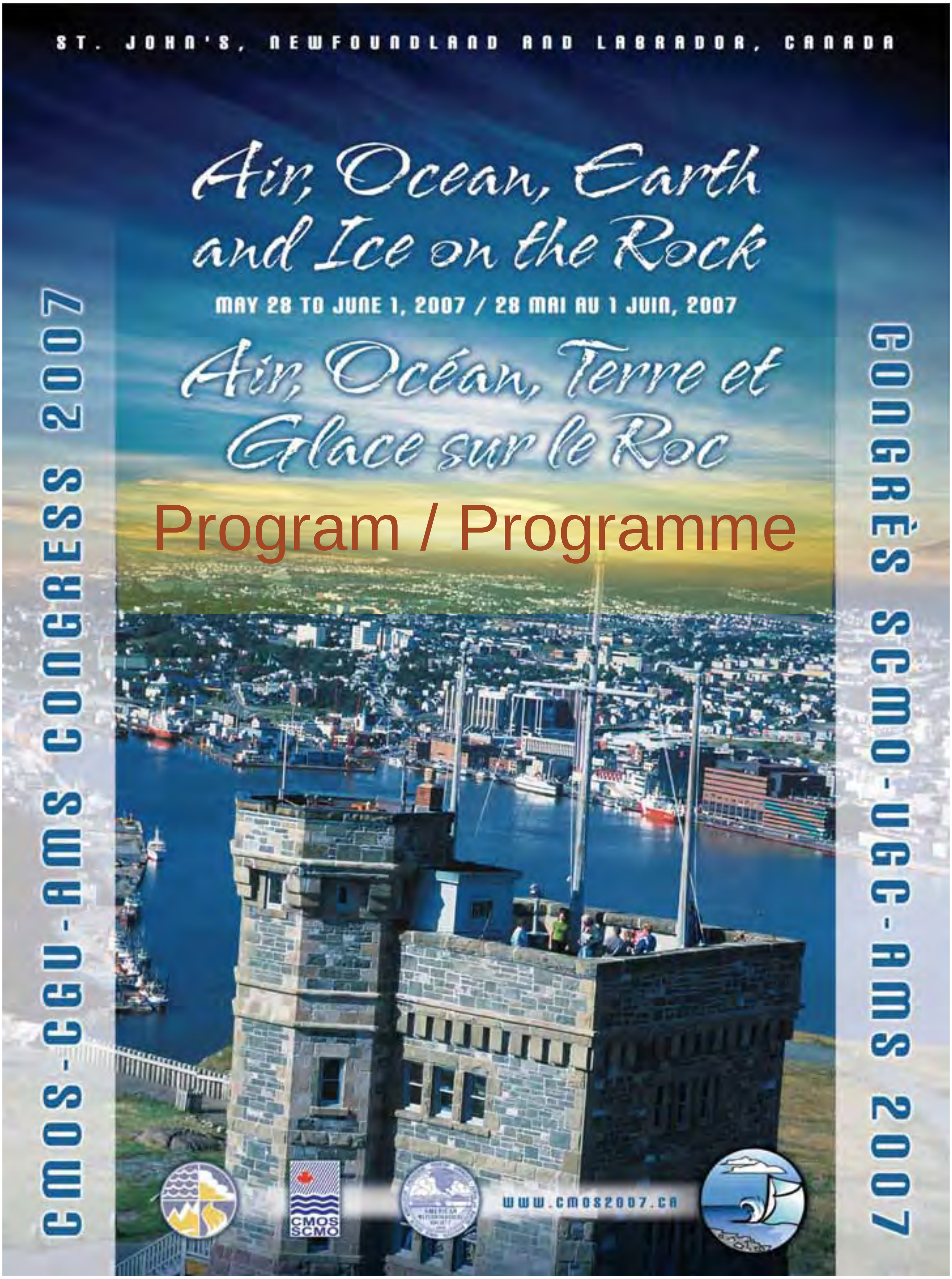
ST. JOHN'S, NEWFOUNDLAND AND LABRADOR, CANADA
Air, Ocean, Earth and Ice on the Rock
MAY 28 TO JUNE 1, 2007 / 28 MAI AU 1 JUIN, 2007
Air, Océan, Terre et Glace sur le Roc
Program / Programme
CMOS-CGU-AMS CONGRESS 2007
CONGRÈS SCMO-UGC-AMS 2007
CMOS SCMO
WWW.CMOS2007.CA

Canadian Meteorological and Oceanographical Society (CMOS)
Société canadienne de météorologie et d'océanographie (SCMO)
41st Congress / 41iéme Congrès

Canadian Geophysical Union (CGU)
Union géophysique canadienne (UGC)
Thirty-Third Annual Meeting / Trente-troisième Rencontre Annuelle

American Meteorological Society (AMS)
Ninth Conference on Polar Meteorology and Oceanography /
Neuvième Conférence sur la météorologie et l'océanographie polaires

CMOS-CGU-AMS Congress 2007 / Congrés SCMO-UGC-AMS 2007

St. John's 2007

May 28 to June 1, 2007
28 Mai au 1 Juin, 2007

Theme: Air, Ocean, Earth and Ice on the Rock
Thème: Air, Océan, Terre et Glace sur le Roc

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Message from the Premier

I am delighted that the Canadian Meteorological and Oceanographic Society, the Canadian Geophysical Union and members of the American Meteorological society are holding an important congress in St. John's this year. In an island province such as ours, where the weather can change in minutes and the ocean is for many their workplace, your specialty is a topic never far from our minds. We have an abundance of rain, snow, fog, hail, wind, waves and icebergs, and, in fact, you may have the opportunity to admire these icebergs during your stay in St. John's.

Our weather and the ocean are, however, more than topics of conversation. In Placentia Bay on the southeast corner of the province, we have SmartBay, a project of the Canadian Centre for Marine Communications. Placentia Bay is heavily used by oil tankers, ship builders, fishermen, conservationists and tourism operators. To increase safety and minimize conflicts, the SmartBay project organizers have installed a number of buoys that provide real-time data to ocean resource users which I think you will find interesting. We also have a wealth of ocean-related educational and research organizations for you to visit. I hope your visit to our province proves profitable, and filled with new knowledge, fresh insights and new friendships.

Newfoundland and Labrador is a province born of seafarers. We have a long history and, I believe, a bright future in working with the sea. I wish you every success with your congress. I hope you enjoy your stay in our province and that you will have an opportunity to experience our culture as well as our science

Sincerely,

DANNY WILLIAMS, Q.C.
Premier of Newfoundland and Labrador

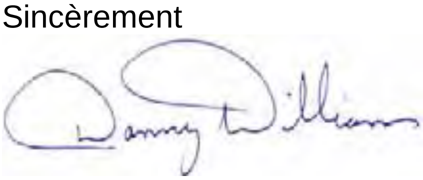
Message du Premier Ministre

Je suis ravi que la Société Canadienne de Météorologie et d'Océanographie, l'Union Géophysique Canadienne et l'American Meteorological Society aient choisi la ville de St. John's pour tenir un congrès aussi important. Dans une province insulaire comme la nôtre, où les conditions météorologiques peuvent changer d'un moment à l'autre et où l'océan est pour plusieurs un lieu de travail, vos sujets de recherches respectifs ne sont jamais très loin dans notre esprit. Les conditions météorologiques y sont souvent très complexes. Nous avons annuellement beaucoup de pluie, de neige, de grêle, de vent, de brouillard et d'icebergs. Vous aurez possiblement l'opportunité d'admirer ces icebergs durant votre séjour à St. John's.

Nos conditions météorologiques et océaniques sont plus que des sujets de conversation. Le projet 'SmartBay' localisé dans la Baie de Placentia est un projet mis sur pied par le Centre Canadien de Communications Marines. Cette baie située dans le coin sud-est de notre province est un endroit maritime très achalandé. Nous y retrouvons des pétroliers, des pêcheurs, des excursions touristiques, des organisations écologistes ainsi que des constructeurs de navires. Afin d'y accroitre la sécurité et ainsi minimiser les possibilités d'accidents, les organisateurs du projet 'SmartBay' y ont installé plusieurs bouées qui fournissent des données en temps réel aux usagers. Je crois que vous trouverez ce projet intéressant. Nous avons également une richesse d'organismes éducatifs et de recherche reliés à l'océan, et que vous pourrez visiter. J'espère que votre passage dans notre province sera profitable, remplis de nouvelles connaissances et de nouvelles perspectives et que vous aurez l'occasion de vous y faire de nouveaux amis.

Terre-Neuve et Labrador est une province issue de marins. Nous avons une longue histoire et, je le crois, un avenir rempli de promesses pour les domaines liés à l'océan. Je vous souhaite le plus grand des succès avec votre congrès. J'espère que vous apprécierez votre passage dans notre province et que vous aurez l'opportunité d'apprécier notre culture et notre science.

Sincèrement



DANNY WILLIAMS, Q.C.
Premier Ministre de Terre Neuve et Labrador

City of St. John's

As Mayor of our Capital City, it is an honour and privilege to extend greetings and best wishes to all who are visiting our city to participate in the Canadian Meteorological and Oceanographic Society (CMOS) Annual Congress and the Canadian Geophysical Union (CGU) and the American Meteorological Society (AMS) joint meeting.

We are glad you have chosen St. John's to hold this special event. Our City is renowned by its friendly people, its historic downtown, harbour front location and beautiful vistas. We are working on becoming an "oil" capital and, as well, in developing our already burgeoning tourism industry. Over the next few days, we hope you make our city your home and you will take the time to visit some of our city's historical and natural landmarks and points of interest and enjoy our city's night life with its great entertainment and finest cuisine.

We wish you well in your discussions as you meet to discuss the challenges facing your organization today and hope that your meeting will be a rewarding and unforgettable experience. May you have an enjoyable stay in St. John's and return home with fond memories of our city.

Andy Wells

Andy Wells
Major

Ville de St. Jean

En temps que maire de notre ville capitale, j'ai l'honneur et le privilège d'offir la bienvenue et mes meilleurs voeux aux participants au Congrès 2007 de la Société canadienne de météorologie et d'océanographie (SCMO), de l'Union géophysique canadienne (UGC) et de l'American Meteorological Society (AMS) qui visiteront notre belle ville.

Nous sommes fiers que vous avez choisi St. Jean pour votre congrès. Notre ville est reconnue pour son peuple chaleureux, son centre-ville historique, son port et ses vues superbes. Nous travaillons fort pour établir notre réputation comme capitale d'huile et pour développer notre industrie touristique. Durant les jours qui viennent, nous espèrons que vous vous sentirez chez vous dans notre ville and que vous prendrez le temps de visiter les lieux historiques, les attraits naturels et les points d'intéret de la ville ainsi que sa vie nocturne de divertissement et de fine cuisine.

Nous vous souhaitons plein succès dans vos discussions sur les défis auxquels vos organisations font face aujourd'hui et nous espèrons que le congrès vous offrira une expérience enrichissante et inoubliable. Que votre séjour à St. Jean soit agréable et que vous retournerez chez vous avec des bons souvenirs de notre ville.

Andy Wells

Andy Wells
Maire

SPC Welcome

On behalf of the Science Program Committee (SPC), we would like to cordially welcome you to the CMOS-CGU-AMS Congress 2007.

Thanks to your support and contributions, to the enthusiasm and hard work of session conveners, CMOS head office staff, and SPC members, we are proud to present the Congress' science program comprising plenary sessions by internationally recognized invited speakers and special and general sessions with exciting talks and posters. The program, developed under the Congress theme, "Air, Ocean, Earth and Ice on the Rock", and key objectives of the International Polar Year, reflects the Congress' goal to explore, link, bridge and integrate the scientific interests of the CMOS, CGU, AMS and the Eastern Snow Conference. We hope you will enjoy this excellent opportunity for interactions and exchanges among meteorologists, oceanographers, geophysicists, climate scientists and other interested scholars, experts, and participants.

Newfoundland, known for severe winter storms, frequent spring fog and iceberg emergence, is located at a pivotal point in the world climate system, one of the most important regions for the exchange of heat between the polar and tropical regions. Nature has made St. John's the Canadian weather capital. Your gathering here during the Congress will make it the 2007 Canadian capital of the Earth Sciences.

Enjoy your Congress!

Guoqi Han, Rod Blais and Taneil Uttal
Co-chairs, the Science Program Committee

Bienvenue du CPS

Au nom du Comité du programme scientifique, nous aimerions vous offrir la bienvenue au congrès SCMO-UGC-AMS 2007.

Grâce à votre appuie et vos contributions, à l'enthousiasme et le travail diligent des chefs de sessions, aux membres d'équipe au bureau chef de SCMO, et aux membres du CPS, nous avons le plaisir de vous présenter un programme scientifique rempli de sessions plénières présentées par des orateurs invités de calibre international et des sessions générales intéressantes avec des présentations et des affiches excitantes. Ce programme, développé sous le thème du congrès, "Air, Océan, Terre et Glace sur le Roc", ainsi qu'avec les buts clés pour l'Année polaire internationale, reflète le but du congrès d'explorer, de lier, de rapprocher et d'intégrer les intérêts scientifiques de la SCMO, UGC, AMS et de la Conférence Nivale de l'Est. Nous espèrons que vous allez trouver ce congrès agréable et une excellante opportunité pour générer des interactions et des échanges entre météorologues, océanographes, géophysiciens, climatologues et les autres experts, universitaires intéressés, et participants.

Terre-Neuve, reconnu pour ses tempêtes d'hiver sévères, sa brume printanière fréquente, et l'apparence des icebergs, est situé à un point clé du système climatique mondial, une des régions les plus importantes pour l'échange de chaleur entre les régions polaires et tropicales. La nature a fait que St. Jean se retrouve comme capitale de la météorologie au Canada. Avec votre participation au congrès, St. Jean deviendra la capitale canadienne des sciences de la Terre pour 2007.

Amusez-vous au congrès!

Guoqi Han, Rod Blais et Taneil Uttal
Co-présidents, Comité du programme scientifique

CMOS Welcome

On behalf of CMOS Council, I welcome you to this 41st Annual Congress of the Canadian Meteorological and Oceanographic Society, hosted jointly with the Canadian Geophysical Union (CGU) and the American Meteorological Society (AMS). It is especially meaningful for me for two reasons. First, as a homecoming, since St. John's is my own birthplace, the place that stimulated my earliest interest in weather, where I completed my undergraduate studies, and where I still visit as often as possible. Second, having CGU, CMOS and AMS co-host this congress for the first time is something I have personally worked towards for the past 10 years, in fact, since chairing the 1997 Saskatoon CMOS Congress. The theme given to this congress, Air, Ocean, Earth and Ice on the Rock,is therefore very appropriate.

The two congress committees, Local Arrangements led by Fraser Davidson and Catherine Hogan, and Science Programming led by Guoqi Han and Rod Blais, have accomplished a truly fine job of organizing our most ambitious congress since the first 1967 CMOS Congress. In one sense, this joint congress represents an official acknowledgement of the importance of interdisciplinary processes in our sciences, as it formally adds the earth and its environment in space, and especially land-atmosphere processes, to atmospheric, oceanographic, and air-sea interactions. This is especially true in the context of climate change, which has captured the interest of all Canadians in the past few years.

(Continued on next page)

Bienvenue de SCMO

Au nom du conseil SCMO, j'aimerais vous offrir la bienvenue au 41ème congrès annuel de la Société canadienne de météorologie et d'océanographie, présenté en collaboration avec l'Union géophysique canadienne et l'American Meteorological Society. Pour moi, ce congrès est particulièrement sentimental pour deux raisons. Premièrement, je retourne à la ville de ma naissance, St. Jean, où mon intérêt envers la météorologie s'est développé, où j'ai poursuivi mes études universitaires de premier cycle, et où je visite aussi souvent que possible. Deuxièmement, j'ai travaillé pendant 10 ans, depuis le congrès SCMO 1997 à Saskatoon où j'ai travaillé comme président, pour arriver à un congrès conjoint entre SCMO, UGC et AMS. Le thème du congrès, Air, Océan, Terre et Glace sur le Roc, me semble très approprié.

Le comité des arrangements locaux, dirigé par Fraser Davidson et Catherine Hogan, ainsi que le comité du programme scientifique, dirigé par Guoqi Han et Rod Blais, ont réussi à organiser le congrès le plus ambitieux depuis le premier congrès SCMO en 1967. D'un côté, ce congrès conjoint donne son appui officiel à l'importance des études scientifiques interdisciplinaires en incluant la Terre et son rôle dans l'espace avec les interactions atmosphériques, océanographiques et entre l'atmosphère et la mer. Ceci est particulièrement important pour mieux comprendre le changement climatique, un domaine auquel le peuple canadien s'intéresse de plus en plus durant les dernières années.

(Continué de la page suivante)

We hope that this congress will be successful for you. Apart from learning about the latest advances in our sciences, the annual congresses of CMOS, CGU and AMS are our best opportunity to renew old friendships and make new contacts in these fields each year. I would be remiss if I did not encourage you to attend not only the scientific sessions, but also some of the business meetings of the two societies, and perhaps even experience the joy of volunteering on one or more committees in the near future. We also urge you to attend the Awards Luncheon and the Banquet, times for great food, entertainment, and to acknowledge the efforts of our colleagues through the various awards.

While you are in St. John’s, do try to take in some of the delights of this historic old city, first settled almost 500 years ago. While I hope the weather cooperates during your stay, don’t let any adverse effects bother you (bye), if only because St. John’s weather gives real meaning, like nowhere else, to that cliché, “if you don’t like the weather, stick around for a few minutes”. It can really change that fast here.

Our thanks to the many members of the organizing committees, too numerous to mention here but their names appear at the front of this book, and a special thanks to our Executive Director, Ian Rutherford, and the dedicated staff of the CMOS National Office who devote a huge amount of time to processing the abstracts and registrations.

Best wishes to all for an exciting and productive meeting in St. John’s.

Geoff Strong
President, CMOS
2006-07

Nous espérons que ce congrès vous plaira. En découvrant les avancements les plus récents dans nos sciences, ces congrès annuels offrent l'opportunité à chaque année de rétablir vos anciennes amitiés et d'établir de nouveaux liens entre les divers champs d'études. Je vous encourage à participer aux sessions scientifiques ainsi qu'aux assemblées générales annuelles des trois sociétés et de peut-être devenir bénévole pour l'un des comités dans le futur. Nous vous encourageons aussi d'assister au dîner de remise de prix et aux banquets pour apprécier des délicieux repas, pour vous divertir et pour supporter vos collègues qui ont mérité divers honneurs.

Durant votre séjour à St. Jean, prenez le temps de visiter quelques-unes des attraits de cette ville historique, établie il y a 500 ans. Même que je souhaite que la météo vous semblera agréable, ne laissez pas une météo mauvaise vous déprimer car la météo de la ville de St. Jean renforce comme nul autre place l'expression que "si vous n'aimez pas la météo, attendez quelques minutes". Ça peut vraiment changer aussi vite que ça.

Nous remercions sincèrement les membres des comités d'organisation, trop nombreux pour être mentionnés içi mais qui sont listés dans le programme du congrès, et un remerciement spécial à notre directeur exécutif, Ian Rutherford, et les membres dévoués à l'office national de SCMO qui offrent une grande partie de leur temps pour organiser les résumés et pour diriger l'inscription.

Mes meilleurs voeux à tous pour un congrès excitant et productif à St. Jean.

Geoff Strong
Président, SCMO
2006-07

CGU Welcome

Welcome to Air, Ocean, Earth and Ice on the Rock, the 2007 CMOS-CGU-AMS joint Congress

The Canadian Geophysical Union is very pleased to be a part of this joint meeting. It brings together all disciplines included in the seven current International Associations of the International Union of Geodesy and Geophysics (IAG, IAGA, IAHS, IAMAS, IAPSO, IASPEI, IAVCEI) as well as the first new International Association to be added to the IUGG in 80 years, the International Association of Cryospheric Science. IACS is scheduled for formal approval at the IUGG meeting in Perugia in July, 2007. Since CGU has a partnership agreement with NRC, which pays our annual fees to the IUGG, we are responsible for the activities of the Canadian National Committee (the CNC) for the IUGG. As part of an initiative to rejuvenate the CNC-IUGG the CGU is sponsoring a meeting of national representatives of the seven IUGG associations at this Joint Congress. The Executive Committees of CGU and CMOS will also holding a joint meeting to discuss the possibility of further collaborative activities in the future. I believe this will be an exciting and all encompassing meeting and hope you all benefit from the broader scope of this year's meeting. Enjoy the meeting and let us know what you think of it.

Gary Jarvis
CGU President.

Bienvenue de l'UGC

Bienvenue à Air, Océan, Terre et Glace sur le Roc, le congrès SCMO-UGC-AMS 2007

L'Union géophysique canadienne a le plaisir de participer à ce congrès conjoint. Ce congrès rassemble tout les disciplines scientifiques des sept associations internationales de l'Union géodésique et géophysique internationale (AIG, IAGA, AISH, IAMAS, IAPSO, IASPEI, IAVCEI) ainsi que la première association internationale a se joindre à l'UGGI depuis 80 ans, l'Association internationale des sciences cryosphériques (International Association of Cryospheric Science - IACS). L'acceptation de l'incorporation de l'IACS est prévu à la réunion UGGI à Perugia au mois de juillet 2007. Puisque l'UGC est en partenariat avec le CNRC, qui paie nos frais pour l'UGGI à chaque année, nous sommes responsables pour les activités du Comité national canadien (CNC) de l'UGGI. Pour aider le renouvellement du CNC-UGGI, l'UGC organise une réunion entre les représentants nationals des sept associations de l'UGGI durant ce congrès conjoint. Les comités exécutifs de l'UGC et de SCMO organise aussi une réunion ensemble pour discuter la possibilité d'entreprendre d'autres activités conjoints dans le futur. Je crois que ce congrès sera excitant et rassemblera une diversité impressionante de disciplines scientifiques. J'espère que vous bénéficierez de cette diversité au congrès de cette année. Amusez-vous au congrès et dites-nous ce que vous y pensez.

Gary Jarvis
Président UGC.

AMS Welcome

The American Meteorological Society (AMS) Committees on Polar Meteorology and Oceanography, Air-Sea Interactions and Climate Variability and Change are delighted to be part of the CMOS-CGU-AMS Congress 2007 in St. John's Newfoundland. We are looking forward to exciting opportunities to exchange ideas and research results with our colleagues with the Canadian Meteorological and Oceanographical Society (CMOS) and Canadian Geophysical Union (CGU) on different themes including those of the International Polar Year.

The 2007 AMS Statement on Climate Change states:
"Despite uncertainties, there is adequate evidence from observations and interpretations of climate simulations to conclude that the atmosphere, ocean, and land surface are warming; that humans have significantly contributed to this change; and that further climate change will continue to have important impacts on human societies, on economies, on ecosystems and on wildlife through the 21st century and beyond……"

This statement indicates that scientists in this time in history have an especially important role to investigating and understanding our environment. Clearly this is a task that must transcend the boundaries of the separate disciplines and international borders.

On the behalf of the AMS we would like to welcome all participants of this joint congress. We look forward to the creative, productive, and stimulating interchanges that will forward our scientific understanding to better understand the important environmental issues facing the planet earth.

Taneil Uttal
Michael Alexander
Lucie Vincent

Division Chairs

Bienvenue de l'AMS

Les comités sur la météorologie et l'océanographie polaire, sur les interactions entre l'atmosphère et la mer, et sur la variabilité et le changement climatique de l'American Meteorological Society (AMS) ont le plaisir de participer au congrès SCMO-UGC-AMS à St. Jean, Terre-Neuve. Nous anticipons de merveilleuses opportunités pour échanger nos idées et nos résultats scientifiques avec nos collègues de la Société canadienne de la météorologie et de l'océanographie (SCMO) et de l'Union géophysique canadienne (UGC) sur de nombreux thèmes incluant ceux reliés à l'Année polaire internationale.

La déclaration de l'AMS sur le changement climatique en 2007 cite:
"Désormais les incertitudes, il existe amplement d'observations et d'analyses des simulations climatiques pour conclure que l'atmosphère, l'océan, et la surface de la Terre se réchauffent; que l'espèce humaine est largement responsable pour ces changements; et que les changements climatiques continueront à avoir des impactes importantes sur les sociétés humaines, sur les économies, sur les écosystèmes et sur la faune à travers le 21ème siècle et dans le futur......"

Cette déclaration souligne l'importance pour les scientifiques d'aujourd'hui d'étudier et de mieux comprendre l'environnement. Pour accomplir cette tâche, il est clair que nous devons surpasser les frontières de nos disciplines et les frontières internationales.

Au nom de l'AMS, nous offrons la bienvenue à tout les participants et participantes du congrès conjoint. Nous prévoyons des échanges créatives, productrices et stimulantes qui avanceront notre compréhension des aspects environnementaux auxquels notre planète fait face.

Taneil Uttal
Michael Alexander
Lucie Vincent

Division Chairs

CMOS-CGU-AMS 2007 / SCMO-UGC-AMS 2007
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Air, Ocean, Earth and Ice on the Rock • May 28-June 1 2007
Email: Cmos2007@cmos.ca

Dear CMOS-CGU-AMS 2007 attendee,

On behalf of the Local Arrangement's committee, we welcome you to the joint Congress of CMOS-CGU-AMS 28 May – 01 June, 2007 in St. John's Newfoundland and Labrador, Canada. This year's theme is Air, Ocean, Earth and Ice on the Rock! This is a unique conference that combines the annual CGU and CMOS meetings with 160 attendees from three AMS groups. We anticipate 1100 scientists to participate in the disciplines of meteorology, oceanography, climatology, hydrology, geophysics, limnology, and cryosphere.

We hope you find this both a useful and endearing conference in this international polar year and that you enjoy the city of St. John's and the province of Newfoundland and Labrador while you are here.

The local arrangement committee members have been working hard to ensure a smooth, enjoyable and productive conference. Please enjoy and have a good conference in St. John's Newfoundland and Labrador.

Sincerely,

Dr. Fraser Davidson
LAC Chair of CMOS-CGU-AMS 2007

Cher Participant/Participante de la SCMO-UGC-AMS 2007,

Au nom du comité des arrangements locaux, nous vous accueillons chaleureusement au Congrès de SCMO-UGC-AMS à St. Jean, Terre-Neuve, du 28 mai au 01 juin, 2007. Le thème de cette année est Air, Océan, Terre et Glace sur le Roc! Nous prévoyons un congrès unique où 160 participants de l'AMS se joigneront aux congrès annuels de la SCMO et de l'UGC. Nous anticipons la participation de 1100 spécialistes en météorologie, océanographie, climatologie, hydrologie, géophysique, limnologie et le cryosphère.
Nous espèrons que vous vous épanouisserez scientifiquement tout en vous baignant dans la culture de la ville de St. Jean et la province de Terre Neuve et Labrador.

Le comité des arrangements locaux a travaillé fort pour vous assurer une conférence agréable et intéressante. . Je vous souhaite une bonne conférence où vous pourrez profiter de la camaraderie scientifique dans l'ambiance spéciale de St. Jean, Terre Neuve et Labrador.

Sincèrement,

Dr. Fraser DavidsonPrésident (arrangements locaux) de la SCMO-UGC-AMS 2007

CMOS

The Canadian Meteorological and Oceanographic Society (CMOS) is the national society of individuals and organisations dedicated to advancing atmospheric and oceanic sciences and related environmental disciplines in Canada. The Society's aim is to promote meteorology and oceanography in Canada, and it is a major non-governmental organisation serving the interests of meteorologists, climatologists, oceanographers, limnologists, hydrologists and cryospheric scientists in Canada. CMOS was officially created in 1967 as the Canadian Meteorological Society and adopted its present name in 1977, following an invitation by the Canadian Meteorological Society to the oceanographic community in Canada to join the Society. However, CMOS has a rich history dating back to 1939 when it was known as the Canadian Branch of the Royal Meteorological Society.

CGU

On October 24, 1945, the National Research Council (NRC) of Canada convened the first meeting of an Associate Committee to advise it on the needs of geophysics, with J.T.Wilson as the Chairman of the committee. Activities of geophysicists in Canada were coordinated by ACGG by forming a number of subcommittees. In 1974, the ACGG was replaced by a professional society called "The Candian Geophysical Union, a joined Division of the Geological Association of Canada (GAC) and of the Canadian Association of Physicists (CAP)", and with J.T.Wilson as its first president. In 1993, the CGU formed a Hydrology Section. Now with about 500 members, CGU serves as the national focus for geophysical sciences and carries on the traditional responsibility of representing Canada in the IUGG through a Canadian National Committee (CNC/IUGG).

AMS – Polar

The American Meteorological Society promotes the development and dissemination of information and education on the atmospheric and related oceanic and hydrologic sciences and the advancement of their professional applications. Founded in 1919, AMS has a membership of more than 11,000 professionals, professors, students, and weather enthusiasts. AMS publishes nine atmospheric and related oceanic and hydrologic journals — in print and online — sponsors more than 12 conferences annually, and offers numerous programs and services. *Polar Meteorology and Oceanography Committee*: The studies of polar meteorology and oceanography involve multidisciplinary research on phenomena that impact the weather and climate of the polar regions. The polar atmosphere, snow and ice covers, and the atmosphere's interface with the oceans and the landmasses are all brought together for systematic study and analysis within polar meteorology and oceanography.

SCMO

La Société canadienne de météorologie et d'océanographie (SCMO) est une société nationale de personnes et d'organisations vouées à l'avancement des sciences atmosphériques et météorologiques liées aux disciplines environnementales au Canada. Un des principaux organismes non gouvernementaux à servir les intérêts des météorologues, océanographes, limnologues, hydrologues et scientifiques cryosphériques, la Société vise à promouvoir la météorologie et l'océanographie au Canada. La SCMO a vu le jour officiellement en 1967 et a adopté son nom actuel en 1977 après que la Société météorologique du Canada ait invité la communauté océanographique du Canada à se joindre à elle. Toutefois, la SCMO a une riche histoire qui remonte à 1939 alors qu'elle était connue sous le nom de Section canadienne de la Société royale des météorologues.

UGC

Le 24 Octobre, 1945 le Conseil National de Recherche Canada (CNRC) a convenu la première rencontre d'un comité associé dirigé par J.T. Wilson pour donner avis sur les besoins en géophysique. Ce comité devint en 1946 le Comité Associé de la Géodésie et de la Géophysique (CAGG) du CNRC avec la participation de la IUGG (Union International de Géodésie et Géophysique).

En 1974, la CAGG fut remplacé par la Union Géophysique Canadienne sous tutelle jointe de l'Association Géologique du Canada (AGC) et de l'association Canadiennes des Physiciens et Physiciennes (ACP) et J.T. Wilson était son premier président. En 1993, l'UGC a formé sa section en Hydrologie. Maintenant avec 500 membre, l'UGC est un point focal de la géophysique, et assume la charge de représentant du Canada à la IUGG avec son Comite National Canadien pour la IUGG.

AMS – Polaire

La « American Meteorological Society » promouvoit le développement et la dissémination d'information et d'éducation en matière scientifique atmosphérique incluant les liaisons avec l'océanographie et l'hydrologie. Ceci inclus aussi l'avancement des applications professionnelles de cette science. Fondée en 1919, l'AMS compte 11,000 membres incluant professionnels, professeurs, étudiants et amateurs. L'AMS publies neuf journaux et supporte plus de 12 conférences par an ainsi que plusieurs programmes et services. Le comité de Météorologie et d'océanographie polaire se concentre sur la recherché multidisciplinaire relier a la météorologie et le climat des régions polaires.

Bursary Recipients, Student Travel
Récipiendaires des bourses, voyage d'étudiants

Student	University	Supervisor	Affiliation *
M. I. Abrahamowicz	McGill University	Tremblay	CMOS
Nasim Alavi	Guelph	Jon Warland	CGU
Ibraheem Ali	Calgary	Alexander Braun	CGU
Robert Armstrong	Saskatchewan	John Pomeroy Lawrence Martz	CGU
David Avalos	New Brunswick	Marcelo Santos	CGU
Andrew Ballinger	University of Oklahoma	Phillip Chilson	AMS
Francesco Barlettta	Quebec Rimouski	Guillaume St-Onge	CGU
L. Bianucci	University of Victoria	Denman	CMOS
C. Brenan	University of Victoria	Weaver	CMOS
Pamela Bucher	Manitoba	Andrew Frederiksen	CGU
Weihan Chan	University of Delaware	Daniel Leathers	AMS
Yi-Ching Chung			ESC
Krystopher Chutko	Queen's	Scott Lamoureux	CGU
J. Cox	McGill University	Gyakum	CMOS
Mohammed Dabboor	Calgary	Alexander Braun	CGU
Chris DeBeer	Saskatchewan	John Pomeroy	CGU
Eric DeGiuli	UBC	Garry Clarke	CGU
S. Dragan	Universite du Quebec a Montreal	Girard	CMOS
J. Christian Dupuis	New Brunswick	Karl Butler Brent Petersen	CGU
Tim Duval	McMaster	J.M. Waddington	CGU
Mahmoud Abd El-Gelil	York	Spiros Pagiatakis	CGU
B. Else	University of Calgary	Yackel	CMOS
John Evangelatos	New Brunswick	Karl Butler John Spray	CGU
Tarrah Fairweather	Western	Irena Creed	CGU
Xing Fang	Saskatchewan	John Pomeroy	CGU
J. Ferland	Universite du Quebec a Rimouski	Gosselin	CMOS
William Floyd	UBC	Markus Weiler	CGU
A. Forest	Universite Laval	Fortier	CMOS
A. Fraser	University of Toronto	Strong	CMOS
T. Gaman	Universite du Quebec a Montreal	Torlaschi	CMOS
G. Gascon	McGill University	Stewart	CMOS
Sanaz Ghias	York	Gary Jarvis	CGU
Mark Gordon	York University		ESC
Irina Gorodetskaya	Columbia University	L.-Bruno Tremblay	AMS
H. Greene	McGill University	Leighton	CMOS
Kristen Harrison	McMaster	J.M. Waddington	CGU
Warren Helgason	Saskatchewan	John Pomeroy	CGU
Jamie Lynn Hood	Calgary	Masaki Hayashi	CGU
Matthew Izawa	Western	R Flemming	CGU
John F Jackson	Calgary	Masaki Hayashi	CGU
J. Jackson	University of British Columbia	Ingram	CMOS
Gerhard Kapeller	Leopold-Franzens University, Innsbruck Austria	Peter Rutschmann	CGU
Nicholas Kinar	Saskatchewan	John Pomeroy	CGU
Robert Kingdon	New Brunswick	Marcelo Santos	CGU
K.E. Knowland	McGill University	Gyakum	CMOS
Inka Koch	Alberta	Martin Sharp	CGU
Azdeh Koohzare	New Brunswick	Marcelo Santos Petr Vanicek	CGU
Sarah Kopczynski			ESC

*Affilation Codes: CMOS – Canadian Meteorology and Oceanographic Society
AMS – American Metrological Society
ESC – Eastern Snow Conference
CGU- Canadian Geophysical Union

Student	University	Supervisor	Affiliation *
Dolly Kothawala	McGill	Tim Moore	CGU
Eleni Koukidis	Guelph	Aaron Berg	CGU
Ashley Krakowka	Manitoba	Ian Ferguson	CGU
Michel Lajoie	Quebec Rimouski	Guillaume St-Onge	CGU
Philippe Lamothe	Laval	Rock Santerre	CGU
Elizabeth L'Heureux	Toronto	Berndt Milkereit	CGU
Gro Lilbaek	Saskatchewan	John Pomeroy	CGU
Jimmy MacDonald	Saskatchewan	John Pomeroy	CGU
Sean T Michaletz	Calgary	Edward Johnson	CGU
S.T. Michaletz	University of Calgary	Johnson	CMOS
Denika Moir	Calgary	Masaki Hayashi	CGU
Tara Moran	Calgary	Shawn Marshall	CGU
Sarah Mouneimne	Calgary	Bernhard Mayer	CGU
Natasha Neumann	University of British Columbia		ESC
Philip Nievinski	New Brunswick	Marcelo Santos	CGU
Christelle Not	Quebec Montreal	Hillaire Marcel	CGU
Claire Oswald	Toronto Mississauga	Brian Branfireun	CGU
J-P Pinard	University of Alberta	Wilson	CMOS
E. Pison	Universite du Quebec a Montreal	Torlaschi	CMOS
V.K. Praveen	University of Alberta	Myers	CMOS
Agathe Lise Provonost	Quebec Rimouski	Guillaume St-Onge	CGU
Rebeca Quinonez-Pinon	Calgary	Caterina Valeo	CGU
Lynn Raaflaub	Calgary	Caterina Valeo	CGU
Taoufik Radi	Quebec Montreal	Anne de Vernal	CGU
Jenna O. Rapai	Guelph	Jon Warland	CGU
S. Rattan	University of Alberta	Myers	CMOS
Andrew Rees			ESC
Vidyavathy Renganathan	Calgary	Alexander Braun	CGU
Murray Richardson	Toronto Mississauga	Brian Branfireun	CGU
M. Rozanska	Universite du Quebec a Rimouski	Poulin	CMOS
Kate Sinclair	Calgary	Shawn Marshall	CGU
Gunjan Sinha	Saskatchewan	Sam Butler	CGU
Andrey Skvortsov	Victoria	Andrew Weaver	CGU
P. Spence	University of Victoria	Weaver	CMOS
P. St-Laurent	Universite du Quebec a Rimouski	Saucier	CMOS
Dan Thomson	McMaster	J.M. Waddington	CGU
Peter Toose	University of Waterloo		ESC
Julie Turgeon	McGill	Tim Moore	CGU
Wouter van der Wal	Calgary	Patrick Wu	CGU
Ursule Boyer Villemaire	Quebec Rimouski	Guillaume St-Onge	CGU
Brett Wheeler	Simon Fraser	Gwenn Flowers	CGU
Nicole Wright	Simon Fraser	Bill Quinton	CGU
Yi Yi	Waterloo	Thomas Edwards	CGU
Celina Ziegler	Carleton	Sean Carey	CGU

*Affilation Codes: CMOS – Canadian Meteorology and Oceanographic Society
AMS – American Metrological Society
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CGU- Canadian Geophysical Union

Local Arrangements Committee (LAC)

Fraser Davidson	Chair LAC	Président LAC
Catherine Hogan	Executive Director	Directrice exécutive
Rod Blais	CGU Program Lead	Chef Programme UGC
Guoqi Han	CMOS Program Lead	Chef Programme SCMO
Taneil Uttal	AMS Program Lead	Chef Programme AMS
Ian Rutherford	CMOS Executive Director	SCMO Directeur Exécutive
Dale Foote	Education Lead	Chef du programme d'éducation
Derm Kearney	Education Team Member	Membre du programme d'éducation
Debbie Anne Power	Webmaster	Webmestre
Marilyn Keller	Transportation Lead	Chef du programme de transport
Jan Woodford	Communications Lead	Chef du programme de communications
Susan Keough	Communications Team	Membre du programme de communications
Jackey Locke	Communications Team	Membre du programme de communications
Colin Farquharson	CGU Rep	Représentant de l'UGC
Richard Asselin	CMOS Publications Rep	Représentant des publications SCMO
Jim Helbig	LAC Treasurer Lead	Chef Trésorier du LAC
Terry Courish	LAC Sponsorship Lead	Chef du programme de commanditation
Oscar Koren	Exhibits Lead	Chef du programme des exposants
Len Zedel	Conference Kits Lead	Chef du programme des trousses de conférence
Gary Bruce	I.T. and A.V. Lead	Chef du programme informatique et audiovisuel
Kim Welford	Translation Lead	Chef de traduction
Marjorie Huntington	AMS Logistics	Logistique d’AMS
Charlene Chubbs	Recording Secretary	Secrétaire
Nadine Wells	Volunteer Coordinator Lead	Chef du programme des volontaires
Nancy Chen	Event Awareness Lead	Chef de la promotion du congrès
Margaret-Anne Stroh	Registation Lead	Chef d'Enregistement
Ken Snelgrove	Publications Lead	Chef du programme de publication

Science Program Committee (SPC)

Co-Chairs / Co-présidents

Guoqi Han (CMOS) Rod Blais (CGU) Taneil Uttal (AMS)

AMS Reps / Représentant de l'AMS

Mike Alexander Uma Bhatt Lucie Vincent

CGU Reps / Représentant de l'UGC

Jim Buttle Colin Farquharson Ken Snelgrove

CMOS Reps / Représentant de l'CMOS

Fraser Davidson Paul Ford Brad deYoung

REGISTRATION AND INFORMATION DESKS

The registration desk is located on the main floor of the St. John's Convention Centre (CC), 120 New Gower Street. Hours of Operation:

Mon. May 28	Tues. May 29	Wed. May 30	Thurs. May 31	Fri. June 1
12:00 - 20:30	7:30 - 16:00	7:30 - 16:00	7:30 - 16:00	7:30 - 12:00

INFORMATION- TOURISM DESK

In addition to the Registration Desk we are pleased to offer an Information Desk at both the Congress Centre and the Delta Hotel.

The Information Desk at the Convention Centre will be open each day from 7:30 a.m. to 10:00 a.m. and the Information Desk at the Delta is open daily from 10:15 a.m. to 4:00 p.m.

The Information Desk can provide you with directions, information on local restaurants, attractions, the social calendar etc. If we don't know it, we will find it!

CONGRESS MEETING ROOMS

To accommodate the volume of congress attendees, we have two venues connected via a pedway; the St. John's Convention Centre and the Delta Hotel. Signage and volunteers will provide you directions between the venues (allow for a 5 min transition). You may use the pedway or transit outside paying careful attention to traffic lights. In addition the Congress booklet (and on our Website) contains the various meeting room locations.

In the event you require assistance in moving from one venue to the other, please contact the registration desk, the information desk or any congress volunteer (wearing a volunteer vest) and we will provide you with safe and timely transition assistance between the two centres.

St. John's Convention Centre (CC) Meeting Room List

CC-Main Level Marconi Room

This room will be used for:

- Daily Plenary Sessions
- Ice Breaker May 28th
- Daily Luncheons CMOS-CGU-AMS (May 29 – June 1)
- Reception/Gala – CMOS-AMS May 31st
- Joint Entertainment CMOS-CGU-AMS May 31st

CC-2nd Floor Brown Room
Alcock Room

Delta Hotel Meeting Room List

Lower Level	Brownsdale
Main Level	Avalon A, B, C, D Harbourview E, F and G Bonavista Trinity Internet Café Rant and Roar Room – CMOS-CGU-AMS Headquarters Exhibitor and Volunteer Lounge
Second Level	Governor Gower Governor Lemarchant Governor Duckworth Governor Cochrane Executive Boardroom

INTERNET AND COMPUTERS

We are pleased to provide a Internet Café in the Delta Hotel near the Exhibits area. There are also a number of "hot spots" for wireless throughout both venues. Hours of operation are:

Mon. May 28	Tues. May 29	Wed. May 30	Thurs. May 31	Fri. June 1
Not avail	7:30 - 18:00	7:30 - 18:00	7:30 - 18:00	7:30 - 14:00

SPEAKER READY DESK

To expedite downloading of presentations to ensure a smooth flow of each session we are pleased to offer you a Speaker Ready Room. This room is located in the Executive Boardroom, second level, Delta Hotel. Instructions on equipment, format, etc are contained in this Congress booklet and on-line. Hours of Operation 09:00 - 18:30

MESSAGE BOARD

A Message Board will be available in the Delta Hotel, Main Floor Lobby, near the Information Desk. This board is provided for your convenience to leave or receive messages from other attendees or your home or office.

MEDIA ROOM

A room is being provided for media. It is location in the Governor Lemarchant room of the Delta Hotel

POSTER SESSIONS

The Science Posters for this Congress are located in and near Salon D on the main level of the Delta Hotel. Presenters will be by their posters to discuss their work. POSTER SESSION SCHEDULE:

2DP	3DP
Wed. May 30	**Thurs. May 31**
16:00 - 17:30	15:30 - 17:00

Refreshments will be served near the Exhibits area in the Crush Lobby outside Salon D.

POSTER SESSION GUIDELINES

Maximum poster dimensions are 4' tall and 4' wide. Posters should be put up the morning of the poster session in Salon D at 08:00. Pins will be available to pin your poster to the boards. Signage will indicate where your poster will go. Posters must be removed following the poster session.

ORAL PRESENTATION GUIDELINES

For 15 minute presentations please ensure your presentation is 12 minutes or less. This will allow 2 minutes for questions and 1 minute for changeover. It is important that the sessions run smoothly and on time to permit people to attend parallel sessions. Please note that the congress computers are the only computers permitted to run presentations (see notes below).

TRANSFERRING YOUR ORAL PRESENTATION TO CONGRESS COMPUTERS

If you are presenting an oral talk, your presentation must be uploaded to the congress's computer network in the speaker ready room by 18:00 (6pm) of the day prior to your presentation

Congress meeting room computers are the only ones permitted to run presentations on

The congress computers run windows XP with the following software:
Microsoft PowerPoint XP (2003), Adobe Acrobat 7.x or higher, QuickTime 6.x or higher, Macromedia Flash Player 7.x or higher, and Internet Explorer 6.x or higher.

Please bring your presentations on one of the following media: USB hard drive (Pocket Drive, iPod), USB flash drive, 3.5-in diskette, CD-ROM, CD-R, or DVD (Use of rewritable CDs (CD-RW) should be avoided, as compatibility problems can occur). Presenters seeking to edit their presentations on site using a laptop that has a USB port will need to copy their files from their laptop to the Congress computer network using a USB storage device.

Note that if graphics or video clips are not embedded in a presentation, they must be downloading as well. Presentations created on a Macintosh and converted to run on a PC should be tested on a PC before arriving at the meeting. Any links should be checked at the meeting to ensure that they remain functional. Please note there is no internet connection on the presentation computers.

Transfer procedures and File Naming:

(1) Ensure that the file name of the presentation is as follows:
  a. **O02-1C1.7_lefaivre_**1923.ppt or **O02-1C1.7_lefaivre_**1923.pdf
  b. I.e. AbstractCode_1stAuthorName_AbsID.ppt

(2) Verify your talk runs on a windows XP machine (i.e. test your presentation on a congress computer in the internet cafe).

(3) Go to the speaker ready room prior to 6pm the day before your presentation.

(4) Volunteers will assist you in downloading your presentation to the congress network.

(5) For piece of mind, keep a backup copy of your presentation on a usb stick

RUNNING EVENT

Monday May 28th 4:30 pm (Depart lower Delta Lobby: New Gower Street Entrance).
Start the week with a healthy walk or run and have a glimpse of the St. John's scenic waterfront. There will be a guided run/walk for all conference attendees who would like to tour the downtown waterfront on foot. The run/walk will depart from the lower entrance of the Delta Hotel (New Gower Street) on Monday May 27th at 4:30 pm. Please arrive a few minutes early to pick up the run route. This will be a 3K walk and 5K run loop departing and returning to the hotel. The run/walk is informal and at your own risk. Please check the conference web site for the route map. The run route takes us along the historic St. John's Harbour to Prescott Street All are welcome. There is no registration. Just show up 5 minutes early for a briefing. All levels of runners and walkers are accommodated. Volunteers from the Running Room in St. John's will be there to lead the group.

TEACHERS’ DAY

CMOS-CGU-AMS 2007 is pleased to announce that we have high school level teachers travelling from across Newfoundland and Labrador to attend teachers’ day. We have an exciting array of subjects and speakers, which will allow these educators to enrich their knowledge and curriculum of oceanography, earth science and meteorology. Our sincere thanks to the NL Department of Education and the various School Board Districts for providing both time and resources to allow us to host this important event.

ICE BREAKER

This year’s Ice Breaker is being held at the St. John’s Convention Centre from 19:00 to 21:00 on Monday, May 28. Each delegates registration package contains a ticket for admission to this event. Your ticket can be exchanged for one free drink and a cash bar is available. In the event that you wish to bring a guest, extra tickets are available for purchase from the registration desk ($32). Food will be served. The Honourable Trevor Taylor, Minister of Innovation, Trade and Rural Development, a proud supportor of CMOS-CGU-AMS 2007 will wellcome conference attendees on behalf of the Province.

AWARDS LUNCHEON

The Parsons-Patterson Luncheon and Awards Ceremony will be held in the CC - Marconi Ballroom on Wednesday, May 30 at 12:30 p.m.

BANQUET

Due to the conference size, the banquets will be held in two separate venues. CMOS-AMS members will eat in the Marconi Room of the Convention Centre and CGU-ESC members will eat in Salon A of Delta Hotel.

Societies	**CMOS-AMS**	**CGU-ESC**
Location	Convention Centre Marconi Hall	Delta Hotel Avalon Ballroom
6:30-7:00 pm	Refreshments	Refreshments
7:00-9:00 pm	Banquet / Awards	Banquet / Awards
9:00-9:15 pm	Joint evening in the Convention Centre Marconi Hall	
9:15-9:45 pm	Newfoundland and Labrador Entertainment	
9:45-11:30 pm	Music / Dance: Live Band*	

*We are proud to present “Traces” a terrific local band providing tunes from the 70’s and 80’s onwards. They are sure to provide you with an opportunity to “have a scuff” or just sit and listen to “the oldies and the goodies”!

PARTNERS PROGRAM

McCarthy’s Party have put together a great partner and tour program for our delegates and partners. Visit our website at www.cmos2007.ca and click on Programs – Social Program for detailed information on the many tours from which you and/or your partner can avail. In addition for an exciting list of local attractions see www.cmos2007.ca under THINGS TO DO.

TECHNICAL TOURS

Two technical tours will take place on Monday, May 28. Buses will leave the Delta Hotel (lower entrance) at 1:30 pm and return by 4:00pm. Admission is free but seating is limited. The two tours are:

1. **NRC - Institute for Ocean Technology** - http://iot-ito.nrc-cnrc.gc.ca/
2. **Landmark Visualization Centre Memorial University** - http://www.mun.ca/creait/CSLV/

See http://www.cmos2007 for details.

CGU / UGC Awards

THE WILSON MEDAL

The J. Tuzo Wilson medal is awarded annually by the Canadian Geophysical Union for outstanding contributions to geophysics in Canada. Factors considered in the selection include scientific or technological research, instrument design and development, contributions to the geophysical industry and teaching excellence. The award is made by the CGU executive on the recommendations of a special committee struck for this purpose. The selection committee seeks formal written nominations from the membership, plus letters of support and a current curriculum vita. Nominations for the Wilson medal may be submitted by CGU members at any time. Medal winners since 1978 have been: J. Tuzo Wilson, Roy Lindseth, Larry Morley, George Garland, Jack Jacobs, Ian Gough, Ted Irving, Harry Seigel, Michael Rochester, David Strangway, Ernie Kanasewich, Len Collett, Gordon West, Thomas Krogh, Don Russell, Alan Beck, Mike Berry, Charlotte Keen, Petr Vanicek, Chris Beaumont, Ron Clowes, David Dunlop, Don Gray, Roy Hyndman, Doug Smylie, Garry Clarke, Dick Peltier, and Ted Evans. In 2006, the winner was Alan Jones of the Dublin Institute for Advanced Studies.

CGU YOUNG SCIENTIST AWARDS

The CGU Young Scientist Awards, inaugurated in 2005, recognize outstanding research contributions by young scientists who are members of the CGU. Both the quality and impact of research are considered. To be eligible for the award, the recipient must be within 10 years of obtaining their first Ph.D. or equivalent degree. The awards are made by the CGU Executive on the recommendations of a special committee struck for this purpose. The selection committee seeks formal written nominations from the membership, plus letters of support and a current curriculum vitae. Nominations for the CGU Young Scientist Awards may be submitted by CGU members at any time. The 2005 winners were Shawn J. Marshall and J. Michael Waddington.

CGU MERITORIOUS SERVICE AWARD

The CGU Meritorious Service Award, inaugurated in 2004, recognizes extraordinary and unselfish contributions to the operation and management of the Canadian Geophysical Union by a member of the CGU. All members of the CGU are eligible for this award, although the award is not normally given to someone who has received another major award (e.g. the J. Tuzo Wilson Medal). Nominations for the CGU Meritorious Service Award may be submitted by CGU members at any time. The award is made by the CGU Executive based on recommendations from the CGU Awards Committee, and is based on lifetime contributions to CGU activities. This is the third year for the award. Award winners since 2004 have been: Ron Kurtz, Ted Glenn and Rod Blais. The 2007 CGU Distinguished Service Award goes to Edward Krebes, University of Calgary

CGU BEST STUDENT PAPER AWARDS

A number of awards will be presented in recognition of outstanding performance in scientific research and presentation by students. Each of the awards comes with a $500 monetary prize. The awards will be announced and presented at the CGU Awards Banquet. To be considered for an award, the student must be the first author and presenter of the paper.

There are four CGU, CGU-HS and CGU-GS awards for oral presentations :

- CGU Best Student Paper Award (all fields of geophysics)
- Chevron Canada Outstanding Student Paper in Seismology
- D.M. Gray Award for Best Student Paper in Hydrology
- Geodesy Award for Best Student Paper in Geodetic Research & Education

There are two CGU, CGU-HS and CGU-GS awards for poster presentations:

- Shell Canada Best Student Poster Award (other than hydrology)
- Campbell Scientific Award for Best Student Poster in Hydrology

KIOSK D'ENREGISTREMENT ET D'INFORMATION

Le kiosk d'enregistrement est situe sur le niveau principale du Salon des Congres de St. John's (CC) au 120 Rue New Gower. Les heures d'ouverture sont ci-dessous:

lun 28 Mai	mar 29 Mai	merc 30 mai	jeu 31 mai	ven 1 juin
12:00 – 20:30	7:30 - 16:00	7:30 - 16:00	7:30 - 16:00	7:30 - 12:00

KIOSK D'INFORMATION ET DE TOURISME

Nous avons un kiosk d'information au salon des congres et a l'hôtel Delta.

Le kiosk d'information au salon des congres sera ouvert tout les jours de 7:30 a 10:00 le matin et le kiosk d'information a l'hôtel Delta sera ouvert de 10:15 a 16:00 heures tout les jours.

Le kiosk d'information peut vous donner des infos sur les restaurants, les sites culturelles, le calendrier sociale . Si nous ne savons pas quelques chose, nous le trouverons !

SALES DE REUNIONS DU CONGRES

Nous avons deux lieux pour le congres; il s'agit du salon de congres de St. John's et de l'hôtel Delta. Des panneaux ainsi que les volontaires vous guiderons d'un lieu a l'autre. Envisager une transition de 5 minutes.

Vous pouvez soit utiliser le passage élevé couvert ou en faisant très attention, traverser la route dehors. Le livre programme et le site web contiennent la carte des diverses salles des sessions scientifiques.

Si vous avez besoins d'aide a changer de lieu du congres, veuillez signaler ce besoin au kiosk d'enregistrement ou demander un volontaire (qui porte une veste volontaire). Nous vous trouverons du transport entre les deux lieux. Océan

Liste de salles du Salon des Congres de St. John's

CC- Niveau 1 Salle Marconi

Cette salle est utilisé pour:

- Les sessions plénières
- Le Brise Glace du 28 mai
- Les dîners du midi pour le congres CMOS-CGU-AMS (29 mai – 1 juin)
- Reception/Gala – SCMO AMS le 31 mai
- Divertissement pour SCMO-UGC-AMS le 31 mai

CC- Niveau 2 Salle Brown
Salle Alcock

Liste des Salles de l'hôtel Delta

Niveau Inférieure Brownsdale

Niveau 1
Avalon A, B, C, D
Harbourview E, F and G
Bonavista
Trinity
Café Internet
Salle « Rant and Roar » – SCMO-UGC-AMS QG
Salles des exhebiteurs et des volontaires

Niveau 2
Governeur Gower
Governeur Lemarchant
Governeur Duckworth
Governeur Cochrane
Salon Executif

INTERNET ET ORDINATEURS

Nous vous offrons le Café Internet a l'hotel Delta proches des kiosks commerciaux. Nous vous offrons aussi acces wifi dans certaines zones : Les heures d'ouvertures sont :

lun 28 mai	mar 29 mai	merc 30 mai	jeu 31 mai	ven 1 juin
Pas dispo.	7:30 - 18:00	7:30 - 18:00	7:30 - 18:00	7:30 - 14:00

BUREAU DES PRESENTATEURS

Pour faciliter la sousmission de présentation, nous vous offrons le bureau des présentateur. Il est situe dans la Salle Exécutif du 2ieme étage de l'hôtel Delta. Les instructions, les questions sur le format … sont présenté sur notre site web est dans le livre programme. Heures d'ouverture 09:00 - 18:30

PANNEAU DE MESSAGERIE

Un panneau pour des messages et disponible dans le foyer de l'hôtel Delta proche du kiosk d'information. Ce panneau est pour laissez ou recevoir des messages pour vos collègues, de votre bureau…

SALON DE LA PRESSE

Le salon pour la presse est situe' dans la chambre du Gouverneur Lemarchant de l'hôtel Delta.

SESSION POSTERS

Les séances de posters sont situe au Salon D de l'hôtel Delta. Les présentateurs seront la pour discuter de leurs travaux. HORAIRE DES SESSIONS POSTERS

2DP	3DP
merc 30 mai	**jeu 31 mai**
16:00 – 17:30	15:30 - 17:00

Des rafraîchissements seront servis proches des sessions posters dans le foyer de l'hôtels proches des kiosks commerciaux.

AVIS POUR LES POSTERS

La dimension maximum de tout poster est 4' par 4'. Les posters sont afficher le matin a partir de 8 heurs la journée de la session et doivent être descendu après la sessions. Des épingles sont disponible pour afficher les posters. Des signes indiqueront ou votre poster doit être afficher.

AVIS POUR LES PRESENTATIONS ORALES

Pour un créneau de présentation de 15 minutes, noter que votre présentation doit être 12 minutes ou moins avec 2 minute pour des questions et 1 minute pour la transition. Respecter cet horaire pour que les sessions scientifiques s'enchaînent proprement. Veuillez utiliser l'ordinateur de la session. L'usage de son proper ordinateur n'est pas permit (voir ci-dessous).

LE TRANSFERT DE LA PRESENTATION ORALE AU ORDINATEURS DU CONGRES

Si vous présentez un discours orale, votre présentation doit être soumis au bureau des présentateurs au plus tard a 18 :00 heures le jour avant votre présentation.

L'ordinateur de la salle de session du congres
est le seul permit sur lequel vous présentez

Nos ordinateurs auront Windows XP avec le logiciel suivant:
Microsoft PowerPoint XP (2003), Adobe Acrobat 7.x ou plus, QuickTime 6.x ou plus, Macromedia Flash Player 7.x ou plus, et Internet Explorer 6.x ou plus.

Veuillez amener *votre présentation sur une des media suivante : Cles usb (IPOD…), diskette 3.5 pouces, CD-ROM, CD-R ou DVD. Eviter l'usage des CD-RW car ils ont une probabilité plus élever de problème de compatibilité. Si vous avez un transfert a faire de votre ordinateur portable, utiliser une clé usb.*

Si vous avez des graphiques ou des clips vidéo qui ne sont pas contenu dans le fichier de présentation, veuillez vous assurez que ces vidéo sont aussi mise sur l'ordinateur de la conférence.

Les présentations créer sur des macintosh devront être vérifier pour s'assurer qu'ils tournes sur un PC avant d'arriver au congres. Vérifiez que tout vos liens fonctionne bien sur les ordinateurs du congres. Il n'y pas de lien Internet externe pour les ordinateurs dans les salles de présentations.

Procédures de transfert et de nomenclature de fichiers:

(1) Assurez vous que votre nom de fichier pour votre présentation soit de la forme suivante :
   a. **O02-1C1.7_lefaivre_**1923.ppt ou **O02-1C1.7_lefaivre_**1923.pdf
   b. I.e. AbstractCode_PremierAuteur_AbsID.ppt

(2) Vérifiez que votre présentation tourne sur Windows XP (i.e. testez votre présentation sur un ordinateur du congres).

(3) Allez au salon des présentateurs avant 18 :00 le jours avant votre présentation.

(4) Des volontaires vous assisterons avec le transfert de votre présentation.

(5) Gardez une clé USB de votre présentation avec vous au cas ou.

COURSE A PIED / MARCHE

Lun 28 mai 16:30 (Départ du Delta Lobby inférieure: Entrée Rue New Gower).
Commencer la semaine d'un bon pas avec une promenade ou une course a pied le long du port pittoresque de St. John's.
Il y aura une marche/course guider avec départ a 16:30 du Delta est retour a l'intérieure d'une heure.

Venez quelques minutes en avance pour réviser le parcours. La marche sera de 3 km et la course a pied de 5 km avec départ et retour a l'hôtel. Le trajet sera sur la page web du congres. Cette excursion est informelle est a votre propre risque. Le voyage vous amènera le long du port jusqu a la rue Prescott. Tous sont la bienvenue. Tous les niveaux de coureurs et de marcheurs sont la bienvenue. Il y'aura des volontaires du "Running Room" de St. John's pour vous guider.

JOURNEE ENSEIGNANTE

LA SCMO-UGC-AMS 2007 a le plaisir de vous annoncer que nous invitons des enseignants du secondaire en science de toute la province pour notre journée Enseignante.
Nous avons une variété de sujets de présentations et de présentateur qui permet aux éducateurs d'enrichir leurs connaissances et le curriculum de leurs classes en océanographie, sciences de la terre et météorologie. Nous apprécions le support de département d'éducation de la province ainsi que des conseils scolaires qui nous ont fourni des ressources et du temps pour réaliser cet événement.

BRISE GLACE

Cet année le Brise Glace sera le 28 mai au salon des congres de St. John's de 19 :00 a 21 :00. Votre billet ce trouve dans la trousse d'enregistrement du congre. Votre billet est échangeable pour une boisson gratuite. Si vous voulez amener un invite, des billets sont disponible pour 32$. Des canapés seront servit.
L'Honorable Trevor Taylor, Ministre de l'Innovation, de commerce et de développement rural ; un grand supporter du congres sera la pour vous inviter au nom de la province

DINNER PALMARES

Le dîner palmarès Parsons-Patterson sera dans le Salon du Congres, Hall Marconi le Mercredi le 30 mai a 12:30.

BANQUET

Le banquet sera en deux parti. Les membres de la SMOC et AMS seront dans le Hall Marconi (CC) et les membres de la UGC et ESC seront au Salon A de l'hôtel Delta.

Societies	**CMOS-AMS**	**CGU-ESC**
Location	Convention Centre Marconi Hall	Delta Hotel Avalon Ballroom
6:30-7:00 pm	Refreshments	Refreshments
7:00-9:00 pm	Banquet / Awards	Banquet / Awards
9:00-9:15 pm	Tous ensembles dans le Hall Marconi	
9:15-9:45 pm	Soirée Terre Neuve et Labrador	
9:45-11:30 pm	Musique / Dance: Live Band*	

*Nous sommes fiers de vous présenter le groupe « Traces », un ensemble musicale qui vous épaterons avec de la musique des années 70, 80 a aujourd'hui. Vous pourrez danser ou simplement écouter et jaser.

PROGRAM DES PARTENAIRES

McCarthy's Party a mis ensemble un programme pour les délègues et leurs compagnons. Visitez notre site web www.cmos2007.ca sous la rubrique Programme – Programme Social pour les détails sur des visites guider dans lequel vous aimeriez participer. Il y a aussi une liste des attractions locales sous la rubrique « quoi visiter? ».

VISITE TECHNIQUE

Il y aura deux visites techniques le 28 Mai. Les bus partiront de l'entrée a l'étage inférieure (Rue New Gower) a 13:30 et vous retournerons vers 16:00. C'est gratuit mais il y'a une limite de 50 personne par visite/bus. Les deux visites sont:

(1) **NRC - Institute for Ocean Technology** - http://iot-ito.nrc-cnrc.gc.ca/
(2) **Landmark Visualization Centre Memorial University** - http://www.mun.ca/creait/CSLV/

Voir http://www.cmos2007 pour les détails.

CMOS-CGU-AMS 2007 GALA'S

DELEGATES PLEASE NOTE:

YOU WILL BE GIVEN A CHOICE FOR THE MAIN COURSE FOR THE GALA DINNER

YOU MUST RETURN YOUR BANQUET TICKET TO CHOOSE YOUR ENTRÉE

PLEASE NOTE CUT-OFF FOR EXCHANGING YOUR BANQUET TICKET FOR YOUR MEAL CHOICE IS

TUESDAY, MAY 29

2:00 p.m.

You will not be admitted to the dinner with just a banquet ticket.

NOTICE TO CONGRESS DELEGATES

**ALTHOUGH PREVIOUSLY SCHEDULED
BUS SERVICE WILL NOT BE OFFERED FROM
THE FOLLOWING HOTELS:**

**RAMADA INN
BEST WESTERN
THE CAPITAL**

**WE WILL HOWEVER MAKE ARRANGEMENTS
TO HAVE YOU TRANSPORTED TO THE
MEETINGS IN THE MORNING
AND ALSO AFTER THE ICE BREAKER
ON MAY 28
AND FOR THE GALA ON JUNE 1**

**PLEASE CONSULT THE REGISTRATION DESK
FOR DETAILS**

Map of Downtown St. John's (Convention Centre in Lower Left Corner)

MORNING SHUTTLE BUS SERVICE

FROM HOTELS TO THE CONVENTION CENTRE

Bus service will be provided from Tuesday morning, May 29th, to Friday morning, June 1st. Busses arrive at the Convention Centre by 8:00 a.m. each morning.

ROUTE	DEPARTURE
Route 1	
Memorial University of Newfoundland*	**0700, 0720, 0740**
*Memorial stop: Hatcher House residence	
Route 2	
Comfort Inn Airport, 106 Airport Road	**0700, 0740**
Super 8 Motel, 175 Higgins Line*	**0710, 0750**
*Super 8 stop: use Higgins Line bus shelter	
Route 3	
Holiday Inn, 180 Portugal Cove Road	**0700, 0720, 0740**
Hillview Terrace Suites, Torbay Road & MacDonald Drive*	**0705, 0725, 0745**
*Hillview Terrace stop: use Wadlyn Crescent bus shelter	

EVENING SHUTTLE BUS SERVICE

MONDAY EVENING, MAY 28TH

FROM THE CONVENTION CENTRE TO HOTELS – 9:15 P.M. (after Icebreaker)

Busses will operate on a "load and go" basis.

THURSDAY EVENING, MAY 31ST

FROM HOTELS TO THE CONVENTION CENTRE – See schedule below

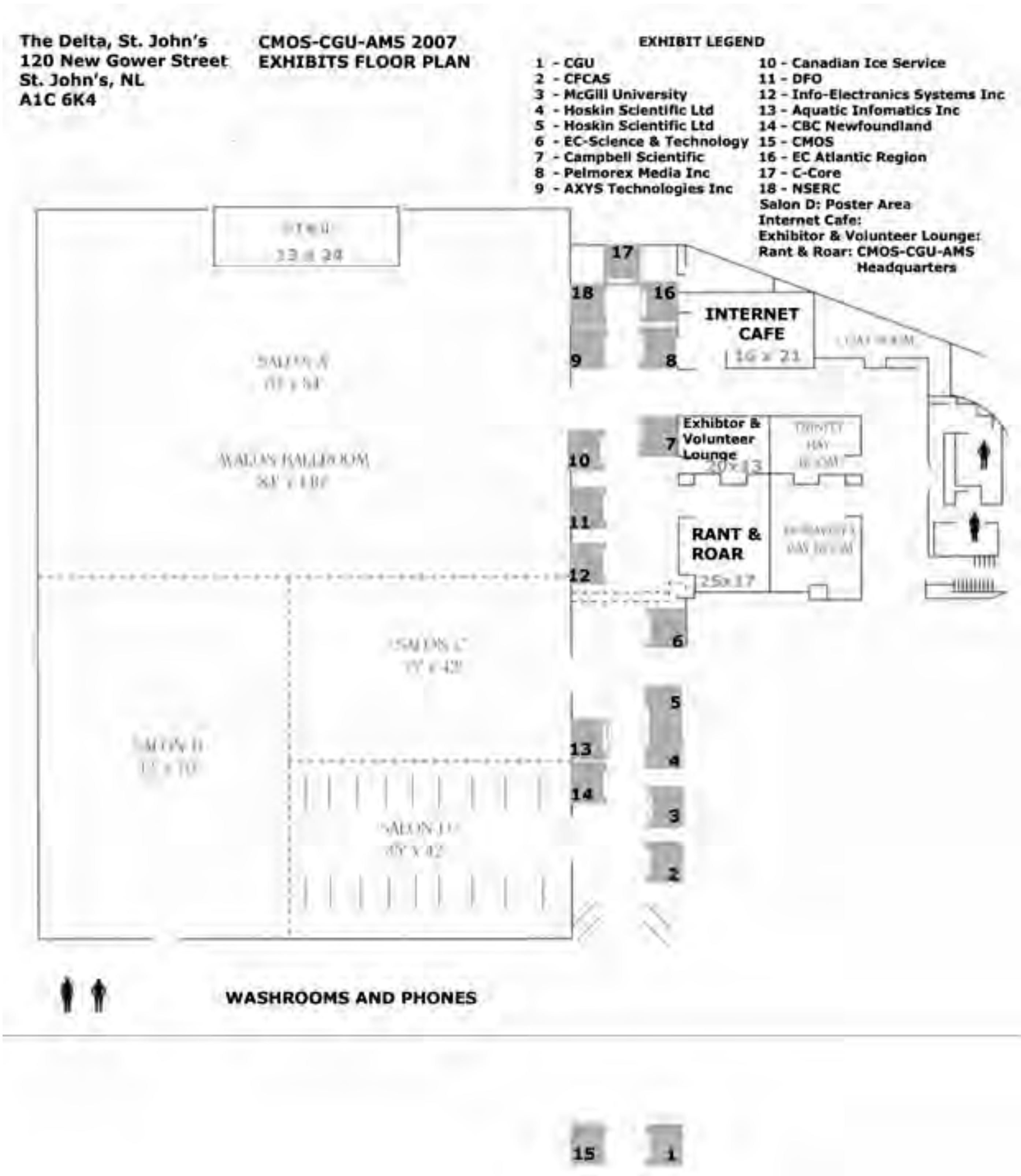
Drop off at the Delta Hotel and the Convention Centre by 6:30 p.m.

Route	Departure
Route 1	
Memorial University of Newfoundland*	**1740, 1800, 1820**
Route 2	
Comfort Inn Airport, 106 Airport Road	**1740, 1820**
Super 8 Motel, 175 Higgins Line*	**1745, 1825**
Route 3	
Holiday Inn, 180 Portugal Cove Road	**1740, 1800, 1820**
Hillview Terrace Suites, Torbay Road & MacDonald Drive*	**1745, 1805, 1825**

THURSDAY EVENING, MAY 31ST

FROM THE CONVENTION CENTRE TO HOTELS – 11:15 P.M. (after the Gala Banquet)

Busses will operate on a "load and go" basis.



The Delta, St. John's
120 New Gower Street
St. John's, NL
A1C 6K4
CMOS-CGU-AMS 2007
EXHIBITS FLOOR PLAN
EXHIBIT LEGEND
1 - CGU
2 - CFCAS
3 - McGill University
4 - Hoskin Scientific Ltd
5 - Hoskin Scientific Ltd
6 - EC-Science & Technology
7 - Campbell Scientific
8 - Pelmorex Media Inc
9 - AXYS Technologies Inc
10 - Canadian Ice Service
11 - DFO
12 - Info-Electronics Systems Inc
13 - Aquatic Infomatics Inc
14 - CBC Newfoundland
15 - CMOS
16 - EC Atlantic Region
17 - C-Core
18 - NSERC
Salon D: Poster Area
Internet Cafe:
Exhibitor & Volunteer Lounge:
Rant & Roar: CMOS-CGU-AMS Headquarters
INTERNET CAFE
16 x 21
Exhibtor & Volunteer Lounge
20x13
RANT & ROAR
25x17
WASHROOMS AND PHONES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SONTEK
Hydrologists and technicians can measure water velocity and flow with precision and efficiency using Acoustic Doppler Equipment. Acoustic Doppler Instruments measure water level and vertically-integrated velocity, they current profile, and The FlowTracker easily attaches to wading rods featuring a discharge mode based on USGS/ISO standards.
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OTT
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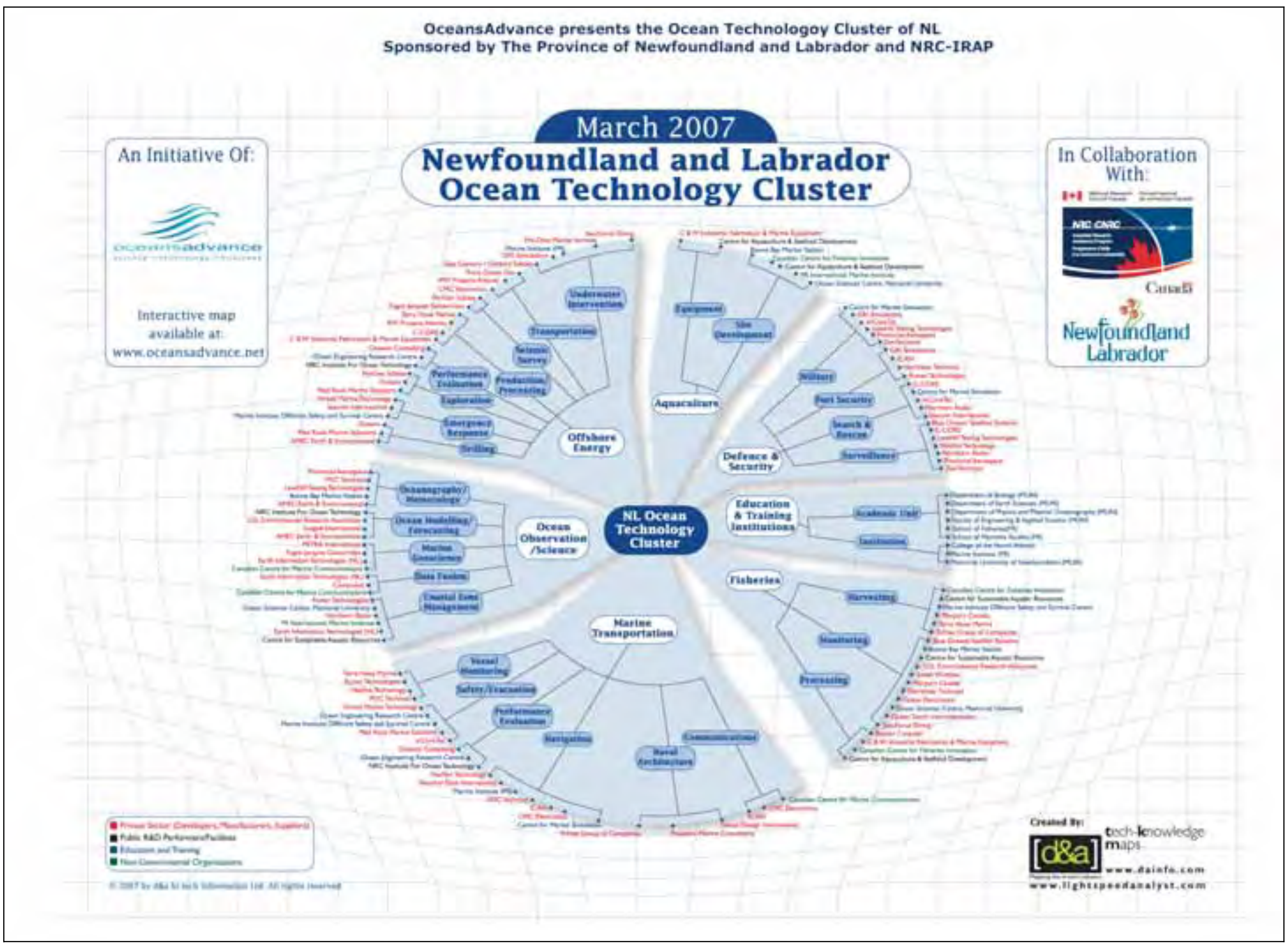
MEMORIAL UNIVERSITY



The NRC Institute for Ocean Technology was established in 1985 to provide technical expertise in support of Canada's ocean industries. The Institute's capability is unique to the nation — no other organization offers the combination of knowledge, experience and world-class facilities. NRC-IOT conducts ocean technology research by modeling ocean environments, predicting and improving the performance of engineered systems that operate in them, and supporting the development of innovative technologies of importance to Canada's marine industries.

Among the tools that support this research is a 200-metre Towing Tank with wavemaking capability; a 75m by 32m Offshore Engineering Basin that generates waves and current; and a 90m Ice Tank, the world's longest simulated Arctic environment. Specialized measurement tools allow companies to evaluate the efficiency and performance of prototypes and existing technologies, improving competitiveness and opening market opportunities.

In 2003 the Institute inaugurated its Ocean Technology Enterprise Centre, a facility to assist the growth and development of new ventures in ocean technology. With a Young Entrepreneurs Program and an Ocean Technology Co-Location Program, the centre helps new and established companies to develop their concepts and technologies in a supportive environment, with access to NRC-IOT facilities and expertise.

For further information, please see http://iot-ito.nrc-cnrc.gc.ca

Environment Canada Environnement Canada

Bruce Whiffen

Public Talk
Wednesday May 30th
7:00 – 8:40 pm
Marconi Hall, St. John’s Convention Centre

Warren Washington

Severe Storms and Strange Events in Newfoundland & Labrador
by Bruce Whiffen, MSC - Environment Canada
&
Climate Modeling of the 20th and 21st Centuries
by Dr. Warren M. Washington
National Center for Atmospheric Research, Boulder, Colorado

Severe Storms and Strange Events in Newfoundland & Labrador

As a consequence of its unique mid-latitude location along the boundary between North America and the North Atlantic, Newfoundland is frequented by a variety of meteorological systems. Heavy snow, high winds, blizzards, ice storms and heavy rains all converge in season. The Gulf Stream, Labrador Current, Gulf of St. Lawrence and even the Grand Banks conspire to aggravate our circumstance. Reliance on the ocean and our need to live along the coast ensure that the impact of these storms is often severe and sometimes devastating.

Bruce Whiffen was born and raised in Bonavista, Newfoundland. He received a Master of Science degree, majoring in Phyics, from Memorial University of Newfoundland in 1982 and a Diploma in Meteorology from Dalhousie University in 1984. He has worked with Environment Canada’s Meteorological Service since 1984, mostly at the Newfoundland Weather Centre in Gander. Since 2000, he has been working out of the Environment Canada district office in Mount Pearl and is presently Acting Manager of Service Design and Coordination. Bruce, his wife Joan and children Stephanie and Joseph live in Mount Pearl.

Climate Modeling of the 20th and 21st Centuries

Everyone knows that climate has always changed. So what is unique about climate changes over the last century or so? Most climate scientists now believe that humankind is changing the earth’s climate system and that significant global warming is taking place. Some scientists are skeptical of this view and think the observed changes result from natural climate variability. A review of recently observed climate change will be presented and compared with climate model simulations. These simulations are extended into the 21st century and beyond. A brief description of what is in climate models will be given with an emphasis on the physical processes. A discussion of future developments will also be given including interactions with the biosphere. Finally, at the end there will be a discussion of the scientific uncertainties from the latest IPCC assessment along with an analysis of policy options including increased use of renewable energy sources and possible geoengineering the climate system.

Warren M. Washington is a senior scientist and head of the Climate Change Research Section in the Climate and Global Dynamics Division at the National Center for Atmospheric Research (NCAR). Born in Portland, Oregon, Washington earned a bachelor's degree in physics and a master's degree in meteorology from Oregon State University. After completing his doctorate in meteorology at Pennsylvania State University, he joined NCAR in 1963 as a research scientist. Washington's areas of expertise are atmospheric science and climate research, and he specializes in computer modeling of the earth's climate. He has published more than 100 papers in professional journals. **For more information see http://www.cgd.ucar.edu/ccr/warren/**

Interdisciplinary (I)

I01: Atmospheric and Oceanographic General Contributions

Convener: Guoqi Han <hang@dfo-mpo.gc.ca>

This session will consist of contributions related to atmospheric and oceanographic sciences that will not fit appropriately into the other sessions.

I02: A year in the life of the Arctic Ocean Shelf: the Canadian Arctic Shelf Exchange Study (CASES)

Conveners: Louis Fortier <louis.fortier@bio.ulaval.ca>, Savithri Narayanan

By any standards, the Canadian Arctic Shelf Exchange Study represents one of the most ambitious multidisciplinary and international effort so far to understand the biogeochemical and ecological impacts of the present decline in arctic sea ice cover. The Arctic Ocean in general and the Canadian sector of the Beaufort Sea in particular have been warming and loosing sea-ice rapidly in the last 30 years. The CASES study logged over 15 500 scientist-days in the Beaufort Sea, including the one-year expedition of the research icebreaker Amundsen during which 225 scientists from 8 countries took rotations to study all aspects of the ecosystem. The central hypothesis of the study was that sea-ice dictates the nature and magnitude of carbon and contaminant fluxes on and at the edge of the Mackenzie Shelf in the Beaufort Sea. The resulting synthesis of observations will lay the ground for future modeling studies coupling sea-ice dynamics, biology and biogeochemistry. It will provide the background for the several publications that we expect will result from CASES over the coming years. This session presentations will illustrate the integration of the biological and physical disciplines into a comprehensive set of studies that will identify the processes dictating the response of the Mackenzie Shelf ecosystem to atmospheric and ice regimes.

I03: Atmosphere-Cryosphere-Solid Earth Interactions

Conveners: Stephane Belair < Stephane.Belair@ec.gc.ca >, Diana.Verseghy < Diana.Verseghy@ec.gc.ca >

Land surface/cryosphere fluxes of heat, water, carbon, and momentum are of significant importance in all types of atmospheric modeling, from local to global scales, short to climate scales, and for several weather and climate elements (e.g., low-level air characteristics, boundary-layer mixing, cloud formation, precipitation, carbon content of the atmosphere). In this session, we solicit contributions concerned with the representation of the land surface/cryosphere or with their impact on the atmosphere. A wide variety of subject is appropriate for this session, including modeling, analysis, and assimilation of the land surface (solid earth, vegetation) and cryosphere (permafrost, soil freeze/thaw, snow on the ground, glaciers), and impact studies on NWP and climate simulations and forecasts. Contributions about other subjects related to atmosphere-cryosphere-solid earth will also be considered.

I04: New Developments in Numerical Modelling of the Oceans and Atmosphere

Conveners:Paul Myers < myers@sumeria.eas.ualberta.ca > , Paul Kushner

Recent developments in numerical models of the physical and biogeochemical components of the climate system have been impressive.Increasing computer power and advances in numerical techniques have provided an opportunity to create simulations on finer scales that include increasingly complex processes. Novel methods include the choice of hybrid vertical coordinates, unstructured or adaptive meshes, combinations of finite difference, finite volume and finite element methods, advection schemes, parameterization by statistical methods, and modular software frameworks to test these new schemes in a systematic way. Validation of these increasingly complex models is now becoming a critical issue, as are observability and controllability of the model's degrees of freedom. We solicit contributions covering any of the mentioned topics, including those that aim to quantify the improvements brought about by the recent model developments.

I05: Coupled Environmental Prediction Systems

Convener: Hal Ritche < Hal.Ritchie@EC.GC.CA >

In recent years there have been major advances in numerical modelling in a variety of environmental prediction domains, covering a wide range of time and space scales. Together with rapid increases in computer power, it is now feasible to develop interdisciplinary coupled environmental prediction systems in which numerous component numerical models interact to produce more comprehensive environmental predictions than was previously possible. This session will include presentations on such systems being developed in Canada and internationally. It is expected that this will include recent research and development on coupled atmosphere-ocean-ice prediction systems at both global and regional scales, together with preliminary connections to biological and chemical models.

I07: Monitoring Earth Systems Dynamics from Space

Convener: Alexander Braun < braun@ucalgary.ca >

The Earth is a dynamic planet and comprises multiple systems which act on different spatio-temporal scales. These systems, e.g. cryosphere, solid Earth, atmosphere and oceans, are often coupled and it is mandatory to monitor and understand each system individually as well as their relations to other systems in order to understand the present system dynamics and to make predictions for the future. In the last decades, satellite platforms have been used to monitor Earth systems from space, e.g. RADARSAT/SRTM, ERS/ENVISAT, LANDSAT/SPOT, CHAMP/GRACE, TOPEX/JASON-1, GPS, TERRA/AQUA, to name a few. These missions provide scientists with a wealth of new data of homogenous accuracy and resolution, and almost global coverage. This session invites contributes dealing with the observation of Earth systems on scales ranging from the meter level to continental scales and time scales of hours to decades. Particular emphasis should be put on monitoring Earth systems from space and analyze the spatio-temporal variability and the interaction/correlation between coupled Earth systems. The session aims to bring together scientists from different disciplines exploiting satellite data to understand Earth system processes. It is expected that the different contributions show synergies in data handling, assimilation, and analysis, which can be beneficial to a wide range of disciplines. INVITED SPEAKER: Dr. Remko Scharroo

I08: The Influence of Sea Ice Variability on the Atmosphere and Ocean

Conveners:Mike Alexander <Michael.Alexander@noaa.gov> , Clara Deser <cdeser@ucar.edu>, Uma Bhatt <bhatt@gi.alaska.edu> , John Cassan <cassano@cires.colorado.edu>

Complex interactions take place between many components of the climate system, including the atmosphere, ocean, snow, and ice occur in polar regions.Variations in sea ice effects the global climate by altering the surface albedo and the exchanges of heat, moisture and momentum between the atmosphere and ocean. This session will address the impact of natural and anthropogenic variations in Arctic and Antarctic sea ice on the atmosphere and ocean from theoretical, numerical, and observational perspectives. Abstracts are welcome on research covering all time and space scales ranging from the influence of leads on the adjacent atmosphere and ocean, to the global atmospheric and oceanic response to the reduction in sea ice due to the increase in greenhouse gases.Phenomena of interest include the effect of sea ice variability on air-sea fluxes, boundary layer processes, clouds, storms and storm tracks, the circulation of the Arctic and Antarctic Oceans, deep water formation and the thermohaline circulation, and the dominant patterns of atmospheric and oceanic variability.

I09: Exploring the Synergy between Geodesy and Meteorology

Conveners: Marcelo Santos < msantos@unb.ca >, Susan Skone2

Global Navigation Satellite Systems (GNSS) such as the Global Positioning System (GPS) have become a tool for meteorology, by allowing the estimation of water vapour content in the atmosphere. Dedicated satellites, such as the newly launched COSMIC mission, having on-board GPS satellites, can also contribute to meteorology by exploring the atmosphere-induced bending of GPS signals while propagating through the atmosphere, to furnished round-the-clock weather data, monitor climate change, and improve space weather forecasts. Geodetic positioning can benefit from meteorology by using data available via Numerical Weather Prediction (NWP) models, such as the Canadian GEM. NWP data can be used for enhancements in correction tropospheric-generated errors that affect GNSS observations. This session or workshop will explore this synergy that exists between Geodesy and Meteorology. Presentations on novel advancements in modelling the troposphere using GNSS and NWP applied to positioning, error sources, instrumentation, and dedicated missions to observe the troposphere using GNSS techniques will be called upon. This session is co-sponsored by the International Association of Geodesy, Commission INVITED SPEAKER: Dr. Seth Gutman

I10: Modeling Polar Oceans and Sea Ice

Conveners: David M. Holland < holland@cims.nyu.edu >, Andrey Proshutinsky < aproshutinsky@whoi.edu >

The focus of this session is on identifying the current status of polar ocean and/or sea-ice modeling, to highlight areas of progress, to clarify the key weaknesses, and for the latter to elicit proposals for improving the current simulations. Papers are invited on modeling of the polar oceans and/or sea ice environments as well as the synthesis of polar region observational studies with modeling efforts. Both Arctic and Antarctic studies from regional to basin scale as well as global models with a focus on the polar oceans and/or sea ice simulations are sought. Studies involving the intercomparison of numerical models of ocean and/or sea ice, and their validation against observational studies are also welcomed.

I11: Hydrometeorological Prediction in Cold Regions and Seasons

Conveners: Sean Carey <sean_carey@carleton.ca>, Alain Pietroniro <Al.Pietroniro@ec.gc.ca>, John Pomeroy <pomeroy@usask.ca>, William Quinton <wquinton@wlu.ca>

The cold regions including high mountains and high latitudes and cold seasons that are dominated by snow cover remain a considerable challenge in environmental modelling. Improving the operation of models for cold regions and seasons is highly relevant because of their importance as water sources for both streamflow and oceanic freshwater and because of the strong influence of snow cover extent and duration on the atmospheric system. This session encourages papers that address: a) improved understanding of key processes relating to the hydrometeorology of cold regions and seasons, b) new parameterizations of land surface hydrology and snow processes that control the coupled atmospheric-hydrological system in cold regions; c) validating and improving models for water, snow, weather and climate systems leading to better prediction and simulation of related atmospheric impacts on water resources and surface climates in cold regions and seasons.

I12: Drought over Canada

Conveners: Ron Stewart <ronald.stewart@mcgill.ca> , John Pomeroy < john.pomeroy@usask.ca >

Drought is an aberration in the water and energy cycle that develops from complex interactions between the atmosphere, oceans and land surface. It changes the flows of water and energy and the dominant processes that mediate these flows, such that water deficits and other extreme conditions are sustained over sustantial space and time. Research on drought in Canada has recently been advanced through the establishment of the Drought Research Initiative. In this Session, contributions are solicited on a range of issues related to Canadian drought including: (1) effects of initial conditions and feedback processes on drought's formation, structure, evolution and cessation, (2) effects of global and regional change on drought, (3) drought impacts on hydrology and water resources systems, (4) other impacts from drought and adaptation to drought, (5) methodologies for improving drought monitoring and prediction.

I13: International Polar Year Coordination

Convener: Taneil Uttal < Taneil.Uttal@noaa.gov >, Ellsworth Ledrew <ells@watleo.uwaterloo.ca >

The International Polar Year will be a time of enhanced research and observations that will benefit from coordination of activities and efforts. This session invites papers describing Activities that have been endorsed by the International Polar Year committee as well as individual efforts that may not be yet officially incorporated into the IPY organizational charts. An emphasis of this session will be discussion period during which a conversation can be initiated on how IPY activities can be coordinated, in particular to enhance interdisciplinary collaborations and observations.

I14: Soils and Climate Change

Conveners: Sue Grayston < sue.grayston@ubc.ca > , Nathan Basiliko < nathan.basiliko@utoronto.ca >

Soils are an important store of carbon (C) globally and play a role in climate through the exchange of carbon dioxide, methane, and nitrous oxide. Net greenhouse gas emissions from soils to the atmosphere occur primarily through the activities of microorganisms, however, rates are often difficult to predict because of concomitant autotrophic soil respiration, plant mediated methane transport, and complex linkages between hydrologic cycles and microbial activities. Northern boreal and sub-boreal forests and wetlands hold approximately 20% (450 Pg C) of biosphere C with 85% of the C present in soils. The fate of these large amounts of C underscores the importance in understanding feedbacks between the carbon budget and climate change, resource management, and land-use changes in these ecosystems. This session invites presentations dealing with soil C and greenhouse gas biogeochemistry in northern terrestrial ecosystems particularly emphasising the role of climate, environmental, and land-use changes, including resource management such as forestry.

I15: Biogeoscience

Convenors: Nigel T. Roulet < nigel.roulet@mcgill.ca >, Edward.A.Johnson < johnsone@ucalgary.ca >

There is a recognized need that some problems in environmental change require knowledge and understanding which crosses traditional disciplinary physical and natural science, and some extent social science boundaries (hydrology, meteorology/climatology, biology, geology, economics and engineering). Biogeoscience is an emerging interdiscipline that brings together the biological sciences, geosciences and engineering to study environmental systems. Biogeoscience differs from past environmental interdisciplinary approaches in that it is interested in coupled processes over a range of time and space scales from sediment budgets-fish habitat of a stream reach, to distributed ecological-hydrological watershed models, to earth surface dynamics models and global circulation models. This session invites papers which demonstrate the full range of disciplines and time and space scales of biogeoscience. We wish this session to show the diversity of research, instrumentation development, and data collection and processing taking place in the Biogeosciences.

Atmosphere (A)

A01: Health Issues of Weather and Climate
Convener: Denis A. Bourque <denis.bourque@ec.gc.ca>
The session under this theme would be an opportunity to present original work in the area of "Health Issues of Weather and Climate", including material which could address Climate / Climate Change and health issues; Weather and Health issues; Operational Weather-based Health Products & Programs; and papers/research which address the policy and economic aspects of weather and climate on health issues.

A02: Atmospheric Community Modelling
Conveners: Ron McTaggart-Cowan <rmctc@sca.uqam.ca>, Xin Qiu <Xin.Qiu@rwdi.com>
In support of atmospheric research, the Meteorological Research Branch of MSC provides the scientific community with a state-of-the-art atmospheric model. The goal of this Community modelling session is to bring together the many users of the Canadian community models, communicate results, exchange ideas, and facilitate new collaborations.

A03: Canadian Society of Agricultural and Forest Meteorology Technical Session
Convener: Ian Strachan <ian.strachan@mcgill.ca>
Contributions are solicited on all topics related to agricultural and forest meteorology, and to those related to meteorological aspects of other natural ecosystems. Appropriate topics include, but are not limited to modeling and measurement of fluxes of energy, mass and trace gases, studies of interactions between the atmosphere and land surfaces, and the effects of weather and climate on agriculture and forestry (including climate change).

A04: Operational Meteorology
Convener: Paul Ford <Paul.Ford@EC.GC.CA>
This session is intended for submissions regarding the use and interpretation of observed and modelled meteorological data for the generation of forecast products in an operational setting.

A05: Open access to meteorological data :
Conveners: Miguel Tremblay < miguel.tremblay@ec.gc.ca >, Nicole Bois < nicole.bois@ec.gc.ca >
Access to meteorological data is essential in a number of studies and for the private sector. We propose a session that explains what data are accessible, what are the technical way to retrieve them and some examples of realisations in different sectors with those data. This session propose to expose: how the differents meteorological public services provide data to other sectors (private, public, academic); the technology used to dissemenate the data; example of public use of meteorological data; example of academic use of meteorological data; the right granted and the restriction about the usage of meteorological data in Canada; the vision of Environment Canada concerning which data will be available in the future and how they intend to dissimenate them.

A06: Polar Clouds and Aerosols: Properties, processes, and climatic significance
Conveners: Matthew Shupe < matthew.shupe@noaa.gov > ,Von Walden < vonw@uidaho.edu >
Due to cold and dry conditions in Polar regions, clouds and aerosols have a heightened radiative impact at these high latitudes. Various cloud and aerosol properties influence the formation, persistence, and balance of cloud phases and thereby play a significant role in precipitation processes and efficiency. In addition, atmospheric hydrometeors and particles participate in important Arctic feedback processes. Despite the clear roles that clouds and aerosols play in Polar radiation and hydrology, many of their climatically important processes are not well understood. Moreover, the spatial and temporal variability inherent in these atmospheric constituents may play a key hand in larger scale Polar climate variability. This session welcomes contributions that will further our knowledge on Polar clouds, aerosols, and/or their interactions. Specific topics may consider, but are not limited to, cloud microstructures, aerosol composition, the indirect effects, cloud formation and maintenance, and the climatic significance of these constituents.

A07: Intensive Arctic Atmospheric Observatories

Conveners: Matthew Shupe < matthew.shupe@noaa.gov > , Kimberly Strong <>

The Arctic is under heightened scrutiny in recent years because it is thought to be a bellwether for global climate change. A system of interdependent Arctic processes involving the sea-ice/snow-covered surface, atmospheric composition, temperatures, and circulations define both the regional climate and its impact on global climate. In particular, the Arctic atmosphere plays a predominant role in these processes. Accurate and timely measurements of chemical composition, radiation, clouds and aerosols, precipitation, winds, and meteorological parameters are essential to understanding the Arctic atmosphere. These measurements allow for early detection and long-term monitoring of changes in the physical and chemical state of the atmosphere, and provide insight into the processes that drive air quality, ozone depletion, and climate change. The upcoming International Polar Year 2007-2008 is timely in its ability to forge international collaborations and coordinate otherwise disparate efforts towards improving our understanding of the Arctic atmosphere, among other topics. A major IPY endeavor is to identify, realize, and/or coordinate the measurements and results of current and future intensive Arctic atmospheric observatories. In support of this effort, this session invites contributions regarding intensive Arctic atmospheric observatories, their instruments, measurements, and key scientific findings.

Climate (C)

C01: Climate change projection, detection and attribution

Conveners: Andrew Weaver < weaver@uvic.ca > , John Fyfe < John.Fyfe@ec.gc.ca >

This session welcomes all papers concerning: 1) The detection of climate change above the background of natural, unforced variability as well as its attribution to changes in either anthropogenic of natural external forcing. 2) The projected 21st Century changes to the physical climate system (e.g. those involving the atmosphere, land surface, oceans and sea ice). Especially welcome will be analyses of the coupled ocean-atmosphere general circulation model simulations made in support of Working Group 1 of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4).

C02: Polar Climate Stability

Convener: Wm. Richard Peltier < peltier@atmosp.physics.utoronto.ca >

Earth's climate system is characterized by significant (north) polar amplification of the response to greenhouse gas induced global warming. Such high latitude amplification of the forced variability is not only characteristic of the present warm interglacial but was also characteristic of past glacial intervals in which the forcing was primarily associated with variations in the seasonal distribution of solar insolation that arises due to the action of gravitational n-body effects upon the Earth's orbit around the Sun. Aside from the forced variability characteristic of the "greenhouse" and "ice-house" worlds, these states of the climate system also exhibit marked differences in their unforced internal modes of variability, including the northern and southern annular modes, ENSO, and the other ocean basin scale modes of variability such as the Atlantic Multi-decadal Oscillation (AMO). The purpose of this session is to promote the interchange of ideas and understanding of the issue of polar climate stability and variability between those working primarily on the modern system and those working upon the same issues from the perspective of paleo-climatology. Since the states of the system visited in the deep past have involved much stronger forcing than is currently being felt under conditions of greenhouse gas induced global warming, the observed responses are commensurately larger and often simple to detect in spite of the lack of direct instrumental observations. In general the interest of this session will be in the coupled atmosphere-ocean-sea ice-land surface processes system, including those interactions that involve (potential large) responses of continental ice sheets such as that on Greenland.

C04: Climate Change and Variability in the Polar Regions

Convener: Lucie Vincent <Lucie.Vincent@ec.gc.ca>

Recent studies of the Polar Regions have demonstrated that the climate systems can change rapidly in a warmer world. The average air temperature of the Arctic has risen by almost twice the rate of the rest of the world over the past several decades while it has increased six times faster in the Antarctic Peninsula. Accurate and timely measurements of temperature, precipitation and many other climatological parameters are essential for a better understanding of the current state of the climate and its variability over the past. Reliable climatological observations are also needed to determine a baseline climate for future climate projections and impact studies. This session invites contributions describing i) the current state of climate in the Polar regions, ii) the long-term trends and variations in temperature, precipitation, water vapour, wind, as well as in upper air data, and iii) any problems or difficulties arising in climate observations, such as changes in networks, instrumentations or observing practices, which can influence the proper assessment of any climate trends.

C05: High Resolution Climate Modelling

Conveners: Colin Jones < jones.colin@uqam.ca > , Ayrton Zadra <ayrton.zadra@ec.gc.ca>,
René Laprise <laprise.rene@ouranos.ca>

To better support climate impact and adaptation efforts, Global and Regional climate models are increasingly being applied at high resolution, with the aim to provide more accurate and detailed estimates of regional climate phenomena and climate change. This session will highlight issues and techniques pertinent to the development and application of high-resolution climate models. Contributions encompassing all aspects of high-resolution climate modelling are welcomed including: Regional Modelling techniques, Variable Resolution Modelling techniques, parameterisation development and evaluation for high-resolution climate models, diagnostic techniques for model evaluation etc.

Geophysics (G)

G03: Multi-scale Deformation Monitoring for Earth Science and Engineering

Convener: Georgia Fotopoulos <foto@civ.utoronto.ca>

Deformations of the Earth’s surface occur over time due to natural Earth processes (from post-glacial rebound to earthquakes) as well as anthropogenic activities (such as mining and oil & gas production). One way to monitor these deformations is to determine the elevation differences between certain epochs. Currently there is a diverse set of measurement tools that can be used to obtain elevation differences, including space-based platforms such as SAR, InSAR, Lidar, TerraSAR-X and GNSS. On smaller ‘engineering’ scales 3D Lidar scanning systems coupled with terrestrial surveying and GNSS measurements can also be used. The challenge for reliable continuous deformation monitoring on multiple scales is to optimally combine the data from various sources in order to detect elevations changes at the centimetre and possibly sub-centimetre level. Contributions are invited to this session that deal with measuring elevation changes through the use of space-based and/or terrestrial measurement schemes. Applications ranging from local or small-scale engineering problems to more regional or larger-scale land deformations are welcome. The session will bring together researchers in the geosciences and engineering in order to address the common problem of surface deformations.

G04: Geomagnetism, paleomagnetism and rock magnetism

Conveners: Phil McCausland < pmccausl@uwo.ca >, Joe Hodych < jhodych@mun.ca >

This session welcomes contributions in paleomagnetism, rock magnetism and geomagnetism. Anticipated submissions include but are not limited to: the reversal behaviour of the Earth's field, paleomagnetism as applied to tectonic problems, paleogeography, rock magnetism as applied to environmental geology, meteorite classification. This will be the first dedicated session at a Canadian meeting in the geomagnetism/paleomagnetism field of research for some time.

G05: The North Atlantic rifted margin: geophysical processes and constraints

Conveners: J. Kim Welford < kwelford@esd.mun.ca >, Keith Louden < Keith.Louden@dal.ca >

This session welcomes contributions on the structure and evolution of rifted margins, particularly those of the North Atlantic and the Arctic or their analogues. Contributions may range from geological constraints upon rifted margins to seismic and potential fields constraints, modelling, basin analysis and discussion of hypotheses for the tectonic development of the margins. This session is a companion to "Atlantic and Arctic petroleum exploration". INVITED SPEAKER: Dr. Brian E. Tucholke

G06: Understanding the Relationships Between Terrestrial and Oceanographic Datums

Conveners: Jiangliang Huang < jianhuan@NRCan.gc.ca >, Daniel R. Roman < Dan.roman@noaa.gov >

Terrestrial heights are often more closely linked to changes in geopotential surfaces with respect to a specified geopotential termed the geoid. While the geoid is meant to approximate the ocean surface, local variations (both long and short term) from oceanographic and meteorological sources can cause significant changes from the geoid. The focus of this session is to better define these differences through modeling, cases studies, and analysis.

G07: Structure and dynamics of the continental mantle lithosphere
Conveners: Ian Ferguson < ij_ferguson@umanitoba.ca >, Andrew Frederiksen
This session aims to integrate geophysical observations and geodynamic modeling to further our understanding of the nature of the mantle lithosphere. Evidence of structures and processes from all types of data (teleseismic, deep refraction, magnetotelluric, gravity, heat flow) is welcome. Also, postulated structures and motions of the mantle lithosphere supported by theory, numerical modelling or physical scale modelling experiments are encouraged.

G08: Advances in geophysical techniques: theory and applications
Conveners: Rod Blais < blais@ucalgary.ca >, John Bancroft <bancroft@crewes.org>
This session will provide a forum for new developments in geophysical techniques, including examples of improved detection and resolution resulting from new survey design methods, novel implementations of traditional data acquisition techniques, and advances in numerical modelling and interpretation procedures. Contributions are welcome from all fields - seismics, potential fields, electromagnetics.

G09: Near-surface geophysical applications
Conveners: Karl Butler < kbutler@unb.ca >, Anthony Endres < alendres@sciborg.uwaterloo.ca >
This session encourages contributions illustrating the application of shallow geophysical techniques of all kinds to hydrogeological, geotechnical and environmental problems. Case histories are particularly welcome.

G10: Seismically unravelling the mysteries of the crust
Conveners: Charles Hurich < churich@mun.ca >,David Snyder < dsnyder@NRCan.gc.ca >
This session aims to bring together researchers who are all investigating the structure of the Earth's crust via seismic methods, but on very different scales and applications, from hard rock mineral exploration, to basin studies in petroleum exploration, and crustal investigations.

G11: Geophysics for Petroleum Exploration and Production in Atlantic Canada
Conveners: Michael Enachescu < michaele@mun.ca >, Steve Kearsey <Stephen.Kearsey@huskyenergy.ca>,
Phonse Fagan < pfagan@vulcanminerals.ca >
We invite papers on all aspects regarding the use of geophysical methods for oil and gas exploration and production offshore and onshore Atlantic Canada. The session will include papers regarding geophysical activity in new areas such as Nova Scotia Slope, Orphan, Laurentian, Maritime, Sydney and Labrador offshore basins, and the Paleozoic trend onshore Atlantic Provinces. Reservoir geophysics papers on developed and undeveloped oil and gas fields of the Atlantic sedimentary basins are also solicited.

Hydrology (H)

H01: Hydrology
Convener: Jim Buttle <JBUTTLE@trentu.ca>
This is a general session for Hydrology.

H02: Isotope tracing of water balance and climate processes
Conveners: Jean Birks < sjbirks@uwaterloo.ca >, John Gibson < john.gibson@ec.gc.ca >,
Thomas Edwards < twdedwar@uwaterloo.ca >
The heavy stable isotopes of oxygen and hydrogen are particularly useful tracers of hydrological and climatological processes because of the systematic mass-dependent partitioning as water passes through the hydrologic cycle. This isotopic labelling has been used to study water-cycling at the local, regional, and global scales. This session invites submissions of papers using isotopes tracer to better understand the hydrological cycle including: isotopic labeling of precipitation, tracing runoff pathways, streamflow generation mechanisms, water residence times, water yields, and partitioning of water sources and sinks including evapotranspiration partitioning. Discussion will include application of isotope tracers for the evaluation of hydrological and hydroclimatic models and the organization of regional, national and global networks that serve to build scientific capacity for tracer-based research.

H03: Watershed Experiments in BC

Convener: Darryl Carlyle-Moses <dcarlyle@tru.ca>

This session will focus on recent results from paired watershed hydrology studies in Canada. Topics will range from the field -based process studies on canopy interception loss and soil moisture to the evaluations of watershed models.

H04: Prediction In Ungauged Basins

Conveners: Christopher Spence < chris.spence@ec.gc.ca >, Robert Metcalfe < robert.metcalfe@mnr.gov.on.ca >, John Pomeroy

The concept of the International Association for Hydrological Sciences (IAHS) Prediction in Ungauged Basins (PUB) program has been widely embraced by the Canadian water resource community. This is because the PUB science plan is seen by many as a useful foundation from which gaps in Canadian water science and management can be addressed. The gaps are many as Canada is struggling to improve its understanding of the hydrological and water quality regimes of its northern permafrost, interior prairie and western mountain regions, among others. Interest is driven by the low density of gauging sites relative to predictive needs, the seasonality of runoff and streanflow processes, uncertainty in spatial precipitation estimates, and the difficulty in defining the contributing area of basins in Canada. This session solicits contributions that discuss the progress of science in the context of the PUB initiative abroad and in Canada. Emphasis will be on studies that strive to reduce predictive uncertainty, especially those associated with the efforts of PUB working groups relevant to the Canadian context. The session will explore gaps in our community's efforts to reduce predictive uncertainty in Canadian ungauged basins, and potentially highlight priority areas for further work.

H05: Ecological Flow Needs: Understanding Stream Processes and the Effects of Altered Flow Regimes on Aquatic Ecosystems

Conveners: Daniel Peters < Daniel.Peters@ec.g.ca >, Robert MetCalfe < robert.metcalfe@mnr.gov.on.ca >

The hydrological regime of many streams in North America has been altered with dams, diversions, and water withdrawals (e.g., irrigation, hydroelectric power production, and municipal/industrial uses), as well as via landscape alterations (e.g., agriculture and urbanization). Modifications to the magnitude, timing, frequency, duration, and rate-of-change of flow can adversely affect associated sediment, biogeochemical and thermal regimes to the detriment of a stream's ecology. Despite a large scientific effort in the last three decades to improve our understanding of the relationship between streamflow and the ecological integrity and function of riverine ecosystems, more research is needed to advance and validate scientifically-based holistic ecological flow methods. Also, development of ecological flow standards are required that would be applicable to the wide-ranging eco-hydrological regions of Canada. This session invites papers that advance our understanding of stream processes and the effects of altered flow regimes on aquatic ecosystems.

H06: Glaciers and Ice Sheets – Processes and Modelling

Conveners: Sarah Boon < boon@unbc.ca >, Gwenn Flowers < gflowers@sfu.ca >

Glaciers, ice caps and ice sheets play an increasingly well-recognized role in the global climate system. They are valuable archives of past environmental conditions, and indicators of current environmental change. Their dynamic response to change shapes landscapes and alters sea level, and can be examined using in-situ, modelling and remote-sensing techniques. We invite contributions on all aspects of glaciology, particularly those addressing the properties and processes of present-day ice masses. This session will bring together glaciologists, geomorphologists, climatologists, remote sensers, and others, who work in diverse geographical locations but share an interest in the state and sensitivity of our cryosphere. INVITED SPEAKER: Dr. C. van der Veen

Ocean (O)

O01: Oceanography of the Northwest Atlantic

Convener: Guoqi Han <hang@dfo-mpo.gc.ca>

Significant advances in understanding oceanographic feature in the Northwest Atlantic have been made since 1990s. Systematic collection of in situ and satellite data has stimulated many new analytical, modeling, and data assimilative investigations focusing on various aspects of the Northwest Atlantic shelf/ocean circulation, hydrography, and ecosystem impacts. This session solicits papers studying oceanographic issues on various spatial and temporal scales, their links to the atmospheric variability and basin-scale circulation in the North Atlantic, and their impacts on climate and ecosystems from theoretical, observational and/or modeling approaches. Topics include, but are not limited to the shelf circulation and hydrography, the Labrador Current, the Gulf Stream and North Atlantic Current, Labrador Sea circulation, and associated processes such as baroclinic instability, water mass formation, air-sea interaction, and Gulf Stream rings, and their implications for the Northwest Atlantic ecosystem. The session aims to provide a forum for reviewing the recent progresses, identifying problems and challenges, and promoting collaborative studies.

O02: Operational Oceanography

Conveners: Charles Hannah < hannahc@mar.dfo-mpo.gc.ca >, Denis Lefaivre, Andry Ratsimandresy

Operational oceanography has become one of the major topics in oceanographic research and development over the past decade, with significant challenges and great opportunities. This session provides a forum for discussions on recent advances in developing effective and efficient operational oceanography systems, including initiatives and planning, oceanographic observations, data management, forecasting models, data assimilation, products dissemination and practical applications.

O03: Coastal Oceanography and Inland Waters

Conveners: Jinyu Sheng < jinyu.sheng@dal.ca >, Ram Yerubandi , Guoqi Han

We convened this session in CMOS2006 and we plan to do it again in CMOS2007. This session will focus on aspects of physical processes and modeling of coastal oceans, estuaries and inland waters. Topics include for example: coastal physical oceanography, storm surges, tsunamis, estuarine dynamics, hydrology and hydrodynamics of large lakes, air-lake interactions, mixing and dispersion of material in the coastal waters.

Snow (S)

S01: General Eastern Snow Conference Contributions

Convener: Andrew Klein <klein@neo.tamu.edu>

This session will encompass general contributions on scientific, engineering and operational issues related to snow and ice that do not fall under any specific ESC session.

S02: Remote Sensing of Snow Cover

Conveners: Chris Derksen < Chris.Derksen@ec.gc.ca >, Richard Kelly

Satellite data can provide spatially continuous, temporally consistent, and synoptically sensitive snow cover information across vast regions for which conventional measurements are sparse or non-existent. With a global reduction in surface observing sites, lengthening satellite time series, and the availability of new satellite technology, there are growing opportunities to enhance the retrieval of snow cover information from satellite data. We invite contributions focussed on all satellite measurement techniques and frequencies (optical, radar, passive microwave, LIDAR, etc.), the retrieval of all snow cover parameters (extent, depth, water equivalent, snow on sea ice etc.). The contributions in this session will be relevant to climatological, hydrological, and numerical modelling applications.

S03: Snowfall and Snow Cover Measurement

Conveners: Daqing Yang < ffdy@uaf.edu > , Craig Smith < Craig.Smith@ec.gc.ca >

Unbiased precipitation time series are required for large scale hydrological and climatological studies. Measurement of solid precipitation, particularly at high latitudes, is complicated by high wind speed events, trace snowfall, and mixed phase/freezing rain events which can introduce a high degree of uncertainty into snowfall measurements. An additional challenge is the application of point snowfall and snow cover measurements to applications that demand a spatial perspective, such as the validation of gridded remote sensing and model products. This session solicits contributions related to all facets of snowfall and cover measurements, including investigations related to gauge corrections, other in situ measurements, and operational snow cover monitoring.

S04: Snow Processes: Measurements and Modelling

Conveners: Janet Hardy < Janet.P.Hardy@erdc.usace.army.mil >, Steven Fassnacht < srf@cnr.colostate.edu >

Terrestrial snow cover has a significant impact on global climatological, hydrological, ecological, and atmospheric processes by modifying energy exchange between the surface and atmosphere, serving as the frozen storage term in the water balance, impacting nutrient cycling and plant phenology, and reacting with atmospheric contaminants. Implicit to improving our understanding of the role of snow cover in these myriad processes are enhanced observations and modelling of processes such as blowing snow, snow cover – vegetation interactions, energy, moisture, and gas fluxes over snow covered surfaces, and two-way reactions between snow and atmospheric chemistry. This session encourages submissions on a range of subject areas that address the role of snow cover related processes in these various physical systems.

S05: Snow Cover and Climate

Conveners: Ross Brown < Ross.Brown@ec.gc.ca > , Allan Frei < Afrei@hunter.cuny.edu >

Interactions between snow cover and the atmosphere are challenging to resolve because the presence of snow cover modifies energy exchange with overlying air masses, but it is these air masses which deposit and ablate snow cover. General circulation models must accurately portray the extent, magnitude, and variability of terrestrial snow cover and mass in order to realistically capture the role of snow in large scale climate processes. Given the importance of snow cover as a key variable for climatological, hydrological and numerical modelling applications, this session will solicit papers that address long term trends in snow cover from observational datasets, interactions between snow cover and synoptic scale climate, low-frequency associations between snow cover and the atmosphere, and model-based assessments of snow cover/atmospheric interaction.

Interdisciplinaire (I)

I01: Contributions Générales en Sciences Atmosphériques et Océanographiques
Coordinateur: Guoqi Han <hang@dfo-mpo.gc.ca>
Cette session rassemble les contributions reliées aux sciences atmosphériques et océanographiques qui ne font pas partie des autres sessions spécifiques.

I02: Un An dans la Vie du Plateau Continental Arctique: Le Projet "Canadian Arctic Shelf Exchange Study" (CASES)
Coordinateurs: Louis Fortier <louis.fortier@bio.ulaval.ca>, Savithri Narayanan
Le projet CASES (Canadian Arctic Shelf Exchange Study) représente un des efforts les plus multidisciplinaires, internationaux et ambitieux entrepris pour améliorer notre compréhension des impacts biochimiques et écologiques du déclin de la banquise arctique. Durant les derniers trente ans, l'Océan Arctique en général et la portion canadienne de la mer de Beaufort en particulier se réchauffent et perdent leur glace de mer. Dans la mer de Beaufort, les scientifiques du projet CASES ont passé 15,500 jours à rechercher tous les aspects de l'écosystème, incluant une expédition d'un an sur le brise-glace Amundsen comprenant 225 scientifiques en rotation parvenant de 8 pays. L'idée que la mer de glace dicte la nature et la magnitude des flux de carbone et de contaminants sur la marge et sur le plateau du Mackenzie dans la mer de Beaufort forme l'hypothèse centrale du projet. La synthèse des observations établira la fondation de base pour les futures simulations sur l'interaction entre la dynamique de la mer de glace, la biologie et la biochimie, ainsi que pour les publications qui apparaîtront dans les années qui viennent grâce au projet CASES. Les présentations pour cette session illustreront l'intégration des disciplines biologiques et physiques pour établir des projets multidisciplinaires pour mieux comprendre les processus qui dictent comment l'écosystème du plateau du Mackenzie réagit aux différents régimes atmosphériques et de glace.

I03: Les Interactions entre l'Atmosphère, le Cryosphère et la Terre Solide
Coordinateurs: Stephane Belair < Stephane.Belair@ec.gc.ca >, Diana.Verseghy < Diana.Verseghy@ec.gc.ca >
Les flux de chaleur, d'eau, de carbone et de mouvement entre la surface terrestre et le cryosphère sont importants pour tous types de simulation atmosphérique, à toutes les échelles spatiales et temporelles, et pour plusieurs éléments météorologiques et climatiques (e.g., les caractéristiques de l'air à basse altitude, le mélange entre les couches de limite, la formation des nuages, la précipitation, les teneurs de carbone dans l'atmosphère). Pour cette session, nous sollicitons des contributions visées sur la représentation de la surface terrestre et du cryosphère ou leur impact sur l'atmosphère. Ces contributions peuvent inclure des simulations, des analyses, et des synthèses de la surface terrestre (Terre solide, végétation) et du cryosphère (pergélisol, congélation et dégel du sol, couverture nivale, glaciers), ainsi que les études sur leurs impacts sur la prévision numérique de la météorologie et du climat. Les contributions sur d'autres sujets reliés aux interactions entre l'atmosphère, le cryosphère et la Terre solide seront aussi considérées.

I04: Les Nouveaux Développements dans la Simulation Numérique des Océans et de l'Atmosphère
Coordinateurs:Paul Myers < myers@sumeria.eas.ualberta.ca > , Paul Kushner
Les développements récents dans les modèles numériques des composants physiques et biogéochimiques du système climatique sont impressionnants. Avec les ordinateurs plus puissants et les avancements dans les techniques numériques, il est maintenant possible de générer des simulations à l'échelle de plus en plus fine sur des processus de plus en plus compliqués. Les nouvelles méthodes incluent le choix de coordonnées verticaux hybrides, les grilles non-structurées ou adaptives, la combinaison des méthodes numériques de différences finies, de volumes finis et d'éléments finis, les mécanismes d'advection, la paramétrisation statistique, et des gammes de logiciels modulaires pour tester les nouvelles méthodes d'une manière systématique. La validation des modèles de plus en plus compliqués, ainsi que l'observabilité et le contrôle des nombreux détails du modèle, représentent maintenant les plus gros défis. Nous sollicitons des contributions sur tous les sujets ci-dessus ainsi que sur les efforts pour quantifier les améliorations dû aux nouveaux développements dans la simulation numérique.

I05: Systèmes de Prévision Environnementale Couplés
Coordinateur: Hal Ritche < Hal.Ritchie@EC.GC.CA >
Récemment, il y a eu des avancements importants dans la simulation numérique pour la prévision environnementale à plusieurs échelles spatiales et temporelles. En combinaison avec les ordinateurs plus puissants, il est maintenant possible de développer des systèmes interdisciplinaires de prévision environnementale couplés dans lesquels les

différents composants numériques interagissent pour générer des meilleures prévisions environnementales qu'avant. Pour cette session, nous recherchons des contributions sur les systèmes de prévision développés au Canada et ailleurs. Il est entendu que cela inclut la recherche et les développements récents sur les systèmes de prévision couplés entre l'atmosphère, l'océan et la glace aux échelles globales et régionales, ainsi que leurs liens avec les modèles biologiques et chimiques.

I07: La Surveillance de la Dynamique des Systèmes de la Terre à partir de l'Espace

Coordinateur: Alexander Braun < braun@ucalgary.ca >

La Terre est une planète dynamique composée de différents systèmes qui agissent à différentes échelles spatiales et temporelles. Ces systèmes (e.g., le cryosphère, la Terre solide, l'atmosphère, les océans) sont souvent couplés et doivent être surveillés et compris indépendamment, ainsi que leurs interactions, pour pouvoir comprendre la dynamique de notre planète et faire des prévisions pour le futur. Durant les dernières décennies, les satellites ont surveillé la Terre à partir de l'espace (e.g., RADARSAT/SRTM, ERS/ENVISAT, LANDSAT/SPOT, CHAMP/GRACE, TOPEX/JASON-1, GPS, TERRA/AQUA). Grâce à ces missions, les scientifiques ont eu accès à des données précises et à une résolution homogène partout sur la planète. Pour cette session, nous sollicitons des contributions qui traitent des observations de la dynamique de notre planète, à toutes les échelles spatiales et temporelles. En particulier, nous recherchons des contributions sur la surveillance des systèmes de la Terre à partir de l'espace et les analyses de la variabilité spatiale/temporelle et les interactions/corrélations des systèmes couplés de la Terre. Cette session rassemblera les scientifiques de plusieurs disciplines qui utilisent des données de satellite pour mieux comprendre les systèmes de la Terre. Il est anticipé qu'il existera une synergie dans les méthodes de traitement de données, d'interprétation et d'analyse entre les différentes disciplines qui bénéficiera tous les participants. CONFÉRENCIER INVITÉ: Dr. Remko Scharroo

I08: L'Influence de la Variabilité de la Glace de Mer sur l'Atmosphère et l'Océan

Coordinateurs:Mike Alexander <Michael.Alexander@noaa.gov> , Clara Deser <cdeser@ucar.edu>,
Uma Bhatt <bhatt@gi.alaska.edu> , John Cassan <cassano@cires.colorado.edu>

Dans les régions polaires, il existe des interactions complexes entre les composants du système climatique (e.g., l'atmosphère, l'océan, la neige, la glace). Par exemple, la variabilité de la glace de mer influence le climat global en affectant l'albédo de surface et les échanges entre la chaleur, l'humidité et le mouvement de l'atmosphère et des océans. Cette session sera visée sur l'impact des variations naturelles et anthropogènes de la glace de mer arctique et antarctique sur l'atmosphère et l'océan déduit par les observations, la théorie, et les simulations numériques. Les contributions sur toutes les échelles spatiales et temporelles (e.g., l'influence du plomb sur l'atmosphère et l'océan, l'influence globale des réductions de glace de mer dû aux gazes de l'effet de serre) sont bienvenues. Aussi d'intérêt sont les phénomènes de l'effet de la variabilité de la glace de mer sur les flux entre l'air et la mer, les processus des couches limites, les nuages, les tempêtes et leurs trajectoires, la circulation dans les océans Arctique et Antarctique, la formation d'eau profonde et la circulation thermohaline, et les tendances dominantes des variations atmosphériques et océaniques.

I09: L'Exploration de la Synergie entre le Géodésie et la Météorologie

Coordinateurs: Marcelo Santos < msantos@unb.ca >, Susan Skone2

Les systèmes globaux de navigation par satellite (Global Navigation Satellite Systems (GNSS)) comme le système mondial de localisation (Global Positioning System (GPS)) sont utilisés couramment en météorologie pour estimer la quantité de vapeur d'eau dans l'atmosphère. Des satellites météorologiques, comme la nouvelle mission COSMIC, qui contiennent des satellites GPS, contribuent à la météorologie en utilisant les perturbations des signaux GPS par l'atmosphère pour fournir des données météorologiques continuelles, pour surveiller le changement climatique, et pour améliorer les prévisions météorologiques dans l'espace. La localisation géodésique peut bénéficier de la météorologie en utilisant les données produites par les prévisions numériques météorologiques, comme le GEM canadien. Ces données peuvent améliorer la correction des erreurs dans les observations GNSS causées par le troposphère. Cette session servira de forum pour l'exploration de la synergie entre la géodésie et la météorologie. Les présentations sur les avancements sur la simulation du troposphère avec l'utilisation des données GNSS et de prévision météorologique pour la localisation, les erreurs de source, et l'instrumentation, ainsi que les missions dédiées à l'observation du troposphère avec les méthodes GNSS sont bienvenues. Cette session est co-commanditée par l'Association Internationale de la Géodésie. CONFÉRENCIER INVITÉ: Dr. Seth Gutman

I10: La Simulation des Océans Polaires et de la Glace de Mer

Coordinateurs: David M. Holland < holland@cims.nyu.edu >, Andrey Proshutinsky < aproshutinsky@whoi.edu >

Cette session a pour but d'identifier la situation actuelle dans la simulation des océans polaires et/ou de la glace de mer, de souligner les progrès réalisés, de confronter les faiblesses clés, et de proposer comment améliorer les simulations courantes. Nous invitons des contributions sur la simulation des océans polaires et/ou des environnements avec de la glace de mer, ainsi que sur la synthèse des études incorporant des observations et des simulations. Les études dans l'Arctique et dans l'Antarctique aux échelles de bassin, régionales et globales qui sont visées sur les océans polaires et/ou la mer de glace sont bienvenues. Des comparaisons de modèles numériques d'océans et/ou de mer de glace, ainsi que leurs validations relatives aux observations sont aussi recherchées.

I11: Les Prévisions Hydrométéorologiques pour les Régions et les Saisons Froides

Coordinateurs: Sean Carey <sean_carey@carleton.ca>, Alain Pietroniro <Al.Pietroniro@ec.gc.ca>, John Pomeroy <pomeroy@usask.ca>, William Quinton <wquinton@wlu.ca>

Les régions froides recouvertes de neige (e.g., hautes montagnes, hautes latitudes, saisons froides) posent un défi aux simulations environnementales. Puisque les régions froides représentent des sources importantes d'eau fraîche pour les rivières et les océans et puisque l'étendue et la longévité de la couverture nivale influence le système atmosphérique significativement, il est essentiel que les modèles pour les régions et les saisons froides soient améliorés. Pour cette session, nous encourageons des contributions qui adressent: a) une meilleure compréhension des processus importants dans l'hydrométéorologie des régions et des saisons froides; b) une nouvelle paramétrisation des processus hydrologiques sur la surface terrestre et de la neige qui contrôlent la conjonction entre l'atmosphère et l'hydrologie dans les régions froides; c) la validation et l'amélioration des modèles des systèmes d'eau, de neige, de météorologie et de climat utilisés pour avancer les prévisions et les simulations des impacts atmosphériques sur les ressources d'eau et le climat dans les régions et durant les saisons froides.

I12: La Sécheresse au Canada

Coordinateurs: Ron Stewart <ronald.stewart@mcgill.ca> , John Pomeroy < john.pomeroy@usask.ca >

La sécheresse est une anomalie dans le cycle d'eau et d'énergie causée par des interactions complexes entre l'atmosphère, les océans et la surface terrestre. En modifiant la circulation de l'eau et de l'énergie et les processus clés qui dirigent cette circulation, la sécheresse cause des manques d'eau et d'autres conditions extrêmes à long terme et sur de vastes régions. Des avancements dans la recherche sur la sécheresse au Canada ont récemment eu lieu grâce à l'établissement de l'Initiative de Recherche sur la Sécheresse. Pour cette session, nous sollicitons des contributions visées sur la sécheresse canadienne incluant (1) l'effet des conditions initiales et des processus de rétroaction sur l'initiation, la structure, l'évolution et la terminaison de la sécheresse, (2) l'effet des changements régionaux et globaux sur la sécheresse, (3) l'impact de la sécheresse sur les systèmes hydrologiques et sur les ressources d'eau, (4) les autres impacts de la sécheresse et de l'adaptation à la sécheresse, (5) les méthodologies pour améliorer la surveillance et la prévision de la sécheresse.

I13: Coordination de l'Année Polaire Internationale

Coordinateur: Taneil Uttal < Taneil.Uttal@noaa.gov > , Ellsworth Ledrew <ells@watleo.uwaterloo.ca >

L'intensification de la recherche et de la récolte d'observations durant l'Année Polaire Internationale (API) nécessitera une bonne coordination d'activités et d'efforts. Pour cette session, nous sollicitons des contributions sur les activités déjà approuvés par le comité de l'Année Polaire Internationale, ainsi que les efforts indépendants qui ne font pas encore partie des plans du API. La session servira de forum pour discuter la coordination des activités du API, et en particulier comment promouvoir les collaborations et les observations interdisciplinaires.

I14: Le Sol et le Changement Climatique

Coordinateurs: Sue Grayston < sue.grayston@ubc.ca > , Nathan Basiliko < nathan.basiliko@utoronto.ca >

Le sol représente une réserve importante de carbone (C) dans le monde et joue un rôle dans le système climatique avec l'échange de dioxyde de carbone, de méthane et d'oxyde nitreux. Les émissions nettes de gaz à effet de serre entre le sol et l'atmosphère sont causées principalement par les microorganismes mais les taux sont difficiles à estimer dû à la respiration concomitante autotrophique du sol, le transport de méthane contrôler par les plantes, et les liens complexes entre les cycles hydrologiques et les activités microbiennes. Les forêts boréales et sub-boréales dans le nord et les terres humides retiennent 20% (450 Pg C) du carbone dans la biosphère tandis que 85% du carbone est retenu dans le sol. Pour prévoir le destin de ces quantités marquantes de carbone, une meilleure compréhension des rétroactions entre le bilan du carbone et le changement climatique, la gestion des ressources, et l'utilisation des terres dans ces écosystèmes est requise. Pour cette session, nous sollicitons des contributions sur le carbone dans le sol et la biogéochimie des gaz à effet de serre dans les écosystèmes terrestres dans le nord. En particulier, nous encourageons des présentations sur le rôle des changements climatiques, environnementaux et d'utilisation des terres, incluant la gestion de ressources comme la sylviculture.

I15: La Biogéoscience

Convenors: Nigel T. Roulet < nigel.roulet@mcgill.ca >, Edward.A.Johnson < johnsone@ucalgary.ca >

Pour mieux comprendre certains problèmes dû aux changements environnementaux, il est nécessaire de prendre une approche interdisciplinaire en incorporant diverses sciences physiques, naturelles et parfois sociales (hydrologie, météorologie/climatologie, biologie, géologie, économie et génie). La biogéoscience est une nouvelle interdiscipline qui rassemble les sciences biologiques, géologiques et le génie pour étudier des systèmes environnementaux. La différence entre la biogéoscience et les autres interdisciplines environnementales est que la biogéoscience est visée sur les processus couplés qui agissent sur plusieurs échelles spatiales et temporelles (e.g., les interactions entre le bilan sédimentaire et l'habitat du poisson dans une rivière, les modèles de l'écologie et l'hydrologie d'un bassin hydrographique, les modèles de la dynamique de la surface terrestre et de la circulation globale). Nous sollicitons des contributions sur tous les aspects et toutes les échelles spatiales et temporelles de la biogéoscience. Nous voulons que cette session démontre la diversité de recherche, d'instrumentation, de développement, et de récolte de données et leurs analyses dans la biogéoscience.

Atmosphère (A)

A01: Effets Météorologiques et Climatiques sur la Santé

Coordinateur: Denis A. Bourque <denis.bourque@ec.gc.ca>

Les sessions incluses sous ce thème offrent l'opportunité de présenter des résultats originaux dans le domaine des effets météorologiques et climatiques sur la santé. Dans ce cadre, nous invitons des contributions sur les effets du climat et du changement climatique sur la santé; les effets météorologiques sur la santé; les produits et programmes de santé reliés à la météorologie; et sur la recherche visée sur la politique et les aspects économiques des effets météorologiques et climatiques sur la santé.

A02: Simulation Atmosphérique Communautaire

Coordinateurs: Ron McTaggart-Cowan <rmctc@sca.uqam.ca>, Xin Qiu <Xin.Qiu@rwdi.com>

Pour supporter la recherche atmosphérique, la branche de recherche météorologique du Service Météorologique du Canada offre à la communauté scientifique un modèle atmosphérique du dernier cri. Le but de cette session communautaire sur la simulation est de réunir les chercheurs utilisant nos modèles atmosphériques pour qu'ils(elles) puissent communiquer leurs résultats, échanger leurs idées et faciliter de nouvelles collaborations.

A03: Session Technique de la Société Canadienne de Météorologie Agricole et Forestière

Coordinateur: Ian Strachan <ian.strachan@mcgill.ca>

Nous sollicitons des contributions sur tous les sujets de recherche reliés à la météorologie agricole et forestière, et à ceux reliés aux aspects météorologiques des écosystèmes naturels. Les contributions recherchées incluent, mais ne sont pas limités aux, simulations et mesures des flux d'énergies, de masse et de gaz traces, études des interactions entre l'atmosphère et la surface terrestre, et les effets de la météorologie et du climat sur l'agriculture et la sylviculture (incluant le changement climatique).

A04: Météorologie Opérationnelle

Coordinateur: Paul Ford <Paul.Ford@EC.GC.CA>

Les contributions recherchées pour cette session sont visées sur l'utilisation et l'interprétation des données météorologiques observées et simulées pour la production de produits de prévision dans un environnement opérationnel.

A05: Accès libre aux données météorologiques

Coordinateurs: Miguel Tremblay < miguel.tremblay@ec.gc.ca >, Nicole Bois < nicole.bois@ec.gc.ca >

L'accès aux données météorologiques est essentiel pour de nombreuses études et pour le secteur privé. Le but de cette session est d'expliquer quelles données sont accessibles, quelle est la propre manière d'accéder aux données et comment les données peuvent être utilisées dans différents domaines. La session éclairera: comment les différents services publics météorologiques partagent leurs données avec les autres secteurs (privé, public, académique); la technologie requise pour partager les données; un exemple de l'usage des données météorologiques par le secteur public; un exemple de l'usage des données météorologiques par le secteur académique; les droits et restrictions envers l'usage des données météorologiques au Canada; la vision d'Environnement Canada concernant quelles données seront accessibles dans le futur et comment elles seront disséminées.

A06: Les Nuages Polaires et les Aérosols: Propriétés, processus, et signification climatique

Coordinateurs: Matthew Shupe < matthew.shupe@noaa.gov > ,Von Walden < vonw@uidaho.edu >

Dans les régions polaires de hautes latitudes, l'impact radiatif des nuages et des aérosols est élevé dû aux conditions froides et sèches. Une variété de propriétés des nuages et des aérosols influence la formation, la persistance, et la balance des phases des nuages et donc, joue un rôle important dans le processus et l'efficacité de la précipitation. De plus, les hydrométéors et les particules atmosphériques contribuent à un processus important de rétroaction dans l'Arctique. Tandis que les contributions des nuages et des aérosols au rayonnement polaire et à l'hydrologie sont bien connues, leurs rôles vis à vis d'autres processus climatiques ne sont pas bien compris. De plus, il est possible que la variabilité spatiale et temporale des nuages et des aérosols influence de manière importante la variabilité du climat polaire à très grande échelle. Pour cette session, nous sollicitons des contributions qui augmenteront nos connaissances sur les nuages polaires, les aérosols, et/ou leurs interactions. Les contributions recherchées incluent, mais ne sont pas limités aux, microstructures des nuages, la composition des aérosols, les effets indirects, la formation des nuages et leurs longévités, et la signification climatique des nuages et des aérosols.

A07: Observatoires Atmosphériques Intensifs dans l'Arctique

Coordinateurs: Matthew Shupe < matthew.shupe@noaa.gov > , Kimberly Strong <>

Récemment, l'Arctique sollicite beaucoup d'attention due au fait que les changements climatiques à l'échelle globale seront ressentis là en premier. Un système de processus interdépendants dans l'Arctique, influencé par la quantité de glace de mer et de neige à la surface, la composition atmosphérique, les températures, et les circulations, dicte le climat régional ainsi que le climat global. En particulier, l'atmosphère dans l'Arctique joue un rôle important dans ces processus. La récolte de données précises est essentielle et doit être faite fréquemment. Ces données traitent de la composition chimique, du rayonnement, des nuages et des aérosols, de la précipitation, des vents, et de d'autres paramètres météorologiques pour améliorer nos connaissances de l'atmosphère dans l'Arctique. Ces données permettent la détection précoce et la surveillance à long terme des changements physiques et chimiques de l'atmosphère, et contribuent significativement à notre compréhension des processus qui dirigent la qualité de l'air, l'épuisement de l'ozone, et le changement climatique. L'Année Polaire Internationale (API) en 2007-2008 offre une opportunité spéciale pour établir des collaborations internationales et pour rassembler de nombreux projets indépendants pour améliorer nos connaissances sur l'atmosphère dans l'Arctique, parmi d'autres sujets. Un but important de l'API est d'identifier, de réaliser, et/ou de coordonner la récolte de données et les résultats des observatoires atmosphériques qui opèrent présentement et qui opéreront dans le futur. Pour supporter ce but, nous sollicitons des contributions sur les observatoires dans l'Arctique, leurs instruments, leurs données, et leurs résultats scientifiques importants.

Climat (C)

C01: Prévision, Détection et Attribution du Changement Climatique

Coordinateurs: Andrew Weaver < weaver@uvic.ca > , John Fyfe < John.Fyfe@ec.gc.ca >

Pour cette session, nous sollicitons des contributions concernant: 1) La détection du changement climatique au-delà de la variabilité naturelle et les causes de ce changement, soient anthropogènes ou naturelles. 2) Les changements climatiques physiques qui sont prévus pour le 21ème siècle (e.g., ceux reliés à l'atmosphère, la surface terrestre, les océans et la glace de mer). En particulier, nous recherchons des analyses sur les simulations couplées de la circulation générale entre l'océan et l'atmosphère entreprises en support du Quatrième Rapport d'Évaluation du Groupe de Travail 1 du Groupe d'experts Intergouvernemental sur l'Évolution du Climat (GIEC).

C02: Stabilité du Climat Polaire

Coordinateur: Wm. Richard Peltier < peltier@atmosp.physics.utoronto.ca >

Le système climatique terrestre est caractérisé par l'amplification significative de l'effet de serre dans le pôle nord dû au réchauffement global. Cette amplification forcée de la variabilité dans les hautes latitudes est non seulement associée avec le réchauffement interglacial courant mais semble caractériser les anciens intervalles glaciales où la variabilité était dû au changement saisonnier de l'isolation solaire causé par les forces gravitationnelles qui affectent la Terre durant son orbite autour du soleil. Autre que cette variabilité forcée de l'effet de serre et de la maison de glace, le système climatique semble aussi démontrer des variations non-forcées, comme les modes annulaires du nord et du sud, le phénomène ENSO, et les autres variations à l'échelle des bassins océaniques comme l'oscillation multi-décennal de l'Atlantique (AMO). Cette session a pour but de promouvoir l'échange d'idées et de connaissances sur la stabilité et la variabilité du climat polaire entre les chercheurs travaillant sur notre système climatique moderne et les chercheurs travaillant sur les mêmes problèmes en paléoclimatologie. Malgré un manque de données et d'observations pour les anciens systèmes climatiques, ceux-ci ont vécu des perturbations plus prononcées que celles présentement causées par l'effet de serre dû au réchauffement global, et donc les anciens changements étaient plus importants et plus faciles à identifier. En général, cette session sera concentrée sur les interactions couplées de l'atmosphère, l'océan, la glace de mer et la surface terrestre, ainsi que l'influence (possiblement très importante) des nappes glaciaires continentales comme celle du Groenlande.

C04: Le Changement Climatique et la Variabilité des Régions Polaires
Coordinateur: Lucie Vincent <Lucie.Vincent@ec.gc.ca>
Des études récentes sur les régions polaires ont démontré que les systèmes climatiques changent rapidement avec le réchauffement global. Durant les dernières décennies, l'augmentation de la température moyenne dans l'Arctique a été le double de l'augmentation globale. L'augmentation sur la Péninsule Antarctique était encore plus prononcée, six fois l'augmentation globale. La fréquente récolte de données précises sur la température, la précipitation et les autres paramètres climatologiques est essentielle pour une meilleure compréhension du climat d'aujourd'hui et de sa variabilité dans le passé. Des observations climatologiques fiables sont aussi nécessaires pour définir un climat de base pour les études sur la prévision et sur les impacts du climat dans le futur. Nous invitons des contributions visées sur i) le climat actuel dans les régions polaires, ii) les tendances et variations à long terme de la température, la précipitation, la vapeur d'eau et le vent à différentes élévations, et iii) les problèmes et difficultés envisagés pour les observations climatiques causés par les changements de réseaux, d'instrumentation et de pratiques d'observation qui influenceront la détection précise des changements climatiques.

C05: Simulation Climatologique à Haute Résolution
Coordinateurs: Colin Jones < jones.colin@uqam.ca > , Ayrton Zadra <ayrton.zadra@ec.gc.ca>,
René Laprise <laprise.rene@ouranos.ca>
Pour mieux comprendre les impacts et les adaptations climatiques, les chercheurs utilisent de plus en plus des modèles climatiques globales et régionaux à haute résolution. Le but de ces modèles est de générer des prévisions précises et détaillées des phénomènes climatiques régionaux et du changement climatique. Cette session visera sur les questions techniques seyantes sur le développement et l'application des modèles climatiques à haute résolution. Des contributions sont recherchées sur tous les aspects de la simulation climatique à haute résolution, en particulier les techniques pour les simulations régionales, les techniques pour les simulations avec différentes résolutions, la paramétrisation et l'évaluation des modèles climatiques à haute résolution, les techniques diagnostiques pour l'évaluation des modèles, etc.

Géophysique (G)

G03: Surveillance de la Déformation à Plusieurs Échelles pour les Sciences de la Terre et en Génie
Coordinateur: Georgia Fotopoulos <foto@civ.utoronto.ca>
Avec le temps, la surface de la Terre se déforme dû aux processus naturels (e.g., relèvement post-glaciaire, tremblements de terre) et aux activités anthropogènes (e.g., industrie minière et pétrolière). Une manière de surveiller ces déformations entraîne l'observation des changements d'élévation à différentes époques. Présentement, il existe plusieurs méthodes pour calculer les changements d'élévation incluant des systèmes aériens de l'espace comme SAR, InSAR, Lidar, TerraSAR-X et GNSS. À l'échelle des projets de génie, il existe des systèmes de balayage tridimensionnels Lidar qui peuvent être accompagnés par de l'arpentage et avec des données GNSS. Le défi pour la surveillance précise et constante de la déformation à plusieurs échelles est de rassembler des données parvenant de différents systèmes pour détecter des changements d'élévation au niveau des centimètres et plus précisément si possible. Pour cette session, nous invitons des contributions sur les changements d'élévation détectés par la

surveillance aérienne de l'espace et/ou avec des systèmes terrestres. Les problèmes de déformation à petite échelle en génie ainsi que les problèmes plus régionaux et à grande échelle sont bienvenus. La session rassemblera les chercheurs en sciences de la Terre et en génie qui s'intéressent aux problèmes de la déformation de la surface terrestre.

G04: Géomagnétisme, Paléomagnétisme et le Magnétisme des Roches

Coordinateurs: Phil McCausland < pmccausl@uwo.ca >, Joe Hodych < jhodych@mun.ca >

Pour cette session, nous sollicitons des contributions sur le paléomagnétisme, le magnétisme des roches et le géomagnétisme. Les contributions recherchées incluent, mais ne sont pas limitées à, l'inversion du champs magnétique de la Terre, le paléomagnétisme pour adresser des problèmes tectoniques, la paléogéographie, le magnétisme des roches et ses applications dans le domaine de la géologie environnementale, et la classification des météorites. Cette session marque pour la première fois depuis longtemps à un congrès canadien, une session dédiée exclusivement à la géomagnétisme et à la paléomagnétisme.

G05: La Marge en Dérive du Nord Atlantique: Processus Géophysiques et Constraintes

Coordinateurs: J. Kim Welford < kwelford@esd.mun.ca >, Keith Louden < Keith.Louden@dal.ca >

Nous sollicitons des contributions sur la structure et l'évolution des marges en dérive, particulièrement celles du Nord Atlantique et de l'Arctique ou leurs analogues. Les contributions recherchées peuvent être visées sur les contraintes géologiques des marges en dérive, les contraintes sismiques et/ou des champs potentiels, les simulations, les analyses de bassin, et les hypothèses sur l'évolution tectonique des marges. Cette session est jumelée avec la session "La Géophysique pour l'Exploration et la Production Pétrolière dans le Canada Atlantique". CONFÉRENCIER INVITÉ: Dr. Brian E. Tucholke

G06: Les Relations entre les Références Altimétriques Terrestres et Océanographiques

Coordinateurs: Jiangliang Huang < jianhuan@NRCan.gc.ca >, Daniel R. Roman < Dan.roman@noaa.gov >

Les élévations terrestres sont liées de près aux changements des surfaces d'altitude géopotentielle relatives au géoïde. Mais, tandis que le géoïde est considéré comme approximation de la surface de la mer, des sources océanographiques et météorologiques peuvent causer des variations régionales (à long et à court terme) qui affectent le géoïde. Le but de cette session est de mieux définir les différences entres les élévations terrestres et le géoïde avec des simulations, des études de cas, et des analyses.

G07: Structure et Dynamique du Manteau Lithosphérique Continental

Coordinateurs: Ian Ferguson < ij_ferguson@umanitoba.ca >, Andrew Frederiksen

Cette session a pour but d'intégrer les observations géophysiques et les simulations géodynamiques afin de mieux comprendre la nature du manteau lithosphérique. Nous sollicitons des contributions sur l'évidence des structures et des processus parvenant de tous types de données – télésismique, réfraction profonde, magnétotéllurique, gravimétrique, flux de chaleur. De plus, nous encourageons des contributions sur les structures postulées et les mouvements du manteau lithosphérique supportés par la théorie, par des simulations numériques ou par des simulations physiques.

G08: Les Avancements dans les Techniques Géophysiques: Théorie et Applications

Coordinateurs: Rod Blais < blais@ucalgary.ca >, John Bancroft <bancroft@crewes.org>

Cette session offre un forum pour la présentation de nouveaux développements en techniques géophysiques. Les contributions peuvent inclure des exemples de détection et de résolution améliorée avec l'usage de nouvelles méthodes de récolte de données, de nouvelles manières d'exécuter des récoltes de données traditionnelles, et des avancements dans les procédures de simulation numérique et d'interprétation. Nous encourageons des contributions de tous les domaines en géophysique – sismologie, champs potentiels, électromagnétique.

G09: Applications Géophysiques Peu Profondes

Coordinateurs: Karl Butler < kbutler@unb.ca >, Anthony Endres < alendres@sciborg.uwaterloo.ca >

Pour cette session, nous encourageons des contributions illustrant l'application des techniques géophysiques peu profondes de tous types pour les problèmes hydrogéologiques, géotechniques et environnementaux. Les études de cas sont particulièrement bienvenues.

G10: Éclaircir les Mystères de la Croûte Terrestre avec les Méthodes Sismiques
Coordinateurs: Charles Hurich < churich@mun.ca >,David Snyder < dsnyder@NRCan.gc.ca >
Cette session a pour but de rassembler les chercheurs qui étudient la structure de la croûte terrestre avec les méthodes sismiques, à différentes échelles et pour différentes applications, soient pour l'exploration minière ou pour l'exploration pétrolière ou pour les études de la croûte entière.

G11: La Géophysique pour l'Exploration et la Production Pétrolière dans le Canada Atlantique
Coordinateurs: Michael Enachescu < michaele@mun.ca >, Steve Kearsey <Stephen.Kearsey@huskyenergy.ca>, Phonse Fagan < pfagan@vulcanminerals.ca >
Nous invitons des contributions sur tous les aspects de l'utilisation des méthodes géophysiques pour l'exploration et la production pétrolière maritime et terrestre dans le Canada Atlantique. Des contributions sur la recherche géophysique dans les bassins maritimes du talus Néo-Écossais, Orphan, Laurentien, Maritime, Sydney et Labradorien, et dans les variations terrestres durant le Paléozoïque dans les provinces atlantiques. De plus, nous recherchons des contributions sur la géophysique de réservoir dans les champs de pétrole et de gaz développés et non-développés dans les bassins atlantiques.

Hydrologie (H)

H01: Hydrologie
Coordinateur: Jim Buttle <JBUTTLE@trentu.ca>
Cette session offre un forum général pour l'hydrologie.

H02: L'Utilisation des Traceurs Isotopiques pour Surveiller la Balance d'Eau et les Processus Climatiques
Coordinateurs: Jean Birks < sjbirks@uwaterloo.ca >, John Gibson < john.gibson@ec.gc.ca >, Thomas Edwards < twdedwar@uwaterloo.ca >
Les isotopes stables et lourds d'oxygène et d'hydrogène sont des traceurs très utiles pour surveiller les processus hydrologiques et climatologiques dû à la partition systématique de la masse d'eau durant les différentes étapes du cycle hydrologique. Ces traceurs sont utilisés pour étudier le cycle hydrologique aux échelles locales, régionales et globales. Pour cette session, nous sollicitons des contributions sur l'utilisation des traceurs isotopiques pour mieux comprendre le cycle hydrologique, en particulier le rôle des traceurs pour surveiller la précipitation, les chemins de ruissellement, les mécanismes pour la génération du débit d'eau, le temps de séjour de l'eau, les apports d'eau, et la partition des sources et des puits d'eau incluant la partition par l'évapotranspiration. Les discussions incluront l'utilisation des traceurs isotopiques pour l'évaluation des modèles hydrologiques et hydroclimatiques et la formation de réseaux régionaux, nationaux et globaux pour mieux encourager la recherche visée sur l'utilisation scientifique des traceurs isotopiques.

H03: Expériences dans les Bassins Hydrographiques en Colombie-Britannique
Coordinateur: Darryl Carlyle-Moses <dcarlyle@tru.ca>
Cette session est visée sur les récents résultats des études hydrologiques des bassins hydrographiques couplés au Canada. Les contributions peuvent traiter des études sur le terrain (e.g. pertes dû au couvert forestier, l'humidité du sol) ainsi que sur les évaluations des modèles de bassin hydrographique.

H04: Prévision pour les Bassins Non-Mesurés
Coordinateurs: Christopher Spence < chris.spence@ec.gc.ca >, Robert Metcalfe < robert.metcalfe@mnr.gov.on.ca >, John Pomeroy
En gros, la communauté canadienne des ressources d'eau supporte l'idée du programme de Prévision pour les Bassin Non-Mesurés (Prediction in Ungauged Basins – PUB) parvenant de l'Association Internationale pour les Sciences Hydrologiques (AISH). Ceci est largement dû au fait que le plan scientifique du PUB offre une fondation solide pour addresser les manques dans les sciences et l'entretien d'eau au Canada. Ces nombreux manques existent parce que le Canada n'a pas encore atteint une compréhension profonde des régimes hydrologiques et de la qualité d'eau dans les régions de pergélisol dans le nord, des prairies centrales et des régions montagneuses de l'Ouest, parmi d'autres. L'intérêt pour ce programme provient du petit nombre de sites de mesure relatif au prélèvement de données nécessaire pour la prévision, du caractère saisonnier des processus de ruissellement et du débit d'eau, de l'incertitude des

estimations spatiales de précipitation, et de la difficulté avec laquelle les zones qui contribuent aux bassins hydrographiques sont identifiées au Canada. Pour cette session, nous sollicitons des contributions sur le progrès scientifique atteint au Canada et dans le monde entier sous le cadre du programme PUB. Nous recherchons des études visées sur la réduction de l'incertitude des prévisions, particulièrement pour les groupes du PUB qui travaillent sur des problèmes au Canada. Durant la session, nous examinerons les manques dans les efforts communautaires pour réduire l'incertitude de prévision dans les bassins Canadiens non-mesurés, et nous identifierons les régions prioritaires pour les efforts scientifiques dans le futur.

H05: Les Besoins Écologiques pour l'Écoulement: Comprendre les Processus des Cours d'Eau et l'Impact de la Modification du Débit sur les Écosystèmes Aquatiques

Coordinateurs: Daniel Peters < Daniel.Peters@ec.g.ca >, Robert MetCalfe < robert.metcalfe@mnr.gov.on.ca >

Le régime hydrologique des cours d'eau en Amérique du Nord est modifié par les barrages, les diversions et les retraits pour l'utilisation humaine (e.g., irrigation, production d'énergie hydroélectrique, utilisations municipales/industrielles), ainsi que par les changements de paysage (e.g., agriculture, urbanisation). Les variations de magnitude, synchronisation, fréquence, durée, et vitesse d'écoulement peuvent compromettre les régimes sédimentaires, biogéochimiques et thermiques et peuvent mettre en péril l'écologie d'une rivière ou d'un fleuve. Malgré trois décennies d'études scientifiques sur la relation entre le débit d'eau et l'intégrité et la fonction des écosystèmes des cours d'eau, plus de recherche est nécessaire pour avancer et pour valider les méthodes scientifiques qui traitent de l'écologie et de l'écoulement simultanément. De plus, des standards pour l'écoulement écologiques sont essentiels pour les diverses régions éco-hydrologiques au Canada. Nous sollicitons des contributions qui avancent nos connaissances sur les processus des cours d'eau et sur l'impact de la modification de débit sur les écosystèmes aquatiques.

H06: Les Glaciers et les Nappes Glaciaires – Processus et Simulation

Coordinateurs: Sarah Boon < boon@unbc.ca >, Gwenn Flowers < gflowers@sfu.ca >

Les glaciers, les calottes polaires et les nappes glaciaires jouent un rôle de plus en plus reconnu dans le système climatique global. Ils représentent une agglomération des conditions environnementales du passé, et un témoignage des changements environnementaux actuels. Leurs réactions dynamiques au changement affectent la surface terrestre et le niveau de mer, et peuvent être sondées in situ avec les simulations et les techniques de télédétection. Nous sollicitons des contributions sur tous les aspects de la glaciologie, en particulier ceux qui adressent les propriétés et les processus des masses de glace d'aujourd'hui. Cette session assemblera des glaciologues, des géomorphologues, des climatologistes, des télédétecteurs, et d'autres chercheurs, qui travaillent à différents endroits autour du monde mais qui partagent un intérêt pour le système cryosphérique et ses sensibilités. CONFÉRENCIER INVITÉ: Dr. C. van der Veen

Océan (O)

O01: L'Océanographie du Nord-Ouest de l'Atlantique

Coordinateur: Guoqi Han <hang@dfo-mpo.gc.ca>

Depuis les années 1990s, des avancements scientifiques importants ont amélioré nos connaissances dans le nord-ouest de l'Atlantique. La récolte de données systématique in situ et par satellite a engendré plusieurs études analytiques, de simulation et de synthèse sur divers aspects de la circulation océanique et sur le plateau continental, de l'hydrographie, et des impacts écologiques. Pour cette session, nous sollicitons des contributions visées sur les études océanographiques à différentes échelles spatiales et temporelles, sur leurs liens à la variabilité atmosphérique et à la circulation océanique dans le nord Atlantique à l'échelle du bassin, et sur leurs impacts sur le climat et les écosystèmes parvenant des analyses théoriques, d'observations et/ou de simulations. Les sujets peuvent inclure, mais ne sont pas limités à, la circulation océanographique et l'hydrographie du plateau continental, le courant du Labrador, le Gulf Stream et le courant de l'Atlantique Nord, la circulation dans la mer du Labrador, les processus associés à l'instabilité barocline, la formation des masses d'eau, l'interaction entre l'air et la mer, les anneaux du Gulf Stream, et les impacts sur l'écosystème du nord-ouest Atlantique. Cette session a pour but d'offrir un forum pour la présentation de récents progrès, l'identification de problèmes et de défis, et la promotion des collaborations scientifiques.

O02: L'Océanographie Opérationnelle

Coordinateurs: Charles Hannah < hannahc@mar.dfo-mpo.gc.ca >, Denis Lefaivre, Andry Ratsimandresy

Durant la dernière décennie, l'océanographie opérationnelle est devenue une des matières marquantes dans la recherche et le développement océanographique, emportant des défis significatifs et des merveilleuses opportunités. Cette session offre un forum pour la présentation des avancements récents dans le développement des systèmes efficaces pour l'océanographie opérationnelle, incluant les initiatives et la planification, les observations océanographiques, la gestion des données, les modèles de prévision, l'assimilation des données, la dissémination des produits et le développement d'outils pratiques.

O03: L'Océanographie Côtière et les Eaux Intérieures

Coordinateurs: Jinyu Sheng < jinyu.sheng@dal.ca >, Ram Yerubandi , Guoqi Han

Cette session a été offerte à CMOS2006 et le sera encore à CMOS2007. Cette session est visée sur les processus physiques et la simulation des océans côtièrs, des estuaires et des eaux intérieures. Les sujets recherchés incluent l'océanographie côtière physique, la crue des eaux, les tsunamis, la dynamique des estuaires, l'hydrologie et l'hydrodynamique des grands lacs, les interactions entre l'air et les lacs, et le mélange et la dispersion des matériaux dans les eaux côtières.

Neige (S)

S01: Contributions Générales pour la Conférence Nivale de l'Est (Eastern Snow Conference)

Coordinateur: Andrew Klein <klein@neo.tamu.edu>

Cette session rassemble les contributions générales en science, en génie et sur toutes les questions opérationnelles reliées à la neige et à la glace qui ne font pas partie des autres sessions ESC plus spécifiques.

S02: La Télédétection et la Couverture Nivale

Coordinateurs: Chris Derksen < Chris.Derksen@ec.gc.ca >, Richard Kelly

Les données de satellite fournissent de l'information précise et régulière sur la couverture nivale à travers de vastes régions où il existe peu de données conventionnelles ou pas de données du tout. Avec la réduction des sites d'observations à la surface de la Terre, l'augmentation du nombre de données récoltées par satellite, et de nouvelles technologies satellites, il existe de plus en plus d'opportunités pour la récolte de données sur la couverture nivale par satellite. Nous invitons des contributions visées sur les techniques de récolte de données par satellite à différentes fréquences (optique, de radar, micro-onde passive, LIDAR, etc.), et sur la récolte de tous les paramètres sur la couverture nivale (l'étendue, la profondeur, la masse d'eau, la quantité de neige sur la glace de mer, etc.). Les contributions pour cette session seront d'intérêt pour les applications climatologiques, hydrologiques et pour les simulations numériques.

S03: Les Mesures des Chutes de Neige et de la Couverture Nivale

Coordinateurs: Daqing Yang < ffdy@uaf.edu > , Craig Smith < Craig.Smith@ec.gc.ca >

Les études hydrologiques et climatologiques nécessitent des fréquentes récoltes de données impartiales de la précipitation. L'incertitude des mesures de précipitation solide, particulièrement dans les hautes latitudes, augmente avec les épisodes de vents violents, de chutes de neige légères, et de phase mixte/pluie verglaçante. L'extrapolation spatiale des données de chutes de neige et de la couverture nivale échantillonnées à quelques sites sur de vastes régions pose un autre défi pour la validation des résultats de la télédétection et des simulations. Pour cette session, nous sollicitons des contributions sur toutes les facettes des mesures des chutes de neige et de la couverture nivale, incluant les études reliées aux corrections des mesures, aux autres mesures in situ complémentaires, et à la surveillance de la couverture nivale opérationnelle.

S04: Les Processus de Neige: Mesures et Simulations

Coordinateurs: Janet Hardy < Janet.P.Hardy@erdc.usace.army.mil >, Steven Fassnacht < srf@cnr.colostate.edu >

La couverture nivale terrestre représente une réserve dans la balance d'eau qui impacte le recyclage des éléments nutritifs et la phénologie des plantes, et qui réagit avec les contaminants atmosphériques. De plus, cette réserve influence significativement les processus climatologiques, hydrologiques, écologiques et atmosphériques à travers le monde en modifiant l'échange d'énergie entre la surface et l'atmosphère. Pour améliorer nos connaissances sur le rôle de la couverture nivale dans plusieurs processus, nous nécessitons de meilleures observations et simulations sur les processus des rafales de neige, les interactions entre la couverture nivale et la végétation, les flux d'énergie, d'humidité et de gazes sur les surfaces recouvertes de neige, et l'interaction entre la neige et la chimie atmosphérique. Nous encourageons les contributions sur tous les sujets qui adressent le rôle de la couverture nivale dans les processus des systèmes physiques.

S05: La Couverture Nivale et le Climat

Coordinateurs: Ross Brown < Ross.Brown@ec.gc.ca > , Allan Frei < Afrei@hunter.cuny.edu >

Il est difficile de reconnaître les interactions entre la couverture nivale et l'atmosphère puisque la présence de la couverture nivale modifie l'échange d'énergie avec les masses d'air au-dessus et ce sont ces masses d'air qui contrôlent l'accumulation de neige et l'ablation nivale. Les simulations de la circulation générale doivent précisément reproduire l'étendue, la magnitude et la variabilité de la couverture nivale terrestre et sa masse pour pouvoir capturer le rôle de la neige dans les processus climatiques à grande échelle. Puisque la couverture nivale joue un rôle important dans la climatologie, l'hydrologie et les simulations numériques, nous sollicitons des contributions visées sur les changements de la couverture nivale à long terme, les interactions entre la couverture nivale et le climat à l'échelle synoptique, les relations entre la couverture nivale et l'atmosphère à fréquence basse, et les interactions simulées entre la couverture nivale et l'atmosphère.

DAY 1

Lonnie Thompson
Byrd Polar Research Center, USA
Email: thompson.3@osu.edu

Title: Abrupt climate change: past, present, and future
Titre: Changement climatique soudain: passé, présent et futur

BIO: Dr. Lonnie G. Thompson is one of the world's foremost authorities on paleoclimatology and glaciology. He has led more than 50 expeditions during the last 30 years, conducting ice-core drilling programs in the world's polar regions as well as in tropical and subtropical ice fields. Recently, Thompson and his team developed lightweight solar-powered drilling equipment for the acquisition of histories from ice fields in the high Andes of Peru and on Mount Kilimanjaro in Tanzania. The results of these histories, published in more that 200 articles, have contributed greatly toward the understanding of the Earth's past, present and future climate system. Other Thompson-led expeditions have recovered a 460-meter-long ice core, the world's longest from a mountain range (Alaska, 2002); the first tropic ice core (Peru, 1983); and cores containing the entire sequence of the Last Glacial Stage as well as cores dating over 750,000 years in age, the oldest outside the polar regions (Tibet, 1992). Thompson's research has resulted in major revisions in the field of paleoclimatology, in particular, by demonstrating how tropical regions have undergone significant climate variability, countering an earlier view that higher latitudes dominate climate change. Thompson has received numerous honors and awards. In 2005, he was elected to the National Academy of Sciences and was awarded the John and Alice Tyler Prize for Environmental Achievement. He has been selected by Time magazine and CNN as one of "America's Best" in science and medicine. His research has been featured in hundreds of publications, including National Geographic and the National Geographic Adventure magazines. He and his team are the subject of a new book entitled: Thin Ice: Unlocking the Secrets of Climate in the World's Highest Mountains by Mark Bowen published in late 2005. In 2006, he has been elected member of the American Philosophical Society, Alumni member of Phi Beta Kappa and chosen to receive the Roy Chapman Andrews Society, 2007 Distinguished Explorer Award.

ABSTRACT: Over the last 30 years ice core records have been systematically recovered from eleven high-elevation ice fields, ten of which are located in the low latitudes. Three lines of evidence for abrupt climate change both past and present are presented. First, annually and decadally averaged δ18O (temperature proxy) and net mass balance histories (precipitation proxy) for the last 400 years and 2000 years, respectively, demonstrate that the current warming at high elevations in the mid- to lower latitudes is unprecedented for at least the last two millennia. Second, the continuing retreat of most mid to low-latitude glaciers, many having persisted for thousands of years, signals a recent and abrupt change in the Earth's climate system. Finally, rooted, soft-bodied wetland plants, now exposed along the margins as the Quelccaya ice cap (Peru) retreats, have been radiocarbon dated and when coupled with other widespread proxy evidence, provides strong evidence for an abrupt mid-Holocene climate event that marked the transition from early Holocene warmer conditions in Peru to cooler, late Holocene conditions. This abrupt event, roughly 5200 years ago, was widespread and spatially coherent through much of the world and was coincident with structural changes in several civilizations. These three lines of evidence argue that the present warming and associated glacier retreat are unprecedented in some areas for at least 5200 years. The ongoing global scale, rapid retreat of mountain glaciers is not only contributing to global sea level rise, but threatening fresh water supplies in many of the world's most populous regions. The current and present danger posed by ongoing climate change and the human response will be discussed.

DAY 1

Louis Fortier
Université Laval, Canada
Email: Louis.fortier@bio.ulaval.ca

Title: The melting Arctic sea-ice: death and rebirth of an ecosystem
Titre: La fonte des glaces de mer dans l'Arctique: mort et renaissance d'un écosystème

BIO: Trained at Laval and McGill Universities and a NATO postdoctoral fellow, Louis Fortier holds the Canada Research Chair on the Response of Arctic Marine Ecosystems to Climate Change at Université Laval. A specialist of zooplankton and fish larvae, he headed the Regroupement stratégique Québec-Océan (formerly GIROQ) from 1996 to 2005. An indefatigable promoter of a multidisciplinary and cross-sectorial approach to the ecosystem-level concerns raised by the warming of the Arctic, he has led the NOW (International North Water Polynya Study) and CASES (Canadian Arctic Shelf Exchange Study) NSERC Research Networks. He is the Project Leader for the Canadian Research Icebreaker Amundsen and the Scientific Director of ArcticNet, a Canadian Network of Centres of Excellence dedicated to the study of the transforming coastal Canadian Arctic. Louis Fortier was elected « Scientifique de l'Année 2004 » by Radio-Canada and « Personnalité scientifique de 2005 » by La Presse and Radio-Canada. In 2006, Université Laval awarded him the title of Grand Diplomé and the Gloire de l'Escolle Medal of the Alumni Association. He was made an Officer of the Order of Canada by the Governor General in February 2007.

ABSTRACT: The highly dynamic and thermodynamic ice sheet that covers the Arctic Ocean and its ancillary seas dictates biological productivity and carbon fluxes over 15 millions km2 (or 4.2%) of the global ocean surface. As far as we know, the arctic ice cover has persisted for at least the last 3.7 MA and perhaps since the Eocene, allowing a unique flora and fauna to evolve and adapt to some of the most extreme environmental conditions at the surface of our planet. The resulting low-diversity ecosystem of highly specialized organisms is threatened by the on-going shrinking of its icy biota. Beyond the charismatic Polar bear, intriguing organisms (many of them newly discovered), ranging in size from the ice-adapted microbes and their viruses to the ice-dwelling Polar cod and Boreal whale, will be impacted by the on-going regression of the ice, many negatively, some positively. In the short term (until 2050?) the relaxation of the severity of arctic conditions is expected to increase productivity and carrying capacity of the ecosystem, to the benefit of existing populations. However, in the longer term (by the end of the century?), the lengthening of the ice-free season on the Shelves, the dismissal of the perennial Central ice pack, the warming and mixing of the surface layer, and the intensifying penetration of Atlantic Water into Arctic basins could spell the rapid displacement of Arctic specialists by Atlantic (and Pacific) generalists. This Atlantification of the Arctic Ocean will boost its overall biological productivity at the cost of a major loss of biodiversity.

DAY 2

Brian Hoskins
University of Reading, UK
Email: b.j.hoskins-at-reading.ac.uk

Title: Weather Systems and Climate Processes
Titre: Les systèmes météorologiques et les processus climatiques

BIO: Dr. Brian Hoskins is a Royal Society Research Professor and Professor of Meteorology at the University of Reading His degrees are in mathematics from the University of Cambridge and he spent post-doc years at NCAR and GFDL before moving to Reading, where he rose through the ranks and was Head of department for 6 years. His research is in weather and climate, in particular the understanding of atmospheric motion. His major research achievements have been in the areas of frontogenesis, baroclinic wave life cycles, storm-track organisation, Rossby wave forcing & propagation, potential vorticity, monsoons & subtropical anticyclones and spectral models. His international roles have included being vice-chair of the Joint Scientific Committee for the World Climate Research Programme and President of the International Association of Meteorology and Atmospheric Sciences. He has also had numerous roles. He is a member of the science academies of the UK, USA, China and Barcelona and has received a number of awards.

ABSTRACT: There is an increasing realisation that the weather-climate problem is a seamless one from days to decades. Most of the impact of climate variation and change is through the weather and its extremes. Weather phenomena feed back on the evolving ambient flow, which in turn gives the background on which the weather occurs. This conceptual framework will be developed and some particular examples of weather and climate phenomena and the challenge in simulating them in models will be discussed.

DAY 2

James P. Bruce
Soil and Water Conservation Society, Canada
Email: jpbruce@sympatico.ca

Title: Extreme events in a changing climate
Titre: Les événements extrêmes dans un climat changeant

BIO: Dr. Jim Bruce served in increasingly responsible positions in Environment Canada, beginning as weather forecaster and in hydro meteorological research. Subsequently, he was first Director, Canada Centre for Inland Waters, Burlington and for 8 years to 1985 as an Assistant Deputy Minister. He was Director of Technical Cooperation and Acting Deputy Secretary-General of the World Meteorological Organization (WMO), Geneva, with responsibility for projects world-wide on weather and disaster warning systems, water, climate and air quality. He subsequently chaired the UN's Scientific and Technical Committee for the International Decade for Natural Disaster Reduction. In the past decade Jim has served as a consultant at home and abroad on adaptation to climate variability and change and on natural disaster mitigation.

He is an Officer of the Order of Canada, a Fellow of CMOS, a Fellow and Honorary Member of AMS and a Fellow of the Royal Society of Canada. He has been awarded Honorary Doctorates from University of Waterloo and McMaster University.

ABSTRACT: Global mean temperature changes were driven overwhelmingly by greenhouse gas increase since the mid-1960's and greenhouse gases will continue to dominate changes in coming decades. A number of types of extreme events are associated with these changes due to related phenomena, such as increases in atmospheric water vapour, and warming of the upper layers of the oceans. A review will be given of changes in extremes observed to date and projected into the future. Some economic and social consequences of this trend in extreme hydrometeorological events are outlined both for Canada and the world, along with assessments of other factors which also influence the rapidly rising disaster losses. Information will be presented on Soil and Water Conservation Society studies of impacts of changes in the heavy rain regime in the Great Lakes basin on erosion of agricultural lands and on water quality. This issue brings to the fore again the importance of disaster loss reduction and erosion prevention measures as adaptations to climate change, and the very inadequate measures taken to date in Canada.

DAY 3

C. K. Shum
The Ohio State University, USA
Email: ckshum@osu.edu.ca

Title: Role of space geodesy in the quantification of 20th century sea level rise
Titre: Rôle de la géodésie spatiale dans la quantification de la montée du niveau de la mer

BIO: Dr. C.K. Shum earned his B.Sc., M.Sc., PhD in Aerospace Engineering from the University of Texas at Austin. He is currently a full professor in Geodetic Science, School of Earth Sciences, The Ohio State University, responsible to support comprehensive academic program including teaching of graduate and undergraduate students, and serve as the Co-Director of the Laboratory for Space Geodesy and Remote Sensing, conducting research in various projects in interdisciplinary field of Earth science. He has published over 100 journal articles and book volume articles and oversees a comprehensive research program in Earth science and engineering. He served as a contributing author to the 2001 Intergovernmental Panel for Climate Change (IPCC) Third Assessment Report's chapter on Sea Level Change, and as a Lead Author on the 2007 IPCC Fourth Assessment Report chapter on Ocean Climate and Sea Level. He serves on the Executive Committee of Ohio State University's Byrd Polar Research Center. He is an expert in space geodetic and remote sensing measurement systems for interdisciplinary science studies which include the determination of Earth's gravity field and its temporal variations, global sea level variations, ice sheet mass balance, ocean tide modeling, glacial isostatic adjustment, GPS meteorology using LEO limb-sounding and Synthetic Aperture Radar Interferometry application of ice stream velocity and deformation. He was the President of Section II, Advanced Space Technology, International Association of Geodesy, which advocates the use of space geodetic measurements for interdisciplinary applications. He currently serves as the Vice President for IAG's Commission I, Reference Frames. He received NASA awards for contribution to the TOPEX/POSEIDON project. He received the Senior Weikko A. Heiskanen Geodesy Award, at Ohio State University in 1998. He was AGU's Geodesy Section Secretary, 1996-1999. He received the Lumley Research Award, College of Engineering, Ohio State University, in 2004, awards from NASA on TOPEX/POSEIDON mission and Flight Operations Team (1994, 1996), TOPEX Gravity Field Modeling and Precision Orbit Determination Team (1993, 1994), TOPEX Science Mission, and contributions to the GRACE mission (2006). He is a Fellow of the International Association of Geodesy since 1995.

ABSTRACT: Geodesy in the 21st Century is evolving into a cross-disciplinary science and engineering discipline. The complicated dynamic processes of the Earth system manifested by interactions between the solid Earth and its fluid layers, including ocean, atmosphere, cryosphere and hydrosphere, are linked with such phenomena as global sea level rise and global climate change. Increasingly accurate and innovative space geodetic and remote sensing observations are enabling one to address such complex interdisciplinary research problems as the determination and quantification of the causes of present-day sea level rise. The current and post-IPCC Third Assessment Report (TAR, 2001) determination of the 20th Century sea level rise is estimated to be around 1.7-1.8 mm/yr. While the observations could not be explained by plausible geophysical causes during the 2001 TAR by ~40%, the assessment during the current IPCC Fourth Assessment Report (FAR, 2007) effort implicates a much closer budget in that the geophysical explanations largely accounts for the observed sea level rise. However, the agreement could potentially be accidental due to largely unknown geophysical factors including anthropogenic water impoundment and potential hydrologic imbalance. This paper discusses the role of space geodesy in the determination and explanation of the causes of the 20th century global sea level rise, using data including tide gauges (1900-2004), multiple satellite altimetry (1984-2005), hydrographic data, satellite gravimetry (GRACE, 2002-2006) and radar altimetry observed mass changes of large ice sheets (1992-2004). The paper also summarizes the current IPCC assessment of the 20th century sea level rise budget and its interpretation.

DAY 3

Susan Allen
University of British Columbia, Canada
Email: sallen@eos.ubc.ca

Title: Physical controls on phytoplankton biomass and composition in the Strait of Georgia: results from a 1-D model

Titre: Contrôles physiques sur la production phytoplanctonique et la composition du Strait of Georgia: résultats provenant d'une représentation unidimensionelle

BIO: Dr. Susan Allen is a physical oceanographer. Trained as a physicist, applied mathematician and fluid dynamicist, her early, and one of her continuing focuses is the dynamics of rotating flow over topography with particular emphasis on submarine canyons. Using theory, laboratory experiments, numerical simulations and collaborating with observationalists she has generated an overall picture of the pattern and strength of upwelling over submarine canyons. In the process her group has shown the limitations of numerical models in simulating advection of stratified flow over steep topography.

In collaboration with Douw Steyn, she has made contributions to the field of atmospheric buoyancy driven flow over and through mountains. In her third area of research, she has worked with biologists looking at the effect of physical processes on advection of zooplankton and the timing of the spring bloom in the Strait of Georgia. Susan Allen was a member of the steering committee of Canada GLOBEC, has sat on a number of CMOS committees including the Science Committee and is currently a member of CNC-SCOR and the DFO Science advisory committee. She has held a faculty appointment at UBC since 1990 where she teaches physical oceanography, ocean and atmosphere dynamics and numerical techniques.

ABSTRACT: The Strait of Georgia is a semi-enclosed coastal sea with a strong estuarine circulation. The growing season starts with a classic spring-bloom followed by strong summer productivity. We have coupled a one-dimensional vertical-mixing model that uses a K-Profile parameterization of the boundary layer to a NPZD-class of biological model with 2 to 12 compartments. Two-dimensional physical processes, such as the estuarine circulation, are parameterized. The model is forced with hourly meteorological data and daily river data. The benefits and limitations of model choices will be discussed. The coupled biophysical model has been successfully used to determine the physical factors that control the arrival time of the spring bloom. Wind was found to be the primary control with strong winds delaying the bloom and weak winds causing the bloom to arrive earlier. The summer productivity is maintained by the estuarine circulation. Effects of inter-annual variations of physical factors (such as wind and river flow) on the biomass and composition of summer phytoplankton will be discussed.

DAY 4

Garry Clarke
University of British Columbia, Canada
Email: clarke@eos.ubc.ca

Title: The Lake Agassiz megaflood and 8200 BP cold event: was there a causal link?

Titre: La méga inondation du Lac Agassiz et l'événement froide de 8200 ans avant le présent: il y a t'il un lien de causalité définitif?

BIO: Dr. Garry Clarke is a professor of geophysics in the Department of Earth and Ocean Sciences at the University of British Columbia. His research specialty is glaciology and his particular expertise is in ice ages, global change, cryospheric agents of abrupt climate change and glacier physics. He has spearheaded a 35-year glaciological field study in the Yukon Territory and is also active in the development of theory and computational models of glacier and ice sheet dynamics. He is currently involved with the Polar Climate Stability Network and the Western Canadian Cryospheric Network, both funded by CFCAS. Clarke has served as President of the International Glaciological Society and the Canadian Geophysical Union and received the highest scientific awards of both these organizations. He is a Fellow of the Royal Society of Canada, the American Geophysical Union, and the Arctic Institute of North America.

ABSTRACT: The most conspicuous climate event of the past 10,000 years occurred while North American was exiting from the last Ice Age and is commonly known as the “8.2 kyr BP cold event”. The timing of this event appears to coincide with a geologically remarkable flood – the final draining of ice-dammed glacial Lake Agassiz. The volume of released water has been estimated as ~151,000 km3, more than ten times that of Lake Superior, the largest contemporary freshwater lake. Model-based estimates place the peak discharge at ~5 Sv and the duration at ~0.5 yr. The cause of the 8.2 kyr event remains controversial. Earlier abrupt climate change events seem to have been associated with ocean circulation changes in response to freshening of the North Atlantic, either by redirection of deglacial meltwater or by melting of iceberg armadas launched from the Laurentide Ice Sheet. The switching mechanism for which there is the strongest evidence is that associated with changing the operation of the North Atlantic meridional overturning circulation (MOC). The Agassiz megaflood presents a near-ideal case for testing this idea because the volume of released freshwater and rate of delivery are well constrained. Several recent modeling studies, aimed at simulating the 8.2 kyr event, support the idea that the flood triggered a change in the MOC but there is scant evidence in the marine sedimentary record to support this claim. In this paper we combine hydraulic modelling of the flood forcing, with coupled ocean–atmosphere modelling of the climate response to reconcile model predictions with the paleoenvironmental evidence.

DAY 4

Marika Holland
National Center for Atmospheric Research, USA
Email: mholland@ucar.edu
Title: A seasonally ice free Arctic?
Titre: Un Arctique saisonnièrement libre de glace?

BIO: Dr. Marika Holland received her Ph.D. from the University of Colorado under the direction of Dr. Judith Curry in 1997. She spent the following two years as a postdoctoral fellow at the University of Victoria, BC working with Dr. Andrew Weaver. Marika returned to Boulder Colorado in 1999 as a scientist at the National Center for Atmospheric Research in the Climate and Global Dynamics Division. Marika's research interests focus on the role of sea ice in the climate system, including ice/ocean/atmosphere feedback mechanisms, high latitude climate variability and change, and the impact of sea ice on deep water formation in the North Atlantic. She has worked extensively on coupled climate modeling and the improvement of sea ice models for climate simulations.

ABSTRACT: Observations show large and coordinated changes are occurring in the Arctic climate system. Perhaps the most striking of these is a significant decline in summer Arctic ice extent that has accelerated in recent years. Climate models project that decreases in the Arctic ice cover will continue into the foreseeable future, and suggest that a seasonally ice-free Arctic could be realized within the next century. However, different models differ considerably on the rate and character of these projected changes. For example, several models suggest that abrupt retreat of the summer ice cover is likely while others show more gradual change under the same external forcing scenario.

Here we explore projected changes in Arctic ice cover over the 21st century for a number of climate models and investigate the factors that lead to the large scatter in their projections. We address the mechanisms that drive the rapid retreat that occurs in some models and discuss reasons why not all models project this type of decline. This includes an analysis of the changing simulated Arctic heat budgets and information on the strength of important feedback mechanisms and how they differ among the models. To the extent possible, we discuss what this analysis suggests about how and when a seasonally ice-free Arctic might be realized.

Explanations

To find out where and when you will present your poster/talk, you will need to understand the abstract scheduling code.

Example: **C02-1D5.6**

Part 1 - Part 2

The abstract session code is in two parts delineated by a dash. The code portion before the dash indicates the scientific theme of the session in which the abstract is located. The second part following the dash provides where and when the talk is given (day,time,location). Details are provided below.

Part 1: Session Theme: **C02**

- The letter denotes the scientific discipline
  - P: Plenary; A: Atmosphere; C: Climate; G: Geophysics; I: Interdisciplinary; H: Hydrology; O: Ocean; S: Snow
- The 2 digit number denotes the specific session within the discipline
  - i.e. C02: Polar Climate Stability**.**

Part 2: Location and time of the talk **1D5.6**

- The first digit denotes the day (i.e.1: Tues; 2: Wed; 3: Thurs; 4: Friday).
- The second character is a letter (A-D) denoting the time slot of the day (plenary, morning, early afternoon, late afternoon).
- The third character is either:
  - A number (1-9) indicating which of the oral session rooms the abstract is situated in. This number will correspond to the name of the room.
  - The letter P denoting a poster session.
- The final digit after the dot indicates the order of the abstract in the particular oral/poster session.

Thus for the above example: **C02-1D5.6:** This abstract is in the Climate Theme session 2 (Polar Climate Stability) on Tuesday in the late afternoon (16:00-18:00) in session slot 5 (DH-Avalon B). It is the 6th paper in this session.

Explications

Pour trouver ou et quand vous aller présenter votre abstract sous forme de poster ou de discours oral, vous aller devoir comprendre le code.

Example: **C02-1D5.6**

Part 1 - Part 2

Le code horaire de votre abstract est en deux parti séparer par un tiret. La portion avant le tiret, indique le thème scientifique de la session dans lequel l'abstract est situe. La deuxième portion du code suivant le tiret indique ou est quand l'abstract sera présenter (journée, heure et salle). Trouver plus de détails ci-dessous.

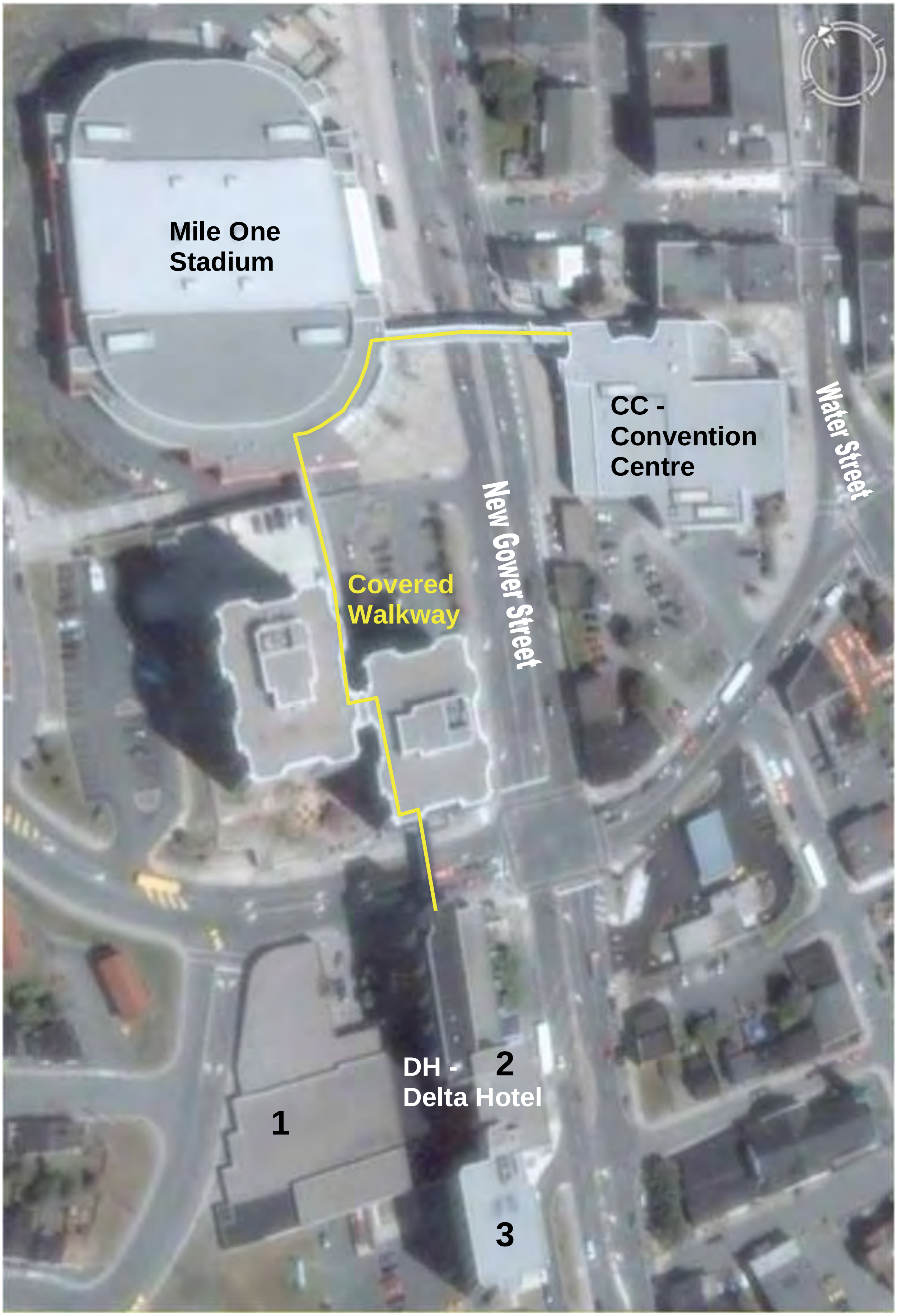
Portion 1 du code: Thème de la session: **C02**

- La lettre dénote le sujet scientifique :
  - P: Plénière; A: Atmosphère; C: Climat; G: Géophysique; I: Interdisciplinaire; H: Hydrologie; O: Océan; S: Neige
- Le second charactere denote le theme de la session specifiquement
  - i.e. C02: Stabilité du Climat Polaire**.**

Portion 2 du code: Ou est quand: **1D5.6**

- Le premier caractère, un chiffre, dénote le jour de la présentation (i.e.1: Mar; 2: Merc; 3: Jeudi; 4: Ven).
- Le second caractere, une lettre (A-D), dénote la vitrine temporelle de la session (Plénière, Matin, début après midi, fin d'après midi)
- Le troisième caractère est soit:
  - Un chiffre (1-9) qui indique dans quelle session oral (la salle de présentation) est situe le discours .
  - La lettre P qui dénote la session poster (Salon D de l'hôtel Delta).
- Le dernier chiffre après le point, indique la position de la présentation ou du poster dans la session en question.

Ainsi pour l'exemple ci-dessus : C02-1D5.6, cet abstract est classe dans le sous-thème 2 (Stabilité du Climat Polaire) faisant partie du thème : Climat, le Mardi en fin d'après-midi (16 :00 a 18 :00) dans la session 5 (DH-Avalon B). C'est la 6ieme présentation dans cette session.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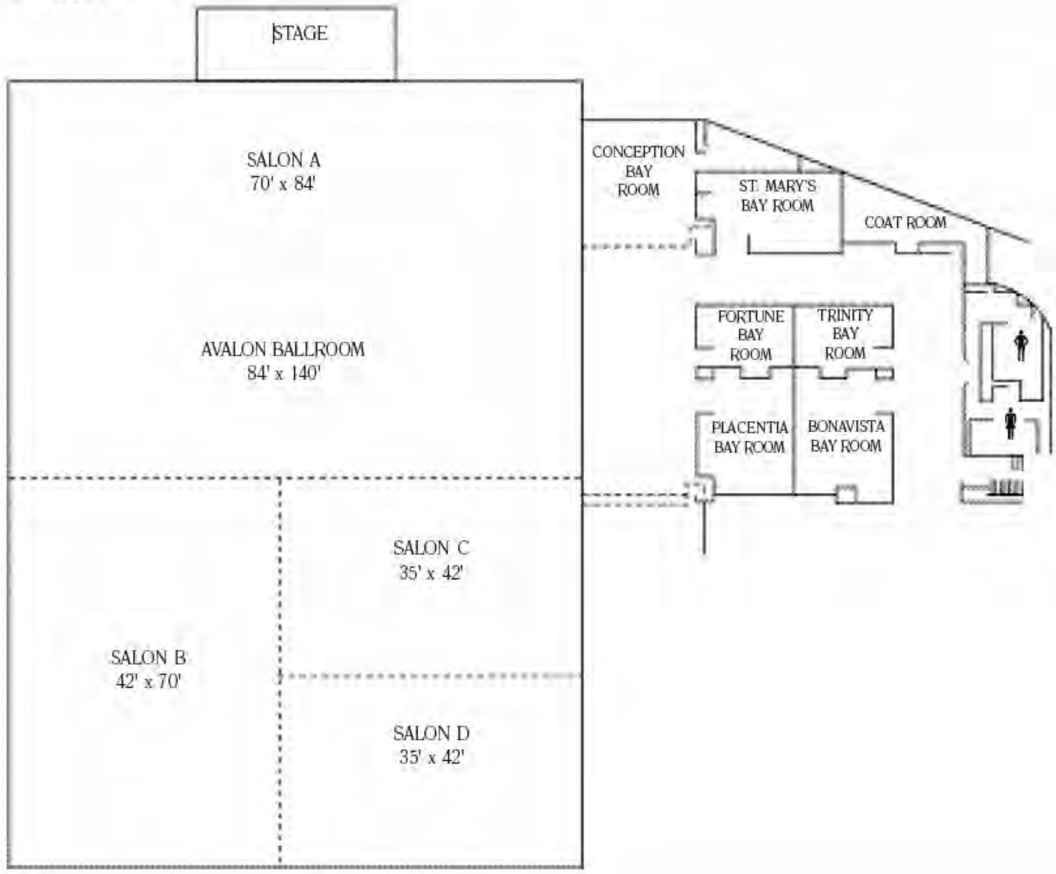

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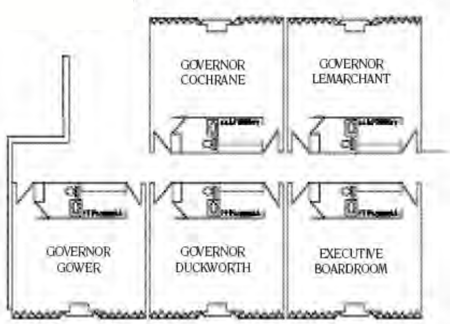

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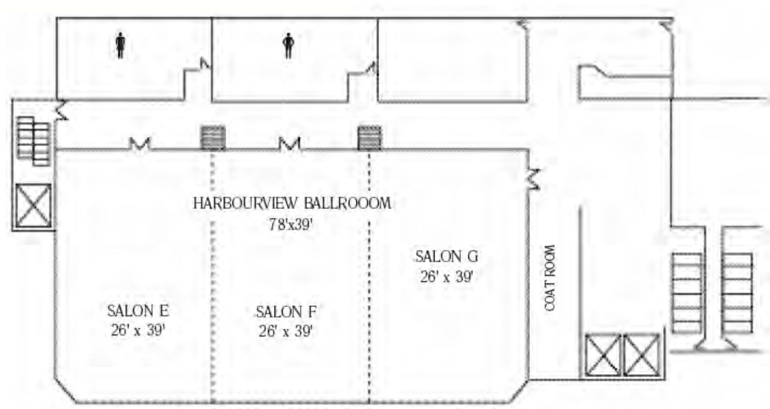
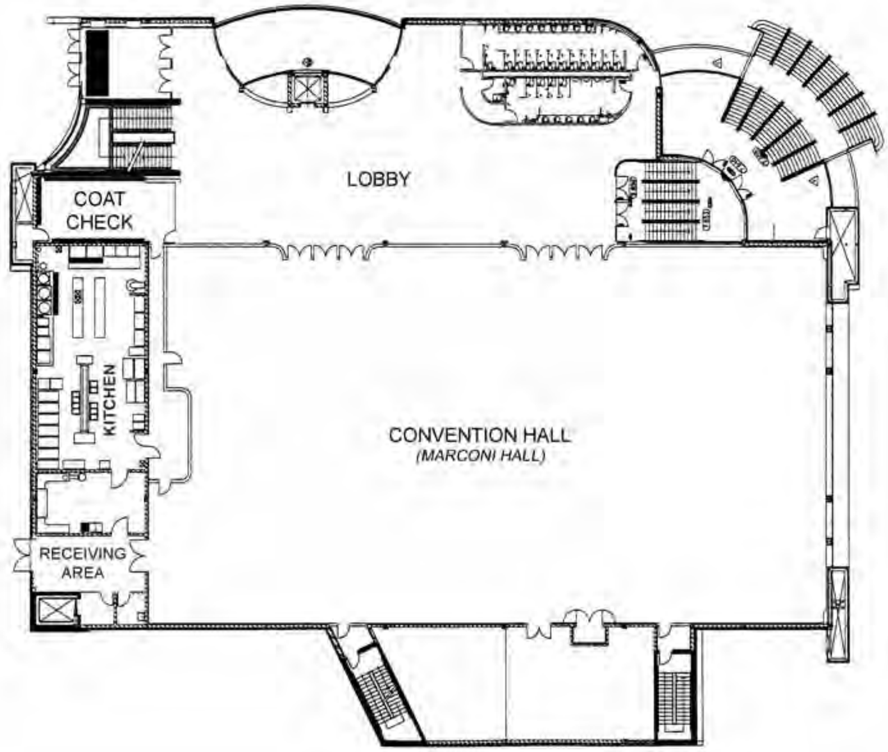
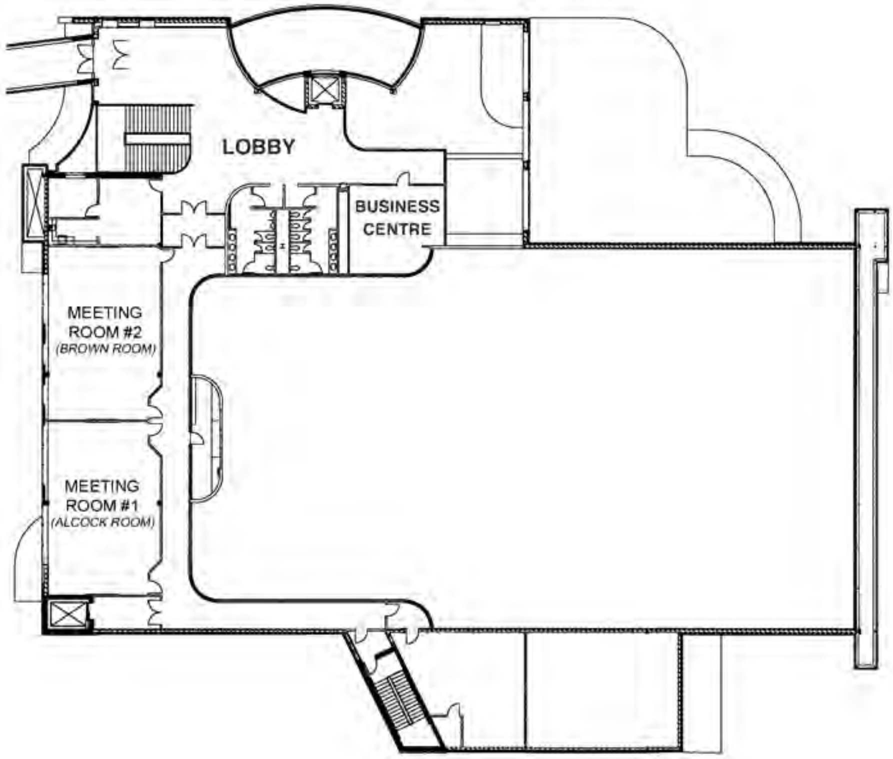


Brownsdale is Located on the Lower Level of Delta Hotel



CC – Convention Centre – Main Level



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CMOS - CGU - AMS 2007 SCHEDULE

TEACHERS' DAY

Time of day	Monday 28-May-07	Tuesday 29-May-07	Wednesday 30-May-07	Thursday 31-May-07	Friday 1-Jun-07 (TEACHERS' DAY)
	Registration Mon (12:00 noon - 8:30 p.m.) Tue - Thur (7:30 a.m. - 4:00 p.m) Fri (7:30 a.m. - 12:00 noon)				
8:00 - 8:15		Plenary 1A			
8:15 - 8:45			Plenary 2A	Plenary 3A	Plenary 4A
9:00 - 9:30					
9:30 - 10:00					
10:00 - 10:30		Health Break	Health Break	Health Break	Health Break
10:30 - 11:00		Session 1B	Session 2B	Session 3B	Session 4B
11:00 - 11:30					
11:30 - 12:00					
12:00 - 12:30					
12:30 - 13:00	registration, business meetings special meetings	Lunch	Awards Lunch	Lunch	Lunch
13:00 - 13:30					
13:30 - 14:00		Session 1C		Session 3C	Session 4C
14:00 - 14:30			Session 2C		
14:30 - 15:00					
15:00 - 15:30					
15:30 - 16:00		Health Break		Poster Session 3D	Health Break
16:00 - 16:30		Session 1D	Poster Session 2D		Session 4D
16:30 - 17:00					
17:00 - 17:30					
17:30 - 18:00					
18:00 - 18:30		AGM's			
18:30 - 19:00				Reception	
19:00 - 19:30	Icebreaker		Public Lecture	Banquets <CMOS-AMS> <CGU>	
19:30 - 20:00					
20:00 - 20:30					
20:30 - 21:00					
21:00 - 21:30				Entertainment	
21:30 - 22:00					
22:00 - 22:30					
22:30 - 23:00					

Day (-1) / jour (-1)		*Sunday, May 27 / dimanche 27 Mai*
Room / salle	**Time / heures**	**Session Name / Nom de la Session**
DH-Avalon C	08:00-18:00	Sunphotometry WS1: Polar AOD during IPY. Presentations and discussions on Polar AOD, AERONET, AEROCAN, RIMA, starphotometry
DH-Gov. Gower	17:00-19:00	CMOS / CGU Joint Executive

Day 0 / jour 0		*Monday, May 28 / lundi 27 Mai*
Room / salle	**Time / heures**	**Session Name / Nom de la Session**
DH-Avalon C	08:00-18:00	Sunphotometry WS2: scientific & operational management AERONET, RIME, PHOTON (TBC) and AEROCAN
DH-Exec. Boardroom	09:00-14:00	CGU Executive
DH-Gov. Duckworth	09:00-12:00	CMOS Private Sector Committee
DH-Gov. Gower	09:00-12:00	CMOS Publications Committee
DH-Bonavista Bay	09:00-11:00	CMOS SPEC
DH-Gov. Cochrane	09:00-12:00	CNC SCOR
DH-Brownsdale	09:00-17:00	GOAPP
DH-Avalon A	09:00-17:00	Probabilistic Forecasting Workshop
DH-Avalon D	09:00-16:00	DFO COMDA
DH-Bonavista Bay	11:00-13:00	CMOS UPEC
DH-Gov. Duckworth	13:00-14:00	CMOS Centre Chairs
DH-Gov. Gower	13:00-14:00	CMOS Scientific Committee
DH-Gov. Cochrane	13:00-14:00	CMOS Student Committee
DH-Harbourview	14:00-16:00	CMOS Council
CC- Brown	14:00-17:00	ESC
DH-Exec. Boardroom	14:00-17:00	CGU Hydrology
CC-Alcock	14:00-17:00	CGU Geodesy
DH-Harbourview	16:00-18:00	CFCAS AGM

Day 1 / jour 1		***Tuesday, May 29 / mardi 27 Mai***
Room / salle	**Time / heures**	**Session Name / Nom de la Session**
DH-Avalon B	18:00-20:00	Hydrology AGM
DH-Gov. Gower	18:00-20:00	Geodesy AGM
DH- Harbourview	18:00-20:00	CMOS AGM

Day 2 / jour 2		***Wednesday, May 30 / mercredi 27 Mai***
Room / salle	**Time / heures**	**Session Name / Nom de la Session**
DH-Gov. Cochrane	16:00-18:00	CNN-IUGG
DH-Avalon B	17:30-19:00	CGU AGM

Teachers' Day Activities - Room: DH-Brownsdale

Day 4 / jour 4			***Friday, June 1 / vendredi 27 Mai***
Time / heures	**Scientific Discipline**	**Topic**	**Presenter**
08:15-08:30	Welcome		
08:30-09:00	Earth Science I	Quake chasers: Activities from the Polaris Group	Stella Heenan
09:30-10:00	Earth Science II	EduKits for high schools in Newfoundland and Labrador: Earth Systems 3209	Jeremy Hall
10:00-10:30		*** Refreshment Break	
10:30-11:15	Meteorology I	Climate change science and impacts on Newfoundland and Labrador	Gary Lines
11:15-12:00	Meteorology II	Data crunching exercises using archived meteorological data or data available online.	Dale Foote & Derm Kearney
12:00-13:00		*** Lunch Break	
13:00-13:45	Oceanography I	Oceanography of the Newfoundland and Labrador continental shelf, including the Labrador Current.	Eugene Colbourne
13:45-14:30	Oceanography II	Fluid dynamics demonstrations.	Iakov Afanassiev
14:30		Geo Centre Tour (Bus Leaves DH)	
16:30		Geo Centre Tour (Bus Returns DH)	

Day 1, Tuesday, May 29- Session Schedule — *Morning / matin*
1er jour, mardi 29 mai – Horaire des presentations

Room	CC-Marconi (Plenary Chair: Taneil Uttal)			
08:15	Opening Ceremony (Chair: Kim Welford)			
08:30	**Plenary Day 1**: Lonnie Thompson	Abrupt Climate Change: Past, Present and Future		
09:15	**Plenary Day 1**: Louis Fortier	The melting Arctic sea-ice: death and rebirth of an ecosystem		
10:00-10:30	**COFFEE BREAK / PAUSE CAFÉ**			10:00-10:30
Block / Room	Session 1B1 DH-Harbourview E	Session 1B2 DH-Brownsdale	Session 1B3 CC- Brown	Session 1B4 CC- Alcock
Session-Title (Chair)	O02-Operational Oceanography (Charles Hannah)	G09-Near-surface geophysical applications (Karl Butler)	S01-Eastern Snow Conference Contribution (Andrew Klein)	H01-Hydrology (Jim Buttle)
10:30	Pierre Bahurel: Operational Ocean Monitoring and Forecasting at Mercator Ocean (I)	Danika L. Muir: Characterization of subsurface structure and water distribution within alpine deposits using electrical resistivity imaging	Claude Duguay: Continental-Scale Simulation of Lake Ice Cover Phenology, Thickness, and Composition in Canada	Mike Waddington: Stream-peatland hydrologic interactions in the coastal zone of the James Bay Lowland: The two decade Waddyssey of Woollyses
10:45		Anthony Endres: Monitoring Seasonal Variations in Soil Water Content using Multiple Frequency GPR Techniques	Ross Brown: Improved mapping and understanding of the spatial and temporal variability in snow water equivalent over Quebec	Pete Whittington: Rewetting an abandoned block-cut peatland using spring melt: How much water is available?
11:00	John Loder: Vision for a "CAnadian Network of Operational Oceanography Systems" (CANOOS)	J. Christian Dupuis: Pinnacles and pitfalls in seismoelectric measurement	Andrew Barrett: An Evaluation of Techniques for Spatial Interpolation of Snow Depth	Jonathan Price: Water flow in Sphagnum moss
11:15	Andry William Ratsimandresy: The validation of C-NOOFS and its availability to users	Ian Ferguson: Electromagnetic imaging of gold mine tailings in Nopiming Provincial Park, Manitoba, Canada	Rae Melloh: Continuous mapping of snow depth and density on the Ethan Allen Firing Range, Vermont	Kristen Harrison: Storage and episodic release of gas in peat: effects of temperature & atmospheric pressure
11:30	Kyoko Ohashi: Assessing the Performance of DalCoast3 in Simulating Three-dimensional Circulation on the Scotian Shelf	Karl Butler: Seasonal effects in a time lapse conductivity survey designed to monitor the migration of sludge in waste rock at Fire Road Mine	P.A. Taylor: Visibility During Blowing Snow Events Over Arctic Sea Ice	Scott Brown: Community-Scale Evapotranspiration in a Western Boreal Plain peatland, North Central Alberta
11:45	Gregory Smith: Using physically-based data assimilation to study ocean climate signals	Ashley Krakowka: Electrical and magnetic properties of the Duport gold deposit, Ontario	Hans-Peter Marshall: High-resolution near-surface snow stratigraphy as inferred by ground-based broadband microwave radar measurements: Devon Ice Cap, Nunavut, Canada 2004-05, CryoSAT calibration	James Buttle: Estimating long-term evaporation from boreal forest lakes in northeastern Ontario using stable isotopes
12:00	Gleb Panteleev: Reanalyis and forecast of the circulation in the Bering and Chukchi Seas.	John Evangelatos: A magnetic investigation of the Ile Rouleau (Mintunikus Island) impact structure in Lake Mistassini, Quebec, Canada	Gernot R. Koboltschnig: Contribution of glacier melt to river runoff of alpine catchments under extreme climatic conditions	Shawn LeCompte: Vegetative Controls on the Spatial Variability of Evapotranspiration in Low Arctic Tundra; Daring Lake, NWT, Canada.
12:15	Mingrui Dai: A 3D variational data assimilation system for estimating sea-ice from satellite data	Hubert Gagné: Morphosedimentology of submarine canyons and fans in the Les Escoumins area, lower St. Lawrence estuary (Québec)	David Collins: Changes in quantity and variability of runoff from Alpine basins with climatic fluctuation and glacier decline	Daniel Peters: Hydroclimatic Controls on the Water Balance and Fluctuation of Lake Athabasca
12:30-13:30	LUNCH / DÎNER			12:30-13:30

(I) – Invited Talk

10:00-10:30	COFFEE BREAK / PAUSE CAFÉ					10:00-10:30
	Session 1B5 DH-Avalon B	Session 1B6 DH-Avalon C	Session 1B7 DH-Harbourview F	Session 1B8 DH-Avalon A	Session 1B9 DH-Harbourview G	
	C02-Polar Climate Stability (Wm Richard Peltier)	A01-Health Issues of Weather and Climate (Denis A. Bourque)	A02-Atmospheric Comm. Modeling (R. J. McTaggart-Cowan)	I01-Atmospheric & Oceanographic General (Mike Alexander)	I10-Modeling Polar Oceans & Sea Ice (David Holland)	
	Garry Clarke: A glacier-resolving model for mountain glacier systems	Paul Becker: The new German Heat-Health Warning System	Jocelyn Mailhot: An overview of recent developments of the GEM-LAM 2.5 km model	Amanda Adams: Topographically trapped waves along the Transantarctic Mountains	Ruediger Gerdes: Twentieth century Arctic sea ice volume variability in coupled climate models and ocean-sea ice hindcasts	
	Martin Sharp: Can we determine the intensity of surface melt on ice caps using active microwave remote sensing?	Marc Beauchemin: Urban heat island characterization in the development of a heat advisory and alert program in Montreal, Québec	Amin Erfani: Recent changes to the GEM-LAM at 2.5 km horizontal resolution	Christopher Fuhrmann: A Closer Look at Ice Storm Severity in the Southeastern United States Using an "Ingredients-Based" Methodology	John Weatherly: Modeling the Recent Anomalous Arctic Sea Ice Distribution	
	Shawn Marshall: Modelling the Holocene Evolution of Icefields in the Queen Elizabeth Islands, Canada	Denis Bourque: Weather Associations of Presentation Patterns at Canadian Hospital Emergency Rooms	Garry Toth: Evaluation of GEM LAM forecasts over Alberta in the summer of 2006	Sylvain Heilliette: A proposed approach for the assimilation of cloudy infrared radiances	Cornelia Koeberle: The future state of the Arctic sea ice budget	
	Lev Tarasov: A comparison between ICE-5G and a deglacial Northern Hemispheric chronology from calibrated glaciological modelling	Kent Moore: Ambient Ozone on Mount Everest	Jason Milbrandt: A New Cloud Microphysics Scheme for the GEM-LAM-2.5	Bob Jones: Historical Meteorological and Oceanographic Photos	Jan Sedlacek: The granular sea-ice model in spherical coordinates and its application to a global climate model	
	Christian Reuten: Bayesian EOF analysis of temperature and precipitation fields as input for glacier mass balance models	Kirsty Duncan: Climate hange, migratory species and pandemic flu	Bertrand Denis: Atmospheric kinetic energy spectra from high-resolution GEM models	Ron McTaggart-Cowan: Climatology of Tropical Cyclogenesis in the North Atlantic (1948-2004)	Sanjay Rattan: Impact of the parameterization of unresolved oceanic eddies on the represent. of sea-ice in an eddy permitting model of the North Atlantic using NEMO	
	Christian Zdanowicz: A new ice-core record from the Prince of Wales icefield, Ellesmere Island: Initial results and paleoclimatic significance.	Marie-France Sottile: Different approaches in constructing climatic scenarios for 3 health impact studies	John.D. Wilson: Lagrangian simulation of wind transport in a complex urban environment	Shawn Milrad: Synoptic-scale typing and precursors of significant cool-season precipitation events in Atlantic Canada, 1979-2005	Alexander Braun: Arctic sea ice freeboard height estimation from ICESat and models	
	Gabriel Wolken: Climatological perspectives on changes in late Neoglacial perennial snow/ice extent in the Queen Elizabeth Islands, Arctic Canada	Q. Li: Pos. Impacts of Climate Change on Econo. Losses & Health Care Costs due to Heat-& Air Pollut.-related Premature Mortality in S.-C. Can. Using Downscaled Future Climate Scenarios	Jean-Paul Pinard: An Improved MC2 (Anemoscope) Modeling Technique in a Mountainous Yukon Terrain	Adam Monahan: On Annular Modes and Zonal Jets	Ryan Walker: Towards modelling the ice bridge in Nares Strait	
	Cornelis Van der Veen: A Community-Driven Ice-Sheet Modeling Initiative		Keith Hines: Arctic Development of a Polar-Optimized WRF	William Richards: Atmospheric Hazards in Canada: Reducing Vulnerability to Extreme Meteorological Events	Greg Holloway: Arctic Ocean topostrophy from current meters	
12:30-13:30	LUNCH / DÎNER					12:30-13:30

Day 1, Tuesday, May 29- Session Schedule **Early Afternoon / début après-midi**

1er jour, mardi 29 mai – Horaire des presentations

12:30-13:30	LUNCH / DÎNER			12:30-13:30
Block / Room	Session 1C1 DH-Harbourview E	Session 1C2 DH-Brownsdale	Session 1C3 CC- Brown	Session 1C4 CC- Alcock
Session-Title (Chair)	O02-Operational Oceanography (Charles Hannah)	G07-Struct. & dyn. of the contin. mantle lithosphere (Ian Ferguson)	S05-Snow Cover & Climate (Ross Brown)	H01-Hydrology (Jim Buttle)
13:30	Richard Dewey: VENUS: A Cabled Ocean Observatory in Saanich Inlet and the Strait of Georgia	David Eaton: Dynamic morphology of lithospheric keels from viscous coupling to mantle flow (I)	Richard Fernandes: Production and Evaluation of Snow Cover Essential Climate Variable for Canada	Shusen Wang: Simulation of climate change impact on ecosystem water budget
13:45	Richard Dewey: A Year of Observations form VENUS in Saanich Inlet		David Robinson: A Climate Data Record of Hemispheric Snow Cover Extent During the Satellite Era	Chad Shouquan Cheng: Possible Impacts of Climate Change on Rainfall-related Streamflow in Ontario using Downscaled Future Climate Scenarios
14:00	Charlie Bishop: Autonomous Underwater Gliders: Sensor Dynamics and Preliminary Data Analysis.	Pamela Bucher: A teleseismic study of the upper mantle, St. Lawrence Rift Valley	Stephen Dery: Poleward amplification of Northern Hemisphere weekly snowcover extent trends	Eghbal Ehsanzadeh: Detection of Trends in Timing of Low Flows in Canadian Stream Flows(RHBN)
14:15	Ryan Mulligan: Real-time forecasting of wave conditions in a coastal bay	Russell Pysklywec: Mantle lithosphere deformation and crustal entrainment/accumulation during continental collision: An example from South Island, New Zealand	Thomas Huntington: Impacts of climate change on snow water equivalent, snow cover, snowmelt regime and related hydrologic variables in the northeastern USA during the 21st century	Seidou Ousmane: A Bayesian method to homogenise short time-scale precipitation data series using a reference station
14:30	Lindsay Hillier: Validating and improving Canadian Coast Guard's CANSARP Search and Rescue ocean drift theory	Gunjan Sinha: On the Origin and Significance of Subadiabatic Temperature Gradients in the Mantle	Richard Heim: Trends of Snow Cover and Snowfall in a Warming World	Brian Branfireun: The runoff response and mercury mass balance of an urban microcatchment
14:45	David Brickman: Real-time risk assessment model for ballast water exchange in Atlantic Canada	Sanaz R.Ghias: Mantle Convection Models with Temperature and Depth-dependent Thermal Expansivity	Christopher Fletcher: How reliable is Eurasian snow cover as a seasonal climate predictor?	Stefan Pohl: Hydrology of a Small Upland Tundra Lake
15:00	Denis Lefaivre: Water Level Forecasting in the St. Lawrence River between Montreal and Saint Joseph de la Rive.	Andrew Frederiksen: A possible subducted fragment in the transition zone beneath central Canada?	Stefan Sobolowski: Northern Hemisphere Winter Climate Variability: Response to North American Snow Cover Anomalies	Philip Marsh: Hydrology of lakes and channels in the outer Mackenzie Delta
15:15	Charles O'Reilly: Atlantic Storm Surge and Tsunami Warning System	Yuri Kinakin: Effect of a Thermal Plume Impact on the Heat Flow of the Lithosphere	Lily Ioannidou: Variability of Snow Cover and of Cyclonic Activity over Western Canada	Christopher Spence: On the Relation Between Dynamic Storage and Runoff
15:30-16:00	COFFEE BREAK / PAUSE CAFÉ			15:30-16:30
extension 16:00		Stephane Mazzotti: Temperature Control of Continental Lithosphere Strength and Deformation (I)		

12:30-13:30	LUNCH / DÎNER			12:30-13:30
Session 1C5 DH-Avalon B	Session 1C6 DH-Avalon C	Session 1C7 DH-Harbourview F	Session 1C8 DH-Avalon A	Session 1C9 DH-Harbourview G
C02-Polar Climate Stability (Garry K.C. Clarke)	A05-Open access to meteorological data (Miguel Tremblay)	A02-Atmospheric Comm. Modeling (Xin Qiu)	I01-Atmospheric & Oceanographic General (Paul Ford)	I10-Modeling Polar Oceans & Sea Ice (David Holland)
C. Hillaire-Marcel: The Atlantic Meridional Overturning: Evidence for a singular modern thermohaline linkage between the Arctic & the North Atlantic? (I)	Nicole Bois: EC meteorological weather data sharing and distribution - it's context and conditions (I)	Yonghong Yao: Impacts of North Atlantic extratropical hurricanes on the upper ocean	Michael Alexander: Tropical-Extratropical Interactions, Air-Sea Feedback and the Pacific Decadal Oscillation	Dimitris Menemenlis: High resolution global-ocean and sea-ice data synthesis
Anne de Vernal: Reconstructing sea-ice conditions in the Arctic and subarctic seas during the late Pleistocene and Holocene	Mario Ouellet: The Road Weather Information Network: A Successful Example of a Federal-Provincial-Private Partnership	Martin Charron: An improved global Ensemble Prediction System for operational medium-range weather forecasts at CMC	Johannes Gemmrich: Are "unexpected" waves as important as rogue waves?	Elizabeth Hunke: Global atmospheric forcing data for Arctic ice-ocean modeling
Jennifer McKay: Holocene paleoceanography of the Western Arctic (Alaska Margin)	Peter Silva: Distribution systems for Environment Canada meteorological data (I)	Ian Folkins: Convective Diagnostics for the CGCM3 model	Meiji Honda: Inter-basin link of variability in the tropospheric circulation over the North Atlantic and North Pacific: Its interdecadal modulations and seasonal	Alexandra Jahn: Interannual variability in the Arctic Ocean freshwater balance
Francesco Barletta: A high-resolution Holocene paleomagnetic record from the Chukchi Sea: preliminary results and potential for chronostratigraphy	Robert Morris: Access to the Meteorological Service of Canada's Historical Data	Jiangnan Li: Radiation Model in Canadian GCM	Edward Hudson: Acetone and other volatile organic compounds in surface seawaters from the Nordic seas as measured by solid-phase microextraction (SPME) methods.	Youyu Lu: Seasonal and inter-annual variations of the Arctic ice-ocean state: a modelling study based on NEMO
Christelle Not: 230Th-231Pa Stratigraphy of very low sedimentation rate cores from Alpha Ridge (Arctic Ocean)	Norm Paulsen: Status of open Access to Environment Canada Warning Data (I)	Paul Vaillancourt: The impact of a new radiative transfer scheme in GEM meso-strato on the surface temperature.	Kent Johnson: Meteorological Education and Training: It is not just Environment Canada anymore	Simon Prinsenberg: Monitoring the fluxes through the Canadian Arctic Archipelago. Simon Prinsenberg, Bedford Institute of Oceanography
Agathe Lisé-Pronovost: Physical and magnetic properties of high resolution Holocene sediment cores from the Chukchi Sea margin : preliminary results	Miguel Tremblay: METRo, the Road forecasting model of Environment Canada: an example of free and open software from the government of Canada (I)	Irena Paunova: Aerosol-Cloud Interactions in MC2 Model: Sensitivity to Collision-Coalescence and Aqueous-Phase Chemistry	Tom Shalansky: Improved products and services through a knowledge exchange approach	Andrew Willmott: A coastal polynya opening model based on shock methods
Taoufik Radi: Dinocysts as proxy of primary productivity in the Northern Hemisphere	Benoit Archambault: Data exchange in the framework of the APEC Climate Center (I)	C. Stroud: Relative Importance of Primary and Secondary Aerosol Components in Fresh and Aged Air Mass: Results with Environ. Can. Unified Regional Air Quality Model (AURAMS)	Gabor Fricska: "Training" workshops as a tool for knowledge exchange	David Holland: The Role of Thermal and Mechanical Processes in the Formation of the Ross Sea Summer Polynya
Maria Abrahamowicz: Modeling Iceberg Sedimentation in the Southern Ocean:A Window into Antarctica's Glaciation History	Franco Petrucci: Atlas canadien d'énergie éolienne et AnémoScope: données disponibles et exemples d'utilisation	Xin Qiu: The Application of High Resolution GEMLAM Meteorology and the CMAQ Modelling System in Support of Marine Air Quality Management	Gadal Jaymie: Meteorological Education and Training: Breaking the Log Jam at the Downstream End	
15:30-16:00	COFFEE BREAK / PAUSE CAFÉ			15:30-16:30

15:30-16:00	COFFEE BREAK / PAUSE CAFÉ			15:30-16:00
Block / Room	Session 1D1 DH-Harbourview E	Session 1D2 DH-Brownsdale	Session 1D3 CC- Brown	Session 1D4 CC- Alcock
Session-Title (Chair)	O01-Oceanography of the N.W. Atlantic (Guoqi Han)	G10-Seismically unravelling the mysteries of the crust (Charles Hurich)	S05-Snow Cover & Climate (Ross Brown)	H01-Hydrology (Jim Buttle)
16:00	Brad de Young: New Ocean Ideas and Approaches in the Northwest Atlantic (I)	Speaker from Previous Session (G07-1C2.8)	L.Baker Perry: Synoptic Classification of Snowfall Events in the Great Smoky Mountains, USA	Fred Beall: Influence of basin scale, morphology and physiography on flow regime within the Batchawana River watershed.
16:15	Brad de Young: On the interaction of the Labrador Current and the Deep Western Boundary Current with the North Atlantic Current		Hengchun Ye: Rain on Snow Events over Northern Central Eurasia	Dean Shaw: Modelling contributing areas in prairie river basins
16:30	Guoqi Han: Seasonal and interannual variability of the Scotian Slope circulation	Bernd Milkereit: Geophysical signature of meteorite impact craters - first and second order footprints	Florent Domine: A few seldom considered snow-climate feedbacks	John Jackson: Testing the Versatile Soil Moisture Budget model for groundwater recharge estimation in a northwest Canadian Prairie
16:45	Yuri Geshelin: Currents and Hydrographic Variability in Orphan Basin, 2004-06	Alexandra Kirshner: Seismic Analysis for Gas Hydrate Studies in the Ulleung Basin, offshore South Korea	Andrey Skvortsov: Factors governing glacial inception in the UVic earth system climate model	Rebeca Quiñonez-Piñón: Spatial Error Propagation While Scaling Up Forest Transpiration: Sources and Reduction of Error
17:00	Joe Craig: Recent changes in density stratification on the Newfoundland and Labrador shelf.	Vladimir Gerasik: Seismic properties of waves at the surface of a porous layer	Carl Egede Bøggild: Albedo observations with high concentrations of Black Carbon from high Arctic snow packs	Raoul Granger: Measuring and modelling lake evaporation
17:15	Ingrid Peterson: Sea Ice Draft Measurements from an Upward-Looking Sonar Moored on the Labrador Shelf	Charles Hurich: Seismic characterization of heterogeneity: progress, problems and examples	William Richards: Atmospheric Hazards: Snowstorms in Atlantic Canada 1955 – 2005	Rich Pawlowicz: Computing the conductivity of fresh waters and salinity from conductivity
17:30	Paul Myers: Labrador Sea Variability: Circulation and Hydrography (I)	Elizabeth L'Heureux: Influence of scattering on the seismic detection of mineral deposits in hardrock environments	Mindy Brugman: What? Another Snow Day! : Driving Mechanisms of Extreme Snow Events over BC	
17:45	Xiaoming Zhai: Surface eddy diffusivity for heat in a model of the northwest Atlantic Ocean			
18:00-19:30	CMOS AGM Chair: Geoff Strong DH-Harbourview E	Geodesy AGM Chair: Marcello Santos DH-Gov. Gower		

15:30-16:00	COFFEE BREAK / PAUSE CAFÉ			15:30-16:00
Session 1D5 DH-Avalon B	Session 1D6 DH-Avalon C	Session 1D7 DH-Harbourview F	Session 1D8 DH-Avalon A	Session 1D9 DH-Harbourview G
C02-Polar Climate Stability (Martin Sharp)	A05-Open access to meteorological data (Miguel Tremblay)	A06- Polar Clouds and Aerosols (Matthew Shupe)	I01-Atmospheric & Oceanographic General (Taneil Uttal)	I14-Soils and Climate Change (Sue Grayston)
Andrew Weaver: The response of the Atlantic meridional overturning circulation to increasing atmospheric CO2: Sensitivity to mean climate state	Yan Shen: Meteorological Model Data Support in Regional Airshed Modeling	James Sloan: Methods and Applications of Measurements of Particle Sizes and Habits in Ice Clouds	Hannah Carmichael: On the aggregation of ice pellets and their consequences on freezing rain	Nathan Basiliko: Soil greenhouse gas, nutrient, and microbial biomass dynamics in recently fertilized western Canadian plantation forests
Kirsten Zickfeld: Impacts of changes in the Atlantic meridional overturning circulation on the global carbon cycle	Xin Qiu: Applying Regional GEM Operational Output to Air Quality, Wind Energy, and Air Force Training Projects	Edwin Eloranta: The measurement of particle size in Arctic clouds using high spectral resolution lidar and millimeter wavelength radar data.	Didier Davignon: Using online atmospheric mercury chemistry to assess long-range transport and deposition to the Arctic.	Tarrah Fairweather: Nitrous oxide (N_2O) outputs from a nitrogen saturated northern hardwood forest: The source of the missing nitrogen (N) in catchment
Xiaolu Yu: Modeling 20th Century Climate Using CCSM3: Solar Variability and Its Effect on Climate	Frank Seglenieks: The success of the weather data archive at the University of Waterloo weather station	Paul Lawson: In situ and Remote Observations of Microphysical Properties of Mixed-Phase Clouds in the Arctic	Stanislav Derevyanko: Exponential growth of inhomogeneities in the distribution of water droplets in a turbulent air	Julie Turgeon: Partitioning decom-position in Canadian forest floors into dissolved organic carbon and carbon dioxide – Relevance of vegetation type and degree of decomposition
Cecilia Bitz: Climate response to a freshwater pulse in Modern, Last Glacial Maximum and Greenhouse Warming Climates	Pierre Fogal: Data Management for The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut	Mark Ellison: Properties of water-only, mixed-phase, and ice-only clouds over the South Pole	James Drummond: Recent Results from the Measurements Of Pollution in the Troposphere (MOPITT) Instrument	Sami Ullah: Topographic controls of greenhouse gas fluxes in deciduous forests soils, southern Quebec
Guido Vettoretti: The Tropical Climate Response to Fresh Water Induced Reductions is Atlantic Meridional Overturning Circulation	Patrice Constanza: A Data Access Interface (DAI) and Data Integration Facility using Google Earth: Part 1 (I)	Pavlos Kollias: Cloud phase identification using radar Doppler spectra	Daniel Figueras-Nieto: Numerical sub-grid convective transport of chemical tracers in AURAMS: ICARTT evaluation	Amanda Diochon: Changes in the structure and temperature sensitivity of the mineral soil organic carbon pool across a managed red spruce forest chronosequence
Eric DeGiuli: Modelling the 10.3 ka BP outburst flood of the Baltic Ice Lake	Khanh-Hung Lam: A Data Access Interface (DAI) for Climate-Related Impact Studies, Part II: Interface for Data Extractions and Weather-Climate Indicator	Matthew Shupe: Vertical motions and microphysics in Arctic mixed-phase stratus	Irina Marinov: Impact of Southern Ocean mixing and winds on atmospheric pCO2	Jenna Rapai: Evaluation of heat pulse probe method for measuring soil thermal physical properties during freeze-thaw in agricultural soils.
Stephen Griffiths: Modelling postglacial variations in global tides		Dana Veron: Parameterizing the impacts of mixed-phase layer clouds on shortwave radiation	Lisa Phinney: Contribution of Marine Activities to Ambient Air Chemistry in Coastal Regions of Atlantic Canada, Phase I: Halifax Harbour	
Gordan Stuhne: Unstructured Grid Climate System Modeling		Erica Key: Towards an Arctic cloud database for cloud radiative forcing studies in the Beaufort-Amundsen region	Aleksandra Tatarevic: Application of the EarthCARE Instrument Simulator to Validation of Aerosol-Cloud Parameterisation in Climate Models	
Hydrology AGM Chair: Lawrence Martz DH-Avalon B				

Room	CC-Marconi (Chair: Paul Ford)			
08:30	**Plenary Day 2**: Brian Hoskins	Weather Systems and Climate Processes		
09:15	**Plenary Day 2**: James P. Bruce	Extreme events in a changing climate		
10:00-10:30	COFFEE BREAK / PAUSE CAFÉ			10:00-10:30
Block / Room	Session 2B1 DH-Harbourview E	Session 2B2 DH-Brownsdale	Session 2B3 CC- Brown	Session 2B4 CC- Alcock
Session-Title (Chair)	O01-Oceanography of the Northwest Atlantic (Guoqi Han)	G08-Advances in geophysical techniques (Rod Blais)	S02- Remote Sensing of Snow Cover (Chris Derksen)	H02-Isotope tracing of water balance & climate (Jean Birks)
10:30	Jinyu Sheng: Circulation and Variability over the Eastern Canadian Shelf during the Period 2001 to 2005, A Numerical Study	Hugh Miller: The inversion of magnetic data – the role of remanent magnetization	james foster: A Blended Snow Extent and Snow Water Equivalent Product	Kristof Sturm: A review of stable water isotope modelling: from process studies to isotope-enabled atmospheric circulation models. (I)
10:45	Shastri Paturi: A Tidal Model for the Northwest Atlantic	Hugh Miller: The role of constraints in the inversion of gravity data	Anne Nolin: A Multi-Sensor Synergistic Approach To Improving Fractional Snow Cover Mapping In Forested Areas	
11:00	Keith Thompson: Short Term Predictability of the North Atlantic	Colin Farquharson: Three-dimensional inversion of gravity data for blocky models using a minimum-structure algorithm and general measures	Florent Domine: Retrieving snow grain size and specific surface area from infrared reflectance	Robert Field: Regional modeling of the stable water isotopes over ice core sites in Canada
11:15	Entcho Demirov: Simulation of interannual variability of the North Atlantic Ocean.	Rod Blais: Multiresolution Analysis and Synthesis of Geopotential Fields	Laura Brown: Using satellite imagery to validate snow distribution in a large northern basin simulated by a hydrological model	Kate Sinclair: The influence of vapour trajectory on the isotopic signal in the Canadian Rocky Mountain snowpack
11:30	Sanjay Rattan: Impact of the parameterization of unresolved eddies in an eddy-permitting model of the North Atlantic using NEMO	Mohamed Elhabiby: Wavelets as a regularization tool – A combined wavelet and conjugate gradient method for the inversion of geodetic integrals	Naoki Mizukami: Use of passive microwave derived snow water equivalent climatology and SNOTEL measurements for hydrologic forecasting in the Western U.S.	Jeffrey McKenzie: The application of stable isotopes as a tracer of glacial melt water in the Cordillera Blanca, Peru
11:45	Michael Alexander: The impact of reemerging sea surface temperature anomalies on the North Atlantic climate system	Mahmoud Abd El-Gelil: On the potential of least-squares self-coherency spectrum to recover low-frequency seismic normal modes: Detection and Splitting		John Gibson: Interannual variability in lake and wetland runoff on the Boreal Plain: an isotopic perspective of regional water budget dynamics
12:00		John Bancroft: Traveltime Calculations Using Spherical Wave Assumptions	Libo Wang: Relationships Between Spatial Patterns of QuikSCAT Derived Pan-Arctic Terrestrial Snowmelt Onset and Summer Sea Ice Concentration Anomalies (2000 – 2005)	Kevin Tattrie: Defining flowpaths and connections between wetlands and lakes on the Boreal Plain: evidence from physical and isotopic hydrology
12:15	Eugene Colbourne: State-of-the-Ocean - North Atlantic, Early 21st Century	Hans J. Mueller: Recent development of experimental techniques for high-pressure mineral physics under simulated mantle conditions	Debbie Putt: Validation of hemispheric scale SWE distributions with SSM/I	Tricia Stadnyk: A framework for isotopic-partitioning within mesoscale hydrologic modelling: isoWATFLOOD.
12:30-14:00	AWARDS LUNCH / DÎNER PALMARÈR			12:30-14:00

(I) – Invited Talk

Public Talk
Wednesday May 30th
7:00 – 8:40 pm
Marconi Hall, St. John's Convention Centre

10:00-10:30	COFFEE BREAK / PAUSE CAFÉ			10:00-10:30
Session 2B5 DH-Avalon B	Session 2B6 DH-Avalon C	Session 2B7 DH-Harbourview F	Session 2B8 DH-Avalon A	Session 2B9 DH-Harbourview G
C02-Polar Climate Stability (Anne de Vernal)	C01-Climate change projection, detection (Andrew J. Weaver)	A06-2B7 Polar Clouds and Aerosols: (Matthew Shupe)	I01-Atmospheric & Oceanographic General (Paul Ford)	I15-Biogeoscience (Nigel Roulet)
Konrad Gajewski: Paleoclimates of northern Canada - a synthesis	Clara Deser: Atmospheric Circulation Response to Projected Future Changes in Arctic Sea Ice:Results for a seasonally ice-free Arctic	Masataka Shiobara: Aerosol optical properties in Arctic spring obtained from combined measurements with sky-radiometer and micro-pulse lidar at Ny-Alesund, Svalbard	Marco Carrera: Surface Wind Channeling in the St. Lawrence River Valley	Vivek Arora: Modelling carbon flux due to land use change as an interactive component of a terrestrial ecosystem model
Andre Viau: Reconstructing high-latitude climate variability in N. A. during the Holocene using pollen data: How well do these compare to high-resolution multi-proxy records?	Yvan Orsolini: Predicted changes in northern hemisphere and Arctic summer cyclones in the 21st century	Renate Treffeisen: Arctic smoke – aerosol characteristics during a record air pollution event in the European Arctic and its radiative impact	Martha Shulski: The influence of sea ice and topography on the wind regime of the Beaufort Sea coast	Susan Ziegler: Effects of nutrient enrichment on autotrophic-heterotrophic coupling within headwater stream biofilms as revealed by 13C-PLFA
Bianca Fréchette: Cloud cover changes in the eastern Baffin Island and southern Greenland regions since 7000 cal. years BP: pollen evidence	Alvaro Montenegro: What if we burn it all? Modelling the long term effects of maximum anthropogenic CO2 emissions.	Robert Stone: Direct Aerosol Radiative Forcing by Arctic Aerosols; Observed and Modeled	Gordon Swaters: Evolution of solitary marginal disturbances in baroclinic frontal geostrophic dynamics with dissipation and time-varying background flow	Nigel Roulet: Modelling the carbon dynamics of northern peatlands
Wm. Richard Peltier: GRACE satellite signal interpretation over North America and Greenland: The influence of past and present rates of ice-sheet and glacier disintegration	William Merryfield: 20th and 21st Century changes in ocean mixed-layer depth as simulated by current-generation coupled climate models	Patrick Grenier: Study of the correlation between water vapour and sulfate-to-aerosol ratio in the High Arctic.	Amir Shabbar: The abnormal impact of 1998-2000 La Nina in North American and the relationship to North Pacific atmosphere-ocean variability	Jon Warland: Micrometeorological measurements of carbon isotope ratios over two agricultural management systems
Hugo Beltrami: Climate from underground temperatures: The Earth's Selective Long-Term Memory	Xiangdong Zhang: Acceleration of Summer Sea Ice Reduction in the 21st Century: Projection by the IPCC AR4 Climate Models	Rodrigo Munoz-Alpizar: Dynamical Feedback associated with the Dehydration-Greenhouse Feedback Mechanism on the Arctic Region.	Babak Tavakoli Gheynani: Large Eddy Simulation of Highly Convective Boundary Layers, on Earth and on Mars	
M. Bruce Stevens: North American climate of the last millennium: Model and observation	Louis-Philippe Caron: Inferred tropical cyclone statistics from 6 IPCC Coupled Global Climate Models: Eval. the sim. of the recent past & assessing predicted trends for the future.	Seiji Kato: Cloud effects on the Arctic radiation budget	P.A. Taylor: Modelling dust distributions in the atmospheric boundary layer on Mars	Lynn Raaflaub: Spatial variation patterns in the moisture content of the organic layer of the forest floor
Christian Chouinard: Ground surface temperature history inferred from temperature depth profiles in Northern Quebec: Evidence for recent warming.	Thomas Bracegirdle: Simulated Antarctic climate change over the 21st century	Irina Gorodetskaya: Longwave cloud forcing as a trigger for the Arctic melt onset	Wensong Weng: Modelling the Boundary-Layer flow over Changes of Surface Conditions and Its Application in Wind Energy	Ken Denman: How much carbon dioxide can the ocean accept?: Simulations with the CCCma global ocean carbon model
Christian Chouinard: 50000 years ground surface temperature histories inferred from temperature depth profiles in deep boreholes.	Stephen Vavrus: Recent and Future Behavior of Arctic Clouds	James Spinhirne: Improvement in satellite polar cloud detection and analysis from lidar observations by the Geoscience Laser Altimeter System	Paul Spence: The influence of mesoscale eddies and boundary currents on surface freshwater forcings used to drive MOC variations.	Gregory Flato: The equilibrium bio-climate of CCCma's coupled climate-carbon model
12:30-14:00	AWARDS LUNCH / DÎNER PALMARÈR			12:30-14:00

Day 2, Wednesday, May 30- Session Schedule *Early Afternoon / début après-midi*
2[ième] jour, mercredi 30 mai – Horaire des presentations

12:30-14:00	AWARDS LUNCH / DÎNER PALMARÈR			12:30-14:00
Block / Room	Session 2C1 DH-Harbourview E	Session 2C2 DH-Brownsdale	Session 2C3 CC- Brown	Session 2C4 CC- Alcock
Session-Title (Chair)	O03-Coastal Ocean. & Inland Waters (Jinyu Sheng)	G04-Geo., paleo. & rock magnetism (Phil McCausland)	S02-Remote Sensing of Snow Cover (Chris Derksen)	H03-Watershed Experiments in BC (Darryl Carlyle-Moses)
14:00	Alex Hay: Perspectives on Six-Years Experience with a Real-Time Coastal Observing System (I)	Michael Wheeler: A magnetic susceptibility meter designed to avoid eddy current errors: its application to conductive samples from the Voisey's Bay ore deposit, Labrador.	Richard Kelly: Analysis of time series of satellite passive microwave estimates of SWE over the Colorado Cold Lands Processes	Chelene Krezek: Impacts of timber harvesting on the flow regime of a coastal stream; from the headwaters to the entire watershed.
14:15	Kevin Lamb: Shear Instabilities in Internal Solitary Waves (I)	Joseph Hodych: Origin of hematite in the late Neoproterozoic carbonates of the Johnny Formation, Death Valley, and its paleomagnetic implications.	Yi-Ching Chung: Factors controlling radiobrightness of a snowpack under a discontinuous canopy in early spring	Chris Hopkinson: Comparing alpine drainage basin attributes derived from three independent DEM sources
14:30	Li Zhai: Coastal dynamical response to local wind forcing, tides, and buoyancy forcing in Lunenburg Bay of Nova Scotia	Phil McCausland: Low-latitude Laurentia during early Ediacaran time: Preliminary paleomagnetic results from the 615 Ma Lighthouse Cove volcanics, Newfoundland	Hans-Peter Marshall: Ground-based FMCW radar measurements of dry snowpacks during the 2006-07 NASA CLPX field experiment	Rita Winkler: Upper Penticton Creek: Logging Effects on Water Yield Regimes from Small Headwater Streams in South-Central British Columbia
14:45	Stephen Griffiths: Internal tide generation at the continental shelf	Sergei Pisarevsky: Animated models of late Neoproterozoic palaeogeography (I)	Peter Toose: The influence of lakes and snow re-distribution on passive microwave remote sensing of snow water equivalent in a tundra environment	David Spittlehouse: Modelling the influence of Mountain Pine Beetle infestation in lodgepole pine forests on the site water balance
15:00	Rich Pawlowicz: The circulation and residence time of the Strait of Georgia using a simple mixing-box approach		Chris Derksen: The Contribution of AMSR-E 10.7 GHz Measurements to Improved Boreal Forest Snow Water Equivalent Retrievals	D. Carlyle-Moses: Upper Penticton Creek: Influence of Rainfall Event Separation Time on the Analytical Modelling of Canopy Interception Loss from a Mature Lodgepole Pine (Pinus contorta var. latifolia) Stand
15:15	Richard Dewey: Direct Measurements of Bioturbulence in the Wake of Vertical Zooplankton Migrations		Ahmet Emre Tekeli: Determining snow water equivalent values for eastern Türkiye using AMSR-E	Tim Giles: Upper Penticton Creek: Effects of logging on physical water quality
15:30	David Janes: Simulations of Sill Processes in the Saguenay Fjord		Sarah Kopczynski: Passive microwave signatures of short-lived snow melt events in Muir Inlet, Glacier Bay, AK	Brian Heise: Upper Penticton Creek: Effects of logging on aquatic invertebrates and stream temperature
15:45	Patrick Timko: The Influence of Wind Stress on the East Australian Current		Andrew Klein: How well can we map changes in small tropical glaciers from satellites?	Younes Alila: Modelled forest road and harvesting impacts on the peak flow regime of a snow-dominated catchment (I)
16:00-17:30	POSTER SESSION (2DP) / SESSION POSTER (2DP) DH-Avalon D (see next page)			16:00-17:30
17:30 - 19:00				

12:30-14:00	AWARDS LUNCH / DÎNER PALMARÈR			12:30-14:00
Session 2C5 DH-Avalon B	Session 2C6 DH-Avalon C	Session 2C7 DH-Harbourview F	Session 2C8 DH-Avalon A	Session 2C9 DH-Harbourview G
C02-Polar Climate Stability (Andrew J. Weaver)	C01-Climate change projection, detection (W. J. Merryfield)	A07-Intensive Arctic Atmos. Observatories (Matthew Shupe)	I05-Coupled Envir. Prediction Systems (C. Harold Ritchie)	I15-Biogeoscience (Nigel Roulet)
Andrew Bush: Nonstationary teleconnection patterns and the potential influence of interannual variability on millenial-scale ice sheet dynamics.	Andreas Jonsson: Detection and attribution of the effects of climate change and ozone depletion in the stratosphere.	John Burkhart: IASOA in a global context: requirements for inclusion into the Integrated Global Observation Strategy.	Hal Ritchie: The Lunenburg Bay Project (I)	Elaine Matthews: Seasonal and interannual inundation dynamics in boreal environments: A link to high-latitude warming?
Kent Moore: Large-Scale Reorganizations of the Climate as Expressed in the Oxygen Isotope Record in an Ice Core from Mount Logan	Xiaolan Wang: Detection of human influence on trends of atmospheric storminess and northern oceans wave heights	Jussi Paatero: Pallas-Sodankylä atmospheric observatory in northern Finland during the IPY-2007/2008	Duo Yang: Evaluation of a real-time fog prediction using high resolution GEM-LAM	Elyn Humphreys: Record temperatures in 2006 and their effects on carbon dioxide exchange over tundra in the central southern arctic
Robert Field: Modeling stable water isotope composition using GCMs as a tool to understand the climate signals in ice cores	Catherine Brennan: Measuring oxygen concentrations improves the detection capabilities of an ocean circulation observation array		William Perrie: Operational Coupled Ocean Wave Prediction systems	Tim Moore: Effects of nutrient addition on vegetation and carbon cycling in an ombrotrophic bog
Marc d'Orgeville: The relation of the Pacific Decadal Oscillation with the Atlantic Multidecadal Oscillation	Steven Lambert: The Influence of Global Warming on Landslide Potential along the British Columbia Coast	Georg Hansen: The Zeppelin Observatory – A European Cornerstone of Arctic Atmospheric Monitoring during IPY	Charles A. Lin: Real Time Flood Forecast and Flood Alert Map over the Huaihe River Basin in China Using a Coupled Hydro-meteorological Modeling System	Murray Richardson: Using light detection and ranging to study peatland form and function
T. Moran: δ18O-temp. relationships on the Prince of Wales Icefield, Ellesmere Island, Can.: the relative importance of vapour mass trajectory versus temperature on isotopic values	John Cassano: Predicted changes in synoptic forcing of net precipitation in large Arctic river basins during the 21st century		Keith Thompson: Overview of Ocean Data Assimilation to be Carried Out by the Global Ocean and Atmosphere Prediction and Predictability Research Network	Laura Chasmer: Using airborne lidar for the assessment of MODIS spectral vegetation indices across a boreal jack pine chronosequence
Clarck Hongxu Zhao: Impact of seasonality on the low-frequency teleconnection patterns in the boreal winter SLP	Jessica Cox: Intense regional climate change in northwestern Canada	Marjorie Shepherd: Multi-Decadal Observations from the Environment Canada Dr. Neil Trivett Global Atmosphere Watch Observatory – Alert, Nunavut	G.J. Boer: The QBO and extratropical seasonal predictive skill	Danielle Solondz: Community Scale Carbon Dioxide Fluxes Within a Forested Wetland- Pond Complex in the Western Boreal Plain
Weihan Chan: Arctic Summer Sea-Ice Area and the Winter North Atlantic Oscillation	Lee Titus: Creating Climate Scenarios by Utilizing a Statistical Downscaling Technique for St John's NL.	James Drummond: The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut	William Merryfield: The Coupled Historical Forecast Project: Formulation, goals and experimental results	Carl Mitchell: Biogeochemical hot spots: How do they apply to mercury cycling in peatlands?
Guillaume St-Onge: New sedimentological and multibeam bathymetric data on Lake Agassiz final outburst flood	Taneil Uttal: Effects of Seasonal Averaging Periods on Detecting Surface Temperature Trends in the Arctic	Taneil Uttal: A new climate observatory facility in Tiksi, Russia	Youmin Tang: Decadal Variation of ENSO Predictability	Sean Michaletz: A heat transfer model of crown scorch in forest fires. (I)
16:00-17:30	POSTER SESSION (2DP) / SESSION POSTER (2DP) DH-Avalon D (see next page)			16:00-17:30
CGU AGM Chair: Gary T Jarvis				

16:00-17:30	POSTER SESSION (2DP) / SESSION POSTER (2DP) DH-Avalon D			16:00-17:30
Poster Number	2DP.1 / .10	2DP.2 / .11	2DP.3 / .12	2DP.4 /.13
A02-Atmospheric Commun. Modelling (Xin Qiu)	Lori Neary: Comparison of Aura-MLS upper troposphere CO measurements with 2 global chemical models	Norm O'Neill: Evaluation of regional air quality models in the presence of moderate to strong aerosol events.	Irena Paunova: Aerosol Direct Radiative Forcing in GEM Model	Brad Snyder: The use of the GEM-2.5km Model for Forecasting Gap winds over Vancouver Island
A03- Can. Society of Agricultural & Forest Meteorology (Ian Strachan)	Ian Strachan: Measurement and Modeling of CO2 and CH4 Fluxes at the Mer Bleue Cattail Marsh	John.D. Wilson: Determining Ammonia Emissions from a Cattle Feedlot with an Inverse Dispersion Technique	David Spittlehouse: Evaluation of hemispherical photography for determining the radiation balance of a snowpack below forest canopies	Ray Garnett: Climate Change & Canadian Prairie Agriculture: -a long view
A04- Operational Meteorology (Paul Ford)	Marco Carrera: Evaluation and verification of the Canadian Precipitation Analysis (CaPA)	Chris Doyle: Meteorological Preparations for the 2010 Winter Olympic and Paralympic GAmes	Olivier Fortin: Vérification du gem-lam dans le cadre de la prévision maritime pour le secteur de Donnacona à l'île-aux-coudres	Patrick King: The Woodstock Tornado Revisited in view of Current Conceptual Models
A06-Polar Clouds and Aerosols (Matthew Shupe)	Andrew Ballinger: Evidence of sub-visible charged particles in the polar summer mesopause region: Implications for noctilucent cloud formation in a changing climate	Keith Hines: An Assessment of Atmospheric Moisture and Cloud Cover Characteristics Forecast by AMPS	Patrick Grenier: Assessment of the Arctic Dehydration/Greenhouse Feedback using CloudSat and CALIPSO datasets.	André Gröschke: Measure the spectral aerosol optical depth with a star photometer in polar areas
A07-Intensive Arctic Atmospheric Observatories (Matthew Shupe)	Taejin Choi: Heat, water vapor and momentum exchanges at the Dasan Station in Ny-Alesund, Svalbard, the Arctic	Annemarie Fraser: Ground-Based Zenith-Sky DOAS Measurements of Ozone and NO2 and PEARL, Eureka, Nunavut	Russ Schnell: Long Term Atmospheric Measurements at the Barrow, Alaska, Baseline Observatory and the Greenland Environmental Observatory, Summit, Greenland.	Robert Stone: The Study of Polar Aerosols during the International Polar Year
H01- Hydrology (Jim Buttle) P.1-P.9	Clement Agboma: Application of the VIC Model for Water and Energy Budget Studies in the Upper Assiniboine River Basin	Darryl Carlyle-Moses: Preliminary Investigation of the Hydrologic Importance of Bryophyte Dominated Forest Floors in Three Stands of the Montane Spruce Biogeoclimatic Zone	Timothy Duval: Determination of solute transport properties through peat soils: laboratory experiments	Anthony Endres: Evaluating Numerical Model Simulations of Vadose Zone Response to Unconfined Pump Tests
--------------- P.10-P.18	Rebeca Quiñonez-Piñón: The Use of Different Sapwood Area Mensuration Methods: Implications in Modelling Canopy Transpiration and Catchment's Water Balance	M. Rebeca Quiñonez-Piñón: Validating Gravimetry Measurements in Canada with a Continental Scale Hydrological Database	Lynn Raaflaub: Hydrological properties of the organic layer of the forest floor for use in drying models	Dan K. &Thompson: Moisture and climatic forcings on Sphagnum productivity in a cutover peatland
O02-Operational Oceanography (Charles Hannah)	Sean Hartwell: Development of the Lunenburg Bay Coastal Observatory: a practical guide to operational oceanography	Ron Lindsay: Predicting Seasonal Ice Extent in the Arctic	Phillip MacAulay: A Real-Time Water Level (RTWL) System for Atlantic Canada.	Adhi Susilo: Approximate Boltzmann Integral for Operational Ocean Wave Forecasts
O03-Coastal Oceanography and Inland Waters (Jinyu Sheng)	Laura Bianucci: A Biogeochemical Box Model of Patagonian Tidal Fronts	Patrick Timko: The Hydrography of Clode Sound, Newfoundland	Rich Pawlowicz: An anoxic fjord revisited: seasonal cycle, deep and intermediate renewal, and interfacial	Zhigang Xu: New Types of Tsunami Charts for Eastern Canadian Coastal Sites

Poster Number	2DP.1	2DP.2	Poster Number	2DP.1
A05 Open access to meteorological data (Miguel Tremblay)	Al Pankratz: An informal poll regarding Environment Canada and data sharing		H04-Prediction In Ungauged Basins (Christopher Spence)	Jonathan Stolle: A scale by scale intercomparison of satellite radar data (TRMM) and regional meteorological
H05-Ecological Flow Needs: (Daniel Peters)	Jeff Crocker: Sensitivity of aquatic organisms to direct and indirect effects of decreased flow: towards the development of a sensitivity index	Jan Simonson: An Indicators Approach for Assessing Hydrological Alteration in the South Saskatchewan River Basin, Alberta, Canada.		

16:00-17:30	POSTER SESSION (2DP) / SESSION POSTER (2DP) DH-Avalon D			16:00-17:30
2DP.5 / .14	2DP.6 / .15	2DP.7 / .16	2DP.8 / .17	2DP.9 / .18
Slavko Vasic: Comparison of Precipitation from Numerical Weather Prediction Models and Radars Using a Multicategory Approach				
Madhav Khandekar: The Canadian Prairie drought in the context of Global Warming: A synthesis				
Arnold Ashton: An Evaluation of the GEM-LAM (Limited Area Model) over Ontario	Jacqueline Spilak: An examination of TAF quality for Vancouver (CYVR) and Calgary (CYYC) 1999-2006			
Amy Solomon: Mesoscale Simulations of Polar Clouds During M-PACE	Taneil Uttal: Radar, Radiometers, Interferometers and Lidar in Eureka, Canada for Cloud and Aerosol Studies			
Kimberly Strong: Ozone Measurements from the Canadian ACE Arctic Validation Campaigns	Mei Gao: Three-Dimensional Polar Winds Retrieved From AIRS and MODIS	Natasa Skific: Analysis of heat and moisture transport in the polar regions in the 20th century	Taneil Uttal: International Arctic Systems for Observing the Atmosphere (IASOA) IPY Activity 196	
Raoul Granger: A Boundary layer integration experiment for lake evaporation	Newell Hedstrom: The hydrology of a boreal fen in central Saskatchewan	Zuoxin Liu: Applying Pedo-transfer Functions to Simulate Spatial Heterogeneity of Cinnamon Soil Water Retention Characteristics in Western Liaoning Province	Claire Oswald: Laboratory column experiments to determine the hydrological and chemical controls on mercury mobility in soils	Caterina Valeo: GPS Derived Precipitable Water Vapour as a Source of Data for Evapotranspiration Modelling
Anne Watelet: From barren to reclamed land in Sudbury, northern Ontario: 45 years of hydrological changes	Sitotaw Yirdaw: Groundwater Storage from GRACE Over the Assiniboine Delta Aquifer (ADA) of Manitoba: Early Result	Kathy Young: Role of snow in the hydrology of a high arctic riparian wetland	Bing Chen: Impact of Climate Change on Agrichemical Loss in Watershed Systems	Richard Warren: Soil Trafficability Assessment in the Morris area, Manitoba
Douglas Schillinger: High frequency acoustic observations of episodic mixing events in Lunenburg Bay.	Yu Shi: Development of an Atlantic Canadian Coastal Sea Level Neural Network Model (ACCSLENNT)			
Pierre St-Laurent: Freshwater and heat budgets of Hudson Bay	Sarah Crookshanks: High-energy sedimentary processes in Kluane Lake, Yukon Territory	Ming Guo: Study of High-Resolution Circulation Model in St. John's Harbor, Newfoundland		

Poster Number	2DP.1	2DP.2	2DP.3	2DP.4
O01-Oceanography of the Northwest Atlantic (Guoqi Han)	Guoqi Han: Monthly-mean circulation and mixing over the Newfoundland Shelf and Slope	Nancy Chen: Low-frequency variability of the Labrador Current at 47N	Entcho Demirov: Interannual variability of the Labrador Sea sea surface temperature	Atif Taoussi: Simulation and Analysis of the DMS and Sulfate during the CSOLAS-SABINA Campaign.
H02-Isotope tracing of water balance and climate processes (Jean Birks)	Maija Heikkila: Holocene paleoclimate dynamics inferred from stable isotope stratigraphy of sediments in Lake Saarikko, southeastern Finland	Michael Moncur: Isotopic and geochemical tracing of groundwater and surface water discharge from an abandoned tailings impoundment	Sarah Mouneimne: Using stable isotope ratios to infer annual and spatial variability in source water contributions in the upper Bow River basin, Alberta	Yi Yi: The distribution of water isotopes in evaporating sphagnum columns: potential implications for quantifying water fluxes

Day 3, Thursday, May 31- Session Schedule — *Morning / matin*
3ièmer jour, jeudi 31 mai – Horaire des presentations

Room	CC-Marconi (Chair: Guoqi Han)	
08:30	**Plenary Day 3**: C.K. Shum	Role of Space Geodesy in the Quantification of 20th Century Sea Level Rise
09:15	**Plenary Day 3**: Susan Allen	Physical controls on phytoplankton biomass and composition in the Strait of Georgia: results from a 1-D model
10:00-10:30	**COFFEE BREAK / PAUSE CAFÉ**	10:00-10:30

Block / Room	Session 3B1 DH-Harbourview E	Session 3B2 DH-Brownsdale	Session 3B3 CC- Brown	Session 3B4 CC- Alcock
Session-Title (Chair)	O03-Coastal Ocean. & Inland Waters (Jinyu Sheng)	G05-The North Atlantic rifted margin: (Kim Welford)	S03-Snowfall and Snow Cover Measurement (Daqing Yang)	H04-Prediction In Ungauged Basins (Christopher Spence)
10:30	Francois Saucier: Estuarine circulation in the Gulf and Estuary of St. Lawrence (I)	Brian Tucholke: Evolution of the Newfoundland-Iberia Rift (I)	Daqing Yang: Bias corrections of long-term (1973–2004) daily precipitation data over the northern regions	Marc Stieglitz: Land-Atmosphere Coupling and Freeze-Thaw Dynamics (I)
10:45	Denis Lefaivre: Dynamics of the Position of the Salt Intrusion in the St. Lawrence River near Quebec City		Jessica Cherry: Development of a Daily, Land-Based Pan-Arctic Snowfall Reconstruction for 1940-1999	
11:00	Bo Yang: Numerical Study of Circulation, Retention, and Dispersion in the Bras d'Or Lakes of Nova Scotia using a Numerical Circulation Model	Keith Louden: Continental rifting, breakup and early sea-floor spreading offshore Nova Scotia and the eastern Grand Banks: A summary of results from the Mariprobe Program	Eva Mekis: Adjustment of Historical Daily Snow Observations in Canada	Christopher Spence: Canadian contributions to the Prediction in Ungaged Basins (PUB) Initiative
11:15	Marek Stastna: The effects of no slip boundary conditions on topographic generation of large amplitude internal solitary waves	Julie Smith: Processing and interpretation of ERABLE seismic reflection data from the southeast Newfoundland rifted continental margin	Steven Fassnacht: Integrating the Ground and Snow Surfaces to Yield Snow Depth	Markus Weiler: Classification of watershed sensitivity to peak flow modification after forest disturbance
11:30	Van Thinh Nguyen: Numerical simulation of internal solitary waves generated by tidal forcing over three-dimensional topography in the St. Lawrence Estuary	Jeremy Hall: Extension across the southeast Newfoundland continental margin: estimates from fault heaves and crustal thinning	Andrew Rees: The Distribution, Properties and Role of Snow Cover in the Open Tundra	Richard Fernandes: Historical and Projected Trends in Land Surface Evapotranspiration over Canada
11:45	Charles Hannah: Polynyas and tidal mixing in the Canadian Arctic Archipelago	Sharon Deemer: Mapping the U reflector in the Newfoundland Basin with the spectral decomposition technique	Bruce Ramsay: Snow Cover and Its Fractal Dimension	Frank Seglenieks: Simulated streamflow on ungauged basins of the Mackenzie Basin, results from Mackenzie runoff assessment project
12:00	Marina Blokhina: Evolution of shoaling internal solitary wavetrains: observations and simulations	J.Kim Welford: Crustal structure of the Newfoundland rifted continental margin from constrained 3-D gravity inversion	Grant Petty: Satellite passive microwave retrieval and validation of snowfall over high-latitude oceans	Douglas Stiff: Flood Risk in Oxford, Nova Scotia: Mapping flood inundation in an ungauged meso-scale watershed.
12:15	Keir Colbo: Studies of the Internal Tide in the Lower Bay of Fundy	Michael Enachescu: Extent of oceanic crust in the northern Labrador Sea: New data and new impasse in an old controversy	Guillaume Fortin: Intra-annual thaw-refreeze cycles and the seasonal snowpack evolution.	Steven Fassnacht: The Conceptual Beaver Dam Influence on the Discharge of a Small Mountain Watershed
12:30-13:30	LUNCH / DÎNER			12:30-13:30

(I) – Invited Talk

10:00-10:30	**COFFEE BREAK / PAUSE CAFÉ**				10:00-10:30
	Session 3B5 DH-Avalon B	Session 3B6 DH-Avalon C	Session 3B7 DH-Harbourview F	Session 3B8 DH-Avalon A	Session 3B9 DH-Harbourview G
	C05-High Resolution Climate Modelling (Colin Jones)	A03-Can. Society of Agric. & Forest Met. (Ian Strachan)	A07-Intensive Arctic Atmos.Observatories (Matthew Shupe)	I07-Monitoring Earth Systems Dynamics (Alexander Braun)	I12-Drought over Canada (Ron Stewart)
	Hugh Morrison: Modeling interactions between the clouds, aerosol, surface, and radiation in the Arctic using WRF and MM5. (I)	Trevor Coates: Ammonia and particulate matter measurements from an open feedlot	Kimberly Strong: Investigating Middle Atmospheric Chemistry at the Polar Environment Atmospheric Research Laboratory (PEARL)	Remko Scharroo: Monitoring Sea Level Change and Natural Hazards with Satellite Altimetry (I)	Barrie Bonsal: Droughts in Canada: An Overview
		John Postma: Lagrangian Stochastic Probability Density Function Modelling of Concentration Fluctuations in Canopy Flows	Rebecca Batchelor: Measurements of atmospheric trace gases in the Arctic: First light measurements from the new FTIR spectrometer at PEARL		Ron Stewart: Canadian Prairie Drought and DRI
	Danahé Paquin-Ricard: Evaluation of Cloud-Radiation Interaction in the Canadian GEM Model Using ARM Observations	P.A. Taylor: A note on Sudbury area wind speeds - a tale of forest regeneration	Chi-Shing Wong: 13C/12C and 18O/16O in atmospheric CO_2 at the WMO Station at Alert, NWT: Long-term changes and influence of Siberia atmospheric inflow	Wooil M. Moon: Overview of New Space-borne Fully Polarimetric SAR (Synthetic Aperture Radar)Systems and Geophysical Applications	K.K. Szeto: Water cycling and drought in three major river basins in N. America
	Yanjun Jiao: Cloud processes simulated by the Canadian Regional Climate Model along a cross-section in the Pacific Ocean	John.D. Wilson: Surface-layer statistics over a uniform salt flat: the adequacy of Monin-Obukhov scaling	Asan Bacak: Surface measurements of size and composition of particulate matter at Eureka, Nunavut	C.K. Shum: Geodynamic Studies Using Spaceborne Gravimetry	Eyad Atallah: A Series of Unfortunate Events
	Adam Monahan: The Probability Distribution of Surface Momentum Fluxes	Laura Chasmer: Vegetation Structural and Topographic Heterogeneity Influences on Carbon Dioxide Uptake and Respiration within a Mature Jack Pine Forest in Saskatchewan, Canada	Von P. Walden: Fractional cloud cover and longwave cloud radiative forcing at the surface over Eureka, Canada	Jianliang Huang: Estimation of the time-variable part of the geoid from monthly GRACE solutions	Geoff Strong: Atmospheric Moisture and Thunderstorm Drought
	Yanping He: The Land Surface Wind Probability Distributions: A High Resolution Observational Study	Pierre-Luc Lizotte: Measurement of net CO_2 exchange using a portable profiling system	Matthew Shupe: Cloud occurrence at Arctic atmospheric observatories	Wouter van der Wal: Secular geoid rate in North America from GRACE: methodology, accuracy and interpretation	Travis Logan: Future changes in temperature, precipitation and forest drought indices as simulated by the Canadian Regional Climate Model (CRCM 4.1.1).
	Amanda Adams: Using the Foothills Climate Array and meoscale modeling to understand the role of chinooks on local climate	Laura Wittebol: 'Bottom-Up' Evidence for NBL Budget Measurement Scale	William Ward: Waves and coupling processes at the Polar Environment Atmospheric Research Laboratory (PEARL)	Mohamed Elhabiby: Wavelet Representation of the Deflection-Geoid and Inverse Vening Meinesz Integrals	Joan Klaassen: Managing and Preparing for Drought: An Assessment of Drought Indices in Ontario
	Colin Jones: The benefits of increased model resolution in simulating high impact weather events.	Shannon Fargey: Relating the frequency and distribution of southwestern Alberta storm events to seasonal rainfall patterns	Daniel Nadeau: Understanding High Winds Events in the Eastern Canadian Arctic	Pierre Heroux: GPS Precise Positioning Made Easy: NRCan Products Behind the Scene	Richard Lawford: A review of the requirements for drought information on the Canadian Prairies
12:30-13:30	LUNCH / DÎNER				12:30-13:30

12:30-13:30	LUNCH / DÎNER			12:30-13:30
Block / Room	Session 3C1 DH-Harbourview E	Session 3C2 DH-Brownsdale	Session 3C3 CC- Brown	Session 3C4 CC- Alcock
Session-Title (Chair)	O03-Coastal Ocean. & Inland Waters (Jinyu Sheng)	G11-Geophysics for Petroleum Exploration... (Michael Enachescu)	S03-Snowfall and Snow Cover Measurement (Daqing Yang)	H05-Ecological Flow Needs: (Daniel Peters)
13:30	D.A. Greenberg: Unstructured mesh modelling in the nearshore (I)	Steven Ings: Salt and shale tectonics at passive continental margins: Insights from margin-scale numerical models that couple deformation to fluid flow	Craig Smith: The relationships between wind speed and snowfall catch efficiency for the Geonor T-200B precipitation gauge	Daniel Peters: The Science of Instream Flow Needs in Canada
13:45	Blair Greenan: Observations of a Spring Bloom at Halifax Station 2	Phonse Fagan: Structural and Stratigraphic Elements of the Laurentian Basin, Atlantic Coast of Canada (I)	Jimmy MacDonald: Gauge performance of 2 common solid precipitation gauges in a prairie environment	Wendy Monk: Application of a hydrological regime classification for rivers across Canada
14:00	Brent Else: Estimation of Air-Sea Carbon Dioxide Exchange in Hudson Bay, Canada from Ship and Satellite Observations		Wendy Ryan: Preliminary Results of Ultrasonic Snow Depth Sensor Testing for National Weather Service (NWS) Snow Measurements in the U.S. and Work toward Operational Readiness	Nelli Horrigan: Modelling the effects of flow on Canadian river ecosystems: developing an ecological index of flow modification
14:15	Zhigang Xu: A Demonstrative System for Real-time Tsunami Simulations	Victoria Hardy: Seismic characterization of Cretaceous sequences within the Orphan Basin, offshore Newfoundland and Labrador		David Tenenbaum: Digital terrain analysis to support the development of an ecological flow needs standard
14:30	Julia Mullarney: Resonant Modulation of a Tidal Jet	Ayiaz Kaderali: Using VSP's to Correct Deficiencies in Surface Seismic Data. (I)	Alexandre Fischer: Investigating the Advantages of using a Multi-parameter Approach to Derive Automated Snowfall	C. Wendell Koning: Determining Instream Flow Needs for the South Saskatchewan River Basin, Alberta, Canada
14:45	Che Sun: Hydrographic Analysis of the Kuroshio Current in the East China Sea Based on a Streamfunction Method		Shelley Knuth: Estimation of Snow Accumulation in Antarctica Using Automated Acoustic Depth Gauge Measurements	David Scruton: The 'Natural Flow Paradigm' and Atlantic salmon: Moving from concept to practice
15:00	Joannie Ferland: Spatial distribution of phytoplankton production and biomass in the Hudson Bay Complex in summer 2004 and 2005https:	David Lowe: Heavy mineral provenance of the Flemish Pass and Orphan basins, offshore Newfoundland	William Floyd: Snowfall monitoring with a remote camera network	Natasha Neumann: Understanding the Effects of Surface Water - Groundwater Interactions on Aquatic Habitat in the Okanagan Valley: A Multi-Technique Approach
15:15	Jordan Dawe: Resolution of bottom boundary layer transports in a numerical model of canyon upwelling	Jordan Stead: The continental margin of northeast Newfoundland and southern Labrador: regional context, geological evolution and petroleum prospectivity	Tahani Alsarayreh: Snowflakes falling on water: Can underwater sound levels be used to measure snowfall rates?	Robert Metcalfe: Impacts of waterpower peaking on physical riverine processes and implications for setting environmental flows
15:30-17:00	POSTER SESSION (3DP) / SESSION POSTER (3DP) DH-Avalon D (see next page)			15:30-17:00
18:30-00:00	Reception / Banquete / Entertainment			18:30-00:00

12:30-13:30	LUNCH / DÎNER					12:30-13:30
	Session 3C5 DH-Avalon B	Session 3C6 DH-Avalon C	Session 3C7 DH-Harbourview F	Session 3C8 DH-Avalon A	Session 3C9 DH-Harbourview G	
	C05-High Resolut. Climate Modelling (Colin Jones)	A04-Operational Meteorology (Paul Ford)	I08- Influence of Sea Ice on the Atmos. (Mike Alexander)	I07-Monitoring Earth Sys. Dyn. from Space (Alexander Braun)	I09- Synergy between Geodesy and Meteor. (Marcelo Santos)	
	Liqiang Sun: seasonal climate prediction using regional climate models (I)	Derrick Kania: The Southern Manitoba Tornado Outbreak August 05 2006.	Mark Serreze: Moving Toward a Seasonally Ice-Free Arctic Ocean (I)	Steven Solomon: Mapping shallow seabed morphology in the Mackenzie Delta region using Synthetic Aperture Radar	Seth Gutman: Geodesy and Meteorology: Synergy, Serendipity and Reciprocity (I)	
		Alice (Aihong) Ou: Meteorological Analysis of the Severe Rainstorm that Caused Extensive Flooding in Southern Alberta during 5-9 June 2005				
	Etienne Tourigny: Seasonal Prediction at the Regional Scale: An analysis of Regional Climate Model performance over the tropical Americas	Mark Pilon: The Aug. 10, 2006 Avalon Heavy Rain Event	Meiji Honda: Intra-seasonal relationship between the Northern Hemisphere sea ice variability and the North Atlantic Oscillation	Stein Rune Karlsen: A multitemporal and multisensor based mapping of the snowmelt and phenological pattern in Finnmark county, North Norway	Marcelo Santos: A discussion on Height Systems used in Geodesy and Meteorology	
	Bernard Dugas: Diagnostic results from regional-scale climate simulations with the GEM model: Part1 - GEM Global	David Patrick: An Evaluation of Severe Thunderstorm Motion Algorithms over the Canadian Prairies in 2006	Halldor Bjornsson: The Influence of Sea Ice on Air Temperature Variability in Iceland	Richard Lawford: Integrated Global Water Cycle Observations and their potential contributions to societal needs and a Global Earth Observation System of Systems	Zhizhao Liu: Seasonal Variations of the Accuracies of GPS-Derived Water Vapor	
	Ayrton Zadra: Diagnostic results from regional-scale climate simulations with the GEM model: Part 2 - GEM-LAM	William Burrows: Dynamical-Statistical Models for Lightning Prediction to 48-hr	Wieslaw Maslowski: Arctic Ocean – Sea Ice – Atmosphere Interactions: 1979-2004 Model Results (I)	Wooil M. Moon: Monitoring and Study of the Characteristics of Internal Waves in the East (Japan) Sea by Synthetic Aperture Radar – ERS1/2, RADARSAT, and ENVISAT ASAR	Hal Ritchie: GPS-derived Precipitable Water Vapour at a Tropical Location	
	Minwei Qian: The Influences of NAO and the Hudson Bay sea-ice on the Climate of Eastern Canada	Bob Kochtubajda: Lightning and radar features within the Carnduff Saskatchewan Thunderstorms of May 28, 2006		Julien Choisnard: Sensitivity of sea surface wind from satellite-based radar for weather analysis	Felipe Nievinski: Accuracy in zenith tropospheric delay from the Canadian regional numerical weather model	
	Zavareh Kothavala: Issues arising from the transferability of two Canadian Regional Climate Models to non-native domains	Neil Taylor: The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE): i) Project Overview (15:00)	Jennifer Jackson: Identification of a near-surface temperature maximum in the southern Canada Basin, Arctic Ocean	Rick Danielson: Marine wind analysis with the benefit of Radarsat-1 synthetic aperture radar data	Stephen Macpherson: Impact of ground-based GPS observations on the Canadian Regional Analysis and Forecast System	
	Philippe Lucas-Picher: Investigating RCM's internal variability using an ageing tracer	ii) Testing of Mesonet Instrumentation (15:15)	Jan Sedlacek: Sensitivity model study of Arctic ice-ocean interactions during the Little Ice Age using different radiative and wind stress forcings	Matthew Izawa: Comp. of Atmos. Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS) & Purple Crow Lidar (PCL) Temperature Profiles in the Middle Atmosphere	Craig Smith: Intercomparison of integrated precipitable water vapour estimates made by radiosondes, GPS and NWP in southern Alberta	
15:30-17:00	POSTER SESSION (3DP) / SESSION POSTER (2DP) DH-Avalon D (see next page)					15:30-17:00
18:30-00:00	Reception / Banquete / Entertainment					18:30-00:00

15:30-17:00	POSTER SESSION (3DP) / SESSION POSTER (3DP) DH-Avalon D (page 1)			15:30-17:00
Poster Number	3DP.1 / .10	3DP.2 / .11	3DP.3 / .12	3DP.4 /.13
C04-Climate Change and Variability in the Polar Regions (Lucie Vincent) P.1-P-9	Clarck Hongxu Zhao: Reduction in Himalayan Snow Accumulation and Weakening of the Trade Winds over the Pacific Since the 1840s	Richard Lawford: Contributions of the Global Energy and Water cycle EXperiment (GEWEX) to climate science	Keith Hines: Centennial-Scale Southern Annular Mode Variability in Observations and IPCC AR4 Models	Radan Huth: Arctic Oscillation and Barents Oscillation: two spurious modes of atmospheric circulation variability
------------------ P.10-P.12	Claudie Beaulieu: Performance of several homogenization techniques to detect shifts in precipitation data	Stephanie V. Skoblenick: Sea ice variability in the Canadian Arctic 1982–2004: Links to surface, cloud and radiation properties	Lucie Vincent: Observed trends and changes in radiosonde temperature and humidity in Canada	
C05-High Resolution Climate Modelling (Colin Jones) P.1-P-9	Keith Hines: High Resolution Regional Climate Simulations over Greenland with Polar MM5	Keith Hines: Verification of Polar WRF in AMPS	Dragan Simjanovski: An Evaluation of cloud and radiation processes simulated by GEM-LAM for the Arctic SHEBA year.	Philippe Roy: Évaluation de la variabilité et des extrêmes (précipitation et température) simulées par deux versions du modèle régional canadien du climat
------------------ P.10-P.11	Dimitri Parishkura: Evaluation of statistical Downscaling tools: reconstruction of the variability and extremes of monsoon regime in Sahel	Katja Winger: Storm track climatologies from GEMCLIM		
I05-Coupled Environmental Prediction Systems (C. Harold Ritchie)	Hal Ritchie: Initiating an Operational Canadian Global Assimilation and Prediction Capability for the Coupled Atmosphere-Ocean-Ice System (I)	Xiaobing Zhou: Assimilation of Historical SST Data for Long-term ENSO Prediction	Francois Roy: The predictability of daily sea surface temperatures in the Gulf of St. Lawrence for the initialization of coupled atmosphere-ice-ocean forecast	Rick Danielson: The search for ocean influences on midlatitude cyclones
I07-Monitoring Earth Systems Dynamics from Space (Alexander Braun)	Ibraheem Ali: Combining TOPEX and ICESat altimetry for the determination of the Great Lakes surface	Mohammed Dabboor: Object – oriented classification of polarimetric E-SAR data	Vidyavathy Renganathan: Accuracy assessment of ICESat over complex surface types in Churchill, Manitoba.	Keith Hines: The Impact of the Adelie Land Katabatic Wind Regime on Cyclogenesis
I08-The Influence of Sea Ice Var. on the Atmos. & Ocean (Mike Alexander)	Uma Bhatt: Influence of Regional Sea Ice Variability on Arctic Tundra	Uma Bhatt: The Atmospheric Response to Summer Arctic Sea Ice Anomalies	Masayo Ogi: Summer minimum Arctic sea ice extent and the associated summer atmospheric circulation	Axel Schweiger: Variability of autumn cloud cover over the Arctic Ocean and its links to changes in sea ice.
S02-Remote Sensing of Snow Cover (Chris Derksen)	Dorothy Hall: Validation of the AFWA-NASA snow product in the Lower Great Lakes Basin	Stein Rune Karlsen: Polarview: Nordic snow monitoring service	James Foster: Melting snow from passive microwave observations for a microwave/visible blended product: first results	Jim Foster: Validation of a new microwave/visible blended snow product using CLPX-1 observations

Poster Number	3DP.1	3DP.2	3DP.3	3DP.4
C01- Climate change projection, detection and attribution (Andrew J. Weaver)	Budong Qian: A preliminary study of the 2006/7 early winter temperature anomaly	Brian Horton: Multivariate Classification of Calgary Weather Systems: Exploring Trends, Variability and Synoptic Relationships, 1953-2004		
C02- Polar Climate Stability (Andrew J. Weaver)	M. Bruce Stevens: Subsurface heat storage in climate model simulations: Bottom boundary placement	Evelise Bourlon: Millennial scale Holocene climate oscillations in paleoceanographic records from Atlantic Canada	Barletta: A high-resolution Holocene paleomagnetic record from the Chukchi Sea: preliminary results and potential for chronostratigraphy	Lise-Pronovost: Physical and magnetic properties of high resolution Holocene sediment cores from the Chukchi Sea margin : preliminary results
I01- Atmospheric & Oceanographic General (Guoqi Han)	Jennifer Verlaine Lukovich: On the relationship between polar stratospheric zonal flow and surface cyclonic activity	William Richards: Atmospheric Hazards: Extreme Wind Gust Climatology in Atlantic Canada 1955 – 2000	Stanton Tuller: Temporal Trends in Air Density	

15:30-17:00

POSTER SESSION (3DP) / SESSION POSTER (3DP)
DH-Avalon D (page 1)

15:30-17:00

3DP.5 / .14	3DP.6 / .15	3DP.7 / .16	3DP.8 / .17	3DP.9 / .18
Elizabeth Cassano: Relationships between Arctic climate modes and daily weather patterns in the Mackenzie and Yukon watersheds	Jennifer Francis: Drivers of Trends in Arctic Surface Longwave Fluxes	Paquita Zuidema: The Seasonal Cycle and Variability in Cloud Liquid Water Paths over the Sea-Ice-Free Arctic	Ewa Milewska: Polar clouds – climatic perspective	Gabrielle Gascon: Major precipitation events in the Eastern Canadian Arctic
Daniel Caya: Le modèle régional canadien du climat : impacts des changements climatiques sur le cycle hydrologique dans la péninsule Québec/Labrador	Jean-Philippe Paquin: The effect of the rigid lid position on hemispheric simulations using the Canadian Regional Climate Model : Results and future research	Leo Separovic: Reproducible Signal and Internal Variability Noise in an Ensemble of RCM Simulations	Martin Leduc: Regional Climate Model sensitivity to domain size	Eleni Koukidis: Sensitivity of the Statistical DownScaling Model (SDSM) to the Selection of Reanalysis Products: Impacts on hydrological modelling
Samira Ben Said: Validation and Application of a Single Column Coupled Atmosphere-Ocean-Biogeochemical Model for DMS				
Chen Xu: Spherical Harmonic Analysis and Synthesis in Satellite Gravity Gradiometry Using the Torus Approach				
Clara Deser: The Transient Atmospheric Circulation Response to Arctic Sea Ice Anomalies	Brian Hill: Ice Databases at the Institute for Ocean Technology			
Debbie Putt: EOFs of SSM/I-retrieved snow water equivalent	Peter Romanov: Improvement of EOS satellites data-based snow mapping through synergy of visible/infrared and microwave products.	Frédérique Pivot: Assessing the Capability of Spaceborne Altimeter and Scatterometer Data for the Retrieval of Snow Water Equivalent in Canada.		

Poster Number	3DP.1	3DP.2	3DP.3	3DP.4
I02-A year in the life of the Arctic Ocean Shelf: (CASES) (Louis Fortier)	Cédric Magen: Iron and Manganese as Tracers of Different Sedimentation Regimes in the Beaufort Sea Region (I)			
I04- New Dev. in Num. Modelling of the Oceans & Atmos. (Paul Myers)	Jeremy Krieger: Modeling the Beaufort Sea coastal wind regime using MM5 and WRF			
I10-Modeling Polar Oceans and Sea Ice (David Holland)	Jun Inoue: Effect of heat transmission through melt ponds and ice on melting during summer in the Arctic	Andrew J. Willmott: The effect of tides on dense water formation in Arctic shelf seas		

15:30-17:00	POSTER SESSION (3DP) / SESSION POSTER (3DP) DH-Avalon D (page 2)			15:30-17:00
Poster Number	3DP.1	3DP.2	3DP.3	3DP.4
I11-Hydromet. Prediction in Cold Regions and Seasons (John Pomeroy)	Sarah Boon: Snowpack variability between forest stands: effect of altered canopy cover due to beetle infestation	Chris DeBeer: Application of the Cold Regions Hydrological Model for simulating snow accumulation and melt at an open and a forested site, Canadian Rocky Mountains		
I12-Drought over Canada (Ron Stewart)	Garth van der Kamp: Assessing the water and energy balances at the BERMS flux towers, 1999 to 2005	Robert Armstrong: Evaluation of Evaporation Estimation Methods during a Summer Drying Period	Erin Evans: Low-Accumulation Precipitation Events at Locations Across the Prairies During the 1999-2005 Drought	Heather Greene: Cloud Fields Associated with the Recent Drought over the Canadian Prairies
I14-Soils and Climate Change (Sue Grayston)	Maria Strack: Carbon dioxide exchange from peat-Sphagnum monoliths under varying moisture conditions	Sharon Billings: Influences of elevated CO2 and N fertilization on soil organic carbon cycling in a pine forest soil	Dave Risk: In-situ incubations highlight the climatic sensitivity of soil organic matter pools	
I15-Biogeoscience (Nigel Roulet)	Merrin Macrae: Annual Contribution of Tile Drains to Basin Discharge and Phosphorus Export in a First Order Agricultural Catchment	Merrin Macrae: Effect of Flooding from Upstream Sources on Riparian Nutrient Dynamics: Results from the First Flood		
G07-Structure & dyn of the continental mantle lithosphere (Ian Ferguson)	Ian Ferguson: Determining the deep electrical resistivity structure of the Grenville Province in Ontario, Canada			

15:30-17:00	POSTER SESSION (3DP) / SESSION POSTER (3DP) DH-Avalon D (page 2)			15:30-17:00
Poster Number	3DP.1	3DP.2	3DP.3	3DP.4
S01-General Eastern Snow Conference Contributions (Andrew Klein)	Miles Ecclestone: The Eastern Snow Conference and the Atlantic Provinces, especially the Province of Newfoundland and Labrador	LeeAnn Fishback: Snowpack geochemistry of tundra environments in the Hudson Bay Lowlands		
S03-Snowfall and Snow Cover Measurement (Daqing Yang)	Claude Duchon: Measuring Heavy Snowfall using Five Different Windshields - each with a Vibrating-wire Precipitation Gauge	Nicholas Kinar: An Automated Gauge for Acoustically Determining Snow Water Equivalent		
S04-Snow Processes: Measurements and Modelling (Steven Fassnacht)	Marc Amyot: Influence of temperate mixed and deciduous tree covers on Hg concentrations and photoredox transformations in snow.	Paul Bartlett: The representation of snow interception and unloading in the Canadian Land Surface Scheme.	Thomas Kaempfer: Modeling heat and mass transfer in snow at a microstructural level using a phase-field approach - first results	
S05-Snow Cover & Climate (Ross Brown)	Krystopher Chutko: Estimating potential snow/ice melt energy availability for a plateau ice cap using a High Arctic weather station record	Guillaume Fortin: Winter Climate Trends of the Chic-Chocs Mountains (1970-2007).	Yvan Orsolini: Interannual variability of the Aleutian and Icelandic Lows in an ensemble GCM simulation forced by snow cover satellite observations	Jerry Toupin: Winter climate along the St. Lawrence Valley.
G04-Geomagnetism, paleomagnetism and rock magnetism (Phil McCausland)	Michel Lajoie: High resolution chronostratigraphy in the Hudson Bay and Strait since the last deglaciation: preliminary results	U. Boyer-Villemaire: High resolution Holocene chronostratigraphy using paleomagnetic records in the Sept-Îles area, Gulf of St. Lawrence, Eastern Canada		

Day 4, Friday, June 1- Session Schedule *Morning / matin*

4ièmer jour, vendredi 1 juin – Horaire des presentations

Room	CC-Marconi (Chair: John Pomeroy)	
08:30	**Plenary Day 4**: Garry Clarke	The Lake Agassiz megaflood and 8200 BP cold event: was there a causal link?
09:15	**Plenary Day 4**: Marika Holland	A seasonally ice free Arctic?
10:00-10:30	**COFFEE BREAK / PAUSE CAFÉ**	10:00-10:30

Block / Room	Session 4B1 DH-Harbourview E	Session 4B2 DH-Brownsdale	Session 4B3 CC- Brown	Session 4B4 CC- Alcock
Session-Title (Chair)	I04-Numerical Model of the Oceans and Atmos. (Paul Myers)	G03-Multi-scale Deformation Monitoring (Georgia Fotopoulos)	S04-Snow Processes: Meas. & Modelling (Steven Fassnacht)	H06-Glaciers and Ice Sheets – Processes and (Sarah Boon)
10:30	Roy Walters: A Finite Element Coastal Ocean Model: Investigation of Semi-Lagrangian Methods. (I)	Donald Forbes: Integrating GPS and tide-gauge data with geological evidence and other tools to estimate vertical motion and sea-level change in the western Arctic	Bruce Davison: The Hysteretic Relationship between Snow Covered Area and Depth – Measurement and Modelling	Cornelis Van der Veen: Intermittent thinning of Jakobshaun Ibsræ, West Greenland, since the Little Ice Age (I)
10:45		Mohammed Dabboor: Digital elevations from SRTM and ICESat: Effects of terrain slope and dynamic terrain	Nicholas Kinar: An Evaluation of a Distributed Blowing Snow Model in the Rocky Mountains	
11:00	Julie Pietrzak: Insights into the Indian Ocean Tsunami from GPS, altimeters, tide gauges and unstructured mesh ocean models	Georgia Fotopoulos: Outlier detection for a combined vertical motion model – case study for the Great Lakes	Susan Frankenstein: FASST and SNTHERM in both Forested and Open Sites	Lei Yang: Greenland Outlet Glacier Flow Speed and Surface Meltwater Production
11:15	Veluthedath Kuzhiyil Praveen: An initial analysis of a North Atlantic configuration of the prismatic version of FEOM	Azadeh Koohzare: The pattern of vertical crustl movements in Canada using geodetic data	Richard Essery: Modelling longwave radiation to snow beneath forest canopies using hemispherical photography	Jason Box: Greenland ice sheet monthly surface air temperature reconstructions: 1784-2006
11:30	Nadja Steiner: Simulating gas exchange with a 1-D Coupled Atmosphere-Ocean-Biogeochemical Model	Wooil M. Moon: Surface Land Deformation Monitoring using JERS-1 SAR Data and the PSInSAR Technique	Stefano Endrizzi: Application and validation of a snow energy-balance model at two midlatitude alpine sites	Inka Koch: Comparison of ice core proxies for summer temperature with observations
11:45	Amanda Adams: Parameterization of wind farms: A step towards understanding their impact on local climate	Philippe Lamothe: A study of crustal deformation in the Charlevoix, Quebec seismic zone using GPS.	Steven Fassnacht: Snowpack property variations below the canopy	Christian Zdanowicz: Recent glacier cover changes in the southern Baffin Island region:Evidence fom surface and airborne observations.
12:00		Kaiwen Xia: Earthquake rupture speeds and modes observed in the laboratory	Florent Domine: Relationships between several snow properties: new avenues for snow physics parameterization	Mike Demuth: Characterising glacier facies regime shifts on Devon Island Ice Cap, Nunavut, Canada
12:15			P-Y Li: Lagrangian Stochastic simulation of blowing snow events	Luke Copland: Rapid loss of the Ayles Ice Shelf, Ellesmere Island
12:30-13:30	LUNCH / DÎNER			12:30-13:30

(I) – Invited Talk

10:00-10:30	**COFFEE BREAK / PAUSE CAFÉ**			10:00-10:30
Session 4B5 DH-Avalon B	Session 4B6 DH-Avalon C	Session 4B7 DH-Harbourview F	Session 4B8 DH-Avalon A	Session 4B9 DH-Harbourview G
C04-Climate Change in Polar Regions (Lucie Vincent)	A04-Operational Meteorology (Paul Ford)	I08-Influence of Sea Ice Variability on: (Mike Alexander)	I02- Arctic Ocean Shelf: (CASES) (Louis Fortier)	I13-International Polar Year Activities (Taneil Uttal)
J.C. Falkingham: Sea Ice in Canada's Changing Climate	Ismail Gultepe: The Fog Remote Sensing and Modeling (FRAM) Field Project	Kent Moore: Air-Sea-Ice Interactions: Observations and modelling of cloud streets over the marginal seas of the Arctic Ocean (I)	David Barber: Ocean-Sea Ice-Atmosphere processes during the Canadian Arctic Shelf Exchange Study (CASES)	André Rochon: Evolution of sea surface conditions in the Beaufort Sea during Pre-historical and historical times: the last ~1000 years
Stephen Howell: Sea Ice in the Northwest Passage: Past, Present, and Future Variability	Garry Toth: Automated Fog Forecasts from Existing NWP Forecast Output			Jan Bottenheim: OASIS-CANADA
Jennifer Francis: Drivers of Variability in Arctic Winter-Maximum Sea Ice Extent	Tamara Gaman: Adaptative processing for weather radar measurements	Thorsten Markus: High resolution monitoring of variability the marginal sea ice zone using satellite passive microwave data	Jennifer Verlaine Lukovich: On the relationship between the motion of the central Arctic pack ice and the circumpolar flaw lead polynya system.	Jean-Pierre Blanchet: Detection and Assessment of the Dehydration-Greenhouse Feedback in the Arctic: A Status Review for the IPY
Mark Anderson: Arctic Sea Ice Snowmelt Onset Dates Derived from Passive Microwave for 1979-2005, an update for current conditions	Michael Leduc: Radar differential reflectivity (ZDR) in snow… some observations and hypotheses.	Peter Guest: A New/Old Method for Measuring Turbulent Heat Fluxes Over Leads	Ryan Galley: On the spatial and temporal variability of sea ice in the southern Beaufort Sea: 1980 - 2004.	Jocelyne Bourgeois: Spatial and temporal trends of climate and airborne contaminants from Arctic snow and ice cores: a Canadian IPY contribution
Alain Royer: 15 years of daily summer land surface temperature variation over Canada/Alaska derived from SSM/I EASE-Grid database	Elena Pison: Effect of the Spatial Variability of Precipitation on Polarimetric Radar Observables	Cecilia Bitz: Sea ice and the present polar warming asymmetry (I)	John Iacozza: On the Relationship Between Snow Distribution and Sea Ice Surface Roughness in the Canadian Arctic.	David Barber: The International Polar Year: Circumpolar Flaw Lead (CFL) System Study
Cheng-Zhi Zou: MSU-Derived Tropospheric Temperature Trend over the Polar Oceans	Sethu Raman: Role of Boundary Layer Baroclinic Conditions on the Development of the East Coast Atlantic Winter Storms		Sergiy Savelyev: Blowing, Drifting and Resting Snow: CASES 2004	Lev Tarasov: Global warming and polar tidewater glacier response: a Canadian IPY project on Belcher Glacier, Nunavut
Georg Hansen: Trends and variability of the Arctic tropopause, and their link to stratospheric processes	Yves Pelletier: Current and future status of CMC's operational production system	Marilyn Raphael: The influence of Antarctic sea ice extremes on large scale atmospheric variability in the Southern Hemisphere.	Alexandre Langlois: Development of a Snow Water Equivalent (SWE) Retrieval Algorithm over First-Year Sea Ice using In-Situ Passive Microwave Data	Trudy Wohlleben: International Polar Year 2007-2009: the role of the Canadian Ice Service.
Jaclyn Trzaska: GPS radio occultations of arctic temperature profiles	Rob Honch: Prototyping new products for the Canadian Air Navigation System (ANS). 'TafPlus' and 'V-CMAC'.	Brian Rose: Constraints on atmospheric and oceanic heat transport from an idealized coupled climate model with sea-ice	Magdalena Rozanska: Influence of abiotic factors on the seasonal changes in ice algal abundance and composition in Southeastern Beaufort Sea	Ayrton Zadra: Modelling and data assimilation activities in TAWEPI (Thorpex Arctic Weather and Environmental Prediction Initiative)
12:30-13:30	LUNCH / DÎNER			12:30-13:30

12:30-13:30	LUNCH / DÎNER			12:30-13:30
Block / Room	Session 4C1 DH-Harbourview E	Session 4C2 DH-Brownsdale	Session 4C3 CC- Brown	Session 4C4 CC- Alcock
Session-Title (Chair)	I11-Cold Regions Hydromet. Prediction (John Pomeroy)	G06- Terrestrial and Oceanographic Datums (Jiangliang Huang)	S04-Snow Processes: Meas. & Modelling (Steven Fassnacht)	H06-Glaciers & Ice Sheets–Proc & Model. (Sarah Boon)
13:30	Julie Friddell: The IP3 Research Network: Improved Processes and Parameterisation for Prediction in Cold Regions	Michael Foreman: Mean Sea Surface Topography for the Northeast Pacific Ocean and Its Continental Shelves (I)	Nick Rutter: The effect of summer snowfall events on the energy and mass balance of an Alpine glacier	Martin Sharp: Melt Season Duration on Eurasian Arctic Ice Caps, 2000-2004
13:45	Alain Roberge: Atmospheric Rivers affecting Western Canada: synoptic climatology and trajectory analysis.		Gerhard Kapeller: Hybrid modelling of two-phase avalanches and related phenomena – a turbulent dense flow approach	Anthony Arendt: Combining GRACE and Airborne Laser Altimetry Measurements to Calculate Ice Mass Changes in Alaska and northwestern Canada
14:00	Warren Helgason: Characterization of the near-surface boundary layer in a mountain valley clearing	Charles O'Reilly: The "3-D" Coastline of the new Millenium (Managing Datums in N-Dimension Space) (I)	Peter Taylor: Field Measurements of the Effect of Snow Particles on Wind Profile	Sven Kotlarski: Glacier mass and energy balance in the European Alps simulated by the regional climate model REMO
14:15	Chris Hopkinson: Scale biases in glacial melt estimates using a GIS energy balance model and a lidar-derived DEM	Vicki Childers: High-Altitude Aerogravity in Gulf of Mexico for Geoid Improvement (I)	Mark Gordon: The variation of blowing snow particle size, number, and velocity with height	Brett Wheler: Glacier-climate relationships in the Donjek Range, St. Elias Mountains, Yukon Territory
14:30	John Pomeroy: The influence of canopy temperature on incoming longwave radiation for snowmelt in coniferous Forests	Robert Kingdon: A forward modeling approach to estimating effects of three-dimensional topographical density distributions on orthometric height	Gro Lilbaek: Ion Enrichment of Snowmelt Runoff Water caused by Basal Ice Formation	Joseph Shea: Glacier boundary layer meteorology and implications for regional mass balance modeling
14:45	Nicholas Kinar: Acoustic Determination of Snow Water Equivalent	Yan Ming Wang: Notes on the Spherical Terrain Correction	Gregor Kos: Determination of Selected Organic Compounds in Snow and Air in the Canadian Arctic	D. Scott Munro: Distributed modelling of glacier mass balance from off-glacier AWS data.
15:00	Jaime Hood: Preliminary water balance of a glaciated alpine watershed: Lake O'Hara Research Basin	David Avalos: The Mexican Gravimetric Geoid: state-of-the-art and future directions	Parisa Ariya: Snow reactions: impacts on atmospheric chemistry	Stephen Dery: The Western Canadian Cryospheric Network (WC2N): An update
15:15	Masaki Hayashi: Ground water response to meteorological forcing in a moraine-talus field around Opabin Glacier, Lake O'Hara Research Basin	Jianliang Huang: Comparing two approaches for integral conversion of ground gravity into local geoid	Shawn Allan: Improving Winter Forecasting using WRF-ARW: High-Resolution Applications of a Mesoscale Model Installed on a Linux Cluster	R.D. Moore: Coupled modelling of glacier and streamflow response to future climate scenarios in British Columbia
15:30-16:00	**COFFEE BREAK / PAUSE CAFÉ**			15:30-16:00

12:30-13:30	LUNCH / DÎNER			12:30-13:30
Session 4C5 DH-Avalon B	Session 4C6 DH-Avalon C	Session 4C7 DH-Harbourview F	Session 4C8 DH-Avalon A	Session 4C9 DH-Harbourview G
C05-High Resol. Climate Modelling (Colin Jones)	A04-Operational Meteorology (Paul Ford)	I03-Atmos.-Cryos.-Solid Earth Interact. (Stéphane Bélair)	I02- Arctic Ocean Shelf: (CASES) (Louis Fortier)	I13-International Polar Year Activities (Ellsworth LeDrew)
Daniel Caya: Progress and perspectives of the regional climate modelling activities at Ouranos	Bertrand Denis: Summer QPF skill comparisons of the GEM-LAM 2.5 and the GEM-REG 15 km	Aaron Berg: Design of soil moisture observatories for remote sensing calibration and validation: Opportunities and Design Challenges	Jody Deming: Sea ice as a reactor for cold-adapted microbes: Insights from the CASES overwintering expedition (I)	Robert Morris: Data Management Planning at Environment Canada and the International Polar Year (I)
Emilia Paula Diaconescu: The impact of lateral boundary data errors on the simulated climate of a nested Regional Climate Model	John Cassano: Application of an objective synoptic weather pattern classification scheme to numerical weather prediction in the Antarctic	Richard Essery: Effects of sub-Arctic shrub canopies on snowmelt energetics		
Adelina Alexandru: Influence of large-scale nudging on RCM's internal variability	Chris Fogarty: An experimental numerical model for forecasting tropical cyclones at the CHC	Ola Persson: Two Years of High-Resolution Surface Energy Budget Measurements at the Alert SEARCH Site: Atmosphere-Snow-Soil Interactions	Cédric Magen: Origin and Fate of Particulate Organic Carbon in the Beaufort Sea shelf – Amundsen Gulf area, Canadian Arctic. (I)	Thomas Puestow: Polar View and the IPY Ice Logistics Portal (I)
Hélène Côté: Effects of configuration changes on CRCM downscaled North-American climate	Allan Rahill: Adjusting to a new high resolution global version of the GEM model	Michael Town: Clouds and Energy Transfer over the Antarctic Plateau.	Piotr Trela: Fine-Scale Diurnal Distribution of Zooplankton and Arctic Cod in Franklin Bay, Canadian Arctic, Recorded with Underwater Video.	
Sven Kotlarski: High-resolution Climate Change Scenarios for Germany and the European Alps	Wei Yu: Development of a high resolution wind forecasting system in Environment Canada	Steven Kokelj: A recent increase in the rates of thermokarst slumping in the Canadian western Arctic.	Alexandre Forest: Annual cycle of particulate organic carbon export in the Franklin Bay (Canadian Arctic): environmental control and food web implications	Mark Parsons: IPY Data Management–Building the Legacy
Peter Jackson: Downscaling temperature and precipitation for glacier mass balance studies	Marie-France Turcotte: Current and future seasonal forecasting at the Canadian Meteorological Center	Nasim Alavi: Assimilating soil moisture data in the CLASS model to improve latent heat flux estimation	Tara Connelly: Quantity, Quality, and Source of Organic Matter in Near-bottom Waters of the Beaufort Sea Shelf, Arctic Ocean	Ronald Weaver: NSIDC DAAC Data Sets and Proposed Services to the IPY Community
Laxmi Sushama: An RCM projection of soil thermal and moisture egimes for North American permafrost zones	Benoit Archambault: Results of the 4 models Historical Forecast Project 2 (HFP2) on seasonal forecast.	Pablo Grunmannn: Evaluation of the Canadian Land Data Assimilation (CaLDAS) over North America	Kyle G. Simpson: New Production in the Cape Bathurst polynya	James Moore: Data Sources and Management for the 2007-2009 International Polar Year using the Cooperative Arctic Data and Information Service (CADIS)
Andrew Harding: Artificial neural networks and the analysis of influences relevant to southern European climate extremes.	Marie-France Turcotte: Canadian Ensemble Prediction System : overview of the current and the future operational configuration.	Stéphane Bélair: High-resolution Land Surface Modeling and Assimilation: Surface Processes in the Next Generation of Operational Environmental Forecasting Systems	Huixiang Xie: Biogeochemical cycling of carbon monoxide in the southeastern Beaufort Sea: Autumn vs. spring	Ellsworth LeDrew: The Canadian IPY Master Directory as a Resource for Canadian IPY Scientists (I)
15:30-16:00	**COFFEE BREAK / PAUSE CAFÉ**			15:30-16:00

Day 4, Friday, June 1- Session Schedule *Late Afternoon / fin d'après-midi*

4[ièmer] jour, vendredi 1 juin – Horaire des presentations

15:30-16:00	**COFFEE BREAK / PAUSE CAFÉ**				15:30-16:00
Block / Room	Session 4D1 DH-Harbourview E	Session 4D2 DH-Brownsdale	Session 4D3 CC- Brown	Session 4D4 CC- Alcock	
Session-Title (Chair)	I11-Cold Regions Hydromet. Prediction (John Pomeroy)				
16:00	Garth van der Kamp: Use of deep groundwater observation wells for continuous monitoring of kilometre-scale vertical water balance				
16:15	Nicole Wright: Spatial and temporal variations in active-layer thawing and hillslope runoff generation in a discontinuous permafrost basin				
16:30	Celina Ziegler: Delineating Streamflow Contributing Areas in a Subarctic, Subalpine Watershed Using High Frequency and Synoptic Sampling Water Quality Data				
16:45	Yinsuo Zhang: Evaluation of the simulation and parameterization algorithms for ground thawing and freezing in permafrost region				
17:00	William Quinton: Snowmelt Runoff from Peat Plateaus: Magnitude, Timing and Influence on the Basin Hydrograph				
17:15	Frank Seglenieks: Runoff modelling of the Scotty Creek basin				
17:30	Xing Fang: Effects of Drought on Canadian Prairie Wetland Snowmelt Hydrology				
17:45	Lei Wen: Towards the establishment of a drought monitoring and seasonal prediction system over Canada using the Variable Infiltration Capacity (VIC) hydrological model				
18:00	Conference Finished / La conférence a fini				18:00

15:30-16:00	COFFEE BREAK / PAUSE CAFÉ			15:30-16:00
Session 4D5 DH-Avalon B	Session 4D6 DH-Avalon C	Session 4D7 DH-Harbourview F	Session 4D8 DH-Avalon A	Session 4D9 DH-Harbourview G
C04-Polar Climate Change & Var. (Lucie Vincent)	A04-Operational Meteorology (Paul Ford)			
Claude Labine: A Climatology of the Agassiz Icecap, 1988 - 2006	Barbara Casati: Forecast Verification: Issues and Recent Research Developments			
John Jacobs: Climate Variability in the Central Labrador Highlands	Barbara Casati: A wavelet-based spatial verification approach to account for the variation in scale representativeness of observation networks			
Kent Moore: Warming in the High Arctic: Evidence from an instrumental record spanning 125 years	Allan Coldwells: Operational Avalanche Forecast Program of the Pacific Storm Prediction Centre in Vancouver			
Katherine Emma Knowland: The influence of interannual variability of weather parameters on winter roads in the Northwest Territories	Richard Jones: Update on SCRIBE			
Matthew Peros: Holocene climate and vegetation change on Victoria Island, western Canadian Arctic	Gordon McBean: A Systems Dynamic Modelling Approach to Assessing Elements of a Weather Forecasting System			
Ola Persson: Mesoscale Influence on Regional Climates at Arctic Sites	Laurie Neil: Development of SAR-Derived Winds for Forecast Operations at the Pacific Storm Prediction Centre			
Keith Hines: An evaluation of Antarctic near-surface temperature and snowfall in IPCC AR4 GCMs	John Ogletree: NinJo - Environment Canada's New Meteorological Workstation - Operational Possibilities (I)			
William Neff: Reconstr. of an Antarctic Oscillation Index (AAOI) Using Upper Air & NCEP/NCAR Reanalysis Data to Examine Trends & Multi-Decadal Variability over Antarctica, 1957-2007	Nathalie Gauthier: Atlas canadien d'énergie éolienne: validation et développements futurs			
18:00	Conference Finished / La conférence a fini			18:00

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Adams, Amanda I01-1B8.1 I04-4B1.5 C05-3B5.6
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Agboma, Clement H01-2DP.1
Ainslie, Bruce C05-4C5.6
Alavi, Nasim I03-4C7.5
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Avalos, David G06-4C2.6
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Bacak, Asan A07-3B7.4
Bachmayer, Ralf O02-1C1.3
Bagniewski, Witold I10-1B9.1
Bahurel, Pierre O02-1B1.1
Bai, Le-Sheng H06-4B4.3 A02-1B7.8 C05-3DP.1
Baibakov, K. A02-2DP.2
Baird, A.J. H01-1B4.4
Baird, Donald H05-3C4.1 H05-3C4.3 H05-3C4.4 H05-2DP.1
Baird, Mark O03-2C1.8
Baker, Brad A06-1D7.3
Baldwin, Susan O03-2DP.3
Ball, David A04-3C6.1
Ballinger, Andrew A06-2DP.1
Balmaseda, Magdalena O02-1B1.5
Bancroft, John G08-2B2.7
Bancroft, Doug I05-3DP.1
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Barletta, Francesco C02-1C5.4
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Barsugli, Joseph C02-1D5.4
Bart, John L. A01-1B6.3
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Batchelor, Rebecca A07-3B7.2
Bayley, Owain S04-4C3.1
Beall, Fred I14-1D9.2 H01-1D4.1
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Beaulieu, Claudie C04-3DP.10
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Bentley, Laurence R. G09-1B2.1
Berg, Kent H05-2DP.2
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O01-1D1.5 17:00

Recent changes in density stratification on the Newfoundland and Labrador shelf.

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Density stratification in the water column has well documented effects in regulating primary productivity in the coastal waters of Atlantic Canada. Quantifying and understanding the density structure of the ocean has therefore been a continuing initiative as part of the Atlantic Zonal Monitoring Programme (AZMP) in recent years. The physical forcing that determines the intensity, phase and duration of water column stratification in the Northwest Atlantic has experienced significant variability during the past several decades. We outline our methods of estimating the mixed layer depth and stratification of the water column using high resolution hydrographic data obtained from a fixed station (Station 27) and at various locations on the Newfoundland and Labrador Shelf. Trends in these indices are discussed in the context of recent ocean climate change and the potential influence on biological productivity on the Newfoundland and Labrador Shelf.

O01-2DP.1 16:00

Monthly-mean circulation and mixing over the Newfoundland Shelf and Slope

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Three-dimensional finite element models are implemented for the Newfoundland and Labrador Shelf to investigate climatological monthly-mean wind- and density-driven circulation. Monthly-mean wind-driven circulation is computed with wind stresses from the NCEP-NCAR reanalysis data prescribed at the sea surface and large-scale remote forcing specified at the open boundary determined from a North Atlantic model. Density-driven circulation is simulated with prescribed density gradients from a monthly temperature and salinity climatology and with inflows prescribed at the open boundary. The model results are examined against various in situ observations (moored current meter data, satellite drifter data and vessel mounted ADCP data) and discussed together with literature information. The seasonal-mean circulation solutions are discussed in terms of the relative importance of wind to density forcing for the Labrador Currents and the mixing effects and biological implications. The model results indicate significant seasonal and spatial variations. The model results are consistent generally with previous study results and in approximate agreement with observations for the major currents. The region is dominated by the equatorward flowing Labrador Current along the shelf edge and along the Labrador and Newfoundland coasts. The Labrador Current is strong in the fall/winter and weak in the spring/summer. The mean transport of the shelf-edge Labrador Current is 7.5 Sv at Hamilton Bank and 5.5 Sv through the Flemish Pass. The seasonal ranges are 4.5 and 5.0 Sv at the two sections, respectively. Density- and wind-driven components are both important in the inshore Labrador Current; while the density-driven component dominates the shelf-edge Labrador Current.

C01-2C6.7 15:30

Creating Climate Scenarios by Utilizing a Statistical Downscaling Technique for St John's NL.

Lee Titus

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In order to best assess the expected climate change impacts on a species, ecosystem or natural resource in a region, climate variables and climate change scenarios must be developed on a regional or even site-specific scale (Wilby et al, 2002). To provide these values, projections of climate variables must be ‘downscaled’ from the GCM results, utilizing either dynamical or statistical methods (IPCC, 2001).

In this study, three climate variables (maximum temperature, minimum temperature and precipitation) were statistically downscaled (SDSM by Wilby and Dawson), utilizing the output from two general circulation models (CGCM2 and HADCM3) for St John’s Newfoundland. Analyses were performed comparing the different output from the models as well as giving future scenarios for climate in each tri-decade (2010-2039, 2040-2069, 2070-2099). Shifts in the distributions for temperature were examined to identify changes in mean and variability. Extreme climate indices were calculated for each site to represent local weather extremes; in this case, heat wave occurrence and duration (temperature meeting or exceeding 30C) and extreme annual maximum precipitation amounts.

Downscaled results from the site validated well when compared with the observed climate and gave a better result than the raw GCM output, providing confidence in the downscaling approach. In the 2070-2099 period values developed from the CGCM2 showed an increased mean maximum temperature of 3.7 degrees with a decrease in variability. In comparison, the HadCM3 results show a mean maximum temperature increase of 5.1 degrees for the same period and the variability increased. The CGCM2 exhibited no heat wave events while the HADCM3 had more frequent and longer duration events. The 100 year return period maximum rainfall amount increased by 50 percent or more.

I01-1B8.4 **11:15**

Historical Meteorological and Oceanographic Photos

Bob Jones

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In 2005, a project to post historical photographs began on the CMOS web site. Its main focus was to try to tell the story of Canadian meteorology and oceanography by showing people in groups at special occasions. In the oceanographic area, an exception was made to include ships because of their important role in data gathering. To date, over 400 photos have been contributed from both communities.

The meteorological area now has ten sub-categories. The photos include courses, offices, presentations, meetings and significant events. The talk will explain how to find the site, search the database of names, contribute a photo and obtain a posted photo. Many well-known CMOS people will be seen during the presentation. Due to time constraints, only a small selection of the photos will be shown.

O03-3C1.2 **13:45**

Observations of a Spring Bloom at Halifax Station 2

Blair Greenan, Brian Petrie, Glen Harrison, Peter Strain

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Moored observations of physical, chemical, and biological variables are discussed for the period of the spring bloom in 2002 on the Scotian Shelf. This field program is investigating whether short-term physical events are an important factor in the primary productivity of this ecosystem. Results show a phytoplankton bloom starting at the Halifax Line Station 2 (HL2) several days after the moorings were deployed in mid-March and persisting through mid-April. During this period, changes in the physical properties were dominated by longer-term trends such as surface warming through increased insolation. However, chlorophyll measurements indicate that phytoplankton concentration can change substantially over a period of several days. This may be related to processes controlling the spatial variability in the biological fields in the advective region of the Scotian Shelf.

I15-2C9.8 **INVITED/INVITÉ 15:45**

A heat transfer model of crown scorch in forest fires.

Sean T. Michaletz, Edward A. Johnson

(Presented by *Sean Michaletz*)
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Crown scorch is the heat-induced necrosis of branches, buds and/or foliage in the buoyant plume above a low intensity (I ≤ 2500 kW m^-1) surface fire. Crown scorch is a widely used predictor of post-fire tree mortality and has become a common component of tree mortality and forest gap models. Predictions are typically based on Van Wagner s model from 1973, which is statistical, based on foliage data, and inappropriate for a priori predictions. Here we derive and validate a more physically complete model of crown scorch. The model links a line source plume model with a lumped capacitance heat transfer analysis which is applicable to branches, buds, and foliage diameters of about 1 cm or less (i.e. tree crowns). This model is general to any tree species during any season, is independent of experimental fire data, and is appropriate for a priori predictions. The lumped capacitance model is validated using laboratory heating experiments, and the entire crown scorch model is validated using experimental fire data. The model predicts differences between bud and foliage necrosis heights, illustrating the need to include heat transfer processes in crown scorch models.

G06-4C2.1 **INVITED/INVITÉ 13:30**

Mean Sea Surface Topography for the Northeast Pacific Ocean and Its Continental Shelves

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Three-dimensional, ocean salinity and temperature data from several archives are combined with NCEP winds to force an irregular-grid model of seasonal sea surface elevations and flows in the Northeast Pacific Ocean and its continental shelves. Additional components in the flow field, such as the California Undercurrent, are included through the inversion of ocean current measurements off Vancouver Island. The resultant seasonal elevations are validated against TOPEX/POSEIDON observations, and a mean sea surface is computed and compared with the latest geoid estimates provided by Natural Resources Canada. Differences will be discussed and related to the planned development of new Canadian vertical datum to meet both geodetic and oceanographic purposes.

I01-1B8.5 **11:30**

Climatology of Tropical Cyclogenesis in the North Atlantic (1948-2004)

Ron McTaggart-Cowan[1], *Glenn Deane*[2], *Lance Bosart*[2], *Christopher Davis*[3], *Thomas Galarneau*[2], *Colin Jones*[1]

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The threat posed to North America by Atlantic tropical cyclones (TCs) was highlighted by a series of intense landfalling storms that occurred during the record-setting 2005 hurricane season. By contrast, the 2006 season had activity well below average despite predictions of sustained high levels of TC development frequency. Recent field studies and numerical experiments have led to the development of conceptual models describing pathways for tropical vortex initiation; however, our understanding of -- and therefore our ability to predict -- tropical cyclogenesis remains limited. This study addresses the issue of TC spin-up by developing a dynamically-based classification scheme built on a diagnosis of North Atlantic hurricanes between 1948 and 2004.

A pair of metrics are presented that describe TC development from the perspective of external forcings in the local environment. These discriminants are indicative of quasigeostrophic ascent forcing and lower level baroclinicity and are computed for the 36~h leading up to TC initiation. A latent trajectory model is used to classify the evolution of the metrics for 496 storms, and a physical synthesis of the results yields six identifiable categories of tropical cyclogenesis events. The "pure tropical" (tropical development) category accounts for 42% of Atlantic TCs, while events with varying flavors of perturbation from this archetype make up the remaining 58% of storms. A geographical clustering of the groups suggests that the classification scheme is identifying fundamentally different categories of tropical cyclogenesis. Moreover, significant differences between the post-initiation attributes of the classes indicate that the evolution of TCs may be sensitive to the pathway taken during development.

H03-2C4.1 **14:15**

Comparing alpine drainage basin attributes derived from three independent DEM sources

Chris Hopkinson[1], *Masaki Hayashi*[2], *Karen Miller*[2], *Derek Peddle*[3]

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As part of an alpine hydrological study in the Lake O'Hara watershed in the Canadian Rocky Mountains, three independent digital elevation data sets were obtained for the purpose of watershed characterization. The three digital elevation model (DEM) data sources were: 1) Archived public access Terrain Resource Information Mapping (TRIM) contour vectors at 1:20,000 scale; 2) Digital softcopy photogrammetry with a raster DEM pixel size of 5m generated in October 2006; 3) Airborne LiDAR point cloud data with approximate point postings varying from 2m to 4m resolution, collected by the Canadian Consortium for LiDAR Environmental Research (C-CLEAR) in August of 2006. The terrain attributes investigated were: elevation, slope, aspect, and ground surface texture; while the watershed hydrological features investigated were the watershed boundary, the stream network, the pixel-based upstream catchment area and the topographic wetness index.

GIS data layers for each of the terrain and watershed attributes were created for each of the three DEM data sets collected. To facilitate comparison, all datasets were converted to a common raster format with a grid cell resolution of 5m. While all datasets were registered to the NAD83 CSRS datum, there were some slight biases that needed to be corrected before a fair comparison of attributes could be performed. Comparisons were made by taking the layers generated from the softcopy photogrammetry DEM as the reference and then subtracting the LiDAR and TRIM attribute layers. The differences observed can be divided into three categories: 1) raw data scale/resolution; 2) data collection method; 3) DEM interpolation procedures. Specific observations, lessons learned and implications for hydrological modeling will be presented.

I11-4C1.4 **14:15**

Scale biases in glacial melt estimates using a GIS energy balance model and a lidar-derived DEM

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Beam radiation is often the dominant heat input to melting alpine glacier surfaces in temperate regions. For melt model purposes, it is necessary to characterize the geometric relationship between the ice surface and the incident beam. GIS can be used to generate ‘view factor’, ‘slope’ and ‘aspect’ from DEMs but previous studies have shown that these calculations are scale dependent. The influence of DEM scale on simulated glacier melt was quantified by running a GIS energy balance model over a DEM of Peyto Glacier in the Canadian Rockies. DEMs were generated at eight scales ranging from 1 m to 1000 m grid cell resolutions from airborne lidar data collected in August 2002. Modelled melt values over the glacier terminus were validated at 14 ablation stakes during August 2003. It was found that total melt increased logarithmically with scale (r2 = 0.83) by 4% over the range of scales investigated. Melt over the ablation zone only increased linearly with DEM resolution (r2 = 0.98) by 11%.

It was further found that this ‘scale-effect’ could be mitigated by the introduction of a pixel surface area ‘scale-factor’ to account for surface texture and slope variations between scales. This is important because the variation in pixel surface area is often not accounted for in raster GIS-based models. However, although including a surface-area correction-factor reduced the systematic scale-effect in basin-wide melt, there remained incongruence in the ablation and accumulation zone observations. In the ablation zone there was a systematic increase in the melt predicted (~5%) as resolution decreased from 1 m to 1000 m (r2 = 0.89), with the opposite affect in the accumulation zone (r2 = 0.79). This observation results from the ‘averaging’ of terrain attributes across the glacier surface as resolution is reduced. Of practical significance, it is noted that between the 1 m to 100 m pixel resolutions, the scale influences were small and not statistically significant. Unfortunately, micro morphological influences at the sub m level were not assessed in this study but it is believed that scale effects at this resolution would be present due to highly heterogeneous surface slope, area and shadowing effects over actively melting and crevassing surfaces.

H01-1C4.8 **15:15**

On the Relation Between Dynamic Storage and Runoff

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Recent hydrological process research implies that hillslope and small catchment runoff generation can be likened to flow from a series of storage reservoirs. Unit hydrograph theory as derived by Nash, Dooge and Wooding provides a foundation for evaluating the function controlling such runoff. This transfer function, k at the sub-basin scale and K at the basin scale, was derived using nested measurements of surface storage and runoff in a Canadian Prairie catchment during the 2006 spring snowmelt. The research objective is to evaluate the nature of k; how it behaves and what it indicates about hydrological processes, patterns and functions. The change in runoff relative to the change in storage indicates the hydrological function of a sub-basin, and k is indicative of the efficiency of this functioning. The size of the largest store in the watershed will control K when k is constant among sub-basins. Spatial variation in k is the cause of the commonly observed variability in runoff response at the basin scale. Thresholds are an important part of the function governing the transfer of storage to runoff. There is temporal variability in storage thresholds, but the storage threshold of a drainage area will be dictated by the size of the store located at its bottom.

I10-1B9.8 **12:15**

Arctic Ocean topostrophy from current meters

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Progress comparing velocity fields from several Arctic ocean (AOMIP) models is achieved by reducing velocity fields to topostrophy, defined fxV.S where f is Coriolis vector, V is horizontal velocity and S is gradient of total depth. As a scalar, topostrophy is easily mapped, averaged and otherwise analyzed. Strongly positive topostrophy corresponds to "cyclonic rim currents", for example. It was found previously that basin-integrated topostrophy clearly segregated some AOMIP models' behavior from others. What have been missing thus far are direct observations with which to compare. Hence a compilation has been prepared from current meters in the Arctic and worldwide, collecting more than 13,000 records from more than 2200 sites spanning more than 80,000 current meter months. We begin analyzing how topostrophy varies systematically with latitude, with depth and for selected regions.

I13-4B9.7 **12:00**

International Polar Year 2007-2009: the role of the Canadian Ice Service.

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The Canadian Ice Service (CIS) is expected to play a major supporting role during IPY 2007-09, given the increase in scientific research activity that will take place in the Canadian Arctic during this time. The CIS will primarily be involved in:

1) providing logistical assistance to Canadian Coast Guard ice breakers and marine research vessels in the field, as well as to other shore-based scientists; and

2) archiving and disseminating sea ice data and Radarsat1 satellite images for scientific research.

The CIS will also be actively contributing sea ice products to the Polar View international sea ice information web portal from March 2007 to March 2009.

I11-4D1.5 **17:00**

Snowmelt Runoff from Peat Plateaus: Magnitude, Timing and Influence on the Basin Hydrograph

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(Presented by *William Quinton*)
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Field studies were initiated in 1999 at Scotty Creek, Northwest Territories, Canada, in order to improve the understanding and model-representation of the major water flux and storage processes within the wetland-dominated region of discontinuous permafrost. From these studies, there has emerged a conceptual model of runoff generation that recognises distinct hydrological roles among the major peatland types peat plateau, flat bog and channel fen. The hydrological function of the peat plateaus is mainly one of runoff generation, owing to their relatively high topographic position, relatively deep snowpack, and limited capacity to store meltwater due to the presence of permafrost. For 5 consecutive annual freshets (2002 – 2006), snowmelt runoff from an instrumented peat plateau was computed from the water balance and from the Cold Regions Hydrological Model (CRHM). It is demonstrated that the magnitude and timing of basin discharge during the spring freshet is largely controlled by the runoff regime of the peat plateaus, and that the latter was strongly controlled by the soil thaw regime. Field measurements combined with image analysis methods were used to derive a composite hydrograph for the overall cover of peat plateaus at Scotty Creek. Physically-based methods of routing this composite hydrograph to the basin outlet were also discussed.

C05-4C5.2 **13:45**

The impact of lateral boundary data errors on the simulated climate of a nested Regional Climate Model

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Climate-change projections at regional scale can be obtained by using a Regional Climate Model (RCM) nested by the large-scale data from a Coupled General Circulation Model (CGCM). Because these nesting data are not perfect, the RCM simulations can be affected by CGCM simulation errors. In this presentation we present the response of an RCM to errors in nesting data. The study uses a perfect-model framework nick-named the Big-Brother Experiment (BBE). The BBE permits to evaluate the errors due to the nesting process excluding other model errors; scale decomposition permits to analyse the impact of the large-scale nesting data on the small scales simulated by the RCM.

It is found that the errors contained in the large scales of the driving model are transmitted to and reproduced with little changes by the RCM. In general, the RCM restores a great part of the driving-model small-scale errors, even if they do not take part in the nesting process. The RCM small scales are seen to improve slightly in regions with important orographic forcing due to its finer resolution.

However, when the large scales of the driving model have errors, the small scales developed by RCM have errors as well, suggesting that the large scales precondition the small scales. In order to obtain correct small scales, it is necessary to provide the accurate large-scale circulation at the lateral boundary of the RCM.

G03-4B2.6 **11:45**

A study of crustal deformation in the Charlevoix, Quebec seismic zone using GPS.

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The highest concentrated seismic activity in eastern Canada is related to the Charlevoix Seismic Zone (CSZ) where five earthquakes with a magnitude of six or higher occurred in the last 350 years. The most recent one originated from the northern Charlevoix area in 1925. Seismic activity of this magnitude and frequency is usually attributed to crustal deformation caused by the interaction of plate boundaries. This is not the case for the Charlevoix region as it is located on the stable North American Plate. Its tectonic activity is probably related to the intraplate deformation caused by postglacial rebound. Postglacial rebound is the uplift of the Earth's lithosphere after an extended period of glaciation during which the lithosphere was depressed by the weight of the ice. In the Québec-Labrador region, the ice sheet reached a thickness of a few kilometers at its peak around 18000 years ago. The present research concerns the use of high precision GPS measurements to determine the local deformations caused mainly by postglacial rebound in the Charlevoix region. A part of a 1st order geodetic network chosen strategically along the Saint-Lawrence was surveyed by GPS in 1991 and 2005. The coordinate calculations were realized using the BERNESE v5.0 software with a precision of a few millimeters where several IGS stations were used to tie the network to the International Terrestrial Reference Frame (ITRF2000). The coordinate changes of these geodetic points between 1991 and 2005 allowed for the determination of horizontal and vertical velocities leading to information on the crustal deformation of this region. The results obtained agree quite well with previous GPS survey results conducted on Canadian Base Network (CBN) pillars in eastern Canada and also with geophysical postglacial rebound models.

H04-3B4.6 **12:00**

Flood Risk in Oxford, Nova Scotia: Mapping flood inundation in an ungauged meso-scale watershed.

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Between September 21 and 23, 1999, remnants of Hurricane Harvey converged with another active storm and 302 mm of rain fell in a 30-hour period in the area surrounding the town of Oxford, Nova Scotia. The town site is located about 40 km from the New Brunswick border and is situated on the flood-plain at the confluence of River Phillip and Black River. The damage associated with this flood event has led to the need to better understand the interplay between weather, landscape and river stage in this ungauged basin. Using the hydrological model HEC-HMS as input to the hydraulic water level model HEC-RAS we reconstruct the upper-catchment run-off events that preceded the September 1999 flood. For the upper-catchment we classify landuse using multispectral Landsat ETM+ imagery

in conjunction with surficial geology maps and assign hydraulic properties to each subbasin within HEC-HMS. Within the flood-plain, we calculate vegetation heights from the LiDAR derived digital elevation model (DEM) to establish surface roughness parameters. We also use our DEM to provide a platform for flood inundation models as calculated from HEC-RAS. High-resolution DEMs derived from LiDAR are a valuable source of information and aid in the understanding of the subtle behaviour of water within ditches and along roads within a town. For comparisons we also calculate a simple best fit plane for flood inundation over the town centre (~5 km2) defined by measurements of previous flood levels with an RMS error of 37.9 cm (n=14) and compare these values against the more rigorous HEC based flood inundation methodology.

C04-4B5.2 **10:45**

Sea Ice in the Northwest Passage: Past, Present, and Future Variability

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The Northwest Passage (NWP) lies in the middle of the Canadian Arctic Archipelago (CAA) linking the Atlantic and Pacific oceans and may represent the 'holy grail' for the shipping industry under climate induced reductions in summer-time sea ice. The NWP was discovered by Sir Robert M'Clure in the 1850s, but ever-present sea ice has always prevented the practical use of it. However, numerous studies have reported decreases in summertime Arctic sea ice cover over the past several decades and Global Climate Model (GCM) simulations continue to predict future decreases. These decreases - particularly in thick perennial or multi-year ice (MYI) - have led to considerable speculation about a more accessible NWP in the CAA.

We investigate changing MYI conditions within the NWP from 1968-2006. Despite increasing annual air temperatures in the CAA, MYI within the NWP remains relatively unchanged with light ice years interspersed with heavy ice years. No statistically significant decreasing trend in MYI for regions of the NWP was found in fact, some regions exhibit a slight increase. A considerable amount of MYI was lost in 1998 but conditions have since recovered and returned to historic levels. Results of this analysis suggest that the ice regime of the CAA operates such that when MYI is removed it gradually recovers on cycles that operate around 5 years in length. Because of this mechanism the NWP might be one of the last ice regions in the Northern Hemisphere to experience changes significant enough to facilitate a summertime ice-free NWP.

S05-1C3.6 **14:45**

How reliable is Eurasian snow cover as a seasonal climate predictor?

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This paper reexamines the question of whether autumn Eurasian snow cover provides seasonal predictability for Northern Hemisphere winter climate anomalies. Previous observational and modelling studies have shown that predictability from snow cover may arise through excitation of an annular-mode signature in the stratosphere, with subsequent downward propagation from the stratosphere back to the surface on a timescale of several weeks. Robust lower-tropospheric precursors of these stratospheric events are difficult to find because of strong natural variability in the winter polar stratosphere. We demonstrate the reliability of a snow-forcing mechanism for these events using an 80-member ensemble of integrations using the Geophysical Fluid Dynamics Laboratory Atmosphere/Land model AM2/LM2. These idealised experiments place a useful bound on the predictability that can be expected from using Eurasian snow cover as a predictor, and also provide insight into the dynamics of the large-scale circulation response to snow forcing.

I11-4D1.4 **16:45**

Evaluation of the simulation and parameterization algorithms for ground thawing and freezing in permafrost region

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Ground thawing and freezing processes have a strong influence on the hydrology and energy balance, particularly in permafrost regions. Current methods used to simulate ground thawing and freezing processes range from simple thermal unit methods to complex numerical schemes that solve the heat conduction equations with multiple ground layers. The accuracy of the simulation largely depends on the suitability of the simplifying assumptions of the algorithms, the quality and availability of data inputs, and the parameterization of soil thermal parameters. In this study, four algorithms to simulate ground thawing and freezing processes were evaluated against detailed field measurements at two permafrost sites: Scotty Creek, Northwest Territories and Wolf Creek, Yukon Territory. The algorithms include a simple Stefan formulation (SSF), a two directional Stefan algorithm (TDSA), a finite difference heat transfer algorithm with energy-based thaw/freeze calculation (FDEC) and a finite element heat transfer algorithm with apparent heat capacity parameterization for thaw/freeze calculation (FEAC). In addition, the suitability of model freezing and thawing prediction for each algorithm was evaluated against: (1) thermal conductivity parameterization, (2) unfrozen water parameterization, (3) soil layer resolution, and (4) different time steps. Results showed that: (1) With site specific parameterization, the heat transfer equation based methods (FDEC and FEAC) could better simulate the observed overall cycles of thawing and freezing than the two Stefan formulations (SSF and TDSA). (2) The two heat transfer based algorithms, especially FDEC, require smaller time step and finer vertical resolutions than the SSF and TDSA algorithms for realistic simulations. (3) The parameterization methods for both the thermal conductivity and the unfrozen water content had more profound effects on the freezing process than the thawing process. Results from this research will provide guidelines for the implementation of appropriate ground thermal models based on the type and quality of data.

I08-3C7.5 **15:00**

Identification of a near-surface temperature maximum in the southern Canada Basin, Arctic Ocean

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Recent observations from the Canada/Japan/USA joint study of the Canada Basin, Arctic Ocean, reveal a near-surface temperature maximum layer (NSTML) with distinct properties. The NSTML is found at a depth of ~20m and is characterized by a temperature that is at least 0.1ºC warmer than the

surface mixed layer, low transmissivity, salinities < 30, and strong stratification. The NSTML was observed in the summer over the period 2002-06 and was the warmest in 2006. It also appears that the NSTML is warmest when the ice concentration was minimal (and thus melting maximal). The freshwater content of this layer was calculated relative to a base salinity of 31. It was found that the freshwater content was greatest in 2006. We propose three mechanisms that could have created the NSTML – the advection of a warmer ice-free surface layer under an ice-covered surface layer, the modification (increased salinity) and subsequent advection of river runoff into the Canada Basin, and the modification (warming, freshening and offshore transport) of Alaskan Coastal Current Water.

C01-2B6.6 **11:45**

Inferred tropical cyclone statistics from 6 IPCC Coupled Global Climate Models: Evaluating the simulation of the recent past and assessing predicted trends for the future.

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Tropical cyclones (TCs) are a temperature dependent phenomenon, forming only over tropical waters exceeding a threshold of ~26°C. Hence, it is anticipated that an increase in tropical Sea Surface Temperatures, as a consequence of increased concentrations of greenhouse gases, will have an impact on these systems. However, since TC development is also influenced by other climatic factors, their response to increasing levels of greenhouse gases is extremely complex. The exact nature and sign of any future changes in TC activity remains an open question.

Since Global Climate Models (GCMs), due to their coarse resolution, cannot resolve TCs, studies that have looked at the response of TC-like systems in GCMs with increasing levels of greenhouse gases have often produced contradictory results. To circumvent this problem a different approach is pursued here, whereby the temporal evolution of the main large-scale climatic fields controlling TC formation are analysed and used to infer the number of TCs in a given basin. This approach appears more suited to the present resolution of GCMs. The main variable used in our study is the TC Yearly Genesis Parameter (YGP), pioneered by Gray (Gray, 1975). The YGP consists of 6 large-scale parameters, 3 dynamical and 3 thermal, the variability of which have been shown to correlate strongly with annual numbers of TCs at the ocean basin scale. A second, similar large-scale parameter, the Convective-YGP (Royer et. al. 1998) has also been used. In the Convective-YGP the 3 thermal parameters (SST threshold, mid-tropospheric relative humidity and the vertical gradient of moist atmospheric stability) are replaced by a single parameter, the model-simulated convective precipitation. The YGP and Convective-YGP can both be used to infer basin-scale TC activity.

We first analyse the YGP and Convective-YGP for the period 1983-2002 derived from the ERA-40 reanalysis data, to show that they both give a reasonable global number and spatial distribution of implied TCs when compared to observations. We then investigate the 20th century climate of six GCMs whose simulations were submitted to the IPCC for the 4th assessment report. This is done to establish that the GCMs give a reasonable estimate of the present (1983-2002) number and geographic distribution of TCs. We further extend the GCM analysis backwards in time, through the 20th century, to investigate if the models suggest a trend in inferred TC numbers. Finally we assess the trend in inferred TC activity in the six GCMs, using 3 different emission scenarios for each GCM (a total of 18 realisations of future TC activity). This allows a probabilistic estimate to be developed for potential future TC activity as given by the YGP and Convective-YGP and to determine if statistically significant changes are predicted by the GCMs.

G05-3B2.6 **12:00**

Crustal structure of the Newfoundland rifted continental margin from constrained 3-D gravity inversion

J. Kim Welford, Jeremy Hall

(Presented by *J.Kim Welford*)
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The rifting history of the Atlantic continental margin of Newfoundland is very complex and so far has been investigated at the crustal scale primarily with the use of 2-D seismic surveys. While informative, the results generated from these surveys cannot easily be interpreted in a regional sense due to their sparse sampling of the margin. A 3-D gravity inversion of the free air data over the Newfoundland margin allows us to generate a 3-D density anomaly model that can be compared with the seismic results and used to gain insight into regions lacking seismic coverage. Results of the gravity inversion show good correspondence with Moho depths from seismic results. A shallowing of the Moho to 11 km depth is resolved on the shelf at the northern edge of the Grand Banks, in a region poorly sampled by other methods. In regions of good seismic coverage, discrepancies between the seismically constrained Moho and the inverted Moho are found to correlate with regions of inferred serpentinized mantle. Comparisons between sediment thickness and crustal thickness show deviations from local isostatic compensation in locations which correlate with faults and rifting trends. Such insights must act as constraints for future paleoreconstructions of North Atlantic rifting.

I01-2B8.8 **12:15**

The influence of mesoscale eddies and boundary currents on surface freshwater forcings used to drive MOC variations.

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Numerous coupled atmosphere-ocean climate modelling studies have shown the existence of multiple equilibria of the ocean's Meridional Overturning Circulation (MOC). Transitions between different rates of water mass formation have been invoked to explain the large-scale climate events (e.g. the 8.2 kYr event) found in paleo records and are often discussed as a possible consequence of global warming. In previous studies, variations in rates of deep water formation have been modelled by applying freshwater perturbations to the North Atlantic and Southern oceans. Computational constraints have limited the models used in these studies to horizontal grid spacings greater than 100 x100 km, requiring mesoscale ocean mixing to be crudely parameterized and the width of boundary currents greatly exaggerated. This research project investigates the influence of mesoscale eddies and boundary currents on the surface freshwater forcings used to drive variations in the behaviour of the THC. The hypothesis being that a greater magnitude of freshwater forcing will be required to substantially disturb the MOC when they are better resolved; eddies and boundary currents will significantly redistribute the freshwater and weaken it's impact on deep water formation. Results from systematically increasing the resolution of the global, coupled Earth System Climate Model (ESCM) by a factor of 10 and applying freshwater forcings similar to the 8.2 kYr event will be presented.

H04-3B4.4 **11:30**

Historical and Projected Trends in Land Surface Evapotranspiration over Canada

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There is increasing evidence of an intensification of the hydrological cycle in Northern latitudes. Studies over Russia and the continental U.S. have identified an increasing land surface evapotranspiration (ET) during the latter 20th century and project increases in ET over the 21st century. We quantify historical and projected trends in ET over Canada using an advanced land surface model driven with gridded historical observations and downscaled IPCC AR4 GCM forecasts. The process to produce the historical climate and land surface parameters is described. Validation of model results against gauged basins is discussed. ET projections are generated by driving the model with for three IPCC scenarios (A1,A2 and B1) over a range of IPCC models using monthly climate fields to include the impact of seasonal variability on soil and vegetation controls on ET. Historical trends suggest annual ET increasing on the order of 0.5%/year between 1960 and 2000 in all areas of Canada except the high Arctic and Prairies, with over half of the trends significantly different from zero. Annual ET over the Prairies is limited by water availability and therefore does not respond to warming to the same extent as other regions of Southern Canada. Additionally, ET is projected to remain constant or increase during the 21st century with the exception of the water limited Prairie region. Needs for further research, especially for parameterizing land surface response to changing climate conditions, is discussed.

I10-1C9.2 **13:45**

Global atmospheric forcing data for Arctic ice-ocean modeling

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We compare three forcing data sets, all variants of NCEP forcing, in global ice-ocean simulations and evaluate them for use in Arctic model studies. The data sets include the standard Arctic Ocean Model Intercomparison Project (AOMIP) protocol, standard NCEP forcing fields, and the data set of Large and Yeager (2004). We explore their performance in Arctic simulations using a global, coupled, sea ice-ocean model, and find that while these forcing datasets have many similarities, the resulting simulations present significant differences, most notably in ice thickness and ocean circulation. This underscores the sensitivity of Arctic sea ice and ocean to slight changes in environmental forcing parameters. This study also highlights the difficulties faced by the model intercomparison community attempting to disentangle simulation differences due to model physics from those caused by small differences in forcing parameters. Assessing the simulation uncertainty due to inaccuracies in the forcing data provides context for the simulation uncertainty associated with model physics.

S05-1C3.1 **13:30**

Production and Evaluation of Snow Cover Essential Climate Variable for Canada

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The Global Climate Observing System has specified the requirement of daily snow cover maps at 1km resolution or better as an essential climate variable. A method for producing this required dataset using polar orbting passive optical sensors, extending back to 1985 and forwards in near real time, is

discussed. The approach relies on daily NOAA-AVHRR observations, calibrated against in-situ measurements, to estimate snow cover between 1985 and 2000. A novel time series smoothing algorithm is implemented to fill in data gaps. Snow cover is mapped on an ongoing basis from 2000 onwards using a combination of the AVHRR based algorithm and existing global products from NASA and NOAA.

Agreement between mapped snow cover and in-situ snow course data is summarized on a land cover basis for major ecozones across Canada. Our evaluation suggests that the current product meets GCOS standards except in mountainous regions where topographic effects on the satellite signal as well as difficulty in matching mapped snow cover to in-situ measurements are problematic. We then discuss ongoing work for the production of snow cover maps for the northern Western Hemisphere and for the dissemination of these products to the scientific community and the public.

H01-1C4.3 **14:00**

Detection of Trends in Timing of Low Flows in Canadian Stream Flows(RHBN)

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Abstract A study of trends and variability of low flow characteristics was conducted for the Reference Hydrometric Basin Network (RHBN established in order to assess the effects of possible climate change on Canada's water resources). Low-flow index of 7-day from 220 hydrometric stations was extracted and examined to detect trends in timing of 7-day low-flows in both summer and winter portions of the year. Also, 17 stations with the significant number of zero 7-day low flows were examined to detect trends in the number of zero events. Man-Kendall (MK) nonparametric trend test was applied to the time series to investigate the existence of any trend at a 90% confidence level. In order to account for serial correlation, the variance of the S statistic was modified if its absolute value exceeded a certain confidence interval. It was observed that in 17% of the studied sites, timing of summer 7-day low flows showed significant trends where in 66% of these sites it shifted to arrive earlier but later for the rest of the sites. No clear pattern was observed in the distribution of upward or downward trends. Significant trends were observed in 19% of stations for winter 7-day low-flow. In 72% of detected trends, the winter 7-day low-flow shifted to arrive earlier. Regardless of the direction, the trendy sites were concentrated in Pacific and Atlantic coasts while there was no evidence of trends in Central Canada (Prairies, Northern Canada, Ontario, and Eastern Quebec). At a 90% confidence level, 65% of the stations studied for trend in the number of zero events showed significant upward or downward trends; however, after modifications to account for autocorrelation, only 12% of the studied stations showed significant trends. The stations with dominant zero 7-day low flows were exclusively observed in Prairies and Northern Canada.

S05-1C3.3 **14:00**

Poleward amplification of Northern Hemisphere weekly snowcover extent trends

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Significant negative trends in Northern Hemisphere weekly snowcover extent (SCE) are observed between 1972 and 2006. Monotonic trend analyses inferred from the Mann-Kendall test reveal strong declines in SCE during spring and summer over North America and Eurasia over the 35-year period, with lesser declines during winter and some increases in fall SCE. The weekly mean trend attains -1.32, -0.80, and -0.49 million square kilometres/(35 years) over the Northern Hemisphere, North America, and Eurasia, respectively. Trends in the standardized SCE time series reveal coherent responses over Eurasia and North America (r = 0.83, p

S05-1D3.4 **16:45**

Factors governing glacial inception in the UVic earth system climate model

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Attempts to understand climate change and variability on long timescales requires understanding physical and chemical interactions between the ocean, atmosphere, cryosphere and land surface. The success of earth system models therefore relies on their representation of each individual subcomponent (e.g., ocean, atmosphere, sea ice, land surface, land ice etc), as well as the interaction between the subcomponents of the climate system.

Attempting to simulate glacial inception at 116 kyr represents a difficult challenge for earth system models as it involves the interaction of all subcomponents of the climate system. The failure of many models to simulate glaciation may be attributed to either technical problems associated with coupling incompatible subcomponent models, or the inability to resolve or parameterize certain physical processes. Glaciation is particularly sensitive to land and atmospheric snow processes and their interaction. It is highly important to model them as close to realistic as possible.

Intermediate complexity models are suitable tools for examining the issue of glacial inception as they can be integrated for thousands of years, thereby lending themselves to extensive sensitivity analyses. Computational efficiency comes at the price that atmospheric dynamics is often poorly represented. In this presentation, problems related to glacial inception modeling and recent improvements introduced into the UVic earth system climate model will be discussed.

H06-2DP.4 **16:00**

The vulnerability of streamflow to changes in glacier runoff under future climate change in the Saskatchewan River Basin

Laura Comeau[1], *Alain Pietroniro*[2], *Mike Demuth*[3], *Pablo Dornes*[4]

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Glaciers in western Canada have generally been decreasing in extent over the last century, and with climate models projecting higher temperatures with associated higher melt rates, this has led to concerns over the future water availability in rivers fed by glacial runoff. Much analysis has been done on past snowmelt and glacier fed streamflow trends in relation to climate fluctuations with hydrological models used typically on large continental and small single basin scales. Only a few studies have used hydrological models to project future glacial and snowmelt fed streamflows and there is a need to develop and test hydrological models for studies on a number of watersheds on a regional scale, and to examine the effects of glacial contribution as a separate component to snowmelt runoff. An ongoing study of the glacier-fed North and South Saskatchewan River basins by Pietroniro et al (in press) uses the regional hydrological model WATFLOOD to project streamflow under future climate change. It has been found that glacial contribution to streamflow is related to glacier area which has been decreasing over the last couple of decades, and that mean annual streamflow is estimated to decrease when GCM projected future climate data is applied. However the study uses 1998 glacier extents when assessing future streamflow trends and the accuracy of WATFLOOD in modeling glacier runoff needs to be assessed. A study by Dornes et al (in press) has compared measured streamflow data from gauges in glacierised and non-glacierised basins in this region to assess the glacier runoff contribution as a separate component to snowmelt. The first purpose of this study is to compare this observed data with the modeled glacier runoff data to assess the accuracy of WATFLOOD. The second purpose is to apply a glacier surface evolution model to WATFLOOD which will then be run with GCM climate data for the year 2050. The outputs will be examined to assess the effect of decreasing glacier extents on streamflow under future climate change in the North and South Saskatchewan Rivers.

O01-2B1.7 **12:15**

State-of-the-Ocean - North Atlantic, Early 21st Century

Eugene Colbourne[1], *Ken Drinkwater*[2], *Harald Loeng*[2], *Svein Sundby*[2]

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The ocean climate in the North Atlantic has undergone dramatic changes throughout the 20th and early 21st centuries. A significant warming event was observed in northwestern areas during the 1920s that continued to the late-1960s. This was followed by a 30-year period of extreme, near-decadal, variability with ocean water mass properties trending towards cold-fresh conditions. An examination of meteorological and oceanographic data from standard stations and sections reveals a remarkable out-of-phase thermal relationship between eastern and western areas of the North Atlantic during this period. When cold conditions dominated the Northwest Atlantic, temperatures in the Nordic and Barents Seas were generally warmer-than-normal and conversely when conditions were warm. However, since the mid-1990s the relationship between the two regions has shifted to a pan-Atlantic ocean warming response with record setting atmospheric and oceanic temperatures during recent years. This study indicates that the out-of-phase thermal relationship between the two areas historically, and its recent departure is caused in part by processes operating in both regions that are connected by links to the large-scale atmospheric forcing. In this presentation, we examine the extent and magnitude of climate changes in the North Atlantic based on historical and recent observations.

A02-1B7.3 **11:00**

Evaluation of GEM LAM forecasts over Alberta in the summer of 2006

Garry Toth

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In the summer of 2006, model fields from the GEM LAM NWP model were made available over a western Canadian window as well as an eastern Canadian window. The western window included most of BC, Alberta and western Saskatchewan. In addition to the usual model output, some special

fields, such as a pseudo-radar reflectivity, were available. In Edmonton, members of the Hydrometeorology and Arctic Lab (HAL) and the Prairie and Arctic Storm Prediction Centre (PASPC) worked together to evaluate the LAM output, mostly for situations related to summer convection over Alberta. For example, the time of model initiation of convection in the Alberta foothills was verified. Radar observations of convection were the principal tool used in verifying the LAM forecasts. Model near-surface temperatures and dewpoints were also examined in some cases. Some comparisons were made with the forecasts provided by the operational GEM regional NWP model. In this talk, a few cases from Edmonton's summer 2006 evaluation will be presented, and some tentative conclusions drawn.

C01-2C6.2 **14:15**

Detection of human influence on trends of atmospheric storminess and northern oceans wave heights

Xiaolan Wang[1], *Val Swail*[1], *Xuebin Zhang*[1], *Francis Zwiers*[1], *Yang Feng*[1], *Myles Allen*[2]

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According to the HadSLP2 for the period of 1955-2004 and the ERA40 reanalysis for 1958-2001, the atmospheric storminess (as inferred from geostrophic wind energy) and ocean wave heights have increased in the high-latitudes of northern hemisphere (especially the northeast North Atlantic in winter), with decreases to the south. These trend patterns were found to contain a detectable response to increases in greenhouse gases and sulphate aerosols, with the response being estimated from nine coupled climate models simulations of human-induced climate change in the atmosphere and statistical simulations of the corresponding changes in ocean wave heights (both seasonal means and extremes). However, the climate models were found to significantly underestimate the magnitude of the response in general, while these models also underestimate the internal variability in some cases.

I14-1D9.3 **16:30**

Partitioning decomposition in Canadian forest floors into dissolved organic carbon and carbon dioxide – Relevance of vegetation type and degree of decomposition

Julie M.L. Turgeon, Tim R. Moore

(Presented by *Julie Turgeon*)
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We examined the production of dissolved organic carbon (DOC) and carbon dioxide (CO2) during the laboratory decomposition of litters representing Canadian forest types at varying degrees of decomposition from ten study sites across Canada (Douglas fir, Black spruce, Jack pine, Aspen, Boreal mixed wood, White pine, Black spruce / jack pine, Balsam fir, Sugar maple and Sugar maple / american beech), where organic matter samples were collected. The C content varied from 22 to 75% (mean 49%) and C:N ratios varied between 17 and 86 (mean 40). Production values for the 30-day incubation varied between 1.1 to 61.7 mg DOC/gC and 1.6 to 88.2 mg CO2-C/gC. Of the 42 samples, 19% produced more DOC than CO2-C (CO2-C:DOC < 1), 33% produced approximately the same amount of DOC and CO2 (ratio 1.0 to 1.5), 10% between 1.5 and 2, 14% between 2 and 2.5 and only 24% produced more than 2.5 times more CO2-C than DOC. We partitioned these results into litter type: most of the coniferous litter was in the 1 to 1.5 CO2-C:DOC category, while deciduous litter was distributed almost evenly between categories. When we divided the litter samples between degree of

decomposition (living, fresh, partly decomposed and decomposed), we unable to discern any relationship between degree of decomposition and CO2-C:DOC values but patterns were observed for DOC and CO2 production. The C:N ratio was not significantly related to the amount of DOC and CO2 produced or the CO2-C:DOC ratio. While coniferous and deciduous samples did not show significant differences (P=0.000), the other types of vegetation (sphagnum, feather moss, dicranum, lichen and roots) showed significantly higher production of both DOC and CO2. The production of DOC and CO2 showed similar results between the F and H horizons, but were significantly different from the fresher material (P=0.000).

H05-3C4.6 **14:45**

The 'Natural Flow Paradigm' and Atlantic salmon: Moving from concept to practice

David Scruton, *Eva Enders*, *Keith Clarke*

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The 'Natural Flow Paradigm' is becoming an important first principle in the setting of managed flow regimes throughout the world, including Canada. This principle simply states that managed flow regimes should consider including elements of natural hydrological variability, both seasonally and inter-annually, in prescribed flow regimes in order to maintain the ecological integrity of the river system. This principle, while laudable, is in direct conflict with development interests and both developers and regulatory agencies are struggling to identify what elements of hydrological variability are critical to maintain ecological health of rivers. In this paper these issues are explored in the context of wild anadromous Atlantic salmon populations. A conceptual model is developed to link the life history patterns of salmon to natural hydrological variability in an example that incorporates both migratory and spawning/rearing flow requirements. In this example, the river mainstem is considered to provide life history requirements that are primarily linked to migration (upstream to habitat s in the tributaries for spawning and rearing, downstream to the ocean), while the smaller tributaries are considered where most of the freshwater production (spawning, rearing of juveniles, over-wintering) is occurring. A hypothetical managed flow regime is then developed to provide the necessary flow variation to support Atlantic salmon life history requirements, while permitting flow regulation and modification.

H02-2B4.5 **11:45**

Interannual variability in lake and wetland runoff on the Boreal Plain: an isotopic perspective of regional water budget dynamics

John Gibson[1], *Jean Birks*[2], *Kevin Tattrie*[3]

[1] Environment Canada
[2] Alberta Research Council
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A stable isotope mass balance technique for estimating water yield is applied to a 5-year isotopic time-series from fifty lakes in hydrologically complex, wetland-rich terrain of northeastern Alberta. The dataset, gathered as part of CEMA-sponsored research in the oil sands region, is designed to improve baseline understanding of hydrologic response at undisturbed sites in the area, as well as to constrain water yield estimates to lakes as part of a dynamic critical loadings assessment. The approach uses readily obtainable physical and climatological data combined with analysis of evaporative isotopic enrichment of deuterium and oxygen-18 in lake water as a quantitative tracer of throughflow, lake

residency and runoff. The results illustrate practical limitations of working in ungauged basins, but also provide an indication of added value to be gained by incorporating such site-specific measurements within water quality networks. Implications for the role of lakes and wetlands in the regional runoff are discussed.

C04-4B5.6 **11:45**

MSU-Derived Tropospheric Temperature Trend over the Polar Oceans

Cheng-Zhi Zou, *Mei Gao*

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The Arctic surface has been found to be warming almost twice as fast as the rest of the world. The confidence on the earth's surface temperature trend is mainly relied on the dense surface observational network. However, the atmospheric temperature trend derived from conventional observations is questionable because these observations are sparse, especially over the Southern Ocean. The Microwave Sounding Unit (MSU) on board the National Oceanic and Atmospheric Administration (NOAA) polar-orbiting satellites have been realized to offer a unique opportunity for monitoring climate change of the atmosphere. However, the tropospheric temperature trends derived from these measurements are under significant debate, mostly caused by calibration errors.

NOAA/NESDIS/ORA has recently released a simultaneous nadir overpass (SNO) dataset between the NOAA satellites. These SNO matchup datasets are generally found over the Polar Regions near 80 degrees of latitude. They contain observations of the nadir pixels between any two MSU satellites to within 100 seconds and a ground distance of 110 km. The simultaneous nature of this dataset allows inter-calibration of the MSU instruments at the root observational level for climate trend detection with a high accuracy, especially over the polar region. In this presentation, we discuss the characteristics of the SNO datasets and present a method of using these datasets for MSU inter-calibration. We will present the MSU-observed tropospheric temperature trends over both the Arctic and Antarctic regions based on the SNO inter-calibration. The results suggest that the Arctic troposphere is warming at 0.4-0.6 K per decade in the period from 1987 to 2004. Over the Southern Ocean, the zonally averaged trend is found to be 0.05 K per decade during the same period.

H01-1D4.5 **17:00**

Measuring and modelling lake evaporation

Raoul Granger, *Newell Hedstrom*

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Evaporation from open water bodies is an important component of the energy and water balances for many watersheds. This is particularly true in regions such as the Western Canadian Boreal and Shield where open water represents a significant portion of the surface area. Since hydrologic, atmospheric and climate models operate on time steps of the order of one hour, a reliable approach to the calculation of lake evaporation at this time scale is necessary. The paper presents the initial results of a field study of open water evaporation carried out on Crean Lake, in Prince Albert National Park. Lake evaporation was measured directly using eddy covariance equipment; and the boundary layer characteristics over the water were measured. Observations were made as well over the upwind land surface. The relationship (and lack thereof) between open water evaporation and land surface evapotranspiration is demonstrated. Whereas land surface evapotranspiration is known to respond closely to the net radiation supply, the results show that lake evaporation is not driven by the energy supply, but responds rather to the effectiveness of the turbulent transfer mechanism (the humidity gradient and the wind field). Correct modeling of open water evaporation requires knowledge of the dynamics of the water surface temperature and of the overlying advective boundary layer. The analytical solution of advection over water presented by Weisman and Brutsaert (1973) is tested; the results show that the method works well only for the case of an unstable profile over the water (the condition for which it was developed). For the stable conditions over water, a new flux-gradient parameterization is suggested for the re-analysis of the boundary layer.

H01-2DP.5 **16:00**

A Boundary layer integration experiment for lake evaporation

<u>Raoul Granger</u>, Newell Hedstrom

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Modelling lake evaporation for short time steps requires an understanding of the advection of heat and moisture; this in turn relies on knowledge of the developing boundary layer over a wet surface. As part of an open water evaporation study carried out at Crean Lake in Prince Albert National Park, two instrumented tethered balloons were deployed simultaneously, upwind and downwind of the lake. A series of lightweight, self-logging sensors attached to the balloon lines provided measurements of temperature, humidity and wind speed to a height of approximately 100m. The profile measurements obtained from the balloons, along with those from fixed instrument towers, allowed for an examination of the developing boundary layer over the lake. During the experiment, the developing boundary layer was slightly unstable. For the 5 km fetch involved, the height of the internal boundary layer was approximately 45m; this corresponds well with values reported in the literature. The effect of the evaporating lake surface on the atmospheric humidity profile is clearly demonstrated. A boundary layer integration technique, comparing the upwind and downwind horizontal transport of moisture, is applied to calculate the effective average open water evaporation; the results are compared with the lake evaporation rates measured directly using the eddy flux equipment at the fixed tower.

A02-1C7.3 **14:00**

Convective Diagnostics for the CGCM3 model

<u>Ian Folkins</u>, Toni Mitovski

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Shortcomings in convective parametrizations are probably the dominant sources of error in climate and weather forecast models. We introduce two new observationally based convective diagnostics to help test the treatment of convection in the third generation Coupled Global Climate Model. We calculate dynamical divergence profiles from rawinsonde arrays in the tropics and compare them with model output. This is a useful test of the treatment of convective mass transport in a model. We also use TRMM rainfall data and radiosonde temperature profiles to determine the mesoscale temperature response to tropical deep convection. This is compared with the mesoscale response in the CGM3 model.

S03-3B3.2 **10:45**

Development of a Daily, Land-Based Pan-Arctic Snowfall Reconstruction for 1940-1999

Jessica Cherry[1], *Bruno Tremblay*[2], *Marc Stieglitz*[3], *Stephen Dery*[4], *Gavin Gong*[5]

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A new product, the Pan-Arctic Snowfall Reconstruction (PASR) is developed to address the problem of cold season precipitation gauge biases for the 1940-1999 period. The method used to create the PASR is different from methods used in other large-scale precipitation data products and has not previously been employed for estimating pan- arctic snowfall. The NASA Interannual-to-Seasonal Prediction Project Catchment Land Surface Model is used to reconstruct solid precipitation from observed snow depth and surface air temperatures. The method is tested at four stations in the United States and Canada where results are examined in depth. Reconstructed snowfall at Dease Lake, British Columbia and Barrow, Alaska is higher than gauge observations. Reconstructed snowfall at Regina, Saskatchewan and Minot, North Dakota is lower than gauge observations, probably because snow is transported by wind out of the Prairie region and enters the hydrometeorological cycle elsewhere. These results are similar to gauge biases estimated by a water budget approach. Reconstructed snowfall is consistently higher than snowfall from ECMWF Reanalysis-40 but does not have a consistent relationship with snowfall derived from the WMO Solid Precipitation Intercomparison Project correction algorithms. Advantages of the PASR approach include (1) the assimilation of snow depth observations captures blowing snow where it is deposited and (2) the modeling approach takes into account physical snowpack evolution. These advantages suggest the PASR product could be a valuable alternative to statistical gauge corrections and that arctic ground-based solid precipitation observing networks might emphasize snow depth measurements over gauges.

A01-1B6.5 **11:30**

Climate hange, migratory species and pandemic flu

Kirsty Duncan

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Environment and health dominate international journals, newspapers, and global search engines with climate change and avian flu usurping world headlines. A google search for ‘climate change’ gives 111,000,000 hits, a hunt for ‘climate change and human health’ provides 16,900,000 results, and ‘pandemic flu’ yields 5,470,000 returns. According to the TAR, global mean temperature is projected to increase 1.4-5.8o C over the coming century, a rise greater than any increase experienced by humans during the past 10,000 years. Climate change is a growing concern to the World Health Organization (WHO) because of its potentially serious health consequences, including an increase in illness and death related to extreme temperature events, weather events, and infectious disease. A more pressing issue for the WHO is pandemic flu, which leading influenza experts fear is inevitable, if not imminent; for example, evidence suggests that influenza A H5N1 is now endemic in parts of Asia, is affecting new mammalian hosts, is expanding its geographic range, and is increasingly pathogenic. Between February 2006 and April 2006, 32 countries, located in Africa, Asia, Europe, and the Middle East, reported their first cases in birds. This spread marks the fastest and most extensive geographical spread of any highly pathogenic influenza virus since the disease was first described in 1878. The virus has now affected some of the world’s most densely populated and impoverished regions—areas poorly served by health care and surveillance systems. Future climate change is likely to impact

migratory bird species, their breeding and non-breeding areas, migration routes, and stopover sites. This paper will therefore explore the environmental controls for key migratory species, and how climate change may influence their survival and distribution, and possibly affect the spread of highly pathogenic influenza.

I01-1B8.6 **11:45**

Synoptic-scale typing and precursors of significant cool-season precipitation events in Atlantic Canada, 1979-2005

Shawn Milrad, *Eyad Atallah*, *John Gyakum*

Department of Atmospheric and Oceanic Sciences, McGill University
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The issue of Quantitative Precipitation Forecasting (QPF) continues to be a significant challenge in operational forecasting, particularly in regions susceptible to extreme precipitation events. Accordingly, the four provinces of Atlantic Canada (New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland) are affected annually by frequent and occasionally extreme precipitation events, particularly in the cool season (October-April). These events include flooding rainstorms, paralyzing snowstorms, and damaging windstorms.

Statistical precipitation climatologies of four Atlantic Canada stations (Fredericton, NB; Charlottetown, PEI; Halifax, NS; St. John's, NF) will be presented for 1979-2005, based on unique precipitation events occurring over, at most, a 48-hour time period. Subsequently, four classes of precipitation events (light, moderate, heavy, extreme) are developed and synoptically analyzed for the purpose of discovering dynamically relevant synoptic regimes and precursors within each precipitation category at each station. Preliminary results indicate that extreme precipitation events at all four stations are associated with extensive warm air advection (WAA), mostly caused by cool-season intense maritime cyclones; a surprisingly significant minority of these events are associated with continental cyclones that originate west and northwest of the analyzed stations. There are also not insignificant differences in the types of events among the four stations, which will also be explored.

Composite plots will be displayed, with fields including Sea Level Pressure (SLP), 500 hPa heights, 1000-500 hPa thickness, and heights and winds on the Dynamic Tropopause (DT). Analyses will be completed using the National Centers for Environmental Prediction (NCEP) North American Regional Reanalysis (NARR) and the NCEP Global Reanalysis.

A07-2C7.5 **15:30**

The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut

James Drummond[1], *Pierre Fogal*[2], *CANDAC Science Team*[1]

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The PEARL laboratory at Eureka Nunavut (80N, 86W) is designed to measure the atmosphere in the altitude range of 0-100km at a single location. The Arctic atmosphere is widely regarded as a system that is undergoing significant changes and these will have impact over a wider area and to lower latitudes.

PEARL is a laboratory operated by the Canadian Network for the Detection of Atmospheric Change

(CANDAC) whose research is carried out under four major themes: Arctic Troposphere Transport and Air Quality; The Arctic Radiative Environment: Impacts of Clouds, Aerosols and Diamond Dust; Middle Atmospheric Chemistry in the Arctic and; Waves and Coupling Processes. The laboratory also carries out satellite validation programs.

The laboratory also participates in international programs such as International Polar Year (IPY) and has an ongoing relationship with the Study of Environmental Arctic Change (SEARCH) program in the US.

The laboratory is equipped with a number of lidars, radars, spectrometers, radiometers and other optical equipment. It is permanently staffed. Data are collected from the instruments, which are mainly operated remotely, and moved south through a combination of a high speed internet link and hand carried disks.

For IPY PEARL intends to carry out a number of enhancements. The duty cycle of the current equipment will be increased and observations will be intensified. In addition a number of specific campaigns will be carried out in association with other groups including several from Environment Canada.

PEARL is supported by many organisations including: the Canadian Foundation for Climate and Atmospheric Science (CFCAS); the Canadian Foundation for Innovation (CFI) the Ontario Innovation Trust (OIT); the Nova Scotia Research and Innovation Trust (NSRIT); the Canadian Space Agency (CSA); Environment Canada (EC); and the Natural Sciences and Engineering Research Council (NSERC).

I05-3DP.1 **INVITED/INVITÉ 16:00**

Initiating an Operational Canadian Global Assimilation and Prediction Capability for the Coupled Atmosphere-Ocean-Ice System

Hal Ritchie[1], *Doug Bancroft*[2], *Greg Flato*[3], *John Loder*[4], *Normand Scantland*[5], *Keith Thompson*[6], *Dan Wright*[4]

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[2] Marine and Ice Services Division, EC, Ottawa ON
[3] Canadian Centre for Climate Modelling and Analysis, EC, Victoria BC
[4] Bedford Institute of Oceanography, DFO, Dartmouth NS
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Environment Canada (EC), the Department of Fisheries and Oceans (DFO), and the Department of National Defence (DND) all need the products and modelling capabilities that can be provided by an operational global coupled atmosphere-ocean-ice data assimilation and prediction system. Argo floats, together with other data sets (e.g., altimeter, remotely sensed sea surface temperature, and tropical moored arrays) provide tremendous potential for the development of ocean data assimilation systems. An inter-departmental advisory panel (comprised of the authors listed above) developed recommendations for an operational Canadian coupled atmosphere-ocean-ice data assimilation and modelling capability. These recommendations have been accepted by senior departmental managers, resulting in the development of a new inter-agency initiative referred to as the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS). In the past year agreement-in-principle has been reached with the Mercator group (France) to install a version of their ocean data assimilation and prediction system at the Canadian Meteorological Centre, and collaborate in a number of core research projects directed towards improved capabilities for atmosphere-ocean-ice

prediction at various scales. Initial resources have been put in place for the establishment of three major inter-related activities: 1) an operational activity based on coupling the Canadian atmospheric GEM model with the Mercator system; 2) a research and development (R&D) activity consisting of government and academic research networks to develop and maintain a system tailored to Canadian needs in the longer term; and 3) a products activity to identify, develop and disseminate relevant products and outputs. The operational activity is being built upon existing EC infrastructure. The R&D activity will be enhanced through a new research network funded by the Canadian Foundation for Climate and Atmospheric Sciences. This talk will provide an overview of CONCEPTS and its applications, and will summarize results to date and plans for the future.

I02-4B8.1 **10:30**

Ocean-Sea Ice-Atmosphere processes during the Canadian Arctic Shelf Exchange Study (CASES).

David Barber, *Jennifer Lukovich*, *Jens Ehn*, *Tim Papakyriakou*, *Ryan Galley*, *John Iacozza*

Centre for Earth Observation Science, University of Manitoba
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Recent observed changes in the Western Canadian Arctic stimulated the formation and eventual funding of a multidisciplinary research network known as the Canadian Arctic Shelf Exchange Study (CASES). CASES is an international effort under Canadian leadership to understand the biogeochemical and ecological consequences of sea ice variability and change in the Southern Beaufort Sea. It was funded (2002-2007) by the Natural Sciences and Engineering Research Council (NSERC), three collaborating federal departments, and nine collaborating countries. A central aim of the CASES field program was to study the fall and winter pre-conditioning of the Mackenzie Shelf/Cape Bathurst Polynya ecosystem by the minimum fall and winter discharge of the Mackenzie River, and its spring and summer development in response to the intense freshet and the variable ice break-up.

In this paper we provide an overview of the CASES research results pertaining to the role of sea ice in controlling physical and biogeochemical processes operating across the ocean-sea ice-atmosphere interface. We summarize research findings at the hemispheric scale which describe the annual cycle of sea ice in this region and show how the Beaufort Gyre controls the operation of the polynya along with recent evidence of changes in the seasonal circulation of the gyre. We also present evidence for the role of the decreasing summer minimum of sea ice and how this controls sea ice dynamic processes and the associated control this has on snow catchment hydrology within the CASES region. We complete the review with an assessment of the role these physical processes have on associated biological coupling in the CASES study region.

I13-4B9.5 **11:30**

The International Polar Year: Circumpolar Flaw Lead (CFL) System Study

David Barber[1], *Gary Stern*[2], *Jody Deming*[3]

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The circumpolar flaw lead (CFL) system is formed when the central pack (which is mobile) moves away from coastal fast ice, opening a flaw lead that occurs throughout the winter season. The flaw

lead is circumpolar, with recurrent and interconnected polynyas forming in the Norwegian, Icelandic, North American and Siberian sectors of the circumpolar arctic. Due to a reduced ice cover these regions are exceedingly sensitive to physical forcing from both the atmosphere and ocean, and provide a unique laboratory from which we can gain insights into the changing polar marine ecosystem. This IPY project is a Canadian led international effort to study, for the first time ever, the circumpolar flaw lead system throughout an annual cycle. The project will over-winter the Canadian Research Icebreaker (NGCC Amundsen) in the flaw lead off Banks Island, NT, where it will stay mobile over the period November 1, 2007 to August 31, 2008. This $40M project brings together over 200 scientists from 14 different countries to participate with Canadian scientists leading 10 highly integrated research teams.

In this presentation we provide a scientific framework for the CFL project relative to other large scale arctic climate change initiatives in IPY. We review the science plans for each of the ten teams in CFL with a particular emphasis on the integration of traditional knowledge of Inuvialuit living in the study area. We describe how the international science teams are integrated into the Canadian teams and our plans for both a marginal ice zone and fast ice zone study of the ocean, sea ice, atmosphere and associated ecosystem. We also describe mooring operations being conducted within the study area, in collaboration with ArcticNet, and summarize some of the major outreach efforts which are associated with this project. As a flagship project of the Canadian IPY program, CFL will be highly visible nationally and internationally, addressing major issues pertaining to the effects of high latitude climate change on the integrated polar marine system.

A06-1D7.6 **17:15**

Vertical motions and microphysics in Arctic mixed-phase stratus

Matthew Shupe[1], *Pavlos Kollias*[2], *Ola Persson*[1], *Greg McFarquhar*[3], *Michael Poellot*[4], *Edwin Eloranta*[5]

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Vertical motions leading to condensation play a critical role in the formation of condensate and the partitioning of phase in mixed-phase clouds. Using measurements from the Mixed-Phase Arctic Cloud Experiment (M-PACE), which was conducted at the Atmospheric Radiation Measurement (ARM) Program's North Slope of Alaska (NSA) site in the fall of 2004, the role of vertical motions in Arctic mixed-phase stratus is examined. Estimates of vertical velocity and other cloud macro- and microphysical properties are made using cloud radar Doppler spectra and supporting measurements from lidar, microwave radiometer, and soundings. In general, the retrievals of vertical motion compare well with nearly coincident measurements by research aircraft, lending credence to the use of radar for deriving these cloud-scale motions in this type of cloud. The average vertical motion observed in the liquid portions of these fall mixed-phase stratus is an updraft of 0.56 m/s with a range of 1.75 m/s upward to 0.46 m/s downward. It is found that the liquid and ice water mass simultaneously increase in an updraft due to growth by vapor deposition. These mixed-phase clouds are typically liquid-dominant, although the liquid-to-ice ratio actually decreases during an updraft. This behavior is largely due to the relatively slower decrease of liquid during a downdraft, which allows for the persistence of liquid water, and the pulse-like behavior of relatively quick ice formation and fallout associated with the cloud-scale circulations. Spectral analysis of the derived vertical motion timeseries indicates dominant scales-of-motion in the range of 0.7-10 km. Typical circulation strengths, which are indicated by variations in vertical velocity, are on the order of +/- 0.7 m/s from the mean state.

H05-3C4.4 **14:15**

Digital terrain analysis to support the development of an ecological flow needs standard

David Tenenbaum[1], *Donald Baird*[2], *Nelli Horrigan*[2], *Daniel Peters*[1]

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The CABIN database of observations of macroinvertebrates offers a rich dataset of observations of ecological response to flow conditions. Comparison of macroinvertebrate community characteristics to descriptors of flow conditions (created via Richter's IHA or RVA) offers a means to identify key parameters. Unfortunately, in many cases, CABIN samples are not co-located with a flow gauge where time series observations of flow conditions have been collected in the period preceding the CABIN sample. In order to produce a dataset of sufficient size and statistical power to effectively examine the relationships between the flow conditions and community, the Fraser River Watershed was selected for the construction of a dataset where CABIN samples could be matched to the most suitable available flow record. Suitability for matching a flow record to a CABIN sample was assessed both in terms of the proximity of the flow gauge to the sampling location, and by matching a series of catchment characteristics as derived by making use of D8 digital terrain analysis to identify upstream contributing areas for both the flow gauges and sampling locations, and to produce terrain statistics describing these upstream areas.

I11-4C1.1 **13:30**

The IP3 Research Network: Improved Processes and Parameterisation for Prediction in Cold Regions

Julie Friddell, *John Pomeroy*

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IP3 is a Canada-wide research Network devoted to enhanced understanding of surface water and weather systems in cold regions, particularly Canada's Rocky Mountains and western Arctic. The Network has been funded by the Canadian Foundation for Climate and Atmospheric Sciences for 2006-2010. Through improved understanding and parameterisation of hydrological, hydrometeorological, and climatic processes in cold regions, IP3 will make contributions to better weather and climate prediction at regional and smaller scales, estimation of streamflow from ungauged basins, prediction of changes in Rocky Mountain snow and water supplies, calculation of freshwater inputs to the Arctic Ocean, and sustainable management of mountain and northern water resources. These issues are of key importance to agriculture and urban and industrial development in the Canadian Prairies and northwest.

This work is being accomplished through intense field data collection along a transect of high latitude (Arctic) and high altitude (Rockies) instrumented research basins that characterize Canada’s cold regions. Field observations focus on mass and energy fluxes of snowpacks, glaciers, open water, vegetation, and runoff generation processes over frozen ground. The collected data will be used to improve parameterisation of these cryospheric processes for incorporation into process hydrology and coupled land surface – hydrology models. The improved models will then be used to simulate water resources, near-surface atmospheric fluxes, and weather and climate in cold regions, at scales that are useful to various public and private sectors that require water- and weather-predictive capabilities for their operation. The models’ performance will be evaluated at the IP3 research basins and in larger

regional domains. Both the field data and model outputs will be archived into a database that will be available to Network collaborators and eventually to the public.

H06-4C4.5 **14:30**

Glacier boundary layer meteorology and implications for regional mass balance modeling

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Any effort to model glacier mass balance on regional scales first requires an understanding of the relations between boundary layer meteorological variables (temperature, vapour pressure, wind speeds) and corresponding large-scale atmospheric conditions. Field data collected at a transect of on-ice stations at Place Glacier during the 2006 ablation season are explored in relation to conditions at a ridge-top station representing regional atmospheric characteristics. Katabatic flows were persistent, and their strength was related to the temperature difference between the air mass and the glacier boundary layer. Extreme positive and negative temperature and moisture gradients occurred within the boundary layer, and these gradients have strong implications for mass balance modeling using both degree day and energy balance methods. Simple models were employed to examine some critical assumptions which must be made in order to estimate glacier mass balance on regional scales.

S03-3C3.1 **13:30**

The relationships between wind speed and snowfall catch efficiency for the Geonor T-200B precipitation gauge

Craig Smith[1], *Daqing Yang*[2]

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The Geonor T-200B accumulating precipitation gauge is being employed by many national climate observation programs as the standard instrument for precipitation measurement, including winter precipitation. As with all precipitation gauges, the Geonor suffers from a systematic bias due to wind that creates a substantial underestimation in the measurement of snowfall. In windy and cold conditions, this underestimation can be nearly 100%. To adjust Geonor measurements of snowfall for this systematic bias, the relationship between gauge catch efficiency and wind speed at gauge height must be derived. This is accomplished by comparing the catch of the Geonor to that of the World Meteorological Organization reference for solid precipitation, the Double Fence Intercomparison Reference (DFIR). Relationships between catch efficiency and wind speed have been examined for three different climate regimes: southern Finland, the Canadian Prairies, and southern Ontario. Although the catch efficiency-wind speed relationships for each of these sites are similar, variability exists due to difference in wind and temperature conditions during snowfall events. Based on these similarities and differences, the utility of one wind adjustment curve for the Geonor T-200B is assessed. Test application of the adjustment curve will be conducted at selected climate monitoring stations in northern regions.

S03-3C3.4 **14:30**

Investigating the Advantages of using a Multi-parameter Approach to Derive Automated Snowfall Measurements

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Environment Canada has developed an algorithm, designated S3-1, to automate the derivation of 'snowfall' measurements. The algorithm was developed using data collected over three winter seasons from several test sites equipped with three SR50 Sonic Ranging Sensors (Campbell Scientific), and a Geonor Total Precipitation Gauge with a single alter-shield. The algorithm calculated a 'snowfall' statistic when the ensemble of three SR50 sensors showed an increase in 'snow-on-ground', and the Geonor indicated precipitation had occurred. A review of the S3-1 algorithm is presented with verification statistics and case studies demonstrating the algorithm's performance in light, moderate, and heavy snowfalls, mixed precipitation, and drifting and blowing snow events. The strengths and weaknesses of the instruments used by the S3-1 algorithm, along with a discussion of how other instruments can potentially improve on the ability to accurately measure snowfall amounts, is also presented.

G10-1D2.2 **16:45**

Seismic Analysis for Gas Hydrate Studies in the Ulleung Basin, offshore South Korea

Alexandra Kirshner[1], *Michael Riedel*[1], *Dong-Geun Yoo*[2], *Keun-Pil Park*[2], *Byong-Jae Ryu*[2], *Roy Hyndman*[3]

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Multichannel seismic data can assist in locating and quantifying occurrences of natural gas hydrate. The area of the study is the Ulleung Basin in the East Sea (off South Korea). Detailed interval velocity profiles are the most important tool to quantify the amount of gas hydrate. Seismic velocity is increased by the presence of gas hydrates relative to a hydrate-free background trend. Previous analyses of short-offset MCS data yielded an estimate of the background trend, but with large uncertainty. The data used in this study have much larger offset (3.8 km), which greatly improves velocity resolution. This also offers the opportunity to carry out amplitude-vs-offset analyses. The results of this study will be used in assessing potential drilling targets. The Ulleung Basin is characterized by widespread bottom-simulating reflectors (BSR), which are indicative of the occurrence of gas hydrates. However, the BSR is generally weak, associated with relatively low concentrations of gas hydrates. In contrast, very high concentrations may be associated with numerous vertical zones of reduced reflectivity that have been mapped over a large area in the Ulleung Basin. Many zones are characterized by pull-up structures, indicating lateral increase in velocity. These blank zones have striking similarity to cold vents offshore Vancouver Island, which are associated with massive occurrences of gas hydrates, as recently demonstrated by Integrated Ocean Drilling Program Expedition 311. We have analyzed seismic sections with blank zones, as well as sections away from these structures in order to constrain the velocity contrast between them. The observed velocity increase within blank zones was converted to gas hydrate concentration using a simple porosity reduction model. Refined rock-physics modeling will be carried out with future studies to better constrain gas hydrate concentrations, using results from the drilling campaign.

C02-1D5.1 **16:00**

The response of the Atlantic meridional overturning circulation to increasing atmospheric CO2: Sensitivity to mean climate state

Andrew Weaver

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The dependence on the mean climate state of the response of the Atlantic meridional overturning circulation (AMOC) is investigated in 17 increasing greenhouse gas experiments with different initial conditions. The AMOC declines in all experiments by 15% to 31%, with typically the largest declines in those experiments with the strongest initial AMOC. In all cases, changes in surface heat fluxes, rather than changes in surface freshwater fluxes, are the dominant cause for the transient AMOC decrease. Surface freshwater fluxes actually switch from reducing the transient AMOC decrease, for low values of atmospheric CO2, to reinforcing the transient AMOC decrease, for higher values of atmospheric CO2. In addition, we find that due to changes in the strengths of feedbacks associated with water vapour and snow/sea ice, the climate sensitivity and transient climate response of the UVic model strongly depends on the mean climate state.

A06-1D7.2 **16:15**

The measurement of particle size in Arctic clouds using high spectral resolution lidar and millimeter wavelength radar data.

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The ratio of the lidar and radar scattering cross section is sensitive to cloud particle size. High Spectral Resolution Lidar (HSRL) provides robustly calibrated scattering cross sections without the uncertainties introduced when conventional lidar data are corrected for attenuation. This paper explores the use of HSRL data and 35 GHz radar data for measuring particle size, particle phase, number density and the water content of Arctic clouds.

Lidar-radar size retrievals provide the effective diameter prime. This quantity is proportional to the fourth root of: (mass of the average particle squared)/(projected area of the average particle). Conversion of effective diameter prime to commonly derived size measures such as effective diameter, mean diameter, median mass diameter, or mean mass of the ice particles requires knowledge of the ice crystal shape.

Mitchell(J. Apl. Meteor. V29 p153-163) and others have presented power-law relationships to describe the volume and projected area of ice crystals as a function of crystal size. We have implemented these to allow particle size retrieval for a wide variety of particle habits.

This paper will present examples of particle size data acquired in the high Arctic at Eureka, Canada (80 deg N, 85 deg W) where the University of Wisconsin HSRL has operated since Sept 2005. We will describe efforts to constrain the selection of ice crystal type used in the particle size retrievals with radar measured fall velocities. Validation of derived particle microphyiscs is provided by a comparison of lidar-radar precipitation with conventional measurements. Lidar-radar estimates of water content along with radar measured Doppler velocities at an altitude of 150 m are used to compute precipitation rates. Favorable comparisons with surface measurements are achieved when the ice crystals in Arctic snowfall are modeled as bullet rosettes.

I05-2C8.4 14:45

Real Time Flood Forecast and Flood Alert Map over the Huaihe River Basin in China Using a Coupled Hydro-meteorological Modeling System

Lei Wen[1], *Charles A. Lin*[2], *Zhiyong Wu*[3], *Guihua Lu*[3], *Jianyun Zhang*[4], *Yang Yang*[5], *Yufei Zhu*[6], *Linying Tong*[6]

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A coupled hydro-meteorological modeling system is established for real time flood forecast and flood alert over the Huaihe River Basin in China. The system consists of the mesoscale atmospheric model MC2 (Canadian Mesoscale Compressible Community) that is one-way coupled to the Chinese Xinanjiang distributed hydrological model, a grid-based flow routing model, and a module for acquiring real time gauge precipitation. The system had been successfully tested in a hindcast mode using 1998 and 2003 flood cases in the basin, and has been running daily in a real time mode for the summers of 2005 and 2006 over the Wangjiaba sub-basin of the Huaihe River Basin. The MC2 precipitation combined with gauge values is used to drive the Xinanjiang model for hydrograph prediction and production of flood alert map. The performance of the system is illustrated through an examination of real time flood forecasts for the severe flood case of July 4-15, 2005 over the sub-basin, which was the first and largest flood event encountered to date. The 96-hour forecasts of MC2 precipitation are first evaluated using observations from 41 rain gauges over the sub-basin. The forecast hydrograph is then validated with observations at the Wangjiaba outlet of the sub-basin. MC2 precipitation generally compares well with gauge values. The flood peak was predicted well in both timing and intensity in the 96-hour forecast using the combined gauge-MC2 precipitation. The real time flood alert map can spatially display the propagation of forecast floods over the sub-basin. Our forecast hydrograph was used as operational guidance by the Bureau of Hydrograph, Chinese Ministry of Water Resources. Such guidance has been proven very useful for the Office of State Flood Control and Drought Relief Headquarters in operational decision making for flood management. The encouraging results demonstrate the potential of using mesoscale atmospheric model precipitation for real time flood forecast, which can result in a longer lead time compared to traditional methods.

H05-3C4.3 14:00

Modelling the effects of flow on Canadian river ecosystems: developing an ecological index of flow modification

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Flow alteration affects riverine macroinvertebrate communities through changes in current velocity, available oxygen, temperature and the temporal pattern and frequency of high and low flow events. Understanding the roles played by these mechanisms is important for derivation of scientifically defensible guidelines for river flow management. Using Canada-wide data extracted from the CABIN online database we developed a flow index based on velocity preferences of macroinvertebrate taxa similar to the LIFE index developed in UK, but using optima and indicator value information derived

from Canonical Correspondence Analysis. To further refine the index, we considered the effect of flow-related versus other contributing factors (such as habitat and water chemistry) on the index by developing a Bayesian belief network. The flow index calculated for Canada-wide data was found to increase with flow velocity up to 1 m/s, at which point its value declined, indicating a loss of sensitive taxa, possibly through physical disturbance. Using a Reference Condition Approach based on historical data from the Fraser River, British Columbia, the flow index correctly identified sites with low current velocity (more than 1 standard deviation from the mean for a group of reference sites) in 82% of cases. The Bayesian belief network was highly accurate in classifying sites with low, medium and high values of the flow index based on flow-related and other stress factors, demonstrating a high potential for use in scenario modelling and sensitivity analysis.

O03-2DP.1 **16:00**

A Biogeochemical Box Model of Patagonian Tidal Fronts

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The broad Argentine Continental Shelf (~1,000,000 km2) is economically important because of the many fisheries supported by high primary productivity and ecological diversity. The elevated productivity is in general associated with frontal zones, in particular the shelf break front and the tidal fronts that characterize the region. Tidal fronts on the Patagonian Shelf (south of 39ºS) are the transition zone between coastal waters that, according to recent observations, are a source of atmospheric carbon dioxide (CO2) and mid shelf waters that act as a sink. The present work describes the physical and biological processes responsible for these patterns, utilizing a numerical box model with coastal and mid-shelf compartments separated by a tidal front. The coastal zone is represented by a single homogenized 50 km wide and 40 m deep compartment. The stratified mid shelf region consists of two compartments, representing an upper layer of variable depth and a deep layer, both 250 km wide. The total depth of the mid shelf region is 105 m. The model is forced with parameterized heat fluxes at the surface and by exchange with the outer shelf. In addition to mixing and advection, a winter convection model was included in the mid-shelf compartment. Biological processes are modelled with a NPZD ecosystem model (Nutrients – Phytoplankton – Zooplankton – Detritus). Besides nitrogen nutrients (nitrate and ammonia), carbon and oxygen cycles are also included. Results showing annual cycles (including phytoplankton blooms and air-sea fluxes of CO2 and O2), and model sensitivity to various parameters will be presented.

C05-3DP.4 **16:00**

Évaluation de la variabilité et des extrêmes (précipitation et température) simulées par deux versions du modèle régional canadien du climat

Philippe Roy[1], *Philippe Gachon*[2], *René Laprise*[3]

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Les statistiques des extrêmes de températures et de précipitation telles que simulées par le modèle régional canadien du climat (MRCC, versions 3.7.1 et 4.1.1 pilotées en mode réanalyse) sont évaluées et comparées avec les observations quotidiennes sur 3 zones géographiques situées sur le Nord-Est des

États-Unis, ainsi que le Sud-Est du Canada. Les observations sont interpolées sur la grille à 45 km du MRCC à l'aide de deux types de krigeage (ordinaire et universel). Plusieurs simulations couvrant la période 1961-1990 sont évaluées en utilisant des indices climatiques permettant de caractériser l'intensité, la fréquence et la durée de certains extrêmes. Les résultats préliminaires en été, sur une des régions géographiques d'intérêt (Pennsylvanie, USA), suggèrent une performance variable à simuler les distributions statistiques de températures (minimale ou maximale) selon la saison. Certains biais froids dans la température maximale (25e à 75e centile surtout) sont fortement réduits dans la nouvelle version du modèle. Bien que le régime moyen de précipitation soit assez bien simulé dans les deux versions, le MRCC surestime le nombre de jours pluvieux, mais sous-estime l'intensité par jours de pluie et les plus fortes précipitations. Cependant, les maximums de jours secs consécutifs sont relativement bien reproduits.

H01-1C4.7 **15:00**

Hydrology of lakes and channels in the outer Mackenzie Delta

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The outer Mackenzie Delta is an extremely low lying area dominated by a large number of lakes and channels. The Kendall Island Bird Sanctuary, and two anchor fields of the proposed Mackenzie Gas Pipeline, are located in this area. The hydrology of the numerous lakes and channels of the outer delta are not well understood at present, a factor that introduces large uncertainties in considering the environmental impact of future development in the outer Delta. The hydrology of these lakes and channels are controlled by a number of factors, including discharge from the Mackenzie and Peel Rivers, storm surges, river ice, and tides for example. Preliminary analysis will demonstrate the spatial and temporal variability in water levels in this region, and consider the relative importance of various processes controlling water levels of the lakes and channels.

I10-1C9.7 **15:00**

The Role of Thermal and Mechanical Processes in the Formation of the Ross Sea Summer Polynya

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Three decades of satellite observations collected during spring and early summer have shown a recurring region of ice-free water forming in the sea-ice cover in the Ross Sea, Antarctica. This Ross Sea summer polynya plays an important role in heat exchange between the ocean and atmosphere, ventilation of deep water, and is characterized by high biological productivity. Despite its appearance each year, the relative importance of different physical processes to its formation and maintenance are not widely agreed upon. Here we use a three-dimensional coupled ice/ocean model to better understand processes controlling the dynamics of the Ross Sea polynya. Results from the model control run agree favorably with satellite microwave imagery of sea ice. Model sensitivity studies suggest that polynya dynamics are insensitive to the amount of snowfall, the presence of the Ross Ice Shelf cavity, tides, and solar radiation penetrating through the ice. The model results also corroborate earlier findings that both the advection of sea ice and heat entrainment from warm Modified Circumpolar Deep Water play a role in Ross Sea polynya development. More importantly, the model

further demonstrates that advection of sea ice due to winds plays the primary role in summer polynya formation. Additionally, we suggest that 1) heat entrainment reduces the rate of sea ice formation rather than melts existing sea ice, and 2) advection of sea ice due to synoptic wind events associated with variations in atmospheric pressure are the processes primarily responsible for the formation and expansion of the Ross Sea summer polynya.

S04-3DP.1 **16:00**

Influence of temperate mixed and deciduous tree covers on Hg concentrations and photoredox transformations in snow.

Alexandre Poulain, Virginie Roy, Marc Amyot

(Presented by *Marc Amyot*)
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Mercury dynamics in snow packs under forested canopy are currently unknown, even though these snow packs may represent important Hg pools eventually released towards lakes at snowmelt. We followed Hg distribution and partitioning in snowpacks under different temperate canopy types over space and time, and conducted short-term experiments on Hg redox behaviour in these snow packs. Hg concentrations were ca. 2 times higher in snow deposited under coniferous than deciduous canopies; the lowest concentrations were observed in snow over a frozen lake in the same watershed. In snow on the ground, up to 80% of the Hg was bound to particles between 10 and 70 µm. Incubations of snow in situ showed that i) Hg photoreduction and evasion was significant in open areas (lake surface) but was greatly hampered by light attenuation under winter canopies and ii) oxidation of newly produced Hg(0) was a significant process in boreal snow, affecting Hg evasion to the atmosphere. We used a mass balance approach to compare Hg pools in snow packs with wet deposition measured by precipitation collectors. A net gain of Hg was observed in snow under mixed canopies whereas, under a deciduous canopy, the pool of Hg stored at the end of the winter was comparable to that of wet deposition. Snow over lake acted as a winter source of Hg. Whereas most Hg deposited by snow on lakes is lost before snowmelt, Hg deposited on the forested watershed is largely retained in snowpacks, presenting a threat to systems receiving meltwaters.

S04-4B3.1 **10:30**

The Hysteretic Relationship between Snow Covered Area and Depth – Measurement and Modelling

Bruce Davison[1], *Steven Fassnacht*[2], *Ric Soulis*[3]

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The relationship between snowcovered area (SCA) and average snow depth is dependent on the history of the snowpack. In particular, this relationship is hysteretic during the initial accumulation and late melt phases of the snowpack. An algorithm has been developed to account for this hysteresis in land-surface schemes that make use of the grouped response unit or tile to account for sub-grid heteorogeneity. Continuous measurements of snow depth were taken with digital photographs at 3-hour intervals in the boreal forest of south-central Saskatchewan. To avoid the complication of canopy effects, the photographs were taken in a clearing that had been harvested in 2002. Analysis of the imagery illustrate that the SCA-depth hysteresis does in fact exist.

The algorithm has been incorporated into the Canadian Land Surface Scheme (CLASS), the Modélisation Environnmentale Communautaire (MEC) system, and the MEC Surface Hydrology (MESH) prototype, which is the successor of WATCLASS. Results show the impact of implementing the algorithm on a variety of scales, comparing to measured data at flux towers with CLASS at the 2002 harvested site, looking at results over the Whitegull creek watershed with the MESH prototype, and examining the impact of the algorithm over North America with MEC.

P-4A1.1 **INVITED/INVITÉ 08:30**

The Lake Agassiz megaflood and 8200 BP cold event: was there a causal link? / La méga inondation du Lac Agassiz et l'événement froide de 8200 ans avant le présent: il y a t'il un lien de causalité définitif?

Garry Clarke[1], *Andrew Bush*[2], *Claude Hillaire-Marcel*[3]

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The most conspicuous climate event of the past 10,000 years occurred while North American was exiting from the last Ice Age and is commonly known as the “8.2 kyr BP cold event”. The timing of this event appears to coincide with a geologically remarkable flood – the final draining of ice-dammed glacial Lake Agassiz. The volume of released water has been estimated as ~151,000 km^3, more than ten times that of Lake Superior, the largest contemporary freshwater lake. Model-based estimates place the peak discharge at ~5 Sv and the duration at ~0.5 yr. The cause of the 8.2 kyr event remains controversial. Earlier abrupt climate change events seem to have been associated with ocean circulation changes in response to freshening of the North Atlantic, either by redirection of deglacial meltwater or by melting of iceberg armadas launched from the Laurentide Ice Sheet. The switching mechanism for which there is the strongest evidence is that associated with changing the operation of the North Atlantic meridional overturning circulation (MOC). The Agassiz megaflood presents a near-ideal case for testing this idea because the volume of released freshwater and rate of delivery are well constrained. Several recent modeling studies, aimed at simulating the 8.2 kyr event, support the idea that the flood triggered a change in the MOC but there is scant evidence in the marine sedimentary record to support this claim. In this paper we combine hydraulic modelling of the flood forcing, with coupled ocean–atmosphere modelling of the climate response to reconcile model predictions with the paleoenvironmental evidence.

A04-4B6.2 **10:45**

Automated Fog Forecasts from Existing NWP Forecast Output

Garry Toth

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A new project known as FRAM (Fog Retrieval and Modelling) has as its goal to improve our understanding of fog and its formation and to improve fog forecasting capability in Canada through improved tools. This involves studies in several broad areas (e.g. observations of fog structure, satellite techniques, climatological techniques, statistical techniques, NWP). In the area of NWP, a few researchers have used special 1-D models with improved physics and boundary-layer representations to make fog forecasts in a few cases. These applications are very specialized, often only in a research mode. It is felt that much information from existing forecast models is available that

could potentially be very useful in an organized approach to fog forecasting. This presentation will outline current work being done with operational NWP output as part of the FRAM fog project. The UPS Fog technique (Baker et al, 2002) for radiation fog has been modified and expanded through a new rules-based fog forecast system driven by a set of forecast variables from the GEM regional operational NWP forecast model. The technique will be briefly described and a few forecast examples given. The talk will conclude with some ideas for how work in this area may proceed.

G11-3C2.2 **INVITED/INVITÉ 14:00**

Structural and Stratigraphic Elements of the Laurentian Basin, Atlantic Coast of Canada

Phonse Fagan[1], *Michael Enachescu*[2]

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The Laurentian Basin covers an area of 60,000 square km between the island of Newfoundland and province of Nova Scotia. The basin was placed under a petroleum exploration moratorium in 1967 because a boundary dispute related to the presence of the French islands of St. Pierre and Miquelon off the south coast of Newfoundland. An early petroleum assessment by GSC estimated that the basin could contain recoverable resources of 8-9 tcf natural gas and 600 to 700 million barrels of oil. The structural boundaries of the Laurentian Basin are loosely defined and are more tied to the boundaries of the moratorium block than to any obvious geological features. The landward flank of the basin's Mesozoic section onlaps Late Paleozoic sediments, part of an extensive Carboniferous system, that is currently being explored in onshore and offshore basins throughout Atlantic Canada. From a tectono-stratigraphic point of view, the basin's location at the intersection of the Mesozoic Scotian Shelf extensional margin and the Southern Grand Banks extensional/strike slip margin, dictates that elements of both systems will be observed in its structural style and stratigraphy. Additionally, the basin partially overlies the confluence of the Paleozoic suture between the Avalon and Meguma terranes and the Mesozoic active Newfoundland Fracture Zone, and thus provides the opportunity to look for linkages and interplay between Mesozoic tectonic lineaments and the pre-existing basement fabric. For this study, various vintage seismic data was tied to wells in adjacent basins on the Scotian Shelf and Southern Grand Banks to help decipher its stratigraphic and structural evolution. In this regard the basin can be subdivided into tectono-stratigraphic packages which can be correlated along strike to the surrounding basins – including within the deep water depocentres. This study also addresses the basin's petroleum systems including the possibility of Mesozoic reservoirs being sourced by Paleozoic source rocks.

C02-2B5.1 **10:30**

Paleoclimates of northern Canada - a synthesis

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Regional syntheses of well-dated, multi-proxy reconstructions of Holocene climates are needed to permit an understanding of the causes of century to millennial-scale climate variations. One region of interest is northern Canada, where high resolution and well dated paleoclimate records are becoming available. The early Holocene was warm across the entire Arctic, as shown in lake sediment records from several sites from the southern Arctic Islands. Variability of several timescales is identified in high-resolution records from all sites that have been studied at sufficient resolution. Transitions in lake

sediment parameters and diatom and pollen assemblages occur synchronously with ice core records and reconstructions from pollen diagrams from southern Canada and the United States. We will discuss the various records that are available from this region and present a synthesis of the paleoclimate record for the region.

G05-3B2.7 **12:15**

Extent of oceanic crust in the northern Labrador Sea: New data and new impasse in an old controversy

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During 2006 Geophysical Service Incorporated (GSI) acquired two regional multi-channel seismic (MCS) reflection lines across the Labrador Sea at the approximate latitude of the northern Saglek Basin, on the Labrador shelf (Canada) and Lady Franklin Basin on the Greenland shelf (Denmark). More precisely, the two NE-SW trending lines run between 59º and 63º North Latitude and 51º to 63º West Longitude and are each approximately 750 km long. These 12 second, 7200 m streamer recorded data are crucial for deciphering the nature of the basement beneath the sedimentary cover of the Labrador Sea shelf, slope and rise. They also help to clarify the evolution of the Labrador Sea and its sedimentary basins through the following stages: 1) Mesozoic intra-cratonic extension (intercontinental rifting); 2) mantle exhumation and transitional crust formation; 3) Cenozoic oceanic crust creation (oceanic rifting) and 4) cessation of oceanic rifting (drifting) with associated prominent regional thermal subsidence. The lines are complementary to earlier MCS research data in the area and offer critical information in determining: a) if any true oceanic crust was emplaced between the northern Labrador and Greenland shelves; b) the location, timing, extent and modality of such emplacement; and c) if a continuous mid-ocean spreading ridge was active in the area. These lines will also provide fundamental geoscientific data in support of Canada's ongoing United Nations Convention on the Law of the Sea (UNCLOS) negotiations regarding the delineation of maritime jurisdictional boundaries in the Labrador Sea. Of particular interest is that the lines show the presence of thick Mesozoic and probably older sedimentary basins with potential hydrocarbon resources, in currently drillable water depths (3km) lying far seaward of the 200 NM limit, and well beyond any boundary that might be defined by currently proposed bathymetric criteria.

A04-4B6.6 **11:45**

Role of Boundary Layer Baroclinic Conditions on the Development of the East Coast Atlantic Winter Storms

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The U.S. East Coast and adjacent coastal waters have long been known to be a favorable area for wintertime cyclogenesis. In many instances, storms that develop in or near the offshore waters of North Carolina and northward can be classified as explosive cyclogenesis. These rapidly deepening cyclogenesis events sometimes experience surface pressure drops exceeding 1 mb per hour for 24 hours. A major factor is the existence of strong boundary layer baroclinicity caused by the meandering of the Gulf Stream in this region. The Atlantic Surface Cyclone Intensification Index (ASCII) was introduced to define this process. This index was tested as an operational tool for the period 1994-

1996. ASCII was later improved by including a measure of the upper-level influence associated with the East Coast cyclones. This paper will present results demonstrating the role of the Gulf Stream eddies and the sea surface temperature patterns on the development of the U.S. east coast winter storms.

I14-1D9.1 **16:00**

Soil greenhouse gas, nutrient, and microbial biomass dynamics in recently fertilized western Canadian plantation forests

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Fertilization of plantation forests in British Columbia with nitrogen (N, as urea) or a mixture of N and other nutrients 10 to 40 years following planting is becoming increasingly common. Beyond the intended effect of enhancing rates of primary production, fertilization also has the potential to alter soil carbon, nutrient, and in particular, greenhouse gas dynamics, however these effects are largely unknown. We fertilized soil plots with N or a mix of N, phosphorus (P), and micronutrients at an operationally realistic rate of 200kg N per ha in 25yo lodgepole pine, western hemlock, and Douglas fir plantations in three biogeoclimatic zones of BC. For up to 7 months following fertilization we measured soil fluxes of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) and soil N, P, and microbial biomass dynamics. Fertilization resulted in an initial increase in CO2 efflux as urea was mineralized, but rates returned to control levels within 14 days in all forest types. Consistent with this pattern, soil ammonium (NH4+) concentrations increased concomitantly. Beyond rapid mineralization to NH4+, there was surprisingly little transformation of N over the measurement period. NH4+ was largely retained in the soil organic horizons with moderate uptake by microbial biomass and little oxidation to nitrite and nitrate. In the lodgepole pine site, fertilization with urea led to a short-lived suppression of soil CH4 uptake, presumably due to NH4 inhibition of CH4-monoxygenases. N2O efflux was significantly greater than 0 in fertilized plots at only 1 measurement date in 1 forest type (Douglas fir) following fertilization. We conclude that in western Canadian conifer plantations with acidic soils, initial impacts of fertilization on soil greenhouse gas dynamics are short-lived and relatively minor.

I13-4C9.4 **14:45**

NSIDC DAAC Data Sets and Proposed Services to the IPY Community

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The International Polar Year offers an opportunity to the science community for ground breaking science. The data sets required by the IPY projects described in the submissions list on the IPY website span studies to be conducted by individual scientists to international consortia of programs and across many geophysical disciplines. Satellite data will no doubt play an important role in these proposed studies.

The National Snow and Ice Data Center (NSIDC) Distributed Active Archive Center (DAAC) is a repository for snow and ice data products from the US NASA Earth Observing System satellites.

These satellites and sensors provide a significant advancement over their predecessors and are providing a wealth of information on snow and ice. The Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the Aqua and Terra spacecraft and the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) on the Aqua spacecraft provide improved visible/infrared and passive microwave imagery and products. The Geoscience Laser Altimeter System (GLAS) on the Ice, Cloud, and land Elevation Satellite (ICESat) is the first satellite-borne laser altimeter and represents an entirely new technology for ice remote sensing. Specifically the NSIDC DAAC archives and distributes data from the MODIS sensors on AQUA and TERRA, the GLAS instrument in ICESat, and the AMSR-E instrument on AQUA. All of these data products will be of interest to some degree to IPY research programs.

This paper will describe the data products distributed by the NSIDC DAAC and offer suggestions as to how these data can be acquired by IPY research programs. NSIDC's philosophy is to work with our science clientele in the distribution of data and data products and in the modification of distribution approaches based on user comment.

In addition to distribution of data sets and products, NSIDC is involved in several IPY projects. This paper will briefly describe our involvement in the Global Inter-agency IPY Polar Snapshot Year (GIIPSY) and the IPY Data and Information Service (IPY-DIS) efforts, with emphasis on the role NSIDC DAAC data sets play in these projects.

A06-2B7.4 **11:15**

Study of the correlation between water vapour and sulfate-to-aerosol ratio in the High Arctic.

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Sulfates, especially from human activities, represent a major aerosol species in the Arctic atmosphere during the polar night, and they are believed to significantly impact the hydrological cycle. Because of their high solubility, they are very good cloud condensation nuclei, whereas by lowering the homogeneous freezing point of droplets they limitate ice crystals formation. This has a consequence on the water vapor mixing ratio, and this effect could be temperature-dependant. In this communication, we present a study of the correlation between the humidity and the sulfate-to-aerosol ratio fields in the High Arctic for the winters 2003 to 2005. Water vapor mixing ratio profiles are retrieved from the Atmospheric InfraRed Sounder (AIRS, aboard the AQUA satellite) measurements, whereas aerosol concentrations are simulated using the Northern Aerosol Regional Climate Model (NARCM). The analysis is carried in the lower troposphere (at levels 925mb, 850mb and 700mb), and the effect of temperature is investigated.

A03-3B6.8 **12:15**

Relating the frequency and distribution of southwestern Alberta storm events to seasonal rainfall patterns

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The meteorological processes that bring rainfall to a region govern the spatial coherence of rainfall patterns. We analyze 110 summer rainfall events (greater than 1 mm) between May and August 2005-2006 in southwestern Alberta, based on data collected in the Foothills Climate Array (FCA), a network of 300 meteorological stations with a spatial coverage of 24 000 km2. Each station consists of a tipping-bucket rain gauge and a temperature-humidity logger. Rain events are classified into frontal (distinguished by contrasting air masses), cyclonic (upslope) and convective (local and mesoscale). A number of features are quantified for each rain event, including storm duration, total event accumulation, peak 5-minute and 1-hour intensities, correlation distances, temperature, humidity, and changes in temperature, relative humidity, and specific humidity over the event. This provides an overall assessment of the surface meteorological characteristics during each event. Geostatistical analysis is used to determine the contribution of the individual storm events to the overall spatial pattern of monthly and seasonal rainfall in the region. Further analysis assesses the role of regional topography in the distribution of rainfall events and patterns. The detailed information being captured within the FCA network provides a new perspective on meteorological processes in southern Alberta and how the length scales of variability in seasonal rainfall patterns.

A04-3C6.2 **13:45**

Meteorological Analysis of the Severe Rainstorm that Caused Extensive Flooding in Southern Alberta during 5-9 June 2005

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In June 2005, a family of four consecutive major rainstorms passed over southern Alberta, Canada. Extensive rainfall of these storms caused flooding in southern Alberta. The second storm occurred June 5-9 with a maximum rainfall of 240 mm was the most severe one in terms of flooding damage. To improve scientific understanding and forecasting of the severe rainstorm, we made a detailed analysis of the synoptic and mesoscale evolution of this storm to address the following questions: What are the main physical mechanisms contributing to the heavy precipitation that caused flooding? Is it feasible to predict the likely occurrence of such major rainstorm? Our synoptic analysis shows that a blocking high combined with a cut-off cold low at the 500 mb level was the major steering system for this case. Another feature of the storm was a well-defined moisture tongue at 700 mb and 850 mb that presented over the northern Great Plains and western Canadian Prairie. The surface maps indicated that quasi-stationary inverted trough and trowal (Trough of Warm air ALoft) over southern Alberta were the major synoptic feature of this case. The inverted trough and trowal caused prolonged upslope flow. The analysis of the hodographs suggests that amount of vertical shear in the lower troposphere were correlated with precipitation intensity. The most intense precipitation of the rainstorm occurred along the foothill area east of the Rocky Mountains, where the orographic lifting is significant due to strong upslope flow. About half of the observed rainfall came from orographic uplift. The analysis of the radar and satellite images suggests that the spatial organization of the surface rainfall was strongly influenced by the orography of the underlying surface.

G04-2C2.4 **INVITED/INVITÉ** **14:45**

Animated models of late Neoproterozoic palaeogeography

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Revealing of past continental configurations has advanced by extending our knowledge backwards through time. Although the evolution of Pangaea and Gondwanaland is relatively well established, the exact configuration of the earlier supercontinent Rodinia, and its predecessors, are still widely debated due to our poor knowledge of palaeogeography in the late Neoproterozoic, the interval during which the last portion of Rodinia broke apart and Gondwanaland was formed. The latest Neoproterozoic – Early Cambrian interval is marked by at least two major tectonic reconfigurations of the Earth: the final breakup of the remnants of the Rodinia supercontinent and the assembly of Gondwanaland. This was also one of the greatest orogenic epochs (Baikalian – Pan-African – Cadomian – Timanian orogenies). Many high-quality palaeomagnetic poles were used to construct Phanerozoic APWPs for the majority of continents, and there is general agreement about Phanerozoic tectonic history. In contrast, late Neoproterozoic palaeomagnetic data are scarce and controversial, and it is impossible at this stage to apply the traditional APWP method. Recent palaeomagnetic data from northern Russia and Ukraine are in favour of the “conservative” model in which Baltica rifted off Laurentia-Amazonia around 600 Ma with the opening of East Iapetus and Tornquist Sea. This was followed by separation of Amazonia and Laurentia and opening of Western Iapetus. At the same time, a complicated process of collision between several continental blocks on the other side of the globe caused closure of oceanic basins and the assembly of Gondwanaland. This was accompanied by major accretionary events along north Gondwanan (Cadomian orogeny), east Baltican (Timanian orogeny) and south Siberian (Baikalian orogeny) margins. New data from Siberia suggest its rifting off the northern Laurentia and separate drift until the closure of the Urals Ocean in Permian. Here I present a series of global palaeogeographic reconstructions and animations for the latest Neoproterozoic – Early Cambrian.

A04-3C6.1 **13:30**

The Southern Manitoba Tornado Outbreak August 05 2006.

Derrick Kania[1], *Patrick McCarthy*[1], *Robert Paola*[1], *Dave Patrick*[2], *David Ball*[3]

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During the late afternoon and early evening of August 05, 2006 a number of severe thunderstorms produced at least 5 tornadoes over southern Manitoba. The tornadoes resulted in the death of one person and injured at least 22 people. This is the first tornado death in Manitoba since 1977. A meteorological and operational assement of the storm environment is presented.

O03-2C1.5 **15:00**

The circulation and residence time of the Strait of Georgia using a simple mixing-box approach

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Observations from the 3 year STRATOGEM program in the Strait of Georgia show a pronounced seasonal cycle in temperature and dissolved oxygen in intermediate waters, lagging behind the characteristics of source waters. Phase lags in oscillating systems arise due to internal time scales which can be interpreted in fluid systems as residence times. Using this approach we construct a quantitative and internally consistent circulation scheme for this region which matches independent

estimates of derived quantities such as air/sea heat flux, subsurface oxygen utilization, and primary production. The scheme suggests that the intermediate water is the most important part of this 3-layer system, and that dependence of the estuarine circulation on variations in fresh inflow is weak. The deep water is volumetrically less important, but changes in oceanic source waters can produce a seasonal variation in the overall circulation by driving deep renewal in summer and this can affect the surface temperatures. Intermediate water residence times are about half a year and deep water is renewed once per year. Surface water residence times are a few months at most, but the Fraser river plume has a fresh water residence time of only around 1 day.

O03-2DP.3 **16:00**

An anoxic fjord revisited: seasonal cycle, deep and intermediate renewal, and interfacial chemical and microbial regimes of Nitinat Lake.

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Observations of physical, biological, and chemical parameters of Nitinat Lake were obtained between July 2003 and February 2005. This lake is a classic example of a permanently anoxic seawater fjord, 200m deep, which has been unstudied in almost 30 years. Freshwater forcing and hence estuarine circulation is strongly seasonal and intermediate waters are renewed alternately by mixing from the surface in winter which moves isopycnals downwards and by horizontal inflow of subducted ocean water in summer which forces isopycnals upwards. High spatial resolution measurements of nitrate and sulfide using a new instrument show that during the summer there is a subsurface region of suboxic water in mid-fjord. No suboxic regime is evident at either the river end of the fjord (where oxygen and sulfide interfaces coincide in a nitrate-depleted water column), or at the ocean end (where oxygen, nitrate, and sulfide interfaces coincide or overlap). Polymerase chain reaction (PCR) analysis shows sulfate-reducing bacteria from the suboxic zone down to at least 100m, and fluorescence observations suggest the possible presence of sulfur-oxidizing bacteria near the anoxic boundary. Deep water inflows from the ocean are restricted by the shallow entrance, however the renewal time for the fjord is a surprisingly short 5 years.

H01-1D4.6 **17:15**

Computing the conductivity of fresh waters and salinity from conductivity

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An algorithm is developed to compute the conductivity of lake waters and dilute seawaters using their chemical composition. The mixture is considered as a sum of binary electrolytes rather than a sum of ions and this allows effects of ion association to be included. included. Bounds on the accuracy of the algorithm for specific classes of binary electrolytes are assessed and it is estimated that the algorithm has an overall accuracy of better than 2% for salinities less than about 4 g/L. Comparison with dilute seawater conductivities is generally much better than 1%, but agreement with lake and river water measurements is more scattered. Some of this difference may be due to a lack of data on ion pairing effects between bivalent metals and bicarbonate but may also result from uncertainties in the measured chemical compositions. An iterative procedure incorporating this algorithm is used to compute specific conductivity and salinity from in situ measurements of conductivity in waters where only relative amounts of ions are known. It is found that conversion to specific conductivity is

reasonably independent (to within about 1%) of the ionic composition for most world river waters, but is somewhat different than that for KCl solutions. However, derived salinities are quite sensitive to the composition, and the ratio of ionic salinity to specific conductivity varies between 0.6 and 0.9.

G11-3C2.6 **15:15**

The continental margin of northeast Newfoundland and southern Labrador: regional context, geological evolution and petroleum prospectivity

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The region offshore Newfoundland and Labrador encompassing the southern Hopedale Basin, St. Anthony Basin, and western Orphan Basin records a complex history of Precambrian and Paleozoic deposition and orogenic events, peneplaning and new basin development during Mesozoic rifting and Tertiary thermal subsidence. This area contains significant primary petroleum potential within the Mesozoic sedimentary basins, as well as secondary targets within the underlying Paleozoic units. The juxtaposition of features associated with previous tectonic events and the contemporary Wilson Cycle makes this area an ideal location to investigate the role of tectonic inheritance in controlling the development of the Mesozoic-Cenozoic basins. An improved tectonic framework of the interconnected basin and intervening arches is established by combining recent digital seismic reflection datasets with older seismic, gravity and magnetic data. The compiled data also aids in identifying areas of greatest petroleum potential.

I05-3DP.3 **16:00**

The predictability of daily sea surface temperatures in the Gulf of St. Lawrence for the initialization of coupled atmosphere-ice-ocean forecast

François Roy[1], *Manon Faucher*[1], *François J. Saucier*[2], *André Méthot*[1], *Pierre Pellerin*[3]

(Presented by *Francois Roy*)
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Recent demonstrations have shown the importance of air-sea exchanges and sea ice – ocean dynamics in meteorological forecast models. The coupling of an ocean circulation model of the Gulf of St. Lawrence (GSL) with the Canadian operational Global Environmental Multiscale (GEM) forecast model raises questions on how to initialize the ocean on a daily basis. The sea ice - ocean model must produce accurate sea surface temperatures (SST) to initialize and drive the meteorological forecast. The heat content of the surface 50 m depth layer of the GSL is strongly linked to the daily to seasonal evolution of atmospheric conditions. SST fields currently used in the uncoupled GEM make use of daily analyses of satellite imagery data. Those are relatively accurate but they only represent the first few meters of the surface layer and cannot account for the strong SST variability over daily to longer forecast periods. Herein we use the ocean circulation model to nowcast SST. Climatologic temperature and salinity fields from previous hindcast solutions are used to initialize oceanic simulations driven by atmospheric analyses from GEM. Results are compared with SST analyses and in situ temperature data. Starting from the beginning of either the cooling or the warming period of the GSL, modeled SST converge toward observations in prognostic simulations (without SST assimilation). The effect of introducing an initial bias (herein reaching 2°C in average over the GSL) vanishes from the modeled SST after a few months. To further improve results, we explore

introducing the boundary layer physics from GEM into the ocean model. We present examples of coupled and uncoupled meteorological forecasts where modeled SST can be used without introducing spurious air-sea fluxes. Finally, we discuss data assimilation of the deeper water masses on a longer time scale.

G05-3B2.3 **11:15**

Processing and interpretation of ERABLE seismic reflection data from the southeast Newfoundland rifted continental margin

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The Newfoundland/Iberia conjugate continental margins developed during Jurassic and Cretaceous time. They are good places to study rifted margins since they are non-volcanic, so that extensional crustal structures are not altered or obscured by magmatic processes. The boundaries between continental, transitional, and oceanic crust are well constrained on the Iberian margin from detailed seismic and drilling data. Data coverage in the deep-water sections of the Newfoundland margin has improved so that we can make increasingly detailed comparisons with interpretations of data from the conjugate margin. The "ERABLE" seismic reflection survey was recorded in the Newfoundland basin by the Geological Survey of Canada and IFREMER in 1992. We are processing and interpreting ERABLE data from the southern margin of Flemish Cap extending into the Newfoundland Basin. Various types of noise posed challenges for producing a seismic section that represents subsurface reflectivity. Such noise includes multiples—seismic waves bouncing within the water column—and seismic waves scattered from irregularities on the seafloor. F-k and radon filters improve the signal to noise ratio in deep water, but were less successful in the shelf region of the Flemish Cap. The final processed lines are used in combination with other geophysical data to gain a better understanding of the evolution of rifting in the Newfoundland Basin. An interpretation of the boundaries between continental, transitional, and oceanic crust is presented for the ERABLE and related seismic profiles.

G05-3B2.5 **11:45**

Mapping the U reflector in the Newfoundland Basin with the spectral decomposition technique

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The widespread U reflector in the Newfoundland Basin has long been associated with postrift uplift of a nonvolcanic Newfoundland margin. ODP Leg 210 drilling results revealed that the high reflectivity of the U event is due to the presence of thin basalt sills emplaced within much lower velocity sedimentary units. A network of regional seismic profiles have been used to map the U horizon with the spectral decomposition technique. Assuming that the reflectivity of U throughout the Newfoundland Basin results from subhorizontal layering similar to the stratigraphy drilled at Site 1276, spectral decomposition gives an overview of the variability in the layering. In this process, low frequency peak amplitudes represent thicker layering between sills, or thicker sills, and high frequency peak amplitudes represent more closely spaced, or perhaps thinner, sills.

Preliminary analyses suggest that there are general trends in the dominant frequencies of U on some of the lines including lower frequency generally to the south and in the central Newfoundland Basin. The character of U is, at least on some lines, affected significantly by the presence of a basement high

where marked changes in amplitude are observed from one side to the other. In places, the complicated arrivals have variable frequency content with time suggesting that if there are multiple sills involved in the layering, the sills are of different thickness.

G05-3B2.4 **11:30**

Extension across the southeast Newfoundland continental margin: estimates from fault heaves and crustal thinning

Jeremy Hall, *Sharon Deemer*

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A 565 km long deep seismic reflection line—SCREECH 3—crosses the Newfoundland rifted margin. It starts on unextended continental crust, crosses the shelf-bound Jeanne d'Arc basin, shelf-edge basins, transitional crust in deep water and ends on undisputed oceanic crust. The continental crustal basement is that of the 35-40 km thick Avalon terrane of the Appalachian orogen. Its thinning across the margin is imaged on the reflection data and confirmed by Moho mapped from coincident wide-angle seismic. Reconstructing an originally constant-thickness crust of 36 km, the most oceanward continental crust has to be moved back 120 km. The extended crust is composed of half-graben with major bounding listric normal faults. The amount of extension estimated from the heaves across those faults is around 85 km. The discrepancy between these two measures of extension may be partly due to inestimable extension across minor faults. These measures show the original continental edge to be 20-55 km seaward of the present day shelf break, an offset that should be duly reckoned in reconstructions of the conjugate margins. This is the beginning of a reassessment of the fit of the N. Atlantic rifted margins around Newfoundland.

S03-3DP.2 **16:00**

An Automated Gauge for Acoustically Determining Snow Water Equivalent

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Previous work has shown the possibility of estimating Snow Water Equivalent (SWE) by the use of sonar and seismological principles. To create a portable gauge suitable for point measurement of SWE, a custom electronic circuit was designed and deployed at field sites situated in prairie and sub-alpine environments. The circuit is comprised of sub-systems which provide intelligent control over aspects of power management, data capture and post-processing. To allow the gauge to operate in laboratory and remote field locations, a dual power supply with seamless switchover between line adapter and battery power was implemented. An onboard charger provides support to the battery pack. A 16-bit mixed-mode microprocessor implements system administration and user interface tasks, whereas an embedded Digital Signal Processor (DSP) running a stripped-down version of the Linux kernel analyzes the captured signal from a sound wave that has been reflected from the snowpack. Point measurements of SWE are georeferenced by an integrated GPS module. User interface support is provided by two Liquid Crystal Displays (LCDs), as well as by a keypad with audible and tactile feedback. The captured data can be transferred to a computer via Universal Serial Bus (USB). The gauge allows for measurement of SWE to be conducted in a non-invasive fashion. Compared to traditional methods of determining SWE by the use of a measuring rod and a sampling tube, the acoustic gauge allows for SWE to be quickly estimated. Some limitations of the gauge, the accuracy of its results and directions for further research are also discussed.

I11-4C1.6 **14:45**

Acoustic Determination of Snow Water Equivalent

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A continuous frequency-swept acoustic wave was used to determine Snow Water Equivalent (SWE) at sites representative of prairie and sub-alpine environments. Using principles of sonar and seismology, digital signal processing provided a means of estimating SWE from the reflected wave by a recursive relationship that utilizes a shape parameter associated with snow crystal geometry. Numerical optimization of the shape parameter using data collected from gravimetric sampling suggests that an acoustic wave may have the potential to be used as a means of distinguishing between snowpacks comprised of different snow crystal shapes. By an iterative technique, the porosity, density, tortuosity and depth of snow were estimated. Correlations between the gravimetric and acoustically-determined values of SWE were determined for data collected at field locations situated in Saskatchewan and British Columbia. However, for sites with snowpacks containing high liquid water content, the acoustic technique did not prove to be useful in determining SWE. The acoustically-determined values for the tortuosity were approximately equal to unity, a finding that corresponds to values characteristic of other porous substances. Limitations of the method and possible avenues for additional work are also addressed.

I01-1B8.3 **11:00**

A proposed approach for the assimilation of cloudy infrared radiances

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A practical approach for the assimilation of cloudy infrared radiances is proposed. The impact is evaluated in 1D-var simulations involving AIRS radiances from about 100 channels. Cloudy radiances are modeled assuming an effective cloud height and emissivity. The spectral variation of the emissivity is considered through its dependence on the effective particle size, including mixed-phase situations. Monte Carlo simulations demonstrate the large potential gain of assimilating cloudy radiances as opposed to only assimilate radiances which are not sensitive to clouds. The original approach was to predetermine the cloud parameters from 1D-var and then fix these in 3D-var, thereby requiring only minor changes to the operational assimilation system. Due to the strong sensitivity of the radiances to cloud parameters, this idea is no more considered. A first estimate of the cloud parameters is obtained from the traditional CO_2-slicing technique. The 3D-var code directly takes over from there. The assimilation code is modified to allow the estimation at each observation point of the 4 cloud parameters: height, emissivity, ice and water effective particle size. It is found that it is best to let these parameters vary freely to minimize retrieval biases in temperature and humidity profiles.

O02-1B1.4 **11:30**

Assessing the Performance of DalCoast3 in Simulating Three-dimensional Circulation on the Scotian Shelf

Kyoko Ohashi[1], *Jinyu Sheng*[1], *Keith R. Thompson*[1], *Charles G. Hannah*[2], *Harold Ritchie*[3]

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DalCoast3 is an operational forecast system for predicting the three-dimensional shelf circulation and hydrography on the Scotian Shelf and Gulf of St. Lawrence. The forecast system consists of an outer barotropic model, covering the northwest Atlantic Ocean, and an inner model that includes both barotropic and baroclinic dynamics, covering the Gulf of St. Lawrence and the Scotian Shelf. The outer model provides lateral open boundary conditions to the inner model. The forecast system is used to simulate the three-dimensional circulation during the period from August 2000 to March 2001. Model results are compared to sea level measurements from coastal tide gauges as well as bottom pressure and current measurements made on Sable Island Bank, and are shown to be in fairly good agreement. The tidal currents predicted by DalCoast3 agree better with observations than the results of a barotropic tidal prediction model, especially near the bottom. Examination of the physical processes affecting the circulation on Sable Island Bank shows that tidal circulation accounts for as much as 50% and 80% respectively of the total variance in the simulated surface and bottom currents. The wind-driven currents account for about 75% and 30% respectively of the variance in surface and bottom currents after the tides have been subtracted. Comparison between baroclinic and barotropic model results suggests the importance of baroclinicity in the circulation and its associated variability during the study period.

H05-3C4.2 **13:45**

Application of a hydrological regime classification for rivers across Canada

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Characterization of the flow regime is essential for understanding and predicting hydrological conditions and the consequent distribution, density and composition of instream communities. Stream flow has been traditionally considered to be a valuable descriptor of physical instream environment and is of critical importance in sustaining the natural biodiversity and community structure. Long-term daily hydrological data were extracted from the online HYDAT database for rivers across Canada. Monthly averages of daily discharge records ($m^3 s^{-1}$) were expressed as runoff (mm month^{-1}) to standardize for differences in catchment area. Classifications of the long-term (1984 2003) and annual hydrological regimes based on both shape (timing) and magnitude of runoff clearly demonstrate geographical gradients in hydrological conditions at regional and national scales. These reflect known climatic and physical characteristics of catchments. The hydrological clusters exhibited clear between- and within-region variations and highlighted local, regional and national sensitivity in hydrological response. A subset of rivers were randomly selected from each of the hydrological clusters to examine whether certain hydroecological variables can be used to discriminate between different hydrological clusters. The results suggest that hydrological classification can help in the development of current hydrological understanding and could help form the basis for development of management frameworks specifically designed for the “river types” identified within the classification.

S04-4B3.2 **10:45**

An Evaluation of a Distributed Blowing Snow Model in the Rocky Mountains

Nicholas Kinar, *John Pomeroy*

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Blowing snow is an important but poorly quantified component of mountain snow hydrology. The Distributed Blowing Snow Model (DBSM) is therefore examined as a tool to simulate snow redistribution and sublimation in cold mountainous basins. DBSM uses a simplified version of the physically-based Prairie Blowing Snow Model (PBSM) to characterize snow transport. The blowing snow routine is coupled with a complex wind flow routine derived from the Jackson-Hunt (J-H) theory of windflow over hills. PBSM and its derivatives are steady-state models that do not adequately deal with limited fetch distances, a common characteristic of alpine environments. Moreover, the Jackson-Hunt theory can only be applied when neutral stratification is present. This is not always the case for the boundary layer that develops over snowpacks in the mountains. The J-H theory is limited for application to low-lying hills with slope < 1:4. For more complicated topography, inadequate representation of flow separation in the lee of an obstruction (such as a sharp ridge) is a consequence of applying the J-H theory to more complicated terrain. When this occurs during a DBSM model run, insufficient accumulation of snow in the lee of hills can be rectified by application of a heuristic algorithm in DBSM which considers a portion of snow passing over a ridge to be deposited in the upwind gully. The successes and limitations of the mountain DBSM model are examined by its application to the alpine portion of Marmot Creek (50° 56' N 115° 08' W), a basin situated in the Kananaskis River valley of the Rocky Mountains west of Calgary, Alberta. The successes and limitations of the mountain DBSM model suggest the way forward for more physically accurate approaches to characterizing blowing snow transport in the Rocky Mountains.

I05-2C8.1 **INVITED/INVITÉ 14:00**

The Lunenburg Bay Project

John Cullen[1], *Hal Ritchie*[2]

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A major research project entitled “Interdisciplinary Marine Environmental Prediction in the Atlantic Coastal Region” has been in progress for several years, funded by the Canadian Foundation for Climate and Atmospheric Sciences, under the leadership of Dalhousie University in collaboration with Environment Canada (EC) and Fisheries and Oceans Canada (DFO). In this project a multidisciplinary team is developing a real-time prediction capability for the coastal regions of Atlantic Canada. This research and development is making heavy use of an advanced atmosphere-ocean observing system in Lunenburg Bay, Nova Scotia. The observations are being used to guide and test the marine coastal prediction system in an examination of many marine environmental phenomena such as waves, surface winds, sea breezes, fog, coastal upwelling, and currents in coastal embayments, that are important on daily to weekly time scales. It is producing coupled atmosphere/ocean/wave/biological models and techniques that will be suitable for adaptation by government agencies and it will produce improved numerical models for describing and forecasting coastal ocean physical and biological conditions. As a key part of meeting these objectives, we are planning an integrated observation, data assimilation, forecasting and verification demonstration project, starting in June 2007 with an initial intensive period and subsequent “on call” episodes for cases that are expected to be of particular interest. The essential elements include atmosphere, ocean, wave and biology models in a (one-way) coupled system, assimilating Lunenburg Bay data, evaluating skill, and presented on the Lunenburg Bay project web site. Research on other aspects (e.g. 2-way coupling) will be conducted during the experiment. There will be interactions with EC meteorologists, with real time access to observations, analyses and forecasts for evaluation by EC, DFO and other users. An overview, status report, and results obtained in preparation for the demonstration project will be presented.

I09-3C9.4 **14:30**

GPS-derived Precipitable Water Vapour at a Tropical Location

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Station PIMO of the International GPS Service (IGS) has operated since 1998, but the records have not been analyzed for meteorological data. In this study hourly averages for Zenith Wet Delay and Water Vapor (WV) equivalent are compiled for monthly, seasonal, annual and multi-annual periods. Monthly averages are also compiled for seasonal, annual and multi-annual periods with particular focus on the 1999-2000 La Nina event. Hourly GPS data is also used to calibrate derived WV equivalents against rain gauge measurements during significant storms such as Typhoons Xangsane and Cimaron in 2006.

O03-3B1.4 **11:15**

The effects of no slip boundary conditions on topographic generation of large amplitude internal solitary waves

Marek Stastna

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In recent years it has become clear, theoretically, observationally and experimentally, that the interaction of internal solitary-like waves with background currents can induce vigorous hydrodynamic instabilities in the bottom boundary layer (BBL). In this talk we will explore the effect of imposing no slip boundary conditions while simulating the flow of a stratified fluid over topography. We find that in the classical "resonant generation" configuration, vortex shedding associated with an instability in the BBL precludes the formation of high amplitude, flat-crested solitary waves. However, for periodic, or tide-like, currents, regions of parameter space exist in which the instabilities in the BBL increase the incidence of generation of large amplitude solitary and solitary-like waves.

S04-4C3.8 **15:15**

Improving Winter Forecasting using WRF-ARW: High-Resolution Applications of a Mesoscale Model Installed on a Linux Cluster

Shawn Allan, *John Filipkowski*

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The Advanced Weather Research and Forecasting Model (WRF-ARW) has been in use operationally by AMEC Earth and Environmental since the summer of 2006. Initial experience with high-resolution runs of the model has shown it does a good job depicting mesoscale weather phenomena such as lake-effect snow, and augmenting coarser resolution models like the GFS over the data sparse Atlantic Ocean. The model data has been directly incorporated into the AMEC forecasting platform.

WRF is run on a 20-node parallel Linux cluster for each of two domains, the first using NAM model data for both initial and lateral boundary conditions solved on a horizontal grid covering Ontario at 8 km horizontal resolution and 36 vertical levels. The second domain uses GFS for both initial and lateral boundary conditions, solved on a grid covering Ontario and Atlantic Canada to east of the Grand Banks at 20 km horizontal resolution with 36 levels in the vertical. Output data, converted to GRIB1 format using an NCEP postprocessor, includes standard meteorological variables and several diagnostic variables such as precipitation type, visibility, and wind gusts. A brief discussion will be given of some of the challenges and drawbacks of the WRF model to date.

Implementing WRF has paid dividends by leading to better forecasts for a number of client interests. Improved modelling of lake-effect snow squalls in Ontario has led to more accurate road forecasts during cold air outbreaks over the Great Lakes. The WRF run initialized by GFS, along with a number of other models including the stellar Canadian GEM, is consulted regularly by meteorologists and has been used a number of times during major winter storms. Both high-resolution GEM and WRF model data are also made available to the public over Placentia Bay in Newfoundland as part of the Smart Bay initiative.

S02-2B3.1 **10:30**

A Blended Snow Extent and Snow Water Equivalent Product

james foster[1], *Dorothy Hall*[1], *John Eylander*[2], *Ed Kim*[1], *Bhaskar Cjoudhury*[1], *George Riggs*[3], *Marco Tedesco*[4], *Richard Kelly*[5]

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Snow cover is a key component of the Earth's energy balance and a key storage mechanism for water. Melting snow contributes upwards of 70% of the total annual water supply in the western U.S., and in the Hindu Kush Himalayas, snow and ice melt is a vital resource for approximately 500 million people in surrounding countries. The ability to characterize snow storage more accurately at the drainage basin scale is crucial for improved water resource management. For example, more reliable snow inputs to hydrological models will provide improved information relating to flood control and irrigation, and knowledge of snowpack ripening is paramount for better flood prediction. Furthermore, snow cover, snow water equivalent (SWE) and albedo are critically-needed parameters for climate models.

Snow-cover extent is currently available from various satellite sensors including the Moderate-Resolution Imaging Spectroradiometer (MODIS) on board both Terra and Aqua, launched in 1999 and 2002, respectively. SWE is available from the SSM/I series of sensors on DMSP satellites and from the Advanced Microwave Scanning Radiometer (AMSR-E) on board Aqua, and snowmelt data can be derived from the SeaWinds scatterometer on the QuikSCAT satellite as well as from AMSR and SSM/I (onset of snowmelt). However, a blended snow product, for the entire globe, utilizing visible, passive microwave and scatterometer data has here-to-for been lacking. The blended snow product presented here considers the necessary snow inputs required for climate and hydrology purposes in one user-friendly product. Snow cover extent, SWE and snowmelt are mapped and measured globally on a daily or near-daily basis, initially at a resolution of 25 km. In areas of persistent cloud cover, where it is not possible to use MODIS, QuikSCAT and or AMSR-E are being employed to map snow extent. The blended product has been evaluated using data from meteorological stations and SNOTEL sites (including measurements from the CLPX-1 2002-03 field experiment in Colorado) as well as field measurements from the lower Great Lakes drainage area.

This blended snow product will soon be available for scientific and modeling applications as well as for operational weather forecasting and educational purposes. By late 2007, it will be employed to update the current Air Force Snow Depth (SNODEP) model.

I11-3DP.2 **16:00**

Application of the Cold Regions Hydrological Model for simulating snow accumulation and melt at an open and a forested site, Canadian Rocky Mountains

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Uncertainty in the response of streams and rivers within the Rocky Mountains to changes in climate or surface vegetation is promoting the development of numerical models to simulate the effects of these changes. Because snow accumulation and melt processes here are strongly controlled by complexities in terrain and vegetation, it is important to characterize the small-scale variation of the landscape within a model in order to properly represent the hydrological behavior of this environment. The Cold Regions Hydrological Model (CRHM) is a flexible object-oriented modeling system that can be used to develop, support, and apply dynamic hydrological process algorithms. CRHM provides a platform from which to generate a land-use sensitive mountain hydrology model. However, the ability of many algorithms within CRHM to accurately simulate specific physical and hydrological processes in this environment has yet to be tested.

Snow accumulation and melt routines within CRHM were used to simulate the evolution of the snowpack over two winters for a small clearing and an adjacent sub-alpine forest site. These sites are in Marmot Creek Research Basin in the Front Ranges of the Canadian Rocky Mountains, and on-site meteorological observations are available here. The simulations were compared with continuously measured snow depth and periodic surveys of snow water equivalent to evaluate model performance. Particular attention was paid to the accuracy of snow interception and sublimation routines and to snow ablation routines under forest canopies. Uncertainty in specifying forest snow albedo and in representing sub-canopy turbulent transfer led to various model outcomes. Improved unloading and melt routines are suggested by the results. The study fulfills fundamental requirements for model point evaluation that must be met before a more comprehensive modeling exercise can be successfully applied to this basin and others in the region.

I11-4D1.8 **17:45**

Towards the establishment of a drought monitoring and seasonal prediction system over Canada using the Variable Infiltration Capacity (VIC) hydrological model

Lei Wen[1], *Charles A. Lin*[2], *Zhiyong Wu*[3], *Guihua Lu*[4]

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Warming of the climate system is unequivocal. This unambiguous warning is clearly spelled out in the 21-page Summary for Policymakers released by the Intergovernmental Panel on Climate Change on 2 February 2007. Global warming would lead to more frequent extreme weather events, such as floods,

droughts and heat waves. The establishment of an accurate and timely extreme event monitoring and prediction system is of prime importance for minimizing extreme weather damage. A drought monitoring and seasonal prediction system is being developed for the Liard Basin, a sub-basin of the Mackenzie River Basin. Presently, the system uses the Variable Infiltration Capacity (VIC) land surface macroscale hydrology model driven by observed and forecast maximum and minimum air temperatures and precipitation to simulate daily soil moisture values starting from 1 January, 1951 up to the present. The simulated soil moisture values are used to calculate a soil moisture index for agricultural and hydrological drought severity. The drought monitoring component of the system comprises two modules: a 55-yr retrospective soil moisture climatology in the top 1-m layer from VIC, and a real time drought monitoring module using the operational Canadian GEM (Global Environmental Multiscale) model daily output for driving the VIC model. These modules have already been implemented over China. We plan to develop a seasonal drought prediction scheme for Canada with a focus on the Prairie regions, in collaboration with the seasonal Historical Forecast Project team. The Liard Basin drains an area of 275,000 km2 and is a sub-basin of the Western Canada Sedimentary Basin that straddles the Northwest and Yukon Territories boundary with the Province of British Columbia. The Liard River joins the Mackenzie River at Fort Simpson and is a major tributary of the Mackenzie River system. The VIC model is applied over a grid of 2,800 points with a resolution of 1/8 degree × 1/8 degree. Using the observed maximum and minimum air temperatures and precipitation, the VIC model is first calibrated and validated with daily hydrographs at Fort Simpson for the period 1 January, 1975 to December 31, 2001; calibrated VIC is then used to re-construct daily soil moisture values for the period 1 January, 1951 to 31 December, 2005. VIC performs well over both calibration and validation periods. The calculated soil moisture index explains well most documented drought events in the Liard Basin over the past 55 years. The real time drought monitoring is achieved by updating the soil moisture index fields every 24 hours with the lead time up to 10 days.

C05-4C5.7 **15:00**

An RCM projection of soil thermal and moisture egimes for North American permafrost zones

Laxmi Sushama[1], *Rene Laprise*[2], *Daniel Caya*[1], *Diana Verseghy*[3]

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The fourth-generation Canadian Regional Climate Model (CRCM4) projected changes to the soil thermal and moisture regimes for the continuous, discontinuous, sporadic and isolated permafrost regions in North America, for the 2041–2070 period with respect to the 1961–1990 base period are presented. The projections suggest a significant increase in the near surface soil temperatures for all permafrost zones, with maximum changes for the continuous permafrost zone. No significant changes in the timing of minimal and maximal near-surface soil temperatures are projected by the CRCM4. However, the distributions of both minimal and maximal temperatures, at the surface and for the various near- surface soil layers, for the future climate, are significantly different from those for current climate. Results also suggest significant changes to the thawing and freezing indices, which are major controls on the active layer thickness (ALT). Intensification of the hydrologic cycle in future climate for the various permafrost zones is projected with important changes to the soil moisture regime, which are reflected in the reduction of the frozen soil moisture content, which in turn increases the deep drainage for all permafrost zones.

I12-3B9.1 **10:30**

Droughts in Canada: An Overview

Barrie Bonsal

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Droughts are one of the most dramatic manifestations of variations in the water cycle. Large-area, prolonged droughts are among Canada's costliest natural disasters having major impacts on a wide range of sectors including agriculture, forestry, industry, municipalities, recreation, health and society, and aquatic ecosystems. Although most regions of Canada have experienced drought, southern regions of the Canadian Prairies are more susceptible mainly due to their high variability of precipitation in time and space. This presentation provides an overview of droughts in Canada with an emphasis on the Canadian Prairies. Firstly, past trends and variability in drought occurrence across various regions of the country during the instrumental and recent paleo record are reviewed. Potential future droughts as they relate to climate change are also discussed. This is followed by a description of existing knowledge regarding the large-scale atmospheric causes related to Canadian drought. Current monitoring techniques, modelling and prediction capabilities, and adaptation strategies of Canadian droughts are then presented. The talk concludes with the identification of major research gaps and program needs regarding North American droughts that will aid in our ability to understand and predict their occurrence, monitor/model their status, and adapt to their negative effects.

O02-1B1.7 **12:15**

A 3D variational data assimilation system for estimating sea-ice from satellite data

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A 3D variational sea ice data assimilation system is under development at the Canadian Ice Service. The assimilation algorithm is adapted from an operational implementation for weather prediction, and is extended to 3D-FGAT (first guess at appropriate time) for sea ice. The prediction model consists of a multi-category sea ice model coupled to the primitive equation Princeton Ocean Model (POM). The sea ice observations are derived by a linear mapping from AMSR-E brightness temperatures and their derivatives, accounting for the seasonal variability of the sea ice emissivity. The observation error variances are estimated. The choice of AMSR-E parameters to be assimilated is based on the relative performance differences of the entire system.

O03-3B1.7 **12:00**

Evolution of shoaling internal solitary wavetrains: observations and simulations

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Internal solitary waves (ISWs) are increasingly regarded as an integral component of coastal oceans, especially with respect to their suspected role as transporting and mixing agents. In this resentation, we focus on the evolution of internal solitary wavetrains upon impact with shoaling bottoms. Field observations and numerical simulations are used to quantify ISWs characteristics, energetics and transport properties during the shoaling process.

I14-1D9.6 **17:45**

Evaluation of heat pulse probe method for measuring soil thermal physical properties during freeze-thaw in agricultural soils.

Jenna Rapai

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Agricultural soils are a major source of greenhouse gases, particularly nitrous oxide, in Canada. Spring freeze-thaw cycles can comprise as much as 50% of annual nitrous oxide emissions from agricultural soils. The events producing these large fluxes of nitrous oxide occur over a very short period when rapid soil thawing occurs. Characterization of the soil conditions during this period requires the quantification of the ratio of liquid to solid water. Conventional methods for measuring soil moisture, such as time-domain reflectometry, do not distinguish between liquid and solid water. Heat pulse probes measure soil heat capacity, thermal diffusivity, and thermal conductivity. These parameters are different for liquid water versus ice. Heat pulse probes (HPP) can utilize these values to obtain the ratio of liquid water to ice; allowing a better understanding of the role of water in the soil system during freeze-thaw. Laboratory and field testing of HPPs took place at the University of Guelph, in a temperature controlled environment, and at the Elora Research Station. Laboratory measurements were done on 20 cm hand packed cores of soil obtained from the field site. Cores were subject to multiple freeze-thaw cycles limited to the vertical direction. Field testing took place for two seasons continuously from fall through to spring in order to capture any and all freeze and thaw events. Through the use of HPP, together with data obtained using time-domain reflectometry, a better understanding of the role freeze-thaw processes play in the production of nitrous oxide can be obtained. Preliminary results from the above experiments will be presented.

C05-3C5.5 **14:45**

The Influences of NAO and the Hudson Bay sea-ice on the Climate of Eastern Canada

Minwei Qian[1], *Rene Laprise*[1], *Colin Jones*[1], *Daniel Caya*[2]

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Sea-ice cover over the Hudson Bay exhibits large variability in the freeze-up season normally in November and December. Its influence on the climate over Eastern Canada has been studied with the Canadian Regional Climate Model (CRCM) in three steps. First, a seven-year continuous simulation from 1991 to 1997 was performed as a control run to evaluate the simulated climate variability over Eastern Canada, associated with the NAO (North Atlantic Oscillation). Eight additional experiments were performed with modified sea-surface conditions that were prescribed over the Hudson Bay. These integrations were used to estimate the contribution of the Hudson Bay sea-ice on the climate variability of Eastern Canada. Finally, climate variability related to sea-ice anomalies was compared to that related with the NAO. Results show that the NAO is the dominant factor controlling climate variability over Eastern Canada. The contribution of HB sea-ice anomalies to climate variability is significant only in the immediate coastal region. Under the influence of different phases of NAO, Hudson Bay sea-ice anomalies co-vary with temperature and precipitation anomalies downstream of the Hudson Bay over Eastern Canada. The ultimate cause of this relationship is NAO variability forcing on both Hudson Bay sea ice concentration and temperature/precipitation over Eastern Canada.

C01-2B6.3 **11:00**

What if we burn it all? Modelling the long term effects of maximum anthropogenic CO_2 emissions.

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The estimated sum of all fossil-fuel stocks available for human consumption contains about 5000 Pg C. The long term (4500 years) response of two earth system climate models to the introduction of 5000 Pg C as CO_2 in the atmosphere is analyzed. Emissions rates follow the IPCC A2 scenario up to 2100 and then decline linearly to reach zero in year 2300. Both models indicate the presence of significant amounts of anthropogenic CO_2 in the atmosphere and large temperature anomalies thousands of years into the future, with global mean surface air temperatures ~4.7,°C warmer and near one third of the anthropogenic CO_2 still present in the atmosphere 4500 years after emissions stop. These values are higher than the levels estimated by previous modelling experiments. Results also suggest that mechanisms associated with changes in ocean dynamics result in a positive feedback for atmospheric CO_2 in the first two thousand years after emissions cease. Based on a exponential decay fit to the average of the adjusted CO_2 curves starting at year 2300, 75% of the anthropogenic CO_2 has a half life of approximately 1300 years. The removal of the remaining 25% of the anthropogenic input requires silicate weathering, which has an estimated time scale of about 400 thousand years. These results confirm other findings that point to the very long time scale anthropogenic CO_2 effects on the planet. This understanding could, like in the cases of nuclear wastes or human induced species extinctions, be used in the social and political arenas as a way to quantify the seriousness of such impact. Over the next 300 years, the modelled carbon gain due to climate-carbon feedback tends to increase, with values at year 2300 that range from ~5% to ~25%. The higher value mainly due to much lower terrestrial carbon stocks registered under warmer climate.

I02-4B8.4 **11:30**

On the Relationship Between Snow Distribution and Sea Ice Surface Roughness in the Canadian Arctic.

John Iacozza[1], *David Barber*[1], *Simon Prinsenberg*[2]

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Our objective is to investigate the relationship between surface roughness and snow distribution over first-year sea ice at local (i.e. ground-based measurements) and regional (helicopter-based measurements) scales. This work is a preliminary step in understanding the dynamic processes responsible for the creation of snow distributions that would influence ecological, oceanographic and climatological aspects of the Arctic marine system. Results suggest that the snow depth and surface roughness parameters (average and standard deviation) vary between sites and are reasonably consistent at different scales. The average snow depth sampled at the local and regional scales range from approximately 5 cm to 35 cm, with a standard deviation between 2 cm and 35 cm. The average surface roughness varies from 7 cm to 55 cm. Sites at the two scales also exhibit similar correlation lengths with respect to surface roughness, with values less than 25 m for most sites. The standard deviation in snow depth is best estimated using the standard deviation in the surface roughness at the local level, accounting for approximately 70% of the variability in the snow depth. This relationship is non-linear and is best modeled using a logistic function. The best estimate for the mean snow depth is the mean surface roughness at the regional scale. This logarithmic relationship is able to account for approximately 80% of the variability in the snow depth.

C01-2B6.8 **12:15**

Recent and Future Behavior of Arctic Clouds

Stephen Vavrus[1], *Jennifer Francis*[2], *Axel Schweiger*[3]

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Clouds are known to be one of the most important elements of the Arctic climate system, strongly reducing wintertime cooling and summertime heating. Cloud coverage thus has a strong influence on surface temperature, snow melt, and sea ice volume. During recent decades, polar cloudiness and cloud properties have shown interesting behavior that begs further investigation. Wintertime central Arctic cloud coverage has decreased, while springtime cloudiness has increased in association with greater cloud liquid water and optical depth. These variations seem to be related to changes in atmospheric circulation and sea ice, suggesting that ice cover may interact closely with clouds and that anticipated future losses of sea ice may be important for the response of high-latitude clouds.

A suite of global climate models (GCMs) from the IPCC AR4 archive has been analyzed with respect to simulations of recent past and projected future cloudiness. None of the models is able to reproduce both the observed decrease in wintertime Arctic cloudiness and the increasing trend in springtime cloud cover during recent decades. In addition, none of the GCMs produces enough decadal variability in polar cloud amount to match the magnitude of observed trends, regardless of the sign. Models are in better agreement as to future changes in Arctic clouds, generally projecting greater cloud cover (especially low cloudiness) as greenhouse warming takes hold during this century. We speculate that the simulated relationship between climatic warming and increased cloud amount is caused by greater moisture availability, due to enhanced poleward water vapor transport in the moister global atmosphere and expanded areas of open water within the Arctic Ocean as the ice pack shrinks. These changes should result in clouds that are more liquid in composition and optically thicker than at present. Depending on how these changes vary seasonally, such altered cloud properties may significantly mitigate future Arctic warming or add to the numerous positive feedbacks within the polar climate system.

O03-3C1.8 **15:15**

Resolution of bottom boundary layer transports in a numerical model of canyon upwelling

Jordan Dawe, *Susan Allen*

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Submarine canyons on the edge of the continental shelf enhance exchanges between the shelf and the deep ocean, acting as ramps where frictional forces can overcome the influence of rotation and stratification. However, accurate model simulation of these systems is difficult due to the wide range of scales that must be resolved, from the ~10km wide, ~500m deep canyons to the ~20m deep bottom boundary layer (BBL) where frictional forces are prevalent. Resolving the transport within the BBL is especially difficult as the velocity structure varies rapidly in the vertical, requiring high vertical resolution to represent it properly. In this work, conditions for resolution of the BBL fluid transport in a numerical model are examined. A series of idealized 1-d and 2-d models are used to plot the dependence of bottom boundary layer velocity structure, transport, and particle displacement on model resolution. Using this data, a high-resolution numerical model is constructed. Numerical model

particle trajectories are compared with a laboratory model of canyon upwelling to validate the 1-d and 2-d model results.

A04-4C6.2 **13:45**

Application of an objective synoptic weather pattern classification scheme to numerical weather prediction in the Antarctic

John Cassano, *Mark Seefeldt*

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Self-organizing maps (SOMs), a relatively new technique for meteorology applications, are used to evaluate operational numerical weather prediction forecasts for the Antarctic. The SOM technique is applied to 5+ years of Antarctic Mesoscale Prediction System (AMPS) forecasts to create an objective synoptic climatology of the Ross Ice Shelf region of Antarctica. This synoptic climatology is based on sea-level pressure (SLP) and is defined by 20 unique SLP patterns. Each forecast period from AMPS is associated with a specific SLP pattern in the synoptic climatology and compared with the SLP patterns identified for the SLP analyses valid at the same time. This comparison provides information on the mis-prediction of synoptic weather patterns by AMPS. Model validation statistics for near surface meteorological variables are calculated for each weather pattern in the synoptic climatology. The results indicate that AMPS has varying skill, which depends on the synoptic pattern.

H01-1C4.6 **14:45**

Hydrology of a Small Upland Tundra Lake

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The phenomenon of rapid lake drainage of permafrost lakes in circumpolar regions has been well documented. This rapid drainage occurs when lakes form new drainage channels through ice rich permafrost, resulting in the complete, or partial, drainage of the lake in a few hours. Given the vast number of permafrost controlled lakes in many Arctic regions, and considering the projections of above average climatic warming trends for many northern regions the concern is that many small tundra lakes could disappear, with significant implications to Arctic hydrology and ecology.

Little is known about the causes for such rapid lake draining. As a first step towards understanding the reasons for this phenomenon, this study will examine the hydrology and water balance of a small upland tundra lake located in the Mackenzie delta region of north-western Canada. A small scale hydrologic model (TOPOFLOW) is used to simulate the inflow into the lake. The model was validated for the area against measured streamflow data for seven years. Precipitation onto and outflow from the lake was obtained from observations, while evaporation from the lake was computed using the Priestley - Taylor equation and observed climate data. The results were combined to compute a complete lake water budget for 2006. The obtained results were validated against observed lake levels.

Future work will focus on calculating lake levels for an extended time series and relating them to known instances of rapid lake drainage in nearby lakes. In conjunction with the analysis of other factors such as average air temperature, this should provide important insights to understand the

complex interaction of climate, permafrost conditions, and hydrology for the rapid drainage of Arctic lakes.

C01-2C6.5 **15:00**

Predicted changes in synoptic forcing of net precipitation in large Arctic river basins during the 21st century

John Cassano[1], *Petteri Uotila*[2], *Amanda Lynch*[2], *Elizabeth Cassano*[1]

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Daily output from fifteen global climate system models and two global reanalyses were analyzed to create a synoptic climatology of Arctic sea level pressure and to assess predicted changes in net precipitation over the Arctic. The method of self-organizing maps was used to create the synoptic climatology. The model derived synoptic climatology was compared to that from two global reanalyses and this comparison was used to select a subset of models which best reproduced the currently observed synoptic climate of the Arctic. Of the fifteen models evaluated in this way only 4 models were able to reproduce the key features of the Arctic synoptic climate as depicted by the two global reanalyses. The synoptic climatology from this subset of 4 models indicates an increase in cyclonically dominated weather patterns over the 21st century. The models also projected an increase in net precipitation over the Arctic cap and the large Arctic river watersheds during the 21st century. Using the synoptic climatology, a method to assess thermodynamic and circulation related changes in net precipitation was derived. The results of this assessment indicate that thermodynamic changes are responsible for more than 75% of the predicted change in Arctic net precipitation during the 21st century.

C04-3DP.5 **16:00**

Relationships between Arctic climate modes and daily weather patterns in the Mackenzie and Yukon watersheds

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The method of self-organizing maps (SOMs) was used to create an objective synoptic climatology of daily sea-level pressure (SLP) patterns over the Yukon and Mackenzie watersheds. This synoptic climatology was based on ERA40 data and identified a total of 35 unique SLP patterns for this region. The frequency of occurrence of these patterns on seasonal, annual, and interannual time scales has been determined. Relationships between the frequency of occurrence of the different daily SLP patterns and the major modes of Arctic climate variability (Arctic Oscillation and Pacific Decadal Oscillation) have also been determined. Finally, changes in the frequency of occurrence of these weather patterns over time (from 1958-present) has been evaluated. These results provide a method for relating daily weather patterns to the larger climate of this region, and provides a physically consistent link between weather and climate.

C05-3C5.6 **15:00**

Issues arising from the transferability of two Canadian Regional Climate Models to non-native domains

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Regional climate model (RCM) simulations between years 2000 to 2004 were conducted with the Canadian Regional Climate Model (MRCC) and the climate version of the operational forecast model of Environment Canada (GEM-LAM) over seven different regions of the globe with the objective of assessing their "transferability". That is, the ability of RCMs to simulate the variability of continental scale climates over different regions of the world with minimal parameter changes. Where useful, an analysis of the simulated surface energy budget (surface radiation and turbulent fluxes) is made using CEOP flux observations. This aids in understanding the cause of deviations in surface temperatures and humidity from those observed.

To gauge the transferability to other continents, we have evaluated their performance separately for winter and summer seasons, using CEOP observations taken from: 1 mid-latitude coastal site, 2 mid-latitude continental sites, 2 Arctic sites, 2 sub-tropical land regions, 1 equatorial land station and 1 equatorial island. We present time-series, frequency distributions, bias estimates and mean diurnal cycle results for these stations, highlighting geographic areas and/or seasons when the two RCMs perform well or where they diverge.

MRCC and GEM-LAM simulated the annual cycle of surface temperature close to the observations over mid-latitude regions of Europe and North America. The largest deviations were observed at high altitude stations, arctic regions, and the tropics for different reasons. The analysis yields an insight about how the two models simulate the timing of convection or frontal progression in different regions of the world. Where possible we use extra CEOP observations to determine the cause of a given model deviation and make recommendations for improvements for the model concerned.

H01-2DP.6 **16:00**

The hydrology of a boreal fen in central Saskatchewan

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The Boreal Ecosystem Research and Monitoring Sites (BERMS) Southern Fen location originally part of the Boreal Ecosystem-Atmosphere Study (BOREAS) experiment 1994-1996 was re-commissioned in the summer of 2002 to monitor wetland hydro-ecology and carbon fluxes. The site is located approximately 100 kilometers northeast of Prince Albert, Saskatchewan near Narrow Hills Provincial Park (Latitude: 53.78 degrees North, Longitude: -104.616 degrees West). It is a patterned fen surrounded by black spruce and jack pine forest. The central part of the Southern Fen is predominately un-treed and is dominated by herbaceous vegetation consisting of buckbean and various species of sedges. The dominant shrubs in the central area are bog birch and willow species. Scientific interests include an understanding of wetland ecology, carbon exchange and the significance of wetlands to the regional hydrology; particular attention was given to evaluating changing environmental and climatic

conditions such as seasonal and inter-annual wet and dry conditions. Data for 2003-2006 include precipitation, other climatic variables, evapotranspiration measured by eddy correlation, water table heights in and near the fen, peat surface movements and snow surveys. Hydrologic conditions varied from extremely dry in 2003, with the water table well below peat surface, to extremely wet in 2005 and 2006 with the peat surface completely submerged. The water balance of the fen is assessed on the basis of the data and further analyzed with the Cold Region Hydrological Model (CRHM). Emphasis in analysis is put on understanding the wetland hydrology, specifically, the evapotranspiration over the dry and subsequently flooded fen surface, runoff to regional streamflow over the fen surface and subsurface redistribution and storage of water.

A04-3C6.7 **15:00**

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE): Project Overview

Neil Taylor[1], *David Sills*[2]

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The Canadian Prairies are subjected to a high frequency of severe thunderstorms with an average of 203 severe weather reports received by Environment Canada each summer. The Alberta Foothills are a preferential region for thunderstorm development and experience the most thunderstorm days of all the Prairie Provinces. Most storms developing there move eastward to affect the Edmonton – Calgary corridor; one of the most densely populated and fastest growing regions in Canada. Alberta has proven to be particularly susceptible to costly thunderstorm events; Public Safety and Emergency Preparedness Canada estimate that since 1981 more than 40 lives and $2.5B have been lost due to severe storms.

Recent severe weather studies have stressed the importance of mesoscale convergence boundaries and boundary-layer water vapour in thunderstorm development. However, these boundaries and associated processes cannot be adequately resolved using existing synoptic surface and upper-air observation networks in the Prairie Provinces. Over the Alberta Foothills for example, there is a 30 000 square kilometre area without a single surface observation station. Conceptual models for severe storm outbreaks in Alberta are nearly 20 years old and do not focus explicitly on mesoscale boundaries (e.g., the dryline) that are now known to be important in the region.

Environment Canada researchers and other interested scientists from academia and the private sector are planning a field experiment over the Alberta Foothills to investigate boundary-layer processes associated with convective initiation (CI). The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE), planned for summer 2008, will investigate the importance of boundary-layer water vapour availability / stratification and mesoscale convergence boundaries to the development of severe thunderstorms over the Alberta Foothills. Measurements obtained through a high-resolution network of surface (stationary and mobile), upper-air, and airborne instruments will be used together with measurements from existing platforms to better understand important mesoscale processes in this thunderstorm genesis zone. UNSTABLE goals are to better understand the processes leading to the development of severe thunderstorms, refine conceptual models related to CI, and assess the utility of mesoscale numerical models to resolve physical processes over the Alberta Foothills. Results will be transferred to operational forecasters to improve accuracy and lead time for severe thunderstorm watches and warnings. An overview of the science questions to be answered, the proposed methodology, and the status of the project will be presented.

A04-3C6.8 **15:15**

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE): Testing of Mesonet Instrumentation

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The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) is a field study designed to investigate boundary-layer processes associated with severe thunderstorm development over the Alberta Foothills. The primary areas of interest for UNSTABLE are the importance of boundary-layer water vapour and mesoscale convergence boundaries to convective initiation and severe thunderstorm development in Alberta. UNSTABLE is being developed by the Hydrometeorology and Arctic Lab (HAL) and Cloud Physics and Severe Weather Research Section (CPSWRS) of Environment Canada in collaboration with other Environment Canada divisions and members of the academic and private meteorology sector.

A network of surface and upper-air instrumentation is being designed to provide measurements for the experiment with sufficient spatial and temporal resolution to resolve important boundary-layer processes related to convective initiation and severe storm development. A major component of this network is a mesoscale network (mesonet) of stationary and mobile surface observations providing frequent sampling of atmospheric thermodynamic and kinematic variables. The mesonet will include deployment of 10-20 transportable weather stations and one or more mobile weather stations to augment data from the existing synoptic observation network. The incorporation of mobile surface measurements is critical for resolving mesoscale convergence boundaries (e.g. the dryline) in time and space within a network of fixed observation sites.

During the summer of 2006, one mobile and three transportable mesonet stations were tested in the Alberta Foothills. The mobile station proved to be physically robust and data collected and compared to those obtained from fixed stations show good correlation. Results of these tests will be presented highlighting the significant variability of atmospheric characteristics over short space and time scales. This variability points to the necessity of mesoscale measurements to resolve processes important for convective initiation and severe storm development.

C05-3C5.1 **INVITED/INVITÉ 13:30**

seasonal climate prediction using regional climate models

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Regional Climate Models (RCMs) provide an essential component of the model hierarchy. RCMs nested within the global ones enable the predictability of regional climate processes to be studied in much greater spatial and temporal details. They provide a direct means to make seasonal climate predictions on the spatial scales often most relevant to risk management decision makers. This paper presents an assessment of the current state of knowledge and capability in seasonal climate prediction using RCMs. The discussion covers, 1) sources of predictability at regional scales, 2) predictability at smaller spatial and temporal scales, 3) values added by RCMs for seasonal climate forecasts, and 4) a brief consideration of the coming decades that seeks to improve season climate forecasts using RCMs.

S05-1C3.2 **13:45**

A Climate Data Record of Hemispheric Snow Cover Extent During the Satellite Era

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It has been 40 years since satellite-derived maps of Northern Hemisphere snow cover extent (SCE) began being produced by National Oceanic and Atmospheric Administration meteorologists. No other environmental variable has been mapped from satellite data in a generally consistent manner for such a long period. Information generated from these maps has been used in international assessments of climate variability and change, and in numerous investigations regarding the role of snow cover in the climate system. Despite their proven climate utility, meteorological forecasting has long been the driving force behind producing these maps. As such, changes (documented and undocumented) in mapping methodologies have occurred over time, without a focus on their climatological continuity. In particular, 1999 brought a change from weekly to daily maps and a greatly increased resolution to the map's digitized grid. Members of our Global Snow Lab, as well as others elsewhere, have kept a watchful eye on changes in this satellite environmental data record (EDR). We saw the need to thoroughly scrutinize the EDR and to develop a satellite SCE climate data record (CDR). This presentation will discuss efforts within the Global Snow Lab to do just that, and will introduce this CDR. Comparisons of climatologies and time series between the new CDR and the past EDR will be presented, along with estimates of CDR error limits. Updated time series analyses of regional to hemispheric SCE through 2006 will also be discussed, along with efforts underway that will integrate visible and microwave satellite and station-observed estimates of extent and depth into valuable new CDRs.

H06-4B4.4 **11:30**

Comparison of ice core proxies for summer temperature with observations

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In the Canadian high Arctic, variations in glacier mass balance are largely attributable to melt-driven variations in summer mass balance. Reconstruction of past summer temperatures is therefore critical to understanding the long term mass balance history of glaciers and ice caps in the region. Ice cores may provide proxy records of summer temperature because warmer summers and increased melt should be reflected in heavier delta 18 O and increased fractions of refrozen melt water within ice and firn. In this study, annual maximum values of delta 18 O and annual melt layer thickness are extracted from two ~20m long ice cores from the Prince of Wales Icefield (PoW), Ellesmere Island Canada (dated 1966-1999 and 1975-1999). These proxies are compared to annual summer (mean June, July and August) temperatures from nearby weather stations and mass balance records from the Queen Elizabeth Islands.

Summer temperatures from Alert and Resolute show no trend for 1966-1999 and only a weak positive trend is present in the Eureka record. The oxygen isotopes and annual melt records, however, clearly show a significant trend toward more melt and heavier delta 18 O at the end of the last century, especially in the 1980s. The annual mass balance records decrease significantly from 1966 to 1999, particularly at the end of the 1980s. The discrepancy of temperature records and proxies may be due to the fact that the temperature can only be recorded by the proxies when it snows (oxygen isotopes) or when temperature rises above melting (melt layers). Similarities in the two different proxy records and similar trends in the mass balance record suggest, however, that regional or altitudinal differences

cause the discrepancies between proxies and measured temperature, since the weather stations are several hundred kilometers away by the sea and at sea level elevations.

I11-4D1.2 **16:15**

Spatial and temporal variations in active-layer thawing and hillslope runoff generation in a discontinuous permafrost basin

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Peat plateau hillslopes are hydrologically important to basin runoff in cold regions, because they accumulate a large proportion of the basin snow water prior to spring melt and contribute to streamflow generation long after other landscape types have become depleted with snow cover, even into the summer months. Underlain by permafrost, peat plateau hillslopes discharge precipitation inputs primarily through the saturated zone between the water table and the frost table, where the depth of this zone controls the magnitude and timing of hillslope drainage to stream channels, given the depth-dependency of saturated, hydraulic conductivity, and the relative impermeability of the upper boundary of the frozen saturated layer. This study examines the role of active layer development on hillslope runoff generation of peat plateaus at Scotty Creek, a small (152 km2), wetland-dominated discontinuous permafrost basin in Northwest Territories, Canada. Field studies examined the distribution of frost-table depths of a peat plateau hillslope at a variety of spatial scales during spring melt, and prior to freeze-up, over four consecutive years (2003-2006), in order to determine how soil moisture, vegetation characteristics, surface topography, precipitation inputs, and air temperature affect soil thaw rates, and to evaluate the importance of the spatial and temporal variations in active layer development to the timing and rate of lateral flow on the peat plateau. Using a detailed grid of surface and subsurface topography, the flow and surface storage relationships of the plateau hillslope were examined. The results of this study provide insight into how runoff is generated from these hillslopes; details of which may improve basin-scale hydrological models for northern, wetland-dominated basins.

G10-1D2.4 **17:15**

Seismic characterization of heterogeneity: progress, problems and examples

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Methods for the characterization of geologic heterogeneity using back scattered seismic and EM waves are receiving increasing attention, particularly as an aid to building and understanding realistic predictive models. Geologic systems that benefit from heterogeneity characterization range from shallow aquifers and petroleum reservoirs to crustal regimes with protracted magmatic and deformation histories. The goal of heterogeneity characterization is generally to invert the back scattered wave field for some form of statistical description of the spatial distribution of heterogeneity. In the case of porous reservoirs, these descriptions can be applied to models aimed at predicting fluid flow characteristics and to conditioning stochastic reservoir simulations. In the case of igneous and metamorphic terrains, mapping of heterogeneity variations provides an alternative interpretation tool that can reveal macro-scale petrofabric variations indicative of crustal processes such as intrusion of igneous bodies and strain partitioning related to partial melting and migmatization. Relative estimates of heterogeneity can be readily extracted from back scattered wave fields but absolute estimates of spatial properties are more difficult. The difficulty in deriving absolute estimates arises primarily from three issues, 1) the limited bandwidth of the wave field, 2) the variation in the back scatter response of continuous and modal lithologic fields and, 3) the recently identified coupling of the vertical and lateral properties of the differential operator that links the velocity and reflectivity fields. In this presentation we will show examples of heterogeneity estimation applied to several types of seismic data. These examples will illustrate the value of the technique as well as demonstrate ongoing efforts to surmount the recognized limitations.

H01-1B4.6 **11:45**

Estimating long-term evaporation from boreal forest lakes in northeastern Ontario using stable isotopes

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Stable isotopes have been used to estimate lake evaporation in remote landscapes in Canada where hydrometric data are lacking. This information is particularly useful for assessing the impacts of land use change (e.g. forest harvesting) on lake water balances. We used the stable isotope method to estimate long-term open-water evaporation from headwater lakes with similar geology, relief and climate on the flank on a north-south esker in northeastern Ontario. Mean annual precipitation is approx. 780 mm and mean annual regional evaporation is approx. 450 mm. Precipitation, groundwater and lake water for five lakes were sampled during the 2004 open water period and analyzed for δ18O and δD, while 13 lakes (included the five 2004 lakes) were sampled in 2005. Long-term lake evaporation estimates using late-summer samples in 2004 ranged from 72 329 mm (δ18O) and 109 570 mm (δD), while 2005 estimates ranged from 45 411 mm (δ18O) and 66 640 mm (δD). There was good agreement between evaporation estimates for the lakes sampled in 2004 and 2005. The lake with the smallest estimated evaporation appears to be strongly influenced by groundwater inputs from the esker, and an alternative use of the stable isotope method is to identify lakes whose evaporation estimates deviate markedly from regional values from other sources. Such a deviation indicates hydrogeologic conditions requiring further investigation to understand groundwater inputs to lakes and the overall lake water balance. Evaporation estimates for the remaining 12 lakes agree with regional estimates of lake evaporation, although morphometric properties did not explain inter-lake variations in evaporation estimates. Most of these headwater lakes do not have surface outflows, and are losing 300 – 400 mm of water per year through their lake beds to underlying groundwater. Such losses are supported by seepage meter data. These lakes currently receive limited groundwater inputs from their forested basins; however, this situation may change should enhanced groundwater recharge accompany harvesting of the lake basins.

A04-4C6.4 **14:15**

Adjusting to a new high resolution global version of the GEM model

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On October 24 2006, the Canadian Meteorological Centre implemented an upgraded version of the GEM global model. A significant increase in resolution and an updated physics package improved the model skill and changed not only the quality of the forecast but also the look of the output fields. The new version of the global model is more active cyclonically and the meteorological structures and QPF patterns are more realistic. Thus, when evaluating the model ouputs, one has to adjust to these changes. After summarizing the changes to the global model and showing some objective scores, we will present some situations and cases where the model behavior has improved. For example, these cases will show that the new model has a better handle on hurricane development and tracking but also show it can develop realistically stronger lows in the medium range.

G08-2B2.2 **10:45**

The role of constraints in the inversion of gravity data

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Techniques for the inversion of gravity data have evolved since the 1970's. Modern techniques depend on a knowledge of the uncertainty in the observed gravity and in the production of a reference model to assess the inversion success. The challenge of inverting potential field data is to guide the inversion process through from the infinite mathematically possible models to geologically plausible models. The path to the final model depends on the inherent uncertainty and spatial properties of the raw gravity data set, and on the statistical properties and spatial distribution of the rock density data set. Using an example from the gravity survey over the Voisey's Bay nickel-cobalt-copper deposit, the influence of each of these is explored. Uncertainty in the original gravity data provides the control in the final misfit. The spatial distribution of the initial gravity acquisition locations controls the capacity of the inversion to correctly locate the inferred density distribution. The degree of statistical variation in the subsurface rocks controls the inferred density values and through these the inferred subsurface geology. The spatial distribution of the rock samples and the developed geostatistical model control the lateral and vertical resolution of the inversion. The final model is a obtained through process which involves considerable input from the interpreter to steer the process to a geologically reasonable outcome.

I08-3C7.1 **INVITED/INVITÉ** **13:30**

Moving Toward a Seasonally Ice-Free Arctic Ocean

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At projected rates of greenhouse gas loading, the Arctic Ocean may become ice free in summer well before the end of this century, possibly with far-reaching implications. Given observations that the sea ice cover is quickly shrinking as the Arctic warms, it appears that this transition is well underway. However, just when the Arctic will completely lose its summer ice cover is uncertain. Part of this stems from recognition that the Arctic system has and always will exhibit strong natural variability. It also reflects a number of competing seasonal interactions between the atmosphere, sea ice and ocean that are still not well understood. Key issues include seasonal processes associated with the positive ice-albedo feedback through which initial ice loss sets in motion a chain of events fostering further loss, impacts of the Arctic Ocean on the atmospheric circulation, and the role of cloud cover. There is growing concern over the possibility of a tipping point - that once the sea ice thins to a critical

threshold, it will become vulnerable to very rapid collapse, with natural variability serving as the trigger. Some studies suggest that we may have already passed the tipping point. This talk addresses these and other issues drawing on assessments of the Arctic's present-day heat budget and atmospheric circulation, oceanographic data, satellite observations, and results from a variety of model simulations.

G08-2B2.1 **10:30**

The inversion of magnetic data – the role of remanent magnetization

Hugh Miller, *Michael Wheeler*, *Joseph Hodych*

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The inversion of magnetic data is more complex than the inversion of gravity data for two reasons. First the magnetic field is a vector and second the magnetization of the source can be acquired in the present Earth's field (Induced magnetization) or remain from a former magnetization episode in the history of the rock (Remanent Magnetization). Two inversion packages have been used to invert the ground magnetic data collected over the Voisey's Bay nickel-cobalt-copper deposit. One of these packages can handle remanent magnetization, the other cannot. Uncertainty in the original gravity data and the deviation of the model from a reference model provides the control of the final misfit. In addition to these fundamental differences in the operation of the inversion packages, the usual controls on the inversion arise from the survey layout, knowledge of the statistical variations in the rock properties, and constraint on the location of the anomalous rock body. The inversion to a final model which is geologically realistic requires the interpreter to comprehend these complex interactions and guide the inversion process.

C04-3DP.6 **16:00**

Drivers of Trends in Arctic Surface Longwave Fluxes

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Recent analyses of satellite-derived dynamic and thermodynamic forcing parameters suggest that anomalies in downwelling longwave (infrared) radiation fluxes (DLF) account for most of the variance in the extent of perennial sea ice in six peripheral seas around the Arctic Ocean [Francis et al., 2005; Francis and Hunter, 2006]. We also observe significant increases in DLF in spring through autumn over most of the region, pointing to DLF as an important driver of the dramatic sea ice loss that has occurred in recent decades. What is unclear, however, is which of the many possible atmospheric variables are causing DLF variability and change? In this presentation we examine the contributions of varying temperature, cloud properties, and precipitable water to DLF changes using a radiative transfer model, measurements from the Surface Heat Balance of the Arctic (SHEBA) field campaign, and satellite-derived observations to identify drivers of change in Arctic DLF.

C04-4D5.2 **16:15**

Climate Variability in the Central Labrador Highlands

John Jacobs[1], *Trevor Bell*[1], *Mariana Trindade*[2]

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Impacts of climate change may be most apparent near ecoregion boundaries or transition zones such as boreal and alpine treelines. Monitoring for ecosystem change in such areas is underway, including some projects of the International Polar Year. Understanding and modeling vegetation – climate relationships requires a good record of the mesoscale and local climate. In northern regions, climatological records tend to be biased toward low elevation locations. However, short-term observations from field locations can be used with long-term records from such permanent stations to produce a useful synthetic record for the area of interest. Since 2001, as part of a larger study of treeline ecosystems in Labrador, climatological observations have been conducted in the central Mealy Mountains. There, where summits approach 1100 m a.s.l., tree line occurs at about 600 m a.s.l. and ground temperatures indicate the presence of sporadic permafrost. Five years of record reveal a subarctic-alpine climatic regime that is driven by alternating continental and maritime (Labrador Sea) influences in a regular seasonal progression. The regional instrumental record (beginning ca. 1940), is dominated by the NAO/AO, particularly in winter. Temperature trends through the 20th century are slight and not statistically significant, except for the winter cooling through the early 1990s that is generally recognized over northeastern Canada and southwestern Greenland, and which ended in the mid-to-late 1990s. Multivariate analysis of the regional record allows us to extrapolate from the short field record to produce a synthetic long-term record of the alpine area that can be used with proxy data from tree rings to reconstruct climate-treeline relationships of the past 200 years or more and, potentially (using sub-fossil tree material) to examine conditions during a mid-Holocene warm interval (ca. 4000 yr ago). Key words: Climate variability, subarctic-alpine climate, proxy records, Labrador.

C05-3B5.2 **11:00**

Evaluation of Cloud-Radiation Interaction in the Canadian GEM Model Using ARM Observations

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Clouds are one of the dominant sources of uncertainty in climate models. A part of this uncertainty comes from cloud-radiation interactions that control the surface and top of atmosphere net radiation. This interaction is controlled by many clouds characteristics such as: cloud microphysics (e.g. liquid and ice water content and partitioning), the clouds macro-structure (cloud fraction and timing within the diurnal cycle), etc. Due to their various scales and their extreme complexity, processes controlling the cloud-radiation interaction are highly parameterised in present-day climate models.

In this presentation we evaluate the cloud-radiation interaction and microphysical parameterisations in the new Canadian Regional Climate Model, based on the limited area version of GEM (Global Environmental Multiscale Model, Côté et al. 1998). GEM employs a prognostic total cloud water variable, with a Sundqvist-type bulk-microphysics scheme, along with a new radiation scheme based on the correlated-K approach (Li and Barker 2005). GEM-LAM was integrated for the period 1998-2004 over 2 domains, centred on the ARM Southern Great Plains site, and North Slope of Alaska site, respectively. Both integrations used ECMWF reanalysis as lateral boundary conditions, prescribed SSTs and employed a horizontal resolution of ~ 42 km.

To evaluate the models ability to reproduce the interaction between cloud-microphysics and radiation,

we compare the simulated co-variability of solar and terrestrial radiation as a function of liquid water path (LWP), with the same co-variability from observations. We compare simulated frequency distributions of LWP and precipitation rate, for different seasons and periods of the diurnal cycle, with equivalent observed distributions. Comparison across different seasons, the diurnal cycle and at both ARM sites allows an evaluation of the microphysical processes in GEM across a wide range of meteorological conditions. It further allows us to identify climate regimes where cloud-radiation processes are simulated well and regimes that require improvement.

O03-2C1.3 **14:30**

Coastal dynamical response to local wind forcing, tides, and buoyancy forcing in Lunenburg Bay of Nova Scotia

Li Zhai, *Jinyu Sheng*

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Observations made by a multidisciplinary ocean observatory in Lunenburg Bay (LB) of Nova Scotia demonstrate that the observed temperature and salinity in LB had significant spatial and temporal variability in the summer and fall of 2003. Heat budget analysis indicates that the variations of the hydrographic observations are affected by both the local (i.e., surface heating and vertical mixing and advection) and non-local (horizontal advection and mixing) processes. The observed currents are decomposed into the tidal and non-tidal components. The semi-diurnal M2 tidal flow is the major tidal constituent and explains more than 50% of the total variance of the observed tidal currents at the three mooring sites in the Bay, which are consistent with previous studies. The observed non-tidal currents have significant temporal variations with the first EOF (empirical orthogonal functions) mode correlated strongly with the local wind forcing and the second EOF mode correlated strongly with the vertical shear of the horizontal currents estimated from horizontal density gradients based on the thermal wind relation.

The three-dimensional circulation and hydrography during the study period are also studied using a nested-grid coastal circulation modelling system. Numerical model results demonstrate that the spatial and temporal variability of the simulated temperature is forced mainly by the local wind forcing during the upwelling/downwelling events. The model results also have a strong baroclinic throughflow over the deep water region outside Lunenburg Bay, and baroclinic Kelvin waves generated around East Point Island when the southeastward wind dies down and propagate into the Bay. Quantitative comparisons between the observations and model results demonstrate that the nested-grid system reproduces reasonably well the observed sea level, temperature and salinity, and currents.

I09-3C9.6 **15:00**

Impact of ground-based GPS observations on the Canadian Regional Analysis and Forecast System

Stephen Macpherson, *Godelieve Deblonde, Josep Aparicio, Barbara Casati*

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The atmosphere introduces a signal delay between Global Positioning System (GPS) satellites and ground-based receivers which is routinely estimated to a high degree of accuracy in geodetic precise positioning applications. The total delay due to the neutral atmosphere, called zenith tropospheric

delay (ZTD), depends on surface pressure, temperature and integrated water vapour (IWV). Given measurements of surface pressure and temperature, IWV can be retrieved from ZTD estimates for meteorological applications. Half-hourly ZTD and retrieved IWV observations for North America are available in near real time from the NOAA Global Systems Division (GSD) research network of GPS sites. Collocated or nearby surface weather observations (pressure, temperature and relative humidity) are also provided.

Studies have shown that assimilation of ground-based GPS observations (IWV or ZTD) can have a significant impact on forecasts of humidity and precipitation. This paper presents results of data impact experiments involving the addition of the NOAA/GSD network ZTD and surface weather observations to the Environment Canada (EC) regional (North America) data assimilation system (RDAS). The RDAS is a three-dimensional variational (3D-Var) data assimilation system with first-guess provided by the EC Global Environmental Multiscale (GEM) regional forecast model. The impact on 48-hour regional GEM forecasts initialized with analyses from the RDAS is evaluated for two periods: summer 2004 and winter 2004/2005. The assimilation of GPS observations produces a generally positive impact on humidity forecasts in the mid-troposphere for the 0-24h range (based on verification with North American radiosondes), especially for the summer period in the southeast US. Verification of 24h precipitation accumulation forecasts with rain gauge measurements shows an overall positive impact, most evident in 12-36h and 24-48h accumulations over the central US region.

C04-4B5.3 **11:00**

Drivers of Variability in Arctic Winter-Maximum Sea Ice Extent

Jennifer Francis, *Elias Hunter*

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While summer-minimum sea ice extent in the Northern Hemisphere has declined dramatically in past decades, winter-maximum sea ice extent has remained relatively stable -- until recently [e.g., Comiso, 2006]. Winter sea ice extent is confined by coastline everywhere except in the Barents Sea (north of Scandinavia) and in the Bering Sea (north of the Aleutian Islands), thus most of the variability and loss depicted in the Northern Hemispheric mean extent results from the behavior of ice in these two regions. Using a combination of satellite-derived observations and products from the European Centre for Medium-range Weather Forecasts (ECMWF) 40-year Reanalysis (ERA-40) and operational analyses, we investigate the spatial and temporal variability in the maximum ice extent in these two regions and the drivers of interannual differences. Preliminary results suggest that winter ice extent in these two seas is driven by markedly different forcing mechanisms.

A07-2DP.7 **16:00**

Analysis of heat and moisture transport in the polar regions in the 20th century

Natasa Skific

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This study explores seasonal temporal and spatial variability of the Arctic atmospheric energy budget, derived from daily data of ECMWF 40 year Reanalysis (ERA-40). In particular, it focuses on the meridional and zonal advection of heat and moisture, and moisture convergence during the winter (DJF) and summer (JJA) months. The analysis utilizes a self-organizing map (SOM) approach, in order to diagnose dominant modes of energy transport in the 20th century.

I14-3DP.1 **16:00**

Carbon dioxide exchange from peat-*Sphagnum* monoliths under varying moisture conditions

Maria Strack[1], *Jonathan Price*[2]

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Sphagnum moss is the major peat-forming vegetation in boreal peatlands. The relationship between *Sphagnum* moss productivity and moss moisture content has been documented; however, the link between moss moisture content and conditions in the underlying peat column is less clear. We monitored moisture content throughout two peat monoliths dominated by *Sphagnum fuscum* and *S. magellanicum*, and CO_2 exchange under drying conditions, and rewetting, from below and via simulated precipitation events. Surface moss moisture was related to water table position but varied between species. Both moss moisture and water table position could be used to explain net CO_2 exchange and respiration during drying and rewetting from below, although hysteresis was apparent. Precipitation complicated these relationships because small events ($_2$ exchange without affecting water table position or subsurface water contents. Although these small events will be difficult to measure in the field, they must be included in ecohydrological models of *Sphagnum* productivity because they may contribute significantly to seasonal carbon balance.

H01-2DP.9 **16:00**

GPS Derived Precipitable Water Vapour as a Source of Data for Evapotranspiration Modelling

Caterina Valeo, *Susan H. Skone*, *M. Rebeca Quiñonez-Piñón*

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The amount of water vapour in the atmosphere can significantly influence evapotranspiration (ET) rates and thus, accurate quantification of atmospheric water vapour is essential for accurate modelling and reliable predictions related to this process. GPS derived precipitable water vapor (PWV) may present an excellent source of data for use in modelling the ET process. The University of Calgary operates a GPS monitoring network in Southern Alberta with the objective (one of several) to evaluate GPS derived precipitable water vapour measurements for use in weather and climate applications. The network collects continuous PWV data with high temporal and spatial resolution; this presents an excellent opportunity to investigate the utility of such data for use in modelling changes in soil moisture and ET rates over southern Alberta farms. Equipment deployed in several barley fields in July of 2003 was used to estimate ET for a two week period. This data, along with GPS derived PWV data and Environment Canada meteorological data from several stations were analyzed to determine the utility and feasibility of using GPS derived PWV data in support ET modelling.

A04-3C6.5 **14:30**

Dynamical-Statistical Models for Lightning Prediction to 48-hr

William Burrows

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Dynamic-statistical models for spatially-continuous lightning probability prediction in three-hour intervals to 48 hours in the warm months have run at the Canadian Meteorological Center (CMC) since 2003 (Burrows et al., WAF, 2005). Since the original development it became possible to include important predictors not previously available. New models were developed and have run daily since April 2006. One model was built for each 3-hr period. Resolution is 15 km. Training data consists of just 1 day per month March to September 2005 for a domain covering the northern United States and much of southern Canada. There are two predictands derived from observations by the North American Lightning Detection Network: (1) "time-area coverage" of lightning (similar to probability), and (2) number of flashes per three-hours. Several predictors from deep convection parameterization in the GEM regional model are included, plus important environment predictors. Calculations are on a moveable 9*9 grid centered on each grid point at four times in each three-hour diurnal period (t, t+1, t+2, and t+3 hours), giving 324 data points with which to calculate derived predictors as statistics of basic predictors, e.g. the minimum Showalter index; the fraction of points with upward deep convection velocity greater than 20 m/s. Data reduction keeps the number of predictors to 50 or less. Tree-structured regression, a modern data-mining technique, is used to derive models. Cross-validation shows the trees fit 80-90% of expected predictand variance. Trees have 300-700 nodes, allowing for quasi-continuous prediction across the whole domain. Prediction is year-round, and forecast coverage is extended to regions not included in the training data such as northern Canada and the southern United States. Use by Canadian forecasters has grown for thunderstorm prediction in public forecasts and convective area depiction in aviation forecasts. There has been considerable interest from forestry groups in using the forecasts for 1-2 day fire likelihood predictions.

I08-3DP.6 **16:00**

Ice Databases at the Institute for Ocean Technology

Brian Hill[1], *Stephen Jones*[2]

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The Institute for Ocean Technology was established in St. John's in 1985 (at that time called the Institute for Marine Dynamics) to provide technical expertise in Canada's ocean technologies. In support of the various research activities, several North Atlantic ice related databases have evolved. The first to be derived, The Newfoundland Ice Extent, was the historical occurrence of sea ice on the Grand Banks from 1810, based on contemporary reports in shipping newspapers and gazettes, reports of the International Ice Patrol (IIP), and information from the Canadian Ice Service.

In a collaborative effort with the Bedford Institute of Oceanography, an historical time series for the ice extent in the Gulf of St. Lawrence and Scotian Shelf over a similar period was determined. The reports used in constructing these two time series contained much information on ships being damaged by sea ice and icebergs. The importance of the latter was quickly realized as of value to the marine transportation industry and to the institute's own study of bergy bit impact forces, and with further research a ship collision with iceberg database was constructed comprising some 670 events, still occurring at the rate of 1 – 2 per year.

The historical documents researched contained much iceberg information, in some cases doubling the annual number reported by the IIP in its infant years. NRC maintains an iceberg sightings database, primarily from 1960 to present. IOT has transcribed all the IIP data and submitted it for inclusion and is currently working on data from other sources. When complete there will be approximately 150 years of iceberg data available for interannual comparison.

This paper highlights some of the trends with time and some comparisons with the North Atlantic Oscillation and solar activity.

I15-2B9.1 **10:30**

Modelling carbon flux due to land use change as an interactive component of a terrestrial ecosystem model

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Land use change (LUC) affects the regional and the global climate via biophysical and biogeochemical pathways. The terrestrial ecosystem modules of the current generation of coupled carbon-climate and earth system models typically do not simulate carbon emissions from land use change. Instead these emissions are specified as an external source much like fossil fuel emissions which leads to inconsistencies. We propose a simple treatment of LUC emissions and implement it in the Canadian Terrestrial Ecosystem Model (CTEM) that is component of the Canadian Centre for Climate Modelling and Analysis (CCCma) coupled climate model.

Deforestation of natural vegetation and abandonment of cropland is inferred from changes in cropland area. When the croplands area increases it does so at the expense of natural vegetation and the biomass of natural vegetation is reduced. The biomass generated by replacement of natural vegetation may be burned, turned into short term paper and pulp products and/or long term wood products. Rather than assigning climate independent specified turnover times for these products, as in done in existing approaches, we allocate them to the model's heterotrophic carbon pools which have climate-dependent short and long turnover times. The resulting 1850-1992 LUC emissions simulated in this way compare well with estimates from Houghton and Hackler [2002] up to 1960 but are lower after that due to differences in crop area used. Simulated emissions for the entire 1850-1992 period are 117 Pg C compared to Houghton and Hackler's [2002] estimate of 138 Pg C. Out of the total simulated emissions of 117 Pg C, about 20% (23 Pg C) is due to the reduced capacity of the terrestrial biosphere to uptake carbon because of a reduction in area of the natural vegetation. Sensitivity analysis suggests that even the simplest approach, where all the removed biomass is allocated to model's litter pool, is able to provide a reasonable first order estimate of LUC emissions.

A01-1B6.7 **12:00**

Possible Impacts of Climate Change on Economic Losses and Health Care Costs due to Heat- and Air Pollution-related Premature Mortality in South-central Canada Using Downscaled Future Climate Scenarios

Qian Li[1], *Chad S. Cheng*[1], *Guilong Li*[1], *Heather Auld*[2]

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Science evidence suggests that climate change would portend significant health risks. For instance, intense heat wave and smog events consistent with climate change are already affecting the health and welfare of human being. As a result, it would increase the demands on the social infrastructure (including emergency services and social support systems) protecting the health of vulnerable populations. To estimate these possible impacts, we developed an automated synoptic weather typing approach to determine the differential and combined impacts of extreme temperatures and air pollution on human mortality for four selected cities (Montreal, Ottawa, Toronto and Windsor) in

South-central Canada. Economic losses and health care costs due to premature mortality under the current and future climates were then estimated.

The synoptic typing was comprised of principal components analysis, an average linkage clustering procedure, and discriminant function analysis. The weather typing procedures were able to identify weather types highly associated with elevated mortality rates and high air pollution levels and then to facilitate assessments of the differential and combined impacts of extreme temperatures and air pollution on elevated mortality. Elevated mortality or premature mortality was defined as conditions where daily mortality exceeded the baseline mortality. Statistical downscaling methods were used to downscale GCM scenarios for three Canadian GCMs (CGCM1 IPCC IS92a & CGCM2 IPCC SRES A2/B2) and two U.S. GCMs (GFDL R30 Coupled Climate Model IPCC SRES A2/B2). The discriminant function analysis was then used to project the future weather types. The projected air pollution concentrations were estimated using within-weather-type historical regression models applied to the downscaled climate change scenarios. These air pollution projection models have also incorporated various air pollution emission scenarios. Two independent approaches were used to assess climate change impacts on heat- and air pollution-related premature mortality for two-time windows (2040-59, 2070-89).

A value of a statistical life (VSL) and hospital inpatient costs (HIC) adapted from the study of Ontario Medical Association were used to estimate the economic losses and health care costs due to premature mortality. Ensembling five GCM scenarios, the model projected: across the study area, economic losses and health care costs due to heat-related mortality could possibly increase by factors of 2 and 3 for the 2050s and 2080s, respectively. The corresponding figures due to air pollution-related mortality could likely increase about 20–30% and 30–45% for the two future time slices. This increase could be largely driven by increases in ozone-associated premature mortality.

C01-2C6.4 **14:45**

The Influence of Global Warming on Landslide Potential along the British Columbia Coast

Steven Lambert[1], *Matthias Jakob*[2]

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Jakob et al. developed a landslide prediction system applicable to the west coast of British Columbia. Inputs to the system include the 28-day accumuated precipitation, the total 24-hour precipitation and river run-off.

It is of considerable interest to determine if the potential for landslides will increase under global warming. The precipition data required by the landslide prediction algorithm can easily be obtained from climate models. Using two versions of the CCCma coupled model, precipitation statistics for current day simuations are evaluated using analyses (Xie-Arkin) and rain guage data.

For the current day, the models are reasonably successful in simulating the winter season mean precipitation, the 28-accumulation, but are less successful in simulating the 24-hour amounts. In spite of this shortcoming, it will be assumed that the models are able to simulate precipitation regimes which can be used to assess landslide potential. If this is indeed the case, the models simulate an increase in both the 28-day and the 24-hour amounts which suggests that there will be an increased risk of landslides under global warming.

H03-2C4.7 **INVITED/INVITÉ 15:45**

Modelled forest road and harvesting impacts on the peak flow regime of a snow-dominated catchment

Peter K. Kura[1], *Younes Alila*[1], *Markus Weiler*[1], *Rita Winkler*[2]

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Forest hydrologists have traditionally used paired watershed experiments as a tool to assess the effects of forest roads and harvesting on catchment hydrology. Such studies, however, limit researchers that wish to disentangle the combined effects of roads and tree removal or study management schemes other than the existing scenario. To date, none have collectively examined simulated peak flow regime changes in snow-dominated watersheds for a wide range of return intervals, with the application of various harvesting levels with and without roads, including a particular look at the effects of forest roads alone. Such an assessment can only be made possible with a model that has been developed and calibrated at a site containing a rich set of internal catchment process observations for evaluation of model performance and internal structure. This study takes advantage of such a model application and employs the Distributed Hydrology Soil Vegetation Model (DHSVM) developed for the Upper Penticton Creek Watershed Experiment to investigate the isolated and combined effects of forest roads and harvesting on the peak flow regime of 241 Creek, for return periods ranging from 1-100 years. Longterm simulations suggest no significant effect of prior (20% harvest area) and current (30% harvest area) operational scenarios on peak flow regimes, while planned harvesting (50% harvest area) is expected to significantly increase hourly, daily and weekly flood peaks with recurrence intervals ranging 10-100 years (9-25% over Control). Roads were found to mitigate treatment flood peaks across the board (6-9%) by transporting simulated flows directly and indirectly out of the basin through flowpaths other than the outlet. Study findings suggest that peak flow regimes are fairly tolerant to the current level of harvesting in this particular watershed, but that further harvesting operations may affect this element significantly.

O01-1D1.8 17:45

Surface eddy diffusivity for heat in a model of the northwest Atlantic Ocean

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Eddies influence the surface heat budget both by modifying the surface heat flux and by the lateral transfer of heat within the surface mixed layer. It is shown that the presence of eddies modifies the surface heat flux in a model of the northwest Atlantic Ocean by more than 100 W m^{-2} over the Gulf Stream system. The diffusive effect of eddies is then illustrated by comparing two model runs, in the second of which the surface heat flux acts only on large spatial scales and interaction with the mesoscale eddies is suppressed. This second run exhibits finer-scale structure and tighter thermal fronts than in the fully interactive run. Finally, we estimate the surface eddy diffusivity associated with surface thermal damping from the fully interactive run. The estimated diffusivity takes large values (more than 10^3 m^2 s^{-1}) south of the Gulf Stream and smaller values elsewhere.

A05-1C6.1 **INVITED/INVITÉ** 13:30

EC meteorological weather data sharing and distribution - it's context and conditions

Miguel Tremblay

(Presented by *Nicole Bois*)
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This presentation will explain the constraints in which EC operates currently and what are the options for the users.

The government of Canada his bound by the Crown Copyright Act, but still with the Meteorological Service of Canada Free data sharing policy, users have flexible access to Canadian met data. Dissemination costs and support apart, more and more data are now available freely with minimal attribution conditions.

A01-1B6.6 **11:45**

Different approaches in constructing climatic scenarios for 3 health impact studies

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Ouranos has produced climatic scenarios for a number of health impact projects. Three examples include: Allergies related to extension of the pollen growing season in the Montreal region, Mortalities associated with temperature rises in province of Quebec, as well as Expansion of Montreal urban heat islands according to projected temperatures changes. Scenario construction has been dependent on project needs (variables, periods, frequencies, etc), and based on the best available tools and techniques at the time of production. Considering that simulation models and scenario development techniques improve continuously, advantages and disadvantages, variability, uncertainties of the various methods used in the 3 impact studies will be discussed. Some health results from the three studies will also be presented.

I12-3DP.3 **16:00**

Low-Accumulation Precipitation Events at Locations Across the Prairies During the 1999-2005 Drought

Erin Evans, *Ronald Stewart*

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Drought on the Canadian Prairies is a recurrent issue. When it sets in, the effects are pervasive and can include water shortages, crop failures, farm and business bankruptcies and irreversible environmental damage. The most recent bout that Prairie residents had with drought was a multi-year event that began in 1999 and lasted into 2005. This period of drought had enormous ramifications for the national economy, depleting the Canadian GDP by billions of dollars. Given the impact of this recent event, there is clearly a need to further our scientific understanding of the onset, evolution and cessation of drought. One way to characterize drought is by investigating precipitation. We have documented and characterized precipitation events at selected locations over the duration of this recent drought. Preliminary results at Calgary show that, during this drought, the fraction of days receiving (any amount of) precipitation was similar to, or slightly above what would be expected under average conditions. Further analysis reveals that under these drought conditions there were fewer high-accumulation events (≥35 mm/day) than occur for a non-drought environment. Climatologically, low-accumulation events, defined as ≤10 mm/day, are an important source of moisture in the Prairies,

accounting for over 50% of the total annual precipitation. During the recent drought, the dearth of large events resulted in these low-accumulation events providing an even greater portion of the total precipitation (58-60%). The persistence of low-accumulation events even during drought must be due to one or more of several factors including sub-cloud evaporation (with corresponding low-level atmospheric moisture conditions) and change in character of the storm systems themselves. Use is being made of model products, satellite and radar information, and surface observations to determine the means through which these events persisted at locations across the Prairies.

C02-1D5.8 **17:45**

Unstructured Grid Climate System Modeling

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An unstructured grid, finite-volume numerical model is being developed and applied to climate-related problems. The work addresses a number of the issues that presently complicate climate simulation, particularly the wide range of scales over which relevant processes interact. For example, modeling changes in northern sea-ice extent within the overall context of climate change requires that the Arctic archipelago be finely resolved. Also, the importance of tidal processes to the energy balance of the overall climate system is increasingly being recognized, even though their effects are largely localized to regions of high activity (of which the Arctic region is an example). In numerical simulations, allowing the constraints imposed by local dynamics to determine global resolution is extremely expensive, while unstructured grid numerical methods permit selectively increased resolution in arbitrarily complex regions of interest. Improved geometric representation of coastlines can also be achieved.

After giving a brief overview of the technical aspects of the numerical modeling framework, I will discuss the latest results that are available at the time of the conference. As of this writing, a variety of representative results have been obtained that highlight the advantages of the new scheme in the context of global baroclinic ocean simulation and tidal modeling. A sea-ice component is also under development, and we hope to be able to describe some relatively elaborate simulations involving interactions amongst baroclinic, tidal, and sea-ice dynamics. A project of this nature always leaves a great deal of scope for further work, and the presentation will conclude with an update on the outstanding issues.

O01-2B1.1 **10:30**

Circulation and Variability over the Eastern Canadian Shelf during the Period 2001 to 2005, A Numerical Study

Jinyu Sheng

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The three-dimensional shelf circulation and associated variability over the eastern Canadian shelf during a 5-year period from January 2001 to December 2005 are studied using a three-dimensional z-level ocean circulation model. The model domain covers the northwest Atlantic Ocean between 284E and 330E and between 35N and 66N with a horizontal resolution of (1/3) in longitude and 31 z-levels in the vertical. The model is forced by the 6-hourly NCEP/NCAR wind forcing and monthly mean climatology of sea surface heat and freshwater fluxes. The newly developed semi-diagnostic method

is used in the multi-year numerical simulations. The main advantage of this method is to prevent the model drift of large-scale circulation, while the meso-scale eddies are fully free to evolve. The 5-year model results are used to examine the main physical processes responsible for the seasonal, month-to-month and meso-scale variablilities of circulation and hydrography over the eastern Canadian shelf.

A02-1B7.5 **11:30**

Atmospheric kinetic energy spectra from high-resolution GEM models

Bertrand Denis

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Kinetic energy spectra computed from two configurations of the Canadian GEM mesoscale model are inspected with the goal of finding the -5/3 slope reported by observational studies. The two configurations involved are the so-called Regional 15-km GEM and experimental GEM-LAM 2.5-km model. Two domains covering 1000 km x 1000 km each are used: the West domain which encompasses the Canadian Rocky Mountains and the East domain which includes South-East Ontario and South-West Quebec. The main spectral decomposition technique employed is the bi-dimensional Discrete Cosine Transform (2D-DCT) (Denis et al., 2002) but the commonly used bi-dimensional Discrete Fourier Transform with detrending (2D-DFT) (Errico, 1985) is also considered.

Various aspects influencing the slope of the kinetic energy spectra are explored such as the model resolution, the geographical domain location, the spin-up time, and the diurnal and seasonal effects. The main conclusion of this study is that these aspects play an important role in the determining the capability of the GEM-LAM 2.5 km in producing the -5/3 slope. On the technical side, an intercomparison of different spectral decomposition strategy is discussed. These include the 2D-DCT, 2D-DFT, and the north-south/east-west averages of 1D-DCT/1D-DFT. The benefit of using the DCT is demonstrated.

A04-4D6.4 **16:45**

Update on SCRIBE

Richard Jones

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Since July 2005 the SCRIBE forecast production tool was implemented within EC’s operational production of public forecasts. Through the SCRIBE interface, the forecasters at the Storm Prediction Centres (SPC) edit weather element forecasts which can be used to produce a variety of different products including the public forecasts in both official languages. Icons on EC’s principle web site are derived from the transmitted weather element files. The text of the weather bulletins are no longer edited by the forecaster. The official weather element files produced by SCRIBE are available on the weatheroffice web site in XML format. Marine SCRIBE also implemented in the SPC’ s produces marine weather element files, forecast bulletins (in both official languages), MAFOR and NAVTEX bulletins as well as synoptic based weather warnings notices. The weather element files is used by weatheroffice EC’s web site to light the warnings “battle board” and to provide users up-to-date information. In late 2007 the public SCRIBE will be extended to day 10 based on ensemble forecasts. In the plans are snow density, hourly forecasts, direct model precipitation types. Further down the road is SCRIBE - AQ. Air Quality forecasts will be based on the public weather element forecasts and air quality model forecast guidance. Also in the future will be an integration of SCRIBE with NINJO.

A02-2DP.5 **16:00**

Comparison of Precipitation from Numerical Weather Prediction Models and Radars Using a Multicategory Approach

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We evaluate precipitation from numerical weather prediction models using radar-retrieved precipitation as reference. The hourly accumulated precipitation fields, obtained from Canadian and US operational models and from the US composite radar network, are compared over large domain of the central and eastern US. A scale decomposition method is combined with several other statistics to evaluate the forecasts in a way that could serve as a useful template for other verification studies. These diagnostic methods have shown that models exhibit some common as well as model-specific forecast characteristics relative to observations. We also recognized the weakness some of the used statistical methods. Statistical approaches that yield a single-valued measure of correlation between forecasts and observations do not offer all the information about spatial and distributional aspects of the closeness of two complex fields. Thus, such measures can be inadequate in assessing the overall performance of the forecasts. To overcome these problems, we use an advanced approach for forecast verification based on the joint distribution of the forecasts and observations. In general, this approach enables a complete description of the forecast quality. In order to reduce the dimensionality of the verification problem, in this study we adopt a so-called multicategory approach (associated with a binned precipitation intensity) to count a joint frequency of the forecasts and observations. To reduce or to eliminate possible ambiguities in the interpretation of the results, we factor the joint distribution into conditional and marginal distributions.

C05-3B5.3 **11:15**

Cloud processes simulated by the Canadian Regional Climate Model along a cross-section in the Pacific Ocean

Yanjun Jiao, *Colin Jones*

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The GCSS (GEWEX Cloud System Study) Pacific Cross-section Intercomparison (GPCI) is an international project to evaluate and improve the representation of cloud and precipitation processes in weather and climate prediction models. In this study, the 4th generation of the Canadian Regional Climate Model (CRCM) has been integrated over the Pacific Ocean in the context of the GPCI project. Seasonal mean results simulated by the CRCM for the period of June-July-August 1998 are analyzed and compared with different observations and reanalysis along a cross-section, which extends from the stratocumulus regions off the coast of California, across the shallow cumulus areas in the central Pacific, down to the deep convection regions of the ITCZ.

To improve simulated cloud and cloud related processes, a number of modifications have been introduced in the CRCM model physics such as Bechtold-Kain-Fritsch mass flux convective scheme (both shallow and deep convections), vertical diffusion in the boundary layer and large-scale cloud formation schemes. Comparison results show that these modifications have a significant beneficial influence on the CRCM simulation of the vertical structure of the relative humidity, cloud distribution, and the amount of the convective and large-scale precipitation.

C02-1D5.2 **16:15**

Impacts of changes in the Atlantic meridional overturning circulation on the global carbon cycle

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An Earth System model of intermediate complexity is used to quantify the effects of a reorganization of the Atlantic meridional overturning circulation (AMOC) on CO_2 uptake by the ocean and the terrestrial biosphere. We find that the sign and magnitude of the response differ under preindustrial and anthropogenic CO_2 conditions. In the preindustrial case, a complete AMOC shutdown leads to increased oceanic CO_2 uptake. On land, the cooler and dryer climate associated with AMOC shutdown causes a reduction in net primary productivity and hence carbon uptake. These processes act to slightly decrease atmospheric CO_2 concentrations. Under anthropogenic CO_2 emissions, AMOC shutdown acts to significantly reduce oceanic carbon uptake. This reduced uptake is caused largely by a decline in marine export production. On land, carbon storage slightly increases due to lower soil respiration rates. Altogether, these processes lead to modestly higher CO_2 concentration levels in the atmosphere. Our results emphasize the role of terrestrial and marine biology in determining the response of the global carbon cycle and provide a contribution towards an improved understanding climate/carbon-cycle feedbacks in past and future climate changes.

I08-4B7.3 **11:15**

A New/Old Method for Measuring Turbulent Heat Fluxes Over Leads

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Leads are an important component of sea ice variability. Despite the importance of fluxes from leads in the overall surface energy budget of sea ice regions, there have been few measurements of turbulent heat fluxes from leads. During the MaudNESS project in the austral winter of 2005, radiosondes attached to a kite indirectly measured surface turbulent heat fluxes from leads in the Eastern Weddell Sea near Maud Rise. The author performed two kite flights over leads with similar widths and upwind ice conditions. Each flight consisted of several vertical profiles. Lead mean surface fluxes were estimated by measuring the excess temperature and humidity downwind of the leads, estimating the wind speed profiles and performing a heat and moisture budget quantification. The measured sensible (latent) heat fluxes were 318 Wm-2 (158 Wm-2) and 258 Wm-2 (85 Wm-2) for the two flights; the values were lower in the second flight due to lower wind speeds. The average neutral sensible heat transfer coefficients for the two flights was $(1.48 \pm 0.13) \times 10^{-3}$, and the average neutral latent heat flux coefficient was $(1.47 \pm 0.09) \times 10^{-3}$. These values are enhanced from what would be expected in a typical open ocean situation with the same air-sea temperature and humidity differences due to the relatively short fetches. Kite radiosonde profile measurements are an economically viable method for measuring lead heat fluxes that avoid many of the logistical problems associated with other methods for measuring fluxes over leads.

C04-3DP.9 **16:00**

Major precipitation events in the Eastern Canadian Arctic

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Residents of the eastern Canadian Arctic suffer through some of the worst weather in the country with heavy rain, snowstorms and blizzards commonly occurring. It is normally very difficult to predict such events and so they often severely impact the Northern Communities. Most of the previous research carried out in the Arctic focused on winter events, but summer storms are also a major issue since they produce a large amount of precipitation. The goal of this study is to advance our understanding of the mechanisms through which hazardous precipitation is produced within both summer and winter storm events. The initial information being utilized was mainly obtained from the 1955-2006 weather station information from Environment Canada. The Cambridge Bay, Clyde River, Coral Harbour, Hall Beach, Iqaluit and Resolution weather stations were selected since they have the longest-term data records for Nunavut. The 10 most severe one-day precipitation events for each station were identified with a weighting function incorporating the duration of the precipitation and its total amount. With this information, a precipitation hazard index for the eastern Canadian Arctic was developed based on the meteorological conditions (wind, temperature, precipitation type) associated with the precipitation events. Many of the most hazardous events occurred during the summer and their precipitation was in the form of rain. Unlike the other stations, Clyde River's top three events occurred during April and these consisted entirely of snow; 6 out of its 10 most severe events were due to snowstorms. Coral Harbour experienced the highest rainfall of any station with 128 mm on October 10, 1973. There were often systematic patterns in the winds during these events with, for example, Iqaluit normally experiencing south-east winds as a result of channeling by the surrounding topography. Furthermore, the overall trend in these hazardous precipitation events is towards increased frequency.

P-2A1.2 **INVITED/INVITÉ** **09:15**

Extreme events in a changing climate / Les événements extrêmes dans un climat changeant

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Global mean temperature changes were driven overwhelmingly by greenhouse gas increase since the mid-1960's and greenhouse gases will continue to dominate changes in coming decades. A number of types of extreme events are associated with these changes due to related phenomena, such as increases in atmospheric water vapour, and warming of the upper layers of the oceans. A review will be given of changes in extremes observed to date and projected into the future. Some economic and social consequences of this trend in extreme hydrometeorological events are outlined both for Canada and the world, along with assessments of other factors which also influence the rapidly rising disaster losses. Information will be presented on Soil and Water Conservation Society studies of impacts of changes in the heavy rain regime in the Great Lakes basin on erosion of agricultural lands and on water quality. This issue brings to the fore again the importance of disaster loss reduction and erosion prevention measures as adaptations to climate change, and the very inadequate measures taken to date in Canada.

O03-2DP.6 **16:00**

High-energy sedimentary processes in Kluane Lake, Yukon Territory

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The Little Ice Age advance of the Kaskawulsh Glacier in the St. Elias Mountains raised the level of Kluane Lake, the largest lake in the Yukon, by as much as 30 m and reversed the outflow direction, creating the 18 km long Slims River sandur. In the twentieth century the delta has advanced 3.6 km, which is the highest rate of any glaciolacustrine delta in the Cordillera, decreasing from 74 m/a (1899-1914) to 18 m/a (1970-2006). Data from moored instruments, sediment traps, water column profiling, and high-resolution sub-bottom acoustic surveys document lacustrine sedimentary processes in this very dynamic environment. Suspended sediment concentrations in the river of up to 7 g/L generate continuous, diurnally fluctuating turbidity currents in Kluane Lake with peak velocities in excess of 0.5 m/s. The turbidity of the underflows also varies diurnally by up to 600 NTU. Seasonal and short-term water level fluctuations in Kluane Lake influence the sediment delivery to the lake basin. The turbidity currents have created a field of large sediment waves in fine-grained sediment on the prodelta slope that are analogous to those of marine systems, but previously not reported from lakes. These bedforms have mean wavelength of 130 m (range 16 – 440 m) and mean amplitude of 2.3 m (range 0.1 – 9.0 m). They are migrating up-slope and their internal architecture is consistent with a sedimentary record formed by turbidity currents having alternating supercritical and subcritical flow. Accumulation in the prodelta area of Kluane Lake has averaged 0.4 m/a between 1970 and 2006 based on acoustic surveys, and was 0.3 m in 2006 based on sediment trap results.

I03-4C7.5 **14:45**

Assimilating soil moisture data in the CLASS model to improve latent heat flux estimation

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Accurate specification of the surface soil moisture in land surface models has a potential to improve the evapotranspiration estimates. In recent years a number of assimilation techniques have been proposed to assimilate remotely sensed soil moisture in different land surface models. To date there is no optimal solution for assimilation of soil moisture. In this study 4 different assimilation techniques were used to assimilate the soil moisture data collected from an agricultural site into the CLASS model (Canadian Land Surface Scheme). Soil moisture was measured continuously at 8 points in a 30ha field and in a 7 × 7 grid at 11 times during the growing season. These data were used to update the model using the assimilation techniques. The techniques evaluated included adjustment of the cumulative distribution function of modeled soil moisture and observation, an ensemble Kalman filter, matching the probability density function of the model and observed data, and direct assimilation of soil moisture data into the model. We evaluate the application of these methods based on their effect on improving latent heat flux estimates of the model. The results from the model were compared with the eddy covariance measurement of latent heat flux at the same site and the model run without soil moisture assimilation. The results from this field test indicate that latent heat flux in CLASS is highly sensitive to the soil moisture and to the assimilation schemes.

C02-1C5.8 **15:15**

Modeling Iceberg Sedimentation in the Southern Ocean:A Window into Antarctica's Glaciation History

Maria Abrahamowicz[1], *Bruno Tremblay*[1], *Trevor Williams*[2], *Tina van de Flierdt*[2]

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Ice-rafted debris (IRD) in Southern Ocean sediments indicates the presence of ice on Antarctica through time. The isotopic signature of IRD can be matched with the signature of different provenance sectors of Antarctica to identify the source of IRD, and thus the launching sites of the icebergs that carried it. Results of a pilot study at ODP Leg 188 Site 1165, offshore of Prydz Bay, Antarctica, revealed a major change of IRD provenance around the mid-Miocene climate transition (~14 Ma). Prior to 14 Ma, the IRD at Site 1165 is dominated by material from the Prydz Bay area. After 7 Ma, the IRD shows a mixed provenance from Wilkes Land and Prydz Bay, probably indicating a more dynamic East Antarctic ice sheet. Today IRD at Site 1165 originates again from the Prydz Bay area. We have developed an Iceberg Drift Model (IDM) designed to investigate iceberg sediment discharge in the Southern Ocean. We model the Lagrangian trajectories of icebergs, which we treat as point particles. The dynamics of each modeled iceberg is controlled by a momentum equation, which includes representations of water, air, wave radiation, and sea-ice drag forces as well as Coriolis and pressure gradient forces. The thermodynamics consist of empirical relationships for basal and lateral melting rates, as well as erosional loss. The model is forced with simulated ocean currents, temperatures, winds and sea-ice thicknesses/concentrations from the CCSM3 Community Climate Model. Our IDM is validated against drift trajectories of satellite-tracked Antarctic icebergs. Sensitivity of iceberg sedimentation to iceberg size, sediment profile, release site and time of release are then investigated. Finally the model is run with contemporaneous forcing for the last 50 years and present day drift patterns are compared with results from the isotopic analysis of IRD layers at site 1165.

A07-3B7.8 **12:15**

Understanding High Winds Events in the Eastern Canadian Arctic

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Strong surface winds are an inherent aspect of the Eastern Canadian Arctic climate yet few studies have focused on these features. As a result, arctic winds are often poorly predicted by current weather forecasting models. To better predict the arctic weather, we need to understand the role of the Arctic's unique geographical and meteorological features such as mountains, sea-ice, very stable atmospheric stratification and the strong Coriolis force. In this study, we hypothesize that these features have an impact on high wind events in the eastern Canadian Arctic.

To test this, we examine the long-term data records of six meteorological stations across southern Nunavut: Baker Lake, Cambridge Bay, Clyde River, Coral Harbour, Hall Beach and Iqaluit. For our analysis, we defined a high wind event as having hourly surface winds in excess of 36 km/h for at least 3 h. We then identified the 2 or 3 typical storm tracks for each station. We averaged the meteorological parameters of all the storms following these tracks over a 50-yr period, thus creating 2 to 3 average cases per station. By comparing the 5 most severe high wind events with their respective average case, we identified how the Arctic's geographical and meteorological features enhance strong surface winds.

High wind events are usually associated with intense cyclones located over Hudson Bay or Labrador Sea, particularly in wintertime. Under this large scale setting, blocking and channelling due to the stable boundary-layer stratification typically occur at Clyde River and Iqaluit, enhancing the surface

wind speed. Over flatter terrain, high wind events typically occur when the station is situated in a region of strong synoptic pressure gradient between an anticyclone and a cyclone.

S04-3DP.3 **16:00**

Modeling heat and mass transfer in snow at a microstructural level using a phase-field approach - first results

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Snow is a highly porous medium consisting of an ice matrix and porous space containing water vapor. With time, snow undergoes metamorphism and its microstructure evolves. There is a strong interaction between the snow microstructure and chemical or physical properties of snow such as the heat conductivity. On the one hand, heat flow through snow induces mass flow and thus an evolution of the ice-pore network; on the other hand, the microstructure influences heat flow as heat transport is due to conduction in the ice and pores as well as associated with phase change processes and water vapor transport in the pore space. We developed a phase-field model which solves the coupled heat and mass transport problem, including phase-change processes, in a given ice-pore network. Simulations of heat and mass flow through different ice lattices subjected to a temperature gradient were used to determine the relative contributions to the macroscopic heat flow. Zones of sublimation and resublimation were identified. The results underline the link between microstructure and heat conductivity.

G07-1C2.6 **15:00**

A possible subducted fragment in the transition zone beneath central Canada?

Andrew Frederiksen

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The Kula and Farallon Plates were ancient oceanic plates subducted beneath western North America in the Cenozoic and Mezozoic. The Kula plate is completely vanished, while remnants of the Farallon include the Juan de Fuca and Cocos plates. Fragments of the Farallon Plate have been detected at transition-zone depths beneath the USA and Mexico via large-scale tomography (Van der Lee and Nolet, 1997). Using data from the POLARIS FedNor project, the Canadian National Seismograph Network, and previous temporary instrument deployments, a P-wave velocity model of the upper mantle beneath Ontario was generated (Frederiksen et al., submitted to JGR), aimed primarily at resolving lithospheric structure beneath the Superior Province. However, the large aperture of the array used provided significant resolution down to 800-900 km; an examination of cross-sections at these depths led to the serendipitous discovery of a planar, horizontal high-velocity feature at about 700 km depth beneath much of the study area. Resolution tests and plate tectonic scenarios will be presented, in order to examine whether this feature can be attributed to Kula or Farallon subduction, and the implications for asthenospheric flow patterns affecting the North American lithosphere.

G05-3B2.1 **INVITED/INVITÉ** **10:30**

Evolution of the Newfoundland-Iberia Rift

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Initial rifting between Newfoundland and Iberia occurred in a wide-rift mode during Late Triassic to Early Jurassic time. A second, Late Jurassic to Early Cretaceous rift phase focused extension at future distal margins and led to seafloor spreading. Structural and stratigraphic relations suggest that this phase consisted of three episodes: 1) Late Jurassic-Berriasian rifting that culminated in separation of continental crust in the southern rift; 2) Valanginian-Hauterivian rifting of continental crust (northern rift) and subcontinental mantle lithosphere (southern rift) that culminated in separation of continental crust in the north; and 3) Barremian-Aptian continued rifting and exhumation of mantle lithosphere that was at least partially subcontinental. A prominent, rift-wide seismic horizon that is developed near the Aptian/Albian boundary is interpreted to have formed when the asthenosphere breached the subcontinental mantle lithosphere, rifting ended, and relatively magmatic seafloor spreading commenced. We consider mantle exhumation up to that time to be 'transitional extension' that cannot be simply characterized as either continental rifting or seafloor spreading. Episode 3 (and possibly episode 2) transitional extension included intraplate rifting of previously exhumed mantle plus minor magmatism, probably because a well defined plate boundary was not established and in-plane tensile stress was elevated throughout the plates. At the episode 2/3 transition, the southern rift was affected by plume magmatism that formed the Southeast Newfoundland Ridge, the J Anomaly Ridge, and the Madeira-Tore Rise. During the later part of episode 3 there was also at least local magmatism and formation of apparently normal ocean crust. Post-rift magmatism occurred in the Newfoundland Basin, expressed at ODP Site 1276 by two diabase sills (ages 105 and 98 Ma) that intruded Aptian-Albian sediments. There is no known magmatism of comparable age and extent on the Iberia margin. The source of magma in the Newfoundland Basin is postulated to be the Madeira and Canary hotspots, over which the basin probably passed at 100-90 Ma.

G06-4C2.2 **INVITED/INVITÉ 14:00**

The "3-D" Coastline of the new Millenium (Managing Datums in N-Dimension Space)

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Advances in Remote Sensing and GPS technology has made it possible to develop very high resolution digital elevation models (DEMS) of topographic landforms. Recent projects utilizing airbourne terrestrial laser (LIDAR) has created DEMs of coastal shore and inter-tidal areas with horizontal footprints of less than 1 meter square containing decimeter vertical precision. These data were reviewed by several partners which included hydrographers, geomorphologists, coastal engineers, academic researchers, Emergency Measures Organizations and the Transportation Safety Board.

The coastline can no longer be considered as two dimensional lines on paper, but as a three dimensional land form which is undergoing very dynamic physical change. It has been proposed to utilize Remote Sensing to initiate high resolution 3-D baseline mapping in appropriate low-lying areas under threat of coastal flooding, rising sea level and tsnuami run-up.

This presentation discusses several applications of merging land and sea data sets for coastal zone management and natural disaster mitigation. Stakeholders include all levels of governments, the insurance industry, National Defence as well as numerous environmental and marine interests affected by climate change.

I04-4B1.4 **11:30**

Simulating gas exchange with a 1-D Coupled Atmosphere-Ocean-Biogeochemical Model

Nadja Steiner[1], *Svein Vagle*[2], *Ken Denman*[3], *Craig McNeil*[4]

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A 1-D coupled atmosphere-ocean-biogeochemical model has been developed to study gas exchange at the atmosphere-ocean interface. The coupled model consists of an atmospheric Single Column Model (SCM), based on the CCCma AGCM (Canadian Centre for Climate Modelling and Analysis-Atmospheric General Circulation Model), the General Ocean Turbulence Model (GOTM) and a 7-component ecosystem model embedded in GOTM. The ecosystem model also includes oxygen, nitrogen, carbon, silica and DMS cycling. The study focuses on simulated and observed N2 and O2 variability. The comparison of these gases allows for separation of physical and biological processes. The model also tests different parameterizations for gas exchange, including a formulation for gas injection via bubbles, which affects gas concentrations within the whole mixed layer. Observations are derived from a long-term air-sea exchange mooring which has been maintained in the North Pacific near Ocean Station Papa (OSP, 145 W, 50 N) since September 2002 as part of the Canadian Surface Ocean Lower Atmosphere Study (C-SOLAS). The mooring provides a new long-term data set for gas measurements. In addition to Conductivity, Temperature and Depth (CTD) recorders at two depths, the mooring is equipped with ProOceanus Gas Tension Devices (GTDs) measuring the total gas pressure at four different depths, two oxygen sensors, two fluorometers for chlorophyll estimates, and an upward-looking 200~kHz echo-sounder for bubble measurements. Data collected from June 2003 to June 2004 are compared with the simulations. For most of the time the model shows good agreement with observations. However, in summer 2003 the observations reveal a strong oxygen and chlorophyll event, which is not reproduced in the standard model run. OSP is a High Nutrient Low Chlorophyll (HNLC) region, limited by the macro nutrient iron. Increases in usually low chlorophyll values occur occasionally due to natural iron enrichment (dust deposition, eddy transport, below surface layer transport). Although limitations of 1-D modelling become apparent here, an assumed input of iron in the model is able to explain the differences between simulated and observed oxygen and chlorophyll maxima.

G03-4B2.7 **12:00**

Earthquake rupture speeds and modes observed in the laboratory

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A laboratory model is designed to monitor spontaneous frictional ruptures in the laboratory, i.e., laboratory earthquakes. A frictional contact, which mimics the geological fault, is simulated using two brittle photoelastic polymer plates held together by friction. The pre-uniaxial static loading, which simulates tectonic loading in the crust, is exerted by a hydraulic press. The exploding wire technique is used to trigger the rupture within a controlled environment while keeping the spontaneous nature of the rupturing. The fault is oblique to the compression axis to provide the shear driving force for continued rupturing. The full stress fields are visualized with the photoelastic method and are recorded at extremely high rate with high speed camera. Laboratory earthquake experiments are carried out along an interface between similar and dissimilar materials. Under proper loading conditions, a shear

rupture which initially propagates at Rayleigh wave speed, jumps to a supershear speed (close to the longitudinal wave speed) after propagating a finite distance L in a similar material system. For the dissimilar material system, directionality of rupture propagation is observed. Depending on the loading, different rupture speeds and modes are observed for this experimental configuration. The supershear and subRayleigh to supershear rupture transition have been proposed for the 2001 Kunlunshan Earthquake. The events in the famous Parkfield seismic sequence represent good examples of earthquakes along a bimaterial interface. Laboratory observations can be used to interpret these events and settle down the debates associated.

O02-1C1.8 **15:15**

Atlantic Storm Surge and Tsunami Warning System

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Storm surges and tsunamis are both serious issues for coastal zone management. Real-time forecasting and alert systems can both prevent loss of life and mitigate the damage caused by these hazards. Canada and the United States have recently undertaken measures to develop an enhanced capacity for early warning of surges and tsunamis in the Atlantic. Part of this effort includes dissemination of high frequency sampled and polled water levels in real-time.

Tsunami forecasting is initiated through monitoring of seismic events. It then requires a priori knowledge of modeled tsunami propagation. However, for confirmation of earliest arrivals, and for amplitude estimation at future arrival sites, decision makers must have immediate access to real-time data. In Atlantic Canada, the means for corroboration of anticipated extreme water levels is now available through the Permanent Water Level Network.

Future development of appropriate land management practices, risk reduction measures, and the design of mitigation strategies all require geo-scientific and climatological knowledge in order to better estimate flood probabilities under changing rates of relative sea-level rise (SLR) and, in the case of storm surges, the possible effects of a warming climate. Further, they depend on an adequate understanding of vertical land/sea datums and realistic mapping of hazard zones.

Determination of the potential for, and the spatial extent of, coastal flooding, especially in areas of high vulnerability, is a key element of any alert system. The coastline can no longer be considered as a line on paper, but should instead be understood as a 3-D landform subject to physical change through time. To this end, airborne laser altimetry provides new capabilities for development of time-dependent, high-resolution digital elevation models of low-lying, flood-prone terrain. It can also be used to support other innovative approaches to risk reduction and hazard mitigation.

C02-1D5.6 **17:15**

Modelling the 10.3 ka BP outburst flood of the Baltic Ice Lake

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Following the last ice age, recession of the Scandinavian ice sheet produced, in what is now the southern Baltic Sea, the ~350 000 km^2 Baltic Ice Lake. Forced by isostatic uplift, the lake experienced episodic flooding and lowering via open-air, ice-marginal outlets. We consider the largest of these events, which at 10.3 ka BP lowered the lake 25m and released 7 800 km^3 of fresh water into the North Sea. Developed with newly available paleo-shoreline data, a high resolution digital model of the paleo-bathymetry constrains the geometry and hypsometry of the flow path. We couple these data with a one-dimensional ice-marginal outburst flood model to estimate the flood hydrograph. Based on Spring-Hutter theory, the model is able to accommodate flow path variations in geometry, and in particular does not posit a unique breach point. Uncertainty in frictional roughness coefficients and flow assumptions is explored, and the possible climatic influence of rapid fresh-water discharge is discussed. To validate the applicability of the model, it is applied to the well-observed 2002 outburst flood from glacier-dammed Russell Fiord in Alaska. We estimate the flood hydrograph and compare with USGS data.

S05-3DP.1 **16:00**

Estimating potential snow/ice melt energy availability for a plateau ice cap using a High Arctic weather station record

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Weather monitoring stations are sparsely distributed across the Canadian High Arctic, and therefore spatial interpolation of the data is often used to estimate meteorological conditions at remote study sites. Furthermore, the existing monitoring stations are located at or near sea level, thus requiring extrapolation of conditions to higher elevations. This research examined the 42-year (1961-2003) meteorological record for Resolute, Nunavut, from both ground level and upper air measurements. Two methods were employed to determine temperature profiles in order to estimate the potential melt energy availability at an altitude of 300 m asl. First, a mean lapse rate calculated during a "representative" time span in early July was applied to the daily temperature record between May 1 and September 30 (MJJAS) each year. Second, daily calculations of the elevational temperature gradient were made and applied to each individual day during the melt (MJJAS) period. Overall, the mean lapse rate approach benefited from ease of use and rapidity of application, while the daily method benefited from a higher resolution understanding of the temperature gradient and detailed characterization of thermal inversions. The results from the two methods show that the presence of thermal inversions during the melt season significantly affect the potential melt energy availability at 300 m asl. Daily calculations indicate a mean 43.3% increase in melting degree-days compared to mean lapse rate estimation, and represents a significant amount of total seasonal melt energy in this environment. Coincident timing between thermal inversions and melt events (positive temperatures) show that positive and weakly negative temperature gradients are an important source of this increased melt energy. Trends in inversion frequency through the past 22 years suggest that the occurrence of such inversions has increased, potentially leading to increased melt energy availability in the future.

I10-1C9.3 **14:00**

Interannual variability in the Arctic Ocean freshwater balance

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The freshwater transport from the Arctic Ocean to the northern North Atlantic by sea-ice and the surface ocean shows large interannual variability. As variations in the freshwater transported into the northern North Atlantic can have an impact of the strength of the meridional overturning circulation and cause Great Salinity Anomalies, a better understanding of the variability of these fluxes is necessary. We present a detailed characterization of the interannual variability of all terms of the Arctic Ocean freshwater balance (i.e., runoff, net precipitation, Bering Strait inflow, liquid freshwater export, and sea-ice export) over the period 1950-2005, as simulated by a high resolution version of the Univeristy of Victoria Earth System Climate model (UVic-ESCM). The UVic-ESCM consists of a 3-D global ocean circulation model, an elastic-viscous-plastic sea-ice model, a land surface and vegetation model, and an energy moisture balance model for the atmosphere. It is forced with daily NCEP reanalysis winds and global atmospheric CO_2 concentrations. The simulated interannual variability of sea-ice export through Fram Strait, as well as river runoff and Bering Strait flow are compared with available observations and other model results. We show the effect of atmospheric modes on different components of the freshwater balance in the Arctic Ocean, compare the magnitude of changes in the liquid and solid Arctic Ocean freshwater storage, and assess the effect of changes in freshwater storage in the Arctic Ocean on the simulated meridional overturning circulation.

H06-4B4.7 **12:15**

Rapid loss of the Ayles Ice Shelf, Ellesmere Island

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In August 2005, almost the entire Ayles Ice Shelf (87.1 sq km) calved off and created a new 66 sq km ice island in the Arctic Ocean. This resulted in the loss of ~7.5% of the remaining Ellesmere Island ice shelves, and reduced their remaining number from 6 to 5. A series of MODIS satellite scenes indicate that the entire calving occurred within a period of approximately an hour. Seismic records from Alert record a distinct low frequency, long duration event as the ice shelf disintegrated. The combination of anomalously warm air temperatures, long-term regional warming, high offshore and along-shore winds, record low sea ice conditions and the loss of a semi-permanent landfast sea ice fringe are the likely driving factors behind this collapse.

H06-4B4.5 **11:45**

Recent glacier cover changes in the southern Baffin Island region:Evidence fom surface and airborne observations.

Christian Zdanowicz M.[1], *Demuth Michael N.*[1], *Koerner Roy M.*[1], *Lavergne Jean-Claude*[2], *Savopol Florin*[2], *Armenakis Costas*[2], *Kinnard Christophe*[3], *Mercier Geneviève*[3], *Lauriol Bernard*[3]

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Annual measurements over the past >40 years reveal a trend to increasingly negative mass balance on ice caps of the Queen Elizabeth Islands (Canadian High Arctic) that has become more accentuated since the mid-1990s. Mass balance changes on these ice caps is largely determined by greater losses to melt during summer, while accumulation rates have remained relatively constant. The observed trend is therefore tentatively ascribed to recent summertime warming in the High Arctic which causes increased melt losses, while snow accumulation in the cold seasons has remained essentially constant over the period of record. The lack of comparable long-term records of glacier observations on Baffin Island makes it difficult to verify the regional coherency of these observations across the eastern Arctic. In order to fill this observational gap, the National Glaciology Program (Natural Resources & Environment Canada) has taken steps to initiate a program of glacier mass balance monitoring in the southern Baffin Island region. In the context of this effort, we will present a summary of existing observational evidence for recent (last ~60 years) glacier changes in the southern Baffin Island region. Our information is drawn from multiple sources, which include surface elevation change measurements on Grinnell ice cap (Meta Incognita Peninsula), lichenometric estimates of recent glacier retreat rates in Akshayuk Pass (Cumberland Peninsula), airborne laser altimetry on Barnes and Penny ice caps, time series of summer melt percentage from cores drilled on Penny ice cap, and change detection studies on small inland plateau ice caps. Collectively, the available evidence suggests that the rate of ice cover reduction (through net mass loss or redistribution) has accelerated over recent decades, and that at least part of this trend could be ascribed to a regional warming trend in the eastern Arctic that is manifesting itself more strongly since the mid-19th century.

H01-2DP.11 **16:00**

Validating Gravimetry Measurements in Canada with a Continental Scale Hydrological Database

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Water balance simulation is a basic but essential part of large-scale hydrological modelling. Gravity data provided by GRACE (Gravity Recovery and Climate Experiment) presents an alternative to in situ data for verifying and supporting hydrological and glacier mass balance studies on a continental scale. This work attempts to determine the utility of GRACE data for use in large-scale mass balance calculations by developing a hydrological database that supports hydrological mass balance calculations for major drainage basins within Canada. The development of the database is determined by the spatial and temporal scale of the GRACE data. A variety of monthly observed hydro-climatological data essential to hydrological mass balance modelling were collected for 2003, 2004 and 2005 for all of Canada (where available) and northern USA (where needed). Initial monthly water balance analysis focused on the Nelson River Catchment (over 1,000,000 km^2). GRACE estimates of average equivalent water height were also computed for the Nelson Catchment. Preliminary results demonstrate that GRACE data show a seasonal cycle characteristic of snow accumulation and melt in western Canada.

S02-2C3.2 **14:15**

Factors controlling radiobrightness of a snowpack under a discontinuous canopy in early spring

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The microwave emission of a wet snowpack at frequencies below the Debye relaxation of liquid water is governed by vertical profiles of ice grain size, temperature, and liquid water content. Thus, microwave brightness observations, such as from AMSR-E 6.9GHz channel, can be used to constrain

the evolution of models predicting the snow pack properties, particularly when liquid water is present. In the snow pack modelling, we find that while ice grain growth and ablation during the freeze/thaw cycles of spring melt are primarily influenced by snow processes, they are also affected by water vapor exchanges between the soil and snow. Liquid water in the snow pack forms as pendular rings at the contact points between ice grains. For the emission model, we find that these rings have enhanced absorption and scattering cross sections relative to the same quantity of water in the form of spheres. The microwave brightness of snow also includes reflected downwelling radiance. The 6.7 GHz sky at zenith is only a few Kelvin, but downwelling radiance from a discontinuous canopy is near the physical temperature of the canopy so that the reflected contribution to a snowpack's brightness temperature can be 10's of Kelvin. We use temperature, moisture, and grain size profiles from Soil-Snow-Vegetation-Atmosphere Transfer Model (SSVAT), and pendular ring models to compute absorption and microwave brightness temperatures. We validate our models with observations of horizontally polarized, 6.7GHz brightness in early spring near Fraser, Colorado, collected during CLPX. For the situation at the CLPX site, our models predict a 6.7 GHz brightness temperature increase of near 7K from processes associated with water vapor exchanges between soil and snow, as much as a 4K increase from pendular rings rather than spheres of liquid water, and 28K increase from downwelling canopy radiance. These predictions are consistent with the CLPX observations.

H01-1D4.4 **16:45**

Spatial Error Propagation While Scaling Up Forest Transpiration: Sources and Reduction of Error

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(Presented by *Rebeca Quiñonez-Piñón*)
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Accurate forest transpiration estimates are valuable input parameters for regional and global modelling of climate change, hydrology, and for forest conservation programs. Tree allometric correlations are a common and effective method for scaling up single trees' transpiration to even the catchment scale. To create reliable prediction models and conservation programs, it is crucial to not only obtain accurate transpiration estimates, but to also report the error associated with the final transpiration estimates; however, information on error propagation in the actual Literature is generally lacking, or only an overview is presented. Here, the authors identified the sources of error and estimated the error associated with the final transpiration estimates. First, fine input scaling parameter data was used to create allometric correlations between sapwood area and leaf area. Authors used the TRAC optical device to calculate leaf area, and wood tissues microscopical analysis to calculate sapwood area. Absolute errors were calculated by the rules of error propagation derived from Taylor series. The propagated error is mainly reflected as: a) the error on sapwood area estimates, b) the error on leaf area estimates, and c) the error associated with the linear regression models. Results demonstrate that the errors associated with leaf area are directly correlated to the plot size. Also, results showed that the error associated with sapwood area became negligible at the tree and stand scales. Definitely, the reduction of error on sapwood area establishes microscopical analysis a robust mensuration technique. Overall, the error associated with final estimates of forest transpiration was reduced by using fine input data to develop the scaling parameters and the allometric correlations between the scaling parameters (i.e. leaf area and sapwood area).

C02-2C5.4 **14:45**

The relation of the Pacific Decadal Oscillation with the Atlantic Multidecadal Oscillation

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The relation of the Pacific Decadal Oscillation (PDO) with the Atlantic Multidecadal Oscillation (AMO) is first investigated based on analyses of SST observations over the last century. It is shown that the AMO leads the PDO by 13 years but also lags the PDO by 17 years. The AMO and PDO might therefore be viewed as two components, in phase quadrature, of the same oscillation cycle with a period of approximately 60 years. It is also argued on the basis of the same observations that the PDO can be viewed as involving an ocean basin scale mode of adjustment with decadal time scale that is superimposed on a multidecadal modulation.

The validity of this interpretation of the PDO is further investigated in coupled global climate model simulations. Analyses of the PDO will be described as this develops in different simulations performed using the NCAR CSM 1.4 or CCSM 3.0 models. In simulations at equilibrium, a PDO pattern develops that has decadal timescale. In transient simulations, for instance in which the Atlantic thermohaline circulation is reduced through the application of anomalous freshwater forcing, the dominant variability in the Pacific sector is found to be due to a basin wide adjustment process, superimposed upon which there remain vestiges of the equilibrium PDO.

Finally the relation of the PDO and the AMO to multidecadal fluctuations in the global warming trend of the last century will also be discussed, both from the perspective of SST observations and of simulations of the last century of climate evolution.

H01-2DP.10 **16:00**

The Use of Different Sapwood Area Mensuration Methods: Implications in Modelling Canopy Transpiration and Catchment's Water Balance

M. Rebeca Quiñonez-Piñón, Caterina Valeo

(Presented by *Rebeca Quiñonez-Piñón*)
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Tree sap flow mensurations provide sap mass flow (volume of water transpired by a tree) when multiplied by the tree's sapwood area. To scale up sap mass flow from single trees to the canopy scale, it is common to use either sapwood area or leaf area as the scaling parameter. In this work, we test how the use of different sapwood area mensuration methods influence transpiration values scaled at the catchment level. We focused on sapwood area because it has been widely proven that optical devices such as the TRAC give reliable LAI estimates, and previous work by the authors has demonstrated that controlling the plot size, the error on leaf area estimates can be controlled as well. However, there is little knowledge of the reliability of the different sapwood area mensuration methods. Thus, sapwood area was estimated in individuals of 5 boreal vascular species using four methods: 1)the light transmission method, 2)change in wood coloration, and 3)wood tissue microscopical analysis. The first two methods showed under and overestimations between -61% and 35% of the sapwood area estimated with the third method. We computed and created spatial graphics of the total forest transpiration for plots of 100 m^2 and 3,600 m^2 and for a Lusk Creek sub-basin (Alberta, Canada) using the sapwood area estimates obtained with the three different methods. It was noticed that the over and underestimations of sapwood area do not reflect significant changes in mass sap flow at the smaller plot scale, but they drew significant changes at the sub-basin scale. The differences for scaled values of transpiration become highly significant when it comes to forest water yield estimations and management. Hence, for further inferences using the scaled transpiration values, it is essential to know the degree of error carried along the scaling process.

H02-2B4.3 **11:15**

The influence of vapour trajectory on the isotopic signal in the Canadian Rocky Mountain snowpack

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The stable isotopes of oxygen and hydrogen are traditionally used as either tracers in hydrological sciences or as a means of reconstructing long term climate in paleoclimatic archives. This work suggests that they also have a valuable application to understanding contemporary relationships between regional synoptic conditions and snow accumulation. Once established, these relationships can be used as a tool to understand the effect of changing winter storm tracks on the accumulated snowpack and water resources in alpine regions.

Snowpits have been sampled for stable isotope analysis over three accumulation seasons at two field sites in the Canadian Rocky Mountains: the Haig Glacier in Kananaskis Country and the Opabin Glacier in the Lake O'Hara catchment (Yoho National Park). Results from 2004/2005 and 2005/2006 show that the isotopic profile of the seasonal snowpack has a high degree of spatial correlation, suggesting that there is a strong regional control on the isotopic composition of solid phase precipitation in Western Canada. In addition, the snowpack appears to be subject to minimal post-depositional modification at the glacier sites in our study areas. This enabled us to identify the isotopic fingerprint of each major storm system in the snowpack stratigraphy. Once 'located' within the snowpack, storms were classified based on their synoptic climatology and an average isotopic value was assigned to each storm and storm type. Preliminary work suggests that a Rayleigh distillation can account for the final isotopic composition of the Rocky Mountain snowpack, so long as the vapour source region and trajectory are explicitly modelled for each major snow event.

H01-1D4.3 **16:30**

Testing the Versatile Soil Moisture Budget model for groundwater recharge estimation in a northwest Canadian Prairie setting.

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Millions of topographic depressions in the Canadian prairies periodically store surface water runoff, allowing soil moisture and shallow water table recharge. In semi-arid regions such as the northwestern prairies groundwater recharge is minimal, accurate simulation of recharge requires processes between surface and groundwater are well characterized. The study site located at Spy Hill northwest of Calgary is characterized by hummocky topography, with clayey soils and a regional water table 40m below the ground surface. The site is comprised of native grassland and an alfalfa cultivated field. Two depression and adjacent upland sites have been monitored since 2003; these are equipped with time domain reflectometry (TDR) waveguides monitoring soil volumetric water content (VWC) and tensiometers monitoring soil matric potential. The native grass upland site has an eddy covariance system monitoring actual evapotranspiration (AET) and a meteorological station. The Versatile Soil Moisture Budget (VSMB) model is used as it was developed for soil water studies in the Canadian prairies. The VSMB is a multi-layer water balance model. Potential evapotranspiration (PET) is calculated using Priestly-Taylor method, vegetation water uptake is user defined as a crop coefficient and actual evapotranspiration (AET) is determined as a function of PET and crop coefficient. The

performance of VSMB was tested to simulate observed VWC, AET and PET in upland settings. VSMB PET was overestimated as a result of assumptions in the models Priestly-Taylor calculation. AET was underestimated due to user defined crop coefficient values being too low. During 2006 the VSMB accurately predicted soil moisture content at the pasture and alfalfa sites. All model runs produced no upland area recharge. The addition of upward flow and unsaturated hydraulic conductivities to the model will allow accurate prediction of soil moisture, realistic water flow and reduce errors in AET and crop coefficient estimates.

C02-2C5.5 **15:00**

δ^{18}O-temperature relationships on the Prince of Wales Icefield, Ellesmere Island, Canada: the relative importance of vapour mass trajectory versus temperature on isotopic values

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In the spring of 2005, a high-resolution ice core was retrieved from the Prince of Wales (POW) Icefield, Ellesmere Island, Nunavut, Canada. One of the primary objectives associated with this ice core is development of an annually-resolved temperature record for the past 1000 years. Initial calibration of the δ^{18}O-temperature relationship is performed using sections of the core that coincide with historical air temperature records from Environment Canada s Eureka weather station (located approximately 200 kilometres from the drill site) and from National Center for Environmental Prediction (NCEP) reanalysis data. Both temperature datasets indicate low correlation with δ^{18}O values. Minimal improvements to this relationship result when precipitation-weighted δ^{18}O-temperature data are used, based on the seasonality of Eureka precipitation. This research proposes the use of a single-stage Rayleigh-distillation model in order to determine the relative importance of changing vapour mass trajectories on snow-water isotope values on the POW Icefield. Development of such a model is anticipated to improve understanding of the δ^{18}O-temperature relationship.

The POW Icefield receives most of its moisture from the southeast (Baffin Bay and the Labrador Sea), as indicated by the strong east-west asymmetry in snow accumulation rates on the Icefield. As a result, glaciers on the east coast extend to sea level, while the outlet glaciers on the western margin terminate terrestrially at elevations of 400-600 m. A single-stage Rayleigh-distillation model, used in conjunction with NCEP reanalysis data, will be developed and calibrated using spatial isotope data collected from snowpit isotope stratigraphies at 25 sites across the Icefield. Understanding the influence of vapour mass trajectory and temperature on δ^{18}O values on the POW Icefield will allow improved temperature reconstructions from the ice core. Proxy data relating to air mass origin (e.g. deuterium excess, ion chemistry) will eventually be used to extend the Rayleigh modelling beyond the historical (NCEP) period, enabling temperature reconstructions of the last millennium.

C01-2B6.4 **11:15**

20th and 21st Century changes in ocean mixed-layer depth as simulated by current-generation coupled climate models

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The depth of the surface ocean mixed layer is an important regulator of air-sea interaction, ocean ventilation, and biological production, and is likely to be influenced by (and influence) anthropogenically induced climate change. This study examines the evolution of ocean mixed-layer depth over the 20th and 21st centuries as simulated by an ensemble of coupled climate models contributing to the IPCC Fourth Assessment. Radiative forcing is historical during the 20th century, and is governed in the 21st century by the SRES A1B scenario, which describes greenhouse gas accumulations of intermediate severity, with atmospheric CO2 concentrations exceeding 700 ppmv by 2100. The modelled trend at most locations is for a progressive shallowing of the mixed layer as the earth's climate warms, although in certain regions the mixed layer tends to deepen. Relations between these trends and changes in regional and seasonal influences such as near-surface stratification, surface buoyancy flux and wind stress are discussed. Comparisons are made to the observed shallowing over the past half century of the winter mixed layer at Ocean Station P in the Gulf of Alaska.

C05-3B5.4 **11:30**

The Probability Distribution of Surface Momentum Fluxes

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Momentum fluxes at the interface between the atmosphere and the land or ocean surface mediate interactions between these fundamental components of the climate system, and so it is important that they be accurately simulated in climate models. Standard bulk drag formulae for surface fluxes are nonlinear in the resolved winds, and so gridbox-averaged fluxes are not equal to the flux associated with the gridbox-averaged winds. Accurate simulation of the gridbox-averaged flux requires the probability distribution of the winds on the subgrid scale. This talk will present a parameterisation of the probability density function (pdf) of surface momentum fluxes over the ocean in terms of the pdf of surface vector winds. It will be shown that observed flux distributions are significantly influenced by the observed non-Gaussian structure in the vector winds. An analytic theory for the pdf of surface momentum fluxes and implications for the parameterisation of surface momentum fluxes in GCMs will be discussed.

I01-1B8.7 **12:00**

On Annular Modes and Zonal Jets

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Large-scale statistical modes of zonal-mean extratropical atmospheric variability such as the zonal index or the annular mode are generally interpreted in terms of variability of the zonal jet, in particular with fluctuations in jet position. In this talk, an idealised kinematic model of a jet in zonal-mean zonal wind which fluctuates in position, strength, and width is considered. This model is sufficiently simple that in many cases the leading Empirical Orthogonal Function (EOF) modes for both zonal-mean zonal wind and zonal-mean geopotential can be computed analytically. These analytic EOF modes are then compared to standard interpretations of the EOF modes of observed zonal-mean zonal wind and of zonal-mean geopotential, respectively the zonal index and annular modes. It is shown that the idealised model is able to reproduce the observed EOF structures when observed fluctuations in jet position, strength, and width are accounted for. However, it is not possible in general to relate individual EOF modes to individual jet degrees of freedom (position, strength, or width). Furthermore,

it is shown analytically that in general there is no one-to-one correspondence between EOF modes of zonal-mean zonal wind and zonal-mean geopotential when the mean jet width is comparable to the width of the analysis domain. It is concluded that the zonal index mode and the annular mode are related but distinct.

S03-3B3.1 **10:30**

Bias corrections of long-term (1973–2004) daily precipitation data over the northern regions

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A consistent daily bias correction procedure was applied at 4802 stations over high latitude regions (North of 45N) to quantify the precipitation gauge measurement biases of wind-induced undercatch, wetting losses, and trace amount of precipitation for the last 30 years. These corrections have increased the gauge-measured monthly precipitation significantly by up to 22 mm for winter months, and slightly by about 5 mm during summer season. Relatively, the correction factors (CF) are small in summer (10%), and very large in winter (80–120%) because of the increased effect of wind on gauge undercatch of snowfall. The CFs also vary over space particularly in snowfall season. Significant CF differences were found across the USA/Canada borders mainly due to differences in catch efficiency between the national gauges. Bias corrections generally enhance monthly precipitation trends by 5–20%. These results point to a need to review our current understanding of the Arctic fresh water budget and its change.

A07-3B7.3 **11:00**

13C/12C and 18O/16O in atmospheric CO2 at the WMO Station at Alert, NWT: Long-term changes and influence of Siberia atmospheric inflow

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The Arctic has been undergoing accelerated warming in recent years. There have been changes in the atmospheric CO2 and its isotopic ratios of 13C/12C and 18O/16O. Environment Caanda has been manning the international WMO Station at Alert, NWT to detect the changes. Comparisons of the data sets by the Climate Chemistry Laboratory, Environment Caada and other international groups are presented. The area is affected by inflow of air from Siberia, Russia. The atmospheric changes in Canadian Arctic and effect of Russian air flow are discussed.

S02-2B3.4 **11:15**

Using satellite imagery to validate snow distribution in a large northern basin simulated by a hydrological model

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Concern of climate change and variability in high latitude regions has increased the demand to assess the impacts on water resources including the regional scale snow accumulation and melt, and discharge of large rivers to the Arctic Ocean. Availability of hydrologic data are limited for this vast region, and it is often necessary to evaluate seasonal change in snow cover and runoff contribution using macroscale hydrologic models. While these models are usually validated using measured discharge at the basin outlet, there are insufficient ground-based observations to evaluate the seasonal change of the melting snow cover in large catchments. The MODIS global snow cover product provided by the National Snow and Ice Data Center (NSIDC) offers suitable information to validate simulated snow coverage in rugged sub-arctic terrain, such as the Liard basin (275,000 km2) in Canada. Changing extent of snow cover simulated by the SLURP macro-hydrologic model using two sets of reanalysis data was compared with MODIS imagery at four bi-weekly intervals in 2000 and 2001. Despite resolution differences between the model and MODIS, results indicate that the general pattern of snowmelt in the Liard basin is comparable between the MODIS imagery and the model results, with melt occurring from the lower elevations in the east where less snow was accumulated, to the higher elevations in the west with higher snow accumulation. This demonstrates the usefulness of employing remote sensing in macroscale hydrologic model verification.

A06-2DP.3 **16:00**

Assessment of the Arctic Dehydration/Greenhouse Feedback using CloudSat and CALIPSO datasets.

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Recent observations have shown that the Arctic warming trend predicted by climate models based mostly on the greenhouse effect is not realized during winter, possibly due to an aerosol-induced counteraction. During the cold season, this aerosol effect includes the dehydration-greenhouse feedback (DGF), a mechanism associated to the long-range transport of anthropogenic sulfur dioxide and sulfates into the Arctic. Sulfuric acid, an end-product of atmospheric sulfur oxidation, covers practically all other aerosols and, by reducing the homogeneous freezing temperature, favours the predominance of precipitating diamond dust over ice fog. The consequent acceleration in the dehydration of air masses as they enter the Arctic is accompanied by a reduction in the water content greenhouse effect, and the subsequent surface cooling, by propagating through the boundary layer, promotes further dehydration. The magnitude of this feedback mechanism, whose numerical simulations have revealed the potential to be of climatic significance, may now be assessed with satellite observations. In this communication, we present a methodology for assessing the DGF effect using CloudSat radar reflectivity and CALIPSO lidar backscattering datasets, and we discuss preliminary results.

I12-3B9.5 **11:30**

Atmospheric Moisture and Thunderstorm Drought

Geoff Strong

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One objective of the Drought Research Initiative (DRI) considers thunderstorm drought. Thunderstorms are an essential component of the prairie water balance, so much so that their absence

often signals the initiation of a drought, while the return of thunderstorms often heralds the cessation of a drought. While prairie thunderstorms are obviously related to the diurnal cycle of temperature and humidity, storm outbreak periods often occur in cycles as well, that is, periods of several consecutive days when severe convective storms occur in the same general region. These cycles are also related to similar cycles in atmospheric temperature and humidity, moderated by available water supply and regional evapotranspiration. This presentation explores both short-term cycles and longer-term climate trends in these variables, utilizing surface and radiosonde data. The high time and space resolution of atmospheric moisture retrieved from GPS data are included in this study as a possible means for monitoring both daily evapotranspiration and early signals of drought initiation or cessation.

Convective storms are also known to occur along the periphery of a region of drought, most frequently near the boundary between dry and moist air masses. One analogy to this is that Alberta thunderstorms are often initiated over the foothills by a dryline, which itself originates over the mountains by processes similar to the more well-known winter Chinook, and interacts with moist boundary layer air converging beneath a capping lid over the foothills. This DRI sub-project is therefore also investigating dynamic processes relating thunderstorms and drought, and similarities with dryline-initiated thunderstorms. Both short-term cycles and case studies are examined in the above contexts.

I11-3DP.1 **16:00**

Snowpack variability between forest stands: effect of altered canopy cover due to beetle infestation

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British Columbia is undergoing a major mountain pine beetle (Dendroctonus ponderosae) infestation that has now spread to Alberta. This infestation impacts snow interception, accumulation and melt, and is thus of particular importance for nival hydrological regimes. A pilot study was conducted on the Nechako Plateau near Vanderhoof, BC to examine the impact of canopy change due to infestation on snow stratigraphy and metamorphism in dead, alive and logged stands. Monthly snow pit data were collected in each of these three stand types, and differences in snow properties examined in the context of stand-specific meteorological data and classifications of canopy health. Results indicate that canopy degradation due to beetle kill alters local snow accumulation and meteorology, significantly affecting snowpack evolution over the season. The dead stand in particular represents a key transitional stage that approaches open stand conditions with increasing time since stand death. Despite the same climatic/snow inputs over a winter season, each stand has a very different snowpack structure at the onset of spring melt, contributing to differences in melt timing and volume between the stand types.

H06-2DP.1 **16:00**

Air temperature lapse rates at Andrei Glacier, northwestern BC

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Air temperature lapse rates are often used in numerical models of alpine glacier melt and mass balance to extrapolate data from a single meteorological station to locations distant from that station. As field measurements of alpine lapse rates are limited, however, they are often assumed to be constant at -6ºC

km-1 (moist adiabatic lapse rate; MALR). How do measured lapse rates compare with the MALR? Can 500 mb synoptic maps be used to derive surface air temperature lapse rates in areas for which measurements are unavailable? To explore these questions, three meteorological stations were installed along an elevational transect in the Andrei Glacier catchment (56° 55' N, 130° 55' W), recording hourly average air temperature (ºC), barometric pressure (kPa), and precipitation (mm) from July – September, 2006.

Daily lapse rates between the lowest and highest stations are far from constant: the standard deviation is 1.5ºC, with a range of ±2 standard deviations. 52% of daily lapse rates fall between –6 to –8ºC km-1 and correlate with surface pressure measurements, indicating a potential link to large-scale synoptic configurations. The high elevation station is most representative of these larger-scale climatic conditions, as the low elevation station is often trapped within the glacier boundary layer despite its location 2 km downvalley from the glacier toe. While upper-level synoptic maps show a general relationship with surface conditions, the connection between upper-level and surface conditions must be determined prior to using these maps to derive surface air temperature lapse rates. Interactions between the glacier and local meteorology can alter the thickness and extent of the glacier surface boundary layer, effectively decoupling surface air temperature lapse rates from the regional synoptic configuration.

S03-3DP.1 **16:00**

Measuring Heavy Snowfall using Five Different Windshields - each with a Vibrating-wire Precipitation Gauge

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During the three-day period 17-19 March 2003, 130 mm of rain and liquid equivalent snow were recorded at the Marshall, CO field observation facility south of Boulder operated by the National Center for Atmospheric Research. Five heated Geonor T-200 3-wire gauges continuously recorded 1-minute accumulations of precipitation, each gauge in a different windshield. The five windshields were the WMO Double Fence Intercomparison Reference (DFIR), a two-thirds size DFIR, two differently spaced double-Alter shields, and a traditional single Alter shield. The event can be characterized as a 16-hour period of discontinuous rain followed by a 37-hour period of continuous snowfall with wind speed between 0 and 11 ms-1 and 3m air temperature during snowfall between -1.0 and 0.5 C. The results show the two highest storm total accumulations were from the DFIR and 2/3 size DFIR with the least storm total from the single Alter at 65% of the DFIR. The cause of the undercatch is the design of the windshield. We will show a plot of the ratio of 15-minute accumulations from the gauge in the single Alter shield to those from the gauge in the DFIR versus wind speed and compare it to previous snowfall events. All gauges were heated with a fine wire wrap so that the temperature of the collection cylinder varied between 0 C and 2 C. Because of the high snowfall rate, the duty cycle of heating of heating influences the 1-minute precipitation rates in a predictable way. Also of interest is the observation of "snow dumps" that occur when an accumulation of snow in or on the collection cylinder rim detaches and falls into the bucket. This precipitation event demonstrates the sensitivity of estimating liquid equivalent snowfall to the type of windshield employed and the comparative insensitivity when only rain is occurring.

I10-3DP.1 **16:00**

Effect of heat transmission through melt ponds and ice on melting during summer in the Arctic

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To observe sea ice and ocean conditions in the Arctic in summer, a trans-Arctic research cruise of the U.S. Coast Guard Cutter (USCGC) Healy was conducted from 5 August to 30 September 2005. The relationship between the ice concentration observed by the on-board ice-watch and temperature above the freezing point (Δ T) measured by expendable conductivity-temperature-depth (XCTD) sensors had a negative correlation (CT-relationship) before freeze onset, which means that, as ice concentration decreases, Δ T increases due to the larger absorption of solar radiation. Δ T in high ice-covered region (> 90%), however, remains more than 0.1 K during melting season, suggesting that sea-ice and melt-pond areas work as heat source areas as well as leads. By separating the effects of heat input from open water, melt ponds, and ice on heating of mixed layer, it was found that the contribution of the transmitted heat through ponds and ice on the Δ T-gain are large in highly ice-covered region. To examine the effect of heating from there on ice melting, a simplified ice-ocean coupled model was applied. By changing the heat input to obtain the analyzed Δ T-gain for each surface category, transmittances of ponds and ice were indirectly estimated as 55% and 9%, respectively. After including the effects of transmitted heat through ponds and ice, modeled results agreed with the observed CT-relationship. A comparison between results by turning on/off the effect of transmitted heat through ponds and ice, showed that it amplified the open water-albedo feedback in the highly ice-covered region.

I04-4B1.3 **11:15**

An initial analysis of a North Atlantic configuration of the prismatic version of FEOM

Veluthedath Kuzhiyil Praveen[1], *Paul G Myers*[1], *Sergei Danilov*[2]

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A new prismatic version of a 3D Finite Element primitive-equation Ocean Model (FEOM) is used for the study of North Atlantic (97^oW- 15^oE and 3^oS - 80^oN). The model was developed at the Alfred Wegener Institute for Polar and Marine Research (AWI), Germany. The present version has a triangular unstructured horizontal mesh, refined in regions of steep topography with prismatic geopotential vertical levels. An older version used tetrahedral partitioning in the vertical. The model has a maximum finite element size of 35 km,mainly in the deep ocean and a minimum resolution of 7km in areas of steep topography as well as the Labrador Sea. The model will be forced with the CORE surface flux data set. Here we will present the preliminary results on the circulation, hydrography and heat transport in the model, focusing on the subpolar North Atlantic and the Labrador Sea. Comparisons with observations will also be presented.

C01-2B6.7 **12:00**

Simulated Antarctic climate change over the 21st century

Thomas Bracegirdle, *William Connolley*, *John Turner*

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Here we will present a new estimate of Antarctic climate change over the twenty first century based on data from 19 of the 24 models that were submitted for the Intergovernmental Panel on Climate Change (IPCC) Assessment Report Four (AR4). Over the Antarctic continent and the Southern Ocean the different models produce a range of responses to climate forcing, even under a single scenario. To provide more reliable estimates of future change, a weighting scheme has been applied to the output of the AR4 models, which depends on a measure of their ability to reproduce the climate of the late 20th century. As well as an assessment of parameters that have been considered in other analyses of AR4 model data, we also present an assessment of the projected change to the near-surface wind over terrestrial and coastal Antarctica.

C02-1C5.1 **INVITED/INVITÉ 13:30**

The Atlantic Meridional Overturning during OIS 1-11 and OIS 27-31 cycles : Evidence for a singular modern thermohaline linkage between the Arctic and the North Atlantic?

Claude Hillaire-Marcel[1], *James E.T. Channel*[2], *Anne de Vernal*[1], *Nathalie Fagel*[3], *Bassam Ghaleb*[1], *Reda Lamziouaq*[1], *Jennifer McKay*[1], *Mihail Preda*[4], *Yassir Satte*[1], *Ross Sevenson*[1], *Joseph Stoner*[5]

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Variations in source of deep Labrador Sea sediments and the intensity of the Western Boundary Undercurrent (WBUC) provide information on the origin of Deep North Atlantic Water (DNAW) masses and the overall Atlantic Meridional Overturning (AMO) pattern. We compare isotopic, mineralogical and geochemical properties of sediments from ODP-IODP Sites 646 and U1305 (Eirik Ridge, appr. 3500 m deep) over two time intervals, marine oxygen isotope stages (OIS) 27 to 31 (Jaramillo interval; IODP cores 1305) and OIS 1 to 11 (ODP cores 646; cf. Fagel & Hillaire-Marcel, 2006). Clay mineralogical assemblages, Nd and common lead isotopes in clay-size fractions (≤ 2 µm) are used as proxies for water mass sources and mixing, whereas sedimentation rates from oxygen isotope stratigraphies, relative abundance of sortable silts, and ^{230}Th vs. ^{231}Pa-fluxes, provide information on WBUC paleo-intensities, and therefore the production rates of DNAW masses. Clay mineralogical assemblages, Nd and common lead isotopes in clay-size fractions (≤ 2 µm) are compared between sediments spanning respectively (marine) oxygen isotope stages (OIS) 27 to 31 (Jaramillo interval; IODP cores 1305) and sediments from OIS 1 to 11 (ODP cores 646; cf. Fagel & Hillaire-Marcel, 2006). A major objective is to compare THC patterns of 100 kyr vs. 40 kyr orbitally-tuned climatic cycles, and to highlight THC properties during interstadials warmer than the present one. OIS cycle 1-11 sediments show large amplitude fluctuations in clay assemblages between two end-members: i) an even mixture of chlorites and illites (glacial erosion sediments from Greenland & the Canadian Shield), and ii) smectites originating primarily from either the alteration basalts from the Reykjanes ridge, the Icelandic and Faeroe islands (OIS 1-11), or from the erosion of soils over central and inner Greenland and/or the western European margin (OIS 27-31). In addition, the OIS 27-31 record shows a much higher proportion of chlorites in the illite-chlorite erosional end-member, thus suggesting contributions from distinct source rocks. Furthermore, whereas erosional sources dominate during warm stages of the OIS 27-31 interval, they are relatively more abundant during cold stages of the OIS 1-11 interval. Similar distinct features are also seen in the geochemical properties of the corresponding clay fractions. Throughout the OIS 1-11 interval, oscillations between two end members are observed. They consist respectively of i) a mixture of Precambrian shield sources with Panafrican-Variscan sources during glacials, and ii) a mixture of mid-Atlantic volcanic sources with Panafrican-Variscan sources during interglacials. The geochemical properties of OIS 27-31 fall outside the field defined by these three components, and suggest contributions from another source,

which we hypothesize to be Tertiary volcanic terrains from inner Greenland, a source that particularly important during interglacial periods of the OIS 27-37 interval. In addition, sedimentation rates during OIS 5e and 11, when compared to those of OIS 1, as well as the corresponding isotopic composition of planktic and benthic foraminifers, lead to even question the contribution of Denmark Strait Overflow Water (DSOW) during interglacials prior the present one (mid- to late Holocene). We tentatively conclude that the modern AMO pattern, also characterized by Labrador Sea Water formation due to winter cooling and convection in this basin, is exclusive to the present interglacial. Furthermore, the contribution of deep water from the Arctic, with intense DSOW formation, can also be questioned during earlier interglacials, notably during OIS 5e.

A04-2DP.3 **16:00**

Vérification du gem-lam dans le cadre de la prévision maritime pour le secteur de Donnacona à l'île-aux-coudres

Olivier fortin

(Presented by *Olivier Fortin*)
Environnement Canada
Contact: olivier.fortin@ec.gc.ca

Vérification du gem-lam à trois points d'observation représentatifs du secteur maritime de Donnacona à l'île-aux-coudres dans le but d'intégrer ce modèle à scribe marine

O03-3B1.6 **11:45**

Polynyas and tidal mixing in the Canadian Arctic Archipelago

Charles Hannah[1], *Frédéric Dupont*[2], *Michael Dunphy*[1]

[1] Bedford Institute of Oceanography, Fisheries and Oceans Canada
[2] Quebec-Ocean, Université Laval
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A tidal model of Canadian Arctic Archipelago was used to map the tidal mixing parameter h/U^3 and areas with the potential for tidally-induced upwelling. The results support the idea that many of the recurring polynyas in the archipelago are tidally-driven, sensible heat polynyas. The strong tidal mixing means that the polynya locations also have the potential for enhanced plankton production in the summer. As a result the spatial distribution of tidal mixing may play a role in the patterns of early human settlement.

S05-1C3.5 **14:30**

Trends of Snow Cover and Snowfall in a Warming World

Richard Heim

NOAA/National Climatic Data Center
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Snow will be significantly impacted as temperatures rise in a greenhouse-warmed world. Changes in the geographical pattern of snow cover and snowfall can be expected. Snowfall will decrease in some areas and increase in other areas (both in terms of amount and frequency), while snow cover is expected to decrease in frequency, amount, and spatial extent, and snow season length will decrease. In situ observations of snowfall and snow depth extend back at least a century in the United States,

and over much of the 20th century in other countries. At the NOAA National Climatic Data Center, snow climatologies for the Cooperative (COOP) Station Network have been computed and near-real time COOP data are used to monitor snow variability on an operational basis. This paper will utilize the COOP snowfall and snow depth data base to examine the relationship between snow and temperature, and to assess the variability of snow in the U.S. over the last 100 years.

A04-4B6.4 **11:15**

Radar differential reflectivity (ZDR) in snow… some observations and hypotheses.

Michael Leduc, *David Hudak*, *Sudesh Boodoo*, *Norman Donaldson*

Environment Canada Cloud Physics and Severe Weather research Section
Contact: ledmike@gmail.com

Differential reflectivity (ZDR) in snow is very complicated. Falling snow crystals tend to have larger horizontal than vertical dimensions and thus positive values of ZDR, sometimes exceeding 3 dB. However many factors, such as riming turbulence and aggregation, reduce the ZDR values to zero or less.

King Radar near Toronto was upgrade to polarimetric capability in the summer of 2004. We will present case data from the past 3 winters demonstrating the patterns of ZDR associated with selected synoptic winter storm and snowsquall events. Some early speculations on how ZDR data, including vertical profiles, could be used to improve radar estimates of snow accumulation will be presented.

I12-3B9.6 **11:45**

Future changes in temperature, precipitation and forest drought indices as simulated by the Canadian Regional Climate Model (CRCM 4.1.1).

Travis Logan, *Diane Chaumont*, *Daniel Caya*

Ouranos
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Future changes in temperature and precipitation, in particular the frequency and duration of drought conditions, could have important impacts on forest-fire risk, agricultural production and hydrological resources in North America. Simulated data from the most recent version of the Canadian Regional Climate Model (CRCM 4.1.1), as well as a selection of General Circulation Models (GCMs), are used to analyse future changes in temperature, precipitation and drought indicators, over Eastern Canada and the North-Eastern United States. This study focuses on simulated changes in the Canadian Drought Code (CDC), a component of the Canadian Forest Service's Canadian Forest Fire Weather Index (FWI), as well as changes in dry-spells. Results indicate that various regions in Canada could experience drier summer conditions under climate change. Calculated annual changes typically show an increase in both temperature and precipitation. However, seasonal changes in precipitation are potentially insufficient to offset increases in temperature and subsequent increases in evapotranspiration for certain regions.

S03-3C3.7 **15:15**

Snowflakes falling on water: Can underwater sound levels be used to measure snowfall rates?

Tahani Alsarayreh, *Len Zedel*

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It is well known that rain falling on the ocean's surface generates underwater sound with a characteristic peak at a frequency of 13.5 kHz. Falling rain generates sound in two ways; there is a direct impact sound, but more importantly, there is also a ringing sound caused by air bubbles injected into the water by the raindrops. The sound generated by falling rain is such that ocean rainfall rates can be estimated by evaluating spectral characteristics of the sound. There are also some reports that snow generates sound similar to that of rain but it is hard to imagine that the mechanisms responsible for rain sounds could be the same as those that cause sound from falling snow. We explore the sound generated by falling snow through laboratory measurements under different atmospheric conditions with an associated variety of snowflake types. We find that there is a well defined spectral peak at around 14 kHz (similar to that of rain) however, it is clear that only a small proportion of snow flakes generate the characteristic narrowband sound. These laboratory observations are complemented with field observations that further support the presence of a spectral peak associated with snowfall events. The long term goal of this work is to determine if sound levels can be used to quantify ocean snowfall rates.

S01-1B3.2 **10:45**

Improved mapping and understanding of the spatial and temporal variability in snow water equivalent over Quebec

Ross Brown[1], *Dominique Tapsoba*[2]

[1] Environment Canada @ Ouranos
[2] Institut de recherche d'Hydro-Québec (IREQ)
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Snow accumulation over Quebec and adjacent Labrador is significant at a continental scale representing the 2nd largest maxima after the western cordillera with annual maximum snow accumulation averaging 200-300 mm of water equivalent. This resource is of vital importance to the economy, ecology and society of Quebec. However, relatively little has been published about snow cover variability and change in this region of North America due to important limitations in the available snow observing systems.

This talk will describe results from a project to develop detailed (10 km resolution) gridded maps of SWE over southern Québec from historical surface observations of snow depth and SWE. The project has assembled an historical snow course database for Quebec and surrounding regions which contains 158,377 observations covering the period 1936-2006. These data are being interpolated to a 10 km grid using the method of kriging with external drift following Tapsoba et al. (2005) which takes account of variables affecting the spatial distribution of snow cover such as topography and vegetation cover. The method also provides an estimate of the error in the interpolated values. The distribution of the available observations is quite variable in space and time but there are sufficient observations to generate SWE maps for most of Quebec south of ~55ºN for a period of approximately 30 years (~1967-1996) for 15-day windows centred on February 01, March 01 and April 01. The talk will also present the results of an initial analysis of the spatial and temporal variability in SWE over Quebec over the period since ~1950 which shows evidence of an abrupt decrease in winter snow accumulation over southern Quebec in the late 1970s due to a shift in winter circulation linked to the North Atlantic Oscillation pattern.

Reference: Tapsoba, D., V. Fortin, F. Anctil and M. Haché, 2005: Apport de la technique du krigeage avec dérive externe pour une cartographie raisonnée de l’équivalent en eau de la neige : Application aux bassins de la rivière Gatineau. Can. J. Civil Engineering, 32, 289-297.

H01-1C4.2 **13:45**

Possible Impacts of Climate Change on Rainfall-related Streamflow in Ontario using Downscaled Future Climate Scenarios

Chad Shouquan Cheng, *Guilong Li*, *Qian Li*

Environment Canada
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The flood damage costs in Ontario, Canada have risen significantly from the early to the late of the last century. Climate change might increase rainfall-related flood damage costs in the future. To evaluate this possible climate change impact, this study has attempted to estimate changes in occurrence frequency of future high-level streamflow events under downscaled GCM climate scenarios for four selected river basins (i.e., Grand, Humber, Rideau, and Thames rivers) in Ontario. Meteorological data used in the analysis included hourly/daily observations from meteorological stations at the international airports nearby the river basins and climate stations located in the river basins for the warm months (April–November) of 1958–2002. Six-hourly NCEP-NCAR upper-air reanalysis weather data at eight atmospheric levels for the same period were also used in the study. Automated synoptic weather typing integrated with cumulative logit and non-linear regression analyses was applied to estimate future daily rainfall amounts. An autocorrelation correction model was applied to estimate future daily streamflow volumes, using downscaled GCM scenarios. Statistical downscaling methods were used to downscale GCM scenarios for three Canadian GCMs (CGCM1 IPCC IS92a, CGCM2 IPCC SRES A2/B2), one U.S. GCM (GFDL-CM2.0 IPCC SRES A2), and one German GCM (ECHAM5/MPI-OM IPCC SRES A2), for three-time windows (2016–35, 2046–65, 2081–2100). The historical runs (1961–2000) of the five GCMs were also downscaled and used to correct the GCM and downscaling model biases. Preliminary results show that under climate change scenarios, frequency of the future heavy rainfall and high flow events could increase in the future. The low flow events could also increase in the future due to the dry condition.

P-2A1.1 **INVITED/INVITÉ 08:30**

Weather Systems and Climate Processes / Les systèmes météorologiques et les processus climatiques

Brian Hoskins

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There is an increasing realisation that the weather-climate problem is a seamless one from days to decades. Most of the impact of climate variation and change is through the weather and its extremes. Weather phenomena feed back on the evolving ambient flow, which in turn gives the background on which the weather occurs. This conceptual framework will be developed and some particular examples of weather and climate phenomena and the challenge in simulating them in models will be discussed.

O03-2C1.7 **15:30**

Simulations of Sill Processes in the Saguenay Fjord

David Janes, *Daniel Bourgault*

Memorial University, Department of Physics and Physical Oceanography
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A laterally averaged non-hydrostatic numerical model is used to characterize sill processes in the Saguenay Fjord. Focus is on the generation of internal waves and turbulence. More precisely, interest is on understanding at what stage of the tidal flow internal waves are being generated, how are their characteristics affected by changes in tidal forcing, and what portion of the tidal energy is converted to internal waves and turbulent kinetic energy.

A04-2DP.1 **16:00**

Evaluation and verification of the Canadian Precipitation Analysis (CaPA)

Marco Carrera[1], *Vincent Fortin*[2], *Bruce Brasnett*[3], *Barbara Casati*[2], *Stéphane Bélair*[2], *Stéphane Gagnon*[4]

[1] Environment Canada, Canadian Meteorological Centre and Meteorological Research Division
[2] Environment Canada, Meteorological Research Division
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The Canadian Precipitation Analysis (CaPA) project was initiated in November 2003 with the goal of producing a real-time precipitation analysis for Canada. CaPA is based upon the Optimum Interpolation (OI) technique, combining information from a short-range regional GEM model forecast with raingauge observations from the SYNOP surface network, and two networks within the province of Québec, a regional surface network (Réseau Météorologique Coopératif du Québec) and a MESONET network, to produce a precipitation analysis over 6-hour periods at a resolution of 15 km. A pre-operational product has been running at the Canadian Meteorological Centre (CMC) since the summer of 2005.

Prior to the operational release of CaPA an evaluation study was undertaken to assess the skill of CaPA as compared to the global OI precipitation analysis currently operational at CMC. This study reports upon a comparison between CaPA and the global OI precipitation analysis for a series of Canadian manned surface stations for the 5 month period June to October 2006. Both continuous and categorical verification scores will be presented in an effort to identify areas where CaPA improves upon the existing precipitation analysis product.

G09-1B2.2 **10:45**

Monitoring Seasonal Variations in Soil Water Content using Multiple Frequency GPR Techniques

Colby Steelman, *Anthony Endres*

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Ground-penetrating radar (GPR) is a non-invasive method of monitoring temporal and spatial variations in soil water content in the upper few meters of the vadose zone. While there has been significant studies investigating GPR soil moisture techniques, there has been few, if any studies applying this technique under the natural field conditions with seasonal variations commonly encountered in Canada. In this study, soil water content variations in upper few meters of soil are being monitored using GPR over a range of seasonal soil moisture conditions, including freeze/thaw cycles. This work is being conducted at two active agricultural sites located near Woodstock and Bamberg, Ontario. Soil moisture at the Woodstock site is currently monitored using a range of stationary instrumentation; GPR surveys are being conducted at a survey location adjacent to this instrumentation. The Bamberg site contains two survey locations with varying soil textures and

drainage characteristics. GPR methods include common mid-point (CMP) and reflection profile soundings over 2 m transects conducted every 2-4 weeks. Measurements have been conducted since May 2006 using a range of antenna frequencies (225, 450 and 900 MHz). The direct ground wave is being examined to infer shallow soil water content variations in the upper few decimeters. CMP velocity analysis techniques and reflection profiles are being conducted to investigate vertical soil moisture variations in the upper 2 meters. The GPR results are being compared to additional soil moisture and geophysical measurements that are conducted in conjunction with the GPR surveys (i.e., ground conductivity measurements using a Geonics EM38 and gravimetric soil samples). The Woodstock data is also being compared to the soil moisture equipment installed at the site. This paper will discuss the results of this ongoing study. Preliminary results have shown significant seasonal variations in the direct wave velocity with minor velocity differences between the three frequencies. The two Bamberg survey sites display contrasting wetting and drying characteristics in the upper decimeter of soil. CMP surveys conducted across shallow frozen ground surfaces (< 5 cm thickness) during the winter season have shown that the direct ground wave may not always be visible, depending on both the frost line depth and the antenna frequency.

S04-4B3.3 **11:00**

FASST and SNTHERM in both Forested and Open Sites

Susan Frankenstein[1], *Anne Sawyer*[2], *Julie Koeberle*[3], *Daniel Hopkins*[1]

[1] ERDC CRREL
[2] College of Natural Resources, Colorado State University
[3] 3USDA NRCS, Snow Survey Office
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We carried out numerical experiments of snow accumulation, depletion and density as well as surface energy fluxes over 5 CLPX sites in Colorado and 3 SNOWMIP2 sites using SNTHERM and FASST (Fast All-season Soil STrength). SNTHERM is a multilayer snow model developed to describe changes in snow properties as a function of depth and time using a one-dimensional mass and energy balance. The model is intended for seasonal snow covers and addresses conditions found throughout the winter, from initial ground freezing in the fall to snow ablation in the spring. It has been used by many researchers over a variety of terrains. FASST is a one-dimensional dynamic state of the ground model. It calculates the ground's moisture content, ice content, temperature, and freeze/thaw profiles, as well as soil strength and surface ice and snow accumulation and depletion. Advantages/Disadvantages of the two models will be discussed as well as model performance at the various sites.

H01-2DP.4 **16:00**

Evaluating Numerical Model Simulations of Vadose Zone Response to Unconfined Pump Tests

Melissa Bunn, *Jon Paul Jones*, *Anthony Endres*

(Presented by *Anthony Endres*)
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Pump tests are the chief tools used by hydrologists to both determine aquifer parameters and assess the water resource potential of unconfined systems. The aquifer parameters in these tests are typically arrived at using analytical solutions. However, the recent work of Endres et al. (2007) suggests that these analytical solutions do not adequately account for vadose zone processes contributing to the spatial and temporal variations in drawdown observed during a given test. Narasimhan (2007) has suggested that variably-saturated numerical models, which represent vadose zone processes more

rigorously than analytical solutions, are a viable alternative for analyzing unconfined pump test results. In this study, three state-of-the-art numerical models: Integrated Hydrogeology Model (InHM), HydroGeoSphere (HGS), and FEFLOW, are used to analyze a heavily instrumented 7-day pump test in an unconfined aquifer at CFB Borden, Ontario. The Brooks-Corey and van Genuchten functions were employed to generate the constitutive relationships used to simulate the unsaturated zone. The values used in these functions were either measured in the field or extracted from the literature. All of the simulations presented in this work were able to adequately reproduce observed water table drawdowns. However, within the vadose zone, the level of agreement between simulated and observed behavior decreased significantly. Specifically, the formation and persistence of an extended capillary fringe observed during the drawdown phase of the pump test could not be replicated by the models. Moreover, none of the models used in this work were able to reasonably reproduce the observed translation of the soil moisture profiles in the vadose zone during the pump test. Additional mechanisms such as air-entry value effects, entrapment of water in pores, and the reduction in porosity as a response to increased tension during pumping may need to be included. Based on our results there is an urgent need to improve the way in which numerical models account for fluid dynamics above the water table.

C05-3B5.7 **12:15**

The benefits of increased model resolution in simulating high impact weather events.

Colin Jones[1], *Ron McTaggart-Cowan*[2], *Katja Winger*[2], *Samuel Girard*[1]

[1] CRCMD/University of Quebec at Montreal
[2] Environment Canada
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The Canadian Regional Climate Modelling and Diagnostics Network (CRCMD) plans to develop the Limited-Area version of the GEM model (Global Environmental Multi-scale model) for application as a high-resolution Regional Climate Model (RCM). High resolution in the sense used here means ~10-15km per model grid square. This development is intended to provide more detailed estimates of regional climate and climate change over North America and is particularly targeted at an improved representation of high impact weather.

As an initial estimate of the potential benefits accruing from increasing resolution from the present-day standard for RCMs, ~45km to ~15km, we have performed a suite of 2-year integrations of GEM-LAM encompassing the entire continental North America at 3 horizontal resolutions (15km, 30km and 45km). The model was integrated for the period 1992-1994 using lateral boundary conditions derived from the ECMWF 40-year reanalysis. This period was chosen to focus on the extreme flooding experienced in the summer of 1993 over the Upper Mississippi basin and to determine whether significantly increased resolution improves the representation of the intense precipitation during this period.

In this presentation we compare frequency distributions of precipitation simulated by the 3 GEM-LAM integrations against high-resolution, observed daily precipitation over the continental USA. We aim to determine if the higher time frequency characteristics of the observed precipitation are better simulated as model resolution is increased, in particular the tail of the distribution. A lower resolution, hourly observed precipitation data set is also employed to evaluate the representation of the diurnal cycle of precipitation in the 3 model versions. We wish to establish if GEM-LAM can accurately represent the spatially varying physical processes controlling the diurnal cycle of precipitation in different regions of the USA.

S05-1C3.7 **15:00**

Northern Hemisphere Winter Climate Variability: Response to North American Snow Cover Anomalies

Stefan Sobolowski[1], *Gavin Gong*[1], *Mingfang Ting*[2]

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[2] Lamont-Doherty/Columbia University
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This study focuses on the role of large-scale snow anomalies in influencing both local and remote climate. In particular, links between autumn-winter snow anomalies over North America and winter climate parameters throughout the Northern Hemisphere are examined. A pair of GCM ensemble experiments are performed from September through February, with high/low prescribed snow forcings that reflect observed autumn snow extent extremes. Analysis of 40-member ensemble differences reveals a dynamic atmospheric wave response in the troposphere, across North America and extending downgradient into Eurasia. Additionally, robust responses in both seasonal and monthly surface air temperature and sea level pressure (SLP) fields are observed. Over North America a negative temperature / positive SLP response is seen while over Europe a positive temperature / negative SLP response is observed. A preliminary hypothesis to explain these findings is that the snow forcing over NA results in a downstream stabilization of the atmosphere, which alters Atlantic storm track activity and associated stationary wave patterns during the winter. The contribution of North American orography to the modeled land surface-atmosphere interaction is evaluated via an additional pair of ensemble experiments in which North American mountains are removed.

I01-2B8.5 **11:30**

Large Eddy Simulation of Highly Convective Boundary Layers, on Earth and on Mars

Babak Tavakoli Gheynani

Earth and Space Science, York University
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Suspended atmospheric dust is an important driver of the boundary layer circulation and climate system of Mars. It is also an important factor in Earth's atmosphere. Convective boundary layers generate a variety of dynamical structures including dust devils which provide an observable form of dust lifting into the atmosphere. Large Eddy Simulations (LES) of planetary boundary layers are performed in this study to compare physical characteristics of simulated convective vertical vortices to those of observed dust devils. Our LES allows time-evolving simulation of turbulence and convection in a three-dimensional computational box and has been successfully used for a wide range of terrestrial atmospheric problems. Our LES model is based on the NCAR LES, adapted and developed for Martian applications. As a necessary part of preparation for future upcoming data from the NASA/CSA Phoenix mission to Mars, scheduled for launch in 2007, this study examines the possible formation and maintenance mechanisms for vertical vortices in the highly convective Martian boundary layer.

G04-2C2.1 **14:00**

A magnetic susceptibility meter designed to avoid eddy current errors: its application to conductive samples from the Voisey's Bay ore deposit, Labrador.

Michael Wheeler, *Joseph Hodych*, *Hugh Miller*

Department of Earth Sciences, Memorial University of Newfoundland
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Modern magnetic susceptibility meters usually apply alternating magnetic fields, inducing eddy currents that can lead to errors when measuring electrically conductive samples. We describe a susceptibility meter that avoids such errors by applying a static magnetic field to the sample. The meter is magnetically shielded and consists of two identical air-cored solenoids that are centered symmetrically on either side of a fluxgate magnetometer probe with their axes parallel to the probe axis. Direct current is passed in opposite directions through the two solenoids. This produces no net magnetic field at the fluxgate probe until a sample is placed into one of the solenoids. The probe then detects the magnetization induced in the sample by the static magnetic field within the solenoid. This meter was used to measure the magnetic susceptibility of cylindrical samples from Voisey's Bay with varying amounts of sulphide mineralization. The same samples were also measured with a commercial alternating field susceptibility meter (Sapphire Instruments SIB2) operated at 700 Hz and then at 19 kHz. The results did not greatly differ, suggesting that errors due to eddy currents could be neglected when applying susceptibility meter readings to aeromagnetic interpretation at Voisey's Bay.

I15-2B9.5 **11:30**

Spatial variation patterns in the moisture content of the organic layer of the forest floor

Lynn Raaflaub, *Caterina Valeo*

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Wetness of the decomposing organic layer of forest floors (duff) influences the amount and location of mineral soil exposed during forest fires. Since exposed mineral soil is essential to tree regrowth for certain forest species, the spatial variation in duff moisture can be considered an important factor in the forest recruitment process. To determine both the patterns of spatial variation in duff moisture, and to ascertain the primary factors shaping these patterns, two field campaigns were conducted in a montane forest. In these campaigns, daily duff moisture measurements were collected at regular intervals in ten 10m×10m plots and along two 60m hillslope transects. The plots were chosen because they represented a variety of canopy types, densities and hillslope gradients. A full range of meteorological conditions were experienced over the study period, ranging from very wet to very dry. Variations of duff moisture were more pronounced during wet periods than in extended periods of drying. The influence of canopy composition, tree density, tree proximity, and hydraulic gradient on the patterns of duff moisture was determined using modelling techniques. Results indicate that tree density and proximity are the most important factors affecting duff moisture. Consequently, interception was found to be the primary controller of duff moisture patterns, and its influence was found to be at the centimetre scale.

H01-2DP.12 **16:00**

Hydrological properties of the organic layer of the forest floor for use in drying models

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Distributed modelling of the moisture content of the decomposing organic layer of forest floors (duff) over large scales is an important tool in managing forest resources, yet knowledge of duff characteristics essential for this modelling is limited. In an attempt to quantify some of the characteristics of duff that spatially determine moisture content, a number of laboratory experiments were carried out in a controlled environment on duff from six different forest stands (*Popolus tremuloides, Picea glauca, P. mariana, Pinus banksiana, P. contorta* and mixed) over two extremes in

duff thickness: between trees, where the duff tends to be at its thinnest, and beside trees, where the duff tends to be at its thickest. These experiments were designed to establish the variations in density and porosity, de-absorption characteristic curves, saturated hydraulic conductivity, and drying curves of the duff. Comparisons were made between the samples based on three categories: canopy type, location and layer. Density and moisture characteristic curves were found to exhibit greater variation vertically within the duff layer then between canopy type and location. Based on these results, moisture characteristic curves were created for the upper and lower duff layers. These relationships were applied to Richards' equation to produce duff drying curves. Comparisons between modelled and measured drying curves were used for verification.

I03-4C7.4 **14:30**

A recent increase in the rates of thermokarst slumping in the Canadian western Arctic.

Steven Kokelj[1], *Tevor Lantz*[2]

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The aerial extent and growth rates of thermokarst slumps in western Arctic Canada have increased significantly since 1973 in concert with accelerated climate warming. More than 540 slumps were mapped in 3739 km2 of upland terrain east of Mackenzie River Delta. The slumps were primarily within ice-rich morainal deposits immediately adjacent to tundra lakes. There were significantly fewer slumps on the leeside of lakes (SW, S and SE), suggesting that the most intense summer winds (N, NW), contribute to slump initiation. To evaluate change over time, all slumps on 24, 49 km2 study plots were mapped on 1950, 1973 and 2004 aerial photographs. The aerial extent of slumping relative to the disturbed area in 1950 had increased by 15% in 1973 and by 36% in 2004. The mean rate of slump growth from 1973 to 2004 was almost twice the rate estimated for the period from 1950 to 1973 and the mean maximum rates of headwall retreat have more than doubled. New slumps contributed only 9% to the total increase in disturbed area from 1973 to 2004, indicating that over the next several decades, most slumping will occur in association with pre-existing disturbances. As the frequency and magnitude of thermokarst disturbance increases with continued climate warming, the effects of slumping on landscape evolution and soil and lake chemistry will likely magnify the direct effects of warming on terrestrial and aquatic ecosystems.

A07-2DP.6 **16:00**

Three-Dimensional Polar Winds Retrieved From AIRS and MODIS

Cheng-Zhi Zou[1], *Mei Gao*[2], *Weizhong Zheng*[3], *Jeff Key*[1]

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In this presentation we will summarize recent improvement in the three-dimensional polar winds retrieval algorithm developed in NESDIS/ORA and provide retrieval results using AIRS (Atmospheric Infrared Sounder) and MODIS data. The current algorithm is based on thermal wind dynamics plus a comprehensive planetary boundary layer parameterization scheme. Mass conservation scheme developed by Zou and Van Woert (2002) is used to constrain the final winds to conserve mass. The algorithm uses satellite temperature soundings as input and a tie-on wind at a certain level as a boundary condition. Over the ocean area, satellite observed surface winds such as from SSM/I or QuikSCAT are used as a lower boundary condition. Over the land area where surface wind

observations are not available, satellite feature tracking winds are used as an upper boundary condition. We tested the algorithm using the NASA AIRS temperature retrievals and NESDIS MODIS feature tracking winds over the polar region as inputs. The wind retrievals are compared to the radiosonde observations over both the Arctic and Antarctica. In the presentation we will discuss the bias and root-mean-square statistics of the comparison as well as future plans in applying the wind retrievals for polar climate research.

I07-3C8.5 **14:45**

Sensitivity of sea surface wind from satellite-based radar for weather analysis

Julien Choisnard, *Stephane Laroche, Jean-Marc Belanger*

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The impact of sea surface winds from satellite-based radar on numerical weather analysis is discussed. Scatterometer and Synthetic Aperture Radar (SAR) satellites provide an increasing amount of sea surface backscattering observations. Sea surface radar backscatter is mainly related to the local wind, which generates sea surface roughness. Several geophysical model functions have been developed to retrieve the sea surface wind vector from radar backscattering, taking into account several parameters such as the viewing geometry and frequency.

Scatterometer winds are currently assimilated in most meteorological centres. Pre-operational results of QuikSCAT wind assimilation at the Canadian Meteorological Centre are presented. A small but positive impact is observed, rising some questions about the information content of such data and the sensitivity of the data assimilation system to sea surface winds. The increasing number of SAR satellites also motivates the evaluation of the information content of such data. SAR satellites provide much higher spatial resolution data compared to scatterometers, but with a smaller spatial coverage and a limited number of simultaneous backscattering measurements.

To evaluate the benefit of assimilating backscatter observations or simply wind vector retrievals (either cartesian or polar components), information and sensitivity matrices of a simple one observation case are compared. These comparisons indicate that nonlinear observation operator and non-Gaussian distribution may limit the amount of information that can be extracted. Information content of backscatter measurements and its sensitivity to wind speed and direction is also evaluated for the C-band geophysical model functions used for ASCAT scatterometer onboard METOP-1 and SAR onboard RADARSAT-1.

I02-4C8.3 **14:15**

Fine-Scale Diurnal Distribution of Zooplankton and Arctic Cod in Franklin Bay, Canadian Arctic, Recorded with Underwater Video.

Piotr Trela, *Don Deibel*

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Distribution of zooplankton in the water column is not random. Changes in physical properties, patchy distribution of food, and behavioural traits result in zooplankton aggregating in fine, clearly defined layers, at scales often below the resolution of conventional instruments, such as towed nets and pumps. The advent of underwater video instruments enables us to observe zooplankton at scales of 10s of cms and meters, along with the physical properties of the water column at comparable scales. In

addition, underwater video may record fragile organisms that can be easily destroyed during net tows or subsequent sample preservation, transport and storage. We present vertical profiles of zooplankton from diurnal series recorded in Franklin Bay, southeastern Beaufort Sea. We observed pronounced vertical stratification among the dominant taxa. Some of them, such as Aglantha sp., other hydromedusae, and unidentified (meroplankton?) organisms, stayed in the surface half of the water column, while the others, the copepods and the Arctic cod, stayed predominantly in the deep layer. The upper boundary of the copepod layer moved upward during the dark period, despite the fact that the surface light signal was attenuated by almost 2 metres of ice and snow.

A02-1C7.7 **15:00**

Relative Importance of Primary and Secondary Aerosol Components in Fresh and Aged Air Masses: Results with Environment Canada's Unified Regional Air Quality Model (AURAMS)

Craig Stroud[1], *Paul Makar*[1], *Mike Moran*[1], *Wanmin Gong*[1], *Sunling Gong*[1], *Shao-Ming Li*[1], *John Liggo*[1], *Jeff Brook*[1], *Brian Wiens*[1], *Qi Zhang*[2], *Jose Jimenez*[3]

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As urban plumes age chemically, it is hypothesized that the secondary aerosol fraction increases due to gas-to-particle conversion processes, aerosol-phase oligomerization reactions and in-cloud aerosol production mechanisms. The increase in the secondary aerosol fraction plays a critical role in altering the cloud-activating and optical properties of the aerosol distribution. This paper used a nested version of Environment Canada's unified regional air quality model (AURAMS) to predict primary and secondary aerosol concentrations in the Edmonton air shed during the PRAIRIE 2005 field intensive. Several case study periods will be highlighted to study the evolution of the modelled primary and secondary particle contributions representing fresh urban emissions, fresh petrochemical emission and an aged air mass which has undergone cloud processing. Model results will also be compared to measurement-derived estimates of secondary organic aerosol (e.g. OC/EC method). A factor analysis was applied to the aircraft mass spectrometer organic aerosol measurements to deconvolve the data set into hydrocarbon-like and oxygenated (HOA and OOA) organic aerosol fractions. The measurement-derived HOA and OOA fractions will be compared to AURAMS's predictions for the primary and secondary organic aerosol fraction.

I01-1D8.1 **16:00**

On the aggregation of ice pellets and their consequences on freezing rain

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Winter precipitation is an important issue for Canada. However, prediction of precipitation type when the temperature is near 0°C is often difficult because so many types of precipiattion (snow, freezing rain, ice pellets, and wet snow) can occur in this temperature range and their consequences vary greatly. The importance of addressing this issue was recently identified at a recent US workshop on cool season forecasting as a key issue where it was agreed that "the most serious problem (in forecasting)… is the accurate determination of precipitation type…". In attempting to address the problem of determination of precipitation type, cloud microphysics was identified as the highest priority process to be improved (Ralph et al., 2005).

The objective of this study is to examine one aspect of this overall issue. Specifically, the microphysics of ice pellet formation will be addressed and the ability of these to sometimes occur as aggregates. These aggregates with sizes up to at least 6 mm diameter and composed of several individual ice pellets sometimes occur in storms and sometimes not. It is hypothesized that they are readily able to sweep up freezing rain drops and thereby decrease the occurence of this hazardous form of winter precipitation. This issue was examined by modeling the freezing of a distribution of raindrops as they evolve into ice pellets and fall through the atmosphere to identify zones in which aggregates could occur; modeling collisions with freezing rain and other semi-frozen particles; and carrying out free fall experiments to characterize terminal velocity changes with degree of aggregation. The results indicate that aggregtaion can sometimes be very effective at eliminating freezing rain but the conditions need to be quite precise for this to occur.

O03-3B1.3 **11:00**

Numerical Study of Circulation, Retention, and Dispersion in the Bras d'Or Lakes of Nova Scotia using a Numerical Circulation Model

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The Bras d'Or Lakes are a semi-enclosed salty water lake system in central Cape Breton Island of Nova Scotia, Canada, and connected to the North Atlantic Ocean via several narrow channels. In October 2000, an oyster parasite known as Haplosporidium nelsoni (MSX) was discovered at several localized sites within the Lakes. A three-dimensional (3D) hydrodynamic model is used in the study of the circulation, hydrography, and retention/dispersion of MSX disease in the Lakes. The 3D circulation model is first used in the process study of the lake circulation in response to tides, wind forcing and buoyancy forcing associated with freshwater runoff. The model is also used in simulating the 3D circulation, temperature/salinity distributions in summer 1974, during which currents and hydrographic measurements were made at several locations in the Lakes. The simulated 3D velocity fields are used to track the trajectory of passive particles carried by the model currents. A transition matrix calculated from the 3D particle trajectories is used to examine the exchanges of passive particles between different sub-areas in the Lakes. The model results demonstrate that the particle exchanges between several small bays over the western areas and main basins of the Lakes are much weaker than those between the two main basins (i.e., North Basin and Bras d'Or Lake), due to the restriction of narrow passages between the bays and the main basins. This study indicates that the 3D lake hydrodynamic model and the Lagrangian tracking module are very useful tools for ecologists and biologists in estimating disease dispersal in the Lakes.

O03-3C1.3 **14:00**

Estimation of Air-Sea Carbon Dioxide Exchange in Hudson Bay, Canada from Ship and Satellite Observations

Brent Else[1], *Tim Papakyriakou*[2], *John Yackel*[1]

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Oceans play an important role in carbon cycling. Globally, about 2 Gt of CO2 is removed from the atmosphere annually by physical and biological ocean processes, moderating to a degree our anthropogenic input. However, the magnitude and direction of carbon flux is spatially variable, and

the processes responsible for this variability are subject to modification (for example by climate change). This potential for change has motivated studies of most of the Earth's oceans, but to date few studies have been carried out in the Canadian Arctic, including Hudson Bay.

During the 2005 ArcticNet cruise of Hudson Bay on the CCGS Amundsen, measurements were carried out to observe air-sea CO2 exchange. A meteorological tower located near the bow of the ship recorded atmospheric CO2 concentration and meteorological variables relevant to quantifying CO2 flux. A custom-built gas analyzer pump was used to measure dissolved CO2 in the surface ocean at approximately 60 discrete locations in Hudson Bay. Upon analysis of the field data, relationships between sea surface temperature, coloured dissolved organic material (CDOM) and sea surface CO2 were identified. These relationships were exploited using remotely sensed variables to extrapolate dissolved CO2 observations across the entire study region.

In this presentation, initial calculations of CO2 flux using bulk aerodynamic methodologies with in situ and remote sensing data are shown. The bulk aerodynamic method is based on the air/sea gradient of CO2 and empirical parameterizations of gas transfer velocity between the two media. Although this method results in only an estimate of CO2 flux, it offers a first look at air-sea gas exchange in Hudson Bay. Preliminary results show a strong relationship between coastal processes and the magnitude and direction of CO2 flux in the area. These patterns are discussed, and hypotheses about controls on carbon flux in Hudson Bay are proposed.

H06-4C4.8 **15:15**

Coupled modelling of glacier and streamflow response to future climate scenarios in British Columbia

K. Stahl[1], *R.D. Moore*[1], *J.M. Shea*[1], *D.G. Hutchinson*[2], *A.J. Cannon*[2]

(Presented by *R.D. Moore*)
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In mountain regions around the world, glacier melt is an important source of freshwater, particularly during the summer dry season. In Western Canada, summer streamflow in glacier-fed streams has been decreasing over the last three decades, a period marked by glacier recession. This study uses the semi-distributed precipitation-runoff model, HBV-EC, coupled with a glacier response model based on volume-area scaling, to investigate the sensitivity of streamflow to changes in glacier cover for three basins that are located in different areas of British Columbia and have different glacier coverages. The model is driven into the future assuming three different types of climate scenarios: a continuation of the current climate and two downscaled transient GCM scenarios with greenhouse gas forcing. The modelled glacier mass balance is used to re-scale the glacier every decade using an accepted volume-area scaling relation. The model application shows marked reductions in glacier area and summer streamflow even under the assumption of a continuation of the present climate. These trends are even stronger for warming scenarios downscaled from General Circulation Model simulations.

C02-1C5.7 **15:00**

Dinocysts as proxy of primary productivity in the Northern Hemisphere

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Estimation of productivity and export productivity in the global ocean is an important issue. Recent estimation of modern oceanic primary productivity, based on remotely sensed ocean color data have been used by biogeochemical modellers to understand the mechanisms controlling the pattern of export productivity. However little is known about the distribution of primary productivity and export production in the past ocean. In order to develop a proxy of past productivity, we explored the possibility of using the assemblages of organic-walled dinoflagellate cysts (or dinocysts) in marine sediment. Dinoflagellates represent an important part of the primary production in the ocean, and their populations that include both phototrophic and heterotrophic taxa seem to depend upon the trophic structure of upper water masses. We analysed the reference “modern” dinocyst database that comprises 1171 sites from the North Atlantic, Arctic and North Pacific oceans. For each site, we compiled two sets of primary productivity data derived from satellite observations: (1) The dataset from the Coastal Zone Color Scanner (CZCS) program applied to observations from 1978 to 1989 and (2) the data set from the MODerate resolution Imaging Spectroradiometer (MODIS) program using observations from 2002 to 2005. We performed Canonical Correspondence Analysis (CCA) with 57 dinocyst taxa and 8 sea-surface parameters (winter and summer salinity, winter and summer temperature, sea-ice cover, summer, winter and annual primary productivity). CCA results show that primary productivity is a determinant parameter of dinocyst assemblages. We tested the Modern Analogue Technique (MAT) for reconstruction of productivity based on dinocysts. The error of prediction (Root Mean Square Error = RMSE) is about ±15-25%, depending upon the productivity dataset. The best performance is obtained for winter productivity using the MODIS data. It is noteworthy that the RMSE for all estimated productivity parameters is narrower than the mean differences between productivity data derived from the MODIS and CZCS datasets. Therefore, we conclude that dinocysts can be used to reconstruct productivity with reliability as good as possible given the uncertainty inherent to primary productivity estimates from satellite observations. The MAT has been applied to North Atlantic time series, and led to reconstruct large amplitude variations of productivity, with low values being recorded during the last glacial maximum.

A05-1D6.6 **17:15**

A Data Access Interface (DAI) for Climate-Related Impact Studies, Part II: Interface for Data Extractions and Weather-Climate Indicator

Khanh-Hung Lam[1], *Stéphane Gagnon*[1], *Charles Lin*[1], *Van-Thanh-Van Nguyen*[2], *Philippe Gachon*[1], *Philippe Poudret*[1]

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The Global Environmental and Climate Change Centre (GEC3) in collaboration with Environment Canada (EC, through the Climate Change Scenarios Network developed by the Adaptation and Impacts Research Division) have developed a Data Access Interface (DAI) to optimize the diffusion of climate and climate scenarios data to their members and partners. DAI is designed to response to a large number of requests from users with different needs and requirements for data of appropriate time and space scales. In the first year of this project, the DAI team has explored a variety of strategies for extracting and disseminating information efficiently. It soon became apparent that managing this flow of information among different tools to deal with many laborious tasks, and with a great potential for making human errors, may all contribute to the inefficiency of the system operation. The present paper will describe the first phase of the DAI system dealing with the automated process for handling the number of requests for data, in particular EC observed climatological data. The team is working closely with EC to automate the whole data distribution process from the initial receipt of electronic submissions of data requests until the final stage of data distribution. The implementation of this web-based automated processing of data requests would suggest that, in the second phase of this project, it is possible to build additional components to allow weather forecasters, climatologists and climate change scientists to receive necessary information (e.g., severe weather conditions, or climate indices based extremes) more efficiently and more rapidly, as changes in the extremes constitute major key issues for many impacts and adaptation studies across Canada.

H06-4B4.3 **11:15**

Greenland ice sheet monthly surface air temperature reconstructions: 1784-2006

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Meteorological station records and atmospheric data assimilation model output are used to develop monthly, seasonal, and annual reconstructions of Greenland ice sheet surface air temperature reaching back in time from the present to the late-1700s. Data assimilation model data were produced spanning 1957-2006 and have the advantage of continuous spatial coverage over Greenland and surrounding seas. Long term in-situ temperature records spanning 1784-2006 have the advantage of a more than four times the time coverage as the spatial data. This study combines the strengths of both data sources to create long-term regular gridded data for use in climate studies. The quality of the monthly temperature reconstructions is assessed using independent in-situ observations. Applications of the data set to melt water production and glacier dynamics modeling are discussed. Spatial and temporal patterns of temperature trends are also presented.

I12-3B9.2 **10:45**

Canadian Prairie Drought and DRI

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The Canadian Prairies are often subjected to drought and it is sometimes catastrophic. The most recent event occurred over the period 1999-2005 and it produced some of the driest conditions over the historical record. To address such droughts, a research network DRI (Drought Research Initiative) has been established. The particular focus of DRI is to better understand the factors that led to, sustained and ended this recent drought including its internal structure and to contribute to the better prediction of such events. To accomplish this objective, the drought is being considered from several perspectives involving the atmosphere, surface and sub-surface and it also includes the role of vegetation. This drought was unusual in that its large scale forcing was quite variable over its duration, regions of record high precipitation sometimes occured simultaneously across the Prairies, and cloud fields were common. It nonetheless produced some of the greatest reduction in sub-surface moisture on record and it led to major declines in river flows. The DRI research community from across the country is furthermore working closely with many partners affected by the drought so that they can better cope with such events in the future. This presentation summarizes DRI by providing an overview of the recent drought's characteristics as well as DRI's objectives, key scientific issues, recent progress, and future plans.

C05-3DP.3 **16:00**

An Evaluation of cloud and radiation processes simulated by GEM-LAM for the Arctic SHEBA year.

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Due to the unique conditions in the Arctic (e.g. extreme low temperatures and water vapour mixing ratios, highly reflective sea-ice/snow surfaces, low-level inversions and the absence of solar radiation for extended periods) the macrophysical and microphysical processes controlling cloud formation and cloud-radiation interaction are complex and unique. The difficulty of simulating these processes was recently highlighted during the Arctic Regional Climate Model Intercomparison Project (ARCMIP). The objective of this study is to evaluate the new Canadian Regional Climate Model (the limited area version of the Global Environmental Multiscale model (GEM-LAM)) for the period September 1997 to October 1998 over the western Arctic Ocean. This period was coincident with the observational campaign of the Surface Heat Budget of the Arctic Ocean (SHEBA) project. The domain is approximately the same as the one used during the Arctic Regional Climate Model Intercomparison Project (ARCMIP). Surface downwelling solar and terrestrial radiation, surface albedo, vertically integrated water vapour, liquid water path and cloud cover simulated by GEM-LAM are evaluated against the SHEBA observation data. GEM-LAM is also compared to the eight other ARCMIP participating models.

C04-3DP.7 **16:00**

The Seasonal Cycle and Variability in Cloud Liquid Water Paths over the Sea-Ice-Free Arctic

Paquita Zuidema Paquita Zuidema

(Presented by *Paquita Zuidema*)
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Of the liquid and ice cloud phases, the liquid phase typically dominates the cloud optical depth and is most important to the surface radiation budget. The recent decline in sea ice and increase in surface temperatures foster expectations that cloud liquid water should be increasing in the Arctic. This justifies an examination of satellite microwave-derived liquid water paths (LWPs; SSMI and AMSR-E) and from the surface-based microwave radiometer dataset at Barrow, Alaska. While the satellite datasets are limited to sea-ice-free regions, they are a useful complement to cloud datasets based on visible and infrared sensors. The SSMI time series from 1987-2006, evaluated using two separate retrieval products, shows a wintertime LWP increase south of the Bering Strait and southwest of Greenland, an autumnal increase north of the Bering Strait, and decreases in other locations and seasons. The wintertime increase is also evident within the 2002-2006 record from the surface-based microwave radiometer at Barrow, Alaska. A wintertime rise in surface temperature could help explain the associated wintertime LWP increase. A strong seasonal cycle in cloud liquid water is well-resolved in the north Atlantic sector because large portions are ice-free year-round; lag/lead relationship with water vapor will be presented towards shedding light on the cloud formation mechanisms.

O01-1D1.7 **INVITED/INVITÉ** **17:30**

Labrador Sea Variability: Circulation and Hydrography

Paul Myers[1], _Chris Donnelly_[2], _Nilgun Kulan_[1], _Mads Ribergaard_[3], _Brett Wheler_[1]

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The climate of the North Atlantic and the Arctic are linked in a number of ways. Decadal variability in ocean properties, winds, precipitation, etc. have been linked to both the North Atlantic and Arctic oscillations and to each other through feedback loops. A key feature of all these loops is the role of freshwater. In this talk, issues of freshwater in the Labrador Sea are considered from modelling studies, atmospheric reanalyses and historic oceanic data. Data studies will focus on a climatological and triad study of the Labrador Sea as well as a historical analysis of the West Greenland Current from 6 sections. The modelling results will focus on a regional eddy permitting model of the sub-polar gyre as well as a coupled ocean-sea/ice model of the entire North Atlantic.

A02-1B7.7 **12:00**

An Improved MC2 (Anemoscope) Modeling Technique in a Mountainous Yukon Terrain

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While MC2 (Anemoscope) successfully modeled the wind climate of the Gaspe region, it produced questionable results for the southern mountainous Yukon. Modified “wind climate” boundary-conditions based on Whitehorse upper-air observations have improved the simulation results. In the Whitehorse region the dominant winds aloft are southwesterly at about 10 to 13 m/s, while low level winds range from 2 m/s at the valley bottom to 8 m/s at the mountain tops. Winds in valleys running parallel to the winds aloft are pushed along the same direction by downward momentum transport, but winds in NW-SE oriented valleys are southeasterly, in response to forcing by the large scale pressure gradient. The NCAR/NCEP Reanalysis produces geostrophic winds aloft that are southwesterly and of the order 5 m/s while winds below the mountaintops are southeasterly at 6 m/s around mid-valley height, and 10 m/s at sea level. Using the Reanalysis “climate table” to set boundary conditions, the Anemoscope toolkit also rotates the sea level wind direction by -40 degrees and reduces the speed by 40 %. Contrary to observations, the resulting mesoscale simulation yields southerly winds at the mountaintops and in some of the southwest valleys, and southeasterly and easterly winds in most other valleys. The model also produces a narrow range of wind speeds (in the range of 4 to 6 m/s) from the valley bottom to the mountain tops. In this study boundary conditions for MC2 are generated directly from the upper air observations, and only the winds above the mountaintops are extracted from the measurements. The wind fields below the mountaintops are treated as parallel to the wind immediately above the mountains and their amplitudes are proportionately smaller. The resulting simulations produce winds that are in better agreement with the available measurements, as regards both speed and direction.

H06-4B4.1 **INVITED/INVITÉ** **10:30**

Intermittent thinning of Jakobshaun Ibsræ, West Greenland, since the Little Ice Age

Cornelis Van der Veen[1], _Beata Csatho_[2], _Toni Schenk_[3]

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Rapid thinning and velocity increase has been observed on major Greenland outlet glaciers during the last two decades. To assess whether recent trends deviate from longer-term behavior, we measured glacier surface elevations and terminus positions for Jakobshavn Isbræ, west Greenland, from historical photographs. Combined with data from historical records, aerial photographs, ground surveys, airborne laser altimetry, and field mapping of lateral moraines and trimlines, the history of changes since the Little Ice Age was reconstructed. For the lower reach of the glacier, several periods characterized by distinct behavior can be identified. During the first half of the 20th century, the calving front appears to have been grounded and the glacier was thinning steadily at rates of several m/yr. Sometime during the late 1940s the terminus became ungrounded. Over the northern branch thinning continued at least until the mid 1980s during a period when the calving front was stationary with only minor annual fluctuations. Over the southern branch thinning subsided in the 1960s followed by thickening between the 1960s and 1980, resulting a relative deepening of the northern part of the glacier. North of the fjord, aerial photographs and satellite imagery indicate continuous thinning and retreat of the ice sheet margin until the present, while in the south the initial retreat was followed by a readvance in the 1960s. Due to a brief period of substantial thickening of the northern ice stream in the early 1990s, the elevation difference between the northern and southern branches disappeared in 1997. Thinning of the entire floating ice tongue and lower reaches of the grounded parts of the glacier started between 1997 and 1999 and continues to the present, causing a drastic retreat of the calving front to the grounding line at the head of the fjord accompanied by an almost doubling of ice velocity.

C05-4C5.3 **14:00**

Influence of large-scale nudging on RCM's internal variability

Adelina Alexandru[1], *René Laprise*[1], *Ramon de Elia*[2], *Sébastien Biner*[2]

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In a previous study devoted to the characterization of internal variability in the Canadian Regional Climate Model (CRCM), we have shown that internal variability may have a more complex behavior than previously thought, and that its impact on seasonal averages is far from negligible. That study did not consider the effects on internal variability of large-scale nudging-a technique increasingly popular to drive regional climate models (RCMs). This technique consists in partially imposing the large scale of the driving fields on the RCM simulation with the aim of disallowing large and unrealistic departures between driving and driven fields.

In this presentation we will discuss the impact of large-scale nudging on the CRCM internal variability based on a series of experiments performed on several different domains over North America. Each experiment consists in an ensemble of 15 three-month simulations differing only in initial conditions (IC) performed under a given large-scale nudging configuration. Changes in large-scale nudging configuration mostly affect the intensity with which the CRCM simulation is forced to follow the driving fields. Preliminary results show that large-scale nudging diminishes in general the internal variability, although this does not occur in all cases. The general consequences and overall effect of the use large-scale nudging will also be discussed.

A02-1C7.4 **14:15**

Radiation Model in Canadian GCM
Jiangnan Li

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A new radiation scheme is used for General Circulation Model (GCM) in Canadian Center for Climate Modeling and Analysis (CCCma). This new scheme has many advantages over the old radiation scheme: 1) For gaseous transmission the correlated k-distribution (CKD) method is used. This is a recently developed new technology which can be applied to a single absorption line while old band models address only mean values for bands. 2) Various aspects of radiative transfer through clouds are investigated. The new scheme enables to handle the cloud overlap and cloud inhomogeneity precisely. 3) Aerosol radiation interaction is also addressed. New aerosol optical properties parameterizations have been developed for sea salt, dust and sulfate. 4) This model contains a proper treatment of spectral overlap between solar and infrared radiation. 5) This model is very efficient and can be extended to 100 km. This radiation scheme will be used for Canadian middle atmospheric model, regional model, aerosol model, etc.

A03-3B6.6 **11:45**

Measurement of net CO2 exchange using a portable profiling system
Pierre-Luc Lizotte, *Ian Strachan*

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In order to better quantify the continuous net ecosystem exchange (NEE) at the farm scale, a transportable tower-based eddy covariance and profiling system was tested during three field campaigns in summer 2006. The profile measurement system, equipped with a low-cost closed-path infrared gas analyser (LI-840) was designed to measure the carbon dioxide (CO2) storage especially during weak mixing periods under stable conditions. The profile consisted of five inlet levels between the ground and a height of 18 m. The eddy covariance system was installed at a height of 24 m. A tethered blimp-based measurement system for the nocturnal boundary layer (NBL) budget technique was deployed on several calm nights to compare with the concentrations and fluxes determined with the profiling system. The NBL budget technique was used to quantify the portion of CO2 storage estimated by the profiling system over the entire nocturnal boundary layer height. The profiling system was re-deployed for a portion of the campaign to determine horizontal and vertical advection. The two-dimensional horizontal positioning of the profile inlets allowed an examination of the CO2 advective gradient in relation to the wind direction. A near-surface advection analysis provided parameters for further adjustments of the NEE at the actual farmland.

C04-3DP.11 **16:00**

Sea ice variability in the Canadian Arctic 1982–2004: Links to surface, cloud and radiation properties
Stephanie V. Skoblenick, *Stephen E.L. Howell*, *John J. Yackel*

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The spatiotemporal variability of seasonal and perennial sea ice in Canada’s Arctic was examined in relation to changes in surface, cloud and radiation properties. Using the Canadian Ice Services (CIS)

digital ice charts in combination with the extended AVHRR Polar Pathfinder dataset (APP-x), correlations and trends in total sea ice concentration (SIC), multi-year ice concentration (MYIC) and 10 radiative parameters were identified for seasonal averages from 1982-2004. Results show a negative trend in surface albedo at -0.24%/year. No significant trends for surface air temperature, net shortwave or longwave radiation were identified for the entire Canadian Arctic. Regionally, the Beaufort region has shown decreasing SIC trends in the northwest and increasing MYIC trends in the east, likely related to increased Beaufort gyre reversals. A reduction in surface albedo in the Beaufort in recent years and possible increases in clouds over the Beaufort and northern Canadian Arctic may also be the byproduct of these large-scale changes in atmospheric circulation. The southern Canadian Arctic regions show no significant increasing or decreasing trends in SIC, MYIC, or the radiative parameters. However, strong correlations between SIC and the radiative parameters in these southern regions suggests that if trends ever did become apparent, albedo-feedback processes could begin to dominate. Significant trends were not observed for the Baffin Bay region; however, decreasing trends in SIC, downwelling and upwelling shortwave radiation were identified for Foxe Basin. These results support the strong regional variability of sea ice and thermodynamic controls in Canada's Arctic regions and the need for more regionalized analyses.

G10-1D2.3 **17:00**

Seismic properties of waves at the surface of a porous layer

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Studies of wave processes in porous media are motivated mostly by applications in the field of seismic prospecting in petrophysics. For example, low frequency seismic prospecting (~50Hz) is intended to detect and analyze interesting geological horizons under sediment layers with a thickness of up to several kilometers. High frequency prospecting, or acoustic logging (~100Hz), is used for measurements in wells, directed at the particular beds of interest. However, unlike perfect elasticity, the effect of the porosity, and its influence on wave propagation in the attenuating multiphase medium, is not completely understood. In order to investigate the basic properties of the waves propagating along the surface of a porous layer, we consider the model problem for an infinitely deep porous layer subjected to harmonic line surface traction for the widely recognized Biot's system of equations, which include both dissipation and inertia effects. Complex analysis techniques are applied to invert an analytical solution in the Fourier transformed domain. As a result, the response signal is decomposed into four contributions, related to the P1, P2, S and Rayleigh waves. Each wave contribution is investigated asymptotically in the far-field zone. It is demonstrated that unlike the Rayleigh wave, compression and shear waves exhibit strong geometric attenuation along with viscous attenuation. Moreover, it is shown that the values of the phase shifts in the far-field zone can be found exactly for each wave, and thereby the individual wave trains that emerge in the far field can be compared to the Rayleigh mode. Finally, we discuss the implications of these results for the inverse problem of determining the mechanical properties of a porous layer from surface acoustic logging.

I07-3B8.1 **INVITED/INVITÉ** **10:30**

Monitoring Sea Level Change and Natural Hazards with Satellite Altimetry

Remko Scharroo[1], *Laury Miller*[2], *Walter Smith*[2]

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Tide gauges all over the world monitor sea level change. However, these tide gauges are generally located along coasts and on the Northern Hemisphere. Furthermore, they measure sea level relative to the land, and the motion of the land over the years might be in question.

In contrast, altimeters provide near-global coverage in open ocean as well as relatively close to the coast, and provide an absolute sea surface height, related to the earth's centre of mass. Still, the use of altimetry in sea level change studies is not without complications. The measurements need to be corrected for a host of phenomena that impact on their accuracy: delay of the pulse through the atmosphere, ocean tides, and instrumental drifts, to name some.

Over the last 15 years, six satellites have been building up a continuous record of global and regional sea level and its trends. All satellites show a consistent global mean sea level rise of about 3 mm/year, but they also demonstrate that the trends vary significantly from one ocean basin to another. Some analytical techniques are now employed to link the tide gauge records with those of the altimeters with the objective to extend the near-global record provided by the altimeters to a century time span only covered by the tide gauges.

The two dramatic coastal natural disasters of the last 3 years, the Boxing Day tsunami in the Indian Ocean and the impact of Hurricane Katrina on Louisiana, were both observed by a number of altimeters. For the first time a tsunami was convincingly identified in the altimeter data. Although altimetry is not likely to improve tsunami warning systems, it does already contribute to hurricane forecasting. It has been demonstrated that the sea level measured by altimetry is a better proxy for total heat content in the upper ocean than sea surface temperature data.

G08-2B2.4 **11:15**

Multiresolution Analysis and Synthesis of Geopotential Fields

Rod Blais

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Geopotential fields are harmonic outside of their sources and hence expressible in terms of spherical harmonic expansions, and these are very appropriate for multiresolution analysis and synthesis. For numerous applications, discrete computations using Chebychev quadratures and least squares for equiangular grids in latitude and longitude are very advantageous and well known. However, for some applications, different strategies are required as equiangular grids are not appropriate for various reasons. The geopotential models EGM96 of degree and order 360, and EGM06 of degree and order 2160, from the U.S. NGA, will be used in these discussions along with some application considerations.

O01-1D1.6 **17:15**

Sea Ice Draft Measurements from an Upward-Looking Sonar Moored on the Labrador Shelf

Ingrid Peterson, Simon Prinsenberg, Don Belliveau

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Sea ice draft over the Labrador Shelf was measured using an upward-looking ice profiling sonar (IPS) moored on Makkovik Bank during the ice seasons of 2002-2003 and 2004-2005. The data were converted to a spatial series using ice velocity data collected with an acoustic Doppler current profiler (ADCP), and were compared with ENVISAT synthetic aperture radar (SAR) imagery, surface analysis wind data from the CMC (Canadian Meteorological Centre) GEM regional model, and ice charts from the Canadian Ice Service.

In 2003, the weekly mean non-zero ice draft increased from about 0.8m in January to 2-3m in mid-February to late April, and then decreased to 2m in May. In 2005 when the ice extent was generally lower, daily mean ice draft was less than 2m until late March. For both years, the annual maximum sea ice draft was observed in April. The daily ice draft distribution shows that level ice was predominant in the early and late ice season of 2003. Deformed ice was predominant throughout much of the February-April period, with several periods of low ice draft associated with offshore wind events. In 2005, level ice was predominant until late March when 4m-thick deformed ice produced by a major onshore wind event was advected offshore.

Ice draft measurements were in good qualitative agreement with CIS ice charts during periods predominated by level ice, however the ice charts do not provide information on thick deformed ice. In SAR imagery from April 2003, both dark and bright-toned floes were present, corresponding to low (~1m) and high (>5m) ice drafts respectively. In SAR imagery from April 2005, only bright-toned ice rubble was observed, and was associated with ice drafts of 2-4m.

C02-2C5.7 **15:30**

Arctic Summer Sea-Ice Area and the Winter North Atlantic Oscillation

Weihan Chan[1], *Daniel Leathers*[1], *Jennifer Francis*[2]

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A statistically significant correlation between summer sea-ice area and the winter NAO is observed over the period 1979 – 2004. This relationship is further confirmed by correlations with the surface air temperature, surface pressure and 500 mb geopotential height anomalies and by examining extreme high and low sea-ice cover years. Varying Arctic sea-ice area is crucial to the ice-albedo feedback in the Arctic. The modulation of this feedback may help to explain the relationship between the summer ice-extent and the NAO several months later. Decreased sea-ice cover during the summer, when the Arctic experiences nearly 24-hours of daylight, will cause an increase in the solar radiation absorbed by the ice-free portions of the ocean. The increased absorbed energy may gradually be released through the following autumn and winter, causing a subsequent change in the Arctic circulation manifested in the NAO. Preliminary results supporting this hypothesis will be presented.

I11-4C1.7 **15:00**

Preliminary water balance of a glaciated alpine watershed: Lake O'Hara Research Basin

Jaime Hood, *Masaki Hayashi*

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The Opabin watershed is a 5.3 square-kilometer alpine watershed within the Lake O'Hara Research Basin (LORB) with an elevation range of 2018-3490 m. The terrain is rugged, contains a small pocket

glacier and is dominated by exposed bedrock, glacial moraines and talus slopes, with alpine meadows and sub-alpine forest at lower elevations. Previous work at LORB has indicated that groundwater may play a larger role in alpine regions than previously thought. It is hypothesized that surficial debris such as moraines and talus slopes act as water reservoirs, slowing the release of water from snow, rain and glacier melt. The objectives of the Opabin study are to evaluate the sub-surface transfer of 'inputs' (snow, ice and rain) to 'outputs' (surface water flows) in terms of residence time and hydraulic characteristics, through these subsurface reservoirs. An increased understanding of this 'transfer function' will be beneficial to successful predictive modeling efforts, allowing for less reliance on basin specific model calibration. A water balance approach is used to quantify the watershed inputs and outputs and the preliminary results are presented here.

Field data were collected during April through October 2006. Data collected included maximum SWE in April, bi-weekly SWE surveys during the melt season, areal summer precipitation, glacier mass balance monitoring and surface water level and flow measurements. Meteorological data were obtained from an on-site automatic weather station. Computation of the water balance indicates that both snowmelt and summer rain are significant inputs. Preliminary analysis of temporal trends in hydrologic input and output indicate there is seasonal storage of water in the watershed. Reducing the error associated with the snowmelt input will increase our confidence in these results. A more sophisticated quantification of snowmelt is required due to the large elevation gradient, topographic heterogeneity and shading effects in this rugged watershed; as such, a spatially-distributed snowmelt modeling approach is being undertaken.

A04-4D6.1 **16:00**

Forecast Verification: Issues and Recent Research Developments

Barbara Casati, *Laurence Wilson*

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Verification is a key component of weather forecasting. In fact, verification not only allows one to monitor and compare the performance of weather forecasts, but also to analyze the nature of the forecast error. A targeted diagnostic verification provides guidance for forecasters and NWP modelers, which leads to new developments and improvements.

Traditional continuous and categorical scores (e.g. MSE, ETS, bias) can provide a general overview of the forecast performance. However, these scores often do not deal optimally with problematic variables, such as precipitation or extreme events. Moreover, verification methods based on a point-by-point comparison do not account for the spatial structure of weather variables: displacement errors are not explicitly measured; the scale-dependency of predictability is not assessed; high resolution models are often heavily penalized by their intrinsic high variance; and verification results are difficult to interpret in meaningful physical terms.

In the last decade the research scientific community has focused in developing some new verification approaches which address these issues. This talk aims to review some of these verification techniques. Examples are provided and a verification strategy for GEM-LAM 2.5 and for the forthcoming Vancouver 2010 Olympic Games FDP is discussed.

S04-3DP.2 **16:00**

The representation of snow interception and unloading in the Canadian Land Surface Scheme.

Paul Bartlett[1], *Murray MacKay*[1], *Natasha Neumann*[2], *Diana Verseghy*[1]

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The ability of forest canopies to intercept snow before it reaches the ground surface can have a large impact on the amount of snow accumulated in the snowpack and on the forest water balance. Intercepted snow held aloft in the canopy is more exposed to the wind and much can be lost to sublimation. Snow that falls to the forest floor, either as throughfall or after unloading from the canopy, is sheltered and is less likely to sublimate. The length of time that snow is held in the canopy is therefore an important factor in the modelling of forest-snow interaction and on the forest water balance. In the Canadian Land Surface Scheme (CLASS), the modelling of snow interception has evolved from a small interception capacity with no explicit unloading, to a larger interception capacity with an assumed unloaded fraction, to unloading over a specified time scale. Recently, photographs of forest canopies have been analyzed in conjunction with observed meteorological conditions to determine whether the rate of unloading can be modelled based on factors that control the process (e.g. temperature, wind speed, radiation input). Model runs of CLASS version 3.3 are presented from Canadian boreal forests located in Central Saskatchewan, employing each of the interception and unloading algorithms that have appeared over time. Modelled snowpack and related variables are compared among the model tests and against observations.

I15-2C9.4 **14:45**

Using light detection and ranging to study peatland form and function

Murray Richardson[1], *Brian Branfireun*[1], *Carl Mitchell*[2]

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Using high-resolution Light Detection and Ranging (LiDAR) topographic data, detailed micro-morphological characteristics can now be examined for peatlands from a wide range of hydro-geomorphic settings. Strong potential exists to use these data to infer the magnitude and extent of hydrological and biogeochemical interactions between peatlands and the rest of the catchment. Here, we present a study utilizing LiDAR surveys of physiographically diverse landscapes and associated headwater peatlands in central Ontario, northwestern Ontario, and northern Minnesota. Analyses of very high-density LiDAR ground returns reveal subtle, quantifiable peatland microtopographic variations that reflect the relative influence of upslope contributing area on peatland hydrology and biogeochemistry. When these analyses are coupled to empirical data on peatland pore water chemistry that is dependent on upland-peatland interaction (in this case, mercury methylation), clear relationships can be observed. Some LiDAR accuracy issues and analysis techniques will be discussed in light of their potential applications to peatland research. Numericallly describing within-peatland heterogeneities using this remote sensing approach may help experimentalists and modelers structure field investigations and quantitatively address spatial variability of hydrological and biogeochemical processes.

H05-3C4.7 **15:00**

Understanding the Effects of Surface Water - Groundwater Interactions on Aquatic Habitat in the Okanagan Valley: A Multi-Technique Approach

Natasha Neumann[1], *Jeff Curtis*[1], *Adam Wei*[1], *Diana Allen*[2], *Kari Long*[3], *Howie Wright*[3]

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A multi-technique approach was developed to determine the extent and types of surface water – groundwater interactions in streams of different sizes in the Okanagan basin, including physical measurements, geochemistry and modeling approaches. The combination of approaches provides a more comprehensive picture of near-surface processes than each method alone. Differential discharge measurements at the reach scale provide calculation of a net loss or gain of water in the stream section, while point measurements of hydraulic head at nested piezometers provide site-specific information. Water geochemistry can be used to determine patterns of recharge from losing streams and the source of water (hyporheic or 'true' groundwater) to gaining stream reaches. Finally, modeling can discern the influence of environmental factors on streambed infiltration and seepage. These approaches were applied to tributary creeks and the mainstem of Okanagan River, and preliminary results are presented. These examples will demonstrate the importance of considering groundwater – surface water interactions when discussing aquatic habitat.

A01-1B6.2 **10:45**

Urban heat island characterization in the development of a heat advisory and alert program in Montreal, Québec

Marc Beauchemin

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Intense heat episodes create health problems and cause excess mortality. Recall the 2003 heat wave in France which resulted in an excess of 20 000 deaths. Canadians living in big cities are also impacted by heat waves.

Heat waves occur naturally but are amplified by climate change and the urban heat island phenomenon (UHI). In the future, they are expected to become more frequent and/or more intense with increasing greenhouse gases and increasing urbanisation. In response, the Montreal public health authorities are developing a heat advisory and alert program in order to warn the public of imminent danger and to prepare health care services to cope with heat stressed patients.

One of the prerequisites for this program was a better understanding of the thermal characteristics of Montreal. Environment Canada through its MSC-Quebec regional office contributed to this effort by conducting a historical analysis of the UHI in Montreal and a field campaign. The historical analysis uses a comparison of urban versus rural air temperatures at a dozen weather stations. The field campaign measured air temperature but also surface temperature of different urban materials during the month of July 2005. Others partners of this project analyzed the UHI trend using thermal satellite images. Comparison of UHI using weather station temperatures and satellite images is actually underway (MSC-UQAM collaboration).

We present here the results of these different works and our recommendations for the heat prevention program. It is hoped that this program and its development can help other Canadian cities to develop their own advisory program.

Partners of this project are the “Direction de la santé publique de Montréal”, Health Canada, the Ouranos consortium, UQAM, and Environment Canada. Financial sources came from the « Health » program of the Climate Change Action Fund and from the “Conseil Régional de l'Environnement de Laval”.

S02-2C3.3 **14:30**

Ground-based FMCW radar measurements of dry snowpacks during the 2006-07 NASA CLPX field experiment

Hans-Peter Marshall[1], *Nick Rutter*[2], *Gary Koh*[3], *Shad O'Neel*[1], *James McCreight*[4]

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During the 2006-07 NASA Cold Lands Processes Experiment (CLPX), we made ground-based microwave radar measurements covering a wide range of sensor parameters (4-18 GHz, multiple incidence angles, polarizations, bandwidths) as well as a wide range of dry snowpack conditions. Repeated measurements were made at 5 different locations, spanning the range of environments covered within the 100 km x 10 km CLPX 2006-07 study region in Northern Colorado, during each of the three separate, week-long Intensive Observation Periods (IOPs).

Recent improvements in the portability and accuracy of our Frequency Modulated Continuous Wave (FMCW) radar system, and the development of a new lightweight sled for deployment, allowed continuous measurements from the centimeter to the kilometer scale to be made. At 0 degree incidence, measurements from this radar system can be used to estimate snow depth, SWE, and the location of major stratigraphic boundaries. The radar is also mounted on the sled at a height of 2.30 meters (far-field) at an oblique incidence angle to simulate backscatter measured over the study site by a coincident airborne Ku-band scatterometer. In-situ measurements of snow depth, SWE, and stratigraphy are compared with estimates from the radar, and the error in the retrieval of these properties is quantified. The high-resolution radar-derived snow properties were geo-located with survey-grade GPS, along transects up to 1 km. These measurements are used to quantify and characterize the variability and spatial structure of the snow at 3 different times during the winter and in a range of snowpack types and environments. Backscatter at oblique incidence angles, covering a range of sensor parameters, are compared at the same locations during the three IOPs.

C05-3C5.4 **14:30**

Diagnostic results from regional-scale climate simulations with the GEM model: Part 2 - GEM-LAM

Ayrton Zadra[1], *Bernard Dugas*[1], *Katja Winger*[2], *Paul Vaillancourt*[1]

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Several simulations using Environment Canada's Global Environmental Multiscale (GEM) forecast model were run for the 1978-2004 period. Their configurations range from 2.0-degree uniform global, to 0.5-degree in limited areas mode (GEM-LAM) over North-America and Europe, and global stretched grids (SG) over the same domains. January and July time-slices with a global uniform 0.5-

degree resolution were also performed for the same period. In these simulations, the choice of physical parametrizations was largely based on that of the mesoglobal model, currently used by the Canadian Meteorological Centre (CMC) for operational forecasts. In this presentation, we focus on the North-American and European results obtained with the GEM-LAM model, which will provide the dynamical kernel for the next generation of the Canadian Regional Climate Model (CRCM5). Boundary conditions for these simulations were provided by ERA40 reanalyses or by global climate-scale simulations of GEM. Climatological results are presented and evaluated against control runs, reanalyses and available observations.

H01-2DP.16 **16:00**

Role of snow in the hydrology of a high arctic riparian wetland

Kathy Young

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Riparian wetlands are unique strips of saturated and vegetated ground forming important links between terrestrial landscapes and aquatic zones. They serve to modify fluvial and chemical processes and have been well studied in temperate environments. These linear wetlands are common features in high arctic landscapes running along streams and rivers, yet their hydrology is not well understood. Woo and Young (2003) provide some information on their hydrology through their study on Cornwallis Island-a polar desert environment. Water tables in the wetland continually remain high from seasonal snowmelt runoff and extended over-bank flooding from snow-choked stream channels. Here, I describe the hydrology of a riparian wetland situated within a polar oasis landscape near Eastwind Lake, Ellesmere Island, Nunavut (80o80'N, 85o35'W) during the 2006 field season. Unlike the Woo and Young (2003) study, snow in the channel does not promote a period of extended over-bank flooding but in fact initially serves as a dam, blocking stream water from entering and flooding the wetland. It is only during a warm, sunny period that the channel snow melts and the wetland becomes recharged and water tables are allowed to rise. At this point, meltwater from late-lying snowbeds further up the stream channel is essential for also maintaining elevated water levels. Depriving the wetland of stream water early in the season likely has short-term implications for plant growth, evaporation (dry surface), subsurface flow and water chemistry (increasing solutes). A combination of field data (climate, hydrology) and a snowmelt model (Woo and Young, 2004) is employed to explore the dual role of snow (blockage/recharge) in the hydrology of a riparian wetland.

I14-1D9.4 **16:45**

Topographic controls of greenhouse gas fluxes in deciduous forests soils, southern Quebec

Sami Ullah, *Tim Moore*

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Forest landscapes are not homogenous, but consist of a mosaic of well, moderately, and poorly drained soils determined by topography. Variation in topography and drainage classes influences biogeochemical controllers of N2O and CH4 fluxes from soils such as moisture, N mineralization and production and decomposition of organic carbon. We measured N2O and CH4 fluxes from two deciduous forests near Montreal, along transects running from high-elevation, well-drained to low-elevation, poorly-drained soils. One site is an old-growth and the other, a mature-managed forest. In-situ gas fluxes were measured bi-weekly using static chambers. When averaged from May to December, 2006, upland soils emitted 1.7 ± 0.5, while low-elevation wetland soils emitted 2.0 ± 0.6

ug N2O-N m-2 h-1. On certain sampling dates, upland soils in the old-growth forest consumed atmospheric N2O at rates ranging from -0.3 to-5.7 ug N2O-N m-2 h-1. CH4 is consumed in upland soils (-1.9 mgCH4 m-2 day-1) and is produced in wetland soils (5.8 mg CH4 m-2 day-1). Rates of CH4 consumption were more than twice as large in the upland old-growth forest than in the managed forest. Soil C:N ratio, moisture and CO2 production rates accounted for 38%, while soluble organic C, total N and temperature accounted for 83% variability in N2O emissions from wetland and upland soils, respectively. CH4 fluxes are regulated mainly by soil moisture, temperature and CO2 production rates, which accounted for 75% variability in CH4 fluxes both in the upland and wetland soils. As the soil moisture, aeration status and organic C accumulation rates are regulated by topography, therefore, it is important to integrate topographic features of a forested landscape while quantifying and modeling the fluxes of greenhouse gases.

I13-4B9.8 **12:15**

Modelling and data assimilation activities in TAWEPI (Thorpex Arctic Weather and Environmental Prediction Initiative)

Ayrton Zadra[1], *Gilbert Brunet*[1], *Greg Flato*[2], *Pierre Gauthier*[1], *Youyu Lu*[3], *Jocelyn Mailhot*[1], *Paul Vaillancourt*[1]

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The primary objective of the TAWEPI initiative is to develop and validate a regional Numerical Weather Prediction (NWP) model over the Arctic in support of IPY projects. The proposed model, called Polar-GEM, will be a twin of the Environment Canada operational regional GEM model used for one- to two-day weather forecasts. The Polar-GEM system will be developed in collaboration with the CMC (Canadian Meteorological Centre) and TAWEPI will contribute through the following modelling and data assimilation activities, described in this presentation: (i) improved representation of snow processes and air-sea interaction in northern latitudes; (ii) improved representation of high-latitude clouds and cloud/radiation interactions in the Arctic; (iii) implementation and validation of a detailed dynamical-thermodynamic sea-ice model coupled with ocean currents in the Arctic; (iv) sensitivity of weather forecast over polar regions to lower-latitude influences and vice-versa; (v) assimilation of hyperspectral infrared radiances in the Arctic; (vi) production of stratospheric analyses, including evolution of the ozone layer over the Arctic.

O03-3C1.1 **INVITED/INVITÉ 13:30**

Unstructured mesh modelling in the nearshore

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As part of the Department of Fisheries and Oceansd COMDA (Centre for Ocean Model Development and Application), we are evaluating the model FVCOM (Finite Volume Coastal Ocean Model - Changshen Chen, U. Mass. Dartmouth) for application to nearshore modelling problems. The model is fully nonlinear, baroclinic with many options for display and further application (biology, sediment, particle tracking, difuusion and advection of passive scalars, etc.). We will initially be looking at its suitability for aquaculture and tidal power problems in the Bay of Fundy and fresh water transport through the Arctic Archipelago.

O03-2C1.2 INVITED/INVITÉ 14:15

Shear Instabilities in Internal Solitary Waves

Kevin Lamb

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There have been several oceanic observations of Kelvin-Helmoltz billows in internal solitary waves and attempts have been made to estimate the associated energy loss. Accurate estimation of this energy loss is desirable because it is a determining factor for the lifetime of a solitary wave and the associated mixing is one way an ISW can affect the stratification of the water column. In this talk I will discuss numerical simulations of this process. A new method for computing an internal solitary wave solution of the full incompressible Euler equations with a low Richardson number (less than 0.1) will be described. Using these as initial waves in numerical simulations shear instabilities are triggered by creating disturbances with a prescribed frequency ahead of the wave. The dependence of the resulting instabilities will be compared with a spatial instability analysis and the energy loss from the wave will be discussed.

C02-1C5.2 13:45

Reconstructing sea-ice conditions in the Arctic and subarctic seas during the late Pleistocene and Holocene

Anne de Vernal[1], *Claude Hillaire-Marcel*[1], *Stéphanie Ladouceur*[1], *Thomas Richerol*[2], *André Rochon*[2], *Sandrine Solignac*[1]

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Sea-ice is a very important parameter in the climate and ocean system, which is believed to have experienced large amplitude changes during the recent geological past of the Earth. However, it is also a parameter difficult to reconstruct quantitatively from proxy data. The most direct proxies of past sea-ice are found in marine sediments. They include sedimentary tracers of particles entrained and dispersed by sea-ice, biogenic remains associated with sea-ice or with ice-free conditions, in addition to isotopic indication of brine formation or mixing with meltwater. The knowledge of past sea-ice is thus fragmentary. Most studies report on the presence or absence of sea-ice, and only few provide reconstruction of the seasonal extent of sea-ice. One of the most useful proxies for the reconstruction of the seasonal extent of sea-ice cover in high latitudes of the Northern Hemisphere are dinocysts (organic-walled cysts of protists). The isotopic composition (18O) of polar planktic foraminifera may provide complementary indication on brine formation associated with the freezing of sea water. The development of a large dinocyst database from the analyses of surface sediment samples in the Arctic and subarctic seas permitted the development of transfer functions to reconstruct the duration of sea-ice in terms of months per year at given sites. There are, however, important caveats : (i) low sedimentary fluxes and very low biogenic productivity characterize multi-years perennial sea-ice areas; (ii) large variations of sea-ice cover from one year to another occur along the polar front; (iii) the last centuries were possibly marked by significant sea-ice cover changes, which were not necessarily recorded from instrumental observations but could be integrated into the proxy record of surface sediments used as a reference to interpret its relationship to modern sea ice. The few detailed records available from the study of box cores tend to support the hypothesis of significant sea-ice variations in the Arctic and subarctic seas on a centennial scale. On a longer time scale, that of the Holocene, sea-ice cover trends can be depicted from a few time series. They indicate significant

fluctuations of sea-ice extent, with different trends in the western and eastern Arctic, thus suggesting complex mechanisms involving insolation, rate of sea-ice formation in the Russian Arctic (related to freshwater budget and wind strength) in addition to drift pattern across the Arctic. At the scale of the last climate cycle, records from the northwest North Atlantic show a coupling between sea-ice extent and large amplitude fluctuations such as the Heinrich events or the Younger Dryas, supporting the hypothesis that sea-ice may act as an "amplifier" in the climate system. Worth of mention is the fact that sea-ice maxima during Heinrich events are also marked by shift towards depleted 18O values in planktic foraminifers, suggesting that sea-ice not only spread but also formed in the northwest North Atlantic during these extreme cold episodes.

G09-1B2.7 **12:00**

A magnetic investigation of the Ile Rouleau (Mintunikus Island) impact structure in Lake Mistassini, Quebec, Canada

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With the discovery of shatter cones on Ile Rouleau (a.k.a. Mintunikus Island) in the mid-1970s the sub-circular island, 1 km in diameter, was identified as belonging to an impact structure with an age predating the last glaciation. The structure is hosted in the dolomite-rich Lower Albanel Formation of the Paleoproterozoic located in Lake Mistassini, Quebec. The crater's diameter is less than 5 km, as indicated by the absence of shatter cones on an adjacent island. Ile Rouleau itself is thought to represent the central peak structure characteristic of complex craters. On Earth, this size coincides with the gradational boundary between a simple and complex crater, thus providing a rare opportunity to study the morphometric and geophysical structure of this transition. In late June, 2006, we acquired 288 line-km of bathymetric and magnetic data in a 6.5 by 10 km area surrounding Ile Rouleau using an acoustic depth sounder and an Overhauser-type proton precession magnetometer towed behind a 5 m aluminum boat. A DGPS receiver, incorporating CDGPS differential corrections, was used for positioning. Magnetic field measurements were obtained at intervals of 1 second or approximately 4 – 5 m along each line. Survey lines, oriented both perpendicular and parallel to the regional geological structure, were spaced 100 m apart within 2.5 km of the island and 300 m apart at greater distances. A map of the total magnetic field shows several interesting anomalies. The most prominent feature is a high-amplitude (35 nT) anomaly that wraps around the western side of Ile Rouleau and correlates with a bathymetric trench measuring approximately 400 m wide by 140 m deep. To the east, an arc-like anomaly that may be impact-related lies parallel to the island 100 m from shore. N-S trending anomalies in the westernmost portion of the survey grid are assumed to originate from crystalline basement rocks that subcrop beneath the sedimentary cover. We are currently modelling bathymetric effects in the data, and calculating vertical and horizontal derivatives that may help to enhance any impact-related signal. This will be followed by Euler deconvolution depth-to-source estimations and more detailed inverse and forward modelling with the intention of inferring the configuration of faults and other structures at the Ile Rouleau impact site.

C02-2C5.1 **14:00**

Nonstationary teleconnection patterns and the potential influence of interannual variability on millenial-scale ice sheet dynamics.

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The teleconnection patterns associated with interannual variability, and the El Nino Southern Oscillation in particular, are likely to have been different in the past when topographic forcing by massive continental ice sheets altered the climatological planetary wave field. Numerical models may be able to assist in reconstructing what these teleconnection patterns were and how proxy data records should be interpreted. In this talk, we discuss simulated ENSO teleconnection patterns from the Last Glacial Maximum to today and demonstrate using a coupled atmosphere-ice sheet general circulation model that millenial-scale ice dynamics may have been influenced by the teleconnection patterns of interannual variability, particularly during ice sheet inception and demise.

S02-2C3.6 **15:15**

Determining snow water equivalent values for eastern Türkiye using AMSR-E

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Microwave remote sensing (RS) has the advantage over optical imagery of not being affected by cloud, or requiring solar illumination. Microwave RS enables the direct determination snow water equivalent (SWE), which is an important snow parameter for water resource management, hydrologic simulations and forecasting. The accuracy of remotely sensed SWE values has always been a concern. Despite the fact that the possible sources of errors are known (such as vegetation, snow grain size), they are not evaluated quantitatively very well. Thus, quantifying and understanding the possible error sources are important both for algorithm development and accurate computation of SWE. This study compares AMSR-E derived SWE estimates with ground data for 2002/2003 winter period for eastern region of Türkiye. This region is one of the major headwaters of Euphrates and Tigris rivers. These rivers are largely fed from snowmelt. Thus, accurate determination of SWE is important in forecasting the snowmelt discharge and optimum resource management not only for Türkiye but also for downstream nations namely Syria, Iran, Iraq and Saudi Arabia. Initial analyses show that AMSR-E mainly over estimates snow water equivalent (SWE) in early season. As winter progresses in-situ recorded SWE values, obtained during manual snow surveys, increase higher than those of AMSR-E, leading to underestimation by AMSR-E. The differences between AMSR-E and in-situ SWE values and the possible reasons are presently being researched.

KEY WORDS: snow water equivalent, AMSR-E, validation,

C05-4C5.4 **14:15**

Effects of configuration changes on CRCM downscaled North-American climate

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The role of the Ouranos Climate Simulation Team is to provide regional climate change projections for impact and adaptation studies to Ouranos partners and members of the community. Decision-making resulting from impact and adaptation studies need to rely on the most credible climate projections and require hence a thorough uncertainty assessment. In order to accomplish this, the Climate Simulation Team takes advantage of a comprehensive database of regional climate simulations, annually increased by over a thousand simulated years. Regional climate models uncertainties originate from different sources: uncertainties from GHG emissions scenarios, internal variability (e.g., triggered by differences in the initial conditions), sensitivity to nesting configuration (e.g., domain size and location, relaxation technique, driving imperfections), dependence on RCM physics and dynamics (e.g., type of convective parameterization), and dependence on boundary forcing. (e.g., type of GCM). In this occasion, we will present results of our recent study of the Canadian Regional Climate Model (CRCM) sensitivity to domain size, type and frequency of driving data including the use of different Coupled General Circulation Model (CGCM3) members. These experiments are based on 30-year long climate simulations. The importance of these uncertainty sources will be put into context by comparing them to those originated by the driving GCM.

H02-2B4.7 **12:15**

A framework for isotopic-partitioning within mesoscale hydrologic modelling: isoWATFLOOD.

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In fitting with the movement to quantify, with greater certainty, hydrological processes over large scales, the primary objective of this research is to provide a relatively simple and inexpensive method to validate flowpaths within hydrologic models. This work seeks to include stable water isotope fractionation into the hydrological modelling framework for the purposes of validating hydrological processes through the prediction of isotopic enrichment or depletion, where those processes are verifiable through measured heavy-isotope concentrations. This will be accomplished by accounting for isotopic enrichment during evaporation from surface and soil waters, thus requiring an explicit evaporation-transpiration partitioning. The intended application of this research is to mesoscale, remote basins having scarce amounts of input data and field measurements due to practical constraints. The modelling platform chosen for this study is the WATFLOOD hydrological model due to its ability to simulate and predict accurate streamflow estimations for mesoscale basins without a multitude of hydrological parameters.

Building upon an existing six-component tracer model which compartmentalizes sub-storage flows and routing contributing to streamflow, 1) an isotope-mixing model is applied to calculate a mass of heavy-isotope in each compartmental storage, 2) compartmental flows transfers a flux-weighted portion of the mass in each storage compartment, 3) if there are any wetlands, a mixing and recalculation of concentrations (mass) occurs, and 4) a mass outflow of each flow component is estimated as a percent contribution to total channel flow. Heavy-isotope concentrations are subject to enrichment resulting from isotopic fractionation due to evaporation, and concentration and/or dilution resulting from flow routing into, and out of, storage compartments. The Craig and Gordon model is used to quantify the partitioning of heavy- and light-isotopes resulting from isotopic fractionation due to evaporation from open water, intercepted water, and near-surface soil water.

Today, science and technology have a significant role to play in the management and development of the world’s water resources. Isotope hydrology is becoming an essential tool for national water authorities in not only evaluation of water resources, but validation of the very tools used for prediction of quantity and quality of these resources.

I05-3DP.4 **16:00**

The search for ocean influences on midlatitude cyclones

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Models of the tropical atmosphere and ocean often seek to validate theories of the stability of coupled processes. Unfortunately, no coupled theories have ever been found to apply in the midlatitudes, in part because the atmosphere's impact on the ocean appears so dominant. Numerous hypotheses have been proposed, however, that the midlatitude ocean also has a local impact on the atmosphere. Among the relevant suggestions, some are easier to test. One such hypothesis is that there is a seasonal variation in this impact and that only relatively short timescale simulations may be required to examine it. Observational support for this approach is given by making seasonal comparisons of strong cyclones at the entrance to the Northern Hemispheric storm tracks.

A04-4B6.5 **11:30**

Effect of the Spatial Variability of Precipitation on Polarimetric Radar Observables

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It is known that specific differential phase shift, KDP, is a good indicator of liquid water and rain rate within the radar resolution volume. However, negative values of KDP are frequently observed through the melting layer and within hail events. They are not yet completely understood and some uncertainty is raised on the meteorological interpretation of KDP. Previous studies have suggested different individual interpretations of the negative values of KDP, and the effects of the backscattering process, the particle degree of common orientation, and the variable reflectivity in the radar volume were proposed as possible explanations. In this work we use a nonuniform beam filling model based on radar data and the equations of radar observables to combine and assess the three different effects previously mentioned. In the presentation we show their relative contribution to the negative values of KDP.

G11-3C2.3 **14:15**

Seismic characterization of Cretaceous sequences within the Orphan Basin, offshore Newfoundland and Labrador

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The Orphan Basin is the largest of the Mesozoic basins on the east coast of Canada. Located between the Grand Banks and the Labrador Sea it is situated northeast of St. John’s and comprises an area of approximately 150,000 km2. The geological evolution of the basin is similar to that of the Jeanne d’Arc, Flemish Pass and Porcupine Basins. It is a wide, highly extended, non-volcanic rift, consisting of an eastern Jurassic basin and a western Cretaceous basin, each with distinct tectonic and sedimentary histories. This basin was affected by three major rifting episodes: Late Triassic-Early Jurassic (Tethys), Late Jurassic-Early Cretaceous (Atlantic) and Late Cretaceous (Labrador) rifts. Late Cretaceous extension and inversion may have affected the area. Paleozoic basement ridges overlain in the west by thin Cretaceous sediments and in the east by thicker Jurassic and Cretaceous sediments characterize the basin. Renewed interest has focused on the East Orphan Basin where recent 2D seismic grids were acquired by GSI and donated to Memorial University. The GSC-Atlantic has given access to the BASIN website and CANSTRAT has donated lithological logs of all wells on the

Atlantic margin. This study focuses on the evolution of the Orphan Basin during the Cretaceous. Several major uniformities were mapped to clarify the distribution and provenance of Cretaceous strata and evaluate their petroleum potential. Good quality Cretaceous reservoirs have been drilled in the Orphan, Flemish and northern Jeanne d'Arc basins. Cretaceous age source rocks were encountered at ODP Leg 210 site 1276 and proven Early Cretaceous source rocks have been found in the Hopedale Basin, Labrador. Direct Hydrocarbon Indicators are seen in the Orphan Basin seismic sequences. These observations give hope that a Cretaceous age source can be found in this basin within several deep elongated troughs in the west or within larger depocenters in the east.

G07-1C2.4 **14:30**

On the Origin and Significance of Subadiabatic Temperature Gradients in the Mantle
Gunjan Sinha, *Samuel Butler*

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It is well established that the temperature gradients in the interiors of internally-heated mantle convection models are subadiabatic. The subadiabatic gradients have been explained to arise due to a balance between vertical advection and internal heating, however, a detailed analysis of the energy balance in the subadiabatic regions has not been undertaken. In this paper, we examine in detail the energy balance in a suite of simple, two-dimensional convection calculations with mixed internal and basal heating. We find that there are three causes of subadiabatic gradients. One is the above-mentioned balance between vertical advection and internal heating, which becomes significant when the ratio of internal heating to total surface heat flow is large. The second mechanism involves the growth of the "overshoot" of the geotherm near the lower boundary where the dominant balance is between vertical and horizontal advection. This latter mechanism is significant even in relatively weakly internally heated calculations. For time-dependent calculations, we find that secular cooling can be locally a dominant term in the energy equation and can lead to subadiabaticity. However, it does not show its signature on the shape of the time-averaged geotherm. We also compare the basal heat flow with parameterized calculations based on the temperature drop at the core-mantle boundary, calculated both with and without taking the subadiabatic gradient into account and we find a significantly improved fit with its inclusion.

I07-3C8.6 **15:00**

Marine wind analysis with the benefit of Radarsat-1 synthetic aperture radar data
Rick Danielson[1], *Michael Dowd*[1], *Harold Ritchie*[2]

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A nonlinear regression approach is employed to assess improvements in operational surface marine wind forecasts when synthetic aperture radar (SAR) measurements are also available. Analyses are constructed for coastal regions of eastern and western North America using a 2D-variational cost function, which simultaneously minimizes differences between the analyses and both wind forecasts and SAR measurements. The error covariance matrices that define the cost function are tuned using an independent set of buoy observations, which permit improvements in the resulting wind fields to be estimated. Comparisons are made with conventional methods of combining SAR and model data.

I08-3C7.6 **15:15**

Sensitivity model study of Arctic ice-ocean interactions during the Little Ice Age using different radiative and wind stress forcings

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In the past, the main drivers of the Little Ice Age (LIA) have been identified as volcanic eruptions, insolation changes and greenhouse gas changes. Furthermore, changes in the global ocean circulation have been detected from proxy data. One component which links the atmosphere and the ocean circulation is the sea ice. This study investigates the role Arctic sea ice has played in shaping the LIA climate using a global intermediate complexity model with an EMBM for the atmosphere, a GCM for the ocean, and a dynamic-thermodynamic model for the sea ice. In order to carry out this study, different wind stress fields for the LIA period are used for the model. In addition to a climatological wind stress field and one obtained from an AGCM run for the LIA, three other wind stress fields have been developed using NAO reconstructions for the LIA. The results of a sensitivity study are presented using these different wind stress and radiative forcings, and in particular, the changes to the sea-ice cover and ocean circulation are examined.

I03-4C7.7 **15:15**

High-resolution Land Surface Modeling and Assimilation: Surface Processes in the Next Generation of Operational Environmental Forecasting Systems

Stéphane Bélair, *Vincent Fortin*, *Pierre Pellerin*, *Bernard Bilodeau*, *Dorothée Charpentier*, *Isabelle Doré*, *Marco Carrera*, *Wei Yu*, *Aude Lemonsu*, *Alexandre Leroux*, *Stéphane Chamberland*

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Significant progress has been achieved in the last decade for land surface processes in numerical weather prediction (NWP) systems. These processes, and more specifically the representation of surface fluxes of heat, water vapor, and momentum, have lead to significant improvement of NWP at small and large scales, for short, medium, and extended range forecasts. In the next few years, meaningful improvements in surface processes are expected, with the advent of high-resolution external land surface modeling and assimilation systems. Because land surface systems are much less expensive (computationally speaking) than full 3D atmospheric models, they can be integrated at much higher horizontal resolution. Using high-resolution databases for orography, soil texture, vegetation, and urban cover, it is possible to “refine” predictions from current atmospheric systems by integrating land surface models in an external manner, and by downscaling atmospheric forcing (e.g., low-level winds, temperature and humidity, precipitation, radiation) using high-resolution geophysical characteristics related to orography. In this presentation, we will describe the external land surface modeling and assimilation systems that are currently being developed at the Science and Technology Branch of Environment Canada. Results obtained with these new systems will be presented, with emphasis on the prediction of soil wetness, snow characteristics, urban conditions, and low-level winds, temperature, and humidity.

G08-2B2.8 **12:15**

Recent development of experimental techniques for high-pressure mineral physics under simulated mantle conditions

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The Earth's mantle has a mass of about 4.08 . 1021 tons and represents 68 % of the total mass of the Earth. The Earth's mantle is only accessible by indirect methods, such as seismological studies. The interpretation of seismic data from the Earth's deep interior requires measurements of the physical properties of Earth materials under experimental simulated mantle conditions. MAX80, maximum conditions of about 12 GPa / 2000 K, and the sister apparatus MAX200x, designed to reach 25 GPa and 2400 K, are installed at HASYLAB beamlines. Both apparatus are equipped for XRD with a Ge-solid-state detector, for transient ultrasonic interferometry, as well as with a radiography system to measure the change of volume and shape of the sample under in situ conditions. Some recent results on the non-quenchable high-P – low-P clinoenstatite transition and to the quartz-coesite transition will be given to discuss the different interferometric techniques, including the XRD-data and X-radiography results, necessary to detect the phase transitions under in situ conditions and to measure the sample deformation. Parallel to the installation of MAX200x some innovative experiments were carried out to improve the potentials of multi-anvil apparatus in terms of maximum pressure and limitation of stress inside the sample and the anvils.

I10-1B9.4 **11:15**

The granular sea-ice model in spherical coordinates and its application to a global climate model

Jan Sedlacek[1], *Jean-Francois Lemieux*[1], *Lawrence A. Mysak*[1], *L. Bruno Tremblay*[1], *David M. Holland*[2]

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The granular sea-ice model (GRAN) from Tremblay and Mysak (1997) is converted from cartesian to spherical coordinates. In this conversion, the "metric" terms in the divergence of the deviatoric stress and in the strain rate are included. As an application, the GRAN is coupled to the global Earth System Climate Model from the University of Victoria. The sea-ice model is validated against standard data sets. The sea-ice volume and area exported through Fram Strait agree well with values obtained from in-situ and satellite derived estimates. The sea-ice velocity in the interior Arctic agrees well with buoy drift data. However, the model tends to underestimate the thickness distribution. The thermodynamic behaviour of the sea-ice model over a seasonal cycle at one location in the Beaufort Sea is validated against the Surface Heat Budget of the Arctic Ocean (SHEBA) data sets. The thermodynamic growth rate in the model is almost twice as large as the observed growth rate, and the melt rate is 25% lower than observed. The larger growth rate is due to the thinner ice to begin with and the absence of internal heat storage in the ice layer in the model. The lower summer melt, on the other hand, is due to the smaller than observed net ocean heat flux.

O02-1B1.6 **12:00**

Reanalyis and forecast of the circulation in the Bering and Chukchi Seas.

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We present two sets of results of the variational data assimilation applied for the reanalysis and short-range forecast of the currents in the Chukchi and Bering Seas. The model used for the reanalysis is designed specifically for the efficient variational assimilation of long-term observations in ocean regions strongly governed by flow through open boundaries and by atmospheric fluxes. The circulation in the Chukchi Sea is reconstructed from various sources of observations including 2.0 months of velocity, temperature and salinity records from moorings and CTD observations in autumn 1990 (www.frontier.iarc.uaf.edu/~gleb). Assimilation of mooring velocities allows us to estimate volume, heat and salt transports in the Chukchi Sea. The reconstructed circulation pattern reveals periodical reverse of the East Siberian Current and flow through the Bering Strait, which are the important features of the Chukchi Sea circulation. The quasi-stationary circulation in the Bering Sea is reconstructed from drifter and mooring observations, climatological temperature and salinity fields, and climatological surface fluxes of momentum, heat and fresh water. As a result of the reconstruction the estimates of volume transports through the Aleutian straits have been derived. Several numerical examples show that the reconstructed climatological sea surface height distribution can be effectively used for operational hind-cast and forecast of the circulation in the Bering Sea.

P-4A1.2 **INVITED/INVITÉ 09:15**

A seasonally ice free Arctic? / Un Arctique saisonnièrement libre de glace?

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Observations show large and coordinated changes are occurring in the Arctic climate system. Perhaps the most striking of these is a significant decline in summer Arctic ice extent that has accelerated in recent years. Climate models project that decreases in the Arctic ice cover will continue into the foreseeable future, and suggest that a seasonally ice-free Arctic could be realized within the next century. However, different models differ considerably on the rate and character of these projected changes. For example, several models suggest that abrupt retreat of the summer ice cover is likely while others show more gradual change under the same external forcing scenario.

Here we explore projected changes in Arctic ice cover over the 21st century for a number of climate models and investigate the factors that lead to the large scatter in their projections. We address the mechanisms that drive the rapid retreat that occurs in some models and discuss reasons why not all models project this type of decline. This includes an analysis of the changing simulated Arctic heat budgets and information on the strength of important feedback mechanisms and how they differ among the models. To the extent possible, we discuss what this analysis suggests about how and when a seasonally ice-free Arctic might be realized.

S03-3C3.3 **14:00**

Preliminary Results of Ultrasonic Snow Depth Sensor Testing for National Weather Service (NWS) Snow Measurements in the U.S. and Work toward Operational Readiness

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This presentation will provide a description of installation criteria and preliminary results of the 2006-2007 National Weather Service operational readiness evaluation of ultrasonic snow depth sensors. A suite of three depth sensors are being installed at each of 17 NWS test sites including: 14 weather forecast offices, 2 test bed sites and 1 cooperative station located at Colorado State University. Automated data from this array of sensors will be compared to traditional 6-hour and daily manual measurements of snowfall, depth and water equivalent. There is great interest and need to automate snow observations in order to track snow accumulation in near real-time without the need for trained observers for various applications such as weather forecasting and verification, flood warning systems, transportation applications and public information. Depth sensors have been available commercially for several years, but are just now being considered for use in operational weather and climate observing systems by the NWS. Estimating snowfall from continuous readings of total depth requires considerable understanding of snowpack characteristics such as settling, melting, and redistribution in addition to understanding electronic sensor output and signal processing. While the technology has excellent potential, there are a number of climate data continuity issues related to changing data collection methodologies that this program will be addressing. For example, changing frequency of observations and moving from spatial averaging (which trained observers do when snow accumulation is irregular) to point measurements could introduce biases. However, there are already known variations and inconsistencies in manual observations that have always plagued snowfall data, and automation may reduce some observational inconsistencies. As a project goal, analysis will be conducted to quantify errors in manual snow observations using a dense network of trained observers. This project is being conducted in collaboration with Environment Canada (EC) with the hopes of standardizing snow measurements across our borders.

O03-3B1.5 **11:30**

Numerical simulation of internal solitary waves generated by tidal forcing over three-dimensional topography in the St. Lawrence Estuary

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The action of tides on density-driven circulation, internal gravity waves and mixing has been investigated in the St. Lawrence Estuary (SLE) by many authors over the years. Observations have revealed that internal waves are prominent in the upper SLE (DeGuise, 1977; Bourgault et al., 2001) and near the boundary between the upper and the lower estuary (Ingram, 1978; Galbraith, 1992; Saucier and Chasse, 2000). In particular, the studies of Bourgault and Kelley (2003) and Bourgault, Kelley and Galbraith (2005) have revealed the existence of internal solitary waves (ISWs) running up a sloping boundary of an island in the St. Lawrence Estuary. They suggested that the wavetrain emanated from somewhere near the 120 m deep trough off Cap-de-la-Tete-aux-Chien. Unfortunately, there are no direct field measurements of ISWs in this estuary to verify this hypothesis. Given the need to understand the processes of ISW generation, propagation, and interaction with boundaries, we have done some idealized three-dimensional numerical simulations of these processes. The complexity of the bottom topography in the SLE makes a three-dimensional model necessary. In addition, the hydrostatic approximation breaks down for small-scale processes, such as the steepening, formation and breaking of non-linear internal waves. Therefore, the study of ISW in the SLE is beyond the capability of two-dimensional nonhydrostatic and three-dimensional hydrostatic models. A nonhydrostatic three-dimensional model is required. This study, using the MIT general circulation model (MITgcm) (Marshall et al.,1997), investigates the generation of ISW by tidal forcing over a depression in a open channel, whose idealized topography is based on the North Channel of the SLE. The physical parameters for the numerical model are setting up to the same values as in the study of Bourgault, Kelley and Galbraith. As an aid to contribute to the understanding of the generation and propagation of ISW in the SLE, the results of these simulations have verified the Bourgault and Kelly\'s hypothesis. It has shown that due to the tidal forcing over Cap-de-la-Tete-aux-Chien topographic depression, the internal waves are generated which evolve into a series of solitary waves, and then propagate toward the sloping boundary at the Ile-aux-Lievres Island as shown in the observations of Bourgault and Kelley.

C05-3B5.1 **INVITED/INVITÉ 10:30**

Modeling interactions between the clouds, aerosol, surface, and radiation in the Arctic using WRF and MM5.

Hugh Morrison

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The Arctic atmosphere-surface system is tightly coupled, meaning that changes in one component can have a large impact on the other components of the system. Recent upgrades in the treatment of clouds, aerosol, and radiation in the Penn State/NCAR mesoscale model (MM5) and the Weather Research and Forecasting model (WRF) allow for the simulation of interactions between these components, i.e., the clouds, aerosol, radiation, dynamics, and surface. This study focuses on the low-level, stratiform cloud regimes that were commonly observed during the Surface Heat Budget of the Arctic Ocean (SHEBA) and Mixed-Phase Arctic Cloud Experiment (MPACE) field studies. It is found that the correct simulation of key cloud parameters (phase, water path) is critical in simulating the radiative fluxes, surface temperature, structure of the boundary layer, and large-scale dynamics. The correct simulation of clouds in turn depends on details of the treatment of the cloud microphysics and aerosol. This sensitivity to the cloud microphysics and aerosol is strongly dependent on the surface type. For the open ocean conditions encountered during MPACE, there is much less sensitivity compared to the ice-covered conditions encountered during SHEBA.

O02-2DP.2 **16:00**

Predicting Seasonal Ice Extent in the Arctic

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How well can the extent of arctic sea ice be predicted for periods of up to a year? A coupled ice ocean model is used to estimate monthly averages of the state of the of the ice-ocean system for the past 48 years. The field variables from the model output, such as ice concentration, thickness, or thickness distribution measures and ocean temperature, are then used to determine the best linear prediction model for each month using step-wise regression. The monthly field variables are collapsed to a single number using a weighting based on the spatial correlation map of the variable with the predicted ice extent. The forecast skill of the procedure is determined by fitting the model with 35-year subsets of the available data and making subsequent projections based on independent data taken from beyond the fit period. In predicting the September ice extent for the pan-arctic region, the forecast skill, relative to climatology, is 0.77 for six months lead (from March) and 0.75 for 11 months lead (from October). The ice concentration is the most important variable for the first two months and the ocean temperature at 234 m is most important afterwords. The trend in the ice extent accounts for 76% of the variance of the pan-arctic ice extent, so most of the forecast skill is found by determining model variables that best represent this trend. The annual cycle of the forecast skill is investigated for six-month lead times. The best skill, 0.90, is for predicting the June ice extent from December. The worst, 0.48, is for predicting February ice extent from August. There is less skill in making regional predictions. Three month predictions of the September extent were determined for each of eight longitudinal sectors. The best skill, 0.77, is for the Barents Sea sector, while some other sectors show no skill. The physical and statistical basis for the predictions are discussed.

I12-3DP.4 **16:00**

Cloud Fields Associated with the Recent Drought over the Canadian Prairies

Heather Greene, Henry Leighton, Ron Stewart

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International Satellite Cloud Climatology Project (ISCCP) data is being used to study cloud characteristics over the Canadian Prairies for the period 1989-2005. The specific information being used is D2 data which consists of monthly averages of three hour satellite information for 130 variables including mean cloud amounts, mean cloud top temperature, mean cloud top pressure, cloud types, mean optical thickness, precipitable water, mean snow/ice amount and many others. The cloud characteristics of the drought period over this region, 1999-2005, are compared to those of the non-drought period, 1989-1998, for subsections of the Prairies. Gridded precipitation anomaly plots are used to determine the drought severity for each subsection.

It is hypothesized that cloud fields should show systematic declines over the drought prone regions. Preliminary analyses of cloud amounts throughout the Prairie Provinces, however, indicate that the overall mean cloud amount has not significantly changed between the two periods. The mean low cloud amount has, however, decreased slightly (3%) from the non-drought period to the drought period, whereas the middle and high cloud amounts have slightly increased (3% and 1% respectively). These low, middle, and high cloud amount variations are statistically significant. The results furthermore indicate that the year with the lowest cloud fraction, 1998, was not even a drought year. These results as well as their seasonal and diurnal variations will be presented.

A03-3B6.7 **12:00**

'Bottom-Up' Evidence for NBL Budget Measurement Scale

Laura Wittebol[1], *Ian Strachan*[1], *Elizabeth Pattey*[2], *Monique Leclerc*[3]

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Stable nocturnal conditions in the lower atmosphere allow greenhouse gases to accumulate which in turn can be measured using the nocturnal boundary-layer (NBL) budget method. While the height of this atmospheric 'chamber' has been shown to be defined relatively clearly by a wind speed maximum, its horizontal extent, typically on the order of several km, is much more difficult to define. Here we explore the upwind area represented by GHG flux values obtained using the NBL budget method for a typical agricultural farm in Eastern Canada. A footprint parameterization is first used to approximate the upwind source area of measured GHG concentrations. We use CH4 from known point sources existing upwind of our measurement location as tracers to show the spatial extent of the upwind source area measured by detailed vertical profile concentration data from the NBL budget method. Results show that the most important part of the NBL-measured GHG flux is represented by an upwind area of up to 2 to 3 km, meeting the desired scale of the typical agricultural farm.

A06-2B7.3 **11:00**

Direct Aerosol Radiative Forcing by Arctic Aerosols; Observed and Modeled

robert stone

(Presented by *Robert Stone*)
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Aerosols in the Arctic atmosphere affect the surface-atmosphere radiative balance in complicated ways. They attenuate solar and terrestrial radiation directly and interact with clouds to produce indirect effects. Aerosol radiative impacts depend on their chemical, physical and optical properties as well as solar geometry and properties of the intervening atmosphere and surface. While the Arctic atmosphere is generally very clean, incursions of both natural and anthropogenic aerosols produce perturbations that vary latitudinally and seasonally. Their cumulative effects are not well understood. To make accurate climate impact assessments it is essential to quantify the radiative forcing by the different aerosol types. With the complement of instruments now operating near Barrow, Alaska it is possible to characterize Arctic aerosols, infer their optical properties and evaluate their radiative impact on the surface-atmosphere system. Closure experiments are being conducted in which empirical results are used to corroborate model simulations. We demonstrate how this approach has been applied to estimate the direct radiative forcing by dust from Asia and by smoke from boreal forest fires. The dust event occurred in April 2002 when snow covered the surface, while the smoke event took place in July 2004 after the snow had melted. Despite having very distinctive properties, dust over snow and smoke over bare tundra both tend to cool the surface while heating the layers in which they reside. This imbalance tends to increase atmospheric stability during the day, an indirect effect of aerosols that may suppress cloud formation. The model results are shown to be very useful for evaluating heating rate profiles and also for making evaluations when and where observations are difficult to obtain. Results represent a first but important step in making regional climate impact assessments utilizing data from a circum-Arctic network of observatories being established during the International Polar Year.

C04-3DP.10 **16:00**

Performance of several homogenization techniques to detect shifts in precipitation data

Claudie Beaulieu[1], *Taha B.M.J. Ouarda*[1], *Ousmane Seidou*[1], *Xuebin Zhang*[2], *Gilles Boulet*[3], *Abderrahmane Yagouti*[3]

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Hydroclimatic data records often undergo artificial disturbances that do not reflect the real climate variations. These disturbances can be related for instance to station relocation, instrument replacement, change in observation procedures or modification in the immediate environment of the site. Such changes can introduce artificial shifts in the data series which may wrongly be interpreted as real climatic changes. To avoid this kind of mistake, data should be homogenized. Homogenization is the technique of detecting and correcting these artificial disturbances. The objectives of this research project are to identify the most appropriate methods for the homogenization of precipitation series, and to develop new techniques which overcome the weaknesses of existing approaches.

Different techniques for the homogenization of precipitation data were investigated in this study. These methods are based on statistical tests (the Standard Normal Homogeneity Test, the bivariate test, the sequential t-test, the sequential rank-sum test and the Jaruskova test), regressive models (multiple regression, two-phase regression) or Bayesian approaches (univariate for a single shift, multivariate for a single shift and multivariate for multiple shifts). The comparison of the different methods is based on a Monte-Carlo simulation study. Five synthetic data sets were generated: homogeneous series, series with one shift, series with multiple shifts, series with a shift in the variance and series with a trend. Each data set consisted of a series to be homogenized and three correlated neighbour series. The selected techniques were applied to these synthetic series and their performances were compared.

It was found that none of these methods was efficient for all kinds of inhomogeneities, but some of them performed fairly well: the Bayesian technique for multiples shifts, the standard normal homogeneity test, the method of Jaruskova, the bivariate test and the Wilcoxon sequential test.

A07-2DP.4 **16:00**

The Study of Polar Aerosols during the International Polar Year

<u>*Robert Stone*</u>

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The Study of Polar Aerosols during the International Polar Year

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Despite the important role aerosols play in modulating the radiation budget of the high latitudes, our knowledge of their physical and radiative properties, horizontal and vertical distributions and temporal variability are inadequate. Monitoring sites are sparse and satellite retrievals of aerosol properties are currently prone to error. To improve our knowledge of aerosols, a bipolar network of sun and star photometers is being established to monitor aerosol optical depth AOD. The POLAR-AOD program (IPY Project # 171) aims to characterize the means, variability and trends of the climate-forcing properties of aerosols in Polar Regions. Through coordinated activities data will be collected, archived and analyzed by participants from 40 research groups representing 22 countries. During IPY measurements will be made at 15 Arctic and 16 Antarctic locations with support of established national programs. Archiving and data management, inter calibration efforts and research activities will be coordinated primarily by the Italian Institute of Atmospheric Science and Climate. AOD measurements will be used to characterize different aerosol types, infer their optical properties, and in conjunction with other observations quantify their direct radiative impact on the surface energy budget. Aerosol-induced perturbations to the surface-atmosphere thermal structure will be investigated through a set of closure experiments using observations in conjunction with radiative transfer models. Natural and anthropogenic aerosols will be distinguished. Climatologies of their seasonal and regional patterns will be established. Collectively, studies will provide a basis to improve parameterizations of aerosol processes in climate models and thus reduce the uncertainty in climate predictions. An overview of the POLAR-AOD project is given in the context of the Global Climate Observing System (GCOS) and other existing programs; Global Atmosphere Watch, the U.S. Study of Environmental Arctic Change and the International Arctic Systems for Observing the Atmosphere (Project #196) that will coordinate a number of interdisciplinary activities during IPY.

C02-1B5.5 **11:30**

Bayesian EOF analysis of temperature and precipitation fields as input for glacier mass balance models

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Data analysis to assess the impact of regional climate on glaciers faces numerous challenges: wide ranges of spatio-temporal scales, variable data quality and quantity, irregular spatial distribution, data gaps and unknown correlations. To address these challenges we combine Bayesian inference with principal component (EOF) analysis. We focus on temperatures and precipitation in the North American Cordillera (144-114 W, 47-68 N). This region is well suited for this study, because it covers a wide range of climates and because digital elevation models and climate data are available at high spatial resolution. EOF analysis on North American Regional Reanalysis data for the period from 1979 to 2006 substantially reduces the dimensionality of the space-time climate field. A set of hierarchically nested models can be constructed by combining linear combinations of EOFs. Using a Bayesian approach we determine efficient EOF representations of the reanalysis data and, outside the period of observations, optimally infer EOF loadings as follows: Model-to-data fit is balanced with a penalty for model complexity, which provides an objective criterion for deciding the number of EOFs to retain. We determine the probability density functions of the principal components and the unexplained residual. Further inferences are performed with trend models for the reanalysis time period. This dual Bayesian-EOF approach yields an efficient representation of the climate fields for 1979-2006. To estimate temperature and precipitation fields before the reanalysis period, we use station observations and proxy data as logical prior information to determine the EOF loadings.

A02-1C7.8 **15:15**

The Application of High Resolution GEMLAM Meteorology and the CMAQ Modelling System in Support of Marine Air Quality Management

Xin Qiu[1], *Colin di Cenzo*[2], *Wayne Boulton*[1], *Jeff Lundgren*[1], *Mike Lepage*[1], *Martin Gauthier*[1]

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In the Spring of 2007 a modelling study was undertaken to determine the potential impacts on air quality and acid deposition that would result from using different levels of sulphur in marine diesel fuel. The area of interest was the coast of British Columbia. Crucial to this determination was the need for highly resolved simulations of meteorological data over areas of complex mountainous terrain and in the marine environment. We will describe how the GEMLAM data was used to drive the chemical transport model CMAQ. Results from a number of different emission change scenarios were evaluated, both for the present and for 2020. Impacts on visibility, ambient levels of PM2.5, ozone, and ammonia, and on sulphur and nitrogen acid deposition will be presented.

A05-1D6.2 **16:15**

Applying Regional GEM Operational Output to Air Quality, Wind Energy, and Air Force Training Projects

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Xin Qiu, Wayne Boulton, Ron Chapman, Mike Lepage

In recent years, the authors have developed a wide range of applications using Canadian Regional GEM forecast output. The regional GEM model which outputs on 15 km horizontal grids and 58 eta vertical layers, provides 48-hour forecasts twice daily covering all of North America. The forecast data along with GEM analysis, provide high quality meteorological data in Canada that can be used for a wide variety of applications, including: air quality modeling, real-time air quality forecasting, wind energy mapping and wind turbine sitting, and even an assessment of noise impacts associated with air force training activities in eastern Canada.

The presentation will provide an overview of a few select case studies. Case Study 1 will describe the use of operational regional GEM forecast outputs to develop real-time air quality forecasts in Alberta in support of oil and gas flaring operations. Case Study 2 will describe a software system developed to convert GEM outputs in FST format to a format suitable for use with the CALPUFF air quality model system to support regional and local-scale environmental impact assessments. Case Study 3 will describe the use of operational GEM outputs to develop a local climatology of the military training area northwest of Goose Bay, Labrador. This project also involves the development of an integrated software system for forecasting how and where sound emanating from supersonic aircraft will reach the ground during training activities.

S05-1D3.1 **16:00**

Synoptic Classification of Snowfall Events in the Great Smoky Mountains, USA

L. Baker Perry[1], *Charles E. Konrad*[2], *David G. Hotz*[3], *Laurence G. Lee*[4]

(Presented by *L.Baker Perry*)
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Mean annual snowfall in the Great Smoky Mountains National Park (GSMNP) exhibits considerable spatial variability, ranging from 30 cm in the valleys to nearly 250 cm at higher elevations. Snowfall can be tied to a variety of synoptic classes (e.g. Miller Type A or B cyclones, northwest flow), but the frequency and significance of different synoptic classes is not fully understood, particularly at higher elevations. In this paper, we manually classify all snowfall events during the period 1991 to 2004 according to a synoptic classification scheme, calculate mean annual snowfall by synoptic class, and develop composite plots of various synoptic fields. Hourly observations from nearby first-order stations and 24-hr snowfall totals from five sites within the GSMNP are used to define snowfall events. NCEP/NCAR reanalysis data are used to develop composite plots of various synoptic fields and to compare differences in synoptic field values between heavy and light snowfall events for selected synoptic classes.

G07-1C2.3 **14:15**

Mantle lithosphere deformation and crustal entrainment/accumulation during continental collision: An example from South Island, New Zealand

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Across most of the South Island, New Zealand two continental plates are in right-lateral oblique collision, causing crustal thickening, thrusting and uplift of the Southern Alps. As with most other active continental orogens the fundamental tectonic mechanisms by which the converging lithosphere is accommodated are uncertain. It may be that the mantle lithosphere is subducting in a plate-like style, or foundering/dripping in a more diffuse viscous manner, or undergoing combinations of these. In the overlying crust, continental material on the Pacific Plate is thrust over Australian Plate along the Alpine Fault, but only rocks of middle crustal grade are exhumed at the surface. The fate of the lower crustal material is still unclear. It has been interpreted that it may be thickening and accumulating beneath the orogen, underthrusting westwards, or perhaps some portion is entrained into the mantle. The purpose of this work is to study the dynamics of the crust-mantle interface at collision to consider how the mantle lithosphere and lower crust evolve together. We adopt a forward modeling approach using computational geodynamic routines for finite thermo-mechanical deformation. Modeling parameters such as material rheology and density, convergence rate, assumed geotherm, and geometry/structure are varied to determine the primary controls on the behaviour of material at the mantle-crust boundary. We test what styles of mantle lithosphere consumption are consistent with entrainment (coupling) or accumulation (decoupling) of lower crust. The models are interpreted in the context of the active orogenesis at South Island, but provide insights into the dynamics of the enigmatic deep lithosphere.

C02-2B5.7 **12:00**

Ground surface temperature history inferred from temperature depth profiles in Northern Quebec: Evidence for recent warming.

Christian Chouinard[1], *Richard Fortier*[2], *Jean-Claude Mareschal*[1]

[1] GEOTOP-UQAM-MCGILL
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Four temperature profiles were measured in deep boreholes in permafrost at the Raglan mine located in the Cape Smith foldbelt near the northern tip of the Ungava peninsula, Northern Quebec. The site is a barren rock desert on an elevated plateau. The boreholes were logged in September 2006 more than three years after drilling was completed, allowing return to thermal equilibrium. Thermal conductivity measurements were made on core samples. Radiogenic heat production is small and can be neglected. The temperature profiles show deviations from steady state due to recent variations in ground surface temperature (< 300 years). Three methods were used to infer the ground surface temperature history (GSTH): 1) forward modeling where the assumed GSTH is used to calculate the temperature anomalies of permafrost and compare with the measured ones, 2) a standard inversion with an algorithm based on singular value decomposition, and 3) a Monte Carlo inversion. The results show a strong warming between the mid-1700s and the early 1900s followed by a cooling episode which lasted approximately 50 years. The ground surface at Raglan has experienced a 1.7°C warming in the past century and a 2.7°C warming since the minimum of the Little Ice Age (late 1700s). Between the 1920s and the 1970s, a cooling of 0.3°C has occurred in the region with temperatures remaining relatively stable until the mid-1990s. The borehole measurements suggest 1.5°C ground surface temperature warming over the past 10 years.

C02-2B5.8 **12:15**

50000 years ground surface temperature histories inferred from temperature depth profiles in deep boreholes.

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Several deep boreholes (>2000m) have been logged for temperature near Sudbury and Manitouwadge in Ontario. Thermal conductivity and radiogenic heat production measurements were made on core samples from the same holes. From these temperature depth profiles, the heat production, and the thermal conductivity data, we calculated the perturbations to the steady-state temperature regime. These perturbations are interpreted as caused by past temperature changes at the ground surface. We have used two different inversion techniques, one based on the singular value decomposition algorithm and the other based on a Monte Carlo search of parameter space to obtain a 50000 years ground surface temperature history (GSTH) for each region. We compare this GSTH with other GSTHs inferred from deep boreholes located in Central and eastern Canada to establish a spatial distribution of ground surface temperatures during the last glacial maximum (LGM) and the Holocene. Our analysis suggests that at LGM the temperatures were near 0°C at the base of the ice sheet throughout most of central Canada, and relatively colder (~ -5°C) near the eastern edge of the Laurentide glacier.

S04-4C3.4 **14:15**

The variation of blowing snow particle size, number, and velocity with height

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Recent measurements of blowing snow have been made at Churchill, MB and near Egbert, in Southern Ontario. An automated digital camera system measures the size, velocity, and number density of blowing snow particles. These data are compared to concurrent measurements of wind speed and temperature, as well as the blowing snow particle number flux (measured using particle counters based on the design of Brown and Pomeroy). The variation with height of blowing snow particle size, number, and velocity is investigated, and parameterizations of these variables are suggested.

A03-2DP.3 **16:00**

Evaluation of hemispherical photography for determining the radiation balance of a snowpack below forest canopies

David Spittlehouse

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Hemispherical photographs are regularly used to determine canopy leaf area and photosythetically active radiation below canopies. Accurate determination of the radiation balance below forest canopies is required in snow melt modelling work. Interception of solar radiation and the high snow albedo means that the solar and longwave balance is of similar size. Measurements of above and below canopy downward short and longwave radiation were used to evaluate the accuracy of a hemispherical photographs and an analysis program to aid determining these fluxes. A Kipp and Zonen CNR1 below the canopy and a CNR1 or pyrgeometer and a pyranometer above the canopy were used to measure these fluxes and diffuse radiation was calculated. Solar radiation transmissivity and canopy longwave radiation view factor were measured and calculated with the Spot Light Interception Model and hemispherical photographs for 6 locations in 4 stands. There was excellent agreement between the measured and modelled data.

C02-2C5.3 **14:30**

Modeling stable water isotope composition using GCMs as a tool to understand the climate signals in ice cores

Robert Field[1], *Kent Moore*[1], *Gerald Holdsworth*[2]

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The stable water isotope (SWI) composition of ice cores is conventionally assumed to provide a method of temperature reconstruction because of the temperature dependence of isotope fractionation when water forms in clouds. The isotope fractionation is also influenced, however, by the conditions under which the moisture originally evaporated and its transport between source and deposition regions. This complicates the use of ice cores as indicators of local climate, but also makes them useful as proxies of broader circulation patterns. The goal of our work is to better understand what controls the SWI composition of precipitation in the southwestern Yukon, and in particular, to better-interpret the SWI signal from the Mount Logan ice core.

To this end, we are conducting experiments with the GISS ModelE general circulation model, which

is equipped with SWI diagnostics. Preliminary results show that the model performs well in capturing regional and seasonal SWI variation at selected sites in Canada. In the Yukon, SWI variability is controlled by both the local temperature as well as large-scale circulation anomalies such as the Pacific North America teleconnection pattern and ENSO. The strength of these relationships is highly dependent on seasonality, which provides a possible explanation for the lack of circulation signals detected thus far in the Mt. Logan ice core.

A03-3B6.4 **11:15**

Surface-layer statistics over a uniform salt flat: the adequacy of Monin-Obukhov scaling

John D. Wilson[1], *Keith McNaughton*[2], *Rob Clement*[2]

(Presented by *John.D. Wilson*)
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Signals from sonic anemometers at nine levels up to 30 m above ground were recorded at 20 Hz, over a smooth playa in Western Utah where the fetch of uniform upwind surface was of the order of 100 km. The purpose of the experiment was to explore McNaughton's proposed revision of Monin-Obukhov similarity theory (MOST) to account for modulation of surface layer wind by the "outer" or boundary-layer scale eddies. The smoothness of the salt flat surface resulted in small friction velocities even during solid winds, thus many periods with small |L| (magnitude of the Obukhov length) and large values of z/|L| at the higher instruments. Here the experiment will be described, and the adequacy of conventional MOST scaling to organize the data assessed.

A03-3B6.2 **10:45**

Lagrangian Stochastic Probability Density Function Modelling of Concentration Fluctuations in Canopy Flows

John Postma[1], *John Wilson*[1], *Eugene Yee*[2]

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Turbulent mixing of gases occurs in many of the earth's natural and anthropogenic systems: air pollution, the spread of pollen and spores, seeking a mate or food, inflammability and combustion, transport of odours, and chemical reactions. Elements of these processes depend not only on the mean concentration of the gases but also upon the concentration variance and the higher-order moments of concentration. A means to understand and predict these concentration fluctuations would therefore be a valuable tool for engineering, risk assessment and emergency preparedness.

This presentation will introduce the Interaction by Exchange with the Conditional Mean (IECM) micromixing model and how it can be modified such that it can be used to predict concentration fluctuations in highly disturbed canopy flows.

H06-4C4.7 **15:00**

The Western Canadian Cryospheric Network (WC2N): An update

Andrew Bush[1], *John Clague*[2], *Garry Clarke*[3], *Stephen Dery*[4], *Peter Jackson*[4], *Brian Menounos*[4], *Stan Marshall*[5], *Dan Moore*[3], *Dan Smtih*[6], *Eric Steig*[7], *Roger Wheate*[4]

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The Western Canadian Cryospheric Network (WC2N) is a consortium of six Canadian universities, two American universities and government and private scientists who are examining the links between climatic change and glacier fluctuations in western Canada. Glaciers provide windows into past and present behaviour of the climate in the North Pacific region since they they are well distributed in western Canada and are sensitive to changes in precipitation and temperature. Glaciers are also important for western Canada since they serve as frozen reservoirs of freshwater. This presentation will provide a brief overview of the network's activities and progress over the past year as well as planned field activities and research for the upcoming years.

H03-2C4.3 **14:45**

Modelling the influence of Mountain Pine Beetle infestation in lodgepole pine forests on the site water balance

David Spittlehouse

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Mountain pine beetle is killing an extensive area of lodgepole pine trees in British Columbia. Depending on the density of trees in a stand this could have a significant impact on the site water balance and water available to flow to streams. A process based model, developed and tested at the Upper Penticton Creek Watershed Experiment, was used to evaluate changes in the water balance when the all trees in a stand are killed and needles retained (red attack), needles drop off and trunks and branches remaining (grey attack), the stand burns or it is clearcut. The red attack stand maintains the precipitation and radiation interception characteristics of a forest but there is no tree transpiration. The grey attack has reduced interception and increased below canopy evaporation. Burnt and clearcut sites have minimal precipitation interception and have the highest soil-surface evaporation rates of the treatments. The grey attack, fire and clearcut sites have the highest drainage losses due to the reduce precipitation interception. The soil in the red attack stand remains moist during the summer because of low below-canopy evaporation rates. The burnt and clearcut situations are also moist because there is little or no vegetation to dry out the deeper layers of the soil.

H02-2DP.3 **16:00**

Using stable isotope ratios to infer annual and spatial variability in source water contributions in the upper Bow River basin, Alberta

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Many researchers have documented changes to streamflow in southern Alberta in the past one hundred years. Streamflow has declined significantly during the 20th century, and peak streamflow due to spring snowmelt is generally occurring earlier in the year. These changes have the potential to significantly affect how we utilize our water resources, particularly in southern Alberta where water managers rely on river water to support irrigation and municipal uses. Despite the economic and social importance of the Bow River as an essential water resource, scientists have not yet fully ascertained the underlying factors that are causing the decline in streamflow. It is the overall goal of this study to use $^{18}O/^{16}O$ and $^{2}H/^{1}H$ ratios at the river basin scale to identify the annual and spatial variability in snow and rainfall contributions to the Bow River. The study area encompasses 7,700 km^2 of the Bow River catchment from the headwaters in the Rocky Mountains to the western edge of Calgary.

River and tributary water samples were collected from May 2004 to December 2006 and have been analyzed for $\delta^{18}O$ and $\delta^{2}H$. In addition, precipitation samples have been collected from 1992 to 2006 in Calgary and from 2002 to 2006 in the Rocky Mountain Foothills. This presentation will examine the annual and spatial variability of the stable isotope ratios with a view to understanding the underlying causes and the implications for future river flows. Changes in flow rates, the annual snow and rainfall amounts, and the isotopic composition of precipitation events will all be examined as potential contributors to the observed trends in the stable isotope composition of river water. The implications of these short-term observations will be discussed in the context of the long term flow rate and precipitation records for the Bow River basin.

I10-1C9.5 **14:30**

Monitoring the fluxes through the Canadian Arctic Archipelago. Simon Prinsenberg, Bedford Institute of Oceanography

Simon Prinsenberg

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Monitoring the fluxes through the Canadian Arctic Archipelago.

Simon Prinsenberg, Bedford Institute of Oceanography

Year-long moorings have been in place in Lancaster Sound to measure the heat and freshwater fluxes passing through the Canadian Arctic Archipelago. Mooring technology had and is still being developed to monitor theses fluxes. Mooring obstacles such as the presence of North Magnetic Pole and mobile ice ridges reaching 25m had to be overcome. Technologies overcoming these obstacles will be presented as well as the mooring results themselves. Present moorings needs to hide the instrumentation beneath the depths where ridge keels can damage them, which for mobile First Year ice is around 30m. Developments are still underway to develop an energy efficient under-ice profiler for collecting ocean parameter profiles (0 to 50m) beneath a mobile ice cover. The profiler is called the ICYCLER and is an observation platform that now carriers a CTD, Flourometer and Oxygen sensor. The mooring program will continue as part of Canada’s contribution to the International Polar Year Program.

A04-3C6.6 **14:45**

Lightning and radar features within the Carnduff Saskatchewan Thunderstorms of May 28, 2006

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A series of thunderstorms traversed the Carnduff area of southeastern Saskatchewan on May 28, 2006. The first event occurred between 03:28 and 10:55 UTC and was electrically very active, producing over 1,850 cloud-to-ground and cloud-to-cloud flashes. The next significant event occurred between 18:12 and 21:05, yielding 255 flashes. A few intermittent flashes from other cells were also detected between these two events.

Radar and lightning characteristics for these two events are discussed using archived data from the Foxwarren radar facility located in southwestern in Manitoba and the Canadian Lightning Detection Network. CAPPI and maximum reflectivity analyses at various height thresholds, as well as the temporal evolution of reflectivity and storm temperature structures are used to compare and identify any differences between these two events. Particular attention is focused on a 3-hr period when a large number (52) of unusually strong positively-charged cloud-to-ground flashes with peak currents > 100kA were detected. The lightning climatology of large current flashes reveals that the Carnduff area typically receives an average of 2 flashes in May and about 46 over the summer season.

I08-4B7.6 **12:15**

Constraints on atmospheric and oceanic heat transport from an idealized coupled climate model with sea-ice

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What sets the total meridional heat transport and its partition between atmosphere and ocean, and how does the transport in one fluid respond to changes in the other? We use a simple model to study some of the fundamental constraints on heat transport. The atmospheric model is an extension of the purely thermodynamic Budyko-Sellers energy balance model to include some dynamics, and it predicts the zonally averaged surface wind stress and temperature. This is coupled to a simple model of heat transport by wind-driven ocean gyres. A simple sea-ice model is included, and affects the surface albedo and heat flux.

Sea-ice is key to the model behaviour. Without ice, the total heat transport is essentially fixed by geometrical constraints and is very insensitive to the dynamics. Atmospheric eddies adjust to compensate almost perfectly for changes in ocean heat transport. With ice, the total heat transport depends on the size of the ice cap, and the size of the ice cap is sensitive to the ocean heat transport. The compensation is therefore much less exact: increasing ocean heat transport causes a poleward retreat of the ice, which causes a drop in the total heat transport. The ``snowball earth" large ice sheet instability is present in this model, but relative to Budyko-Sellers it requires a much larger cold perturbation due to the wind-driven ocean.

A02-1B7.6 **11:45**

Lagrangian simulation of wind transport in a complex urban environment

John.D. Wilson[1], *Nils Ek*[2], *Real d'Amours*[2], *Eugene Yee*[3], *Fue-Sang Lien*[4]

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Computing power now renders practicable a causal computational model of the transport of material born on the urban winds. This entails computing the wind field with high spatial resolution (order metres) and providing that wind field to a dispersion model, albeit Eulerian or Lagrangian. The rationality of the approach is obvious: however the magnitude of the computational task is reasonably daunting, and so earlier efforts along these lines have taken the case of one isolated building or a regular array of self-similar obstacles. Here we summarize the performance of a Lagrangian stochastic dispersion model "driven" by a flow field from a building-resolving Reynolds-averaged Navier-Stokes model (Lien and Yee), the latter (potentially) driven by a mesoscale weather analysis/prediction model (CMC's GEM-LAM). Test cases include the ideal uniform surface layer, an array of identical "buildings" in water channel flow, and a field tracer experiment in downtown Oklahoma City.

G07-1C2.5 **14:45**

Mantle Convection Models with Temperature and Depth-dependent Thermal Expansivity

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This study investigates the effects of temperature- and depth-dependent thermal expansivity in 2D mantle convection models in both plane-layer and cylindrical-shell geometries. For simplicity, most previous mantle convection models have used a constant coefficient of thermal expansion, α , although there are some limited earlier studies of the effects of temperature and depth-dependent coefficient of thermal expansion in plane layer models. We consider α to have the form $\alpha(z,T) = \alpha_z(z)\alpha_T(T)$ and employ the results of separate mineral physics experiments to determine the functional forms of $\alpha_z(z) = 1/ (1+2.0255e\text{-}4{*}z)^3$, and $\alpha_T(T) = a_0 + a_1T + a_2/T^2$. Note that $\alpha_z(z)$ decreases with depth while $\alpha_T(T)$ increases with T. We find that the depth-dependence and temperature-dependence of α each have a significant effect on the mean surface heat flux (or Nusselt number) and the mean surface velocity of the convecting system. For $\alpha = \alpha_z(z)$, the decrease of α with depth causes a decrease of surface heat flux by about 25% and a decrease in mean surface velocity by about 40%, relative to the constant-α case, in either geometry. Consequently, studies of the effects of depth-dependence of α alone would seriously underestimate these surface parameters. However, when $\alpha = \alpha_z(z)\alpha_T(T)$ (i.e., the temperature-dependence of α is also included) our predicted values of surface heat flow and velocity increase; $\alpha_T(T)$ compensates for the effects of $\alpha_z(z)$. Compared to models with $\alpha = \alpha_z(z)$, for Earth-like conditions our predicted values increase by 34% and 75%, respectively, in Cartesian coordinates, and by 23% and 60%, respectively, in cylindrical geometry.

C05-3DP.8 **16:00**

Regional Climate Model sensitivity to domain size

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Regional Climate Models are increasingly used to add small-scale features that are not present in their lateral boundary conditions (LBC). It is well known that the limited area over which a model integrates must be large enough to allow the full development of small-scale features (Jones et al., 1995). On the other hand, integrations on very large domains have shown important departures from the driving data, unless large-scale nudging is applied (e.g., Castro and Pielke, 2005).

The domain size problem is handled here by using the "Big-Brother" approach developed by Denis et

al. (2002b). This method consists first of simulating a high-resolution climate sample (four winter months), nick-named Big-Brother (BB), that uses a large domain of integration. The next step is to degrade this dataset with a low-pass filter to emulate the coarse-resolution LBC that are usually taken from a Global Climate Model. Those artificial nesting data (FBB) are hence used to drive new simulations (LBs for Little-Brothers), with the same model, but on smaller and different domain sizes.

A comparison of the LB fields with those of the unfiltered reference (BB) over the area common to all simulations (practically the entire Quebec Province of Canada) displayed important effects due to domain size changes on the numerical solutions. The climate time average (stationary) and the transient-eddy standard deviation are examined for the mean sea-level pressure (slp), the horizontal wind speed magnitude (wm), the relative humidity (rh) and the precipitation rate (pcp) fields. The spatial correlation between the patterns of the LBs with BB tends to increase when the domain size is reduced from 144x144 to 72x72 grid-points. Also, the extraction of the small-scale features, which do not exist in the nesting data, allowed detecting important underestimations of the transient variability in the vicinity of the inflow boundary especially for the wm and rh fields at 700-hPa. It suggests the existence of a “spatial spin-up”, a characteristic distance that the large-scale flow needs to travel before demonstrating the small-scale transient particularities responsive to the different forcings of the model as: surface fluxes or other sub-grid physical processes.

A03-2DP.2 **16:00**

Determining Ammonia Emissions from a Cattle Feedlot with an Inverse Dispersion Technique

T.K. Flesch[1], *J.D. Wilson*[1], *L.A. Harper*[2], *R.W. Todd*[3], *N.A. Cole*[3]

(Presented by *John.D. Wilson*)
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An inverse-dispersion technique is used to calculate ammonia (NH3) gas emissions from a cattle feedlot. The technique relies on a simple backward Lagrangian stochastic (bLS) dispersion model to relate atmospheric NH3 concentration to the emission rate QbLS. Because the wind and the source configuration are complicated, the optimal implementation of the technique is unclear. Two categorically different measurement locations (for concentration and winds) are considered: within the feedlot, or downwind. The in-feedlot location proved superior, giving a nearly continuous QbLS time series. We found average emissions of 0.15 kg-NH3 per animal per day in both 2004 and 2005, representing a loss of 63% (2004) or 65% (2005) of the dietary nitrogen in the animal feed. Downwind measurement locations were less useful for several reasons: a narrow range of useable wind directions; ambiguity in the choice of wind statistics; low NH3 concentrations; and deposition of NH3.

O03-2DP.5 **16:00**

Freshwater and heat budgets of Hudson Bay

Pierre St-Laurent[1], *Francois J. Saucier*[1], *Fiammetta Straneo*[2], *David Barber*[3]

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An important freshwater source for the Labrador Sea is the Hudson Bay System (HBS), which receives 18% of the Arctic river runoff. The HBS freshwater and heat budgets are examined using a regional sea ice-ocean model and observations. A one year hindcast simulation (2003-2004) is conducted under realistic forcings for runoff, atmosphere, ocean boundaries, and tides. The HBS freshwater budget is controlled by the net flow through the mouth of Hudson Strait (-41 mSv liquid, reference salinity 34.8; -5 mSv solid; negative fluxes are outward), runoff (+28 mSv), precipitation-evaporation (+11 mSv), and Arctic waters flowing through Fury & Hecla Strait (+9 mSv). The heat budget is controlled by the Hudson Strait flow (-147 TW liquid; -5 TW solid), Arctic waters through Fury & Hecla Strait (+122 TW), runoff (+30 TW), precipitation (+19 TW), and surface fluxes (-13 TW). Both budgets are almost closed (+2 mSv, 0.5% of total content; +6 TW, 0.1% of total content), and significant seasonal variations are found. Notably, the net seawater transport through the mouth of Hudson Strait has a large annual mean (-132 mSv), but a +15 mSv monthly mean in March. This reversal is related to runoff and inflow through Fury & Hecla Strait, both minimum in late winter. Observed salinity in southern Hudson Strait also shows strong seasonal fluctuations with a freshet from October to December. The model reproduces well the timing of the freshet and relates it to the eastern Hudson Bay buoyancy current. As a next step the interannual variability of the freshwater and heat budgets will be examined.

A02-1B7.4 **11:15**

A New Cloud Microphysics Scheme for the GEM-LAM-2.5

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With increasing computer resources, operational weather centres are moving quickly towards running high-resolution limited-area models (LAMs) for operational NWP. The Canadian Meteorological Centre has, for some time, been running the GEM-LAM model in real-time experimental mode over two windows in Canada with grid-spacings of ~2.5 km. At this resolution, most clouds are fairly well-resolved and the model does not employ any convective parameterization scheme. Consequently, the cloud microphysics scheme plays a very important role. The quantity and phase of the precipitation is determined almost entirely from the microphysics parameterization and there are important feedbacks to the model dynamics through latent heat release and precipitation loading.

A new microphysics scheme, appropriate for the GEM-LAM-2.5, has been developed. The parameterization is essentially an efficient version of the Milbrandt-Yau (2005) multimoment scheme, which includes several hydrometeor categories and microphysical processes and employs state-of-the-art bulk modelling techniques. The proposed scheme will soon be tested in real-time in the GEM-LAM-2.5 in the current experimental Canadian windows as well as in the MAP D-Phase experiment in Switzerland. The scheme is also a candidate for the operational configuration of the GEM-LAM that will be used for the 2010 Winter Olympics. An overview of the scheme will be given and some model results will be presented.

H06-4B4.2 **11:00**

Greenland Outlet Glacier Flow Speed and Surface Meltwater Production

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Several major Greenland glaciers have been reported to exhibit abrupt flow acceleration and calving-front retreat in recent years. We hypothesize that climate warming is a partial cause of observed acceleration. In this study, the relationship between Polar MM5 regional climate model 3-hourly annually integrated positive degree day (PDDA) and ice flow variations at 3 major glaciers in Greenland is investigated. The three glaciers are: Jakobshavn Gl. (~69oN, 49.5oW); Kangerdlugssuaq Gl. (~68.6oN, 33oW); and Helheim Gl. (~66.3oN, 38.1oW). Model temperature uncertainties are evaluated using independent in-situ observations. We find that PDDA anomalies are positively correlated with ice velocities for all three glaciers. We therefore do not reject our hypothesis. We conclude that thermal forcing explains a significant amount of variance. PDDA anomalies correlate higher with glacier velocities than do temperature anomalies for any season. Further, we find that the relationship between PDDA and ice velocities tends to be nonlinear, which indicates that thermal effects, as indicated by linear regression, under-explain the true acceleration relationship with surface meltwater production.

C04-4B5.1 **10:30**

Sea Ice in Canada's Changing Climate

J.C. Falkingham

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The Canadian Ice Service (CIS) has been producing charts depicting the sea ice conditions in Canadian waters on a regular basis since 1969. In the past few years, these charts have been digitized and compiled in a geospatial digital database. Continuing analysis of the database, as it is updated annually, is yielding increasingly interesting facts about the changes in Canada's sea ice regime over nearly 40 years. In general terms, there has been a decline in the extent of sea ice during the summer that parallels the overall reduction in sea ice throughout the northern hemisphere. However, in some areas, Hudson Bay in particular, the sea ice reduction has been much greater than the general trend, leading to heightened expectations of increased shipping activity into the Port of Churchill and elsewhere in the region. Conversely, other areas, including the Northwest Passage, have seen little or no reduction in summer sea ice, largely because of sea ice advection from the Arctic Ocean. This has led to a wide diversity of opinion about the future of shipping in the Northwest Passage over the coming decades and the urgency with which Canada should respond to perceived threats to environmental and national security. There is reason to believe that Russia's Northern Sea Route and even trans-polar routes directly across the Arctic Ocean will become clear of summer ice before the Northwest Passage. However, shipping is occurring regularly in the Canadian Arctic now and will continue to increase as the value of northern resources rises, even in the face of continuing sea ice hazards.

G07-1C2.8 **INVITED/INVITÉ** **16:00**

Temperature Control of Continental Lithosphere Strength and Deformation

Stephane Mazzotti[1], *Roy Hyndman*[1], *Claire Currie*[2], *Andrew Frederiksen*[3]

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The elastic thickness of continental lithosphere is closely related to its total strength and therefore to its susceptibility to tectonic deformation and earthquakes. We test the dependence of elastic thickness

(Te) in western North America to crust and upper mantle temperatures and compositions by comparing Te from topography-gravity coherence to upper mantle temperatures derived from shear wave velocities (Vs). We find a good Te – Vs correlation of the form expected based on laboratory data. Te distribution is strongly bimodal, less than 20 km for the high temperature Cordillera and over 100 km for the adjacent cold Canadian Shield. Only intermediate thermal regimes have intermediate Te that suggests a weak layer in the lower crust over a stronger upper mantle. Strength envelopes based on laboratory data correspond to the observed Te for thermal regimes with temperatures at the Moho of 800-900C for the Cordillera and 400-500C for the Shield, in agreement with temperatures from Vs and other estimators. Our study supports the conclusion that lithosphere strength is controlled primarily by temperature and that laboratory-based rheology provides a good first order estimate of the deformation behavior of the crust and upper mantle. The Cordillera and other continental back-arcs are weak enough to be deformed by plate boundary forces, whereas cratons are generally too strong. In the Cordillera, the upper mantle is too hot for brittle failure and earthquakes occur only in the upper 10-15 km of the crust. In the cool craton, earthquakes do not occur in the upper mantle because the total lithosphere strength is too great for significant deformation by plate tectonic forces.

G03-4B2.3 **11:00**

Outlier detection for a combined vertical motion model – case study for the Great Lakes

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The proper identification and removal of outliers in the combination of vertical displacements derived from GPS, tide gauges, satellite altimetry and GRACE is presented. Initial results indicate that typical data snooping methods are inadequate in dealing with these heterogeneous data sets and their relative errors. In this paper, extensive data screening procedures are investigated within the context of a combined dynamic geoid model using GPS velocity data, joint tide gauge and altimetry data, and vertical displacements from GRACE. A case study for the Great Lakes is used where computed vertical displacements vary between -2mm/yr (subsidence) along southern shores and 3 - 4mm/yr (uplift) along the northern shores. Outlier detection is a necessary pre-screening procedure in order to ensure reliable estimates of relative errors in the combined least-squares adjustment (via re-scaling of covariance matrices) and to ensure that the final vertical displacement model is not corrupted and/or distorted by erroneous data.

I07-3B8.5 **11:45**

Secular geoid rate in North America from GRACE: methodology, accuracy and interpretation

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The improving accuracy of the geoid in Canada makes it relevant to estimate its temporal variations and assess their contribution to the future vertical datum. While terrestrial gravimetry and GPS measurements can be combined to estimate the geoid rate, here we present the results obtained solely from GRACE data. The geoid rate pattern follows the familiar shape of postglacial rebound, however, interannual and long-term variations in continental hydrology can also contribute to the estimated geoid trend. From the point of view of modernization of the vertical datum, we wish to correct for the

hydrology signal as only secular changes in geoid from postglacial rebound are of interests. From the point of view of postglacial rebound studies, secular mass changes from other processes (ice melting, hydrology, tectonics) are to be removed as well.

GRACE estimates of mass changes require filtering and spatial smoothing since errors increase with decreasing wavelength. We investigate the dependence of the geoid rate on the level of smoothing and show that the rate decreases significantly with increased spatial smoothing. We also investigate the leakage signal from melting of Alaska glaciers and Greenland ice sheet. Correcting for the hydrology long-term mass changes reduces the geoid rate peak by a few tenths of mm/yr and alters the geoid rate pattern west and southeast of Hudson Bay. In addition, we compare two techniques to estimate the secular geoid changes from GRACE, namely least squares and principal component analysis.

We conclude that GRACE gives a reliable estimate of the geoid rate in Canada after filtering and smoothing up to a wavelength of 400 km. Physical processes contribute significantly to the uncertainty of the estimated geoid rate, therefore, care must be taken in the interpretation of the pattern and error bars.

I01-3DP.3 **15:30**

Temporal Trends in Air Density

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Much work on climate variations involves individual elements. Climate, however, is a composite. It is useful to look at trends and variations in indices that combine multiple elements. Density is a property of the atmosphere controlled by air temperature and humidity. It helps control, and is related to, air pressure. West coast, mid-winter, air density trends and variations from the mid-1940s into the 1990's are examined with special emphasis on Cape St. James. Density at the four synoptic hours was computed as a function of air temperature, pressure and humidity. Average December - January period values are presented for individual years and 5-year running means. Computed air density is most sensitive to air temperature and pressure. Absolute variations in density were small but the relative variation was large. The maxima approached three standard deviations above the mean and minima two standard deviations below the mean. Trends included declines from the late 1040s to the late 1950s and late 1960s to the very early 1980s. These were separated by an upward trend from the late 1950s to late 1960s. The trends of air temperature and humidity were opposite those of density. These trends are influenced by the high densities in the winters of 1949-1950, and 1968-1969/1971-1972 and low densities in the winters of 1957-1958 and 1982-1983. High densities are found in winters with pronounced arctic outbreaks bringing cold, dry air over the region. Low densities accompanied warm, relatively humid winters. Air pressure is usually directly correlated with density. Density, temperature and humidity were well correlated with the PNA and PDO indices. These reflect the relation of major air pressure systems and the general circulation with the advection of air masses of different characteristics. Density was poorly correlated with the Southern Oscillation index and AO index.

A04-4D6.3 **16:30**

Operational Avalanche Forecast Program of the Pacific Storm Prediction Centre in Vancouver

Allan Coldwells

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The presentation focusses on the operational program of Avalanche support provided by the Pacific Storm Prediction Centre in Vancouver. It begins with a brief history of the partnership between Environment Canada and the main client the Canadian Avalanche Centre in Revelstoke. The main product will then be broken down by section for the benefit of the international audience. This will include a map of the various forecast regions that are involved during this seasonal product. As well, the importance of the meteorological fields will be discussed and the operational considerations will be given. Finally some of the challenges will be presented along with ideas for possible changes for future products.

A05-1D6.5 **INVITED/INVITÉ 17:00**

A Data Access Interface (DAI) and Data Integration Facility using Google Earth: Part 1

Patrice Constanza[1], *Lam Khanh hung*[2], *Milka Radojevic*[2], *Nguyen Van-thanh-van*[1], *Charles Lin*[1], *Philippe Gachon*[2], *Philippe Poudret*[2]

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We describe a web-based Data Access Interface (DAI) developed through a partnership among the Global Environmental and Climate Change Centre based at McGill University, the Climate Change Scenarios Network of Environment Canada, and the Ouranos consortium on regional climate change and impacts based in Montreal, Canada. Weather and climate data from different sources (e.g., the North American Regional Reanalysis, different global and regional climate models, weather stations for Canada and northeast US) are available for members. Most of the data are downloaded and stored at a central facility located at Ouranos with tape and robot access capability. Access to the data by members of the partner organizations is through an electronic registration procedure, and an additional data protection step in case of proprietary data. We have also implemented Google Earth as a data integration and visualization facility where environmental data from different sources are geo-referenced and overlaid with the local geography. Support will be offered to members to use this tool. The DAI facility provides an integrated and standardized framework to access weather and climate data for research and teaching.

C02-1B5.7 **12:00**

Climatological perspectives on changes in late Neoglacial perennial snow/ice extent in the Queen Elizabeth Islands, Arctic Canada

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The reduction of perennial snow/ice and the change in the equilibrium-line altitude (ELA) trend surface in the Queen Elizabeth Islands (QEI) following the Little Ice Age (LIA) appear to be linked to complex interactions associated with ocean-atmosphere-ice-land feedbacks in high latitude northern regions. Regional-scale spatial variation in the change in the ELA trend surface in the QEI between the LIA and 1960 corresponds to specific patterns of summer climate variability found in the modern record (1949-2002). Extreme warm (1953-1962) and cold (1965-1974) decades in the modern record were used as analogs of climatic conditions during the early 20th century and the LIA, respectively. The spatial pattern of ELA change (LIA to 1960) is consistent with the first Empirical Orthogonal Function (EOF-1) of mean summer surface air temperature (SAT) in the modern record, the positive (negative) phase of which is strongly in place during the extreme warm (cold) decade. SAT anomalies

in the QEI during the warm (cold) decade are positively correlated with a weak (strong) QEI-distal (QEI-proximal) polar vortex, higher (lower) than normal SSTs in the North Atlantic, and one of the lowest (highest) periods of sea-ice extent during the 20th century. The climatic conditions during the cold decade are believed to describe conditions, which if sustained, would lead to a LIA-type cold episode capable of long-term snowline lowering and perennial snow/ice expansion. The climatic conditions during the warm decade are considered to be suitable modern analogs for those that might have occurred during the early 20th century in the Canadian High Arctic, which led to substantial modification to the terrestrial cryosphere.

I14-3DP.2 **16:00**

Influences of elevated CO2 and N fertilization on soil organic carbon cycling in a pine forest soil

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We assessed soil organic matter (SOM) dynamics via incubations and soil aggregate size and chemical fractions in soils supporting an aggrading pine forest exposed to elevated CO2 and N fertilization (Duke Forest FACTS site, U.S.A.). We exploited the depleted C isotopic signature of the supplemental CO2 to quantify the fraction of SOM resulting from the additional C after 9 years of fumigation. In laboratory incubations, we assessed microbial respiration to characterize the effect of elevated CO2 and N fertilization. There was no significant effect of elevated CO2 on organic C stocks, either in bulk soil or aggregate size or chemical fractions. In elevated CO2 plots, bulk soil organic C accumulated at a mean rate of 352.7 ± 44.8 microgram C/g soil/y during approximately 9 years of fumigation, a rate similar to that calculated from Schlesinger and Lichter (2001) after three years of fumigation. Rates of C incorporation into SOM were greatest in the largest size fraction (154.8 ± 19.3 microgram C/g soil/y) and least in the smallest size fraction (69.6 ± 10.6 microgram C/g soil/y), typically associated with older, recalcitrant SOM. Incubation data indicate that elevated CO2 can increase, and fertilization can decrease, microbial respiration of labile organic matter. As more recalcitrant material was accessed, fertilization of elevated CO2 soils resulted in a 29% decline in respiration, potentially due to an increase in microbial growth efficiency. The carbon isotopic composition of respired CO2 in these incubations indicates that fertilization also results in an increase in microbial respiration of 13C-enriched organic components. These data suggest that lower quality organic material with elevated CO2 can promote greater microbial respiration, while inorganic N availability may mitigate this effect by increasing microbial growth efficiencies.

C05-3B5.6 **12:00**

Using the Foothills Climate Array and meoscale modeling to understand the role of chinooks on local climate

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Located on the lee side of the Canadian Rockies, southwestern Alberta and the city of Calgary experience a local climate that is greatly influenced by Chinooks. The horizontal variability of the Chinooks in this region is not well understood. The Foothills Climate Array (FCA), which consists of a mesonet of over 320 weather stations, was established in 2003 as a long-term observational study

covering an area 200km by 120km in southern Alberta. The high temporal and spatial resolution of the FCA mesonet makes it an excellent tool for examining the local variability of temperature and humidity associated with the Chinooks of Southwestern Alberta. Data from the FCA is being analyzed in conjunction with high-resolution, mesoscale simulations in order to understand the processes that control the observed variability. Understanding the local climate and it's associated processes in this region is an important step towards climate downscaling and regional climate modeling in the topographically complex Canadian Rockies.

O03-2DP.7 **16:00**

Study of High-Resolution Circulation Model in St. John's Harbor, Newfoundland

Ming Guo, *Brad deYoung*

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The MIT General Circulation Model (MITgcm) is used in a high-resolution coastal area, St. John's Harbor, Newfoundland. The model is forced by local observed wind stress and Orlanski radiation condition is applied on open boundaries. The results of a two-month simulation are compared with current data from the harbor entrance - the Narrows. Comparison between the simulation result and the observational data reveals that local wind stress is the dominant force for the two-layer vertical structure of the along channel subtidal flow in the Narrows. The model confirms the observed complex vertical structure of the along channel current at the center of the Narrows during autumntime in 2000, and reveals that Kelvin waves propagating along the outer coastline also play a significant role.

C05-3C5.3 **14:15**

Diagnostic results from regional-scale climate simulations with the GEM model: Part1 - GEM Global

Bernard Dugas[1], *Ayrton Zadra*[1], *Katja Winger*[2], *Paul Vaillancourt*[1]

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Several simulations using Environment Canada's global Environmental Multiscale (GEM) forecast model were run for the 1978-2004 period. Their configurations range from 2.0-degree uniform global, to 0.5-degree in limited areas mode (GEM-LAM) over North-America and Europe, and global stretched grids (SG) over the same domains. January and July time-slices with a global uniform 0.5-degree resolution were also performed for the same period. In these simulations, the choice of physical parametrizations was largely based on that of the mesoglobal model, currently used by the Canadian Meteorological Centre (CMC) for operational forecasts. In this presentation, we focus on the North-American and European results obtained with the global SG and uniform high resolution configurations. Climatological results are presented and evaluated against lower resolution control runs, reanalyses and available observations.

REFERENCES 1) Cote, J. et al. (1998): The operational CMC/MRB global enviromental multiscale (GEM) model: Part I - Design considerations and formulation. Mon. Weather Rev., 126, 1373-1395. 2) Dugas, B. et al. (2005): Current status of GEM Climate simulations at RPN. WGNE Blue Book.

C05-3DP.11 **16:00**

Storm track climatologies from GEMCLIM

Katja Winger[1], *Bernard Dugas*[2], *Ayrton Zadra*[2]

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Several simulations using GEMCLIM, Environment Canada's GEM forecast model in climate mode, were run for the 1978-2004 period. The simulation configurations range from 2.0 degree uniform global to 0.5 degree in limited areas over North-America and Europe and global stretched grids over the same domains. Storm track climatologies for these simulations and for ERA40 are presented and compared.

I15-2B9.2 **10:45**

Effects of nutrient enrichment on autotrophic-heterotrophic coupling within headwater stream biofilms as revealed by 13C-PLFA

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Headwater streams represent the primary location within watersheds for biogeochemical cycling of terrestrially-derived nutrients, with nutrient processing typically driven by epilithic biofilm communities. Headwater streams, however, are also the most impacted by land use activities occurring in watersheds. Nutrient enrichment is currently a major form of environmental change impacting watersheds and the associated downstream coastal ecosystems. Carbon cycling within epilithic biofilm communities of four northwest Arkansas (U.S.A.) headwater streams representing a gradient of nutrient concentration was investigated using mesocosms containing benthic substrate and stream water. 13C-bicarbonate was added to light and dark mesocosms and incubated in situ, followed by removal of biofilm to determine the 13C content of individual phospholipid fatty acids (PLFA). Both the net primary production and chlorophyll:C ratios increased while biofilm C:N ratios decreased with increasing nutrient enrichment along the gradient represented by the four streams studied. Net dissolved organic carbon (DOC) release occurred in light incubations in all streams but with the greatest proportion of the autotrophically-derived DOC (20% versus

I04-3DP.1 **16:00**

Modeling the Beaufort Sea coastal wind regime using MM5 and WRF

Jeremy Krieger[1], *Jing Zhang*[1], *Xingang Fan*[1], *Donald Morton*[2], *Anna Klene*[3], *Martha Shulski*[1]

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The North Slope of Alaska, bounded in the south by the Brooks Range and in the north by the Beaufort Sea, is a complex geographical and topographical environment which offers unique challenges for mesoscale meteorology modeling. The combination of orographic effects caused by wind flow over the Brooks Range along with Arctic sea breeze effects due to the land-sea ice/ocean contrast along the Beaufort Sea coast results in a particularly difficult environment to successfully model. As larger-scale models are generally incapable of sufficiently resolving these localized effects,

and are therefore insufficient for properly simulating the coastal surface wind regime, a study has recently been established to correct this deficiency through the development of a mesoscale model tuned specifically for the Beaufort Sea region, with the goal of producing more accurate long-term simulations of the surface wind than are currently available.

As an initial step in this project, the two preeminent community mesoscale models, MM5 and WRF, were each used to produce two months of simulations for a domain encompassing the Beaufort Sea. As environmental conditions along the northern Alaskan coast are radically different in the summer and winter due to the extreme changes in solar insolation and presence of sea ice, both summer and winter months were selected for the comparison in order to test the ability of the two models to simulate the wind regime in varied conditions. In-situ observational data collected as a part of this study were used to validate model performance, with particular emphasis placed on evaluating the capabilities of the models to simulate the orographic and sea breeze-influenced surface wind regime.

C02-2C5.8 **15:45**

New sedimentological and multibeam bathymetric data on Lake Agassiz final outburst flood

Guillaume St-Onge[1], *Patrick Lajeunesse*[2]

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Hudson Bay and Hudson Strait were the sites of a dynamic and rapid deglaciation that culminated in the catastrophic drainage of proglacial Lake Agassiz into the North Atlantic around 7700 yr BP (8500 cal BP). Evidence for that outburst flood was the identification of a centimeter to decimeter-thick hematite-rich red layer that was previously observed in Hudson Strait sediments around 8000 yr BP. In this paper, we have identified a sequence of two flood-induced turbidites (i.e., hyperpycnites) in a reddish layer from two cores collected in northern Hudson Bay (core AMD0509-27bLEH) and western Hudson Strait (core AMD0509-28PC) in 2005 onboard the icebreaker CCGS Amundsen. These two reddish layers can be correlated to a red bed previously identified as a regional isochron in Hudson Strait and associated with the final drainage of Lake Agassiz around 8500 cal BP. Regardless of the exact timing of the catastrophic drainage, the hyperpycnites described in this paper suggest that they were deposited following two pulses, which is in agreement with one of the scenarios proposed by Clarke et al. (2003) [Science 301, 922-923] for the catastrophic drainage of Lake Agassiz. Finally, new bathymetric data collected by the CCGS Amundsen using its hull mounted multibeam sonar also support a large outburst flood.

O03-3C1.6 **14:45**

Hydrographic Analysis of the Kuroshio Current in the East China Sea Based on a Streamfunction Method

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The P-N hydrographic section in the East China Sea (ECS) has been regularly covered in the past half century. To study the variation of the Kuroshio Current and its interaction with the adjacent waters, we apply a streamfunction projection method called geostrophic empirical mode (GEM) to diagnose the data. The result shows that the salinity of the Kuroshio Intermediate Water (KIW) increases from summer to spring in accord with the seasonal variation of the Kuroshio transport. Further analysis

suggests that the KIW property in this region is dominated by the inflow of low-salinity waters from the east through the Kerama Gap rather than the ECS slope water or other upstream sources.

H06-4C4.1 **13:30**

Melt Season Duration on Eurasian Arctic Ice Caps, 2000-2004

Martin Sharp[1], *Libo Wang*[2]

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Time series of enhanced resolution QuikSCAT scatterometer images were used to map the extent and duration of surface melt over ice caps in Svalbard, Novaya Zemlya, and Severnaya Zemlya during the 2000-2004 period. Based on the sharp reduction in microwave backscatter on the appearance of liquid water in snow, dates of melt onset and freeze-up over most areas of the ice caps were estimated using a dynamic threshold method. Results were compared to the MODIS surface temperature product for periods of clear sky conditions. The inferred time of melt onset corresponded closely with the time when the surface approached the melting point. Melt occurred at all elevations on all of the ice caps in each of the five summers studied. Dates of melt onset ranged from mid- May to mid-June on Svalbard, from late May to mid-June on Novaya Zemlya, and from late May to late June on Severnaya Zemlya. Freeze-up occurs between early September and mid-October on Svalbard, mid-September to early October on Novaya Zemlya, and from late August to late September on Severnaya Zemlya. Melt season duration ranges from 2 months at high elevations to 4 months at low elevations on Svalbard and Novaya Zemlya, and from one month at high elevations to three months at low elevations on Severnaya Zemlya. The longest melt seasons were 2001 (Svalbard and Novaya Zemlya) and 2003 (Severnaya Zemlya), and the shortest were 2000 (Svalbard), 2004 (Severnaya Zemlya, and high elevations on Novaya Zemlya), and 2002 (low elevations on Novaya Zemlya). Melt season duration is well correlated with air temperatures in June and August, but the slope of the relationship varies significantly between the 3 regions.

A06-2B7.6 **11:45**

Cloud effects on the Arctic radiation budget

Seiji Kato[1], *Norman Loeb*[2], *Patrick Minnis*[2], *Fred Rose*[1], *David Rutan*[1], *Thomas Charlock*[2], *Eugene Clothiaux*[3]

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TOA shortwave and longwave irradiances over the Arctic are estimated from CERES radiance measurements. Snow and sea ice angular distribution models used for the shortwave irradiance estimate are a function of cloud and snow/sea ice fractions, cloud optical thickness, and surface brightness. Longwave angular distribution models are a function of the cloud fraction and cloud top and surface temperature difference. In addition, the surface longwave and shortwave irradiances are computed using MODIS-derived cloud properties and temperature and water vapor profiles from reanalysis. Cloud cover over the Arctic is derived from MODIS radiances by the CERES cloud algorithm.

The mean cloud fraction over the Arctic increases from approximately 0.5 in winter to about 0.8 in summer. The daytime cloud cover increased at the rate of 0.047 per decade from March 2000 through

Feb. 2004, while the daytime snow and snow and sea ice fraction decreased at the rate of 0.064 per decade. Because of a large cloud fraction in summer and increasing trend of cloud fraction, the statistical significance of the TOA albedo change in the same period is less than an 80% confidence level. Therefore, ice-albedo feedback is weakened because of presence of clouds and increased cloud cover.

About 50% of radiation emitted by the Arctic is provided by dynamics from midlatitudes. Therefore, understanding cloud effects on meridional energy transport is as equally important as understanding local cloud feedback processes in the Arctic. The atmospheric cloud effect is cooling and dominated by the longwave effect. Because stronger atmospheric cooling effects by clouds in polar regions than in midlatitudes and the atmospheric cooling effect is caused by relatively stationary low-level clouds, clouds increase the meridional temperature gradient in the atmosphere. Therefore, it is postulated that clouds increase the rate of meridional energy transport from midlatitude to polar regions, especially in winter.

A05-2DP.1 **INVITED/INVITÉ 16:00**

An informal poll regarding Environment Canada and data sharing

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An informal poll of sixteen individuals working in the federal and provincial governments, academia and the consulting industry was conducted in order to obtain their perceptions of the weather arm of Environment Canada and how it shares meteorological data. Twelve responses were obtained. Generally favourable impressions and responses came back from people who used existing pre-packaged products. More negative impressions and responses were obtained from people whose needs fell outside this area. It was concluded that the high quality observational and model data sets developed by the Meteorological Service of Canada are significantly underused due primarily to limited access by users outside the department. This indicates that MSC needs to conduct outreach, both to determine user needs, and to make users aware of what is available. A list of recommendations that could improve MSC's data sharing is included.

I11-4D1.7 **17:30**

Effects of Drought on Canadian Prairie Wetland Snowmelt Hydrology

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Severe drought developed on Canadian Prairies during the period of 1999-2002. Wetlands represent an important water resource on Canadian Prairies providing water supply to farms and habitat to wildlife. The physically-based Cold Regions Hydrological Modelling platform (CRHM) was used to analyze the impacts of this recent drought on the water supply over a Canadian prairie wetland. CRHM is based on a modular, object-oriented structure in which component modules represent basin descriptions, observations, or physically-based algorithms for calculating hydrological processes such as wind redistribution of snow, snowmelt, infiltration into unsaturated frozen soils, and snowmelt runoff. To calculate the water balance of a basin, modules are linked into a purpose built model for the basin of interest. The model simulations were conducted for the watershed of wetland 109 at St. Denis NWA, Saskatchewan for the hydrological years during the drought period of 1999-2002 and the non-

drought period of 2005/06. Results show that much lower precipitation, less snow accumulation, shorter snowcover duration, suppressed blowing snow sublimation, enhanced winter evaporation, and ultimately much lower runoff to wetland developed during the drought. Compared to the spring of 2006, there was only 26%, 3%, and 30% of runoff in the springs of 2000, 2001, and 2002, respectively. This is consistent with the observed snow accumulation and water levels. An analysis of the sensitivity of runoff to land cover was conducted. Summer-fallowed fields replaced stubble fields in the contributing area of the model. The results of the land use change show that runoff to the wetland increased by 36%, 6%, and 1% in the springs of 2000, 2001, and 2002, respectively, corresponding to this land cover change. These results show that springtime hydrological sensitivity to drought is strongly controlled by land cover and agricultural practice.

C02-1B5.2 **10:45**

Can we determine the intensity of surface melt on ice caps using active microwave remote sensing?

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In the Arctic, inter-annual variability in the surface mass balance of glaciers and ice caps arises primarily from variations in the intensity of summer melt. Given the paucity of in situ mass balance measurements in this region there is thus considerable interest in using remote sensing to map the intensity of summer melt. Active microwave remote sensing has been widely used to identify melt occurrence and derive estimates of the dates of melt onset and freeze-up and the duration of summer melt across much of the Arctic. Estimation of melt intensity, however, remains elusive. For single grid cells, the time integral of the reduction in microwave backscatter that results from the presence of water in snow and firn during summer may be a good index of melt intensity. However, the amplitude of the seasonal backscatter reduction varies systematically across ice caps as a function of the character of near surface snow and firn facies. This precludes the use of the integrated backscatter reduction to compare melt intensity in different grid cells, and it complicates the interpretation of inter-annual changes in integrated backscatter reduction for cells in which facies characteristics change from year to year. In this paper we explore the potential for using the magnitude of the winter backscatter to classify grid cells on Canadian Arctic ice caps in terms of facies in order to generate groups of similar cells for which the integrated summer backscatter reduction can be compared. Using air temperature records from sites on the Prince of Wales Icefield, Ellesmere Island, we then evaluate the relationship between the summer positive degree day total and the integrated summer backscatter reduction for groups of grid cells with similar facies characteristics. The potential for using this approach to validate melt predictions from regional scale mass balance models will be discussed.

A04-4B6.3 **11:00**

Adaptative processing for weather radar measurements

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Accurate determination of the precipitation intensity is a long-standing objective in radarmeteorology. Usually, radar reflectivity is measured and then transformed into precipitation intensity. The

instantaneous value of the radar received signal is due to the contributions of a large numbers of hydrometeors within the radar resolution volume. The instantaneous values from the same volume in space exhibit large pulse-to-pulse fluctuations and averaging over many samples is required to estimate the mean echo intensity used for the calculation of radar reflectivity. Usually, reflectivity is estimated by averaging signal samples in range and azimuth with the consequence of a decrease in radar data resolution. Sometimes, radar measurements are affected by the attenuation, which should be carefully, evaluated and corrected before rainfall retrieval. The accuracy and precision of the estimate of the reflectivity upon correction for attenuation have been examined by Torlaschi and Zawadzki(2003). They showed that improving the accuracy of a reflectivity by adding the propagation power losses implies a loss of precision of the same order of magnitude. For these reason an adaptative scheme for the processing of weather radar measurements that will remove the bias due to the attenuation at the same time that pulse-to-pulse echo fluctuations, will be presented. Work is underway to determine the mesh of the measurements cells which could be variable in space, will be adapted to the weather conditions, and providing an optimal compromise between spatial resolution and precision of estimate. An algorithm for attenuation removal using propagation differential phase shift as the predictor variable will be used.

A07-3B7.4 **11:15**

Surface measurements of size and composition of particulate matter at Eureka, Nunavut

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Significant levels of synthetic organic pollutants (so-called persistent organic pollutants, or POPs) such as pesticides, PCBs and semi volatile industrial chemicals have been found in the Arctic snowpack and wildlife, providing unequivocal evidence for the long range transport of these materials into the Arctic. Both the origins of these materials and the mechanisms responsible for their transport have been investigated for many years. It is generally accepted that gas phase transport occurs via the “grasshopper” mechanism, which is an annual cycle in which the materials are sequentially volatilized and dispersed in the summer and deposited back to the surface in the winter. The lower average temperatures at high latitudes cause the retention of the materials that are deposited there, with the result that they become more concentrated with time in the high Arctic and bio-accumulate in the ecosystem to levels at which they become a hazard to the health of the species at the top of the food chain. Using the methods of regional chemical transport modelling, we have shown previously that at mid-latitudes a significant fraction of the transport of these semi-volatile organics results from their partitioning to atmospheric particulate matter (PM). In the size range below about 1 µm, intercontinental transport of PM is possible, providing an additional mechanism for the transport of these organics to the Arctic. To determine whether this mechanism is responsible for some of the POPs detected in the Arctic, we have installed an Aerosol Mass Spectrometer to measure size distribution and composition of the PM arriving at the Polar Environmental Atmospheric Research Laboratory (PEARL), at 80N;86W near Eureka, Nunavut. We will report the results of our initial measurements, which were made during 2007. When combined with semi-Lagrangian trajectory modelling, these results will identify the most probable sources of the contaminated PM.

O03-2C1.4 **14:45**

Internal tide generation at the continental shelf

Stephen Griffiths[1], *Roger Grimshaw*[2], *W.R. Peltier*[1]

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Internal tides are generated as the surface tide flows over topography. Their dynamical significance is well-known, including important roles in vertical mixing and the global distribution of tidal friction. However, modelling of their generation remains a challenge, largely because of the detailed nature of the topography typically involved, and the small scales present in internal wave beams.

Here we use a linear model of three-dimensional hydrostatic stratified flow over arbitrary topography, which is ideal for simplified studies of internal tide generation. The model uses a modal decomposition of the vertical structure of the dynamical fields, which is carefully chosen so that the bottom boundary condition and free-surface condition are automatically satisfied. The problem is reduced to solving a coupled set of partial differential equations in two horizontal directions and time, for which a variety of standard techniques are available. There are no restrictions on the stratification, so both interfacial waves and internal wave beams may be simultaneously resolved. Typically only a few modes are needed to capture the bulk of the internal wave flux.

Here we use this technique to study internal tide generation at the continental slope. We consider both the response to long surface waves normally incident on a two-dimensional slope, and simple three-dimensional scenarios with forcing by a coastal Kelvin wave. In both cases we examine the spatial and temporal form of the internal wave drag on the surface tide, which is intimately related to the internal wave energy fluxes radiating from the topography. The dependence of these quantities on the topographic profile and stratification are discussed.

C02-1D5.5 **17:00**

The Tropical Climate Response to Fresh Water Induced Reductions is Atlantic Meridional Overturning Circulation

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A number of previous modelling studies of the impact of freshwater forcing (FWF) applied to high latitude ocean basins have investigated possible triggering mechanisms for the Younger-Dryas cold reversal. Using the NCAR CSM v1.4 (AOGCM), a range of different FWF anomalies have been applied to the North Atlantic that vary in magnitude from 0.1Sv to 1.0Sv, for varying durations of time, usually 100 years in length. Here we present evidence of the atmospheric and oceanic pathways along which the Northern Hemisphere cooling signal propagates from the North Atlantic as the thermohaline circulation either slows substantially, or recovers from a period of reduced activity, and the changes the signal induces in various aspects of the climate system along the way. In particular, we will demonstrate how the response in tropical climate variability to a FWF event manifests itself most prominently in changes that occur in the behaviour of the ENSO phenomenon. The most prominent climate dynamical mechanisms involve the well known repositioning of the atmospheric Hadley Cell and the Intertropical Convergence Zone. These Atlantic meridional overturning signals are teleconnected to the Tropical Pacific within 2 decades suggesting a mixed coupled atmosphere-ocean bridge rather than an atmosphere-only bridge or ocean-only bridge. Various mechanisms that comprise this North Atlantic-Tropical Pacific atmospheric-ocean bridge will be discussed.

C02-1D5.7 **17:30**

Modelling postglacial variations in global tides

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A longstanding challenge in oceanography is the production of accurate global maps of the amplitude and phase of a given tidal component, simply from Laplace's tidal equations supplemented by the corresponding astronomical forcing and global bathymetry. Over the last forty years, such prognostic models have increased in accuracy, partly due to increases in computing power, but also as the role of additional physical processes have been recognised (such as the effects of oceanic self-attraction and Earth loading, and more recently the role of a significant internal tide drag). By comparison with data-constrained hydrodynamic tide models, which take advantage of near-global satellite altimetry, prognostic tide models can now achieve impressive accuracy, particularly in the open ocean.

We have developed a prognostic tide model with complete global coverage. It uses simple finite-difference numerics with variable spatial resolution, having approximately twice the resolution at high latitudes than at the equator. Thus it allows for detailed study of the polar oceans, which are relatively poorly constrained by satellite altimetry. We place special emphasis on implementing a realistic parameterisation of the internal tide drag, which is often tuned in other models to fit observations.

Using this model, we calculate the amplitude and phase of the largest tidal constituents, and consider their form since the Last Glacial Maximum (LGM). Of particular interest is an examination of the significant enhancement of the lunar M2 tidal amplitude in the Labrador Sea at LGM, reported in previous studies, which has possible implications for polar dynamics. To examine this and other changes with more care, an accurate bathymetry is essential; we use the ICE-5G reconstruction, which has key improvements over datasets used in previous studies. Also important, for the internal tide drag parameterisation, is knowledge of the ocean stratification. In contrast to previous studies, this is diagnosed in a consistent way, by using results from coupled atmosphere-ocean climate simulations for LGM and present-day conditions.

C04-4D5.1 **16:00**

A Climatology of the Agassiz Icecap, 1988 - 2006

Claude Labine[1], *Roy Koerner*[2]

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Climate data from the summit of the Agassiz Ice Cap has been continuously collected since 1988. This database is one of the longest climate records obtained by an automatic weather station for a circumpolar icecap. This collaborative research between the Northern Division of the Geological Survey of Canada and Campbell Scientific Canada is part of one of the longest running Industrial Partnership Programs within Natural Resources Canada. Although not lengthy enough to produce a climatic normal (30 years), this record is long enough to allow us to present an initial climatology. The main focus of the presentation will be to show the climate for this site with emphasis on the temperature and snowfall records. A synthesis of the change in climate, although limited by the record length reminds us of local scale within a region. The presentation will also touch on some of the instrumental challenges and solutions, which are part of part of the realities of automatic instrumentation in extreme environments.

H03-2C4.4 **15:00**

Upper Penticton Creek: Influence of Rainfall Event Separation Time on the Analytical Modelling of Canopy Interception Loss from a Mature Lodgepole Pine (Pinus contorta var. latifolia) Stand

Darryl Carlyle-Moses[1], *Graeme Schimpf*[1], *David Spittlehouse*[2]

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During the growing-seasons of 1998 and 1999 incident rainfall, throughfall and stemflow were measured in a mature lodgepole pine (Pinus contorta var. latifolia Dougl.) stand in the central interior of British Columbia as part of the Upper Penticton Creek Watershed Experiment. Respectively, interception loss, throughfall and stemflow accounted for 23.9 %, 75.9 % and 0.2 % of the 444.2 mm of cumulative incident rainfall over the two seasons. Two analytical models, the reformulated Gash model and the Liu model for use in sparse canopy forests, were evaluated for future use in this and similar stands in the region. In addition, the models were run using storm event separation time periods of 2, 6 and 12 hours. The reformulated Gash and Liu models underestimated observed interception loss by 17, 29, and 4 %, and 12, 35 and 13 % using storm event separation times of 2, 6, and 12 hours, respectively. Using derived canopy storage capacity and mean during event evaporation rate data, the average time required for the canopy to dry was determined empirically to be ~ 12 to 15 hours. Good agreement between study period observed and simulated interception loss was found using a time separation period of 15 hours with the reformulated Gash model simulating observed interception loss to within 1 %, while the reformulated Liu model underestimated interception loss by 7 %. Reasons for the differences in how the models performed based on storm event separation times are discussed. Evaluations of the two models in simulating interception loss at the rainfall event time scale and how well the models transfer from one growing-season to the next are also conducted.

H01-2DP.2 **16:00**

Preliminary Investigation of the Hydrologic Importance of Bryophyte Dominated Forest Floors in Three Stands of the Montane Spruce Biogeoclimatic Zone of British Columbia

Katherine Burles, *Darryl Carlyle-Moses*

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In three coniferous stands of the Bonaparte Plateau of British Columbia weekly water balances of the red stem moss (Pleurozium schreberi) dominated carpets were derived for the mid-growing-season (Year Day 162 – 225) of 2006. The bryophyte mat water storage capacities of the three stands were determined using laboratory wetting methods. Taking the proportion of forest floor covered by bryophyte carpet into consideration, the laboratory wetting results suggest that water storage at field capacity was 71.3 ± 18.1 m^3 / ha, 79.8 ± 22.8 m^3 ha, and 44.2 ± 12.8 m^3 / ha, within a mature lodegepole pine (Pinus contorta var. latifolia) – hybrid spruce (Picea glauca x englemannii) – subalpine fir (Abies lasiocapa) stand, a pine – spruce – fir stand with mountain pine beetle infested trees selectively cut, and a juvenile pine stand (approx. 20 years-old), respectively. Weekly throughfall input to the bryophyte carpet was measured using manually read gauges, while change in carpet water content was determined using in situ gravimetric methods. Drainage from the carpet was assumed to occur if the sum of weekly throughfall and the moss water content at the onset of the week exceeded the carpet field capacity, while weekly evaporation was estimated as: evaporation = throughfall – drainage – change in storage. During the two month study period incident rainfall on the canopies of

the three study stands was 61 mm. The interception by and subsequent evaporation from the bryophyte carpets accounted for 53, 55, and 37 % of the combined 37, 35, and 33 mm of canopy + bryophyte carpet interception loss in the mature, selective cut mature, and juvenile stand, respectively. These preliminary results indicate that the hydrologic role of the live bryophyte carpet layer is not inconsequential and should be considered when assessing the hydrologic impacts of the current mountain pine beetle epidemic in western Canada.

H04-3B4.3 **11:15**

Classification of watershed sensitivity to peak flow modification after forest disturbance

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Forest cover is a key modifier of a watershed's peak flow regime. Where forest cover is reduced due to logging or natural disturbances such as fire and insect/disease outbreaks, peak flows are, in most cases, increased. Based on GIS data available for the entire province of British Columbia with its diverse climatic regimes and hydrologic processes, we developed a methodology that classifies the sensitivity of watersheds to peak flow modification based on input characteristics and runoff generation processes. The input model component uses climatic data to derive mean annual snowmelt and maximum rainfall rates for BC for each month at a 400m grid resolution. It calculates the time of occurrence of peak flow and the precipitation regime of a watershed: snowmelt-dominated, rainfall-dominated, and transitional. This allows mapping peak flow generating input for each 3rd order watershed in BC. The runoff generation model component delineates dominant peak flow producing hydrologic processes at the watershed level: channel interception, Hortonian Overland Flow, Saturation Overland Flow and Shallow Subsurface Flow. This delineation is based on a combination of factors such as relief, slope, aspect, drainage density, drainage pattern, and hillslope morphology. The model components are validated against provincial hydro-climatic data sets. Derived maps at 25m resolution are then used to classify the watershed into different peak flow regimes to derive a sensitivity rating for different disturbance scenarios. This rating can be incorporated into a framework to assess risks to infrastructure, drinking water, and fish habitat.

G08-2B2.6 **11:45**

On the potential of least-squares self-coherency spectrum to recover low-frequency seismic normal modes: Detection and Splitting

Mahmoud Abd El-Gelil[1], *Spiros Pagiatakis*[1], *Ahmed El-Rabbany*[2]

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Seismic data analysis has been providing very useful information on the Earth's internal structure, particularly when combined with magnetic and gravity data. Superconducting gravimeters (SG) contribute additional knowledge on the Earth's interior through careful spectral analyses of gravity records particularly after a strong earthquake. Recent research shows that the best SGs are less noisy than seismometers for frequencies less than 1.5 mHz. The latest strong earthquakes in Peru (June 2001) and Sumatra (December 2004) with moment magnitudes Mw = 8.4 and 9.3, respectively, were sources of good quality SG data for the investigation of the gravest seismic normal modes. Detecting and measuring these mode frequencies and their damping factor can provide additional constraint to the Earth models. In addition, precise estimation of their singlets improves the Earth density profile.

In this contribution, we use SG data recorded after the Sumatra earthquake at eight Global Geodynamics Project (GGP) stations to investigate the long-period seismic modes. First, the solid Earth tide is subtracted from the data, followed by an atmospheric pressure correction based on a frequency-, and location-dependent admittance estimated by the Least-Squares response method. Subsequently, after "cleaning" all SG data records, the least-squares spectrum is used to search for seismic normal modes in the frequency band 0.278-1.500 mHz. The analysis of the data is performed in two stages: The first stage involves the analysis of each individual station record using the least-squares self-coherency analysis approach (Pagiatakis et al., 2007). In the second stage, we construct the product spectrum of all stations from the self-coherency spectra of the individual stations with the aim to identify the singlets associated with the rotational/ellipsoidal splitting of each mode. The results show clearly the excitation of the 0S2, 0S3, 0S4, 0S5 and 0S0 modes both in the self-coherency spectra (single station data) and in the product self-coherency spectrum representing all stations. The singlets of 2S1, which are very difficult to detect, are also visible in the product self-coherency spectrum.

Pagiatakis, S.D., Yin, H. and Abd El-Gelil, M. (2007). Least-squares self-coherency analysis of superconducting gravimeter records in search for the Slichter triplet. Physics of the Earth and Planetary Interiors Vol. 160, Issue 2 , Pages 108-123.

I02-4C8.2 **INVITED/INVITÉ 14:00**

Origin and Fate of Particulate Organic Carbon in the Beaufort Sea shelf – Amundsen Gulf area, Canadian Arctic.

Cédric Magen[1], *Gwénaëlle Chaillou*[1], *Sean A. Crowe*[1], *Alfonso Mucci*[1], *Bjørn Sundby*[2], *Ryosuke Makabe*[3], *Hiroshi Sasaki*[3]

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We examined the distribution and composition of organic matter in sediment cores from the Chukchi and Beaufort Seas and the Amundsen Gulf to establish the origin of the organic carbon. We determined the bulk C:N ratio and the stable isotopic composition (d13C and d15N) of organic carbon and nitrogen of bottom sediment and sediment trap material. The oxygen penetration depth was also determined and used as an indicator of sediment reactivity. Organic carbon concentrations in surface sediments were similar on the Beaufort Sea shelf and slope and in the Amundsen Gulf. The C:N ratios did not vary significantly, except at one deep station in the Chukchi Sea. Oxygen penetrated deeper into the Amundsen Gulf sediments than elsewhere, indicating that organic matter is oxidized at or near the sediment surface, leaving little reactive organic carbon to be buried. The d13C values of sediment trap material were more negative than in underlying sediment, indicating preferential loss of light carbon during degradation of organic matter and the accumulation of heavier carbon in the sediment. The sediments from the Beaufort Shelf, the Amundsen Gulf and the Chukchi Sea revealed a linear relationship between d13C and d15N. The lightest isotopic signature found in the shelf sediments is unlikely to be caused by bacterial oxidation of settling particulate matter, indicating a large terrestrial carbon component. The sharp difference between the organic carbon isotopic composition between the Mackenzie Shelf (d13C -25.9; d15N 3.5) and the Amundsen Gulf (d13C -23.4; d15N 7.5) indicates a terrigenous origin for the organic matter on the Beaufort Shelf and a marine origin in the Amundsen Gulf, suggesting that the organic carbon carried by the Mackenzie River does not reach the Amundsen Gulf.

O02-1C1.1 **13:30**

VENUS: A Cabled Ocean Observatory in Saanich Inlet and the Strait of Georgia

Richard Dewey, *Verena Tunnicliffe*, *Adrian Round*

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The Victoria Experimental Network Under the Sea (VENUS) is a cabled ocean observatory, with arrays in Saanich Inlet and the Strait of Georgia. The first leg was deployed in February 2006 with an observatory node at 100m depth in Saanich Inlet. The second, deeper (nodes at 300 and 175m) array will be deployed in the Strait of Georgia during the summer of 2007. The cabled observatory allows for unprecedented power and bandwidth to and from instruments connected to the observatory "nodes" with wet mateable plugs. Data is retrieved and available over the web in near real-time. Preliminary instruments include standard oceanographic devices such as CTDs and ADCPs, as well as inverted echo-sounders, broadband hydrophones, and user controllable pan and tilt digital cameras. Advanced systems under development include vertical profilers and a dedicated delta dynamics laboratory. The data archive and instrument access are provided through the VENUS web site (http://www.venus.uvic.ca/), where galleries can be searched and data products requested. An overview of the observatory infrastructure, the data archive, and how users can access the facility will be presented.

O02-1C1.2 **13:45**

A Year of Observations form VENUS in Saanich Inlet

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The Victoria Experimental Network Under the Sea (VENUS) is a cabled ocean observatory, with the first array in Saanich Inlet deployed in February 2006. Connected to an observatory node at 100m depth are a suite of oceanographic instruments including CTDs, inverted echo-sounders, an ADCP, broadband hydrophones, and a user controllable pan and tilt digital camera. The data archive and instrument access are provided through the VENUS web site (http://www.venus.uvic.ca/), where galleries can be searched and data products requested. Data started flowing in February 2006, and continues in real-time today. Seasonal variations in temperature, salinity, dissolved oxygen, and zooplankton abundance, among other parameters, are clearly evident in the time series to date. Prominent are the variations in vertical zooplankton migration patterns from summer to winter and the fall transition to hypoxia near the bottom. An overview of the instrument systems and the sensor signals will be presented.

I02-3DP.1 **INVITED/INVITÉ** **16:00**

Iron and Manganese as Tracers of Different Sedimentation Regimes in the Beaufort Sea Region

Cédric Magen[1], *Gwénaëlle Chaillou*[1], *Carole Gilbert*[1], *Sean A. Crowe*[1], *Alfonso Mucci*[1], *Bjørn Sundby*[2]

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The distribution of Fe and Mn in sediments provides information about the balance between the supply of organic matter and the oxidant demand it generates. This balance is a characteristic property

of each sedimentary environment. We analyzed sediment cores from the Mackenzie shelf and slope and the Amundsen Gulf for HCl-extractable and dissolved Mn and Fe. The Mackenzie Shelf cores contained low levels of solid Mn phases (

O03-2C1.6 **15:15**

Direct Measurements of Bioturbulence in the Wake of Vertical Zooplankton Migrations

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Ocean turbulence can be generated by many dynamic processes; from surface waves and wind stress, by shear instabilities, through internal wave breaking, and within bottom boundary layer. What role swimming nekon play in the global mixing budget has been of great speculation. Saanich Inlet, a protected fjord on southern Vancouver Island is dynamically quiescent, but supports a vibrant biological ecosystem with high surface productivity, dense migrating zooplankton populations, and healthy herring and juvenile Pollock stocks. Spring and summer phytoplankton blooms are accompanied by dense layers of diurnally migrating euphausiids. In April 2005, a free-falling vertical microstructure profiler (VMP) was repeatedly deployed during both the dusk and dawn migration periods. Using a 200 kHz echo-sounder to track the euphausiids, a strong correlation was established between elevated turbulence dissipation rates and the wake of the zooplankton. Mixing rates over 100 times the back-ground levels were recorded. Although still relatively low in comparison to the most vigorous turbulence found within many oceanic boundary layers, this ubiquitous mixing phenomena could contribute significantly over large spatial areas, twice each day. Measurements and future sampling plans will be discussed.

H01-1C4.4 **14:15**

A Bayesian method to homogenise short time-scale precipitation data series using a reference station

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A great number of techniques have been developed to detect artificial disturbances in an hydroclimatic data series using a reference station. Most of these techniques rely on linear regression to model the dependence between the target series and the reference series, thus implicitly assuming a normal distribution for both series. Hence, these techniques cannot safely be used on daily, monthly or even seasonal precipitation data series. Transposition of shifts detected at a yearly scale to shorter scales is difficult do justify as the magnitude of the disturbance may not be the same throughout the year. The presentation will deal with a Bayesian changepoint approach derived of product-partition theory which is developed to deal with short-scale precipitation data. It describes the dates of occurrence of precipitation as a Poisson process, and assumes that the magnitudes of the events are exponentially distributed. The observation series are searched for sudden changes in the parameters, and then the probability distributions of the changepoints at the reference station are used to infer the non-stationary climate signal. The resulting non stationary intensity parameter is the used as an explanatory variable in a similar model of the target to detect any variation that is not consistent with that of the reference station. The main analytical developments as well as applications on both simulated and real data series will be presented. The advantages of the new model over classical

approaches will be highlighted. Key words: product-partition models, changepoints, Poisson Process, Bayesian Statistics

S02-2B3.2 **10:45**

A Multi-Sensor Synergistic Approach To Improving Fractional Snow Cover Mapping In Forested Areas

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Current satellite-derived snow covered area products do not adequately characterize vegetation effects on snow cover retrievals. Although the MODIS binary snow product incorporates a correction for vegetation canopy over snow it remains limited for hydrologic purposes because it assigns values of either 0% or 100% snow cover to pixels. An alternative product, the MODIS Snow Covered Area and Grainsize (MODSCAG) product, provides the fraction of snow cover in a pixel thereby providing the higher precision needed for hydrologic applications. However, daily retrievals from MODSCAG produce only the projected area of snow cover and do not incorporate any vegetation correction making it less accurate in areas with forest canopy especially when viewing at off-nadir. In this work, we present a vegetation correction that uses satellite-based retrievals of vegetation gap fraction information from the Multi-angle Imaging SpectroRadiometer (MISR). The viewable fraction of the ground (FGROUND) is computed as 1-BHRPAR-FPAR where FPAR is the fraction of photosynthetically active radiation and BHRPAR is the PAR-integrated bihemispherical reflectance integrated. Both BHRPAR and FPAR are MISR standard products. This study focuses on the region covered in the Cold Land Processes Experiment (CLPX). We assume that changes in measured snow fraction that are detected with MODSCAG are a function of the true snow cover fraction reduced by 1-FGROUND. For validation of the retrievals, we use data collected from the two winters of CLPX field campaigns. These data include measurements of snow covered area and canopy properties such as density, height, viewable gap fraction and forest cover type.

I07-3DP.2 **16:00**

Object – oriented classification of polarimetric E-SAR data

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Classification of land use/cover using full polarimetric SAR data is one of the most important applications of radar polarimetry. Full polarimetric SAR data can shed light on the scattering behavior of land use/cover, thus providing better land use/cover classification compared to single – channel SAR. Different methods have been proposed to analyze polarimetric SAR data such as the a) Pauli method, b) Cloude – Pottier method which produces entropy, a-angle and anisotropy images, c) the Freeman – Durdan method which produces the double bounce, surface and volume images, d) analysis to sphere, diplane and helix, e) analysis based on the Huynen parameters, and f) decomposition based on different combinations of entropy and anisotropy.

In this study, an investigation of various polarimetric analysis methods is performed. Then, a knowledge based classification method for the classification of the various land use/cover is

developed. This method relies on the integration of the information provided by all analysis decomposition methods of the polarimetric SAR data. Thus, the classification method is proven to be very efficient in discriminating land use categories and subcategories with high accuracy. Information provided by the Cloude – Pottier analysis and the images produced by different combinations of entropy and anisotropy is crucial for the determination of the number of the scattering mechanisms which are involved in the in the classification rules. Features provided by Freeman, Pauli, and other analysis methods, efficiently attribute the scattering mechanisms and contribute significantly to the classification performance. Among these methods, the Freeman analysis is found to be very efficient, particularly for the discrimination of objects which mainly present a volume backscattering mechanism. The use of additional features, such as length/width, area, neighborhood, also improve the classification. The knowledge based method proposed here is superior compared to other classification methods in terms of accuracy and potential number of categories discriminated.

I07-3DP.1 **16:00**

Combining TOPEX and ICESat altimetry for the determination of the Great Lakes surface

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The Sea Surface Height is a crucial element in determining the Sea Surface Topography (SST), which is a small quantity of about 1 meter, and represents the difference between the Mean Sea Level (MSL) and the geopotential surface (geoid), SST=MSL-geoid. For many geodetic and geosciences applications it is necessary to define a highly accurate, globally consistent, active, and integrated reference height system. A unique global height system definition must be related to a common (global) geopotential surface, which is the geoid. Thus, knowing the SST, especially along the coastal areas, will help to unify height systems with inconsistent zero points.

Radar satellite altimetry missions (e.g. TOPEX) are considered one of the most effective and accurate techniques to measure the global Sea Surface Height (SSH) with respect to a reference ellipsoid. However, the measurements accuracy of these missions is degraded in coastal and shallow areas due to inherent limitations, namely, 1) the large footprint diameter (2-20 km), and 2) the large spacing between along track and cross-track measurements. In order to improve the accuracy of determining SST in coastal areas, high space/time resolution measurements are needed.

The Ice, Cloud and land Elevation Satellite mission (ICESat), a laser altimetry mission with a data rate of 40 Hz and a footprint diameter of 65 m is a good candidate for performing altimetry near the coast and for providing high resolution data sets over water when it is validated with another mission like TOPEX. The ICESat full-rate 40-Hz ocean data are inherently noisier than the 1-Hz TOPEX data due to the laser mission’s undersampling of ocean waves, wind effects, and swell. Therefore certain procedures to homogenize and unify heterogeneous multi-satellite missions are required.

The objective of this work is to compare ICESat and Topex measurements over the Great Lakes area in order to examine the potential of combining ICESat and Topex altimetry over water to improve the accuracy of SST determination. The Great Lakes were initially chosen as tides, waves and swell are greatly diminished.

G03-4B2.2 **10:45**

Digital elevations from SRTM and ICESat: Effects of terrain slope and dynamic terrain

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The Ice, Cloud, and land Elevation Satellite (ICESat) provides an almost globally – distributed data set of elevations well suited for evaluating the vertical accuracy of the Shuttle Radar Topography Mission (SRTM) digital elevation models (DEMs). The SRTM, using a C-band (5.6 cm wavelength) Interferometric Synthetic Aperture Radar (InSAR), has produced the most accurate near – global DEM covering land areas between 56oS and 60oN. ICESat radar altimetry provides a footprint size of approximately 65 meters on the Earth's surface, which is comparable to the horizontal resolution of the SRTM 90-meter DEM.

This study analyses the effect of the terrain slope and slope direction on the derived elevation differences between ICESat and SRTM data. ICESat is a vertical-looking laser altimeter while SRTM is a side – looking radar: both measure terrain elevations. This study also investigates the spatio – temporal changes in the elevations of a dynamic surface area using ICESat data acquired between 2003 and 2006. Thus, the objectives of this study are: 1) the investigation of the relationship between the elevation errors and the slope and slope direction in a high relief area; and, 2) the interpretation of the elevation changes over a desert area.

In order to conduct a consistent comparison among the two height data sets, it is imperative that all the heights refer to the same vertical datum. For the purpose of this study, the data comparisons are performed in terms of ellipsoidal heights with respect to a TOPEX ellipsoid. The area of interest is the Kingdom of Saudi Arabia, where the western part exhibits mountain chains with high relief (static area) and the southeastern part comprises a desert with moving sand dunes (dynamic area).

H02-2DP.2 **16:00**

Isotopic and geochemical tracing of groundwater and surface water discharge from an abandoned tailings impoundment

Michael Moncur[1], *Carol Ptacek*[2], *Jean Birks*[3], *Dave Blowes*[2], *Masaki Hayashi*[4]

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Release of acid drainage from mine-waste disposal areas is a problem of international scale. Drainage from sulfide-rich waste can result in contaminated surface waters, directly through surface runoff and indirectly, from discharge of contaminated groundwater flow. Camp Lake, located in Northern Manitoba, receives both direct and indirect drainage from an abandoned tailings impoundment, which has severely affected the quality of the downstream watershed. Nearly a century of sulfide oxidation at this mine site has resulted in extremely high concentrations of oxidation products in the surface water and groundwater discharging from the two tailings impoundments, both of which flow into an adjacent semi-isolated shallow bay in Camp Lake. The incorporation of these aqueous effluents has altered the composition of the lake water, which in turn has modified the physical limnology of the lake. The various sources of water and solutes to the lake (surface inflows, perched water table, primary water table) contribute varying concentrations of metals to the overall contaminant loadings to the lake, and can be characterized by distinct 3H, δ18O, and δ2H compositions. Geochemical profiles of the water column indicate that, despite its shallow depth (6 m), the bay is stratified throughout the year. The greatest accumulation of dissolved metals and SO4 is in the lower portion of the water column, with concentrations up to 8500 mg/L Fe, 20,000 mg/L SO4, 30 mg/L Zn, and 100 mg/L Al, including elevated concentrations of Cu, Cd, Pb, and Ni. This stratification is mirrored in the

δ18O, δ2H and d-excess profiles within the lake water column, with an evaporatively enriched surface layer overlying the isotopically lighter, higher d-excess hypolimnion.

C05-3DP.7 **16:00**

Reproducible Signal and Internal Variability Noise in an Ensemble of RCM Simulations

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A twenty-member ensemble of the Canadian Regional Climate Model (CRCM) simulations with perturbed initial conditions is conducted for one summer season over a large mid-latitude domain with lateral boundary conditions derived from NCEP reanalyses. The time-dependent ensemble mean is regarded as a reproducible signal associated to lateral boundary and surface forcing. The departures from the ensemble mean are used to sample the stochastic part of the model solution. Geographical distribution and spectral behavior of the ratio of variances of these two components are analyzed in order to determine the nature of downscaled spatiotemporal variability. When instantaneous atmospheric states are considered, results show that large scales exhibit very little variability of stochastic nature. At scales between 1000 and 200 km the nature of downscaled information depends strongly on the variable and weather pattern. The fine-scale features are downscaled mainly in stochastic form, except for surface variables. In addition, oceanic and continental regions are associated with distinct vertical profiles of the relative magnitude of the stochastic component. When seasonal averages instead of instantaneous fields are analyzed, results show little spatial variability of stochastic nature, with exception of precipitation that retains non-negligible stochastic component at small scales. Results suggest the need of an ensemble of simulations when seasonal averages of precipitation are to be downscaled.

I04-4B1.1 **INVITED/INVITÉ 10:30**

A Finite Element Coastal Ocean Model: Investigation of Semi-Lagrangian Methods.

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Coastal ocean hydrodynamic models are subject to a number of stability constraints. The most mportant of these are the Courant-Friedrichs-Levy (CFL) constraint on gravity waves, a Courant number (Cr) constraint on advection, and a time-step constraint on the vertical component of horizontal viscous stresses. The model presented here removes these constraints using a semi-implicit approximation in time and a semi-Lagrangian approximation for advection. The accuracy and efficiency of semi-Lagrangian methods depends critically on the methods used to calculate trajectories and interpolate at the foot of the trajectory. Here three methods to calculate trajectories on unstructured grids (Runge-Kutta, analytical integration, and a new power-series expansion method) are compared. In addition, a new high-order quadratic interpolation method is presented, and compared to other linear methods (local linear, global linear) all on unstructured grids. In the end, the power series method for trajectory calculation and the quadratic method for interpolation give the most efficient and accurate results. These methods are tested in two limits: small timestep limit for tsunami propagation and inundation, and long timestep limit for coastal forecasting.

H01-1D4.2 **16:15**

Modelling contributing areas in prairie river basins

Dean Shaw[1], *Al Pietroniro*[2], *Lawrence Martz*[1]

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This study provides a methodology for determining the influence of topographic depressions on contributing area and on the hydrologic response of river basins. Topographic depressions (potholes) influence the timing and magnitude of runoff events in the basin through impoundment of spring melt and storm runoff and subsequently reduce the overall basin contributing area. Currently, water resources practitioners do not have a repeatable, scale-independent method of determining the contributing area of the basin. An examination of the methods employed by P.F.R.A and the United States Geological Survey reveal them to be highly subjective, fixed in scale, and derived based on an arbitrary definition of runoff exceedance. In the case of the PFRA, it is estimated from a median flow.

Extensive literature surveys indicate that there are currently no hydrological models that incorporate the dynamic nature of topographic depressions into a deterministic framework. It is expected that incorporating non-contributing areas into runoff calculations will improve the ability of hydrological models to simulate surface and sub-surface runoff in regions where potholes are a dominant landscape feature, such as the Canadian Prairies.

In most recent hydrological models, standard topographic analysis tools are often used (e.g. TOPAZ – Martz 1992, Shaw et al, 2005) to determine flow pathways and directions for runoff estimates. However using such established tools to try and simulate the dynamics in these regions has proven unreliable. As an example, simulation of a prairie pothole landscape at the St. Denis Wildlife Area using a LIDAR based digital elevation model with current topographic analysis tools has proved to be highly unsatisfactory. This work proposes a new algorithm that uses a pothill-filling algorithm based on the local contributing area estimated on a cell-by-cell basis. Potholes are filled to a pre-determined sill elevation where they can then drain to an adjacent pothole. An iterative solution to re-distribute water through the landscape is required in order to obtain a proper water balance. Surface runoff in this scheme can be calculated using a sophisticated land-surface scheme to a simple runoff ratio. The results in the St. Denis region show promising results.

A01-1B6.1 **10:30**

The new German Heat-Health Warning System

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The 2003 heat wave in Western Europe with a death toll of over 35,000 people 7,000 of which occurred in Germany has clearly pointed out the danger that can arise from a long-lasting heat load. As a consequence of it, Germany has started to build up a Heat-Health Warning System. The heat load is determined by using the 'perceived temperature' in connection with an adaptation effect. This means that the human adaptability to continuously changing weather conditions and thus the variability of the regional climate is taken into account. The 'perceived temperature' is determined through a simple heat budget model of the human organism which includes the main thermophysiologically relevant mechanisms of the heat exchange with the atmosphere. The most important meteorological parameters included in the model are air temperature, humidity, wind speed and radiation fluxes in the short-wave and long-wave ranges. The human body reacts differently to its thermal environment due to

physiological adaptation (short-term acclimatisation) which augments the efficiency of the thermal regulation system and thus reduces the thermal load effectively acting on an individual. In addition to this, the short-term behaviour-based adaptation through changing clothes reduces the thermal stress acting on the individual. A basic restriction of the Heat-Health Warning System in its current form is that it provides only statements on the conditions prevailing outside. The indoor situation which most of the times varies largely from the conditions outside is not yet taken into account. Further development activities are undertaken to expand the Heat-Health Warning System used at the DWD by adding a thermal simulation model for buildings. The aim is to provide estimates of the 'perceived temperature' in various rooms inside in relation with the predicted open-air weather conditions and to complement the heat warnings by relevant supplementary statements relating to the indoor climate.

O03-2DP.2 **16:00**

The Hydrography of Clode Sound, Newfoundland

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Clode Sound is a small glacially carved fjord on the east coast of Newfoundland. The inlet has a coincident sill and contraction and a single source of fresh water located at the head of the inlet. We compare observations of temperature and salinity taken from the inlet in the summers of 1996 and 1997 to those observed at Station 27 on the Newfoundland shelf. During the summer, the inflow of fresh water and input of solar radiation leads to the formation of a well mixed surface layer within the inlet. When considered as a two-layered system, tidal forcing during spring tides may lead to supercritical flow across the sill. During neap tides, exchange flow across the sill may occur. The exhange flow may occur as either classical estuarine circulation or reverse estuarine circulation. The occurrence of reverse estuarine circulation during neap tides is weakly correlated with the occurrence of steady easterly winds. We also present the observed baroclinic tides across the sill and discuss efforts to model these tides using a modified form of the Princeton Ocean Model.

I04-4B1.5 **11:45**

Parameterization of wind farms: A step towards understanding their impact on local climate

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Wind power is the fastest growing non-fossil source of primary energy. As concern over CO2 emissions pushes society towards cleaner energy sources, the demand for wind power will continue to increase. As the number and size of wind farms grows, their influence on the local and regional climate must be considered. Large wind farms directly influence the atmospheric boundary layer by (1.) reducing wind speeds, (2.) generating blade scale turbulence in the wake of the turbines, and (3.) generating shear driven turbulence due to the turbine wake. Consequentially, large wind turbines can also have indirect effects on the local climate by influencing surface fluxes, advection of heat and moisture, and turbulent transport in the boundary layer. The Weather Research and Forecasting Model (WRF) has been modified to include a new energy conserving wind farm parameterization. The new parameterization exerts an elevated drag force on the wind, converts a fraction of the resolved flow into turbulent kinetic energy, and keeps track of the energy generated by the parameterized wind

turbines. Keeping track of the energy generated by the turbines allows for examination of the intended climate benefit of wind energy (reduction of CO2 emissions) to the unintended climate impacts (changes in the atmospheric boundary layer). This paper will present results from simulations using the new wind farm parameterization and discuss the local and regional climate changes associated with large wind farms.

O03-2C1.8 **15:45**

The Influence of Wind Stress on the East Australian Current

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The East Australian Current (EAC) is a southward flowing western boundary current that flows along the east coast of Australia. Typically, the main branch of the EAC separates from the continental shelf between 30° S and 31.5° S then propagates eastward to form the Tasman Front. It has been shown that as the EAC flows southwards along the coast and separates it uplifts nutrient rich slope water onto the shelf. The uplift of the isopycnals onto the shelf produces a source of nutrient rich water that resides just below the euphotic zone and is readily available for upwelling in the presence of northerly (upwelling favourable) winds. During upwelling events, the rate of slope water flowing onto the shelf increases. The additional slope water flows southwards along the continental shelf extending far south beyond the point of EAC separation. Lagrangian particle tracking within the bottom layers of the model indicate that uplifted water may originate from as deep as 500 m. Our modeling studies also indicate that even in the presence of southerly (downwelling favourable) winds the EAC driven uplift is strong enough to continually maintain a source of nutrient rich slope water on the shelf.

S04-4C3.1 **13:30**

The effect of summer snowfall events on the energy and mass balance of an Alpine glacier

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Increased surface albedo resulting from summer snowfall events heavily impacts the energy and mass balances of Alpine glaciers. Global climate models (GCMs) currently predict an increase in air temperatures that will cause an increase in the proportion of summer precipitation falling as rain at high elevations. It is uncertain, however, whether increased temperatures or decreased summer snowcover will have the greater impact on glacier mass balance. To investigate, meteorological and energy flux measurements were made at Glacier de Tsanfleuron, Switzerland, in August of 2005 and 2006. There were several days with precipitation in each month, but this mostly fell as rain in 2005 and as snow in 2006, due to lower temperatures.

Mass balance calculations were made using ice ablation, snow depth and snow water equivalent observations. Energy balance calculations from fluxes between the atmosphere and surface ice or snow used 1) direct observations of total net radiation, and 2) estimations of turbulent (sensible and latent heat) fluxes using the bulk aerodynamic method from air temperature, wind speed and humidity observations. Bulk transfer coefficients were tuned using direct measurements of latent and sensible heat fluxes by the eddy covariance method over ice, dry snow and melting snow surfaces. The melt-retarding effect of high glacier surface albedos resulting from summer snowfall are quantified and

presented. The MOSES land surface scheme, which is used in the HadCM3 GCM and which incorporates full surface energy and mass balance calculations, is used to estimate the effect of warmer air temperatures on summer precipitation and ice melt rates. The relative impacts on the supraglacial energy and mass balances of 1) a reduction in the duration of high albedo snowcover, and 2) an increase in thermally induced melt rates as a consequence of future warmer air temperatures are discussed.

S02-2B3.7 **12:15**

Validation of hemispheric scale SWE distributions with SSM/I

Debbie Putt, Robert Gurney, Keith Haines

ESSC
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This paper assesses the retrieval of snow water equivalent (SWE) from the Special Sensor Microwave/Imager, through comparisons with ground observations of SWE and runoff, model output and empirical orthogonal functions (EOFs). A static difference algorithm is used, with a correction for forest cover. Most validation studies of SSM/I retrieved SWE concentrate on the catchment scale, where the large pixel size and sensitivity of the retrieval to land cover type can be important. This study attempts to validate the retrieval on the hemispheric scale where these local effects are minimised. A ten year average of Northern Hemisphere monthly means is presented and compared to a ten year HadCM3 model run. There are significant differences between the two, particularly over Siberia where the satellite data shows high values (~150mm) and the model shows low values (~50mm). Runoff data from Siberian rivers is shown to support higher values than in the model, though the observations may be subject to some overestimation due to depth hoar. The EOF method is used to establish patterns in northern hemisphere SWE. Results are shown for the Northern Hemisphere, North American continent and Eurasian continent. They show that the seasonal cycle is the highly dominant pattern, with some significant low frequency variability captured in some higher EOFs (see poster presentation). The patterns of SWE from SSM/I appear robust at the hemispheric scale. This dataset is a better basis for hemispheric-scale estimates of snow distribution than GCMs, or sparse in situ data.

S02-2DP.5 **16:00**

EOFs of SSM/I-retrieved snow water equivalent

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Empirical orthogonal functions (EOFs) are a means of identifying patterns in data, and quantifying the amount of variance that each explains. EOFs of SSM/I-retrieved snow water equivalent (SWE) are taken, firstly to establish the quality of the data themselves and secondly to determine the presence of any interannual patterns. Three regions are considered: the entire Northern Hemisphere, the North American continent and the Eurasian continent. Eurasia, with its much larger land mass and high values of SWE, is shown to dominate the Northern Hemisphere patterns. In all cases the first EOF explains over 80% of the variance in the dataset, with the next EOF explaining less than 5%. The second EOF shows certain topographic features more distinctly than the original data, such as the Rockies. Having removed the seasonal cycle, EOFs were taken of this anomaly dataset. Here the EOFs in all three regions were more distinctly separated. Over Eurasia, the first EOF is most important in the central region. In North America the first EOF is conentrated over central Canada. In

many of the years the time series for anomaly EOF1 has opposite sign for Eurasia and North America, suggesting that anomalies are anticorrelated in these regions.

A07-2C7.2 **14:15**

Pallas-Sodankylä atmospheric observatory in northern Finland during the IPY-2007/2008

Jussi Paatero, *Juha Hatakka*, *Tuomas Laurila*, *Heikki Lihavainen*, *Hannele Hakola*, *Esko Kyrö*, *Jouni Pulliainen*, *Yrjö Viisanen*

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The first meteorological observations in Sodankylä, northern Finland were made during the First International Polar Year in 1882-1883. Regular aerological observations at the Arctic Research Centre of the Finnish Meteorological Institute (FMI-ARC) have been conducted already over 60 years constituting one of the longest upper atmosphere meteorological observation series north of the Arctic circle. Since 1994 the FMI's Pallas-Sodankylä site has been one of the 22 global stations of the World Meteorological Organization's Global Atmosphere Watch (GAW) programme.

Upper-air weather, ozone, aerosol and radioactivity soundings are made at Sodankylä as well as several ground-based and ground-level measurements: broad band albedo of forested and open terrain, surface spectral reflectance, spectral UV radiation, airborne radioactivity, surface weather parameters, total ozone column, deposition of acidifying compounds, and aerosol optical depth. Carbon dioxide flux between a pine forest and the atmosphere is also measured. The FMI's northernmost weather radar is situated on the top of Luosto fell 25 km south of FMI-ARC. The range of the radar covers most of the northern Finland.

Most of the tropospheric air composition and related meteorological measurements are made at Pallas. The measurements include reactive gases, greenhouse gas concentrations, aerosol particle number concentration and size distribution, PM10, aerosol scattering coefficient, black carbon, volatile organic compounds, inorganic compounds in the air and precipitation, and stable isotopes. We measure carbon dioxide flux between a spruce forest and the atmosphere and methane and carbon dioxide fluxes between a northern mire and the atmosphere.

The scientific activities at Pallas-Sodankylä atmospheric observatory are connected to several IPY projects, e.g. IASOA, POLARCAT and POLAR-AOD.

C05-3DP.9 **16:00**

Sensitivity of the Statistical DownScaling Model (SDSM) to the Selection of Reanalysis Products: Impacts on hydrological modelling

Eleni Koukidis, *Aaron Berg*

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Despite important advances in regional scale climate models for downscaling GCM output to the local scale, statistical procedures such the Statistical Downscaling Model (SDSM) are still used widely as they are readily adaptable to assess numerous GCMs and scenarios. To produce accurate daily predictions of future climate variables at the local to regional scale, the SDSM statistically identifies relationships between large-scale predictors (i.e. GCM) and local-scale predictands, using a multiple linear regression model. Reanalysis data are important components for the structuring of the SDSM, as they supply the predictor values for the calibration and validation of the model. Two prominent reanalyses commonly in use are the National Center for Environmental Prediction / National Center for Atmospheric Research (NCEP/NCAR) 50 year reanalysis (NRA50) and European Centre for Medium-range Weather Forecasts (ECMWF) 40 year reanalysis (ERA40). It is well known that the reanalysis products contain differences and biases which may impact the development of downscaling scenarios when used with the SDSM. In this study, separate downscaled precipitation and temperature scenarios were generated from several GCMs, using the SDSM with the calibrations and validations derived from both the NRA50 and ERA40 over the Brantford climate station in Southern Ontario. The separate downscaled scenarios were then used as the climatic inputs into the Soil and Water Assessment Tool (SWAT) hydrologic model to identify the sensitivity of a hydrological model to the downscaled climates over the Fairchild Creek watershed. Statistical comparisons between the hydrologic simulations indicates that the choice of the reanalysis used to calibrate the SDSM will significantly impact the downscaled scenarios and thus impact hydrologic simulation accuracy.

I01-1B8.1 **10:30**

Topographically trapped waves along the Transantarctic Mountains

Amanda Adams[1], *Gregory Tripoli*[2]

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Low level flows over the Ross Ice Shelf, Antarctica are greatly influenced by the proximity of the Transantarctic Mountains. While barrier winds and katabatic flows are the most common topographically induced features, topographically trapped waves can also occur and propagate along the Transantarctic Mountains resulting in extreme and hazardous weather conditions for McMurdo Station on Ross Island. This talk will discuss results from simulations performed with the University of Wisconsin – Nonhydrostatic Modeling System (UW-NMS) that demonstrate the formation and propagation of topographically trapped waves. These waves are characterized by temperature drops of 10-20 degrees Celsius per hour and are followed by wind speeds in excess of 30 m/s. Automatic Weather Station (AWS) observations are consistent with the simulated progression of these events. Sensitivity experiments will be presented that demonstrate the role of the Transantarctic Mountains in controlling the spatial extent and propagation speed of the trapped waves.

A07-2DP.1 **16:00**

Heat, water vapor and momentum exchanges at the Dasan Station in Ny-Alesund, Svalbard, the Arctic

Taejin Choi, *Bang Yong Lee*, *Young Jun Yoon*, *Seong-Joon Kim*

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The four potential feedbacks between the impacts of climate change on the Arctic and the global climate systems have identified as follows based on the Paleoclimate studies and the contemporary Arctic ones (Terry et al., 2004): 1) albedo, 2) greenhouse gas emissions and/or uptake through biological response to warming, 3) greenhouse gas emissions from methane hydrates released from thawing permafrost and 4) increased freshwater fluxes that could affect thermohaline circulations. The Ny-Alesund science town in Svalbard, Norway is suitable for the researches related with the feedbacks due to its north most location (~79N), where anthropogenic effects may be minimized. Turbulent fluxes of sensible heat, water vapor and CO2 have been measured at a semi-desert of Ny-

Alesund since summer of 2003. These data can be used to better understand 1) the thermal properties at the active layer and the permafrost, 2) the response of polar ecosystem to the environmental changes, and 3) the impact of atmospheric boundary layer on the aerosol formation. Due to system failure and weak but frequent rain event, flux data retrieval rate was not so high but data was available to evaluate and compare turbulent exchanges of heat and water vapor at the site for four summer seasons. Based on the preliminary results, the magnitudes of evaporative fraction and ground heat flux were similar to the results reported previously near our site. However, energy imbalance was relatively larger and changed with wind direction. The effects of different averaging time and coordinate rotation on turbulent fluxes were not significant. Concomitant measurements at two heights did not make any significant difference in turbulent fluxes. Additional analyses will be made and reported in detail at the presentation. This study was supported by ‘Integrated research on the Composition of Polar Atmosphere and Climate Change (COMPAC)’ (PE07030 of Korea Polar Research Institute).

A03-2DP.1 **16:00**

Measurement and Modeling of CO2 and CH4 Fluxes at the Mer Bleue Cattail Marsh

Ian Strachan[1], *Marie-Claude Bonneville*[1], *Elyn Humphreys*[2], *Nigel Roulet*[1]

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Carbon cycling in the wetland soil-plant-atmosphere system is mostly attributed to the combined fluxes of carbon dioxide (CO2) and methane (CH4). The combination of high CO2 sink potential and high CH4 emissions determines whether a wetland is a net GHG source, and if it generates a cooling or warming impact on the Earth’s climate. Eddy covariance measurements of net ecosystem CO2 exchange (NEE) from May 2005 to December 2006 revealed that the marsh was a net CO2 sink from June to September, and a CO2 source for the remaining months. The cumulative CO2 balance is a net uptake of 264 g C m-2 from May 2005 to April 2006, and a net uptake of 516 g C m-2 from May 2005 to December 2006. The marsh was a stronger CO2 sink during the 2005 growing season (344 g C m-2) compared to the 2006 growing season 284 g C m-2). In 2005, growing season net CO2 fluxes were strongly correlated with vegetation biomass and leaf area index. Fluxes of CH4 were measured from water, soil and plants using closed chambers and resulted in a net annual area-weighted emission from the marsh of 206 g C m-2. Consequently, the net (CO2 + CH4) annual C balance of this wetland corresponded to a sink of 58 g C m-2. A simple radiative forcing model based on the marsh CO2 and CH4 exchange rates suggests that, despite the net carbon uptake, this wetland is contributing to atmospheric warming because of the large CH4 efflux. Future potential climate impacts of this marsh were evaluated using different emission scenarios that could result in response to climatic or environmental changes. Overall, short-term impacts are driven by CH4 emission rate, while the CO2 flux determines the impacts on longer time horizons.

A06-2B7.1 **10:30**

Aerosol optical properties in Arctic spring obtained from combined measurements with sky-radiometer and micro-pulse lidar at Ny-Alesund, Svalbard

Masataka Shiobara[1], *Masanori Yabuki*[1], *Kazuma Aoki*[2], *Maki Yamano*[3], *James R. Campbell*[4]

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Tropospheric aerosol has a potential to change the global climate by the direct and indirect effects on the radiation balance in the planetary atmosphere. Aerosol optical properties are essential for the direct effect of aerosols. A sky-radiometer (Prede, POM-02) and a micro-pulse lidar (MPL, NASA-upgraded SESI model) have been operated for six years to present at Ny-Alesund, Svalbard to observe aerosol optical properties and vertical structures. Aerosol optical properties, such as optical thickness, single scattering albedo and refractive index at selected wavelengths, and the volume size distribution are retrieved from measurements of the direct solar beam and the sky radiance distribution by the sky-radiometer. The vertical structure of aerosol layers and their temporal variations are observed by MPL. Preliminary results from the Arctic measurements, particularly focused on haze events in spring season, will be shown and discussed in this paper.

C04-4B5.7 **12:00**

Trends and variability of the Arctic tropopause, and their link to stratospheric processes

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Series of monthly mean thermal tropopause pressure have been derived for the locations Oslo(10.1º N, 59.6º E), Andøya (69.3º N, 16.0º E) and Ny-Ålesund (78.9º N, 11.0º E) as well as zonal averages at 60º, 70º and 80º N for the period 1979 to 2006, based on the ERA-40 reanalysed data and ECMWF operational data. These monthly averages are analysed with respect to long-term trends and year-to-year variability, using multi-linear regression as the main tool. Parameters included are the atmospheric tele-connection pattern series (NOAA-CPC analysis), QBO, the local 30-hPa level temperature, solar flux and volcanic aerosols. Almost all monthly (and seasonal) pressure means reveal negative trends, but most of them not significantly at the 95 % level. A preliminary multi-linear regression analysis of the year-to-year tropopause pressure variability (until 2001)reveals a dominant influence of middle stratosphere conditions (temperature), especially at the highest latitudes, varying significantly with season. The influence of the QBO is moderate and stronger at the highest latitudes. With respect to tele-connection patterns, the Scandinavia pattern is the most prominent at both sites, in contrast to results on total ozone from the same locations. Also other patterns show an impact distinctly different from their influence on total ozone, implying that modulation of the tropopause pressure is not the only way in which tele-connection pattern influence total ozone. We will present an extended analysis, including the recent 5 years, when stratospheric dynamics again have shown a major change compared to the late 1990s.

H02-2B4.1 **INVITED/INVITÉ** **10:30**

A review of stable water isotope modelling: from process studies to isotope-enabled atmospheric circulation models.

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Stable water isotopes (SWI, i.e. $H_2\,^{18}O$ and HDO) are widely used in fields ranging from paleo-climatology to hydrology. The fractionation of these heavier isotopologues with respect to the common $H_2\,^{16}O$ water molecule is dependent on temperature, distillation rate (i.e. rainout intensity), cloud and sea-spray microphysics, storm-tracks... Therefore SWI represent a powerful proxy that

integrates the main parameters of climate (temperature, precipitation, synoptic circulation patterns), yet it is not trivial to untangle the influence of each parameter.
In this presentation we review the different model types that reproduce the SWI fractionation in the atmosphere. Historically, SWI models were developed upon the Rayleigh distillation paradigm and defined the isotope effects: temperature/latitude, amount and altitude effects. Distillation models were later improved to include kinetic effects and multiple stage rain-out, up to full featured trajectory (Lagrangian) models. A distinct approach, in a gridded (Eulerian) referential, resulted in the incorporation of SWI diagnostics in circulation models. At each model time-step, SWI fractionation processes are computed throughout the atmospheric and land-surface water cycle. The advantages and drawbacks of each model category will be discussed, based on examples by following models: ICM, ECHAMiso and REMOiso.

G11-3C2.5 **15:00**

Heavy mineral provenance of the Flemish Pass and Orphan basins, offshore Newfoundland
David Lowe, Paul Sylvester, Michael Enachescu

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The Orphan and Flemish Pass basins are deep water frontier basins, located approximately 500 km to the northeast and 400 km to the east of the Avalon Penninsula, respectively. They are fault bounded rift-basins that formed during Mesozoic intra-continental rifting that preceded the breakup of Pangaea and seafloor spreading in the North Atlantic. Exploration of these basins over the past thirty years has provided evidence for the presence of an interconnected petroleum system. The Flemish Pass Basin is known to contain Kimmeridgian-aged source rocks and Late Jurassic to Early Cretaceous reservoir-quality sandstones. Recently, these strata have been traced into the East Orphan Basin using seismic markers that were intercepted by wells in the northern Flemish Pass Basin. The same geophysical studies suggest that periods of syn-depositional communication occurred between the Flemish Pass and Orphan Basins. Four key wells in the area are the focus of this study: Panther P-52, Baccalieu I-78, Mizzen L-11 and Blue H-28. Baccalieu and Mizzen are located in the Northern Flemish Pass Basin, Panther is on the eastern Central Ridge complex, and Blue is located in the West Orphan Basin. Collectively, these four wells have good coverage of Late Jurassic, Cretaceous and Tertiary strata. In this study, analyses of detrital heavy minerals are used to determine provenance. Heavy mineral ratios, selective heavy mineral geochemistry, U-Pb zircon dating, and qualitative zircon analysis are all methods used in this study to define heavy mineral assemblages and to identify sediment sources. The objectives of this study are: (a) to determine if the Jurassic, Cretaceous and Tertiary sandstones contain specific heavy mineral characteristics that can be used for correlation and provenance studies, (b) to determine the provenance of Tertiary, Early Cretaceous and Late Jurassic strata, and (c) to determine if correlations exist between age-equivalent units in the Flemish Pass and West Orphan basins, based on shared provenance.

S04-4B3.4 **11:15**

Modelling longwave radiation to snow beneath forest canopies using hemispherical photography
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Forest canopies reduce the shortwave radiation and increase the longwave radiation reaching the underlying surface, compared with open areas, and thus influence the rate at which forest snowpacks melt. The sub-canopy radiative environment can be highly heterogeneous, with temporal persistence depending on canopy structure and differing for shortwave and longwave fluxes, and this influences the rate at which snow-free ground emerges during snowmelt. Radiometer arrays have been used to measure spatial variability in forest radiation, but a large collection of such instruments is expensive and requires regular attention in snowy environments. Hemispherical photography is often used for rapid collection of data on canopy structure, and many software packages have been developed for modelling transmission of shortwave radiation using hemispherical photographs, but modelling of longwave radiation has received much less attention. Results are used here from radiometers located beneath forest stands of varying density at two sites: the Fraser Experimental Forest in Colorado and the Marmot Creek Research Basin in Alberta. We assess how well longwave radiation can be modelled by simply using sky view calculated from hemispherical photographs taken above the radiometers to weight longwave emissions from the canopy, calculated using measured air temperature as a proxy for canopy temperature, and atmospheric longwave radiation measured with a radiometer above the canopy or in a nearby clearing. We investigate the extent to which the modelled longwave radiation can be improved if shortwave radiation measurements are available, allowing an estimation of daytime canopy heating, or is degraded if above-canopy is parametrized as a function of air temperature and humidity when measurements are not available. The limitations of this simple method are explored by application to the extreme case of a forest edge, and errors introduced by equating canopy and air temperatures are discussed in an accompanying paper (Pomeroy et al., “The influence of canopy temperature on incoming longwave radiation to snow in coniferous forests”).

I07-3C8.1 **13:30**

Mapping shallow seabed morphology in the Mackenzie Delta region using Synthetic Aperture Radar

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Nearshore morphology in the Mackenzie Delta region of the Beaufort Sea is poorly known because much of the region is both very shallow (< 2 m) and highly turbid. Synthetic Aperture Radar (SAR) has been used to map nearshore morphology of lakes in Alaska by taking advantage of the ability of radar waves to penetrate fresh water ice. This technique has been extended to the Mackenzie Delta nearshore region where winter ice forms from river water that is sufficiently fresh. SAR allows the delineation of freshwater sea ice that freezes to the seabed (bottom-fast ice or BFI). A time series of imagery throughout a winter depicts the progressive growth of areas where BFI occurs as the ice thickens and if ice thickness is known at the time of imaging, the delineation of BFI zones represents a proxy for bathymetry. BFI was mapped through the winters of 2001-02, 2003-04, 2004-05 and 2005-06 and isolated images from other years are available. Extensive nearshore shoals have formed at the mouths of active distributaries that are separated by larger, slightly deeper embayments. Narrow channels can be seen to transect the shoals both aligned with and orthogonal to the river outflow. A detailed image from a thick ice year (1993) depicts channels fanning out to feed distributary mouth bars. Comparison of images acquired over more than 10 years suggest that shoal migration can exceed 100 m per year and channel incision of the shoals to depths of >5 m has occurred. The BFI imagery suggests that there is sufficient room beneath the sea ice cover to permit river discharge to reach the shelf without requiring extensive networks of sub-ice channels.

S05-3DP.2 **16:00**

Winter Climate Trends of the Chic-Chocs Mountains (1970-2007).

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Over the last century a slight increase in winter temperatures have been observed in southeastern Quebec. As thaw-refreeze cycles can have a great influence on many different geomorphological, ecological and hydrological processes such as slushflows, snow avalanches and frost damaging, can this warming of the air temperature during wintertime can be observed in the Chic-Chocs mountains? The Chic-Chocs mountains are located in the central part of the Gaspé Peninsula, with particular winter conditions such as a greater amount of snow on the ground and a longer snow cover duration conditions, that could be mainly explained by the distance to the sea and the altitudinal gradient. Recent research has made a distinction between snow climate and avalanche climate, the latter focusing on the specific snow conditions that are favourable to avalanche triggering. Very few studies however, of either snow climate, have been conducted in the Gaspé Peninsula.

For a better understanding of the snow climate and the environmental changes, a monitoring began during the winter 2006-2007. That project has two main parts : 1) an analysis of the climatic trends for the study region from 1970 to 2006 and; 2) a snow monitoring for the entire winter period (2006-2007). The main goal of this poster is to present : 1) the winter climate conditions during the 1970-2006 period. A series of maps showing the principal trends for air temperatures, precipitations and total amounts of snow on the ground for the period from 1970 to 2006 are presented. The spatial distributions of these factors are discussed in regards to the altitude and distance to the sea; 2) the preliminary results from the snow monitoring are also presented and discussed.

S03-3B3.8 **12:15**

Intra-annual thaw-refreeze cycles and the seasonal snowpack evolution.

Guillaume Fortin

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Winter thaw-refreeze events are frequent in southeastern Quebec. A thaw followed by a refreeze has a significant impact on the snowpack structure and indirectly on hydrological and microclimatological processes. Recent studies conducted in Eastern Canada have shown a slight increase of maximum temperatures during the winter period suggesting that thaw-refreeze cycles may have increased.

Different approaches to characterize thaw-refreeze cycles using a temperature index already exist. In this paper we used different thaw-refreeze indexes to identify thaw-refreeze cycles during three consecutive winters (2000-2003) and their impact on the snowpack structure. We choose different maxima and minima temperatures in combination with different time durations. The temperatures vary from -3°C to 6°C and the duration from 6 to 24 hours. In depth snow monitoring has been conducted in open fields at the J.C. Chapais experimental farm near Quebec City. This paper discusses the relationships between thaw-refreeze events and the associated ice features (thick basal ice layers, intra-pack layers and surface crusts) that are directly or indirectly related to the thaw-refreeze cycles. Snowpack patterns can be affected in different ways by the presence of such ice features, which can, for example, modify or impede water flow through the snowpack, slow the gaseous exchanges between the soil and the atmosphere and so on. The temperature threshold and the length of time during which the temperature is above the threshold are crucial factors for a better understanding of ice feature formation and evolution in open areas such as agricultural fields.

O02-1C1.4 **14:15**

Real-time forecasting of wave conditions in a coastal bay

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Numerical simulations of wave conditions in a coastal bay using the nearshore wave model SWAN are presented. The field site is Lunenburg Bay, a coastal embayment on the southern shore of Nova Scotia approximately 8 km long and 4 km wide. It has irregular bathymetry characterized by a typical depth of 10 m and is exposed to wave energy from the North Atlantic Ocean. Surface wave observations have been collected at various locations in the bay since 2002.

Validation of the model is presented for two events with large swell and strong winds, and predicted wave spectra are compared with observations inside the bay. Hurricane Juan, Sept. 2003, had offshore significant wave heights up to 9 m and Extra-Tropical Storm Nicole, Oct. 2004, had wave heights up to 4 m. The relative importance of physical processes including refraction, whitecapping, bottom friction and wave breaking are compared at several locations. Two whitecapping dissipation expressions have been used, including a newly proposed spectrally local expression. The new expression has an improved prediction of the wind-sea portion of the wave spectrum, especially in the presence of swell.

For 2007, the model is used for real-time forecasting of wave conditions in the bay, with forecast predictions of offshore waves, winds and water levels as inputs. Offshore wave conditions are generated using GEM-global (1 degree) wind forecasts to force the WaveWatch III model over the North Atlantic. A series of nested grids bring the waves to the boundary of Lunenburg Bay. The SWAN model is run for the bay using these boundary conditions, in addition to GEM-regional (15 km) wind forecasts and tidal water level predictions. Inside the bay, the forecast nearshore wave conditions are compared to real-time observations. Particular attention is paid to both incoming swell and locally-generated wind sea peaks in the wave spectra.

I07-3C8.4 **14:30**

Monitoring and Study of the Characteristics of Internal Waves in the East (Japan) Sea by Synthetic Aperture Radar – ERS1/2, RADARSAT, and ENVISAT ASAR

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Hydrographic data obtained from several ship experiments have shown that internal waves are frequently observed in the East (Japan) Sea, mostly in the continental slopes located along the western side of the East Sea. It is well known that oceanic internal waves can be detected well in synthetic aperture radar (SAR) images. Interactions between surface capillary-gravity waves and horizontally varying surface currents induced by internal waves produce variations in sea surface roughness which can be detected by SAR. C-band SAR images from ERS, ENVISAT ASAR and RADARSAT have been used to study the characteristics of internal waves in the East Sea. Both SAR observations and in-situ measurements were carried out during IWXES (Internal Wave eXperiment in the East Sea) in 2003 and 2004. The in-situ measurements include currents and water temperatures, which were made using thermistor chains, recording current meters and acoustic Doppler current profilers (ADCPs) located in the shelf and the slope. The observed properties of internal waves from many SAR images were compared and verified from in-situ measurements and theories. Theoretical simulation results are also compared with observations.

I05-2C8.2 **14:15**

Evaluation of a real-time fog prediction using high resolution GEM-LAM

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As a component of the Lunenburg Bay Multidisciplinary Modelling System, the high resolution (2.5 km) GEM-LAM (a limited area version of the Global Environmental Multiscale Model) was implemented for real-time fog prediction during summer 2006, in cooperation with the FRAM (Fog Remote Sensing and Modelling) field experiment. The model performance under different configurations and schemes (e.g. condensation and MoisTKE) compared to FRAM data, meteorological observations and satellite images, as well as operational GEM output has been evaluated and will be presented. The implication of the work for the two-way coupling between GEM-LAM and an ocean model will also be briefly mentioned.

S01-1B3.5 **11:30**

Visibility During Blowing Snow Events Over Arctic Sea Ice

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(Presented by *P.A. Taylor*)
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A significant number of blowing snow events occur in many parts of Canada each year. They are a hazard to public safety and transportation since visibility can be significantly reduced during the occurrence of blowing snow. Although research on visibility in blowing snow events has been done in the past, more work is required to better understand the mechanism of reduced visibility and to better predict visibility during blowing snow events. This paper presents results from a field study on visibility during Arctic blowing snow events over sea ice in Franklin Bay, NWT, Canada from mid January to early April 2004 during the CASES 2003-2004 expedition. Here we focus on the relations between horizontal visibility (Meteorological Optical Range or MOR), wind speed and particle counts. Visibilities at two heights, wind and temperature profiles, plus blowing and drifting snow particle counts at several heights were monitored continually during the study period. Good relations between visibility and wind speed were found in individual events of ground blowing snow with correlation coefficients > 0.9. A poorer relationship was observed in the event of blowing snow with concurrent precipitating snow. A theoretical visibility model based on work by Pomeroy, using a mean radius of 50 μm, predicted visibility with a mean error of 0.18 km and root mean squared error of 1.3 km. Observed visibility at 1.5 m had a strong relation with particle counter readings with an R2 of 0.92 and was consistent among all events.

G03-4B2.5 **11:30**

Surface Land Deformation Monitoring using JERS-1 SAR Data and the PSInSAR Technique

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A large portion of the tidal flat in western coast of Korean peninsula has been reclaimed for agricultural, residential and industrial use. The Namdong national industrial complex, once a vast salt field, is one of reclaimed areas located near Incheon city. According to the survey on ground stability conducted by Korean Land Corporation in 1999, the Namdong industrial area was revealed to stand on weak ground but safety problems are still not reported. More precise observation is required because subtle deformation can occur in this area. Permanent scatterer interferometric SAR (PSInSAR) technique provides millimeter accuracy in deformation measurement by analyzing the phase series of time-coherent radar targets to retrieve surface deformation. Other factors which can modify the phase – DEM error, atmospheric phase screen, and residual phase ramp – are calculated from many interferograms sharing the same master acquisition and excluded. In this study, we applied PSInSAR technique to detect and monitor the ground deformation in the Namdong industrial area. JERS-1 SAR data sets of 27 scenes covering the time span 1992-1998 have been exploited. We estimated spatial displacement rate variability over this industrial field using a linear deformation model. The result highlighting deformation phenomena occurring in Namdong industrial field was reported.

S01-1B3.6 **11:45**

High-resolution near-surface snow stratigraphy as inferred by ground-based broadband microwave radar measurements: Devon Ice Cap, Nunavut, Canada 2004-05, CryoSAT calibration campaign

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Broadband microwave Frequency Modulated Continuous Wave (FMCW) radar measurements were made during the spring of 2005 and 2006, at the CryoSat validation site on Devon Ice Cap, Nunavut, Canada. Metal reflector experiments were performed by inserting a large metal plate into a snowpit, parallel to visually identified layer transitions. This allowed interpretation of the age of specific radar reflections which were relatively continuous in the region surrounding the study site (weak percolation facies). By mapping the snow depth to a given reflector, accumulation rate patterns over large areas can be estimated at high spatial resolution. Annual and average variability are studied using these estimates for the upper 2 meters, which corresponds to approximately 4-5 years of accumulation. The utility of complimentary neutron probe snow density measurements, 900 MHz pulse radar measurements, and digital photography is also explored.

G04-2C2.3 **14:30**

Low-latitude Laurentia during early Ediacaran time: Preliminary paleomagnetic results from the 615 Ma Lighthouse Cove volcanics, Newfoundland

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Laurentia's apparent motion and paleogeographic relations during the Ediacaran Period (630-543 Ma) are uncertain and controversial. Preliminary paleomagnetic data from flows and dykes in the type area for the 615 Ma Lighthouse Cove volcanics on Belle Isle, Newfoundland, have expanded existing early Ediacaran results for Laurentia. Three of the four new sites carry a stable remanence with directions that are similar to those published for the correlative Long Range dykes of Labrador and the Cloud Mountain basalts of northern Newfoundland. The preliminary combined result for the comagmatic Long Range dykes and Lighthouse Cove volcanics is D=117, I=59 degrees (a95=14 degrees, k=11.5; N=11 sites), placing the Labrador portion of Laurentia at 39°S paleolatitude at 615 Ma. Comparison with the published paleomagnetic result from the coeval Egersund dykes of Baltica shows that the `Caledonide' margins of Laurentia and Baltica likely faced one another as anticipated from Grenvillian geological relationships, but may have been separated by up to 3000 km at 615 Ma, consistent with those margins having become passive by the Late Neoproterozoic. Laurentia appears to have had rapid APW throughout the Ediacaran period, moving from low latitude at 615 Ma to the south polar region at 590-570 Ma and then back to low latitude by Cambrian time. Laurentia's apparent polar wander path during the Ediacaran describes a large "Ediacaran loop" of 50 to 65 myr duration with APW rates in excess of 30 cm/yr. Such large and rapid APW for Laurentia implies the occurrence of unusually rapid plate motions or a dominant contribution from true polar wander to the apparent motions of all continents during Ediacaran time.

A03-3B6.3 **11:00**

A note on Sudbury area wind speeds - a tale of forest regeneration

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(Presented by *P.A. Taylor*)
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A 34% reduction in 10-m wind speeds at Sudbury airport over the period from 1975-1995 appears to be a result of significant changes in the surface roughness of the surrounding area due to land restoration and reforestation following historical environmental damage caused by high sulphur dioxide and other industrial emissions. Both 850-hPa winds extracted from the NCEP/NCAR reanalysis project database and wind measurements at meteorological stations 200 km to the north and 120 km to the east of Sudbury do not show the same decrease. In order to quantitatively assess these changes in observed wind speed, geostrophic drag laws were employed to illustrate potential changes in near-surface wind speeds in areas surrounding the airport. A model of the internal boundary-layer flow adjustment associated with changes in the surface roughness length between the surroundings and the grass or snow surface of the airport was then applied in order to compute expected annual average wind speeds at the airport site itself. The estimates obtained with this relatively simple procedure match the observations and confirm that reforestation is likely the major cause of the reduced wind speeds. This finding bears economic, social, and ecological importance as it will influence things such as wind energy potential, wind loads on structures, wind chill and home heating costs through to the biology of small to medium sized lakes.

H05-2DP.1 **16:00**

Sensitivity of aquatic organisms to direct and indirect effects of decreased flow: towards the development of a sensitivity index

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(Presented by *Jeff Crocker*)
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As part of the National Agri-Environmental Standards Initiative (NAESI) Environment Canada is developing ecological indicators of hydrological alteration. This is being achieved by determining the direct and indirect (e.g. elevated temperature and reduced oxygen) effects of reduced flows on aquatic life. Here we present results from a global literature review and meta-analysis with the aim of developing a sensitivity index to diagnose and quantify the effects of reduced flows to Canadian river fauna. Fish, Ephemeroptera, Plecoptera, Trichoptera, and Diptera showed a slightly negative responses, while Coleoptera, Odonata, Isopoda, and Annelida showed slightly positive responses. Analysis of indirect effects indicated that taxa responding negatively to low flow tended to have a lower thermal tolerance and higher oxygen requirements than taxa which responded positively. This suggests elevated temperature and reduced oxygen level associated with low flow conditions could be major indirect cause of reduced abundance or local extirpation of taxa. Overall, our results indicated that it is possible to distinguish taxa groups which are sensitive to the direct and indirect effects of reduced flows, and the implications of this result are discussed in relation to the requirement to develop ecosystem-based standards for the protection of natural flow regimes in rivers.

O02-2DP.1 **16:00**

Development of the Lunenburg Bay Coastal Observatory: a practical guide to operational oceanography

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(Presented by *Sean Hartwell*)
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Since June 2002, a coastal observation and prediction system has been operated in Lunenburg Bay, Nova Scotia. The Marine Environmental Prediction System (MEPS-Bay) observatory uses a network of instruments to measure meteorological variables and physical, optical and acoustic properties of the water column at several sites, supported by an intensive field program for maintenance and ground-truthing. MEPS-Bay provides data in near-real time to an access and visualization system in support of a modeling effort which will provide interdisciplinary ocean forecasts during the 2007 field season. Many challenges have been addressed during development of this multidisciplinary observing system, and the experience provides useful guidance in the design of operational systems in the future. We review the intricate paths of the data from its various sources to end-users and the efforts needed to maintain an accurate and reliable system. The advantages of automated measurements and their reliance on maintenance and ground-truthing are discussed as well the inherent importance of managers and well-trained technical experts. We conclude that an important product of MEPS-Bay is a clear understanding of what it will take to establish an operational interdisciplinary coastal observatory.

O01-1D1.3 **16:30**

Seasonal and interannual variability of the Scotian Slope circulation

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Seasonal and interannual sea level and current variations over the Scotian Slope are examined using ten years of TOPEX/Poseidon (T/P) satellite altimeter data. The altimetric current anomalies are combined with climatological mean circulation field of a finite element model to construct nominal absolute currents. The seasonal-mean results indicate that the sea level is highest in late summer and lowest in late winter and the surface slope circulation is strong winter/fall and weaker in summer/spring. The total transport associated with the westward shelf-edge current and with the eastward slope current, calculated by combining the T/P data with a climatological seasonal-mean density field, reveals a substantial seasonal change dominated by the barotropic component. The present analysis reveals prominent interannual changes of the sea level and current anomalies for the study period. The sea level was lowest in 1996/1997, when the Gulf Stream was in its most southern position. The mean winter circulation over the Scotian Slope was strongest (up to 30 cm/s in both the southwestward shelf-edge current and northeastward slope current) in 1998 and weakest (weaker and broader shelf-edge current) in 1996, which may be related to the fluctuation of the equatorward Labrador Current strength and of the Gulf Stream north-south position. The study also suggests that the root-mean-square (RMS) current magnitude is positively correlated with the occurrence of the Gulf Stream warm core rings (WCR) on the interannual scale, while WCR's yearly-mean kinematic properties seem to have small variations.

S04-4B3.8 **12:15**

Lagrangian Stochastic simulation of blowing snow events

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An Inertial Particle - Lagrangian Stochastic model is applied to simulate a number of blowing snow events. The scenarios were idealised to horizontally homogeneous terrain in upwind locations. The model was limited to strong wind and near-neutral conditions. A steady state was also assumed. In this model, the background fluid velocity in the vicinity of a snow particle is calculated using a 3-D Langevin equation. Velocities of snow particles, assumed spherical, are computed by adopting a non-linear drag law. The model was applied to snow particles of a range of radii. Particle number densities (# m-3) of snow particles for each particle radius calculated from the model at each height were first nomalised by the particle number density at a reference height. Then the snow particle number densities and size distribution of snow particles radii at the reference height were assumed to follow a Gamma distribution which were good-fits from field measurements. Comparisons of our model predictions and two sets of field data will be discussed: 1) the British Antarctic Survey's second Stable Antarctic Boundary Layer Experiment conducted at Halley in 1991; 2) Schmidt's blowing snow experiments at Laramie, Wyoming, USA in 1974. We will also compare our model outputs with those obtained from an Eulerian model (PIEKTUK) which is a 2-D, fetch-dependent model involving the turbulent diffusion of heat and moisture.

I07-3B8.2 **11:00**

Overview of New Space-borne Fully Polarimetric SAR (Synthetic Aperture Radar)Systems and Geophysical Applications

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Airborne and space-borne SAR systems have become very imposrtant tools of geological and geophysical research (e.g. InSAR, D-InSAR and PSinSAR). One can now monitor the minute displacements and continuous deformantion with ever increasing accuracy, independent of weather conditions and without sun light. Two new fully ploarimetric SAR systems (TerraSAR-X and RADARSAT-2) will be put into orbit this year and we will now have fully polarimetric SAR systems in three frequencies; L-, C-, and X-bands. These new Earth orbiting fully polarimetric SAR systems operating in multiple frequencies provide us with new challanges and also with new opportunities. This paper will briefly review the polarimetric SAR theory and the status of new POLSAR application developments in Earth Sciences.

I07-3C8.2 **14:00**

A multitemporal and multisensor based mapping of the snowmelt and phenological pattern in Finnmark county, North Norway

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Phenology, in its simplest terms, is a study of cyclic events of nature. An immediate and observable effect of global warming is a shift in the seasonal phenological cycle, which is often the first indication of transition in ecosystems. In winter the snow cover protects the plants and soil from the low air temperatures above. In spring, however, the snow cover prevents a warming of the soil. Once the snow has melted, solar radiation falls directly on the soil surface, and then the soil begins to thaw and plant life is activated. Hence, for modelling future distribution of plants it is important to first monitor the year-to-year changes of snowmelt and greenup pattern.

In this project we combine snow cover maps with phenological maps for Finnmark county in North Norway for the 2006 spring period. The snow cover area maps are based on both microwave (ASAR) and optical (MODIS) sensors. These maps have 250m spatial resolutions and up to daily time resolution, and are mainly based on algorithms developed in the EU5 project EnviSnow. The phenological maps are based on NDVI thresholds from the MODIS sensor. These maps have 250m spatial resolutions and 16-days or better time resolution, and are based on algorithms developed in the Norwegian Research Council project PhenoClim.

The results show that the snow melts in late April in the south-facing parts of the lowland and the onset of growing season starts here 2-3 weeks after the snow has melted. In the mountain parts, at 400 m a.s.l., the snow melts in general in mid-June and the greening starts only few days later. The results also revealed that in the mountain parts the actual date on which the growing season begins varies locally by several weeks depending on the depth of the winter snow layer.

I01-2B8.6 **11:45**

Modelling dust distributions in the atmospheric boundary layer on Mars

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(Presented by *P.A. Taylor*)
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A time and height dependent eddy diffusion model is used to investigate possible scenarios for the size distribution of dust in the lower atmosphere of Mars. The dust is assumed to either have been advected from a distant source or to originate locally. In the former case, the atmosphere is assumed to initially contain dust particles with sizes following a modified gamma distribution. Larger particles are deposited relatively rapidly while small particles are well mixed up to the height of the afternoon maximum boundary layer and are deposited more slowly. In other cases, a parameterization of the dust source at the surface is proposed. Model results show that smaller particles are rapidly mixed within the Martian boundary layer, while larger particles ($r > 10$ µm) are concentrated near the ground with a stronger diurnal cycle. In all simulations we assume that the initial concentration or surface source depend on a modified gamma function distribution. For small particles (cross-sectional area weighted mean radius, reff = 1.6 µm) distributions retain essentially the same form, though with variations in the mean and variance of the area-weighted radius, and the gamma function can be used to represent the particle size distribution reasonably well at most heights within the boundary layer. In the case of a surface source of larger particles (mean radius 50 µm) the modified gamma function does not fit the resulting particle size distribution. All results are normalised by a scaling factor which can be adjusted to correspond to an optical depth for assumed particle optical scattering properties. Similar applications to dust on Earth will be discussed.

H02-2B4.2 **11:00**

Regional modeling of the stable water isotopes over ice core sites in Canada

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Ice cores taken from Mt. Logan are unique among paleoclimate indicators in North America because of the mountain’s high altitude. Moisture at this elevation is thought to originate from remote sources, whereas moisture at lower altitudes is thought to originate from local sources. This source difference is thought to contribute to step function in the stable isotope composition of moisture with increasing altitude. The delta-18 decreases gradually between up to 5km, but decreases rapidly above this elevation.

To better understand this behaviour, were are using the REMOiso regional climate model. REMOiso is an isotopically-equipped version of Max Planck Institute for Meteorology’s regional model. We are currently running the model at 0.5 degree horizontal resolution with 31 vertical layers, which allows for much higher resolution of topography than a general circulation model. This is expected to provide much more realistic modeling of the stable behaviour at Mt. Logan. This talk will discuss preliminary results from REMOiso, focusing on the modeled vertical structure of isotopic composition and moisture transport over the northeast Pacific Ocean.

I01-2B8.7 **12:00**

Modelling the Boundary-Layer flow over Changes of Surface Conditions and Its Application in Wind Energy

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The surface underlying atmospheric boundary-layer flow is often inhomogeneous, sometimes changing continuously but often abruptly. A numerical model is presented to study such flow over changes in surface conditions. These changes can include surface roughness, thermal and moisture properties. The results are discussed and compared with other models and published field data with emphasis on single and multiple step changes in surface roughness under neutral thermal stratification. A simplified calculation procedure uses assumed forms of wind profile within one or multiple internal boundary layers and estimates of internal boundary-layer height. This is particularly useful for wind energy resource and wind loading assessment applications in combination with calculations of topographic effects.

O03-3C1.5 **14:30**

Resonant Modulation of a Tidal Jet

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Lunenburg Bay, on the south eastern coast of Nova Scotia, is the site of an interdisciplinary coastal observatory with permanent moorings recording hydrodynamic, atmospheric and biological data. During the ebb phase of the tide a strong jet exits two coves along a narrow channel and enters the main bay with maximum velocities reaching 1m/s. Eddies and whorls form at the jet edge and it serves as an important mechanism for mixing throughout the bay.

We report data from the observatory and an additional instrument array deployed during the summer of 2005. Pressure and velocity spectra reveal an oscillation with a period of approximately one hour. The oscillation appears to be a resonant amplification of the broad-banded high-frequency (on the timescales of hours) energy on the Scotian Shelf. The oscillation has larger amplitudes in winter, likely associated with increased storminess.

During the field experiment, the oscillation sea surface displacement at the head of the bay was small (~0.05m) with little effect on the tidal currents in the main bay. However, there is a significant modulation of velocities within the jet (ca. 0.4 m/s). The observations are compared to numerical results using the hydrodynamic model Delft3d. A simple two-dimensional case reproduces the seiche motions well. An analysis of the phases of the oscillation throughout the bay indicates that the signal is consistent with wave propagation along the channel, which forces a pumping mode within the coves. The oscillation interacts nonlinearly with the M2 tide, causing a broadening of the oscillation spectral peak.

A02-2DP.2 **16:00**

Evaluation of regional air quality models in the presence of moderate to strong aerosol events.

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During the 2004 to 2006 period a program of synchronized sunphotometry and lidar backscatter measurements were carried out at Egbert, Ontario (70 km north of Toronto). A variety of events, ranging from moderate to strong pollution events, long and short distance smoke transport, long distance dust transport and the presence of thin homogeneous clouds were registered and optically analyzed. These data were employed to help evaluate the performance of the Canadian GEM-AQ air quality model as well an aerosol optical assimilation model (NOMAD). The evaluations were based on optical indicators of integrated aerosol content (aerosol optical depth), particle size indicators such as Angstrom exponent, and vertical profiles of the aerosol backscatter ratio. Some preliminary analyses will be presented; the focus will be on the problems associated with emissions modelling, the influence of cloud screening algorithms in the data and in the model, the robustness of particle size information in the passive optical data and the ability of the models to capture subtle variations, and the vertical performance of the models relative to the lidar backscatter data.

H06-4C4.2 **13:45**

Combining GRACE and Airborne Laser Altimetry Measurements to Calculate Ice Mass Changes in Alaska and northwestern Canada

Anthony Arendt[1], *Scott Luthcke*[2], *Christopher Larsen*[3], *Waleed Abdalati*[2], *Craig Lingle*[3], *Keith Echelmeyer*[3], *William Krabill*[4]

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Although smaller in total volume than the ice sheets, glaciers of Alaska and northwestern Canada have high rates of mass turnover and are making a large contribution to rising sea level. Aircraft altimetry measurements have broadened our understanding of the mass variations of these glaciers, but errors in regional estimates remain large. Identifying a set of glaciers to represent a region is a challenge, in part because tidewater glaciers exhibit dynamic variations that are not necessarily synchronous with adjacent glaciers.

Time-variable gravity measurements from the NASA/DLR Gravity Recovery and Climate Experiment (GRACE) satellites are providing information about changes in the distribution of mass within and at the surface of the Earth. After correcting for other sources of mass change such as glacial isostatic adjustments (GIA), GRACE yields direct measurements of glacier mass balance, circumventing errors in converting elevation changes to mass equivalents.

Here we describe our ongoing efforts to measure mass changes of Alaska glaciers between 2003-2006 using GRACE data. We are employing a unique data processing method that uses inter-satellite range-rate measurements to obtain local mass concentration (mascon) solutions. The high spatial resolution afforded by this approach will improve our ability to isolate glacier mass changes from those occurring outside the region of interest. At the same time, the high temporal resolution will allow us to isolate specific mass change events for comparison with climate data. Our solutions will include explicit corrections for the large rates of GIA that are occurring in the Glacier Bay region in response to recent tidewater disintegration.

Elevation changes between NASA's 2005 airborne topographic mapping campaign and the February 2000 Shuttle Radar Topography Mission for glaciers of the Yakutat and Glacier Bay regions will be presented. These illustrate one of several datasets that will be used for validation and comparison with GRACE solutions.

S03-3B3.3 **11:00**

Adjustment of Historical Daily Snow Observations in Canada

Eva Mekis

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Reliable long-term snow measurements are critical for climatic and hydrological analysis. Compared to other neighboring countries, additional to total precipitation, Canada has separate rain and snow observations available in the National Archive. Each manual snow observation consists of two parts: the value measured by snow ruler and a flag with additional information related to the observation (accumulated, estimated, missing value or trace). In order to get the snowfall precipitation out of the freshly fallen snow, climate dependent SWEAF (Snow Water Equivalent Adjustment Factor) map was computed. The density corrections based upon coincident ruler and Nipher measurements were mapped for Canada and applied to all ruler measurements in the Historical Adjusted Climate Database. Including trace flags corrections in the database has several advantage and disadvantage; it is the subject of a long debate. Trace flag was not observed consistently through time. To prove this, starting from the beginning of the twentieth century the trace counts will be presented for each decade for several locations across the country. But avoiding trace correction from the bias-corrected precipitation datasets would lead to deficiencies in the final water budget. First the description given to the observers will be summarized using several Observation Manuals (MONOBS). The frequency of daily observations taken and the type of trace (ice crystal or snow trace) are also important factors in the trace adjustment. One trace flag may contain up to 4 trace observations. In the same time, the ice crystal, which often occurs on the North, contains lower water content. The switch from imperial to metric system caused further confusion by decreasing the minimum measurable amount given to the observers. Range studies of small precipitation observations will be presented to understand further the scale of the problem. At the end alternative solutions for the trace correction will be given.

S05-1D3.5 **17:00**

Albedo observations with high concentrations of Black Carbon from high Arctic snow packs

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It is well known that even small concentrations of black carbon (BC) will affect the Arctic snow surface albedo. In fact, a concentration as low as 10-8 may under optimal conditions reduce the albedo with 1%. The importance of BC on the Arctic snow albedo can best be illustrated by mentioning that impact of BC on snow is separately mentioned in the recent IPCC 4th assessment report – summary for Policymakers.

Published results show that the theoretical the effect of BC on albedo can be calculated by using multiple scattering theory. However, theory does not compare well with observations, since the observed impact is two to five times higher. Some of the error may likely be attributed to errors associated with low BC .

At the conference results from observations will be presented with a large variety of BC concentrations and corresponding snow albedos from high Arctic snow packs. The setting of Longyearbyen on Svalbard forms a unique setting for observing the impact of BC on snow albedo. A coal mine in town results in continuous transport to the harbour for shipping. During unloading from trucks a cloud of BC is released and a fan of aeolian deposited BC is to be found in the snow covered vicinity of the harbour. Results will be presented showing a large variety of BC concentrations and and snow albedos.

C04-3DP.12 **16:00**

Observed trends and changes in radiosonde temperature and humidity in Canada

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Radiosonde observations represent a valuable resource for the analysis of climate trends occurring in the upper levels of the atmosphere. Studies of upper-air temperatures based on radiosonde data have shown a warming of the troposphere and cooling of the stratosphere since the middle of the century. Upper-air observations were mainly taken for forecasting purposes and not to study the climate. Changes in instruments due to improved technology have made the observations more accurate however they have as well generated artificial biases in the long-term time series. This work presents an assessment of the trends and changes in radiosonde temperature and humidity records in Canada. The cause of the biases will be discussed along with some examples taken at northern locations.

I02-4C8.5 **14:45**

Quantity, Quality, and Source of Organic Matter in Near-bottom Waters of the Beaufort Sea Shelf, Arctic Ocean

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Arctic shelves are characterized by high algal production and are also highly influenced by river inputs. Because of the Arctic's sensitivity to climate change, much emphasis is being placed on understanding sources, transformations, and fate of carbon on its continental shelves. When assessing carbon cycling, research tends to focus on the quantity and quality of carbon resources in the upper-water column and sediments. Near-bottom water, often overlooked in carbon budgets, regulates the exchange and transport of organic matter between the water column and the sea floor, and therefore, influences the fate of organic matter on continental shelves. Near-bottom waters are also a reservoir for various consumer food resources resulting from sedimentation and resuspension. We evaluated the sources, quantity, and quality of organic matter in near bottom waters across the Beaufort Sea shelf by integrating chlorophyll, fatty acid, C, N, and P concentration and ratio, and C and N stable isotope data of particulate matter. These tools allow us to assess the importance of terrestrial inputs from the Mackenzie River and upper-water column and near-bottom water links as sources of organic matter in near-bottom waters. Our data show that the quantity and quality of organic matter is highly variable in this dynamic environment. With low C:N, C:P and high polyunsaturated fatty acids (PUFA) at some stations, we conclude that near-bottom waters can be an important and generally neglected reservoir of labile organic matter that can fuel near-bottom food webs. However, conclusions about the source,

quantity, and quality of organic matter reflects the tools used (i.e. chlorophyll, C:N, PUFA, etc.), highlighting the need for multiple and compound specific tools to increase accuracy in ecosystem studies.

C02-1C5.4 **14:15**

A high-resolution Holocene paleomagnetic record from the Chukchi Sea: preliminary results and potential for chronostratigraphy

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We present a new detailed high-resolution Holocene paleomagnetic record from the Chukchi Sea. Core HLY0501-05JPC (hereinafter referred to as core 5JPC) was raised in the summer 2005 on board the USCGC Healy in the Chukchi Sea as part of the Healy-Oden Trans-Arctic Expedition (HOTRAX) in order to establish a pan-Arctic Quaternary stratigraphy. The aim of this study is to establish a high-resolution Holocene magnetic stratigraphy for the Western Canadian Arctic using the paleomagnetic secular variation (PSV) and relative paleointensity variation. The natural remanent magnetization (NRM) was studied by progressive alternating field (AF) demagnetization of u-channel samples and the characteristic remanent magnetization (ChRM) was easily isolated. Representative vector end-point diagrams indicate that core 5JPC is characterized by a strong (10^{-2} Am^{-1}) and stable single component magnetization, with maximum angular deviation values (MAD) generally less than 5°. Aside from the base of core 5JPC where sediments are sandy and characterised by colour changes, the component paleomagnetic inclination vary close to the expected inclination (80°) for the latitude of the core site based on a geocentric axial dipole field model (GAD). Magnetic parameters such as low-field volumetric magnetic susceptibility (K_{LF}), anhysteretic remanent magnetization (ARM) and isothermal remanent magnetization (IRM) vary by less that one order of magnitude, whereas the K_{LF} versus IRM diagram is compatible with magnetic grain size generally comprised between 1 and 16 µm. These data are consistent with dominant low-coercivity ferrimagnetic minerals such as magnetite or titanomagnetite. Records of relative paleointensity proxy (RPI) were constructed using K_{LF}, ARM and IRM as normalizers. Almost identical results were obtained with the three normalizers suggesting that the sediments may provide reliable RPI proxies determinations. Finally, six ^{14}C AMS dates were used to construct a preliminary age model and the PSV and RPI proxies will be compared with other high-resolution Northern Hemisphere records.

S02-2C3.7 **15:30**

Passive microwave signatures of short-lived snow melt events in Muir Inlet, Glacier Bay, AK

Sarah Kopczynski[1], *Joan Ramage*[1], *Daniel Lawson*[2], *David Finnegan*[2], *Edward Evenson*[1], *S.J. Taggart*[3]

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We link timing and magnitude of short-lived pre-spring snow melt events in Muir Inlet, Glacier Bay, AK with Special Sensor Microwave Imager (SSM/I) passive microwave observations. Timing, duration and volume of snowmelt are measured in situ by automated water collection and temperature sensors, while automated thermistor strings record fjord water temperatures. Spring melt starts April 7 when SSM/I brightness temperatures (Tb) exceed 246K and diurnal Tb differences (DAV) exceed

10K. Prior to spring melt, we observe 8 long and 6 short duration sub-snow pack melt events, persisting 1 to 10 days and yielding 0.1 to 1 inches meltwater. Melt events occur at the low elevation station approximately 1 day earlier than at the high elevation site. More meltwater tends to be generated in the lower elevation, with the exception of several short duration (1-2 day) events in February. Six of the 8 longer melt events occur when Tb > 235K and DAV > 10K, while shorter events do not correlate to specific Tb transitions. Tb and fjord water temperature track air temperature until mid-March, when warmer air temperatures increase surface melt. In March fjord water cools significantly, likely due to increased glacial meltwater flux. The end of SSM/I detected spring-melt precedes warming of fjord waters by 5 days. At Muir Inlet, the volume of spring freshet is less than the volume of water generated by these early pre-spring events, yet it is not clear how much of this early melt is retained in lower snow pack strata. We do observe strong correlations between these pre-spring melt events and cooling of fjord water temperature following them, arguing that at least some of the melt water does travel to the fjord and is thus not entirely retained in snow pack or groundwater storage.

I03-4C7.1 **13:30**

Design of soil moisture observatories for remote sensing calibration and validation: Opportunities and Design Challenges

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Knowledge of the soil moisture state is critical to our understanding of the global water and energy cycles yet routine observation is hindered by the cost of establishing appropriate sampling arrays and the high spatial variability of the soil moisture state. Passive microwave sensors aboard existing and proposed satellite platforms offer the best solution for estimating the surface soil moisture content, which can then be assimilated into land surface parameterization schemes for estimates of root zone soil moisture. One promising satellite mission planned for launch in early 2008 is the Soil Moisture and Ocean Salinity Mission (SMOS). This satellite platform will carry a passive low frequency microwave sensor (L band) capable of detecting soil moisture estimates from the top 5 centimetres with a global return interval of 2-3 days. To date, however, very few ground-based networks have been established for ongoing validation and calibration of the satellite observations and for understanding how to successfully propagate information obtained from the surface for soil profile estimation. In this presentation we will describe our efforts to establish two soil moisture monitoring networks over southern Ontario, and central Saskatchewan. We will address issues with sampling design for establishing a semi-permanent soil moisture observatory for satellite calibration and validation. Specifically we will describe how many measurement locations are required to represent the mean of a satellite pixel, optimal sensor installation, measurement capacity for validation of freeze-thaw states, and the impacts of land-use practices on mean soil moisture values and variability.

I11-4C1.2 **13:45**

Atmospheric Rivers affecting Western Canada: synoptic climatology and trajectory analysis.

Alain Roberge, *John Gyakum*, *Eyad Atallah*

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There can often be significant interactions between the high and tropical latitudes during the Northern Hemisphere's cool season. In periods of highly amplified flow, these interactions can lead to the

poleward transport of significant tropical moisture into portions of western and northwestern Canada. These events, often referred to as Pineapple Express (PE) events, are characterized by large plumes of warm, moist air coming from near Hawaii, and reaching the west coast of North America. Also called "atmospheric rivers", these phenomena are responsible for numerous storms and floods. As such, a study is undertaken to document the synoptic-scale signatures associated with the PE.

Preliminary results indicate that this large scale moisture transport is often associated with the sub-tropical jet stream, which is curved due to a full-latitude ridge of high pressure located just offshore of the west coast of North America concomitant with a strong low-pressure system located in the Gulf of Alaska. Although the extent of a PE can reach as far south as California and as far north as the coast of Alaska, this study will focus on events that attain latitudes of 45° N and greater. A climatology of moisture transport and height anomalies will be developed in order to objectively quantify criteria that will define a PE. Parcel trajectories from specific cases will also improve our understanding of key precursors to a PE event.

A06-1D7.5 **17:00**

Cloud phase identification using radar Doppler spectra

Pavlos Kollias[1], *Edward Luke*[2], *Matthew Shupe*[3]

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Specification of hydrometeor phase in clouds is critical for the determination of their radiative properties and the evolution of their macrophysical and microphysical structure. Cloud phase identification from remote sensors is regarded as particularly challenging especially at temperatures (from below 0 to -30 °C) where both liquid and ice cloud phases are sustainable. Depolarization measurements from lidars and radars have the potential to identify non-spherical (ice) particles; however, such measurements are not widely available and contain uncertainties. A new technique that utilizes recorded Doppler spectra from profiling cloud radars to identify the hydrometeor phase is described here. The phase retrieval algorithm uses morphological feature of the recorded Doppler spectra to extract information on hydrometeor phase using a neural network technique. The technique is applied to a month-long dataset of mixed-phase clouds collected during the Mixed-Phase Artic Cloud Experiment (MPACE) conducted by the Atmospheric Radiation Measurement (ARM) program in September-October of 2004 in the North Slope of Alaska. The phase retrievals exhibit great morphological consistency when compared with observations from a High Spectral Resolution Lidar and other ARM sensors available during the experiment. Due to the ability of cloud radars to penetrate liquid layers, this radar-based technique does not have the limitations of lidars and provides phase information at the radar resolution (45 m and 2 sec). The technique is applicable to all profiling radars that have sufficient sensitivity to observed thin clouds and we demonstrate that Doppler spectra morphology can be used to highlight physical processes in clouds.

I07-3B8.4 **11:30**

Estimation of the time-variable part of the geoid from monthly GRACE solutions

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The geoid, an equipotential surface of the Earth's gravity field that closely represents the global mean sea level, varies with time in response to mass redistributions caused by various processes in the Earth system. These processes, which include atmospheric, oceanic and hydrological circulations, solid earth and ocean tides, crustal motions, various geodynamic events, and mass variations inside the Earth, can be detected by the GRACE satellites. GRACE is a twin-satellite gravity mission launched in 2002 for mapping the Earth's gravity field and its time-variable component with unprecedented accuracy at a spatial resolution of about 450 km.

In this contribution, we present results on the time-variable part of the geoid over Canada from the available monthly GRACE gravity models. Our results indicate that the seasonal geoid variability is about 5 mm in RMS for wavelengths longer than 450 km. This variation is mainly due to the hydrological cycle. On the other hand, the inter-annual trend reaches an approximate maximum of 1.5 mm per year and is closely correlated with post-glacial rebound in Canada.

A05-1D6.3 **16:30**

The success of the weather data archive at the University of Waterloo weather station

Frank Seglenieks, *Eric Soulis*

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The University of Waterloo weather station has been in operation since 1998 providing detailed weather information for researchers and the general public. Current conditions, updated every 15 minutes, are presented on the main website (weather.uwaterloo.ca) as well as links to a publicly accessible archive of past weather conditions.

This study will summarize the types of weather information that are requested by the public, the methods of delivery of the data to the public, and the various ways the data from the station have been used by the public.

The UW weather station archive allows members of the public to download every reading that has ever been recorded at the station. The main archive is accessible through the weather station website in two different formats: an SQL query based web search or comma separated value files.

Although the data archive is available every 15 minutes, in practice most users are interested in the daily summaries of the data. As well, the general public are less likely to be interested in such readings as incoming shortwave radiation or humidity, instead they are more likely to only be interested in temperature and precipitation. This demand is what prompted the need to create the daily temperature and precipitation comma separated value files.

Although every use of the UW weather station data archive is not tracked, from feedback we are aware of the weather station archive being used for the following purposes: feasibility for solar energy and wind energy generation, data sets for undergraduate courses, engineering consultants interested in temperatures for setting concrete, landscape companies wanting to know if they should water newly planted beds, migraine sufferers checking up on the atmospheric pressure, and police agencies needing data for criminal investigations.

C04-4B5.5 **11:30**

15 years of daily summer land surface temperature variation over Canada/Alaska derived from SSM/I EASE-Grid database

Alain Royer[1], *Ghislain Picard*[2], *Michel Fily*[2]

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Polar regions are anticipated to evolve significantly in response to the expected increase in temperature over the next decades. To bypass the lack of meteorological stations in boreal high latitudes, remote sensing observations are the only alternative for monitoring the actual evolution. This project deals with the development of a new database of summer land surface temperature over Canada/Alaska derived from satellite microwave measurements as this type of data presents the strong advantage of being slightly influenced by the atmosphere. Over the 1988-2005 period, the database includes observations from 3 different sensors (SSM/I on board DMSP F8, F11 and F13) whose characteristics vary (mainly calibration and time of acquisition). As a consequence, sensor replacement induces artifacts in the derived surface temperature which, in turn, bias the climatic analysis of the series. We present here a normalization method to overcome the sensor changes and to interpolate missing data. Over Canada/Alaska, the normalization method uses a diurnal cycle model derived from ERA40 re-analysis (ECMWF 2.5°) dataset which is fitted to the two satellite measurements available per day. The derived parameter is thus a consistent hourly series of temperatures during the summer (without snow). This approach shows that SMM/I F8 data are biased by -2.03°C over the whole Canada/Alaska area, when compared to SSM/I F11 and F13 data. The normalization approach is validated against in situ measurements; the mean accuracy is of the order of 2.5 - 3 K. Trend over the last 15 years confirms the observed climate trend (increase of summer surface temperature of + 0.1 ± 0.04°C per year) as well as regional impacts of climate variability (El Niño, Pinatubo). The derived annual sum of positive degree-days (thawing Index) shows that the lower values of this thawing Index are well related to the presence of continuous and dense discontinuous permafrost.

A02-1B7.2 **10:45**

Recent changes to the GEM-LAM at 2.5 km horizontal resolution

Amin Erfani[1], *Jocelyn Mailhot*[2], *André Méthot*[1], *Michel Desgagné*[2], *Jason Milbrandt*[2], *Andre Plante*[1], *Neil McLennan*[1], *Bertrand Denis*[2], *Victor Thomas*[1], *Richard Moffet*[1]

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Since summer of 2005 two experimental GEM-LAM windows at 2.5 km resolution, one over southern British Colombia and parts of Alberta and the other over southern Ontario and Quebec, are being run daily in operational mode at CMC. The evaluations of the two windows are made possible in collaboration with the operational forecasters on duty from various centers across the country. Some problems such as the model cloud spin up time, precipitation typing and amounts, location of the precipitation with respect to the mountains and the initial conditions of surface parameterization are identified. A new nesting strategy, that was implemented last fall, has proven to reduce the cloud spin up time drastically at a low cost. The issues of the precipitation are under examination using a new multi-moment explicit condensation scheme. Some research and development (R & D) is under way to resolve other issues. This presentation will provide the recent changes to the GEM-LAM at 2.5 km and will offer some highlights of the present R & D work for further improvement to the performance of this model.

H01-1D4.1 **16:00**

Influence of basin scale, morphology and physiography on flow regime within the Batchawana River watershed.

Fred Beall[1], *Chelene Krezek*[1], *Irena Creed*[2]

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The distribution of gauges on natural streams throughout Canada is limited in many regions, particularly in Northern areas, and is generally confined to larger basins. Simple methods to predict flows at ungauged catchments are needed for numerous water resource applications. One potential method employs Flow Duration Curves (FDCs) to describe the regional hydrological regime. To improve our confidence in these methodologies and to develop metrics for the comparison of basins, the sensitivity of FDC's to different watershed characteristics is needed. Within the Batchawana River watershed, draining into the eastern end of Lake Superior, a hierarchy of gauges has been monitored since 2003, ranging from 1st to 6th order in scale. A natural biogeoclimatic gradient separates the watershed into different physiographic regions. Due to the proximity to Lake Superior and local orographic effects in areas of high relief, precipitation varies approximately 200 mm across the watershed. The southern portion is within the Great Lakes – St. Lawrence Forest region and the northern portion is part of the Boreal Forest region. The watershed contains numerous lakes and wetlands providing morphological variability in the gauged basins. These characteristics make the Batchawana an ideal watershed to test the sensitivity of metrics derived from FDCs on: 1) basin scale, 2) climate and physiographic setting, and 3) basin morphology. We will present the results of this analysis and discuss the utility of this approach.

H04-3B4.5 **11:45**

Simulated streamflow on ungauged basins of the Mackenzie Basin, results from Mackenzie runoff assessment project

Frank Seglenieks[1], *Eric Soulis*[1], *Al Pietroniro*[2]

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This study is focused on assessing runoff and streamflow in the Mackenzie basin pipeline corridor at ungauged locations. Environment Canada will require both model and observed data in order to assess industry estimates of hydrologic conditions required for design considerations with respect to stream crossings. Since much of the proposed pipeline route is ungauged, a distributed hydrological model is required to assess initial hydrological design parameters.

NWRI and the Department of Civil engineering at the University of Waterloo have established a joint venture that will provide improved modeling and runoff estimates needed for assessing the proposed development of the Mackenzie valley pipeline. The emphasis is on contributing to sustainability strategies for northern rivers, contributing to scientific understanding of these systems, and developing partnerships to improve the understanding of the hydrology of the Mackenzie River Basin.

The WATFLOOD distributed hydrological model was used in this study and run for the time period of

1961 to 1990. Input data for the model came from two different sources: Environment Canada observation stations and weather model output from the European Centre for Medium Range Weather Forecasts (ECMWF) ERA-40 reanalysis product.

Output from the model simulations were used to fill in missing streamflow simulations on gauged basins and to create simulated streamflow records on ungauged basins. Flow frequency diagrams were also produced for all major rivers that flow into the Mackenzie River from Fort Simpson to the Mackenzie delta.

S03-3C3.5 **14:45**

Estimation of Snow Accumulation in Antarctica Using Automated Acoustic Depth Gauge Measurements

Shelley L. Knuth, Dr. Gregory J. Tripoli, Jonathan E. Thom, George A. Weidner, Dr. Charles R. Stearns

(Presented by *Shelley Knuth*)
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Antarctica is a continent of many meteorological unknowns, the most significant of which is the temporal and spatial distribution of precipitation. Traditional methods of quantifying precipitation, such as estimates from microwave sounders, snow gauges, or radar are not feasible or not available in Antarctica at the present time. Consequently, the amount of accumulation at a given site, whether by blowing snow or falling precipitation, remains largely unknown. Acoustic depth gauges (ADG) provide the only concrete real-time information for accumulation in Antarctica. However, ADGs only measure snow depth change and not precipitation. The real issue is determining the influence of precipitation on snow depth change as observed from the ADGs. The focus of this project is to evaluate the usefulness of continuous automated snow depth measurements for the purpose of measuring precipitation. There are two specific goals of this work – 1) to determine if the accumulation of snow at a given observation site is significantly affected by the horizontal transport of snow; and 2) to determine if measurements of snow depth change are sufficient to define precipitation patterns. This project, lasting from 2003-2006, resulted in the placement of eight ADGs mounted onboard automatic weather stations (AWS) at several locations across Antarctica. Using information from the AWS, ADG, and other data collected, preliminary studies on expected causes of accumulation at each station were conducted. The results suggested that observation of snow depth change alone was not sufficient to determine precipitation. However, closer examination of the measurements suggested that when depth observations were combined with other measurements, the potential exists to accurately estimate the contribution of precipitation to depth change.

P-3A1.1 **INVITED/INVITÉ** **08:30**

Role of Space Geodesy in the Quantification of 20th Century Sea Level Rise / Rôle de la géodésie spatiale dans la quantification de la montée du niveau de la mer

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Geodesy in the 21st Century is evolving into a cross-disciplinary science and engineering discipline. The complicated dynamic processes of the Earth system manifested by interactions between the solid

Earth and its fluid layers, including ocean, atmosphere, cryosphere and hydrosphere, are linked with such phenomena as global sea level rise and global climate change. Increasingly accurate and innovative space geodetic and remote sensing observations are enabling one to address such complex interdisciplinary research problems as the determination and quantification of the causes of present-day sea level rise. The current and post-IPCC Third Assessment Report (TAR, 2001) determination of the 20th Century sea level rise is estimated to be around 1.7-1.8 mm/yr. While the observations could not be explained by plausible geophysical causes during the 2001 TAR by ~40%, the assessment during the current IPCC Fourth Assessment Report (FAR, 2007) effort implicates a much closer budget in that the geophysical explanations largely accounts for the observed sea level rise. However, the agreement could potentially be accidental due to largely unknown geophysical factors including anthropogenic water impoundment and potential hydrologic imbalance. This paper discusses the role of space geodesy in the determination and explanation of the causes of the 20th century global sea level rise, using data including tide gauges (1900-2004), multiple satellite altimetry (1984-2005), hydrographic data, satellite gravimetry (GRACE, 2002-2006) and radar altimetry observed mass changes of large ice sheets (1992-2004). The paper also summarizes the current IPCC assessment of the 20th century sea level rise budget and its interpretation.

C04-4D5.4 **16:45**

The influence of interannual variability of weather parameters on winter roads in the Northwest Territories

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Every winter in the Canadian arctic, highways are engineered over the frozen lakes, rivers, and snow-covered land. The purpose is to transport heavy machinery, fuel, and other supplies to remote communities, and mines in a cost effective manner. The fact that the Northwest Territories (NWT) is located in a region of most pronounced cold-season warming in the Northern Hemisphere suggests that winter road seasons are becoming progressively shorter.

Research has focused on Norman Wells, at the center of the Mackenzie River Basin winter road network, and will include Inuvik, Fort Simpson, and Yellowknife in the final analysis. Yearly data on the opening and closing dates of the winter roads since 1982 have been acquired, analyzed, and compared statistically to both surface temperature data and to large-scale synoptic structures. Three extreme early-opening years and two extreme late-opening years were selected for this study. The synoptic conditions, prior to opening dates, were subsequently analyzed, using global and regional reanalysis as well as output from the Canadian Regional Climate Model. Animations will be produced from Modis satellite data for these five case studies to understand the evolution of the conditions prior to the winter road opening date.

This analysis of meteorological conditions associated with various winter road opening dates promises to provide planners with more precise information germane to this road construction.

I14-1D9.2 **16:15**

Nitrous oxide (N_2O) outputs from a nitrogen saturated northern hardwood forest: The source of the missing nitrogen (N) in catchment budgets?

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Primary production within forests was traditionally considered to be limited by rates of nitrogen (N) cycling, with little N leaving the forest. However, many forest systems have shifted from being N limited to N saturated due to persistent atmospheric deposition of N. In N saturated forests, N outputs to the atmosphere or to aquatic systems should be equal to N inputs. Yet, N mass budgets of N saturated systems indicate that only about 50% of N entering the system is discharged from forests in the form of dissolved inorganic (nitrate and ammonium) and organic N in surface waters. We hypothesized that the "missing N" from N mass budgets may be attributed to gaseous forms of nitrogen, namely nitrous oxide (N_2O) and dinitrogen (N_2). Since field-based measurements of N_2 efflux cannot easily be done, we tested this hypothesis by monitoring N_2O outputs from upland and wetland-dominated catchments in the Turkey Lakes Watershed, Ontario, Canada during the spring melt and autumn storms of 2006. We observed that when N_2O outputs from the spring melt and autumn storms are included in N mass budgets, N outputs greatly exceed N inputs. The major pathway for N output was soil N_2O efflux to the atmosphere which was much higher than both aquatic N_2O and traditionally measured dissolved inorganic and organic N outputs. Additionally, we observed that both soil N_2O efflux and aquatic N_2O export from wetland-dominated catchments were larger than those from upland-dominated catchments. These findings suggest that N saturated systems are potentially large sources of N_2O. Furthermore, the importance of wetlands and N saturated areas in determining the magnitude of N_2O efflux complicates the estimation of total N export from complex terrain that may be very important in determining Canada's contribution to global warming.

I13-4C9.3 **14:30**

IPY Data Management—Building the Legacy

Mark Parsons

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The legacy of the International Geophysical Year and past International Polar Years is in the scientific data collected. The upcoming IPY will result in an unprecedented collection of geophysical and social science data from the Polar Regions. To realize the full scientific and interdisciplinary utility of these data it is essential to consider the design of data management systems early in the experimental planning process. This presentation will present an array of high level data management considerations for the IPY including cross-disciplinary data access, essential documentation, system guidance, and long-term data archiving and how the IPY has begun to address these issues.

The primary means by which IPY is addressing data management is through the IPY Data Policy and Management Subcommittee and by endorsing an IPY Data and Information Service as described in the IPY Framework document. We will review the initial work and future plans of these and related groups including details of the IPY Data Policy, data strategy, and actual data flow. Interactions with other international efforts, such as the Global Earth Observing System of Systems, will also be discussed.

Ultimately a long-term test of the legacy of IPY will be the quality, availability, and usability of the data collected. IPY is working hard to ensure that legacy.

I15-2C9.6 **15:15**

Community Scale Carbon Dioxide Fluxes Within a Forested Wetland- Pond Complex in the Western Boreal Plain

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Climate change will have serious implications for sensitive northern ecosystems, such as the forested wetland-pond complexes throughout the Western Boreal Plain (WBP). It is expected that climate change at high latitudes will be among the largest and fastest of any region and may be augmented by land-use change (e.g. timber removal, road establishment, and corridor creation to enable industry access to prime regions for extraction of timber and oil). This study examines rates of net ecosystem exchange (NEE), total respiration (RESP) and gross ecosystem production (GEP) of CO_2 from the period of snowmelt through to fall freeze-back. Seasonal patterns and ranges of NEE, RESP and GEP in a peatland-forested hillslope transect with different substrate, plant communities, hydrology, and microclimates have been analyzed. Examining understory CO_2 dynamics and environmental conditions will explain what physical changes (e.g. canopy removal) will directly affect the growth and sequestering of carbon in understory species improving our ability to develop predictive relationships among carbon exchange, and environmental controls in forested wetland carbon exchanges. A closed dynamic chamber system was used to measure the CO_2 exchange at 18 sites located in peatlands, riparian zones and upland forested areas spanning a wide range of micro-climates and vegetation communities. An analysis of the environmental conditions (soil and air temperatures, photosynthetic active radiation, depth to frost, soil moisture, and water table) used along with above and below ground productivity were measured in order to understand the role of productivity in sequestering carbon. Results show that differences in microclimate have the strongest influence on variations in CO_2 exchange. Thus, CO_2 exchange within different landscape units in the WBP may not react the same to climate change and disturbances.

C04-4D5.5 **17:00**

Holocene climate and vegetation change on Victoria Island, western Canadian Arctic

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A detailed pollen record from northwest Victoria Island provides the first quantitative Holocene climate reconstruction for the western Canadian Arctic. The pollen percentage data indicate that Arctic herbs increased over the Holocene in response to gradual cooling. The influx of locally- and regionally-derived pollen grains tracked temperature changes observed in the GISP2 ice-core record and biogenic silica values from Arolik Lake, Alaska, suggesting that Holocene climate changes closely controlled Arctic plant productivity. The quantitative climate reconstructions indicate that July temperature cooled by 1 – 1.5 ºC during the Holocene, but the pollen influx values suggest this might be a minimum estimate. The pollen-based reconstructions record an increase in temperature of ~0.5 ºC over the last 100 years, and the pollen percentage and influx data indicate significant impacts of recent warming on the regional vegetation. However, recent changes in pollen percentages and influx values are minor compared to those that occurred during the early Holocene, underscoring the importance of developing long-term records to contextualize recent climate changes.

C01-3DP.2 **16:00**

Multivariate Classification of Calgary Weather Systems: Exploring Trends, Variability and Synoptic Relationships, 1953-2004

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Multivariate synoptic exploration of weather system frequency over Calgary identified changes in climate and relationships between weather systems and precipitation and snowfall not previously observed. Fourteen weather systems were objectively defined using a combination of principal components analysis, cluster analysis and discriminant functions analysis. All days from 1953 to 2004 were classified using Environment Canada observations from Calgary International Airport. The multivariate procedure successfully distinguished seasonal weather systems and ranked the importance of precipitation and snow bearing weather systems in terms of amount and frequency. Over the observation period warm, dry high pressure systems have become more frequent at the expense of precipitation bearing frontal systems. Two specific weather systems dominate annual precipitation amount and frequency and have not changed significantly in frequency over the observation period. As a result, annual precipitation amounts have not changed significantly. Five other weather systems bear smaller amounts of precipitation and have decreased significantly in frequency resulting in lower annual snowfall amounts. Finally, in response to the positive phase of large scale synoptic indices, the winter frequency of warm weather systems increased, while cold frontal systems decreased.

A07-3B7.2 **10:45**

Measurements of atmospheric trace gases in the Arctic: First light measurements from the new FTIR spectrometer at PEARL

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In order to fully understand the mechanisms and processes which result in ozone depletion and climate change, quality measurements of atmospheric trace gases from high latitude observatories are essential. The atmospheric observatory at Eureka (80ºN, 86ºW) has recently been rejuvenated by the Canadian Network for the Detection of Atmospheric Change (CANDAC). A new Bruker IFS 125HR Fourier transform infrared spectrometer was installed at the Polar Environment Atmospheric Research Laboratory (PEARL), 610m above sea level, in July 2006. With a resolution of 0.0035 cm^{-1} and the capability of making automated measurements of approximately 15 different trace gases in the mid-infrared region, this instrument promises to be an essential component of the Arctic observing network. This presentation will introduce the instrument and present preliminary results from the 2006 first-light and 2007 polar sunrise campaigns.

I12-3B9.3 **11:00**

Water cycling and drought in three major river basins in N. America

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Local evaporation has been shown to be an important source of moisture for precipitation in many continental regions. The precipitation recycling ratio (defined as the fraction of total precipitation that is derived from local evaporation) for three adjacent major river basins along a north-south transect over the Great Plains and its northern extension (the Mackenzie, Saskatchewan and Mississippi basins) are evaluated by applying the ECMWF ERA-40 reanalysis data to the bulk recycling estimation method of Eltahir and Bras (1994). Recycling results and associated water cycling processes in the three regions are compared to better understand warm-season water cycling in regions that are characterized by different climate in N. America. In particular, the relative roles of cold- and warm-season water cycling processes, the large-scale and regional circulations, and local and external moisture sources, as well as the couplings of these processes, in governing the variability of warm-season precipitation and the development of hydrometeorological extremes such as drought in the regions will be explored. Implications of the results to improving dynamical seasonal predictions of warm-season precipitation and drought will also be discussed.

H01-2DP.14 **16:00**

From barren to reclamed land in Sudbury, northern Ontario: 45 years of hydrological changes / De la pseudo-désertification au reboisement des terres à Sudbury, au nord de l'Ontario: 45 ans de changements hydrologiques.

Anne Watelet

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Vegetation and soil loss resulting from mining and smelting activities in Sudbury, northern Ontario, has become well documented. On the contrary, the effects of this environmental degradation on the hydrological balance and water level of lakes and streams have not been studied. For the last thirty years, watersheds have been revegetated and forested. Using geographical information system and simulation, this study aims at contrasting hydrological conditions preceding and following land reclamation. Preliminary results indicate that soil depth is an important parameter but that tree density is getting high enough to influence the balance.

La destruction de la végétation et l’érosion des sols qui ont résulté des activités minières à Sudbury dans le nord de l’Ontario, commencent à être bien documentées. Cependant, les effets de cette dévastation environnementale sur le bilan hydrique et le niveau d’eau des lacs et cours d’eau sont moins connus. Alors que les bassins versants sont revégétés et reboisés depuis trente ans, de nouvelles conditions hydrologiques se sont établies. Le système d’information géographique et la simulation permettent de comparer les conditions hydrologiques précédant et suivant l’effort de reboisement. Les résultats préliminaires indiquent que si la faible profondeur des sols est un paramètre clé, la densité des arbres, sans cesse croissante, vient maintenant influencer le bilan.

G04-2DP.1 **16:00**

High resolution chronostratigraphy in the Hudson Bay and Strait since the last deglaciation: preliminary results

Michel Lajoie[1], *Guillaume St-Onge*[2], *Patrick Lajeunesse*[3]

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Several gravity and piston cores were collected in Hudson Bay and Strait onboard the CCGS Amundsen in 2005 in order to develop a high resolution chronostratigraphy since last deglaciation. The coring sites were selected based on data from a hull mounted 3.5 kHz subbottom profiler and multibeam sonar of the ship that show the areas to have a high sedimentation rate. Sediment cores were collected in south eastern (cores 20 PC and KUJ 01), central (core 27b LEH) and northern (core 17PC) Hudson Bay and western Hudson Strait (cores 28 PC and 14e PC). Onshore, the cores were run through a Multi Sensor Core Logger for the determination of wet bulk density and volumetric whole core magnetic susceptibility. The cores were also scanned using a CAT-Scan for the identification of sedimentary structures and the extraction of CT numbers. The cores were then split, photographed, described and measured for color reflectance using a hand-held spectrophotometer. Grain size measurements were also carried out using a Coulter Counter Laser Sizer. As a whole, the cores are characterized by olive grey to dark grey clayey silts. However, in cores 27b LEH and 28 PC, reddish sediments are observed from 147 cm to the base of core 27b LEH and from 296 cm to 304 cm in core 28 PC. Ten pelecypod shells or shell fragments were dated using the AMS ^{14}C method and indicate that the cores are predominantly composed of postglacial sediments. Preliminary observations of the different physical and magnetic susceptibility profiles indicate that several features can be correlated. Moreover, analyses from the two reddish layers indicate a low magnetic susceptibility and a high a* values. This was previously observed in the Hudson Strait sediments and is related to the final drainage of Lake Agassiz (see also St-Onge and Lajeunesse, this meeting). Sediment samples were collected 1 cm above and below these reddish layers and contain foraminera that will be use for ^{14}C dating. Finally, paleomagnetism analyses are currently underway to help better constrain the ages of the two reddish layers and to develop a regional chronostratigraphy framework.

I12-3B9.7 **12:00**

Managing and Preparing for Drought: An Assessment of Drought Indices in Ontario

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Drought conditions experienced over southern Ontario from mid-1997 through 1999, during 2001 and 2002, and again in the summer of 2005 have heightened concerns with many municipalities and provincial Conservation Authorities over the future of regional water resources. Under climate change, scientists project that more frequent and intense drought is likely. Vulnerability to drought under climate change will be compounded by additional stressors such as population growth and suburban sprawl.

The ‘Tap Runs Dry’ drought study focuses on an evaluation of the urban impacts of recent droughts and documents the adaptive responses to the drought conditions in case study communities in the Greater Toronto Area, Guelph and Kitchener-Waterloo, Ontario. One component of the study is to use drought indices to help determine the severity, duration and spatial coverage of the recent droughts in comparison to historical droughts over the instrumental period of record. Standard drought indices such as the Standardized Precipitation Index (SPI), precipitation departure from normal and precipitation deciles were evaluated for their usefulness in the identification and monitoring of drought conditions.

The Ontario Low Water Response Plan (OLWR) was developed by the Province in Ontario in 1999 to ensure that provincial and local authorities are advised of and prepared to take water conservation actions in the event of low water conditions in provincial watersheds. Three water level conditions, Levels I, II and III, are defined using specific precipitation and streamflow criteria, based on their departure from average conditions over certain time periods (i.e. from 1 to 18 months). The OLWR has an added benefit of having conservation, restriction and mandatory regulatory adaptive actions associated with the three threshold severity levels defined within the program. The 'Tap Runs Dry' project assesses the OLWR to determine its usefulness in monitoring drought related low flow conditions and in providing guidance to potential response actions as the level of low water availability and drought severity increases. The potential use of the OLWR to predict drought risk conditions as they emerge and evolve is also discussed.

G05-3B2.2 **11:00**

Continental rifting, breakup and early sea-floor spreading offshore Nova Scotia and the eastern Grand Banks: A summary of results from the Mariprobe Program

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This paper reviews the nature of continental rifting, breakup and earliest sea-floor spreading offshore Nova Scotia and the eastern Grand Banks, based on observations from coincident seismic reflection and refraction profiles primarily taken during the Mariprobe Program. These profiles represent the best constraints to date on how margin structures evolve both along as well as between rift segments. For the Nova Scotia margin, our results indicate that volcanism associated with the US East Coast margin only influenced the extreme southwestern segment. The termination of the volcanism is coincident with the southern limit of the slope diapiric salt province and a major change in character of the East Coast Magnetic Anomaly. Across the central margin, we observe a wide region of highly thinned continental crust extending beneath and seaward of the salt. An unusual zone of large rotated-fault blocks terminate abruptly at the continent-ocean boundary, coincident with a major change in the style of rifting along the margin. Further north, the region of thin crust widens and a transitional basement interpreted as highly serpentinized mantle appears. The thickness of initial ocean crust reduces significantly from south to north. For the eastern Grand Banks and Newfoundland basin, thinning of the continental crust is much more abrupt than for the Nova Scotian margin. Within the seaward zone of highly thin crust, however, we observe similar features but in reverse sequence. A wide transitional region occurs in the southern part, with partially serpentinized mantle overlain by basement that varies from highly thinned continental crust to highly serpentinized mantle (HSM). This transitional region becomes narrower to the north and the HSM zone terminates south of Flemish Cap. These results suggest that each margin segment exhibits complex but also consistent variations of continental thinning and the exposure of mantle or production of ultra slow spreading crust.

G10-1D2.5 **17:30**

Influence of scattering on the seismic detection of mineral deposits in hardrock environments

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Seismic sections from crystalline environments represent contributions from both large scale impedance contrasts (lithological contacts, dikes/sills, faults, etc.) and background scattering effects. We categorize scattering environments as seismically transparent or reflective (noisy) depending on the ratio of seismic frequency to the dominant scale of heterogeneity, or the size of scatterers. This

heterogeneity and the resulting noise in seismic data can vary significantly depending on the area, making certain places unfavorable to seismic exploration. For mineral exploration in hardrock media, an accurate understanding of the scattering effects involved is crucial to proper processing and interpretation of seismic data. To this end, we present some recent numerical modelling to illustrate the effect of heterogeneity on recorded seismic data, and discuss how this affects our ability to accurately locate and define mineral deposits in scattering environments. Our model heterogeneity is based on log data from the Sudbury impact structure in the Canadian Shield. The Shield itself is known to have very large heterogeneity scale lengths, however within the vicinity of Sudbury, impact-induced fracturing and melting has produced areas with a wide range of scales. Embedded in these areas are several massive sulfide deposits, which are known to have characteristic seismic signatures depending on their shape, size and composition (based on models with homogeneous backgrounds). Our results show that seismic imaging may not be able to detect an orebody if the scale length of background heterogeneity is of the same order of magnitude as the size of the body, even if the deposit represents a significant impedance contrast. Moreover, if background scale lengths are large, amplitude and travel-time fluctuations introduced by this heterogeneity may alter the expected response from the orebody.

H02-2DP.1 **16:00**

Holocene paleoclimate dynamics inferred from stable isotope stratigraphy of sediments in Lake Saarikko, southeastern Finland

Maija Heikkilä[1], *Thomas W D Edwards*[2], *Heikki Seppä*[3]

(Presented by *Maija Heikkila*)
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Paleoclimate research in northern Europe has produced a large amount of quantitative high-resolution data illustrating both the general trends of climate evolution and short-term climatic events during the Holocene. So far, however, regional studies have mainly concentrated on the Atlantic and the northernmost sector of North Europe, as well as mean annual temperature records based on biological proxies in southern Sweden, southern Finland and Estonia. These studies have yielded valuable insight into some facets of climate system dynamics, but studies of climate history in the more continental and southern parts of the area are still lacking. Broader spatial coverage of sites providing high-resolution records is clearly needed to enable better regional comparisons of Holocene climate dynamics in North Europe. Studies are underway to produce Holocene records of δ18O and δ13C from both cellulose and carbonate fractions in the sediments underlying Lake Saarikko, a small open-drainage basin located in southeastern Finland. Cellulose δ18O stratigraphy should record changes in local precipitation δ18O, modified to some extent by secondary signals deriving from changes in the water balance of the lake, while the δ18O difference between co-existing cellulose and carbonate should reflect variations in summer lake water temperature. These data will be combined with independent pollen-based estimates of annual and seasonal temperature change during the Holocene from nearby Lake Laihalampi to enhance understanding of paleoclimate at the northern edge of the ecotone between the temperate and the boreal bioclimatic zones in Europe. Data obtained from ongoing monitoring of annual and seasonal variability in the isotopic composition of Lake Saarikko will provide key additional information about the lake's response to climate over short time-scales.

G06-4C2.7 **15:15**

Comparing two approaches for integral conversion of ground gravity into local geoid

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Despite recent advances in global gravity field modelling through gravity-dedicated satellite missions (CHAMP, GRACE) and high-resolution combined geopotential models (e.g. EGM'07), local ground and airborne gravity data still maintain their importance for determination of a precise and detailed local geoid model. Standard methods in solving the geoid from ground gravity data are based on Green's surface integrals that represent solutions to boundary-value problems of potential theory. In the classical approach, reduced gravity is continued to some known reference surface and then used for conversion into the disturbing potential by surface-integrated convolution of continued gravity with a respective Green's function. Thus, two integral equations must numerically be evaluated with one of them representing an inverse problem with complicated numerical solutions. Besides stipulating the mean mass density within topography, they form the major complication for geoid determination from ground gravity.

In this study, this classical approach is compared with an alternative solution that combines continuation and conversion of ground gravity in one integral equation. Both approaches are used for evaluation of the local geoid over a test region in Western Canada. Numerical computations of both approaches are compared in terms of consistence, stability and efficiency. The geoid models are also evaluated for external accuracy by using levelling benchmarks with measured GPS heights available over the test area.

A04-3C6.4 **14:15**

An Evaluation of Severe Thunderstorm Motion Algorithms over the Canadian Prairies in 2006

David Patrick[1], *Justin Hobson*[2]

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Severe thunderstorm cells over the Canadian Prairies during the summer of 2006 are examined to determine relationships between observed cell motion and various severe thunderstorm motion algorithms. There were 191 single and multiple element cases during the summer, including 149 hail, 25 wind, 24 tornado and 8 heavy rain occurrences. The cases were stratified by storm severity and storm type. Environmental proximity soundings were generated using Canadian Meteorological Centre GEM model data interpolated to the site and time of the severe weather. Proximity soundings were also generated in the pre-storm environment 1 hour and 3 hours prior to the severe weather occurrence. Six storm motion algorithms were derived using the proximity soundings: mean wind 0-6 km AGL, mean wind 0-8 km AGL, 30R75, Bunkers method, Bunkers method using at 0-8 km AGL mean wind, and the density-weighted mean wind from the base of the convection to the top of the convection. The performance of the algorithms is evaluated for various types of severe weather and the results are presented.

C01-3DP.1 **16:00**

A preliminary study of the 2006/7 early winter temperature anomaly

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The anomalous weather in early winter 2006/7 across Canada, especially the extreme warm event in eastern Canada, has attracted a lot of attention from the media and the public, with particular concern as to whether these climatic events would be expected to be normal in the future. In this preliminary study, taking Ottawa as an example, we analyzed the climate data over the early winter period in an attempt to partially respond to these concerns. The unseasonably warmer weather in Ottawa started on November 6 and ended on January 15, in comparison to the 1961-1990 climate normals, with 6 days below normal daily mean temperatures over the entire 71-day period. This warm period was replaced by a cold spell, but that is beyond the scope of this study. The early winter (Nov 6-Jan 15) mean maximum temperature for 2006/7 was 4.4ºC, 6ºC higher than the 1961-1990 normal for the same period and approximately 3.5 times the standard deviation. Assuming a Gaussian distribution, such a departure is likely to occur once every 4200 years. The early winter mean maximum, minimum and mean temperatures for 2006/7 were all ranked the highest since 1895. Accumulated heat degree days and the number of above-freezing days (daily minimum temperature above 0ºC) for this early winter were also record-breaking. However, temperatures for individual days in this early winter were not record-breaking, although many days were ranked among the warmest for the period. Daily minimum and mean temperatures on January 7 of 2007 were 19.6 and 18.0ºC higher than the 1961-1990 normals, and the corresponding anomalies were both ranked as the third highest among early winter daily anomalies since 1895. Examining daily values for the Ottawa region for 1961-1990 and 2040-2069 from climate change simulations conducted using two general circulation models (CGCM2 and HadCM3), we note that the 2006/7 early winter anomaly is still not likely to become “normal” by the middle of this century. Uncertainties remain high as climate predictions at the GCM scale is not always comparable to local climate.

O01-2B1.3 **11:00**

Short Term Predictability of the North Atlantic

Keith Thompson[1], *Yimin Liu*[1], *Youyu Lu*[2]

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The predictability of the North Atlantic with lead times ranging between 1 and 60 days is explored using a numerical model of the North Atlantic with a horizontal resolution of 1/3 of a degree. Two types of numerical integration are performed using realistic surface forcing for the period 2003 to 2006. In a free run, the model is spectrally nudged towards an observed seasonal climatology in order to suppress drift and bias of the model's temperature and salinity field. No other data are assimilated. In the assimilation runs we jointly assimilate altimeter (sea level) and Argo (temperature and salinity profile) data using a new assimilation method developed recently by Thompson and Liu. The predictability of the ocean is explored by comparing results from the free runs with 60-day ocean forecasts made from initial conditions derived from the assimilation runs. In this way we can assess the impact on predictability resulting from better knowledge of the state of the ocean. Results are presented for different subregions of the North Atlantic to illustrate the impact on predictability of vigorous eddy fields, baroclinic Rossby waves and large-scale barotropic changes.

O02-2DP.3 **16:00**

A Real-Time Water Level (RTWL) System for Atlantic Canada.

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The 2004 Sumatra Tsunami triggered a worldwide heightened awareness of the dangers of extreme water level events. In Canada this precipitated the decision to develop an Atlantic Tsunami/Storm Surge Warning System. As part of this initiative the Canadian Hydrographic Service (CHS) Atlantic was tasked to develop a real-time data collection strategy for its Atlantic water level (tide) gauges and to develop a real-time web-based interface to provide appropriate views of the real-time water level data to the Atlantic Storm Prediction Center (ASPC), the North American Tsunami Warning Center in Palmer Alaska and designated Emergency Measures Organizations (EMOs).

Notwithstanding the tsunami/storm surge warning system requirement for real-time data and access to this data, CHS Atlantic recognizes and envisions other present and future applications for these new capabilities. These include, but are not limited to: operational oceanography, navigation, shipping, and flood risk assessment. To meet its developing vision for water level data, to comply with the new tsunami mandate, and in anticipation of future water level client needs, CHS Atlantic has undertaken the RTWL Project.

The aims of the RTWL Project are: (1) to redress the limitations of existing tide gauge infrastructure (equipment housing, sensors, data recorders, and data transmission methods); (2) to establish the appropriate water level data acquisition, data storage, and data dissemination systems; (3) to develop cutting edge water level quality control algorithms; (4) to incorporate advanced data products (forecasts) into CHS's water level capacity.

We will review the RTWL project's present state of implementation, discuss its ongoing developments, overview CHS Atlantic's intentions for it in the future, and present new observations illustrating its capabilities.

G11-3C2.4 **INVITED/INVITÉ 14:30**

Using VSP's to Correct Deficiencies in Surface Seismic Data.

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Surface seismic data in White Rose and adjacent regions pose several challenges to the processor and interpreter. The issues are those of imaging and stratigraphic resolution.

Structurally, the area is complexly faulted. The water bottom is extremely hard, generating strong multiples. Immediately above the reservoir, there is a high amplitude reflection event, below which multiples cascade.

The reservoir is comprised of sandstones overlain by shales and mudstones, The top of the reservoir has a very low impedance contrast between it and the overlying shales, resulting in a very weak reflection at the reservoir top. This weak reflectivity, coupled with water-bottom multiples with periods that make these multiples coincident with the reservoir top reflection causes destructive interference, making seismic picking and mapping challenging. Furthermore, the reservoir base is a discontinuous reflector. Faulting occurs at various scales through the reservoir and the ability to interpret these faults is crucial to maximizing recoverable hydrocarbons.

Significant improvement in the seismic data was attained by honouring information from well logs where it related to the seismic response. Several VSP datasets were used to provide a bridge between log data in depth and the seismic response in time. Effective anisotropy parameters as determined from a walkaway VSP, were also used in the reprocessing of the seismic data.

A 1D calibrated anisotropic velocity model derived from VSP data provided the means to guide the selection and optimization of processing parameters. A fully elastic synthetic gather was produced and used to test multiple removal parameters and algorithms.

A further directly measurable parameter from the borehole data was inelastic attenuation, 'Q', and an inverse 'Q' filter was applied to the surface data.

This presentation will show the improvements attained in reprocessing the seismic data using available well information.

C02-1B5.6 **11:45**

A new ice-core record from the Prince of Wales icefield, Ellesmere Island: Initial results and paleoclimatic significance.

Christian Zdanowicz[1], *Jiancheng Zheng*[1], *David Fisher*[1], *Christophe Kinnard*[2], *Mark Marschner*[3], *Dorthe Dahl-Jensen*[4], *Lindsey Nicholson*[5], *Martin Sharp*[5], *Vivian Wasiuta*[6], *Anne-Lise Norman*[6], *Shawn Marshall*[7]

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In April-May 2005, a joint University-Government research team recovered a series of cores totalling ~360 m from the Prince of Wales (PofW) icefield on central Ellesmere Island (78.4 N, 80.4 W, 1630 m asl). The purpose of this project is to investigate the coupled sea-ice / climate variability in the northern Baffin Bay sector of the High Arctic over the past millennium using ice-core poxies as well as sea-ice cover and meterological data. The longest PofW core (to bedrock) is 178 m long and preliminary analysis indicates that the climate record it contains extends back at least to the Wisconsin-Holocene transition (11,550 yr BP), with optimal temporal resolution over the last two millennia. The core was sampled at very high resolution (1.3 cm / sample) on a newly developed continuous ice-core melter system, and samples are being analyzed for stable O and H isotope ratios, major ionic impurities, and other properties. A second, 150-m long core will be analyzed for isotopes of S and O to help apportion sources of sulphate in the ice. In this presentation, we will report initial results from the oxygen isotope, conductivity, density and physical stratigraphic analyses of the main PofW core. In particular, methodological refinements to the melter system have allowed for the development of a record of ice density and melt-features (proxies for summer warmth) of unprecedented resolution for the Canadian Arctic. The paleoclimatic significance data of these and other results will be discussed in the context of findings from ice-core records previously developed in the Canadian Arctic (N. Ellesmere, Devon and Baffin Islands) and from Svalbard and Greenland.

A06-1D7.7 **17:30**

Parameterizing the impacts of mixed-phase layer clouds on shortwave radiation

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Mixed-phase clouds are quite prevalent in the Arctic, making up about one-third of all Arctic clouds. However, most climate models represent such clouds with a single phase, in part due to the limited observations of mixed-phase clouds properties and their impact on radiation. The Surface Heat Budget of the Arctic (SHEBA) program and the Mixed-Phase Arctic Cloud Experiment (M-PACE) have provided two unique data sets of cloud microphysical and macrophysical properties. Several case studies from both campaigns have been selected to investigate the impact of multiphase clouds on shortwave radiation fields. Numerous cloud characteristics including the size and distribution of ice and liquid patches in the cloud have been determined from co-located radar and lidar observations. Liquid and ice are not homogeneously distributed throughout the cloud suggesting that a statistical representation of cloud properties may be a more successful approach to modeling radiative transfer in these situations. Therefore, a stochastic radiative transfer model is used to simulated shortwave radiation flowing through an inhomogeneous mix of ice and liquid patches in a layer cloud. Model results from the case studies indicate that a linear approximation similar to cloud fraction may capture the impact of the presence of both water phases at large scales.

H06-4C4.6 **14:45**

Distributed modelling of glacier mass balance from off-glacier AWS data.

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The introduction of the automatic weather stations (AWS) to the Peyto Glacier Basin has opened up exciting new prospects for glaciological research. Together with improved digital elevation models (DEM) and remote sensing (RS) data, they allow day-to-day modelling of accumulation and ablation, such as to capture the seasonal net mass balance cycle from the data of an off-glacier AWS. Validation against data from selected AWS sites on the glacier itself generates confidence in the mass balance numbers produced from the model, but information from these stations is also used to build the model structure. In terms of the accumulation structure, it appears that the distribution of precipitation data according to a winter mass balance – elevation relationship must give way to one that is based upon an environmental lapse rate and a suitable threshold temperature for the onset of snow. These, together with DEM identification of slope angles that are too steep to hold snow, are the initial steps toward rational modelling of snow distribution in mountain basins. Others to consider include what to do with blowing snow, sublimation and snow pack densification. The ablation structure rests largely on the rich background of the much employed surface energy exchange approach to estimating ice and snow melt, where DEM, RS and off-glacier AWS data are used to distribute melt estimates over the glacier surface, thus extending the processes at work beyond the confines of a few point studies. The model elements are DEM controlled radiation inputs, RS estimates of ice albedo and a boundary-layer transfer scheme based upon air mass temperature. Future elements to consider are roughness length augmentation due to snow pack ripening and the effect of melt water content on snow pack albedo. Given that the principal off-glacier AWS inputs of precipitation, radiation and temperature are also associated with the outputs of large-scale climate models, it may be interesting to explore the results of nesting the Peyto Basin within a large grid model.

G07-2DP.1 **16:00**

Determining the deep electrical resistivity structure of the Grenville Province in Ontario, Canada

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The deep electrical resistivity of the Grenville Province in southern Ontario is being investigated in the POLARIS project using very long period magnetotelluric (MT) recordings from three observatory-style sites that were installed in Summer 2006. The locations for the sites were chosen from the 30 POLARIS seismograph sites in the region. Logistic constraints such as insufficiently deep soil and the presence of former mining operations and electromagnetic noise excluded many of the POLARIS sites as good MT locations. Shorter-period MT recordings made at the remaining sites allowed exclusion of locations with unsuitable responses for deep soundings, due to either strong distortion by near-surface features or strongly three-dimensional crustal responses. The three final locations chosen were selected from five candidate sites so as to provide a good geographical coverage of the Grenville Province.

MT recordings are being made at each observatory MT site using NIMS MT instruments, 50 to 100 m long electrode lines, and Russian-bucket style electrodes. Data are telemetred to central hubs and made publicly-available on the internet on a daily basis. The sites have now been fully calibrated and the MT responses are in good agreement with those obtained from the shorter duration recordings. Factors limiting resolution are electrode noise, which varies with the electrode resistivity; time-varying self potentials due to varying soil moisture; freezing of electrodes at one site; and breaks in the data caused by battery recharging problems. Once the last problem is overcome it is expected that with robust remote-reference spectral analysis it will possible to resolve MT responses to periods approaching or exceeding 105 s, capable of resolving the resistivity of the deep lithosphere. The magnetic field recordings can also be used to investigate the geomagnetic source fields and to define these fields for studies of geomagnetic induction on powerlines and pipelines.

C02-1C5.6 **14:45**

Physical and magnetic properties of high resolution Holocene sediment cores from the Chukchi Sea margin : preliminary results

Agathe Lisé-Pronovost[1], *Guillaume St-Onge*[1], *Leonid Polyak*[2], *Dennis Darby*[3]

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Piston cores HLY0501-06JPC (72°30’41’’N/157°01’58’’W, water depth: 673 m, length: 1554 cm) and HLY0501-08JPC (71°37’41’’N/156°51’33’’W, water depth: 90 m, length: 1396 cm) were collected on board the USCGC Healy in the Alaskan/Chukchi Sea margin as part of the Healy-Oden Trans Arctic Expedition (HOTRAX) in order to reconstruct climate variability in the Arctic during the Holocene. On board the USCGC Healy, the piston cores were ran into a Multi Sensor Core Logger for determination of wet bulk density, volumetric magnetic susceptibility and p-wave velocity, then split and described. In the laboratory, the cores were photographed with a high resolution digital camera and sampled with u-channels. These u-channels were then passed through a CAT-scan (Computerized Axial Tomography Scan) in order to identify the sedimentary structures and to extract the CT numbers, which primarily reflect changes in density with a 1-mm downcore resolution. In this paper, we will present the physical and magnetic properties of these two cores as a first step to construct a robust chronostratigraphy for the Chukchi Sea margin area. The physical and magnetic properties of core HLY0501-06JPC in conjunction with the detailed visual description allowed the identification of 4 main lithostratigraphic units, whereas 2 main lithostratigraphic units are distinguished in core HLY0501-08JPC. Three AMS ^{14}C ages in the upper unit (0-1213 cm) of core HLY0501-08JPC suggest sedimentation rates higher than 1 m/kyr and the deposition of postglacial sediments. On the

other hand, the lower unit (1213-1396 cm) is composed of stiff, grey mud with IRD and high values of magnetic susceptibility, density and CT number. Dropstones, IRD and high amplitude changes in the physical and magnetic properties of core HLY0501-06JPC are also observed in the 3 lower units (855-1554 cm), possibly highlighting a deglacial regime in both cores lower units. Finally, paleomagnetic analyses are currently underway to correlate the cores together and to construct a full vector regional paleomagnetic master curve (inclination, declination and relative paleointensity).

A02-1C7.6 **14:45**

Aerosol-Cloud Interactions in MC2 Model: Sensitivity to Collision-Coalescence and Aqueous-Phase Chemistry

Irena Paunova[1], *Henry Leighton*[2]

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The feedbacks between the aerosol, cloud microphysics and cloud chemistry are investigated in a mesoscale model. The model is added simple bulk aqueous-phase sulfur chemistry fully coupled to the aerosol and microphysics, both described by explicit bulk double-moment parameterizations. A case of summertime stratocumulus cloud system is simulated at high resolution (3 km grid spacing) and the evolution of an observed continental aerosol spectrum that changes during the course of the simulation as a result of cloud processing is examined.

The results demonstrate that the bulk approach to the aerosol and droplet spectra represents correctly the feedbacks in the coupled system. The simulations capture the characteristic bimodal aerosol size spectra resulting from cloud processing with one mode of particles consisting of those that did not participate as CCN and a second mode in the region of 0.08-0.12-μm radii comprising those that were affected by processing. New information is revealed about the impact of various processes and the spatial distribution of the processed aerosol. One cycle of physical processing produced a relatively modest impact on the processed particle mean radius of the order of 3-5 % that was comparable to the impact of chemical processing, while continuous physical recycling produced a much larger impact as high as 30-50 %. Spatially, the impact of processing is found initially in the downdraft regions below cloud and at later times at substantial distances downwind. It is shown that cloud processing can either enhance or suppress the number of activated drops in subsequent cycles.

I08-4B7.1 **INVITED/INVITÉ 10:30**

Air-Sea-Ice Interactions: Observations and modelling of cloud streets over the marginal seas of the Arctic Ocean

Kent Moore

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High latitude air-sea interaction is an important component of the earth's climate system and the exchanges of mass and energy over the marginal ice zone are complicated processes that, are at present, not well understood. In this talk, I will provide an overview of the field work that my group has done on investigating the role that sea ice plays in modulating air sea interaction over the Labrador and Irminger Seas. I will also discuss the modelling work that we have done that has been able to successfully resolve the formation and evoltuiotn of cloud streets over both the marginal ice zone and the open ocean.

H01-2DP.8 **16:00**

Laboratory column experiments to determine the hydrological and chemical controls on mercury mobility in soils

Claire Oswald, *Brian Branfireun*

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In most terrestrial environments, the predominant form of mercury, Hg(II), is associated with organic matter (OM). Higher concentrations of Hg are usually found in the organic-rich soil horizons near the surface of the forest floor as opposed to the underlying mineral soil. In the larger context of understanding the residence time of Hg in basin uplands and the controls on the transport of Hg to freshwater bodies, a lab experiment was designed to investigate vertical transport processes through the soil profile. Spatially representative bulk soil samples were collected from the mineral and organic horizons of a boreal shield catchment located in the Experimental Lakes Area, near Kenora, Ontario. The homogenized soil samples were packed into acid-washed Teflon columns, and water containing Hg and dissolved organic matter (DOM) was allowed to flow through the tubes. To test the hypothesis that the majority of Hg will be sequestered in the uppermost layers of the soil, the effluent was collected for Hg and DOM analysis and soil samples were extracted to examine the distribution of sorbed Hg over the length of the column. This information was then used as a baseline against which to compare the effects of varying the amount and intensity of flow, the quality of the DOM, and the pH of the water on the sequestration of Hg in the soil column. These experiments will help to elucidate the effects of differences in storm magnitude and intensity, the source of OM in different landscape units and the chemistry of the water flowing through the soil on the mobility of Hg in mineral and organic soils.

C01-2C6.6 **15:15**

Intense regional climate change in northwestern Canada

Jessica Cox, *John Gyakum*

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Anthropogenic climate change and accompanying rising global surface temperatures have been well established; however there is large spatial variability in the magnitude of this warming trend. Many model projections, including those made in support of Working Group I of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), predict polar amplification of warming with increased CO2 levels, but forecast the largest North American warming to be over the Canadian archipelago of northeastern Canada, not, as has so far been observed, in the Mackenzie River Basin of northwestern Canada. Possible causes for the unique warming of this area, at its strongest in wintertime, include northward shifting storm tracks combined with increased Pacific SSTs and orographically induced positive feedbacks, or the inhibition of radiative formation of polar continental air masses typical of this region.

To explore the relative importance of these possible causes we have chosen 11 representative stations in the Mackenzie River Basin with long-term temperature records. At these stations we have created surface air temperature climatologies for every winter day since 1948, using a 30-year running mean, which clearly shows the overall warming trend but with significant interseasonal variability. We also examined the magnitude of the warming trend in tropospheric upper-air layers to determine its vertical structure. Additionally, we identified and characterised anomalously hot and cold events in the region

in order to examine the secular evolution of synoptic structures during this 50-year period of extreme climate change.The processes identified in this study may be relevant for research on mechanisms responsible for future climate change.

I12-3B9.4 **11:15**

A Series of Unfortunate Events

Eyad Atallah, John Gyakum

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While it is understood the feedback mechanisms such as evapotranspiration (or, in the case of drought, the lack thereof) can have a significant impact on the presence and/or severity of drought, synoptic-scale forcing, if of sufficient magnitude, can over-ride these feedback mechanisms and either instigate or alleviate drought conditions. Therefore, the primary focus of this work is to understand the relative importance of the synoptic-scale on the modulation of the drought. Towards this end, the large-scale moisture transport by the synoptic-scale flow is examined. Also, the quasi-geostrophic forcing for ascent is calculated, and compared with the static stability of the atmosphere in terms of their relative importance for modulation of the precipitation in the region.

Preliminary results indicate that this drought can not be characterized by a single pattern. At least three disparate flow regimes appear to contribute significantly to the most recent Prairies drought. Only one of these regimes consisted of stereotypical high amplitude ridging over northwestern Canada. Furthermore, the moisture transport trajectories for periods characterized by drought are largely from the west, indicating that moisture arriving in the area is mostly in the middle to upper-troposphere as lower-level moisture is “scoured” out by the higher terrain to the west. This is in comparison to periods characterized by average to above average precipitation, where moisture transport vectors have a more southerly component, indicating significant advection of low-level moisture into the Canadian Prairies from the Gulf Coast region of the United States.

C05-3DP.6 **16:00**

The effect of the rigid lid position on hemispheric simulations using the Canadian Regional Climate Model : Results and future research

Jean-Philippe Paquin[1], Daniel Caya[2], Richard Harvey[3], René Laprise[1]

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A hemispheric configuration of the Canadian Regional Climate Model (CRCM) has been tested at an intermediate (180 km) horizontal resolution. First results showed that large negative biases in the temperature field, mainly seen in the winter lower stratosphere, developed after a short simulation period. Some assumptions were made regarding the causes of these biases; it was hypothesized that the position of the rigid lid at an altitude around 30km inhibits some dynamical processes existing in the stratosphere. To test this hypothesis, two groups of 5-year simulations (1991-1995) using the degraded ERA40 reanalyses as LBC were made, one with the rigid lid at 30km and the other at 45km.

Results show that with the higher lid, the temperature biases are locally reduced in the lower stratosphere but problems are still present in the upper stratosphere. Several factors seem to contribute to these biases between the CRCM and ERA40. First, ERA40 are biased by several degrees in the simulated period in the upper stratosphere, resulting in more complicated CRCM's validation since its results are compared to the ERA40 field. Second, the CRCM uses parameterizations of gravity wave drag and roof drag imported directly from the second generation Canadian GCM that may be inadequate. Third, stratospheric ozone concentration data used in this experiment overestimate the real concentration for the simulated period. There is no interactive chemistry in the CRCM but radiation interacts with ozone especially in the 45km experiments. Fourth, effects of the Pinatubo's eruption in 1991 are assimilated in ERA40 but the CRCM is incapable of taking into account its effects. All those hypothesis will need future research and development of new diagnostics tools to be verified and quantified.

C02-2C5.6 **15:15**

Impact of seasonality on the low-frequency teleconnection patterns in the boreal winter SLP

Hongxu Zhao, *Kent Moore*

(Presented by *Clarck Hongxu Zhao*)
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The Arctic Oscillation (AO) and the North Atlantic Oscillation (NAO) have been identified as important modes of variability in the Northern Hemisphere (NH) winter sea-level pressure (SLP) field. However, there is a debate on which one is most fundamental in describing this variability. A key uncertainty is our lack of knowledge of the impact of seasonality on the low-frequency teleconnection patterns in the boreal winter SLP. There has been an inconsistency in the definition of the base fields upon which the various EOF decompositions have been applied in the studies of climate variability in NH. Some studies used monthly mean fields during winter, while the others used winter mean fields. The use of monthly mean field clearly includes information on both intra-seasonal and inter-annual timescales, while the use of winter mean fields filters out the former and as a result only includes information on the latter. This study investigates the impact that differing definitions of the base fields have on the EOF decomposition of the NH winter SLP field. We argue that a definition of the base fields that includes variability on both intra-seasonal as well as inter-annual timescales results in spurious teleconnection patterns that are not representative of climate variability on inter-annual timescales.

I01-1D8.5 **17:00**

Numerical sub-grid convective transport of chemical tracers in AURAMS: ICARTT evaluation

Daniel Figueras-Nieto, *Ashu Dastoor*, *Junhua Zang*

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It is widely accepted that large convective storms have a major impact on the chemical composition of the troposphere. In particular deep convection has an important impact on the distribution of chemical tracers which subsequently have an effect on cloud properties and climate.

In this project a new numerical scheme has been developed for sub-grid scale transport of chemical tracers .This scheme is a modification of the Kain-Fritsh 1990 sub-grid scale convective scheme. The

Kain-Fritsh scheme is currently operational in the Global Environmental Multiscale (GEM) model at Environment Canada. With the forthcoming developments of chemical weather versions of GEM this scheme will be implemented in these, hence the importance of it being tested beforehand.

The new scheme has been implemented in A Unified Regional Air-quality Modeling System (AURAMS) model from Environment Canada. AURAMS is an Eulerian, size-resolved, composition-resolved, regional-scale, particulate-matter, air quality model. The primary evaluation of the scheme has shown promising results. We will here present a full evaluation of the scheme during the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) period running AURAMS at 15km resolution in a nested configuration.

G10-1D2.1 **16:30**

Geophysical signature of meteorite impact craters - first and second order footprints

Bernd Milkereit[1], *L'Heureux Elizabeth*[1], *Ugalde Hernan*[2]

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Through the integration of seismic and potential field data, remote sensing, exploration drilling and numerical modeling, we can constrain the size, shape and morphology of most terrestrial impact craters. New petrophysical and potential field data from the mid-sized Wanapitei, Bosumtwi and Monturaqi structures, as well as seismic data from Ries, Sudbury and Bosumtwi demonstrate the common geophysical signatures of impacts: pronounced gravity lows, prominent magnetic anomalies and often reflective target stratigraphy. Target rocks are subjected to high pressure and temperature conditions during impact, resulting in fracturing, stress-induced shearing and mixing of materials. There is typically an exponential decay in both porosity and fracture density as radial distance from the crater center increases. Fracture porosity will enhance the first-order gravity low associated with impact structures, and serve to reduce seismic parameters in the second order (velocities and densities) by increasing total porosity out to a limit where impact damage is negligible. In seismic profiles, areas of high brecciation appear transparent; footwall and basement structures in particular show no traceable horizons despite the sometimes large vertical contrasts observed in petrophysical logs. Analysis of physical property logs indicate that these structures have small scale lengths that describe the high degree of mixing and heterogeneity, resulting in only small amounts of seismic scattering. As a consequence of this mixing, pre-impact lithologies are typically disrupted in the vicinity of impact structures, giving rise to characteristic seismic profiles such as those over the Ries, Sudbury and Chicxulub impact structures.

A05-1D6.4 **16:45**

Data Management for The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut

Pierre Fogal[1], *James Drummond*[2], *Ashley Harrett*[1], *Adam Diamant*[1]

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The PEARL laboratory at Eureka Nunavut (80N, 86W) is designed to measure the atmosphere in the altitude range of 0-100km at a single location. It is operated by the Canadian Network for the Detection of Atmospheric Change (CANDAC). The Arctic atmosphere is widely regarded as a system that is undergoing significant changes and these will have impact over a wider area and to lower latitudes.

The PEARL laboratory is extremely far North and extremely isolated. Access is only by charter plane and therefore the transmission of data from the site is a challenge before issues of data management can be addressed. PEARL does possess the most Northerly geostationary communications link in the world, but it does not have a high bandwidth. Much data has to be hand carried out of the site.

The challenge for PEARL staff is to manage the data from the 15 or so instruments operating at the site and archive the data so that it is accessible by both network scientists and the community in a timely fashion. Post-processing of data must also occur to render it suitable for incorporation into international databases. The objective is to achieve the free flow of information which is the hallmark of International Polar Year activities.

PEARL is supported by many organisations including: the Canadian Foundation for Climate and Atmospheric Science (CFCAS); the Canadian Foundation for Innovation (CFI) the Ontario Innovation Trust (OIT); the Nova Scotia Research and Innovation Trust (NSRIT); the Canadian Space Agency (CSA); Environment Canada (EC); and the Natural Sciences and Engineering Research Council (NSERC).

G09-1B2.3 **11:00**

Pinnacles and pitfalls in seismoelectric measurement

J. Christian Dupuis[1], *Karl E. Butler*[1], *Anton W. Kepic*[2]

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Theoretical and numerical models for seismoelectric signals arising from electrokinetic coupling in porous media have become increasingly sophisticated in recent years, but there remain difficulties in measuring these signals under normal field conditions. Ambient electromagnetic noise originating from a multitude of sources is routinely two to three orders of magnitude greater than the seismoelectric signals. Improved instrumentation, signal processing and field procedures have helped increase our success rate at acquiring these elusive signals. In this presentation, we recommend some strategies for data acquisition and present some lessons learned with reference to field experiments we have carried out on surface and in boreholes over the past few years.

Vertical seismoelectric profiling experiments, employing seismic sources on surface and electrodes suspended in shallow boreholes, have proven effective for testing qualitative and quantitative models of seismoelectric coupling proposed in the literature. In addition to a well-characterized environment, the borehole provides an inherent reduction in electromagnetic noise and lower electrode contact impedance. These experiments have also shown that the amplitude of the co-seismic seismoelectric signal accompanying the seismic P-wave arrival is sensitive to the different types of sediments encountered in the borehole and thus may become an effective logging tool.

Seismoelectric surveys conducted on the earth's surface are susceptible to higher electrical noise levels from power lines and AM radio broadcasts, variable soil conditions that affect the contact impedance, and strong co-seismic effects which can obscure the weaker interfacial seismoelectric signals emanating from depth that are of most interest in exploration applications. The use of low noise, high impedance buffering preamplifiers, multi-channel acquisition, dense shooting patterns and powerline noise removal schemes help to obviate these challenges. Attention to details in combination

with an appropriate geological setting can yield meaningful results as demonstrated by our recent success at imaging interfaces within the vadose zone of a sandy aquifer near Perth, Western Australia.

I15-2B9.4 **11:15**

Micrometeorological measurements of carbon isotope ratios over two agricultural management systems

Jon Warland, *Gordon Drewitt*, *Claudia Wagner-Riddle*

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Micrometeorological measurements of isotopic carbon dioxide fluxes were obtained over conventional and no-till agricultural plots in fall after harvest and in spring before planting. The fields used in this study were managed in a corn-soybean-wheat rotation which provided a combination of C3 and C4 isotopic signature. Measurements were obtained following corn harvest in the fall of 2005 and prior to planting in spring of 2006. Results show that the immediate incorporation of corn residue likely provided more C4 substrate for respiring soil organisms. In contrast, the no-till plots, characterized by large amounts of organic matter on the surface, showed a respiration signature more representative of C3 organic matter. Both conventional and no-till treatments showed a reduction in respired isotope ratio from fall to spring suggesting a gradual depletion of labile corn substrate over the course of the winter. Estimates of isotope ratios using concentration measurements in the Keeling mixing model approach have a much larger footprint, providing information about area in which the research station is located. These results also showed a decrease in isotope ratio from fall to spring.

G03-4B2.4 **11:15**

The pattern of vertical crustl movements in Canada using geodetic data

Azadeh Koohzare, *Petr Vanicek*, *Marcelo Santos*

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In this study, we compiled a map of vertical crustal movements (VCM) in Canada using the method of smooth piecewise algebraic approximation (SPAA). The area of study is divided into patches and piecewise algebraic surfaces are fitted to 2D observation points and tilt between them, where geometrical constraints are enforced between the parameters of the surfaces. The VCM model obtained in this research is numerically manageable. It gives enough details of the movements. Enforcing the continuity and smoothness in the first derivatives throughout the surfaces, the VCM model highlights the long wavelength spatial variations of the crust in Canada, mainly due to Post Glacial Rebound (PGR). The rate of changes of orthometric height obtained from the map of VCM was compared with the map of rate of gravity changes ($\dot{g}$) in Canada. The PGR hinge line follows the same pattern in both maps and the close correlation between the map of VCM and $\dot{g}$ map is easily traceable and is in a fairly good agreement with simulated model of Jachens (1978) in different areas. The VCM was also compared with geodetic height changes based on GPS solutions in Canadian Base Network (CBN) stations. The VCM is consistent with the computed geodetic height changes from GPS solution in most areas in Canada, except the Canadian prairies. This investigation showed the disagreement of VCM in the Canadian prairies with the GPS solution. In this study, some of the probable causes of such inconsistencies are explored.

S04-4C3.6 **14:45**

Determination of Selected Organic Compounds in Snow and Air in the Canadian Arctic

Gregor Kos[1], *Parisa A. Ariya*[2]

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The presented study addresses the understanding of the exchange of volatile organic compounds (VOC) between the snow pack and overlying atmosphere. Snow and air samples were collected at in Alert, Nunavut in the Canadian Arctic and snow samples were analysed for selected halogenated, aromatic and oxygenated VOC on site using solid phase micro-extraction and gas chromatography with flame ionisation detection (SPME-GC/FID). Air samples were collected in electropolished canisters for further analysis in the laboratory with a cryofocusing system coupled to a GC-FID. Samples were tested for 20 different (semi-)VOC covering a wide range of chemical functionalities (aromatic, halogenated, oxygenated). Concentrations were in the lower ng/L range (air samples) and in the lower µg/L range (near surface snow). Snow profile measurements revealed accumulation in the topmost 3 cm of the snowpack for some samples and VOC concentrations in snow over land and sea-ice were of similar magnitude. Results and ongoing data analysis strive to provide an improved description of atmospheric boundary layer processes. Additionally, aerosol and bioaerosol analyses will contribute to the understanding of snow-atmosphere exchange processes.

C04-3DP.1 16:00

Reduction in Himalayan Snow Accumulation and Weakening of the Trade Winds over the Pacific Since the 1840s

Hongxu Zhao, *Kent Moore*

(Presented by *Clarck Hongxu Zhao*)
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Over a century ago, Blanford suggested a negative correlation between the western Himalayan snow cover and the Northwest Indian summer monsoon rainfall, an observation that formed the basis of the snow-monsoon feedback mechanism and resulted in the first forecast of the intensity of the summer monsoon in India. Recently, an opposite relationship between Tibetan snow cover and Indian summer monsoon has been proposed. However, the relatively short length of the instrumental observations in the region restricts the further study of the relationship between the two climate systems. In this work, a 196-year record of snow accumulation extracted from southern Himalayan ice cores is shown to contain a decreasing trend that began in the 1840s, however, the All Indian summer monsoon rainfall shows no evidence of such a trend. It is argued that the negative trend in the snow accumulation is associated with the weakening of trade winds over Pacific Ocean, which may have resulted in a reduction in the easterly transport of moisture towards Asia, thereby contributing to the decreasing snow accumulation at the Dasuopu site. Evidence from NCEP reanalysis can show that the negative trend in the snow is associated with long-term changes in the regional Hadley and Walker circulations over the latter half of the 20th century. The decoupling between the snow accumulation and Indian summer monsoon could be attributed to the extreme height of the ice core site that effectively decoupled the two systems due to the highly stratified atmosphere.

H06-2DP.3 16:00

Tabular iceberg studies 2001-2007

Jonathan Thom[1], *Douglas R. MacAyeal*[2], *Mac Cathles*[2], *Shelley Knuth*[1], *Kelly Brunt*[2]

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In March 2000, iceberg B15 calved from the front of the Ross Ice Shelf to become the largest recorded iceberg observed from space since satellite observations began. Beginning in January 2001, a large piece of the original iceberg, B15A, spent approximately 5 years drifting near Ross Island, where the United States' McMurdo Station is located. This drift pattern allowed field parties to deploy on its surface a variety of instruments including automatic weather stations (AWS), global positioning system receivers, seismometers, and automated cameras. The scientific goals were to observe how icebergs drift, and as they move north into milder climates observe the processes that cause their breakup. During this project icebergs B15A, B15J, C16, C25, B15K and 'Nascent iceberg' (a piece of the Ross Ice Shelf not yet calved at approximately 180° longitude) were instrumented. Most of the icebergs left the vicinity of Ross Island in 2005 and 2006, however iceberg B15J still remains east of Terra Nova Bay. Simultaneously, satellite images of the icebergs have been collected during this time period.

The work presented here gives an overview of the meteorological and oceanographic features seen in the data collected. Of particular interest is the fact that icebergs have proven to be excellent observation platforms for ocean swell generated by far-field storms. Other aspects of our data show that iceberg drift in the near coastal region south of the Antarctic convergence (where the west wind and east wind meet) is very consistent, with several icebergs following similar trajectories. A unique aspect of the iceberg instrumentation package, specifically the B15A AWS, is that it represents a "roving weather observer" and is able to obtain surface data from unusual oceanic locations impossible to visit otherwise. A discussion of the meteorological data seen by this roving AWS will be presented.

A04-4C6.5 **14:30**

Development of a high resolution wind forecasting system in Environment Canada

Wei Yu[1], *Anna Glazer*[2], *L.D. Tran*[2], *L Chardon*[2], *A. Plante*[3], *G. Roberge*[4], *A. Forcione*[4]

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The Science and Technology Branch of Environment Canada initiated a research project on the development of a high resolution (~200 m) wind forecast system. The system is expected to be used for special environmental applications such as prediction of wind power electricity generation and surface wind prediction for Vancouver Winter Olympics. This system consists of three components: a Limited Area Model (LAM), a microscale model, and a Local Error Handler (LEH). The LAM, at a resolution of 2.5 km, will be nested in the Canadian Meteorological Centre's (CMC) regional operational model which is run twice a day (00 and 12 UTC) for a forecast horizon of 48 hours at a resolution of 15 km. The output of the LAM will be used as input of the microscale model for further downscaling of winds and temperature at a resolution of about 200 m. If needed, LEH will be applied to remove model error by using real-time in situ data. The forecasting system can be run on a cluster of PCs connected with regular gigabyte switches. The operator of wind farms, with modest investment on computer facility, can eventually use it to do wind forecasts.

In collaboration with Hydro-Quebec, the forecasting system will be run operationally for a one-year (May 2007 - April 2008) trial for a region covering all the wind farms in the eastern Gaspe (Quebec) and the Atlantic Wind Test Site (AWTS). This wind forecast system, together with preliminary results from test runs, will be presented.

A04-4B6.1 **10:30**

The Fog Remote Sensing and Modeling (FRAM) Field Project

Ismail Gultepe[1], *Stewart G. Cober*[1], *George A. Isaac*[1], *Jason Milbrandt*[2], *Patrick King*[1], *Peter Taylor*[3], *Gary Pearson*[4], *Bjarne Hansen*[1]

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The purpose of the Fog Remote Sensing And Modeling (FRAM) project was to characterize fog formation, evolution, and dissipation in continental and marine environments, and use the derived results in numerical simulations and remote sensing studies. Phase 1 of the project took place during the winter of 2005-2006 in southern Ontario. Phase 2 of the project took place during the summer of 2006 in Nova Scotia (NS) along the Atlantic coast. These phases focused on winter continental fog and summer marine fog, respectively. Observations included droplet, ice, aerosol sizes and concentrations, surface temperature from optical probes, visibility from a visibility meter, liquid water content (LWC) profile from a microwave radiometer (MWR), and inferred fog properties such as effective size from satellites (e.g. MODIS). The results were used to develop relationships between visibility, relative humidity, liquid water content, and precipitation rates for rain and snow which could be incorporated in numerical forecast models.

During the winter of 2005-2006, an increased frequency of fog formation was observed in southern Ontario relative to the 30-year climatology. It is suggested that the combination of snow on the surface during several rain events likely caused this increase in frequency. An increase was also observed in the marine fog frequency during the summer of 2006 over the NS site. This can be related to increased moisture flow from ocean surface and colder temperatures over the land. The phase 3 of the project, which will take place during summer of 2007, will be used as a validation of the previous year conditions for the fog formation over the NS site. Overall, some results obtained using observations and model simulations will be given and applications to operational models will be discussed.

I01-1D8.4 **16:45**

Recent Results from the Measurements Of Pollution in the Troposphere (MOPITT) Instrument

James Drummond[1], *John Gille*[2], *David Edwards*[2], *Jay Kar*[3], *Florian Nichitiu*[3], *Jason Zou*[3]

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The MOPITT instrument was launched on the Terra spacecraft on 19th December 1999 and has now completed over seven years of measurements of carbon monoxide from space and taken over 1.8 billion measurements.

The vertical resolution of the MOPITT measurements and the shape of the averaging kernel have given rise to the conventional wisdom that MOPITT measurements do not give much indication of source strengths and other near-surface issues. However, recent studies have shown that this is not

always the case and under some circumstances there is substantial information available about surface issues.

The long time series of MOPITT measurements extending over seven years also permits studies of variability on annual timescales or longer. (This does not include sensitive analysis trends of concentrations due to accuracy issues) This gives rise to a number of possibilities for looking at phenomena which have annual or biennial cycles.

The MOPITT instrument was built by COMDEV in Cambridge, Ontario and financed by the Canadian Space Agency. The Terra mission and the US processing of MOPITT data is financed by NASA. Support for the MOPITT project has also been provided by the Canadian Foundation for Climate and Atmospheric Science and the Natural Sciences and Engineering Research Council.

H01-2DP.13 **16:00**

Moisture and climatic forcings on Sphagnum productivity in a cutover peatland

D.K. Thompson, J.M. Waddington

(Presented by *Dan K. &Thompson*)
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Gross ecosystem production (GEP) was measured at a sub-boreal ombotrophic peatland (Cacouna Bog) 15 km NE of Riviere-du-Loup, Quebec, in the summers of 2005 and 2006. The Cacouna bog was extensively mined between 1940 and 1970 using the block cut method. The combination of exposed, high bulk density peat and low water table (c. –30cm) has produced a succession vegetation community of ericaceous shrubs, invasive trees, and only c. 10% Sphagnum moss cover. Chamber-based measurements were made at three locations arranged longitudinally along a cut trench. Volumetric water content (VWC) and temperature probes at four depths, tensiometers, and a meteorological station provided high temporal resolution moisture and climatic data. June August precipitation in 2005 was 167 mm below the 30-year mean; in 2006, the deviation was only 17 mm below normal. Mean monthly temperature deviations for the same periods were +0.2 and +2.5 ˚C, respectively. As a result, the cooler, dry summer of 2005 depressed VWC by 10-20 %, soil water tension by 20-40 mb, and maximum GEP by 5-10 g C m-2 d-1 as compared to 2006. Lab studies are underway to further quantify our field observations of species-dependent reductions in GEP at low soil tensions. In October 2006, 29 peat dams were constructed to block ditches draining the site, raising the water table in the study area by over 1 m. Fieldwork in 2007 will focus on the effect of increased moisture supply on these formerly water-stressed vegetation communities.

G04-2DP.2 **16:00**

High resolution Holocene chronostratigraphy using paleomagnetic records in the Sept-Îles area, Gulf of St. Lawrence, Eastern Canada

Ursule Boyer-Villemaire[1], *Guillaume St-Onge*[2], *Patrick Lajeunesse*[3], *Jacques Locat*[4], *Gabrielle Labbé*[3], *Christelle Not*[5], *Bassam Ghaleb*[5], *Claude Hillaire-Marcel*[5]

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Recent multibeam and seismic surveys uncovered a 30-40 m-thick sedimentary sequence embedded in a 4.5 km–wide circular submarine structure in the Sept-Îles area, Gulf of St. Lawrence. The first working hypothesis is that the sedimentary sequence would have escaped glacial erosion due to its particular morphology, possibly allowing the preservation of several glacial/interglacial sequences. The second hypothesis is that sedimentation within and outside the circular structure is significantly different. In order to test these two hypotheses, box, gravity and piston cores were collected within and outside the circular structure during cruises COR0503 and COR0602 onboard the RV Coriolis II. Laboratory methods included core description, initial physical and magnetic property measurements (Multi Sensor Core Logger, CAT-Scan, color reflectance), grain size and high resolution numerical imagery. ^{210}Pb measurements in the sandy surface layer of box cores sampled inside and outside the submarine structure indicate the presence of recently deposited sediments with similar sedimentation rates. In addition, four AMS ^{14}C dates from a piston core (COR0602-047PC) taken in the thinner sequence of seismic reflectors within the submarine structure indicate that the base of the core is about 13 000 cal BP. This suggests that several glacial/interglacial sequences were not preserved in the submarine structure. These results are nonetheless valuable to infirm the second hypothesis. Indeed, based on the correlation of physical properties, sedimentation within and outside the structure appears to be alike and are composed of three main lithostratigraphic units: 1) a proximal glaciomarine unit, 2) a distal glaciomarine unit and 3) a thin modern sandy top unit. Paleomagnetic analyses are presently being performed and will allow the establishment of a precise chronostratigraphy for the area.

A07-2DP.2 **16:00**

Ground-Based Zenith-Sky DOAS Measurements of Ozone and NO_2 and PEARL, Eureka, Nunavut

<u>Annemarie Fraser</u>[1], *Florence Goutail*[2], *Tobias Kerzenmacher*[1], *C. T. McElroy*[3], *Clive Midwinter*[1], *Kimberly Strong*[1], *Jennifer Walker*[4], *Hongjiang Wu*[5]

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The University of Toronto Ground-Based Spectrometer (UT-GBS) is a portable zenith-sky-viewing UV-Visible spectrometer, assembled in 1998. Since then it has participated in eight polar sunrise field campaigns at the Polar Environmental Research Laboratory (PEARL) in Eureka, Nunavut (80°N, 86°W, Feb. - Apr. 1999-2001, 2003-2007). In August 2006, a second instrument (the PEARL UT-GBS) was permanently installed at PEARL as part of the refurbishment of the lab by the Canadian Network for the Detection of Atmospheric Change (CANDAC). Vertical column density amounts of ozone and NO_2 are regularly retrieved, while slant column densities of BrO and OClO are retrieved when possible.

We will discuss measurements from the 2004 – 2007 Eureka campaigns, which were held as part of the validation effort for the ACE (Atmospheric Chemistry Experiment) satellite. During all these campaigns, a SunPhotoSpectrometer (SPS) and MAESTRO-G (Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation-Ground) were also operated. In 2005 – 2007, a SAOZ (Système d'Analyse par Observations Zénitales) spectrometer was part of the instrument suite. Identical analysis algorithms have been applied to all five instruments, and ozone and NO_2 results will be presented.

C02-1D5.3 **16:30**

Modeling 20th Century Climate Using CCSM3: Solar Variability and Its Effect on Climate

Xiaolu Yu, *Richard Peltier*

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20th century climate simulations conducted by National Center for Atmospheric Research (NCAR) using the Community Climate System Model Version 3 (CCSM3) have shown that the combination of natural and anthropogenic forcings are required to reproduce the time evolution of observed globally averaged surface temperatures. These simulations include greenhouse gases, ozone, tropospheric and stratospheric aerosol effects, as well as solar variability. In order to assess the interplay between the influence of solar variability and aerosol as well as other radiative forcings on the current climate, and the interactions of the solar forcing with internal variability modes, we conducted studies involving two CCSM3 simulations of modern climate since 1870 forced by the total solar irradiance (TSI) reconstructions of Lean el al. in 2000 and in 2005 respectively. Compared to the old Lean data, the new reconstructed dataset has only one fourth secular irradiance increase since Maunder Minimum (due to the reduction of contributions from background component) but higher in magnitude almost throughout the past three centuries. Simulated climate forced by the new solar forcing shows a good fit to observations in both global and hemispheric mean surface temperature, capturing all the important warming and cooling periods in the 20th century. Strong polar warming, another important feature observed in the last thirty years of the 20th century, is also reproduced by the simulation.

A07-2C7.3 **14:45**

The Zeppelin Observatory – A European Cornerstone of Arctic Atmospheric Monitoring during IPY

Georg Hansen[1], *Ove Hermansen*[1], *Johan Ström*[2]

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The Zeppelin Observatory at Ny-Ålesund on the Arctic Archipelago of Svalbard, Norway (78.92º N, 11.86º E, 475 m.a.s.l.) was established in 1990 as an atmospheric background monitoring station of the European EMEP programme in the high Arctic. The infrastructure is operated by the Norwegian Polar Institute, while the Norwegian Institute for Air Research (N ILU), in cooperation with Stockholm University is responsible for the scientific programme. Since the early 1990s, the monitoring programme has been extended continuously, and comprises today a wide range of species, based on a multitude of instruments and techniques: inorganic main compounds of the Convention on long-range transboundary air pollution; greenhouse gasses (CO2, methane, CFCs, HCFCs, HFCs, tropospheric ozone) and related gases, such as CO; heavy metals, especially mercury; organic pollutants (PCBs, DDT, HCB, HCH, sum PAH), and a wide range of aerosol parameters (physical, chemical, optical). The station contributes today to EMEP, the Global Atmospheric Watch (GAW) programme, the Arctic Monitoring and Assessment Programme (AMAP) and the Network for Detection Atmospheric Composition Change (NDACC). During IPY, the Zeppelin Observatory and other atmospheric research activities in Ny-Ålesund will be part of the IASOA (International Arctic Systems for Observing the Atmosphere) network and support various IPY projects, such as POLARCAT, COPOL and POLAR-AOD. We will present a status of the facility, the measurement programme, future plans and give an overview of available data and scientific results.

A05-1C6.8 **15:15**

Atlas canadien d'énergie éolienne et AnémoScope: données disponibles et exemples d'utilisation

Franco Petrucci

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Le groupe de recherche ÉOLE d’Environnement Canada a développé l’Atlas canadien d’énergie éolienne et le logiciel AnémoScope issu de la même technologie de modélisation. Les réanalyses globales NCEP sur 50 ans ont servi de base de données météorologique pour établir la climatologie des vents pour tout le Canada et le modèle communautaire MC2 a été utilisé pour faire le downscaling des réanalyses jusqu’à une résolution de 5 km. Plusieurs variables météorologiques d’intérêt pour l’industrie éolienne telles que le vent et l’énergie disponible ainsi que les distributions statistiques de celles-ci ont été calculées pour plusieurs niveaux. De plus, pour les consultants ou utilisateurs de ces données désirant une représentation à plus haute résolution de ces variables, un logiciel de type GIS tournant sur Windows a été mis au point qui permet de tourner le modèle MC2 et un modèle micro-échelle jusqu’à une résolution de l’ordre de 100 m partout sur le globe. Les données de l’Atlas sont disponibles gratuitement et peuvent être obtenues directement à partir du site web de celui-ci. Le logiciel AnémoScope est habituellement vendu sous licence aux firmes de consultants et est aussi disponible aux institutions d’enseignement. Les raisons de ceci seront expliquées. Des exemples des données disponibles à partir de l’Atlas et d’AnémoScope seront présentés ainsi que la façon d’accéder à celles-ci pour l’Atlas. Quelques exemples d’utilisations et d’études effectuées dans l’industrie et dans les secteurs public et académique seront aussi présentés. Enfin il y aura un bref aperçu de la prochaine version de l’Atlas et des développements futurs du logiciel AnémoScope.

A05-1C6.7 **INVITED/INVITÉ 15:00**

Data exchange in the framework of the APEC Climate Center.

Benoit Archambault

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APEC Climate Center (APCC) is the result of an international cooperation of the APEC member economies, it produce skillful real-time climate predictions. As part of the Asia-Pacific Economic Cooperation (APEC), Canada is a model provider of APEC Climate Center (APCC). One objective of the APCC is to produce seasonal forecasts with a Multi Model Ensemble (MME). This MME is based on 16 models from different institutions like MSC(Canada), NCEP(USA), COLA(USA), KMA(Korea), JMA(Japan), BOM(Australia) and others. In this presentation, I will describe the data exchange policy in the context of this international cooperation .

I01-1B8.2 **10:45**

A Closer Look at Ice Storm Severity in the Southeastern United States Using an “Ingredients-Based” Methodology

Christopher Fuhrmann[1], *Charles Konrad*[1], *Andrew Grundstein*[2], *Matthew Cuviello*[1]

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Freezing rain is responsible for a large percentage of weather catastrophes in the southeastern U.S. Forecasters across the region have long used “rule-of-thumb” approaches to predict freezing rain,

relying heavily on generalized synoptic analogs (i.e., weather patterns associated with previous ice storms) and composite vertical profiles of temperature. While using pattern recognition allows the forecaster to gain insight into the meteorological scenarios associated with freezing rain, such a method is not as useful in assessing the magnitude of the precipitation (i.e., distinguishing an ordinary event from an extraordinary event). In this study, we employ an "ingredients-based" approach to understanding ice storms in the southeastern U.S. To carry this out, a climatology of ice storms was created using data from the first-order weather station at Greensboro, NC and storm reports from Storm Data. The climatology identifies events displaying a wide range of freezing rain totals, which we categorize as light, moderate, heavy, and very heavy. By analyzing the climatology on an event-by-event basis, we identify the ingredients responsible for each ice storm (e.g., ascent, moisture, shallow cold air). The strength of each ingredient is measured using conventional meteorological fields (e.g., mixing ratio, vorticity) obtained from surface weather station data, gridded datasets (e.g., NCEP re-analysis), and atmospheric soundings. From this we identify the set of ingredients that most effectively distinguish different intensities of ice storms. We also assess the synoptic circulation patterns and associated air trajectories that bring these ingredients together. Using this approach, we can ascertain both the range of synoptic patterns that are most effective in assembling the necessary ingredients for freezing rain and the usefulness of the generalized synoptic analogs commonly used by forecasters.

I15-3DP.1 **16:00**

Annual Contribution of Tile Drains to Basin Discharge and Phosphorus Export in a First Order Agricultural Catchment

Merrin Macrae[1], *Michael English*[2], *Sherry Schiff*[3], *Michael Stone*[4]

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Tile drainage improves conditions for agriculture but alters hydrological pathways and the rates nutrient transfer to receiving streams. The significance of tiles in agrochemical export has been well documented but factors governing temporal variability in nutrient export are poorly understood, particularly during winter months in temperate regions when melt events occur. This study examines spatiotemporal variability in tile discharge and nutrient export to determine the contribution of tiles to basin discharge, soluble reactive phosphorus (SRP) and total phosphorus (TP) export over a one-year period. The study was conducted in Strawberry Creek, a first order agricultural basin in southern Ontario, Canada. Hydrometric and water quality was measured continuously in seven drainage tiles and the basin outlet. Tile discharge was highly variable at both moderate (wet versus dry periods) and smaller (within-event) temporal scales. Tiles contributed

I12-3DP.2 **16:00**

Evaluation of Evaporation Estimation Methods during a Summer Drying Period

Robert Armstrong, *John Pomeroy*, *Lawrence Martz*

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Spatially variable topography, vegetation and available water are inherent in natural landscapes. Complex interactions within the soil-vegetation-atmosphere system present difficulties for determining reliable estimates of evaporative fluxes between the land surface and atmosphere.

Methods available for estimating evaporation (includes both water losses via evaporation from soil and exposed water, and transpiration from plants) can vary widely as a result of different theoretical approaches and data requirements. Three useful approaches to estimating 'actual' evaporation are evaluated during a summer drying period (2006) for a mixed-grass site located in the St. Denis National Wildlife Area within south-central Saskatchewan. A Penman-Monteith (P-M) type combination approach explicitly takes into consideration the influence of resistances and energy balances on evaporation from non-saturated surfaces. A Dalton-type bulk transfer (BT) approach typical of land surface schemes considers turbulent transfer along with the humidity gradient between the surface and atmosphere by incorporating land surface temperature observations. Granger and Gray developed an extension of the Penman equation to the case of non-saturated surfaces using a feedback approach (G-D) that considers the relative evaporation, G or the ratio of actual to potential evaporation and the relative drying power of the air, D. The models are evaluated for several temporal scales; seasonal, daily, and hourly. Preliminary results suggest that all three approaches have 'reasonable' applicability for estimating seasonal evaporation within the natural environment. A comparison of model results will be made with soil moisture constrained evaporation in a hydrological model. Evaporative losses for other locations in the Canadian Prairies will also be examined during the 1999-2004 drought period. Potential sites include a short mixed grass prairie (Lethbridge, Ameriflux site) and a native prairie site (Kernen Research Farm) located just east of Saskatoon, Saskatchewan.

I01-1C8.4 **14:15**

Acetone and other volatile organic compounds in surface seawaters from the Nordic seas as measured by solid-phase microextraction (SPME) methods.

Edward Hudson[1], *Kadek Okuda*[1], *Parisa Ariya*[2]

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Through processes which are still poorly understood, photochemical degradation of dissolved organic matter in surface ocean waters is thought to contribute volatile organic compounds (VOCs) to the remote marine troposphere. These VOCs in turn affect the oxidative budget of the troposphere, as well as being useful as tracers of oxidative processes. Acetone is a VOC of particular interest because it may affect the tropospheric HOx budget, and it is not known whether the oceans are a source or sink of this important oxygenated compound. Methods for broad, facile, low-cost, direct characterization of VOCs in seawater would contribute greatly to understanding VOC formation processes. We report here on solid phase microextraction (SPME) methods which allow this kind of characterization of VOCs (including light carbonyl compounds and hydrocarbons) in seawater, and on their application to surface waters sampled in the far North Atlantic (Greenland and Norwegian Seas, Fram Strait) during the summer of 2004. In particular, our measurements of acetone concentrations in selected samples constitute the first such observations in North Atlantic or Arctic waters, and are consistent with, although on the lower end of, figures for the subtropical Atlantic and Pacific.

A01-1B6.3 **11:00**

Weather Associations of Presentation Patterns at Canadian Hospital Emergency Rooms

Denis A Bourque[1], *Abdel Maarouf*[2], *Joseph Shaykewich*[3], *G.A. McBean*[4], *Jinhui Zhao*[5], *Yang An*[5], *John L. Bart*[6], *Judith Leech*[7]

(Presented by *Denis Bourque*)
[1] Meterorological Service of Canada, Environment Canada
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[3] (Meteorologist, private sector)
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A project was undertaken to determine whether the nature and patterns of people seeking help at Canadian hospital Emergency Rooms could be associated with certain near-term characteristics of the weather. This is based on the premise, found in the literature, that day-to-day weather conditions can affect the state of human health and mental well-being which, in turn, could lead to variable demand patterns on the medical services provided by hospitals. This information might prove extremely valuable to hospital administrations. We analysed the presentation patterns at the Emergency Rooms (ERs) of five Canadian hospitals, representing more than 600,000 visits over 5 years, in relation with various weather conditions during the 48 hours prior to patient arrivals at the ER. We explored the relationship between extreme values (high and low) of temperature, relative humidity, wind, barometric pressure, windchill (in winter), humidex (in summer) and precipitation, to total presentations at the hospitals as well as presentations for some specific disease groups. We also looked at the relationships of presentations to a meteotropic synoptic typing index (MediClim) constructed based on German research. This paper concentrates on describing the structure of the experimental setup, including the two analytical approaches used. Results will also be presented.

I13-4C9.1 **INVITED/INVITÉ 13:30**

Data Management Planning at Environment Canada and the International Polar Year

Robert Morris

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International Polar Year (IPY) projects involving Canadian researchers are well represented in the network of proposals endorsed by the international Joint Committee. These projects contribute to understanding environmental, climatic and social changes taking place in the Earth's Polar regions, particularly in Canada's North. Each project plan has a data management component to address IPY data management requirements, including long-term archiving of and access to research data sets. Environment Canada has been identified in some of the projects as the data centre for their research data. The purpose of this presentation is to describe some of the steps being planned at Environment Canada to participate in this data management role for the IPY projects.

Data management practices are evolving to keep up with the rapidly changing issues such as intellectual property and privacy, internet access, metadata standards and on-line databases. Each of these represents enormous opportunities as well as significant challenges. These are long-standing issues for government departments, companies, agencies and universities and the introduction of the IPY project data adds an additional dimension that has the potential to provide a catalyst to move these issues forward. This presentation will discuss plans at Environment Canada to deal with some of these aspects of data management. In particular, specific actions to deal with IPY data and the coordination required with the projects, other government departments and universities to ensure a consistent approach and desirable outcome will be presented.

A07-3B7.1 **10:30**

Investigating Middle Atmospheric Chemistry at the Polar Environment Atmospheric Research Laboratory (PEARL)

Kimberly Strong[1], *and the AMAC Science Team*[2]

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K. Strong (1), R. Batchelor (1), J.R. Drummond (1,2), P.F. Fogal (1), A. Fraser (1), R. Lindenmaier (1), A. Manson (3), C.T. McElroy (4), C. Midwinter (1), G. Shepherd (5), R.J. Sica (6), J. Sloan (7), K.A. Walker (1,7), W. Ward (8), J. Whiteway (5), T.G. Shepherd (1), J.C. McConnell (5), P.F. Bernath (7,9)

(1) University of Toronto, (2) Dalhousie University, (3) University of Saskatchewan, (4) Environment Canada, (5) York University, Canada, (6) University of Western Ontario, (7) University of Waterloo, (8) University of New Brunswick, (9) University of York, UK

The recently established Polar Environment Atmospheric Research Laboratory (PEARL) is located in the Canadian high Arctic at Eureka, Nunavut (80°N). It is being equipped with a suite of instrumentation to investigate chemical and physical processes in the atmosphere from the ground to 100 km. One of four research themes being pursued at PEARL is that of Arctic Middle Atmosphere Chemistry, which is focussed on the question of “What is the composition of the Arctic atmosphere above the site and how is it changing with time?” The overall goal of this theme is to improve our understanding of the processes controlling the Arctic stratospheric ozone budget and its future evolution, using measurements of the concentrations of stratospheric constituents, in conjunction with dynamical, radiative, aerosol/PSC, and meteorological observations also made at PEARL. The complexity of the atmosphere and the different spectroscopic signatures of its many chemical constituents make it impossible to measure all relevant species using any one remote sounding technique. Rather, these measurements will be made using the complementary capabilities of several of the PEARL instruments, including an ozone lidar, a Fourier transform infrared spectrometer, a UV-visible grating spectrometer, and an Atmospheric Emitted Radiance Interferometer. This presentation will provide an overview of the Arctic Middle Atmosphere Chemistry theme, including its scientific motivation, objectives, and planned measurements and science activities. Activities in the first year will be discussed, along with some of the early measurements.

C02-2C5.2 **14:15**

Large-Scale Reorganizations of the Climate as Expressed in the Oxygen Isotope Record in an Ice Core from Mount Logan

Kent Moore[1], *Gerald Holdsworth*[2]

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There exists a growing body of evidence suggesting that a change in the climate of the North Pacific region occurred around 1850 with a transition from a predominately multi-decadal mode of variability to one characterized by inter-annual variability. Changes in the climate of the Arctic and Europe have also been reported to have occurred around this time. These changes are thought to have been associated with the end of the Little Ice Age. In the North Pacific, a transition back to multi-decadal climate variability may have taken place during the 1970’s. Through the analysis of an ice core stable oxygen isotope time series from a high elevation site on Mount Logan in the Gulf of Alaska region, we argue that these transitions are associated with large-scale reorganizations of the climate between a

state in which the there exists a high degree of correlation between the North Pacific and North Atlantic regions to one where there is not.

H01-1B4.4 **11:15**

Storage and episodic release of gas in peat: effects of temperature & atmospheric pressure

K. Harrison[1], *J.M. Waddington*[1], *A.J. Baird*[2], *E. Kellner*[1]

(Presented by *Kristen Harrison*)
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Recent research suggests that entrapped gas in peatlands may act as a significant storage mechanism for CH_4; however, the episodic release of these gases via ebullition has also been identified as a major pathway for CH_4 transfer to the atmosphere. We developed simple models to examine ebullition and fluctuations in entrapped gas content (VGC). The ebullition model initiates V_g fluctuations through production and variations in pressure and temperature; gas fluctuations that exceed an applied gas storage threshold are released via ebullition. The V_g model similarly uses production, temperature and pressure to generate fluctuations in V_g, however uses measured ebullition events to focus on the influence of pressure and temperature on V_g. Peat cores were incubated for 190 days in the laboratory and volumetric gas content, ebullition, temperature and atmospheric pressure were measured. Laboratory results agreed with the application of a threshold value for modelling ebullition, and given the simplicity of the model, good agreement was found between measured and modelled values with an r^2 of 0.66 in the final 120 days. More realistic production and bubble retention values would improve model fit. The V_g model also generated good agreement with measured data with an average r^2 value of 0.56 with a maximum r^2 of 0.97. Results from these models indicate that peat temperature and atmospheric pressure are dominant controls on V_g fluctuation and that there is a strong relationship between V_g fluctuation and the episodic release of gas from peat.

C01-2C6.1 **14:00**

Detection and attribution of the effects of climate change and ozone depletion in the stratosphere.

Andreas I. Jonsson[1], *Theodore G. Shepherd*[1], *Victor I. Fomichev*[2]

(Presented by *Andreas Jonsson*)
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The stratosphere is an ideal place for the detection and attribution of anthropogenic effects on climate, because the global-mean temperature is very close to being in radiative balance at every altitude. Thus, dynamical feedbacks are negligible and global-mean temperature changes can be directly linked to the radiative forcing agents. A key issue for attribution in the stratosphere is to separate the effects of CO_2 increase and the ozone depletion resulting from CFCs.

In the past, CO_2 increases have cooled the stratosphere and the CFC-induced ozone loss has increased this cooling. In the future, as CFCs slowly decline, the two effects will operate in opposite directions. Traditionally the CFC-impact has been attributed through the ozone changes themselves, but this is not quite correct because ozone is also affected by CO_2-induced temperature changes.

In this study, the detection and attribution of the effects of CO_2 and CFC-induced ozone loss on

stratospheric global-mean temperature is assessed using a special set of simulations performed with the Canadian Middle Atmosphere Model as the Canadian contribution to the recently published 2006 WMO/UNEP Ozone Assessment.

H03-2C4.6 **15:30**

Upper Penticton Creek: Effects of logging on aquatic invertebrates and stream temperature

Brian Heise

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I examined the effects of clearcut logging on aquatic insects and stream temperature as part of the Upper Penticton Creek Watershed Experiment, in south-central British Columbia. Aquatic insect communities were monitored using artificial substrate baskets placed in Dennis Creek for one year pre-harvest and four years post-harvest, in 241 Creek for two years pre-, and two years post-harvest, and in an unharvested control (240 Creek) for five years. Both logged creeks experienced significantly increased numbers of mayflies (disturbance intolerant), true flies (disturbance tolerant), total insects, and the proportion of shredders (insects that eat leaves falling into the streams from the riparian zone). As well, 241 Creek showing an increase in genus diversity. These results differ greatly from a study conducted at Sicamous Creek, where fine logging slash left in the stream had a large deleterious effect on the aquatic insect community. To assess temperature effects water temperatures were recorded above, in and below clearcuts in Dennis and 241 Creeks. Summer maximum temperatures increased by 7 to 14 °C, and thermal recovery took at least 450 m once the streams re-entered the intact forest canopy. My management recommendations for the logging of small, high-elevation streams based on this research are 1) removal of all fine slash from logged streams, and 2) increased retention of shade trees/shrubs in riparian zones of these streams where elevated stream temperatures are a concern for downstream salmon and trout populations.

I15-3DP.2 **16:00**

Effect of Flooding from Upstream Sources on Riparian Nutrient Dynamics: Results from the First Flood

Merrin Macrae[1], *Richard Bourbonniere*[2], *Jamee DeSimone*[1], *Bobby Katanchi*[1], *Meagan Leach*[3], *Angela Straathof*[1], *Michael Stone*[1], *Zheng Zhang*[1]

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A forested riparian site in Southern Ontario receives hydrologic and nutrient inputs from both adjacent agricultural fields and an upstream reservoir/dam. For most of each year, the riparian zone and adjacent surface waters receive continuous inputs from the upstream dam (

C04-4D5.3 **16:30**

Warming in the High Arctic: Evidence from an instrumental record spanning 125 years

Kent Moore, *Aarti Motala*

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The identification of changes in the Arctic climate is of great interest as the warming associated with increased concentrations of greenhouse gases is expected to be amplified in this region. Unfortunately there is a scarcity of long-term Arctic meteorological observations that can be used to assess the existence or magnitude of such an amplified warming. Here we use 3 years worth of surface air temperature measurements collected at Discovery Bay (81N 64W) in the eastern Canadian Arctic during the 1870s and 1880s by the Nares and Greely expeditions to assess the degree to which the climate of the region has changed over the intervening years. We show that there has been an autumn and winter warming in excess of 3C over this period of time that falls outside the range of current variability.

C02-1C5.5 **14:30**

^{230}Th-^{231}Pa Stratigraphy of very low sedimentation rate cores from Alpha Ridge (Arctic Ocean)

Christelle Not[1], *Claude Hillaire-Marcel*[1], *Bassam Ghaleb*[1], *Roger Francois*[2]

(Presented by *Christelle Not*)
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Paleoceanographic studies of Arctic sediment are problematic because sedimentation rates are very low and ^{14}C-dating difficult due to carbonate dissolution. The scarcity of foraminifers also limits the setting of oxygen isotope stratigraphies. Here we use U-series isotopes to produce a stratigraphy for Arctic sediments spanning ca 200ka. The Alpha Ridge is characterized by very uniform sedimentary deposition essentially linked to vertical particulate rain. This property led us to investigate the behavior of ^{230}Th, ^{231}Pa, ^{226}Ra and ^{210}Pb in a practically ideal setting, i.e., where sedimentary advection is negligible. Two sites (core 11: 2644 m deep and core 12: 1585 m deep), located 20 nm apart, were cored with a 70 cm-long multicorer during the 2005 Hotrax Expedition (Eos, Vol. 86, No. 52, 27 Dec. 2005). Lead 210 distributions are practically identical in both cores. From 0 to 1 cm the ^{210}Pb profile is controlled by the decay of excess ^{210}Pb. Below, from 1 to 7 cm, it is controlled by the diffusion of ^{226}Ra from the sediment towards the water column. From 7 cm to bottom, both ^{210}Pb and ^{226}Ra are controlled by ^{230}Th-excesses (^{230}Thxs). Here again, despite their large bathymetric difference, the two sites show almost identical ^{230}Th-distributions, thus identical ^{230}Th-fluxes despite the 1 km-bathymetric difference. Three peaks in ^{230}Thxs and ^{231}Paxs are seen (0-7cm, 17 cm and 30 cm). These peaks match periods of higher fine and carbonate rich particle flux and thus suggest interglacial/interstadial conditions and/or high turbidity events in the basin. First order estimates of ages from the relative decay of excesses in these two isotopes suggest an isotopic stage 5 age for the bottom peak. In such settings, ^{230}Thxs and, indirectly ^{210}Pb distributions downcore, can be used to constrain the stratigraphy of late Pleistocene sediments, and may compensate for the absence of a reliable oxygen isotope stratigraphy.

I13-4B9.1 **10:30**

Evolution of sea surface conditions in the Beaufort Sea during Pre-historical and historical times: the last ~1000 years

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In order to reconstruct the evolution of sea surface parameters (temperature, salinity, sea ice cover) in the Beaufort Sea for the historical and prehistorical period, and assess the impact of anthropogenic activities, a series of 3 boxcores was collected in the Mackenzie Trough as part of the CASES

program. Dinoflagellate cysts (dinocyst) and freshwater palynomorphs are used as proxy indicators of sea surface conditions and freshwater input, respectively. The cores were dated using 210Pb, and range from 1000 A.D. to the modern period, providing a pluriannual to decennial-scale resolution for our reconstructions. The highest sedimentation rate (1.2 mm/yr) is recorded at the offshore site, and it decreases gradually toward the mouth of the Mackenzie River (0.4 mm/yr). The energy at the river mouth induces a bypass of the proximal trench and shelf areas, allowing sediment deposition further offshore. We observe the passage from a heterotrophic to an autotrophic regime over the last 1000 years, which we associate with increased nutrient input and/or increased open water conditions throughout the study area. The period between 1000 and 1550 A.D. is marked by low sea surface temperature, high sea ice cover and reduced primary productivity. The Little Ice Age period (1550 to 1850 A.D.) is marked by maximum dinocyst fluxes (enhanced productivity) and low sea surface temperature in surface waters. The maximum abundance of freshwater palynomorhs, accompanied by a reduction of salinity suggests increased freshwater inflow from the Mackenzie River. The industrial period (1850 A.D. and onward) is marked by a decrease of dinocyst fluxes by a factor of 2.5. These data suggest that anthropogenic activities over the last 160 years may be related to the decrease in surface productivity in the Beaufort Sea. However, we do not observe a clear warming or cooling trend with respect to the reconstructed sea surface parameters.

C05-3DP.5 **16:00**

Le modèle régional canadien du climat : impacts des changements climatiques sur le cycle hydrologique dans la péninsule Québec/Labrador

Anne Frigon, *Michel Slivitzky*, *Daniel Caya*

(Presented by *Daniel Caya*)
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Nous présenterons les résultats de projections de changement climatique produites avec la dernière version du Modèle régional canadien du climat (MRCC4). Le MRCC est piloté à ses frontières par deux membres du Modèle couplé canadien climatique global (MCCG3). Les projections suivent le scénario d'émission de gaz à effet de serre SRES-A2 du Groupe intergouvernemental d'experts sur l'évolution du climat (GIEC). Les périodes du passé récent (1961-1990) et du futur (2041-2070) ont été simulées. Ces projections permettent d'explorer l'impact des changements climatiques sur les écoulements et les précipitations pour 21 bassins versants situés dans la péninsule Québec/Labrador. Nous comparons également ces résultats avec ceux obtenus d'une projection réalisée à l'aide du modèle ARPEGE-Climat. L'équipe Simulations climatiques d'Ouranos utilise le modèle ARPEGE-Climat suite à l'obtention d'une licence de Météo-France. La configuration d'ARPEGE-Climat développée pour ces simulations est un domaine global de résolution spectrale T159, étiré avec un facteur 2.5 et centré à 50ºN 95ºO, soit sur Winnipeg. Deux simulations climatiques d'ARPEGE-Climat ont été produites à Ouranos : une première sur le passé récent (1958-2001) et une seconde en climat futur (2038-2081) suivant le scénario d'émission de gaz à effet de serre SRES-A2. Finalement, les résultats de simulations du MRCC sur la période 1961-1999, pilotées aux frontières par des réanalyses d'observations, ont permis de valider les composantes du cycle hydrologique sur ces 21 bassins.

O03-3C1.7 **15:00**

Spatial distribution of phytoplankton production and biomass in the Hudson Bay Complex in summer 2004 and 2005https:

Joannie Ferland[1], *Michel Gosselin*[1], *Michel Starr*[2]

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The spatial distribution of phytoplankton production and chlorophyll a (chl a) biomass were investigated in the Hudson Bay Complex (HBC), from 2 to 15 August 2004 and from 31 August to 10 September 2005. Sampling were conducted at 6 stations along a longitudinal transect in northern Hudson Bay (ca. 60°N) and at 4-6 stations in the Foxe Basin/Hudson Strait (FB/HS). Samples from the euphotic zone were size-fractionated to determine the contribution of small (0.7-5 µm) and large cells (>5 µm) to total phytoplankton production and biomass. Total production and biomass were significantly higher the FB/HS region than in Hudson Bay (325-3444 vs. 261-1345 mg C m-2 d-1 and 7-51 vs. 30-87 mg chl a m-2, respectively). In the Bay, production decreased gradually eastwards in 2004 whereas the maximum values were recorded at the eastern side of the transect in 2005. In 2004, production was dominated by small phytoplankton cells in the Bay and Foxe Basin and by large cells in the Strait. In 2005, production was generally dominated by small cells in the whole HBC. Biomass was dominated by large cells in the whole HBC in 2004 but only in the FB/HS region in 2005. During both years, the total production was inversely correlated with the density stratification index of the water column (i.e. difference in sigma-t between 75 m and surface) and the Brunt-Väisälä frequency. This suggests that vertical mixing is governing the total phytoplankton production distribution, through nutrient supply. Future warming and the anticipated greater freshwater input from precipitation would contribute to increase stratification that may further reduce Hudson Bay primary production. This phenomenon however might be compensated by the anticipated reduction of sea-ice melt which contributes to the freshening of surface waters during spring and summer.

A06-1D7.8 **17:45**

Towards an Arctic cloud database for cloud radiative forcing studies in the Beaufort-Amundsen region

Erica Key[1], *Peter Minnett*[1], *Ryan Galley*[2], *Matthew Shupe*[3], *David Barber*[2], *Tim Papakyriakou*[2], *Xin Jin*[2], *Byongjun Hwang*[2]

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For ten years, cloud microphysical, meteorological, and radiative information has been collected at the Atmospheric Radiation Measurement (ARM) site at the North Slope of Alaska (NSA). This rich dataset provides a unique time series with which to characterize cloud-radiation interactions, which may be extended to areas lacking such a sophisticated instrument suite. One approach is to use the cloud properties and microphysical retrievals to construct a set of relationships, in a "look-up table," that can be used in a variety of analyses, including those directed at providing insight into cloud forcing at similar locales. Using the ARM data, we explore the cloud and surface cloud radiative forcing signatures over the CCGS Amundsen during the year-long CASES campaign in 2003-4 in the Amundsen Gulf. The shipboard experiment consisted of two phases: fall and spring/summer transits and an overwintering phase, which included deployment of ice stations on nearby floes. First, radiation, meteorological, ceilometer, and visual cloud measurements provide an environmental back-drop which can be compared against coincident measurements at the NSA site in Barrow to determine whether the large-scale atmospheric pattern over Barrow is also that which is influencing shipboard measurements. Next, the shipboard environmental measurements (relative humidity and temperature profile, cloud base height, incident radiation etc.) are matched with the appropriate range of cloud microphysics derived from the NSA dataset to obtain the parameters necessary to drive radiative

transfer models. A validation of the procedure and results is conducted using ICESat data available for the CASES time period.

O02-1C1.3 **14:00**

Autonomous Underwater Gliders: Sensor Dynamics and Preliminary Data Analysis.

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Since acquiring four underwater electric gliders, the National Research Council-Institute for Ocean Technology and Memorial University of Newfoundland have been exploring the potential for these autonomous underwater vehicles to gather oceanographic information with application to the Newfoundland Shelf. In 2006 we conducted two major test deployments: one starting in Trinity Bay, which proceeded out over the shelf, and another in Conception Bay to test an oxygen sensor. In total we have recorded over a months worth of data and have flown over 700 kilometers. Preliminary data includes estimates of surface currents, depth averaged currents, temperature, salinity, and dissolved oxygen. Analysis includes 1) comparison of the Trinity Bay glider data with DFO AZMP data, and 2) analysis of the Conception Bay test of the Aanderra Oxygen Optode, concentrating on the effects of a slow time constant with attempts to correct as a first-order linear differential.

A07-2DP.5 **16:00**

Ozone Measurements from the Canadian ACE Arctic Validation Campaigns

Kimberly Strong, *Kaley A. Walker*, *ACE Arctic Validation Campaign Team*

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Kimberly Strong (1), Kaley A. Walker (1,2), R. Batchelor (1), R. Berman (3), P.F. Bernath (2,4), S. Bingham (1), C. Boone (2), J. R. Drummond (1,5), H. Fast (6), P.F. Fogal (1) A. Fraser (1), D. Fu (2), F. Goutail (7), A. Harrett (1), M. Harwood (8), T. E. Kerzenmacher (2), R. Lindenmaier (1), P. Loewen (2), K. MacQuarrie (2), C.T. McElroy (6), O. Mikhailov (1), C. Midwinter (2), R. Mittermeier (6), V. Savastiouk (6), R. Skelton (2), K. Strawbridge (6), K. Sung (1), J. Walker (1), and H. Wu (1)

(1) University of Toronto, (2) University of Waterloo, (3) Spectral Applied Research, (4) University of York, UK, (5) Dalhousie University, (6) Environment Canada, (7) Service d'Aeronomie, CNRS, Verrieres-le-Buisson, France

Four springtime validation campaigns have been conducted in the Canadian high Arctic to provide correlative measurements for the Atmospheric Chemistry Experiment (ACE) satellite mission. There are two instruments on-board the satellite: a high-resolution (0.02 cm-1) infrared Fourier Transform Spectrometer (ACE-FTS) and a dual UV-visible-NIR spectrophotometer called MAESTRO (Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation).

The validation campaigns took place at the Polar Environment Atmospheric Research Laboratory (PEARL) (formerly Environment Canada's Arctic Stratospheric Ozone (AStrO) Observatory) in Eureka, Nunavut (80 N, 86 W) between February and April in 2004, 2005, 2006 and 2007. This period coincided with the most chemically active time of year in the Arctic and a significant number

of satellite overpasses. Seven ground-based instruments were operated during the 2004 campaign: a ground-based version of the ACE-FTS (PARIS-IR - Portable Atmospheric Research Interferometric Spectrometer for the Infrared), a terrestrial version of the ACE-MAESTRO, a SunPhotoSpectrometer, a zenith-viewing UV-visible grating spectrometer, a Bomem DA8 Fourier transform spectrometer, a Differential Absorption Lidar and a Brewer spectrophotometer. For the 2005 campaign, a Systeme d'Analyse par Observations Zenithales (SAOZ) instrument and a second Brewer were added to the instrument complement. In 2007, a Bruker 125HR Fourier transform spectrometer and a second UV-visible grating spectrometer also participated. Also, balloon-borne ozonesonde and radiosonde sensors were flown frequently during the four campaigns.

This presentation will focus on comparisons of ozone measurements made by the ground-based, balloon-borne and satellite-borne instruments during the 2004-2006 ACE Arctic Validation campaigns. Comparisons of both retrieved columns and profiles will be presented. Also, the results from the 2004, 2005 and 2006 campaigns will be intercompared to highlight the differences between the two years. Preliminary results from the 2007 campaign will also be highlighted.

H05-2DP.2 **16:00**

An Indicators Approach for Assessing Hydrological Alteration in the South Saskatchewan River Basin, Alberta, Canada.

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The province of Alberta, Canada is undergoing economic growth unprecedented in its short history. The combination of agricultural intensification, oil and gas activities and rapid population increase is placing significant pressure on water resources, especially in the southern third of the province where most of the demand is placed on rivers.

Understanding how increased withdrawals impact the natural environment over time can be a daunting task. Hydrologic indicators are used widely to give a snapshot of the current condition of the natural environment compared to some desired state and as a means to observe changes over time. This paper discusses the use of two such indicators for the South Saskatchewan River Basin (SSRB), the major river basin in southern Alberta. The methods are based on the traditional IHA (Indicators of Hydrologic Alteration) analysis and DHRAM (Dundee Hydrological Regime Assessment Method).

The traditional IHA method is a statistical analysis of flows in a stream prior to and after some major structural change such as construction of a dam. The method requires reasonably long periods of flow record before and after the structural change takes place. In Alberta, the length of flow records between the pre- and post impact periods can be very different or have large gaps. Consequently, the IHA method was modified so that natural flow was compared with recorded flow for a given post-impact period. This creates two datasets for detecting changes in the flow regime. DHRAM was then applied to the result using a modified scoring system to reflect the relative amount of change in summary indicators. These methods are applied to 28 reaches in SSRB.

O02-1B1.5 **11:45**

Using physically-based data assimilation to study ocean climate signals

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Our focus is on improving the realism of ocean data assimilation schemes and using assimilation to investigate ocean climate signals. The main aim is to produce a high-resolution 50 year global ocean reanalysis assimilating temperature and salinity observations. A novel assimilation scheme will be employed, whereby temperature and salinity profiles are assimilated in terms of spiciness on isopycnal surfaces. This allows us to exploit the larger spatial and temporal decorrelations of this quantity, compared with assimilation on geopotential surfaces, allowing flow dependent assimilation and recovery of water mass information.

Two configurations of the NEMO ice-ocean model will be employed in this study. A 1 degree resolution version with a tropical enhancement to 1/3 degree will be used mainly for testing and sensitivity studies, while the ¼ degree DRAKKAR version will be used to perform the high-resolution reanalysis. Results from a series of experiments over the Argo period, assimilating on depth, temperature and density surfaces will be presented. A discussion of error statistics from collocated temperature and salinity profiles will also be included.

I02-4B8.6 **12:00**

Development of a Snow Water Equivalent (SWE) Retrieval Algorithm over First-Year Sea Ice using In-Situ Passive Microwave Data

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Due to recent warming temperatures, we are very uncertain about the response of snow over a full range of time and space scales in the context of Arctic climate variability and change. In this work we present a daily snow geophysical and electrical properties evolution dataset concordant to passive microwave brightness temperatures from an in-situ surface based radiometer. The objectives in this work are a) to present these 'state' variables and to investigate the processes, which govern variability in the vertical, horizontal and temporal dimensions, b) to describe how snow thermophysical properties affect passive microwave emission and scattering mechanisms and c) to develop new statistical SWE algorithms accounting for an evolving snow thickness over first-year sea ice using winter in-situ passive microwave emission for snow on landfast sea ice. The data collection occurred during the Canadian Arctic Shelf Exchange Study (CASES) overwintering mission that took place in Franklin Bay, NWT, Canada between December'03 and June'04.

Results from 2 sampling areas shows that differences in thickness are significantly changing the vertical and temporal evolution of the snow properties. Significant kinetic growth (0.25-0.48 mm·day-1) was measured coincidently with increasing salinity and wetness that was moving upward the snowpack by capillarity with the addition of new layers (snowfall). A SWE algorithm has been developed from the data using coincident in-situ passive microwave measurements. SWE predictions over thick snow are quite accurate, and showed very good agreement with the physical data (R2 = 0.94) especially during the cooling period (i.e. from freeze up to the minimum air temperature recorded) where the snow is dry and cold. Thin snow SWE predictions also showed fairly good agreement with field data (R2 = 0.70) during the cold season.

A01-1B6.4 **11:15**

Ambient Ozone on Mount Everest

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Ozone is a recognized global risk to human health. Areas such as the Himalaya have previously been thought to have the world's cleanest air. In this submission to Nature (Letters), we present the first ever surface ozone measurements on Mount Everest. We report high ozone levels on the summit and slopes of Mount Everest. We discuss the sources of the ozone, both stratospheric and the long distance transport of pollution via the Indian sub continent and south East Asia. We also reveal a new health risk for remote populations in the Himalaya who may be exposed to elevated levels of ozone similar to those found in industrialized cities. We identify the presence of ozone at extreme altitudes as a yet unidentified occupational hazard for Sherpas, Nepalese and Tibetans associated with employment in guiding and mountaineering in the Mount Everest.

H03-2C4.2 **14:30**

Upper Penticton Creek: Logging Effects on Water Yield Regimes from Small Headwater Streams in South-Central British Columbia

Rita Winkler[1], *Younes Alila*[2], *Dave Spittlehouse*[1]

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The effect of forest land-use on community water supplies and aquatic habitat has been of concern for many years in the dry southern-interior of British Columbia. In 1984, the Upper Penticton Creek Watershed Experiment was established to address these concerns in headwater drainages typical of the Okanagan Plateau. This long-term paired watershed experiment includes the 5 km2 watersheds of 240, 241 and Upper Dennis Creeks. Each watershed is gently sloping over an elevation range of 1600 to 2150 m and is forested with lodgepole pine and mixed Engelmann spruce and subalpine fir. From 1984 to 1995, the watersheds remained undeveloped. Since 1995, 30 and 50% of the 241 and Upper Dennis Creek watersheds have been clearcut and the 240 Creek watershed remains an unlogged control.

Streamflow in the Upper Penticton Creek study area is predominantly generated by snowmelt, with April to June water yields averaging 78% to 84% of the annual total. Average annual water yields are 1697, 1623, and 1446 dam3 from 240, 241, and Upper Dennis Creeks, respectively. Average maximum daily discharges range from 0.91 m3 s-1 in 240 and 241 Creeks to 0.68 m3 s-2 in Upper Dennis Creek. August through October flows average 5 to 7% of the total annual yield. The effects of increasing logging extent were assessed against the ten-year pre-logging relationships between 240 Creek and 241 and Upper Dennis Creeks. Changes in annual, seasonal, and 7-day maximum and minimum water yields were observed beginning one year after winter logging 20% of the 241 Creek watershed and after 50% of the Upper Dennis Creek watershed. These effects are thought to be linked to stand-scale changes in snow accumulation and melt, the water balance, and roads.

I11-4D1.6 **17:15**

Runoff modelling of the Scotty Creek basin

Frank Seglenieks[1], *William Quinton*[2], *Eric Soulis*[1]

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Field studies were initiated in 1999 at Scotty Creek in the central Mackenzie River Basin to improve understanding and model-representation of the major water flux and storage processes within a wetland-dominated zone of the discontinuous permafrost region.

A conceptual model of runoff generation was developed that recognizes distinct hydrological roles among the major peatland types of flat bog, channel fen and peat plateau. This model contributes to resolving some of the difficult issues in the hydrologic modeling in this region, especially in relation to the storage and routing functions of wetlands-dominated basins underlain by discontinuous permafrost.

The conceptual model was tested using the WATFLOW model, a combination of the WATFLOOD hydrological model with the land surface scheme CLASS. At first the model was run in column mode to see how it would simulate soil temperatures and soil moistures that were collected from field studies during 2004 and 2005. Next, distributed WATFLOW runs were performed to see how well the model could simulate the overall runoff. The first runs were done with only the peat plateau and bog land classes and this evolved to using runs that included the channel fens. Results were encouraging and lay a good foundation for not only the rest of this IP3 study, but can serve as a model of the interaction between process and modelling for the other IP3 studies.

I01-1C8.8 **15:15**

Meteorological Education and Training: Breaking the Log Jam at the Downstream End

Gadal Jaymie, *Kent Johnson*

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It has long been known that in order to maximize the usefulness of forecasts, decision makers need to know a great deal about both meteorology and the limitations and potentials of forecasts. Advances in meteorological science over the past decade have delivered into the realm of possibility high resolution models, coupled models, environmental prediction, and ensemble forecasts. In achieving these and other scientific advancements, we have long since left behind almost all users in terms of what we can now provide that they cannot use. As a result, the MSC has been hesitant to develop forecast products that have long since been possible, and the gap between what-we-know and what-we-tell continues to widen with each year. Considering the enormous potential benefits to decision makers, education of users has become one of MSC’s most pressing needs, as its lack is effectively forming a log-jam in the flow of science to Canadians. Opportunities for training non-meteorologists in the use of weather information will be discussed as well as a means for determining where to focus limited government resources.

C02-2B5.2 **10:45**

Reconstructing high-latitude climate variability in North America during the Holocene using pollen data: How well do these compare to high-resolution multi-proxy records?

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High-latitude regions are naturally more sensitive to climate perturbations due in part to strong surface albedo feedback. In this study, we use a large network of modern and fossil pollen data to investigate climate variability above 50°N in North America during the past 12,000 years. Climate variables such as July, January, annual precipitations and growing-degree-days (GDD) are reconstructed at 100-year intervals to evaluate climate variability at several time and space scales. In general, preliminary results show both low and high frequency climate variability occurring during the Holocene that compare reasonably well with high-resolution continental to hemispheric scale temperature reconstructions using multiple proxy records. Regional climate time series and vegetation reconstruction using plant-functional types in the region are presented to synthesize climate variability across high-latitudes in North America.

H06-4B4.6 **12:00**

Characterising glacier facies regime shifts on Devon Island Ice Cap, Nunavut, Canada

Mike Demuth[1], *Elizabeth Morris*[2], *Hans-Peter Marshall*[3], *David Burgess*[4], *Roy Koerner*[1], *John Sekerka*[1], *David Fisher*[1]

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As the Earth's coldest regions undergo marked changes due to atmospheric warming, so will the surface facies configurations of its glaciers and ice sheets. Their percolation and wet snow zones will expand upwards and occupy more area. The inherent stratigraphic complexity of these zones will then impart greater uncertainty in glacier and ice sheet mass balance estimates derived from traditional stake and pit methods. Using impulse and FM-CW Gound Penetrating Radars, borehole neutron scattering and manual snow stratigraphy measurements, our goal is to better describe the spatial and temporal variability of the percolation and wet-snow facies. In particular we interpret marked facies regime shifts for the site that are supported by manual in situ mass balance and snowmelt observations. Improved knowledge of such variability has practical significance. First, uncertainties in glacier and ice sheet mass balances remain largely unquantified – this is unsatisfactory as it concerns documenting relatively small changes over large areas. Second, the retrieval of wide-area mass balance change using elevation changes from repeat airborne and orbital altimetry (e.g., ALTM, ICESat, CryoSat) will require information on snow density, densification and the spatial scale of variability over the altimeter footprint.

C02-1C5.3 **14:00**

Holocene paleoceanography of the Western Arctic (Alaska Margin)

Jennifer McKay[1], *Anne de Vernal*[1], *Claude Hillaire-Marcel*[1], *Christelle Not*[1], *Michel Preda*[1], *Leonid Polyak*[2]

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A multi-proxy approach to the analysis of marine sediments is being used to investigate Holocene paleoceanographic changes in the western Arctic. This approach includes the use of dinocyst assemblage data to quantitatively reconstruct of sea-surface conditions (e.g., maximum summer temperature, salinity and seasonal extent of sea-ice cover), as well as grain-size, geochemical and clay mineralogical analyses to investigate variations in sediment source. Marine sediment cores were collected from the Alaska Margin during Leg 1 of the trans-Arctic Hotrax expedition (Darby et al., 2005, EOS v.86). Here we present results for a trigger core (TC) and corresponding piston core (PC) collected from site HLY0501-05 (415 m water depth) in the Beaufort Sea off Point Barrow, Alaska. The TC and upper 1240 cm of the PC are composed of a homogeneous, sulphide-rich, olive gray mud (Unit 1). This unit is underlain by 433 cm of darker gray to grayish brown sandy mud (Unit 2). Sedimentation rates for Unit 1, determined using a combination of 210Pb dating (TC) and AMS 14C dating of bivalve shells (PC), are high (130 to 140 cm/kyr) and remarkably constant. Thus, it is possible to reconstruct paleoceanographic conditions at multi-decadal timescales for the last 9000 years. Preliminary results from dinocyst assemblage data suggest that sea surface conditions have fluctuated throughout the Holocene. In general, periods of higher sea surface temperature (SST) are associated with higher salinity and reduced sea-ice cover (e.g., the period from 1800 to 1000 years B.P.). However, on shorter timescales, SST fluctuates independently from salinity and sea-ice, suggesting that SST may not directly influence sea-ice cover. There has also been a substantial decrease in pollen flux reflecting a decrease in pollen production in the source area and/or a decrease in wind transport to the site over the past 5000 years.

A04-4D6.8 **17:45**

Atlas canadien d'énergie éolienne: validation et développements futurs

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Le groupe de recherche ÉOLE d'Environnement Canada a développé l'Atlas canadien d'énergie éolienne. Les réanalyses globales NCEP sur 50 ans ont servi de base de données météorologique pour établir la climatologie des vents pour tout le Canada et le modèle communautaire MC2 a été utilisé pour faire le downscaling des réanalyses jusqu'à une résolution de 5 km. Plusieurs variables météorologiques d'intérêt pour l'industrie éolienne telles que le vent et l'énergie disponible ainsi que les distributions statistiques de celles-ci ont été calculées pour plusieurs niveaux. Une validation de l'Atlas a été effectuée avec des données de mâts de mesure qui sont utilisés dans l'industrie de l'énergie éolienne. Une description de la méthodologie de downscaling sera présentée ainsi que les résultats des vérifications et les sources possibles d'erreur. Les avenues d'amélioration pour la prochaine version de l'Atlas seront discutées ainsi que le transfert de la méthodologie développée dans les modèles opérationnels de prévision.

I13-4C9.5 **15:00**

Data Sources and Management for the 2007-2009 International Polar Year using the Cooperative Arctic Data and Information Service (CADIS)

James Moore[1], *Florence Fetterer*[2], *Mohan Ramamurthy*[3], *Don Middleton*[4], *Ron Weaver*[2]

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The International Polar Year (IPY) will be an unprecedented opportunity to collect data from crysopheric regions around the globe in a coordinated fashion. The legacy of IPY will be the rich datasets generated during two years of regional intensive measurements and indeed the ongoing monitoring that may result. The IPY framework document outlined points relevant here relating to data noting they will be interdisciplinary, they need to be freely and openly accessible, data

management strategy needs to encourage international coordination and the data will serve as a legacy for IPY.

Obviously, data submission is crucial to the success of the IPY data management strategy. Innovation, flexibility, incentives and coercion are all options to consider for getting as much data as possible submitted to the multiple IPY archive sites. New and emerging technologies will be utilized to simplify the submission process. We will discuss components of an effective strategy that encourage participants to submit IPY data to the archive. The strategy includes early contact with the participants to explain the approach and the value of their adherence to the established guidelines.

We will present an emerging example of this strategy now being implemented for a major IPY initiative and new effort, the Arctic Observing Network (AON). NCAR Earth observing Laboratory, Computational and Information Systems Laboratory (CISL) and collaborators from the UCAR Unidata Project and the National Snow and Ice Data Center are now developing the Cooperative Arctic Data and Information Service (CADIS). CADIS will facilitate the discovery and use of data by encouraging standardization and exchange of metadata through an IT structure friendly to web applications and other applications. We will describe implementation plans for this coherent and well integrated approach to Arctic data management.

C04-3DP.8 **16:00**

Polar clouds – climatic perspective

Ewa Milewska

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Northern airport stations are used to examine trends in various cloud types in the polar region. Archived cloud layer records required rigorous pre-processing to account for major discontinuities in the observing procedures and quality control, to assess impacts of automation and changing archiving practices, and to classify the layers into low, middle, and high cloud categories. Annual, seasonal, day- and night-time trends in the total cloud cover, as well as in the occurrence of mainly cloudy sky conditions in the summation amounts of low, middle, and high clouds are computed, as well as trends in the occurrence of stratiform and other clouds.

I15-2C9.2 **14:15**

Record temperatures in 2006 and their effects on carbon dioxide exchange over tundra in the central southern arctic

Elyn Humphreys[1], *Peter Lafleur*[2]

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In 2006, summer temperatures were as much as 4 °C greater than normal in the Canadian Southern Central Arctic (Environment Canada). We show the impact of this exceptionally warm and early summer on carbon dioxide exchange (CO_2) between arctic tundra and the atmosphere. The eddy covariance technique was used to obtain a continuous record of CO_2 fluxes between May and September in 2004, 2005, and 2006 above mixed heath and sedge tundra located 300 km NE of Yellowknife, NWT. In each year, the tundra was a sink for CO_2 but with 2 times more CO_2 uptake in 2006 compared to 2004. The landscape in this region is dramatically heterogeneous with dry upland

and wet lowland tundra dissected by lakes and ponds. CO_2 fluxes and C stocks were measured for a nearby sedge fen and compared with those of the more upland tundra. With up to 80 cm of peat below the fen surface, this ecosystem has clearly been a significant C sink in the past. In 2006, CO_2 uptake was 1.7 times greater in the fen. Although year-round measurements have not been made at these sites, we speculate on the influence of fall and winter respiration rates on the contemporary annual CO_2 budget of these tundra ecosystems.

I01-1C8.7 **15:00**

"Training" workshops as a tool for knowledge exchange

Gabor Fricska, Tom Shalansky, Jacques Descurieux, Kent Johnson

Meteorological Service of Canada
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Historical efforts in outreach and in understanding of client needs have been largely unidirectional. Examples of "outreach" activities have included presentations, rollouts of new products as well as demonstrations at trade shows or other events. Needs assessments have consisted of meetings to "hear about concerns" or of verbal or written surveys. These efforts have produced some success though the results were less than that which was envisioned. Recently, Environment Canada has begun a series of client workshops, focused on current and emerging capacity in meteorology. These workshops combine the push and pull aspects to create a true knowledge exchange. Various exercises are completed during the one day workshop, targeted at different client groups who make decisions based on weather forecasts. The knowledge exchange workshop has been delivered to client groups in the forest, aviation, transportation and other sectors. A number of common themes have emerged from the workshop feedback and evaluations. Clearly, the knowledge exchange approach has produced positive results and this strategy will be continued in the future as a tool in developing future products and services.

A04-2DP.2 **16:00**

Meteorological Preparations for the 2010 Winter Olympic and Paralympic GAmes

Chris Doyle

Environment Canada, Metorological Service, Vancouver
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Activities by MSC contributing to the development of weather support for the 2010 Winter Olympic Games in Vancouver are well underway. The venue for the Games is a region of complex alpine terrain with a nearby land-ocean interface. Much of the Olympic area - the region of south-western British Columbia encompassing the lower Fraser river valley and the narrow valley extending from Vancouver to Whistler, is a near-pristine wilderness with a sparse observational and climatologic record.

To meet the weather-forecasting needs of the Olympics, three main initiatives are underway: increasing the density and types of weather observations in the Olympic area, improving forecaster training in the meteorology of complex alpine terrain and introducing operational high resolution NWP model output with downscaled fields at very high resolution. There is also a significant research dimension to the Games weather program. Like other Olympics, a Nowcasting and a forecast/research demonstration project is planned to run in parallel with operational training and forecasting efforts.

C04-4D5.7 **17:30**

An evaluation of Antarctic near-surface temperature and snowfall in IPCC AR4 GCMs

Andrew Monaghan[1], *David Bromwich*[1], *David Schneider*[2]

(Presented by *Keith Hines*)
[1] Byrd Polar Research Center, Ohio State University
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Recently published statistical reconstructions of snowfall and temperature over Antarctica allow long-term interdecadal variability to be assessed at the continental scale for the first time. The annual-average Antarctic temperature record now extends back to 1800, the annual snowfall record back to 1955, and seasonal temperature records back to 1960. The new observational records are compared to the twentieth century simulations from global climate models (GCMs) run in conjunction with the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). The IPCC AR4 GCMs appear to overestimate annual Antarctic near-surface temperature trends by a factor of 2-3 over the past century, and by more than 5 times during the latter half of the century. The GCM snowfall variability compares reasonably to the observations over the period of overlap, for which there are generally upward trends. The GCMs are able to simulate the observed sensitivity of Antarctic snowfall to near-surface temperature, suggesting that if Antarctic near-surface temperature does increase as predicted by the GCMs for the end of the 21st century (2-3.5 K according to Chapman and Walsh in press), snowfall will also increase by about 10-20%. However, substantial improvements to simulations of Antarctic near-surface temperature in the GCMs will be required in order to increase confidence in snowfall predictions, and the consequences for global sea level. The causality of the amplified Antarctic near-surface temperature increases in the GCMs is investigated. It is found that an increase in column precipitable water vapor is the main reason for an increase in downward longwave radiation incident at the surface, which in turn increases the near-surface temperature. Additional work is necessary to elucidate the cause of the strong water vapor feedback in the GCMs.

C05-4C5.1 **13:30**

Progress and perspectives of the regional climate modelling activities at Ouranos

Daniel Caya

Ouranos
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The efforts of the Ouranos Climate Simulation Team are devoted to three main objectives: 1) development and validation of the Canadian Regional Climate Model (CRCM), 2) production of regional climate change projections over Canada, and 3) evaluation of the uncertainty associated to the climate change projections. A simultaneous involvement in these areas requires a major logistic effort in which large quantities of simulations are constantly generated and analysed. The increasing wealth in data availability that this effort generates allows us to periodically update our climate change projections as well as our estimation of uncertainty. A progress report of our latest results in these areas will be presented. In addition, an assessment of the CRCM performance in international intercomparison projects will be discussed. Future opportunities and challenges for our team and the regional climate modelling community in general will be addressed.

H02-2B4.6 **12:00**

Defining flowpaths and connections between wetlands and lakes on the Boreal Plain: evidence from physical and isotopic hydrology

Kevin Tattrie[1], *John Gibson*[2]

[1] University of Victoria
[2] Environment Canada
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This paper presents first hydrology results from 5-year study of aquatic sensitivity to acid deposition in the oil sands region of northeast Alberta, sponsored by the NOxSOx Management Working Group of the Cumulative Environmental Management Association (CEMA). Two lake basins were selected for detailed study in the vicinity of Fort McMurray in areas typified by extensive wetland cover, very low topographic relief (

A05-1C6.6 **INVITED/INVITÉ 14:45**

METRo, the Road forecasting model of Environment Canada: an example of free and open software from the government of Canada

Miguel Tremblay

Environnement Canada
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In 2006, Environment Canada released METRo as a Free and Open Source Software under a GPL license.

Following the release, many people from the private sector have downloaded and evaluated it. It is currently used across Canada by several companies and provinces.

This presentation will explain how the software can be obtained and used, what is special about the way it is documented, what collaboration have been made possible with other governments and academia.

We will conclude with a discussion about the future of METRo and how it will depend on collaborative efforts and the needs of its user base.

I01-1C8.6 **14:45**

Improved products and services through a knowledge exchange approach

Jacques Descurieux, Gabor Fricska, Tom Shalansky, Kent Johnson

(Presented by *Tom Shalansky*)
Meteorological Service of Canada
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The meteorological community, traditionally dominated by government, has been product centred where science capacity drives what is delivered to clients. The reason for implementing new products and services has been, at times, nothing more than "because it can be done". Such an approach leads to an increasing chasm between the producers of the products and the consumers of the products. The abandonment of the traditional, product centric and unilateral communication approach to the provision and delivery of services is proposed. It is postulated that a model based on a better knowledge of the user's decision making process would lead to collaborative learning between "experts" and "users". The resulting co-production of knowledge would be valuable for both the

weather service and its multiple audiences. This model implies that the MSC may have to adopt a new communication model and knowledge exchange based paradigm where some meteorologists will have to transition from their traditional forecaster role to that of knowledge brokers between producers of information and consumers of that information.

H06-2DP.2 **16:00**

Secular change in the glacier cover contributing flow to a World Heritage River – initial findings from work in the Ragged Ranges and headwaters of the South Nahanni River, N.W.T.

Mike Demuth[1], *Daniel McCarthy*[2], *Christian Zdanowicz*[1], *Veronique Pinard*[1], *Louis Robertson*[1], *David Murray*[3], *Steve Catto*[4]

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[2] Brock University
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The South Nahanni River headwaters contain the largest assemblage of glaciers in the Northwest Territory - glaciers that remain hereto unstudied. The majority of these are located in the Ragged Ranges of the Logan and Selwyn Mountains. River flow from these headwaters plays an important but yet to be comprehensively defined role in the functioning of eco-systems related to the South Nahanni River and its tributary, the Flat River.

Using recent and historical remote sensing imagery, space-based geodesy and information from geobotanical assays conducted in the glacier foreland, we provide a rudimentary description of the recent and past-century contraction of some notable glaciers in this region. We describe ongoing work towards a better understand the variability of glacier cover, snowpack and related river flows for a region that serves as a northward and eastward extension of perspectives on surface energy balance and hydrological inputs provided by several observing sites in operation in the Rocky Mountains, Interior Ranges and Coast Mountains.

I10-1B9.7 **12:00**

Towards modelling the ice bridge in Nares Strait

Ryan Walker[1], *David Holland*[2], *David G. Barber*[1]

[1] University of Manitoba
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The North Water (NOW) Polynya, the largest polynya in the Canadian Arctic, is made possible by the formation of an ice bridge across Smith Sound which blocks the southward flow of ice from the Lincoln Sea through Nares Strait. Modelling of ice bridges presents a number of technical challenges relating to sea ice rheology, notably the role of tensile strength and the validity of the continuum hypothesis at high spatial resolution. We discuss efforts to improve the ice dynamics in the POLAIR (Polar Ocean-Land-Atmosphere-Ice Regional) modelling system in order to address these challenges. These efforts will focus on implementing a fast implicit solver for the viscous-plastic equations which allows the use of various yield curves.

A04-4D6.2 **16:15**

A wavelet-based spatial verification approach to account for the variation in scale representativeness of observation networks

Barbara Casati, *Vincent Fortin*, *Laurence Wilson*

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Forecasts defined over spatial domains are often characterized by a coherent spatial structure and the presence of features. Verification methods ought to account for this intrinsic spatial structure. When observations at specific geographical locations are used for the verification, this issue becomes particularly challenging because of the variation in scale representativeness of the observation network across the domain.

This study addresses some of the issues related to the verification of spatial precipitation forecasts against a network of gauges unevenly distributed in space. A new wavelet-based method to reconstruct a precipitation field from sparse gauge observations is introduced. The reconstructed fields are used to perform a scale-oriented verification and compare the Canadian Precipitation Analysis versus its GEM 15 background model.

I01-1C8.5 **14:30**

Meteorological Education and Training: It is not just Environment Canada anymore

Kent Johnson, *Jaymie Gadal*

Meteorological Service of Canada
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Environment Canada has a role to promote economic development and competitiveness of Canadian industry. The potential for meteorology to contribute to economic growth is large and is growing quickly with the advent of probabilistic decision-making tools. Traditionally, Environment Canada has focused needs for training and education in meteorology internally. However, the fraction of meteorologists outside of Environment Canada is growing rapidly. Various levels of government employ meteorologists as do numerous industries. In addition, there is an active and growing private sector in Canada providing meteorological products and services. Outside of Environment Canada, there is a lack of opportunity for training and development of meteorological professionals. The infrastructure to develop a training program, even a modern, distance-based program, is high and thus, many smaller employers cannot afford it. These is a role for Environment Canada to work with other governments and with private industry to develop a Canadian meteorology training program. This paper will discuss a process and options thorough which Canadian meteorologists, whether in the public or private sector, can be on the leading edge of our science.

A06-2DP.2 **16:00**

An Assessment of Atmospheric Moisture and Cloud Cover Characteristics Forecast by AMPS

Ryan Fogt, *David Bromwich*

(Presented by *Keith Hines*)
Polar Meteorology Group / Byrd Polar Research Center, Columbus, OH, USA
Contact: fogt.13@osu.edu

Antarctic Mesoscale Prediction System (AMPS) forecasts of atmospheric moisture and cloud fraction (CF) are compared with observations at McMurdo and South Pole stations in Antarctica. Overall, it is

found that the model produces excessive moisture at both sites in the mid to upper troposphere due to a weaker vertical gradient of moisture in AMPS. Correlations with observations suggest AMPS does a reasonable job of capturing the low level moisture variability at McMurdo and the upper level moisture variability at South Pole. The model under-predicts the cloud cover at both locations, but changes to the AMPS empirical CF algorithm remove this negative bias by more than doubling the weight given to the cloud ice path. A "pseudo satellite" product based on the microphysical quantities of cloud ice and cloud liquid water within AMPS is evaluated against Defense Meteorological Satellite Program (DMSP) imagery to examine the broader performance of cloud variability in AMPS. Theses comparisons reveal that the model predicts high level cloud cover and movement with fidelity, which explains the good agreement between the modified CF algorithm and observed CF. However, this product also demonstrates deficiencies in capturing low level cloudiness over cold ice surfaces, related both to the contouring of the cloud liquid water species and insufficient supercooled liquid water in the microphysics scheme. The poster demonstrates that AMPS predicts overall CF and high cloud variability notably well, making it a reliable tool for longer term climate studies of these fields in Antarctica.

A06-1D7.1 **16:00**

Methods and Applications of Measurements of Particle Sizes and Habits in Ice Clouds

Igor Grishin, *Michael Earle*, *James Sloan*

(Presented by *James Sloan*)
University of Waterloo
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The sizes and morphologies of cloud particles greatly influence light scattering and the redistribution of solar energy in the atmosphere. Ice crystals in cirrus clouds exhibit a variety of sizes, shapes and habits, depending on the ambient temperature and relative humidity during their nucleation and growth phases. We have developed a means of imaging micron-sized ice particles in the laboratory under temperature conditions representative of those in cirrus clouds to permit the study of these properties. This uses a cryogenic flowtube equipped with an optical microscope coupled to a CCD camera. The resulting images are of extremely high resolution (~ 1 um), allowing the structural details of the various ice crystal habits to be examined. We also measure infrared spectra of the same ice particles to obtain further information. In this presentation, we will discuss the measurements and complementary image processing algorithms we have developed to determine the size and shape information from the images. These algorithms are based on the localization of contrast regions in the original image, followed by morphological analysis of the particle edges. Using this approach in combination with the method of moments, we can retrieve information about the particle size, aspect ratio (asphericity parameter) and compactness and relate this to the particle formation conditions. The method was applied to the retrieval of size and shape distributions of water, sodium chloride and ammonium sulfate aerosols in the temperature range 213 - 243 K. Here we will illustrate the utility of these algorithms in characterizing ice particles in model cirrus clouds, and discuss the advantages and limitations of this approach.

O03-2C1.1 **INVITED/INVITÉ** **14:00**

Perspectives on Six-Years Experience with a Real-Time Coastal Observing System

Alex Hay

Dalhousie University
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The Lunenburg Bay Coastal Observatory, established in 2001 and in semi-continuous operation since, has been the focus of interdisciplinary research on prediction and predictability in coastal marine environments. This talk briefly summarizes the overall goals of the projects, and then focuses on some of the central results pertaining the coastal dynamics that have arisen because of this window on the coastal ocean.

A04-4C6.6 **14:45**

Current and future seasonal forecasting at the Canadian Meteorological Center

Marie-France Turcotte, *Juan Sebastian Fontecilla, Benoît Archambault*

Centre météorologique canadien
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Since 1995, the Canadian Meteorological Center has been producing seasonal temperature and precipitation anomaly forecasts using objective methods: numerical models for season 1 (month 1-2-3) and statistical methods for seasons 2 to 4 (months 4 to 12). Forecast for season 1 is generated by GEM and GCM2 models with 6 members each. Deterministic and probabilistic products are generated from this ensemble.

Recently, 35 years of seasonal hindcasts has been conducted with four different models: the CCCma AGCM3, CCCma AGCM2 and the RPN GEM and the RPN SEF. This ensemble of hindcast constitute the second Historical Forecast Project (HFP2) which follows the protocol established by the PCMDI for the SMIP2/HFP. This 4 model set up will be the next operational seasonal forecast system to be implemented at CMC later this year.

An overview of the current and the future system will be detailed.

A03-3B6.1 **10:30**

Ammonia and particulate matter measurements from an open feedlot

Sean McGinn[1], *Trevor Coates*[1], *Thomas Flesch*[2], *Brian Crenna*[3]

(Presented by *Trevor Coates*)
[1] Agriculture and Agri-Food Canada
[2] University of Alberta
[3] Thunder Beach Scientific
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Emission of ammonia (NH_3) from livestock manure is an important environmental issue as it is a major contributor to atmospheric NH_3. Elevated concentrations of NH_3 can impact regional air quality and atmospheric visibility because of its role as a precursor for aerosol formation. The goal of our study was to measure the quantity of NH_3 emitted from an open beef feedlot and also obtain measurements of fine particulate matter (PM 2.5). Our study was conducted between June and October 2006 at a 22,000 head feedlot located in southern Alberta. Open-path lasers measured NH_3 concentration within and downwind of the feedlot. Three portable Beta attenuation monitors were employed upwind, within, and downwind of the feedlot to record concentrations of particulates less than 2.5 µm in size. NH_3 concentration and meteorological data were used with a backwards Lagrangian stochastic (bLS) dispersion model to estimate NH_3 emissions from the feedlot. During our study, an average of 2750 kg NH_3 per day was lost from the entire feedlot, equivalent to 73.1 µg NH_3 m^{-2} s^{-1} or 122 g NH_3 $head^{-1}$ d^{-1}. The diurnal pattern of NH_3 emissions was bi-modal, where peaks existed at mid-afternoon and late evening. Particulate matter concentration averaged over 24 h ranged from 3 to 34 μg/m^3 for the upwind site, 3 to 51 μg/m^3 for the downwind site, and 5 to 100 μg/m^3 within the feedlot. Minimum values occurred during periods with or directly following rain.

G06-4C2.4 **14:30**

A forward modeling approach to estimating effects of three-dimensional topographical density distributions on orthometric height

Robert Kingdon, *Petr Vanicek*, *Marcelo Santos*

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Recent efforts from the University of New Brunswick have shown that, in situations involving high elevations and high density contrasts with non-vertical interfaces, two-dimensional models of topographical density do not provide centimeter level accuracy in orthometric height calculations. On the contrary, a three-dimensional model is needed in these cases. However, the three-dimensional density distribution is not well known in most areas, and determining it from seismic inversion or other geophysical techniques is an involved process and beyond the scope of our current work. Instead, we have sidestepped for now the problem of reverse modeling to find a three dimensional density distribution and instead used a forward modeling approach to determine, given that we know the density distribution in a certain area, the effect is has on geodetic quantities. This is useful both to determine density effects for areas where the three dimensional distribution is known, and also to identify more clearly which areas we need to find a distribution for.

To this end we have developed software to calculate effects of either a variety of simple density distributions, or a provided density distribution determined by e.g. seismic inversion. Using numerical integration, our software calculates density effects on gravity and gravity potential, as well as derived quantities such as effects on mean gravity along the plumbline, effects and corrections to Helmert mean gravity, and effects and corrections to Helmert orthometric height. This could easily be extended to calculating effects on geoid height or related quantities. The software has been validated by testing against results calculated manually for certain data points and well defined density distributions, and against currently existing geophysical forward modeling software.

I01-1C8.2 **13:45**

Are “unexpected” waves as important as rogue waves?

Johannes Gemmrich, *Chris Garrett*

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Rogue waves have received considerable scientific attention in recent years. They are commonly defined as waves with height $H \geq 2.2H_s$, where H_s is the significant wave height (typically the average height of the highest one third of the waves). Linear superposition of random wave components leads to a Rayleigh distribution of wave heights, and it is expected that one in about 16000 waves (or one wave every two days for a ten second wave period) is larger than 2.2 H_s. We suggest that the “unexpectedness” of large waves is also of great concern to ships and beachcombers. In linear simulations we examine the probability of a wave being α times larger than any of the preceding N dominant waves. We derive the frequency of such waves as a function of α and N for various wave spectral shapes. To give one example, in developing seas the likelihood of a wave twice the size of any wave within the preceding 22 dominant wave periods ($\alpha = 2$, $N = 22$) is as high as that for a classical rogue wave.

C02-1B5.4 **11:15**

A comparison between ICE-5G and a deglacial Northern Hemispheric chronology from calibrated glaciological modelling

Lev Tarasov[1], *W. R. Peltier*[2]

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We present a comparison between two different deglacial reconstructions. Employing independently inferred margin chronologies, the ICE-5G reconstruction has been tuned to closely fit RSL and geodetic constraints. However, the reconstruction lacks meaningful error bars and has no intrinsic glaciological self-consistency. An on-going Bayesian calibration of the MUN/UofT Glacial Systems Model (GSM) includes these constraints along with fundamental glaciological self-consistency. Furthermore, the North American component is also constrained by marine limit and strandline observations. The Bayesian methodology also provides objective error bars relative to the constraint data. Examination of ice chronologies and fits to relative sea level and marine limit observations will elucidate the trade-offs of these different approaches. The analyses will also identify key data holes and dynamical issues that need to be addressed in order to further improve the quality of deglacial reconstructions.

I05-2C8.5 **15:00**

Overview of Ocean Data Assimilation to be Carried Out by the Global Ocean and Atmosphere Prediction and Predictability Research Network

Keith Thompson[1], *Dan Wright*[2], *Yimin Liu*[1]

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The Canadian Foundation for Climate and Atmospheric Sciences has recently funded a new research network entitled “Prediction and Predictability of the Global Atmosphere-Ocean System from Days to Decades”. The network brings together 16 researchers from 9 universities from across Canada to work on improving the predictive skill of coupled systems on both regional and global scales. This presentation will provide an overview of the ocean data assimilation to be carried out on time scales of days to seasons for both ocean-only and global coupled systems. The presentation will conclude with a brief summary of a new technique developed by Thompson and Liu for jointly assimilating altimeter (sea level) and Argo (vertical profiles of temperature and salinity) data. Cross validation will be used to show that the parameters and ocean fields estimated using the new assimilation technique are reasonable and the scheme leads to useful predictive skill of the ocean.

C05-3C5.7 **15:15**

Investigating RCM’s internal variability using an ageing tracer

Philippe Lucas-Picher[1], *Daniel Caya*[2], *Ramon de Elia*[2], *René Laprise*[1], *Sébastien Biner*[2]

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Regional climate models (RCMs) have been used for more than a decade to generate small-scale regional climate features that cannot be obtained by general circulation models (GCMs). To provide high-resolution climate information on their limited area domains, RCMs need information at their boundaries, which usually comes from GCMs or reanalyses. This information controls the RCMs simulations. The degree of constraint of the lateral boundary forcing on a RCM simulation depends on the domain size and the flow regime. In spite of this control, the RCM solution yields a certain level of internal variability. Therefore, differences in the RCM circulations are possible for a given set of lateral boundary condition (LBC). RCM simulations launched with small differences in their initial conditions, but fed by the same set of LBC, will diverge one from another leading to different states after few days.

In this work, an ensemble of simulations with the Canadian RCM started with different initial conditions for various domain sizes were realized. Statistical analysis of the simulations shows that lateral boundary forcing is less effective as the domain expanded, increasing the internal variability. An attempt is made to investigate the cause of this dependence. With this objective, an ageing tracer is used to measure the residency time of the atmospheric parcels into the limited area domain. This tool can serve to determine the flow regime properties and to evaluate in a certain way the degree of constraint by the lateral boundary information on the RCM simulation. In this perspective, a relation between the residency time and the RCM's internal variability is sought.

S03-3C3.6 **15:00**

Snowfall monitoring with a remote camera network

William Floyd, *Markus Weiler*

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Rain-on-snow (ROS) events primarily generate peak flow in the coast mountain watersheds of British Columbia. As climate change progresses, ROS events may increase in number, severity and spatial coverage, thus it is important to gain a better understanding of the different processes which govern such events. Of particular interest to both scientists and land managers is the role of canopy interception, especially in areas where timber harvesting occurs. Monitoring ROS events is difficult due to the rapidly changing meteorological conditions, especially the accumulation and ablation of snow, both on the ground and that stored in the canopy. To overcome difficulties with monitoring ROS events we used an innovative experimental design to monitor snow dynamics in a remote watershed dominated by ROS events. Nested within an established hydrometric and climate station network, we installed 8 remote camera stations to monitor, at an hourly time step, state of precipitation, snow accumulation, snow ablation, snow water equivalent, interception and stem flow under different aged forest stands. The camera network provided excellent qualitative and quantitative data that would have otherwise been undetected using traditional methods. Furthermore, remote sensing and photogrammetric software is used to develop routines which efficiently extract time series of different variables from the images.

I11-4D1.3 **16:30**

Delineating Streamflow Contributing Areas in a Subarctic, Subalpine Watershed Using High Frequency and Synoptic Sampling Water Quality Data

Celina M. Ziegler[1], *Sean K. Carey*[2]

(Presented by *Celina Ziegler*)
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The spatial and temporal nature of streamflow response to rainfall and snowmelt in discontinuous permafrost environments continues to be poorly understood. Uncertainty remains as to what areas of the basin contribute runoff during different times of the year and whether certain areas of the basin exhibit threshold-like runoff behaviour. To improve our understanding of these issues, a study was undertaken to relate natural stream hydrochemistry with hydrometric fluxes using both high-frequency data and a synoptic sampling approach. A research program was initiated in an 8 square kilometre sub-catchment of the Wolf Creek Research Basin, 15 km south of Whitehorse, Yukon Territory. Measurements began in May 2006 and continued through August. Water quality sondes were stationed at four points along the stream to measure water temperature, pH, specific conductivity (SpC), and dissolved oxygen (DO) at 15-minute intervals. Spatial samples were collected at approximately five day intervals from stations at 200 m intervals along Granger Creek, and with associated rain, soil water, and ground water samples. The water samples collected were analyzed for major anions and cations, including chloride (Cl-), bromide (Br-), nitrate (NO3-), phosphate (PO43-), sulphate (SO42-), sodium (Na+), potassium (K+), calcium (Ca+), and magnesium (Mg+). In general, chemical species showed increased mass downstream, suggesting that the contribution of groundwater to streamflow occurred in equally as contributing area increased. Two component hydrograph separations with SpC and Cl- indicate that pre-event water dominated the hydrograph during baseflow, yet during snowmelt, event water dominated the hydrograph for approximately 10 days. There were significant differences in hydrograph separation depending upon the selection of tracers.

G08-2B2.3 **11:00**

Three-dimensional inversion of gravity data for blocky models using a minimum-structure algorithm and general measures

Colin Farquharson

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Minimum-structure inversions, in which a measure of model structure is minimized in conjunction with data misfit, and in which the parameters being sought are the physical properties in cells in an otherwise fixed mesh, are generally robust, reliable, and produce models with few, if any, artifacts. However, the sum-of-squares, or l2, measure that is typically used produces smeared-out, fuzzy models. Such models may or may not be appropriate depending on ones knowledge of the subsurface. It is possible to modify the traditional minimum-structure inversion procedure to use measures other than the sum-of-squares measure. In particular, if an l1 measure of the spatial derivatives of the model is used, models comprising uniform regions separated by sharp interfaces can be constructed. Also, explicit incorporation of diagonal derivatives in addition to the usual horizontal and vertical derivatives enables dipping interfaces to be generated. It is therefore possible to produce piecewise-constant, blocky models while retaining the reliability of the minimum-structure approach. Examples will be given for the 3-D inversion of gravity data.

C04-3DP.3 **16:00**

Centennial-Scale Southern Annular Mode Variability in Observations and IPCC AR4 Models

Ryan Fogt[1], Andrew Monaghan[1], Martin Visbeck[2], Julie Jones[3], Phil Jones[4], Gareth Marshall[5], David Bromwich[1]

(Presented by *Keith Hines*)
[1] Polar Meteorology Group / Byrd Polar Research Center , The Ohio State University, Columbus, OH, USA
[2] Physical Oceanography Group, IFM-GEOMAR, Kiel, Germany
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Two different techniques are used to reconstruct the long-term (1865-2005) variability of the leading mode of Southern Hemisphere atmospheric circulation, the Southern Hemisphere Annular Mode (SAM). Recent studies link seasonal trends in the SAM since the 1960s to climate changes across the Southern Hemisphere, specifically a warming in the Antarctic Peninsula region and weak cooling across the remainder of the Antarctic continent. The Peninsula warming trend is more than 2oC in the last 50 years at some stations, exceeding most warming trends globally, and is linked to recent ice shelf collapses. A number of modeling studies attribute recent these upward trends in the SAM to anthropogenic forcing from stratospheric ozone depletion and/or greenhouse gas (GHG) increases, both of which can cool the polar stratosphere and strengthen the polar vortex. Other studies support the role of natural forcing in governing SAM variability, including tropical Pacific sea surface temperature (SST) variability. Given the climatic impacts of the SAM trends, it is necessary to assess whether they are outside the range of past variability. Here we show that the reconstructed SAM has considerable decadal- to centennial-scale variability, and only during austral summer is the late-20th century positive trend in the SAM outside of the range of the centennial-scale variability. The reconstructions are compared to the SAM from 20th century global climate model simulations associated with the Intergovernmental Panel on Climate Change Fourth Assessment Report. The models reproduce the SAM trends within uncertainty only during austral summer, while during the other seasons most models predict significant long-term trends (1865-2005) that are not present in the reconstructions. These results indicate that realistic stratospheric ozone forcing is needed to adequately simulate long-term SAM variability and to accurately project SAM behavior into the future.

A05-1C6.4 **14:15**

Access to the Meteorological Service of Canada's Historical Data

Robert Morris

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There has been an ongoing evolution in the area of access to historical climate, weather and water data at the Meteorological Service of Canada (MSC). At the same time, work continues in various areas that provide potential for future enhancements. This presentation will describe the existing data access practices, policies and procedures, both through Environment Canada’s Internet site and through service contacts, along with current issues and plans for upcoming changes. The presentation will also discuss ongoing work in related subjects and its impacts on access to data. Some of these areas include geomatics and metadata standards, data formats, data base technology, advances in archived data sets, and the MSC Data Management Framework project. Finally, the issue of responding to users’ requirements will be discussed.

C05-3DP.2 **16:00**

Verification of Polar WRF in AMPS

Daniel F. Steinhoff[1], *David H. Bromwich*[1], *Kevin W. Manning*[2]

(Presented by *Keith Hines*)
[1] Polar Meteorology Group / Byrd Polar Research Center, The Ohio State University, Columbus, Ohio USA
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The Antarctic Mesoscale Prediction System (AMPS) is an experimental, real-time mesoscale modeling system developed in support of the United States Antarctic Program (USAP) by the National Center for Atmospheric Research (NCAR) and the Polar Meteorology Group of the Byrd Polar Research Center at The Ohio State University (OSU). Development of AMPS has been ongoing since its inception in 2000, and its use has grown beyond USAP operations to include support of international Antarctic activities as well as use in atmospheric research applications. AMPS currently employs Polar MM5, a version of the fifth-generation Pennsylvania State University-NCAR Mesoscale Model optimized for use in polar regions by OSU. The Weather Research and Forecasting Model (WRF), released in 2005, has been developed as a replacement for MM5. Development of polar modifications to WRF (Polar WRF) has been ongoing at OSU with Polar WRF slated to replace Polar MM5 within AMPS. In this study concurrent forecasts from AMPS Polar WRF and AMPS Polar MM5 are compared with available surface and upper-air observations to test the validity of Polar WRF forecasts. Statistical analysis is done to determine the robustness of Polar WRF forecasts in a climatology setting. Case studies are presented for a detailed look at Polar WRF performance in real-time forecasting of Antarctic weather. Results from this research will aid in further improvements of Polar WRF that will benefit both operational and research interests in Antarctic real-time numerical weather prediction.

I10-1C9.4 **14:15**

Seasonal and inter-annual variations of the Arctic ice-ocean state: a modelling study based on NEMO

Youyu Lu[1], *Jie Su*[1], *Gilles Garric*[2], *Simon Prinsenberg*[1]

[1] Bedford Institute of Oceanography
[2] Mercator-Ocean
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The seasonal and inter-annual variations of the sea-ice and ocean state in the Arctic are simulated using the NEMO (Nucleus for European Modelling of the Ocean) model with two horizontal resolutions. The coarser grid model allows us to examine the Arctic ice-ocean state following a 20-year long spin up, in particular the drifting of temperature and salinity relative to the observed climatology, the circulation and the distribution of sea ice thickness and concentration. The higher resolution model better resolves the circulation, and hence the ice and freshwater transports through the Canadian Arctic Archipelago. The benefits of increasing the horizontal resolution are assessed by comparing the model results with available observations.

O01-2B1.2 **10:45**

A Tidal Model for the Northwest Atlantic

Shastri Paturi[1], *Guoqi Han*[2], *Brad de Young*[1], *Yuchan Yi*[3], *C.K. Shum*[3]

[1] Memorial University of Newfoundland
[2] Fisheries and Oceans Canada
[3] Ohio State University
Contact: hang@dfo-mpo.gc.ca

We developed a three-dimensional tide model for major semi-diurnal and diurnal constituents in the Northwest Atlantic. Multi-mission altimetric tides were assimilated into the model. The impacts of the data assimilation were investigated. The model tidal heights were compared with coastal tide gauge and bottom pressure gauge data. The model tidal currents were evaluated against current meter data.

I02-4B8.3 **11:15**

On the spatial and temporal variability of sea ice in the southern Beaufort Sea: 1980 - 2004.

Ryan Galley[1], *Phillip Hwang*[1], *Erica Key*[2], *David Barber*[1], *Peter Minnett*[2], *Jens Ehn*[1]

[1] CEOS, University of Manitoba
[2] RSMAS, University of Miami
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The CASES study region, formed by the southern Beaufort Sea and Amundsen Gulf are of considerable interest from a climate variability and change standpoint for several reasons. It is in this area that an all-important gradient of sea ice age and thickness occurs, an inter-connection of the Arctic multi-year pack with various thickness classes of mobile first year sea ice as well as landfast sea ice of the Canadian Arctic Archipelago. The interaction of these sea ice regimes creates a flaw lead system which has been a persistent feature of the region and has analogs on both sides of the pole. Canadian Ice Service digital ice charts for the western Arctic region were analyzed for the period 1980 – 2004 on a 4km^2 grid in order to characterize: [1] the mean end-of-winter (end-of-summer) sea ice concentration, areal extent and volume as a function of type in the study area, [2] the trend in variability of sea ice as a function of type at the end-of-winter (end-of-summer) in the region, [3] the timing and [4] the rate of break -up and freeze-up of sea ice in study region. Sea ice concentration as a function of type in the region has changed over the 25-year period studied (1980 – 2004) and that changes observed in the central Arctic multi-year pack may be changing dynamic and thermodynamic sea processes in the predominately first year ice within the study region. Break-up and the opening of the flaw lead system in spring appears to be a dynamically forced and temporally variable event, while freeze-up occurs with little variability through the 25-year time series and is thermodynamically driven.

O03-3B1.1 **INVITED/INVITÉ 10:30**

Estuarine circulation in the Gulf and Estuary of St. Lawrence

Francois Saucier[1], *Francois Roy*[2], *Simon Senneville*[1], *Greg Smith*[3]

[1] Université du Québec à Rimouski
[2] Meteorological Service of Canada
[3] Reading University
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The estuarine dynamics embedded in the general circulation of the Gulf and Estuary of St. Lawrence are simulated using a primitive equation prognostic sea ice - ocean model over a period of six years using detailed tidal, atmospheric, hydrologic and oceanic forcing. The vertical and seasonal structures of mass transport at the mouth of the Estuary and through other main sections of the Gulf are examined as functions of wind and St. Lawrence River runoff forcing. The simulation resolves a mean cyclonic circulation of 0.58 Sv, including 0.2 Sv inflowing at depth through Cabot Strait, and 0.34 Sv circulating from the Strait of Belle Isle to Cabot Strait (with a branch of 0.1 Sv circulating around Anticosti Island). The mean residence time of deep shelf slope waters is 2.7yr in the Laurentian Channel and 1.2yr in the Estuary. The system acts like a typical estuary through the first 150m depth, involving the gravitational circulation of the intermediate layer that is linearly proportional to runoff (and mainly driven by tidal mixing at the head of the Laurentian Channel), and like a typical high

latitude marginal sea during fall and winter, with transport in the deeper layer inversely proportional to runoff (stratification – limited ventilation). Because of the strong spatial and temporal variability, we isolate the effects of runoff and wind stress through sensitivity experiments. These experiments show that the wind-driven motion in the Estuary and Gulf is the main factor driving the withdrawal of the deep layer during fall and winter in the Estuary. The experiments also show the strong limiting effects of winds (generally producing northward flow along western Newfoundland) on the intrusion of shelf waters into the Gulf.

H01-1B4.1 **10:30**

Stream-peatland hydrologic interactions in the coastal zone of the James Bay Lowland: The two decade Waddyssey of Woollyses

J.M. Waddington, *M-k. Woo*

(Presented by *Mike Waddington*)
McMaster University
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The James Bay Lowland is one of Canada's largest peatland complexes. The coastal zone of this peatland has a series of parallel raised beach ridges separated by 'inter-ridge peatlands. The age and peat depth in these peatlands increases with distance inland from the coastal zone. This variation in peat depth and the channelization of flow from inland portions of the peatland at breaks in the beach ridges leads to complex stream-peatland surface and subsurface flow interactions.

We examined the hydrology of several stream segments and their adjacent peatlands near Ekwan Point, on the western coast of James Bay during the summers of 1987 and 1988 (2 decades ago). Four patterns of exchange of water between these inter-ridge peatlands and the streams were identified: a) stream with pass through the peatland with minimal interaction, b) streams which flow through the peatland and have substantial interaction, c) streams which begin in peatlands, and d) stream channels which end in peatlands. Differences in these stream-peatland interactions are reflected in the storm responses of streamflow at each of the representative sites. At streams with substantial interaction, the peak flow was reduced and the recession prolonged compared to the stream that has little exchange of water within the peatland. The stream-peatland interaction varied during the summer period likely leading to differential rates of peat accumulation in these the youngest peatlands of the James Bay Lowland.

A04-4C6.8 **15:15**

Canadian Ensemble Prediction System : overview of the current and the future operational configuration.

Marie-France Turcotte, *Stéphane Beauregard*, *Jacques, Jr. Hodgson*, *Benoît Archambault*

Centre météorologique canadien
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The Ensemble Prediction System (EPS) has been running operationally at the Canadian Meteorological Centre (CMC) since February 1996. Several improvements have been brought to the system since then (doubling of the number of members, increase in horizontal resolution, update of the Ensemble Kalman Filter as well as the model physics parameterizations). In that set-up the Canadian EPS has sixteen members, eight of them produced by integrating the SEF model and eight more by integrating the GEM model; the model integrations are done from sixteen perturbed analyses; each member has its own physics parameterization; integration of the members is performed out to sixteen days in the 00 and 12 UTC production cycles.

A new configuration is under development at CMC. An overview of the major changes will be given.

This presentation will also give an overview of the products that have been developed based on the Canadian EPS as well as a brief overview of the North American Ensemble Forecast System (NAEFS) project which involves operational exchange of ensemble members between Canada and the United-States.

I07-3DP.4 **16:00**

The Impact of the Ade□lie Land Katabatic Wind Regime on Cyclogenesis

Daniel F. Steinhoff, David H. Bromwich

(Presented by *Keith Hines*)
Polar Meteorology Group / Byrd Polar Research Center, The Ohio State University, Columbus, Ohio USA
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The most intense katabatic wind regime in Antarctica is located along the coast of Adelie Land, where the annual mean wind speed recorded at Cape Denison in 1912-13 by Douglas Mawson's Australasian Antarctic Expedition was 19.4 m/s. Both observational and model-based studies have identified the off-shore region of the George V Coast (near 150°E) to be a region of cyclogenesis, although few studies have provided a physical explanation as to why cyclogenesis occurs there. Extensive research of mesoscale cyclone activity in the Ross Sea region has identified katabatic winds as a key component of cyclogenesis events. For the Adelie Coast region it is inferred that off-shore katabatic winds aid in establishing a low-level baroclinic zone favorable for cyclone development, as cold drainage flow from the inland plateau is advected into the coastal maritime environment. Cyclogenesis would be expected to occur on the cyclonic shear side of the katabatic jet (to the east) as the katabatic jet interacts with the ambient synoptic-scale flow. In this study the results from the manual tracking of cyclonic features from two years of high-resolution MODIS infrared imagery are analyzed to determine the level of cyclogenesis, cyclolysis, and overall cyclone activity in the Adelie Coast region. Climatological fields from the 1979-2002 ERA-40 reanalysis are used to determine the synoptic setting of cyclogenesis events. Output from the Antarctic Mesoscale Prediction System (AMPS) is used to determine the role of katabatic winds and other mechanisms in coastal cyclogenesis for case study events. Besides determining the physical mechanisms responsible for cyclogenesis, the results provide the best climatology of cyclone activity for the Adelie Coast region to date.

C02-1B5.1 **10:30**

A glacier-resolving model for mountain glacier systems

Christian Schoof[1]*, Tom-Pierre Frappe-Seneclauze*[1]*, Etienne Berthier*[2]*,* *Garry Clarke*[1]

(Presented by *Garry Clarke*)
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Melting mountain glaciers represent the fastest cryospheric contribution to sea level rise at present, and the Western Canadian Cordillera, stretching north into the Yukon and Alaska, is one of the biggest components of that trend. One of the main challenges in modelling mountain glacier systems and predicting their rate of retreat (or advance) is to resolve the complex topography in which they are situated. Here we present and compare two different approaches to this problem. The first treats individual glaciers as one-dimensional (in the same way one might regard a river as one-dimensional), but allows for temporally varying connections between glaciers in an interlocking system of mountain

valleys. The second method resolves both horizontal dimensions (as is also done in ice sheet modelling), but pays special attention to the migration of glacier margins using a variational formulation. Practical examples are given for both methods applied to a section of the Canadian Cordillera.

S05-1D3.6 17:15

Atmospheric Hazards: Snowstorms in Atlantic Canada 1955 – 2005

William Richards[1], *Bjarne Hansen*[1], *Yahya Abuamer*[2]

[1] Environment Canada
[2] BSc Candidate, University of New Brunswick
Contact: william.richards@ec.gc.ca

Heavy snowstorms often cause economic and social disruptions. However, little is known about their severity and frequency of occurrence. Daily snowfall data underestimate snowfall from storms that occur over more than one climatological day. This leads to a bias when estimating the magnitude of extreme events. Data from the national meteorological observational network were used to reconstruct historical snowfall events for 32 locations in Eastern Canada. These events were used to derive the annual frequency of events by severity, median and maximum duration of events, and magnitude of events for return periods from two to 100 years.

I01-3DP.2 15:30

Atmospheric Hazards: Extreme Wind Gust Climatology in Atlantic Canada 1955 – 2000

William Richards[1], *Yahya Abuamer*[2]

[1] Environment Canada
[2] BSc Candidate, University of New Brunswick
Contact: william.richards@ec.gc.ca

Extreme winds are one of the meteorological hazards that affect Atlantic Canada. We analyzed the extreme wind gusts recorded at 30 stations in eastern Canada to derive the return level wind for periods of 10 to 100 years. Wind gusts with a 100 year return period range from 123 to 194 Km/hr. They are probably higher in unique locations like Cape Breton, western Newfoundland and the (Atlantic) Labrador Coast. Extreme wind gusts are likely to be higher at exposed areas along the coasts than at inland locations. Annual extremes occur more frequently in winter than in summer. When annual extremes occur in summer they are smaller, on average, than when they occur in winter.

H02-2DP.4 **INVITED/INVITÉ** 16:00

The distribution of water isotopes in evaporating sphagnum columns: potential implications for quantifying water fluxes

Yi Yi[1], *Peter Whittington*[2], *Jonathan Price*[2], *Thomas Edwards*[1]

[1] Department of Earth Sciences, University of Waterloo
[2] Department of Geography, University of Waterloo
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A series of column experiments was conducted to characterize the isotopic (δ18O and δ2H) profiles developed in sphagnum pore waters evaporating under controlled conditions. A constant water table was maintained in five identical 25-cm columns, which were subsampled at intervals of 1, 2, 4, 7, and

15 days into contiguous 5-cm increments, from which pore waters were extracted for isotopic analysis. As expected, the columns developed upward-convex isotopic profiles that reflect the dynamic balance between the counteracting effects of upward capillary flow and downward diffusion of the heavy isotopic species 1H2H16O and 1H1H18O, which are concentrated near the surface because of preferential loss of 1H1H16O during evaporation. Data points clustered tightly along an evaporation line of slope 3.79 in δ18O-δ2H space, with maximum respective enrichments in the uppermost 5-cm increments of ~6 and ~23 compared to input water δ18O and δ2H. High evaporation rates (average 4.5 mm/d) prevailed under the dry experimental conditions (~25 % RH), accompanied by rapid development of hydrologic and isotopic steady-state (

C05-3DP.1 **16:00**

High Resolution Regional Climate Simulations over Greenland with Polar MM5

David Bromwich, Lin Li, Lesheng Bai, Jason Box

(Presented by *Keith Hines*)
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The Greenland Ice Sheet sits in a critical location in the North Atlantic Ocean and has had several deep ice cores extracted to detail the climatic history of this region on the glacial-interglacial time scale. Also net melting of the ice sheet is thought to be the leading cryospheric source for contemporary global sea level rise. These key climatic aspects provide a strong motivation for better understanding of the contemporary climate of Greenland. A limiting factor is that consistent weather records are primarily available from coastal locations apart continuous automatic weather station (AWS) records from the Greenland Climate Network commencing in the 1990s. Based on the previously documented quality performance of Polar MM5 in simulating the near-surface and free atmospheric variability over Greenland, Polar MM5 has been run from 1957-2006 using initial and boundary conditions from the European Centre for Medium-Range Weather Forecasts (ECMWF) 40-year reanalysis and supplemented after August 2002 by the ECMWF TOGA operational analyses. The simulations are validated against AWS observations and shallow ice core records. The model fields are used to explore the spatial and temporal variability of Greenland Ice Sheet climate, in particular the modulation by the North Atlantic Oscillation.

I08-3C7.3 **14:15**

The Influence of Sea Ice on Air Temperature Variability in Iceland

Halldor Bjornsson, *Trausti Jonsson*

Icelandic Meteorological Office
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Iceland lies just south of the main sea ice edge in the GIN Sea and Denmark Strait. As a result, sea ice only occurs sporadically at the coast. However, the presence of sea ice north and north-west of Iceland influences air temperatures in Iceland in various ways.

We will discuss how influences of the sea ice can be seen in maps of mean temperature in Iceland and how a specific spatial cooling anomaly appears during winters when sea ice conditions are heavy. Furthermore, we will discuss how the recent warming in Iceland has been influenced by a retreat of sea ice from Icelandic waters, and how the sea ice influences the timing of temperature minima during late winter.

I01-1B8.8 **12:15**

Atmospheric Hazards in Canada: Reducing Vulnerability to Extreme Meteorological Events

William Richards

Environment Canada, Adaptation and Impacts Research Division
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Canadians are vulnerable economically and socially to natural atmospheric hazards. Social and economic losses have increased significantly over the last 3 decades which places a tremendous burden on Canadians, taxpayers and the insurance industry. While the number of geophysical disasters has been relatively constant, the rate of weather-related disasters has increased five-fold since the 1960's. Disaster recovery payments by insurance companies and taxpayers have been doubling every five to 10 years throughout the 1980s and 1990's.

Without changing the approach to natural disasters, mal-adapted communities and governments will continue to be burdened by accelerating social and economic costs due to weather-related natural disasters. In order to properly prepare for these events it is necessary to understand the probability of their occurrence. This risk is often difficult to quantify because the data and information are scattered and difficult to access or understand.

In 2005 Environment Canada, in cooperation with provincial partners, launched a website (www.hazards.ca) to communicate scientifically sound data and information which is necessary for sustainable infrastructure design and reducing the risk of expensive disasters. Initially containing data for Ontario and Quebec, the project is being extended to the rest of Canada. The website will enable Canadians to reduce vulnerability to extremes of weather by providing better data for infrastructure design, weather warning criteria and disaster and emergency plans.

C05-3B5.5 **11:45**

The Land Surface Wind Probability Distributions: A High Resolution Observational Study

Yanping He[1], *Adam Hugh Monahan*[2]

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Understanding and simulating the probability distribution of land surface winds is important in regional climate simulation, extreme weather forecasts, and wind energy development and management. The probability distribution of land surface winds are estimated from high-resolution weather station data globally during the period from 1978 to 2005. The leading three moments are characterized, and their relationships will be compared with those observed over the oceans. The Weibull distribution(often widely used in wind engineering) is compared with the observed surface wind speed PDF over Tropical and mid-latitude continents.Effects of buoyancy forcing and horizontal heterogeneity will be described and presented. Surface wind probability distributions from Canadian Regional Climate Model simulations and from ERA40 and NCEP/NCAR reanalysis products will be compared with land weather station observations to further understand and better represent surface wind distributions for regional climate modeling.

I10-1B9.6 **11:45**

Arctic sea ice freeboard height estimation from ICESat and models

Alexander Braun[1], *Vidyavathy Renganathan*[2], *Rene Forsberg*[3], *Henriette Skourup*[3]

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In the context of climate change, sea ice is one f the prominent indicators of global warming. Particularly, the Arctic exhibits significant variability in sea ice extend and concentration over the last decades. Sea ice thickness is one of the controlling factors in sea ice dynamics and heat transfer between the ocean and atmosphere. However, only few measurements exist which allow for an accurate quantification of sea ice thickness and variability. In this paper, sea ice freeboard height, which eventually can be transformed into sea ice thickness, is estimated using observations of the NASA laser altimetry mission ICESat. As ICESat measures the elevation of sea ice only, the instantaneous ocean surface must be either (i) measured or (ii) modeled to derive freeboard heights. The first approach is also know as lowest level filtering, and the sea surface height is measured in open leads nearby the sea ice. The second approach uses models of ocean tides, tidal loading, a geoid model, and mean dynamic topography to estimate the instantaneous sea surface height. Both methods result in freeboard height maps of the entire Arctic between 2003 and 2006, which are, however, limited by the fact that ICESat is only operation for about 5 months per year. Current limitations and potential solutions will be presented.

I01-2B8.2 **10:45**

The influence of sea ice and topography on the wind regime of the Beaufort Sea coast

Martha Shulski[1], *Anna Klene*[2], *Jing Zhang*[1], *Xingang Fan*[1], *Jeremy Krieger*[1], *Don Morton*[2]

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The North Slope region of Alaska exhibits an Arctic climate and is bounded to the south by the southwest to northeast oriented Brooks Range and to the north by the Beaufort Sea. Winds are consistently high and most often come from an easterly direction. As is typical for an Arctic region, precipitation is light and snow cover is present for much of the year. This area is of high economic significance because of resource extraction and development in the nearshore and offshore portions of the North Slope. A study has recently been funded to investigate the wind field throughout this region, specifically in relation to the documented sea breeze and topographic effects. Data from meteorological observing stations were compiled from the various networks available, including the National Weather Service, Federal Aviation Administration, University of Alaska Fairbanks, and the Minerals and Management Service. These data include inland, coastal, and offshore stations in this region and cover a time period of at least five years, with some more than 30 years. Wind speed and direction components were viewed in relation to distance from the coast to determine the magnitude and strength of the sea breeze effect, which is primarily confined to the ice and snow-free period. The variability of sea ice cover may also impact sea breeze frequency and magnitude. In addition, the wind field was shown to exhibit influences from the Brooks Range, which is dependent on the prevailing direction. These results will further be used to evaluate forecasts generated by mesoscale meteorological models, such as the Weather Research and Forecasting (WRF) model, with the ultimate goal of improved forecasts in this region.

O03-3B1.8 **12:15**

Studies of the Internal Tide in the Lower Bay of Fundy

Keir Colbo[1], *Dave Greenberg*[2], *Alex Hay*[1]

[1] Dalhousie University
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Observations from the lower Bay of Fundy in 2002 show the presence of energetic high-frequency internal wave packets that are phase-locked to the tidal cycle. An analysis of the observations provides the direction of propagation and suggests several likely generation sites. To investigate further a finite element sigma layer model (QUODDY) is used to simulate oceanic conditions consistent with a typical September. The model is run with increased resolution over the lower Bay of Fundy. Although, the model is hydrostatic and thus incapable of simulating the eventual transformation of the internal tide into a soliton train, we hope that the model can resolve the generation processes and initial propagation of the wave. Of particular interest is the possibility that the internal tide could play a role in changing the dynamics of the tidal currents (magnitude and phase) in the stratified lower Bay.

The model results will be discussed with a particular focus on the sensitivities, and overall capacity of the model to resolve internal waves. On-going work involving the use of the Finite Volume Coastal Ocean Model (FVCOM) to study the same processes will also be addressed.

A05-1C6.3 **INVITED/INVITÉ 14:00**

Distribution systems for Environment Canada meteorological data

Miguel Tremblay

(Presented by *Peter Silva*)
Environnement Canada
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This presention will describe the distribution system of Environment Canada for meteorological and climate data.

The different data offerings will be presented, their format and how it possible to retreive them on the EC website. The software and hardware architecture supporting this dissemination will be explained.

Finally, statistics (nbr of users, hits, bandwith) of access to those data will be presented.

H01-2DP.15 **16:00**

Groundwater Storage from GRACE Over the Assiniboine Delta Aquifer (ADA) of Manitoba: Early Result

Sitotaw Z. Yirdaw[1], *Kenneth Snelgrove*[2]

(Presented by *Sitotaw Yirdaw*)
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Water storage, which includes groundwater, soil moisture, and snow, plays a major role in hydrologic water balance and has many possible applications in hydrological modeling. High spatial resolution

distributed moisture storage could be considered as a valuable information for model parameterization and validation. However, it is well known that this storage is difficult to measure over the scales needed for hydrological model applications. Despite its coarse spatial resolution of the storage, GRACE (Gravity Recovery And Climate Experiment) promised to fill this gap. Previous studies in Mackenzie and Saskatchewan River basins have assisted in generating methodologies and error bounds that will be useful in assessing moisture balances at regional level. This paper investigates the feasibility of GRACE gravity information for hydrological model studies. There is great potential of GRACE in capturing regional groundwater storage. The significance of this storage can be investigated by downscaling efforts using the measured data available in the Assiniboine Delta Aquifer (ADA) of Manitoba. The effort will be to obtain and evaluate local groundwater storage information from coarse resolution GRACE storage. Preliminary result shows that the downscaled storage estimates compared favorably with the measured groundwater storage over the study area.

A02-1B7.8 **12:15**

Arctic Development of a Polar-Optimized WRF

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Previous work with the 5th generation Penn State/National Center for Atmospheric Research NCAR) Mesoscale Model (MM5) demonstrated that the polar-optimized version of the mesoscale model (Polar MM5) achieved a much improved performance for both the Antarctic and Arctic regions. Therefore, development is proceeding on “Polar WRF,” a polar-optimized version of the state-of-the-art Weather Research and Forecasting model (WRF). Testing and development work for Polar WRF began with winter and summer simulations for ice sheet surface conditions using a Greenland area domain with 40-km resolution. The simulations facilitated improvements to the Noah land surface model (LSM) for ice sheet surfaces. The Polar WRF simulations were of similar quality to those of Polar MM5, which had the benefit of development over a period of nearly 10 years. Development work for Polar WRF now proceeds with Arctic simulations of land, open ocean and sea ice areas. Development work in the Antarctic will be described elsewhere. The Surface Heat Budget of the Arctic Ocean (SHEBA) during 1997/98 and recent Atmospheric Radiation Measurement (ARM) North Slope of Alaska (NSA) observations provide excellent opportunities to test Polar WRF over ocean and land surfaces. Furthermore, a new treatment for grid points containing both open water and sea ice was very recently added to Polar WRF’s Noah LSM and is being tested with Arctic simulations.

H01-1C4.5 **14:30**

The runoff response and mercury mass balance of an urban microcatchment

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The majority of mercury emissions are to the atmosphere, however almost all human exposure to mercury is through the consumption of contaminated fish. Therefore, to link mercury emissions to human exposure necessitates knowledge of its transport pathways. The deposition and transport of mercury has been studied extensively in natural environments, but there has been little research on catchments dominated by urban surfaces. This research focuses on the deposition and washoff of mercury within Mississauga, ON, a city whose waterways flow directly into Lake Ontario. The

washoff of mercury was determined through high-resolution sampling of runoff quantity and quality from an impervious microcatchment. The amount and intensity of precipitation, and rain mercury concentration was measured on-site. Before and after each rain event, the amount and concentration of Hg associated with street dust within the catchment was quantified. A mercury mass balance was performed for the microcatchment based on changes in the surface storage, precipitation inputs, and runoff outputs. Our data show that over 50% of the total storm load is transported within the first five minutes of runoff generation, and that roughly 90% of the Hg is transported in association with particles. These results quantitatively demonstrate the importance of the 'first flush', and indicate that mercury dissolved in rain is only a small fraction of that delivered to urban surface waters.

O03-3B1.2 **10:45**

Dynamics of the Position of the Salt Intrusion in the St. Lawrence River near Quebec City

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The freshwater flow from the St. Lawrence River meets the salt water near the eastern end of Orléans Island, downstream of Quebec City, Qc, Canada. Freshwater is pumped in the Quebec City area for domestic and industrial use. Recent observations of low flow events raised the question whether salt water could taint the freshwater at Quebec City. This presentation is to document the possibility of such an event. Measurements of temperature and salinity are available at 5 min intervals from a CTD deployed onboard the container ship Cicero sailing weekly round trips between Montreal (Qc) and St. John (Nfld) between years 2000 and 2005. A salinity value of one near the surface is used to define the position of the salt intrusion. We examine this position as a function of tidal currents and freshwater runoff. The mean position of the intrusion, associated with a mean runoff rate of 11200 m3/s, is found 46 km downstream from the Levis headland. The tides move the salinity front 13 km upstream and downstream from this mean position. The variation of the freshwater flow has an influence of similar magnitude. In the range of observed runoff, from 9000 to 19000 m3/s, the salinity front is moved 10 km upstream or downstream from its mean position. The combined effects of tides and freshwater flow move the salt intrusion as close as 31 km from Lévis, and as far as 78 km. Based on this analysis, freshwater intakes west of Orléans Island appear safe from salt waters. On the other hand, runoff lower than 9000 m3/s was not observed during the period considered, while values as low as 7800 m3/s were observed in the past. A three dimensional circulation model is used to examine the vertical structure of the intrusion, and extend the results to extremely low runoff conditions.

S04-4C3.5 **14:30**

Ion Enrichment of Snowmelt Runoff Water caused by Basal Ice Formation

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Once meltwater reaches the base of a snowpack it can infiltrate the underlying stratum, runoff, or refreeze and form a basal ice layer. Basal ice formation is most common early in melt over saturated or very cold frozen soils. Meltwater becomes enriched in ion concentrations compared to the parent snow due to ion fractionation during thaw and percolation through the snowpack. If ion exclusions occur during basal ice formation, further enrichment of runoff water ion concentrations can occur. The influence of basal ice formation on runoff water chemistry was examined by comparing ion

concentrations in runoff water that had sustained basal ice contact to meltwater before basal ice contact. A series of experiments, involving melting a snowpack in a large insulated box over a cold impermeable substrate in a temperature-controlled room, were carried out. A cooling system at the chemically inert base ensured frozen conditions during snowmelt. Meltwater samples were collected throughout melt from within the snowpack using an extraction tube, and runoff water was collected at the base. Samples of the basal ice were collected after each experiment was completed. All samples were analyzed for major anions and cations. Results showed that formation of basal ice layers enriched the runoff water compared to meltwater before basal ice contact. Ion concentrations in basal ice contact runoff water were up to eight times greater than those in no-contact meltwater; however, on average, basal ice contact runoff water showed twice the ion concentrations of the no-contact meltwater. The implications are that basal ice formation will act to strongly alter both meltwater ion pathway and concentration. When no basal ice is present, enhanced infiltration causes relatively dilute runoff of only part of the meltwater ion load. When basal ice is present all meltwater runs off and further ion concentration enrichment occurs.

I10-1C9.6 **14:45**

A coastal polynya opening model based on shock methods

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Coastal polynyas are regions of low ice concentration adjacent to the coast and are formed and maintained by the dynamic interaction offshore winds and sea ice. Sea ice formation in coastal polynyas may contribute to the formation of Arctic intermediate and deep waters and so coastal polynya dynamics may have significant regional and global climatic impacts. Large scale sea ice models do not represent polynyas well due to two main factors. Firstly, the coarse resolution of these models means that polynyas are sub grid scale features and thus cannot be directly captured by the model. Secondly,the large scale sea ice model equations are valid only for length scales significantly larger than those relevant for processes taking place in a coastal polynya. It is therefore not possible to accurately represent polynyas in current sea ice models. The only option is to include indirect parameterisations of polynya effects. A polynya model has been developed utilising shock techniques commonly used in gas dynamics. The polynya edge is viewed as a jump, or shock, in the ice cover. Within the model, ice mass, momentum and energy are all conserved across the polynya edge. The evolution of the polynya and an estimate of the associated salt fluxes may then be calculated. This model can then be used as a polynya parameterisation within a large scale sea ice model.

A07-3B7.7 **12:00**

Waves and coupling processes at the Polar Environment Atmospheric Research Laboratory (PEARL)

William Ward[1], *Alan Manson*[2], *Tatyana Chshyolkova*[2], *Young-Min Cho*[3], *Dragan Veselinovic*[4], *Ding Yi Wang*[4], *Tom Duck*[5], *Gordon Shepherd*[3], *Marianna Shepherd*[3], *R.J. Sica*[6], *Jim Whiteway*[3]

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Waves are the primary means through which various regions of the atmosphere couple. At the Polar Environment Atmospheric Research Laboratory several instruments are being installed to investigate the nature of these coupling processes in polar regions. These instruments include the E-Region Wind Interferometer, the meteor radar, the Spectral Airglow Temperature Imager, the PEARL All-Sky Imager, the ozone and Rayleigh/Mie/Raman lidar, the VHF and cloud radar, the Fourier Transform Spectrometer and the Atmospheric Emitted Radiance Interferometer. Together these instruments provide the means to determine the mean fields, and wave signatures associated with tides, planetary waves and gravity waves from the stratosphere to the mesopause region. Interpretation of these results will be supported with satellite observations, model results and analyses from data assimilation. Collaborations are being developed with other polar observatories so that a global view of these processes in the Arctic middle atmosphere can be developed. This effort will peak during International Polar Year.

S03-3B3.6 **11:45**

Snow Cover and Its Fractal Dimension

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Snow Cover and Its Fractal Dimension BRUCE H. RAMSAY Keywords: snow cover, fractals ABSTRACT The National Oceanic and Atmospheric Administration has been monitoring snow from satellites since 1966. Benoit Mendelbrot created fractal analysis, a technique to compare similar objects, in 1975. Many natural and artificial objects are self-similar. The research being conducted is to determine whether satellite imagery of snow is random or ordered. Fractal analysis determines the condition of the object analyzed. The motivation for this research is to extend our understanding of the progression of the snow line in the United States.

The fractal dimension equation is:

D = log N log d

where D is the Hausdorff-Besicovitch dimension, log N is the generator pattern’s number of line segments, and log d the divisor used to scale down the generator line segments (Peitgen, H-O et al., 1992).

The problem is measuring the distance of the snow line from satellite imagery. The approach of fractal analysis will give researchers an idea of the extent of snow cover. Analytical results will be explicitly defined in the paper on remote sensing of snow cover and fractal analysis.

The time series will be seven seasons (1999-2006), and for each month of the season, the snow line fractals will be computed.

Bruce H. Ramsay, National Oceanic and Atmospheric Administration, University of Maryland, College Park, MD 20742

I01-2B8.4 **11:15**

The abnormal impact of 1998-2000 La Nina in North American and the relationship to North Pacific atmosphere-ocean variability

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Contrary to the impacts ascribed to strong ENSO cold events (La Niña) during the last half of the 20th century, the two-year protracted La Niña during 1998-2000 (L2) produced abnormally warm winter (Dec-Mar) conditions over most of North America. Despite the presence of a moderately strong La Niña, analyses of thermal and dynamical features show that the North American climate was more responsive to the changes in the Pacific-North American sector during L2. The temperature anomalies extended well through the depth of the troposphere and were significantly different from the composite of past seven strong La Niña (L7) cases. Analysis of stationary Rossby waves, diagnosed by Plumb horizontal flux, shows a distinct weakening of wave propagation from the North Pacific towards North America, but an enhanced wave propagation towards subtropical Pacific during L2. Additionally, the wave activity is characterized by vertical circulation patterns over the extratropical North Pacific.

Results show that the differences, in thermal and dynamical features of the atmosphere, between L2 and L7 project onto the atmosphere-ocean teleconnection as revealed by the second mode of canonical correlation analysis. This non-ENSO mode of variability relates the interannual variability in sea surface temperatures to the zonal winds at 200 hPa over the Pacific-North American sector. This study suggests that the presence of the teleconnection, which associates strong north-south sea surface temperature gradient with the strengthening and eastward extension of the 200 hPa zonal winds in the extratropical North Pacific, played a prominent role in producing warmer-than-normal winter temperatures over North America during the prolonged 1998-2000 La Niña.

I10-3DP.2 **16:00**

The effect of tides on dense water formation in Arctic shelf seas

Clare F. Postlethwaite, *Graham R. Tattersall*, *Miguel A. Morales Maqueda*, *Andrew J. Willmott*

(Presented by *Andrew J. Willmott*)
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The Arctic shelf seas are key regions of dense water formation contributing to the global thermohaline circulation. Reports of decreased Arctic summer sea-ice extent highlight the importance of ensuring all relevant Arctic processes are sufficiently represented in climate prediction models. We investigate whether the interaction between tides and sea-ice significantly alters model results of dense water formation. Tidal currents can cause divergence of sea-ice, bringing about the opening of leads within the ice pack. Although these areas of open water are small and short lived, they can lead to large heat fluxes from the ocean to atmosphere and increased salt fluxes to the surface ocean as new ice forms. We present results from a dynamic/thermodynamic sea ice model coupled to a baroclinic coastal ocean model for the Barents and Kara Seas. Comparing results from the model run both with and without tidal forcing indicates differences in the ice distribution for the two scenarios. Results show that including tidal forcing in a coupled coastal ocean/ice model can increase the salt flux to the ocean by 25% and hence have a significant effect on dense water formation in the region.

S02-2B3.6 **12:00**

Relationships Between Spatial Patterns of QuikSCAT Derived Pan-Arctic Terrestrial Snowmelt Onset and Summer Sea Ice Concentration Anomalies (2000 – 2005)

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Summer Arctic sea ice extent has exhibited a strong negative trend through the satellite passive microwave era (1978 to present), particularly in the past decade, driving much speculation regarding a future ice-free Arctic summer. This negative trend (~54000 km2/yr), is actually composed of interannually variable spatial patterns of ice concentration anomalies. In this study we determine the spatial patterns of pan-Arctic spring terrestrial snow melt timing and examine potential linkages with regional sea ice anomalies driven by enhanced temperature contrast between snow-free land and ice-covered ocean. Dates of snowmelt onset were detected from enhanced resolution QuikSCAT backscatter images over the pan-Arctic region (north of 60 degrees latitude) during the 2000 – 2005 period. Evaluation of the QuikSCAT snow melt onset dates was performed using in situ observations from WMO reporting stations in the circum Arctic. Dates of QuikSCAT melt onset were generally associated with a transition to positive daily maximum air temperature, and observed decreases in snow depth. Dates of melt onset were not detected in some dense forest regions (~ 5% of the pan-Arctic domain) in some years, the causes of which are under investigation. The relationship between QuikSCAT derived snowmelt onset and the timing of snow-free conditions was determined using the NOAA daily IMS snow cover product. Preliminary analyses indicate that the timing of terrestrial snowmelt onset is regionally associated with adjacent anomalies in spring and summer sea ice concentration: regional early (late) snowmelt timing is associated with negative (positive) ice concentration anomalies.

S04-4C3.7 **15:00**

Snow reactions: impacts on atmospheric chemistry

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Little is known about snow-atmosphere chemical interactions, despite their potential implications in climate change [Dominé and Shepson, 2002]. Through concurrent experimental and field studies of snow (semi)volatile organic compounds (VOC), snow-embedded microbes and bioaerosols at several urban, suburban/remote mountainous, and Arctic sites, we herein show the influence of snow photobiochemistry on atmospheric VOC. We also demonstrate the importance of biomaterials in induction of microphysical alternations in snow. We will discuss the implication of our results on atmosphere-snow chemical exchange mechanisms and in further investigations of climate change.

G07-1C2.1 **INVITED/INVITÉ** **13:30**

Dynamic morphology of lithospheric keels from viscous coupling to mantle flow

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Recently, it has been recognized that a conspicuous misalgnment may exist between crustal and basal lithospheric tracks of the Great Meteor hotspot in eastern North America. The crustal track is delineated by mantle-derived volcanic material and clusters of seismicity, whereas the deep portion of the track is inferred, based on seismic tomographic images, from a prominent indentation in the lithospheric keel. The misalignment increases with age along the track and is consistent with ~ 4mm/year westward displacement of the base of the plate relative to the surface, parallel to the

estimated sublithospheric mantle-flow direction. Seismic anisotropy analyses using measurements of SKS splitting also reveal fast axes parallel to this direction. Taken together, these observations suggest that basal traction may be slowly deforming the lithospheric keel beneath North America.

O01-1D1.2 **16:15**

On the interaction of the Labrador Current and the Deep Western Boundary Current with the North Atlantic Current

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Results from a high-resolution (1/10-degree) numerical simulation of the circulation in the Northwest Atlantic conducted with a terrain-following coordinate model are presented with the aim of investigating the interaction of the Labrador Current (LC) and the Deep Western Boundary Current (DWBC) with the North Atlantic Current (NAC). It is shown that the simulation of realistic LC and DWBC flowing over very accurate bottom topography leads to a circulation pattern that sheds light on the dynamical mechanism behind the formation of the quasi-stationary meanders of the NAC, as well as on the mass transport between the subpolar and subtropical gyres in the Newfoundland Basin.

I14-1D9.5 **17:15**

Changes in the structure and temperature sensitivity of the mineral soil organic carbon pool across a managed red spruce forest chronosequence

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Forest harvesting can affect organic carbon storage in the mineral soil by altering key controls on decomposition, most notably temperature. Using a successional chronosequence, we sampled the top 50 cm of mineral soil in a mature old growth forest, an immature old growth forest, a 45 year old clearcut, a 15 year old clearcut, a 15 year old whole tree harvested forest, and a recent clearcut. Samples were analyzed for their %C, delta C-13, and %N. Samples from each site were subjected to a density fractionation method to separate soil carbon into three fractions: a free light fraction, an intra-aggregate or occluded light fraction, and a mineral associated heavy fraction. Fractions were analyzed for %C, delta C-13, and %N. Whole soil samples were also incubated in the lab across the region's annual temperatures range at constant moisture to examine the temperature dependence of decomposition in terms of carbon quality and quantity. While changes in bulk soil C stock were undetectable across sites, differences among the fractions across sites were significant. Significant differences in rates of microbial respiration on a per gram of soil and per gram of carbon basis were also detected among sites across the temperature range. These results suggest that forest harvesting not only affects the quantity of carbon stored in the mineral soil but also its temperature sensitivity to decomposition.

I03-4C7.6 **15:00**

Evaluation of the Canadian Land Data Assimilation (CaLDAS) over North America

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A Canadian Land Data Assimilation (CaLDAS) has been developed at the Science and Technology Branch of Environment Canada to improve the initial conditions of soil moisture over continental surfaces of the operational Numerical Weather Prediction models. Soil moisture derived by CaLDAS via its simplified variational method using only screen-level observations of relative humidity and temperature will be compared to those produced operationally by a simple optimum interpolation scheme. Numerical forecasts using CaLDAS soil moisture analyses will be run over a summer period and their skill evaluated.

I07-3DP.3 **16:00**

Accuracy assessment of ICESat over complex surface types in Churchill, Manitoba.

Vidyavathy Renganathan[1], *Alexander Braun*[1], *Georgia Fotopoulos*[2], *C.K. Shum*[3]

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Satellite altimetry data are primarily used for monitoring sea level change and ocean surface dynamics. New missions, such as the laser altimetry mission ICESat, target on more diverse and complex surface types including snow, ice sheets, sea ice, wetlands, rivers and lakes, vegetation, and land. However, the accuracy of these elevation observations must be assessed before they can be successfully used in applications. Hence, it is imperative to continually assess the elevations derived from satellite altimetry. A leveling survey was conducted in Churchill, Manitoba during September 2006. The survey was conducted underneath two ICESat tracks. These tracks passed through various surface types such as tidal flats, rock outcrops, tundra, boreal forests, and open water. The elevation data obtained from the leveling survey are compared with ICESat elevations and the accuracy over each surface type was determined. Over flat regions like the Airport runway, the two data sets agree within 20 cm. Over complex surfaces such as boreal forest and rock outcrops the accuracy is decreased to about 60 cm. It is planned to continue the leveling survey experiment and accuracy assessment, over sea-ice in Churchill, in the year 2007. This study will eventually lead towards a multi-mission and multi-surface calibration site for upcoming satellite missions, e.g. CryoSat-2, TerraSAR-X.

I02-4C8.7 **15:15**

Biogeochemical cycling of carbon monoxide in the southeastern Beaufort Sea: Autumn vs. spring

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Investigations were made of the time- and space-resolved distributions, air-sea fluxes, photoproduction and microbial consumption of carbon monoxide (CO) in the southeastern Beaufort Sea during CASES Legs 1 (autumn) and 7 (spring). Diurnal variation in CO concentration at the surface occurred in autumn but was absent in spring. Surface and depth-integrated CO concentrations were, respectively, 10 and 13 times higher in spring than in autumn. Surface water was nearly always and ubiquitous supersaturated with CO relative to the atmosphere, leading to a net sea-to-air flux with its magnitude being ca. 35 times higher in spring. CO photoproduction in the water column, estimated

from a photochemistry-optics coupled model, was also much larger in spring. Microbial CO consumption in surface water always followed first-order kinetics in autumn but inhibition and saturation kinetics were prevalent in spring. Implications of this marked seasonal difference in CO cycling were discussed.

H01-1B4.3 **11:00**

Water flow in Sphagnum moss

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A new method for determining hydraulic conductivity of low bulk density, large pore size and highly porous undecomposed Sphagnum mosses has been developed that provides new insight and the ability to quantify and model of water flows. Monoliths of Sphagnum moss hummocks were extracted while frozen and fitted snugly into a lysimeter. After a series of water flux experiments the monoliths were sectioned and the characteristic curves relating moisture (vmc), pressure (p)and hydraulic conductivity (K) were determined. Saturated hydraulic conductivity ranged from 2E-01 cm/s near the surface to 1.6E-02 cm/s at 30 cm depth. Unsaturated hydraulic conductivity at field capacity (p=-20 cm)was 6E-06 cm/s near the surface and about 1E-05 cm/s at depth. In a series of laboratory experiments water fluxes including basal seepage, evaporation loss and "rain" events were applied. Under wet conditions upward and downward water fluxes are constrained only by external processes. When drained, the very low hydraulic conductivity limited upward water movement to evaporation. Modeling and lab tests show that upward water movement due to evaporation can be sustained at 0.3 mm h-1, but higher demand could not easily be met because the unsaturated hydraulic conductivity dropped too low.

S01-1B3.1 **10:30**

Continental-Scale Simulation of Lake Ice Cover Phenology, Thickness, and Composition in Canada

Claude Duguay[1], *Frédérique Pivot*[2], *Ross Brown*[3], *Greg Flato*[3]

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This paper presents results of a continental-scale simulation of ice cover phenology (i.e. freeze-up, break-up, and ice duration), thickness and composition (snow ice/congelation ice) for lakes of various depths in Canada obtained with the numerical lake ice model CLIMo. The model was forced with mean daily atmospheric reanalysis data (NCEP) and gridded snow data for the period 1980-1996. Separate model runs were made with fixed snow depth and a varying snow depth to examine the regional influence of snow cover on ice cover thickness and composition. Output maps provide a country-wide picture of: 1) freeze-up and break-up dates, and ice cover duration as a function of lake depth and 2) maximum ice cover thickness and composition (ratio of snow ice to total end-of-year ice thickness) in relation to regional snow accumulation regimes. Simulation results are evaluated against ground-based ice observations from a sample of lakes across Canada for the same time period. For Great Slave Lake and smaller lakes in its vicinity (Northwest Territories), model results are also evaluated by considering biases in reanalysis data.

O01-2B1.5 **11:30**

Impact of the parameterization of unresolved eddies in an eddy-permitting model of the North Atlantic using NEMO

Sanjay Rattan, *Paul Myers*

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A variable eddy transfer coefficient for the Gent and McWilliams parameterization is used an eddy-permitting model of the North Atlantic. It is found that this scheme improves the salinity fields of the North Atlantic, especially the Labrador and the Greenland Seas which are the main focus areas of this study. There is a decrease in the salinity of the Labrador Sea, with improved circulation leading to mixed layer depths which are much closer to observations. Similarly, for the Greenland Sea, increased salinity and improved circulations with better mixed layer depths are found. The freshwater and heat budgets in the Labrador and Greenland Seas are also examined to further determine the circulations and processes that could have led to these improvements. The model multi-year simulations also show reduced model drift. These improvements in NEMO are significant, when studies of the North Atlantic high resolution eddy permitting models show salinization of the Labrador Sea.

I10-1B9.5 **11:30**

Impact of the parameterization of unresolved oceanic eddies on the representation of sea-ice in an eddy permitting model of the North Atlantic using NEMO

Sanjay Rattan, *Paul Myers*

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The ocean serves as the bottom boundary layer for sea-ice. Hence any changes in the ocean circulation would affect sea-ice characteristics. In this study the subgridscale processes of the North Atlantic ocean in the NEMO model are improved through the implementation of a variable eddy transfer coefficient in the Gent and McWilliams parameterization. Improvements are observed in sea-ice concentration and thickness. Sea-ice thickness and concentration decrease along the sea-ice edges in the Labrador and Newfoundland shelf, and increase in the Greenland-Iceland Sea, being closer to observations. This could be due to changes in the heat fluxes at the ice/ocean boundary arising from oceanic parameterization. The net upward heat fluxes at the ice/ocean boundary along the sea-ice edges of the Labrador and Newfoundland shelf increase, while the net upward heat fluxes at the ice/ocean boundary decreases along the sea ice edges in the Greenland-Iceland Sea. The net upward heat fluxes at the ice/atmosphere boundaries along the sea ice edges of the Labrador and Newfoundland shelf are larger (and smaller along the sea ice edges in the Greenland-Iceland Sea). These changes in the fluxes could have implications on coupled ice-ocean-atmosphere models.

I07-3B8.6 **12:00**

Wavelet Representation of the Deflection-Geoid and Inverse Vening Meinesz Integrals

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A new wavelet transform algorithm is used for the evaluation of the deflection-geoid and inverse Vening Meinesz formulae used in satellite altimetry applications. These integrals are used for the determination of geoid undulations and gravity anomalies from the two components of the deflection

of the vertical, respectively. The wavelet approximation is dependent on orthogonal wavelet base functions. The integrals are approximated in finite multiresolution analysis subspaces. A two-dimensional wavelet algorithm is used. The efficiency of the wavelet multiresolution analysis as an alternative approach to the well-established Fast Fourier Transform (FFT) is studied. The characteristics of the base functions and their effects on the results are investigated. The full solution with all equations requires large computer memory, therefore, the multiresolution properties of the wavelet transform are used to divide the full solution into parts. Global wavelet thresholding is used for the compression of the kernel. High compression levels are achieved by combining global wavelet thresholding with level/direction-wise filtering. Because of the fast decrease of the kernel, high compression levels are reached without loss of accuracy. Hard thresholding is used in the compression of the wavelet coefficients kernel matrices. Global thresholding solution achieved 94% compression level with an RMS error of 0.14 mGal in the case of the inverse Vening Meinesz integral, and 88% with a 1.5 cm RMS error in the case of the deflection-geoid formula in comparison to FFT and numerical integration solutions. These compression levels lead to a big saving in the computer memory, and the ability to work with sparse matrices, which increases the computational speed. Conclusions and recommendations are given with respect to the suitability, accuracy and efficiency of this method.

S01-1B3.3 **11:00**

An Evaluation of Techniques for Spatial Interpolation of Snow Depth

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Accurate estimates of snow depth and water equivalent are essential for initialization and validation of hydrologic models for alpine drainage basins. In this paper we evaluate methods for spatial interpolation of field measurements to produce high-resolution snow depth grids for study sites that represent vegetated and non-vegetated prairie, sub-alpine and alpine terrain. A key challenge with evaluation of any interpolation (or extrapolation) method is identifying the true distribution of snow depth. Here we use as ‘truth’ LIDAR measurements of snow depth collected during the NASA Cold Land Processes Experiment, April 2003. LIDAR-derived fields are sampled to generate synthetic 'field-surveys' of snow depth. Local Polynomial Regression, Inverse Distance Weighting, Kriging, and unit-based probability density functions to estimate snow depth are evaluated with respect to contoured fields from LIDAR. The optimum density, spacing, and spatial pattern of survey points under man-hour constraints for each terrain type are explored. These results will inform planning for further surveys and, with caveat, inform planning for surveys in different basins where LIDAR data are not available.

I10-1C9.1 **13:30**

High resolution global-ocean and sea-ice data synthesis

Dimitris Menemenlis

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To help increase understanding and predictive capability for the ocean's role in climate change scenarios, a project called "Estimating the Circulation and Climate of the Ocean, Phase II (ECCO2):

High-Resolution Global-Ocean and Sea-Ice Data Synthesis" aims to produce an increasingly accurate synthesis of all available global-scale ocean and sea-ice data at resolutions that start to resolve ocean eddies and other narrow current systems. The ECCO2 synthesis is being obtained by least squares fit of a global full-depth-ocean and sea-ice configuration of the Massachusetts Institute of Technology general circulation model to the available satellite and in-situ data. ECCO2 results are being used to quantify the role of the oceans in the global carbon cycle, to understand the recent evolution of the polar oceans, to monitor time-evolving term balances within and between different components of the Earth system, and for many other science applications. This talk will introduce the ECCO2 project and present some early user applications, with emphasis on polar regions and sea ice processes.

I13-4B9.6 **11:45**

Global warming and polar tidewater glacier response: a Canadian IPY project on Belcher Glacier, Nunavut

Sarah Boon[1], *Dave Burgess*[2], *Luke Copland*[3], *Gwenn Flowers*[4], *Jeff Kavanaugh*[2], *Shawn Marshall*[5], *Martin Sharp*[2], *Lev Tarasov*[6]

(Presented by *Lev Tarasov*)
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The goal of the IPY project "Glaciodyn" is to investigate the role of ice dynamics in the response of Arctic glaciers and ice caps to global warming, with a view to improving our ability to predict future changes and their impact on sea level and fresh water fluxes to the ocean. The Canadian contribution to Glaciodyn is focused on the Belcher Glacier drainage basin in the northeast sector of the Devon Island ice cap, Nunavut. This is the fastest flowing outlet from the ice cap and a major iceberg calving source. The project involves an intensive field and remote sensing study of the hydrology and dynamics of the glacier, closely linked to the development and validation of a state-of-the-art high order coupled model of ice flow dynamics, ice calving, and glacier hydrology. This model will be used to test hypotheses about the effects of climate warming on meltwater inputs to Arctic outlet glaciers and their impact on ice flow, and to perform simulations of the response of the Belcher Glacier system to recent and projected future changes.

I01-2B8.3 **11:00**

Evolution of solitary marginal disturbances in baroclinic frontal geostrophic dynamics with dissipation and time-varying background flow

Gordon Swaters

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Two-layer frontal geostrophic flow corresponds to a dynamical regime that describes the low-frequency evolution of baroclinic ocean currents with large amplitude deflections of the interface between the layers on length scales longer than the internal deformation radius within the context of a thin upper layer overlying a dynamically active lower layer. The finite amplitude evolution of solitary disturbances in baroclinic frontal geostrophic dynamics in the presence of time-varying background flow and dissipation is shown to be governed by a 2-equation extension of the unstable nonlinear

Schrodinger (UNS) equation with variable coefficients and forcing. The soliton solution of the unperturbed UNS equation corresponds to a saturated isolated coherent anomaly in the baroclinic instability of surface intensified oceanographic fronts and currents. The adiabatic evolution of the propagating soliton and the uniformly valid first-order perturbation fields are determined using a direct perturbation approach together with phase-averaged conservation relations when both dissipation and time-variability are present. It is shown that the soliton amplitude parameter decays exponentially due to the presence of the dissipation but is unaffected by the time variability in the background flow. On the other hand, the soliton translation velocity is unaffected by the dissipation and evolves only in response to the time variability in the background flow. The adiabatic solution for the induced mean flow exhibits a dissipation-generated "shelf region" in the far field behind the soliton, which is removed by solving the initial-value problem.

A04-2DP.4 **16:00**

The Woodstock Tornado Revisited in view of Current Conceptual Models

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The Woodstock tornado of 7 August 1979 was one of the most significant tornadoes in Ontario history. It stands out in many respects; in particular, it is the only F4 tornado to occur after July 1st and the only F4 with a track from the northwest. With such a rare and significant event, it is important to gain as much knowledge as possible about its development so that we may be better able to forecast such an event should it occur again. It appears that a Mesoscale Convective System crossed Georgian Bay in the morning hours causing small tornadoes near Grand Valley and Wiarton. That system left behind an outflow boundary which may have merged with a Lake Erie lake breeze boundary. A warm front marked by a strong Theta-e gradient intersected this line near the time of tornado formation. Based on fragmentary radar information, GOES-2 satellite data, and surface and upper air data, we re-interpret the events in view of current conceptual models. We calculate several indices which have been developed in recent years such as the Supercell Composite index, the significant tornado index and the Energy-Helicity index and assess how useful they would have been on that day.

I02-4C8.6 **15:00**

New Production in the Cape Bathurst polynya

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Vertical profiles of nutrients in the Amundsen Gulf and Cape Bathurst polynya show a significant nutrient enrichment in deep waters relative to source waters in the Beaufort Sea. This anomaly matches closely with our estimates of annual new production determined using standard stable isotopic techniques. We hypothesize that the nutrient enrichment represents local remineralization of new/export production from the overlying waters. The main phytoplankton bloom, delineated from the pattern of nitrate drawdown, lasted approximately 20 days and was terminated by nitrate exhaustion. New production continued at the edge of the nitracline where diffusional processes introduced new nitrogen to the euphotic zone during the post bloom period. The rates of decline of surficial nutrient inventories and of uptake of isotopic tracers during the spring bloom period were equivalent and accounted for roughly 50% of the annual new production.

A04-4C6.3 **14:00**

An experimental numerical model for forecasting tropical cyclones at the CHC

Chris Fogarty

Canadian Hurricane Centre / National Lab for Marine and Coastal Meteorology
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Over the past two hurricane seasons, a tropical cyclone configuration of the MC2 limited area model has been used as an experimental forecasting tool at the Canadian Hurricane Centre. Output from the model using two case examples will be presented. During the 2006 hurricane season, new output display packages were developed to assist forecasters in quickly assessing the output and preparing forecast products and warnings.

A06-2DP.4 **16:00**

Measure the spectral aerosol optical depth with a star photometer in polar areas

André Gröschke

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Aerosol effects on atmospheric radiation remain a major uncertainty in understanding past and present climates and in predicting the future climate. For the monitoring of the seasonal variation and the long-term trend of aerosol optical depth values (AOD) in the Atlantic sector of the Arctic at polar night, a star photometer has been established at AWIPEV Base, Ny-Ålesund, Spitsbergen (78.95°N, 11.93°E) in 1996. But for the austral winter in Antarctica, no measurements has been performed up to now. To close this gap, a Star Photometer will be installed in a 4 m Radom at Dome C on the East Antarctic plateau in 2009. The star photometer is part of the international project TAVERN (quantification of tropospheric aerosol and thin clouds variability including the radiation budget over the east Antarctic plateau). Together with Sun photometers, Lidar and in-situ measurements, year-round measurements will allow a detailed study of the inter-annual and seasonal variations of AOD over the Antarctic plateau. The Star photometer will primarily detect effects like polar stratospheric clouds, tropospheric aerosol events and variations of AOD during the polar night.

A03-3B6.5 **11:30**

Vegetation Structural and Topographic Heterogeneity Influences on Carbon Dioxide Uptake and Respiration within a Mature Jack Pine Forest in Saskatchewan, Canada

Laura Chasmer[1], *Alan Barr*[2], *Andrew Black*[3], *Chris Hopkinson*[4], *Natascha Kljun*[5], *Harry McCaughey*[6], *Paul Treitz*[6]

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Carbon dioxide, water, and energy fluxes should vary spatially and temporally within forested environments due to variations in atmospheric driving mechanisms, hydrology, soil properties and leaf area. The following study tests the hypothesis that within site structural and topographic heterogeneity

will have some influence on CO^2 fluxes within a mature jack pine forest located in Saskatchewan, Canada. A simple flux footprint parameterisation is applied at 30-minute intervals within three periods of study with the extraction of spatially varying tree heights, canopy depth, a proxy indicator for foliage density, and elevation obtained from an airborne light detection and ranging (lidar) instrument. Within footprint average structural components and topography are then related to 30-minute average net ecosystem productivity (NEP), gross ecosystem productivity (GEP) and ecosystem respiration (Re) obtained using eddy covariance methods.

Results of this study illustrate that both structural heterogeneity and topography have a significant influence on CO^2 fluxes at this site, during the periods of study. However, structure and topography are not more significant than meteorological and hydrological driving mechanisms. Leaf area and vegetation height have the greatest influence on NEP and GEP, whereby areas with increased tree heights and foliage tend to have a positive influence on CO^2 uptake for photosynthesis during most days studied. Elevation plays a key role in Re whereby lower elevations with greater tree heights and foliage densities tended to be inversely related to Re for some days in June, but became positively related to Re during warmer and drier periods in July and August. The results of this study indicate that ecosystem sensitivity to structural and topographic heterogeneity may tip the balance towards increased CO^2 uptake or release during periods when ecosystems are close to a net zero carbon balance. This may be especially the case in sensitive northern ecosystems.

I15-2C9.5 **15:00**

Using airborne lidar for the assessment of MODIS spectral vegetation indices across a boreal jack pine chronosequence

Laura Chasmer[1], *Paul Treitz*[1], *Harry McCaughey*[1], *Chris Hopkinson*[2], *Alan Barr*[3], *Andrew Black*[4], *Alexander Shashkov*[5], *Tianshan Zha*[3]

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In this study, airborne lidar is used to examine the influence of within pixel structural heterogeneity on Moderate Resolution Imaging Spectroradiometer (MODIS) operational vegetation products. Lidar structural estimates of canopy height, canopy base height, and gap fraction were first tested at the individual plot level to determine if lidar could be used to accurately extract vegetation structural information from plots located at four jack pine sites at different stages of growth. These structural attributes were then compared at the MODIS pixel level with MODIS spectral indices and NDVI calculated from radiation sensors located on jack pine site eddy covariance flux stations. Lidar structural characteristics were also used to test the ability of MODIS vegetation products to differentiate between classified mixed pixels containing ranges of structural attributes across a widely variable and heterogeneous watershed.

Strong correlations were found between lidar estimates of canopy height, canopy base height, and canopy gap fraction (r^2 = 0.99, 0.94, and 0.84, respectively) when compared to measurements made at the same individual plots across the jack pine chronosequence. This means that lidar can be used as an accurate method for structural evaluation of land cover types, and may be a good alternative for low resolution remote sensing validation. When compared to estimates of NDVI from radiation sensors, we found that MODIS slightly overestimated NDVI and had some confusion between sites. However, despite being slightly overestimated, the relationship between sites were fairly consistent (r^2 = 0.80). NDVI at the flux station was also well correlated with lidar gap fraction, and although these are not directly comparable, it is obvious that decreased gaps within the canopy would be related to increased NDVI values (r^2 = 0.83). MODIS spectral vegetation indices, FPAR, NDVI, and to a lesser extent EVI are most related to gap fraction from lidar (r^2 = 0.89, 0.72, and 0.39, respectively) as opposed to canopy height and canopy depth. From these results, MODIS spectral vegetation indices are able to differentiate between jack pine chronosequence sites. At the watershed level, positive relationships were found between low to high percentages of vegetation cover (and associated structural heterogeneity) at the beginning and end of the growing season when grasses within mostly cleared pixels are dead and brown in colour. However, these relationships become negative during mid-growing season when grasses within mostly cleared pixels are photosynthesizing and are much greener than those found in more mature sites. It is likely that soil moisture has contributed to augmented positive relationships at the beginning and end of the growing season within pixels that contain a greater percentage of vegetation cover.

O02-1C1.7 **15:00**

Water Level Forecasting in the St. Lawrence River between Montreal and Saint Joseph de la Rive.

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Water level forecasting is needed in the St. Lawrence River for navigational purposes both for short term use, 48 hours, and for longer outlook of 30 days. The first one supports mainly dredging operations while the latter is used for planning cargo loading. This presentation is to illustrate the challenges both scientific and technical to maintain and develop an operational oceanography system over the years, since 1997 in this case. The St. Lawrence River flow comes from the outflow of Lake Ontario, the Ottawa River and from other smaller lateral rivers. Upstream flow fall in Lake Saint Louis and Lake des Deux Montagnes. Using stage-discharge relationship in the outflow channels, assimilation of the hourly water level of the two lakes provides both an assessment of the inflow and of the outflow at Lasalle for the St. Lawrence River and at Repentigny for Des Prairies and Des Milles-Iles rivers. These two outflows are used to drive a one-dimensional model to hindcast and forecast the water levels from Montreal to Saint Joseph de la Rive every 300 meters in the navigational channel. The downstream boundary is controlled by the river surface elevation driven by tides and atmospheric forcing provided by the Meteorological Service of Canada, EC. Observed and forecasted flow at the upstream boundary are provided by the Great Lakes - St. Lawrence Regulation Office, EC, for the Lake Ontario outflow; the Ottawa River Regulation Secretariat, EC; the Northeast River Forecast Center, NOAA, USA; the Centre d’expertise hydrique du Québec and others. Water level observation and forecast are blended at the tide gauge stations and interpolated both in space and time.

A03-2DP.4 **16:00**

Climate Change & Canadian Prairie Agriculture: -a long view

Ray Garnett, *Madhav Khandekar*

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The Intergovernmental Panel on Climate Change (IPCC) has predicted global warming of 1.4 to 5.8º C between 1900 and 2100 implying that agriculture may be adversely affected on a worldwide basis. With reference to the Canadian Prairies studies have shown that warmer springs and a longer growing

season will increase potential for developing more diverse cropping systems. Moreover there is unlikely to be any increase in actual evapotranspiration in that more arid conditions in late summer could be avoided. It is also expected that CO^2 concentration increase would result in an increase in the water efficiency of temperate crops by increased carbon fixing and enhancing growth and yield. CO^2 increase has conclusively been shown to improve and strengthen forest growth. Using more than 50 stations evenly distributed over the Canadian prairies for the period 1950-2004 and selected stations for the period 1900 to 2004 seasonal trends of temperature and precipitation were investigated. Preliminary findings show that springs have warmed by over 2ºC while winters have warmed 2º C. between 1950 and 2004. No trend existed in fall and summer temperatures. On an annual basis the increase in temperature was about 1.2º C since 1950. In terms of precipitation no trend was evident in spring and summer precipitation. There was about a 4 mm decline in winter precipitation and a 2mm increase in fall precipitation. No precipitation trend was evident on an annual basis since 1950. North America is a breadbasket of the world. Canadian spring wheat and canola yields and U.S. hard red winter and corn yields in the U.S. were assessed since 1950 to discern any adverse effect of climate change on crop yields to date. The yield series of these grain data did not show any adverse impact of climate change. Finally, research in recent decades has demonstrated that summer droughts on the Canadian Prairies will be determined primarily by the ENSO cycle and Pacific Ocean SST distribution and not by additional warming as suggested by the IPCC.

O03-2DP.4 **16:00**

New Types of Tsunami Charts for Eastern Canadian Coastal Sites

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A tsunami chart is useful for tsunami risk analysis. However, a traditional tsunami chart only bears information on the travel time, not on the amplitude. This is because it is made with an approach where a tsunami is treated as a light ray from an assumed source with an assumed speed. In this approach, one can only deal with the time and speed but not with the amplitude. Moreover, the usefulness of such a chart depends on whether a future tsunami will indeed originate from the assumed epicentre. To overcome this source dependence, another assumption must be employed that a tsunami travel path is reversible like a light ray path and hence if one switches the source and receiver positions, the travel time is still the same.

New types of charts have been recently proposed (Xu, 2006) which have both time and amplitude information, without assumptions on the epicentres, on the speeds, and on the path reversibility. They are constructed with a new method referred to as the all-source Green function method (Xu, 2007), which allows one to calculate the Green's function at a point of interest (POI) as a fundamental response to all sources distributed in the entire domain in a manner consistent with linear shallow water dynamics, accounting for wave refractions/reflections, seabed frictional effects, and the Coriolis effect. From the response functions, one can extract two important pieces of information, the first arrival time and the largest amplitude. Contouring the time gives an arrival time chart and contouring the largest amplitude gives a gain chart. A gain chart gives a number at any source point in the domain to indicate what will be the largest amplitude at a POI if a unit tsunami originates from that source point.

Here we will present both the arrival time charts and the amplitude gain charts for several POIs along the eastern Canadian coast, for possible sources everywhere in the North Atlantic Ocean. We will discuss the spatial features revealed by these charts. We will also explore the possibilities of using two or more time charts and observations to infer a tsunami source.

I07-3B8.7 **12:15**

GPS Precise Positioning Made Easy: NRCan Products Behind the Scene

Pierre Heroux

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Over the past 15 years, Canada has greatly benefited from the worldwide cooperative strategy of the International GNSS Service (IGS). NRCan has been involved in many aspects of the IGS such as providing continuous GPS tracking data from Canadian sites and estimating GPS satellite orbits and clocks. This collaboration has provided open access to GPS data from a global network and given NRCan developers a working environment in which to evaluate and monitor the quality of GPS products supporting national initiatives, such as the Canada-wide Differential GPS Service (CDGPS). The robustness and reliability of tracking data and orbit products created by this initiative have facilitated the maintenance of our national reference frame and enabled the development of user applications that greatly simplify the recovery of precise coordinates for a number of geospatial requirements. Notably, Precise Point Positioning (PPP) applications are now making static and kinematic positioning with centimeter to decimeter accuracy possible for users operating a single GPS receiver. The PPP approach brings great flexibility to GPS field operations, minimizes labor and equipment costs, and simplifies operational logistics by eliminating the need to deploy dedicated tracking stations for observation differencing. Seamless integration of the survey results into national and global reference frames, without the need to establish a ground reference or occupy an existing control points, is also an advantage of PPP over the differential approach.

This paper presents the status of post-mission products and services made avaiable by NRCan, through its Canadian Spatial Reference Service (CSRS), that enhance user positioning capabilities and provide access to a consistent an accurate national spatial reference system. Current and new activities related to the creation and distribution of these products will be reported. Given the relative ease and low cost of streaming GPS data over the public Internet and increased demand for improved Real-Time (RT) positioning and navigation capabilities, GPS products in support of RT applications could soon become available. This additional capability could, in the near future, play a significant role in supporting efforts for improved weather forecasting and monitoring of natural hazards.

I11-4C1.8 **15:15**

Ground water response to meteorological forcing in a moraine-talus field around Opabin Glacier, Lake O'Hara Research Basin

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Recent studies suggest that talus and moraine features may play a dominant role in ground water flow and storage in alpine watersheds. However, little is known about the contribution of different sources of water to the ground water in these features, many of which are associated with alpine or rock glaciers and buried ice, and their response to these inputs. One likely reason for this is the difficulty in installing wells in these types of environments. In this study, we use a large ground water spring and two lakes as surrogates to wells for monitoring the ground water response to inputs in a moraine-talus complex surrounding Opabin Glacier. The objectives of the study are to determine: 1) what water sources (e.g. snow, rain, glacier ice, buried ice) the ground water is reacting to; and 2) how strongly and quickly it is responding (which may provide insight into ground water flow and storage); and if

these change over the summer season. Monitoring of lake levels, spring discharge and meteorological conditions, and sampling of lake and spring water occurred from June through September in 2005 and 2006. The tritium signature in water samples and the seasonal response of the lake level and spring discharge hydrographs indicate that rain and snow melt are the dominant sources of the ground water, though there was a response to melting at Opabin Glacier in July and August. The hydrograph data, along with temporal patterns in 18O of spring water, indicate relatively fast responses to inputs, both seasonally (to the spring freshet) and to individual rain and melt events, which suggests rapid infiltration and a relatively small storage capacity. There is also evidence that the ground water response changes over the season and differs between distributed and point-source (glacier melt) inputs, possibly indicating preferential flow pathways.

P-1A1.2 **INVITED/INVITÉ 09:15**

The melting Arctic sea-ice: death and rebirth of an ecosystem / La fonte des glaces de mer dans l'Arctique: mort et renaissance d'un écosystème

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The highly dynamic and thermodynamic ice sheet that covers the Arctic Ocean and its ancillary seas dictates biological productivity and carbon fluxes over 15 millions km2 (or 4.2%) of the global ocean surface. As far as we know, the arctic ice cover has persisted for at least the last 3.7 MA and perhaps since the Eocene, allowing a unique flora and fauna to evolve and adapt to some of the most extreme environmental conditions at the surface of our planet. The resulting low-diversity ecosystem of highly specialized organisms is threatened by the on-going shrinking of its icy biota. Beyond the charismatic Polar bear, intriguing organisms (many of them newly discovered), ranging in size from the ice-adapted microbes and their viruses to the ice-dwelling Polar cod and Boreal whale, will be impacted by the on-going regression of the ice, many negatively, some positively. In the short term (until 2050?) the relaxation of the severity of arctic conditions is expected to increase productivity and carrying capacity of the ecosystem, to the benefit of existing populations. However, in the longer term (by the end of the century?), the lengthening of the ice-free season on the Shelves, the dismissal of the perennial Central ice pack, the warming and mixing of the surface layer, and the intensifying penetration of Atlantic Water into Arctic basins could spell the rapid displacement of Arctic specialists by Atlantic (and Pacific) generalists. This Atlantification of the Arctic Ocean will boost its overall biological productivity at the cost of a major loss of biodiversity.

A06-2B7.2 **10:45**

Arctic smoke – aerosol characteristics during a record air pollution event in the European Arctic and its radiative impact

Renate Treffeisen[1], *Peter Turnved*[2], *Johan Ström*[2], *Andreas Herber*[3], *Jörg Barreis*[4], *Alfred Helbig*[4], *Robert Stone*[5], *Wolfgang von Hoyningen-Huene*[6], *Radovan Krejci*[7], *Andreas Stohl*[8], *Roland Neuber*[1]

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In early May 2006 a record high air pollution event was observed at Ny-Ålesund, Spitsbergen. An atypical weather pattern established a pathway for the rapid transport of biomass burning aerosols from agricultural fires in Eastern Europe to the Arctic. Atmospheric stability was such that the smoke was constrained to low levels, within 2 km of the surface during the transport. This study puts emphasis on the radiative effect of the smoke. The aerosol size distribution was characterized as having an accumulation mode centered at 165-185 nm and almost 1.6 for geometric standard deviation of the mode. Nucleation and small Aitken mode particles were almost completely suppressed within the smoke plume measured at Ny-Ålesund. Chemical and microphysical aerosol information obtained at Mt. Zeppelin (474 m.a.s.l) was used to derive input parameters for a one-dimensional radiation transfer model to explore the radiative effects of the smoke. The daily mean heating rate calculated on 2 May 2006 for the average size distribution and measured chemical composition reached 0.55 K day-1 at 0.5 km altitude for the assumed external mixture of the aerosols but showing much higher heating rates for an internal mixture (1.7 K day-1). In comparison a case study for March 2000 showed that the local climatic effects due to Arctic haze, using a regional climate model, HIRHAM, amounts to a maximum of 0.3 K day-1 of heating at 2 km altitude.

A02-2DP.3 **16:00**

Aerosol Direct Radiative Forcing in GEM Model

Irena Paunova[1], *Paul Vaillancourt*[2], *Louis Garand*[3], *Knut von Salzen*[4]

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The representation of the effect of aerosols in the Global Environmental Multiscale (GEM) model has been revised by using two model-derived monthly aerosol climatologies: the dataset of the Canadian Center for Climate Modeling and Analysis (CCCMA) and the dataset of Tegen at al. (1997) adopted by the European Center for Medium-Range Weather Forecasts. A total of five aerosol types are considered: sulfate, sea salt and mineral dust for the CCCMA dataset and additionally black carbon and organic carbon for the Tegen's dataset.

The aerosol optical thicknesses (AOT) from the two climatologies are compared against each other and against AOT from satellite-derived climatology, such as that from the GISS Global Aerosol Climatology Project (GACP). The aerosol radiative forcing in the GEM model is evaluated by using the newly implemented narrow-band radiative transfer scheme based on a correlated k-distribution method. The effect of the climatological aerosols is compared to that of the old aerosol and to newly available satellite measurements from MODIS and CERES, and their impact is examined on the short-to-medium-range forecasts.

The results demonstrate that the AOT of the climatological aerosol has a more realistic distribution relative to the old aerosol, which has latitudinal dependence and is confined vertically to the boundary layer. Furthermore, the AOT of the climatological aerosol, which is model-derived, agrees resonably with the AOT from the satellite-derived climatology.

GEM model simulations demonstrate that the climatological aerosol produces a mode realistic distribution of the aerosol radiative forcing, both at the top of the atmosphere and at the surface, than the old aerosol. The GEM model aerosol radiative forcing will be compared to newly available

satellite measurements, such as those from MODIS and CERES, and its impact on the short-to-medium-range forecasts will be examined.

References: Tegen, I., P. Hollrig, M. Chin, I. Fung, D. Jacob, and J. Penner, Contribution of different aerosol species to the global aerosol extinction optical thickness: Estimates from model results, J. Geophys. Res., 102, 23,895-23.915, 1997.

S02-2C3.5 **15:00**

The Contribution of AMSR-E 10.7 GHz Measurements to Improved Boreal Forest Snow Water Equivalent Retrievals

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Passive microwave snow water equivalent (SWE) retrieval algorithms typically exploit the difference between a measurement frequency sensitive to snow grain volume scatter (~37 GHz) with a measurement frequency considered insensitive to snow cover (~19 GHz). These particular frequencies are also commonly used because they extend continuously through the satellite record (1978 to present) even as the sequence of various sensors has evolved. From 2002, the Advanced Microwave Scanning Radiometer (AMSR-E) has acquired data at six frequencies, including the addition of a 10.7 GHz channel.

Given this new low frequency channel, relationships between AMSR-E brightness temperatures and SWE were assessed across the northern boreal forest of Manitoba and the Northwest Territories during the 2005 and 2006 winter seasons using measurements from regionally extensive surveys of snow cover physical properties. Relationships with SWE were statistically stronger for the difference between the vertically polarized 36.5 and 10.7 GHz measurements (r=0.79) compared to the 36.5-18.7 GHz difference (r=0.69) due to two primary factors. First, 18.7 GHz data exhibited sensitivity to snowpack volume scatter at a shallower critical depth than 10.7 GHz measurements. Secondly, the 36.5-18.7 GHz difference was more strongly associated with vegetation (as characterized by a MODIS-derived forest transmissivity dataset) than the 36.5-10.7 GHz difference (r=0.76 versus 0.63).

The difference between 18.7 and 10.7 GHz data was used to discriminate deep (>100 mm WE) from shallow (

Results are also presented from a similar analysis conducted using data acquired over the NASA Cold Lands Processes Experiment domain in Colorado, USA, in 2002 and 2003. In this case, aircraft passive microwave measurements at AMSR-E frequencies were used to compare with ground SWE data. For all study sites, daily AMSR-E observations are analyzed during the season leading up to the field campaigns. Results show that the inclusion of 10.7 GHz measurements in SWE retrieval schemes can reduce uncertainty, particularly in regions of deep snow cover.

O02-1C1.6 **14:45**

Real-time risk assessment model for ballast water exchange in Atlantic Canada

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In a typical year hundreds of vessels exchange their ballast water in the Scotian Shelf/Gulf of Maine region of North America, resulting in a continuous risk of invasion by Aquatic Invasive Species. A model that estimates the relative overall risk of invasion for possible exchange segments along a vessel track will be presented. The model is based on a set of dispersion metrics relevant to the risk of invasion for organisms released in simulated ballast water exchanges. Recently, the risk assessment model has been incorporated into a system that can provide real-time advice regarding the lowest risk region to exchange ballast water for an incoming vessel. The system is based on an operational shelf circulation model that provides the flow fields in which ballast water will be released, and an interactive web interface where the user enters the vessel track and model parameters. The details of this system will be described and a preliminary version of the system will be demonstrated.

I02-4C8.4 **14:30**

Annual cycle of particulate organic carbon export in the Franklin Bay (Canadian Arctic); environmental control and food web implications

Alexandre Forest[1], *Makoto Sampei*[1], *Ryosuke Makabe*[2], *Hiroshi Sasaki*[3], *Hiroshi Hattori*[4], *David Barber*[5], *Yves Gratton*[6], *Paul Wassmann*[7], *Louis Fortier*[1]

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As part of the Canadian Arctic Shelf Exchange Study (CASES), a sequential sediment trap was moored at 200 m depth on the 250 m isobath of the Franklin Bay (Canadian Beaufort Shelf, Arctic Ocean) to assess the downward export of particulate organic carbon (POC) over an annual cycle (October 2003 to September 2004) and within an integrated physical and biological frame (sea-ice, winds, currents, temperature, salinity, photosynthesis, turbidity, and mesozooplankton). In spring and summer, the new-POC production was constrained by a permanently stratified water column and developed as a subsurface microalgal bloom. The large calanoid copepods fed sloppily in that bloom and, consequently, algal and fecal POC fluxes culminated at the same time in July-August (respectively 23 and 24 mg C m-2 d-1). Detrital POC flux peaked thereafter in September (52 mg C m-2 d-1) in accord with the wind-induced resuspension of the recently-settled POC. In fall, fecal and detrital POC fluxes increased (respectively up to 12 and 22 mg C m-2 d-1) following the off-shelf transport of bottom POC related to wind stress and convective mixing. In winter, POC fluxes (2 - 7 mg C m-2 d-1) were linked to resuspension mostly caused by eddy turbulence along the slope. Our results support the estuarine character of the Canadian Beaufort Shelf and illustrate that the Franklin Bay serves as a depocenter for both newly-synthesized POC and old-resuspended POC. We conceptualize that this bimodal input of POC sets the stage for a complementary algal-detrital food web that takes advantage of any food resource available.

A05-1C6.5 **INVITED/INVITÉ 14:30**

Status of open Access to Environment Canada Warning Data.

Norm Paulsen

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The mandate of the MSC is to enhance public safety and informed decision making by issuing weather warnings; forecasting weather, ice and wave conditions; supporting critical weather-sensitive government services; monitoring atmospheric conditions and predicting the state of the climate; monitoring water levels, and providing scientific research for service improvement and policy advice.

So why is much of this information not readily available in an "open access to meteorological data" environment?

The assumption that all the information is readily available as data, is far from the reality. The information exists; but it is not useable data because it is often biased to internal programs and applications. External standards such as CAP-XML use simple data formats with unbiased content specific rules. EC can handle the formats but it's our content that needs to be redefined and standardized to be useable.

I07-3DP.5 **16:00**

Spherical Harmonic Analysis and Synthesis in Satellite Gravity Gradiometry Using the Torus Approach

Chen Xu[1], *Michael Sideris*[1], *Nico Sneeuw*[2]

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It is a computationally demanding task to solve the spherical harmonic coefficients from satellite gravity gradiometry observations due to the enormous amount of unknown parameters and observations. The torus-based semi-analytical approach simplifies the calculating procedure. This approach is an alternative gravity field analysis approach to the space-wise and time-wise approaches due to its efficiency and flexibility to handle any kind of geopotential functionals, e.g., disturbing potential V or gravity gradient tensor components such as Vxx; Vyy. In this approach, under the assumption of a nominal orbit with a constant radius and a constant inclination, the two-dimensional discrete Fourier transform can be applied to get the pseudo-observables, the lumped coefficients. Consequently, the transfer coefficients yield a linear relationship between the lumped coefficients in the spectral domain and the spherical harmonic coefficients in the spatial domain. By taking advantage of the block-diagonal structure of the normal matrix, the spherical harmonics can be easily obtained by least-squares inversion.

Spherical harmonic synthesis generates functionals, such as Vxx; Vyy or their radial and inclination derivatives from the spherical harmonic coefficients. In most cases, it can not be analytically obtained by the traditional approaches. The torus-based semianalytical approach is able to solve this problem. For different functionals, the corresponding transfer coefficients can be multiplied by the spherical harmonics to get the lumped coefficients. Then, the two-dimensional inverse Fourier transform is employed to synthesize the geopotential functionals along the nominal orbit. The radius and inclination variations can be corrected by a Taylor expansion series. Compared with the most accurate direct approach, the test results show that the torus approach is really an alternative and powerful approach for spherical harmonic analysis and synthesis from space-borne gradiometry observations.

I08-3DP.1 **16:00**

Influence of Regional Sea Ice Variability on Arctic Tundra

Uma Bhatt[1], *Donald Walker*[2], *Martha Raynolds*[2], *Josefino Comiso*[3]

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Recent dramatic reductions in sea ice and changes in Arctic vegetation have been well documented and are of growing concern because of how they may impact the ecosystem at high latitudes, which includes permafrost, soils, fauna, as well as humans. The variability in sea ice cover is hypothesized to influence the nearby tundra vegetation by forcing atmosphere and land temperatures changes. To investigate this question, climate analysis techniques are applied to high-resolution passive microwave sea ice concentration and AVHRR land surface temperatures to evaluate the direct relationship between coastal ice and the adjacent land. The spatial variations of the climate-tundra relationships are examined by performing analysis regionally as defined by bioclimate subzones. We find a relationship between sea ice cover and nearby land surface temperatures that is generally consistent with the notion that cooler land surface temperatures are found with above average ice conditions. In addition, we are examining atmospheric circulation anomalies to explain the mechanisms behind the ice area – land temperature relationships.

O01-2DP.4 **16:00**

Simulation and Analysis of the DMS and Sulfate during the CSOLAS-SABINA Campaign.

Atif Taoussi[1], *Jean-Pierre Blanchet*[2], *Maurice Levasseur*[3], *Yvonnick Le Clainche*[4], *Anne-Lise Norman*[5], *Moire Wadleigh*[6], *S. Sharma*[7]

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Oceanic dimethylsulfide (DMS) is the major natural source of sulfur into the atmosphere and contributes to the total tropospheric burden in gaseous and particulates forms through chemistry, nucleation and condensational growth. The biogenically-derived DMS and sulfate aerosol play a role in the cloud microphysics, precipitation, cloud albedo and radiation balance. Following SERIES campaign in the Pacific Ocean, a comparison between NARCM simulation and measurements at P-station showed that DMS and sulfate were from distant origins, in excess of 1000km, and that measurements at one single station were explained by the spatial and temporal integration over most of the Pacific Ocean. Above the boundary layer, the anthropogenic contribution from continental sources dominates. This experiment is now extended to the SABINA campaign that took place in the Northwest Atlantic during spring, summer and autumn 2003. The results of model simulations are compared against observations taken during SABINA with the objective of validating the model and extending the regional analysis over the Northern Atlantic. The validation and understanding of natural aerosol from DMS emission is important for the assessment of anthropogenic influence on climate from sulfur aerosol against the background conditions.

I11-4C1.3 **14:00**

Characterization of the near-surface boundary layer in a mountain valley clearing

Warren Helgason, *John Pomeroy*

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Modeling turbulent exchanges between snow and air in mountain regions is a formidable task. An outstanding concern is how surface heat and mass fluxes are influenced by complex boundary layer flows and whether this limits that applicability of estimation methods based on flux-profile relationships. This study reports wintertime eddy covariance data collected in a 7.5 ha, level meadow located in the Kananaskis River valley, in the Rocky Mountains of Alberta, Canada. The meteorology in this valley is characterized by relatively low mean wind speeds with frequent gusts. During the study period, a logarithmic wind profile was often observed to heights greater than 4.0 m; however the turbulence characteristics measured at 2.0 m differed significantly from typical near-surface atmospheric boundary layer data. In particular there are low frequency wind motions (gusts) that make a significant contribution to the wind speed variances and to turbulent transport of heat and water vapour. These motions contribute strongly to the horizontal wind velocity, where the fourier spectral density displays a marked shift to lower frequencies compared to those expected over flat-terrain, but less to the vertical velocity components due to blocking imposed by the ground surface. Accordingly, the correlation coefficient between the horizontal and vertical components was reduced from 0.3, expected for homogeneous terrain, to 0.1. Despite this, there is still a similar shift to lower frequencies in the cospectral peaks of momentum (and to a lesser degree, sensible and latent heat) suggesting that these low frequency motions are not completely ‘inactive’, as is often assumed. An attempt is made to separate the contribution of ‘non-local’ motions to the heat and vapour fluxes from those resulting from interaction with the local snow surface. The implications are that the scaling relationships postulated by Monin Obukhov similarity theory are violated as are many of the assumptions behind parameterizations of the turbulent heat fluxes in hydrological and land-surface models.

I12-3B9.8 **12:15**

A review of the requirements for drought information on the Canadian Prairies

Richard Lawford[1], *Harvey Hill*[2], *Elaine Wheaton*[3], *Bill Girling*[4], *Alf Warkentin*[5], *Irene Hanuta*[2], *Ronald Stewart*[6]

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The Drought Research Initiative (DRI) is undertaking a focused 5-year science program to study the characterization of drought, drought processes and ways to improve the prediction of drought. Drought research has generated a lot of interest among those resource agencies on the Canadian Prairies that are sensitive to drought. Consultations with these agencies reveal that there is a range and diversity of information needed to help mitigate the effects of on-going droughts or to plan for future droughts. This information varies by sector and user. Over the past six months through consultations with agencies by the DRI Network manager and some DRI investigators, and through the partner presentations at a January 2007 DRI workshop, a number of these needs have been more clearly articulated. This presentation is a summary of these requirements by resource sector which will assess their dependence on information about the seasonality, scale, location, severity, frequency and predictability of drought. It also takes a preliminary look at how DRI could be augmented in order to deal with some of these existing needs and position itself to assist with future research-policy linkages.

I15-2B9.6 **12:00**

How much carbon dioxide can the ocean accept?: Simulations with the CCCma global ocean carbon model

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The Canadian Model of Ocean Carbon (CMOC) has been developed as part of a global coupled carbon climate model. In an integration to preindustrial equilibrium, CMOC reproduces global mean estimates and spatial distributions of various indicators of the strength of the biological pump. The spatial distribution of the air-sea exchange of carbon dioxide is consistent with present-day flux estimates. 'Fertilization' simulations with a well-mixed atmosphere allow estimation of the maximum uptake of carbon dioxide by CMOC for various initial atmospheric carbon dioxide concentrations. These simulations suggest that no plausible ocean fertilization scenario could significantly impact atmospheric carbon dioxide growth. Simulations of the 20th and 21st centuries allow the effects of carbon dioxide growth and climate change to be independently evaluated.

I07-3C8.3 **14:15**

Integrated Global Water Cycle Observations and their potential contributions to societal needs and a Global Earth Observation System of Systems

Richard Lawford

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In 2003, the Integrated Global Observing Strategy Partnership (IGOS-P) launched the Integrated Global Water Cycle Observations (IGWCO) theme to bring together experts from international and national science programs to develop a framework for guiding decisions regarding priorities and strategies for the enhancement of water cycle observations. IGWCO supports the development of interoperable observational systems and integrated data set development for a number of water cycle variables. Through its active engagement in capacity building and links with the Global Water System Project (GWSP), IGWCO also supports the development of water cycle information for broad application. Recently many of these IGWCO activities have been integrated into the Water Cycle Societal Benefit area of the Group on Earth Observations (GEO) and its Global Earth Observing System of Systems (GEOSS). This presentation will outline the activities being undertaken to support the goals of IGWCO and GEOSS and describe some current opportunities and challenges for water cycle observations.

I05-3DP.2 **16:00**

Assimilation of Historical SST Data for Long-term ENSO Prediction

Xiaobing Zhou, *Youmin Tang*, *Ziwang Deng*

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In this study, we will introduce and propose some data-assimilation methods and verify them by performing retrospective forecasts of ENSO events. First, we select the first twenty years, 1876 to

1895, as a test period and assimilate sea surface temperature (SST) data only into the ocean model. The prediction results show it plays an important role for ENSO forecast, especially at lead times beyond 6 months, that spreading SST observations into subsurface via a defined suitable model Background Error Covariance (BEC). The best one of the four data-assimilation schemes proposed here is then chosen to perform the ocean analyses of 126 years from 1876 to 2001. The forecast experiments are initialized by these ocean analyses and performed by a coupled model. It was found the correlations of predicted Sea Surface Temperature Anomalies (SSTAs) averaged in Nino 3.4 region against the observed are close to 0.5 at the first 30 years of 1876 to 1905 and last 50 years or so of 1950 to 2001 at a 12-month lead time.

C04-3DP.2 **16:00**

Contributions of the Global Energy and Water cycle EXperiment (GEWEX) to climate science

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During the past two decades, there have been major developments in climate science and greatly expanded capabilities to observe and model the climate system. Through its research on the global energy and water cycle, the Global Energy and Water cycle EXperiment (GEWEX) has been making significant contributions to these developments. For example, GEWEX has contributed data sets and analysis tools through its Global Radiation Panel projects, improved parameterizations of clouds and land surface processes through its Modeling and Prediction Panel projects, increased understanding of regional hydrometeorological processes through its Regional Hydroclimate Projects and, most recently, comprehensive data sets and services to facilitate model improvements through its Coordinated Enhanced Observing Period (CEOP). This presentation provides an overview of these contributions and outlines GEWEX plans to continue similar contributions until 2012 and possibly beyond.

S05-3DP.4 **16:00**

Winter climate along the St. Lawrence Valley.

Jerry Toupin

(Presented by *Jerry Toupin*)
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Located in Eastern Canada, The St. Lawrence Valley (between Montreal and Quebec City)is known as one of the snowiest populated valleys in the world. Usually more than 200cm of snow falls every winter. Snowstorms are frequent, as more than 10 major snowstorms are registered every year (Plamondon, 1979)interfering greatly with human activities.

Numerical analysis (among others: discrimant analysis, stepwise multiple regression) for the 1971-1980 decade on snow depth for the month of January reveals three-winter-regional climates along this valley: A-) the southern part of Montreal; slightly warmer with less snow and more rainfall, B-) the area around Quebec City; colder with more snow and C-) an intermediate corridor in-between those two cities.

Two major variables were identified as responsible for explaining these three winter regional climates: the daily maximun temperature as well as the amount of rainfall.

I15-2B9.3 **11:00**

Modelling the carbon dynamics of northern peatlands

Nigel Roulet[1], *Francois Saint-Hilaire*[1], *Julie Talbot*[1], *Jianghua Wu*[1], *Elyn Humphreys*[2], *Peter Lafleur*[3]

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Northern peatlands represent one of the world's largest stores of terrestrial carbon and a significant source of atmospheric methane. The magnitude and direction of the CO2 and CH4 fluxes is function the primary production and both oxic and anoxic decomposition of organic matter. These ecological processes are, in turn, controlled to a large extent by the moisture and thermal regimes of a peatland. The McGill Wetland Model (MWM) has been developed to simulate the inputs and outputs of CO2 and CH4 as a function of the surface and soil climate of peatlands. The model processes include photosynthesis and autotrophic and heterotrophic respiration, and the model outputs are plant biomass, carbon accumulation in peat, and the daily exchange of CO2 and CH4 between the peatland and the atmosphere. The peat profile is described in a single box, partitioned into oxic and anoxic conditions by the elevation of an effective water table. The model has been evaluated against the net ecosystem exchange and annual carbon balances from a raised, ombrotrophic bog and a treed, mineral poor fen, but we are continuing to evaluate MWM against additional peatland types. The evaluations show MWM produces the exchanges and storage pools in the right order of magnitude and it reproduces the temporal variability in exchanges reasonably well. Sensitivity analysis reveals a much larger change in ecosystem exchange due to relative small changes in water table, while changes in temperature are secondary. However, we recognize that changes in the structure of the plant community, which is currently not depicted in MWM could have a significant influence of the exchange rates. The development of descriptions of vegetation changes as a function of changes in moisture storage is currently underway.

I05-2C8.8 **15:45**

Decadal Variation of ENSO Predictability

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Two hybrid coupled models (HCMs), one composed of OGCM OPA9.1 and a linear statistical atmosphere (HCM1), and the other composed of an intermediate complexity dynamical ocean and a nonlinear statistical atmosphere (HCM2), were developed to study ENSO predictability for the period from 1881-2000. The historic sea surface temperature (SST) from 1881-2000 was assimilated into both ocean models using Ensemble Kalman filter and OI respectively. Both HCMs have compelling prediction skills for ENSO compared with the best ENSO prediction models in the world.

The both HCMs show that ENSO prediction skills from 1881-2000 vary at inter-decadal and decadal time scale, with high skills appearing at the late 19th and the late 20th century, and low skills appearing at the early 19th century. The possible reasons responsible for the variation of ENSO predictability were analyzed and discussed.

C01-2C6.8 **15:45**

Effects of Seasonal Averaging Periods on Detecting Surface Temperature Trends in the Arctic

Taneil Uttal

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Many studies of temperature trends in the Arctic use traditional seasons of March-April-May (MAM), June-July-August (JJA), September-October-November (SON) and December-January-February (DJF). Examination of these averaging periods for a number of sites (Eureka, Alert, Barrow, Tiksi) which are the sites of existing or proposed intensive Atmospheric Observatories indicate that these seasonal 3-month averaging periods may be obscuring detection of temperature trends. While JJA temperatures are closely clustered and when averaged represent a reasonable summer average, the long period of the Arctic winter with no sun and low sun angles result in an extremely long winter period. This cold 'winter' period effectively lasts for seven months from October through April. May and September temperatures are distinctly warmer, with similar ranges as the Arctic passes through the short melt and freeze-up seasons respectively. This demarcation of 'seasons' varies as might be expected with latitude of the station. It is suggested that to detect temperature trends in the Arctic that it is necessary to quantitatively detect physically forced transitions and that calendar based 'seasons' may substantially obscure detection of surface temperature trends.

A06-2DP.6 **16:00**

Radar, Radiometers, Interferometers and Lidar in Eureka, Canada for Cloud and Aerosol Studies

Taneil Uttal[1], *Matthew Shupe*[2], *Von Walden*[3], *Ed Eloranta*[4], *Ola Persson*[2], *Duane Hazen*[1]

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The NOAA Studies of Environmental Arctic Change Program (SEARCH) has cooperated with the Canadian Network for Detection of Arctic Change (CANDAC) Program and Meteorological Services Canada (MSC) to install a suite of instruments in Eureka, Canada. These include a millimeter cloud radar (MMCR), a high spectral resolution lidar (HSRL), a Polar Atmospheric Emitted Radiance Interferometer (P-AERI) and a microwave radiometer. These instruments represent a combination of active and passive sensors operating in a range of frequencies that collectively make comprehensive measurements of clouds and aerosol properties, surface skin temperature, spectral infrared emissivity, clear-sky downwelling flux, and spectral longwave cloud forcing. The measurements from the sensors are also used to calculate a number of retrieved parameters such as cloud droplet and crystal sizes, cloud phase, integrated precipitable liquid water and atmospheric vapor, temperature and humidity profiles in the boundary layer, the boundary-layer height, and column amounts of trace gases such as CO, CH4, and N2O. These collocated instruments provide a powerful ensemble of measurements for studying clouds, aerosols and atmospheric radiation. A case study is presented demonstrating the utility of the simultaneous measurements to relate cloud and aerosol properties to the atmospheric and surface forcing. Discussion is also presented of how the measurements can be used for validation of satellite measurements and development of model parameterizations.

A07-2DP.8 **16:00**

International Arctic Systems for Observing the Atmosphere (IASOA) IPY Activity 196

Taneil Uttal[1], *James Drummond*[2], *John Burkhart*[3], *Alexander Makshtas*[4], *Jussi Paatero*[5]

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International Arctic Systems for Observing the Atmosphere (IASOA) IPY Activity 196 is coordinating the efforts at Arctic atmospheric observatory sites that are year-round, intensive, permanent, and with year-round staffing. The science mission is to collect the information necessary to understand the processes and mechanisms of Arctic climate change. The logistical mission is to coordinate measurement programs on atmospheric properties such as precipitation, atmospheric radiation, water vapor, ozone, aerosols, chemistry/radio nuclides, cloud properties, climate-grade temperature/winds, snowfall, and surface fluxes between observatories. At present there are intensive observatories of interest at Barrow (Alaska), Eureka and Alert (Canada), Summit (Greenland), Ny-Alesund (Norway), Pallas and Soldankyla (Finland), and Kiruna (Sweden). A primary objective of the IASOA Activity for IPY 2008-2008 will be to develop a new intensive atmospheric observatory in Tiksi, Russia. A number of key science questions have been identified including: (1) How do clouds, aerosols and atmospheric chemistry interact to force the Pan-Arctic surface energy balances and albedo-temperature feedback? (2) What is the relative role of tropospheric dynamics and stratospheric linkages in controlling the Arctic surface variability? (3) What portion of the recent changes in the Arctic weather and climate can be attributed to increases in anthropogenic sources? (4) How does the Arctic atmosphere interact with the rest of the Arctic (marine, cryospheric and terrestrial) system? A number of global atmospheric observing networks will be supported at the intensive observing sites including Global Atmosphere Watch (GAW), Baseline Surface Radiation Network (BSRN), Micropulse Lidar Network (MPLnet), the Ultraviolet Network (UVnet), the Climate Reference Network (CRN), the Aerosol Network (AEROnet) program and others. A particular emphasis will be to respond to the specific recommendations of a number of international assessments (e.g. IPCC, ACIA, AMAP) and research programs (WCRP, CliC, GEWEX, AON and SEARCH) that have recommended that multi-disciplinary "super-sites" be developed to collect the information needed to determine the processes and drivers of environmental Arctic change across disciplines.

A07-2C7.6 **15:45**

A new climate observatory facility in Tiksi, Russia

Taneil Uttal[1], *Alexander Makstas*[2], *Jussi Paatero*[3], *Sergey Matrosov*[4], *Yuri Tsaturov*[5], *John Ogren*[1], *Sam Oltmans*[1], *Russell Schnell*[1]

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A major observational gap in the circum-polar Arctic is the entire Siberian region of Russian. Consequently, Tiksi, Russia has been selected as a location for development of a new Arctic Atmospheric Observatory site that will support measurements that can contribute to a network of intensive sites that includes Barrow, Alert, Eureka, Summit, Greenland, Ny-Alesund, Pallas and Soldankyla. In addition filling a geographical gap, Tiksi has been identified as a particularly important region scientifically for the following reasons: (1) It is located at the confluence of Atlantic and Pacific influences on the Arctic Atmosphere resulting in a wide variety of air masses affecting the climate at Tiksi. Consequently a wide range of conditions are expected ranging from pristine to polluted providing a natural laboratory to assess radiative effects of aerosols and resulting cloud

properties. (2) Tiksi is located near the mouth of the Lena River which is the second largest river draining into the Arctic Ocean. The Lena is the only major Russian River for which most of the drainage basin is underlain by permafrost making it hydrologically complex and particularly vulnerable to climatic warming. (3) The Laptev Sea is an area of significant ice production, and wide variability is at least particularly attributed to synoptic perturbations. Having an observatory central to this region will lead to a better understanding of processes that lead to decreases in the perennial pack. The existing weather station in Tiksi was rebuilt in the summer of 2006 with adequate resources and laboratory space for additional instrumentation for climate studies and monitoring. Present plans are to build a second facility in the summer of 2007 that will be placed close to the weather station but with surrounding terrain that is horizontally homogenous and with a significant clean air sector. Measurement programs being planned by the U.S. National Oceanic and Atmospheric Administration, the Finish Meteorological Institute, the Arctic and Antarctic Research Institute of Roshydromet and the Norwegian Institute for Air Research will be described.

S02-2C3.4 **14:45**

The influence of lakes and snow re-distribution on passive microwave remote sensing of snow water equivalent in a tundra environment

Peter Toose[1], *Ellsworth LeDrew*[2], *Chris Derksen*[3]

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Current North American operational satellite passive microwave snow water equivalent (SWE) retrieval algorithms consistently underestimate SWE levels for tundra environments when compared to regional snow surveys conducted in the Northwest Territories and northern Manitoba, Canada. The poor performance of these algorithms is likely a result of the unique physical properties and spatial distribution of tundra snow, coupled with the abundance of lakes in these regions. To investigate the issue of poor passive microwave SWE algorithm performance on the tundra, Environment Canada collected in-situ measurements of SWE, snow depth, and density at 87 sites within a 25km by 25km study domain located near Churchill, Manitoba in March 2006. Coincident multi-scale passive microwave airborne (70m & 500m resolution) and spaceborne (regridded to 12.5km & 25km resolution depending on frequency) data were measured at 6.9GHz, 19GHz, 37GHz and 89 GHz frequencies during the same time period.

The snow survey data highlighted small-scale localized patterns of snow distribution and deposition on the tundra that influences current SWE underestimation. Snow from the open tundra plains is re-distributed by wind into small-scale vegetated features such as narrow creekbeds, lake edge willows and small stands of coniferous trees. The very large amounts of snow deposited in these spatially-constrained features has little influence on the microwave emission measured by large-scale passive microwave spaceborne sensors and is therefore unaccounted for in current methods of satellite SWE estimation. The analysis of the passive microwave airborne data revealed that brightness temperatures in the longer wavelength frequencies (6.9GHz and 19GHz), were much lower over some tundra lakes, effectively lowering SWE at the satellite scale by reducing the 37-19 GHz brightness temperature difference used to estimate SWE. The unique emission properties of lakes in the wide open expanse of the tundra plains, coupled with an insensitivity to the large amounts of SWE deposited in small-scale vegetation features provides an explanation for current passive microwave underestimation of SWE in a tundra environment.

I08-3C7.2 **14:00**

Intra-seasonal relationship between the Northern Hemisphere sea ice variability and the North Atlantic Oscillation

Meiji Honda[1], *Kentaro Yamamoto*[2], *Yoshihiro Tachibana*[3], *Jinro Ukita*[4]

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An intra-seasonal relationship, including a possible feedback, is investigated between the North Atlantic Oscillation (NAO) and a hemispheric-scale seesaw-like pattern dominant in sea ice variability over the wintertime Northern Hemisphere, with one polarity in the Bering and Labrador Seas and the other in the Okhotsk and Greenland-Barents Seas. Statistical analysis using observational data suggests that a particular phase of NAO and anomalous atmospheric circulation in the Pacific during early winter contribute toward the development of the midwinter hemispheric sea-ice seesaw. In contrast, the ice seesaw tends to damp the preexisting NAO signal during late winter, indicating a reversal of the phase relation between them. This NAO damping may be triggered by the Pacific sea-ice anomalies. Results from numerical experiments generally support this notion and further suggests a stationary Rossby wave train emanated from the North Pacific as a dynamical mechanism for damping the NAO signal.

C04-4B5.4 **11:15**

Arctic Sea Ice Snowmelt Onset Dates Derived from Passive Microwave for 1979-2005, an update for current conditions

Mark Anderson[1], *Andrew Molthan*[2], *Bryan Jackson*[1]

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The Arctic Ocean is an integral part of the global climate system and an area that is observing record breaking seasonal fluctuations. This study investigates the spring snowmelt onset conditions in the Arctic sea ice cover from 1979 to 2005. Snowmelt onset over Arctic sea ice is defined as the point in time when liquid water appears in the snowpack. Physically, the timing of snowmelt onset is important because surface energy absorption increases rapidly at snowmelt onset, owing to changes in surface albedo values. Monitoring the timing of snowmelt onset over Arctic sea ice is facilitated by using passive microwave data, because surface microwave emission changes rapidly when liquid water appears in the snowpack, and data acquisitions are relatively unaffected by cloud cover or solar illumination. The Advanced Horizontal Range Algorithm (AHRA) exploits the changes in passive microwave brightness temperatures between 18GHz (19GHz on SSM/I) and 37GHz brightness temperatures to derive snow melt onset dates over Arctic sea ice from 1979-2005. Comparison between AHRA-derived melt onset dates and temperatures from International Arctic Buoy Program/Polar Exchange at the Sea Surface (IABP/POLES) and NCEP/NCAR Reanalysis-2 illustrates melt onset typically occurs when air temperatures near 0oC. The objective of this paper is to examine the melt onset dates for the Arctic region and discuss the trends in the dates over the period studied. In addition, ice reduction dates are calculated and compared to the melt onset dates to further understand the melt characteristics during the spring. The ice reduction date is when the ice concentration drops below 80%. Both the melt onset and ice reduction dates are derived from passive microwave remote sensing. There is a notable period of time, delta t, between the melt onset and ice reduction. Analysis of delta t for the Arctic over the microwave record provides explanations for changes in sea ice cover over time. For instance, an anomalously short delta t could be an outcome of an atmospheric pattern

that brings unseasonably warm temperatures to the region, reducing the ice concentrations. However, the same delta t could be a result of thinner ice being melted in the same time period with less warm air advection.

In general, the results continue to show a trend to earlier melt onset dates. However the melt onset dates for the more recent years do not show extremely earlier dates, even though the ice cover at the end of the melt season continues to show reduced perennial ice cover in October. The ice reduction dates also show earlier dates, which would indicate a shorter melt season and possible thinner ice cover which is not melting earlier, but is being removed quicker in the spring. Understanding the surface energy budget could be used to determine why patterns in ice concentration and extent occur during certain years, but not for others.

H01-2DP.1 **16:00**

Application of the VIC Model for Water and Energy Budget Studies in the Upper Assiniboine River Basin

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Understanding the dynamics of drought requires a detailed understanding of the energy and water balance within a region. Methods currently exist to assess basin budget studies based on atmospheric analysis. However, it is important that land surface budgets support these results in order to understand surface influences on drought evolution. Hydrological models equipped with energy closure solutions are suited to this role. There are a number of these models available (e.g. MESH (formally WATCLASS), TOPLATS, VIC) and it is the goal of this research to evaluate a number of these to determine those most suited to the analysis of prairie drought. One such model, that is receiving considerable attention, generates runoff based on the Xinanjiang/Arno/VIC variable infiltration capacity concept. Here, the VIC model (Cherkauer et al, 2002) will be employed to examine the hydrologic response of central Saskatchewan's Assiniboine River basin upstream of the Lake of Prairies flood control reservoir. This 13,000 km2 basin has been chosen for detailed study as part of the Canadian Drought Research Initiative (Canada DRI).

A preliminary step in this study entails the successful watershed delineation of the many sub-basins within this region using the Shuttle Radar Topography Mission (SRTM) elevation data at a resolution of 3 arc seconds. Meteorological forcings used to drive the model are from the North American Regional Reanalysis (NARR) data at a resolution of 0.3°. Finally, corresponding soil and vegetation datasets were retrieved from the Canadian Soil Information System (CANSIS) and the Prairie Farm and Rehabilitation Authority (PFRA) databases, respectively. The Upper Assiniboine Basin provides a challenging test bed for any hydrologic scheme. Low topographic gradients are combined with a poorly defined and human augmented drainage network. This means that the lateral moisture transfer; important within hydrologic schemes, may be dominated by in-between grid processes such as blowing snow and groundwater exchanges. Results of these analyses will focus on the period surrounding the drought of 1999-2004.

S05-1D3.2 **16:15**

Rain on Snow Events over Northern Central Eurasia

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This study will exam the characteristics of rain-on-snow events and its changes during the historical records period of 1936-1989 over the northern Central Eurasia. The potential connection to atmospheric circulation and warming climate will be evaluated.

A06-1D7.4 **16:45**

Properties of water-only, mixed-phase, and ice-only clouds over the South Pole

Mark Ellison[1], *Von P. Walden*[1], *James Campbell*[2], *James Spinhirne*[3]

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Downwelling spectral infrared radiances were measured by the Polar Atmospheric Emitted Radiance Interferometer (P-AERI) during 2001 as part of the South Pole Atmospheric Radiation and Cloud Lidar Experiment (SPARCLE). In addition, a micro-pulse lidar was operated from January until June 2001 by NASA as part of the Micro-Pulse Lidar Network (MPLNET). The lidar provides cloud-base height, and in many cases, cloud-top height, since clouds over South Pole are typically optically thin. The P-AERI radiances and the MPL data are used, along with routine radiosonde profiles, to retrieve cloud microphysical properties (cloud optical depth, effective radius, and cloud phase). In-situ measurements made by a Hydrometeor Videosonde (HYVIS) are used to validate the retrievals under certain conditions. We find that water-only and mixed-phase clouds exist over South Pole in the summertime and into the autumn, despite low cloud temperatures (-20 to –30 C). This result indicates that the linear relationship assumed by climate models for how ice and water fractions depend on temperature is probably not valid for the atmosphere over the Antarctic Plateau. The frequency of occurrence of clouds with different phase types will be presented. Variations in the optical depth and effective radii as a function of season will also be presented. The sensitivity of the results to various errors in the observations and retrieval technique will be discussed.

A07-3B7.5 **11:30**

Fractional cloud cover and longwave cloud radiative forcing at the surface over Eureka, Canada

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Downwelling spectral infrared radiances have been measured continuously by the Polar Atmospheric Emitted Radiance Interferometer (P-AERI) at Eureka, Canada since March 2006. These measurements are being made as part of the collaborative effort between the Canadian Network for the Detection of Atmospheric Change (CANDAC) and the Study of Environmental Arctic Change (SEARCH). The P-AERI is operating at the same facility as the Arctic High Spectral Resolution Lidar (AHSRL), Millimeter Cloud Radar (MMCR), and a Microwave Radiometer (MWR). The P-AERI data are used to describe the downwelling spectral infrared radiances throughout an annual cycle (March 2006-March 2007). Clear-sky conditions are detected using a radiance-ratioing technique. These results are used to estimate monthly averages of fractional cloud cover, which can be compared to estimates from the other instruments operating at Eureka. The longwave cloud radiative forcing (LWCRF) at the surface is also calculated over the annual cycle and is compared to estimates from other locations in the Arctic.

H04-3B4.2 **11:00**

Canadian contributions to the Prediction in Ungaged Basins (PUB) Initiative

Christopher Spence[1], *Paul Whitfield*[1], *Robert Metcalfe*[2], *John Pomeroy*[3], *Taha Ouarda*[4], *Alain Pietroniro*[1]

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The goals of the IAHS Prediction in Ungauged Basins (PUB) program have been widely embraced by the Canadian water resource community since the PUB science plan is seen to be a useful foundation from which Canadian water science and management issues can be addressed. The enormous diversity of the Canadian landscape from northern permafrost, interior prairies, boreal forest and mountainous regions are only a part of the complexity of processes and scales that create the hydrological and chemical landscapes of our rivers. Water practitioners are keen to update their tools capturing the recent advances in hydrological science. Amongst these drivers are the low density of streamflow gauges relative to predictive needs, the differing seasonality of runoff generating processes, uncertainty in discharge measurements particularly during the spring river ice breakup, and the difficulty in defining the catchment area contributing runoff in many regions. Canada's contribution to this program to date has included active participation in planning and implementation committees and research groups since the initiative began. Canada has hosted three thematic workshops on prediction in cold regions, mountainous regions and low streamflow regimes with the support of the Canadian Geophysical Union and the Canadian Society for Hydrological Sciences (CWRA-CSHS). These three workshops developed a series of recommendations for PUB activities in Canada that emphasized research of physical processes and subsequent development of useful predictive tools and methodologies for practicing hydrologists. These workshops have proven to be an effective approach with which to identify research gaps and user needs and mobilize collective efforts. The structural framework and opportunities for hydrological science within Canada using the principles of PUB is creating new collaborative opportunities.

A02-1C7.5 **14:30**

The impact of a new radiative transfer scheme in GEM meso-strato on the surface temperature.

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One known problem in the current operational NWP models run by the Canadian Meteorological Centre (CMC) for short to medium range forecasts is the under estimation of the night time minimum temperature. This is known as the cold bias problem. One possible explanation for this cold bias would be that the surface energy radiative budget is biased.

The next major change to the GEM global model is expected in 2008. This project, termed the GEM meso-strato, involves moving the top of the model to 0.1hPa (from 10hPa), increasing the number of vertical levels to 80, some new physical parameterizations, namely a new radiative transfer scheme.

This new radiative transfer scheme was developed at CCCma for the GCM4. It has been shown that this scheme significantly reduces model biases in the surface radiative fluxes. In this presentation, we will provide a brief description of the GEM meso-strato and of the new radiative transfer scheme. We will focus on the impact of these changes on the cold bias problem in the surface temperature.

P-3A1.2 **INVITED/INVITÉ 09:15**

Physical controls on phytoplankton biomass and composition in the Strait of Georgia: results from a 1-D model / Contrôles physiques sur la production phytoplanctonique et la composition du Strait of Georgia: résultats provenant d'une représentation unidimensionelle

Susan Allen[1], *Kate Collins*[2], *Alain Ménesguen*[3], *Rich Pawlowicz*[1]

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The Strait of Georgia is a semi-enclosed coastal sea with a strong estuarine circulation. The growing season starts with a classic spring-bloom followed by strong summer productivity. We have coupled a one-dimensional vertical-mixing model that uses a K-Profile parameterization of the boundary layer to a NPZD-class of biological model with 2 to 12 compartments. Two-dimensional physical processes, such as the estuarine circulation, are parameterized. The model is forced with hourly meteorological data and daily river data. The benefits and limitations of model choices will be discussed. The coupled biophysical model has been successfully used to determine the physical factors that control the arrival time of the spring bloom. Wind was found to be the primary control with strong winds delaying the bloom and weak winds causing the bloom to arrive earlier. The summer productivity is maintained by the estuarine circulation. Effects of inter-annual variations of physical factors (such as wind and river flow) on the biomass and composition of summer phytoplankton will be discussed.

I05-2C8.6 **15:15**

The QBO and extratropical seasonal predictive skill

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HFP2 is a 2-tier 1-season multi-model forecasting experiment which will form the basis of a new version of the CMC operational seasonal forecasting system. Analysis of the HFP2 30-year record of retrospective forecasts, and of seasonal forecasts in general, indicates that they are reasonably skillful at low latitudes as a consequence of the close link to tropical SSTs. Seasonal forecasts are less skillful at higher latitudes and the modest skill that exists is thought to be largely a consequence of teleconnections from the tropics and especially from ENSO. So called "two-tier" seasonal forecasting systems use a prediction of the SST anomaly (the first tier) as bottom boundary conditions for an atmospheric model (the second tier) which generates global forecasts. Multi-model forecasts combine results from different atmospheric models (in this case 4 different models) in order to average out unforecastable natural variability and to make use of the possibility that different models have skill in different regions.

Long timescale processes in the atmosphere and ocean may provide extratropical signals that can be skillfully forecast and this is exploited in the two-tier approach where SST anomalies provide such a signal. Comparatively long timescales are associated with the ocean and to a lesser extent with land surface processes but generally not with the atmosphere. The Quasi-Biennial Oscillation in the tropical stratosphere is an exception and this long timescale process may be linked to the extratropics through planetary wave behaviour. We investigate the possibility that knowledge of the QBO can provide an additional source of seasonal forecasting skill. Such a link is of intrinsic interest, could

potentially motivate attempts to improve the representation of the QBO in models and, in any case, any augmentation of the current modest level of predictive skill should be exploited.

A02-2DP.4 **16:00**

The use of the GEM-2.5km Model for Forecasting Gap winds over Vancouver Island

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In 2005, the Canadian Meteorological Centre (CMC) unveiled the high resolution (2.5km) GEM model (ref) for operational use over select regions of Canada. One area of focus was British Columbia, a region where complex terrain poses many challenges for the weather forecaster and the modeller.

In an effort to establish closer ties between the research and forecaster communities, an operational evaluation of the 2.5km GEM was initiated in the spring 2006. A number of phenomena were identified and forecasters performed daily assessments on the quality of the model simulations. One phenomenon, gap winds (locally referred to as “Qualicums”), affect central Vancouver Island. These winds can have major impacts on marine traffic on the east side of the island; wind speeds up 15 m/s are observed while elsewhere in the strait, winds may be light.

Forecaster evaluation of the GEM 2.5km performance with respect to gap winds revealed a probability of detection of just less than 65% for the summer. These results along with simulations from the model are presented.

I11-4D1.1 **16:00**

Use of deep groundwater observation wells for continuous monitoring of kilometre-scale vertical water balance

Garth van der Kamp[1], *Saul Marin*[1], *Bruce Davison*[1], *Brenda Toth*[1], *Alain Pietroniro*[1], *Harm Maathuis*[2], *Nicholas Kouwen*[3]

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Deep confined aquifers can act as giant weighing lysimeters, and may be used to monitor changes of total vertical water balance on a scale of kilometres. The groundwater pressure in such aquifers reacts instantaneously to changes of the total mechanical load on the formation, including the changes of load due to such hydrological processes as snow accumulation, rainfall, evapotranspiration and runoff. Since distributed hydrological models track the vertical water balance of each grid cell in the model domain, such “aquifer weighing lysimeters” offer the opportunity to test and calibrate distributed hydrological models at the kilometre scale of typical grid cells. Such verification of distributed hydrological models may be particularly important if the models are coupled to atmospheric models, in which case accurate modeling of vertical moisture fluxes to and from the atmosphere are of critical importance. Long-term (40 year) records of deep observation wells in Saskatchewan, Canada, exhibit a clear relation to changes of total vertical water balance at time scales from hours to years. Comparison of the observation well records with precipitation data, snow surveys and hydrological model outputs show that the changes in groundwater level are closely related to the hydrological variables and may in fact provide a better quantitative measure of these variables then most standard observations based on point measurements. Although the use of “aquifer weighing lysimeters” holds considerable promise, applications of the method have to deal with other causes of groundwater level changes that interfere with the hydrological signal. The effects of barometric pressure changes and earth tides can usually be eliminated fairly well. Other long-term transients due to groundwater flow in and out of the aquifer, whether due to pumping or natural causes, are more problematic. Improved techniques for dealing with these types of interference are being developed.

I08-4B7.4 **INVITED/INVITÉ 11:30**

Sea ice and the present polar warming asymmetry

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Opposite surface warming extremes in future greenhouse warming scenarios are usually found at the poles --- maximum warming in the Arctic and minimum warming in the Southern Ocean. Both extremes occur in the vicinity of sea ice cover. But do the extremes depend on the changes in sea ice cover?

Both poles experience ice-albedo feedback and other mechanisms that cause polar amplification, but increasing heat uptake in the Southern Ocean delays the warming there. The influence of sea ice retreat on greenhouse warming is isolated by running a global climate model with the sea ice albedo reduced artificially alone. The summertime sea ice cover that results is roughly the same as from doubling CO2. The same polar warming asymmetry is seen in response to lowering the sea ice albedo, although little warming is seen outside of the polar regions. The experiment shows that even a small reduction in the Antarctic sea ice cover dramatically alters convection and ocean temperature gradients in the Southern Ocean, so that ocean heat uptake is considerably enhanced.

C02-1D5.4 **16:45**

Climate response to a freshwater pulse in Modern, Last Glacial Maximum and Greenhouse Warming Climates

<u>*Cecilia Bitz*</u>[1], *John Chiang*[2], *Wei Cheng*[3], *Joseph Barsugli*[4]

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The magnitude of climate change and the rate of recovery from a freshwater pulse in the North Atlantic varies considerably depending on the background climate, as demonstrated in the Community Climate System Model. The weakened Atlantic meridional overturning circulation (AMOC) and its attendant weakened northward oceanic heat transport after freshening cause sea ice to expand and the surface to cool in the northern North Atlantic. Greater expansion of sea ice is responsible for the greater and more sustained cooling in a Last Glacial Maximum (LGM) climate, compared to modern climate and greenhouse warming (4XCO2) climates. Previously proposed mechanisms to explain AMOC stability involving altered horizontal freshwater transport in the North Atlantic are consistent with relative recovery rates in the modern and 4XCO2 climates, but fail to explain the slow LGM recovery. Instead, sea ice expansion inhibits deep-water formation after freshening in the LGM climate by reducing heat loss to the atmosphere and providing additional surface freshwater. In

addition, anomalous vertical freshwater transport across ~1km depth after freshening is most effective at weakening the stratification in the modern case but is negligible in the LGM case.

C02-1B5.8 **12:15**

A Community-Driven Ice-Sheet Modeling Initiative

Cornelis Van der Veen

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Over the past two decades or so, evidence for active ice sheets – both present-day and in the past – has mounted and the traditional view of ice masses responding sluggishly to external forcings has been replaced by the understanding that large ice sheets can undergo rapid changes. In Greenland, the speed of many outlet glaciers has increased significantly, and the estimated contribution of this ice sheet to global sea-level rise doubled from 0.23 ± 0.08 mm/yr in 1996 to 0.57 ± 0.1 mm/yr in 2005. In the Antarctic Peninsula, ice-shelf break-up has led to flow acceleration of grounded glaciers. In its latest assessment report, the Intergovernmental Panel on Climate Change acknowledges the importance of ice-dynamical effects on ice-sheet evolution and future sea-level rise, but states that “dynamical processes related to ice flow not included in current models but suggested by recent observations could increase the vulnerability of the ice sheets to warming, increasing future sea level rise. Understanding of these processes is limited and there is no consensus on their magnitude.” This statement challenges the glaciological community to improve understanding of the physical processes involved with rapid ice-sheet change, to develop quantitative prognostic models, and to incorporate small-scale processes into whole ice-sheet models. Developing the next generation of more realistic ice-sheet models requires a multi-tiered comprehensive approach, designed to include a hierarchy of models ranging from theory and perhaps intuitive conceptual models based extensively on observations, to time-evolving flowline models aimed at simulating individual glaciers or drainage basins, to fully three-dimensional time-dependent thermo-mechanical models that simulate evolution of the entire ice sheet. Recognizing the need for improving numerical ice-sheet models, and the need to involve the broader community in this effort, the objective of this presentation is to identify major challenges and to outline strategies for overcoming these.

I01-1C8.3 **14:00**

Inter-basin link of variability in the tropospheric circulation over the North Atlantic and North Pacific: Its interdecadal modulations and seasonal dependence

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The Icelandic and Aleutian lows (IL and AL, respectively) are wintertime semipermanent low-pressure systems over the North Atlantic and North Pacific, respectively. The interannual and intraseasonal IL and AL variability are closely related to the North Atlantic Oscillation (NAO) and Pacific-North American (PNA) pattern. Wintertime weather conditions in mid- to high-latitudes can be strongly influenced by variability of the two low pressure systems on multi-timescales. It has been found that an interannual seesaw-like oscillation exists between the AL and IL intensities (the AL-IL seesaw, AIS). Since the seesaw formation is triggered by eastward propagation of stationary Rossby wave trains from the North Pacific into the North Atlantic, this upper-tropospheric downstream

influence could be a basis for predicting climatic conditions in the Euro-Atlantic sector a month ahead. It is also known that the pronounced wintertime warming trend over landmasses observed in the recent decades is associated with concomitant deepening of the AL and IL intensities, a pattern akin to the "Cold Ocean Warm Land" (COWL) pattern, which is the opposite sense to the AIS. The associated SAT anomalies strongly reflect the recent weakening of a land-ocean contrast especially in high latitudes. Interestingly, these respective out-of-phase and in-phase relationships between the IL and AL can be identified as the two leading EOF modes of variability in the upper troposphere for the recent 50 or more winter seasons. Actually, interannual variability and long-term changes and "activeness" of the AIS and COWL for the last half century are essentially extracted in the two leading modes, which reflects the corresponding modulations in the strength of dynamical linkage between the North Pacific and North Atlantic in the upper troposphere.

C05-4C5.5 **14:30**

High-resolution Climate Change Scenarios for Germany and the European Alps

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A set of regional climate simulations (validation, control and scenario runs) has been performed for Germany and the area of the European Alps using the regional climate model REMO at a very high horizontal resolution of 0.088° (approx. 10 km). The lateral driving fields were provided by the ERA15 re-analysis/ECMWF analysis (validation run) and by the coupled global climate model ECHAM5-MPI-OM (control and scenario simulations). In order to assess the dependence of the simulated climate change signals on the future evolution of greenhouse gas concentrations three scenario simulations have been carried out (assuming the IPCC SRES emission scenarios B1, A1b and A2).

This contribution presents an evaluation of the model performance and of the simulated climate change signals with a focus on temperature and precipitation. The validation of simulated precipitation shows a good agreement with observation-based datasets. The accuracy clearly depends on the altitude. In mountainous regions the model underestimates precipitation rates, especially in the summer season. The area mean values for Germany are well reproduced.

By the year 2100 a change in mean annual air temperature from 2.5 to 3.5°C, depending on the emission scenario, is simulated. For annual precipitation no clear trend is visible. The seasonal analysis reveals that summer precipitation is expected to clearly decrease while higher precipitation sums are simulated for the winter months. Mean snow depths will strongly decrease. Soil-atmosphere interactions obviously play an important role for the simulated climate change signals.

H06-4C4.3 **14:00**

Glacier mass and energy balance in the European Alps simulated by the regional climate model REMO

Sven Kotlarski[1], *Daniela Jacob*[1], *Frank Paul*[2]

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In today's state-of-the-art global and regional climate models (GCMs, RCMs) mountain glaciers are represented in an extremely simplified way, or even totally neglected. Their size is usually beyond grid box resolution and only the largest glaciers are treated as fixed surface boundary conditions. Hence, the simulation of a possible feedback of changes in ice cover extent to the atmosphere and of the influence of enhanced glacier melt on runoff conditions is not possible.

To overcome these deficiencies and to represent processes attached to mountain glaciers in an appropriate way, a subgrid glacier parameterisation has been developed and implemented into the RCM REMO. The new scheme replaces the static glacier mask used so far and includes the explicit simulation of glacier mass and energy balance. The total ice mass within a climate model grid box is represented by a two-layer ice cuboid covering a certain fraction of the total grid box area. The glaciated area of an individual grid box is adjusting dynamically depending on accumulation and ablation conditions and the contribution of glacial meltwater to total grid box runoff is explicitly accounted for. In order to assess the effect of changing ice volumes on river discharge in glaciated catchments the routing scheme HD (Hydrological Discharge) is coupled to REMO in an offline mode.

This contribution presents RCM simulations in the European Alps for the period 1958-2003, both with and without the new parameterisation scheme. By accounting for subgrid variability of solar radiation and precipitation within a climate model grid box, a reasonable simulation of mean glacier mass balance is possible. Also, the observed decrease in glacier area during the corresponding time period can be reproduced approximately. Runoff originating from glacier melt leads to an increase in simulated summer discharge.

O01-1D1.1 **INVITED/INVITÉ 16:00**

New Ocean Ideas and Approaches in the Northwest Atlantic

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Over the past century we have seen a lot of interesting cycles in the Northwest Atlantic, with wild swings of cooling and warming. Many of these changes are clearly correlated, including air temperature, sea surface temperature, sea-ice concentration, iceberg flux, and others, but how are they connected? What are the key questions that we would like to address and how have they been changing as the time series of observations grow? What are the new ideas for oceanography of the Northwest Atlantic? What new approaches are presently available? I will address these questions for the Northwest Atlantic in reviewing some of the new approaches that are being developed and applied in the Northwest Atlantic. New observational sensors and platforms are being developed and deployed that offer the potential for providing data previously unavailable. There are also quite a wide suite of models, from the purely physical to the biophysical, at a range of scales from the very high-resolution on the inner shelf to nested basin-scale and global models. What potential do these new modeling and observational techniques offer and how could they be integrated to tackle new questions in the Northwest Atlantic?

I11-4C1.5 **14:30**

The influence of canopy temperature on incoming longwave radiation for snowmelt in coniferous Forests

John Pomeroy[1], *Danny Marks*[2], *Chad Ellis*[1], *Richard Essery*[3], *Janet Hardy*[4], *Aled Rowlands*[3], *Tim Link*[5]

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Snowmelt under coniferous forest canopies is primarily driven by radiation of which longwave radiation constitutes a major portion. Incoming longwave radiation is complicated by the presence of forest canopy; most calculations assume that the canopy temperature is equal to some reference air temperature and that the emissivity of canopy is ~0.98. The first assumption was tested using pyrgeometer arrays at Fraser Experimental Forest and Marmot Creek Research Basin in the Rocky Mountains of Colorado and Alberta respectively. The results show that there is no uniform reference air temperature to which canopy temperature can be derived from and that there is considerable variability in canopy temperature. Normal temperature inversions led to air at the bottom of the canopy being 1o (day) to 3o C (night) cooler than air temperatures at a reference height above the canopy. Canopy temperatures could be distinguished into two groups: needles (including small branches) and tree trunks. Trunks were warmer than needles by 12o to 35o C during clear days and at night and on cloudy days were up to 3o C warmer than needles – the effect was most pronounced in discontinuous stands. The sub-canopy air temperatures matched needle temperature well at night and on cloudy days and all of the time in continuous stands. However, in a discontinuous stand needle temperatures exceeded air temperatures by up to 5o C on clear days. The differences in longwave irradiance due to distance from trunks was an important component of the variability of net radiation under the canopy on a daily basis. An attempt to model the sub-canopy longwave irradiance using sky view, measuring sky longwave exitance and sub-canopy air temperature (substitute for canopy temperature) was satisfactory on cloudy days but underestimated irradiance by up to 30 W m-2 during clear days. Using above canopy air temperatures overestimated longwave at most times but underestimated during clear days. The model was substantially improved by including a trunk fraction in the canopy view (0.3 of canopy fraction for most forests). The most accurate simulations of sub-canopy irradiance used measured trunk temperatures for the trunk fraction and either measured needled or sub-canopy air temperatures for the non-trunk canopy fraction. The results suggest that the longwave exitance from sunlit trunks is a substantial component of longwave irradiance to snow in sunny climates.

S03-3B3.4 **11:15**

Integrating the Ground and Snow Surfaces to Yield Snow Depth

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Snow depth is the most easily comprehendible and measurable point snowpack property, yet illustrates the greatest spatial variability. Manually snow depth measurements can be performed using a ruler inserted into the snow. These measurements have recently been supplemented by LiDAR (Light Detection And Ranging) data estimated by differencing snow-off (summer or fall) from snow-on (winter) aerial surveys – the snow depth is a difference between the ground surface and the snow surface. These high spatial resolution data allow the question: are the spatial properties of the snow surface decoupled from the ground surface?

Three datasets were used to examine the temporal and spatial variations between this potential decoupling. For changes in time, two parallel 50-m long transects of snow depth at a 1-m interval have been measured biweekly or monthly for 2 years in a small meadow adjacent to the Natural Resources

Conservation Service's Joe Wright SNOTEL station near Cameron Pass, Colorado. This has enabled the investigation of temporal changes in the degree of correspondence between spatial ground and snow depth patterns. For changes in two-dimensional space, LiDAR and point snow depth measurements from the NASA Cold Land Process Experiment for March-April 2003 at Walton Creek near Rabbit Ears Pass, Colorado were analyzed. Each ground, snow surface, and snow depth dataset was detrended yielding a linear or planar best fit slope of zero. The spatial structure of the three datasets was compared for each site using roughness indices and fractal analysis – fractal dimension and correlation length. Temporally, the patterns were similar. Decoupled behaviour between ground surface and snow surface was identified by the large difference at certain spatial and temporal scales.

G09-1B2.4 **11:15**

Electromagnetic imaging of gold mine tailings in Nopiming Provincial Park, Manitoba, Canada

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Electromagnetic surveys using EM38, EM31, EM34 and TEM instruments have been done at the Central Manitoba, Ogama-Rockland, and Gunnar gold mine-tailings in Nopiming Provincial Park, Manitoba, Canada. The objectives of the surveys were to map the thickness and electrical conductivity of the tailings; to map variations in pore-water salinity; and to compare the geophysical responses of different tailings. The EM data have been modelled using methods including 2-D and 3-D regularized inversion based on a quadratic programming and integral equation approach. Results show that the electrical conductivity variations between different tailings piles and within individual tailings reflect variations in the tailings and pore water chemistry. The results for the Central Manitoba tailings delineate several zones of high conductivity that are interpreted to be due to acid mine drainage.

S04-4B3.5 **11:30**

Application and validation of a snow energy-balance model at two midlatitude alpine sites

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This work presents the new version of the snow module of the hydrological model GEOtop. The snow module describes the time evolution of a snow cover, several snow properties (like snow density, water content), the energy fluxes exchanged with the atmosphere, and the snowmelt runoff. The main characteristics of such snow module are a multilayer discretization of the snowpack and a fully coupled representation of the snow energy and water budgets, which allow the description of several snowmelt processes, like liquid water production, percolation, refreezing and retention within the snowpack. The model is applied at two midlatitude alpine sites, where measurements of snow depth and of the energy fluxes exchanged with the atmosphere were available, in order to test the performance of the model, to discuss its limitations, and to determine the relative importance of each form of energy transfer in the energy and mass balance of the snowpack. The errors in the estimation of the single surface energy balance components are also carefully analysed, expecially for the longwave atmospheric radiation and the sensible and latent heat fluxes, which are more problematic to simulate. The model shows a performance comparable to other physically-based, and more complicate, snow models.

S01-1B3.7 **12:00**

Contribution of glacier melt to river runoff of alpine catchments under extreme climatic conditions

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Long term climatological observations at the high elevated observatory of Hoher Sonnblick (3106 m a.s.l.) in the Austrian Alps have shown outstanding extreme conditions in the summer of 2003. The water balance of the 'Oberer Pinzgau' catchment (~600km^2, 780 - 3666 m a.s.l., 33 km^2 glacierized) has been simulated using the distributed, HRU (hydrological response units) based water balance model PREVAH for the period from 1999 to 2005. The temporal resolution of one hour made the simulation of diurnal variations of hydrological components, influenced by snow- and icemelt processes possible. Data input of several meteorological stations in- and outside the basin has been used. Observed hourly discharge of a three years period at the catchment outlet in 'Mittersill' as well as satellite images, showing the snow distribution at different points in time were used for the model calibration. In a second three year period the model has been validated using observed runoff and satellite images. Glacier mass balance data of nearby glaciers have been taken for model cross validation. The distributed model simulated the snow accumulation during the cold season and the snow- and icemelt during ablation period. Simulation results show a high fraction of icemelt contributing to runoff in the extreme summer of 2003. The paper presents an approach for the multi validation of model results and shows possibilities for the parameter transformation to ungauged basins.

I07-3B8.3 **11:15**

Geodynamic Studies Using Spaceborne Gravimetry

C.K. Shum[1], *Yiqun Chen*[1], *Hyongki Lee*[1], *Lei Wang*[1], *Yuchan Yi*[1], *Alexander Braun*[2], *Patrick Wu*[2], *Chung-yen Kuo*[3], *Hanseng Wang*[4]

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The successful launch and operation of CHAMP in July 2000, GRACE in March 2002, and the anticipated launch of GOCE in 2007, have provided an unprecedented opportunity of spaceborne gravimetry observations of geodynamic and climate change phenomena within this Decade of the Geopotential. It has been demonstrated that the GRACE satellites, equipped with microwave intersatellite ranging system, is capable of observing coseismic deformation in the form of gravity changes. For the first time, GRACE characterized the permanent crust expansion (density change) resulting from the mega-thrust (Mw=9.2) undersea subduction Sumatra-Andaman earthquake on 24 December 2004. This talk provides a summary of the Sumatra earthquake deformation study and other potential co-seismic studies for smaller magnitude undersea earthquakes using GRACE and the planned GRACE follow-on mission. We will also present research results for other geodynamic studies including the Laurentia glacial isostatic adjustment observations and the constraint using data from GRACE, retracked satellite radar altimetry over land, GPS velocities, and using various models such as laterally varying GIA models.

I13-4B9.2 10:45

OASIS-CANADA

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Little is currently known about the chemistry in the boundary layer air over the Arctic Ocean. With changes in climate being realized in the Arctic, there is now an urgent need to understand the processes that are going on in a rapidly changing environment. Chemicals such as gaseous Hg and CO2 are known to be deposited to the surface but their ultimate fate is poorly determined. Active photochemistry in the snow and ice has been identified. Activation of halide ions from seasalt leads to the production of highly reactive halogen atoms such as Cl and Br that cause often dramatic depletion of O3 from the marine boundary layer. The project “OASIS-CANADA” (Ocean-Atmosphere-Sea Ice–Snowpack) will study these processes directly over the Arctic Ocean in several ways. Instrumented chemical buoys (“O-buoys") will be developed and deployed allowing for the first time year round measurements of atmospheric chemistry in the marine boundary layer directly over the Arctic Ocean. Specially designed Arctic sleds will be instrumented to determine in an autonomous way the flux of key chemical components (O3, Hg, CO2) to the frozen ocean surface (project OOTI - Out On The Ice). Long term data will also be collected from the two year drift expedition of the French sailboat TARA, frozen in the Arctic Ocean. Finally, two large IPY studies on Canadian territory will be joined. Participation in the Circumpolar Flaw Lead project from the Canadian research vessel “Amundsen” opens the opportunity to collaborate with researchers from different fields of expertise (biology, oceanography, computer modeling) to study the air, ice, ocean, and the life they contain as a whole. British scientists will undertake similar studies on Hudson Bay near Kuujjuarapik/Whapmagoostui, P.Q. This is a Canadian contribution to the international OASIS-IPY program (IPY#38).

G08-2B2.5 11:30

Wavelets as a regularization tool – A combined wavelet and conjugate gradient method for the inversion of geodetic integrals

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A new computational scheme using the wavelet transform is employed for the numerical inversion of the integrals involved in geodetic inverse problems. The integrals are approximated in finite multiresolution analysis subspaces and the wavelet algorithm is built using an orthogonal wavelet base function. A set of linear equations is formed in the wavelet domain and solved using the conjugate gradient method. The full solution with all equations requires large computer memory, therefore the multiresolution properties of the wavelet transform are used to divide the full solution into parts. Each part represents a level of the wavelet detail coefficients or the approximation coefficients. Global hard thresholding is used for the compression of the wavelet coefficients of the kernel. Numerical examples are given to illustrate the use of this procedure for the numerical evaluation of the inversion of the Stokes and Poisson (downward continuation) integrals. The Stokes integral was inverted successfully using the full wavelet coefficients matrix. The solution achieved an RMS error of 4.03 mGal in comparison to the reference data. The solution with the conjugate gradient method converged after 101 iterations. The global thresholding approach achieved a 93.5% compression level with 0.12 mGal loss in accuracy in comparison to the full matrix solution. The Stokes inversion solution was repeated after the addition of stationary and non-stationary noise and soft thresholding was used as to de-noise

the data. Efficient filtering of both types of noise was achieved with a 90% improvement in the inverse solutions accuracy. In the case of the Poisson integral, Tikhononv regularization was used. The conjugate gradient method converged after 28 iterations with an RMS accuracy of 5.5 mGal in comparison to the reference data.

G06-4C2.6 **15:00**

The Mexican Gravimetric Geoid: state-of-the-art and future directions

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The Mexican Gravimetric Geoid (GGM) is an ongoing effort from INEGI, the federal institution in Mexico responsible for its computation. The latest version is GGM05. The technique implemented and used for the compilation of GGM05 follows the UNB Stokes-Helmert scheme, dealing with the solution of the geodetic boundary value problem. As many as 1.4 million gravity data measurements were used to generate the GGM05. The resulting geoid provides many useful and interesting insights. The estimated accuracy of GGM05's geoidal heights is 45cm rms. This value comes from comparison against GPS/Benchmark references. Regional and systematic biases, some very high, have been detected on the central part of the country. This fact has lead to an analysis of the computation process and also the reference data. There is an attempt to guarantee the use of a reliable dataset of gravity values to calculate the GGM05, and, on the other hand, to certify the correctness of the benchmark data, some coming from observations 30 years older than the combined GPS data. Recent leveling lines suggest that some of the benchmarks are not in their original place. Vertical crustal movements can explain that. But this new information cannot be used as reference because is not yet attached to the same vertical reference. It has been recently realized that the standard deviations of geodetic heights obtained from GPS are optimistic. So, a question remains in the air: are there gravimetric data pushing the geoid model or are the vertical reference points no longer accurate enough to evaluate a geoid model? This is the fundamental question that this investigation is devoted to.

A06-2DP.5 **16:00**

Mesoscale Simulations of Polar Clouds During M-PACE

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In this study we use the NCAR Weather Research Forecast (WRF) model to study the microphysical properties of Arctic stratus clouds. Intensive ground, remote sensing, aircraft, and radiosonde measurements taken during the ARM Mixed-Phase Arctic Cloud Experiment (M-PACE) on the North Slope of Alaska are used to verify the microphysical characteristics of the model's simulation of mixed-phase clouds. We identify to what extent the model is able to simulate: the maintenance of liquid water in clouds at low temperatures, the role of ice nuclei concentrations in glaciating Arctic clouds, vertical air motions within the clouds, and the direct and indirect radiation effects of aerosols. A double moment cloud scheme is compared to a simpler cloud scheme to identify whether a more realistic treatment of liquid water in clouds allows for a better representation of the Arctic boundary layer. By using a fine-mesh grid spacing of 3 km, the spatial characteristics of these fields are examined to show the role of the Arctic coastline in the Barrow region for producing spatial variability in the clouds and in the surface effects of clouds.

I15-2B9.7 **12:15**

The equilibrium bio-climate of CCCma's coupled climate-carbon model

Gregory Flato[1], *Vivek Arora*[1], *George Boer*[1], *Jim Christian*[1], *Charles Curry*[1], *Ken Denman*[1], *John Scinocca*[1], *Kos Zahariev*[1], *Nigel Roulet*[2]

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The preindustrial equilibrium climate of the terrestrial and oceanic biospheres simulated in the Canadian Centre for Climate Modelling and Analysis (CCCma) coupled climate-carbon model is analyzed. The Canadian Terrestrial Ecosystem Model (CTEM) treats vegetation as a dynamic component of the climate system and provides time-varying climate-dependent vegetation attributes at the land surface boundary. The Canadian Model of Ocean Carbon (CMOC) treats oceanic ecosystem processes using an NPDZ approach and includes parameterizations for iron fertilization, nitrogen fixation and calcifying phytoplankton. Simulated net primary productivities (NPP) and biomasses of the terrestrial and oceanic biospheres are compared with observation-based estimates. The simulated terrestrial global NPP is close to 60 Pg C/year, the vegetation biomass is ~560 Pg C and the soil carbon amount is ~1610 Pg C. Simulated oceanic primary production is ~35 Pg C/year and the export production from the surface ocean ~15 Pg C/year. In the coupled climate-carbon framework, the terrestrial and oceanic ecosystem components simulate the surface-atmosphere exchange of CO2 and the atmospheric CO2 concentration is determined prognostically by treating CO2 as a passive tracer. The concentrations of other greenhouse gases including CH4 and N2O are specified at year 1850 levels. The simulated atmospheric CO2 concentration varies around 288 ppm and shows very little drift at the millennial time scale. These preindustrial equilibrium bio-states of the terrestrial and oceanic biospheres provide suitable initial conditions for transient climate change runs.

O03-3C1.4 **14:15**

A Demonstrative System for Real-time Tsunami Simulations

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A demonstrative system for real-time tsunami simulation will be presented. There is no such system elsewhere yet. This is because all previous attempts have focused either on running a model on the fly or on limited-source Green's functions. Even with a supercomputer and massively parallel computations, it would be very difficult to run a model on the fly in a vast transoceanic domain and yet still win the race for time against a fast moving tsunami. The limited source Green's function approach can provide results very quickly, but unfortunately only for cases in which a tsunami originates within one of a few pre-assumed source regions.

The real-time simulation system to be reported here is based on a new method, referred to as the all-source Green's function method (Xu, 2007, manuscript in preparation). The method pre-calculates the fundamental response functions of a point of interest against all the sources distributed in the entire domain (hence the name all-source Green's function). When an event breaks out, the pre-calculated all-source Green's functions corresponding to the source region of the event will be loaded into RAM and multiplication with the source functions almost instantaneously gives the real response at the point

of interest. The pre-calculated all-source Greens functions are dynamically consistent with the model, and the end result is the same as if you ran the model on the fly.

I08-3DP.4 **16:00**

Variability of autumn cloud cover over the Arctic Ocean and its links to changes in sea ice.

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Clouds have a role in the exchange of heat between the atmosphere and the ice-ocean system. During autumn, when much of the heat gained by the ocean during the summer is lost to the atmosphere, the role of clouds may be particularly relevant. Changes in cloud cover are potentially linked to changes in sea ice though the nature of this relationship is far from clear. In this paper we investigate the variability of autumn cloud cover from 1980-2002 from satellite data sets and reanalysis models and explore potential links to changes in sea ice cover and the large scale circulation.

A02-1B7.1 **10:30**

An overview of recent developments of the GEM-LAM 2.5 km model

Jocelyn Mailhot[1], *Amin Erfani*[2], *Barbara Casati*[1], *Bertrand Denis*[1], *Michel Desgagne*[1], *Claude Girard*[1], *Neil McLennan*[2], *Ron McTaggart-Cowan*[1], *Andre Methot*[2], *Jason Milbrandt*[1], *Andre Plante*[2]

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This presentation will provide an overview of some recent developments of the Limited-Area version of the GEM model (GEM-LAM) run experimentally at CMC since summer of 2005 (2 windows at 2.5-km resolution), in collaboration with the National Laboratories and Regional Storm Centres, and will introduce several related papers to be presented at the Congress. The talk will describe current research and development works (more detailed cloud microphysics scheme, improved numerical accuracy and computer performance of the LAM, …) and will highlight some challenges of high-resolution modeling (data assimilation, objective and subjective verifications of weather elements and precipitation, …). Specific issues related to optimal configuration for high-resolution forecasting and operational strategy for the future will be addressed. An overview of applications to upcoming projects (such as IPY, MAP D-PHASE, UNSTABLE, and the Vancouver 2010 Olympics) will also be presented.

S02-2DP.6 **16:00**

Improvement of EOS satellites data-based snow mapping through synergy of visible/infrared and microwave products.

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Two products generated from observations of NASA's Earth Observing System (EOS) satellites Terra and Aqua provide information on the snow cover. Maps of snow cover distribution are produced using

Moderate Resolution Imaging Spectroradiometer (MODIS) data in the visible and infrared. Snow water equivalent is derived from observations in the microwave spectral band of Advanced Microwave Scanning Radiometer - EOS (AMSR-E) onboard Aqua satellite. Because of physical limitations inherent to both techniques, the products are not free from shortcomings. MODIS-based snow cover maps have gaps in the area coverage due to clouds, whereas AMSR-E has problems in identifying shallow and melting snow and tends to misinterpret mixed land-water scenes as snow-covered. These shortcomings reduce the value of the snow products and complicate their use in numerical weather prediction, hydrological models, climatology and in other environmental numerical applications.

In this study we developed a simple technique that combines EOS snow products to generate continuous snow cover maps on a daily basis. The idea was to make maximum use of accurate MODIS-based snow identification under clear-sky conditions and all-weather snow monitoring capabilities of AMSR-E. The algorithm utilizes a recurrent approach where the previous day snow cover map is used as a first guess for the next day snow map. This map is complemented with the current-day information on the snow cover distribution obtained from the clear-sky portion of MODIS imagery. Snow cover estimates from both MODIS Terra and MODIS Aqua are used. At the next step microwave retrievals of snow cover are incorporated over cloud-obscured areas and over areas where MODIS snow retrievals were not possible due to the lack of daylight. A series of tests has been developed to reduce the amount of snow identification errors in the two snow products.

In the presentation we will discuss the performance of the algorithm during 2005-2006 and 2006-2007 winter seasons. The accuracy of the new snow cover product will be assessed through its comparison with NOAA interactive snow cover analysis and with surface observation data both in Eurasia and North America.

S01-3DP.1 **16:00**

The Eastern Snow Conference and the Atlantic Provinces, especially the Province of Newfoundland and Labrador

Miles Ecclestone, *Peter Adams*

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This the first time the Eastern Snow Conference (ESC) has met in the Province of Newfoundland and Labrador. However the ESC founded in 1939, first Proceedings published in 1952, has a long association with all the Atlantic Provinces of Canada, Prince Edward Island, Nova Scotia, New Brunswick and Newfoundland and Labrador. This association includes members, Presidents and sponsors of the ESC drawn from those Provinces and published papers using data from them, often by researchers from there. This paper summarizes the history of the ESC with a focus on Newfoundland and Labrador.

G09-1B2.8 **12:15**

Morphosedimentology of submarine canyons and fans in the Les Escoumins area, lower St. Lawrence estuary (Québec)

Hubert Gagné[1], *Patrick Lajeunesse*[1], *Guillaume St-Onge*[2], *Andrée Bolduc*[3]

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Multibeam sonar data, acoustic subbottom profiles and two boxcores were used to reconstruct the formation of submarine canyons and fans near Les Escoumins, in the lower St. Lawrence Estuary. The multibeam data were used to generate a high-resolution Digital Terrain Model that shows the presence of a large number of canyons and fans along the northern slopes of the Laurentian Channel. This paper focuses on two of the larger canyons and their associate submarine fans. The chirp profiles recorded on the fans show high amplitude reflectors located at the sediment/water interface and near surface, indicating the occurrence of layers of coarse material. Box cores 76BC (44cm) and 77BC (26cm) were sampled in 2006 onboard the R/V Coriolis II. These cores were run through a Multi Sensor Core Logger (MSCL) for the determination of density, porosity and magnetic susceptibility, as well as through a CAT-Scan for the identification of sedimentary structures and the extraction of CT numbers. Color reflectance measurements were also performed on the split cores using a hand-held spectrophotometer, whereas grain size analyses were realized with a Coulter Counter laser sizer at 1 cm intervals. The grain size data reveal poorly sorted sandy to muddy sands with the possible occurrence of several turbidites. ^{210}Pb measurements are currently underway and should help determine recent sedimentation rates and the modern activity of these canyons and fans. Finally, the combination of the geophysical and sedimentological data suggests that the canyons and fans may have been constructed by the sediment delivery to the bottom of the Laurentian Channel from the eroding coastline and the nearby river deltas of the Les Escoumins and the Portneuf rivers, where sandy sediments were transported by the east-west longshore drift, trapped head of the canyons during their transit and then transported downslope by turbidity currents.

I01-1C8.1 **13:30**

Tropical-Extratropical Interactions, Air-Sea Feedback and the Pacific Decadal Oscillation

Michael Alexander

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Pronounced decadal fluctuations occurred over the North Pacific during the 20th century, which Mantua et al. (1997) termed the Pacific Decadal Oscillation (PDO) based on transitions between relatively stable states of the dominant pattern of North Pacific sea surface temperature (SST) anomalies. The decadal SST transitions were accompa¬nied by widespread changes in the physical and biological state of the North Pacific Ocean and in the atmosphere and ecosystems downstream over the adjacent continents.

Here we explore the processes that impact the PDO, including: i) stochastic atmospheric variability, e.g. random fluctuations of the Aleutian Low; ii) extratropical ocean dynamics with/without feedback on the atmosphere and iii) atmospheric signal originating in the tropics; e.g. ENSO and lower-frequency changes in the Indo-Pacific basin. Based on our understanding of these mechanisms we will examine the predictability of the PDO on interannual to decadal time scales. Finally, we will investigate the extent to which PDO-related SSTs influence climate variability.

O01-2B1.6 **11:45**

The impact of reemerging sea surface temperature anomalies on the North Atlantic climate system

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Extratropical sea surface temperatures (SSTs) are influenced by the "reemergence mechanism" , where thermal anomalies in the deep winter mixed layer persist at depth through summer and are re-entrained into the mixed layer in the following winter. The reemergence mechanism has been shown to occur over much of the North Pacific and Atlantic and has a significant impact on the winter-to-winter persistence of SST anomalies. Here we explore the impact of reemergence in the North Atlantic Ocean upon the climate system using an atmospheric general circulation model coupled to a mixed layer ocean/thermodynamic ice model. The dominant pattern of thermal anomalies below the mixed layer in summer in a 150-year control integration is associated with the North Atlantic SST tripole forced by the North Atlantic Oscillation (NAO) in the previous winter. To isolate the reemerging signal, two additional 60-member ensemble experiments were conducted, where temperature anomalies below 40 m are added to or subtracted from the control integration. The reemerging signal, given by the mean difference between these two experiments, causes the SST anomaly tripole to recur, beginning in fall, amplifying through January and persisting through the following spring. The atmospheric response to these anomalies resembles the circulation that created them in the previous winter, enhancing the winter-to-winter persistence of the NAO. Changes in the transient eddies and their interaction with the mean flow contribute to the response, which can also be thought of the change in occurrence of intrinsic weather regimes.

O01-2B1.4 **11:15**

Simulation of interannual variability of the North Atlantic Ocean.

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The variability of the North Atlantic Ocean is simulated using an ocean general circulation model (OGCM) with 1/3 degree horizontal resolution. The model is forced by NCEP reanalysis surface fluxes for the period 1991 to 2004. Spectral nudging (Thompson et al., 2006, Ocean Modelling) is used to reduce model bias and drift at large time and spatial scales. The variability of seasonal mean model fields driven by the interannual variability in the surface forcing is analyzed. Momentum and energy budgets, including the contributions from eddy variability, are presented and the effect of the assimilation of seasonal mean climatologies of temperature and salinities (through spectral nudging) is analyzed.

I09-3C9.1 **INVITED/INVITÉ 13:30**

Geodesy and Meteorology: Synergy, Serendipity and Reciprocity

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It has long been recognized that the refractivity of the Earth’s non-dispersive atmosphere introduces delays in the propagation of radio waves, and that these delays can introduce significant errors in estimating position using space geodetic techniques. Treating the neutral atmosphere as a nuisance parameter and removing the signal delays caused by variations in temperature, pressure and water vapor was an innovative and masterful approach to a very difficult problem. The recognition that most of the variability in the neutral delay comes from water vapor in the troposphere led to proposals that GPS receivers could be used for atmospheric remote sensing with applications in weather forecasting and climate monitoring. From the time of the first practical demonstration of ground-based GPS meteorology, it took almost 10 years to demonstrate to the operational meteorological community

what many geodesists intuitively grasped: that an improved ability to monitor total column water vapor in the free atmosphere would lead to improvements in weather forecast accuracy. It is interesting therefore to encounter resistance from the geodetic community when it is suggested that refractivity information provided by sufficiently accurate weather models can improve the accuracy of space geodetic techniques such as GPS. In this context I am talking about providing real-time constraints on the ionospheric and tropospheric components of the GPS error budget. The ability to do this with varying degrees of success has been demonstrated by Ahn et al 2006, Bisnath and Dodd 2005, Remondi (personal communication) and most recently Bock (personal communication). Since the ability to resolve double difference integer ambiguities is a practical limitation on GPS positioning accuracy, we will explore the question “what are the levels of accuracy required from atmospheric models such as NOAATrop and USTEC to accomplish this goal in real or near-real time?” The remainder of my talk will focus on a some unanticipated applications of GPS Meteorology that hold great promise for environmental agencies such as NOAA.

I09-3C9.7 **15:15**

Intercomparison of integrated precipitable water vapour estimates made by radiosondes, GPS and NWP in southern Alberta

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The Alberta GPS Atmospheric Moisture Evaluation (A-GAME) project consisted of two intensive field campaigns during the summers of 2003 and 2004. The primary objective of the project was to validate GPS derived estimates of integrated precipitable water vapour (IPWV) by using conventional radiosonde measurements. More than 80 intercomparison measurements were made during the two validation campaigns at 3 co-located GPS-Radiosonde locations. Correlations between GPS and radiosonde estimates were high with r^2 ranging from 0.83 to 0.91 and the rmse varying from 1.2 to 2.0 mm. These relatively high correlations provide justification for the use of GPS derived IPWV for assessing numerical weather predication output of IPWV from Environment Canada’s Global Environmental Multiscale (GEM) model. Intercomparisons between GEM and GPS IPWV are shown for up to 12 locations in the southern Alberta GPS network. The relative differences between GPS and GEM IPWV are sub-divided based on forecast time (from the 0-hour analysis to the 12-hour prognosis) and for storm and non-storm case studies.

O02-2DP.4 **16:00**

Approximate Boltzmann Integral for Operational Ocean Wave Forecasts

Adhi Susilo[1], *William Perrie*[2]

(Presented by *Adhi Susilo*)
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A fast accurate computation of nonlinear wave-wave interactions is important for operational ocean wave modelling. We present a new formulation for wave-wave interactions in this study, and compare results with the so-called Discrete Interaction Approximation (DIA), which is the centre of all modern wave models, such as WAM, WaveWatch and SWAN. Comparisons also include modern versions of the highly accurate computational formulation by Tracy and Resio (1982), and Webb (1978) based on a polar grid with geometrical spaced radii. Although the latter approach also reduces the

computational time, compared to original near-exact calculations by Hasselmann and Hasselmann (1981), this method is also not practical because of the huge number of computations required to account for the entire wave spectrum.

Our new computational method uses the idea of computing the dominant nonlinear wave-wave transfer along the directional bins and applies the Newton-Cotes method to find the integral along loci of resonance for the most important wave-wave interactions. Our method is denoted the Advanced Dominant Interactions (AvDI). By taking account of the dominant transfer along dominant wavenumbers and angles of interactions and approximating integral along the loci of wave-wave interactions resonance, the AvDI method can reduce the required computation time sufficiently that it can be implemented for practical wave modelling. In preliminary tests, AvDI is about 35 times slower than DIA, and more than 135 times faster than the Tracy and Resio (1982) formulation.

AvDI is implemented into the state-of-the-art operational wave forecast model, WAVEWATCHIII, and tested extensively for a real storm, hurricane Juan which made landfall in Nova Scotia in 2003 as a category 2 hurricane. In comparisons with the standard DIA wave-wave formulation in WAVEWATCHIII, we show that AVDI is quite competitive, achieving good results in comparison with observed wave data from 2 nondirectional buoys, moored on the continental shelf off Nova Scotia, and 1 directional buoy, moored off Lunenburg Bay.

Keywords: wind waves, nonlinear interactions, quadruplets, dominant transfer, scaling factor, hurricane Juan, real storm comparisons.

C01-2B6.1 **10:30**

Atmospheric Circulation Response to Projected Future Changes in Arctic Sea Ice:Results for a seasonally ice-free Arctic

Clara Deser

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A seasonally ice-free Arctic is projected to occur by the middle of the 21st century in the NCAR Community Climate System Model under the A1B scenario of greenhouse gas emissions. How does the atmospheric circulation respond to these sea ice concentration changes? To answer this question, we have conducted a set of integrations with the atmospheric model component of CCSM3 forced by the projectedfuture changes in Arctic sea ice concentration. The seasonal cycle of the atmospheric circulation response and associated temperature, precipitation, and surface radiative changes, will be presented and discussed.

I08-3DP.5 **16:00**

The Transient Atmospheric Circulation Response to Arctic Sea Ice Anomalies

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The objective of this study is to investigate the transient evolution of the wintertime atmospheric circulation response to imposed patterns of SST and sea ice extent anomalies in the North Atlantic sector using a large ensemble of experiments with the NCAR Community Climate Model Version 3 (CCM3). The initial adjustment of the atmospheric circulation is characterized by an out-of-phase

relationship between geopotential height anomalies in the lower and upper troposphere localized to the vicinity ofthe forcing. This initial baroclinic response reaches maximum amplitude in 5 - 10 days, and persists for 2 - 3 weeks. Diagnostic results with a linear primitive equation model indicate that this initial response is forced by diabatic heating anomalies in the lower troposphere associated with surface heat flux anomalies generated by the imposed thermal forcing. Following the initial baroclinic stage of adjustment, the response becomes progressively more barotropic and increases in both spatial extent and magnitude. The equilibrium stage of adjustment is reached in 2 - 2.5 months, and is characterized by an equivalent barotropic structure that resembles the hemispheric NAO/NAM pattern, the model~Rs leading internal mode of circulation variability over the northern hemisphere. The maximum amplitude of the equilibrium response is approximately 2-3 times larger than that of the initial response. The equilibrium response is maintained primarily by non-linear transient eddy fluxes of vorticity (and, to a lesser extent, heat), with diabatic heating making a limited contribution in the vicinity of the forcing.

I15-2C9.7 **15:30**

Biogeochemical hot spots: How do they apply to mercury cycling in peatlands?

Carl Mitchell[1], *Brian Branfireun*[2], *Randall Kolka*[3]

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Biogeochemical hot spots are discrete areas showing disproportionately high rates of biogeochemical activity. Previous research has shown that the convergence of multiple hydrological flowpaths carrying limiting reactants to a particular biogeochemical process is imperative to the formation of a hot spot. No research has yet formally characterized biogeochemical hot spots with respect to mercury cycling and in particular, methylmercury (MeHg) production. The production of MeHg is of particular interest because it is a potent neurotoxin known to accumulate in aquatic organisms and biomagnify in aquatic food chains. With specific attention paid to peatland environments, we thus sought to determine whether biogeochemical hot spots of MeHg production exist, where they exist, how large they are, and what hydrological and geochemical factors control their formation. A MeHg hot spot was defined as a zone where the pore water %-MeHg (the proportion of total mercury as MeHg) exceeded the 90th percentile of the survey data set. In this study, this corresponded to samples with %-MeHg exceeding 22%. Hot spots occurred at or near the upland-peatland interface and were related to fluxes of sulphate, organic carbon, and more neutral-pH water from the surrounding uplands. MeHg hot spots were approximately 3 m wide. This information provides a more accurate means of assessing MeHg production in peatlands and points to important watershed hydrological controls. Watershed disturbances that augment upland runoff, such as forest clearing, may both intensify the occurrence of MeHg hot spots and the export of MeHg to susceptible downstream ecosystems.

H01-2DP.18 **16:00**

Soil Trafficability Assessment in the Morris area, Manitoba

Aston Chipanshi[1], *R.T. Warren*[1], *J. Fitzmaurice*[2], *A.J. Nadler*[3]

(Presented by *Richard Warren*)
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Following the Manitoba spring floods of 2006, which submerged some of the productive agricultural land in southern Manitoba, a soil trafficability study (an investigation of when agricultural fields are dry enough to be worked by farmers) was initiated. The study took place round the town of Morris in the Red River valley of Manitoba. Three methods were used to determine the onset of trafficability for farming purposes; a modelling procedure using the Versatile Soil Moisture Budget via the National Drought Model, direct measurements of soil moisture to a depth of 5cm using a theta probe and weekly interviews with farmers. The field survey suggested the arrival of adequate soil trafficability was around May 18, when the measured soil moisture was approximately 35% volumetric moisture content; this date corresponded to a modelled value of approximately 70% of field capacity in the first 30 cm of the soil. Results from measurements, modelling and surveys, though limited in sample size, imply that defining soil trafficability using a standardized soil moisture threshold, e.g. 90% of field capacity, may not be applicable on all soil types. The physical realities of agricultural soils are such that variability within short distances could result in varied physical definitions of a soil trafficability threshold for farming purposes. Management considerations regarding the onset of the growing season (due to heat or frost) may also interact with trafficability in complex ways to induce or delay seeding.

A02-1C7.1 13:30

Impacts of North Atlantic extratropical hurricanes on the upper ocean

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This study explores the relations between the characteristics of the air-sea interactions and extratropical storm development in the North Atlantic during the autumn. Simulations were performed with a relatively fine resolution coupled atmosphere-ocean model. The coupled model consists of the Canadian Mesoscale Compressible Community (MC2) atmospheric model coupled to a recent version of the Princeton Ocean model (POM). Boundary conditions for simulations of autumn storms are given by simulations of the Canadian Climate Centre model, CGCM2 (Second Generation Coupled Global Climate Model), following the IPCC IS92a scenario conditions. The CGCM2 control conditions were obtained from years 1975-1994. We show that interactions between extratropical storms and the upper ocean are effected by strong storm-induced turbulent mixing in the upper ocean and entrainment of underlying cold water into the ocean mixed layer, and related latent and sensible heat fluxes across the air-sea interface. Three types of numerical storm experiments are conducted, corresponding to storms that (i) make landfall, (ii) move along the coastline without making landfall, and (iii) remain over the open ocean. Results suggest that the maximum storm-induced sea surface temperature cooling is dominated by characteristics of the thermostructure of the ocean temperature, the mixed layer depth, the thickness of the underlying cold water, the temperature gradient between the mixed layer and the themocline layer, the storm's intensity in terms of maximum surface level wind speed (10 m height, U10), and the relation of storm tracks to the Gulf Stream and the low level subtropical high system. The upper ocean can reduce storm intensity by as much as 4-5 hPa in the minimum sea level pressure (MSLP), or about 1-2 ms-1 in surface winds. The ocean impacts on the atmosphere differ for differing storm tracks, and although most notable in the lower atmospheric boundary layer, also extend to the top of the troposphere.

O01-2DP.3 16:00

Interannual variability of the Labrador Sea sea surface temperature

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The focus of the present study is the variability of the sea surface temperature of the Labrador Sea and its relation to atmospheric forcing. We use SST and atmospheric reanalysis for the recent 50 years. The major modes of variability in SST and atmospheric data are identified and their long term variability is analyzed. The potential impact of these modes on the Labrador Sea dynamics is discussed.

A07-2C7.4 **15:15**

Multi-Decadal Observations from the Environment Canada Dr. Neil Trivett Global Atmosphere Watch Observatory – Alert, Nunavut

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On July 7th, 1975 the first greenhouse gas measurement was made at Alert, Nunavut. Last summer it celebrated the 20th anniversary of joining the WMO Global Atmosphere Watch program as one of the premier remote sites. This site supports both a research and an operational monitoring program being part of WMO's Global Observing System and hence a key element of the Global Climate Observing System (GCOS). The continuous atmospheric chemistry monitoring of background concentrations of trace gases and aerosols at Alert for thirty years has resulted in the publication of close to 500 scientific papers between 1984 into 2006. This body of scientific knowledge has improved understanding of how the atmosphere interacts with the oceans and biosphere, enabled improved prediction of the states of the earth-atmosphere system in the context of global change, improved estimates of northern hemispheric natural and anthropogenic CO2 and CH4 emissions, and other issues including the long range transport of air toxics and mercury. The large suite of measurements at Alert includes greenhouse gases and isotopes, aerosols (physical and chemical properties), ground-level ozone, peroxyacetyl nitrate, volatile organic compounds, bromine oxide, CFCs, persistent toxic substances, mercury, total column O3 and SO2, solar radiation, and many international collaborations. It is also one of three GAW super sites for GHG flask intercomparisons. A few results from the long term measurements coupled with major intensive field campaigns are improved characterization of Arctic Haze and identification of major contributing source regions, the causes and processes related to springtime ozone and mercury depletion, confirmation of the presence and potential risk of flame retardant and stain repellant chemicals, and improved estimates of northern wetland methane emissions. The Alert GAW data records and measurement activities provide an ongoing baseline understanding of atmospheric chemical composition and change against which special studies, including IPY, are put in context.

I08-3C7.4 **INVITED/INVITÉ 14:30**

Arctic Ocean – Sea Ice – Atmosphere Interactions: 1979-2004 Model Results

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The decreasing Arctic sea ice cover, through positive ice-albedo feedback, may lead to further warming of the upper ocean and lower atmosphere, further reductions of sea ice, and increased

freshwater export into the convective regions of the sub-polar North Atlantic. Such changes have major consequences to the global ocean thermohaline circulation, the long term global ocean heat and salt transports, and climate. However, details of sea ice variability, its causes and effects are not fully understood and require improved knowledge of interactions and feedbacks in Arctic and global climate system.

We use a high resolution coupled ice-ocean model of the Pan-Arctic region forced with realistic interannual atmospheric data to investigate variability of the Arctic sea ice cover and associated forcing and/or response of the ocean and atmosphere. Our model results, validated against observations, suggest that the rate of melt represented by sea ice thickness and volume might be faster than that of ice extent/concentration as determined from satellite data. We argue that the recent decrease of sea ice cover might be in part a result of thermodynamic interactions at the ice-ocean interface due to increased advection of warm Atlantic and summer Pacific waters into the Arctic Ocean. The decrease of the total sea ice volume and the subsequent increase of freshwater content translate into the increased total freshwater export into the North Atlantic. We will discuss the importance of ocean and sea ice feedbacks to the atmosphere and the need for their improved representation in climate model predictions.

H01-2DP.3 **16:00**

Determination of solute transport properties through peat soils: laboratory experiments

Timothy P. Duval, J. Michael Waddington

(Presented by *Timothy Duval*)
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Hydraulic properties of peat soils are variable in space and time, and are significantly influenced by the methods employed in their estimation. Review of the literature indicates that attempts to quantify properties such as hydraulic conductivity, effective porosity, dispersivity, and retardation, through tracer injections in laboratory columns and field-scale plots employ variable methodologies, each with limitations. The present study examines transport of applied solute through peat columns under realistic field conditions. Step injections were applied under a range of vertical hydraulic gradients. Bromide salt tracer was applied in concentrations ten times background levels, not the 100 to 1000 times used in previous experiments. This resulted in a much reduced flocculation caused by coiling of organic molecules in reaction with the tracer, which in turn limited pore dilation. The lower solute concentration also minimized transport retardation via diffusion into inactive pore spaces due to the reduced concentration gradient. These effects were still encountered however, confirming that peat is a dual porosity medium even under natural ionic concentrations. Peat cores extracted in the horizontal direction were also subjected to tracer tests by pivoting the cores 90o in the lab. This study also investigated the use of alternative methods of solute migration in peat cores, including direct millivolt readings and TDR-determined electrical conductivity. These techniques encountered the same problems as traditional methods, but may be more amenable to field deployment.

G04-2C2.2 **14:15**

Origin of hematite in the late Neoproterozoic carbonates of the Johnny Formation, Death Valley, and its paleomagnetic implications.

Joseph Hodych

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Gillette and Van Alstine (1982) showed that hematite in the carbonate-rich uppermost Johnnie Formation near Death Valley carries a remanence that is likely primary (since its reversal pattern is stratigraphically-linked). They suggested that the remanence might be detrital, carried by the ~10 micron hematite grains that constitute ~1% of these rocks. The carbonates include unusual sea-floor precipitates that were originally aragonite fans and are associated with abundant hematite grains. Corsetti et al. (2004) suggested that the fans and their associated hematite grains were both precipitated on the sea-floor as deep anoxic water mixed with surface oxygenated water. Analyzing with a scanning electron microscope, I find that about half the hematite grains associated with the fans contain significant titanium or titanium-rich intergrowths and are therefore unlikely to be sea-floor precipitates. This supports the suggestion that the carbonates carry a primary detrital remanence. It would be advisable to measure the remanence anisotropy of the carbonates to test for the paleomagnetic inclination shallowing to which detrital remanence is susceptible.

I05-3DP.5 **16:00**

Validation and Application of a Single Column Coupled Atmosphere-Ocean-Biogeochemical Model for DMS

Samira Ben Said[1], *Jean-Pierre Blanchet*[1], *Yvonnick LeClainche*[2], *Maurice Levasseur*[2], *Nadja Steiner*[3]

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We have developed a 1-D coupled atmosphere-ocean-biogeochemical model linking a single column version of NARCM (Northern Aerosol Regional Climate Model) to the dimethylsulfide (DMS) production model NODEM (Northern Oceans DMS Emission Model) through the water column ocean model GOTM (General Ocean Turbulence Model). Driven by instantaneous fluxes simulated by atmospheric model after receiving sea surface temperature from the ocean model, the biogeochemical model simulates physicochemical processes responsible for the production, the accumulation and the ventilation of DMS into the atmosphere. Using the same set of biogeochemical parameters as the previous versions NODEM-GOTM (Le Clainche et al., 2004) and NODEM (Lefèvre et al.,2002), the new version NODEM-GOTM-LCM have improved over all simulations of DMS(P) against observations for the seasonal cycles of 1992 at Hydrostation S in the Sargasso sea. In Particular, the timing of local events has improved. Compared to NODEM-GOTM, the new version (NODEM-GOTM-LCM) show a better monthly correlation of DMS(P)at the surface against observation data.

A04-4D6.6 **17:15**

Development of SAR-Derived Winds for Forecast Operations at the Pacific Storm Prediction Centre

Laurie Neil[1], *Ron Saper*[2], *Paris Vachon*[3], *Owen Lange*[4]

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In a collaborative project involving the Meteorological Service of Canada (MSC) and Ottawa-based Vantage Point International (VPI), SAR-derived wind products are being generated and utilized in near real-time for use by marine forecasters at the Pacific Storm Prediction Centre in Vancouver. Funded in large part by the Canadian Space Agency, the MENTOR (Marine ENvironmental moniTORing) project utilizes the SAR and software engineering expertise of VPI, monitoring and modelling capabilities within MSC, as well as the meteorological and local area knowledge of prediction centre forecasters. The objective is to assess the utility of this imagery, and if appropriate establish an in-house capability for MSC to generate, manage, and display these products rapidly for operational use. This presentation describes some milestones as well as the present status of the project, and shows examples of wind images obtained to date. It also touches on the importance of training for operational users, the different purposes for which the data can be used, and the need for a continued supply of high-volume and affordable SAR data over the west coast and elsewhere for various marine applications. Further research needed to address limitations of this dataset will also be outlined.

S02-2C3.8 **15:45**

How well can we map changes in small tropical glaciers from satellites?

Andrew Klein, *Joni Kincaid*, *Kevin Merritt*

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Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and Landsat Enhanced Thematic Mapper (ETM+) images were acquired over the small remaining glaciers on Mt. Jaya, Irian Jaya, Indonesia on May, 29 2003. These two contemporaneous images are used to examine how comparable are the glacier extents mapped from these two instruments. A number of supervised and unsupervised image classification techniques and the Normalized Difference Snow Index (NDSI) were used to map glacier extents. All approaches were found to be in good agreement, with overall accuracies, as compared to visual mapping of the glaciers on an ASTER color composite, typically exceeding 90%. Spectral mixture analysis was also used to estimate the fraction of snow and ice at the subpixel level. The estimated snow and ice fractions from Landsat and ASTER were found to be quite comparable. The developed mapping techniques were used to examine the retreat of the remaining glaciers in the Rwenzori Mountains of Uganda. Our estimates of glacier size from spectral mixture analysis are compared with two other recent recently published satellite estimates of the size of these glaciers.

C01-2B6.5 **11:30**

Acceleration of Summer Sea Ice Reduction in the 21st Century: Projection by the IPCC AR4 Climate Models

Xiangdong Zhang

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Arctic sea ice is a contributing and responding component to global climate change, which impact global energy balance and may amplify global warming signal. Export of Arctic sea ice through Fram Strait and the Canadian Archipelago may also weaken the North Atlantic deep convection and have significant implications for multidecadal climate variability and abrupt climate change event. The recent IPCC AR4 climate models provide comprehensive simulations of various aspects of the Arctic sea ice. In these models, sea ice dynamics and thermodynamics were generally much improved with various complexities, compared with their previous versions. Although we have gained some credibility in projections of the Arctic sea ice changes in the 21st century through multi-model ensemble mean approach, our analysis, as a contribution to the Working Group 1 of the IPCC AR4, still show a large diversity across-models and arcos-mode-ensemble-members. Obvious systematic

biases, for example the overestimated sea ice coverage over the Barents Sea, exist in many models. Physical mechanisms behind the projected changes still have not been fully understood. In this study, we aim to gain a deep insight into the model's credibility and systematic biases in the simulations of the Arctic sea ice through analyzing climate state and changes of each category of sea ice and by comparing model simulations with the updated satellite sea ice data up to 2006. We also diagnosed thermodynamic and dynamic processes associated with sea ice changes in the climate model projections. The results would provide useful information for model improvements and for improving understanding of the projected Arctic sea ice change under the greenhouse emissions forcing.

S04-4C3.2 **13:45**

Hybrid modelling of two-phase avalanches and related phenomena – a turbulent dense flow approach

Gerhard Kapeller, Peter Rutschmann, Stefan Walder

(Presented by *Gerhard Kapeller*)
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The current paper describes the investigation on the efficiency of two avalanche breakers, namely a retaining dam and a coarse grid rack, on a fast dense or turbulent dense flow avalanche. The investigation was in a first step performed in a physical model based on the Froude similarity. The avalanche was generated phenomenologically similar to a prototype avalanche using a two-phase approach. Traditional avalanche simulations are used for large areas and therefore seem not to be able to resolve the turbulent and complex flow pattern in the vicinity of the avalanche breakers. Therefore a physical model was chosen for first tests. The results of the physical experiments helped to verify and improve the efficiency of the breakers. The investigation showed that the deceleration of the avalanche was higher with the coarse grid rack than with the full dam. In a second step 3D numerical simulations were performed with Flow-3D© and compared with results from the physical experiments. Two differing approaches were used namely a continuum simulation using a Bingham or Herschel-Bulkley fluid and a particle simulation. Simulations with both continuum approaches showed unsatisfactory agreement with experiments. The results showed that such simulations are not able to reproduce the dynamics of a turbulent avalanche. They seem only suitable for dense flow avalanches or mud flows. The particle approach using a Lagrangian description of the particles on a fixed Eulerian grid resulted in excellent agreement with experiments. In the particle approach a full coupling of fluid and particles, i.e. particle motion influences fluid motion and vice versa, and a random initialization of the particles in the inflow section was realized. After verification and calibration with the experiments the software can now be used to investigate the flow behaviour of 3D prototype avalanches. Thus the hybrid modelling approach overcomes the geometrical and topographic restrictions of a physical model.

H04-3B4.1 **INVITED/INVITÉ 10:30**

Land-Atmosphere Coupling and Freeze-Thaw Dynamics

Marc Stieglitz[1], FeiFei Pan[2], Jason Smerdon[3], Axel Kleidon[4]

(Presented by *Marc Stieglitz*)
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Snow seasonally covers up to 40% of the Northern Hemisphere landmass and constitutes the most prominent transient feature across continental surfaces. Further, snowmelt and the snowmelt related discharge is the single most import hydrologic event at high latitudes and provides a large fraction of annual runoff and nutrient delivery to the oceans. With respect to forecasting the timing and amount of snowmelt related discharge, the physics of snow growth and ablation, landscape scale heterogeneity, ground freeze-thaw dynamics, and land-atmosphere interactions, all need to be accounted for. However, while climate modelers employ complex models that include for such interactions –i.e., General Circulation Models, for those in the climate impact community, incorporating land-atmosphere interactions is typically not possible. This being the case, impact modelers use the output from forecast models (e.g., air temperature, precipitation) to drive their "offline" land surface models. We will show that by doing so, simulations of the timing of freeze-thaw and snowmelt related discharge lead to corrupted results. We develop a simple model that includes for land-atmosphere interactions, includes freeze-thaw dynamics, and is still primarily an "offline" model. The modeled is composed of three coupled PDE's and employs a time dependent diffusivity to represent freeze-thaw. The model improves the timing of freeze-thaw dynamics and enhances understanding of land-atmosphere feedbacks.

I10-1B9.1 **10:30**

Twentieth century Arctic sea ice volume variability in coupled climate models and ocean-sea ice hindcasts

Ruediger Gerdes[1], *Cornelia Koeberle*[1], *Frank Kauker*[1], *Witold Bagniewski*[2]

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Arctic sea ice volume has decreased since the mid-1960s. However, ocean-sea ice model hindcasts indicate that sea ice volume in the 1950s was almost as low as during the 1990s. On the other hand, the majority of coupled climate models produce a downward Arctic sea ice volume trend when forced with realistic conditions for the 20th century. Still, individual realizations with models that have large amplitude multi-decadal variability can have even negative sea ice volume trends over the last 50 years of the 20th century. To better distinguish long-term trends and natural multi-decadal variability, it is desirable to perform ocean-sea ice hindcasts for the entire 20th century. So far, this was prevented by the lack of atmospheric forcing data suitable for ocean-sea ice models. Recently, AWI has generated such an atmospheric forcing data for the subpolar North Atlantic and the Arctic Ocean. The reconstruction uses a statistical model connecting Arctic and sub-arctic station data and 30 years of NCAR/NCEP reanalysis data based on the redundancy analysis approach. With this forcing applied to the NAOSIM ocean-sea ice model, we find a centennial trend in Arctic sea ice volume superimposed by strong decadal and multi-decadal fluctuations. As an example how the new reconstruction in combination with ocean-sea ice simulations can be utilized, we compare the early 20th century positive NAO phase with the corresponding period from 1970 to 2000. We investigate the reason for the different reaction of Arctic sea ice to the seemingly similar atmospheric forcing during these periods.

S02-2DP.2 **16:00**

Polarview: Nordic snow monitoring service

Eirik Malnes[1], *Stein Rune Karlsen*[1], *Rune Solberg*[2], *Richard Hall*[3]

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A service for near real time snow monitoring has been established for the Nordic peninsula. An area covering Norway, Sweden and parts of Finland will be monitored daily at 250 m spatial resolution using the Terra MODIS and the Envisat ASAR sensors, to provide optimal snow cover classification in a challenging climatic region where clouds are frequent. The service aims at serving public users (hydrology, meteorology, geohazard and environment) as well as commercial hydropower companies, and will be operated in the melting period 1 April-31 July.

The multisensor and multi temporal snow cover maps are based on single sensor snow maps from SAR and optical sensors. Each data acquisition over the area are classified into snow maps and projected on a common grid. A confidence raster is also produced where the accuracy of the classification of each pixel in the snow map is represented as a confidence value between 0 and 100% depending on incidence angle, probability of clouds and wet/dry. Each single sensor product is fused to the latest multisensor product with its associated confidence image to produce an updated snow map.

G06-4C2.5 **14:45**

Notes on the Spherical Terrain Correction

yan ming Wang

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Based on Newton's gravitational law, the gravity of the Earth's topography can be represented by a 3-D integral. If the density of the topographic masses is a function of latitude and longitude only, the 3-D integral can be reduced into a 2-D surface integral of a closed-form kernel. We starting from this 2-D integral and investigate the spherical terrain correction in conjunction with the classical terrain correction derived under planar approximation. Numerically, we evaluate the spherical and the classical terrain corrections at selected sites with different topographic features inside the continental United States (CONUS), using a digital elevation model (DEM). As expected, the spherical effect is significant only when the computation areas become large. The spherical terrain correction has the following general characteristics: i. The spherical and classical terrain corrections are almost the same in the innermost zone of a 1 by 1 degree block. ii. In addition to the innermost zone, also the outer zone has a significant contribution to the spherical terrain correction. Sometimes the contribution of the outer zone is much larger than that of the innermost zone. iii. The terrain correction can be negative in some flat and oceanic areas.

Finally, we propose an efficient approach based on expanding the closed-form kernel into power series of the height differences. An further approximation is then applied to enable the application of the Fast Fourier Transform in the numerical computations. It is shown that if only the first two terms of the series are taken into account, the formal error of the computation is kept below 0.1 mGal.

It is important to point out that the spherical terrain correction gives a much more realistic terrain effect, but it can not be used directly in geoid computations is the case with the classical one. If the spherical terrain correction is to be used for geoid computations, more comprehensive procedures, such as mass condensation and gravity reductions, are involved.

A04-3C6.3 **14:00**

The Aug. 10, 2006 Avalon Heavy Rain Event

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Flooding along the Salmonier River Valley of the Avalon Peninsula due to heavy rains on Aug. 10 2006 caused road damage estimated to be as high as $150,000. Rainfalls likely exceeded 70mm in some locales within a 12 hour time period. Although initial forecasts from the Atlantic Storm Prediction Centre in Dartmouth called for 30mm of rain, amounts in subsequent forecasts were significantly reduced. The NWP guidance did not adequately handle the synoptic pattern presenting a difficult forecasting challenge to the meteorologists on duty preceding and during this event. While forecasters currently commit a considerable amount of time sifting through large quantities of data generated by NWP guidance and manipulating software used to generate forecasts there is a need to reconsider time allocations during the forecast process. More time needs to be freed up to enable the forecaster to carry out a more thorough analysis and diagnoses of real time weather observations. More time allotted to the discriminating use of observational data sets, such as radar estimated QPE products, radar QPE animation, lightning data and satellite imagery could have been very helpful to the meteorologists on duty. Other solutions to facilitate the forecast process are proposed such as a more effective means of choosing the best deterministic forecast or considering the use of forecasts that are probabilistic.

S05-1C3.8 **15:15**

Variability of Snow Cover and of Cyclonic Activity over Western Canada

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The weather and climate of Western North America is to a large extent determined by the Pacific-North American Oscillation a low frequency mode of the atmospheric circulation of the Northern hemisphere that is subject to interannual as well as intraseasonal variations. In this work the intraseasonal component of the PNA variability is examined in relation to the seasonal evolution of the cyclonic activity in the region and of the evolution of a well defined band of high values of snow water equivalent (SWE) that extends from the Great Bear lake to the west, to the western coastline of the Hudson Bay to the east. The evolution of the SWE band is documented for the extended (Oct. to March) winter season by means of satellite microwave retrievals and in situ measurements obtained in snow sampling campaigns while the progresive accumulation of precipitation along preferred paths as the winter progresses, is discussed in the light of the observed changes in the frequency, intensity and location of the cyclonic tracks. The application of a system-based approach to the analysis of the cyclonic activity gives improved estimates of its spatial and temporal variability over the high latitude sector of North America that can lead to a more accurate assessment of the impact of the atmospheric processes on the seasonal evolution of the cryospheric component.

G09-1B2.6 **11:45**

Electrical and magnetic properties of the Duport gold deposit, Ontario

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In order to help relate airborne EM and magnetic survey data from the shear-hosted Duport gold deposit in Shoal Lake, western Ontario, to geological features, ground geophysical measurements have been made using magnetometer, magnetic susceptibility, EM31 and TEM instruments. Ground magnetic survey results show a broad anomaly correlating with an anomaly in the airborne magnetic data as well as several narrow discontinuous anomalies that are not as clear in the airborne data. The magnetic data have been modelled using steeply dipping plates possessing both induced and remanent magnetization. The broad anomaly is interpreted to be due to magnetite-rich gabbroic rocks with a Koenigsberger ratio of less than 1 whereas the narrow discontinuous anomalies are interpreted to be due to pyrrhotite-rich altered basaltic rocks with a Koenigsberger ratio exceeding 1. In-phase EM31 results delineate enhanced near-surface magnetic susceptibility in the pyrrhotitic rocks and apparent susceptibility derived from the response can be compared with the magnetic models. Quadrature EM31 and TEM results indicate that the pyrrhotite-rich rocks also have significantly enhanced electrical conductivity. Examination of the correlation between assay values and magnetic susceptibility measurements made on one drill-core indicates that highest gold content occurs at the margin of the pyrrhotite and magnetite-rich rocks.

I01-1D8.8 **17:45**

Application of the EarthCARE Instrument Simulator to Validation of Aerosol-Cloud Parameterisation in Climate Models

Aleksandra Tatarevic[1], *Jean-Pierre Blanchet*[1], *Rodrigo Munoz-Alpizar*[1], *Éric Girard*[1], *Colin Jones*[1], *Sunling Gong*[2], *Tarek Ayash*[3]

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Following the APEX-E3 aircrafts campaign, the Northern Aerosol Regional Climate Model (NARCM) high resolution simulations based on the Canadian Aerosol Module (CAM) is applied for analysis of the aerosol properties and their effects on the cloud system in Eastern-Asia. This aerosol is strongly influenced by anthropogenic emissions from China and natural aerosol from Gobi desert. The model simulations capture the main features of the 3D structure, the size distribution and the composition of observed aerosols. These simulations are used as input for the Instrument Simulator (Donovan et al) and applied as a diagnostic tool to reproduce the fields of radar reflectivity and lidar backscattering. Lidar and radar simulations of modeled aerosol and clouds are compared against Mie scattering lidar and cloud radar measurements with the aim to assess the potential of validation of the atmospheric model simulation by the direct spaceborne lidar and radar measurements from CloudSat and CALIPSO.

S02-2B3.3 **11:00**

Retrieving snow grain size and specific surface area from infrared reflectance

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The specific surface area (SSA) of snow is its surface area per unit mass. This variable determines light scattering by snow and therefore strongly influences its albedo. It is also important to quantify

the air-snow exchange of contaminants adsorbed to snow surfaces. SSA is delicate to measure, the only established method being methane adsorption at 77 K, a long and tedious experiment. Because of this difficulty, snow grain size (or the equivalent sphere radius) has often been used as a proxy for SSA in many remote sensing applications. Here we present a novel method for SSA measurement based on the rapid and facile measurement of the infrared reflectance of snow in the field using an integration sphere, a laser diode and a photo diode. Field measurements can be performed in a few seconds. The data obtained during Arctic expeditions, confronted with satellite measurements, shows promising prospects for the retrieval of snow SSA, grain size and in general optical properties from satellite measurements.

S05-1D3.3 **16:30**

A few seldom considered snow-climate feedbacks

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Because of its high albedo, a strong snow-climate feedback exists due to the reduced snow cover caused by warming. However, warming will also change the conditions of snow metamorphism, and therefore snow physical properties, such as albedo and heat conductivity. Warmer conditions may enhance the rate of grain growth, further reducing albedo, and this would represent another positive feedback. Reduced depth hoar formation caused by warming will increase the heat conductivity of snow, enhance ground cooling and slow down permafrost thawing. We have performed cold room experiments where we measure the specific surface are (SSA) and heat conductivity of snow under various conditions of temperature and temperature gradient. SSA conditions light scattering and therefore albedo. The data are used to perform simple calculations under different conditions of snowpack structure and climate type, and several positive and negative feedbacks are detected. We conclude that improved snow descriptions in GCMs are mandatory for a full exploration of snow-climate feedbacks.

S04-4B3.7 **12:00**

Relationships between several snow properties: new avenues for snow physics parameterization

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Modeling the role of the snow cover for applications in the fields of climatology, atmospheric chemistry, hydrology, avalanche forecasting and ecology requires the parameterization of snow physical variables such as albedo, permeability, mechanical strength and heat conductivity. Some of these parameterizations are physically based, while some are empirical. From physical considerations, some snow physical properties can be expected to be correlated. These correlations are often not reflected in model parameterization, and this may result in errors in model predictions. Here we performed simultaneous measurements of (1) the heat conductivity of snow, its density and its shear strength, (2) the specific surface area of snow, its permeability and its density. We find excellent correlation between the properties in both sets studied and propose new parameterizations of these properties in physical models of snowpack evolutions.

A04-4D6.5 **17:00**

A Systems Dynamic Modelling Approach to Assessing Elements of a Weather Forecasting System

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The objective of a weather forecasting system is to provide information of maximum benefit to the users. One measure of those benefits is related to the skill of the forecasting system. Other measures of benefits can be gained through polling and socio-economic analyses. Assuming the benefits can be quantified, the role of management is to make the investments in the overall weather forecasting system such that the benefits are indeed maximized. The capacity of the overall systems depends on investments in observing, telecommunication and computing systems, in research and development and in people. In order to study a weather forecasting system from this point of view a systems dynamics mathematical model has been developed. The model incorporates different factors that contribute to the quality of forecast and recognizes that a role of management is to divide the budget into relevant activities. The factors include capital investment, meteorological research, numbers of forecasters and the number of weather observation stations. The system dynamics modeling technique facilitates a dynamic analysis of impacts due to differential investment options. The cases of withdrawal of funds from specific activities, reductions in numbers of forecasters and the closures of weather observation stations are analyzed. Typical fund management scenarios based on different policy options are also simulated. Illustrative case studies will be shown, recognizing the restrictions in terms of data and model limitations.

I01-1D8.2 **16:15**

Using online atmospheric mercury chemistry to assess long-range transport and deposition to the Arctic.

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Mercury is a persistent, ubiquitous contaminant affecting ecosystems on the global scale, including remote regions such as the Arctic. In the atmosphere, gaseous elemental mercury is the dominant species. Its typically slow reaction rate, low solubility in water and its tendency to volatilize at the Earth's surface makes it prone to long-range transport. In the Arctic region, at polar sunrise, gaseous mercury chemistry changes dramatically. In a very dynamic phenomenon, so called mercury depletion events (MDEs), fast halogen oxidation reactions take place in the boundary layer, nearly depleting mercury from large regions. The snow/ice surface re-emits most of the deposited oxidized mercury through photo reduction within a few hours to days. Assessing the impact of MDEs on polar ecosystems requires an estimate of the net amount of deposition during spring and summer, which will indicate how much mercury can potentially become bioavailable.

Environment Canada's multi-scale global mercury model GRAHM (Global/Regional Atmospheric Heavy Metals Model) was extended to include physical and chemical processes specific to MDEs. GRAHM is an online model running inside the Canadian meteorological model GEM, using a global configuration and a semi-climatic integration strategy. For this study, boundary layer concentrations of BrO derived from GOME satellite data were used for the first time in the model. The ability of GRAHM to simulate MDEs can be shown by comparing its output with observations collected at Canadian polar station Alert for years 2002-2004. The model is used to estimate the yearly net accumulation of mercury on the Arctic surface.

C02-2B5.5 **11:30**

Climate from underground temperatures: The Earth's Selective Long-Term Memory

Hugo Beltrami[1], *J. Fidel Gonzalez-Rouco*[2], *Jason Smerdon*[3], *Eduardo Zorita*[4], *M. Bruce Stevens*[1], *Marc Stieglitz*[5], *Hans von Storch*[4]

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Borehole temperature data are now routinely used to reconstruct the long-term trends of climate change during the last millennium. Here we show results from our collaborative efforts to reconstruct global and regional ground temperature and heat flux changes that have been carried out recently, as well as some evidence on the nature of long-term coupling between surface air and ground temperatures. We estimate global ground surface temperature increases of approximately 1 c between 1500 and 2000 C.E. with the vast majority of the change occurring after 1900. Furthermore, estimates of the continental heat gain from subsurface temperatures indicate that all continents (except Antarctica, where we do not have data) have gained about 8×1021 J in the last 50 years.. This amount of heat is equivalent within error estimates, to the heat gained by the atmosphere during the same time period. We also show some preliminary results on the comparison of model simulations of the climate for the last millennium and subsurface temperatures for the northern hemisphere. Finally, we speculate on the possible uses of the documented changes in subsurface temperatures and heat storage as validation fields for state-of-the-art general circulation models.

C02-3DP.1 **16:00**

Subsurface heat storage in climate model simulations: Bottom boundary placement

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The bottom boundary condition placement (BBCP)in land-surface components of General Circulation Models (GCMs) is a critical parameter for realistic modeling of subsurface physics over long time scales. A one-dimensional soil model (1DSM) was used to quantify the influence of BBCP on heat storage capacity in the land-surface submodels of GCMs. Results show that shallow boundary conditions can reduce the capacity of the global continental subsurface to store heat by as much as 1.0×10^23 Joules during a110-year climate change simulation with a 10m bottom boundary. These calculations are relevant for any GCM future climate projection that utilizes a land-surface component with a shallow BBCP (currently10m or less). These shallow boundary conditions preclude a large fraction of the expected subsurface heat gain. This displaced heat may partition to other parts of the simulated climate system. We show some preliminary results of the spatial distribution of the subsurface thermodynamic effects of shallow BBCP in areas in which snow cover and active layer phenomena are present. Our results suggest that climate models of any complexity must impose appropriate BBCP to fully account for subsurface heat storage in future climate change projections.

I14-3DP.3 **16:00**

In-situ incubations highlight the climatic sensitivity of soil organic matter pools

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Although laboratory incubation studies have been critical in advancing our understanding of soil organic matter decomposition dynamics, in-situ studies provide the best hope of capturing true decomposition-climate responses. Few studies have assessed whether laboratory responses are in fact observed in the field, and the extent to which additional physical factors influence organic matter pool stability. We isolated decomposition rates and temperature response in vertically distinct, root free soils at a mature forest and adjacent 3 year-old clearcut. Using a subsurface approach and a new field diffusivity measurement probe, we targeted vertically-distinct soil organic matter pools that, by virtue of chemistry and physical environment, are less active in decomposition with increasing depth. Field studies were complemented with laboratory incubations of the same soils. In-situ decomposition-temperature response was similar between sites and through depth, but decomposition was over 100 times slower at 35 cm than at the soil surface. When values were normalized for temperature and soil carbon content, results for both sites were comparable despite different land use and microclimate. In the laboratory, surface soil respiration rates were broadly comparable to those measured in the field, but a significant discrepancy existed for deeper soils. As expected, incubated soils from 35 cm were more recalcitrant than at the surface, respiring up to 4 times more slowly per gram of organic matter, but incubation rates for deeper soils were > 20 times faster than those observed in the field. These results suggest that temperature and quality alone may not be sufficient predictors of recalcitrant carbon stability in many localities. More emphasis should be placed on assessing the role of simple physical protection (soil moisture, aggregation and other factors) in decomposition dynamics.

A06-2B7.8 **12:15**

Improvement in satellite polar cloud detection and analysis from lidar observations by the Geoscience Laser Altimeter System

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(Presented by *James Spinhirne*)
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Starting in 2003 the Geoscience Laser Altimeter System (GLAS) provides the first global measurements of clouds and aerosol by satellite lidar. From the GLAS data the presence and height of all clouds and significant haze are detected, and in the case of transmissive layers, the thickness is also found. Since bright surfaces and low surface temperature limit the study of polar cloud cover and haze by passive techniques, GLAS measurements of cloud and aerosol layer presence; height and thickness are an advance in capability and accuracy. Comparisons have been made between GLAS data products and ISCCP and MODIS cloud product for the Arctic and Antarctic. Disagreements in monthly averaged parameters are in important measures extreme. Differences between the zonal average GLAS and MODIS cloud fractions are as much as 40% over Antarctica and in the Arctic. From the lidar data there are good monthly statistics on cloud height distribution and optical thickness distribution. For Antarctica zonal average cloud fraction varies from over 93 % for ocean and coastal regions to a consistent average of 40% over the East Antarctic plateau and 60-90% over West Antarctica, and data show there are two basic polar cloud types profiled: stratus below 3 km and cirrus form clouds with cloud top altitude and thickness tending at 12 km and 1.3 km. In addition extensive blowing snow is detected. In the Arctic, some optical thin clouds are found to extend from the surface

to approaching 9 km altitude. Operational problems of the instrument limit the quantity of quality data but there are now over a year's data spread intermittently over three years. A description of cloud statistics and the differences to passive satellite retrievals will be presented.

C02-2B5.6 **11:45**

North American climate of the last millennium: Model and observation

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In order to quantify the outcome of possible future climate scenarios, the variability and forcing of past climate must be well understood. Through comparison of state of- the-art General Circulation Model (GCM) simulations with data such as borehole subsurface thermal profiles, the agreement between reality and surrogate reality can be determined. The boreholes of North America were grouped into eight geographical regions, and their thermal profiles averaged to form robust, representative ensembles. The output from 3 distinct integrations of the GCM ECHO-g (two forced runs and a controlled simulation) were likewise averaged for each region. These 1000-year surrogate realities were then forward-modeled to arrive at the expected subsurface thermal profiles resulting from the climatic trends at the surface. These forward-modeled profiles were then compared with the borehole average thermal profile in each region. In 6 of the 8 regions studied, the forcing runs from ECHO-g are in better agreement with borehole thermal profiles than with the control run. This demonstrates that boreholes are sensitive to external forcing factors, most notably greenhouse gas concentrations, as in ECHO-g. Not only are the ECHO-g simulations in better agreement with borehole data when considering variable external forcing factors, ECHO-g also appears to describe long-term climatic trends at regional scales.

H05-3C4.8 **15:15**

Impacts of waterpower peaking on physical riverine processes and implications for setting environmental flows

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Peaking waterpower facilities are usually associated with larger storage reservoirs that retain water for subsequent release of concentrated discharge peaks during peak energy demand periods. They are able to respond quickly to short-term peak load demands, usually on a daily cycle, resulting in an operational flow regime downstream of the facility that is highly regulated. The degree of alteration to the magnitude, duration, frequency, timing, and rate-of-change of flow (ramping, m3 s-1 hr-1) compared to the pre-development natural flow regime is greatest for waterpower facilities with peaking capabilities. Changes in the flow regime are met with associated changes in sediment, biogechemical, and thermal regimes, all important components of the riverine ecosystem. The influence of a peaking waterpower facility on downstream physical processes and the impact of changing one of the flow variables in the operational flow regime (rate-of-change of flow) is examined for the Magpie river near Wawa, Ontario using the Batchawana river near Sault Ste. Marie, Ontario as a reference for natural flow conditions. Challenges for addressing these impacts in managed flow regimes of peaking waterpower facilities using environmental flow recommendations based on natural hydrologic variability are discussed.

G09-1B2.1 **10:30**

Characterization of subsurface structure and water distribution within alpine deposits using electrical resistivity imaging

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In alpine headwaters of the Rocky Mountains, moraines, talus slopes, and alpine meadows are likely the dominant groundwater reservoirs, but little is known about subsurface flow and storage in these environments. An electrical resistivity imaging (ERI) survey was conducted in the Lake O'Hara Research Basin, Yoho National Park to characterize subsurface structure and water distribution. Compared to conventional methods (e.g. drilling wells), which are very difficult to apply in alpine terrains, ERI provided a fast and non-destructive method to characterize the subsurface.

ERI profiles were run across a small wetland and over the nose of a moraine. The surface of the moraine consisted of dry rock rubble and boulders, so contact resistance was often several hundred thousand ohms. To establish electrical contact, we drove spikes into soaked sponges in salt water that were jammed into boulder contacts. Another enhanced contact strategy was to smear medical contact jell over boulder surfaces and plaster aluminium foil connected to an electrode onto the jell. We used an 800 V transmitter with a Wenner array. Due to the resistive environment, measured potentials were in the volt range with currents as small as 1 mA. Some electrodes had to be installed one or more meters from the designated location and this offset may cause some distortion in the inverted images. The data produced inversions with resistivity values ranging from 500 ohm-m to 100,000 ohm-m. The lowest resistivity values correspond to wetlands and the saturated outflow at the toe of the moraine. The highest resistivity values correspond to dry boulder fields at the surface of the moraine. Although the images seem reliable, ambiguities remain in the interpretation and further geophysical work is planned for the coming summer.

S05-3DP.3 **16:00**

Interannual variability of the Aleutian and Icelandic Lows in an ensemble GCM simulation forced by snow cover satellite observations

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(Presented by *Yvan Orsolini*)
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We have performed a suite of GCM simulations spanning two decades (1979-2000) to attribute circulation anomalies to changes in snow cover extent, with a focus on the northern hemisphere high latitudes. Observed snow cover derived from satellite data has been retrieved from the NISDC, and nudged weekly into the GCM. Control simulations with prognostic or climatological snow variables have been also performed. Our simulations are ensemble simulation with five members, and are carried out at a T63 resolution. We have examined the connection of snow cover variability over Eurasia with several features of the northern hemisphere winter circulation, in particular the Aleutian and Icelandic lows. We find that nudging of realistic snow cover considerably improves the hindcast and the representation of the Aleutian-Icelandic Seesaw in the model. We discuss gains in potential predictability in winter, resulting from the snow nudging.

C02-2B5.3 **11:00**

Cloud cover changes in the eastern Baffin Island and southern Greenland regions since 7000 cal. years BP: pollen evidence

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Canonical correspondence analysis of 831 modern pollen spectra from middle to high latitudes of Canada and Greenland illustrate close relationships with both July air temperature and cloud cover. The amount of sunshine (inversely proportional to cloud cover) seems to be one of the most important climate parameter that controls vegetation growth in Arctic areas and pollen production. On this basis we have used the modern analogue technique (MAT) to simultaneously reconstruct the percentage of July cloud cover and July air temperature. The validation exercises show that MAT permits estimation of July cloud cover and temperature with an accuracy of ±2.3% and and ±1.4°C, respectively. This approach has been applied to Holocene pollen sequences of eastern Baffin Island (Akvaqiak Lake, 66°47’N, 63°57’W, 45 m asl) and southwestern Greenland (Qipisarqo Lake, 61°00’N, 47°45’W, 7 m asl). For the interval spanning 7000 cal. years BP to present, the reconstructions indicate limited changes on eastern Baffin Island with a slight decrease of July cloud cover and air temperature between 7000 to 5000 cal years BP, followed by stable conditions for the remainder of the Holocene. In contrast, the southwest Greenland record reveals that July cloud cover increased of 9% and that July air temperature has progressively decreased of from 12.0 to 8.5°C since 7000 years. The results suggest spatial diffence in Holocene climate trends. The contrasting cloud cover and temperature estimates from both sides of Labrador Sea and Davis Strait points to the determinant influence of North Atlantic waters as moisture and heat source over southern Greenland, whereas Baffin Island apparently remained under relatively uniform Arctic influence, notably through the Baffin Land and Labrador currents.

C04-4D5.6 **17:15**

Mesoscale Influence on Regional Climates at Arctic Sites

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Many of the long-term atmospheric observatories established for the multiagency, international Study of Environmental Arctic Change (SEARCH) are located in coastal regions or in regions of complex topography, or both. Such regions are known to produce mesoclimates which may vary greatly over relatively short distances and may respond differently to changes in large-scale climate forcing. This may explain why climate trends vary greatly on regional scales. The processes forcing the climatic regimes and the annual surface energy budget cycle are examined in detail at two SEARCH terrestrial sites (Alert, Nunavut; Barrow, Alaska) and one pack ice site (SHEBA). Limited data is also used to assess the presence of mesoscale climate regimes at another SEARCH site (Eureka, Nunavut). Mesoscale processes important for the annual climate at the terrestrial sites include terrain-induced flows and sea-breeze effects, emphasizing specific surface energy fluxes directly associated with these phenomena. The pack ice site shows surface energy budget characteristics that are less focused to a given wind regime. Impacts of the mesoscale regimes on the annual climate and surface energy budget cycle for all sites will be compared and contrasted and some assessment of the relative frequency

trends of the mesoclimate regimes will be presented. These results suggest that the future climate change at the terrestrial sites will depend on the response of the dominant mesoscale processes to the large-scale Arctic changes, and may therefore not be of the same magnitude, nor sign, as the large-scale changes.

C01-2B6.2 **10:45**

Predicted changes in northern hemisphere and Arctic summer cyclones in the 21st century

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The last decades witnessed unusual warming over Northern Eurasia, North America, and the Arctic. It appears important to assess the high-latitude atmospheric circulation changes predicted by models for the 21st century. One crucial component of the extra-tropical circulation are the travelling cyclones that largely influence heat and moisture transport, precipitation and cloudiness.

We have used a lagrangian algorithm to track cyclones in the vorticity field of the Bergen Climate Model scenario A1B simulations. Our aim is to examine changes or shifts in cyclone tracks by the end of the century, with respect to current climate conditions. Our focus is on the summer season and the northern hemisphere mid and high latitudes.

Changes in zonal winds and surface temperatures are discussed along with the changes in cyclone tracks.

S02-2DP.1 **16:00**

Validation of the AFWA-NASA snow product in the Lower Great Lakes Basin

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Using the Air Force Weather Agency (AFWA) – National Aeronautics and Space Administration (NASA) Snow Algorithm (ANSA), a blended snow cover / depth / snow-water equivalent (SWE) product has been created by merging Moderate-Resolution Imaging Spectroradiometer (MODIS) and Advanced Microwave Scanning Radiometer – EOS (AMSR-E) standard snow products at 25-km resolution. A Geographic Information System (GIS) was developed to analyze and validate the results of the ANSA algorithm in the Lower Great Lakes Basin. Preliminary validation has been conducted using National Climatic Data Center (NCDC) snow data (1293 stations), and data collected from the Global Learning and Observations to Benefit the Environment (GLOBE) and Students and Teachers Evaluating Local Landscapes to Interpret the Earth from Space (SATELLITES) student-acquired measurements program (232 locations), for three years, for the months of October through April, 2002 – 2005. Ground-based data are interpolated to produce a map of snow extent and depth for comparison with the blended product. A snowmelt-detection product, created using the QuikSCAT Ku-band (13.4 GHz) scatterometer, is overlaid as a separate layer, and will be incorporated into the ANSA. An AMSR-E snowmelt-detection product is also under development and is reported elsewhere. Results for February 2003, for example, show reasonable correlation between ground-based and satellite data with an 88% level of agreement for snow-classified pixels and a 74% level of agreement for pixels classified as no-snow.

I03-4C7.2 **14:00**

Two Years of High-Resolution Surface Energy Budget Measurements at the Alert SEARCH Site: Atmosphere-Snow-Soil Interactions

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Over two years of complete surface energy budget data with 1-minute resolution and ancillary atmospheric, snow, and soil data have been collected at the Alert Global Atmospheric Watch (GAW) Laboratory near Alert, Nunavut. In addition, nearby operational rawinsoundings have been made twice daily. These data have been analyzed to quantitatively reveal the flow of energy between the atmosphere, the snow, and the soil at this high-Arctic site on time scales ranging from less than an hour to the annual cycle. The impact of common atmospheric phenomena and processes on the snow and soil during all seasons are examined, including the changes occurring during the summer melt season and the fall freeze-up. Specific case studies of especially interesting periods will be presented.

G06-4C2.3 **INVITED/INVITÉ** **14:15**

High-Altitude Aerogravity in Gulf of Mexico for Geoid Improvement

Vicki Childers[1], *John Brozena*[1], *Dan Roman*[2]

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During January and February, 2006, NRL partnered with the National Geodetic Survey/NOAA and NASA/GSFC to conduct a high-altitude gravity and lidar survey of the Gulf of Mexico coast along the Florida panhandle and coastal Mississippi and Alabama. The survey was flown aboard the NOAA Cessna Citation at 35,000 ft altitude. The survey was laid out in a grid with 500-km long lines oriented N-S spaced 10km apart with a cross track spacing of 50 km. The survey overlapped at about the 70% level with a previous NRL P-3 gravity survey flown at 2000 ft with a dense line spacing. This overlap provides the opportunity to compare our high-altitude survey with an upward continued-version of the low altitude one to: 1) look for systematic differences between the two surveys; 2) estimate the noise in the high altitude survey; and 3) evaluate our methods of upward continuing the low-altitude data. We found no systematic differences between the surveys and we were able to adapt our processing approach for the unusually large range in the measurements as a result of the high survey altitude. We will discuss these and other findings related to the comparison of these two data sets.

This survey continues work that NRL has done on improving the geoid in the Gulf of Mexico and on comparisons between mean dynamic sea surfaces (from repeat satellite altimetry minus the geoid) and tide gages in the Gulf surveyed in with GPS. We include these new high-altitude data in our geoid and update our comparison with these tide stations.

C05-4C5.8 **15:15**

Artificial neural networks and the analysis of influences relevant to southern European climate extremes.

Andrew Harding[1], *Clare Goodess*[2], *Philippe Gachon*[3], *Van-Thanh-Van Nguyen*[4]

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Recent study, utilising an extensive set of southern European / northern Mediterranean (35º-45ºN, -10º-30ºE) station data (between 1958-2000), has described a number of influences important for regional extreme climate behaviour (temperature and precipitation). Statistical evidence for circulation effects has been accumulated through the analysis of a predictor set, constructed specifically for the region. Predictors include both hemispheric-scale indices of circulation, such as the NAO, and the North Sea Caspian Pattern (NSCP), and meso-scale circulation indices drawn from sea level pressure, humidity at height (850 hPa), and geopotential height (500 hPa) fields. A radial basis-function (RBF) artificial neural network (ANN) has been used to downscale from the circulation predictor set to the STARDEX (STAtistical and Regional dynamical Downscaling of EXtremes for European regions) 'top ten' indices of extremes, and the resulting predictor weights have been analysed by both season and region. When combined with the analysis of variance and trends shared between circulation predictors and indices of extremes, and spatial patterns of extreme climate that persist (for each season) from year to year, the study of neural network model weights may allow for an estimation of the regional causes (both topographic and circulation-based) of extreme climate. Results of interest include:

* the effects of altitude upon the persistence of extreme conditions (across the Mediterranean),

* the effects of orographically channeled winds upon intensity (for the north-west Balkans),

* the differences between rainfall regimes and extreme rainfall for western and eastern coasts (particularly for Iberia),

* and seasonal variations in the importance of much larger, hemispheric-scale, circulation (e.g. the NSCP).

This analysis (over Europe) mirrors similar work being conducted for eastern Canada with multilinear statistical downscaling methods. Both studies contribute toward an increased understanding of links between key (relevant) atmospheric predictors and the behaviour (occurrence, duration, and intensity) of regional surface climate extremes.

H01-1B4.7 **12:00**

Vegetative Controls on the Spatial Variability of Evapotranspiration in Low Arctic Tundra; Daring Lake, NWT, Canada.

Shawn LeCompte, *Michael English*, *Richard Petrone*

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Evapotranspiration plays a significant role in the water cycle, energy balances, climate, and the ecosystem. With expected Arctic warming and subsequent increase in evaporation comes the expectation that many vegetation species will shift northward, changing vegetation assemblages

throughout the Arctic. An increase in vegetation density within existing vegetation communities could produce changes in surface forcing sufficient enough to affect the regional climate of northern land areas during summer (Chapin et al., 1999). Determining the extent to which changes in vegetation assemblages influence evapotranspiration in the Arctic could potentially contribute to a more realistic estimation of evaporation in a warming climate. This project aims to determine whether variations in PET and AET rates measured at six tundra vegetation communities can be attributed to the differing vegetation.

Potential Evapotranspiration (PET) is the maximum rate of evapotranspiration from a vegetated catchment under the condition of unlimited moisture supply, and without advection or heat storage effects (Petrone et al., 2006; Jacobs et al., 2002; Thomas, 2000). The methods used to quantify PET include the Priestly-Taylor method, the use of saturating lysimeters, evaporation pans.

Actual evapotranspiration (AET) is the actual amount of moisture that can be evapotranspired, given measured constraints on soil moisture. Thus, AET is a representative of unsaturated conditions, whereas PET is only reality under saturated conditions. AET was quantified using a series of lysimeters in five different vegetation communities, as well as using isotopic tracers of oxygen obtained from a nearby sphagnum wetland.

A02-2DP.1 **16:00**

Comparison of Aura-MLS upper troposphere CO measurements with 2 global chemical models

Lori Neary[1], *Jonathan H. Jiang*[2], *Nathaniel J. Levesey*[2], *Hui Su*[2], *John C. McConnell*[1]

(Presented by *Lori Neary*)
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In the troposphere, CO is formed by the incomplete combustion of fossil-fuels and by biomass burning. CO is also formed by the oxidation of CH_4 and other hydrocarbons initiated by OH and ozone. The lifetime of CO is a few months in the tropics where there are largest OH mixing ratios. With a lifetime of this magnitude it can serve as a tracer of tropospheric motions. Recent satellite measurements have shown that large plumes of carbon monoxide can reach the upper troposphere through deep convection. Biomass burning in the tropics is a major source of CO and is currently not well represented in the global emission inventories available to the chemical modelling community. To further understand and quantify the impacts of biomass burning and deep convective transport on the chemical constituents in the upper troposphere, comparisons with satellite observations from AURA-MLS and MOPITT were made against two global three-dimensional global air quality models. GEOS-CHEM which is a chemical transport model and GEM-AQ which is an on-line air quality model embedded in GEM, the Canadian wether forecast model . The results show an underestimation of CO during the peak burning seasons, suggesting a deficiency in the emission inventory used in the models. The results of the inter-model comparison also reveal significant differences between the models. GEM-AQ captures the timing of long-range transport as indicated by the measurements from MLS. Both models have difficulty representing transport by deep convection in the tropics.

G07-1C2.7 **15:15**

Effect of a Thermal Plume Impact on the Heat Flow of the Lithosphere

Yuri Kinakin, *Alison Leitch*

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Thermal plumes have been proposed as a significant mechanism for heat transport from the core of the Earth, and the total heat flux from thermal plumes may be used as a lower bound for the total heat flux from the core-mantle boundary. The finite difference mantle convection code CONMG is used to determine the contribution of a thermal plume as it impacts the bottom of the lithosphere to the total heat flux through the lithosphere. Both the time and spatial scales of cooling of the thermal plume are evaluated, as well as the temperature profile of the lithosphere as a function of time. Mantle rheology affects the shape and evolution of thermal plumes, and consequently influences their behaviour upon impact with the lithosphere. Therefore physical parameters, such as the dependency of mantle viscosity on temperature and pressure, are varied during successive simulations. The question of whether or not it is possible to generate crustal melting by conduction of excess heat through the lithospheric mantle is also investigated.

I03-4C7.3 **14:15**

Clouds and Energy Transfer over the Antarctic Plateau.

Michael Town[1], *Von Walden*[2], *Stephen Warren*[1]

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Antarctica plays a significant role in Earth's climate. More energy is radiated to space from the Antarctic ice sheet than is absorbed from the Sun. The continent therefore acts as a sink for atmospheric energy, as well as a driver of global atmospheric circulation. Due to this radiative imbalance the near-surface atmosphere is often very stably stratified. This study improves the current knowledge of energy transfer in the near-surface atmosphere over the Antarctic Plateau. Routine observations of short and longwave radiation, temperature, humidity, and wind speed at the South Pole are used to determine the role of clouds and other factors in the surface energy balance.

Downwelling longwave data are used to determine mean monthly cloud cover and cloud radiative forcing. These results are then compared to estimates from satellites and visual observations. Night-time visual observations of cloud cover are biased low by approximately 20%, even when screened for adequacy of moonlight. Satellite retrievals of cloud fraction are also found to be inadequate, regardless of season.

The surface energy balance is analyzed to reconcile historical discrepancies of up to 50 W m-2 in the energy balance. Sensible and latent heat parameterizations used in models of polar climate, such as the Polar Mesoscale Model (PMM5), are evaluated based on the residual of other components of the surface energy balance. A model of the subsurface temperatures used to close the surface energy balance shows heating rates of up to 10 K/day in the top 30-60 cm of the snowpack. Implications for the transport of water vapor are explored based on the large heating rates and temperature gradients found in the snow pack.

I09-3C9.5 **14:45**

Accuracy in zenith tropospheric delay from the Canadian regional numerical weather model

Felipe Nievinski, *Marcelo Santos*

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We analyze the accuracy of zenith tropospheric delays (ZTD) from analysis and forecast fields of the regional, high-resolution version, of the Canadian GEM numerical weather model (NWM), as compared to radiosonde and surface stations. From the analysis fields we show the accuracy available for GPS post-processing, whereas the forecast fields are relevant for real-time uses, in which case we show the accuracy degradation as the time offset from initialization increases. We give statistics (bias, standard deviation, root-mean-square error) and scatterplots of error in total, hydrostatic and non-hydrostatic (or wet) delay over the model range in latitude, longitude, height, and time offset from initialization. We also compare the performance of slightly different methods to extract ZTD from a NWM.

C05-3C5.2 **14:00**

Seasonal Prediction at the Regional Scale: An analysis of Regional Climate Model performance over the tropical Americas

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The main goals of seasonal prediction are to predict climatic variables of societal interest over 3 to 9 month lead times in order to alleviate the potential consequences of climatic extremes and to assist in resource planning in fields such as agriculture. The drawback of current global scale seasonal forecasting is their low resolution. Regional models can be used to produce more useful forecasts through their higher resolution response to global phenomena. In tropical regions, large-scale atmospheric circulations are linked to the more slowly evolving Sea Surface Temperatures (SST). Thus tropical regions, such as Central America, are promising areas for seasonal prediction at the regional scale. GCMs have some skill in predicting the response of large scale atmospheric circulations to anomalous SST forcing, whereas RCMs are more adept at reproducing the local and higher resolution response to these atmospheric circulations. This can aid in bringing the GCM seasonal predictions down to the spatial scale required by end-users.

In order to assess the added value of regional scale models in seasonal forecasting, the output of hindcasts using these models must be evaluated and compared to observations. Using prescribed SST and analysed lateral boundary conditions, the Rossby Center regional climate model (RCA3), has been used to make high resolution 12 month simulations over the tropical east Pacific and Americas region from 1970-2005. Emphasis is put on El Nino and La Nina composites and the comparison of the model to observations. This will determine if RCMs, when given accurate large-scale forcing, are able to reproduce the main regional scale climatic features over the tropical Americas and the detailed response in this region to the phase of ENSO. The study looks at interanual variability associated with ENSO at two time scales: seasonal and sub-seasonal (using pentad values).

I13-4B9.3 **11:00**

Detection and Assessment of the Dehydration-Greenhouse Feedback in the Arctic: A Status Review for the IPY

Jean-Pierre Blanchet, Éric Girard, Colin Jones, Rodrigo Munoz-Alpizar, Patrick Grenier

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The Arctic is one of the most sensitive region for climate change due to greenhouse gases. The rapid warming, mainly in the sub-Arctic, the retreat of sea ice and the extension of boreal forests at the

southern edge confirm the general predicted warming trend. However, all climate models predict maximum warming during the cold season while many observations and analysis show broad regions with marked cooling trends in that season over recent decades. Clearly, other processes are also active in the Arctic, to the point of reversing the otherwise warming trend on regional and seasonal scales. As part of the International Polar Year activities, our research focuses on a feedback between aerosols, ice clouds, precipitation, radiation and atmospheric circulation likely to modulate profoundly the Arctic climate trend by reversing, at times, the water vapour greenhouse forcing, resulting in cold anomalies, retarding the potential Arctic warming and, very likely, influencing the winter storm activities in the mid-latitudes. In the research to investigate this process, called the dehydration-greenhouse feedback (DGF), we have to rely heavily on new satellites with active (CloudSat and CALIPSO) and passive instruments (AQUA), ground measurements (PEARL and ARM sites) together with sophisticated climate-circulation models accounting for aerosols and clouds in sufficient details. This presentation will summarise our research findings in this area, their climate implications and the strategy followed through the ongoing International Polar Year.

I08-3DP.2 **16:00**

The Atmospheric Response to Summer Arctic Sea Ice Anomalies

Uma Bhatt[1], *Michael Alexander*[2], *Clara Deser*[3], *John Walsh*[4], *Jack Miller*[5], *Michael Timlin*[6], *James Scott*[2]

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It is generally accepted that changes in air temperature and circulation determine sea ice conditions, but it is not understood how the atmosphere is influenced by changes in sea ice. These processes are particularly important to understand since the slowly varying nature of sea ice could be potentially used for predictive purposes. We employ the NCAR CCM 3.6 to investigate the atmospheric response to reduced sea ice during summer.

A control experiment was integrated for 55 years by repeating the mean annual cycle of observed sea ice extent and SST, based on the period 1979-99, when reliable satellite data is available. Sets of 51 member ensemble experiments were constructed by integrating the CCM from April to October using climatological SST and observed sea ice extent from the summer of 1995 (a minimum summer).

The strongest response during the month of August was found in the North Pacific and is character. A Linear Baroclinic Model Study is presented in an attempt to explain the mechanism by which the reduced sea ice forces dynamical changes in the atmosphere.

Additional experiments with only regional ice anomalies in the Kara-Barents or the E. Siberian-Laptev seas will be presented. The modeling results suggest that both of these regions add to the total response.

I10-1B9.3 **11:00**

The future state of the Arctic sea ice budget

Cornelia Koeberle, *Ruediger Gerdes*

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Recent climate scenario runs show more or less pronounced negative trends in Arctic sea ice cover as well as in thickness. Most of the involved models predict ice free summers until the end of 2100, some reach that state even earlier. Little is known about the new dynamical balance that will be reached under such drastically changed conditions. Increased areas of open water at the onset of winter could e.g. lead to increased ice production with subsequent increased ice export through Fram Strait with consequences for the subpolar Ocean. We will look at the budgets of some of the models of the actual IPCC assessment. We have already evaluated available models of the actual IPCC assessment with respect to their ability to simulate ice parameters and their variability in the 20th century. We will confine our analysis to the best (in that sense) models and discuss differences. We will also use the atmospheric data of the best model(s) as forcing data set for a coupled sea ice-ocean model. The budget will be shown and any differences to the budget of the respective IPCC model will be discussed.

A06-2B7.5 **11:30**

Dynamical Feedback associated with the Dehydration-Greenhouse Feedback Mechanism on the Arctic Region.

Rodrigo Munoz-Alpizar, Jean-Pierre Blanchet, Eric Girard, Colin Jones

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During winter, the Arctic atmosphere is a reservoir of cold air that establishes latitudinal pressure gradients forcing the general circulation. The Arctic winter energy budget is mainly a balance between IR radiative cooling of the air mass and heat transport by atmospheric flows. The outgoing IR flux drives the generation of available potential energy, fuelling the production of synoptic storms which in turn supply heat and moisture back into the Arctic, balancing the high-latitude heat deficit. These storms dominate winter conditions in Canada and the sub-Arctic regions. Therefore, winter cooling in the Arctic due to mechanisms such as the Dehydration-Greenhouse Feedback (DGF) may play an important role in the global atmospheric circulation. The DGF process is based on the enhanced removal of water vapor by the production of large ice crystals associated to acidic aerosols. Under these conditions, the atmospheric dehydration rate is a key factor in rapidly producing very cold Arctic air masses feeding the baroclinic development of intense winter storms in the mid-latitude regions. Arctic temperatures, intensity and frequency of mid-latitude winter storms are a direct function of the residence time of atmospheric water in the cold Arctic region. In order to investigate the effect of increased dehydration rates during winter on the energy budget and mid-latitude storm activities, NARCM simulations were performed during the SHEBA winter season (DJF 97-98). Analysis of the components of the energy cycle can help in understanding the life cycle of transient waves in mid-latitude and the role of DGF forcing in storm generation. In this presentation, the role of DGF process on transient eddy available potential energy, transient eddy kinetic energy and the conversion between these two components will be discussed.

A04-4C6.1 **13:30**

Summer QPF skill comparisons of the GEM-LAM 2.5 and the GEM-REG 15 km

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The goal of this study is to objectively compare the quantitative precipitation forecasts (QPF) produced by the operational GEM-REG 15 km to the experimental GEM-LAM 2.5 km. The primary hypothesis underlying the use of the GEM-LAM 2.5 km is its ability to generate skillful small-scale features absent from its lower-resolution driving model, the operational regional GEM-REG 15 km. Secondly, at scales well represented by both models, we expect the GEM-LAM to be at least as good as the GEM-REG. The purpose of this study is to verify these hypotheses in terms of QPF for the summer season over the eastern LAM domain.

Verification of very-high resolution QPF is not obvious with common verification metrics (e.g. RMSE). In fact, these are known to be overly sensitive to the small displacement and timing errors, spatial discontinuities and the high variance at small scales, characterizing high resolution QPF fields. These issues are crucial when comparing two models of different resolution as the GEM-REG 15 km and the GEM-LAM 2.5 km. In this study we explore two different QPF verification approaches which are intended to deal with these issues.

The first approach aims to verifying whether or not the GEM-LAM 2.5 km is as good as the GEM-REG when the GEM-LAM QPF fields are up-scaled to the 15-km grid. The upscaling permits a fair comparison of QPF features at scales present in both models. The second approach uses a neighborhood-based technique which tolerates a certain level of displacement and timing errors. In this approach, the GEM-REG 15 km QPF is first interpolated on the 2.5 km grid. Then, for both models, QPF distributions are created by generating an ensemble of grids which are simply displacements in time and in space of the original grid. Probabilistic verification measures are then employed for the model comparison.

G11-3C2.1 **13:30**

Salt and shale tectonics at passive continental margins: Insights from margin-scale numerical models that couple deformation to fluid flow

Steven J. Ings[1], *Christopher Beaumont*[2], *Christina Morency*[3], *Markus Albertz*[2]

(Presented by *Steven Ings*)
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The post-rift structural evolution of many rifted continental margins has been affected by the mobilization and continued flow of weak syn- or post-rift sedimentary units. There are two end-member deformation styles; ‘salt tectonics’, where the weak mobile unit comprises evaporites (usually halite), and ‘shale tectonics’, where the weak mobile unit is overpressured shale. Examples of regions affected by these deformation styles include the Scotian Margin (salt tectonics), the Niger Delta (shale tectonics), and the Gulf of Mexico (salt and shale tectonics). In these cases, deformation caused by salt and/or shale tectonics is a significant control on the formation of sedimentary depocenters and structural traps important for hydrocarbon exploration.

At the margin scale, salt and shale tectonics are driven by essentially the same process; differential sediment loading which creates a regional pressure gradient in the mobile substrate and causes it to flow seaward. There are, however, important differences in the rheology of the mobile substrate and these differences change the character of the resulting deformation. Salt deforms viscously and has no yield strength, and as a result it begins to flow as soon as it is loaded. Shale, however, is frictional plastic in its pre-yield state and becomes mobile only if its pore fluid pressures are large enough.

In this study, we use margin-scale finite element models to investigate the effect of sediment progradation over salt and weak shale layers. These models use a newly developed algorithm that couples solid matrix deformation to compaction-driven fluid flow for porous clastic sediments (salt is treated as linearly viscous and non-porous). This approach allows an examination of the hydraulic controls on the deformation style in shale tectonic systems. We present model results that illustrate these controls and the first order similarities and differences between salt and shale tectonics driven by differential sediment loading.

I08-4B7.2 **11:00**

High resolution monitoring of variability the marginal sea ice zone using satellite passive microwave data

Thorsten Markus[1], *Anne Kramer*[2]

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The Marginal sea Ice Zone (MIZ) and the sea ice edge are the most dynamic areas of the sea ice cover. Knowledge of the sea ice edge location is vital for routing shipping in the polar regions. The ice edge is the location of recurrent plankton blooms, and is the habitat for a number of animals, including several which are under severe ecological threat. Polar lows are known to preferentially form along the sea ice edge because of induced atmospheric baroclinicity, and the ice edge is also the location of both vertical and horizontal ocean currents driven by thermal and salinity gradients. Finally, sea ice is both a driver and indicator of climate change and monitoring the position of the ice edge accurately over long time periods enables assessment of the impact of global and regional warming near the poles. Several sensors are currently in orbit that can monitor the sea ice edge with spatial resolutions ranging from 15 m (Landsat 7) to 25 km (SSM/I). To monitor the dynamics of the sea ice edge we are using a special method applied to satellite passive microwave data that allows for the detection of the sea ice edge at a quarter of that nominal resolution, i.e. 6.25 km for the SSM/I. Only passive microwave data yield twice-daily uninterrupted measurements. Using Aqua AMSR-E data the resolution can be increased to 3.125 km. The results are twice daily ice edge locations an ice drift vectors. The talk presents results from the Bering Sea and discusses diurnal, seasonal, and inter-annual variability and its correlation with NCEP/NCAR near-surface wind fields.

O02-1B1.1 **INVITED/INVITÉ** **10:30**

Operational Ocean Monitoring and Forecasting at Mercator Ocean

Pierre Bahurel

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The idea of operational oceanography emerged in the eighties in some research groups and national agencies. However, the spinup of this movement took really place in the nineties, after the successful launch of the modern altimeter missions Topex Poseidon and ERS. Several initiatives started at that time in different countries to settle operational ocean monitoring and forecasting centers, all based on 3 pillars: a) real-time reliable access to high quality observation, either remotely sensed or in situ, 2) state-of-the-art OGCM realistic configurations, global of regional, and 3) data assimilation schemes, either advanced such as variational or ensemble methods or simple such as optimal interpolation. This movement was mainly technology pushed: the opportunity of being able to build such systems was there: access to high quality observations from space with a high level scientific community strongly associated to the space missions; large progress made in ocean modeling, both on the academic side

and on the coding with the emergence of high quality OGCM codes; algorithmic development implementing advanced data assimilation schemes in a computing efficient way, the deployment of high capacity computing capabilities in the different countries involved in this business. Now, after this technology pushed movement, at least in Europe with the emergence of GMES, the demand of operational ocean services is increasing: marine safety, oil pollution prevention, environment protection, living resources management are, among others, domains of activity requiring high accuracy estimates of the ocean state, both in real-time, forecast and in reanalysis mode. In France, the main French organizations involved in oceanography (CNES, CNES, IFREMER, IRD, METEO FRANCE and SHOM) decided to create a joint public company: Mercator Océan, whose mission was to establish an operational oceanography center to serve their needs, running state-of-the-art global OGCM assimilating remotely sensed and in situ observation. Mercator Océan is the operator of the global forecasting component of the EU-funded Mersea project, which builds the cornerstones of the future Marine Core Services (MCS) that will be implemented within GMES. Since October 2005, Mercator operates today a global ¼° forecasting system assimilating altimeter data from Jason, Envisat and GFO with an optimal interpolation scheme. In april 2007, Mercator will make a major upgrade of its system with a new model component including prognostic sea ice, enhanced vertical resolution (including partial cells near the bottom) and with a new assimilation scheme based on the singular evolutive extended Kalman filter (SEEK) assimilating altimeter data, in situ profiles of T and S (including ARGO) and SST in a fully multivariate way. After a brief description of Mercator, its links with Mersea, GoDAE and the MCS, we will show some practical applications of operational oceanography. We will then make a focus on the abilities of the very new global ¼° monitoring and forecasting system.

S02-2DP.7 **16:00**

Assessing the Capability of Spaceborne Altimeter and Scatterometer Data for the Retrieval of Snow Water Equivalent in Canada.

Frédérique Pivot[1], *Claude Duguay*[2], *Kyle McDonald*[3], *Bertrand Duchiron*[4], *Anne Walker*[5]

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The potential of scatterometer and altimeter data acquired at Ku-band and C-band for the retrieval of snow water equivalent for major Canadian landscape regions is investigated and compared to that of passive microwave observations. Although the scatterometer and altimeter data were originally intended for determining wind speed and direction over the oceans, recent land studies have demonstrated their sensitivity for monitoring global snow cover and the freeze/thaw status from regional to hemispheric scales.

Observations available from the Topex/Poseidon radiometer and dual-frequency altimeter, the ERS-1/2 Wind scatterometer, the SeaWinds scatterometer on QuikSCAT, and the Satellite Sensor Microwave Imager (SSM/I) are resampled and collocated in a common Equal Area Scalable Earth Grid projection with a 25-km grid cell dimension to facilitate their analysis and intercomparison.

A global picture of the land surface is provided every 6 to 10 days with the ERS-1/2 and Topex/Poseidon systems (early 1990s to present), and on a daily basis with Seawinds on QuikSCAT (1999 to present). Time series of Ku- and C- band backscatter measurements are extracted for the main Canadian land covers (i.e. open, forested and mixed environments) and compared to snow water equivalent (SWE) measurements from snow surveys to assess the multi-sensor radar response to snow cover evolution. An empirical scatterometer/altimeter SWE algorithm is developed which performance is evaluated then compared to that of the SSM/I-based SWE algorithm used operationally for open prairie environments by the Meteorological Service of Canada.

S05-1C3.4 **14:15**

Impacts of climate change on snow water equivalent, snow cover, snowmelt regime and related hydrologic variables in the northeastern USA during the 21st century

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AOGCMs were used to simulate future climate under low and high greenhouse gas emission scenarios to assess the influence of climate changes on snow and related hydrologic variables in the northeastern USA. Temperature and precipitation projections were regionally downscaled and used as inputs to a hydrological model. The variable infiltration capacity (VIC) hydrological model was used to simulate daily snow water equivalent (SWE), snow cover, and snowmelt. The VIC model also simulated soil water content and partitioned runoff into surface runoff, subsurface flow to streams, and daily streamflow. Model climate simulations and results for changes in SWE, snow cover, soil moisture, and stream flow have been previously published in a regional climate impact assessment. The focus of this analysis is on potential changes in snowmelt regime, relations between snowmelt and streamflow, changes in timing of groundwater recharge, and changes in the ratio of snowfall to rainfall during the 21st century. The lower emission scenario results in substantially lower annual average surface air temperature warming (+2.9 ˚C) compared with the high emission scenario (+5.3 ˚C) for 2070-2099 compared with 1961-1990. Model simulations project precipitation increases in annual, and especially in winter periods, but no changes in summer precipitation for 2070-2099. Model projections indicate decreases in total SWE and in the number of days with snow cover during the 21st century. Earlier snowmelt resulting from earlier spring warming and earlier rain on snow events is associated with earlier high spring stream flow. Overall, projected trends in snow regime and in the ratio of snowfall to rainfall are consistent with a decrease in surface runoff during spring months and an increase in infiltration and routing through subsurface flowpaths. VIC model projections are consistent with a shift in the timing of groundwater recharge to earlier in the year and an increase in winter recharge.

A06-2DP.1 **16:00**

Evidence of sub-visible charged particles in the polar summer mesopause region: Implications for noctilucent cloud formation in a changing climate

Andrew Ballinger[1], *Phillip Chilson*[1], *Robert Palmer*[1], *Sheila Kirkwood*[2], *Nick Mitchell*[3]

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The polar summer mesopause (altitude of ~ 85-90 km) is the coldest region of Earth's atmosphere, and is the location of two widely studied phenomena: noctilucent clouds (NLCs) and polar mesosphere summer echoes (PMSE). NLCs are the better understood feature, the thin clouds forming as water molecules freeze at the extremely low temperatures. PMSE, a phenomenon detected by radars, is less understood despite much progress being made over the past decade. The complexity of the physics in the middle atmosphere along with the inherent difficulty of taking in situ measurements near the

mesopause has meant that a comprehensive theory of PMSE does not yet exist.

During the 2005 summer, data were collected from two radars near Kiruna, Sweden (~68° N). The first radar was ESRAD, a 52-MHz MST radar, operated by the Swedish Institute of Space Physics (IRF); the other was a 32.5-MHz meteor radar, located about 1000 m from ESRAD. Together these radars were operated in modes that allowed us to study temporal variations in both the PMSE and incoming meteor signals.

Meteor signals decay at a rate that depends on the ambient temperature and pressure. We present evidence that the decay time of a meteor can also be significantly influenced by charged dust particles, with an enhancement in the summer months likely due to larger sub-visible ice particles. The presence of charged dust and ice particles in the summer mesopause region is thought to be necessary in generating and maintaining PMSE structures. Furthermore, these sub-visible ice particles are likely the beginning of the crystals that grow and form noctilucent clouds at altitudes just below the PMSE layers.

Anthropogenic forcing on the climate system is predicted to lead to a cooling of the mesopause region, coupled with greater water vapor availability. A greater understanding of the ice microphysics at the sub-visible scale may help us understand the way noctilucent clouds might change in the future, and the further radiative implications.

A04-4C6.7 **15:00**

Results of the 4 models Historical Forecast Project 2 (HFP2) on seasonal forecast.

Benoit Archambault, *Marie-France Turcotte, Juan-Sebastian Fonticella*

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Recently, 35 years of seasonal hindcasts has been conducted with four different models: the CCCma AGCM3, CCCma AGCM2 and the RPN GEM and the RPN SEF. This ensemble of hindcast constitute the second Historical Forecast Project (HFP2). This major project represent more than 5600 years of model integration. This experiment is the foundation for the future Canadian seasonal forecast system.

Scores of different combinations of models, for zero and 1 month lead time, for all the 35 years in the period, for El Niño-La Niña years and for years with no significant sea surface temperature anomaly will be shown. Deterministic and probabilistic approaches will be presented.

S01-3DP.2 **16:00**

Snowpack geochemistry of tundra environments in the Hudson Bay Lowlands

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Major element composition of the snow cover is examined from selected sites from the Hudson Bay coast near Churchill, Manitoba inland along an approximately 100 km transect to Marantz Lake. The transect was sampled during March of 2006 at 12 locations to establish the snowpack geochemical variability and estimate geochemical loadings from this region based on the mid-winter snow conditions. The objective is to describe the geochemical changes that are occurring in the snowpack as a result of distance from Hudson Bay. In addition, the influence of land cover type on the snowpack geochemistry is examined. Snow samples were collected from the entire snowpack in triplicate and returned to the field lab in Churchill for processing and preservation. Samples were analyzed for Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analysis for 32 elements to quantify snowpack geochemistry variability among the sites. As expected, the sites closer to the Hudson Bay Coast show higher levels of major cations that are associated with the marine environment. Inland sites show geochemical variability associated with land cover type indicating the potential importance of the tundra environment type to modifications of the snowpack geochemistry.

H01-2DP.17 **INVITED/INVITÉ 16:00**

Impact of Climate Change on Agrichemical Loss in Watershed Systems

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The aim of this paper is to examine the impact of climate change on pesticide loss to surface water through a modeling study. An integrated modeling system which combined a distributed agrichemical loss model with geographic information system (GIS), database, and climate change scenarios was proposed. It can predict pesticide loss through runoff under climatic change conditions. A case study was used to calibrate and verify the proposed system. The atrazine loss in 2050 and 2100 was predicted under different climate change scenarios. With the global warming, the annual streamflow would augment by 3 to 5% and the total atrazine losses would also gradually increase by 1.4 to 1.7%. The maximum concentrations of atrazine in river would be raised by 2.5 to 23%. It was also found that the wet season would always take the biggest share of pesticide-loss contribution to the river. A sensitive analysis disclosed that both of streamflow and pesticide concentration are more sensitive to temperature increase than decrease. This study is the first one to quantify the relationship between pesticide loss and climate change through a mathematic modeling system. The results can help people more effectively assess climate-change impacts, manage pesticide practices, and control water pollution.

I05-2C8.3 **14:30**

Operational Coupled Ocean Wave Prediction systems

William Perrie[1], *Bechara Toulany*[1], *Weiqing Zhang*[2], *Adhi Susilo*[3], *Yongcun Hu*[1]

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This presentation describes our activities at BIO in running wave forecast systems for several network projects. These include GoMOOS, the Gulf of Maine Ocean Observing System www.gomoos.org, SCOOP, the Southeast University Research Association (SURA) Coastal Ocean Observing and Prediction project, www.openioos.org and the Dalhousie CMEP (Centre for Marine Environmental Prediction) project, on “Interdisciplinary Marine Environmental Prediction in the Atlantic Coastal Region” http://eero.ocean.dal.ca/cav/.

This presentation will discuss issues related to 1-way and 2-way nesting of fine-resolution grids with intermediate and coarse resolution grids, using basin scale models such as WW3 (WaveWatch3, the

USA NCEP operational model http://polar.wwb.noaa.gov.waves) and the shelf or nearshore wave model SWAN (http://swan.ct.tudelft.nl). Important concerns are episodic storms such as hurricanes, with waves that are beyond the scale of any field measurement experiments. We discuss quality control and model-buoy data comparisons, which can be displayed online at the click of a buoy icon. We present results for statistical analysis of comparisons, for storms where high quality results have been collected.

We also present results on model integration and upgrades, related to coupling wave and storm surge models, wave-atmosphere-upper ocean, wave and currents and their interactions, and new formulations for nonlinear wave-wave interactions. Model – model comparisons are plotted with observed buoy data, including significant wave height time series, as well as 1-D and 2-D wave spectra. These include storms such as hurricanes Juan (2003), Katrina (2005) and Wilma (2005), as well as data from two Nor'easters. Results show the importance of these processes in the determination of accurate wave forecasts, in waters of the Northwest Atlantic.

A04-2DP.6 **16:00**

An examination of TAF quality for Vancouver (CYVR) and Calgary (CYYC) 1999-2006

Jacqueline Spilak

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The Canadian Meteorological Aviations Centre – West (CMAC-West) issues Terminal Aerodrome Forecasts (TAFs) for all the airports for western Canada and the Territories. The two most important airports (hubs) in this area are the Vancouver International Airport (CYVR) and the Calgary International Airport (CYYC).

This study uses TAF verification data from January 1, 1999 to December 31, 2006. R, a system for statistical computation and graphics, is used to compute a variety of statistics on the TAFs of the two hubs, including: • Determining how the number of amendments varies by year, by season, by month, and by time of day. • Determining how TAF quality varies when related to the length of time taken to issue an amendment following a new observation. • Determining how the probability of detection varies by year, by season, and by month. • Determining how the number of false alarms for weather events varies by year, by season, and by month. • Determining how the length of time TAFs are valid before requiring an amendment varies by season, by month, and by time of day.

The goal of this study is to use the findings about TAF quality to provide useful feedback to the forecasters who created the TAFs and to provide detailed statistics on each hub to help identify seasonal or event bias, focus improvement efforts, and improve the handling of highly variable weather events. Preliminary results will be presented.

S02-2C3.1 **14:00**

Analysis of time series of satellite passive microwave estimates of SWE over the Colorado Cold Lands Processes Experiment study region

Richard Kelly[1], *Thorsten Markus*[2]

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Remote sensing of snow water equivalent (SWE) has exploited the wavelength-dependent temperature of emitted radiation from a snowpack as observed by passive microwave instruments. The natural upwelling radiation from snow-covered terrain is modified by several physical variables: kinetic temperature of the snow, snow grain size, the number of snow grains in the path of the emitted radiation and their volume to air fraction, the underlying surface conditions and in situ vegetation characteristics. For a snowpack with SWE greater than 10 mm, scattering processes by snow grains dominate the microwave emission signal and can be detected at frequencies greater than about 25 GHz. In practical terms, the strength of scattering signal is proportional to the SWE or snow depth, and it is this relationship that forms the basis for estimating SWE in satellite passive microwave approaches. Several approaches have been developed to estimate SWE that range in approach from static empirically-calibrated models, to complex radiative transfer models with several variants between these endmembers. Most approaches are based on instantaneous observations of the snow and do not use information from previous days' brightness temperatures which could serve to constrain the daily variability caused by thermal variations of the snow and atmosphere that are unrelated to bulk SWE. Recent work by Markus et al. (2006) has shown that atmospheric affects can adversely affect the estimation capability of passive microwave algorithm estimates of SWE. This paper presents a time series analysis of brightness temperatures from the Advanced Microwave Scanning Radiometer – EOS channels through two winter seasons (2001-2002 and 2002-2003) of the Cold Lands Processes Experiment (CLPX) in Colorado. Model weather data are also analysed for the CLPX domain to determine the nature of atmospheric variability and how the historical data in the passive microwave record might be used to correct for weather effects in SWE retrievals.

G03-4B2.1 **10:30**

Integrating GPS and tide-gauge data with geological evidence and other tools to estimate vertical motion and sea-level change in the western Arctic

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Projections of relative sea-level rise, flooding, and coastal erosion in the western Arctic require a good understanding of vertical motion and sea-level rise. Safe and sustainable hydrocarbon production in the Mackenzie Delta requires the same information on regional trends combined with estimates of delta loading, compaction, and future production-induced subsidence. Beginning in 2001, we have established an Arctic network of GPS stations, including continuous GPS (CGPS) at Inuvik and Resolute and CGPS co-located with tide gauges at Tuktoyaktuk and Ulukhaktok (Holman) along with other stations in the east. Over time, the data will enable independent measurement of vertical motion and sea-level change. Preliminary estimates of vertical motion range from -2.7±1.1 mm/a at Inuvik to positive values (uplift) at Ulukhaktok and Tuktoyaktuk (where the record is short and frost jacking is a possibility). Geophysical models suggest subsidence at all three sites. The short-term tide-gauge records at Ulukhaktok and Tuktoyaktuk show falling relative sea level (RSL), consistent with uplift, whereas flooded river outlets and submerged tundra polygons, among other evidence, point to a submerging trend. The long-term tide-gauge record at Tuktoyaktuk shows a 35-year RSL trend (1962-1997) of +3.6±1.8 mm/a. If sea-level rise in the Beaufort Sea has been comparable to the global trend during this interval, the implied motion at Tuktoyaktuk is about -2±2 mm/a (subsidence), consistent with the 5-year GPS estimate at Inuvik. In the Mackenzie Delta, long-term subsidence due to sediment loading is slower. Furthermore, compaction in the upper part of the modern delta is limited by 100 m of permafrost, but continues at greater depth and in thaw taliks below lakes deeper than 2 m. We show preliminary GPS results from the delta and examine some of the challenges and opportunities using GPS, InSAR, and LiDAR in measuring the various components of subsidence on the complex delta surface.

H01-1B4.8 **12:15**

Hydroclimatic Controls on the Water Balance and Fluctuation of Lake Athabasca

Daniel Peters[1], *John Gibson*[2]

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Lake Athabasca (7,800 km^2; mean depth 20 m), the 8th largest in Canada, is situated at the mouth of the Athabasca (~160,000 km^2) and Peace (~295,000 km^2) River systems, which make-up the headwaters of the Mackenzie River Basin (~1.8 million km^2). Although not a direct tributary to the lake, the Peace River controls the rate of outflow and occasionally contributes to the delta-lake complex via reversed flow during flood events. At the west-end of the lake, deltas formed by the Birch, Athabasca, and Peace Rivers have extended into the lake, creating a complex of channels, levees and wetlands of varying surface connectivity to the main flow system: the Peace-Athabasca Delta. Lake Athabasca serves as a regulator of flow (>271,000 km^2), biogeochemistry and sedimentation to Great Slave Lake and downstream to the Beaufort Sea. Several recent studies have focused on the importance of extreme flood events to perched wetlands and the influence of hydroelectric reservoir operations on this delta-lake system. Addressing a knowledge gap, the purpose of this paper is to provide a contemporary (1931-2003) understanding of the hydroclimatic controls on the balance of water and level of Lake Athabasca. A quantification of the relative importance of upstream riverine inputs versus local precipitation onto the lake and evaporation from the surface will be provided. This paper is the second in a series examining the hydroclimatology of the large lakes within the Mackenzie River Basin.

H05-3C4.1 **13:30**

The Science of Instream Flow Needs in Canada

Daniel Peters[1], *Donald Baird*[2]

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The natural flow regime (e.g., magnitude & timing) of many streams in Canada has been altered with the introduction of dams, diversions, and water withdrawals (e.g., irrigation, hydroelectric power production, and municipal/industrial uses), as well as via landscape alterations (e.g., agriculture and urbanization). Associated with changes to the flow regime are potential negative impacts to the structure and functioning of the riverine system. Over the last three decades there have been numerous simple to sophisticated instream flow needs methodologies developed to estimate the quantity of water through time required to maintain the 'health' of a river in a particular state. The purpose of this paper is three-fold: 1) review the state of knowledge of instream flow needs in Canada, 2) compare and contrast the instream flow needs methodologies currently proposed and/or applied in the Provinces and Territories of Canada, and 3) discuss the potential of an ecological instream flow needs assessment methodology that can be applied to small agricultural watersheds across Canada, taking into account regionally hydroclimatic and ecological variability.

I07-3C8.7 **15:15**

Comparison of Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS) and Purple Crow Lidar (PCL) Temperature Profiles in the Middle Atmosphere

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ACE-FTS is the primary instrument aboard SCISAT-1, the first Canadian Space Agency small science satellite. ACE uses solar occultation to measure vertical profiles of temperature, pressure, and the volume mixing ratios for several dozen chemical species. The principle scientific goal is to monitor the chemical and dynamical processes affecting the distribution of ozone in the stratosphere and upper troposphere, particularly at high latitudes. ACE measurements can also be used to study the effects of climate change on atmospheric chemistry. The University of Western Ontario's Purple Crow Lidar (PCL) is a large power-aperture product monostatic laser radar capable of simultaneously measuring Rayleigh, Raman, and Na-resonance fluorescence scattering, allowing temperature measurements to be made from the upper troposphere to the lower thermosphere. For this comparison, 7 nights of coincident ACE and PCL measurements were examined. These comparisons revealed a small bias towards higher temperatures in the ACE version 2.2 data. This difference was traced to an apodization problem in the ACE retrievals. The ACE temperatures have been reprocessed with an improved algorithm which improves the apodization (version 3.0). The comparison with version 3.0 temperatures shows that the agreement has improved. Due to the complexity of the ACE retrievals, error estimates are not part of the standard ACE data releases. The coincident ACE-PCL measurements have been used to estimate an ACE temperature error of about +/- 1.8 K.

A06-2B7.7 **12:00**

Longwave cloud forcing as a trigger for the Arctic melt onset

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The Arctic Ocean melt season begins in the end of spring/beginning of summer as a result of the seasonal increase in insolation. Although the solar radiation increase is necessary for the surface temperature to reach the melting point, it is the cloud longwave forcing that regulates the timing of this event. The SHEBA data show that the time of the melt onset is associated with cloudy conditions causing an increase in the downwelling longwave radiation and a substantial drop in the downwelling shortwave flux. The amount of the absorbed solar radiation is further decreased by the high albedo of the snow-covered surface. The increase in the downwelling longwave flux in the end of May favoring the melt onset is associated with the large cloud liquid water path, warm cloud base and several days of continuous cloud presence. Satellite observations show a recent positive trend in cloudiness and downwelling longwave flux at the surface during the spring. The consequences of the seasonality in the radiative fluxes change for the sea ice thickness are explored using a simple thermodynamic sea ice model.

I09-3C9.3 **14:15**

Seasonal Variations of the Accuracies of GPS-Derived Water Vapor

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The determination of the amount and its accuracy of water vapor content in the troposphere is one of the fundamental issues in the weather forecasting and meteorological research. GPS, recognized as a novel tool to atmospheric research, can estimate with a high accuracy the wet component of the tropospheric delay, which can further be translated into water vapor content. In nature, the tropospheric delay (particularly its wet component) is highly variable in both spatial and temporal domains. This particular characteristic explains why it is difficult to derive water vapor content from GPS with a consistently high accuracy. In practical applications, the proper labeling of the accuracies of the GPS-derived water vapor content products is very important. Considering this, in this paper we aim to investigate the temporal variations of the accuracies of the GPS derived water vapor content during a period of one year, in order to find the correlation between the accuracy variations and the four seasons. In order to assess the accuracies of the GPS-derived water vapor contents, one-year long data sets from a few radiosonde sites that are co-located with GPS receivers are used as references. All the GPS derived water vapor contents are compared with the data from radiosondes. In this study, high precision point positioning (HP3) technique is used to estimate the water vapor contents.

C01-2C6.3 **14:30**

Measuring oxygen concentrations improves the detection capabilities of an ocean circulation observation array

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The North Atlantic meridional overturning circulation (MOC) may weaken or even collapse in response to anthropogenic climate forcing, with potentially nontrivial socioeconomic impacts. One currently implemented MOC observation system uses density observations along a zonal transect in the North Atlantic. The resulting signal has, however, a relatively low signal-to- noise ratio due to large internal variability and observation errors. Observations of hydrographic tracers that are mechanistically linked to MOC changes may increase the signal-to-noise ratio. An MOC slowdown is associated in model simulations with a shoaling of the boundary between North Atlantic Deepwater (NADW) and Circumpolar Water (CPW). This shoaling results in detectable trends in water mass tracers. Here we deploy a virtual observation array into a numerical model starting in model year 2006 to test whether observing the apparent oxygen utilization (AOU) in addition to the MOC intensity improves detection capabilities. Our detection method accounts for observation errors, autocorrelated variability, and uncertainty about the initial conditions. Neglecting the effects of observation errors and the uncertainty about the initial conditions results in artificially early detection times. The MOC signal alone enables reliable detection in roughly five decades. Adding AOU observations reduces this detection time by approximately 40%.

S03-3B3.5 **11:30**

The Distribution, Properties and Role of Snow Cover in the Open Tundra

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The spatial distribution and temporal dynamics of arctic and sub-arctic snow cover have a direct influence on regional and hemispheric energy balance, carbon cycling, hydrological cycles and ecological dynamics. However, the distribution and volume of snow across expansive tundra region are largely unknown. Snow cover data were obtained during intensive field campaigns in a 625 km2 portion of the Daring-Exeter-Yamba river basin from 2003 to 2007. The rugged terrain and remoteness of these tundra regions complicate the ability to extrapolate point snow cover measurements over large basins. Furthermore, the dominance of wind-redistribution events leads to uneven snow accumulation patterns and significant loss of snow cover due to mid-winter sublimation. A terrain model is used was to subdivide the complex tundra landscape into unique classes. Terrain classes for the model were delineated based on both topography (slope and aspect) and landscape (lake, wetland, vegetated and boulder field) character. The model allows for the extrapolation of point snow-depth and density measurements to regional estimates of snow cover properties. The ratio of snow cover among different terrain classes both within and from multiple snow survey years has been useful in determining trends and patterns in regional snow cover distribution. Inter-terrain unit relationships show that the accurate determination of snow water equivalent in flat tundra areas can be used to estimate drift storage and SWE stored on frozen lakes. Composite snowpack chemistry from different tundra terrain classes have been examined and compared to composite Nipher gauged snowpack chemistry to provide estimates of sublimation loss. These data, combined with models of regional snow distribution, are very useful for the development of coarse resolution satellite passive microwave remote sensing to estimate snow cover parameters, as well as for contributions to basin scale hydrological research.

I08-4B7.5 **12:00**

The influence of Antarctic sea ice extremes on large scale atmospheric variability in the Southern Hemisphere.

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The response of the extra-tropical Southern Hemisphere atmosphere to extremes of Antarctic sea ice concentration is investigated using a fully-coupled climate model - the NCAR Community Climate System Model-version 3. Average, maximum, and minimum sea ice concentration climatologies were extracted from satellite-observed sea ice concentrations and used to force the model for three 150-year simulations. Initial results for the atmospheric pressure and temperature fields for the winter and summer seasons are discussed. In summer, poleward of 45S, the atmosphere in the minimum case is warmer, deeper and exhibits greater variability than in the control. The differences between the maximum and control cases exhibit a pattern of negative and positive values extending from New Zealand to the south Atlantic. In winter, poleward of 45S the atmosphere is colder, shallower and exhibits less variability than the control in the minimum case. Physical reasons explaining the large scale differences in pressure and temperature, and potential impacts on the different modes of large scale extra-tropical atmospheric variability are discussed.

I12-3DP.1 **16:00**

Assessing the water and energy balances at the BERMS flux towers, 1999 to 2005

Alan G. Barr[1], *G. van der Kamp*[1], *T.A. Black*[2], *J.H. McCaughey*[3], *R. Granger*[1], *N. Hedstrom*[1], *K. Morgenstern*[2], *Z. Nesic*[2]

(Presented by *Garth van der Kamp*)
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The Boreal Ecosystem Research and Monitoring Sites (BERMS) study area is located in central SK, Canada, near the southern limit of the boreal forest and just north of the prairie aspen parkland. It includes flux towers which continuously measure fluxes of carbon, sensible and latent heat for representative landscape elements including a mature aspen stand on hummocky moraine, a mature black spruce stand on a poorly drained site, mature jackpine on a well-drained outwash sand and a fen overlying outwash sand. The 1999-2005 period includes three extreme drought years (2001-2003) followed by two extreme wet years (2004-2005). This study analyses the water and energy balances at the three mature forest and fen sites before, during and following the drought. It also examines the relationship between energy-and water-balance closure by comparing stand-level water balances with gauged streamflow. Boreal deciduous and coniferous forest stands had contrasting seasonal cycles of sensible (H) and latent heat (LE) fluxes. The contrast was diminished by drought, which deeply depleted soil water at the aspen site, due to enhanced evapotranspiration during the first drought year. The ratio of runoff to precipitation was ~ 20% for the two coniferous stands, and ~ 5% for the deciduous stand, showing a fundamental difference in water use. The fen interacted with the surrounding landscape, providing water to the surroundings during the drought, but receiving water during wet years and discharging it as a “green river”. Independent assessment of the water and energy balances confirmed the importance of energy-closure adjustments to H and LE. Without a closure adjustment to LE, runoff was seriously overestimated at all sites.

A04-4B6.8 **12:15**

Prototyping new products for the Canadian Air Navigation System (ANS). 'TafPlus' and 'V-CMAC'.

Rob Honch, *Steven Laroche*, *Michael Schaffer*, *Bruno Larochelle*

Environment Canada
Contact:

The Canadian Meteorological Aviation Centre has prototyped 2 new weather products for evaluation by the various members of the Canadian Air Navigation System.

The first product, called 'TafPlus' is an enhanced version of the regulatory 'TAF' (aerodrome forecast). TafPlus adds a site-specific forecaster discussion as well as a simplified NWP-based meteogram. TafPlus has been issued regularly for Vancouver, Calgary, Toronto, Montréal and Yellowknife since February 01 2007. The Canadian civil air navigation services provider, NAV CANADA, is currently evaluating the potential of the web-distributed product. The goal of TafPlus is to provide enhanced information so that ANS users are able to make more effective decisions than possible by using the TAF alone.

The second product, which is currently in beta testing, is called 'V-CMAC' (Virtual Canadian Meteorological Aviation Centre). The V-CMAC software is a hybrid of an integrated weather display and a contextual multi-user communication mechanism. Various users, such as Airline Dispatch, Air Traffic Control and Flight Information Centres are able to view real-time weather features (satellite

imagery, surface observations, aerodrome forecasts, aviation warnings) on an integrated platform and conduct one-one or one-many conversations with on-line users of the Canadian ANS. V-CMAC provides a virtual environment intended to help counter the physical barriers which separate the various users of the ANS. The goal of V-CMAC is to provide the ANS users with enhanced communication and common situational awareness.

Both products will be demonstrated and discussed.

G07-1C2.2 **14:00**

A teleseismic study of the upper mantle, St. Lawrence Rift Valley

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The St. Lawrence valley region hosts both the Charlevoix and Lower St. Lawrence seismic zones. This region, classified as a continental rift zone, is monitored by seismographs of the Canadian National Seismograph Network (CNSN). A teleseismic study was conducted over the region, with the objectives being to 1) delineate and characterize velocity anomalies created by structures found within the upper mantle; 2) examine any correlation between local seismicity and features found within the upper mantle; and 3) examine the similarities of the upper mantle within the St Lawrence valley and other world-wide rift valleys, as defined in prior tomographic studies.

One hundred and twenty nine events, generated by earthquakes within the teleseismic zone of 30 to 100 degrees, were gathered using an array of six high broadband seismographs and fourteen short period seismographs. A tomographic inversion method, developed by John VanDecar, was used to analyze 2122 measured P-wave travel-time residuals. The process of inversion has generated P-wave velocity models of underlying structures between 30 and 400 km depth. Results have shown high velocity anomalies in the southwest quadrant and slow velocity anomalies in the northeast quadrant of the region, the transition being perpendicular to the rift valley. No mantle anomaly was found parallel to the rift valley, suggesting that the rifting process did not modify the lithosphere on a large scale. The correlation between the observed anomalies and elastic plate thickness leads to the interpretation that the observed prominent velocity change outlines the boundary of the continental lithosphere.

H05-3C4.5 **14:30**

Determining Instream Flow Needs for the South Saskatchewan River Basin, Alberta, Canada

Wendell Koning[1], *Allan Locke*[2], *John Mahoney*[1]

(Presented by *C. Wendell Koning*)
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In 2000, the Province of Alberta introduced a Water Management Policy for the South Saskatchewan River Basin (SSRB) that called for determination of the maximum amount of water that can be allocated for irrigation and other uses in the Red Deer, Bow, Oldman, and South Saskatchewan River sub-basins. Part of this process was the requirement to determine the instream flow needs (IFN's) for protection of the aquatic environment. IFN determinations were developed to reflect the seasonal pattern and general changes in magnitude, frequency, timing and duration of the natural flow hydrograph both within a year and between years, i.e., intra- and inter-annual variability of flow. The

intent was to provide an instream flow determination based on the ecological need for natural flow variation. To meet these expectations, four ecosystem components were chosen to represent the full extent of the aquatic ecosystem: water quality (mainly stream temperature and dissolved oxygen), fish habitat (using the IFIM method, based on resident sportfish), riparian vegetation (primarily for cottonwood tree communities), and channel maintenance (movement of stream substrate). The IFN values for each of the individual components were integrated to produce an ecosystem based value. The final IFN flow values were generated for 27 reaches in the SSRB using a weekly time-step in a flow duration curve format (in total, 1404 flow curves). There were technical and socio-economic challenges in the process.

A02-1C7.2 **13:45**

An improved global Ensemble Prediction System for operational medium-range weather forecasts at CMC

Martin Charron[1], *Gérard Pellerin*[2], *Lubos Spacek*[1], *Guillem Candille*[1], *Peter L. Houtekamer*[3]

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In spring of 2007, an updated version of the global Ensemble Prediction System (EPS) will become operational at the CMC. The changes made to the previous global EPS comprise, in particular, the use of 20 ensemble members instead of 16, a horizontal resolution of 0.9 degree instead of 1.2 degree (and T149 for the spectral model), a system based on the GEM model only instead of using two dynamical cores (GEM and SEF), an improved data assimilation procedure, the use of a stochastic kinetic energy backscatter scheme, as well as the use of a stochastic tendency perturbation methodology. The updated EPS also uses the multi-parameterization approach.

The new elements of the EPS will be introduced and described. Probabilistic scores obtained with this updated EPS show significant improvements over the previous system. The predictive skill of the 500 hPa geopotential has been improved by about 12 hours for 5 to 15 day forecasts. This presentation will describe the contribution of each new element introduced in the EPS to the improved probabilistic and root-mean-square scores. The benefit for probabilistic precipitation forecasts will also be shown.

A04-2DP.5 **16:00**

An Evaluation of the GEM-LAM (Limited Area Model) over Ontario

Arnold Ashton

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The Canadian Meteorological Centre (CMC) has collaborated this past summer and winter seasons with the Regional Offices of the Meteorological Service of Canada to evaluate the performance of a 2.5 km version of the Global Environmental Multiscale Model (GEM). This high resolution model (LAM) has been assessed over Ontario by the Ontario Storm Prediction Centre to provide an operational meteorologist’s perspective. The summer assessment included lake breezes and thunderstorm mode as well as QPF. The ongoing winter evaluation involves synoptic QPF, snow squalls, the presence of CSI and the accuracy of forecasting mesoscale phenomenon with complex terrain. This poster provides a summary of the findings to date and offers some of the strengths and weaknesses of the GEM-LAM model.

A07-2DP.3 **16:00**

Long Term Atmospheric Measurements at the Barrow, Alaska, Baseline Observatory and the Greenland Environmental Observatory, Summit, Greenland.

Russ Schnell

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The Barrow, Alaska, Atmospheric Baseline Observatory was established in 1973 and has collected continuous data on many atmospheric parameters to the present. The steady global increase in carbon dioxide is well documented at Barrow, as is the largest annual amplitude in global zonal average carbon dioxide concentrations observed on earth. This large annual amplitude reflects, for the most part, the summer growth of forests in Russian and Canada. The rapid increase in the concentrations of chlorofluorocarbons up to the implementation of the Montreal Protocol and the subsequent declines are clearly evidenced in the Barrow data as is the fact that total concentrations of these species are largest in the Arctic. Aerosol light scattering measurements show that there has was a 50% decrease in aerosols flowing to Barrow in the springtime between 1983 and 1990, and then a rebound beginning in the mid 1990s. This may reflect the state of the economy in the USSR and then Russia. Spring snowmelt at Barrow has advanced 10 days over the past 60 years (NWS and Barrow data) and sunlight decreased by 8% due to increased cloudiness. At Summit station, ozone measurements show that the station is essentially situated in the free troposphere for most of the year. Summit is downwind of forest fire effluents originating in Alaska, Canada, and Russia, and occasionally receives pulses of air pollution flowing from Europe. Balloon borne ozonesonde flights from Summit in the spring of 2005 documented some of the lowest stratospheric ozone levels ever observed in the Arctic. NOAA measurement programs at the Summit station will be expanded in 2007 to include continuous measurements of a wide range of halocarbons with a gas chromatograph.

I05-2C8.7 **15:30**

The Coupled Historical Forecast Project: Formulation, goals and experimental results

William Merryfield, Badal Pal, George Boer, Greg Flato, Slava Kharin, John Scinocca

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Global Ocean-Atmosphere Prediction and Predictability (GOAPP) is a new, CFCAS-funded research network dedicated to expanding Canadian environmental prediction capabilities and improving knowledge about the predictability of the climate system. A major component of this new effort is the Coupled Historical Forecast Project (CHFP), which will produce an archive of coupled model retrospective multi-seasonal forecasts whose skill can be evaluated against past observations and compared with that of an existing non-coupled (two-tier) seasonal forecast system. An advantage, in theory at least, of coupled (one-tier) forecasts in that they can predict evolution of sea-surface temperature anomalies due to ocean-atmosphere processes.

GOAPP extends and expands the coupled seasonal forecasting research efforts begun as part of the Canadian CLIVAR Network. This talk will review those efforts, describe the coupled multi-seasonal forecast methodology that has been developed at CCCma, present early results and outline the goals of future development for the CHFP.

A05-1D6.1 **16:00**

Meteorological Model Data Support in Regional Airshed Modeling

Yan Shen

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Some previous studies have investigated that relative errors in meteorological data may be larger than the uncertainties in chemical components. This problem leads to an increasing demand to use meteorological model output as input data in regional airshed modeling. One of the primary tasks of meteorological models is to fill in the huge data gaps between weather stations. There is a wide range of regional meteorological models (.e.g. GEM, MC2, WRF, MM5) available today. Each is capable of solving the complex atmospheric processes needed to generate the necessary meteorological data required for air quality models.

Access to meteorological data is essential for the private sector such as air quality assessment companies. However, there are some restrictions about the usage of meteorological data in Canada. Also, since different meteorological models (.e.g. GEM, MC2, WRF, MM5) include different combinations of boundary layer schemes, microphysics, surface schemes, and convective schemes, there are some limitations and strengths of using different meteorological model data for air quality models.

I04-4B1.2 **11:00**

Insights into the Indian Ocean Tsunami from GPS, altimeters, tide gauges and unstructured mesh ocean models

Julie Pietrzak[1], *Anne Socquet*[2], *David Ham*[3], *Wim Simons*[1], *Christophe Vigny*[4], *Robert Jan Labeur*[1], *Ernst Schrama*[1], *Guus Stelling*[1], *Deepak Vatvani*[5]

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The new generation of unstructured mesh ocean models, have an immense potential as research tools for coastal flow problems. We present results from Delfin, a finite volume hydrostatic model and from Finlab, a finite element fully non-hydrostatic model. The Indian Ocean Tsunami caused colossal devastation. Traditionally, the numerical modelling of tsunamis has been carried out using hydrostatic models on structured grids. However, in order to properly simulate the evolution, refraction, diffraction and reflection of these waves requires the accurate representation of the bathymetry and any islands, for example the island chains of the Andaman and Nicobar Islands. Here models using unstructured grids have an advantage. We use data collected at ~60 Global Positioning System (GPS) sites in southeast Asia to determine the bed displacements that occurred in the Indian Ocean during the 26 December 2004 Sumatra-Andaman earthquake. The GPS data are first inverted in order to determine the co-seismic slip along the fault and then vertical bed displacements are derived from these results. This data are then used as the initial surface displacement fields in the numerical models of the tsunami. Modelled tsunami waves are compared to sea level displacements as recorded by the Jason-1 satellite altimeter as well as with arrival times as recorded at coastal tide gauge stations. This is found to be an excellent means to differentiate between the accuracy of a number of different GPS inversions. We demonstrate that GPS data should be included as an important component of future tsunami warning systems and that unstructured mesh models have advantages when modelling regions with complex islands chains.

S03-3B3.7 **12:00**

Satellite passive microwave retrieval and validation of snowfall over high-latitude oceans

Grant Petty, *Longtao Wu*

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Satellite passive microwave radiometers have long been employed to estimate global ocean precipitation rates and monthly totals. But particular challenges are encountered at high latitudes, on account of (1) the high percentage of precipitation that reaches the surface as snowfall, which is intrinsically more difficult to detect via passive microwave methods than rainfall, and (2) the near-total absence of high-quality validation sites. Established passive microwave retrieval algorithm for the Special Sensor Microwave Imager (SSM/I) and the Advanced Multisensor Microwave Radiometer (AMSR) yield similar results at low latitudes but diverge by a factor of two to three at high latitudes, especially during the wintertime when surface snowfall is prevalent. It is therefore essential that these differences be resolved with the aid of high-quality in situ observations of snowfall, particular in view of the planned Global Precipitation Mission (GPM), which explicitly includes high-latitude precipitation as one of its key measurement objectives. Yet in situ observations pose their own technical challenges, including undercatchment of snow and possible orographic effects due to island terrain. Nevertheless a number of existing island weather stations scattered throughout the far southern and northern oceans and previously overlooked by the satellite precipitation community show promise as validation sites. In this paper, the state of passive microwave retrievals of snowfall rate over open water will be reviewed, as will be the opportunities for validation from selected islands. We will describe plans to investigate the reliability of conventional gauge measurements from those islands as estimates of snowfall over the surrounding oceans, and we will solicit input from the community concerning methods for detecting and/or minimizing biases in in situ snowfall measurements.

H06-4C4.4 **14:15**

Glacier-climate relationships in the Donjek Range, St. Elias Mountains, Yukon Territory

Brett A. Wheler, Gwenn E. Flowers

(Presented by *Brett Wheler*)
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The St. Elias Mountains are characterized by extreme environmental gradients and host one of the highest concentrations of surge-type glaciers in the world. In order to understand the connections between various scales of climate variability and the dynamic response of glaciers in this area, we have undertaken a study of glaciers in the Donjek Range, on the northern flanks of the St. Elias Mountains. The study aims first to characterize the glacier-climate relationships in the region by examining spatial variations in the surface energy balance. During the first (2006) field season, we initiated glacier surface and bed mapping, traditional measurements of mass balance and meteorological variables, and GPS measurement of surface velocities on a small valley glacier between the Kluane and Kaskawulsh outlet glaciers. Here we present preliminary surface energy balance calculations and an analysis of spatial variations in meteorological variables for three weeks in July, 2006. Lapse rates over the glacier surface are found to be highly dynamic, non-linear, and extremely sensitive to the glacier wind regime, with averages ranging from -0.3 to -1.5 K/100 m. We evaluate all significant components of the surface energy balance during the measurement period using a simple bulk energy balance model and find that 87% of the melt energy is supplied by radiation and 13% by the sensible heat flux. The latent heat flux is small and negative on average. For

a turbulent exchange coefficient of 0.003 to 0.004 the modelled energy balance is within 2 W/m^2 of that calculated from surface lowering at ablation stakes. Despite this agreement, significant discrepancies are found between the model- and measurement-based calculation of melt energy on shorter timescales. To put these results in a regional context we compare them to meteorological records from nearby weather stations and to daily NCEP 500 mb analysis charts.

A06-1D7.3 **16:30**

In situ and Remote Observations of Microphysical Properties of Mixed-Phase Clouds in the Arctic

Paul Lawson[1], *Paquita Zuidema*[2], *Brad Baker*[1], *Bryan Pilson*[1], *Qizu Mo*[1]

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Microphysical data collected by the National Center for Atmospheric Research (NCAR) C-130 research aircraft during the Surface Heat and Energy Budget in the Arctic (SHEBA), and millimeter radar measurements onboard the SHEBA ship, which was frozen in the Beaufort Sea at 78° N latitude, are discussed and compared. Four days in 1998: 8 July, a mid-level all-ice cloud, 29 July, a boundary-layer all-water cloud, and two mixed-phase clouds, 18 July, a deep stratus cloud and 28 July, a deep cloud with embedded convection, are analyzed. A feature of this study is that for the first time, 2D particle probe imagery is being used in the microphysical analysis. Previous studies reported in the literature used 1D probe and cloud particle imager (CPI) data, but these probes do not adequately capture the large portion of the particle size distribution (i.e., > about 600 microns). The current analysis shows that, for example, particles 1 to 3 cm in dimension were observed on 28 July, and including the larger particles on 18 July increased the measured ice water content from less than 0.5 g m-3 to more than 2 g m-3. In mixed-phase clouds the CPI particle probe data are separated into water and ice portions of cloud and microphysical properties, including particle size distributions, liquid and ice water contents, effective radii, extinction coefficient and equivalent radar reflectivity are computed and compared with products from the millimeter radar. Agreement between in situ and radar produces is good in the all-water and all-ice clouds, but as expected, the radar cannot retrieve liquid water content, effective radius and extinction coefficient in mixed-phase clouds with ice of appreciable size and mass. The exceptionally high ice water contents (> 2 g m-3) observed in the 18 July mixed-phase cloud and the very large aggregates (up to 3 cm) observed on 28 July are unexpected in Arctic clouds. There was incidence of 3 to 5 mm graupel particles on 28 July. Also, supercooled liquid water was observed at -37°C on 28 July. Supercooled liquid is generally only observed at this cold temperature in the protected cores of strong thunderstorms, but may be due to the very low concentrations of ice forming nuclei observed by C-130 instumentation. Finally, on 18 July, 1 to 3 km pockets with high concentrations of small ice particles are observed embedded within the deep stratus cloud. One instance of these high ice concentrations was observed at -12°C, a temperature where there is no known ice multiplication mechanism. The inhomogeneous structure of the mixed-phase Arctic clouds, with layers of ice overlying layers of water, pockets of high ice concentrations at temperatures from – 4 to – 12°C, supercooled drizzle at -19°C, supercooled cloud drops at -37°C, ice particles up to 3 cm and ice water contents up to 2 g m-3 present formidable challenges for remote satellite retrievals, radiative transfer and climate models.

S01-1B3.8 **12:15**

Changes in quantity and variability of runoff from Alpine basins with climatic fluctuation and glacier decline

David Collins

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Impacts of climatic fluctuation on amount and year-to-year variability of runoff were assessed for three moderately-glacierized (36–66% ice cover) and two (near-)ice-free (0–1.9%) headwater sub-basins in the Alpine Aare and Rhône basins, Switzerland between 1900 and 2005, during which period glacier recession was largely sustained. Runoff in the most highly-glacierised sub-basin mimicked annual mean summer air temperature through two warming cycles. In the least glacier-covered basin, the pattern of runoff variation was inverse, reflecting changes in total annual precipitation. Coefficients of variation were used to characterise runoff variability. Variability of flow increased with level of discharge in only the most highly glacierised sub-basin. Coefficient of variation of runoff was less in moderately-glacierized than in (near-) ice-free precipitation-influenced basins, but increased slightly in basins with between 40 and 66% glacierization as energy-availability for snow/icemelt dominated. Overall, however, variability of runoff was negatively related to percentage glacierisation. Summer air temperature (May-September average) increased to the late 1940s – early 1950s before declining to the late 1970s. An increase in 25-year mean summer air temperature of 1.13°C between 1956–1980 and 1981–2005 was coupled with a 13% reduction in mean total annual precipitation. Between the cooler wetter 1960s through 1970s and the warmer drier 1980s through 2000s, runoff variability decreased in the basins having between 0 and 40% glacierization but increased in the more highly glacierized basins. Should warmer air temperatures and drier conditions be sustained, and glaciers continue to decline, runoff will ultimately be reduced irrespective of basin glacierisation but year-to-year runoff variability may either increase or decrease depending on basin glacier cover.

I01-2B8.1 **10:30**

Surface Wind Channeling in the St. Lawrence River Valley

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The presence of orography and complex terrain can lead to thermally and dynamically induced mesoscale wind fields. The phenomenon of channeling refers to the tendency for the winds within a valley to blow more or less parallel to the valley axis for a variety of wind directions above ridge height. The St. Lawrence River valley is a primary topographic feature of eastern Canada, extending in southwest-northeast direction from Lake Ontario, past Montreal and Quebec City and terminating in the Gulf of St. Lawrence. It has long been known to forecasters in eastern Canada that, under certain preferred distributions of the synoptic-scale pressure field and atmospheric stability, the winds within the St. Lawrence River valley can become channeled in the direction of the component of the pressure gradient force aligned along the valley axis, so-called pressure driven channeling.

The objectives of this study are to examine the long-term surface wind climatology within the St. Lawrence River valley. In particular, we will investigate the importance of the various channeling mechanisms within the valley and document the existence of countercurrents associated with pressure driven channeling. The strength and effectiveness of the pressure driven channeling is controlled to a large extent by the synoptic-scale pressure field, namely the position and strength of the cyclone-anticyclone couplet. We will show further that the large-scale factors combined with the orographic forcing provide a mesoscale focus for the frequent occurrence of freezing rain events in the St. Lawrence River valley.

A07-3B7.6 **11:45**

Cloud occurrence at Arctic atmospheric observatories

Matthew Shupe[1], *Taneil Uttal*[2], *Daniel Wolfe*[2], *David Welsh*[2]

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Clouds are of great importance in the Arctic both through their modulation of atmospheric radiation and their pivotal role in the hydrologic cycle. Key factors determining the manner in which clouds impact these climatically important processes are their occurrence fraction, vertical distribution, phase balance, total condensed liquid water, and total optical depth. The composition of clouds can be influenced by synoptic and mesoscale activity, topography, and surface conditions, all of which are uniquely manifested in different regions. In recent years, intensive observations of clouds have been carried out by active and passive remote sensors at a number of atmospheric observatories across the Arctic. In particular, there has been one year of such observations over the Arctic Ocean, nine years of observations in Barrow, Alaska, and approaching two years of observations in Eureka, Canada. A comparison of cloudiness from these three locations highlights the overall frequent occurrence of clouds in the Arctic and the predominance of low cloudiness. However, there are interesting differences between sites which are likely associated with local climate. These differences reinforce the need to make intensive cloud observations at multiple Arctic sites.

A07-2C7.1 **14:00**

IASOA in a global context: requirements for inclusion into the Integrated Global Observation Strategy.

John Burkhart[1], *Georg Hansen*[1], *Kjetil Tørseth*[1], *Taneil Uttal*[2], *James Drummond*[3]

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IASOA is intended to coordinate activities regarding atmospheric observations at various research platforms throughout the Arctic. The program was initiated as an IPY effort and will form a basis as the atmospheric component of an Arctic Observing Network (AON). The Arctic has long been recognized as a sensitive indicator of climate change, and over the past 100 years has warmed nearly twice the amount as the global average warming. Furthermore, despite having limited sources of pollutants, the Arctic is a sink for numerous globally transported pollutants. The mechansisms driving change in the Arctic, and the transport pathways for various compounds are complicated, and not fully understood. A primary objective of IASOA is to lead the synthesis of data to answer questions related to atmospheric change in the Arctic system.

The International Global Atmospheric Chemistry Observation (IGACO) theme of the Integrated Global Observation Strategy (IGOS) has the aim to provide data and information required to quantify changes in the atmosphere on a global scale. Integrating data sets from ground-based, airborne-based, satellite, and data synthesis programs, the program will provide resources for scientists and policy makers to characterize the state of the atmosphere and evaluate observed changes.

We outline the requirements of IASOA such that it will enable seamless integration into the IGACO framework. Measurements of specific chemical species, key atmospheric parameters, and accuracy assurance are required in the IGACO framework. This paper presents an analysis of the present state of the observatories which will form the core of IASOA, and provides recommendations for future development of the network components.

I08-3DP.3 **16:00**

Summer minimum Arctic sea ice extent and the associated summer atmospheric circulation

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Interrelationships between year-to-year variations in September Arctic sea ice extent and summer sea level pressure and surface air temperature at high northern latitudes are examined, making use of microwave satellite imagery and atmospheric data for the period 1979-2006. Linear trends and year-to-year variability about the linear trend lines are considered separately: the latter gives a clearer indication of the physical linkages between fields. Years with low September sea ice extent tend to be characterized by anticyclonic circulation anomalies over the Arctic, with easterly wind anomalies over the marginal seas where the year-to-year variability of sea ice concentration is largest. It is hypothesized that the summer circulation anomalies influence sea ice extent principally by way of the Ekman drift in the marginal seas. The associated surface air temperature anomalies also tend to be largest over the marginal seas, with positive anomalies over the regions of reduced sea ice.

I13-4B9.4 **11:15**

Spatial and temporal trends of climate and airborne contaminants from Arctic snow and ice cores: a Canadian IPY contribution

Jocelyne Bourgeois, *Roy Koerner*, *David Fisher*, *Christian Zdanowicz*, *Jiancheng Zheng*

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Three projects, each associated with a distinct IPY core project, are regrouped under this title. The projects are: 1) Paleo-perspectives on environmental change in the High Arctic: the Canadian contribution; 2) Greenland Ice Sheet reactions to past and present climate change; 3) Trends in the distribution of anthropogenic contaminants in the circumpolar region. Collectively, their aim is to document and reconstruct past and present changes in climate and atmospheric contaminant deposition in the Arctic. The activities proposed under these submissions are closely linked in terms of themes and methods and will support each other. For example, the ice cores to be recovered from Mount Oxford, northern Ellesmere Island (project 1) and northern Greenland (project 2) will serve to develop Arctic climate and pollution histories. Likewise, modern snow samples, collected and analyzed at these sites, will contribute to the pan-Arctic spatial survey of contaminant dispersion (project 3). Although some of the field activities will start in the spring of 2007, most will occur in 2008 or later, as in the case of the Greenland ice coring project.

I02-4C8.1 **INVITED/INVITÉ** **13:30**

Sea ice as a reactor for cold-adapted microbes: Insights from the CASES overwintering expedition

Jody Deming

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When seawater freezes, its salt and other impurities concentrate within the liquid fraction of the ice; as temperatures drop further, the ice becomes effectively impermeable and its liquid fraction diminishes

correspondingly, for a strong brine-concentrating effect. The resulting interior liquids of winter sea ice are thus rich in inorganic salts, but they are also rich in dissolved and particulate organic materials, from exopolymers and detritus to living microbes and, presumably, their viruses. The inhabited pores of winter sea ice can thus be viewed as reactors, where usually widely dispersed entities, particularly bacteria and their viruses, can experience very high contact rates. Recent observations, experiments and model results based on sea ice from the CASES overwintering expedition allow construction of a hypothetical scenario in which virally-mediated lateral gene transfer occurs in winter ice. The converging lines of evidence in support of this scenario include the persistence of sizeable populations of microbes in sea ice through winter, the cultivation of bacteria and infective viruses undaunted by extreme winter conditions, the demonstration of microbial-viral dynamics in very cold sea-ice brines, and the viral infiltration of sequenced genomes of cold-adapted bacteria. Studies of exopolymers and enzymes provide insight into microbial strategies for tolerating winter conditions and viral infection and thus possible gene transfers to increase fitness for the cold. With climate-threatened extinction of sea ice, how will loss of these proposed interior reactors for marine microbes impact biogeochemical cycles and ecosystems of the Arctic? Will unique genes be lost to human discovery and exploitation?

O02-1C1.5 **14:30**

Validating and improving Canadian Coast Guard's CANSARP Search and Rescue ocean drift theory

Lindsay Hillier[1], *Entcho Demirov*[1], *Fraser Davidson*[2], *Brian Stone*[3]

(Presented by *Lindsay Hillier*)
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CANSARP is the automated software used by Canadian Coastguard to determine where a person or drift object may be located in the ocean based on environmental inputs and last know position (LKP). These environmental inputs are ocean currents from an operational ocean forecasting system and environment Canada wind predictions. To evaluate the drift predictions in the ocean, CCG deploys surface drifters both during field experiments and when actually searching for a person in the water. Here we present the first steps and results towards formulating a drift prediction validation methodology for CANSARP. We make use of CANSARP scientific, which provides a Matlab environment for testing various drift theories and environmental impacts on search object drift in the ocean. Results from available historical drift observations will be presented and discussed.

I09-3C9.2 **14:00**

A discussion on Height Systems used in Geodesy and Meteorology

<u>*Marcelo Santos*</u>, *Felipe Nievinski*

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Geodesy uses a variety of height systems intended to define the topographical features of the earth. The most natural one are the geopotential numbers. Even though these are the most convenient height system, it is awkward to use because heights are expressed in units of potential. To bypass that, geopotential numbers are scaled by a reference gravity, resulting in the dynamical heights. If the scale applied corresponds to the mean gravity along the plumbline connecting the point on the surface and the geoid, it results in the orthometric heights. If the scale applied is a mean normal gravity (considering the earth as an ellipsoid), this results in normal heights. There is also the heights provided directly by space geodetic methods, such as GPS, the geodetic heights (most commonly referred to as ellipsoidal heights). Meteorology uses a height system based on geopotential heights. Odd as it may seem at first glance, geopotential height is based on pressure, although its (geo)potential connection is not directly visible. Geopotential heights are the ones used to define the vertical position of the layers in numerical weather models. This paper discusses the height systems used in Geodesy and Meteorology, their relationships, and the implications that exist when using numerical weather models for positioning, or, alternatively, when using GPS for meteorology.

S04-4B3.6 **11:45**

Snowpack property variations below the canopy

Patrick Ewing, *Steven Fassnacht*

Colorado State University, Watershed Science
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The canopy of individual trees has a negative affect on the accumulation of snow around tree boles, resulting in a decrease in snow depth inward from the edge of the canopy to the tree trunk. The relationship between the canopy and the distribution of snow depth has been modeled in various methods, including a Monte Carlo technique, and incorporate factors such as snow-ground interface temperature, air temperature, and shape of the tree well profile. The influence of trees on snow distribution has an effect on the total volume of water available in the snowpack of a forest stand and is important when determining the overall water budget of the forest.

Data were collected during the winter of 2007 near Cameron Pass, Colorado to investigate variations in snowpack characteristics between individual conifer trees and adjacent forest clearings. Measurements of depth, snow profile temperature, snow water equivalent (SWE) and layer characteristics were taken in different direc-tions around ten trees (five *Picea engelmanii*, four *Abies lasiocarpa* and one *Pinus contorta*) and in the clearing to determine a) if there are significant variations in these characteristics around an individual conifer with respect to direction, b) the influence on stand-scale SWE of measurements only taken between trees versus the influence of measurements taken both between trees and adjacent to individual trees, and c) what correlations can be made between SWE adjacent to individual trees and SWE at the stand scale.

Underlying the snow measurements are auxiliary tree data, including diameter at breast height, estimated tree height, distance of canopy edge from the tree bole, ele-vation, and distance as well as direction to neighboring trees. Meteorological data from the adjacent Natural Resources Conservation Service Joe Wright SNOTEL sta-tion were used to evaluate consistency and reliability of the data.

S02-2DP.3 **16:00**

Melting snow from passive microwave observations for a microwave/visible blended product: first results

Marco Tedesco[1], *James Foster*[2], *Dorothy Hall*[2], *Edward Kim*[2], *Bhaskar Choudhury*[2], *Richard Kelly*[3], *George Riggs*[4], *John Eylander*[5]

[1] University of Maryland, Baltimore County and NASA Centre des Vols Spatiaux Goddard
[2] NASA Centre des Vols Spatiaux Goddard
[3] University of Waterloo, Canada
[4] Science Systems & Applications, Inc and NASA Centre des Vols Spatiaux Goddard
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Contact: ed.kim@nasa.gov

Snow cover is a key component of the Earth's energy balance and a key storage mechanism for water. In many areas of the world, people rely on snowmelt runoff for their water resources. It is essential that the extent and water content of seasonal snow cover be determined to a degree of accuracy concomitant with the instrumentation available. The ability to characterize snow storage more accurately at the drainage basin scale is crucial for improved water resource management. Global patterns of snow storage are also key components to the understanding of global change. A project aimed at providing snow cover fraction and area, snow water equivalent (SWE), snowmelt onset and snow albedo for the first time into a single, user-friendly product is currently being carried out by the Goddard Snow Team (GOST) at the Goddard Space Flight Center, in Greenbelt, MD, USA, and funded by the Air Force Weather Agency. In this study, we show first results for an algorithm blending melting snow as derived from AMSR-E brightness temperatures with the recently-released MODIS snow cover product at 0.25 degree resolution. Melting snow is detected by means of threshold values on both brightness temperature values and relative differences between daytime and nighttime values (diurnal amplitude variations, DAV). Microwave and visible data are re-projected into the EASE-grid projection with a resolution of 25 km and co-registered for the generation of the blended product. First results obtained over a test area in the northern United States, and Canada are reported for the period February – May, 2003. These results will be validated by means of ground-based measurements and compared with results obtained from space-borne microwave active data (e.g., QuikSCAT).

S02-2DP.4 **16:00**

Validation of a new microwave/visible blended snow product using CLPX-1 observations

Edward Kim[1], *Marco Tedesco*[2], *Dorothy Hall*[1], *George Riggs*[3], *Jim Foster*[1], *Bhaskar Choudhury*[1], *Richard Kelly*[4], *John Eylander*[5]

[1] NASA Centre des Vols Spatiaux Goddard
[2] University of Maryland, Baltimore County and NASA Centre des Vols Spatiaux Goddard
[3] Science Systems & Applications, Inc. and NASA Centre des Vols Spatiaux Goddard
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This study focuses on the SWE and snow cover products under non-melting conditions. The new blended products are derived from AMSR-E brightness temperatures in combination with the recently released MODIS snow cover product at 0.25 degree resolution and re-projected into the EASE-grid.

In this study, we show first results from a validation study that compares the new SWE and snow cover products against field observations from NASA's Cold Land Processes Experiment-1. Specifically, we use observations from the Feb., 2003 Intensive Observing Period in Colorado, USA.

C05-4C5.6 **14:45**

Downscaling temperature and precipitation for glacier mass balance studies

Bruce Ainslie, *Peter Jackson*

University of Northern British Columbia
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High resolution gridded monthly temperature and precipitation fields, under both historical and future climate scenarios are needed for glacier mass balance studies in the Western Cordillera. In this study a novel hybrid statistical / dynamical downscaling approach is developed which first uses a mesoscale model (RAMS) to develop high resolution meteorological fields over areas of interest. The meteorolgical fields are bias corrected using observations and then statistical downscaling techniques are used to relate coarse resolution NCEP Reanalysis data to the high resolution bias-corrected fields. The statistical transfer functions are then applied to GCM output for future climate scenarios. The method is validated by comparison with prism gridded data and with independent precipitation and temperature observations. The presentation will show preliminary results from the study.

S05-1D3.7 **17:30**

What? Another Snow Day! : Driving Mechanisms of Extreme Snow Events over BC

Mindy Brugman

Pacific Storm Prediction Centre and Coastal and Mountain Meteorology Laboratory, Meteorological Surv
Contact: mindy.brugman@ec.gc.ca

The late fall and winter-time storms affecting British Columbia this year were exceptional in frequency and ferocity – in terms of wind, rain and also snow. In this paper we will focus attention on the record breaking and major snow events during 2006 to 2007 which had high impact weather effects – locally and across the province. Some of the events occurred as isolated heavy snowfalls that caused significant snow days and other storms produced incredible – unprecedented snowfalls that crippled large regions of British Columbia and caused major economic losses. The tremendous snow packs have helped many mountain ski hills but loom precariously as a major flood threat potentially rivaling the 1948 floods depending on springtime snowmelt conditions. Precipitation and temperature model results from the Canadian GEM Global, Regional, Ensemble and LAM will be compared. Driving mechanisms for these extreme snow events will be summarized and factors leading to prolonged snowfalls will be presented. Then a comparison will be made to past major snowy periods obtained by tracking past snow packs and related glacial variations. The controlling effects of climate variables (AO, MJO, ENSO, PDO and solar variations) are examined as well as the expected results from CO2 induced climate warming. Factors controlling the generation of these major snow events – and extended periods of snow days are discussed.

H02-2B4.4 **11:30**

The application of stable isotopes as a tracer of glacial melt water in the Cordillera Blanca, Peru

Jeffrey McKenzie[1], *Bryan Mark*[2]

[1] McGill University
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Glaciers in the tropics are undergoing rapid retreat with many potential devastating consequences for the people who rely on them as a water resource. The Callejon de Huaylas, Peru, is a 5,000 km^2 watershed that trends NW-SE over 130 km between 8º-10º S latitude. This watershed drains Earth's most glacierized tropical mountain range, the Cordillera Blanca, and our previous analyses estimated that upwards of 10-20% of annual (40% dry season) discharge is comprised of glacier melt that is not replaced in the annual hydrologic regime. We present the results of a synoptic sampling campaign during the dry season in July of 2004 and 2005, with an objective to understand the controls on isotopic variability and to test the viability of using stable isotopes of water to quantify the contribution of glacier melt to regional discharge. A total of 85 water samples were collected from rivers, groundwater, and glacial melt throughout the watershed and the stable isotopes ratios ($\delta^{18}O$ and $\delta^{2}H$) were measured. We observe that geospatial dimensions, and in particular the maximum elevation and percent glacial coverage, of the sub-catchments significantly correlate with stable isotope values in both years. We derive a local meteoric elevation effect using samples from non-glacierized sub-catchments and normalize glacierized tributary streams samples. There is an excellent correlation between the glacial cover and the elevation-normalized stream samples. We are able to estimate an apparent glacial contribution area of 20% to the regional watershed, which is greater than the estimated 8% glacial cover measured from remote sensing. The results demonstrate that stable isotopes of water are potentially a useful tool to trace relative glacial melt contributions to a large remote watershed where traditional measurements, such as precipitation sampling and stream discharge, are very limited.

O01-1D1.4 **16:45**

Currents and Hydrographic Variability in Orphan Basin, 2004-06

Yuri Geshelin[1], *John Loder*[2], *Igor Yashayaev*[3]

[1] Climate Data Scientist, Bedford Institute of Oceanography
[2] Head, Ocean Circulation, Bedford Institute of Oceanography
[3] Research Scientist, Bedford Institute of Oceanography
Contact: gesheliny@mar.dfo-mpo.gc.ca

Orphan Basin, a 500-km scale portion of the continental slope and rise north of the Grand Bank, is presently an area of active interest for oil and gas exploration. Its deep water together with harsh environmental conditions pose significant operational challenges. Since 2004 the Bedford Institute, with support from the federal Program on Energy Research and Development (PERD) and industry, has been carrying out an oceanographic observation program in the Basin involving current-meter moorings and an annual water property (CTD) section.

Results from the first year (2004-05) of moored measurements in water depths of 1500 to 2500 m, and from hydrographic surveys in 2004, 2005 and 2006 will be reported. Mean velocities are approximately along-isobath and equatorward (in a large-scale sense) with magnitudes in the 5-10 cm/s range, and with greater vertical shear at the shallower sites apparently associated with the Labrador Current. Peak hourly currents over the 1-year deployment range from 70 cm/s at 30 m below the surface to about 20 cm/s at mid-depth at a 2250-m depth site. The annual cycle of hydrographic variability extends over the whole water column at the 1500-m depth and to about 1000m at the 2250-m site, with a phase lag of about 6 months at depth consistent with advection from the Labrador Sea. The hydrographic sections reveal notable basin-wide changes which are largely in agreement with changes in the corresponding layers of the central Labrador Sea, with both the intermediate (Labrador Sea Water) and deep (Northeast Atlantic Deep Water) waters of the Basin becoming warmer and saltier over the past three years. The sections also show occasional eddies extending over the entire water column.

S01-1B3.4 **11:15**

Continuous mapping of snow depth and density on the Ethan Allen Firing Range, Vermont

Rae Melloh, *Sally Shoop*

CRREL-ERDC
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The impetus of this work was a request to provide a realistic portrayal of distributed snow depth and density on the landscape of the Ethan Allen Firing Range (EAFR) in northern Vermont for ultimate use in a model of vehicle mobility. A realistic snow property distribution that considered the environmental gradients imposed by elevation, ground slope, slope-azimuth, and forest cover type (open, sparse, deciduous, mixed deciduous-coniferous, and coniferous) was desired. An actual historical simulation was not required. This presented a certain freedom to explore snow distribution across environmental gradients in a most general way. We modified meteorological data from an open unforested site near Ethan Allen so that it would reasonably represent changes in temperature, precipitation rate, and radiation (solar and longwave) across the environmental gradients of the EAFR. We used SLTHERM to estimate snow depths and densities for three dates representing early, middle and late phases of seasonal snowmelt. The results were synthesized into equations for snow depth and density as a function of elevation, ground slope, slope-azimuth, and forest type. The equations provide for a continuous mapping of the snow properties on the EAFR landscape rather than a categorical one. The interesting graphical representation of the equations provides a novel way of visualizing snow property distributions across environmental gradients.

O02-1B1.2 **11:00**

Vision for a "CAnadian Network of Operational Oceanography Systems" (CANOOS)

John Loder

Fisheries and Oceans Canada, Bedford Institute of Oceanography
Contact: loderj@mar.dfo-mpo.gc.ca

The federal Departments of Environment (EC), Fisheries and Oceans (DFO), and National Defence (DND) are leading the development of an operational global coupled atmosphere-ice-ocean assimilation and prediction capability for Canada, through an initiative referred to as the Canadian Operational Network for Coupled Environmental PredicTion Systems (CONCEPTS). Evolving collaborations with the Mercator Operational Oceanography Centre (France), academia and other organizations are forming critical contributions to CONCEPTS. To advance its participation in CONCEPTS and in related areas of ocean modelling and prediction, DFO Science has created a national Virtual Centre of Expertise called the Centre for Ocean Model Development and Application (COMDA). A major activity of COMDA is the development of a CAnadian Network of Operational Oceanography Systems (CANOOS), which is envisaged as a coordinated set of existing and new systems for describing and predicting the state of the ocean and its ecosystems. These systems will necessarily build on ocean and atmospheric observing systems, while CONCEPTS will provide a framework for increasing scope, sophistication and capabilities. Examples of existing components of CANOOS are the ocean-ice prediction system for the Gulf of St. Lawrence developed by the Maurice Lamontagne Institute (Quebec) and the reconstruction of interannual variability in snow crab habitat in the southern Gulf of St. Lawrence developed by the Gulf Fisheries Centre (New Brunswick). Marine environment prediction systems developed or implemented by other organizations are also candidates for inclusion in CANOOS. An example of a new system being developed in conjunction with CONCEPTS is the Canada-Newfoundland Operational Ocean Forecasting System (C-NOOFS) led by the Northwest Atlantic Fisheries Centre and the Bedford Institute of Oceanography.

I15-2C9.1 **14:00**

Seasonal and interannual inundation dynamics in boreal environments: A link to high-latitude warming?

Elaine Matthews[1], *Catherine Prigent*[2], *Kyle McDonald*[3], *Fabrice Papa*[4], *Erika Podest*[3]

[1] NASA Goddard Institute for Space Studies
[2] LERMA, Observatoire de Paris
[3] Jet Propulsion Lab., CalTech
[4] Columbia University
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Seasonal and interannual inundation dynamics in boreal environments: A link to high-latitude warming?

Boreal regions, which account for half the world's wetland area, a substantial fraction of all lakes, and major river systems, are experiencing rapid and substantial increases in temperature and altered precipitation patterns. About a third of global methane emissions from wetlands is estimated to come from boreal wetlands. Several recent studies have reported changes in the area of boreal lakes of Siberia and Alaska between the 1950s or 1970s and 2000, suggesting a possible link to high-latitude warming over the last several decades and potentially large methane emissions under future climate regimes. Quantifying high-latitude lake areas using satellite imagery is complicated by natural interannual variability in seasonality and duration of thaw periods, as well as by the inherent difficulty of identifying surface features along the hydro-continuum of rivers, lakes and inundated wetlands. We report on a study that minimizes these definitional and observational problems by relying on a new data set of inundation dynamics derived from a suite of satellite observations optimized for detection of inundation in flooded wetlands, rivers, and small lakes (Prigent et al., 2006, JGR-accepted). This data set represents the first global, multi-year observations of monthly inundation extent and provides a consistent basis for quantifying interannual variations in area, seasonality and duration of boreal inundation. We report on these dynamics and their relationship to climate parameters for the period 1993-2000. This study contributes to establishing the groundwork for investigating large-area changes in hydrological and biogeochemical functioning of inundation boreal environments.

P-1A1.1 **INVITED/INVITÉ 08:30**

Abrupt Climate Change: Past, Present and Future / Changement climatique soudain: passé, présent et futur

Lonnie Thompson

The Ohio State University
Contact: hang@dfo-mpo.gc.ca

Over the last 30 years ice core records have been systematically recovered from eleven high-elevation ice fields, ten of which are located in the low latitudes. Three lines of evidence for abrupt climate change both past and present are presented. First, annually and decadally averaged δ18O (temperature proxy) and net mass balance histories (precipitation proxy) for the last 400 years and 2000 years, respectively, demonstrate that the current warming at high elevations in the mid- to lower latitudes is unprecedented for at least the last two millennia. Second, the continuing retreat of most mid to low-latitude glaciers, many having persisted for thousands of years, signals a recent and abrupt change in the Earth's climate system. Finally, rooted, soft-bodied wetland plants, now exposed along the margins as the Quelccaya ice cap (Peru) retreats, have been radiocarbon dated and when coupled with other widespread proxy evidence, provides strong evidence for an abrupt mid-Holocene climate event that marked the transition from early Holocene warmer conditions in Peru to cooler, late Holocene conditions. This abrupt event, roughly 5200 years ago, was widespread and spatially coherent through much of the world and was coincident with structural changes in several civilizations. These three

lines of evidence argue that the present warming and associated glacier retreat are unprecedented in some areas for at least 5200 years. The ongoing global scale, rapid retreat of mountain glaciers is not only contributing to global sea level rise, but threatening fresh water supplies in many of the world's most populous regions. The current and present danger posed by ongoing climate change and the human response will be discussed.

I13-4C9.2 **INVITED/INVITÉ 14:00**

Polar View and the IPY Ice Logistics Portal

Thomas Puestow, *Charles Randell*, *Desmond Power*

C-CORE
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In collaboration with JCOMM-ETSI, Polar View is developing the IPY Ice Logistics Portal as a convenient point of access to operational sea ice information. The portal will include a standard suite of products consisting of ice information routinely produced by the national ice services and Polar View for both logistics (e.g. sea ice distribution information for shipping) and science (e.g. development and detailed spatio-temporal distribution of ice leads). In addition, specialized, custom-tailored products will be offered in support of specific IPY activities. The products will be generated primarily, but not exclusively, using EO data. The IPY Ice Logistics Portal will be a convenient, single (although not the only) access point for ice-related information. The ice information on the portal will be integrated by geographic area to facilitate user access to products generated for the same area by different national ice services. Polar View will contribute its existing mechanisms to minimize EO data acquisition conflicts and coordinate with EO data providers. Access to the information on the Polar View IPY portal will be open to all IPY researchers. It is anticipated that the IPY ice information portal will continue to function after the end of IPY and become the basis for further integration of operational sea ice products generated by national ice services.

H03-2C4.5 **15:15**

Upper Penticton Creek: Effects of logging on physical water quality

Tim Giles

BC Ministry of Forests and Range
Contact: Tim.Giles@gov.bc.ca

As part of the Upper Penticton Creek Watershed Experiment, physical water quality is being studied in two 500 hectare watersheds (240 and 241 Creeks). The upper elevations of the watersheds tend to be mantled in well-drained sandy tills overlying ridged and hummocky granitic bedrock. Lower elevations are typically blanketed with till on the slopes and glaciofluvial sediments on the flats. Wide riparian floodplains with entrenched meandering creeks are found in both watersheds. There is no evidence of active landsliding as the slopes are generally not steeper than 50%, and when steeper slopes are encountered they tend to be bedrock cored. Accumulations of sediment are noted along the creeks in pools and trapped behind small log jams or single log sills. Natural sediment sources are areas of minor bank collapse, tree upheaval, or, at upper elevations, directly from the bed of the channel. Forestry roads or trails crossing creeks may also be significant sources of loose sediment.

240 Creek is the control watershed and has no logging; 241 Creek has had 30% timber removal. Streamflow data are available from a weir located at the outlet of each watershed. Discrete water samples have been collected by automated samplers and analysed for turbidity and suspended sediment since 1996. Relationships between turbidity and suspended sediment are being developed for

the rising and falling limbs of the spring hydrographs as well as for fall rain-generated flows. Road construction and timber harvesting in the 241 Creek watershed has noticeable short-term impacts on water quality, however the long-term signature of induced sediment movement is poorly defined.

O01-2DP.2 **16:00**

Low-frequency variability of the Labrador Current at 47N

Guoqi Han, Nancy Chen, Dave Senciall

(Presented by *Nancy Chen*)
Fisheries and Oceans Canada
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In this study we used a 3-D tide model to de-tide vessel-mounted ADCP data for the Flemish Cap transect off Newfoundland. The de-tided ADCP currents and volume transport are used to examine seasonal and interannual variability of the inshore and shelf-edge Labrador Current. The ADCP results were evaluated against moored measurements and ocean model results. Effects of de-tiding were also discussed.

G08-2B2.7 **12:00**

Traveltime Calculations Using Spherical Wave Assumptions

John Bancroft, *Xiang Du*

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A new method is presented for estimating the source location of an event, based on the assumption that the event creates a spherical wavefront which is recorded by a number of receivers with fixed locations. This method is suitable for locating microseismic events from well fraccing or identifying areas with unstable geology such as earthquakes or landslides. Other application are for Kirchhoff depth migration in which traveltimes are computed along raypaths then mapped to gridded times, or for propagating first arrival times directly on a grid. Previous methods that computed traveltimes with spherical (or circular) wavefront assumptions used hyperbolic equations to estimate the location of the source. This new method is based on the tangency of spheres (or circles) with radii defined by clock-times. Once the source location and its clock time are defined, traveltimes to any local position can be computed. Spheres are constructed with centers at the receiver locations, with radii proportional to the product of the receiver clock times with the local velocity. An internal sphere that is tangent to the four receiver spheres defines the source location and its clock time. The problem of finding the internal sphere is based on the Apollonius solution of finding an internal circle that is tangent to three other circles (a 2D problem). The numerical method produces two solutions; one will be an internal sphere, and the other an external sphere. The correct solution is the one with the smallest radius.

I01-1D8.7 **17:30**

Contribution of Marine Activities to Ambient Air Chemistry in Coastal Regions of Atlantic Canada, Phase I: Halifax Harbour

Lisa Phinney[1], *David Waugh*[1], *Stephen Beauchamp*[1], *Michael Hingston*[2]

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The air quality in the port city of Halifax is investigated in conjunction with meteorological and ship activity data to identify the effects of ship emissions on ambient concentrations of the Criteria Air Contaminants (CAC's) sulphur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), and ozone (O_3), for the year 2002. The average mixing ratios of these species measured at a downtown Halifax NAPS site were 13 ppb, 43 ppb, 530 ppb, and 23 ppb, respectively. Wind direction determined that 56% of the time air passed over some portion of Halifax Harbour before reaching the air quality monitoring site. The contributions of these across-harbour trajectories to the annual mean ambient concentrations of SO_2, NOx, CO, and O_3 are 57%, 66%, 59%, and 51%, respectively. Highest annual SO_2 concentrations are seen from the direction of the harbour, and are influenced by an Oil Refinery located on the east shore of the harbour and by ship activity, while highest annual NOx concentrations are observed from the direction of the Ferry Terminal, Anchorages, and Coast Guard berths. Thirty episodes were measured during which hourly SO_2 mixing ratios measured at the NAPS site reached peaks above the 99th percentile (50 ppb) and remained above the 95th percentile (38 ppb) for at least one adjacent hour. These episodes accounted for between 1% and 5% of the annual mixing ratios of CAC's measured at the Barrington Street site, and fifteen are identified as likely to have been influenced by ship activity. Two are examined in detail, revealing that marine activity impacted the measurements, leading to elevated levels of SO_2 and NOx. This work concludes that ship activity is an identifiable source of pollutants resulting in reduced air quality in the Halifax area and may constitute up to 30% of the annual SO_2 and NOx mixing ratios.

C02-2B5.4 **11:15**

GRACE satellite signal interpretation over North America and Greenland: The influence of past and present rates of ice-sheet and glacier disintegration

Wm. Richard Peltier

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The Gravity Recovery and Climate Experiment (GRACE) measurements of the time dependence of the gravitational field of the planet provide a unique means of directly measuring the modern rate at which ice covered surfaces of the planet are loosing mass due to high latitude global warming. In regions such as Greenland and Antarctica, however, the interpretation of the observations is made complex because of the fact that these regions were partially deglaciated during the last deglaciation event of the current ice-age, an event that ended approximately 4000 years ago. In order to decontaminate these observations, one needs an accurate model with which one may eliminate the ice-age influence. The ICE-5G(VM2) model of Peltier (2004, Ann. Rev. Earth Planet. Sci., 32, 111-149) that is being emloyed by the international community to make this correction can also be tested by comparing its predictions to the very large amplitude anomaly that GRACE has observed over the Canadian land mass associated with the ongoing rebound of the Earth's crust that is occuring as a consequence of the deglaciation of this region that ended about 6000 years ago. Although the ICE-5G(VM2) model very accurately reconciles the domnant characteristics of the time dependnet gravitational field over this region, the residual misfits can also be usefully employed to further refine the model.

G09-1B2.5 **11:30**

Seasonal effects in a time lapse conductivity survey designed to monitor the migration of sludge in waste rock at Fire Road Mine

Karl Butler[1], *Heather Campbell*[1], *Michele Coleman*[2]

[1] Department of Geology, University of New Brunswick
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NB Coal Limited has been relocating sludge from mine water treatment ponds onto the acid-generating waste rock in its abandoned Fire Road strip mine since 1992. The practice was adopted to address concerns over the land disturbance and potential liabilities associated with an ever growing number of settling ponds. It was also anticipated that the sludge might plug void space within the waste rock thereby reducing the downward diffusion of oxygen and production of acid rock drainage.

In 2004, an EM31 terrain conductivity survey of the mine site revealed that it was possible to locate sludge in the subsurface and infer where it had migrated by mapping spatial variations in apparent conductivity. Elevated apparent conductivities observed over former areas of sludge deposition are likely caused by the presence of water-retentive conductive sludge in the void space above the water table.

We report here on the results of a time lapse survey of apparent conductivity that was undertaken to map the evolution of a ‘plume’ of sludge over a period of several months from the fall of 2005 until the spring of 2006. While there are subtle changes over time that may be related to sludge migration, the dominant changes are seasonal with apparent conductivities reaching a minimum during the mid to late winter. Forward modelling suggests that the main factors controlling this were (i) freezing of moisture in the frost zone, (ii) a drop in the water table, and (iii) a drop in the temperature of the subsurface region (to ~ 6 m depth) sampled by the EM31 instrument. It is possible that apparent conductivity changes associated with sludge movement were somewhat attenuated by the fact that the sludge had been injected into a relatively deep trench excavated into the waste rock, thereby reducing its tendency to migrate laterally through the vadose zone. However, it is clear that methods to control for seasonal effects are an important consideration when attempting to interpret temporal changes in maps of shallow apparent conductivity.

S03-3C3.2 **13:45**

Gauge performance of 2 common solid precipitation gauges in a prairie environment

Jimmy MacDonald, *John Pomeroy*

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Accurate measurement of snowfall is crucial to process hydrology, mass-balance approaches, water resources research and climate change studies. Furthermore, accurate quantification of precipitation inputs is critical as they are the most important input in the hydrology of an environment. The relevance of gauge catch efficiencies has been asserted by the numerous field trials—the most notable being the WMO 1985 CIMO intercomparison. Gauge catch efficiency or undercatch is the result of systematic gauge errors (in design) or more commonly and of a larger magnitude from wind bias (performance). Wind bias is constituted by a deformation of the wind field above the gauge orifice. This deformation causes a larger displacement and acceleration of particles which is turn results in an undercatch in recorded snowfall. An intercomparison of two automated solid precipitation gauges was conducted in the winter of 2005-2006 at St. Denis National Wildlife Area, south-central Saskatchewan. The gauges whose accuracy was verified were the Geonor T-200B and Campbell Scientific TE525 Tipping Bucket gauge with CS705 snow fall adaptor. Both gauges were equipped with alter-shields and validated for gauge catch efficiency based on a reference gauge (Nipher calibrated to truefall by WMO standards). During the snowfall period a variety of storm sizes were observed, displaying windspeeds of < $7ms^{-1}$. Results showed a catch efficiency of 0.74 for the Geonor, and 0.40 for the Campbell Scientific gauge. These results may seem disturbing but demonstrate the need for metadata when synthesizing hydrometeorological data from different sources and environments. Therefore the need for a more thorough analysis of gauge performance with specific focus on alter-shield performance should be conducted in varying station environment/climatic conditions to correct for gauge undercatch losses.

A04-4B6.7 **12:00**

Current and future status of CMC's operational production system

Yves Pelletier

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The Canadian Meteorological Center (CMC) runs, in a fully operational production environment, the models and data assimilation systems that have been developed by its Development Division along with MSC's research groups. The current status of the operational forecasting suite will be reviewed. Significant innovations were introduced in the past year.They include:

35 km global configuration of the GEM model (October 2006)

6-hour spin-up runs of the Regional GEM model (May 2007)

Advances in the operational North American Ensemble Forecasting System

Improvements to the operational system planned for the upcoming year will be presented. These include a report on the ongoing implementation of significant improvements to the Ensemble Prediction System. Follow-up improvements to last year's global model implementation will also be discussed, ranging from additional new data to a major new global model upgrade expected in 2008. Further planned changes or additions to the operational production suite will also be discussed.

C02-3DP.2 **16:00**

Millennial scale Holocene climate oscillations in paleoceanographic records from Atlantic Canada

Evelise Bourlon[1], *Elisabeth Levac*[2]

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The Holocene is a key interval for understanding the present climatic conditions and anticipating future climatic evolution since the boundary conditions of the Holocene climate system were similar to those of the present day climate contrary to glacial intervals.

Multi-centennial and millennial large scale oscillations have been detected in Holocene climatic records from the North Atlantic area. The proposed mechanisms for explaining these oscillations are still debated and their causes are not well constrained. The documentation of the inherent variability of the Holocene climate is crucial to understanding the present climate changes.

The wavelet analysis was used to recognize periodicity in salinity and sea surface temperature in palynological records from LaHave Basin on the Scotian Shelf of Atlantic Canada. Millennial-scale oscillation have been detected and localized in time. Both 900- and 1500-year periods are expressed in

our four datasets. The 1500-year period probably corresponds to the Dansgaard-Oeschger interstadials. Two others periods of about 2200 and 4100 years were also identified.

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The Canadian IPY Master Directory as a Resource for Canadian IPY Scientists

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The International IPY Data Management Committee is working towards an IPY Master Directory that will provide a discovery portal for metadata in either the FGDC (Federal Geographic Data Committee) or GCMD (Global Change Master Directory) standard. This will evolve towards the international ISO standard for Metadata. In Canada, we have been developing a Metadata portal for the ArcticNet program. We propose that this be extended to be the Canadian Master Directory for IPY (CMD-IPY). For those with established Metadata archives, these files can be replicated within the CMD-IPY. For those without established archives or procedures, the ArcticNet structure, modified for the IPY mix of natural, social and health sciences, will be offered to enable metadata contribution to the IPY community. In this presentation we describe the format of the CMD-IPY discovery portal, and address the advantages to the scientists to contribute their metadata to this structure as a contribution to project collaboration and ensuring a data legacy