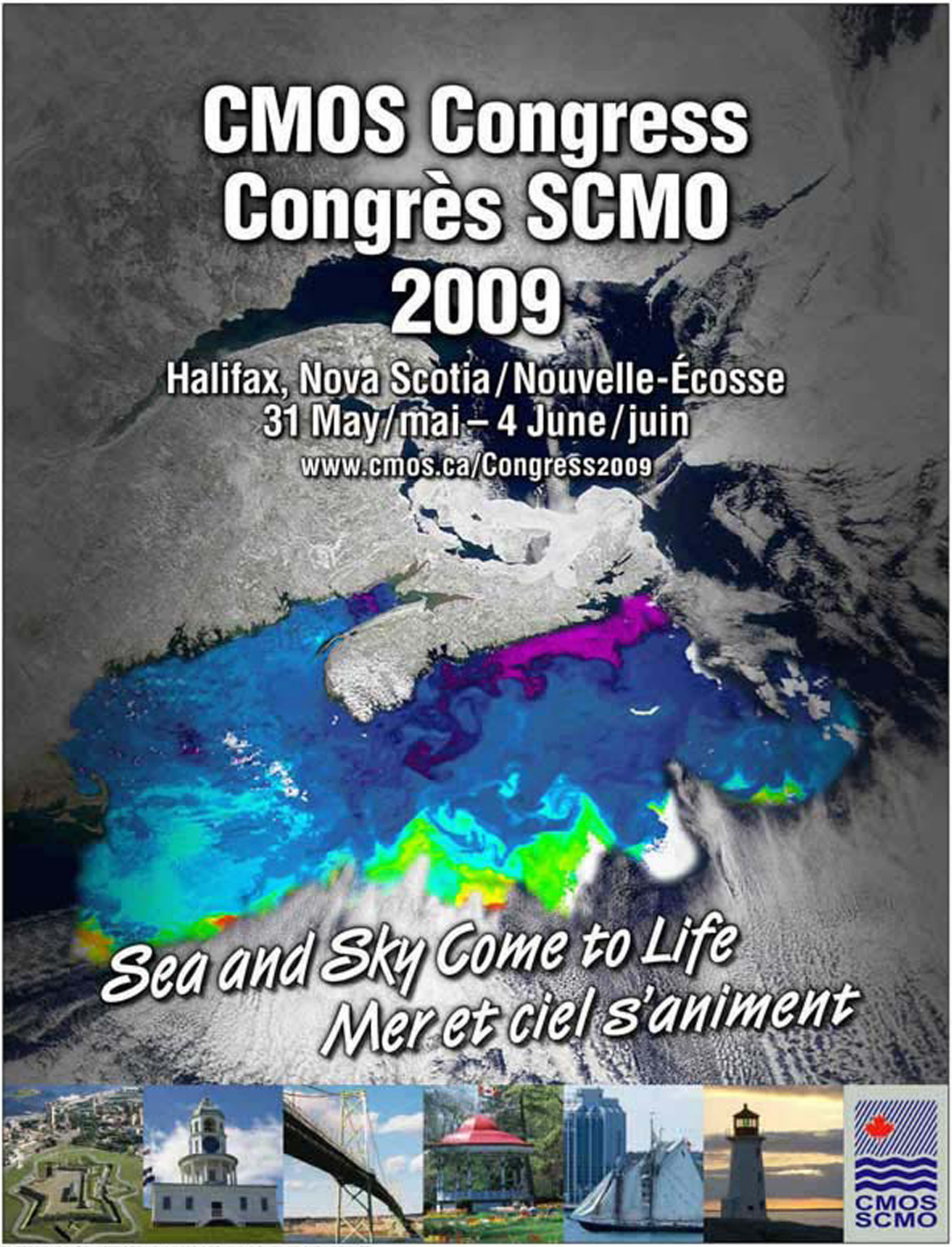

PHOTOGRAPHY COURTESY OF NOVA SCOTIA TOURISM, CULTURE AND HERITAGE

Canadian Meteorological and Oceanographic Society (CMOS)
La Société canadienne de météorologie et d'océanographie (SCMO)

43rd Congress / 43éme Congrès
Halifax 2009

31 May - 4 June / du 31 mai au 4 juin, 2009

Sea and Sky come to Life
Mer et ciel s'animent

Editors / Rédacteurs : Andrew Firth, Yuri Geshelin

PROGRAM / PROGRAMME

http://www.cmos.ca/Congress2009

Abstracts available online at / Les résumés sont disponibles à
https://www1.cmos.ca/abstracts/congress_schedule.asp

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The CMOS 2009 poster is a composite of two satellite images from March 20, 2001. The first image of the land and clouds is a true-color image from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS). This is available in the NASA Visible Earth catalog at **http://visibleearth.nasa.gov/view_rec.php?id=15666**. The second image of the sea surface temperature was obtained from the NOAA AVHRR satellite. The composite was created by Francis Kelly at the Bedford Institute of Oceanography.

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May / mai 2009

Contents

Event Partners / Nos associés

The Weather Network and MétéoMédia:

Canadians have a favorite topic of conversation - the weather. For 20 years, The Weather Network and its French counterpart, MétéoMédia, have been providing weather-related information to Canadians. They are the undisputed leaders of weather information services in Canada across all platforms including TV, web, desktop, mobile and newspapers. One of the core strengths of The Weather Network and MétéoMédia is product and service innovation. Consumers and clients receive added value through the on-going development of in-house meteorological and weather-related content. There are 40 meteorologists on staff, making the parent company Pelmorex Media Inc., the largest employer of meteorologists in the Canadian private sector. The Weather Network and MétéoMédia issue forecasts several times a day for over 45,000 locations in Canada and internationally.

MétéoMédia et The Weather Network :

La météo est de loin le sujet de conversation préféré des Canadiens. Depuis 20 ans, MétéoMédia et son équivalent anglophone, The Weather Network, fournissent aux gens de partout au pays l'information météo dont ils ont besoin. Elles sont les chefs de file incontestées des services d'information météorologique sur des plateformes médiatiques telles que la télévision par câble ou par satellite, Internet, le sans-fil et les quotidiens. Le côté innovateur de MétéoMédia et de The Weather Network en ce qui a trait au développement et à la prestation de produits et services est leur principale force. Tant les utilisateurs des produits et services que les clients des deux sociétés bénéficient de la valeur ajoutée que procure le perpétuel développement interne d'information météorologique. Les 40 météorologues de MétéoMédia et de The Weather Network font de leur compagnie mère, Pelmorex Media Inc., l'entreprise du secteur privé employant le plus grand nombre de météorologues. Ces deux chaînes de télévision diffusent des prévisions plusieurs fois par jour pour plus de 45 000 endroits tant au Canada qu'ailleurs dans le monde.

Welcome from the Premier of Nova Scotia / Mot de bienvenue de Premier Ministre de la Nouvelle-Ecosse

Nova Scotia

Message from the Honourable Rodney J. MacDonald, MLA
Premier of the Province of Nova Scotia
CMOS Congress 2009
May 31 - June 4, 2009

I am very pleased to extend greetings to all members of the Canadian Meteorological and Oceanographic Society (CMOS) who are gathering in our province for the CMOS Congress 2009. Welcome to Nova Scotia!

Our seabound province is an appropriate place for your conference. Your society is concerned with sciences that lead to a better understanding of climate change and its effects on our oceans, coastlines, and inland resources. In Nova Scotia, we take these matters very seriously, and are moving to address them in a number of ways.

The Nova Scotia government has its sights set on being a leader in combating climate change.

We are aggressively reducing greenhouse gas emissions through the actions outlined in our recently released Climate Change Action Plan. The plan works in collaboration with our 2009 Energy Strategy to help prepare our province for the future. Specific actions in the plan focus on alternative energy sources, legislated greenhouse gas and air pollutant reductions, energy efficient homes, transportation, and buildings, and other measures to combat or adapt to climate change effects.

We are also developing a comprehensive water resources strategy and are looking at long-term planning for our coastal areas. Nova Scotia is acting in a coordinated way to deal realistically with meteorological and oceanographic challenges that may arise from climate change. Your society helps to promote the kind of advanced study and research that we need to help make the best decisions possible.

Thank you for your contributions to these sciences. I wish you a very successful conference and hope you enjoy your stay in Nova Scotia.

Sincerely,

Rodney MacDonald

Rodney J. MacDonald
Premier of Nova Scotia

Welcome from the Mayor of Halifax / Mot de bienvenue de la mairesse de Halifax

Greetings from the Mayor

On behalf of Halifax Regional Council, it gives me great pleasure to extend warm greetings and a special welcome to all attending the 43rd Annual Congress of the Canadian Meteorological and Oceanographic Society taking place at the World Trade and Convention Centre, May 31 – June 4, 2009.

CMOS 2009 Congress "*Sea and Sky Come to Life*" will raise awareness and address the latest in the sciences of meteorology and oceanography. It will be an educational experience that will provide delegates with the opportunity to collaborate, share knowledge, and experiences with both national and international participants.

I am pleased that you have chosen Halifax Regional Municipality as the site of your 43rd Annual Congress and invite you to enjoy all our area has to offer. our region's culture is noted for its unique blend of history and tradition, co-existing, comfortably with the contemporary. Enjoy!

Respectfully, I remain

Peter Kelly
Mayor

President's Welcome

On behalf of the CMOS Executive and Council, I'd like to welcome you all to our 43rd Annual Congress: Sea and Sky Come to Life. There is perhaps no better place to reflect this theme than Halifax. With the second largest natural harbour in the world, Halifax is steeped in marine history, both naval and commercial. I hope that you all find some time to explore this wonderful city and enjoy all it has to offer.

For such a large congress to take place, many people have invested numerous years of behind-the-scenes work. We should give our thanks to all the members of the Scientific Program Committee and the Local Arrangements Committee, with particular thanks to the respective Chairs of these committees, Blair Greenan and John Parker. This congress is the culmination of a lot of work for them and their efforts are very much appreciated by everybody here. And many thanks are also due to all the volunteers without whom the congress could never have taken place.

While the CMOS Executive and Council meet by teleconference periodically throughout the year, our congress is a venue at which we can all meet in person, with a number of committee meetings as well as our Annual General Meeting. These meetings are held early on in the Congress and relate to CMOS operations. All CMOS members are welcome to attend these important meetings and get involved in the Society's affairs.

Enjoy the Congress and Halifax!

Sincerely,

Andrew Bush
President, CMOS

Bienvenue du Président

Au nom du Conseil et de l'Exécutif de la SCMO, j'aimerais souhaiter la bienvenue à tous à notre Congrès annuel: Ciel et terre s'animent. Il y a peut-être pas de meilleure place pour réfléter ce thème que Halifax. Avec le deuxième plus grand havre naturel dans le monde, Halifax est riche en histoire marine, à la fois naval et commercial.

Afin qu'un congrès d'envergure aussi grande se matérialise, beaucoup de gens ont investi de nombreuses années de travail derrière la scène. Nous devons offrir nos remerciements à tous les membres du Comité du programme scientifique et du Comité des facilitateurs locaux, particulièrement aux présidents de ces comités, Blair Greenan et John Parker. Ce congrès est le point culminant de beaucoup de travail et leurs efforts sont appréciés grandement par tous. Plusieurs remerciements sont offerts à tous les bénévoles qui ont facilité la mise en place de ce Congrès.

Pendant que le Conseil et l'Exécutif de la SCMO se rencontraient périodiquement par téléconférence durant l' année, notre congrès est une voie par laquelle nous pouvons tous se rencontrer en personne, pour plusieurs rencontres du comité aussi bien que pour notre Assemblée générale annuelle. Ces rencontres se font au début du Congrès et sont reliées aux opérations de la SCMO. Tous les membres de la SCMO sont invités à assister à ces assemblées importantes et à s' impliquer dans les affaires de la Société.

Jouissez du Congrès et de la ville de Halifax!

Sincèrement,

Andrew Bush
Président de la SCMO

Bienvenue du Comité des facilitateurs locaux

Au nom du Comité des facilitateurs locaux, il me fait plaisir de vous souhaiter la bienvenue au 43^{e} Congrès de la Société canadienne de Météorologie et d' Océanographie (SCMO). Le Congrès de cette année, "Mer et Ciel s'animent", met en évidence les liens entre nos sciences de l'atmosphère et d'océanographie et leurs nombreuses disciplines apparentées. C' est avec un grand plaisir que j' assisterai aux nombreuses et diverses présentations ainsi que les affiches.

À la fin d' une journée remplie de la SCMO, le Congrès sera lancer officiellement avec un brise-glace au Brewery Market, qui abrite la plus vieille brasserie opérationnelle de l' Amérique du nord. Riche en tradition et remplie de bons moments, ces établissements peuvent fournir les merveilleuses histoires du passé. J' espère vous voir à cet endroit.

Onze années se sont écoulées depuis le dernier Congrès en Nouvelle-Écosse. En 1998, le Congrès fut présenté sur l' autre côté du havre à Dartmouth. L'évènement de cette année, au World Trade and Convention Centre, prend place au coeur du bas de la ville de Halifax. Situé sur la rue Argyle et à de courtes distances de marche des douzaines de restaurants, de bistrots et de magasins. Seulement à une courte marche dans l' espace de quelques bâtiments se trouve la vue pitoresque du havre.

Beaucoup de travail fut entreprit durant les trois dernières années pour la préparation du Congrès de cette année. Je désire remercier les membres du Comité des facilitateurs locaux et du Comité du programme scientifique pour avoir mis ensemble cet évènement très excitant du Congrès. Ce sont les efforts inlassables des volontaires qui ont contribués au succès de ce Congrès. En plus, aucun Congrès peut être réussi sans l' aide de nos étudiants volontaires. l' expertise de nos présentateurs et le support de nos commandites et nos exposants. Merci à tous.

Notre programme de science est diverse et traite de plusieurs aspects des sciences de la météorologie et de l'océanographie. Les orateurs/oratrices pléniers/plénières sont renommé(e)s internationalement et devraient procurer un départ énergétique pour chacun des quatre jours. Il y aura jusqu'à sept sessions qui se dérouleront en parallel presqu' à chaque jour. Je vous invite à assister, non seulement aux sessions concernant votre discipline, mais à certaines des autres sessions inter-disciplinaires en plus afin d'apprendre comment nos sciences sont appliquées de manières nouvelles et uniques pour adresser les sujets de la société d' aujourd'hui.

Le Comité des facilitateurs locaux et nos volontaires seront à votre disposition durant la semaine pour répondre à vos questions. Vous serez capable de nous reconnaître par les gilets bleus marins que nous porterons. Le Congrès annuel est une occasion de retrouvaille et pour faire de nouvelles connaissances. J' espère que votre visite sera mémorable et que vous serez capable d' ajouter du temps à votre séjour afin de jouir des sites à Halifax et les régions avoisinantes. Je me ferai un plaisir de vous rencontrer et de vous accueillir personnellement dans ma ville natale.

John Parker

Président
Comité des facilitateurs locaux
Congrès 2009 de la SCMO

Local Arrangements Committee Welcome

On behalf of the Local Arrangements Committee, it is my pleasure to welcome you to the 43rd Congress of the Canadian Meteorological and Oceanographic Society (CMOS). This year's Congress, "Sea and Sky Come to Life", highlights the linkages between our atmospheric and oceanographic sciences and their numerous related disciplines. I look forward to attending the many diverse presentations and posters.

After a full day of CMOS committee meetings, the Congress will officially kick off with an Ice Breaker at the Brewery Market, which .houses the oldest working brewery in North America. Steeped in tradition and plenty of good times, these halls are able to share stories of the past. I hope to see you there.

It's been 11 years since the Congress has come to Nova Scotia. In 1998, it was last held on the Dartmouth side of the Harbour. This year's venue, at the World Trade and Convention Centre, is in the heart of downtown Halifax. Located on Argyle Street, it's a very short walking distance from dozens of restaurants, pubs and shopping and just a few blocks away from our picturesque harbour.

A lot of work has taken place over the past three years in preparation for this year's Congress. I would like to thank the members of our Local Arrangements Committee and Science Program Committee for bringing together a very exciting Congress event. It is their tireless volunteer efforts that have contributed to its success. Also, no Congress can be successful without the help of our student volunteers, the expertise of our presenters and the support of our sponsors and exhibitors. Thank you all.

Our science program is diverse, touching on many aspects of the meteorological and oceanographic sciences. The plenary speakers are internationally renowned and should provide for an energizing start to each of our four days. There will be up to seven parallel sessions on any given day. I invite you to attend not only those sessions specifically within your field, but also the inter-disciplinary sessions to learn how our sciences are applied in new and unique ways to address issues in today's society.

The Local Arrangement Committee and our volunteers are at your disposal during the week if you have any questions. You'll be able to recognize us by the marine blue vests we will be wearing. The annual Congress is a time to rekindle old friendships and make new ones. I hope that you enjoy your visit here and that you are able to take some additional time to enjoy the sites of Halifax and its surrounding areas. I'd be happy to meet with you to welcome you personally to my hometown.

John Parker

Chair
Local Arrangements Committee
CMOS Congress 2009

Bienvenue du Comité du programme scientifique

Au nom du Comité du programme scientifique, il me fait plaisir de vous souhaiter la bienvenue au Congrès 2009 de la SCMO. Le thème de ce 43ième Congrès annuel, "Mer et ciel s'animent", fut choisi pour représenter la nature interdisciplinaire croissante de l'océanographie et de la météorologie qui englobe la biologie et la chimie aussi bien que la physique. En effet, ceci se réflète par le fait que cette catégorie "interdisciplinaire" contient presqu'autant de sessions spéciales que toutes les autres catégories combinées. Nous espérons que, par cette tentative d'inclure des disciplines en dehors de la base traditionelle de la SCMO, nous aiderons à augmenter la participation dans notre société et à procurer une voix forte dans l'avenir aux sujets importants pour tous les membres de la SCMO. La grande vision de ce Congrès se réflète aussi dans les présentations plénières de l'ensemble des experts canadiens et internationaux.

Avec des soumissions de 450 résumés, le Comité du programme scientifique et les facilitateurs des sessions spéciales furent défiés pour accommoder tous les résumés dans l'espace et le temps disponible au World Trade and Convention Centre. Je voudrais remercier tous les facilitateurs pour leurs réactivités à mes demandes. Avec sept sessions qui se dérouleront en parallel durant la réunion, il y aura toujours une session d'intérêt à vouloir entendre. Le CPS croit que les sessions d'affiches ont une part intégrale dans le Congrès et on vous encourage à assister à ces sessions dans les après-midis du mardi et mercredi. Les affiches seront exposées pour la durée du Congrès.

Le cours public sera donné mardi soir par Peter Bowyer, le gestionnaire du programme du Centre canadien de prévision aux ouragans. Peter est un orateur dynamique et amusant et je vous encourage à assister à cette présentation sur les leçons apprisent des cyclones tropicaux durant les deux dernières décennies.

J'aimerais offrir des remerciements spéciaux à tous les volontaires qui ont permis de rendre ce Congrès possible. Cela inclut les membres du Comité du programme scientifique, les membres du Comité des préparatifs locaux, les facilitateurs de session, les volontaires présents au congrès qui s'assurent que tout se déroule bien, ainsi que le perssonel du bureau en-tête de la SCMO pour leur temps et leurs conseils spécialisés.

Bienvenue en Nouvelle-Écosse,

Blair Greenan
Président du Comité du programme scientifique

Science Program Committee Welcome

On behalf of the Science Program Committee (SPC), I am pleased to welcome you to the CMOS Congress 2009. The theme of this 43rd Annual Congress, "Sea and Sky Come to Life", was chosen to represent the increasingly interdisciplinary nature of oceanography and meteorology which encompass biology and chemistry as well as physics. Indeed, this is reflected in the fact the "Interdisciplinary" category has almost as many special sessions as the other categories combined. We hope that by attempting to include fields outside the traditional base of CMOS we will help to increase participation in our society and provide a strong voice in the future for issues of importance to all CMOS members. The broad scientific scope of this Congress is also reflected in the plenary presentations from both Canadian and international experts.

With nearly 450 abstracts submitted, the SPC and special session conveners were challenged to accommodate all the abstracts in the space and time available at the World Trade and Convention Centre. I would like to thank all the conveners for their responsiveness to my requests. With seven sessions running in parallel throughout the meeting, there will always be a session of interest to attend. The SPC believes that the poster sessions are an integral part of the Congress and encourages you to attend the sessions on Tuesday and Wednesday afternoons. The posters will be on display for the duration of the Congress.

The public lecture will be given on Tuesday evening by Peter Bowyer, the program manager of the Canadian Hurricane Centre. Peter is a dynamic and entertaining speaker and I encourage you to attend this lecture on lessons learned from tropical cyclones over the past two decades.

I would like to give special thanks to all of the volunteers who made this Congress possible, including the members of the Science Program Committee, the members of the Local Arrangements Committee, the session convenors, the volunteers here at the Congress who are ensuring that everything runs smoothly, as well as to the CMOS Head office staff for their time and expert advice.

Welcome to Nova Scotia!

Blair Greenan

Chair
Science Program Committee

A Word about the Society

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. It is a non-governmental organisation serving the interests of meteorologists, climatologists, oceanographers, limnologists, hydrologists and cryospheric scientists across Canada and internationally. CMOS has a rich history dating back to 1939 when it was known as the Canadian Branch of the Royal Meteorological Society. 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.

Quelques mots à propos de la Société

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 et aux disciplines environnementales connexes au Canada. La Société vise à promouvoir la météorologie et l'océanographie au Canada. C'est un organisme non gouvernemental, servant les intérêts des météorologues, océanographes, climnologues, hydrologues et scientifiques cryosphériques au niveau national et international. La SCMO a une riche histoire qui remonte à 1939 alors qu'elle était connue sous le nom de Section canadienne de la « Royal Meteorological Society». La SCMO a vu le jour officiellement en 1967 et a adopté son nom actuel en 1977 après que la Société météorologique du Canada eut invité la communauté océanographique du Canada à se joindre à elle.

2009 Student Travel Bursary Recipients / Récipiendaires 2009 des bourses de voyage pour étudiants

Student/ étudiant(e)	University/université
Albarran-Melzer, Marna	Centre for Research in Earth and Space Science
Bedard, Joel	École de Technologie Superieure
Bianucci, Laura	School of Earth and Ocean Sciences, University of Victoria
Biswas, Sumita	Earth and Space Science Engineering, York University
Collier, Emily	Earth and Atmospheric Sciences, University of Alberta
Corkum, Matthew	Earth and Space Science, York University
Erven, Lisa	Earth and Ocean Sciences, University of BC
Iserhienrhien, Blessing	Dept of Physics and Astronomy, University of Western Ontario
Jahn, Alexandra	Dept. of Atmospheric and Oceanic Sciences, McGill University
Lapoussiere, Amandine	Institut des Sciences de la Mer, Université du Quebec a Rimouski
Lindenmaier, Rodica	Dept of Physics, University of Toronto
Malik, Khalid	Centre for Research in Earth and Space Science, York University
McCormack, Trudy	Dept. of Atmospheric and Oceanic Sciences, McGill University
McCullough, Emily	Dept of Physics and Astronomy, University of Western Ontario
McLarty, Jennifer	Centre for Research in Earth and Space Science York University
Pogson, Lynn	Dept. of Atmospheric and Oceanic Sciences, McGill University
Steinmoeller, Derek	Dept of Applied Math, University of Waterloo
White, Eric	Dept. of Geography, University of Calgary
Wolfe, Megan	Earth and Ocean Sciences, University of BC

Local Arrangements Committee/ Comité des dispositions locales

John Parker – *Environment Canada*	Local Arrangements Chair
Blair Greenan – *Fisheries and Oceans Canada*	Science Program Committee Chair
Jim Abraham – *Environment Canada*	Sponsorship
Allyn Clarke – *Fisheries and Oceans Canada*	Facilities
Rick Danielson – *Environment Canada*	Chair, Halifax Centre
Frederic Dupont – *Dalhousie University*	Teachers' Day
Colleen Farrell – *Environment Canada*	Social Program
Andy Firth – *Environment Canada*	Publications
Yuri Geshelin – *Fisheries and Oceans Canada*	Publications
Maud Guarracino – *Fisheries and Oceans Canada*	Web Master
Oscar Koren – *Retired*	Exhibits
John Merrick – *Retired*	Local Registration
Ian Rutherford – *CMOS*	Executive Director, ex officio
Jinyu Sheng – *Dalhousie University*	Volunteers
Cindy Vallis – *Environment Canada*	Exhibits
Susan Woodbury – *Woodbury Management Solutions*	Treasurer

Scientific Program Committee/ Comité du programme scientifique

Blair Greenan (Chair) – *Fisheries and Oceans Canada*

Rick Danielson – *Dalhousie University*

Katja Fennel – *Dalhousie University*

Charles Hannah – *Fisheries and Oceans Canada*

Markus Kienast – *Dalhousie University*

Garry Pearson – *Environment Canada*

Helmuth Thomas – *Dalhousie University*

Kumiko Azetsu-Scott – *Fisheries and Oceans Canada*

Tom Duck – *Dalhousie University*

Ian Folkins – *Dalhousie University*

Catherine Johnson – *Fisheries and Oceans Canada*

Steve Miller – *Environment Canada*

Tetjana Ross – *Dalhousie University*

Information

Bureau d'inscription

Heures d'ouverture du bureau d'inscription et de renseignements:

le dimanche, 31 mai	13:00 - 18:00
le lundi, 1 juin	07:30 - 16:00
le mardi, 2 juin	07:30 - 16:00
le mercredi, 3 juin	07:30 - 16:00
le jeudi, 4 juin	07:30 - 12:00

Directives pour les présentateurs/présentatrices:

Présentation orale

Veuillez marquer vos présentations avec le numéro de la session, numéro du papier et le nom du présentateur et de la présentatrice. Nous aurons des volontaires dans les théâtres de lectures au moins 30 minutes avant le début des sessions pour assister avec le chargement des présentations. Votre présentation doit être amenée à votre chambre de session au moins 15 minutes avant le début de la session. Les ordinateurs du Congrès sont équipés avec Microsoft Windows XP Pro, les logiciels Microsoft Office 2003 Pro, le lecteur Adobe Acrobat, le lecteur Quicktime et le lecteur Windows Media. Veuillez apporter vos présentations sur un des média suivant : lecteur disque dur USB, lecteur éclair USB, CD-ROM, CD-R ou DVD. Les présentateurs/présentatrices seront capable d'éditer leurs présentations sur place en utilisant un ordinateur portable avec port USB. Notez que si les graphiques et les échantillons vidéos ne sont pas contenus dans la présentation, alors ils devront être téléchargés. Les présentations générées sur un Macintosh et converties pour rouler sur un PC doivent être examinées sur un PC avant d'arriver à l'assemblée. Dans les cas où la conversion de la présentation n'est pas possible, nous tenterons de faciliter en branchant un ordinateur Macintosh directement au projecteur LCD. N'importe quel lien devrait être vérifié à l'assemblée afin de s'assurer qu'il fonctionne bien. Veuillez remarquer qu'il n'y a pas de ligne internet sur les ordinateurs dédiés aux présentations. Il y aura un ordinateur et un projecteur dans la chambre de préparation des orateurs/oratrices afin de permettre l'essai de leurs présentations.

Présentations des affiches

Les affiches scientifiques pour le Congrès seront situées sur le 1er niveau du World Trade and Convention Centre. Les affiches seront exposées pour la durée du Congrès. Chaque affiche est allouée un espace de 4 pi (1.2 m) par 4 pi (1.2 m). Les tableaux d'affichages peuvent accepter le Velcro ou les épingles (une provision des deux sera disponible). Les affiches pourront être montées n'importe quant après 10 :00 AM le lundi. Les présentateurs/ présentatrices seront obligé(e)s de rester près de leurs affiches pour expliquer leur travail durant la période assignée à la session d'affichage. Les affiches devront être enlevées vers la fin de la pause du déjeuner jeudi.

Horaire de la session d'affichage

Thèmes interdisciplinaires – mardi, le 2 juin entre 15 :30 – 17 :00
Thèmes de l'atmosphère, du climat et d'océanographie – mercredi, le 3 juin entre 15 :00 et 16:30.

Information

Registration desk

The registration and information desk on level 1 of the World Trade and Conference Centre will be staffed daily:

Sunday, May 31	13:00 – 18:00
Monday, June 1	07:30 – 16:00
Tuesday, June 2	07:30 – 16:00
Wednesday, June 3	07:30 – 16:00
Thursday, June 4	07:30 – 12:00

Guidelines for presenters

Oral presentation

Please label your presentation with the session number, paper number and presenter name. We will have volunteers in the lecture theatres at least 30 minutes before the start of the sessions to assist with uploading of presentations. Your presentation must be brought to your session room at least 15 minutes prior to the start of your session. The Congress computers run Microsoft Windows XP Pro with the following software: Microsoft Office 2003 Professional, Adobe Acrobat Reader, Quicktime Player and Windows Media Player. Please bring your presentations on one of the following media: USB hard drive, USB flash drive, CD-ROM, CD-R, or DVD. Presenters will be able to edit their presentations on site using a laptop that has a USB port. Note that if graphics or video clips are not embedded in a presentation, they must be downloaded 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. In cases where the presentation conversion is not possible, we will attempt to accommodate connecting a Macintosh computer directly to the LCD projector. Any links should be checked at the meeting to ensure that they remain functional. Please note that there is no internet connection on the presentation computers. There will be a computer and a projector in the Speaker's preparation room where speakers can test drive their presentations.

Poster presentation

The Science Posters for the Congress will be located on Level 1 of the World Trade and Convention Centre. The posters will be on display for the duration of the Congress. Each poster is allocated a space of approximately 4 ft (1.2 m) by 4 ft (1.2 m). The poster boards can accept both Velcro and pins (a supply of both will be available). Posters can be mounted any time after 10:00 on Monday. Presenters will be required to be by their posters to discuss their work during the assigned poster session. Posters are to be removed by the end of the **lunch break** on Thursday.

Poster Session Schedule:

Interdisciplinary Themes - Tuesday, June 2nd between 15:30 – 17:00
Atmosphere, Climate and Oceanography Themes - Wednesday, June 3rd between 15:00 – 16:30

Directives pour les président(e)s :

Session orale

Un/une assistant(e) sera présent(e) dans la chambre de session. L'assistant(e) sera disponible pour aider à résoudre les problèmes A/V ou techniques d'ordinateur. Chaque ordinateur sera équipé des logiciels suivants : Microsoft Office 2003 Pro, lecteur Adobe Acrobat, lecteur Quicktime et lecteur Windows Media.

Avant le début de la session, le/la président(e) devra communiquer avec l'assistant(e), vérifier si tous les discours sont chargés dans l'ordinateur et si tous les orateurs/oratrices sont présent(e)s dans la chambre de session.

Avant le début de la session le/la président(e) devra s'assurer que chaque orateur/oratrice soit inscrit(e) dans le programme comme présentateur/ présentatrice, ou comme auteur(e), et que chacun/chacune soit suffisamment familier avec le travail pour répondre aux questions.

Le/la président(e) est responsable de faire observer le temps d'ouverture et de fermeture de la session. Le temps alloué pour une présentation inclut la période pour les questions et discussions, ainsi que le changement d'orateur/oratrice. Par considération pour les autres sessions qui se déroulent en parallèle, le temps alloué pour chaque session devra être observé strictement. Un minuteur sera disponible dans chaque chambre de session. Si un espace imprévu apparaît dans l'horaire, cela devra être rempli soit par un papier en réserve, ou une prolongation de la période de questions sur le discours précédent ou par une courte description des sessions affichées concernant la session actuelle.

La mise à jour du programme de session sera affichée à l'extérieur de la chambre bien avant le début de la session. Le/la président(e) recevra une copie de l'assistant(e).

Présentation d'affiche

Les affiches scientifiques pour le Congrès seront situées sur le 1er niveau du World Trade and Convention Centre. Les affiches seront exposées pour la durée du Congrès. Chaque affiche est allouée un espace de 4 pi (1.2 m) par 4 pi (1.2 m). Les tableaux d'affichages peuvent accepter le Velcro ou les épingles (une provision des deux sera disponible). Les affiches pourront être montées n'importe quant lundi après 10:00 AM. Les présentateurs/ présentatrices seront obligé(e)s de rester près de leurs affiches pour expliquer leur travail durant la période assignée à la session d'affichage. Les affiches devront être enlevées vers la fin de la pause du déjeuner jeudi.

Horaire de la session d'affichage

Thèmes interdisciplinaires – mardi, le 2 juin entre 15 :30 – 17 :00
Thèmes de l'atmosphère, du climat et d'océanographie – mercredi, le 3 juin entre 15:00 et 16:30.

Guidelines for chairpersons

Oral-session

One assistant will be present in the session room. The assistant will be available to help with any A/V or computer technical problem. Each computer will be equipped with the following software: Microsoft Office 2003 Pro, Adobe Acrobat Reader, Quicktime Player and Windows Media Player.

Before the session starts, the chairperson should touch base with the assistant, check if all talks are loaded in the computer and if all speakers are in the session room.

Before the start of the session, the chairperson should verify that the person to speak is listed in the program as the presenter, or one of the authors, or otherwise is sufficiently acquainted with the work in order to answer questions.

The chairperson is responsible for opening and closing the session on time. The time allocated for a presentation includes the time for questions and discussions as well as the change over. In consideration of many parallel sessions, the time schedule of the session should be strictly kept. A timer will be available in each session room. Should an unforeseen gap in the schedule appear, it should be filled with a standby paper, an extended question period on previous talks or a short description of the poster sessions associated with the session.

The updated session program will be shown outside of the session room well before the session starts. The chairperson will receive a copy from the assistant.

Poster presentation

The Science Posters for the Congress will be located on Level 1 of the World Trade and Convention Centre. The posters will be on display for the duration of the Congress. Each poster is allocated a space of approximately 4 ft (1.2 m) by 4 ft (1.2 m). The poster boards can accept both Velcro and pins (a supply of both will be available). Posters can be mounted any time after 10:00 on Monday. Presenters will be required to be by their posters to discuss their work during the assigned poster session. Posters are to be removed by the end of the **lunch break** on Thursday.

Poster Session Schedule

Interdisciplinary Themes - Tuesday, June 2nd between 15:30 – 17:00
Atmosphere, Climate and Oceanography Themes - Wednesday, June 3rd between 15:00 – 16:30

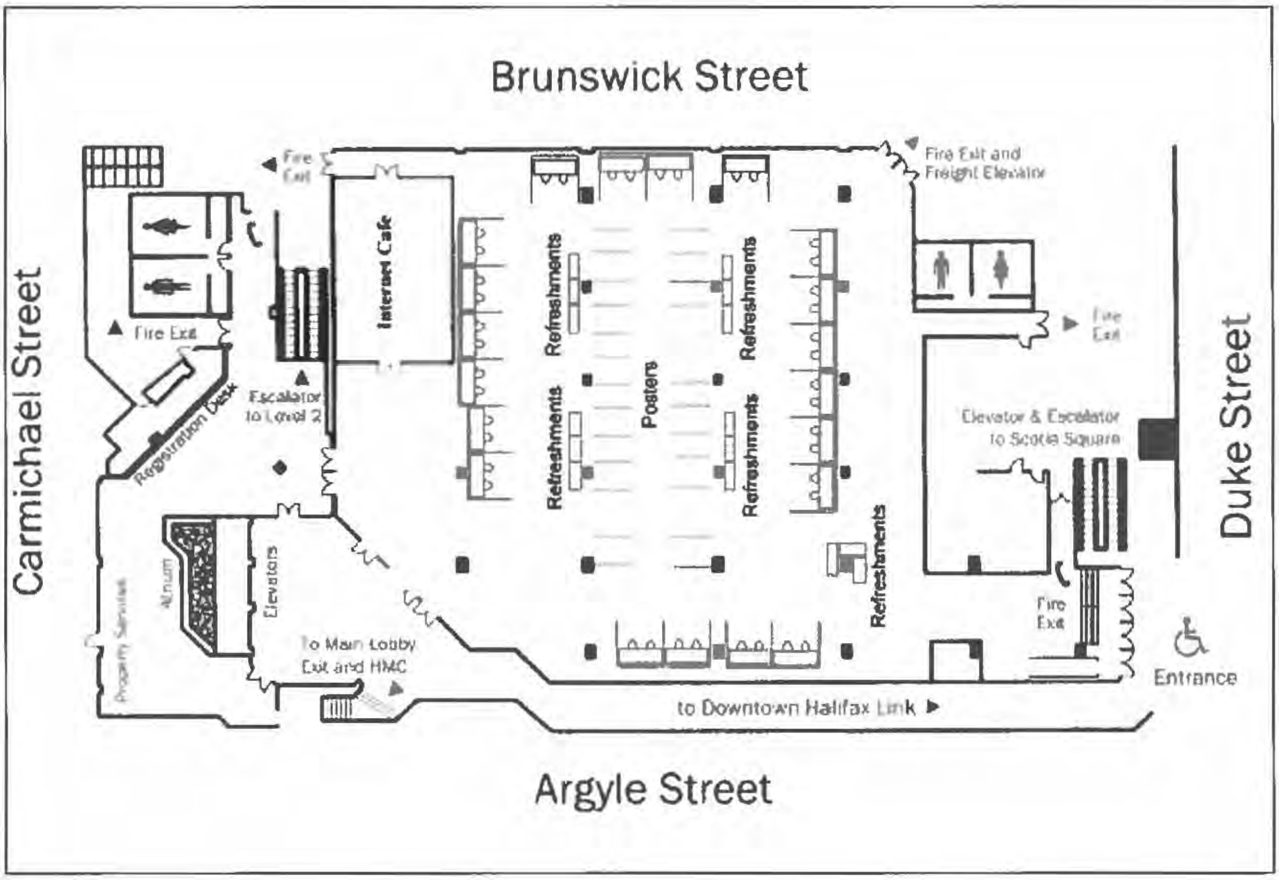
Salles de réunion

Si vous avez besoin d'une salle de réunion en soirée, veuillez contacter un des membres du comité des dispositions locales (ils portent les vestes bleues).

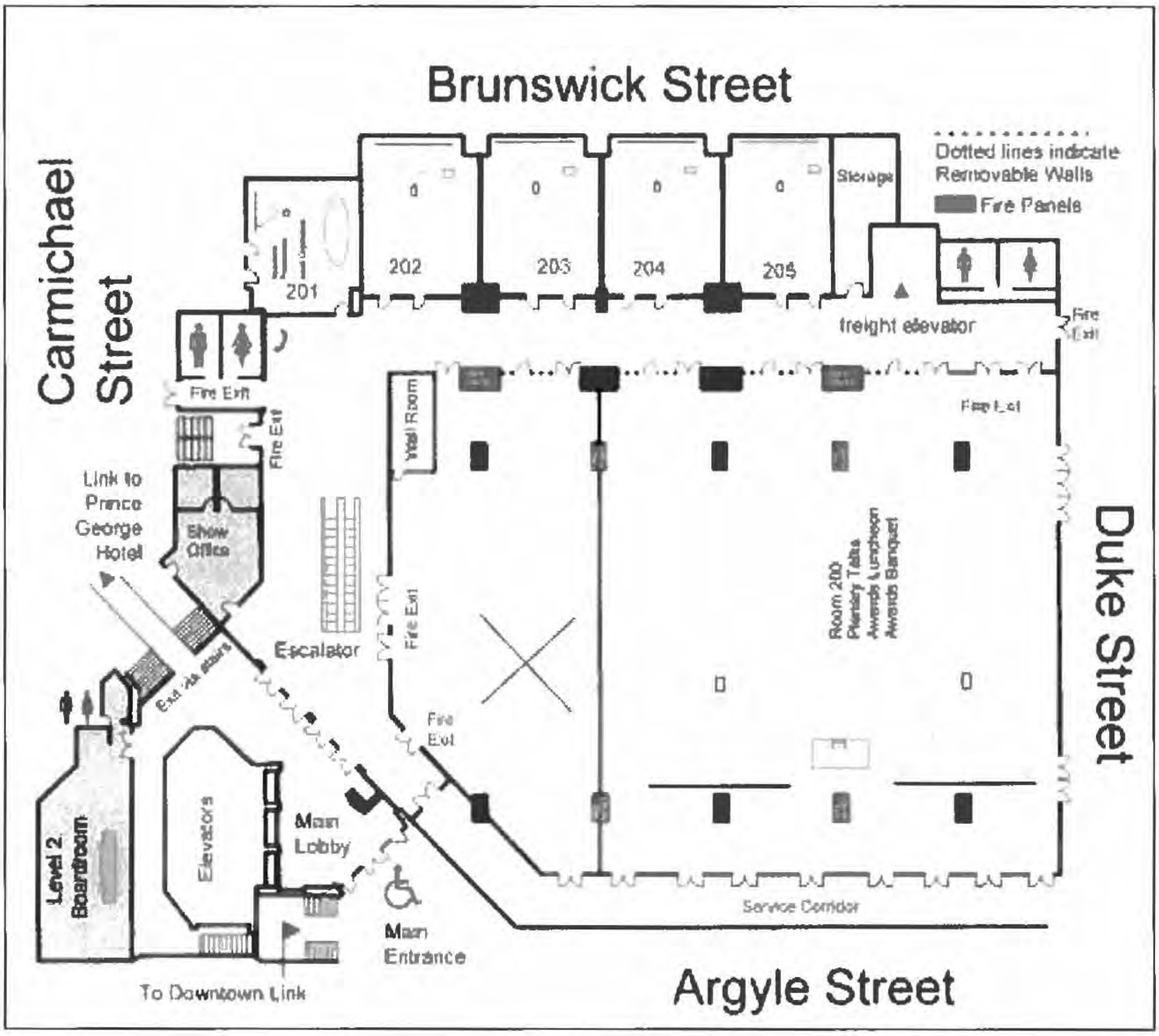
Meeting rooms

If you require an evening meeting room, please contact one of the LAC members (in the blue vests). For meeting rooms, please refer to the floorplans.

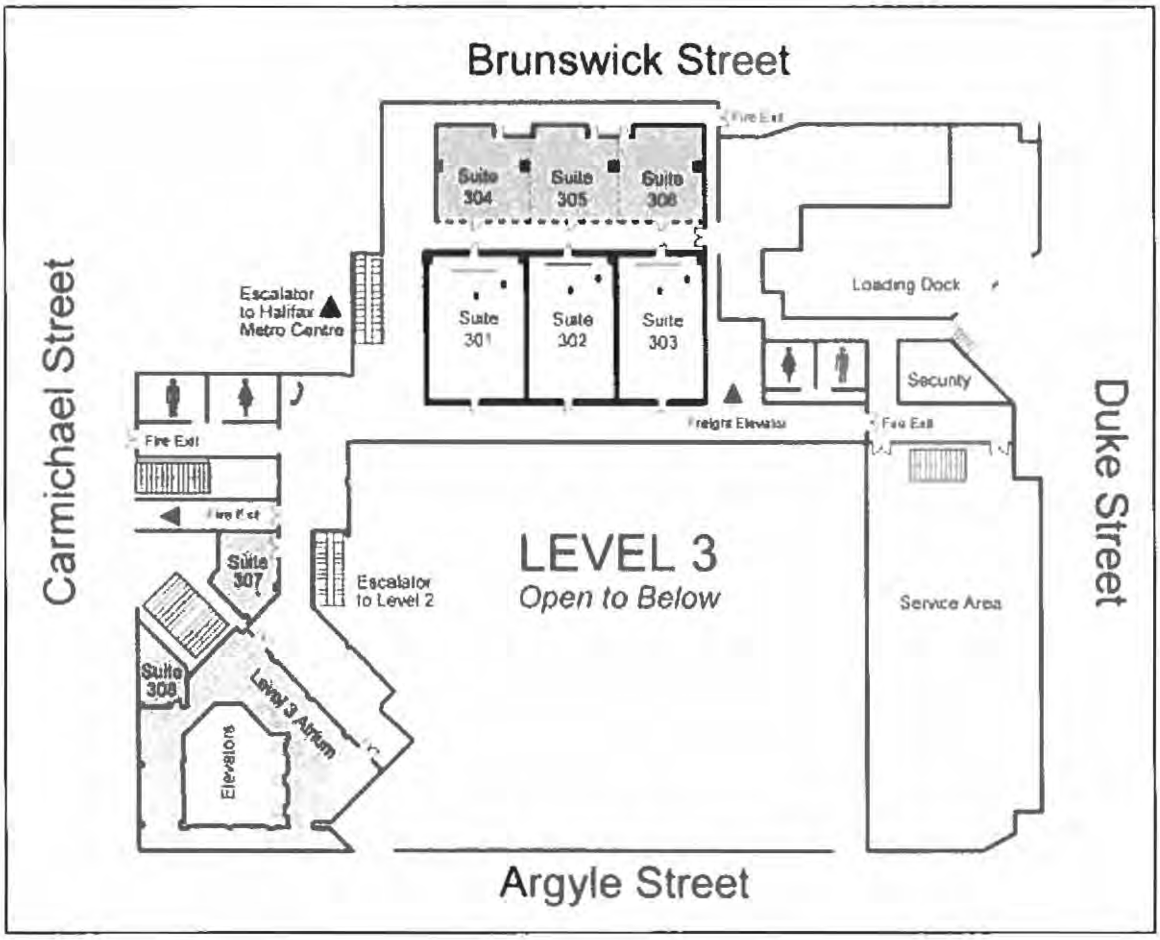
Level 1/Niveau 1



Level 2/ Niveau 2



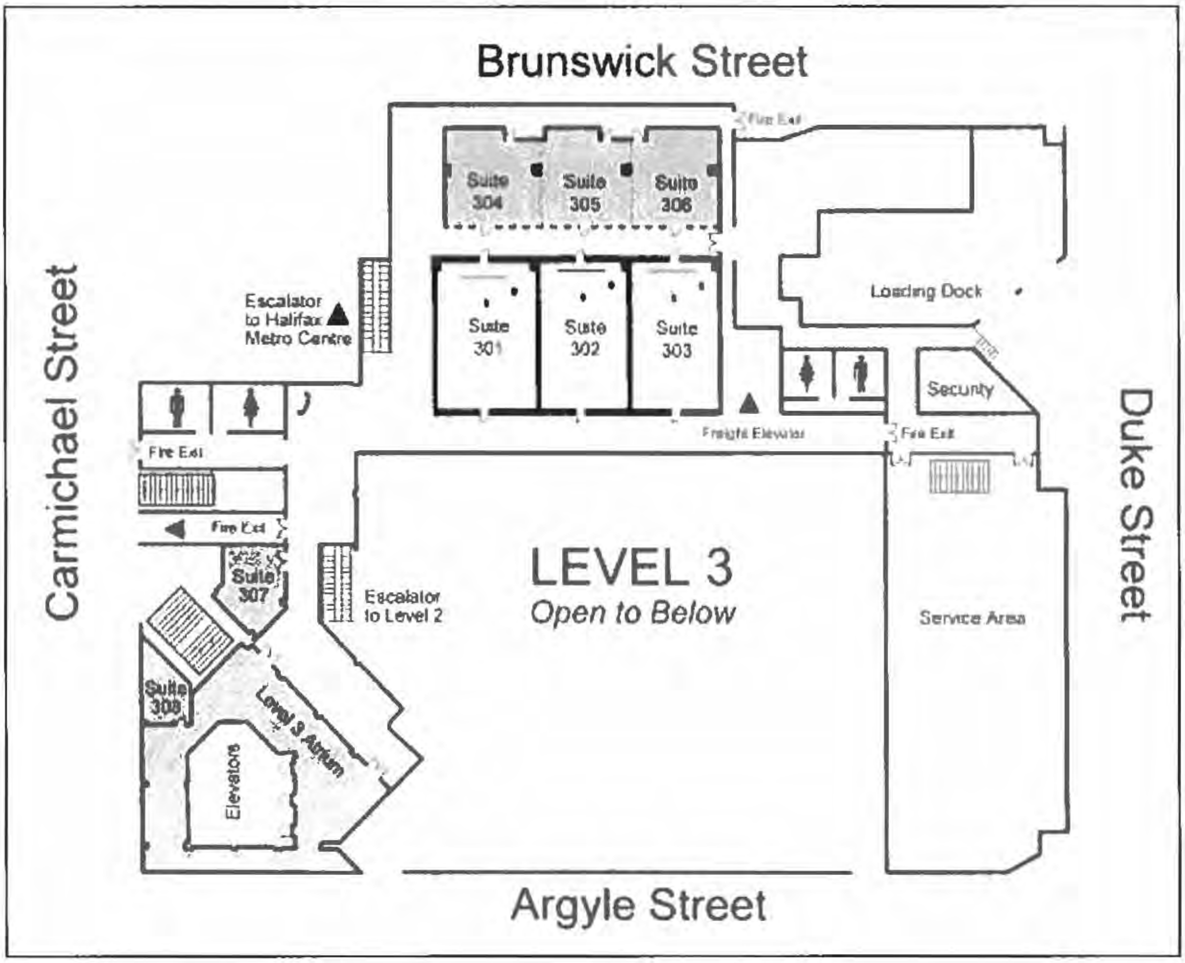
Niveau 3



Réunions

Date	Heure	Salle	Réunion
dimanche 31 mai	9h-13h	2nd level Boardroom	CNC CSRO
dimanche 31 mai	9h-12h	205	Comité des publications
dimanche 31 mai	9h-12h	307	Comité du secteur privé
dimanche 31 mai	9h-12h	308	CÉPU
dimanche 31 mai	13h30-14h30	2nd level Boardroom	Comité scientifique
dimanche 31 mai	13h30-14h30	205	Comité des présidents des centres
dimanche 31 mai	14h30-16h	205	Conseil de la SCMO
lundi 01 juin	12h40-14h	2nd level Boardroom	AGA du FCSCA
lundi 01 juin	17h30-19h	301	Réunion annuelle de la SCMO
lundi 01 juin	19h00-20h	302	Séance de discussion publique du SMC- Sous-ministre adjoint

Level 3



Meetings

Date	Time	Room	Event
Sunday, May 31	09:00–13:00	2nd level Boardroom	CNC SCOR
Sunday, May 31	09:00–12:00	Room 205	CMOS Publications Committee
Sunday, May 31	09:00–12:00	Room 307	CMOS Private Sector Committee
Sunday, May 31	09:00–12:00	Room 308	CMOS University and Professional Education Committee
Sunday, May 31	13:30–14:30	2nd level Boardroom	CMOS Scientific Committee
Sunday, May 31	13:30–14:30	Room 205	CMOS Centre Chairs Committee
Sunday, May 31	14:30–16:00	Room 205	CMOS Council
Monday, June 1	12:40–14:00	2nd level Boardroom	CFCAS Annual General Meeting
Monday, June 1	17:30–19:00	Room 301	CMOS Annual General Meeting
Monday, June 1	19:00–20:00	Room 302	MSC- ADM Town Hall Meeting

Activités sociales

Dimanche 31 Mai 2009 - Une fête dans la cuisine des Maritimes - La réception brise-glace

18h00 à 21h30: Rendez-vous au Brewery Market Courtyard et Red Stag Tavern, 1496 Lower Water Street, Halifax. Des Hors d'Oeuvres et des rafraîchissements seront servis.
Un concert musical sera assuré par les talents de la communauté météorologique et océanographique *(Apportez votre propre instrument!).*

Mardi 02 juin 2009 - Déjeuner Parsons – Patterson

Midi à 14h00: Rendez-vous au Grand Ballroom, niveau 2, World Trade and Convention Centre, 1800 rue Argyle, Halifax

Mardi 02 juin 2009 - Conférence publique gratuite

19h30: Rendez-vous au musée maritime de l'Atlantique - 1675 rue Lower Water
Présentation intitulée « Réflexions du Centre canadien de prévision d'ouragan: Leçons apprises grâce à 20 ans de science » par Peter Bowyer, Centre canadien de prévision d'ouragan.

Mercredi 03 Juin 2009 - Le banquet des récompenses SCMO

17h30 à 18h30: Heure de "coquetels" avec le bar payant; Rendez-vous au Grand Ballroom, niveau 2, World Trade and Convention Centre, 1800 rue Argyle, Halifax

18h30 à 21h00: Rendez-vous au Grand Ballroom, Level 2, World Trade and Convention Centre, 1800 Argyle Street, Halifax.

Jeudi 04 juin 2009 - Cirque du Soleil –Alegria

19h30: Rendez-vous au Halifax Metro Centre, au coin des rues Brunswick et Duke, Halifax, pour ceux d'entre vous qui ont un billet. Veuillez noter qu'un taux préférentiel de groupe s'applique pour les congressistes de la SCMO dans l'achat de billets pour ce spectacle.

Social Agenda

Sunday May 31, 2009 - A Maritime Kitchen Party - Ice Breaker Reception

18:00 - 21:30: Meet at the Brewery Market Courtyard and Red Stag Tavern,
1496 Lower Water Street, Halifax.
Hors d'Oeuvres and beverages will be served.
Open mic featuring talent from the local Meteorological and Oceanographic community *(Bring your instrument).*

Tuesday June 2, 2009 - Parsons - Patterson Luncheon

12:00 - 14:00: Grand Ballroom, Level 2, World Trade and Convention Centre, 1800 Argyle Street, Halifax

Tuesday June 2, 2009 - Free Public Lecture

19:30: Maritime Museum of the Atlantic - 1675 Lower Water Street
"Canadian Hurricane Centre Reflections: Two Decades of Lessons Learned" by Peter Bowyer of the Canadian Hurricane Centre

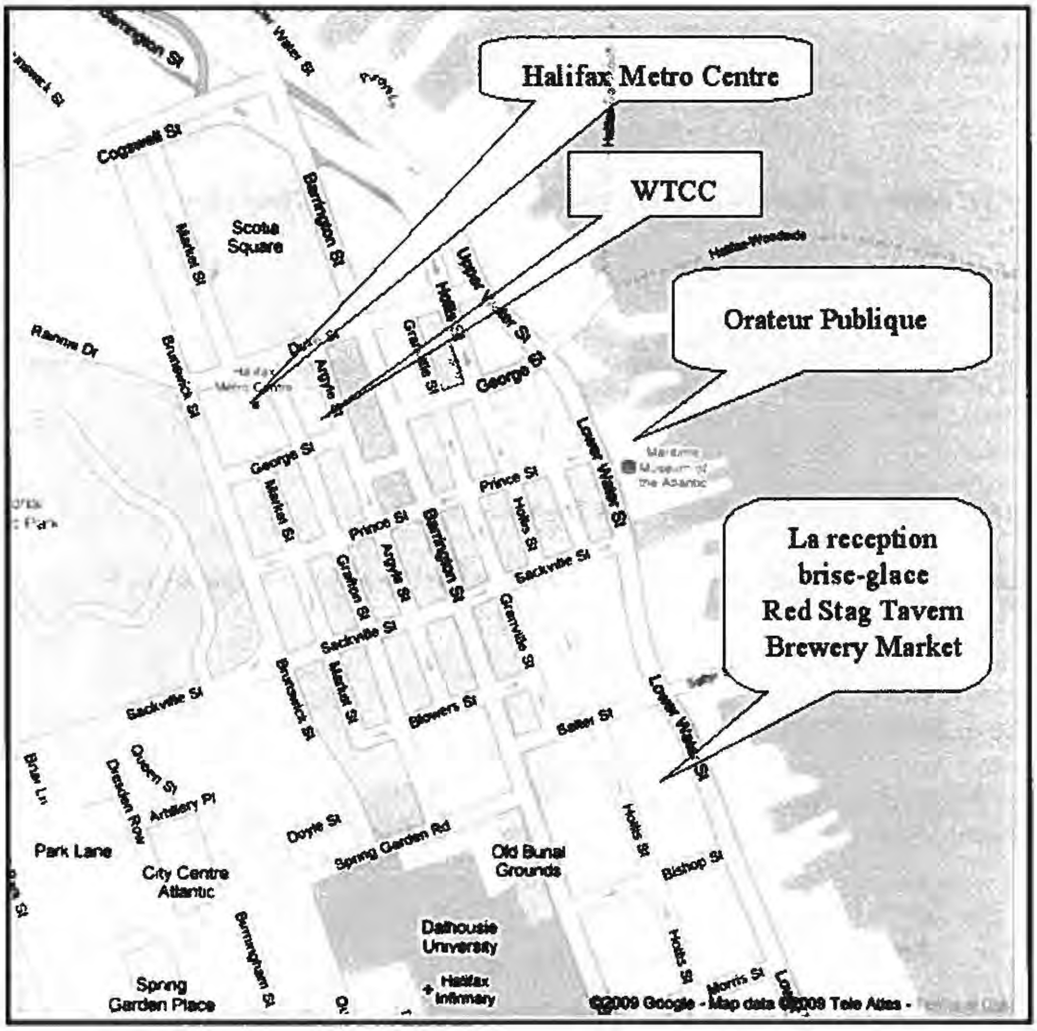
Wednesday June 3, 2009 – CMOS Awards Banquet

17:30 - 18:30 : Cash Bar; meet outside the Grand Ballroom, Level 2, World Trade and Convention Centre, 1800 Argyle Street, Halifax

18:30 - 21:00: Grand Ballroom, Level 2, World Trade and Convention Centre, 1800 Argyle Street, Halifax.

Thursday June 4, 2009 - Cirque du Soleil -Alegria

19:30 : Halifax Metro Centre, Corner of Brunswick and Duke Streets, Halifax. For those of you who have purchased tickets. Please note a group rate is available for CMOS participants.



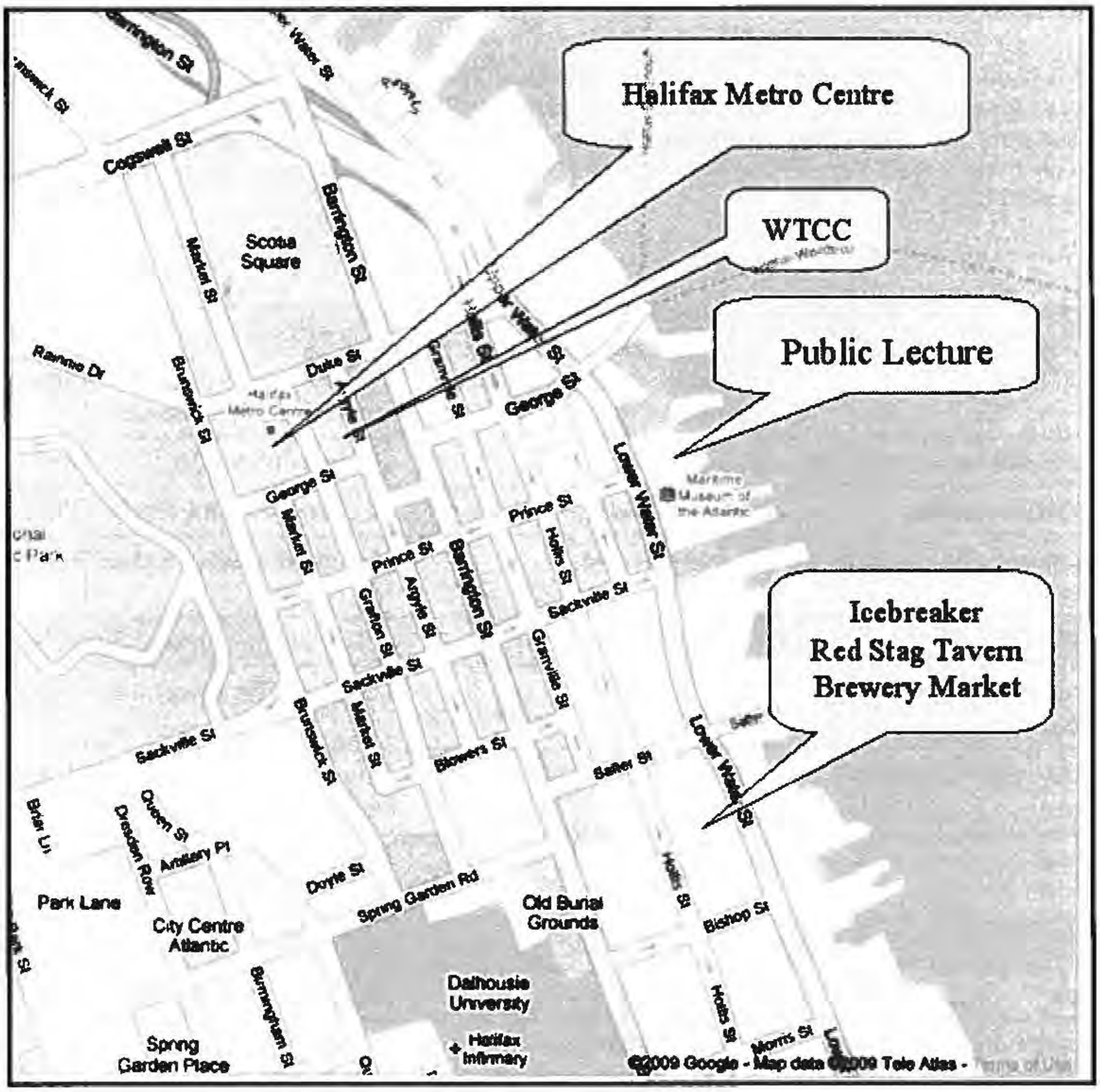
Orateur public

Conférence publique gratuite. le mardi 02 juin 2009 à 19h30 au musée maritime de l'Atlantique
1675 Lower Water Street, Halifax

Peter Bowyer - Centre Canadien de prévision d'ouragan

Réflexions du Centre Canadien de prévision d'ouragan: Leçons apprises grâce à 20 ans de science

Depuis plus de 20 ans le Centre Canadien de prévision d'ouragan a été une source d'information d'importance majeure sur les cyclones tropicaux pour le passé, le présent et le futur. Pendant toutes ces années d'études des cyclones tropicaux, le Centre Canadien de prévision d'ouragan et les habitants de la côte Est du Canada ont beaucoup appris sur ce thème scientifique. Des progrès majeurs ont été réalisés par le Centre Canadien de prévision d'ouragan sur l'observation des cyclones tropicaux, la compréhension de ce phénomène météorologique, leur prediction, et les messages scientifiques délivrés au grand public à propos des cyclones tropicaux. Les canadiens ont également appris à connaître les cyclones tropicaux, se préparer à ce phénomène météorologique, et à répondre aux messages délivrés à propos des cyclones tropicaux. Cette présentation évoquera l'accomplissement du Centre Canadien de prévision d'ouragan depuis 20 ans dans l'étude des cyclones tropicaux, évoquant ainsi les leçons apprises par l'étude de 20 différentes tempêtes incluant: Gloria (1985), 'La tempête parfaite' (1991), Luis (1995), Hortense (1996), Danielle (1998), Harvey and Gert (1999), tempête non identifiée et Michael (2000), Gabrielle (2001), Gustav (2002), Isabel et Juan (2003), Alex et Frances (2004), Katrina (2005), Florence (2006), Noel (2007), Hanna et Kyle (2008).



Public Lecture

Tuesday, June 02, 7:30 PM at the Maritime Museum of the Atlantic - 1675 Lower Water Street

Free Public Lecture by Peter Bowyer of the Canadian Hurricane Centre

Canadian Hurricane Centre Reflections: Two Decades of Lessons Learned

For more than twenty years the Canadian Hurricane Centre (CHC) has been Canada's authoritative source of information on tropical cyclones: past, present and future. During that time there has been a great maturing of both the CHC and the people of eastern Canada in all matters relating to tropical cyclones. On the inside, we are better at observing them, understanding them, predicting them, and communicating about them. On the outside, Canadians are better at being aware of them, preparing for them, and responding to messages about them. This animated presentation will look back over 20-years of CHC enlightenment and enterprise spawned by the "lessons-learned" from 20 different tropical cyclones. The lesson-teaching storms include: Gloria (1985); "The Perfect Storm" (1991); Luis (1995); Hortense (1996); Danielle (1998); Harvey and Gert (1999); Unnamed Storm and Michael (2000); Gabrielle (2001); Gustav (2002); Isabel and Juan (2003); Alex and Frances (2004); Katrina (2005); Florence (2006); Noel (2007); Hanna and Kyle (2008).

Journée des professeurs

Bienvenue à la journée des professeurs de la SCMO, le 3 juin 2009! Nous vous avons préparé un programme riche en présentations d'éducateurs spécialisés et de scientifiques en météorologie, océanographie, climatologie et cryosphère. Gros merci aux participants du congrès qui font une présentation bénévole et aux présentateurs qui font un long déplacement pour cette journée! Les professeurs sont aussi invités à visiter la session poster durant la journée. Noter le numéro de la salle: 2005.

Titre	Auteurs	Organisation	Heure
Mot de bienvenue	Claude Coté et Frédéric Dupont	Organisateurs de la journée des professeurs	8h45
Environmental behaviour changes	Alan Warner	Université Acadia	8h50
Indi the AQHI caterpillar	Chantal Duhaine	Environnement Canada	9h15
Sea-Ice, Icebergs and Glaciers	Ingrid Peterson	Institut d'océanographie de Bedford	9h45
Pause santé			10h15
Educational activities offered by The Biosphere	René Brunet	La biosphère (Montréal)	10h45
Cool Climate, Cool Creatures	Maggie MacIntyre	Musée des sciences naturelles de la N.-É.	11h15
Sky Watchers	Victoria Hudec	Environnement Canada	11h45
Repas			12h15
CloudWatch	Bill Batycky	SEEDS, Alberta	13h00
Improving the Long Term Forecast	Karen Matheson	Science East (Fredericton)	13h30
Cool Classrooms	Rebecca McQuaid	Clean Nova Scotia	14h00
Canadian Hurricane Centre	Peter Bowyer	Environnement Canada	14h30
Pause santé			15h00
Tidal Power in the Bay of Fundy	Richard Karsten	Université Acadia	15h30
Project Atmosphere	Sheila Bourque	SCMO Ottawa	16h00
Education Engagement	Caroline Canning and Karen Potter	Environnement Canada	16h30
Water Resources Education	Krista Hilchey	Nova Scotia Department of Environment	17h00
EC's resources for educators	Susan Bone	Environnement Canada	17h30

Teacher's Day

Welcome to this year CMOS Teacher's Day, Wednesday June 3rd! We have prepared an exciting day packed with lots of presentations by specialized educators and scientific experts in the field of meteorology, oceanography, climatology and cryospheric science. Many thanks to those CMOS attendees who have also volunteered as presenters and to the speakers who traveled from far for this day! The teachers are also invited to visit the Poster Session in room 205 during the day.

Title	Authors	Organization	Time
Welcome	Claude Cote and Frederic Dupont	Teacher's Day organizers	08:45
Environmental behaviour changes	Alan Warner	Acadia U.	08:50
TBA	Janice Ashworth	Ecology Action Center, Halifax	09:15
Sea-Ice, Icebergs and Glaciers	Ingrid Peterson	Bedford Institute	09:45
Health Break			10:15
Educational activities offered by The Biosphere	René Brunet	La biosphere (Montreal)	10:45
Cool Climate, Cool Creatures	Maggie MacIntyre	NS Museum of Natural History	11:15
Sky Watchers	Victoria Hudec	Environnement Canada	11:45
Lunch Break			12:15
CloudWatch	Bill Batycky	SEEDS, Alberta	13:00
TBA	Karen Matheson	Science East (Fredericton)	13:30
Cool Classrooms	Rebecca McQuaid	Clean Nova Scotia	14:00
Canadian Hurricane Centre	Peter Bowyer	Environnement Canada	14:30
Health Break			15:00
Tidal Power in the Bay of Fundy	Richard Karsten	Acadia U.	15:30
Project Atmosphere	Sheila Bourque	CMOS Ottawa	16:00
Education Engagement	Caroline Canning and Karen Potter	Environnement Canada	16:30

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Make your way to the CBC News: Weather Centre booth during the Congress to talk job opportunities with Meteorologist Claire Martin and Senior Producer Mike Prokopec. Trends suggest key positions on CBC's weather team will be available and we'd like you to become a part of it.
For more information contact: mike.prokopec@cbc.ca
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Visit the Canadian Ice Service display or Web site. In it, you will find a wealth of information, including atlases, image archives, links to other notable sites, catalogues, and price lists. Most products and services are available free of charge.

Discover the Canadian Ice Service today.

Canadian Ice Service

Web site: http://ice-glaces.ec.gc.ca

Environnement Canada Environment Canada

Service canadien des glaces
Chef de file en Service d'information des glaces

Chaque année, le Service canadien des glaces obtient une grande quantité de données sur l'Arctique, la baie d'Hudson, la côte est canadienne et les Grands Lacs. Son équipe chevronnée de météorologues, de géographes, de climatologues et de spécialistes en informatique se réunit afin de faire l'analyse de ces données et d'offrir un service d'information des glaces hors pair.

Ces experts connaissent très bien l'Arctique de même que toutes les autres régions envahies par les glaces dans tout le Canada. Ensemble, ils aident le Service canadien des glaces à réaliser son mandat : celui de fournir les renseignements sur les glaces les plus récents et précis. Les renseignements et les services offerts par le Service canadien des glaces sont nombreux. Ils comprennent : des cartes et des bulletins spécialisés, des images radar et satellitaires, l' analyse d'images, des analyses météorologiques, des prévisions adaptées, des avertissements et des breffages. Les gens et les industries qui utilisent les renseignements sur les glaces sont, eux aussi, nombreux : ils vont du chercheur, du pêcheur côtier et du touriste aux grandes compagnies de navigation, aux compagnies d'exploitation pétrolières et gazières en mer, ainsi qu'aux croisiéristes.

Rendez-vous au site du Service canadien des glaces ou à sa page web. Celui-ci renferme une abondance de renseignements, parmi lesquels vous trouverez des atlases à consulter; des archives d'images, des liens vers d'autres sites importants, des catalogues et des listes de prix. La majorité des produits et services vous sont offerts gratuitement.

Découvrez dès aujourd'hui le Service canadien des glaces.

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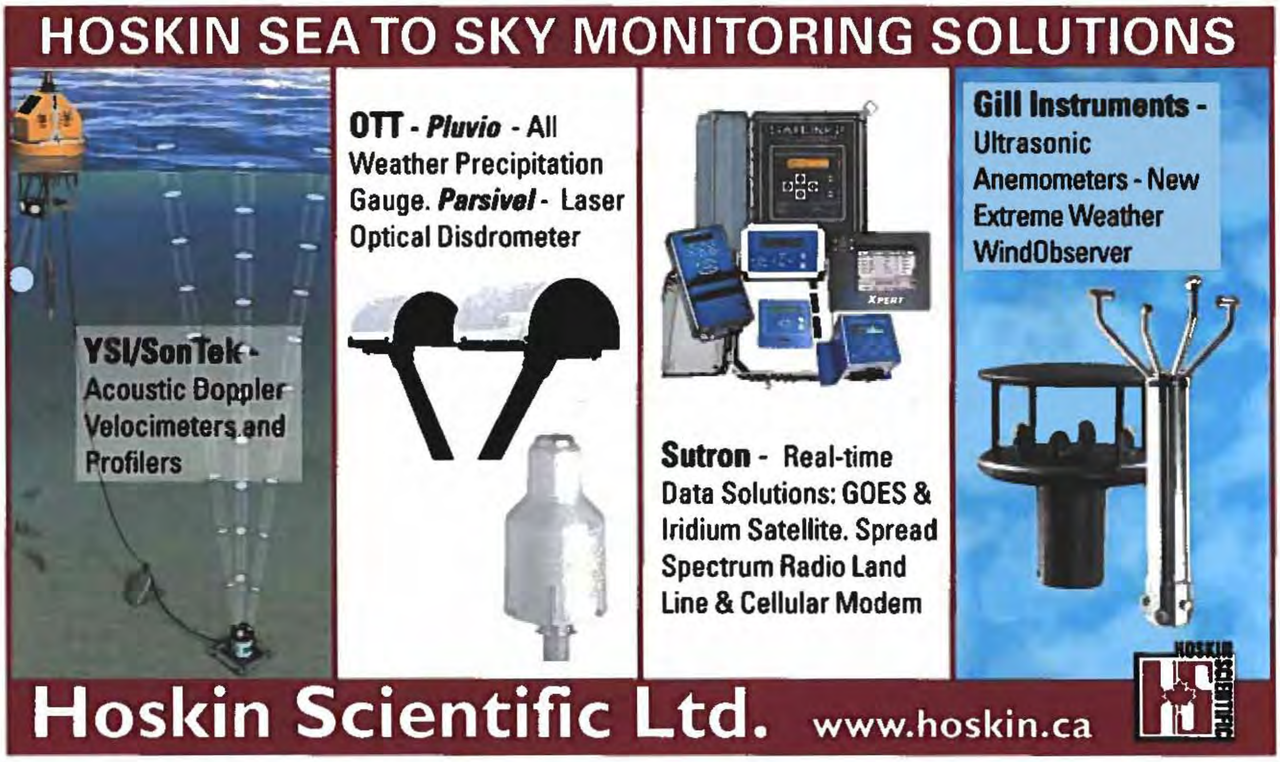
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Public Speaker

Peter Bowyer
Canadian Hurricane Centre

After a physics degree from the University of Toronto, Peter joined the Meteorological Service of Canada in 1981. He became a senior meteorologist in 1985 and served as the primary marine outreach meteorologist in Atlantic Canada for more than a decade, assisting the marine schools by developing a practical and comprehensive meteorology curriculum. In 1999, Peter was appointed as the program manager of the Canadian Hurricane Centre and the national spokesperson on issues relating to tropical cyclones. As the author of two books on marine weather and two scientific journal papers on extreme waves with hurricanes, Peter's work was recognized nationally when he won the 2004 Canadian Meteorological and Oceanographic Society's Andrew Thompson Prize in Applied Meteorology. Peter seizes every opportunity to speak out on the issue of vulnerability and the need for better awareness at the both the individual and societal levels.

Orateur public

Peter Bowyer
Centre Canadien de prévision d'ouragan

À la suite de son degré en Physique à l'Université de Toronto, Peter a joint le Service météorologique canadien en 1981. Il fut promu au niveau de météorologue sénior en 1985 et travailla comme météorologue primaire de sensibilisation à la marine de l'Atlantique canadien pour plus d'une décennie. Il assista les écoles marines en développant un curriculum pratique et compréhensif. En 1999, Peter fut appointé au programme de gestion du Centre canadien de prévision d'ouragan et comme porte-parole sur les sujets reliés aux tempêtes tropicales. En tant qu'auteur de deux livres sur la météorologie marine ainsi que de deux travaux de journal scientifique sur les vagues extrêmes causées par les ouragans, le travail de Peter fut reconnu nationalement lorsqu'il lui fut accordé, en 2004, le prix d'Andrew Thompson en météorologie appliquée par la Société canadienne de météorologie et d'océanographie.
Peter profite de chaque occasion pour parler ouvertement sur les sujets de vulnérabilité et le besoin d'un meilleur état de conscience aux niveaux de l'individu et de la société.

Les conférenciers des plénières

Dr. Jack Beven
Centre national de prévision d'ouragan

Jour 2, 08h30

Jack Beven, Ph.D., est un spécialiste sénior au Centre national de prévision d'ouragan à Miami.

Dr. Beven a reçu son Baccalauréat en Physique de l'Université de l'état de Louisianne (1984), ensuite sa Maîtrise et son Doctorat en Météorologie de l'Université de l'état de Floride (1988,1994).

Dr. Beven commença sa carrière avec le Centre national de prévision d'ouragan en 1988 en tant qu'étudiant interne. Il participa à l'expérience du Cyclone Tropical Motion-90 en 1990, faisant l'étude des typhons dans l'ouest de l'océan Pacifique, et fit parti de l'expérience de la chimie atmosphérique TRACE-A en 1992. On lui accorda une position à plein temps au CNPO en 1993 en tant qu'analyste de carte, ensuite il fut promu au poste de prévisionniste à la marine et à l'aviation en 1994.

Dr. Beven devint un spécialiste d'ouragan en 1999. La position consiste à émettre des prévisions de trajectoire, d'intensité et des rayons du vent ainsi que les veilles et les avertissements associés aux cyclones tropicaux des océans Atlantique et Pacifique Nord.

Dr. Beven est l'auteur principal de la colonne du Centre de prévision tropicale dans le Marine Weather Log (Registre de la Météo des Marins), et l'entraîneur de la technique Dvorak pour estimer l'intensité des cyclones tropicaux à partir d'image satellitaire. Il est instructeur à l'atelier du Centre de prévision tropicale pour les gestionnaires des Mesures d'urgence des États-Unis et pour les météorologues à travers le monde. En plus, il est membre du comité de supervision pour le projet de ré-analyse des trajectoires d'ouragan.

Dr. Beven est un présentateur et participant dans de nombreuses assemblées météorologiques, incluant plusieurs conférences de la Société météorologique américaine concernant les ouragans et la météorologie tropicale, les Conférences de NOAA sur les ouragans, et les Conférences intergouvernementales sur les ouragans, aussi bien que les rencontres variées, incluant la Conférence nationale d'ouragan et la Conférence du gouverneur de la Floride.

Plenary Speakers

Dr. Jack Beven
National Hurricane Center

Day 2, 08:30

Jack Beven, Ph.D., is a senior hurricane specialist at the National Hurricane Center in Miami.

Dr. Beven received his Bachelor's Degree in Physics from Louisiana State University (1984), and his Master's Degree and Doctorate in Meteorology from Florida State University (1988, 1994).

Dr. Beven began his career with the National Hurricane Center in 1988 as a student intern. He participated in the Tropical Cyclone Motion-90 experiment in 1990, studying typhoons in the western Pacific Ocean, and took part in the TRACE-A atmospheric chemistry experiment in 1992. He advanced to a full-time position at NHC in 1993 as a map analyst, and was promoted to a marine and aviation forecaster in 1994.

Dr. Beven became a hurricane specialist in 1999. The position involves the issuance of track, intensity, and wind radii forecasts as well as associated watches and warnings for tropical cyclones in the Atlantic and eastern North Pacific oceans.

Dr. Beven is the lead author of the Tropical Prediction Center (TPC) column in the Mariners Weather Log, and is a TPC trainer of the Dvorak technique for estimating the intensity of tropical cyclones from satellite imagery. He is an instructor at the Tropical Prediction Center workshops for U.S. emergency managers and worldwide meteorologists. In addition, he is a member of the supervisory committee for the hurricane tracks re-analysis project.

Dr. Beven is a presenter and participant in a number of meteorological meetings, including several American Meteorological Society Conferences on Hurricanes and Tropical Meteorology, NOAA Hurricane Conferences, and Interdepartmental Hurricane Conferences, as well as various meetings, including the National Hurricane Conference and Florida Governor's Conference.

Dr. Amy Bower
Institution de Woods Hole Oceanographic

Jour 3, 08h30

Dr. Bower est une scientifique séniore dans le département d'Océanographie physique à l'institut d'Océanographie de Woods Hole au Massachusetts. Elle a reçu son B.Sc. en Physique de l'Université Tufts (en 1981) et son Ph.D. en Océanographie de l'École gradué d'Océanographie à l'Université de Rhode Island (1988). Elle commença sa carrière à Woods Hole en 1988 comme savante avec post-doctorat, se méritant une position permanente en 1999.

Dr. Bower est une observationaliste qui étudie les courants de frontière ouest, les tourbillons et les débordements denses des mers marginales. Elle a dirigé ou co-dirigé de nombreuses expéditions dans les océans de l'Atlantique nord et Indiens. La plupart de sa recherche a pointé sur les courants de couche limite de l'est des États-Unis et du Canada, incluant le Courant golfe, le Courant de l'Atlantique nord et le Courant profond ouest de la couche limite. Ces courants constituent la 'courroie convoyante' océanique dans l'Atlantique nord, étant responsable pour la plupart des flux de chaleur vers le nord du système climatique océan-atmosphère. En exploitant l'utilisation extrême des bouées à flottage neutre, le Dr. Bower a étudié les parcours de ces courants et leurs variabilités.

Un autre point focal dans la recherche du Dr. Bower fut sur les débordements des mers marginales, incluant la Méditerranée et les mers Rouges. Ceux-ci ainsi que les bassins similaires semi-fermés sont les sites de formation pour la plupart des eaux qui remplissent l'océan profond. Typiquement les eaux de ces bassins coulent dans l'océan à travers un détroit peu profond et étroit. En 2001, elle a co-dirigé la première enquête compréhensive du déversement de la mer Rouge dans le golfe de Aden. En 2008, elle retourna à la mer Rouge pour commencer une étude de trois ans des propriétés de l'eau et la circulation à l'intérieur de la mer Rouge en collaboration avec l'Université de science et technologie du roi Abdullah.

Prof. John Cullen
Université de Dalhousie

Jour 1, 09h00

John Cullen est président dans les études de l'Océan à l'Université de Dalhousie. Ses intérêts de recherche incluent la physiologie et l'écologie du phytoplancton marin, les interprétations biologiques des mesures optiques des eaux de surface, les systèmes de prévision et d'observation de l'océan en temps réel, et la culture des micro-algues marines pour les carburants et les protéines. Il dirigea le co-projet du Système de prévision environnementale marine de l'observatoire en temps réel à Lunenburg, Nouvelle-Écosse (2002-2008). Ce projet impliqua les nombreuses applications de sa recherche sur l'utilisation d'une grande variété de mesures optiques pour décrire les dynamiques du phytoplancton marin. La plupart de sa recherche visa l'influence des conditions environnementales (ex. l'apport de substance nutritive ou la radiation ultraviolette) sur le phytoplancton marin. Ceci lui mérita le titre, en 2005, de Camarade de la Société océanographique. En compagnie du Dr. Penny Chisholm, il a co-présidé le premier 'Symposium Iron', convoqué par la Société américaine de Limnologie et d'Océanographie en 1991 pour adresser le sujet de fertilisation de l'océan. Depuis ce temps il a co-convoqué des assemblées internationales sur la fertilisation de l'océan, les floraisons d'algues nuisibles et les systèmes d'observation de l'océan en temps réel

Dr. Amy Bower
Woods Hole Oceanographic Institution

Day 3, 08:30

Dr. Bower is a Senior Scientist in the Department of Physical Oceanography at the Woods Hole Oceanographic Institution in Massachusetts. She received her B.S. in Physics from Tufts University (1981) and her Ph.D. in Oceanography from the Graduate School of Oceanography at the University of Rhode Island (1988). She began her career at Woods Hole as a postdoctoral scholar in 1988, earning tenure in 1999.

Dr. Bower is an observationalist who studies western boundary currents, eddies and dense overflows from marginal seas. She has led or co-led numerous expeditions to the North Atlantic and Indian Oceans. Much of her research has focused on the boundary currents of the eastern United States and Canada, including the Gulf Stream, the North Atlantic Current and the Deep Western Boundary Current. These currents constitute the oceanic "conveyor belt" in the North Atlantic, being responsible for much of the northward heat flux of the ocean-atmosphere climate system. Making extensive use of neutrally buoyant floats, Dr. Bower has studied the pathways of these currents and their variability.

Another focus of Dr. Bower's research has been on the overflows from marginal seas, including the Mediterranean and Red Seas. These and similar semi-enclosed basins are the formation sites for most of the water that fills the deep ocean. The source waters typically flow into the open ocean through a narrow and/or shallow strait. In 2001, she co-led the first comprehensive field investigation of the Red Sea Outflow in the Gulf of Aden. In 2008, she returned to the Red Sea to begin a three-year study of the water properties and circulation within the Red Sea in collaboration with King Abdullah University of Science and Technology.

Prof. John Cullen
Dalhousie University

Day 1, 09:00

John Cullen is the Killam Chair in Ocean Studies at Dalhousie University. His research interests include the physiology and ecology of marine phytoplankton, biological interpretations of optical measurements in surface waters, real-time ocean observation and prediction systems, and the culture of marine microalgae for fuels and protein. He was co-project leader of the Marine Environmental Prediction System real-time coastal observatory in Lunenburg, Nova Scotia (2002 - 2008). This project involved numerous applications of his research on the use of a wide variety of optical measurements to describe the dynamics of marine phytoplankton. Much of his research has focused on the influence of environmental conditions (for example, nutrient supply or ultraviolet radiation) on marine phytoplankton. This led to his selection as Fellow of The Oceanography Society in 2005. With Dr. Penny Chisholm, he co-chaired the first "Iron Symposium", convened by the American Society for Limnology and Oceanography in 1991 to address the issue of ocean fertilization. He has since co-convened international meetings on ocean fertilization, harmful algal blooms and real-time ocean observing systems.

Prof. James Drummond
Université de Dalhousie

Jour 4, 08h30

Dr. Drummond s'est mérité un Doctorat en philosophie (D.Phil) à l'Université d'Oxford où, durant la première crise d'ozone au début des années 1970, il fit certaines des premières mesures des oxydes d'Azote en utilisant les ballons de haute-altitude. Il fut professeur à l'Université de Toronto de 1979-2006, ensuite déménagea à l'Université de Dalhousie afin de prendre en main la Présidence en recherche de télé-sondage de l'atmosphère. Son domaine de recherche est l'étude de la composition de l'atmosphère, avec un grand intérêt à prendre des mesures dans des milieux environnementaux extrêmes. Au tout début durant ses études au niveau de gradué, il commença avec des mesures par ballons et ensuite progressa aux mesures satellitaires et plus récemment, aux études dans le haut Arctique canadien.

Il est le principal enquêteur dans l'expérience satellitaire des Mesures de la pollution dans la Troposphère (MPT) pour mesurer le monoxyde de carbone dans la troposphère qui procure des données globales continuellement depuis 1999. MPT fut le premier instrument à prendre des mesures de polluant à partir de l'espace. Il est le co-enquêteur sur les deux instruments du SCISAT canadien pour l'Expérience Atmosphérique Chimique (EAC) pour les études d'ozone avec emphase sur les latitudes Nordiques.

Récemment il a étudié la faisabilité de prendre des mesures dans l'atmosphère de Mars, où se situe un autre environnement extrême. En tant que principal enquêteur du Réseau canadien pour la détection du changement atmosphérique (RCDCA), il a dirigé l'équipe scientifique de l'université et du gouvernement qui a équipé le Laboratoire de recherche de l'environnement atmosphérique polaire (LREAP), à Eureka, Nunavut. Cette facilité de recherche tout au long de l'année est utilisée présentement pour une variété d'études sur le changement climatique, la qualité de l'air et l'ozone durant l'Année polaire internationale et avec espoir de continuer la prise de ces mesures dans le futur.

Prof. James Drummond

Dalhousie University

Day 4, 08:30

Dr. Drummond gained a Doctorate of Philosophy (D.Phil.) from the University of Oxford where during the first ozone crisis in the early 1970s he made some of the first measurements of nitrogen oxides in the stratosphere using high-altitude balloons. He was a professor at the University of Toronto from 1979-2006 and then moved to Dalhousie University to take up a Canada Research Chair in Remote Sounding of Atmospheres.

His research field is in studies of atmospheric composition, with a penchant for making measurements in extreme environments, beginning with measurements from balloons during his graduate studies and then progressing to satellite measurements and more recently to studies in the Canadian high arctic.

He is the Principal Investigator of the Measurements Of Pollution In the Troposphere (MOPITT) satellite experiment to measure carbon monoxide in the troposphere that has been taking continuous global measurements since 1999. MOPITT was one of the first instruments to measure pollutants from space. He is also a co-investigator on both of the instruments on the Canadian SCISAT Atmospheric Chemistry Experiment (ACE) for ozone studies with an emphasis on Northern latitudes. More recently he has been studying the feasibility of making measurements in the atmosphere of Mars, yet another extreme environment!

As the Principal Investigator of the Canadian Network for the Detection of Atmospheric Change (CANDAC) he has led the university and government scientific team that equipped the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut. This year-round research facility is now being used for a variety of studies concerning climate change, air quality and ozone during International Polar Year and will hopefully continue measurements in the future.

Prof. W. Richard Peltier

University of Toronto

Jour 1, 09h45

W. Richard (Dick) Peltier a reçu son degré sous-gradué en Physique de l'Université de la Colombie Britannique et son Doctorat en Physique de l'Université de Toronto. Sa recherche est dans le domaine de la dynamique des fluides géophysiques. Il s'intéresse au problèmes reliés à la compréhension des processus qui contrôlent l'évolution de l'atmosphère, les océans et la Terre ferme et à la variabilité du climat à long terme. Dr. Peltier s'est mérité les récompenses de Camaraderie de Sloan, Steacie, Killam et Guggenheim. Il est l'ancien président de l'Union Géophysique canadienne et détient le titre de Camarade élu de l'Union Géophysique américaine et de la Société météorologique américaine. Il est un ancien receveur de la Récompense Kirk Bryan de la Société Géologique américaine, de la Médaille Patterson du Service météorologique du Canada, de la Médaille J. Tuzo Miroslav Romanowski de la Société royale du Canada. En 2004 on lui accorda le Prix Vetlesen de la Fondation G. Unger Vetlesen et en 2008, la Médail de Milutin Milankovic de la Société européenne des Sciences Géophysiques, à la fois pour son travail sur la variabilité du climat à basse fréquence ainsi que la théorie des ères glacières. Présentement il est professeur d'Université et professeur de Physique à l'Université de Toronto où il est Directeur fondateur du Centre pour la Science du Changement global ainsi que Directeur scientifique de la faculté SciNet pour le Calcul à Haute performance. Au niveau national il continu comme Principal enquêteur du Réseau
de la Stabilité du climat polaire qui est supporté par la Fondation canadienne pour les Sciences climatiques et atmosphériques (FCSCA).

Prof. W. Richard Peltier
University of Toronto

Day 1, 09:45

W. Richard (Dick) Peltier received his undergraduate degree in physics from the University of British Columbia and his doctoral degree in physics from the University of Toronto. His research is in the area of geophysical fluid dynamics and is focused upon problems connected with the understanding of processes that control the evolution of the atmosphere, the oceans and the solid Earth and of long timescale climate variability. Peltier is a past recipient of the Sloan, Steacie, Killam and Guggenheim Fellowships, is Past President of the Canadian Geophysical Union and is an elected Fellow of the American Geophysical Union and the American Meteorological Society. He is also a past recipient of the Kirk Bryan Award of the Geological Society of America, the Patterson Medal of the Meteorological Service of Canada, the J. Tuzo Wilson Medal of the Canadian Geophysical Union, and the Bancroft Award and the Miroslav Romanowski Medal of the Royal Society of Canada. In 2004 he was awarded the Vetlesen Prize of the G. Unger Vetlesen Foundation and in 2008 the Milutin Milankovic Medal of the European Geosciences Society, both for his work on low frequency climate variability and the theory of ice-ages. His current position is as University Professor and Professor of Physics at the University of Toronto where he is Founding Director of the Centre for Global Change Science and Scientific Director of the SciNet facility for High Performance Computation. At the national level he continues as the Principal Investigator of the Polar Climate Stability Network that is supported by the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS).

Prof. Anne de Vernal
Université du Québec à Montréal

Jour 3, 09h15

Anne de Vernal gradua de L' *Université de Montréal*, où elle fit une thèse de PhD sur l'utilisation de microfossils pour étudier les changements climatiques et océaniques. Depuis 1987, elle enseigne au Département des Sciences terrestres et atmosphériques de l' *Université du Québec à Montréal* (UQAM) comme professeure de paléontologie et les changements globaux sur une échelle de temps des centenaires à des millions d'années. Depuis 2006, elle est directrice du Centre de recherche de Géochimie et Géodynamique CRGG.

Anne de Vernal est une chercheuse reconnue pour ses contributions dans le domaine de palynologie marine(i.e. l'étude des mycro-fossils à matière murale organique) et la paléo-océanographie. Elle est dirigeante dans le domaine de l'écologie-paléoécologie des cystes dinoflagellates et leur utilité pour la reconstruction quantitative des conditions mer-surface du passé dans les hautes latitudes (température, salinité et densité). En particulier, elle a développé des approches pour estimer les variations des glaces marines à travers le temps et a démontré les changements de grande amplitude dans la distribution de la couche de glace Arctique et Subarctique durant les derniers millennia (millénaires). De telles reconstructions sont utilisées présentement comme outils de validation pour la modélisation climatique basée sur les expériences du modèle paléo-climatique.

Anne de Vernal fit parti de plusieurs expéditions en mer dans l'Atlantique Nord et les bassins Subarctique, notamment sur le bateau de forage Joides Resolution à l'intérieur du cadre du Programme intégré de forage océanique (PIFO), qui donna l'opportunité d'explorer le climat régional et l'histoire océanographique durant les derniers millions d'années. Présentement son intérêt est orienté vers la recherche des conditions océanographiques qui prévalaient durant les épisodes chaudes du passé, avec une attention spéciale accordée aux échanges entre les océans Atlantique Nord et Arctique, avec des liens entre la végétation terrestre et le climat.

Prof. Anne de Vernal
Université du Québec à Montréal

Day 3, 09:15

Anne de Vernal graduated from the *Université de Montréal*, where she did a PhD thesis on the use of microfossils for studying climate and ocean changes. Since 1987, she is a professor in the Department of Earth and Atmospheric Sciences of the *Université du Québec à Montréal* (UQAM), where she teaches paleontology and "global changes" on time scales ranging from centuries to millions of years. Since 2006, she is director of the Geochemistry and Geodynamics Research Center GEOTOP

Anne de Vernal is a researcher acknowledged for her contributions in the field of marine palynology (i.e., the study of organic-walled microfossils) and paleoceanography. She is a leader in the domain of ecology-paleoecology of dinoflagellate cysts and their use for quantitative reconstruction of past sea-surface conditions at high latitudes (temperature, salinity, density). In particular, she has developed approaches for estimating variations of sea ice through time and demonstrated large amplitude changes in the distribution of Arctic and subarctic sea ice cover during the last millennia. Such reconstructions are currently used as validation tools for climate modelling based on paleoclimate model experiments.

Anne de Vernal participated to several expeditions at sea in the North Atlantic and subarctic basins, notably on the drill ship Joides Resolution within the framework of the Integrated Ocean Drilling Program (IODP), which provided an opportunity to explore the regional climatic and oceanographic history of the last millions of years. Her present research interest deals with the oceanographic conditions which prevailed during warm episodes of the past, with special attention paid to the exchanges between the North Atlantic and Arctic oceans, and to linkages with terrestrial vegetation and climate.

Prof. Dr. Douglas W.R. Wallace
IFM-GEOMAR

Jour 2, 09h15

Doug Wallace est professeur de Chimie marine à Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel, Germany. Il a obtenu son PhD en Océanographie chimique à l'Université de Dalhousie, en travaillant avec Bob Moore sur les études de traceur de l'océan Arctique et la baie de Baffin. Après son post-doctorat au NSERC à l'Institut d'Océanographie de Bedford, il passa 11 années au Laboratoire national de Brookhaven à Long Island occupant la position de Directeur technique de l'Enquête globale du CO2 dans les océans du Département d'énergie des Etats-Unis. En 1998, il démangea à Kiel où il dirige le Département de Chimie marine et la Division de recherche de Biogéochimie marine du IFM-GEOMAR. Il fut Directeur députe de l'institut de 2004-2008. Il était l'auteur en chef du chapitre du cycle du carbone dans le troisième rapport d'évaluation du IPCC.

Ses intérêts de recherche incluent l'utilisation des traceurs anthropogénique pour estimer la consommation du carbone anthropogénique par l'océan, la production océanique et le flux mer-air des composés organiques-halogènes et le rôle des zones minimum tropicales
d'oxygène pour le cycle des nutriments océaniques. Présentement il est président d'un Projet de recherche collaboratif à long terme de la Fondation de recherche allemande qui étudie les interactions climatique-biogéochimique dans les océans tropicaux (www.sfb754.de). De plus il est le président de SOLAS international (www.solas-int.org).

Prof. Dr. Douglas W.R. Wallace
IFM-GEOMAR

Day 2, 09:15

Doug Wallace is Professor of Marine Chemistry at the Leibniz-Institut für Meereswissenschaften (IFM-GEOMAR) in Kiel, Germany. He obtained his PhD in Chemical Oceanography at Dalhousie University, working with Bob Moore on tracer studies of the Arctic Ocean and Baffin Bay. After a NSERC postdoc at the Bedford Institute of Oceanography, he spent 11 years at Brookhaven National Laboratory on Long Island where he was Technical Director of the US Department of Energy's Global Survey of CO2 in the Oceans. In 1998 he moved to Kiel where he has led the Department of Marine Chemistry and the Marine Biogeochemistry Research Division of IFM-GEOMAR and was also Deputy Director of the Institute from 2004-2008. He was a Lead Author of the carbon cycle chapter of the IPCC Third Assessment Report.

His research interests include the use of anthropogenic tracers to estimate anthropogenic carbon uptake by the ocean, the oceanic production and sea-air flux of natural organo-halogen compounds and the role of tropical oxygen minimum zones for oceanic nutrient cycling. He is presently Chair of a long-term Collaborative Research Project of the German Research Foundation that studies climate-biogeochemistry interactions in the tropical oceans (www.sfb754.de) as well as Chair of International SOLAS (www.solas-int.org).

Descriptions des presentations

Atmosphère

Transition extratropicale des systèmes tropicaux

Steve Miller - Environnement Canada
Personne-ressource: steve.miller@ec.gc.ca

Un des plus grands défis des modèles numériques pour la prévision du temps est le phénomène de transition extratropicale (TE): la transition des cyclones tropicaux lorsqu'ils se déplacent dans les secteurs des latitudes moyennes. Les cyclones tropicaux subissent des changements structurels et dynamiques qui se traduisent par des impacts modifiés pendant que la tempête s'avance: des impacts qui peuvent être plus significatifs que les impacts associés avec le système original. Alors que la TE se manifeste sur tous les bassins océaniques qui sont propices au développement des cyclones tropicaux, les prévisionnistes de la région atlantique canadienne connaissent des défis particuliers pour deux raisons: presque la moitié des cyclones tropicaux dans l'Atlantique nord entreprend une transition, et le secteur de l' Atlantique avec la plus haute fréquence de TE se trouve juste au sud de la Nouvelle-Écosse. Cette session va contenir des travaux qui soulignent la recherche pour améliorer notre compréhension de la transition extratropicale; ainsi que ses impacts sur toutes les parties du globe.

Qualité de l'air: délivrer le bon message

Doug Steeves - Environnement Canada
Randall Martin - Université de Dalhousie
Personne-ressource: DougE.Steeves@ec.gc.ca

La capacité de mesurer et prévoir la qualité de l'air s'améliore rapidement. En même temps survient la responsabilité d'informer le publique afin qu'en retour, le publique puisse ajuster ses activités pour améliorer sa qualité de vie. Pour rencontrer ce défi, le Canada met en œuvre un programme unique en son genre "Risque-de-santé basé sur l'indice de qualité de l'air". Cote air santé (CAS). Cette session cherche pour des présentations apparentées à la gamme entière de mesurage, de prévision et présentation sur la qualité de l'air tout en incluant la liste de sujets suivants mais sans restrictions:
Stratégies d'instrumentations et de mesures
Previsions et techniques
Modélisation informatique et statistique
Recherche scientifique incluant les directions futures
Santé publique et éducation
Promotion et établissement de partenariats

Météorologie opérationnelle

Paul Ford - Environnement Canada
Personne-ressource: paul.ford@ec.gc.ca

Cette session inclut des présentations qui discutent des sujets appropriés à la météorologie. Ces sujets incluent mais ne se limitent pas aux techniques de prévisions du temps, la météorologie satellitaire et de radar, la prévision par modélisation numérique et la prévision du temps sévère.

Session Descriptions

Atmosphere

Extratropical transition of tropical systems

Steve Miller - Environment Canada
Contact: steve.miller@ec.gc.ca

One of the greatest challenges for numerical weather prediction is the phenomenon of extratropical transition (ET): the transition of tropical cyclones as they move into mid-latitudes. ET's undergo structural and dynamical changes which translate into changing impacts while the storm advances; impacts which can be greater than those associated with their tropical origins. While ET occurs in all ocean basins where tropical cyclones develop, the forecasters in Atlantic Canada are particularly challenged for two reasons: almost half of the tropical cyclones in the North Atlantic undergo transition, and the area of greatest frequency for ET in the Atlantic is just south of Nova Scotia. This session will feature papers that highlight research into our understanding of extratropical transition and its impact in all parts of the globe.

Air Quality: Delivering the Right Message

Doug Steeves - Environment Canada
Randall Martin - Dalhousie University
Contact: DougE.Steeves@ec.gc.ca

The ability to measure and forecast the quality of the air is improving rapidly. Along with this comes the responsibility to inform the public so that the public in turn can adjust activities to improve quality of life. To meet this challenge, Canada is implementing a first of its kind "health risk based air quality index" the Air Quality Health Index (AQHI).
This session is looking for presentations related to the entire chain of measuring, forecasting and presenting air quality, including but not restricted to:
Instrumentation and measurement strategies;
Forecast techniques;
Computer modelling & statistics;
Scientific research including future directions;
Public health and education;
Promotion and establishing partnerships;

Operational Meteorology

Paul Ford - Environment Canada
Contact: paul.ford@ec.gc.ca

This session includes presentations discussing issues relevant to operational meteorology. These issues include but are not limited to weather forecasting techniques, satellite meteorology, radar meteorology, numerical weather prediction and severe-weather forecasting.

Radiation, Aérosols et Nuages

Jiangnan Li - Centre canadien pour la modélisation et l'analyse
Personne-ressource: jiangnan.li@ec.gc.ca

Les principaux processus physiques dans les modèles climatiques incluent la radiation, les aérosols, les nuages et leurs interactions. Le changement de la température globale est essentiellement déterminé par ces processus physiques dans l'effet de serre et dans l'effet direct/indirect des aérosols. Cette session encourage la discussion sur l'application des paramétrisations physiques dans les modèles climatiques, et les comparaisons de résultats numériques avec les observations. Les problèmes constatés dans les modèles climatiques canadiens pourraient être soulevés et analysés. De plus les études générales portant sur les nuages, les aérosols et les radiations fondées sur les observations ou la théorie sont les bienvenues.

Les Orages Violents compréhensifs et L'Expérience de la couche limite Albertaine (UNSTABLE)

Neil Taylor - Laboratoire hydro-météorologique et arctique, Environnement Canada
Dave Sills - Section Physique des nuages et du temps sévère, Environnement Canada
John Hanesiak - Centre d'observation de la terre, Université du Manitoba
Jason Milbrandt - Recherche en Prévision Numérique, Environnement Canada
Craig Smith - Division Recherche climatique, Environnement Canada
Geoff Strong - Université de l'Alberta (adjoint)
Susan Skone - Département de génie géomatique, Université de Calgary
Patrick Mccarthy - Centre de prévision des intempéries des Prairies et de l'Arctique, Environnement Canada
Personne-ressource: Neil.Taylor@ec.gc.ca

L'été dernier, Environnement Canada a mené un champ d'étude pour enquêter sur l'initiation d'orages violents sur les Pieds des montagnes de l'Alberta (Alberta Foothills). UNSTABLE est un projet de collaboration impliquant les laboratoires de l'hydrométéorologie et de l'Arctique (Edmonton), la physique des nuages et la section de recherche des phénomènes météorologiques (Toronto), et d'autres divisions au sein d'Environnement Canada. Des scientifiques de l'université du Manitoba, de l'Alberta, de Calgary ont fait des contributions majeures qui furent significatives à la réussite de l'expérience. La campagne sur le champ faite en 2008 fut une expérience pilote pour examiner les stratégies d'une autre expérience à pleine échelle prévue pour 2011.
UNSTABLE a été conçu autour des hypothèses de recherche de trois domaines: processus de la couche limite de l'atmosphère, les interactions de la surface terrestre (e.g., l'évapotranspiration), et de la prévision numérique du temps. Le but ultime d'UNSTABLE est de permettre aux prévisionnistes d'émettre les veilles et les avertissements de temps violents les plus précis possible en terrains accidentés, tout en ayant des bénéfices anticipés pour les prairies et le reste du Canada. Au cours de la période intense d'observation du 9-23 juillet, le personnel sur le terrain a travaillé à recueillir des mesures météorologiques à haute résolution des conditions près de la surface et en altitude liées à un environnement propice à la genèse d'orages. L'instrumentation incluait des équipes de radiosonde fixes et mobiles, des voitures équipées d'instruments de mesures, du matériel de profils spécialisés, des avions de recherche et des réseaux d'observation existants (par exemple, des stations météorologiques par satellite, radar, de détection de la foudre). Les opérations ont été menées sur huit jours en utilisant des temps de vol sur 24 heures, plus de 230 radiosondes, les équipes sur le terrain ont voyagé au-delà de 10 000 km. Les équipes ont été en mesure d'échantillonner la ligne d'air sec et le gradient d'humidité entre les zones agricoles et les zones boisées, et d'autres frontières associées au développement de la tempête.
Nous encourageons les autres chercheurs à travers le pays à présenter leurs travaux reliés aux orages violents et les défis de la prévision sur ce sujet.

Radiation, Aerosols and Cloud

Jiangnan Li - Canadian Center for Climate Modelling and Analysis
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The main physical processes in climate models involve radiation, aerosols, cloud and their interaction. Global temperature change is mainly determined by these physical processes in the green house effect and the aerosol direct/indirect effect. This session encourages discussion on the implementation of related physical parameterizations in Canadian climate models and the comparisons of the model results with observations. The existing problems found in Canadian climate models could be raised and analyzed. In addition the general studies of cloud/aerosol/radiation based on observation or theory are welcome.

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE)

Neil Taylor - Hydrometeorology and Arctic Lab, Environment Canada
Dave Sills - Cloud Physics and Severe Weather Section, Environment Canada
John Hanesiak - Centre for Earth Observation, University of Manitoba
Jason Milbrandt - Recherche en Prevision Numerique, Environment Canada
Craig Smith - Climate Research Division, Environment Canada
Geoff Strong - University of Alberta (Adjunct)
Susan Skone -Department of Geomatics Engineering, University of Calgary
Patrick Mccarthy - Prairie and Arctic Storm Prediction Centre, Environment Canada
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This past summer, Environment Canada led a field program investigating the initiation of severe thunderstorms over the Alberta Foothills. The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) is a collaborative project involving the Hydrometeorology and Arctic Lab (Edmonton), the Cloud Physics and Severe Weather Research Section (Toronto), and other divisions within Environment Canada. Scientists from the Universities of Manitoba, Alberta, and Calgary made major contributions and were important to the success of the experiment. The 2008 field campaign was a pilot experiment to test strategies for a full-scale experiment planned for 2011.
UNSTABLE was designed around hypotheses in three research areas: atmospheric boundary-layer processes, land-surface interactions (e.g., evapotranspiration), and numerical weather prediction. The ultimate goal of UNSTABLE is to allow forecasters to issue the most accurate and timely severe thunderstorm watches and warnings possible in this area of complex terrain, with additional anticipated benefits for the prairies and the rest of Canada.
During the 9-23 July intensive observation period, field personnel worked to collect high-resolution meteorological measurements of near-surface and upper-air conditions associated with environments conducive to thunderstorm initiation. Instrumentation included fixed and mobile radiosonde teams, instrumented cars, specialized profiling equipment, research aircraft, and existing observation networks (e.g., weather stations, satellite, radar, lightning detection). Full operations were conducted on eight days utilizing 24 hours of aircraft flight time, over 230 radiosondes, and field team travel in excess of 10 000 km. Teams were able to sample the dryline, moisture gradients between cropped and forested areas, and other boundaries associated with storm development.
We encourage other researchers across the country to present their work related to severe thunderstorms and forecasting issues.

Progrès récents avec le modèle GEM-LAM 2.5km

Serge Desjardins - Environment Canada
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Cela fait maintenant plus de trois ans que le GEM-LAM (Modèle à Aire Limitée) à 2,5 km de résolution a été implanté au Centre Météorologique Canadien et offre des simulations numériques *expérimentales* sur diverses fenêtres régionales canadiennes. Depuis lors, le développement et l'évaluation du modèle a continué en collaboration avec les laboratoires nationaux et les centres de prévisions à travers le pays. Cette session sera un forum pour la communauté en recherche ou en prévision où les projets à venir, les plus récentes résultats d'évaluations durant l'été ou les saisons d'hiver, des études de cas de phénomènes locaux, et des applications à des projets spéciaux (API, MAP D-PHASE, instable, Jeux olympiques de Vancouver) peuvent être discutés et présentés devant une plus large audience scientifique. Les articles liés à ces thèmes sont demandés pour la présente session. Les articles sur d'autres questions connexes seront également considérés..

Préparations météorologiques pour les jeux Olympiques d'hiver 2010

Chris Doyle - Environnement Canada
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À moins d'un an des jeux d'hiver, les préparations approchent la fin pour tous les aspects des opérations des jeux. L'év&eagrave;nement des Olympiades utilise de façon significative les données et les prévisions du temps. Plusieurs aspects comme la planification de l'horaire et la conduite des évànements, la transportation, la gérance des travailleurs, la diffusion, la sécurité et le confort des spectateurs et des athlètes sont sous les effets des conditions météorologiques. La Société météorologique du Canada (SMC) est la seule à fournir les services météo aux Jeux. Elle est responsable de fournir une variété de support météo à plusieurs des agences officielles ainsi que celles du fédéral qui participeront à la tâche. Des innovations faites aux modèles numériques de prévisions, la production de prévision et le développement des prévisionnistes ont été entrepris pour supporter le programme du service météo. Des projets de recherches affiliées sont en marche. Des additions significatives ont été faites aux systèmes d'observation météo puisqu'ils n'existaient pas dans plusieurs des cas avant la construction des sites. Les préparations pour procurer les services météo pour les Jeux ont entraîné un investissement considérable de la part du Gouvernement du Canada. Quelles que soient les conditions météo la SMC est prête à délivrer.

- Réduction du NWP à l'échelle du site Olympique
- Préparations du NWP pour la prévision aux Olympiades
- Résultats préliminaires du Projet de démonstration de la prévision à courte durée (débutant tôt en 2009)
- Thorpex Tropical Asia-Pacific Regional Campaign Winter phase experiment (data assimilation, forecasting and economic evaluation of weather products for the Olympic period of 2009)
- Aperçu du paquet des services météorologiques pour 2010

Recent Progress with the GEM-LAM 2.5km Model

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It has been more than three years since the GEM-LAM (Limited-Area Model) at 2.5 km resolution has been implemented at the Canadian Meteorological Centre for *experimental* use over selected regions of Canada. Since then, development and evaluation of the model has continued in collaboration with the Regional Storm Centres and the National Laboratories across the country. This session will be a forum for the research and forecaster communities where recent and upcoming model developments, evaluation for summer and winter seasons, case studies of local phenomena, and applications to special projects (IPY, MAP D-PHASE, UNSTABLE, Vancouver Olympics) can be discussed and presented to a larger scientific community. Contributions related to these topics are solicited for this session and contributions about other related subjects will also be considered.

Meteorological Preparations for the 2010 Olympic Winter Games

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With the Games less than a year away, preparations are nearing completion for all aspects of Games' operations. The Olympics is a significant user of weather data and forecasts. Many aspects of the event, including the timing and conduct of the sporting events, Olympic area transportation, workforce management, broadcasting and the safety and comfort of spectator and athletes alike are at the affect of weather conditions. The Meteorological Service of Canada (MSC) is the sole provider of weather services to the Games, and is also responsible for providing a variety of meteorological support to the many Federal and other official agencies who will participate in the endeavor. A number of innovations to Numerical Weather Prediction, forecast production and forecaster development have been undertaken to support the weather service program for the Games, and affiliated research projects are underway. Significant additions have been made to weather observing systems as well, since, in a number of cases, Olympic venues were completely undeveloped prior to venue construction. Preparations to provide weather services on behalf of the Games has entailed a considerable investment on the part of the Government of Canada, and come snowstorms or picture-postcard conditions, the MSC is ready to deliver.

- Downscaling of NWP to the Olympic Venue scale
- NWP preparations for Olympic forecasting
- Preliminary results from the 2010 Nowcasting Forecast Demonstration Project (starts in early 09).
- Thorpex Tropical Asia-Pacific Regional Campaign Winter phase experiment (data assimilation, forecasting and economic evaluation of weather products for the Olympic period of 2009)
- Overview of the weather services package for 2010

Climat

Paléo-Océanographie et Paléo-Climatologie

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Cette session va rassembler les chercheurs intéressés par les dynamiques de l'océan et du climat des temps passés. Les présentations ne vont cibler pas seulement la paléo-océanographie et la paléo-climatologie de la période quaternaire qui précède l'ère des records par instruments. Les contributions sur les sujets reliés aux enregistrements marins, terrestres et glaciologiques du changement passé de l'océan et du climat, et incluant les études sur la modélisation numérique seront considérées.

Homogénéisation des données climatiques et l'analyse des tendances

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La banque de données fiables de long terme est essentielle pour les études du changement climatique. Les données de hautes qualités des stations avec une bonne résolution temporelle et spatiale sont nécessaires pour les analyses de tendance et de variabilité, la vérification des modèles climatiques régionaux et globaux, la validation des données de télédétection et ultimement la détection et attribution appropriée du changement climatique. Cependant il existe des difficultés pour l'analyse de ces ensembles de données à cause des modifications ou fermetures des sites d'observations, du changement dans les procédures et les instruments d'observations, et récemment la réduction des sites climatiques traditionnelles en même temps que l'automatisation croissante.
Des techniques ont été développées pour l'indentification des cas non homogènes dans les ensembles de données due à de tels facteurs non climatiques qui interfèrent avec l'évaluation appropriée des tendances climatiques. D'autres études sont requises pour ajuster les différents éléments climatiques (température, précipitation, vent, pression, humidité et les données de la haute atmosphère) et pour différentes résolutions temporelles
(annuelles, mensuelles, quotidiennes, horaires).
Cette session invite les contributions qui décrivent
1) les sources de déviations dans les ensembles de données climatiques reliées à l'introduction des nouveaux instruments, les changements dans les procédures d'observations, l'automatisation et les autres, et leurs impacts sur les tendances climatiques.
2) les méthodologies pour détecter et ajuster les cas non homogènes dans les ensembles de données climatiques en plus des procédures d'évaluation des méthodes différentes. Les contributions sur le développement d'une base de données pour information historique dans la tendance climatique et les études de variabilité sont les bienvenues.

Le changement climatique et les évènements extrêmes

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Le fait est reconnu largement que sous les changements climatiques, la fréquence des hasards météorologiques et hydrologiques et le coût des dommages associés devraient augmenter au 21ième siècle. Afin d'augmenter la capacité d'adaptation pour minimiser le risque des hasards futurs, l'information scientifique solide sur les estimés futurs est essentielle pour les chefs d'organisation comme outil servant au développement des politiques et de stratégies d'adaptation. Cette information inclut les évaluations quantitatives sur les changements dans la fréquence et la grandeur des hasards météorologiques et hydrologiques avec le climat du futur. Cette session invites les soumissions de papiers concernant les impacts du changement climatique sur les hasards météorologiques et hydrologiques en utilisant GCM, RCM et/ou les scénarios de diminutions statistiques. Les hasards météorologiques/hydrologiques incluent, mais sans limitation des autres sujets, forte chute de pluie, inondation, sècheresse, pluie verglaçante, rafale de vent, ouragan, tornade, etc. Le but de cette session est de procurer une plate-forme pour les chercheurs afin de partager l'information, échanger les développements récents et les applications des analyses des impacts du changement climatique sur les hasards météorologiques et hydrologiques.

Climate

Paleo-Oceanography and Paleo-Climatology

Markus Kienast - Dalhousie University
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This session will bring together researchers interested in ocean and climate dynamcis of the past. Presentations will focus on, but are not limited to, paleoceanography and paleoclimatology of the Quaternary, prior to the instrumental record. Contributions are invited on topics related to marine, terrestrial, and glaciological records of past ocean and climate change, including modelling studies.

Climate Data Homogenization and Trend Analysis

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Long-term and reliable climate datasets are essential for climate change studies. High quality station data with good temporal and spatial resolution are necessary for accurate trend and variability analysis, verification of regional and global climate models, validation of remotely sensed data, and ultimately, the proper detection and attribution of climate change. There remain, however, difficulties for the analysis of these datasets due to observing site modifications or closures, changing observing procedures and instruments, and most recently, downsizing of traditional climate networks along with increasing automation. Techniques have been developed for the identification of "inhomogeneities" in climate datasets due to such non-climatic factors which can seriously interfere with the proper assessment of climate trends. More studies are required for adjusting different climate elements (temperature, precipitation, wind, pressure, humidity, and upper air data) and for different temporal resolutions (annual, monthly, daily, hourly). This session invites contributions describing i) sources of biases in climate datasets related to new instruments, changes in observing procedures, automation and others, and their impact on climate trends; and ii) methodologies for detecting and adjusting inhomogeneities in climate datasets as well as test procedures for evaluation of different methods. Contributions on the development of historical information (metadata) database and use of homogenized data in climate trend and variability studies are also welcome.

Climate Change and Extreme Events

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It has become widely recognized that under a changing climate, the frequency of meteorological/hydrological hazards and associated damage costs would more likely increase in the 21st century. To expand adaptive capacity to minimize future hazardous risks, solid scientific information on future estimates is essential for decision makers to develop adaptation strategies and policies. This information includes quantitative assessments on changes in frequency and magnitude of meteorological and hydrological hazards under the future climate. This session invites submissions of papers concerning climate change impacts on meteorological and hydrological hazards using GCM, RCM, and/or statistical downscaled scenarios. Meteorological/hydrological hazards include (but not limited to) heavy rainfall, flooding, drought, freezing rain, wind gust, hurricane, tornado, etc. The purpose of this session is to provide a platform for researchers to share information, exchange latest developments and applications of climate change impacts analyses on meteorological and hydrological hazards.

Modélisation Régionale Climatique

Laxmi Sushama - Consortium Ouranos /UQAM
René Laprise - Université du Québec à Montréal
Daniel Caya - Consortium Ouranos
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La méthode la plus efficace pour générer des informations détaillées sur les changements climatiques régionaux, à des échelles spatiales et temporelles requises, est par le biais d'un modèle climatique régional (MRC) intégré dynamiquement à l'intérieur d'un modèle climatique global (GCM). Cette session donnera un aperçu de l'état actuel des modèles climatiques régionaux (MRC) et adressera des questions en suspens dans le développement et l';application des MRCs à haute résolution. Des présentations reliées à la réduction régionale des scénarios de changements climatiques de la IPCC, aux projets d'inter-comparaison de MRC, aux effets de la résolution et des paramètres physiques sur la précision des MRC, la transférabilité des MRC et des techniques de diagnostique.

Interdisciplinaire

Interaction atmosphère-océan et les vagues

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Cette session explorera les dynamiques des vagues extrêmes, les courants induits par la tempête, et les ondes de tempête produites par les ouragans sévères. Les processus de couplage seront également considérés. Par exemple, dans une atmosphère couplée –vague-embrun-système de modèle courant, les effets d'embrun et traîné de la vague ont un impact sur les vagues générées par la tempête, la variation de leurs hauteurs et la direction du spectre de la vague reliée à la position et la vitesse de déplacement de la tempête. La diminution ou l'augmentation de la hauteur de la vague significative causéée par l'embrun et la traînée est plus significative dans les régions des vents forts à la droite de la trajectoire de la tempête. Ces processus sont modulés dans la région de la vague maximum et ils ont tendance à se produire après l'évènement des vents maximum dépendant de la vitesse de translation de la tempête. La vitesse de translation de la tempête est importante. La variation directionnelle entre les vents locaux et les vagues générées par le vent à l'intérieur des tempêtes à mouvement rapide qui dépassent le groupe de vagues est notamment différente de la situation où les vagues sont trappées. Les vagues sont trappées lorsque la vitesse de groupe des vagues dominantes est approximativement équivalente à la vitesse de translation de la tempête. Ces processus ont un impact sur les courants océaniques et les ondes de tempête. Les transferts de momentum du vent à la vague et de la vague au courant ont pour effet total de réduire la vitesse des courants de surface. Nous invitons des présentations sur d'autres aspects des systèmes de couplage atmosphère-océan ainsi que les simulations des tempêtes marines.

Monitorage de l'atmosphère et de l'océan

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Les programmes de monitorage procurent des données pour évaluer l'état passé et courant des composantes physiques, chimiques et biologiques de l'environnement aussi bien que l'apport fourni à la prévision des conditions futures. Avec le développement des approches et des explorations nouvelles en utilisant des méthodes multidisciplinaires ; les activités de monitorage à long terme procurent une nouvelle compréhension de la relation parmi les composantes des environnements et les écosystèmes. Dans cette session nous cherchons des contributions qui traitent avec [1] les innovations dans les activités de monitorage et de la technologie, [2] les développements qui améliorent l'accès à l'information, les données et la compréhension utilisée dans les processus de prises de décisions, [3] .des vues d'ensemble des exigences courantes et futures des systèmes d'observation qui sont reliés à la politique et aux besoins scientifiques et opérationnels. D'un intérêt particulier à la demande, ce sont les contributions qui concentrent sur l'utilisation de l'information d'une large gamme d activités de monitorage.

Regional Climate Modelling

Laxmi Sushama - Ouranos Consortium/UQAM
René Laprise - University of Quebec at Montreal
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The most efficient method to generate detailed information on regional climate change, at the spatial and temporal scales required, is through the use of a Regional Climate Model (RCM) dynamically embedded within a Global Climate Model (GCM). This session will provide an overview of the current status of Regional Climate Models (RCMs) and will address outstanding issues in the development and application of high resolution RCMs. Contributions are invited on topics related to regional downscaling of IPCC climate change scenarios, RCM intercomparison projects, effects of resolution and physical parameterizations on RCM accuracy, transferability of RCMs and diagnostic techniques.

Interdisciplinary

Atmosphere-Ocean Interaction & Waves

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This session will explore the dynamics of extreme waves, storm-induced currents, and storm surge in severe hurricane conditions. Coupling processes will also be investigated. For example, in a coupled atmosphere - wave - sea spray - current model system, the effects of sea spray and wave drag have impact on storm-generated waves, their height variations, and directional wave spectra, related to the storm location and translation speed. The decrease or increase of significant wave height due to spray and wave drag is most significant in high wind regions to the right of the storm track. These processes are modulations on the maximum wave region, and tend to occur after the peak wind events, depending on the storm translation velocity. The translational speed of the storm is important. The directional variation between local winds and wind-generated waves within rapidly moving storms that outrun the waves is notably different from that of trapped waves, when the group velocity of the dominant waves approximates the storm translation speed. These processes also have impact on ocean currents and storm surge. The net effect of wind-to-wave and wave-to-current momentum transfers reduces the surface current speeds. Other aspects of atmosphere-ocean coupled systems, including simulations of marine storms are welcome.

Monitoring the Atmosphere and Ocean

Al Wallace - Environment Canada
Pierre Pepin - Fisheries and Oceans Canada
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Monitoring programmes provide data to assess the past and current state of physical, chemical and biological components of the environment as well as input to forecast future conditions. With the development of new approaches and explorations using multidisciplinary methods, long-term monitoring activities are providing new understanding of the relationship among components of environments and ecosystems. In this session, we seek contributions that deal with [1] innovations in monitoring activities and technology; [2] developments that improve access to information, data, and understanding used in decision-making processes; [3] overviews of current and future requirements of observation systems as they relate to policy, science and operational needs. Of particular interest are contributions that focus on the use of information from a wide range of monitoring activities.

AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie

Will Perrie - Pêches et océans Canada

L'Année Internationale Polaire (AIP) 2007-2008 est un programme de deux ans de science, recherche et éducation centré sur les régions polaires. Les chercheurs canadiens et internationaux des universités, des communautés nordiques et les gouvernements travaillent pour avancer notre compréhension des dimensions sociales, économiques et santés aussi bien que les processus géophysiques, climatiques et biologiques. Les soumissions sont bienvenues parmi les projets de AIP ainsi que d'autres sources qui contribueront à notre compréhension des processus atmosphériques, océanographique et hydrologique dans l'Arctique.

Le climat et les écosystèmes marins

Catherine Johnson - Pêches et océans Canada
Angelica Peña - Pêches et océans Canada
Christine Michel - Pêches et océans Canada
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La variabilité et le changement du climat influencent la distribution, l'abondance et les comportements saisonniers des populations marines due aux changements dans leur environnement physique et chimique ci-inclus les changements de température, stratification et les modèles de circulation océanique, glace marine, la provision de PH et les substances nutritives à la surface des eaux. Comprendre et prévoir les impacts du changement climatique sur les écosystèmes marins sera critique dans le futur proche pour gérer les ressources marines et atténuer son impact ainsi que l'impact des autres facteurs anthropogéniques sur les habitats marins et les communautés. Dans cette session, nous encourageons les présentations qui contribuent à la compréhension des mécanismes par lesquels le changement climatique influence les écosystèmes mains, ci-inclus les effets sur la distribution et l'abondance des populations marines, la productivité, les interactions entre les communautés, la biogéochimie, les taux physiologiques, le chronométrage saisonnier, et les modèles historiques de la vie dans toutes les régions océaniques et leurs environnements.

Interactions physiques et biologiques dans l'océan

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La collaboration interdisciplinaire fût la clef du progrès en océanographie durant les 40 dernières années. Cette session encourage les contributions qui se nourrissent des interactions entre les disciplines comme l'océanographie physique, qui furent représentées de bonne façon depuis longtemps aux congrès de la SCMO, et les disciplines de la biologie ou la biogéochimie. Les sujets traitant des études allant des échelles de dissipation jusqu'aux échelles de bassins ainsi que la recherche menée sur le terrain, en laboratoire ou par modèle numérique sont les bienvenus.
''Actuellement on ne peut pas concevoir une question océanographique sans avoir besoin de traverser les autres disciplines''.- Thomas M. Powell (Océanographie, Septembre 2008)

IPY and Related Atmospheric, Oceanographic, and Hydrological Studies

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The International Polar Year (IPY) 2007-2008 is a two year program of science, research & education focused on the polar regions. Canadian and international researchers from universities, northern communities, and governments are working to advance our understanding of cultural, social, economic and health dimensions, as well as geophysical, climate and biological processes. Submissions are encouraged from both IPY and non-IPY projects which will contribute to our understanding of atmospheric, oceanographic, and hydrological processes in the Arctic.

Climate and Marine Ecosystems

Catherine Johnson - Fisheries and Oceans Canada
Angelica Peña - Fisheries and Oceans Canada
Christine Michel - Fisheries and Oceans Canada
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Climate variability and change influence the distribution, abundance, and seasonal timing of marine populations through changes in the physical and chemical environment, including changes in temperature, stratification, circulation patterns, sea ice, pH and nutrient supply to surface waters. Understanding and predicting the impacts of climate change on marine ecosystems will be critical in the near future to managing marine resources and mitigating the impact of climate change and other anthropogenic stressors on marine habitats and communities. In this session, we encourage presentations that contribute to understanding the mechanisms by which climate change influences marine ecosystems, including effects on the distribution and abundance of marine populations, productivity, community interactions, biogeochemistry, physiological rates, seasonal timing, and life history patterns in all ocean regions and environments.

Physical-Biological Interactions in the Ocean

Katja Fennel - Dalhousie University
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Embracing interdisciplinarity has been key to many of the most important advances in oceanography over the past 40 years. This session encourages contributions that cross disciplines between physical oceanography, which has long been well represented at CMOS congresses, and biology or biogeochemistry. From dissipation scales to basin scales, research conducted in the field, laboratory or computer model are welcome.
"Today, one can scarcely conceive of an oceanographic question that does not cut across disciplines." - Thomas M. Powell (Oceanography, September 2008)

Modélisation numérique pour la recherché

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La télédétection provenant de l'espace, de l'aviation et de la surface de la terre procure des occasions avantageuses pour l'avancement de la science de la qualité de l'air et du changement climatique. Les campagnes courantes ou planifiées ayant pour but d'acquérir des observations provenant de la surface de la terre, de l'aviation et des satellites procurent une abondance de données pouvant être utilisée dans la recherche de l'évolution des composantes atmosphériques, océaniques. De plus ces nouvelles données peuvent aider à déterminer les caractéristiques de la surface de la terre. Les télédétecteurs passifs et actifs augmentent notre capacité à capter et observer les propriétés physiques et chimiques de l'atmosphére ainsi que les constituants océaniques. Cette session encourage les contributions sur la théorie de dispersion de la lumière et le transfert de radiation, les technologies de mesurage, l'algorithme de récupération, les validations, l'assimilation des données satellitaires, les nouvelles intuitions et découvertes.

Télédétection de l'atmosphère et de l'océan

Rong-Ming Hu - Université de Dalhousie
Personne-Ressource: hu@fizz.phys.dal.ca / r.hu@herts.ac.uk

La télédétection provenant de l'espace, de l'aviation et de la surface de la terre procure des occasions avantageuses pour l'avancement de la science de la qualité de l'air et du changement climatique. Les campagnes courantes ou planifiées ayant pour but d'acquérir des observations provenant de la surface de la terre, de l'aviation et des satellites procurent une abondance de données pouvant être utilisée dans la recherche de l'évolution des composantes atmosphériques, océaniques. En plus ces nouvelles données peuvent aider à déterminer les caractéristiques de la surface de la terre. Les télédétecteurs passifs et actifs augmentent notre capacité à capter et observer les propriétés physiques et chimiques de l'atmosphère ainsi que les constituants océaniques. Cette session encourage les contributions sur la théorie de dispersion de la lumière et le transfert de radiation, les technologies de mesurage, l'algorithme de récupération, les validations, l'assimilation des données satellitaires, les nouvelles intuitions et découvertes.

Eau, temps et climat servant le secteur énergétique

Anne-Marie Valton - Environnement Canada
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L'énergie devient de plus en plus un enjeu tout aussi important que les changements du climat et l'état de l'eau. Il y a un besoin mondial de traiter cet enjeu dans le contexte des changements climatiques. Nous avons besoin de trouver des manières de gérer la demande et la disponibilité de l'énergie de façon plus efficace. La prévision environnementale dans la science de l'atmosphère et de l'eau peut adresser directement ces importantes priorités en aidant les décideurs à améliorer la gérance des ressources énergétiques. Elles aident aussi à assurer l'égalité entre la quantité de la ressource et la demande d'énergie et à mieux gérer le risque sur l'infrastructure énergétique. Elles peuvent améliorer l'inventaire des gaz à effet de serre ainsi qu'à évaluer le potentiel des ressources renouvelables. Les prévisions environnementales peuvent améliorer la compétitivité et le leadership d'un système énergétique net. Puisque le Canada est parmi un des plus grands producteurs au monde de tous les types d'énergie, il est important de supporter ce secteur et montrer que nous pouvons aider ceux et celles qui prennent les décisions dans ce domaine.

Numerical Modelling for Research

Ronald Mctaggart-Cowan - Environment Canada
Xin Qiu - RWDI
Contact: ron.mctaggart-cowan@ec.gc.ca

This session focuses on the use of numerical models for environmental research. Its goal is to bring together the many users of models developed and used, to communicate results, to exchange ideas, and to facilitate new collaborations. Contributions are solicited on all topics related to numerical environmental modelling for research purposes: atmospheric, oceanic, sea ice, biological, et cetera. Appropriate topics include, but are not limited to model development, coupling, evaluation, and applications to research. The overarching goal of this session is to contribute to the scientific understanding of environmental processes at various scales by using numerical models.

Remote Sensing of the Atmosphere and Ocean

Rong-Ming Hu - Dalhousie University
Contact: hu@fizz.phys.dal.ca or r.hu@herts.ac.uk

Space-based, aircraft-based and ground-based remote sensing provides new opportunities to advance the science of air quality and climate change. Current and planned ground-based or aircraft-based observation campaigns and satellite missions, present a wealth of new information that can be used to investigate the evolution of atmospheric and oceanic compositions and land surface characteristics. Passive and active remote sensors have increased our capability of detecting and monitoring the physical and chemical properties of atmospheric and oceanic constituents. This session encourages contributions from light scattering and radiative transfer theory, new measurement technologies, retrieval algorithm, validations, satellite data assimilation, and new insights and discoveries.

Water, Weather and Climate Serving the Energy Sector

Anne-Marie Valton - Environment Canada
Contact: anne-marie.valton@ec.gc.ca

Energy is becoming a very important issue as much as climate change and water. There is a need worldwide to address this issue in the context of a changing climate: we need to find ways to manage energy demand and supply more efficiently. Environmental prediction in water and atmospheric science can address directly these important priorities by helping the decision makers to improve management of energy resources. They also help to match energy supply and demand and to better manage risk to energy infrastructure. They can also improve inventories of greenhouse gases and evaluate renewable energy potential. Environmental predictions can improve the competitiveness & leadership of a clean energy system. As Canada is among one of the world's largest producers of most types of energy, it is important to support this sector and see how we can help decision makers in this area.

Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE)

Harold Ritchie - Environnement Canada
Brenda Topliss - Pêches et Océans Canada
Personne-Ressource: harold.ritchie@ec.gc.ca

Environnement Canada (EC), Pêches et Océans Canada (POC) et le ministère de la Défense nationale (MDN) requièrent des produits d'information sur l'environnement et des capacités qui peuvent être fournie par un système global opérationnel couplé d'assimilation de données et de prévisions atmosphère-océan-glace. Des données in-situ de flotteurs Argo de concert avec d'autres observations (par exemple, l'altimètre, télédétection de température de surface de la mer) permettent l'assimilation des données océaniques. Une initiative interinstitutionnelle, le Réseau Opérationnel Canadien de Systèmes Couplés de Prévisions Environnementales (ROCSCPE) y compris la participation de Mercator-Océan (France), fournit un cadre pour la recherche et des opérations sur un système couplé de prévision atmosphère-océan-glace.
ROCSCPE inclut des projets de base sur:
1) le développement d'une meilleure assimilation des données et des systèmes de prévision,
2) leur validation à une échelle globale et aux échelles des bassins de l'Atlantique Nord, Arctique et Pacifique Nord,
3) la démonstration des capacités de prévisions océaniques régionales ainsi que leurs applications dans le cadre de l'Entente Canada - Terre-Neuve pour un système de prévision opérationnelle océanique (C-Noofs),
4) et l'assimilation des données et modélisation de la glace de la mer arctique.
Des ressources initiales ont été mises en place pour la constitution de trois activités majeures inter-reliées :
1) une activité opérationnelle basée sur le couplage entre le modèle atmosphérique Canadien GEM avec le système Mercator,
2) un projet d'activités de recherche et de développement (R & D) pour développer et maintenir un système adapté aux besoins du Canada sur un terme plus long,
3) et une activité de produits pour identifier, développer et permettre la diffusion de résultats et autres produits pertinents.
Cette session fournira une vue d'ensemble de ROCSCPE, présentera les résultats jusqu'à date, et révèlera les plans pour les systèmes opérationnels avec potentiel dans le futur.

La météo et la Science Sociale

Jacques Descurieux - Environnement Canada
Personne-Ressource: Jacques.Descurieux@ec.gc.ca

Cette session vise à rassembler des praticiens, des chercheurs, et les membres participants, dans tous les secteurs de l'entreprise météo, qui se consacrent à l'intégration de la météorologie et des sciences sociales. Il devrait se former un forum qui facilite l'intégration complète et durable des sciences sociales dans la recherche et l'application météorologique. L'objectif est de procurer à la communauté météorologique un moyen de connaître et d'examiner davantage les idées, les méthodes et les exemples liés à l'intégration du travail météo-société. Cette session s'adresse aux articles explorant les nouvelles approches pour étudier le temps, le climat, et la société.
Cela comprend, mais sans limitation :

- Méthodes qualitatives et quantitatives pour améliorer la compréhension, la communication, et l'utilisation de l' information provenant des études d'impacts météorologiques et climatiques
- Communiquer l'incertitude et les prévisions
- Croisement des avertissements, et de la gestion des réactions et des situations d'urgence
- Recherche dans l'atténuation, la préparation et la durabilité
- Les sujets de risques et problèmes de communication reliés à la météo dangereuse.

Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS)

Harold Ritchie - Environment Canada
Brenda Topliss - Fisheries and Oceans Canada
Contact: harold.ritchie@ec.gc.ca

Environment Canada (EC), Fisheries and Oceans Canada (DFO), and the Department of National Defence (DND) require environmental information products and capabilities that can be provided by an operational global coupled atmosphere-ocean-ice data assimilation and prediction system. In-situ data from Argo floats together with other observations (e.g., altimeter, remotely sensed sea surface temperature) permit effective ocean data assimilation. An inter-agency initiative, the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) including Mercator-Ocean participation (France), is providing a framework for research and operations on coupled atmosphere-ocean-ice prediction. CONCEPTS includes Core Projects on: 1) development of improved data assimilation and prediction systems; 2) their validation on both global and basin scales for the North Atlantic, Arctic, and North Pacific; 3) demonstration of regional ocean prediction capabilities and applications in the context of the Canada - Newfoundland Operational Ocean Forecasting System (C-NOOFS) and 4) sea ice and Arctic modelling and data assimilation. 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. This session will provide an overview of CONCEPTS, present results to date, and plans for potential future operational systems.

Weather and Social Science

Jacques Descurieux - Environment Canada
Contact: Jacques.Descurieux@ec.gc.ca

This session aims at bringing together practitioners, researchers, and stakeholders, in all sectors of the weather enterprise, who are dedicated to the integration of meteorology and social science. It should be a forum that facilitates the comprehensive and sustainable integration of social science into meteorological research and practice. The objective is to provide the meteorological community with a means to learn about and further examine ideas, methods, and examples related to integrated weather-society work.

This session invites papers exploring new approaches to study weather, climate, and society. This includes, but is not limited to:

- Qualitative and quantitative methodologies for improving understanding, communication, and use of weather and climate information impact studies
- Communicating uncertainty and forecasts
- Intersections of warnings, response and emergency management
- Research in mitigation, preparedness, and sustainability
- Risk and crisis communication issues relating to hazardous weather

Météorologie et Océanographie Militaire

Martha Anderson - Ministère de la défense nationale
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Les sciences de la météorologie et de l'océanographie jouent un rôle important dans le succès militaire. À un niveau tactique, l'environnement peut avoir un impact sur la capacité de l'armée d'entreprendre une mission ou de déployer un capteur. Au niveau opérationnel, les planificateurs doivent comprendre ces effets quand ils orchestrent les activités des divers éléments d'une force multi-nationale. La façon de présenter cette information de manière cohérente dans l'environnement informatique en réseau d'aujourd'hui est tout un défi. Cette session présentera les progrès réalisés en fournissant un appui scientifique à tous les niveaux de l'activité militaire.

La Prévision et la Prévisibilité globale de l'Atmosphère-Océan

Keith Thompson - Université de Dalhousie
Harold Ritichie - Environnement Canada
William Merryfield - Environnement Canada
Personne-Ressource: keith.thompson@dal.ca

Il existe un intérêt scientifique croissant dans l'amélioration et l'extension de l'habilité des modèles globales numériques de prévision de l'atmosphère et de l'océan sur les échelles de quelques jours jusqu'à des décennies. Il est généralement reconnu que cela exige le développement des systèmes de modélisation avec couplage océan-atmosphère et des systèmes d'assimilation. Cela présente un certain nombre de défis liés à l'assimilation des observations dans les systèmes couplés, et l'identification et la compréhension des processus physiques qui procurent et permettent la prévisibilité. Cette séance va contenir des présentations sur des sujets scientifiques, la modélisation et les défis de l'assimilation liés à la prévision et la prévisibilité du système de couplage global.

Dynamiques de l'atmosphère, de l'océan et du climat

Adam Monahan - Université de Victoria
Robert Scott - Université du Texas à Austin
William Merryfield - Environnement Canada
Ron McTaggart-Cowan - Environnement Canada
Marek Stastna - Université de Waterloo
Personne-Ressource: monahana@uvic.ca

Cette séance assemble les soumissions orientées vers les dynamiques de l'atmosphère de l'océan et du climat. Le titre est intentionnellement vaste afin de permettre aux chercheurs qui se concentrent sur l'étude de n'importe quel aspect du système terrestre à partir de perspective dynamique de joindre la session. D'autres séances existent pour adresser les sujets opérationnels, la modélisation numérique et l'acquisition, et l'utilisation des observations. Cependant, les études dynamiques et diagnostiques des systèmes atmosphère-océan et les systèmes climatiques sont souvent difficiles à placer dans des séances particulières. Des études théoriques et de l'analyse des prévisions, le climat et les modèles de processus et de réanalyse et d'autres servent de données d'observation de la précieuse fonction de plus en plus notre compréhension de la dynamique importante et thermodynamique des processus qui conduisent les circulations à travers les échelles temporelles et spatiales. Les études qui ont trait dynamique de l'océan à d'autres composantes du système terrestre, y compris la biologie, sont incluses.

Military Meteorology and Oceanography

Martha Anderson - Department of National Defence
Contact: anderson.ma@forces.gc.ca

The sciences of meteorology and oceanography play an important role in military success. At a tactical level, the environment can impact the ability of the military to undertake a mission or deploy a sensor. At the operational level, planners need to understand these impacts as they orchestrate the activities of the many diverse elements of a multi-national force. How to present this information in a coherent way in today's networked information environment is a challenge. This session will showcase the advances being made in providing improved scientific support for all levels of military activity.

Health Issues of Weather and Climate

Denis Bourque - Environment Canada
Contact: denis.bourque@ec.gc.ca

We are seeking papers in the following areas:
1 - Climate / Climate Change and health issues
Description Health and Climate have been associated for centuries, under the guise of healthy and not-so-healthy climates. However, more recently, various studies have researched the relationship between the human body and specific climatic regimes or zones to determine if there are any adaptations or accommodations which the body has endured. This type of research can then be used to anticipate the stresses which various climate change scenarios will impose on mankind. Papers we are seeking: Original work studying the relationship(s) between man's health (mental and physical), or society's health system and the current climatic environment, and/or original work on the stresses which the health system and/or the individual will have to bear or the adaptations they will need to undergo in the future
2 - Weather and Health issues
Description Day-to-day weather has long been considered to influence the individual and, by extension, the health system. Many studies have been conducted and continue to be conducted to try to ascertain the nature of this relationship, or to determine if this relationship exists at all, often ailment by ailment.
Papers we are seeking Original work studying the relationship(s) between man's health (mental and physical), or society's health system and day-to-day weather, and/or original work on the stresses which the health system and/or the individual will have to bear or the adaptations they will need to undergo should weather patterns change.
3 - Operational Weather-based Health Products & Programs
Description As more interest develops about the impact which the atmosphere has on the person and the health system, new products which are in some manner linked to health issues are being developed and promulgated. Examples in Canada are the Humidex, the Windchill and the UV Index. Other parts of the world have developed the Heat Index (Philadelphia), in Germany they have forecasts of numerous specific health ailments, whereas in the UK they produce forecasts of the National Health System workload and to assit COPD patients manage their ailment. Heat-Health Alerts are a recent development.
Papers we are seeking Original work describing the development, application and impacts of the use of the various weather-based health-related products
4. Papers/research which address the policy and economic aspects of weather and climate on health issues.

Problèmes de santé liés aux conditions météorologiques et au climat

Denis Bourque - Environnement Canada
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Le matériel que nous recherchons pourrait porter sur :
1 – Le climat / les changements climatiques et les problèmes de santé Description La santé évolue en association avec le climat depuis des centaines d'années, dans le contexte de climats plus ou moins favorables à la santé. Cependant, plus récemment, diverses recherches ont étudié les relations entre le corps humain et certains régimes ou zones climatiques, dans le but d'établir s'il y a eu des réactions d'adaptation ou d'accommodation du corps. Ce type de recherche peut ensuite servir à anticiper les pressions exercées sur l'homme par les divers scénarios de l'évolution du climat. Communications recherchées : Des travaux originaux portant sur l'étude d'une ou de plusieurs relations entre la santé humaine (mentale et physique), ou les systèmes de santé des sociétés, et le milieu climatique actuel, et/ou des travaux originaux portant sur les pressions que subiront le système de santé et/ou les personnes, ou les mesures d'adaptation auxquelles ils devront se plier.
2 – Les conditions météorologiques et les problèmes de santé Description Les températures quotidiennes sont connues depuis longtemps pour avoir une influence sur les personnes et par extension, sur l'organisation des soins de santé. De nombreuses études ont été menées et le sont encore aujourd'hui afin d'établir avec certitude la nature de cette relation, ou à tout le moins d'établir si une telle relation existe vraiment; ces études portent souvent sur des malaises ou des problèmes en particulier. Communications recherchées : Des travaux originaux examinant la/les relation(s) entre la santé humaine (mentale et physique) ou l'organisation des soins de santé, et les conditions météorologiques quotidiennes, et/ou des travaux originaux portant sur les pressions que subiront le système de santé et/ou les personnes ou sur les adaptations auxquelles ils devront se plier en réponse à l'évolution des conditions et du régime météorologiques.
3 – Programmes et produits liés à la santé dérivés des renseignements météorologiques Description À mesure qu'un intérêt se manifeste à propos de l'influence exercée sur les personnes et le système de santé par les conditions atmosphériques, de nouveaux produits liés d'une quelconque manière à la santé sont développés et rendus disponibles. Au Canada, nous pouvons citer les indices Humidex, UV et l'indice sur le refroidissement éolien. Dans d'autres parties du monde, on a mis au point d'autres indices du genre, comme l'Indice de chaleur à Philadelphie; en Allemagne, des prévisions sont diffusées quant à de nombreux risques pour la santé, et au Royaume-Uni, on procède à des annonces décrivant l'état d'engorgement des systèmes nationaux de santé. Communications recherchées Des travaux originaux décrivant le développement, la mise en application et les effets de l'utilisation des divers produits liés à la santé dérivés des renseignements météorologiques.
4 – Nous prendrons également en considération les communications / travaux de recherche portant sur les politiques et les aspects économiques des conditions météorologiques et du climat en rapport avec les problèmes de santé.

Océanographie

Composition, Variabitlité et Circulation de l'eau salée: des baies aux bassins.

Charles Hannah - Pêches et océans Canada
Igor Yashayaev - Pêches et océans Canada
Personne-Ressource: hannahc@mar.dfo-mpo.gc.ca

La session couvre la géographie étendue de la recherche océanographique au Canada partant de l'Océan sud jusqu' à l'Atlantique nord ainsi qu'une diversité de sujets à partir des thermodynamiques de l'eau salée jusqu'à la circulation et l'évolution des masses d'eau. Les simulations numériques issues de modèles seront amenées ensemble avec des observations télétransmises et d'autres faites *in situ*. Les plus récentes observations seront prises seulement quelques jours avant le début du congrès.

Global Atmosphere-Ocean Prediction and Predictability

Keith Thompson - Dalhousie University
Harold Ritichie - Environment Canada
William Merryfield - Environment Canada
Contact: keith.thompson@dal.ca

There is growing scientific interest in improving and extending the prediction skill of global atmospheric and ocean models on time scales of days to decades. It is generally recognized that this requires the development of coupled atmosphere-ocean modelling and assimilation systems. This presents a number of challenges related to assimilating observations into coupled systems, and identifying and understanding the physical processes that provide and limit predictability. This session will include presentations on scientific, modelling and assimilation issues related to prediction and predictability of the global coupled system.

Atmosphere, Ocean and Climate Dynamics

Adam Monahan - University of Victoria
Robert Scott - The University of Texas at Austin
William Merryfield - Environment Canada
Ron McTaggart-Cowan - Environment Canada
Marek Stastna - Environment Canada
Contact: monahana@uvic.ca

This session combines submissions with a focus on atmosphere, ocean and climate dynamics. The title of the session is deliberately broad in order to allow researchers who concentrate on the study of any aspect of the earth system from a dynamical perspective to be included. Other sessions exist for addressing operational issues, numerical modelling, and the acquisition and use of observations. However, dynamical and diagnostic studies of the atmosphere, ocean and climate systems are often difficult to slot into particular sessions. Theoretical studies and analyses of forecast, climate and process models and of reanalysis and other observational datasets serve the valuable function of increasing our understanding of the important dynamic and thermodynamic processes that drive circulations across time and spatial scales. Studies that relate ocean dynamics to other components of the Earth system, including biology, are included.

Oceanography

Composition, Variability and Circulation of Seawater: Bays to Basins.

Charles Hannah - Fisheries and Oceans Canada
Igor Yashayaev - Fisheries and Oceans Canada
Contact: hannahc@mar.dfo-mpo.gc.ca

The session covers the broad geography of oceanographic research in Canada from the Southern Ocean to the North Atlantic and a diversity of topics from seawater thermodynamics to the circulation and evolution of water masses. Model simulations will be brought together with remote and in situ observations, the most recent of which will be taken just a few days before the Congress starts.

Assimilation du carbone dans l'océan — Problèmes de l'acidification de l'océan et la faisabilité de fertilisation par le fer.

Kumiko Azetsu-Scott - Pêches et océans Canada
Debby Ianson - Pêches et océans Canada
Michel Starr - Pêches et océans Canada
Personne-Ressource: Azetsu-ScottK@mar.dfo-mpo.gc.ca

Les océans ont emmagasinés jusqu'à 525 milliards de tonnes de carbone depuis le début de la révolution industrielle et ont aidé à décélérer l'augmentation du CO2 dans l'atmosphère. L'augmentation de la quantité de carbone rend l'océan de plus en plus acide. L'acidification est un sujet global avec des conséquences socio-économiques sérieuses. Cette acidification détient le potentiel de changer les structures communautaires et les chaînes alimentaires dans l'océan. Ces changements dégradent et endommagent les écosystèmes et les pêcheries. L'impact le plus direct serait sur les organismes qui produisent des coquilles et des squelettes de carbonate de calcium (CaCO3), alors qu'une évidence croissante démontre que les organismes non-calcifiants sont affectés aussi. Finalement, la fertilisation par le fer qui augmente la production primaire et l'assimilation du CO2 dans l'océan est considérée comme une des stratégies de mitigation pour atténuer ces dommages. On examinera l'état actuel de la connaissance scientifique sur l'acidification de l'océan et la fertilisation par le fer.

Océanographie côtière et les eaux intérieures

Guoqi Han - Pêches et océans Canada
Jinyu Sheng - Université de Dalhousie
Ram Yerubandi - L'institut national de recherche de l'eau
Personne-Ressource: guoqi.han@dfo-mpo.gc.ca

Cette session va considérer tous les aspects depuis les systèmes d'observations jusqu'à la modélisation numérique des processus physiques dans les domaines côtiers, les mers continentales, les estuaires et les eaux intérieures. Les sujets incluent l'océanographie physique côtière, les ondes de tempêtes, les tsunamis, les dynamiques d'estuaires, l'hydrologie et l'hydrodynamique des grands lacs, les interactions terre-lac et le mélange et la dispersion des matériaux. Cependant cette liste de sujets n'est pas limitée.

L'Acoustique dans l'Océanographie

Tetjana Ross - Université de Dalhousie
Personne-Ressource: tetjana@dal.ca

Le point de cette session est de souligner les contributions de l'acoustique sous-marine à l'océanographie. Cela inclut, mais sans limitation, les études menées sur le sonar et l'acoustique passif, le bioacoustique, la structure géologique dans le fond de l'océan, la communication acoustique, les applications navales, le bruit ambiant, la propagation de longue distance, la dispersion de haute fréquence, la production d'image et l'inversion quantitative.

Carbon Uptake in the Ocean – Problems of Ocean acidification and Feasibility of Iron Fertilization

Kumiko Azetsu-Scott - Fisheries and Oceans Canada
Debby Ianson - Fisheries and Oceans Canada
Michel Starr - Fisheries and Oceans Canada
Contact: Azetsu-ScottK@mar.dfo-mpo.gc.ca

Oceans have taken up 525 billion tons of carbon since the beginning of the industrial revolution, and so have helped to decelerate atmospheric CO2 increase. The increased carbon content is causing the ocean to become more acidic. Ocean acidification is a global issue with profound socioeconomic consequences. It can potentially alter community structures and food webs in the ocean, and as a result, degrade and damage ecosystems and fisheries. The most direct impact would be on organisms that form calcium carbonate (CaCO3) shells and skeletons. Meanwhile mounting evidence shows other non-calcifying organisms are also affected. Regardless of this issue iron fertilization to increase primary production thereby increasing oceanic CO2 uptake, is still being considered as one of the mitigation strategies. The current state of scientific knowledge on both ocean acidification and iron fertilization will be examined.

Coastal Oceanography and Inland Waters

Guoqi Han - Fisheries and Oceans Canada
Jinyu Sheng - Dalhousie University
Ram Yerubandi - National Water Research Institute
Contact: guoqi.han@dfo-mpo.gc.ca

This session will focus on all aspects of monitoring and modeling of physical processes in coastal domains, shelf seas, estuaries and inland waters. Topics include but are not limited to coastal physical oceanography, storm surges, tsunamis, estuarine dynamics, hydrology and hydrodynamics of large lakes, air-lake interactions, mixing and dispersion of materials.

Acoustics in Oceanography

Tetjana Ross - Dalhousie University
Contact: tetjana@dal.ca

The focus of this session is to highlight the contributions of underwater acoustics to oceanography. This includes, but is not limited to: sonar and passive acoustics, bio-acoustics, geological structure in the ocean bottom, acoustic communication, naval applications, ambient noise, long-range propagation, high-frequency scattering, imaging and quantitative inversion.

Argo dans les sciences de l'océan et le climat

Denis Gilbert - Pêches et océans Canada
Howard Freeland - Pêches et océans Canada
Igor Yashayaev - Pêches et océans Canada
Personne-Ressource: gilbertd@dfo-mpo.gc.ca

Cette session sera centrée sur les occasions offertes par la disponibilité du tableau global Argo. Argo est un système de données en temps réel offrant des nouvelles occasions pour l'exploration académique de l'environnement océanique ainsi que l'évaluation de l'état de l'océan pour générer des produits contenant des bénéfices sociaux distincts. Comme tel Argo est un contribuant principal au nouveau domaine de l'océanographie opérationnelle. Cependant on encourage des ouvrages sur l'application des ensembles de données pour les applications opérationnelles.
Ainsi on invite des papiers qui adressent les sujets suivants:
a] l'exploration académique de l'environnement océanique Argo
b] l'utilisation d'Argo pour fournir des produits utiles aux applications océanographiques et météorologiques.
c] des synthèses d'Argo à l'échelle régionale et synoptique, les observations de bateaux et les télédétections.

La Baie de Fundy : Le pouvoir de la Marée et la Dynamique des Sédiments

Richard Karsten - Université Acadia
Ryan Mulligan - Pêches et Océans Canada
Personne-Ressource: rkarsten@acadiau.ca

La baie de Fundy est reconnue pour avoir les plus hautes marées du monde et de forts courants de marée qui ont le potentiel de rendre économique la production d'électricité marémotrice. Cette session fournit un forum pour la présentation de la recherche sur l'hydrodynamique et le transport des sédiments dans les bassins de marée, en mettant l'accent sur la baie de Fundy. Les sujets peuvent inclure des courants de marée, les ondes de tempête, le mélange côtier, les plumes d'estuaires, la dynamique des sédiments, la morphologie des fonds marins, la glace, les vagues et les processus fluviaux. Des soumissions sur les études de champs et des recherches numériques sont les bienvenues, et peuvent inclure les enquêtes sur les systèmes naturels ou les implications de l'extraction de l'énergie marémotrice sur l'environnement océanique.

Argo in ocean and climate sciences

Denis Gilbert - Fisheries and Oceans Canada
Howard Freeland - Fisheries and Oceans Canada
Igor Yashayaev - Fisheries and Oceans Canada
Contact: gilbertd@dfo-mpo.gc.ca

This session will focus on the opportunities being offered by the availability of the global Argo array. Argo is a real-time data system offering new opportunities for both academic exploration of the ocean environment as well as the assessment of ocean state for the generation of products that carry distinct social benefits. As such, Argo is a leading contributor to the new field of operational oceanography. Hence we also encourage papers on the application of related data sets for operational applications. Thus we invite papers that address the following topics:
[a] academic exploration of the ocean environment using Argo.
[b] the use of Argo to supply useful products for oceanographic or meteorological application.s
[c] regional and large scale syntheses of Argo, ship-based and remote sensing observations.

The Bay of Fundy: Tidal Power and Sediment Dynamics

Richard Karsten - Acadia University
Ryan Mulligan - Fisheries and Oceans Canada
Contact: rkarsten@acadiau.ca

The Bay of Fundy is renowned for having the world's highest tides and strong tidal currents that may have the potential to make tidal power generation economic. This session provides a forum for presenting research on hydrodynamics and sediment transport in tidal basins, with emphasis on the Bay of Fundy. Topics may include tidal circulation, storm surges, coastal mixing, estuary plumes, sediment dynamics, seabed morphology, ice, wave and river processes. Submissions on field and numerical studies are welcome, and may include investigations into natural systems or the implications of tidal power extraction on the ocean environment.

Week at a Glance

Session Code	Time	1 Room 202	2 Room 203	3 Room 204	4 Room 205	5 Room 301	6 Room 302	7 Room 303
Sunday, May 31 Registration Desk Open 13:00 – 18:00 (Level 1)								
	08:30–18:00	Committee Meetings (available on-line at https://www1.cmos.ca/abstracts/congress_schedule.asp)						
	18:00–21:00	Ice Breaker Reception at the Brewery Market (1496 Lower Water Street)						
Monday, June1 Registration Desk Open 07:30 – 16:00 (Level 1)								
1A	08:30–10:30	Opening Session, Plenary Sessions 1 (Cullen) and 2 (Peltier) in the Grand Ballroom (Level 2)						
	10:30–11:00	Coffee Break (Room 100)						
1B	11:00–12:30	Atmosphere-Ocean Interaction & Waves **(I)**	Physical-Biological Interactions in the Ocean **(I)**	Remote Sensing of the Atmosphere and Ocean **(I)**	Weather and Social Science **(I)**	Global Atmosphere-Ocean Prediction and Predictability **(I)**	Regional Climate Modeling **(C)**	Operational Meteorology **(A)**
	12:30–14:00	Lunch (on your own)						
1C	14:00–15:30	Atmosphere-Ocean Interaction & Waves **(I)**	Physical-Biological Interactions in the Ocean **(I)**	Remote Sensing of the Atmosphere and Ocean **(I)**	Weather and Social Science **(I)**	Global Atmosphere-Ocean Prediction and Predictability **(I)**	Regional Climate Modeling **(C)**	Operational Meteorology **(A)**
	15:30–16:00	Coffee Break (Room 100)						
1D	16:00–17:30	The Bay of Fundy: Tidal Power and Sediment Dynamics **(O)**	Physical-Biological Interactions in the Ocean **(I)**	Remote Sensing of the Atmosphere and Ocean **(I)**	Health Issues of Weather and Climate **(I)**	Global Atmosphere-Ocean Prediction and Predictability **(I)**	Regional Climate Modeling **(C)**	Operational Meteorology **(A)**
	17:30–19:00					CMOS Annual General Meeting		
	19:00–20:00						MSC-ADM Town Hall Meeting	
Tuesday, June 2 Registration Desk Open 07:30 – 16:00 (Level 1)								
2A	08:30–10:00	Plenary Sessions 3 (Beven) and 4 (Wallace) in the Grand Ballroom (Level 2)						
	10:00–10:30	Coffee Break (Room 100)						
2B	10:30–12:00	Water, Weather and Climate Serving the Energy Sector **(I)**	Acoustics in Oceanography **(O)**	Atmosphere, Ocean and Climate Dynamics **(I)**	Carbon Uptake in the Ocean – Problems of Ocean Acidification and Feasibility of Iron Fertilization **(O)**	CONCEPTS **(I)**	Climate Data Homogenization **(C)**	Operational Meteorology **(A)**
	12:00–14:00	Parsons - Patterson Luncheon in the Grand Ballroom (Level 2)						
2C	14:00–15:30	Water, Weather and Climate Serving the Energy Sector **(I)**	Acoustics in Oceanography **(O)**	Atmosphere, Ocean and Climate Dynamics **(I)**	Meteorological Preparations for the 2010 Olympic Winter Games **(A)**	CONCEPTS **(I)**	Coastal Oceanography and Inland Waters **(O)**	Extratropical Transition of Tropical Systems **(A)**
2D	15:30–17:00	Poster Session 1 (Interdisciplinary Themes) – Refreshments Provided and Cash Bar (Room 100)						
	17:00–18:00					NSERC Town Hall Meeting		
	19:30–20:30	Public Lecture (Bowyer) at the Maritime Museum of the Atlantic (1675 Lower Water Street)						

Session Code	Time	1 Room 202	2 Room 203	3 Room 204	4 Room 205	5 Room 301	6 Room 302	7 Room 303
Wednesday, June 3 Registration Desk Open 07:30 – 16:00 (Level 1)								
3A	08:30–10:00	Plenary Sessions 5 (Bower) and 6 (de Vernal) in the Grand Ballroom (Level 2)						
	10:00–10:30	Coffee Break (Room 100)						
3B	10:30–12:00	Paleo-Oceanography and Paleo-Climatology (C)	Numerical Modelling for Research (I)	Recent Progress with the GEM-LAM 2.5km Model (A)	Teacher's Day	IPY and related atmospheric, oceanographic, and hydrological studies (I)	Coastal Oceanography and Inland Waters (O)	Radiation, Aerosols and Cloud (A)
	12:00–13:30	Lunch (on your own)						
3C	13:30–15:00	Argo in ocean and climate sciences (O)	Numerical Modelling for Research (I)	Military Meteorology and Oceanography (I)	Teacher's Day	IPY and related atmospheric, oceanographic, and hydrological studies (I)	Coastal Oceanography and Inland Waters (O)	Radiation, Aerosols and Cloud (A)
3D	15:00–16:30	Poster Session 2 (Atmospheric Sciences, Climate, and Oceanography Themes) – Refreshments Provided and Cash Bar (Room 100)						
	16:30–17:30	Argo Town Hall Meeting			Teacher's Day			
	18:30	Banquet in the Grand Ballroom (Level 2)						
Thursday, June 4 Registration Desk Open 07:30 – 12:00 (Level 1)								
4A	08:30–10:00	Plenary Sessions 7 (Drummond) and 8 (President's Prize Winner) in the Grand Ballroom (Level 2)						
	10:00–10:30	Coffee Break (Room 100)						
4B	10:30–12:00	Air Quality: Delivering the Right Message (A)	Monitoring the Atmosphere and Ocean (I)	Climate Change and Extreme Events (C)	UNSTABLE (A)	IPY and related atmospheric, oceanographic, and hydrological studies (I)	Climate variability and marine ecosystems (I)	Composition, variability and circulation of seawater: bays to basins. (O)
	12:00–13:30	Lunch (on your own)						
4C	13:30–15:00	Air Quality: Delivering the Right Message (A)	Monitoring the Atmosphere and Ocean (I)	Climate Change and Extreme Events (C)	UNSTABLE (A)	IPY and related atmospheric, oceanographic, and hydrological studies (I)	Climate variability and marine ecosystems (I)	Composition, variability and circulation of seawater: bays to basins. (O)
	15:00–15:30	Coffee Break (Level 2)						
4D	15:30–17:00	Air Quality: Delivering the Right Message (A)	Monitoring the Atmosphere and Ocean (I)	Climate Change and Extreme Events (C)				

Aperçu de la semaine

Code / heure de session		1 salle 202	2 salle 203	3 salle 204	4 salle 205	5 salle 301	6 salle 302	7 salle 303
dimanche, le 31 mai bureau d'inscription ouvert de 13:00 – 18:00 (Étage 1)								
	08:30–18:00	Réunions des comités (disponible en ligne à https://www1.cmos.ca/abstracts/congress_schedule.asp)						
	18:00–21:00	Réception Brise-glace à l'ouverture, Brewery Market (1496 Lower Water Street)						
lundi, 1 juin bureau d'inscription ouvert de 07:30 – 16:00 (Étage 1)								
1A	08:30–10:30	Session d'ouverture, Sessions plénières 1 (Cullen) et 2 (Peltier), Grand Ballroom (Étage 2)						
	10:30–11:00	Café (salle 100)						
1B	11:00–12:30	Interaction atmosphère-océan et les vagues (I)	Interactions physiques et biologiques dans l'océan (I)	Télédétection de l'atmosphère et de l'océan (I)	La météo et la Science Sociale (I)	La Prévision et la Prévisibilité globale de l'Atmosphère-Océan (I)	Modélisation Régionale Climatique (C)	Météorologie opérationnelle (A)
	12:30–14:00	Déjeuner						
1C	14:00–15:30	Interaction atmosphère-océan et les vagues (I)	Interactions physiques et biologiques dans l'océan (I)	Télédétection de l'atmosphère et de l'océan (I)	La météo et la Science Sociale (I)	La Prévision et la Prévisibilité globale de l'Atmosphère-Océan (I)	Modélisation Régionale Climatique (C)	Météorologie opérationnelle (A)
	15:30–16:00	Café (salle 100)						
1D	16:00–17:30	La Baie de Fundy : Le pouvoir de la Marée et la Dynamique des Sédiments (O)	Interactions physiques et biologiques dans l'océan (I)	Télédétection de l'atmosphère et de l'océan (I)	Problèmes de santé liés aux conditions météorologiques et au climat (I)	La Prévision et la Prévisibilité globale de l'Atmosphère-Océan (I)	Modélisation Régionale Climatique (C)	Météorologie opérationnelle (A)
	17:30–19:00					Réunion génerale annuelle de la SCMO		
	19:00–20:00						Séance de discussion publique du SMC-Sous-ministre adjoint	
mardi, 2 juin bureau d'inscription ouvert de 07:30 – 16:00 (Étage 1)								
2A	08:30–10:00	Sessions plénières 3 (Beven) et 4 (Wallace), Grand Ballroom (Étage 2)						
	10:00–10:30	Café (salle 100)						
2B	10:30–12:00	Eau, temps et climat servant le secteur énergétique (I)	L'Acoustique dans l'Océanographie (O)	Dynamiques de l'atmosphère, de l'océan et du climat (I)	Assimilation du carbone dans l'océan (O)	CONCEPTS (I)	Homogénéisation des données climatiques et l'analyse des tendances (C)	Météorologie opérationnelle (A)
	12:00–14:00	Déjeuner Parsons – Patterson, Grand Ballroom (Étage 2)						
2C	14:00–15:30	Eau, temps et climat servant le secteur énergétique (I)	L'Acoustique dans l'Océanographie (O)	Dynamiques de l'atmosphère, de l'océan et du climat (I)	Assimilation du carbone dans l'océan (O)	CONCEPTS (I)	Océanographie côtière et les eaux intérieures (O)	Transition extratropicale des systèmes tropicaux (A)
2D	15:30–17:00	Session d'affiches 1 (Thèmes interdisciplinaires) – Rafraîchissements fournis et barre à paiement en argent comptant (salle 100)						
	17:00–18:00					Séance de discussion publique avec CSNRG		
	19:30–20:30	Conférence publique (Bowyer), Maritime Museum of the Atlantic (1675 Lower Water Street)						

de session		salle 202	salle 203	salle 204	salle 205	salle 301	salle 302	salle 303
mercredi, 3 juin bureau d'inscription ouvert de 07:30 – 16:00 (Étage 1)								
3A	08:30–10:00	Sessions plénières 5 (Bower) et 6 (de Vernal), Grand Ballroom (Étage 2)						
	10:00–10:30	Café (salle 100)						
3B	10:30–12:00	Paléo-Océanographie et Paléo-Climatologie **(C)**	Modélisation numérique pour la recherche **(I)**	Progrès récents avec le modèle GEM-LAM 2.5km **(A)**	La journée des enseignants	AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie **(I)**	Océanographie côtière et les eaux intérieures **(O)**	Radiation, Aérosols et Nuages **(A)**
	12:00–13:30	Déjeuner						
3C	13:30–15:00	Argo dans les sciences de l'océan et le climat **(O)**	Modélisation numérique pour la recherche **(I)**	Météorologie et Océanographie Militaire **(I)**	La journée des enseignants	AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie **(I)**	Océanographie côtière et les eaux intérieures **(O)**	Radiation, Aérosols et Nuages **(A)**
3D	15:00–16:30	Session d'affiches 2 (Thèmes de l'atmosphère, du climat et d'océanographie) – Rafraîchissements fournis et barre paiement argent liquide (salle 100)						
	16:30–17:30	Réunion générale sur Argo			La journée des enseignants			
	18:30	Banquet dans le Grand Ballroom (Étage 2)						
jeudi, 4 juin bureau d'inscription ouvert de 07:30 – 12:00 (Étage 1)								
4A	08:30–10:00	Sessions plénières 7 (Drummond) et 8 (Le gagnant du prix du Président), dans le Grand Ballroom (Étage 2)						
	10:00–10:30	Café (salle 100)						
4B	10:30–12:00	Qualité de l'air: délivraison du vrai message **(A)**	Monitorage de l'atmosphère et de l'océan **(I)**	Le changement climatique et les évènements extrêmes **(C)**	INSTABLE **(A)**	AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie **(I)**	Le climat et les écosystèmes marins **(I)**	Composition, Variabitlité et Circulation de l'eau salée: des baies aux bassins. **(O)**
	12:00–13:30	Déjeuner						
4C	13:30–15:00	Qualité de l'air: délivraison du vrai message **(A)**	Monitorage de l'atmosphère et de l'océan **(I)**	Le changement climatique et les évènements extrêmes **(C)**	INSTABLE **(A)**	AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie **(I)**	Le climat et les écosystèmes marins **(I)**	Composition, Variabitlité et Circulation de l'eau salée: des baies aux bassins. **(O)**
	15:00–15:30	Café (Étage 2)						
4D	15:30–17:00	Qualité de l'air: délivraison du vrai message **(A)**	Monitorage de l'atmosphère et de l'océan **(I)**	Le changement climatique et les évènements extrêmes **(C)**				

Session schedules / Horaires des presentations

(I) Interdisiplinary/Interdisciplinaire, **(A)** Atmosphere/Atmosphère, **(C)** Climate/Climat,
(H) Hydrology/Hydrologie, **(O)** Oceanography/Océanographie

Monday/lundi, 1 June/juin				
	Session 1A, Room/salle Grand Ballroom (Level/Niveau 2)			
08:30	Opening Session, *Chair:* John Parker			
09:00	Plenary Session 1, *Chairs:* Katja Fennel and Andy Bush	Fertilization of the ocean for climate mitigation, *John Cullen*		
09:45	Plenary Session 2, *Chairs:* Katja Fennel and Andy Bush	Cryosphere and Climate: From Ice-Age to Anthropocene, *WM. Richard. Peltier*		
10:30	*Coffee/Café(Room/Salle100)*			
	Session 1B-202 Room/salle 202	**Session 1B-203 Room/salle 203**	**Session 1B-204 Room/salle 204**	**Session 1B-205 Room/salle 205**
	(I) Atmosphere-Ocean Interaction and Waves Part 1 of 2 *Chair:* Bash Toulany	**(I)** Physical-Biological Interactions in the Ocean Part 1of 3 *Chair:* Katja Fennel	**(I)** Remote Sensing of the Atmosphere and Ocean Part 1 of 3 *Chair:* Thomas Duck	**(I)** Weather and Social Science Part 1of 2 *Chair:* Rebecca J. Wagner Hochban
11:00	Recent developments in wave modeling *William Perrie*	The response of euphausiids to localized turbulence at a sill in a fjord *Debby Ianson*	Remote sensing of aerosols from the Mideast to the high-arctic: an overview of techniques and recent results *Norm O'Neill*	WAS*IS: integrating meteorology and social science *Julie Demuth*
11:15	Overview of wave modelling research activities at The National Lab for Marine and Costal Meteorology *Garry Pearson*		Aerosol optical measurements acquired at Arctic and sub-Arctic sites during the springtime ARCTAS campaign *Auromeet Saha*	
11:30	The spectral properties of ocean waves generated by Hurricane Juan *Fumin Xu*	Sustainability of scallop populations on Georges Bank: implications of spawning seasonality *Chad Gilbert*	Lidar measurements of gravity waves in the Arctic middle atmosphere *Emily Mccullough*	Pausing for learning or "lessons learned" from rocket scientists *Jacques Descurieux*
11:45	Unexpected waves in costal environments. *Johannes Gemmrich*	Improving confidence in copepod mortality estimates: Choosing formulas and quantifying errors *Pierre Pepin*	Atmospheric gravity waves in the Arctic Mesosphere detected by the PEARL All Sky Airglow *Dragan Veselinovic*	High impact weather impacts studies: helping to identify the risks and develop adaptation strategies to minimize these risks *Joan Klaassen*
12:00	Hindcasting wave conditions in the Mackenzie delta using MIKE21 *Md. Azharul Hoque*	A coupled biophysical sea lice model for the Broughton Archipelago *Dario Stucchi*	Initial results from the E-region wind interferometer, ERWIN-2, at PEARL *Samuel Kristoffersen*	Vigilance map pilot project: implementation at the Meteorological Service of Canada of a tool to integrate information and to communicate weather associated risks *Oliver Gagnon*
12:15	Addition of a module of wave attenuation by ice to the Canadian Wave Model. Presentation and case studies. *Denis Jacob*	3D physical-biological coupled model to assess water-column impacts of bivalve aquaculture in a mussel farm in Ship Harbour, Nova Scotia *Diego Ibarra*	An overview of the Canadian arctic validation campaigns for the Atmospheric Chemistry Experiment (ACE) satellite mission *Kaley Walker*	Economic impacts associated with the December 15th, 2006 wind storm: a draft *Tracey Parker*
12:30–14:00	*Lunch/Déjeuner*			CFCAS AGM *Chair:* Gordon McBean

Monday/lundi, 1 June/juin			
			08:30
			09:00
			09:45
Coffee/Café (Room/Salle 100)			10:30
Session 1B-301 Room/salle 301	**Session 1B-302 Room/salle 302**	**Session 1B-303 Room/salle 303**	
(I) Global Atmosphere-Ocean Prediction and Predictability Part 1of 3 *Chair:* Keith R. Thompson	**(C)** Regional Climate Modeling Part 1of 3 *Chair:* Laxmi Sushama	**(A)** Operational Meteorology Part 1 of 4 *Chair:* Claude Landry	
Impact of recent Arctic ice anomalies on the North-Atlantic summers *Magdalena Balmaseda*	Regional modeling of future Arctic climate *Emily Collier*	VAAC Montréal Operational response to eruptions at Okmok and Kasatochi volcanoes in July and August 2008 *Dov Richard Bensimon*	11:00
	Difficulties of Arctic climate simulation and their solutions using a regional climate *Minwei Qian*	A new model configuration for global medium-range weather forecasts at Environment Canada: GEM Méso-Strato *Martin Charron*	11:15
Seasonal forecast development at CCCma: Toward the second Coupled Historical Forecasting Project (CHFP2) *William Merryfield*	Implementation of lakes in the Regional Climate Model *Andrey Martynov*	Recent and future updates to operational NWP production at the Canadian Meteorological Centre *Yves Pelletier*	11:30
The prospects of decadal prediction *George Boer*	CRCM climate and climate change sensitivity to parameter perturbation *Hélène Côté*	Evaluation of day 6-7 forecasting using the ensemble prediction system / Évaluation des prévisions des jours 6-7 produites à partir du système de prévision d'ensemble *Gérard Croteau*	11:45
Impact of ocean initialization strategies on seasonal forecast skill *Woo-Sung Lee*	Validation of simulated climate over North America using the Canadian Regional Climate Model (CRCM5) coupled to the Canadian Land Surface Scheme (CLASS) *Jean-Philippe Paquin*	Operational implementation at Environment Canada of GPS radio occultation observations *Josep Aparicio*	12:00
The role of soil moisture initialization in seasonal forecasting *Gordon Drewitt*	Sensitivity of land-atmosphere fluxes to the soil model configuration in the Canadian RCM *Katja Winger*	Adapting SCRIBE to the recent National Forecast Program requirements *Claude Landry*	12:15
Lunch/Déjeuner			12:30–14:00

Monday/lundi, 1 June/juin				
	Session 1C-202 Room/salle 202	**Session 1C-203 Room/salle 203**	**Session 1C-204 Room/salle 204**	**Session 1C-205 Room/salle 205**
	(I) Atmosphere-Ocean Interaction and Waves Part 2 of 2 *Chair:* William Allen Perrie	**(I)** Physical-Biological Interactions in the Ocean Part 2 of 3 *Chair:* Tetjana Ross	**(I)** Remote Sensing of the Atmosphere and Ocean Part 2 or 3 *Chairs*: Norman O'Neill and Rong-Ming Hu	**(I)** Weather and Social Science Part 2 of 2 *Chair:* Rebecca J. Wagner Hochban
14:00	Confidence estimates for surface marine wind information from synthetic aperture radar *Rick Danielson*	Plankton biology and the ocean carbon cycle: interactions of mixing and population *James Christian*	PCW: Polar communication and weather satellite: Air quality, weather and climate instruments and goals *John Mcconnell*	Environmental prediction: Empowering Canadians to manage their future *Mark Cantwell*
14:15	High resolution wind stress products retrieved from Radarsat-2 SAR data *Tao Xie*	Nitrogen and carbon cycling on the North American east coast continental shelf *Katja Fennel*	Investigating the variability of ozone and related constituent distributions in the Arctic using ACE-FTS *Jeffrey Taylor*	Real time drought monitoring and forecasting over the Canadian Prairies using the Variable Infiltration Capacity model *Lei Wen*
14:30	Measurement of ocean wave spectra using RADARSAT-2 fully polarimetric SAR image data *Biao Zhang*	Enhanced ocean carbon storage from anaerobic alkalinity generation in coastal sediments *Helmuth Thomas*	Satellite remote sensing of aerosols and trace gases over megacities *Rong-Ming Hu*	Canadian Drought Alert and Monitoring Program (CDAMP) *Sharon Fernandez*
14:45	Identifying SAR features as Signatures of the Gulf Stream *Chris Jones*	Seasonal variability of dissolved inorganic carbon and surface water pCO2 in the Scotian Shelf region of the Northwestern *Elizabeth Shadwick*	Assimilation of ASCAT scatterometer winds in the MSC analysis system *Mateusz Reszka*	Predictability of spring wheat yields from climate and remote sensing data on the Canadian Prairies *Aston Chipanshi*
15:00	Study of blowing snow in Iqualit *Sumita Biswas*	Oceanographic situation of the water column vertical profiler: Neptune Canada *Susan Allen*	Assessment of the impact of observations in data assimilation based on information content and adjoint-based approaches *Pierre Gauthier*	Weather and social science - moving forward *Rebecca Wagner*
15:15	Nearshore dynamics of the Mackenzie River plume in summer *Ryan Mulligan*	Geographical aspects of carbon feedbacks in the climate system *George Boer*	A new era of remote sensing for Canada: the Polar Communication and Weather Mission *Louis Garand*	
15:30	*Coffee/Café*			

Monday/lundi, 1 June/juin			
Session 1C-301 **Room/salle 301**	**Session 1C-302** **Room/salle 302**	**Session 1C-303** **Room/salle 303**	
(I) Global Atmosphere-Ocean Prediction and Predictability Part 2 of 3 *Chair:* William J. Merryfield	**(C)** Regional Climate Modeling Part 2 of 3 *Chair:* Daniel Caya	**(A)** Operational Meteorology Part 2 of 4 Chair: G.A. Isaac	
The influence of the Madden-Julian Oscillation on Canadian wintertime surface air temperature *Hai Lin*	Cloud-radiation interaction as simulated by two microphysics schemes in the Canadian GEM model compared to ARM observations. *Danahé Paquin-Ricard*	Sunrise propane explosion and other fire plumes seen with Canadian weather radars *Norman Donaldson*	14:00
A modelling study of the responses to MJO wind forcing in the tropical Pacific Ocean *Xu Zhang*	Permafrost degradation: A regional modelling approach in the context of climate change *Jean-Philippe Blanchette*	Observations of wind farms with Canadian weather radars *Norman Donaldson*	14:15
The Madden-Julian Oscillation and local and remote forcing of the ocean *Eric Oliver*	The simulation of extremes by two Canadian Regional Climate Models over non-native domains *Zavareh Kothavala*	Forecasting for major Canadian airports using the Canadian Airport Nowcasting System (CAN-Now) *George Isaac*	14:30
North Pacific sea surface temperature climatology and variability in an ensemble of AOGCMs *Fabian Lienert*	The sensitivity of regional climate simulations to domain size and large-scale nudging *Dragana Kornic*	Blending numerical weather prediction and radar in an operational implementation of ARMOR Algorithm for automated quantitative precipitation forecasts *Zach Dufran*	14:45
Redundancy analyses of the coupled atmosphere-ocean system: application to State Space Models and global climate data *Faez Bakalian*	Diagnostic of the Internal Variability in the Canadian Regional Climate Model simulations *Oumarou Nikiema*	Improving hydrologic analysis and applications through the use of a near real-time Storm Precipitation Analysis System (SPAS) *William J. Conway*	15:00
Bred Vector and ENSO predictability in a hybrid coupled model during the period 1881-2000 *Youmin Tang*	Dry spells over Canada in a changing climate *Laxmi Sushama*	The Aviation Weather Decision Support System developed by Weather Decision Technologies *William J. Conway*	15:15
Coffee/Café			15:30

Monday/lundi, 1 June/juin				
	Session 1D-202 Room/salle 202	**Session 1D-203 Room/salle 203**	**Session 1D-204 Room/salle 204**	**Session 1D-205 Room/salle 205**
	(O) The Bay of Fundy: Tidal Power and Sediment Dynamics *Chair:* Richard Karsten	**(I)** Physical-Biological Interactions in the Ocean Part 3 of 3 *Chair:* Katja Fennel	**(I)** Remote Sensing of the Atmosphere and Ocean Part 3 of 3 *Chairs:* Norman O'Neill and Rong-Ming Hu	**(I)** Health Issues of Weather and Climate *Chair:* Denis A. Bourque
16:00	Tides and tidal power in the Bay of Fundy *David Greenberg*	Modelling plankton dynamics and biogeochemical cycles on the Pacific coast of Canada *Angelica Pena*	Measurements Of Pollution In The Troposphere: Nine years, two billion measurements and counting *James Drummond*	Adapting to extreme heat events in Canada ("Heat Waves")Health Canada "Developing Heat Resilient Communities and Individuals" (Pilot communities) *Stephen Dolan*
16:15			TICFIRE: The Thin Ice Cloud in the Far Infrared Experiment *Tarek Ayash*	Which days of hot weather are considered dangerous by heat-health watch warning systems?: A comparison of the predictive capacity of different systems *Shakoor Hajat*
16:30	Observing the velocity structure with moorings and transects in Minas *Keir Colbo*	Effects of mesoscale eddies on biota in the Gulf of Alaska *Shannon Nudds*	The wave-induced fluctuations of underwater angular radiance as observed in Santa Barbara Channel *Jianwei Wei*	Influence of spring and summer weather on pollen season and pollen production in the city of Sherbrooke, Quebec *Elisabeth Levac*
16:45	Efficient extraction of power from near-resonant tidal systems *Brian Sanderson*	Modelling the biological effects of a summer upwelling events in Lunenburg Bay, Canada *Arnaud Laurent*	Monitoring of coastal wetlands with Space-borne Polarimetric SAR Systems: RADARSAT-2 and TerraSAR-X *Wooil Moon*	The Halifax, NS, Experimental Pollen and Spore Count and Forecast Project - What have we learned? *David Waugh*
17:00	Flow past tidal turbines *Richard Karsten*	Modelling biogeochemical cycling and interfacial exchange of climatically important gases *Nadja Steiner*	A comparison of measurements of O2(1Δ) airglow from SPICAM instrument on Mars Express with calculations from GM3 *Ayodeji Akingunola*	Vitamin D action spectrum weighted solar UV irradiance over the US and Canada *Vitali Fioletov*
17:15	Suspended sediment transport measurement using ADCPs & LISSTs, development of a methodology *Sebastien Donnet*	Application of variational data assimilation to coupled physical-biological models of the North Atlantic *Witold Bagniewski*	Phoenix Met: Summer weather at 126W, 68N on Mars *Peter Taylor*	MediClim™ : Introducing a European-style, weather-based health index in North America *Denis Bourque*
17:30–19:00				
19:00–20:00				

Monday/lundi, 1 June/juin			
Session 1D-301 Room/salle 301	**Session 1D-302 Room/salle 302**	**Session 1D-303 Room/salle 303**	
(I) Global Atmosphere-Ocean Prediction and Predictability Part 3 of 3 *Chair:* C. Harold Ritchie	**(C)** Regional Climate Modeling Part 3 of 3 *Chair:* Hélène Côté	**(A)** Operational Meteorology Part 3 of 3 *Chair:* Damian Braet	
A model study of the inter-annual and decadal variations of sea surface height, temperature, and gyre circulation in the North Atlantic *Zeliang Wang*	Glaciers of the Canadian Rockies and their response to global climate change. *Ted Pollock*	Conceptual models *Phil Chadwick*	16:00
Simulation of the 2001-2002 intrusion of cold water into the Gulf of Alaska *Shawn Donohue*	Regional climate model simulations of the severe 1999-2004 Prairie drought: A model inter-comparison study *Kit Szeto*	An early summer hail event over Northeastern Newfoundland from an operational perspective *Damian Braet*	16:15
Simulating the North Pacific Ocean using NEMO *Yunfeng Shao*	A Regional Climate Model for the British Columbia Continental Shelf *Michael Foreman*	Lightning events in the Yellowknife region of the Northwest Territories *William Burrows*	16:30
Assessment of predictive skills of the Labrador Sea eddy permitting circulation model. *Colin Pike-Thackray*	UV-B cloud optical properties for Canada *Jacqueline Binyamin*	The challenge of forecasting high rainfall events in the Maritimes *Mark Pilon*	16:45
Forecasting mesoscale variability of the North Atlantic: Towards an operational system *Keith Thompson*	Climate and regional air quality impacts on Canadian and Ontarian scales using GEM-AQ and GEM-AQ/LAM *John Mcconnell*	The MSC forecasters forums and the future role of the human forecaster *David Sills*	17:00
Development of a nested-grid shelf circulation model using OPA for the eastern Canadian shelf *Jorge R. Urrego-Blanco*	North Atlantic climate modeling results from CGCM3 *Lanli Guo*	Bridging the gap between research and operations: observations within the Meteorological Service of Canada *Brad Snyder*	17:15
CMOS Annual General Meeting *Chair:* Andrew B.G. Bush			17:30–19:00
	NSERC Town Hall Meeting *Chair:* David Grimes A renewed vision and strategic direction for Environment Canada's weather and environmental services		19:00–20:00

Tuesday/mardi, 2 June/juin				
	Session 2A, Room/salle Grand Ballroom (Level/Niveau 2)			
08:30	Plenary Session 3, *Chairs:* Chris Fogarty and Kumiko Azetsu-Scott	The importance of geostationary weather satellites in tropical cyclone forecasting: a perspective, *John Beven II*		
09:15	Plenary Session 4, *Chairs:* Chris Fogarty and Kumiko Azetsu-Scott	Sun, sea, dust and gases. Air-sea biogeochemical interactions in the tropical Eastern North Atlantic, *Douglas Wallace*		
10:00	*Coffee/Café(Room/Salle 100)*			
	Session 2B-202 Room/salle 202	**Session 2B-203 Room/salle 203**	**Session 2B-204 Room/salle 204**	**Session 2B-205 Room/salle 205**
	(I) Water, Weather and Climate Serving the Energy Sector Part 1 of 2 *Chair:* Anne-Marie Valton	**(O)** Acoustics in Oceanography Part 1 of 2 *Chair:* Tetjana Ross	**(I)** Atmosphere, Ocean and Climate Dynamics Part 1 of 2 *Chair:* William J. Merryfield	**(O)** Carbon Uptake in the Ocean – Problems of Ocean Acidification and Feasibility of Iron Fertilization *Chairs:* Kumiko Azetsu-Scott and Paul Lyon
10:30	Wind energy forecast: New challenges in meteorology *Joël Bédard*	Doppler sonar and fish: when can you measure fish speeds? *Len Zedel*	The predictability of ocean-modulated westerly wind bursts and the implications for ENSO forecasts *Geoffrey Gebbie*	Acidification of the hypoxic bottom waters in the Lower St. Lawrence Estuary: A history and potential impacts *Alfonso Mucci*
10:45	A high resolution wind forecasting system for the wind energy sector: An overview on the real-time tests in Quebec *Wei Yu*			
11:00	A high resolution wind forecasting system for the wind energy sector: A focus on mountain waves activity *André Plante*	Applications of active and passive acoustics to marine mammal ecosystem understanding *Yvan Simard*	Global extratropical response to diabatic heating variability of the Asian summer monsoon *Hai Lin*	Spatial variability of pH in the Bedford Basin *Darlene Brownell*
11:15	Environment Canada's future role in support of wind and solar energy forecasting *Franco Petrucci*		Stochastic parameterisation schemes based on rigorous limit theorems *Joel Culina*	Temporal variation of pH and TIC/Alkalinity in Bedford *David Slauenwhite*
11:30	Is wind energy forecast enough? *Serge Besner*	Physical forcing of space-time variation in the copepod prey-field of right whales in Roseway Basin at diel and tidal scales *Kimberley Davies*	On the dynamics of hurricane secondary eyewall formation *Yosvany Martinez*	Climate change, ocean processes, and iron fertilization *Ken Denman*
11:45		Long-term broadband acoustic observations of zooplankton scattering layers in Saanich Inlet, British Columbia *Tetjana Ross*	Land surface wind speed probability distribution: A global view *Yanping He*	Modelling the ocean iron cycle – the major uncertainties *James Christian*
12:00–14:00	*Parsons – Patterson Luncheon in the Grand Ballroom (Level/Niveau 2)*			

Tuesday/mardi, 2 June/juin			
			08:30
			09:15
Coffee/Café (Room/Salle 100)			10:00
Session 2B-301 Room/salle 301	**Session 2B-302 Room/salle 302**	**Session 2B-303 Room/salle 303**	
(I) CONCEPTS Part 1 of 2 *Chair:* B.J. Topliss	**(C)** Climate Data Homogenization *Chair:* Lucie Vincent	**(A)** Operational Meteorology Part 4 of 4 *Chair:* Chris Fogarty	
A framework for research and operations on a global scale – The partnerships of CONCEPTS (three Canadian departments and an international community of oceanographers and meteorologists) *Martin Taillefer*	Impact of meteorological instruments on climate trends *Rodica Nitu*	The National Lab for Marine and Coastal Meteorology –Research, development and support assisting operational forecasting *Chris Fogarty*	10:30
Validation and analysis of the ¼-deg global NEMO-CONCEPTS ocean model *C. Harold Ritchie*	An assessment of the double Alter wind shield for reducing wind bias in snowfall measurements made with the Geonor T-200B *Craig Smith*	Canadian coupled atmosphere-ocean-ice forecast system for the Gulf of St. Lawrence: Operational Validation for ice season 2009 *Serge Desjardins*	10:45
Inter-annual and decadal sea level variations: a CONCEPTS study based on a coarse-resolution global ocean model *Youyu Lu*	Buoy wind inhomogeneities related to changes in averaging method and anemometer type *Bridget Thomas*	Impact study with observations assimilated over North America and the North Pacific Ocean on the MSC global forecast system *Stephane Laroch*	11:00
C-NOOFS: A Canadian pilot project in operational oceanography for the North West Atlantic *Greg Smith*	Homogenization and trend analysis of Canadian near-surface wind speeds *Hui Wan*	Severe thunderstorm and lightning climatology in Atlantic *Rick Fleetwood*	11:15
Resolution increase in a downscaling ocean forecast system for the North West Atlantic: The C-NOOFS example. *Andry Ratsimandresy*	Observed changes in daily temperature and precipitation indices for Southern Québec, 1960–2005 *Abderrahmane Yagouti*	Return periods of prolonged fog events in Canada *Bjarne Hansen*	11:30
Local refinement in the NEMO2.3 ocean *Frederic Dupont*	Second generation of homogenized temperature for trend analysis in Canada *Lucie Vincent*	Ongoing development of automated fog and stratus forecasts from the GEM Regional Operational NWP Model *William Burrows*	11:45
Parsons – Patterson Luncheon in the Grand Ballroom (Level/Niveau 2)			12:00–14:00

Tuesday/mardi, 2 June/juin				
	Session 2C-202 Room/salle 202	**Session 2C-203 Room/salle 203**	**Session 2C-204 Room/salle 204**	**Session 2C-205 Room/salle 205**
	(I) Water, Weather and Climate Serving the Energy Sector Part 2 of 2 *Chair:* Anne-Marie Valton	**(O)** Acoustics in Oceanography Part 2 of 2 *Chair:* Tetjana Ross	**(I)** Atmosphere, Ocean and Climate Dynamics Part 2 of 2 *Chair:* Marek Stastna	**(A)** Meteorological Preparations for the 2010 Olympic Winter Games *Chair:* Chris Doyle
14:00	Micro-scale wind modelling for wind energy applications *Matthew Corkum*	Results from the ROSE Seismic Oceanography Experiment *Blair Greenan*	Wave forcing in the stratosphere as a result of climate change *Michel Bourqui*	Weather services for the Vancouver 2010 Olympic and Paralympic Winter Games *Al Wallace*
14:15	Climate impacts of large scale wind energy production *Amanda Adams*	An intercomparison of acoustic current meters on the Scotian Shelf *Adam Drozdowski*	On the viability of Lagrangian theories of internal wave spectra *G. P. Klaassen*	Thermodynamic, wind and liquid profiling for Olympic weather prediction *Randolph Ware*
14:30	Atmospheric hazards and energy systems: An Ontario example *Joan Klaassen*	Long wavelength ripples in the Nearshore *Trajce Alcinov*	Two mechanisms for enhanced mixing due to shoaling internal solitary-like waves *Marek Stastna*	An experimental numerical prediction system for the 2010 Vancouver Winter Olympic Games *Jocelyn Mailhot*
14:45	Estimation of energy demand taking into account climate change in Southern Quebec *Line Bourdages*	Velocity structure and turbulent stress above evolving sand tipples: Observations with a new multi-frequency coherent doppler profiler *Alex Hay*	Mixed bottom-friction-Kelvin-Helmholtz destabilization of source-driven abyssal overflows in the ocean *Gordon Swaters*	Experimental land surface modeling and assimilation system for the 2010 Vancouver Winter Olympic Games *Natacha Bernier*
15:00	Estimation of net basin supply components for the Upper Great Lakes using MESH *Dorothée Charpentier*	Geoacoustic inversion of surficial gassy sediment. *Marie-Noel R.. Matthews*	Zonal versus meridional velocity variance in the World Ocean: order in the chaotic ocean *Robert Scott*	A Canadian regional ensemble prediction system for North America *Martin Charron*
15:15	Future energy development needs and CIS Arctic sea ice analysis and prediction *Paul Pestieau*	Assessing uncertainties in underwater acoustic propagation in a tactical environment *John Osler*	Comparison of modelled and observed sea ice fluxes in the Canadian Arctic Archipelago *David Huard*	Science and nowcasting olympic weather for Vancouver 2010 (SNOW-V10) – Overview and first results *George Isaac*
15:30-17:00	*Poster Session 1 (Interdisciplinary Themes) –Refreshments Provided and Cash Bar (Room/Niveau 100)*			
17:00-18:00				
19:30-20:30	*Public Lecture (Bowyer) at the Maritime Museum of the Atlantic (1675 Lower Water Street)*			

Tuesday/mardi, 2 June/juin			
Session 2C-301 **Room/salle 301**	**Session 2C-302** **Room/salle 302**	**Session 2C-303** **Room/salle 303**	
(I) CONCEPTS Part 2 of 2 *Chair:* C. Harold Ritchie	**(O)** Costal Oceanography and Inland Waters Part 1of 3 *Chair:* Guoqi Han	**(A)** Extratropical Transition of Tropical Systems *Chair:* Peter Bowyer	
Recent results from the assimilation of sea ice observations in regional coupled ice-ocean models *Mark Buehner*	Satellite observations of ocean processes along the Pacific Coast *W.r. Crawford*	Hurricanes and global warming *Stephen Miller*	14:00
Development of a new ice-ocean prediction system for the Northwest Atlantic *Charles Hannah*			14:15
Heat and wind effects on Arctic sea-ice *Frederic Dupont*	Numerical study of three-dimensional circulation over coastal waters of Nova Scotia during Tropical Storm Alberto using a Five-Level Nested-Grid Ocean Circulation Model *Jinyu Sheng*	A forecasting summary of recent ET events affecting Canada since 2006 *Chris Fogarty*	14:30
Observability of large control vector in a 4D-Var ocean data assimilation *Tsuyoshi Wakamatsu*	Principal modes of circulation variability on the shelf seas of eastern Canada *David Brickman*	A Summary of the impacts of ET events affecting Canada since 2006 *Steve Hatt*	14:45
	Modifying a coupled biophysical model to predict the timing of the spring bloom in Rivers Inlet, British Columbia *Megan Wolfe*	Tropical cyclone rain and wind climatology for Canada – a sneak peak *Alex Donaldson*	15:00
	Assimilation of satellite-derived sea surface temperature into Canadian East Coast Ocean Model (CECOM) *Yongsheng Wu*	An overview of forecast performance at the Canadian Hurricane Centre *Chris Fogarty*	15:15
Poster Session 1 (Interdisciplinary Themes) –Refreshments Provided and Cash Bar (Room/Salle 100)			15:30-17:00
MSC-ADM Town Hall Meeting *Chair:* Norman Marcotte NSERC update on International Review and GSC Structure Review			17:00-18:00
Public Lecture (Bowyer) at the Maritime Museum of the Atlantic (1675 Lower Water Street)			19:30-20:30

Wednesday/mercredi, 3 June/juin				
	Session 3A, Room/salle Grand Ballroom (Level/Niveau 2)			
08:30	Plenary Session 5, *Chairs:* John Loder and Markus Kienast	The Atlantic meridional overturning circulation: A fluid particle's perspective, *Amy Bower*		
09:15	Plenary Session 6, *Chairs:* John Loder and Markus Kienast	Variability of climate and ocean at high northern latitudes: evidence from sedimentary archives, *Anne De Vernal*		
10:00	*Coffee/Café(Room/Salle 100)*			
	Session 3B-202 Room/salle 202	**Session 3B-203 Room/salle 203**	**Session 3B-204 Room/salle 204**	**Session 3B-205 Room/salle 205**
	(C) Paleo-Oceanography and Paleo-Climatology *Chair:* Markus Kienast	**(I)** Numerical Modelling for Research Part 1 of 2 *Chair:* Xin Qui	**(A)** Recent Progress with the GEM-LAM 2.5km Model *Chair:* Serge Desjardins	**Teachers Day**
10:30	A re-examination of Paleocene-Eocene thermal maximum carbon emission estimates *David Carozza*	Use of observations to constrain projection for future climate *Xuebin Zhang*	An overview of recent developments of the GEM-LAM 2.5 km model *Jocelyn Mailhot*	Teachers Day
10:45	Nitrogen isotope evidence of a mid-Holocene deepening of the western equatorial Pacific thermocline ? *Markus Kienast*		An update on the GEM-LAM at 2.5 km horizontal resolution windows running across Canada *Amin Erfani*	
11:00	New dinoflagellate and isotopic evidence for Lake Agassiz drainage along the northeastern Newfoundland Shelf *Elisabeth Levac*	Vertical structure of horizontal currents in global eddying OGCMs *Robert Scott*	LAM2.5 development: Usefulness of feedback and evaluation by operational meteorologists *Richard Moffet*	Teachers Day
11:15	Evaluation and calibration of coral Sr/Ca proxy SST records accounting for seasonal effects *Robert Scott*	Using space filling curves to generate rectangular grids with varying resolutions for ocean modeling *Zhigang Xu*	Comparing GEM Regional, GEM-LAM 2.5 and RUC Model Simulations of Mesoscale Features over Southern Ontario *David Sills*	Teachers Day
11:30	Trigger of stochastic resonance for the onset of El Niño *Zhiyong Huang*	Verification of the latent heat flux predicted over the Lake Superior simulated by the Coupled Environmental Model MEC *Dorothée Charpentier*	The GEM LAM2.5 – Operational Applications and Cases from the Maritimes Region – 2008-2009 *Chris Fogarty*	Teachers Day
11:45	A review of the case for global cooling this century *Dick Morgan*	An improved technique for modeling evapotranspiration on the prairies *Julian Charles Brimelow*	Short-term verification of GEM Regional and GEM-LAM model parameters in the context of significant weather events at CYYZ for the Canadian Airport Nowcasting (CAN-Now) project *George Isaac*	Teachers Day
12:00–13:30	*Lunch/Déjeuner (on your own)*			

Wednesday/mercredi, 3 June/juin			
			08:30
			09:15
Coffee/Café (Room/Salle 100)			10:00
Session 3B-301 **Room/salle 301**	**Session 3B-302** **Room/salle 302**	**Session 3B-303** **Room/salle 303**	
(I) IPY and related atmospheric, oceanographic, and hydrological studies Part 1 of 4 *Chair:* Zhenxia Long	**(O)** Coastal Oceanography and Inland Waters Part 2 of 2 *Chair:* Ran Rao Yerubandi	**(A)** Radiation, Aerosols and Cloud Part 1 of 2 *Chair:* Jaingnan Li	
The Polar Continental Shelf Program's support of International Polar Year research activities in the Canadian Arctic *Martin Bergmann*	Development and applications of Canadian East Coast Ocean Model (CECOM) *Tang Charles*	Radiative forcing by ice crystals from remote blowing snow events at Eureka *Glen Lesins*	10:30
The Storm Studies in the Arctic (STAR) Project: Recent Progress *John Hanesiak*			10:45
Thorpex Arctic Weather and Environmental Prediction Initiative (TAWEPI): an update on modelling and data assimilation activities *Ayrton Zadra*	An FVCOM model off Newfoundland and Labrador *Guoqi Han*		11:00
Analysis of a warm front over the Hudson Strait during the STAR Campaign *Rebekah Martin*	Short term forecasting of sea surface temperature off Canada's East Coast *Keith Thompson*	A convective parameterization with trimodal convective outflow *Ian Folkins*	11:15
Meteorological analysis of an extreme Beaufort coastal storm surge event *David Small*	The Amundsen Gulf eddies *Yves Gratton*	Diagnosing cloud properties and radiative fluxes in the CCCma AGCM4 *Jason Cole*	11:30
The synoptic and planetary scale environments associated with strong wind events along the Beaufort Sea coast *Melanie Cooke*	Process study of hydrodynamics over the Pearl River Estuary using a nested-grid Coastal Circulation Model *Xiaomei Ji*	A simple lidar-derived sulphate index for the Arctic: meaning, validation and importance for thin ice clouds study. *Patrick Grenier*	11:45
Lunch/Déjeuner			12:00–13:30

Wednesday/mercredi, 3 June/juin				
	Session 3C-202 Room/salle 202	**Session 3C-203 Room/salle 203**	**Session 3C-204 Room/salle 204**	**Session 3C-205 Room/salle 205**
	(O) Argo in ocean and climate sciences *Chair:* Denis Gilbert	**(I)** Numerical Modelling for Research Part 2 of 2 *Chair:* Xin Qui	**(I)** Military Meteorology and Oceanography *Chair:* Mario Ouellet	**Teachers Day**
13:30	Separating the steric and eustatic contributions to global sea-level rise *Howard Freeland*	The second generation of the Global Mars Multiscale Model (GM3) *Ayodeji Akingunola*	Military weather services transformation overview *Martha Anderson*	Teachers Day
13:45	Estimating climatologies for the Argo period: Dealing with noise due to mesoscale variability *Simon Higginson*	The staggered hybrid vertical coordinate in GEM *Vivian Lee*	The New Canadian Forces Joint Meteorological Centre *Clarke Bedford*	Teachers Day
14:00	Seasonal cycle and interannual variability of temperature and salinity in the North Atlantic *Igor Yashayaev*	An application of the CMAQ modelling system to determine the impact of marine emission controls over the Pacific Northwest – Air Chemistry *Colin Di Cenzo*	Dust storms vice snowstorms - The challenges of forecasting for Kandahar Afghanistan (as part of a NATO combined effort). *Don Clark*	Teachers Day
14:15	Survey of the Gulf Stream northern recirculation gyre with temperature, salinity and oxygen data from Argo floats *Denis Gilbert*	An application of the CMAQ modelling system to determine the impact of marine emission controls over the Pacific Northwest - Meteorology. *Robert Nissen*	Mesoscale GEM-LAM modeling of RF/IR propagation and refractivity in the littoral zones *Anna Glazer*	Teachers Day
14:30	Impacts of ARGO observations on the Pacific ocean data assimilation *Youmin Tang*	An application of the CMAQ modelling system to determine the impact marine emission controls over the Pacific Northwest – Emissions *Xin Qiu*	An overview of MetOc Halifax ocean products and services *Darryl Williams*	Teachers Day
14:45	Development and evaluation of ice-ocean reanalyses using the S(T) Assimilation System *Gregory Smith*	A sensitivity study of using high resolution WRF model to forecast winds over Southern Alberta *Yan Shen*	Incorporation of winds from the Canadian Ensemble Forecast System into the CANSARP software package for the determination of target search areas for search and rescue operations. *Syd Peel*	Teachers Day
15:00-16:30	*Poster Session 2 (Atmospheric Sciences, Climate and Oceanography Themes) -Refreshments Provided and Cash Bar (Room/Salle 100)*			
16:30-17:30	Argo Town Hall Meeting *Chair:* Denis Gilbert			*Teachers Day*
18:30	*Banquet in the Grand Ballroom (Level/Niveau 2)*			

Wednesday/ mercredi, 3 June/juin			
Session 3C-301 Room/salle 301	**Session 3C-302 Room/salle 302**	**Session 3C-303 Room/salle 303**	
(I) IPY and related atmospheric, oceanographic, and hydrological studies Part 2 of 4 *Chair:* William Allen Perrie	**(O)** Coastal Oceanography and Inland Waters Part 3 of 3 *Chair:* Jinyu Sheng	**(A)** Radiation, Aerosols and Cloud Part 2 of 2 *Chair:* Jaingnan Li	
Arctic blizzard prediction by nonlinear statistical downscaling of GFS Reforecast model outputs *William Hsieh*	An oxygen budget for the Strait of Georgia from ferry-based (and other) measurements *Rich Pawlowicz*	Aerosols, clouds, and their effects on climate and ecosystem *Qilong Min*	13:30
Long-term changes in summer meteorological, sea ice and oceanographic conditions in the Beaufort Sea *David Fissel*			13:45
Cloud and precipitation features over the eastern Canadian Arctic as inferred from CloudSat and Aqua *Alex Laplante*	Improve the utility of a coastal circulation model by assimilating hydrographic observations into the model momentum *Li Zhai*	An evaluation on global aerosol simulation in CCCma AGCM4 model *Yiran Peng*	14:00
Variability of freshwater pathways in the Arctic Ocean *Alexandra Jahn*	A high-order numerical study of western boundary current separation along a curved coastline *Derek Steinmoeller*	Global simulations of aerosol size-dependent impaction scavenging in the ECHAM5-HAM GCM *Betty Croft*	14:15
Carbon cycling in the Arctic Archipelago: The export of Pacific carbon to the North Atlantic *Elizabeth Shadwick*	Hydrodynamic modeling of Lake Ontario: An intercomparison of three hydrodynamic models *Anning Huang*	MAESTRO measurements of atmospheric aerosol extinction *C. Thomas Mcelroy*	14:30
CO2 exchange between Arctic sea ice and the atmosphere: a second look. *Tim Papakyriakou*	Internal wave generation in the St. Lawrence Estuary *Clark Richards*	Evaluation of CRCM output during the 1999-2004 Canadian Prairie drought *Trudy Mccormack*	14:45
Poster Session 2 (Atmospheric Sciences, Climate and Oceanography Themes) - Refreshments Provided and Cash Bar (Room/Salle 100)			15:00-16:30
			16:30-17:30
Banquet in the Grand Ballroom (Level/Niveau 2)			18:30

Thursday/jeudi, 5 June/juin				
	Session 4A, Room/salle Grand Ballroom (Level/Niveau 2)			
08:30	Plenary Session 7, *Chairs:* Tom Duck and William Crawford	Sun, snow and satellites: Remote sounding in a cold country, *James Drummond*		
09:15	Plenary Session 8, *Chairs:* Tom Duck and William Crawford	Plenary to be given by CMOS President's Prize winner, *TBA*		
10:00	*Coffee/Café(Room/Salle 100)*			
	Session 4B-202 Room/salle 202	**Session 4B-203 Room/salle 203**	**Session 4B-204 Room/salle 204**	**Session 4B-205 Room/salle 205**
	(A) Air Quality: Delivering the Right Message Part 1 of 3 *Chair:* David Waugh	**(I)** Monitoring the Atmosphere and Ocean Part 1 of 3 *Chair:* Al Wallace	**(C)** Climate Change and Extreme Events Part 1 of 3 *Chair:* Chad Shouquan Cheng	**(A)** UNSTABLE Part 1 of 2 *Chairs:* Neil Taylor and David Sills
10:30	Climatology of Air Quality Health Index on the Canadian Prairies *Brian Wiens*	Meteorological Service of Canada: Weather and environmental monitoring *Jim Abraham*	Incorporating climate change in integrated forest management *William Richards*	The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) 2008: Project Overview *Neil Taylor*
10:45	A look at the AQHI over Atlantic Canada during the 2002 Quebec Forest Fire Episode *Doug Steeves*		Improving regional climate change projections of temperature for Halifax, Nova Scotia via statistical downscaling. *Lee Titus*	Mesonet observations during the 2008 Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) *David Sills*
11:00	Case study of smog event in the perspective of the new Canadian Air Quality health Index (AQHI), 4 to 7th November 2008 over Saint-Lawrence valley in Quebec region *Jacques Rousseau*	A strategic plan for Environment Canada's Weather and Environmental Monitoring Program *Michael Manore*	Diminished windstorm frequency in Southwest British Columbia and a possible association with the Pacific Decadal Oscillation Regime Shift of 1976-77 *Wolf Read*	Moisture cycling and urban dry islands in thunderstorm environments *Geoff Strong*
11:15	Satellite remote sensing of the Air Quality Health *Randall Martin*	Moving towards a water cycle prediction system in Canada *Alain Pietroniro*	Possible impacts of climate change on wind gust over Ontario under downscaled future climate *Chad Shouquan Cheng*	Exploring surface linkages to convection and convective boundary layer thermal characteristics on the Canadian *John Hanesiak*
11:30	Long-term exposure of fine particulate matter at high resolution from satellite observations *Aaron Van Donkelaar*	The challenges of maintaining automated weather stations. *Darren Tessmer*	A total linear response (TLR) model for assessing climate change impact on annual runoff over large river basins *Lei Wen*	Evaluating GEM-LAM precipitable water vapour output using the southern Alberta GPS network during UNSTABLE 2008 *Craig Smith*
11:45		The role of Prairie and Northern in the installation and maintenance of Environment Canada's Atmospheric Monitoring Networks *Wayne Emond*		Characterization of the dryline in Alberta on 13 July 2008 using observational data from UNSTABLE 2008 *Neil Taylor*
12:00–13:30	*Lunch/Déjeuner*			

Thursday/jeudi, 4 June/juin

			08:30
			09:15
Coffee/Café (Room/salle 100)			10:00
Session 4B-301 Room/salle 301	**Session 4B-302 Room/salle 302**	**Session 4B-303 Room/salle 303**	
(I) IPY and related atmospheric, oceanographic, and hydrological studies Part 3 of 4 *Chair:* Thomas Duck	**(I)** Climate variability and marine ecosystems Part 1 of 2 *Chair:* Christine Michel	**(O)** Composition, variability and circulation of seawater: bays to basins Part 1 of 2 *Chair:* Igor Yashayaev	
The Polar Environment Atmospheric Research Laboratory (PEARL) during International Polar Year and beyond *James Drummond*	Climate-driven changes in the biological productivity of the Arctic Ocean *Jean-Éric Tremblay*	Salinity, chemical composition, and conductivity of natural waters *Rich Pawlowicz*	10:30
Long range atmospheric transport of Aerosols: First Arctic measurements using Quadruple Aerosol Mass Spectrometer *Asan Bacak*		Updated representations of the thermophysical properties of seawater: A new standard for oceanography *D. G. Wright*	10:45
Tropospheric Particles Observed in the High Arctic at Eureka *Thomas Duck*	Contributions from DMS and ship emissions to CCN observed over the summertime North Pacific *Lisa* Phinney	Numerical study on circulation in St Margaret's Bay by a nested-grid ocean model *Fuxi Ma*	11:00
Stratospheric trace gas measurements at Eureka, Nunavut during IPY and comparisons with the Atmospheric Chemistry Experiment on SCISAT *Rodica Lindenmaier*	Phytoplankton production and export in the Hudson Bay system. *Amandine Lapoussiere*	Mozambique channel eddies: A source of heat and salt for the Agulhas Current and beyond *Neil Swart*	11:15
The waves and coupling processes theme at the Polar Environment Atmospheric Research Laboratory (PEARL): The first year of observations and science *William Ward*	How will short-term variability affect a coastal ecosystem subject to climate change? *Sophia Johannessen*	Variability in deep convection in the Labrador Sea in recent years *Igor Yashayaev*	11:30
Meridional coupling of temperature between middle and high arctic latitudes during stratospheric warming events – the SATI and COSMIC perspective *Young-Min Cho*	Effects of local and global change on an inland sea: the Strait of Georgia, British Columbia *Robie Macdonald*	Model study of the Labrador Sea water formation and spreading *Jieshun Zhu*	11:45
Lunch/Déjeuner			12:00–13:30

Thursday/jeudi, 4 June/juin				
	Session 4C-202 Room/salle 202	**Session 4C-203 Room/salle 203**	**Session 4C-204 Room/salle 204**	**Session 4C-205 Room/salle 205**
	(A) Air Quality: Delivering the Right Message Part 2 of 3 *Chair:* Doug Steeves	**(I)** Monitoring the Atmosphere and Ocean Part 2 of 3 *Chair:* Pierre Pépin	**(C)** Climate Change and Extreme Events Part 2 of 3 *Chair:* William G. Richards	**(A)** UNSTABLE Part 2 of 2 *Chairs:* Neil Taylor and David Sills
13:30	Lidar profiling of biomass burning, pollution, and volcanic aerosols from Halifax *Thomas Duck*	Latest progress in building the world's first regional cabled ocean observatory: NEPTUNE Canada *Christopher Barnes*	An evaluation of the NARR precipitation analyses over Southwestern British Columbia *Steven Lambert*	Triggering ,echanisms for the 17 July 2008 hailstorms *Daniel Brown*
13:45	Lake breezes in Southwestern Ontario and their iInfluence on air quality during BAQS-Met 2007 *David Sills*	Interaction of deep ocean currents with the Juan de Fuca Ridge Topographic Complex – NEPTUNE Canada Science *Steven Mihaly*	Increasing trend of synoptic activity and its relationship with extreme rain events over central India *Ajayamohan Ravindran*	Convective wind event over Southeastern Alberta – 15 July 2008 *Steve Knott*
14:00	Sable Island air monitoring: Perspectives on local and long-range pollutant sources and transport. *David Waugh*	Real time water quality and synoptic weather measurements from a buoy station in the Fraser River Estuary *Anthony Ethier*	Possible impacts of climate change on rainfall extremes over Ontario under downscaled future climate conditions *Guilong Li*	Modeling maximum hail size for Alberta storms *G.w. Reuter*
14:15	Off-site fate and transport of airborne arsenic-laden PM2.5 from a historic gold mine tailings site to nearby properties in Nova Scotia *Mark Gibson*	Implications of analyzing short-timescale sea surface temperature changes using ship and buoy observations *Rick Danielson*	Climatology of significant ice dtorms in Atlantic Canada *William Richards*	Mixing heights and convective cloud base heights *Olga Stachowiak*
14:30	Wood stove replacement scenarios: modelling the impact on air quality in the Greater Montreal area with AURAMS *Gilles Morneau*	Representing radar quality for weather radars: Data validity *Norman Donaldson*	Solar magnetic cycles and temperature variability *Dick Morgan*	Lightning climatology at 20 Km^2 and 1 Km^2 resolutions for Canada from CLDN observations *William Burrows*
14:45		Development of image metric techniques to track changes in visibility *Andrew Teakles*		Using GEM output for forecasts of convective initiation on the Canadian prairies: Experimental techniques under development in the Hydrometeorology and Arctic Lab (HAL) *Neil Taylor*
15:00-15:30	*Coffee/Café*			

Thursday/ jeudi, 4 June/juin			
Session 4C-301 **Room/salle 301**	**Session 4C-302** **Room/salle 302**	**Session 4C-303** **Room/salle 303**	
(I) IPY and related atmospheric, oceanographic, and hydrological studies Part 4 of 4 *Chair:* Steven Solomon	**(I)** Climate variability and marine ecosystems Part 2 of 2 *Chair:* Angelica Pena	**(O)** Composition, variability and circulation of seawater: bays to basins Part 2 of 2 *Chair:* Charles G. Hannah	
Changes in the sea-ice regime of the Canadian Arctic Archipelago from enhanced AMSR-E and QuikSCAT imagery *Tom Agnew*	Responses of marine ecosystems to climate change and variability *Ken Denman*	Currents and hydrographic variability in Orphan Basin *John Loder*	13:30
Ice and snow observations made during the IPY Circumpolar Flaw Lead (CFL) program in the eastern Beaufort Sea using helicopter and sled logistics *Simon Prinsenberg*		Current and hydrographic structure across Orphan Basin and Knoll in 2007 and 2008 from ADCP-CTD surveys *Yuri Geshelin*	13:45
Identification, characterization and change of the near-surface temperature maximum in the Canada Basin, 1993-2008 *Susan Allen*	Climate change and carbon and oxygen cycles on the Vancouver Island shelf *Laura Bianucci*	Origin and variability of the deep and abyssal waters of the Northwest Atlantic *Igor Yashayaev*	14:00
Decadal simulations of Arctic sea ice *Zhenxia Long*	Temperature, timing and growth: Implications for outbreaks of a marine invader *Megan Saunders*	Interdecadal variability along 38°N North Atlantic *Ji Lei*	14:15
	Coherent change in multiyear trends of phytoplankton and bacterioplankton *William Li*	Interannual and decadal sea level variability in the Northwest Atlantic *Guoqi Han*	14:30
River-ocean interaction during the break-up at the mouth of the Mackenzie River, Northwest Territories, Canada *Steven Solomon*	Regional variability in copepod phenology: Application of a new individual-based model (IBM) and implications for a changing climate. *Pierre Pepin*	Numerical and observational study of circulation in the Intra-Americas Sea: connection between Gulf of Mexico Loop Current intrusion and throughflow transport variability *Yuehua Lin*	14:45
Coffee/Café			15:00-15:30

Thursday/jundi, 4 June/juin			
	Session 4D-202 Room/salle 202	**Session 4D-203 Room/salle 203**	**Session 4D-204 Room/salle 204**
	(A) Air Quality: Delivering the Right Message Part 3 of 3 *Chair:* Randall Martin	**(I)** Monitoring the Atmosphere and Ocean Part 3 of 3 *Chairs:* Al Wallace and Pierre Pépin	**(C)** Climate Change and Extreme Events Part 3 of 3 *Chair:* Chad Shouquan Cheng
15:30	GEM-MACH15, a new Canadian air-quality forecast model *Donald Talbot*	State of the Canadian Reference Climate Station Network *John Macphe*	The first 21st century extreme climatic event and its impact on six Canadian Prairie communities *Virginia Wittrock*
15:45	GEM-AQ simulation of fine-mode aerosol optical events observed in the Canadian High Arctic at Eureka *Alex Lupu*	New methods for measuring precipitation (solid and liquid) at automatic stations *Rodica Nitu*	Water budget and drought in Central Southwest Asia *Malik Khalid*
16:00	Evaluation of the GEM-AQ model during the INTEX-A field campaign *Jennifer McLarty*	Reference climate station operational precipitation algorithms *Hagop Mouradian*	An assessment of mid-tropospheric circulation patterns associated with Canadian Prairie droughts *Barrie Bonsal*
16:15	Descent of deep stratospheric intrusions in the troposphere *Michel Bourqui*		Extreme precipitation events and the recent drought over the Canadian Prairies *Hannah Carmichael*
16:30			Drought characterization using observed relationships between plant physiology and plant available soil moisture *Julian Charles Brimelow*

Poster Session / La session des affiches

Tuesday/mardi, 2 June/juin				
Poster Session **Room/Salle 100 15:30-17:00**				
	2D-100-I2	**2D-100-I3**	**2D-100-I4**	**2D-100-I5**
	(I) Monitoring the Atmosphere and Ocean *Chair:* Al Wallace	**(I)** IPY and related atmosphere, oceanographic, and hydrological studies *Chair:* Bash Toulany	**(I)** Climate Variability and Marine Ecosystems *Chair:* Catherine Johnson	**(I)** Physical-Biological Interactions in the Ocean *Chair:* Tetjana Ross
1	Characterisation of biogenic slicks - using Langmuir films and ellipsometry *Wendy King*	Model validation of cloud and radiation from the Atmospheric Infrared Radiance Sounder (AIRS) *Ovidiu Pancrati*	Spatial and temporal distributions of dissolved organic matter and carbon monoxide in Arctic first-year sea ice *Huixiang Xie*	Changes in the North Atlantic oscillation influence CO2 uptake in the North Atlantic over the past two decades *Helmuth Thomas*
2	Software tools to monitor a real time sunphotometer network *James Freemantle*	Simulating wind channeling over Frobisher Bay in the Eastern Canadian Arctic during the 7-8 November 2006 wind event *Daniel Deacu*	Ice-algae modeling in the Canadian Arctic Archipelago *Lynn Pogson*	Net impact of subtropical cyclonic eddies on regional air-sea CO2 fluxes: CO2 sink or source? *Feizhou Chen*
3	The role of Prairie and Northern in the installation and maintenance of Environment Canada's Atmospheric Monitoring Networks *John Mravnik*	Fresh water in the northern East Greenland Current from 1982 through 2005 *E. Peter Jones*	Mesocosm-simulated effects of increasing temperature and ultraviolet-B radiation on the CO2 system in sub-Arctic coastal water *Xiaomeng Wang*	*Prochlorococcus marinus* as a source of marine methyl iodide (CH_3I) *Darlene Brownell*
4	Initial results from the STAR surface mesonet *Marna Melzer*	Influence of stationary wave field on stratosphere-troposphere coupling response to idealized Eurasian snow forcing *Karen Smith*	Sinking export of organic material in the eastern Beaufort Sea during summer 2008. *Amélie Sallon*	Parameter optimization of a two-layered diagenetic model through variational data assimilation *Robin Wilson*
5		Coupled hydrologic-land-surface modelling for predicting freshwater flux to the arctic ocean *Bruce Davison*	Environmental control of continental shelf zooplankton communities *Catherine Johnson*	Life on VENUS: Characterizing the benthic larval community at depth in Saanich Inlet. *Kristin Dinning*
6		Cross-shelf exchange in the Arctic Ocean *Erika Sternberg-Bousserez*		Oceanographic setting and variability of Orphan Knoll *Blair Greenan*
7		Forecasting intercontinental transport of pollution into the Canadian High Arctic using a Langrangian particle dispersion model. *Richard Damoah*		Solid phase microextraction (SPME) methods for thedetermination of trace aldehydes and ketones in seawater and ambient air *Edward Hudson*
8				

Tuesday/mardi, 2 June/juin				
Poster Session **Room/Salle 100 15:30-17:00**				
	2D-100-I6	**2D-100-I7**	**2D-100-I8**	**2D-100-I9**
	(I) Numerical Modelling for Research *Chair:* Ronald J. McTaggart-Cowan	**(I)** Remote Sensing of the Atmosphere and Ocean *Chairs:* Norman O'Neill and Rong-Ming Hu	**(I)** Water, Weather and Climate Serving the Energy Sector *Chair:* Anne-Marie Valton	**(I)** CONCEPTS *Chair:* Harold C. Ritchie
1		A 7-year midlatitude climatology of stratospheric temperature using vibrational-RAMAN LIDAR *Blessing Iserhienrhien*	Facilitating effective co-existance of wind turbine development and weather radars *Christine Best*	Validation of the Canadian-Newfoundland Operational Oceanographic Forecasting System *Fraser Davidson*
2		Temperature and water vapour retrievals from the newly commissioned RMR lidar in Eureka Nunavut. *Jonathan Doyle*		
3		Temperature and Ozone Observed by MIPAS/ENVISAT and MLS/AURA: The Global Atmospheric Tides and Comparisons with Model Results *William Ward*		
4		Simulations of the Martian airglow and the recovery of temperature profiles from limb airglow observations. *Stephanie Conway*		
5		Stratospheric Aerosols from the 2008 Kasatochi Eruption observed over Halifax, Nova Scotia *Lubna Bitar*		
6		Comparison of global ACE-FTS observations in the upper troposphere and GEM-AQ simulations *John Mcconnell*		
7		Comparison of CMAM simulations of carbon monoxide (CO), nitrous oxide (N_2O), and methane (CH_4) with observations from Odin/SMR, ACE-FTS, and Aura/MLS *John Mcconnell*		
8		First global observations of groundstate CO_2 in the mesosphere and lower thermosphere by ACE-FTS and analysis using CMAM model *Stephen Beagley*		
9		Characterisation and optimisation of the new CANDAC Raman lidar for lower atmospheric measurements *Graeme Nott*		

Tuesday/mardi, 2 June/juin				
Poster Session **Room/Salle 100 15:30-17:00**				
	2D-100-I10	**2D-100-I11**	**2D-100-I14**	**2D-100-I17**
	(I) Weather and Social Science *Chair:* Rebecca J. Wagner Hochban	**(I)** Military Meteorology and Oceanography *Chair:* Martha Anderson	**(I)** Global Atmosphere-Ocean Prediction and Predictability *Chair:* Keith R. Thompson	**(I)** Atmosphere, Ocean and Climate Dynamics *Chair:* Robert B. Scott
1	Risky business: Encouraging a societal perspective in the design and evaluation of weather warning *Brian Mills*	The Joint Meteorological Centre – a new DND/CF and Environment Canada Initiative *Clarke Bedford*	Nonlinear post-processing of dynamical seasonal climate forecasts *Joel Finnis*	Influence of mesoscale eddies on internal waves of tidal frequency *Michael Dunphy*
2			Simulation of the mixed-layer depth in the North East Pacific *Shawn Donohue*	
3			Parameter estimation for data assimilation with a coupled ocean-atmosphere system *Sergey Skachko*	
4				

Wednesday/ mercredi, 3 June/juin					
Poster Session Room/Salle 100 15:00-16:30					
	3D-100-A4	3D100--A5	3D-100-A6	3D-100-A7	3D-100-A9
	(A) Air Quality: Delivering the Right Message *Chair:* Doug Steeves	**(A)** Operational Meteorology *Chair:* Paul Ford	**(A)** Radiation, Aerosols and Cloud *Chair:* Jiangnan Li	**(A)** UNSTABLE *Chairs:* Neil Taylor and David Sills	**(A)** Meteorological Preparations for the 2010 Olympic Winter Games *Chair:* Chris Doyle
1	Ambient total gaseous mercury, NOx and SO_2 signatures from coal-fired power plants in the Lake Wabamun area of Alberta, Canada *Maxwell Mazur*	Study of cold lows in Arctic observed and simulated by GEM models *Yves Melin*	Aerosol-ice relations in Arctic clouds *Michael Earle*	Examination of moisture and density gradients observed by the FCA during UNSTABLE *Eric White*	Whistler Mountain climatology: Temperature lapse rates in complex terrain for the 2010 Olympics *Lisa Erven*
2	Assessing the penetration of stratospheric air in the foothills of the Canadian Rockies *Real D'Amours*	UMOS-AQ: Forecasting O_3, PM_{25} and NO_2 three-hourly spot concentrations using an updatable MOS methodology - Latest developments *Stavros Antonopoulos*	A statistical model for use in large scale models *Yang Yi Wang*		Strong outflow wind events affect the Callaghan Valley Olympic venues *Andrew Teakles*
3	Troposphere climate change and associated impacts on air quality in Ontario. Part 1: Climate changes as revealed by NARR data *Peter Taylor*	Development of Verification Macros to support the CMAC Performance Measurement Feedback Program *Dan Newall*	Important CH4 shortwave radiative forcing in GCM *Jiangnan Li*		Operational evaluation of GEM-LAM 2.5 km and 1.0km models in view of the Vancouver 2010 Games. *Andre Giguere*
4	Evaluation and impacts of an online biogenic emission model in GEM-AQ using summertime ozone episodes in North America *Kenjiro Toyota*	Évaluation de la passe en parallèle Gulf du modèle Régional Gem / Evaluation of Gem Reg parallel run Gulf *Catherine Vallières*			Ensuring a quality Weather Services program for the 2010 Olympic Winter Games *Chris Doyle*
5	Impact of a new lightning NOx parameterization in GEM-AQ *Lori Neary*	Vertical reflectivity profiles of precipitation during the STAR field campaign *William Henson*			
6	The effect of sub-grid scale convective transport on the long range transport of atmospheric mercury. *Daniel Figueras-Nieto*	The Ontario-Quebec wind-profiler network (OQNet) *Peter Taylor*			
7	New parameterizations for air-sea exchange and dry deposition of slightly soluble gases for regional and global AQ models over coastal water and ocean. *Alain Robichaud*				
8					

Wednesday/ mercredi, 3 June/juin				
Poster Session Room/Salle 100 15:00-16:30				
	3D-100-C2	**3D-100-C3**	**3D-100-C4**	**3D-100-C5**
	(C) Paleo-Oceanography and Paleo-Climatology *Chair:* Markus Kienast	**(C)** Climate Data Homogenization *Chair:* Lucie Vincent	**(C)** Climate Change and Extreme Events *Chair:* Chad Shouquan Cheng	**(C)** Regional Climate Modelling *Chair:* Laxmi Sushama
1	A carbon cycle box model study of the role of methane during the Paleocene-Eocene thermal maximum *David Carozza*	Canadian special metadata database for climate data homogenization *Hui Wan*		Climate change impact on water balance components of North American river basins - Canadian RCM projections and their uncertainty *Marco Braun*
2	Glacial maximum to Holocene contrasts in the dynamics of the eastern equatorial Pacific *Nathalie Dubois*	Systematic errors in reported mean sea level pressure for Canadian dtations resulting from potentially different applications of the plateau correction. *Christopher Hampel*		Assessment of climate change impacts on Canadian rivers flows using Regional Clmate Model projections *Vincent Poitras*
3		The proposed replacement of Liquid in Glass thermometers by digital technology in meteorological networks *Tomasz Stapf*		Sensibility of precipitation to horizontal resolution in the Canadian Regional Climate Model (CRCM) *Michael Jr. Powers*
4				Evaluation of the internal variability in the Canadian Regional Climate Model over an Arctic domain using the Big-Brother Experiment approach *Maja Rapaic*
5				Atmospheric water budget study by scale decomposition with the Canadian Regional Climate Model over North America *Raphael Bresson*
6				CRCM projected changes to the characteristics of precipitation extremes over Canada *Bratislav Mladjic*
7				Projected (1990-2060) changes in surface winds over Southern British Columbia using a Regional Climate Model *Charles Curry*
8				

Wednesday/ mercredi, 3 June/juin				
Poster Session **Room/Salle 100 15:00-16:30**				
	3D-100-02	**3D-100-03**	**3D-100-04**	**3D-100-05**
	(O) Carbon Uptake in the Ocean- Problems of Ocean Acidification and Feasibility of Iron Fertilization *Chair:* Debby Ianson	**(O)** Costal Oceanography and Inland Waters *Chair:* Guoqi Han	**(O)** Acoustics in Oceanography *Chair:* Tetjana Ross	**(O)** Argo in Ocean and Climate Sciences *Chair:* Igor Yashayaev
1	Saturation states for aragonite and calcite in the deep convection region in the Labrador Sea *Kumiko Azetsu-Scott*	Simulating transport in tidally-averaged flows: Sources and scales of errors *Chad Gilbert*	Diurnal to seasonal variability of an Arctic zooplankton community as estimated from moored acoustic Doppler current profiler backscatter data *Kate Collins*	An interactive tool for real-time monitoring and exploration of ocean basins (ArgoBrowser) *Michael Dunphy*
2	Strong seasonal pH variability in coastal upwelling regions at temperate latitudes *Debby Ianson*	Current variability on North-East Newfoundland shelf from historical VM-ADCP data. *David Senciall*	Assessing the isotropy of turbulence using broadband acoustics *Doris Leong*	
3	An automated experimental system for the simultaneous measurements of potentiometric and spectrophotometric \$pH\$ in seawater. *Chris L'Esperance*	What is the fate of the riverine freshwaters of Hudson Bay? *Pierre St-Laurent*		
4				

Author Index / Index des auteurs

The first number refers to the day of the week (e.g. Monday = 1). The second letter represents the session (refer to shaded Session Time Code in Week at a Glance). The number or name following the hyphen represents the room. For oral presentations the number following the period represents the placement in the session. For posters the hyphen is followed by the number of the special session and the placement in the session.

Le premier numéro réfère au jour de la semaine (e.g. lundi = 1). La deuxième lettre représente la session (réfère au Code du temps de session ombragé dans la Semaine d'un coup d' oeil). Le numéro ou nom qui suit le trait d'union représente la salle. Pour les présentations orales le numéro qui suit le point représente le placement dans la session. Pour les affiches le trait d'union est suivi par le numéro de la session spéciale et le placement dans la session.

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Dans l'index situé à la fin de quelques documents, le nom des auteurs est suivi des numéros d'identification et de présentation de tous les résumés correspondants.

1A-GRAND.1 ID:2715 INVITED/INVITÉ 09:00

Fertilization of the ocean for climate mitigation

John Cullen
Department of Oceanography, Dalhousie University
Contact: John.Cullen@dal.ca

Ocean iron fertilization (OIF) is being considered as a strategy for mitigating rising atmospheric carbon dioxide concentrations. One model for implementation is the sale of carbon offsets. The debate over fertilization of the ocean for carbon sequestration began about 20 years ago and has increased in sophistication, but the central themes are unchanged. Recently, recognition of the issue has broadened. OIF is being considered by the ocean policy community (London Convention) and proposals for new research are generating significant controversy. Here I review positions that have been taken over the years and identify key scientific questions that must be addressed directly if the potential risks and benefits of OIF are to be competently assessed. In particular, long- term effects of widespread fertilization, sustained over decades, must be shown to be acceptably predictable and verifiable. I propose that until this can be demonstrated -- and there is good reason to believe that it cannot -- OIF should not be considered a viable technology for climate mitigation.

1A-GRAND.2 ID:3095 INVITED/INVITÉ 09:45

Cryosphere and Climate: From Ice-Age to Anthropocene

Wm. Richard Peltier
Department of Physics, University of Toronto
Contact: peltier@atmosp.physics.utoronto.ca

That climate and the cryosphere have always been strongly coupled is most clearly established by the success of the orbital theory of the Late Quaternary ice-age cycle. Detailed analyses of climate-cryosphere coupling through this period of Earth history have clearly established the importance of nonlinearity in governng system evolution, the most profound feedback involved being that which operates through the carbon cycle. Only by incorporating the impact of co-variation of atmospheric carbon dioxide concentration with continental ice-volume is it possible to reproduce the ice-core and ocean-core observations. At Last Glacial Maximum the impact of the change in surface conditions not only influenced the atmospheric general circulation but also that of the oceans, especially the thermohaline circulation. Modern coupled atmosphere-ocean climate models are able to reproduce the reduced strength of the THC inferred on the basis of the Pa/Th kinematic tracer of overturning strength.The impacts upon the Earth System of these massive perturbations to continental ice-volume are also clearly evident in the Holocene history of relative sea level change. They are also evident in the data sets that may be employed to constrain the rate of global sea level rise now occuring due to ongoing global warming due to increasing atmospheric greenhouse gas concentrations.This influence has significantly destabilized the great polar ice-sheets on both Greenland and Antarctica. Time dependent gravity field data now being measured by the GRACE satellites, which striongly constrain the extent of this instability, have

enabled a detailed assessment of the extent to which we may claim the budget of global sea level rise to be closed.

Atmosphere-Ocean Interaction & Waves (PART 1) / Interaction atmosphère-océan et les vagues (Partie 1)

Room / Endroit (202), Chair / Président (Bash Toulany), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-202.1 ID:2889 **11:00**

Recent developments in wave modeling

William Perrie [1], *Don Resio* [2], *Bechara Toulany* [1], *Lanli Guo* [1], *Weiqing Zhang* [3], *Jean-Pierre Auclair* [4]
[1] Bedford Institute of Oceanography, Dartmouth, Nova Scotia
[2] Engineering Research and Development Center, USACE, Vicksburg MS
[3] Environment Canada, Downsview, Ontario
[4] Dept of Oceanography, Dalhousie University, Halifax, Nova Scotia
Contact: perriew@dfo-mpo.gc.ca

In this presentation we give an overview survey of our activities at BIO in development of wave forecast systems for several network projects; GoMOOS, the Gulf of Maine Ocean Observing System http://www.gomoos.org, SCOOP, an openioos project, http://www.openioos.org and CMEP - the Dalhousie University Centre for Marine Environmental Prediction project, http://cmep-av.ocean.dal.ca. We first discuss recent developments of the new flexible two-way nested grids used in WW3 (WaveWatch3) with respect to the quality and accuracy of the wave model forecasts during hurricane Juan (2003). Secondly, we consider the nonlinear wave-wave interactions, which are at the heart of any development of a next generation forecast model. The conventional approach to wave-wave interactions is the discrete interaction approximation (DIA), which has biases in rapidly developing cyclones and shallow coastal waters. As one example of the way ahead, we introduce a two-scale approximation (TSA) for the nonlinear wave transfers, built on an understanding of the dominant manner in which waves interact with one another. We demonstrate the advantages of these methodologies in simulations of hurricanes Juan and Wilma. Thirdly, as waves grow and develop, they interact with processes in the marine boundary layer, namely sea spray and wave drag, and feedback to the driving fields that generate them. The manner in which these processes affect winds and resulting waves, depends on the storm structure and translation speed. Model intercomparisons are presented for North Atlantic cyclones.

1B-202.2 ID:2828 **11:15**

Overview of Wave Modelling Research Activities at The National Lab for Marine

and Coastal Meteorology

Garry Pearson [1], *Jamie Mclean* [1], *Hal Ritchie* [2], *Doug Mercer* [1], *Steve Miller* [1], *Serge Desjardins* [1], *Roop Lalbeharry* [2], *Syd Peel* [2]
[1] National Lab for Marine and Coastal Meteorology, Meteorological Service of Canada
[2] Recherche en Prévision Numérique, Environmment Canada
Contact: garry.pearson@ec.gc.ca

The Meteorological Service of Canada provides operational wave forecasts for both general marine users and the Department of National Defence (DND). The National Laboratory for Marine and Coastal Meteorology has the responsibility for ongoing maintenance and research & development of the WAM wave model and its associated products. A number of research activities have been ongoing and are planned to further enhance performance and improve products for clients, in direct response to their input.

This presentation will provide an overview of the current operational model suite, ongoing and planned research activities. These activities include upgrades to the WAM model version, expanded forecast domains, treatment of tropical systems, ensemble wave forecasting, data assimilation, verification, use of satellite altimetry and DND product development.

1B-202.3 ID:2704 **11:30**

The Spectral Properties of Ocean Waves Generated by Hurricane Juan

Fumin Xu , *Will Perrie*
Dr.
Contact: xfm67@sohu.com

Juan is recorded as one of the most damaging storms in the modern history of Nova Scotia, Canada. In this paper, the spectral evolution characteristics of waves generated by hurricane Juan are studied, based on the observed 1D wave spectra along Juan's track in deep open ocean waters (buoy 44137) and the 2D wave spectra in shallow coastal waters at the directional waverider (DWR) location. Valuable results are obtained for cyclone-generated wave spectral properties, in both deep and shallow waters. In deep water, as illustrated at buoy 44137, the spectral variation, spectra pattern development, spectral peak frequency, cut-off frequency coefficient and high frequency spectral tail of the wave spectra are analyzed, before, during and after the cyclone's passing. Thus, the spectral variation characteristics during the entire cyclone process are obtained. Properties of the high frequency spectral tail are discussed, using average frequency and peak frequency as the cut-off frequency parameters under different cut-off coefficient conditions, respectively. We suggest reasonable values for the cut-off frequency parameter. Cyclone-generated 2D wave spectra in shallow water (at DWR location) are investigated, shoaling effects, 2D spectral pattern variations, swell and wind waves spectral evolution. Our study shows the invalidity of presently accepted spectral formulae, in describing cyclone-generated waves.

1B-202.4 ID:2913 **11:45**

Unexpected waves in coastal environments.

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 $H \geq 2.2Hs$, where Hs is the significant wave height (typically estimated from records that are several tens of minutes long). This definition of rogue waves is solely based on the wave height. We suggest that the "unexpectedness" of large waves is also of great concern to mariners and beachcombers, and define "unexpected waves" as waves being twice as large as any of the preceding 30 waves. Our simulations suggest that, even in a Gaussian sea, unexpected waves might be as common as rogue waves occurring within a longer wave group. The return period of unexpected waves decreases if modifications of the wave shape due to phase locked second harmonics are allowed for. In particular, shallow water effects significantly increase the probability of occurrence of unexpected waves. We analyze historical Canadian wave buoy records from the Pacific and Atlantic in terms of unexpected waves, and find our simulations to be in agreement with the occurrence rates of unexpected waves obtained from these records. This agreement suggests that extreme waves in the ocean occur largely due to linear superposition.

1B-202.5 ID:2725 **12:00**

Hindcasting wave conditions in the Mackenzie delta using MIKE21

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Climate change is expected to cause greater ice-free open water areas for longer periods than at any time in recent history, with potential increases in storm-related processes in the Arctic Ocean. This can potentially lead to increased wave energy in the Canadian Beaufort Sea. Forecasting and hindcasting of wave conditions therefore becomes increasingly important, because storm-generated waves can impact the coast and seabed. These are major concerns for potential hydrocarbon exploration and infrastructure development in the Mackenzie Delta region of the Beaufort Sea. This study describes storm-generated wave hindcasting in Mackenzie delta using MIKE21 SW, a third generation spectral wave model based on unstructured grids. The model simulates the growth, decay and transformation of wind-generated waves and swell in shelf seas, coastal areas and lakes. Forcing fields are defined by winds, which vary in time and space, as produced by the Meteorological Service of Canada Beaufort (MSCB) wind reanalysis for the period 1985-2005. A fine resolution bathymetry is generated based on data from Canadian Hydrographic Service charts and NRCan field measurements. Measured water levels at Tuktoyaktuk are used as model input for storm surges. Moving boundaries of the ice edge during storms are incorporated. This is done by considering

that the computational grid points with greater than 50% ice act as land points with no wave generation or propagation. Four storms (1985, 1987, 1991 and 2004) are simulated to evaluate the sensitivity of model physics and to account for the most important local effects in predicting nearshore waves in the study area. The study shows that the wave model predictions in shallow water are in good agreement with measured wave parameters when bottom friction and triad interactions are disregarded in model simulations. This might be due to the fact that the parameterizations used in the model have been tuned to environments which are very different from the shallow muddy bottom of the Mackenzie delta region.

1B-202.6 ID:2793 **12:15**

Addition of a module of wave attenuation by ice to the Canadian Wave Model. Presentation and case studies.

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The new module added to the Canadian Wave Model will enable the model to better simulate wave attenuation in an ice field. It is based on an empirical relationship between the eddy viscosity and some of the characteristics of the ice and the waves. To obtain this relationship, over 40 field experiments were reanalysed in terms of ice thickness and concentration as well as significant wave height and peak period. With this empirical eddy viscosity an attenuation coefficient can be calculated using Weber's theory. Three case studies with fairly different ice and wave characteritics were done over the Gulf of St. Lawrence using the operational and the modified version of the Canadian wave model. The new version compares favorably especially when high seas enter the ice field.

Physical-Biological Interactions in the Ocean (PART 1) / Interactions physiques et biologiques dans l'océan (Partie 1)

Room / Endroit (203), Chair / Président (Katja Fennel), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-203.1 ID:2802 **INVITED/INVITÉ** **11:00**

The response of euphausiids to localized turbulence at a sill in a fjord

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Zooplankton employ a variety of behaviours in response to hydromechanical, visual and chemical signals, presumably to avoid predation or to find food. They also form aggregations, to be social, in an attempt to avoid predation, due to physical convergence of currents and where currents intersect a sloping bottom (such as continental shelf breaks). In the latter case the animals strive to maintain their preferred light depth as currents are swept upwards by bathymetry. In this study, we observe Euphausia pacifica (a broadly distributed North Pacific species) in a strong cross-isobath flow at a sill in Knight Inlet, a fjord in British Columbia. These animals form strong aggregations where the current intersects the sill. These aggretions are expected at the animal's preferred light depth, however they are found consistently 10--20 m below that depth. The flow is driven primarily by the tides and velocity shear in the bottom boundary layer (bbl) is strong and predictable. We have developed a physical model in which we embed individual zooplankters to test a variety of responses to the turbulence in the bbl. We find that these animals must choose to swim downwards, below their preferred light level, to reproduce the patterns in the data. Both acoustic data and model results are presented and potential reasons for, and implications of, this downward swimming behaviour are discussed.

1B-203.2 ID:2805 11:30

Sustainability of scallop populations on Georges Bank: implications of spawning seasonality

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Sea scallops (*Placopecten magellanicus*) on Georges Bank are important both ecologically and as commercial fisheries. The population is comprised of 3 distinct scallop beds, which are connected via transport of planktonic larvae spawned in the spring and fall. In order to develop sustainable management strategies and predict effects of climate change on the population, we need to quantify how the different beds and spawning times contribute to larval recruitment.

Here, we calculate larval drift and retention using a 3D particle-tracking model, which couples seasonal currents, larval swimming, turbulent dispersion and larval development. Bed connectivity is quantified, and patterns of larval exchange are shown to differ for each season. Sensitivity to variation in adult distribution, temperature-dependent growth, spawning rates and mortality is assessed. Factors controlling long-term success of the scallop population are analyzed using a modified Markov-chain approach. Implications for management of this population in the context of climate change are discussed.

1B-203.3 ID:2729 11:45

Changes in the North Atlantic Oscillation influence CO2 uptake in the North Atlantic over the past two decades

Helmuth Thomas [1], *A. E. Friederike Prowe* [1], *Ivan D. Lima* [2], *Scott C. Doney* [2], *Rik Wanninkhof* [3], *Richard J. Greatbatch* [4], *Ute Schuster* [5], *Antoine Corbière* [6]
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Observational studies report a surprisingly rapid decline of the CO2 uptake in the temperate North Atlantic Ocean during the last decade. We analyze these changes using numerical model simulations for the period 1979-2004, with interannually varying atmospheric forcing. The reorganization in oceancirculation is a major driver of these CO2 system changes. North Atlantic Oscillation (NAO) climate patterns are overlain by transient events such as the Great Salinity Anomaly. Our analysis indicates that the recent rapid shifts in CO2 flux are decadal perturbations superimposed on the secular trends and highlights the need for long-term ocean carbon observations and modeling to fully resolve interannual variability, which can obscure detection of the long-term changes associated with anthropogenic CO2 uptake and climate change.

1B-203.4 ID:2666 12:00

A Coupled Biophysical Sea Lice Model for the Broughton Archipelago

Dario Stucchi , *Michael Foreman* , *Ming Guo* , *Piotr Czajko*
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Recent research on the interactions between sea lice and wild and farmed salmon in the Broughton Archipelago of British Columbia has underlined the need to better understand the role that physical oceanography plays in the development, behaviour and movement of these lice. In this talk we will describe a model that simulates both the dispersion of lice eggs originating on salmon farms and their development through the nauplii and copepodid life stages. This biological model is coupled to a finite volume circulation model that in turn provides the three-dimensional salinity, temperature and velocity fields that control movement and growth/mortality. A three week simulation for March 2008 will be evaluated against available observations and the utility of these coupled models in helping to design a coordinated aquaculture management plan in 2009 will be briefly discussed.

1B-203.5 ID:3022 12:15

3-D physical-biological coupled model to assess water-column impacts of bivalve aquaculture in a mussel farm in Ship Harbour, Nova Scotia

Diego A. Ibarra , *Katja Fennel* , *John J. Cullen*
(Presented by *Diego Ibarra*)

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Advances in 3-D ocean modeling, coupled ecosystem modeling, and bio-optical instrumentation, present the opportunity to examine the influence of bivalve aquaculture on pelagic dynamics. We designed a study to examine the water-column impacts of mussel farming in Ship Harbour (Nova Scotia, Canada). We coupled an ecosystem model, containing a sessile filter-feeder sub-model, to the Regional Ocean Modeling System (ROMS). For model tuning and ground-truthing, we used data from transects conducted at each tidal cycle over 4 days and nights using a variety of bio-optical instruments as well as water samples. We used our model to quantify the effect of mussels on water-column variables by estimating the difference between model simulations with and without mussels. The resulting 3-D maps of mussel-associated impacts showed a time-averaged decrease in phytoplankton and small detritus (up to 45 and 15%, respectively), and an increase in large detritus, ammonia and nitrate (up to 14, 3 and 2%, respectively). In this work, we demonstrate the applicability of 3-D coupled models for aquaculture management. However, we also emphasize the need for continuous records of at least two independent estimates of phytoplankton to tune and ground-truth models, and ultimately, to understand the impact of bivalve aquaculture on pelagic ecosystems.

Remote Sensing of the Atmosphere and Ocean (PART 1) / Télédétection de l'atmosphère et de l'océan (Partie 1)

Room / Endroit (204), Chair / Président (Thomas Duck), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-204.1 ID:3074 INVITED/INVITÉ 11:00

Remote Sensing of Aerosols from the Mideast to the High-Arctic: An Overview of Techniques and Recent Results

Norm O'Neill [1], *Auromeet Saha* [1], *Madhavi Latha* [1], *Alex Lupu* [2], *Konstatin Baibakov* [1], *Ihab Abboud* [3], *Bruce Mcarthur* [3], *Jim Freemantle* [1], *Glen Lesins* [4]
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Aerosols are an important source of pollution and a key influence on climate change in terms of their direct radiative forcing impact and their indirect effects on clouds. The plethora of ground-based, airborne and satellite sensors dedicated to aerosol remote sensing represents an information revolution which affords new perspectives on local,

regional and world-wide aerosol dynamics. An overview of different sensors and techniques will be presented along with a demonstration of the synergism of aerosol remote sensing information for specific events.

1B-204.2 ID:3044 11:15

Aerosol Optical Measurements acquired at Arctic and sub-Arctic sites during the springtime ARCTAS campaign

Auromeet Saha [1], *Norm O'Neill* [1], *Alex Lupu* [2], *Robert Stone* [3], *Ihab Abboud* [4], *L. J. Bruce Mcarthur* [4], *Jim Freemantle* [1], *Ed Eloranta* [5], *R. Bradley Pierce* [6], *Konstantin Baibakov* [1], *Glen Lesins* [7], *Brent Holben* [8]
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The ARCTAS (Arctic Research of the Composition of the Troposphere from Aircraft and Satellites) campaign during the spring of 2008 provided a unique opportunity to compare and interpret a variety of airborne, groundbased and satellite aerosol measurments. In this communication we present an Arctic-wide interpretation of sunphotometry measurements acquired at a variety of Arctic and sub-Arctic sites and their link with available lidar, satellite data and airborne data. The presentation will focus on sites in Barrow, Alaska (NOAA Earth System Research Laboratory), the PEARL (Polar Environment Atmospheric Research Laboratory) Arctic observatory in Eureka, Nunavut (Canada), Spitzbergen (Ny Alesund and Hornsund) and subArctic AEROCAN / AERONET sites in Resolute Bay, Nunavut, Yellowknife, Northwest Territories (Canada), and Iquluit, Nunavut. Emphasis will be placed on the synchronicity and propagation of extensive and intensive aerosol properties.

1B-204.3 ID:2777 11:30

Lidar Measurements of Gravity Waves in the Arctic Middle Atmosphere

Emily Mccullough [1], *Robert Sica* [1], *K. B. Strawbridge* [2], *J. R. Drummond* [3]
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Stratospheric and mesospheric gravity wave spectra are derived from temperature measurements made in February and March 2009 with the CANDAC (Canadian Network for the Detection of Atmospheric Change) -Environment Canada DIAL lidar in Eureka, Canada (80°N, 86°W). Gravity waves over Eureka have previously been studied using nightly averages. The gravity wave spectrum is highly influenced by the polar vortex and

appears continuous at this time resolution (Duck et al 2001). At higher time resolution (minutes), the Purple Crow Lidar shows gravity wave spectra above London, ON (43°N, 81°W) to contain on the order of four distinct waves on any given night, with the majority of the kinetic energy being carried by one or two dominant waves. Nightly averages of the same measurements yield continuous m^{-3} spectra. The Eureka measurements will be analyzed to determine whether a similar spectral form to the mid-latitude measurements exists.

1B-204.4 ID:3045 **11:45**

Atmospheric Gravity Waves in the Arctic Mesosphere Detected by the PEARL All Sky Airglow Imager

Dragan Veselinovic [1], *William Ward* [1], *Trond Trondsen* [2], *Stephen Brown* [3], *Alan Manson* [4], *Chris Meek* [4]
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A new airglow all sky imager (ASI) was installed as a part of the Waves and Coupling Theme at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut, Canada (80N, 86W) in August, 2007. PEARL is operated by the Canadian Network for the Detection of Atmospheric Change (CANDAC) and houses over twenty atmospheric research instruments. The emissions viewed by the ASI include the oxygen green and red lines, hydroxyl in the near-IR, the sodium doublet, and the N2 first negative group (0,1) band. This instrument is being used to identify gravity wave signatures in the Arctic polar region, monitor longer period variability in the airglow, and to provide contextual information for other airglow instruments operating at the station. Work associated with this paper includes the analysis of two gravity wave events observed during the winter of 2007/2008. Both events were of short horizontal wavelength waves (16 and 8 km, respectively). The observed characteristics of both waves were consistent with the dynamical context at the time of the measurements.

1B-204.5 ID:3051 **12:00**

Initial Results from the E-Region Wind Interferometer, ERWIN-2, at PEARL

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The revised E-region wind interferometer, ERWIN-2 was installed at Eureka, Nunavut at the Polar Environment Atmospheric Research Laboratory in early February, 2008. It is a field widened Michelson interferometer which measures winds in the E-region (~ 90 km altitude) using Doppler shifts in hydroxyl, oxygen green line and O2 airglow emssions. In its new implementation it uses a CCD detector and an optical system which allows

simultaneous viewing in four directions and zenith. It operates by sequentially viewing these three emissions. The measurement cycle occurs in about 3 minutes and with a wind precision of ~3 m/s or better. This observation cadence makes this instrument the highest temporal resolution wind instrument in the world for this region of the atmosphere. This presentation provides details of the configuration, the observation and calibration process, the data analysis approach and some results from the first year of operation.

1B-204.6 ID:3082 **12:15**

An Overview of the Canadian Arctic Validation Campaigns for the Atmospheric Chemistry Experiment (ACE) satellite mission

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Six springtime validation campaigns have been conducted at the Polar Environment Atmospheric Research Laboratory (PEARL) 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 PEARL (formerly Environment Canada's Arctic Stratospheric Ozone (AStrO) Observatory) in Eureka, Nunavut (80 N, 86 W) during spring (February - April in 2004 - 2009). This period coincides 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 - 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. Since 2007, a Bruker 125HR Fourier transform spectrometer and a second UV-visible grating spectrometer have also participated in the campaign. Also, balloon-borne ozonesonde and radiosonde sensors were flown frequently during the five campaigns.

This presentation will provide an overview of the campaign measurements throughout the six years. Comparisons of ozone and other constituent measurements made by the ground-based, balloon-borne and satellite-borne instruments will be presented. Examples will be given to show how the measurements from the first five years have been used for validation and scientific studies.

Weather and Social Science (PART 1) / La météo et la science sociale (Partie 1)

Room / Endroit (205), Chair / Président (Rebecca J. Wagner Hochban), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-205.1 ID:3108 INVITED/INVITÉ 11:00

WAS*IS: Integrating Meteorology and Social Science

Julie Demuth [1], *Rebecca Morss* [1], *Jeffrey Lazo* [2]
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There is growing international and national recognition of the importance of acknowledging and incorporating the problems, objectives, and values of users—those affected by and responsible for managing weather related impacts—in the research, development, and operation of meteorological services. Traditional research, development and service models, driven by individual physical disciplines and independent organizational silos, are incapable of addressing those needs. That may be the primary reason why meteorological information is grossly underutilized for the benefit of society. The next leap forward, however, demands investment in the procurement of a new type of expertise—one that can bridge between social and physical sciences, academic and applied approaches, and from research through service to end user. The WAS*IS program offers an exciting opportunity to accelerate this process.

1B-205.2 ID:2684 11:30

Pausing for Learning or "Lessons Learned" from Rocket Scientists

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Shortly after the Columbia tragedy, the National Aeronautics and Space Administration (NASA) worked extensively on developing a process for learning from critical events regardless of the outcome. The "lessons learned" or "pause and learn" approach is an analytical process with over 25 years of theoretical foundation, now common in program evaluation and knowledge management. It captures and evaluates the chain linking the events, the activities, the intended outcomes and what really happened (good or bad). It is an "organizational learning" process that provides feedback, factual and evidence based answers to difficult questions. This presentation explores the Lessons Learned Process (LLP) and methodology, its potential pitfalls and how it can be adapted for the study of hazardous weather events.

1B-205.3 ID:3071 11:45

High Impact Weather Impacts Studies: Helping to Identify the Risks and Develop Adaptation Strategies to Minimize these Risks

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Extreme weather events in Canada such as Ice Storm ’98, Hurricane Juan 2003, the 2004 Peterborough, Ontario flood event and the B.C. windstorms in 2006/2007 have costly social and economic impact on Canadians. Under a changing climate, scientists project that there will be an increase in weather extremes and climate events. Increasing our understanding of society’s risks to extreme weather and developing strategies to reduce these risks will become increasingly important.

Atmospheric hazards and impacts studies that have been undertaken within Environment Canada’s Adaptation and Impacts Research Division are aimed at enhancing our understanding of how weather, climate variability and climate change impact on society. The research results are then used to promote the development of adaptation strategies that will reduce these risks. Such strategies include proactive disaster risk management actions, such as identifying atmospheric hazard risk information that is needed in the development of improved weather warning, emergency and disaster response systems. Identifying potential critical infrastructure or “impacts” thresholds provides information that can be used, for example, in developing tiered meteorological warning or vigilance systems. Research results are also aimed at creating proactive adaptation strategies, including updating climatic information for design of critical infrastructure, helping to reduce the risk of widespread infrastructure failure and disaster risks when extreme weather conditions do occur.

The presentation will explore the “lessons learned" from Ontario case studies of extreme rainfall, ice, wind and snow storm events in recent years. The development of the Canadian Atmospheric Hazards Network, identification of critical infrastructure failure thresholds for infrastructure design, information for water management planning and implications of the research findings for meteorological weather warning programs and thresholds will also be discussed.

1B-205.4 ID:2685 12:00

Vigilance Map pilot project: implementation at the Meteorological Service of Canada of a tool to integrate information and to communicate weather associated risks

Olivier Gagnon
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The Meteorological Service of Canada provides weather information and warnings to help protect the safety and security of Canadians and their property. In order to be relevant and useful for decision making, MSC’s observations and predictions of the physical states of the environment must be as accurate as possible and warning delays must be sufficient.

To reach a full protection potential, forecasts must also be linked to their foreseeable impacts and warnings must convey understandable and usable information about weather events. The current warning format at MSC sometimes falls short to those requirements. 1- Set thresholds criteria are used for issuing warnings. Those thresholds are not connected to changing local environmental conditions, cutting the link between forecast and foreseeable impacts. 2- No risk explanation nor recommendation are provided with the warnings, reducing warning outreach.

Under the concept of a Vigilance Map, 1- a better integration of in-house and partners' information would be possible. This additional information would be used to take forecasts' context into account before issuing a warning. This would contribute to reduce the number of warnings, to nuance their risk level and to increase their relevance. 2- The new risk communication format would fill actual gaps by including description of the weather event, explanation of associated risks and behaviour advices.

With the Vigilance Map, forecasts and warnings would become more meaningful and suitable for decision making. The Vigilance map would contribue to remedy several shortages highlithed in the 2008 December Report of the Commissioner of the Environment and Sustainable Development in the management of severe weather warnings.

1B-205.5 ID:3107 **12:15**

Economic Impacts Associated with the December 15th, 2006 Wind Storm: A Draft Report

Tracey Parker [1], *Roger Macneill* [2]
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The report provides an economic valuation of the extreme wind storm that struck the Lower Mainland, British Columbia on December 15th, 2006. This weather event inflicted wide-spread property damage throughout the region, with hydro services and transportation corridors being disrupted for several days. Economic estimates of the impacts are derived by aggregating and quantifying the impacts reported within various media and other sources. The report also reviews and estimates a number of typically unreported effects based on a survey questionnaire that was forwarded to Environment Canada (EC) staff personnel who work or reside in the Lower Mainland area. The survey evaluates the individual impacts experienced by local area residents by estimating an average economic value per/household of $179.29, culminating to a total of $165.82 mill when aggregated across the number of households located within Vancouver and Abbotsford census metropolitan areas. Additional effects reported within various media and other sources total $88.40 mill. Aggregating the central value estimate of the typically unreported effects (derived from the survey) and the reported or estimated other effects (from various media and other sources) concludes an estimated economic impact

of the storm totaling $254.22 mill. Although it not possible to quantify every impact, the report itemizes sources and presents methods to inform other similar studies.

Global Atmosphere-Ocean Prediction and Predictability (PART 1) / La Prévision et la prévisibilité globale de l'atmosphère-océan (Partie 1)

Room / Endroit (301), Chair / Président (Keith R. Thompson), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-301.1 ID:2836 INVITED/INVITÉ 11:00

Impact of recent Artic ice anomalies on the North-Atlantic Summers

Magdalena Balmaseda , *Laura Ferranti* , *Franco Molteni*
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Sensitivity experiments conducted with the ECMWF seasonal forecasting system indicate that the ice anomalies of the last two summers had a significant impact on the North-Atlantic atmospheric circulation. Results show that the model response to the ice forcing is strongly dependent on the mean atmospheric circulation, which is affected by the systematic errors of the coupled model. Experiments demonstrates that the mid-latitude sea surface temperature gradients, associated with the Gulf Stream, have a large impact on the model systematic errors, and condition the response of the atmospheric model to the observed ice anomalies.

1B-301.2 ID:2925 11:30

Seasonal forecast development at CCCma: Toward the second Coupled Historical Forecasting Project (CHFP2)

William Merryfield [1], *Woo-Sung Lee* [1], *George Boer* [1], *Greg Flato* [1], *Slava Kharin* [1], *John Scinocca* [1], *Youmin Tang* [2], *Aaron Berg* [3], *Gordon Drewitt* [3]
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As part of CCCma's contribution to the Global Ocean-Atmosphere Prediction and Predictability research network, in partnership with university researchers, an effort has been underway to develop and advance the capability to make seasonal (and eventually decadal) forecasts using climate system models. As with other such efforts, the objective is to tap potential predictability arising from longer time scales in the climate system,

principally from the ocean but also from soil and possibly elsewhere. This requires (i) an appropriate model, (ii) effective strategies to initialize the components of the climate system and generate ensemble realizations, and (iii) an extensive set of retrospective forecasts to enable forecast calibration and skill assessment.

A first such effort, referred to as version 1 of the Coupled Historical Forecast Project, or CHFP1, employed an “off the shelf” model and a very simple initialization strategy under which sea surface temperatures were nudged to the observed time series prior to the start of the forecasts. The resulting forecast skills, though modest, are competitive with those of Environment Canada's current operational system (under which four atmospheric models are forced by persisted SST anomalies), and provide a baseline for assessing impacts of subsequent improvements in the coupled forecasts.

This talk describes forecast system improvements that are culminating in a second set of retrospective forecasts, CHFP2; these include improvements to the climate model components as well as ocean, atmosphere land surface and sea ice initializations. Impacts of these developments on forecast skill are discussed, as is the shape of CCCma's contribution to the international Climate-system Historical Forecast Project established by CLIVAR.

1B-301.3 ID:2915 11:45

The prospects for decadal prediction

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An international impetus has been given to the scientifically and socio-economically important study of decadal climate prediction. Collaboration among WGSIP, WGCM, PCMDI and other groups has initiated a project of coordinated, multi-model, decadal prediction studies which will be part of the next Climate Model Intercomparison Project (CMIP5) and which will contribute importantly to the IPCC AR5.

The motivations and prospects for decadal prediction are briefly reviewed under the headings: (i) the existence of “long timescale” processes, (ii) results of predictability studies, (iii) demonstrations of forecast skill, (iv) scientific interest, and (v) societal importance. CCCma's anticipated participation in this project is described.

1B-301.4 ID:3079 12:00

Impact of Ocean Initialization Strategies on Seasonal Forecast Skill

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The potential for climate predictability at seasonal and longer time-scales resides in the information provided by the initial condition, in particular the subsurface ocean. Many ocean assimilation algorithms have been developed and have contributed to the improvement of seasonal forecasts.

Here we consider several ocean initialization methods. In method (i), SST is simply nudged to the observed time series prior to the start of the forecast. Method (ii) uses an off-line variational scheme which assimilates ocean temperatures from the GODAS reanalysis into a background state provided by (i). In method (iii), salinity assimilation is implemented by using the model T-S relationship with the same assimilated temperature as in (ii). In addition, ocean background error covariances that are more sophisticated than the simple form employed in method (i)-(iii), being determined directly from the temperature variability in the model, are also considered.

Seasonal forecasts using these different ocean initialization schemes have been carried out for the 22 years from 1980 to 2001. Each consists of 12-month integrations commencing September 1 of successive years using the CCCma coupled model. In this talk, the efficacy of these methods will be discussed in terms of (1) the realism of the initial state of the surface and subsurface ocean (2) the degree to which the scheme suffers from "coupled shocks" and (3) the ensemble skill of the resulting forecasts.

1B-301.5 ID:3010 **12:15**

The role of soil moisture initialization in seasonal forecasting

Gordon Drewitt [1], *Aaron Berg* [1], *Slava Kharin* [2], *Woo-Sung Lee* [2], *George Boer* [2], *William Merryfield* [2]
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Soil moisture is an important component of the hydrological cycle and it can strongly influence the exchange of energy between the earth and atmosphere. However, accurate knowledge of the soil moisture state is very difficult to obtain due to the limited number of observation networks. This uncertainty reduces the ability to initialize seasonal climate forecasts models in a realistic manner. As part of the GOAPP (Global Ocean Atmosphere Prediction and Predictability) project, we are investigating how improved soil moisture initialization could increase seasonal forecasting skill. This presentation will discuss the generation of a high-resolution soil moisture gridded dataset using the NCEP/NCAR reanalysis data combined with the Canadian Land Surface Scheme. These soil moisture states will be used for initialization of seasonal forecasts using the Third Generation Atmospheric General Circulation Model from the Canadian Center for Climate Modelling and Analysis. Skill of these forecasts will be compared to those which are only initialized using soil moisture climatology. Regional sensitivities to soil moisture initial conditions will be discussed.

Regional Climate Modelling (PART 1) / Modélisation Régionale Climatique (Partie 1)

Room / Endroit (302), Chair / Président (Laxmi Sushama), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-302.1 ID:3011 **11:00**

Regional modeling of future Arctic climate

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Both numerical climate simulations and recent observations indicate that the polar regions will be significantly affected by anthropogenic climate change. Arctic climate from present day to 2100 is investigated through high-resolution, nested regional climate modeling using Polar MM5. A global climate model simulation for 2010 to 2100, configured with a conservative estimate of greenhouse gas emissions from the IPCC (the upper B2 family), provides the initial and boundary conditions for the regional model.

Results of January and July simulated climate show a strong warming trend in surface temperatures; large spatial variability in precipitation differences, with an increasing trend at high latitudes; and initial increases in snow cover in the first 50 years that are followed by significant decreases in extent by 2100. Meridional moisture transport and circulation patterns are also discussed, with implications for Arctic storminess.

1B-302.2 ID:2902 **11:15**

Difficulties of Arctic Climate Simulation and their Solutions Using a Regional Climate Model

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Climate simulation over the Arctic using a regional climate model (RCM) has to face difficulties caused by circumpolar vertex in summer and Icelandic Low in winter. The circumpolar vertex makes RCM's lateral boundary hard to control error growth in the center of domain; while the Icelandic Low whose strength and position are linked to planetary scale flow makes RCM simulation too sensitive to the domain size. Using Canadian Regional Climate Model (CRCM5) with different domain sizes over the Arctic, the source of model error in summer is found to be different from that in winter.

Carefully setting CRCM5 domain might improve the Arctic climate simulation for winter but has no any improvements for summer. A scheme of spectral nudging has been introduced into CRCM5. The scheme of spectral nudging imposes large-scale atmospheric states on CRCM5 above troposphere and keeps CRCM5 completely free within troposphere. With spectral nudging, CRCM5 simulates Arctic climate precisely both for summer and winter.

1B-302.3 ID:2722 11:30

Implementation of Lakes in the Regional Climate Model

Andrey Martynov , *Laxmi Sushama* , *René Laprise*
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Lakes modify air masses passing over them due to moisture, thermal and frictional differences between the lake surfaces and upwind land areas, thereby exerting important local forcings on the local climate. The great thermal inertia of the lakes also generally acts to reduce the diurnal and annual temperature ranges over and in the vicinity of the lakes. Parameterization of lakes in regional climate modelling is therefore necessary, especially for lake-rich areas like Canada, to allow important feedbacks between the atmosphere, adjacent land and the lakes, and to provide the temporal evolution of lake temperatures and ice cover. Recently two 1D lake models were coupled interactively with the Canadian RCM (CRCM) for the Great Lakes (i.e resolved lakes). Preliminary results from a decadal CRCM simulation for the Great Lakes region with and without lake models will be presented. Differences between simulations and possible ways of improving the performance of coupled model will also be discussed.

1B-302.4 ID:2820 11:45

CRCM climate and climate change sensitivity to parameter perturbation

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Regional Climate Models (RCMs) are useful tools to downscale GCM (Global Climate Model) projections, producing a high-resolution climate change signal based on physical principles. Unfortunately a new source of uncertainty is introduced in the modelling chain. The purpose of this study is to evaluate the relative importance of the RCM as a source of uncertainty. The Climate Simulation Team (CST) at Ouranos has the mandate to produce high-resolution regional climate change simulations over North America for climate impact and adaptation studies. A central element of this mandate is to focus on an estimation of the uncertainty present in the simulations provided. The CST's expertise and its database of regional climate simulations have reached a level of maturity allowing for the development of an uncertainty estimation protocol. This methodology relies on two main axes. The first part of this assessment consists in ensemble-based sensitivity studies of regional climate simulations to variations in the model's parameters. The parameters chosen are those for which very little information is available regarding the proper or optimal setting (e.g., domain size, spectral nudging intensity, etc.). The second stage of this research goes a step further, concentrating on how regional climate change projections could be affected by these same modifications in RCM parameter setup. These analyses are performed for different climate regimes. This presentation will discuss results from both stages and issues such as when and where climate sensitivity to parameter variation is –or is not– translated into climate change sensitivity. Implications for regional climate change studies will be discussed.

1B-302.5 ID:2834 **12:00**

Validation of simulated climate over North America using the Canadian Regional Climate Model (CRCM5) coupled to the Canadian Land Surface Scheme (CLASS)

Jean-Philippe Paquin [1], *Laxmi Sushama* [1], *Katja Winger* [1], *Bernard Dugas* [2]
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The Canadian Land Surface Scheme (CLASS; Verseghy 1991, Verseghy et al. 1993) has been recently coupled to the fifth version of the Canadian Regional Climate Model (CRCM5, based on GEM-LAM; Côté et al. 1998). A 30-year simulation in current climate covering North America at a horizontal resolution of 0.5 degree of this coupled system is validated. Analysis of near surface variables is presented followed by surface water and energy budget calculations. Finally, a comparison between this simulation and an earlier simulation using the previous surface scheme, ISBA (Bélair et al. 2003), is discussed.

1B-302.6 ID:2880 **12:15**

Sensitivity of land-atmosphere fluxes to the soil model configuration in the Canadian RCM

Katja Winger , *Laxmi Sushama* , *Bernard Dugas* , *René Laprise*
UQAM
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The need for a deeper soil module in climate models for simulating realistic surface/sub-surface climate has been the subject of many recent studies. The impact of a deeper land surface scheme on the land-atmosphere fluxes is still not clearly understood. This paper will present some preliminary results of the sensitivity of land-atmosphere fluxes, surface and sub-surface thermal and moisture regimes, to the depth of the soil model, assessed with the Canadian RCM (CRCM5) using deep and shallow configurations of the land surface scheme CLASS3.4 over a domain covering North America.

Operational Meteorology (PART 1) / Météorologie opérationnelle (Partie 1)

Room / Endroit (303), Chair / Président (Claude Landry), Date (01/06/2009), Time / Heure (11:00 - 12:30)

1B-303.1 ID:2670 **11:00**

VAAC Montréal Operational Response to Eruptions at Okmok and Kasatochi Volcanoes in July and August 2008

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The significant eruptions of Okmok and Kasatochi volcanoes in July and August 2008 produced large volcanic clouds prompting operational responses from all three Volcanic Ash Advisory Centres (VAAC) and associated Meteorological Watch Offices in North America. The Montreal VAAC was heavily involved in this response. In addition to issuing Volcanic Ash Advisories, Volcanic Ash Graphics (VAG) were also issued by VAAC Montreal for the first time. Atmospheric transport and dispersion modeling (ATDM) was an important tool used in the response to these events. Detection of volcanic ash (VA) in satellite imagery was initially also used to track areas of VA. For both eruptions, non-volcanic ash tracers (e.g. SO2, sulphates) were tracked over great distances, often masking any volcanic ash (VA) that might have been present. This added to the difficulty in tracking the VA, since it is difficult to know exactly how much time it resides in the atmosphere. For both eruptions, it is believed that after 2 or 3 days, little or no VA remained in the atmosphere. However, many pilots spotted unusual-looking clouds and, knowing that there had been recent volcanic eruptions, reported these as being « volcanic ash clouds ». This led to some confusion and a number of false alarms, since many of these clouds actually contained little or no VA.

1B-303.2 ID:3035 **11:15**

A new model configuration for global medium-range weather forecasts at Environment Canada: GEM Méso-Strato

Martin Charron [1], *Michel Roch* [1], *Mark Buehner* [2], *Louis Garand* [2], *Saroja Polavarapu* [2], *Josée Morneau* [3]
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In 2008, a new configuration of the global medium-range weather forecasting model has been proposed to replace the current operational system at Environment Canada. For this new system, the model lid has been raised from 10 to 0.1 hPa (around 64 km), new sub-grid scale parameterizations were introduced: a correlated-k radiation scheme, a non-orographic gravity wave scheme, a simple methane oxidation scheme, a new ozone climatology, and several other adjustments have been made. Concerning the data assimilation aspects, an improved estimate of the background error covariances has been introduced, as well as a dynamic bias correction scheme.

A description of the new system will be given, and objective verifications against the currently operational system will be presented. Significant forecast improvements are seen at the surface as well as over the whole depth of the atmosphere.

1B-303.3 ID:3033 **11:30**

Recent and future updates to operational NWP production at the Canadian Meteorological Centre

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The Canadian Meteorological Center (CMC) runs, in a fully operational production environment, the NWP models and data assimilation systems that have been developed by its Development Division along with EC's Atmospheric Research groups.

The current status of the operational forecasting suite will be reviewed. Innovations introduced in the past year include:

* Increasing the number of daily Regional GEM model runs from twice to four times daily (Made operational Q1 2009)

* Increasing the area of the high-resolution window of the RegionalGEM to cover more of the Arctic Ocean (Q1 2009)

* The addition of GPS-RO remote-sensing data to the operational data assimilation system (Q1 2009)

* A new version of the UMOS statistical weather modelling system (Q4 2008)

* An extension of the SCRIBE matrices production to days 6 and 7. (Q1 2009)

Improvements to the operational system planned for the upcoming 12 months will be presented. Planned changes include a major global model upgrade that will have a significant impact on the entire NWP production system. Further planned changes or additions to the operational production suite will also be discussed.

1B-303.4 ID:2898 **11:45**

Evaluation of day 6-7 forecasting using the ensemble prediction system / Évaluation des prévisions des jours 6-7 produites à partir du système de prévision d'ensemble

Pierre Bourgouin , *Benoit Archambault* , *Guylaine Hardy*
(Presented by *Gérard Croteau*)
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In winter 2009, the public forecast range was extended to days 6 and 7. Forecasts are based on the Canadian Ensemble Prediction System (CEPS). Public SCRIBE matrices have been produced using the CEPS (20 members + 1 control) since November 2008. A new version of SCRIBE accepts these matrices to produce day 6-7 forecasts.

This presentation will briefly explain the new system, present verification scores and describe its general behavior.

A l'hiver 2009, la portée de la prévision publique a été étendue aux jours 6 et 7. Les prévisions sont fondées sur le système de prévision d'ensemble Canadien (SPEC). Les matrices SCRIBE sont produites à l'aide du CEPS (20 membres + 1 contrôle) depuis Novembre 2008. Une nouvelle version SCRIBE accepte ces matrices pour produire les prévisions de jours 6-7.

Cette présentation expliquera brièvement le nouveau système, présentera des vérifications et en décrira le comportement général.

1B-303.5 ID:2879 **12:00**

Operational implementation at Environment Canada of GPS radio occultation observations

Josep Aparicio , *Godelieve Deblonde* , *Stephane Laroche*
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The assimilation of GPS radio occultation refractivity profiles (about 2000 profiles per day, totaling around 50000 data elements per day) in the global four dimensional variational data assimilation system was approved for transfer to MSC (Meteorological Service of Canada) operations in June 2008. We will present the properties of this new data type, its potential as an unbiased measurement, and its impact on weather forecasts during the different test phases.

Besides having a positive impact on the analysis and weather forecast system, the extremely low bias of these measurements has a particularly high value due to its role as an anchor for several radiance measurement types, whose biases until now were determined nearly exclusively with radiosonde data. Radio occultation provides a much larger and even coverage worldwide, adding many new opportunities to accurately estimate the bias of radiance data under a broad range of atmospheric conditions.

Radio occultation data can be used for verification purposes as well to examine the accuracy of model performance. To provide an overview of the quality of these data, we will particularly comment on a number of geophysical properties that at the level of accuracy of these observations become non-negligible. These properties include: the oblateness of the Earth, the shape of Earth's gravity field, and the departure of air from a perfect gas.

1B-303.6 ID:2819 **12:15**

Adapting SCRIBE to the recent National Forecast Program requirements

Claude Landry , *Gérard Croteau* , *Jean-François Deschenes* , *Louise Faust* , *Manon Lajoie* , *Jacques Marcoux* , *Jamie Mclean* , *Michel Nadeau* , *Reine Parent* , *Jean-Pierre Talbot* , *Denis Vigneux* , *Vanh Souvanlasy*
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SCRIBE is a system developed for the preparation and production of environmental forecasts, and is one of the primary tools in use by forecasters working in the Storm Prediction Centers (SPC) of the Meteorological Service of Canada (MSC). The MSC strives to continually improve the level of service provided to the Canadian population in the field of environmental prediction, and as such several changes to the National Forecast Programs were recently implemented. These and other upcoming changes have required a sustained development effort to ensure the Scribe system meets all National Program requirements.

In this presentation we will put into perspective the recent and future Scribe developments as they relate to public, marine and air quality National Programs, including how they fit into the of National Forecast Production System. We will also discuss other improvements that aim to increase the flexibility of the system and its capacity to support the work of the forecaster.

Atmosphere-Ocean Interaction & Waves (PART 2) / Interaction atmosphère-océan et les vagues (Partie 2)

Room / Endroit (202), Chair / Président (William Allan Perrie), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-202.1 ID:2887 **14:00**

Confidence estimates for surface marine wind information from synthetic aperture radar

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The future assimilation of satellite synthetic aperture radar (SAR) data will likely require estimates of our confidence in its surface information and an identification of the conditions for which model forecasts can be improved. In terms of marine wind information, the combination of Radarsat-1 and model forecast data typically produces

differences of less then 2 m/s in wind speed and about 30 degrees in wind direction, when compared to independent buoy observations. (These comparisons are somewhat better than for model forecasts alone.) Enough Radarsat-2 SAR data was collected during 2008 to permit the first independent estimate of confidence for this SAR satellite. Broad agreement is found in comparison with collocated buoy observations. Preparatory experiments to assimilate this type of marine wind information into an Environment Canada forecast system are also described.

1C-202.2 ID:2812 **14:15**

High resolution wind stress products retrieved from Radarsat-2 SAR data

Tao Xie , *Williams Perrie* , *Biao Zhang* , *Ryan Mulligan* , *Zhenxia Long* , *Lanli Guo*
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Scatterometer ocean wind stress (SOWS) is extensively used in considering wind forces in studies of global marine forecasting. However, we need higher resolution for ocean wind stress products when studying sea surface features, for example in the SOIN project. In this paper, we present a method to retrieve high resolution wind stress products. Firstly, one should get the wind directions for the target area from Quikscat wind products, which must be co-located with Radarsat 2 Synthetic Aperture Radar (SAR) data. Secondly, the SAR image is divided into sub-images, each with the same size. The next step is to interpolate Quikscat wind directions to the sub-images of the SAR image data. Fourthly: wind speed vectors of the sub-images at 10 m reference level above sea surface are retrieved using CMOD5. Using the algorithm of Liu and Tang (1996, J. Geophsyics Res.) and Xu and Scott (2008, Ocean Modelling), one can derive the 10 m neutral wind fields.Using the neutral wind fields, one can calculate the wind stress.

1C-202.3 ID:2813 **14:30**

Measurement of ocean wave spectra using RADARSAT-2 fully polarimetric SAR image data

Biao Zhang [1], *William Perrie* [1], *Yijun He* [2], *Tao Xie* [1], *Zhenxia Long* [1]
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We investigate the feasibility of using RADARSAT-2 fully polarimetric synthetic aperture radar (POLSAR) image data to measure ocean wave slopes and wave spectra. In the azimuth direction, the backscatter cross-section difference between vertical polarization and linear polarization is used to estimate wave slopes. In the range direction, we use the backscatter cross section difference between horizontal polarization and vertical polarization to calculate wave slopes. In the Fourier-transform domain, this orthogonal wave slopes information can be used to estimate a complete directional ocean wave slope spectrum. The advantage of using POLSAR-based algorithm is that a nearly direct measurement of wave slopes is made. The POLSAR measurement does not need to

calculate a hydrodynamic modulation transfer function. This function is not well known and is based on hydrodynamic assumptions. The results estimated from C-band RADARSAT-2 fully polarimetric SAR data show that the ocean wavelength, wave direction, and significant wave height are in agreement with in situ NOAA National Data Center buoy measurement products.

1C-202.4 ID:2823 **14:45**

Identifying SAR features as Signatures of the Gulf Stream

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A primary objective of the Spaceborne Ocean Intelligence Network (SOIN) project is to identify features in RADARSAT images that are due to temperature fronts associated with the Gulf Stream. When SST data is available a direct comparison can be made and SAR features associated with temperature fronts can be readily identified. This however is a rare occurrence as cloud cover is ubiquitous in the region of the Gulf Stream. We therefore aim to identify SAR features associated with temperature fronts without reference to SST data.

Model-assimilated data (HYCOM) is used to identify the location of persistent frontal features associated with the Gulf Stream. An empirical probability distribution(PDF) is constructed for each frontal feature. These PDFs tell us where to look for SAR features associated with the Gulf Stream. The probability that a SAR feature located in a region determined by a frontal PDF is a Gulf Stream signature can be estimated using SAR/SST image pairs. With sufficient data, properties of a SAR feature in addition to location, such as the size and shape of the feature, may be introduced into the probability model.

1C-202.5 ID:2755 **15:00**

Nearshore dynamics of the Mackenzie River plume in summer

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The Mackenzie Delta is a 150 km long section of shallow coastline characterized by muddy sediments where the Mackenzie River outflow is dispersed by many distributary channels. The goal of the present study is to understand the dynamics of the river plume as the flow enters into the nearshore region of the Mackenzie Delta in the southern Beaufort Sea of the Arctic Ocean. The oceanographic conditions during a typical summer period in August 2007 are examined, with a large thermal gradient between river and shelf water and predominantly upwelling-favourable easterly winds. Field observations made 10-25 km from the coastline in shallow water of 2-6 m depth are presented, and show major changes in sea bottom temperature, locally up to 12°C depending on riverine and coastal water interactions. Ship-based CTD observations are used to quantify stratification on the shelf, and sea surface temperatures from satellite observations indicate plume frontal movement and mixing that is strongly correlated with wind. A 3D numerical model is used to examine the dominant forces acting on the plume, with forcing from wind, river flows, tide and surge, and coriolis. Although the river plume can extend over 200 km offshore, it is a very thin 2 m surface layer, and it is significantly affected by wind. The results suggest that easterly winds of 5-10 m/s are sufficient to induce offshore transport of the plume and onshore transport shelf water, leading to separation of the plume from the coast and mixing that can cool the sea surface by 5-10 ºC over a timescale of about a day. The mainly wind-driven density front advection and mixing leads to large fluctuations in water mass properties in the nearshore delta region.

Physical-Biological Interactions in the Ocean (PART 2) / Interactions physiques et biologiques dans l'océan (Partie 2)

Room / Endroit (203), Chair / Président (Tetjana Ross), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-203.1 ID:2928 **14:00**

Plankton biology and the ocean carbon cycle: interactions of mixing and population dynamics

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Models of plankton population dynamics have varying degrees of realism and a range of possible states. Some admit oscillatory solutions and others do not. Numerical ocean biogeochemical models increasingly have explicit ecosystem dynamics and are increasing in spatial resolution. Reducing the amount of numerical smoothing (parameterized horizontal stirring or mixing) associated with coarse resolution may permit ecosystem states to emerge that are not possible in the strongly smoothed or diffusive case. These emergent properties can have surprising effects on the models' predictive skill with respect to critical geochemical quantities like total carbon concentration or surface ocean carbon dioxide concentration.

1C-203.2 ID:2784 **14:15**

Nitrogen and carbon cycling on the North American east coast continental shelf

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Continental shelves are important players in the global cycling of carbon and nitrogen, partly because shelves are biologically productive systems that receive significant nutrient inputs from the open ocean and from terrestrial sources. It has also been suggested that a significant uptake of atmospheric carbon dioxide occurs on shelves. Both the potential for carbon export from shelves and nutrient input from the deep ocean depend directly on the magnitude of shelf edge exchange. We present results from a coupled physical-chemical-biological model for the North American east coast and the adjacent deep ocean that permits resolution of mesoscale shelf edge exchange processes. The model is based on the Regional Ocean Modeling System (ROMS) and includes a biological model of pelagic and benthic nitrogen and carbon cycling, and parameterizations describing the dynamics of inorganic carbon and dissolved oxygen including air-sea gas exchange. Model results suggest that the east coast continental shelves act as significant sinks of fixed nitrogen, but not as disproportionate sinks for atmospheric carbon dioxide when compared to the deep ocean.

1C-203.3 ID:2730 14:30

Enhanced ocean carbon storage from anaerobic alkalinity generation in coastal sediments

Helmuth Thomas [1], *Laure-Sophie Schiettecatte* [2], *Kim Suykens* [2], *Y. J. Mathieu Koné* [2], *Elizabeth H. Shadwick* [1], *A. E. Friederike Prowe* [1], *Yann Bozec* [3], *Hein J. W. De Baar* [4], *Alberto V. Borges* [2]
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The coastal ocean is a crucial link between land, the open ocean and the atmosphere. The shallowness of the water column permits close interactions between the sedimentary, aquatic and atmospheric compartments, which otherwise are decoupled at long time scales (>1000 yr) in the open oceans. Despite the prominent role of the coastal oceans in absorbing atmospheric CO2 and transferring it into the deep oceans via the continental shelf pump, the underlying mechanisms remain only partly understood. Evaluating observations from the North Sea, a NW European shelf sea, we provide evidence that anaerobic degradation of organic matter, fuelled from land and ocean, generates total alkalinity (AT) and increases the CO2 buffer capacity of seawater. At both the basin wide and annual scales anaerobic AT generation in the North Sea's tidal mud flat area irreversibly facilitates 7-10%, or taking into consideration benthic denitrification in the North Sea, 20-25% of the North Sea's overall CO2 uptake. At the global scale, anaerobic AT generation could be accountable for as much as 60% of the uptake of CO2 in shelf and marginal seas, making this process, the anaerobic pump, a key player in the biological carbon pump. Under future high CO2 conditions oceanic CO2 storage via the anaerobic pump may even gain further relevance because of stimulated ocean productivity.

1C-203.4 ID:2740 **14:45**

Seasonal variability of dissolved inorganic carbon and surface water pCO2 in the Scotian Shelf region of the Northwestern Atlantic

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The seasonal variability of inorganic carbon in the surface waters of the Scotian Shelf region of the Canadian northwestern Atlantic Ocean is investigated. Seasonal variability is assessed using hourly measurements covering a full annual cycle of the partial pressure of CO2, (pCO2), and hydrographic variables obtained by an autonomous moored instrument. These measurements are complimented by frequent shipboard sampling of dissolved inorganic carbon (DIC), total alkalinity (TA), and pCO2, at the mooring site, and over the larger spatial scale. Biological processes, and advection are found to be the main factors controlling DIC in the surface waters and mixed layer, while the competing effects of temperature and biology influence surface pCO2 in roughly equal magnitude. Annual mixed layer net community production (NCP) and the air-sea fluxes of CO2 are estimated; the region acts as a moderate net source of CO2 to the atmosphere on the annual scale, with a reversal of this process occurring only during the spring bloom, when a rapid undersaturation of the surface waters is reached for a short period.

1C-203.5 ID:3085 **15:00**

Oceanographic situation of the water column vertical profiler: Neptune Canada

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In August 2009, a water column profiler will be installed on the upper slope off the West Coast of Vancouver Island. It is planned that there will be 4-6 daily profiles of temperature, salinity, chlorophyll fluorescence, CDOM fluorescence, upward and downward irradiance, light transmission, zooplankton backscatter, currents to the surface, CO2, O2 and NO3. All data will be available on the web in near real time. The profiler is located on the upper slope half-way between two submarine canyons. Due to seasonal variations in the wind direction this region experiences summer upwelling, winter downwelling and a seasonal shift in the near surface currents. The shelf experiences a classic spring bloom followed by high primary productivity throughout the summer made possible by the upwelling. To put the future data from the profiler in context, in this presentation we will describe the regional oceanography around the profiler and what types of physical, chemical and biological processes are occurring and should be captured in the profiler observations.

1C-203.6 ID:2916 **15:15**

Geographical aspects of carbon feedbacks in the climate system

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More or less standard linear feedback analysis may be applied to the global average climate system where the input is the radiative forcing and the output the temperature change. The result is codified as the "climate sensitivity" and is a critical climate change parameter. The climate sensitivity/feedback results may be extended to the geographical patterns of temperature change which are largely determined by local feedbacks rather than by the pattern of the forcing (Boer and Yu, 2003).

The global average carbon budget may be treated in a parallel manner giving carbon-temperature and carbon-concentration feedbacks (Boer and Arora, 2008). Carbon-temperature feedback is positive and reasonably linear while carbon-concentration feedback is negative, weakens as CO2 concentration increases and, moreover, is a function of climate state. The nature of both feedbacks indicate that the terrestrial and oceanic systems are less able to compensate for emissions as time progresses.

Carbon feedback mechanisms display regional features just as climate (i.e. energy) feedback mechanisms do and these are also investigated in simulations with the CCCma earth system model CanESM1.

Remote Sensing of the Atmosphere and Ocean (PART 2) / Télédétection de l'atmosphère et de l'océan (Partie 2)

Room / Endroit (204), Chair / Président (Norman O'Neill and Rong-Ming Hu), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-204.1 ID:2953 **14:00**

PCW: Polar communication and weather satellite: Air quality, weather and climate instruments and goals

John Mcconnell [1], *Louis Garand* [2], *Williiam Liu* [3], *Andrew Yau* [4], *Et Al.* [5]
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The Arctic is a region of rapid climate change with warming temperatures and depleting summer ice which may be exacerbated by transport of soot and other anthropogenic material from midlatitudes. It is also the source of winter storms delivering cold air to lower latitudes. Currently data is available for these areas from polar orbiting satellites, but only intermittently at a given location as the satellites pass overhead. Data from geostationary satellites, useful at lower latitudes, is not available for the Arctic because viewing angles to high latitude locations from geostationary orbit are poor. The PCW satellite (Polar Communications and Weather) in a Molniya orbit has been proposed for acquisition of data for high latitudes. This is a quasi-stationary orbit close to apogee. Molniya (lightning) orbits. With a period of 12 hours typical orbits have an apogee altitude of about 39750 km and a perigee altitude of about 600 km. Because the satellite is travelling slowly at apogee, the viewing geometry is maintained for approximately 2/3 of the orbit (8 hr out of every 12). There was a workshop at York University on the 30th January, 2009 to discuss possible science instruments for this satellite. We will report on the meeting focusing on the potential air quality, climate and weather science that could be done using the imaging mid-IR FTS and UV-Vis-NIR instruments working in concert with a Modis Type instrument. The contributions from an auroral imager and some particle and fields instruments were also discussed at the workshop. We will also discuss the auroral imager's possible contributions to stratospheric and mesospheric science.

1C-204.2 ID:2976 **14:15**

Investigating the Variability of Ozone and Related Constituent Distributions in the Arctic using ACE-FTS

Jeffrey Taylor [1], *Kaley Walker* [1], *Jianjun Jin* [2], *Chris Boone* [3], *Peter Bernath* [4], *Gloria Manney* [5]
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The Atmospheric Chemistry Experiment (ACE) is a Canadian scientific satellite mission on-board the SCISAT platform. It was launched in August 2003 and has recently completed five years of measurements. The primary instrument for the ACE mission is a high-resolution (0.02 cm-1) infrared Fourier Transform Spectrometer (ACE-FTS) with a spectral range of 750–4400 cm-1. This instrument makes solar-occultation measurements of over 30 different atmospheric trace gases providing well-resolved vertical profiles from the upper troposphere to the lower thermosphere (under cloud-free conditions). The work shown here will highlight the development and results of an Arctic trace-gas climatology, based on the first four years of ACE-FTS observations. Specifically, this study uses derived meteorological products to map the observations into equivalent latitude space and investigate the variability of O3, HCl, ClONO2, HNO3, H2O, and ClO. By comparing this climatology with other satellite observations and measurements made at the Network for the Detection of Atmospheric Composition Change (NDACC) primary site in Eureka, Nunavut (80.05°N, 86.42°W), changes occurring in the concentrations of these Arctic species can be investigated.

1C-204.3 ID:2991 **14:30**

Simulations of the Martian airglow and the recovery of temperature profiles from limb airglow observations.

Stephanie Conway , *Ian Mcdade*
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Although Mars is our neighbour, the distance between our planets is not easily overcome. This is why the observation of Mars is done remotely. This in itself limits the amount and types of observations possible. Which is why it is imperative that new techniques to retrieve more and new types of information from the possible observational data.

In this work global least square fitting is used to retrieve temperature profiles and Hydroxyl volume emission rate profiles of the Martian atmosphere from simulated nocturnal airglow measurements. The Hydroxyl emission profile is of particular interest because it can be used to calculate Oxygen profiles. Data is simulated for a limb viewing instrument and the products are determined by minimizing the difference between the model results and the simulated data. The Hydroxyl volume emission rates are retrieved, or using theoretical volume emission rates the temperature profile of the atmosphere can be recovered. Work is now in progress to recover both these parameters simultaneously. The results of this investigation will advance the application of remote sensing of planetary atmospheres.

1C-204.4 ID:2895 **14:45**

Assimilation of ASCAT Scatterometer Winds in the MSC Analysis System

Mateusz Reszka [1], *Stéphane Laroche* [2], *Robert Tardif* [2], *Judy St-James* [1]
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[2] Meteorological Research Division, Environment Canada
Contact:

The Advanced Scatterometer (ASCAT) is an instrument operating at 5.255 GHz (C-band) on-board the EUMETSAT Meteorological Operational (MetOp) polar satellite and provides, among other products, retrievals of wind speed and direction over water at 10-meter height. The impact of these observations is examined in preparation for implementation in the MSC operational data assimilation systems. The addition of new wind observations in forecast systems is of primary importance due to the relative scarcity of wind information currently available to NWP centers and the dynamical significance of the streamfunction in the tropics. The ASCAT wind product is both similar and complementary to QuikSCAT wind retrievals, which are already assimilated operationally at MSC and are known to improve the quality of analyses over the oceans. Assimilation experiments with and without assimilation of ASCAT data were performed using the operational global forecast system for a one-month period in March 2008. It is shown that introduction of the ASCAT scatterometer measurements leads to a small but significant improvement in short-range forecasts, especially in the tropics. There is virtually no impact in the Northern Hemisphere, while results in the Southern Hemisphere are somewhat mixed. Although the new observations are available only at the 10-meter height, their influence is transmitted vertically throughout the atmosphere by correlations and the multi-variate formulation of the assimilation scheme, however the details of these mechanisms are still under investigation. Verifications for medium-range forecasts based on analyses obtained from both experiments also demonstrate a small but positive overall impact of the ASCAT data set. Issues related to the accuracy of the ASCAT scatterometer product itself are discussed briefly. Finally, potential avenues are suggested for improvements in the methodology of assimilating scatterometer winds in the future.

1C-204.5 ID:3030 **15:00**

Assessment of the impact of observations in data assimilation based on information content and adjoint-based approaches

Pierre Gauthier , *Cristina Lupu*
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In this presentation, a summary of the discussions and conclusions of the THORPEX Data Assimilation and Observing Systems working group will be presented. From recent studies, the added value of targeted data deployed during observation campaigns is seen as positive but small and this may not be enough to justify expensive observation campaigns. Progress needs to be made to better understand and measure the impact of observations. Observing Systems Experiments (OSEs) are commonly used to assess the impact of observations within existing operational models and the intercomparison of the results between different centres is useful to make some statements about the global observing system. However, OSEs do not quite measure the impact of observations in the actual context in which they are assimilated. Furthermore, the diagnostics used can only give a bulk measure of the impact of observations. In this presentation, results will be presented in which information content and adjoint based methods are used to measure the impact of observations on forecasts. Sensitivities of analyses and forecasts with respect to observations in fact complement OSEs and make it possible to obtain more detailed diagnostics about the impact of observations.

1C-204.6 ID:2716 **15:15**

A new era of remote sensing for Canada: the Polar Communication and Weather Mission

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The Polar Communication and Weather mission (PCW) aims at observing continuously the entire circumpolar region north of 50 N from two satellites in highly elliptical orbits

(12-h period, apogee ~39,500 km, 63.4 degree inclination). Currently in Phase A, the two launches are planned for 2016. The main meteorological payload is an advanced imager with 20 channels covering the spectral range 0.45-14.3 micron at pixel resolution varying from 500 m to 2 km and a refresh time of 15 minutes. The mission also serves the need for seamless communications in the Arctic. Additional payloads considered include a broadband radiometer, a Fourier Transform spectrometer, space weather instruments and an aurora imager. While similar orbits were used in the past for communications, this concept has never been applied for Earth observation. With this mission, for the first time, Canada would become a provider of satellite imagery and derived products in near real time. The main applications are related to numerical weather prediction, climate and environmental monitoring.

Weather and Social Science (PART 2) / La météo et la science sociale (Partie 2)

Room / Endroit (205), Chair / Président (Rebecca J. Wagner Hochban), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-205.1 ID:2743 **14:00**

Risky business: Encouraging a societal perspective in the design and evaluation of weather warning programs

Brian Mills
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The primary role of most National Meteorological and Hydrological Service (NMHS) agencies is the preparation and issuance of warning information to facilitate protection of life and property. Based on a review of international literature, substantive effort is placed on the development and application of verification methods to quantify the accuracy of warnings and other forms of weather forecasts. To date, however, much less effort has been placed on verifying warnings or designing, implementing and evaluating warning programs in terms of societal or economic outcomes. Examples from the Canadian transportation sector will be used to illustrate some of the benefits—and challenges—of incorporating a societal perspective as a complement to traditional evaluation approaches.

1C-205.2 ID:2817 **14:15**

Real time drought monitoring and forecasting over the Canadian Prairies using the Variable Infiltration Capacity model

Lei Wen [1], *Charles Lin* [2], *Zhiyong Wu* [3], *Guihua Lu* [3], *John Pomeroy* [4], *Yufei Zhu* [2]
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We have developed a real time drought monitoring and forecasting system for the Canadian Prairies (1,964,000 km2). The system uses the Variable Infiltration Capacity (VIC) land surface macroscale hydrology model to simulate daily soil moisture values starting from 1 January, 1950, and continually running through present into the future with a lead time of 144 hours. The simulated soil moisture values are used to calculate the Soil Moisture Anomaly Percentage Index (SMAPI) as an indicator for measuring the severity of agricultural and hydrological droughts. The VIC model is applied over a Prairies domain consisting of 4393 grid points with a resolution of 0.25 degree × 0.25 degree. It is driven by daily maximum and minimum air temperature and precipitation from 1,167 meteorological stations for monitoring runs up to the present, and by the operational Canadian GEM (Global Environmental Multiscale) model forecast for the forecasting runs. The VIC model is first calibrated and validated with daily hydrographs from 11 Prairie catchments with drainage areas ranging from 3,750 to 131,000 km2 for the period 1 January, 1975 to December 31, 2001. The calibrated VIC is then used to reconstruct Prairies' daily soil moistures for three soil layers (0-20 cm, 20-100 cm, and 0-100 cm) for the period 1 January, 1950 to 31 December, 2005. A novel feature of the simulation is the consideration of non-contributing drainage areas in the calculation of model runoff. The calculated SMAPI explains well most documented severe drought events in the Prairies over the past 56 years. We update the Prairie SMAPI fields every 24 hour with a forecast lead time up to 6 days and the result is publicly accessible. The initial result indicates that the VIC SMAPI compares favorably with the North American drought monitor over the Canadian Prairies for January 2009.

1C-205.3 ID:3065 14:30

Canadian Drought Alert and Monitoring Program (CDAMP)

Sharon Fernandez , *Don Maciver* , *Neil Comer* , *Baoling Wang* , *Joan Klaassen* , *Heather Auld*
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Drought has an assortment of complex definitions depending on different sectors and issues. In this presentation, drought is defined as precipitation deficiencies caused by persistently below-normal precipitation. Drought can be very localized and have a considerable impact on the ecosystem and agriculture of the affected region. Although droughts can persist for several years, even a short, intense drought can cause significant damage and harm the local economy. Under climate change, scientists project that more frequent and intense drought is likely. Additional stressors such as population growth and land use changes contribute to increases in the vulnerability to drought under climate change.

The Canadian Drought Alert and Monitoring Program (CDAMP) was developed by the Adaptation and Impacts Research Division of Environment Canada with assistance from China to help individuals, farms, communities and municipalities self-monitor and

evaluate their current drought status. This web-based self-analysis tool can be used for drought evaluation through the use of simple precipitation measurement and tracking. CDAMP compares the daily changes of rainfall to critical thresholds to help detect, characterize, and monitor changing atmospheric water availability. If the rainfall values are below an indicated level then a declaration of drought can be directly linked with mandated response actions, including outdoor watering restrictions and fire bans. CDAMP indicators highlight four levels of rainfall deficiency; Code Yellow, Code Orange; Code Red and Code Black, with Code Black being the most severe level of drought.

This program will help individuals farms, communities and municipalities analyze the severity of their current rainfall deficiency compared to historical records and adapt accordingly. The project assessed other drought monitoring techniques to determine their usefulness in monitoring drought related conditions and in providing guidance to potential response actions as the level of low water availability and drought severity increases. The potential use of CDAMP at the individual and community scales to assess current and projected drought risks is discussed.

1C-205.4 ID:3080 **14:45**

Predictability of Spring Wheat Yields from Climate and Remote Sensing Data on the Canadian Prairies

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A multivariate approach was used to predict spring wheat yield (Triticum aestivum L.) on the Canadian Prairies using a water stress index, vegetation index from the AVHRR sensor and the surface wetness and temperature anomalies (derived from SSM/I passive microwave sensor). The water stress index was calculated from weather station-based precipitation, minimum and maximum temperature using a soil water balance approach. The stress index was expressed as a function of water loss to evaporation. Multi-temporal remote sensing data were obtained from Advanced Very High Resolution Radiometer – AVHRR from which weekly values of the Normalized Difference Vegetation Index (NDVI) were calculated. In addition, weekly anomalies of surface wetness and temperature were calculated from SSM/I data (Special Sensor Microwave/Imager). The climate and satellite datasets were used as inputs into a non-linear regression model. The combined use of climate and remote sensing data resulted in an improved prediction of regional wheat yields (R-squared value of about 0.60 across all Prairie Provinces) than when these inputs were used separately. In the future, the yield model will be used in a predictive mode by including seasonal climate data as additional inputs.

1C-205.5 ID:3116 **INVITED/INVITÉ** **15:00**

Weather and Social Science - Moving Forward

Jacques Descurieux

(Presented by *Wagner Rebecca*)
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There is a growing recognition that social and behavioural research is essential to understanding the causes of high societal impact related disasters. Meteorologists will need to consider and integrate the outcome of this research in order to increase the effectiveness of their warning program. According to a recently published article in the AMS bulletin by Lazo et al, they state that "Pressing meteorological, technological and social issues drive the need for social science research on forecasts and warnings including changes and improvements in forecast products, changes in ways to create, manipulate and disseminate information, increased recognition of impacts as social phenomemon, increasing and increasingly diverse population and assets in harm's way, availability of new social science tools, methods, and paradigms and institutional requirements to evaluate, justify and develop guidance for programs and future practices". A panel discussion will discuss the benefits, challenges and opportunities to integrate social science research and meteorology in order to understand the nature and complexity of societal decision making in response to meteorological threats.

Global Atmosphere-Ocean Prediction and Predictability (PART 2) / La Prévision et la prévisibilité globale de l'atmosphère-océan (Partie 2)

Room / Endroit (301), Chair / Président (William J. Merryfield), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-301.1 ID:2689 **14:00**

The influence of the Madden-Julian Oscillation on Canadian wintertime surface air temperature

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Using the homogenized Canadian historical daily surface air temperature (SAT) for 210 relatively evenly distributed stations across Canada, the lagged composites and probability of the above and below normal SAT in Canada for different phases of the Madden-Julian Oscillation (MJO) in the winter season are analyzed. Significant positive SAT anomalies and high probability of above normal events in the central and eastern Canada are found 5-15 days following MJO Phase 3, which corresponds to an enhanced precipitation over the Indian Ocean and maritime continent and a reduced convective activity near the tropical central Pacific. On the other hand, a positive SAT anomaly appears over a large part of the northern and northeastern Canada about 5-15 days after the MJO is detected in Phase 7. An analysis of the evolution of the 500-hPa geopotential height and sea level pressure anomalies indicates that the Canadian SAT anomaly is a result of a Rossby wave train associated with the tropical convection anomaly of the MJO. Hence, the MJO phase provides a useful information for extended-range forecast of Canadian winter surface air temperature. This result also provides an important reference for numerical model verifications.

1C-301.2 ID:2703 **14:15**

A modelling study of the responses to MJO wind forcing in the tropical Pacific Ocean

Xu Zhang [1], *Youyu Lu* [2], *Keith Thompson* [3], *Jing Jiang* [1], *Hal Ritchie* [4]
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A coarse-resolution global ocean circulation model is applied to examine the dynamical response in the tropical Pacific Ocean to forcing associated with the Madden-Julian Oscillation (MJO). The MJO related zonal wind stress is first extracted from realistic atmospheric reanalysis. The ocean response to the MJO forcing is quantified as the difference between two model simulations, one driven by climatological plus MJO winds and one driven by climatological wind. The model simulated variations in sea level anomalies (SLA) and sea surface temperature (SST), forced by the MJO wind, are compared with the MJO related signals extracted from SLA and SST observations, and a "control" model solution that is forced with realistic reanalysis forcing. At the equator, it is confirmed that the MJO forced SLA variations are associated with the tropical Kelvin waves. The MJO forced sea surface temperature (SST) variations are much more complicated. The contributions to SST changes from up/down-welling, zonal advection, and changes in surface heat flux are assessed from model solutions. Finally, the model simulated rectification of SST from MJO into ENSO is analyzed and discussed.

1C-301.3 ID:2858 **14:30**

The Madden-Julian Oscillation and Local and Remote Forcing of the Ocean

Eric Oliver , *Keith Thompson*
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The Madden-Julian Oscillation (MJO) is the dominant mode of atmospheric variability in the tropical atmosphere on intraseasonal timescales (i.e., weeks to seasons). It is an eastward-propagating phenomenon with clear expressions in outgoing longwave radiation, precipitation and zonal wind stress over the tropical oceans. The MJO has the potential to help bridge the gap between between extended-range weather forecasts and seasonal climate forecasts of both the atmosphere and ocean. Observational and modeling

studies have shown that the MJO can drive variability in the tropical ocean through local heat and momentum fluxes. In this study we examine the connection between sea level and the MJO on a global scale. We first identify regions exhibiting a significant (both statistical and practical) relationship between sea level and the MJO. The first region consists of the equatorial Pacific and western coast zones of North and South America. Consistent with previous studies, we identify wind-driven equatorially trapped Kelvin waves propagating eastward along the equatorial Pacific and then poleward along the coastal trapped waveguides of North and South America. The second region includes the shallow waters of the Gulf of Carpentaria along the north coast of Australia and the adjacent Arafura and Timor Seas. Sea level set up by onshore winds is shown to be the dominant physical process. Finally, the northeastern Indian Ocean is shown to be a complex region involving a combination of equatorially trapped Kelvin waves, coastal trapped waves and westward propagating Rossby waves exhibiting characteristics of both local and remote forcing. The implications for deep and coastal ocean forecasting are discussed.

1C-301.4 ID:2918 **14:45**

North Pacific Sea Surface Temperature Climatology and Variability in an Ensemble of AOGCMs

Fabian Lienert , *John C. Fyfe* , *William J. Merryfield*
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Processes residing in the Pacific Ocean substantially determine predictive skill at seasonal, interannual and longer time scales for much of Canada. Our focus here is on processes in the extratropical North Pacific Ocean, and in particular on an evaluation of sea surface temperature (SST) climatology and variability in an ensemble of thirteen state-of-the-art Atmosphere Ocean Coupled Climate Models (AOGCMs). Our motivation is to provide a regional North Pacific benchmark against which the Canadian Coupled Data Assimilation and Prediction System can be usefully compared. Measured against the latest long-term observational SST dataset we find that the AOGCMs reproduce the overall spatial pattern of climatological monthly-mean SST, however the simulated SSTs are systematically too cold in the central North Pacific. We attribute these biases in part to an ensemble-mean Aleutian Low that is too deep and shifted southward, leading to a bias in the mean wind field and therefore thermal advection. We also report on the fidelity of the AOGCM simulated leading mode of North Pacific SST variability known as the Pacific Decadal Oscillation (PDO), computed as the leading Empirical Orthogonal Function (EOF) of monthly-mean SST. The PDO is reasonably well simulated by the AOGCMs, however there are some important biases in both the spatial and temporal dimensions, which are partly due to incorrect coupling between SST and sea level pressure (SLP) fluctuations. The observed PDO and ENSO tend to be in phase. On the other hand, the AOGCM ensemble show an out-of-phase relationship with the PDO lagging ENSO which we argue, using a simple mixed layer model, is associated with unrealistically deep winter mixed layers in most of the AOGCMs.

1C-301.5 ID:2747 15:00

Redundancy analyses of the coupled atmosphere-ocean system: application to State Space Models and global climate data

Faez Bakalian [1], *Harold Ritchie* [1], *Harold Ritchie* [2], *Keith Thompson* [1], *William Merrfield* [3]

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In order to develop coupled data assimilation methods for long-range environmental forecasting using coupled climate models it is necessary to understand the covariance properties of the joint atmosphere-ocean system We focus here primarily on redundancy analysis which can be a powerful statistical tool for exploring relationships “between” random vectors, X1 and X2, related through a regression model. This statistical technique may prove valuable for studying the propagation of information and errors from one medium to the other, which can be of importance to data assimilation. State space models are introduced to aid in the interpretation of the redundancy analysis eigenvectors. Principal component and Redundancy analysis are compared and contrasted using the state space models, and certain repeating properties of the eigenvectors and eigenvalues are identified for weakly coupled systems. Redundancy analysis is then applied to global data fields. The data sets used in this study are the global Sea Surface Temperature (SST) and Sea Level Pressure (SLP) from (i) an NCEP reanalysis and (ii) output from the Canadian Centre for Climate Modelling and Analysis coupled model. Time-lagged Redundancy analyses are carried out on global scales for: 1) SST forcing SLP and 2) SLP forcing SST. The two dominant global patterns identified are 1) ENSO SST patterns and low-high pressure bands in the Pacific ocean and 2) equatorial heating in the Atlantic with mid-Pacific pressure anomaly. The implications of these statistical relationships for modeling the background error covariance, and ultimately prediction of the coupled atmosphere-ocean system using a data assimilative model, are discussed.

1C-301.6 ID:3084 15:15

Bred Vector and ENSO predictability in a hybrid coupled model during the period 1881-2000

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In this study, we conducted a breeding analysis for a hybrid coupled ENSO (El Ni\~{n}o and the Southern Oscillation) model that assimilates the historic dataset of sea surface temperature (SST) for the past 120 years from 1881-2000. Meanwhile, retrospective ENSO forecasts were performed for the same period. For a given initial state, fifteen bred vectors (BVs) of both SST and upper ocean heat content (HC) were derived, respectively, using realistic oceanic analysis as the reference trajectory. It was found that the average structure of the fifteen BVs is insensitive to initial states, and seasonal and ENSO phase independence. It shares many features already seen in other models, and is similar to the

final patterns of Singular Vector analysis. However the structure of an individual BV is quite different from case to case. The BV-rate, which measures the average cumulative growth rate of breed vectors, varies seasonally with the maximum value appearing at the time when the model runs through the boreal spring and summer. It is also sensitive to the strength of ENSO signal, and the stronger ENSO signal the smaller the BV-rate.

Further we explored ENSO predictability using BV analysis. Emphasis is placed on the relationship between BV, which is able to characterize potential predictability without requiring observations, and actual prediction skills, which make use of real observations. The results show that the relative entropy, defined using breeding vectors, is a good measure of potential predictability. A large relative entropy often leads to a good prediction skill; whereas when the relative entropy is small, the prediction skill seems much more variable. At decadal/interdecadal scales, variations in prediction skills are in a good agreement with those in relative entropy.

Regional Climate Modelling (PART 2) / Modélisation Régionale Climatique (Partie 2)

Room / Endroit (302), Chair / Président (Daniel Caya), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-302.1 ID:2872 **14:00**

Cloud-radiation interaction as simulated by two microphysics schemes in the Canadian GEM model compared to ARM observations.

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Clouds are one of the dominant sources of uncertainty in climate models. A large part of this uncertainty arises from the numerous scale interactions, both in space and time, controlling cloud formation and the interaction of clouds with radiation and dynamical processes. Microphysical processes play a key role in controlling the liquid and ice water content of simulated clouds and, as a result, are important controls on the interaction of clouds with both solar and terrestrial radiation.

In this presentation we evaluate the cloud-radiation interaction as simulated by the Canadian Regional Climate Model based on the limited area version of GEM (Global Environmental Multiscale Model, Zadra et al. 2008) with two different microphysics schemes. The first scheme is a bulk-microphysics single moment scheme with total cloud water as a prognostic variable while the second scheme is the Milbrandt and Yau (2005)

double moment scheme with six prognostic variables.

Both simulations are evaluated over the ARM Southern Great Plains site and compared with observations for the period 1998-2004. Both integrations used ECMWF reanalysis as lateral boundary conditions and prescribed SSTs. 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) and integrated water vapor (IWV), with the same co-variability from observations. We compare simulated frequency distributions of LWP, IWV and precipitation rate, for different seasons, with equivalent observed distributions. We finally show the impact of these simulated interactions on the surface radiation budget.

1C-302.2 ID:2861 14:15

Permafrost Degradation: A Regional Modelling Approach in the Context of Climate Change

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Short and mid-term predictions at local and regional scales could be quite challenging for permafrost modelers. In the context of climate change, northern parts of Canada are already experiencing general permafrost degradation, affecting local populations and infrastructures, but which could also lead to a complete set of positive feedbacks related to vegetation distribution, snow cover, soil organic carbon and fresh water discharge for example. To better understand and predict the evolution of the thermal and moisture regimes of permafrost, it is necessary to use advanced modeling tools such as the Canadian Land Surface Scheme (CLASS, Verseghy 1991, Verseghy et al. 1993) and the Canadian Regional Climate Model (CRCM, Laprise 2008).

Compared to the operational version of CLASS actually used in the CRCM, that has only three layers (0.1, 0.25 and 3.75m) and allows only sand and clay soil configuration, the latest version of CLASS is now more optimized to realistically simulate permafrost dynamics. First, its flexible layering scheme resolves the active layer thickness and allows deep soil configuration (e.g., 100m), the latter being more suitable for long simulations reaching the end of the 21st century. Second, its new organic matter soil parametrization can now reflect typical thermal and hydraulic properties involved in organic soils present in northern latitudes.

With these new available features, it is proposed to do 1-D offline tests on typical northern Quebec locations with CLASS forced by the A2 climate change scenario simulated by the CRCM. Preliminary results seem to confirm that adding deeper layers and organic matter to CLASS brings a new thermal inertia that changes the active-layer and near-surface permafrost behavior, with the major effect of delaying the permafrost degradation compared to shallow soil models used in most operational climate models.

1C-302.3 ID:2841 **14:30**

The simulation of extremes by two Canadian Regional Climate Models over non-native domains

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Regional climate model simulations between years 2000 to 2004 were conducted with the Canadian Regional Climate Model (CRCM4) and the Global Environmental Multi-scale Limited Area Model (GEM-LAM). The simulations were performed over six 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. The models simulations were evaluated for the winter and summer seasons, using satellite and field observations measured at sites over the Arctic, the mid-latitudes, the tropics, high-altitudes and in the southern hemisphere. A quantitative assessment of the frequency and magnitude of extreme precipitation and temperature events at the diurnal and sub-daily scales was conducted using time-series, frequency distributions, and bias estimates. CRCM4 displayed a cold bias at most sites during the northern hemisphere winter. GEM-LAM simulated surface temperatures warmer than the observations and was drier during the months of June through August. The same biases were evident in the the ninetieth percentile of three-hourly temperature and precipitation. The largest deviations were noticed at high altitude sites, Arctic regions, and in 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.

1C-302.4 ID:2943 **14:45**

The Sensitivity of Regional Climate Simulations to Domain Size and Large-Scale Nudging

Dragana Kornic , *René Laprise* , *Martin Leduc*
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Regional climate models are sensitive to domain size. Studies show that the area of integration must be large enough to allow the full development of small-scale features. If the integration is performed on a very large domain, it shows important departures from the driving data unless large-scale nudging is applied. The nudging technique consists in forcing large scales not only at the lateral boundaries but also within the domain of integration. The influence of different domain sizes and intensity of large-scale nudging is studied here by using the “perfect model” approach. Three experiments were performed; two experiments with different nudging intensity and one without spectral

nudging, over five different domain sizes. With the increase of large-scale nudging intensity we observe the increase of spatial correlation between the simulations and their reference. The increase in temporal correlations is present as well.

1C-302.5 ID:2824 15:00

Diagnostic of the Internal Variability in the Canadian Regional Climate Model simulations

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The chaotic and nonlinear nature of the atmospheric dynamic is well documented, and it is known that small errors in the initial conditions (IC) of a forecast can grow rapidly and affect the model results.

Because Regional Climate Models (RCMs) are driven at their lateral boundaries by Global Climate Models (GCMs) or reanalyses, it is often thought that the RCMs simulation will not strongly diverge from the forcing fields at the large scale. In an ensemble of nested RCMs simulations driven by identical Lateral Boundary Conditions (LBC), the LBC exert a certain control on the evolution of the interior solution. However, several authors have pointed out the presence of internal variability (IV) in nested models simulations. Recent studies, notably Alexandru et al. (2007), have shown the sensitivity of the Canadian Regional Climate Model (CRCM) to the IC. Their results have revealed that episodically some processes are favourable to the development of large amplitude of internal variability.

In this study, our purpose is to perform a diagnostic of the diabatic and dynamic terms that contribute to the temporal variation of IV. We begin by establishing an evolution equation of the IV, and then we validate this equation by using an ensemble of 20 three-month simulations that differ only in the ICs. Finally, we will identify the processes that lead to episodes of large IV in nested RCM simulations.

1C-302.6 ID:2839 15:15

Dry spells over Canada in a changing climate

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Dry spells are defined as events with daily precipitation less than a certain predefined threshold, which is often based on the analysis of observed data. Assessment of climate change impacts on various dry spell characteristics, particularly the frequency and return levels, is desirable as they are of great socioeconomic interest. This paper will focus on the Canadian RCM (CRCM) simulated dry spells over Canada, their validation and projected changes to their characteristics using en ensemble of CRCM simulations.

Operational Meteorology (PART 2) / Météorologie opérationnelle (Partie 2)

Room / Endroit (303), Chair / Président (G.A. Isaac), Date (01/06/2009), Time / Heure (14:00 - 15:30)

1C-303.1 ID:3014 **14:00**

Sunrise Propane Explosion and Other Fire Plumes Seen with Canadian Weather Radars

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The massive explosion at the Sunrise propane facility in Toronto, August 10, 2008, had an interesting signature on the Environment Canada weather radar north of Toronto. Although media reports focussed on a plume that extended eastward at low levels from the site of the explosion, radar showed a secondary plume from the initial explosion at a higher level, with particles deposited to the northeast. An ability to monitor plumes with weather radars would be useful, but it depends on the presence of large particles, so a quick search was undertaken to search for other examples of plumes. Large wild fires, such as the fires near Porters Lake, N.S in June 2008, regularly present signatures on weather radars, often with diurnal effects. On the other hand, urban fires of structures are rarely seen, presumably because fewer large particles are wafted aloft.

1C-303.2 ID:3013 **14:15**

Observations of Wind Farms with Canadian Weather Radars

Norman Donaldson , *Lillian Yao* , *Robert Paterson* , *Christine Best*
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Several existing wind turbine farms are seen in data from Canadian weather radars. Wind turbines are a new class of “clutter” target because the moving blades are not rejected by Doppler processing that is intended to reject stationary ground targets. Minimizing conflicts with weather radar applications is desired by both EC and the operators. Observations of existing farms can be used to assess software intended to guide discussions with proponents of new wind farms. The observations generally confirm visibility estimates, but returns are variable in time and the relation between visibility and reported values of Doppler corrected reflectivity is complex. The long term study shows diurnal variation in the appearance of the turbines, as well as very short term variations

1C-303.3 ID:2968 **14:30**

Forecasting for Major Canadian Airports Using the Canadian Airport Nowcasting System (CAN-Now)

George Isaac [1], *Monika Bailey* [1], *Faisal Boudala* [1], *William Chang* [1], *Stewart Cober* [1], *Robert Crawford* [1], *Norman Donaldson* [1], *Marc Fournier* [2], *Ismail Gultepe* [1], *Laura Huang* [1], *Alister Ling* [3], *Janti Reid* [1]
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The Canadian Airport Nowcasting Project (CAN-Now) is developing an advanced prototype all-season weather forecasting and nowcasting system that can be used at major airports. This system uses numerical model data, pilot reports, ground sensor observations (precipitation, ceiling, visibility, winds, etc) as well as remote sensing (satellite, radar, radiometer) information to provide detailed nowcasts out to approximately 6 hours. The nowcasts, or short term weather forecasts, should allow decision makers at airports such as pilots, dispatchers, de-icing crews, ground personnel or air traffic controllers to make plans with increased margins of safety and improved efficiency. The system is being developed and tested at Toronto Pearson International Airport (CYYZ) with plans to extend the project to include Vancouver International Airport (CYVR) and ultimately other HUBs such as Calgary and Montreal. Currently, a Situation Chart is being developed to allow users to have a high glance value product which helps them identify significant weather related problems at the airport. Most of this talk will centre on the Situation Chart and how it might be used and improved.

1C-303.4 ID:2874 **14:45**

Blending Numerical Weather Prediction and Radar in an Operational Implementation of ARMOR Algorithm for Automated Quantitative Precipitation Forecasts

Zach Dufran [1], *Richard Carpenter* [1], *Brent Shaw* [1], *Isztar Zawadzki* [2], *Alamelu Kilambi* [2], *Gyuwon Lee* [2]
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While there have been many improvements in numerical weather prediction over the past several decades, the skill of precipitation forecasts is still insufficient for many applications of operational meteorology. The Adjustment of Rain from Models with Radar (ARMOR) algorithm from McGill University has been implemented to combine the latest numerical weather prediction model with radar nowcasting algorithms to produce highly-accurate quantitative precipitation forecasts out to 10 hours.

High resolution Quantitative Precipitation Forecasts (QPF), produced using radar-based

Nowcasting techniques have been beneficial to hydrologic modeling but deficiencies, including difficulty dealing with storm initiation, evolution and variation with motion, result in decreased skill with lead time longer than two hours. Numerical Weather Prediction (NWP) forecasts of precipitation are known to perform better over longer time scales, identifying mesoscale precipitation patterns in the 0-12 hour time frame. However, accuracy is inferior to Nowcasting during the first 3 hours. Weather Decision Technologies (WDT) has licensed and implemented the ARMOR QPF algorithm, which blends NWP models with extrapolation based Nowcasting to optimize short term precipitation forecasting out to 10 hours.

WDT blends forecasts from a high-resolution proprietary implementation of the Weather Research and Forecast (WRF) model and a Nowcasting scheme to run ARMOR over the contiguous US. Inputs to ARMOR include 10 km resolution WRF model precipitation output and 1 km resolution North American radar mosaics that are updated every 5 minutes. Model spatial phase errors and precipitation intensity correction are generated by comparison with US radar precipitation estimates. Motion vectors determine the progression of the precipitation forward in time. This presentation will explain the ARMOR algorithm, provide samples of QPF output in comparison with real-time radar rainfall and discuss the observed skill of ARMOR.

1C-303.5 ID:2799 15:00

Improving Hydrologic Analysis and Applications through the Use of a Near Real-Time Storm Precipitation Analysis System (SPAS)

J. William Conway [1], *Beth Clarke* [1], *Tye Parzybok* [2], *Douglas Hultstrand* [2], *Edward Tomlinson* [3], *Bill Kappel* [3]
(Presented by *J. William (bill) Conway*)
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The use of radar estimated precipitation is among the most important technological advances in improving the accuracy and reliability of hydrologic models in recent years. Not surprisingly, the use of radar estimated precipitation is a significant area of research and is being used in a number of practical applications, such as reservoir inflow monitoring, water resources management, stormwater management, and flood warning systems. Radar data far exceeds the spatial densities of rain gauge networks and has a finer temporal scale (as frequent as 5-minutes) than traditional rain gauges, therefore allowing precipitation estimates to be made at all ungauged locations. While radar estimated precipitation provides a great improvement in temporal and spatial scales for hydrologic modeling, the radar precipitation estimates require correction adjustments to account for under/over estimations, radar beam blockage, hail contamination and radar-precipitation relationships. The Storm Precipitation Analysis System (SPAS) includes state-of-the-science advances in spatial and temporal radar-aided precipitation analysis. Utilizing Weather Decision Technology's (WDT) quality controlled Level-II radar data, SPAS utilizes hourly algorithms and correction adjustments to improve the accuracy and reliability of radar-estimated precipitation for use in many applications, including civil infrastructure design and operational hydrology. For many years, SPAS operated as a post-storm analysis tool, providing hydrologic models the necessary high-resolution precipitation data for calibration and validation. However, SPAS is evolving to have near real-time capabilities using innovative, state-of-the-science techniques. An overview of WDT's radar processing, SPAS and a comparison of precipitation using different radar inputs and ZR algorithms output will be provided.

1C-303.6 ID:2796 **15:15**

The Aviation Weather Decision Support System Developed by Weather Decision Technologies

J. William Conway , *Chip Barrere* , *Brent Shaw* , *Michael Eilts*
(Presented by *J. William (bill) Conway*)
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Weather Decision Technologies (WDT) has developed a turn-key system specifically for forecasters and Air Traffic Control (ATC) personnel that provides automated short-term (nowcasting) detection and prediction of weather phenomena that are hazardous to aviation interests, and provides a state-of-the-science longer range Numerical Weather Prediction (NWP) capability using a customized version of the Weather Research and Forecast (WRF) model. This system, termed the Aviation Weather Decision Support System (AWDSS), integrates data from numerous sources including Doppler radars, satellite, lightning sensor networks, surface sensors, wind profilers, and radiometers. It processes these data through a series of advanced detection and prediction algorithms, and presents the output in a display system customized for both meteorological users and ATC personnel. AWDSS provides detection and forecasts of convective storms, lightning, microbursts, gust fronts, low-level wind shear, turbulence and shear along glide slope, fog detection and prediction of dissipation, temperature inversions (strength and height), icing, ceiling, and visibility. The user is automatically alerted for any of these hazardous conditions and estimates of the time of arrival and departure of the hazards are relayed to the operational users through the display systems. Two displays are provided termed the ATC Aviation Weather Situation Display (ATC-AWSD) which is customized towards ATC personnel and the Met Aviation Weather Situation Display (Met-AWSD) which is customized towards operational meteorological users. The purpose of this paper and presentation will be to discuss the AWDSS in further detail.

The Bay of Fundy: Tidal Power and Sediment Dynamics / La Baie de Fundy : Le pouvoir de la marée et la dynamique des sédiments

Room / Endroit (202), Chair / Président (Richard Karsten), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-202.1 ID:2852 INVITED/INVITÉ 16:00

Tides and tidal power in the Bay of Fundy

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The energy in the tides that could potentially provide much needed green electrical energy is also fundamental to the environment and ecology of the Bay of Fundy. Extraction of energy from this system can give rise to local and far field changes in the tidal regime. Even small changes can lead to significant impacts when thresholds are crossed. We review relationships of the tidal dynamics to some important aspects of the Bay, previous impact studies and the progress of preparatory work for the present tidal power development activities.

1D-202.2 ID:3031 16:30

Observing the velocity structure with moorings and transects in Minas Passage

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In order to evaluate the existing tidal potential, and to provide a modern baseline of the existing flow, several velocity measurements have been undertaken within Minas Passage. The observations consist of moored ADCP measurements and across-channel ADCP surveys. These observations are necessary due to the fairly sparse historical data within the passage. The data provide a means of validating model simulations of the tidal potential but also allow us to study smaller scale features that might not be well resolved in the models. A summary of the features of interest will be presented.

1D-202.3 ID:2972 16:45

Efficient Extraction of Power from Near-Resonant Tidal Systems

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In order to maximize the extraction of power from near-resonant tidal bays it is important to deploy machinery so that it tunes rather than detunes the system. This will be crudely illustrated using an over-simplified calculation. Machine efficiency for extraction of power from a dam outflow is well understood as harvesting as much working power as possible from the power of the outflow. I argue that an in-stream machine must satisfy additional criteria to be deemed efficient. These additional criteria seem to be consistent

with also minimizing environmental disruption. Finally, machine scaling relative to currents is used as a basis to discuss the wisdom of the present approach to development of in-stream tidal power extraction from the Bay of Fundy.

1D-202.4 ID:2825 INVITED/INVITÉ 17:00

Flow past Tidal Turbines

Richard Karsten , *Justine Mcmillan* , *Megan Lickley* , *Ronald Haynes*
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The high tides of the Bay of Fundy and in particular the strong tidal currents in the Minas Passage making it a promising location for in stream tidal turbines. In the coming year, three test turbines will be placed in the water with plans of developing a 200-300 turbine farm that will generate 300 MW of electricity. In this talk we examine the dynamics of flow past a farm of tidal turbines in the Minas Passage. We use three-dimensional, finite-element numerical simulations of the upper Bay of Fundy with high resolution in the Minas Passage. Realistic turbines are represented as regions of high drag in the momentum equations. The flow past these modelled turbines, and groups of turbines is compared to theoretical calculations and idealistic models that estimate the maximum power of an individual turbine, the effect of a fence of turbines and the optimum placement of turbines. The comparisons indicate that the accuracy of theoretical estimates can be strongly affected by the variations in flow and bathymetry found the actual passage. In conclusion, we use our results to determine the optimal location of turbines in a turbine farm.

1D-202.5 ID:3040 17:15

Suspended Sediment Transport Measurement using ADCPs & LISSTs, Development of a Methodology

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In coastal and estuarine environments, Suspended Particulate Matter (SPM) plays a major role in physical, biological, and chemical processes. The understanding of its dynamics is therefore of primary importance to aquatic environmental sciences. Although measurement technologies are continually evolving, it is still nearly impossible to measure the concentration and transport of SPM on large spatial and temporal scales. Traditional sampling techniques (water bottles or pumps), although relatively accurate, are labour-intensive, lack resolution, and inherently under sample in terms of temporal resolution. Numerous remote sensing techniques employing either acoustical or optical sensors (e.g., transmissometer, optical backscatter) have been developed in order to better understand the processes of sedimentation and re-suspension through the entire water column. Although the latest innovations in optical (LISST- Laser In Situ Scattering and Transmissometry) and acoustical techniques (multiple high frequency Acoustic Back Scatter) have been quite successful in allowing measurement of sediment concentration and particle size through the entire water column, these techniques haven't yet been exploited at large scales and few commercial applications have been developed. In this study, we explore the potential for LISSTs instruments to calibrate single frequency Acoustic Doppler Current Profilers (ADCPs) to measure both sediment concentration and transport using data collected in the Avon dynamic Avon River estuary (Bay of Fundy).

Physical-Biological Interactions in the Ocean (PART 3) / Interactions physiques et biologiques dans l'océan (Partie 3)

Room / Endroit (203), Chair / Président (Katja Fennel), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-203.1 ID:3029 INVITED/INVITÉ 16:00

Modelling plankton dynamics and biogeochemical cycles on the Pacific coast of Canada

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The development of a quantitative understanding of the interactions between physical, chemical and biological processes is critical for predicting the marine ecosystem response to climate change. Mechanistic ecosystem models coupled to circulation models are important tools for understanding ecosystem dynamics, to generalize discrete observations and to predict plausible ecosystem changes. In this study, results from coupled plankton/circulation models (ROMS-Regional Ocean Modeling System) developed to study factors influencing bloom dynamics on the continental shelf off Vancouver Island, will be presented. The biological model includes two size classes of phytoplankton and zooplankton, nitrate, ammonia and silicate. Model results show the influence of upwelling, fresh water inputs, and the Juan de Fuca eddy located off the mouth of the Juan de Fuca Strait, on the growth of phytoplankton and the fate of the organic matter produced. The importance of different sources of nutrients (i.e. wind-driven upwelling, topographically controlled upwelling, and the outflow from Juan de Fuca Strait) on primary production and biogeochemical cycles is evaluated.

1D-203.2 ID:2816 16:30

Effects of mesoscale eddies on biota in the Gulf of Alaska

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The Gulf of Alaska (GOA) has been a target for a variety of physical process studies due to its highly productive commercial fisheries. Observations have shown that eddies generated in this region, particularly those along the coast of British Columbia, play an important role in off-shelf transport and distribution of nutrients and biological material. However, to date, few eddies have been surveyed through shipboard measurements and satellite data, and the resulting physical and biological datasets are on very different scales in space and time. This makes the degree to which eddies influence the distribution and abundance of biota in the GOA unknown. Use of the spectral nudging data assimilation scheme in POP (a three- dimensional, general circulation ocean model) produces eddies similar to those observed in the GOA. The purpose of this study was to investigate the influence of these eddies on the distribution and abundance of nutrients and biota in the GOA using POP and simulated passive dispersive material. Comparisons were made between eddies generated along the BC coast and those generated along the Alaska coast with respect to entrainment, vertical and horizontal transport, and retention time. In addition, investigations were made of how the eddies distribute biota during the spring bloom, and whether or not they influence the transport of early life stage of some species in the GOA from their off-shelf spawning grounds to inshore nursery grounds.

1D-203.3 ID:2930 **16:45**

Modelling the biological effects of a summer upwelling events in Lunenburg Bay, Canada

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Along the Atlantic coast of Nova Scotia (Canada), episodic summer upwelling events, induced by the prevailing southwesterly winds, are a significant source of physical and biological variability on the inner Scotian Shelf. Along the coast, they contribute to the flushing of nearshore systems (bays, estuaries) and influence their phytoplankton communities. However, the effects of summer upwelling events on phytoplankton biomass can be rather small in these environments. In Lunenburg Bay (Nova Scotia, Canada) for instance, in 2006 an early summer upwelling event resulted in a moderate two-fold increase in chlorophyll biomass (~2 mg m^3), which is a modest increase in comparison to other inshore systems.
The objective of this study is to determine the underlying biological and physical processes (e.g. transport, grazing, primary production) responsible for the observed increase in phytoplankton biomass during an upwelling event in Lunenburg Bay. The Regional Ocean Modelling System (ROMS) coupled to a planktonic ecosystem model is used to study a sequence of summer upwelling events that occurred in Lunenburg Bay in 2006. Model results are compared with observations collected during a sampling campaign carried out during the upwelling sequence.

1D-203.4 ID:2924 **17:00**

Modelling biogeochemical cycling and interfacial exchange of climatically important gases

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We have developed a 1-D coupled atmosphere-ocean-biogeochemical model to study ecosystem variability and 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 and silica cycling as well as a marine DMS (dimethylsulfide) module. The AGCM includes a comprehensive sulphur cycle which is now coupled to the ocean DMS model. The model has been extensively tested for Ocean Station Papa (OSP, 145W, 50 N) in the Northeast Pacific, where observations are available from a long-term air-sea exchange mooring which has been maintained at a location near OSP from September 2002 to June 2007 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, a pCO2 sensor, two oxygen sensors, two fluorometers for chlorophyll estimates, and an upward-looking 200~kHz echo-sounder for bubble measurements. Additional observations are derived from regular cruises along Line P and an intense measurement period during the Subarctic Ecosystem Response to Iron Enrichment Study (SERIES) in July 2002. We are now in the process of extending the model with a snow - sea ice - ice algae module to study physical and biological processes in high latitudes.

1D-203.5 ID:2843 17:15

Application of variational data assimilation to coupled Physical-biological models of the North Atlantic Bloom

Witold Bagniewski [1], *Katja Fennel* [2], *Mary Jane Perry* [3], *Eric D'asaro* [4], *Nathan Briggs* [3], *Amanda Gray* [4], *Craig Lee* [4], *Eric Rehm* [4]
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Lagrangian floats and seagliders were deployed in the North Atlantic region south of Iceland from late March to early July 2008 and provided 3-D coverage of the spring bloom over time. The measured physical, chemical and bio-optical data, calibrated with data collected on three supporting cruises, was used to develop an ecosystem model

describing the North Atlantic Spring Bloom. The model's physical framework is based on the 1-D General Ocean Turbulence Model (GOTM) which is set up for a North Atlantic site at 60˚ N, 20˚ W and forced with data on wind speed, air pressure, air temperature and humidity. This physical model is coupled to a biological model that includes small phytoplankton, diatoms, zooplankton, detrital nitrogen, detrital silicate, dissolved inorganic nitrogen, silicic acid, chlorophyll and oxygen. We determined the biological parameters that are most important for model behavior through a sensitivity analysis and applied variational data assimilation to optimize these. We will present model-based estimates of primary productivity, carbon fluxes and carbon export associated with the bloom.

Remote Sensing of the Atmosphere and Ocean (PART 3) / Télédétection de l'atmosphère et de l'océan (Partie 3)

Room / Endroit (204), Chair / Président (Norman O'Neill and Rong-Ming Hu), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-204.1 ID:2938 **16:00**

Measurements Of Pollution In The Troposphere: Nine Years, Two Billion Measurements and Counting

James Drummond [1], *John Gille* [2], *Merritt Deeter* [2], *David Edwards* [2], *Jay Kar* [3], *Florian Nichitiu* [3], *Jason Zou* [3]
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The Measurements Of Pollution in the Troposphere (MOPITT) satellite instrument was launched on December 18, 1999 and has now completed nine years of successful measurements of carbon monoxide from orbit. After nine years and some 2,000,000,000 measurements, far from being a routine and boring experiment, the instrument and the atmosphere it observes continue to provide challenges and surprises. This paper will provide an update on the MOPITT experiment with some insights into recent studies using MOPITT data.

Our most recent studies have concentrated on the long-term nature of the carbon monoxide field on the planet and on the shortwave channels of the MOPITT dataset that provide new insights into the atmospheric distribution.

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.

1D-204.2 ID:3076 16:15

TICFIRE: The Thin Ice Cloud in the Far Infrared Experiment

Tarek Ayash [1], *Jean-Pierre Blanchet* [1], *Yann Blanchard* [2], *Alain Royer* [2], *Norm O'Neill* [2], *Linda Marchese* [3], *François Châteauneuf* [3], *Pierre Gauthier* [1], *Jean De Lafontaine* [4], *John Hackett* [5]
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This presentation describes the Thin Ice Cloud in the Far Infrared Experiment (TICFIRE) – a novel mission proposed to conduct space observations of the terrestrial emission of far infrared (FIR) radiation. Band measurements would be made with a microbolometer instrument that is developed by INO (Institut National d'Optique, Quebec) for application in the FIR range. Through these measurements, atmospheric profiles of temperature can be improved and low concentrations of water vapour may be better inferred due to its effectiveness in altering the greenhouse forcing in the FIR regime and in the so-called dirty window (17 to 50 μm). Furthermore, microphysical characterization of thin ice clouds (TIC) can be made, especially the distinction between populations of large ice crystals (TIC-2B) versus small crystals (TIC-1). The TICFIRE data is dedicated to study the very-cold Arctic air masses during winter and to better assess the evolution of large-scale cold systems through TIC formation and dehydration. It also aims to improve medium-range (up to ten days) weather forecasting under extreme cold-air generation in polar regions and near the tropopause. Ultimately, TICFIRE aims at filling a global observational gap in the FIR and enhancing our understanding of the processes involved in cold-air generation. It is currently a high priority for improving medium-range forecasting and climate-change assessment.

1D-204.3 ID:2939 16:30

The wave-induced fluctuations of underwater angular radiance as observed in Santa Barbara Channel

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The radiance variability is of great interest in many realms such as environmental conservation, underwater imaging, special operations, and ocean color research activities. “Radiance in a Dynamic Ocean” is an Office of Naval Research (ONR) funded project that aims to understand the underwater radiance variability in relation to surface boundary layer dynamics. In the summer of 2008, an interdisciplinary field experiment

was completed in Santa Barbara Channel. As the participating team, we successively deployed a newly designed radiance camera on several platforms and obtained the full angular radiance data in this coastal area. Particularly, one radiance camera was mounted in a Bluefin autonomous underwater vehicle (AUV), which cruises along pre-designed courses and depths, and has recorded continuous video of the angular radiance distribution data. In this paper, we report the preliminary findings recorded by the camera on board the AUV. Time series of radiance distribution will be presented. Underwater radiance at several directions is analyzed, from both the principal plane and perpendicular plane. Two sets of continuous measurements at different water depths are discussed. The surface wave focusing effect is primarily responsible for the periodical fluctuations of radiance, although it exhibits quite large variance at different directions.

1D-204.4 ID:3057 **16:45**

Monitoring of Coastal Wetlands with Space-borne Polarimetric SAR Systems: RADARSAT-2 and TerraSAR-X

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Coastal wetlands are often highly productive and have dynamic and diverse ecosystems. Despite the importance of the tidal flats and associated coastal habitats, these areas are sometimes at risk due to high development pressure, such as reclamation and associaated damages and pollution. In addition, coastal wetlands are highly vulnerable to climate changes. Microwave remote sensing using synthetic aperture radar(SAR) system has great potential for quantitative monitoring and mapping of coastal wetlands. There are now fully polarimetric space-borne SAR systems in three frequencies, X-, C-, and L-bands available for us to use, which will be an extremely valuable research tools for monitoring wetlands. In this study, multi-frequency polarimetric air-borne and space-borne SAR measurements have been used to extract information on the surface characteristics in and around the Suncheon Bay in the southern coast and Kyunggi Bay in the western coast of the Korean peninsula. The L- and P-band NASA/JPL AIRSAR and L-band ALOS PALSAR data sets have been acquired over study areas at Quad- and Dual-Pol modes. SAR polarimetry with polarimetric decomposition technique allows discrimination of different types of scattering mechanisms. This study aims to demonstrate its capacity for the assessment of natural habitats especially coastal wetlands. Particularly, multi-frequency polarimetric target characterization methods are presented here for extracting information on features of vegetation in coastal wetlands. In addition, polarimetric forward/inverse scattering models have been developed for quantitative estimation of geophysical parameters such as soil moisture and surface roughness. Roughness inversion algorithms proposed in this paper are useful to estimate the biogenic and physical roughness structures of intertidal flats in coastal wetlands. Recent changes in coastal wetlands will be continually monitored using C-band RADARSAT-2 and X-band TerraSAR-X as well as the ALOS PALSAR data sets.

1D-204.5 ID:2958 **17:00**

A comparison of measurements of O2(1Δ) airglow from SPICAM instrument on Mars Express with calculations from GM3

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GM3 is a multiscale global Mars general circulation model with a vertical domain from the surface to about 160 km. It has a water cycle that includes covered ice cap and regolith as well as bulk ice clouds. The model also includes a COx, Ox, and HOx chemistry of the Martian atmosphere, with a focus on airglow as a means of evaluating the chemistry and dynamics of the model. In this case we focus on the O2(1Δ) airglow and its sources, photolysis of O3 and O self recombination together with its sinks of emission and quenching. We find large values of O2(1Δ) from O recombination in the polar night with the descent of O rich air from the thermosphere. Our model simulation of O2(1Δ) is compared with available measurement from the Spectroscopy for Investigation of Characteristics of the Atmosphere of Mars (SPICAM) instrument onboard the Mars Express orbiter.

1D-204.6 ID:2999 **17:15**

Phoenix Met: Summer Weather at 126W, 68N on Mars

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Near continuous measurements of temperatures and pressure on the Phoenix Lander show interesting features. The temperature data show strong, turbulent fluctuations around mid-day, a steady decline of temperature in late afternoon and bursts of, presumably, turbulent fluctuations in the late evening. Pressure data show diurnal solar tidal features as well as short time scale local minima associated with the passage of vortex structures and dust devils. Data from the first 60 sols of the Phoenix mission indicate that, for this site, most days are approximately the same with temperatures 2-m above the surface varying from a low of -80C at around 0200 local time to a high of about -30C at about 1400 local. Wind directions veer almost continuously; this may be caused in part by local slope winds or by larger scale tidal phenomena. Boundary-layer models and lidar measurements indicate convective, dust laden boundary-layers extending up to about 4 km in mid-afternoon. Later in the summer (Sol 80+ of the mission) there is clear evidence of low level fog, boundary-layer clouds and precipitation of ice particles leading to interesting conclusions about the role of the boundary layer in the hydrologic cycle.

Health Issues of Weather and Climate / Problèmes de santé liés aux conditions météorologiques et au climat

Room / Endroit (205), Chair / Président (Denis A. Bourque), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-205.1 ID:3028 **16:00**

Adapting to Extreme Heat Events in Canada ("Heat Waves") Health Canada "Developing Heat Resilient Communities and Individuals" (Pilot communities)

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Extreme heat events represent a potentially significant health risk, as illustrated by heat wave tragedies in Europe (2003) and Chicago (1995), which killed more than 70,000 and 800 people respectively. Among the principal lessons learned is these tragedies are avoidable with appropriate preparation measures, which typically include heat alert and response system.

Extreme heat events pose a potentially growing public health risk in many regions of Canada, as a result of a changing climate. The IPCC 4th Assessment and Health Canada's recently released report Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity (2008) conclude that many regions in Canada will likely face extreme heat events of increasing intensity, duration and frequency.

Effectively managing the heat risks faced by Canadians requires addressing a number of key information and knowledge gaps. Currently within Canada there are few examples of best practices for heat alert and response systems. In response, Health Canada has received funding to implement a multi-year research project which will include piloting heat alert and response systems in 4 communities. The objective of Health Canada's Pilot Heat Alert and Response Project is to identify best practices, minimum standards and protocols in the design, implementation and evaluation of heat alert and response systems at the regional/municipal-scale in Canada.

Health Canada will speak to delegates about the challenges of developing a HARS in smaller communities, describe lessons learned during the process and provide practical advice for emergency management practitioners on reducing vulnerability to heat in their communities.

1D-205.2 ID:2745 **16:15**

Which days of hot weather are considered dangerous by heat-health watch warning

systems?: A comparison of the predictive capacity of different systems

Shakoor Hajat [1], *Scott Sheridan* [2], *Michael Allen* [2], *Mathilde Pascal* [3], *Karine Laaidi* [3], *Aurelio Tobias* [4], *Ugis Beckis* [5], *Denis Bourque* [6], *Ben Armstrong* [1], *Tom Kosatsky* [7]
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[2] Kent State University
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Prompted by growing concerns about global warming and recent deadly heat-wave events, many countries worldwide have introduced partnerships between weather services, civil protection and public health authorities in order to inform and protect residents from the dangers to health of hot weather. A central function of these heat-plans is the calling of advisories and ultimately the implementation of emergency measures when forecast weather is likely to cause unacceptable impacts to public health. Collectively such initiatives go by the title 'Heat health warning systems (HHWS)'.

HHWS are designed to be activated once temperature (and possibly other weather parameters) are forecast to breach pre-defined values expected to be associated with adverse health impacts. Such levels are commonly referred to as thresholds.

There are currently 4 fundamentally different threshold setting procedures in place in the various HHWS systems in use in cities, regions and countries across North America, Europe and Asia. Such variations reflect the different theoretical bases used in determining the nature of the relationship between hot weather and health. The 4 approaches are listed below:

- Type 1: Synoptic classification into air-mass types - Type 2: Epidemiological analysis of retrospective data - Type 3: Physiologic approach based on heat-budget of the human body - Type 4: Empiric set of temperature/humidity indices, e.g. humidex

All approaches except type 3 are based explicitly (or implicitly in the case of type 4) on exposure-mortality assessments.

To date there has been no consideration of the extent to which identification of heat-adverse days is dependent on the particular approach used to establish thresholds. We will compare the 4 alternate approaches as measured by how well they predict heat-associated mortality on the basis of a common set of historical weather and mortality records.

1D-205.3 ID:2700 16:30

Influence of spring and summer weather on pollen season and pollen production in the city of Sherbrooke, Quebec

Elisabeth Levac , *Vanessa Stretch* , *Simone Sandercombe*
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Airborne pollen and spores have been monitored daily in the borough of Lennoxville (city of Sherbrooke, Qc) since June 2006. A Burkard 7-day Hirst-type volumetric trap is used to collect the pollen and spores, following the international guidelines of the IAA. The goal is to determine how weather influences the start and duration of tree pollination in the spring and early summer, and how it might control daily airborne pollen concentrations. The purpose is to improve our daily forecasts and gain a better understanding of how weather conditions affect airborne pollen concentrations over a 24 hour period. Our data suggest that spring weather does not really affect the start of the pollen season for trees. However, airborne pollen concentrations of the most important producers (especially Pine) show very large year-to-year variability, which could be related to June weather. The warmer and drier weather in June 2007 correspond with pollen concentrations 10 times those of other years. However, the pollen production peak occurs at sensibly the same dates each year. Correlation analyses were performed between airborne concentrations and weather parameters (temperature, relative humidity, wind speed). Overall, few parameters show a signification correlations with hourly and daily airborne pollen concentrations. These results show that more work is needed before we can effectively forecast pollen concentrations on a daily basis. Our work also show the importance of in situ and daily monitoring: while pollen calendars are useful to anticipate the start and the peak of pollination for different plants, in situ daily monitoring is needed to confirm that pollination is indeed occurring. The importance of pollen monitoring in the context of a changing climate will be discussed. The role of pollution at exacerbating allergy symptoms will also be discussed.

1D-205.4 ID:2754 16:45

The Halifax, NS, Experimental Pollen and Spore Count and Forecast Project - What Have We Learned?

David Waugh [1], *Elisabeth Levac* [2], *David Richardson* [3], *Ann Miller* [4], *Tracy Utting* [5], *Chris Macinnis* [6]
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Allergy sufferers benefit from daily predictions of pollen and spore counts. This health benefit was one of the aims of the Halifax, NS, pollen and spore forecast project based at Saint Mary’s University, Halifax, NS. Daily counts (using Burkard Hirst-type volumetric pollen and spore traps) and forecasts were provided, via phone line and website, from May-September to help sufferers manage their symptoms. The forecast methodology was based on an empirical method incorporating recent pollen and spore trends and concentrations in combination with forecast weather variables. Pollen calendars

developed for urban Halifax and two surrounding rural sites were beneficial in highlighting the strengths and weaknesses of the project design. Projected concentrations in 6-hour intervals were provided and led to an increasing demand among the public, but did not succeed in capturing the endorsement of health professionals (who, at the moment, control allergy symptoms via medication and may not see benefits in prevention or monitoring to limit exposure to allergens). Statistical prediction methods have value but have difficulty capturing inter-daily variability. Expansion of time-resolved pollen counts and prediction to other parts of Canada is expensive and alternative methods of counting will need to be developed in order to facilitate this expansion.

1D-205.5 ID:2773 17:00

Vitamin D action spectrum weighted solar UV irradiance over the US and Canada

Vitali Fioletov [1], *Bruce Mcarthur* [1], *Tom Mathews* [1], *Loraine Marrett* [2]
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Solar UV radiation is a major provider of vitamin D for humans. This study examines distribution of solar UV radiation weighted according to the vitamin D action spectrum over North America. Brewer spectrophotometer measurements at 12 sites in Canada and 21 sites in the USA were used to calculate hourly and daily values of spectrally integrated UV irradiance using the vitamin D action spectrum. The same characteristics were also estimated using a statistical relationship between UV irradiance and global solar irradiance, total ozone, and dew point temperature for 45 sites in Canada and 52 in the USA. Different characteristics of the vitamin D action spectrum-weighted UV irradiance distribution over North America are presented in the form of monthly maps. Brewer measurements were also used to analyze the ratio between erythemal and vitamin D action spectrum-weighted UV irradiance. A simple formula that calculates vitamin D action spectrum weighted UV from UV Index is developed. An empirical formula that expresses the ratio of vitamin D action spectrum weighted UV to erythemal UV as a function of the solar zenith angle and column ozone is also suggested. Similarities and differences in geographical distribution of erythemal and vitamin D action spectrum-weighted UV irradiance over the US and Canada are discussed.

1D-205.6 ID:3058 17:15

MediClim™ : Introducing a European-style, weather-based health index in North America

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Associating health with weather has been a topic of discussion for centuries, going as far back as Hippocrates where we find the first written mention. The quest to find the link has been an ongoing challenge, with published scientific studies found as far back as the early decades of the 20th Century. However, success has been elusive, particularly when

the objective is to develop tools to provide forecasts of health conditions, such as migraines or arthritis. The usefulness of such forecasts is undeniable since sufferers could ultimately take pro-active steps to improve the quality of their lives. Recent decades have seen some progress here, one example being in Germany where a weather-health index and associated forecast program have been in public use for nearly 20 years. In this talk we present MediClim™, a weather-health index, and MediClim.com, an Internet weather-health forecast program modelled on the German experience, which we introduced to Canada and the USA this past year. An offshoot of a greater effort to encourage the consideration of weather influences within the practice of medicine in North America, the MediClim™ program provides subscribers with 24-hour advance notice of the potential aggravation of symptoms of five ailments. The index and program will be explained.

Global Atmosphere-Ocean Prediction and Predictability (PART 3) / La Prévision et la prévisibilité globale de l'atmosphère-océan (Partie 3)

Room / Endroit (301), Chair / Président (C. Harold Ritchie), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-301.1 ID:2712 **16:00**

A model study of the inter-annual and decadal variations of sea surface height, temperature, and gyre circulation in the North Atlantic

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A coarse-resolution global ocean and sea-ice model is used to study the inter-annual and decadal variations in the North Atlantic. The model solutions agree well with altimeter observations of sea surface height (SSH) during 1993-2004, and the Reynolds and Smith dataset of sea surface temperature (SST) during 1982-2004. The variations of SSH and SST can be mostly accounted for by the leading modes of their Empirical Orthogonal Functions (EOF). The first Principle Component (PC) of the EOF of SSH, with strong signals at inter-annual and decadal time scales, is strongly correlated with the variations of the North Atlantic Oscillation (NAO). The second PC seems to be related to variations of the East Atlantic Pattern (EAP). The first PC of the EOF of SSH also represents variations in the strength of the subpolar gyre. The model suggests a deceasing trend in the strength of the subpolar gyre in the recent decade since the mid-1990's, consistent with previous studies based on observational data.

1D-301.2 ID:2735 **16:15**

Simulation of the 2001-2002 Intrusion of Cold Water into the Gulf of Alaska

Shawn M. Donohue , *Michael W. Stacey* , *Jennifer Shore*
(Presented by *Shawn Donohue*)
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A 46 year simulation(1960-2006)of the circulation in the Northeast Pacific (NEP), using the Parallel Ocean Program (POP), is used to examine the anomalously large 2001-2002 intrusion cold and fresh (low spiceness) water into the eastern Gulf of Alaska (GOA). Spectral nudging is used to prevent model drift from Levitus climatology. The horizontal resolution of the model is 0.25 degrees, and there are 28 unequally spaced vertical levels. The vertical grid spacing in the upper 150 m is 10 m. The model is forced by monthly NCEP windstress, surface heatflux, freshwater flux, and surface pressure. Spectral nudging is used to prevent model drift from Levitus, monthly climatology.

According to the model, the anomalously cold and fresh water was created by anomalous mixing in the western GOA and was subsequently advected eastwards to the coast and then southwards along the coast of North America. Observed T and S anomalies are reproduced by the model, both along Line Papa in the subpolar region and in subtropical region at Point Conception off southern California within the CalCOFI survey grid. The simulated migration path of the anomalies is easily tracked using near surface T and S and it compares favorably with the path determined from observed SST. Anomalous transport of this kind does not occur at any other time during the simulation.

The model results indicate that the well-mixed colder and fresher (and denser) water of the western subarctic was transported eastward because of a temporally unique, strong dipole windstress field over the GOA during 1999-2002. Ekman transport caused by the wind stress field transported the cold and fresh water into the region of the North Pacific Current. These large T and S anomalies can be viewed as being forced by an enhanced La Nina. This ‘La Nina’, because of its access to the cold mixed water of the western GOA, was able to affect vast regions of the subtropics, and to enhance the California Current system as these anomalies were transported equatorward. This T/S event is the strongest of any observed off southern California, in over 50 years of observations.

1D-301.3 ID:2744 **16:30**

Simulating the North Pacific Ocean using NEMO

Yunfeng Shao , *Michael W. Stacey*
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NEMO is used to simulate the circulation of the North Pacific Ocean. The model domain extends from 30 S (so the equator is included in the simulation) to about 660 N (so the entire Northeast Pacific Ocean and much of the Bering Sea are also included). The horizontal spatial resolution is 0.25 degrees and there are 46 unequally spaced vertical

levels. The model is forced with NCEP observed monthly winds, sea-surface heat flux and sea-surface pressure. Our specific region of interest is the Northeast Pacific Ocean. Thirty-one year simulations, beginning in 1975, both when spectral nudging is employed and when it is not, are compared, with special emphasis on NEMO's ability to reproduce the variability of the North Pacific Current and the Rossby Wave field.

1D-301.4 ID:2978 16:45

Assessment of predictive skills of the Labrador Sea eddy permitting circulation model.

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In this talk we present results from model simulations and data assimilation study of a regional model of the Labrador Sea. The ocean model is coupled sea-ice NEMO model with ¼ degree horizontal resolution and 41 vertical levels. It is initialized from a 10 years model simulations. Singular Evulative Extended Kalman Filter (SEEK) method is used to assimilate satellite altimetry, SST maps and ARGO (temperature and salinity) data. The model is run with NCEP atmospheric forcing for the period of time from 1991 to 2000. The model simulations are compared with observations for the same period of time and predictive skills of the model and data assimilation scheme are assessed.

1D-301.5 ID:2993 17:00

Forecasting Mesoscale Variability of the North Atlantic: Towards an Operational System

Yimin Liu [1], *Keith Thompson* [1], *Serge Desjardins* [2], *Simon Higginson* [1]
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We describe progress in the development of an operational system that can provide 1 to 30 day forecasts of the upper 1000m of the North Atlantic on spatial scales of 10 to 1000 km. The ocean model is based on the NEMO code and has a horizontal grid spacing of 1/6 degree (at the equator) and 32 levels in the vertical with the highest resolution close to the sea surface. Spectral nudging toward a new temperature and salinity climatology (based on a blend of WOA05, almost 10 years of Argo data and 16 years of altimeter data) is used to suppress drift and bias of the model. The atmospheric forcing is calculated by one-way coupling the ocean model to an atmospheric forecast model (GEM) run operationally by Environment Canada. A new physically-motivated multivariate scheme is used to assimilate altimeter and Argo data. The forecast skill, and computational efficiency of the scheme, is quantified and compared to results from other operational forecasts systems for the region.

1D-301.6 ID:3059 17:15

Development of a nested-grid shelf circulation model using OPA for the eastern Canadian shelf

Jorge R. Urrego-Blanco , *Jinyu Sheng*
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As a first step of developing a nested-grid circulation model for the eastern Canadian shelf, we constructed a coarse-grid (1/4º) northwest Atlantic circulation model using the ocean general circulation model known as OPA (Océan PArallélisé). The model domain covers the area between 32ºW and 81ºW and between 33ºN and 57ºN. This model was used to simulate the 3-D circulation from 1990 to 1999 in this study. The model was forced by atmospheric reanalysis fields produced by Large and Yeager (2004) and monthly mean climatologies of temperature and salinity produced by Geshelin et al. (1999). Three different numerical experiments were conducted to examine the model performance in simulating large-scale circulation over the study region. These three experiments are: a) a fully prognostic run without data assimilation; b) a run using the spectral nudging method (Thompson et al. 2006); and c) a run using the semi-prognostic method (Sheng et al. 2001). In the first experiment no hydrographical assimilation is made and model results in this experiment demonstrate significant model drift and unrealistic circulation features for a multi-year model integration. For the spectral nudging experiment the model drift in TS fields is significantly reduced and the hydrographical seasonal cycle is well reproduced by the model as expected. However, tracer variability in this run is strongly damped and the eddy field is less free to evolve in the model. In the semi-prognostic run a correction (or assimilation) term is introduced in the model through the hydrostatic equation while leaving the model tracer equations to be fully prognostic. Model results demonstrate that the semi-prognostic method not only reduces model drift but also improves the tracer field simulation. This method however still damps the mesoscale eddy field. Future work will include the use of a smoothed semi-prognostic method which allows the mesoscale eddy field to be more realistically reproduced. The implications of using these techniques for developing a nested-grid model for the eastern Canadian shelf are also discussed.

Regional Climate Modelling (PART 3) / Modélisation Régionale Climatique (Partie 3)

Room / Endroit (302), Chair / Président (Hélène Côté), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-302.1 ID:3008 **16:00**

Glaciers of the Canadian Rockies and their Response to Global Climate Change.

Ted Pollock

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Temperate mountain glaciers are generally characterized by distinctive accumulation and melt seasons. Consequently, a small change in annual mean temperature can have a significant impact on the total ice mass they contain. Past studies of glacier mass balance under future climate scenarios have been subject to criticism because of the relatively low resolution of global circulation models (90-150km) versus the small scale of most glaciers (1 – 3km) and statistical downscaling methods which do not fully take into account local regional variability. This study investigates the interactions between carbon dioxide, climate, and Rocky mountain glaciers under a relatively conservative IPCC emission scenario for the 21st century through the use of the PSU/NCAR MM5 mesoscale model nested within the Princeton GFDL which is coupled with the MOM ocean model. In this manner climate data at 6 km resolution can be obtained, which is a high enough resolution to resolve regions with large fractions of terrain above the equilibrium line altitude. Changes in global circulation, global ENSO teleconnections, and the impact of these changes on Rocky mountain climate are discussed. Results show increasing temperatures and precipitation, particularly at high altitudes during winter. Initially, this has the effect of increasing snowfall at higher elevations of the Rockies, offsetting the effects of rising temperatures on semi-permanent snow and ice. However, a Northward shifting jet, and ongoing temperature increases eventually reduce snowfall significantly, even at high elevations, resulting in significant increases in equilibrium line altitude as carbon dioxide concentrations approach 600 ppmv.

1D-302.2 ID:2959 16:15

Regional climate model simulations of the severe 1999-2004 Prairie drought: A model inter-comparison study

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The Canadian Prairies is a drought-prone region and model predictions of Prairie droughts have been problematic. One of the worst droughts that affected the region occurred recently during 1999-2004. In this study, the drought event was simulated with several regional climate models (RCMs) that included several different versions of the Canadian Regional Climate Model (CRCM), the Global Environmental Multiscale – Limited-Area Model (GEM-LAM), the Climate version of the Local Model (CLM) and the Regional Spectral Model (RSM). Water and energy budgets computed from the model results are compared with available observations and reanalysis products to assess the extent to which aspects of the extreme event could be simulated accurately with state-of-the-art RCMs. Biases in the simulated regional water and energy budgets are related to regional manifestations of known deficiencies in the models where possible. Implications

of the results to improving drought predictions for the region will also be discussed.

1D-302.3 ID:2665 **16:30**

A Regional Climate Model for the British Columbia Continental Shelf

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Though statistical downscaling has been widely used to interpolate results from global climate models to specific oceanic locations, the resultant fields can be inaccurate if those models are unable to represent important meso-scale features and processes. This is certainly the case in the waters off British Columbia where mountainous terrain, and complicated coastlines and bathymetry combine with seasonally varying winds to produce subregions that have high biological productivity in the summer and that export larvae and nutrients offshore in the winter. In order to better understand how these processes may change in the future, a regional climate model is being developed for the continental shelf waters off British Columbia. Though this model will initially take its atmospheric forcing from one or more regional, atmosphere-only, climate models (either the Canadian Regional Climate Model or the University of Washington regional climate model), it would be clearly beneficial to develop a coupled atmosphere-ocean climate model in the future. In this presentation, we will describe progress in the development of this BC ocean climate model and summarize analyses of the downscaled winds that will be used to force it.

1D-302.4 ID:2749 **16:45**

UV-B Cloud Optical Properties for Canada

Jacqueline Binyamin [1], *John Davies* [2], *Bruce Mcarthur* [3]
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Broadband values of UV-B cloud optical properties are calculated for nine Canadian stations from 26 years of data. Cloud single scattering albedo and asymmetry factor are computed from Mie theory for two values of equivalent droplet radius; 7 micrometers for arctic stations and 10 micrometers for midlatitude and subarctic stations. Overcast cloud optical depths are estimated iteratively for a model cloud layer located between 2 and 3 km above the surface from hourly integrated spectral Brewer spectrophotometer measurements for snow free cases using either the discrete ordinate radiative transfer (DISORT) or the delta-Eddington algorithms. Median cloud optical depth values calculated by both algorithms compare to within 3%. Median values are smaller for arctic stations (9-18) and between 26 and 38 for the rest. Both mean and median values are negatively correlated with latitude. Aerosol effect on cloud optical depth varies between 9-18% on average.

1D-302.5 ID:3002 **17:00**

Climate and regional air quality impacts on Canadian and Ontarian scales using GEM-AQ and GEM-AQ/LAM

John Mcconnell , *Alex Lupu* , *Lori Neary* , *Jacek Kaminski* , *Kenjiro Toyota* , *Kirill Semeniuk*
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Poor air quality has an important impact on human health and can be injurious to animals, agriculture and forestry. We have begun a study to investigate future air quality in Canada and also in Ontario. Future climate change will impact both global and Canadian air quality in various ways. With an increased population, a strong economy (hopefully!) and possible growth of the tar sands and oil extraction, one might expect anthropogenic emissions to change in Canada. Perhaps, more important will be the growth of the economies of both China and India and one can anticipate global emissions of pollutants will also increase and so modify the “background” atmosphere. In addition, with climate change and increasing temperatures there will be changes in natural emissions of chemical species such as isoprene from vegetation which are sensitive to temperature and can drive ozone generation and possibly particle formation. Furthermore, with climate change the Arctic is likely to be ice free during the summer and one can anticipate increased ship traffic from large tankers and container ships, each of which puts out pollution equivalent to a medium-sized town. Also with climate change it is expected that there will be increased boreal forest fires as Canadian (and other) boreal forests adapt to changing climate conditions. Changes in meteorology may lead to increased transport of mid-latitude pollutants into the Arctic such as occurred during the spring of 2006. We plan to carry out scenario studies to assess changes in global and Canadian air quality that might be anticipated over the next 50 years. We will present the current status of this project. We also plan to do a retrospective of Canadian AQ using GEM-AQ to estimate the historical exposure of Canadians to poor air quality over the last 40 years.

1D-302.6 ID:2867 **17:15**

North Atlantic Climate Modeling Results from CGCM3

Lanli Guo [1], *William Perrie* [1], *Yaocun Zhang* [2], *Zhenxia Long* [1], *Tao Xie* [1]
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The simulated climate over North Atlantic area from the CCCma Third Generation Coupled Global Climate Model (CGCM3-T47) is systematically compared with the NCEP/NCAR reanalysis data in terms of mean climate patterns and different time-scale variances over the North Atlantic. Such comparisons demonstrate that the model can capture the major features of mean climate over the North Atlantic, especially the skin temperature whose spatial correlation coefficient with the NCEP/NCAR reanalysis data is more than 0.9. Analysis also shows that CGCM3-T47 has the ability to simulate the seasonal evolution of the westerly jet near the tropopause with clear northsouthward jumps shown in the NCEP/NCAR reanalysis data; however, the simulated CGCM3-T47 maximum zonal wind is stronger. However, we found that there exist some obvious problems in CGCM3-T47 outputs. For example, the simulated positive NAO center is more westward than that reported by NCEP/NCAR data, and the NAO index begins to decrease during the 1980s which is different from that in the reanalysis data. Moreover, CGCM3-T47 underestimates temperature increases (in recent years) over the high latitude area which suggests that it has excessive sea ice extension in that region. This is verified in comparisons with Hadley Centre data. Finally, CGCM3-T47 also has some difficulties in simulating decadal changes of the tropopause westerlies, comparing the recent two decades 1981-2000 to 1961-1980, which is related with the simulation of the meridional atmospheric temperature gradient in the troposphere.

Operational Meteorology (PART 3) / Météorologie opérationnelle (Partie 3)

Room / Endroit (303), Chair / Président (Damian Braet), Date (01/06/2009), Time / Heure (16:00 - 17:30)

1D-303.1 ID:2723 **16:00**

Conceptual Models

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Conceptual models are the words in the language of meteorology. Meteorologists with a thorough vocabulary are able to quickly analyze and diagnosis the atmosphere in all of its complexities. The conceptual model words only go together in particular ways to make the weather story. Ongoing evaluation of the conceptual models allows early detection of deviations of the real atmosphere from the meteorological script. Better understanding of the current atmosphere and the conceptual model result. This improved understanding creates a better prediction.

A conceptual model represents an atmospheric structure. A thorough conceptual model includes the genesis, evolution and decay of the atmospheric structure. A meteorologist conversant with the conceptual model can analyze and diagnosis the structure bringing all of the past science to the task.

Accurate prediction requires the analysis and diagnosis of all of the atmospheric structures occupying the entire forecast domain in time and space. This is only possible by combining the strengths of the meteorologist and the conceptual model. The human strengths of cognitive pattern recognition and situational awareness when combined with the science contained in the conceptual models, allows comprehension of what might

appear to be extraordinarily complex. This approach permits an analysis and diagnosis of the atmosphere that is independent from but complementary to the NWP.

Meteorology is an art as well as a science. Humans have a skill set that is indispensable in solving the earth and atmospheric puzzle. Using the cognitive human skills and a library/vocabulary of conceptual models, the human role in analysis and diagnosis is essential. With the understanding that results from analysis and diagnosis, the human is quite capable of making consistent, reasonable and value added improvements in the numerical weather predictions. At this point, the "Human-Machine Mix" blossoms from a Mechanic-Machine Servitude to the envisioned Professional-Machine Symbiotic relationship.

1D-303.2 ID:2753 **16:15**

An Early Summer Hail Event over Northeastern Newfoundland from An Operational Perspective

Damian Braet
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Scattered elevated thundershowers, some producing reported hail, passed across Newfoundland's Bonavista Peninsula on the afternoon of June 22, 2008. A couple of days later, a supervisor at the Newfoundland and Labrador Weather Office heard of reports of large hail possibly meeting warning criteria during this event from a Gander International Airport observer. The observer had received an account from an eyewitness from the Bonavista Peninsula who had experienced possible warning-criterion sized hail on June 22. Showers and thundershowers were in the forecast during this event, but no watches or warnings were issued. The purpose of this presentation will be to describe the synoptic and mesoscale environments leading up to and including the thundershower event of June 22, 2008; to assess whether possible warning-sized hail from the thundershowers was detectable on radar; and to determine whether nowcasting techniques or NWP guidance would have provided clues to forecasters as to the severity of the thundershowers.

1D-303.3 ID:2850 **16:30**

Lightning Events in the Yellowknife Region of the Northwest Territories

Bob Kochtubajda [1], *William Burrows* [2]
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The convective season and associated lightning activity from thunderstorms in the Northwest Territories (NWT) is characterized as short but intense. During the late evening of August 10 and early morning of August 11, 2008, a powerful lightning storm moved through the southern regions of the NWT and caused numerous power outages and damaged several transformers and other fuses and equipment over the city of

Yellowknife. Several questions will be addressed. How unusual was this event compared to previous storms in the Yellowknife area? How well did the statistical lightning model forecast this event? Lightning flashes recorded by the Canadian Lightning Detection Network over a ten year period (1999-2008) within a 100 km by 100 km area of Yellowknife were examined and twenty four (24) lightning events were identified. The spatial and temporal characteristics of the cloud-to-ground (CG) lightning flashes were analyzed in terms of their polarity, peak current, and multiplicity. The average negative polarity peak currents during the August 2008 event were significantly stronger than any of the previous lightning events.

Favourable conditions for several hours of convective activity over the Great Slave Lake area during the time of this storm were forecast by several special convection fields displayed on the HAL website on the morning of August 10. A large region of elevated CAPE in excess of 2500 J/Kg and effective bulk shear greater than 25 kt was forecast to move toward Yellowknife on the evening of August 10, and to lie over a region of moist and deep low level convergence as a front pushed slowly southeast across the region. The statistical lightning forecast model (Burrows, 2007) successfully predicted the probability of lightning and flash rate out to 45-48 h in advance. The spatial and temporal features of lightning activity in the region were well represented by the model. A significant area of activity over the Yellowknife area in the early morning period was predicted which was subsequently verified by the lightning observations.

1D-303.4 ID:2780 **16:45**

The Challenge of Forecasting High Rainfall Events in the Maritimes

Mark Pilon
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Thanks to advances in NWP guidance in recent years forecasters in Atlantic Region are often aware 24 to 48 hours ahead of time of the potential of a high impact rainfall event occurring over their area of responsibility but may not know precisely when or where it will happen. This poses new problems for the forecaster not previously encountered. While the NWP guidance has advanced in accuracy and capability, the final product which is sent to the end user has changed little in terms of its format and the kind of information it contains. The problem of how to incorporate the desired level of detail and associated uncertainties about a high impact rainfall event into current short term forecast products will be illustrated using a specific case that unfolded during the 2008 Labour Day weekend in the Maritimes. Some possible solutions to the problem will be proposed.

1D-303.5 ID:2830 **17:00**

The MSC Forecasters Forums and the Future Role of the Human Forecaster

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The Meteorological Service of Canada held a series of three 'Forecasters Forum' meetings between 2003 and 2005 to seek input from the meteorological community on the best ways to implement a restructuring strategy and to develop a common vision related to the provision of weather forecasts. The meetings provided significant insight on a number of topics related to operational forecasting in Canada and have added to the larger discussion on these issues in the international meteorological community.

Over the course of the three forums, several themes emerged as overarching concerns. Foremost among them was the future role of the human forecaster. Most forum participants believed that human forecasters should be the "heart of weather prediction", with an increased emphasis on the analysis / diagnosis / prognosis paradigm, and recommended developing the sophisticated tools required to facilitate that role.

Based on results from the forums, it is proposed that the primary role of the future forecaster should be to develop and maintain a sequence of plan-view composite depictions evolving through time to best represent the current and future states of the atmosphere. This would be accomplished using an area-based, object-oriented analysis / forecast system with a toolbox of numerical weather prediction guidance and carefully designed artificial intelligence assistants. The forecaster's work would be focused on high-impact weather events, mainly in the short term but also in the longer term when necessary. Products would be automatically generated from the weather-object database, allowing the forecast team to focus on "hands-on" meteorology and maintaining shared situational awareness at all times.

Work on a prototype analysis / nowcasting system that embodies the above concepts will also be described.

1D-303.6 ID:2909 17:15

Bridging the gap between research and operations: observations within the Meteorological Service of Canada

Brad Snyder , *David Sills*
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A gap can be defined as the difference between two things. In the field of meteorology numerous articles have been written relating to the gap between researchers and operational forecasters and it is generally agreed that when these two communities do interact, progress in the science flourishes. Results from a recent survey of meteorologists shows that more often than not, this interaction is weak.

Two recent examples of interaction between researchers and operational forecasters within the Meteorological Service of Canada (MSC) are given to illustrate successful ingredients for interaction. These are the Research Support Desk and the Mountain Weather Workshop.

Examples are also given where interaction is weak within MSC. We describe the role of

the Science Transfer and Training (STT) meteorologist and offer ideas of how improvements can be made to further enhance the transfer of science into operations.

MSC Town Hall Meeting / Séance de discussion publique du SMC

Room / Endroit (302), Chair / Président (David Grimes), Date (01/06/2009), Time / Heure (19:00 - 20:00)

1F-302.1 ID:2677 INVITED/INVITÉ 19:00

A renewed vision and strategic direction for Environment Canada’s weather and environmental services

David Grimes
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Environment Canada’s weather and environmental services are at a crossroads of opportunity and challenge. Environmental change is having profound effects on Canadians' health and safety, their economic prosperity and their natural environment, particularly in the North. Occurrence and impacts of hazardous weather events are on the rise, and the North is experiencing unprecedented environmental change that is rapidly opening the area up for economic development. The expectations of Canadians are growing for timely and accurate environmental information and forecasts to deal with these important developments. At the same time, Environment Canada’s weather and environmental services are facing a number of challenges. For instance, its technical infrastructure is in need of reinvestment and re-engineering in order to sustainably and effectively meet its mandate; its dissemination mechanisms are in need of modernization; and its aging workforce needs to be renewed. Environment Canada’s weather and environmental services have conducted some consultations to develop a Vision and Strategic Directions for a renewed service offering that will meet the growing and changing needs of Canadians and the stakeholders we serve. In addition to internal process, we have recently undertaken a process of external engagement with our various stakeholders, principle among whom are academe, the media, and economic sectors such as energy, forestry, transportation and agriculture. We are also seeking the views of other government jurisdictions that rely on our products and services, such as municipal Emergency Measures Organizations, the provinces and territories, as well as other federal departments. As Canada’s meteorological and oceanographic society, CMOS’ input into the definition of Environments Canada’s future is critical. A proposed vision for the future of our weather and environmental services and its product and service offerings of the future will be presented, followed by a forum designed to encourage input from the CMOS community.

2A-GRAND.1 ID:2774 INVITED/INVITÉ 08:30

The Importance of Geostationary Weather Satellites in Tropical Cyclone Forecasting: A Perspective

John Beven Il
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The development of the geostationary weather satellite is probably the single most important change that has occurred in the tropical cyclone (TC) forecast process during the past 150 years. By improving the detection and analysis of TCs in data-sparse ocean regions, geostationary satellites and the tools developed to use their data have helped to create a more efficient warning process that has saved countless lives. Improved forecasts and warnings have resulted from both better subjective analysis of TCs and higher-quality data being assimilated into numerical weather prediction models. Moreover, the improved detection capability has impacted TC climatology, as the satellites have observed numerous TCs that would have gone undetected in the pre-satellite era. Geostationary satellite data have also helped document a spectrum of cyclone types and many unusual cyclone events. Finally, future geostationary weather satellites are scheduled to carry improved instrumentation, which should result in additional advances in their TC-related capabilities.

2A-GRAND.2 ID:3120 INVITED/INVITÉ 09:15

Sun, Sea, Dust and Gases. Air-Sea Biogeochemical Interactions in the Tropical Eastern North Atlantic

Douglas Wallace , (and Sopran Investigators)
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The region between Mauritania and Cape Verde is heavily influenced by upwelling and also receives some of the strongest dust deposition in the World Ocean. The region is being intensively studied in the context of the German SOPRAN* programme (www.sopran.pangaea.de), through a combination of cruises as well as long-term observations at Cape Verde and campaigns at the Mauritanian coastline. The presentation will present an overview of recent results including: (1) distribution and air-sea exchanges of key gases; (2) the potential of dust deposition to relieve nutrient limitation of carbon and nitrogen fixation. The presentation will attempt to identify the key questions and unresolved issues arising from these studies and outline opportunities to address them. The latter will include a status report on the Cape Verde Observatory that has been jointly established as part of the international SOLAS programme. * Surface Ocean Processes in the Anthropocene

Water, Weather and Climate Serving the Energy Sector (PART 1) / Eau, temps et climat servant le secteur énergétique (Partie 1)

Room / Endroit (202), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-202.1 ID:2981 **10:30**

Wind Energy Forecast: New Challenges in Meteorology

Joël Bédard [1], *Wei Yu* [2], *Yves Gagnon* [3], *Christian Masson* [4]
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With the sustained growth of wind energy installed capacity for electricity generation, electricity system operators have increasing challenges balancing the electricity grid, notably in regards to minimize the cost of balancing other energy sources. Therefore, there is a pressing need for robust short-term wind forecast models (4 to 48 hrs), and for wind power forecast models, to sustain the integration of wind energy in electricity portfolios of jurisdictions. Indeed, balancing the electricity grid, the transmission load, the power generation dispatch and the energy trades have to be managed according to the demand. Because of the intermittence of the wind, the wind power generation forecast becomes an important issue for the economic viability of wind energy, whether in a regulated market, as in Canada, or in open markets, as in many US states. Since the power forecast is affected by both the intensity and time of the wind, work is needed to assess the uncertainties of models on the amplitude and the phase of wind speed forecasts. This presentation will introduce short-term numerical wind power prediction models, along with uncertainty analysis tools and methodologies used to assess and understand the numerical weather prediction uncertainties. An analysis will be presented for the North Cape (PEI) site where wind data are available from Environment Canada experimental forecasts (GEM-LAM 2.5km), the Wind Energy Institute of Canada (WEICan) anemometer tower data and the PEI Energy Corporation's 10 MW wind power generation data. The objective of the current study is to present a number of possibilities to improve short-term numerical weather predictions and wind power forecasts according to the needs of the wind energy industry. A better knowledge of the wind speed and wind power forecast uncertainties, along with more accurate short-term wind forecast models, will increase the economic value of wind energy on the market.

2B-202.2 ID:2905 **10:45**

A High Resolution Wind Forecasting System for the Wind Energy Sector: An Overview on the Real-Time Tests in Quebec

André Plante [1], *Laurent Chardon* [2], *Sarah Dyck* [2], *Nathalie Gauthier* [2], *Anna Glazer* [2], *Robert Benoit* [3], *Franco Petrucci* [1], *Alain Forcione* [4], *Pierre Dionne* [5], *Julien Choisnard* [6], *Slavica Antic* [6], *Gaétan Roberge* [4]
(Presented by *Wei Yu*)
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Accurate prediction of winds is of critical importance for the electricity grid integration of wind power and daily management of wind farms. Environment Canada (EC) initiated a research project in collaboration with Hydro-Québec (HQ) on the development of a high resolution wind forecasting system: SPÉO (Système de Prévision ÉOlienne). This central part of this system is the GEM-LAM 2.5km. The system is fed with the CMC operational regional forecasts. It is run twice a day (00 and 12 UTC) for a 48-hours forecast horizon at a resolution of 2.5 km.

This experimental forecasting system has been under tests in real-time since May 2007. The meteorologists of EC and HQ evaluate the daily forecasts using real-time observations from both EC meteorological stations and special masts installed in the wind plants, and wind power productions. The hourly forecasts are archived over the last two years and provide a valuable database for analysis of the model’s performance and of other meteorological phenomena. This talk will give an overview of the project and some validation results. Research needs for further improvement of this forecasting system will also be discussed.

2B-202.3 ID:2903 **11:00**

A High Resolution Wind Forecasting System for the Wind Energy Sector: A Focus on Mountain waves Activity

André Plante [1], *Wei Yu* [2], *Laurent Chardon* [2], *Sarah Dyck* [2], *Nathalie Gauthier* [2], *Anna Glazer* [2], *Robert Benoit* [3], *Franco Petrucci* [1]
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The GEM-LAM 2.5 km has been running experimentally for more than one year with a grid centered over the Gaspe area in a joint effort between Environment Canada and Hydro Québec to develop and evaluate the performance of the Système de Prévision ÉOlienne (SPÉO). This system uses the Environment Canada operational regional model

at 15 km resolution to nest the GEM-LAM 2.5 km. The model is integrated for 48 hours at 00 and 12 GMT.

Wind forecast verifications at wind farms show that the GEM-LAM 2.5 km outperforms the regional 15 km especially during mountain wave events. The physical mechanism behind these events is similar to that of the well-known Cape Breton “Les Suetes”. A diagnostic procedure was developed to detect the mountain wave events from the standard model outputs. More than 80 such events were detected between May 2007 and April 2008. Some cases will be presented along with the scores of the regional 15 km and GEM-LAM 2.5 km against wind farm observations.

2B-202.4 ID:3016 11:15

Environment Canada's future role in support of wind and solar energy forecasting

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The emerging solar and wind energy technologies promise to greatly help Canada meet its obligations to reduce GHGs. Compared with conventional sources of energies however, the fuel for wind and solar energy generation is dependant on the weather and is therefore variable. In order for electric utilities to maximize the use and integration of wind and solar into their grids, it is essential that they know in advance and for a certain period of time how much wind and sun they can count on. Therefore, wind and solar energy forecasts are increasingly becoming essential tools for the electric grid operators so that they can make appropriate decisions on how to dispatch other sources of energy when wind and solar are present, etc. For more that two years now, EC has been in collaboration with Hydro-Québec on the development of a complete system to forecast wind energy coming out of wind farms. EC has also been collaborating with CanMET Varennes to provide them with GEM model outputs so that solar radiation forecasts can be derived. In this presentation, the broad lines of these two cooperations will be explained. And given EC's special role as the national weather forecaster, a vision of where wind and solar forecasting could go and the possible contribution that EC could bring to these industries will be presented.

2B-202.5 ID:3087 INVITED/INVITÉ 11:30

Is a wind Energy forecast enough?

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With the plan to integrate large amounts of wind energy into the grid, one has to ask the question; is a reliable wind energy forecast enough to operate the future grid? Considerations are now being given to; other types of forecasts, employment of meteorologists in the energy sector, need for “wind-weather” education in the energy sector?. Much like an airline pilot or a ships captain, the electrical system operator will need not only to understand the forecast, but make sense of the weather and have the tools to see it developing. Training and tools to effectively manage the ever increasing supply of Variable wind energy will be needed in the future. This presentation will describe some of the reasons for these future needs.

Acoustics in Oceanography (PART 1) / L'acoustique en océanographie (Partie 1)

Room / Endroit (203), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-203.1 ID:2891 INVITED/INVITÉ 10:30

Doppler sonar and fish: when can you measure fish speeds?

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Doppler current profilers rely on volume backscatter to infer water velocities remotely. Under certain circumstances these instruments receive acoustic backscatter from larger aggregations of zooplankton and isolated or schooling fish. Under these conditions, the resulting velocities are representative of the fish motions but care must be taken in interpreting the data. Fish present the acoustic system with large discrete targets giving rise to higher accuracy speed measurements than is possible from volume backscatter. However, the discrete nature also gives rise to intermittent observations. As a result, where velocities for large highly concentrated fish schools can be extracted using the usual Doppler profiling algorithms, lower concentrations of fish require a different approach. We discuss the processing required for both conditions and provide example of observations from laboratory trials, large fish schools (Norwegian Herring), and discrete fish (Fraser River Salmon, and Atlantic Cod in coastal Newfoundland).

2B-203.2 ID:2942 INVITED/INVITÉ 11:00

Applications of active and passive acoustics to marine mammal ecosystem understanding

Yvan Simard
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Marine mammals make extensive use of acoustics in realizing their vital tasks to survive, grow and reproduce in the large marine ecosystems they belong to. Man is learning to mimic this general behaviour by using acoustics to determine the keystone characteristics

of these ecosystems, understand their functioning in relation to oceanographic processes and forcing at different scales, monitor their utilisation pattern by marine mammals in time and space and study the effects of noise pollution. Examples of such uses are presented here for the St. Lawrence and Canadian Arctic ecosystems. The Saguenay–St. Lawrence Marine Park (SSLMP) in Eastern Canada is a traditional summer feeding ground for Northwest Atlantic baleen whales. Multifrequency acoustics have been used in the last decade in combination with 3D circulation modeling to demonstrate how this ecosystem "hot spot" is resulting from the two-layer estuarine pumping of krill over a large part of the Gulf of St. Lawrence, their concentration by intensive tidal upwelling interacting with krill behaviour along slopes, and their accumulation in the "dead end" made by the channel head. Along slopes currents, hydraulic jumps over topography, upwelled water fronts and their subduction into the Saguenay fjord generate predictable small-scale structures where krill and fish are trapped and that whales take advantage of. Whale frequentation of this SSLMP ecosystem can be monitored in continue for long periods by detecting and localising their specific vocalisations recorded on hydrophone arrays deployed in the basin. The same acoustic data can be used to measure the shipping noise from the St. Lawrence Seaway, a major continental shipping route, the contribution of the different ship categories, and investigate the impact of this pollution on whale communication. The same acoustic methods were used to demonstrate the mesopelagic nature of the key forage fish species of the Arctic, the arctic cod, and its aggregation in large overwintering concentrations in particular "hot spots" in response to physical-biological coupling, as well as the occupation of the habitat by the marine mammal community over the annual cycle, in response to climate change effect on ice.

2B-203.3 ID:3104 **11:30**

Physical forcing of space-time variation in the copepod prey-field of right whales in Roseway Basin at diel and tidal scales

Kimberley T. Davies , *Douglas J. Schillinger* , *Alex E. Hay* , *Christopher T. Taggart*
(Presented by *Kimberley Davies*)
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Defining the critical feeding habitat for endangered species is the goal of many marine science initiatives. In the pelagic zone, habitat boundaries are difficult to define statically in space because the prey-field is subject to advection and mixing by regional flow fields. Here we address this issue in relation to defining the critical feeding habitat of the endangered North Atlantic right whale. These whales feed on diapausing, lipid rich copepods that are aggregated in high concentrations, near bottom, in the deep (>100m) basins of the Scotia-Fundy region. We ask can variation in the spatial distribution of the right whale prey-field at short (tidal, diel) time scales be explained by variation in the current regime in Roseway Basin. Current speed and acoustic backscatter (zooplankton abundance) data were simultaneously collected using moorings at three locations in the Basin. Two moorings, fitted with upward looking Acoustic Doppler Current Profilers (ADCP; one 300 kHz and one 600 kHz), downward looking Aquadopp profilers, and CTDs (SBE-37), straddled a sloping region on the edge of the Basin where whales feed and were located within one tidal excursion from one another. This ensured a full profile

of current and backscatter estimates and measures of the near-bottom hydrographic properties. The third mooring (upward looking 300 kHz ADCP) was located at the deepest portion of the Basin. The area was concurrently surveyed using a ship-mounted echo-sounder (Simrad, 120 kHz). We illustrate how zooplankton abundance varies in response to tidal advection of water masses and the residual circulation.

2B-203.4 ID:2709 11:45

Long-term broadband acoustic observations of zooplankton scattering layers in Saanich Inlet, British Columbia

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The application of broadband techniques to fish and zooplankton bioacoustics is showing potential to transform the field into one that is much more quantitative. This is because broadband techniques allow the use of the known spectra of organisms or non-biological sources of scattering to distinguish between scatterers, allowing discrimination without the need for extensive groundtruthing. This makes it ideal for remote monitoring of fish or zooplankton assemblages, since continuous net-sampling is often not possible. An upward-looking 85-155 kHz broadband sonar has been collecting data nearly continuously on the Victoria Experimental Network Under the Sea (VENUS) mooring in Saanich Inlet, British Columbia since March 2008. Saanich Inlet is known to have large populations of euphausiids, which create a strong acoustic scattering layer that migrates from depth to the surface and back each day. The spectral response of this layer is examined throughout the annual cycle and the feasibility of using this type of sonar to elucidate changing zooplankton assemblages (due to growth and changing species composition) is assessed.

Atmosphere, Ocean and Climate Dynamics (PART 1) / Dynamique de l'atmosphère, de l'océan et du climat (Partie 1)

Room / Endroit (204), Chair / Président (William J. Merryfield), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-204.1 ID:2798 INVITED/INVITÉ 10:30

The predictability of ocean-modulated westerly wind bursts and the implications for ENSO forecasts

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Westerly wind bursts (WWBs), a significant player in ENSO dynamics, can be modeled using an observationally-motivated statistical approach that relates the characteristics of WWBs to the large-scale sea surface temperature. Although the WWB wind stress at a given location is a nonlinear function of SST, the characteristics of WWBs are well described as a linear function of SST. Over 50% of the interannual variance in the WWB likelihood, zonal location, duration, and fetch is explained by changes in SST. The model captures what is seen in a 17-year record of satellite-derived winds: the eastward migration and increased occurrence of wind bursts as the western Pacific warm pool extends. The WWB model shows significant skill in predicting the interannual variability of the characteristics of WWBs, while the prediction skill of the WWB seasonal cycle is limited by the record length of available data.

The WWB model can be implemented in stochastic or deterministic mode, where the deterministic mode predicts the ensemble-mean WWB characteristics. Therefore, the WWB model is especially appropriate for ensemble prediction experiments with existing ENSO models that are not capable of simulating realistic WWBs on their own. Here, the WWB model is added to a hybrid coupled model which previously only included a linear statistical atmosphere, thus activating a two-way SST-WWB feedback. An ensemble of retrospective forecasts is performed for the years 1979-2002. In particular, the addition of the WWB model improves the prediction of the onset and the development of the large 1997 warm event, pointing to the potential for ENSO prediction skill improvement using this approach.

2B-204.2 ID:2687 11:00

Global extratropical response to diabatic heating variability of the Asian summer monsoon

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Global teleconnections associated with the Asian summer monsoon convective activities are investigated, based on monthly data of 29 Northern Hemisphere summers that are defined as June, July, August and September (JJAS). Two distinct teleconnection patterns are identified that are associated respectively with the diabatic heating variability of the Indian summer monsoon and the west North Pacific summer monsoon. The Indian summer monsoon convective activity is associated with an equator-symmetric pattern which has a far-reaching zonal connection in both hemispheres, whereas the west North Pacific summer monsoon convective activity is connected to a Southern Hemisphere wave train that influences the high latitude South Pacific and South America. A global primitive equation model is utilized to assess the cause of the global circulation anomalies. The model responses to heating sources of both monsoon systems match well the general features of the observed circulation anomalies. It is found that the response pattern is largely determined by the summertime large-scale background mean flow and the location of the heating anomaly.

2B-204.3 ID:2728 **11:15**

Land Surface Wind Speed Probability Distribution: A Global View

Yanping He [1], *Adam Monahan* [2], *Norm Mcfarlane* [3]
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Probability distributions of land surface wind speeds (SWS) are needed for applications such as estimating wind power, surface fluxes, dust emission and for extreme wind risk assessments. Three-hourly observations of surface winds from 3734 weather stations and six-hourly multi-level winds from NCEP-NCAR reanalysis during 1979-1999 are analyzed to produce the probability distribution (PDF) of SWS and consider its correlation with free atmosphere winds over global land. It is found that in regions where the surface winds are well correlated with the above free atmosphere winds, the land SWS-PDF is more Weibull-like due to a dominating influence from free atmosphere; however in regions where surface winds is poorly correlated with free atmosphere winds, the land SWS shows non-Weibull behavior due to strong influence from land surface conditions. From observations, the SWS skewness anonymous from its Weibull value becomes larger when free atmosphere winds become smaller. In most cases, SWS-PDF is more skewed when land surface is stable. The observed relationships of SWS-PDF with free atmosphere winds and land surface conditions explain well the seasonal shift and spatial distributions of SWS-PDF over global land. Physical mechanisms of how the free atmosphere and land surface influence the global land SWS probability distribution are further investigated through a CCCMa Single Column Model (SCM) study. Results from both observations and the SCM study will be presented.

2B-204.4 ID:2964 **11:30**

On the Dynamics of Hurricane Secondary Eyewall Formation

Yosvany Martinez [1], *Gilbert Brunet* [2], *Peter Yau* [1], *Xingbao Wang* [1]
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A simple 2D barotropic “dry” model and the high-resolution PSU-NCAR non-hydrostatic mesoscale model (MM5) are used to study the role of hurricane asymmetries on the secondary eyewall formation. The Empirical Mormal Modes (ENM) and the newly developed Space-Time Empirical Normal Modes (ST-ENM) techniques, together with the Eliassen-Palm (EP) flux calculations, are used to isolate wave modes from the model datasets to investigate their impact on the changes in the structure and intensity of the simulated hurricanes. From the ENM diagnostics of the 2D simulations, it is shown that when asymmetric disturbances are placed outside a strong vortex ring with a large vorticity skirt they relax to form concentric rings of enhanced vorticity that contain a secondary wind maximum. The role of internal dynamics on Concentric Eyewall Genesis (CEG) is further evaluated using the full physics MM5 simulation. The leading modes of the ST-ENM diagnostics exhibit mainly characteristics of vortex Rossby waves (VRWs)

and their contribution to the EP flux divergence induced two regions of maximum tangential wind acceleration; one inside the primary eyewall which accounts for eyewall contraction and the other outside the primary eyewall which explains the development of the secondary eyewall. The fact that the critical radius for some of the leading modes is close to the location where the secondary eyewall eventually develops, for the “dry” and the full-physics experiments, suggests that a wave-mean flow interaction mechanism may be suitable to explain important dynamical aspects of the CEG.

Carbon Uptake in the Ocean - Problems of Ocean Acidification and Feasability of Iron Fertilization / Absorption du carbone dans l'océan - Problèmes de l'acidification des océans et faisabilité de la fertilisation avec le fer

Room / Endroit (205), Chair / Président (Kumiko Azetsu-Scott and Paul Lyon), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-205.1 ID:2679 INVITED/INVITÉ 10:30

Acidification of the hypoxic bottom waters in the Lower St. Lawrence Estuary: A history and potential impacts

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Above and beyond the acidification of the surface ocean by anthropogenic CO2, marine waters can be acidified by accumulation of metabolic CO2. In the open ocean, the concentrations of dissolved inorganic carbon (DIC) and protons typically increase with depth below the euphotic zone and reach maxima in the oxygen minimum zone because CO2 production and O2 consumption are linked through the stoichiometry of respiration. Similarly, where bottom waters are not readily replenished in O2 or isolated from the atmosphere, respiration will consume O2, accumulate CO2 and decrease the pH. A recent study has documented the development of persistent, severely hypoxic waters (DO < 62.5 µmol L-1) in the Lower St. Lawrence Estuary over the last 70 years (LSLE; Gilbert et al., Limnol. Oceanogr. v.50, pp. 1654-1666, 2005). The bottom waters of the LSLE are isolated from the atmosphere by a permanent pycnocline, and metabolic CO2 produced in the bottom water or in the sediment accumulates. We reconstructed the temporal evolution of the pH of the bottom waters from historical and recent data as well as from first principles relating oxygen consumption and metabolic CO2 production through organic matter degradation. Our calculations reveal that the saturation states of the bottom waters with respect to calcite and aragonite have decreased concomitantly with pH over the last 70 years. The bottom waters (below 250 m) in the LSLE remain supersaturated with respect to calcite ($\Omega c \approx 1.03$) but they are now strongly undersaturated with respect to aragonite ($\Omega a \approx 0.65$). Bottom-dwelling, carbonate-secreting organisms (mollusks, bivalves, benthic foraminifera) must now expend more energy to secrete their skeletons, and aragonite shells that settle to the sediment-water interface are now exposed to corrosive waters and less likely to be preserved in the sedimentary record.

2B-205.2 ID:2851 11:00

Spatial variability of pH in the Bedford Basin

Darlene Brownell , *Kumiko Azetsu-Scott* , *Dave Slauenwhite* , *Chris L'Esperance*
Bedford Institute of Oceanography
Contact:

The oceanic uptake of atmospheric CO_2 due to increasing anthropogenic emissions is increasing and as a result acidifying the ocean. Acidification in coastal waters is a potential threat to calcifying organisms including commercial species such as shellfish. Therefore, ccean acidification in coastal regions has profound socioeconomic consequences. The need to quantify these changes is important in understanding and predicting future oceanic conditions. Relative to the open ocean, pH variation in coastal waters is more strongly affected by biological and physical processes on smaller spatial and shorter temporal scales. Potential control factors for coastal pH variability include fresh water input with lower pH, lateral transport of water by tide and estuarine circulation and vertical mixing, and high biological productivity. Bedford Basin is one the best studied basin in east coast Canada and physical and biological characteristics are well described. A field survey of measuring pH using both spectrophotometric and potentiometric methods, at approximately 15 stations in Bedford Basin, before, during and after a spring bloom will be discussed. The results of this experiment will provide information on the spatial variability of pH, together with other carbonate chemistry parameters, in a coastal region.

2B-205.3 ID:2810 11:15

Temporal variation of pH and TIC/Alkalinity in Bedford Basin

David Slauenwhite , *Kumiko Azetsu-Scott* , *Bill Li*
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As part of experiments to determine the processes affecting pH in the marine environment, a one-year time-series was conducted in Bedford Basin, Nova Scotia, measuring pH, alkalinity and total inorganic carbon as well as other physical parameters at 4 different depths (1, 5, 10 and 60m), weekly over the course of the spring

phytoplankton bloom and roughly monthly afterwards. The pH of these waters was found to vary by as much as 0.6 pH units, which represents nearly a factor of 4 difference in acidity. In the waters nearest the surface a rise in pH is attributed in part to annual phytoplankton bloom, which sequesters CO_2 from the water and converts it to fixed carbon, and to increased riparian flux and melt water. Another spiked increase in pH at the surface later in the summer appears to be related to physical process, perhaps mixing or diffusion. The pH is lowest in the deepest depth, where mixing is poor and the water sometimes approaching anoxia. The pH at this depth (60m) increased from 7.5 to 8.0 to the peak of the bloom, then steadily declined back to lower value over the next 200 days. Although alkalinity was fairly stable at all depths over the course of the year, there was an inverse correlation with depth. TIC was more variable in time, especially at the shallowest and deepest layers.

2B-205.4 ID:2896 **11:30**

Climate change, ocean processes, and iron fertilization

Kenneth Denman , *James Christian*
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Observations indicate that the rate of increase in concentration of atmospheric carbon dioxide (CO_2) is increasing faster than projected in any of the Intergovernmental Panel on Climate Change (IPCC) emission scenarios. Several mitigation measures, referred to as "geoengineering options", have been proposed to remove CO_2 from the atmosphere. To be successful, such a mitigation operation must remove "significant" CO_2 from the atmosphere for many decades, be verifiable, and not cause deleterious side effects. One option, purposeful addition of iron to fertilize photosynthetic uptake of CO_2 by phytoplankton in regions of the ocean where iron is a limiting nutrient, has received considerable scientific attention. In the last 15 years, a dozen small scale open ocean iron fertilization experiments have been performed and a succession of models of large scale fertilization have been developed. As successive models have become more realistic, the amounts of CO_2 forecast to be sequestered have dropped, and in all cases are small relative to the amounts of CO_2 projected to be released through fossil fuel burning over the next century for any of the IPCC emission scenarios. Possible side effects include a long term reduction in ocean productivity, alteration of the structure of marine food webs, a more rapid increase in ocean acidity, and increased remineralization associated with the increased downward export of organic carbon particles. Associated effects would be a lowering of subsurface dissolved oxygen, and increased production of the third most important long-lived greenhouse gas, nitrous oxide (N_2O), the magnitude of which is poorly known.

2B-205.5 ID:2926 **11:45**

Modelling the ocean iron cycle – the major uncertainties

James Christian [1], *Kenneth Denman* [1], *Christoph Volker* [2]
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The importance of iron as a limiting nutrient for oceanic ecosystems is now indisputable. The iron cycle in the ocean impacts the biogeochemical cycles of carbon, nitrogen, phosphorus and silica, but the cycle of iron itself is poorly understood. The sources and pathways by which iron reaches the oceans, cycles within the water column, and ultimately is lost to the sediments, remain uncertain, and in some important areas current data appear contradictory or paradoxical. The rapid disappearance of dissolved iron in open-water fertilization experiments, for example, is difficult to reconcile with scavenging rates that allow deep and mid-depth concentrations to be maintained at observed levels. This talk will identify critical points of uncertainty about iron in the ocean, including the variability and concentration-dependence of scavenging rates, regulation of dissolution of aeolian iron, and lower limits to phytoplankton iron requirements. We will discuss approaches to using models and observations to reduce uncertainty, and approaches to evaluating geoengineering scenarios that are robust to these uncertainties.

Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) (PART 1) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE) (Partie 1)

Room / Endroit (301), Chair / Président (B.J. Topliss), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-301.1 ID:3053 10:30

A Framework for Research and Operations on a Global Scale – The Partnerships of CONCEPTS (three Canadian Departments and an International Community of Oceanographers and Meteorologists)

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Environment Canada (EC), Fisheries and Oceans Canada (DFO), and the Department of National Defence (DND) are engaged together in the development of an operational

global coupled atmosphere-ocean-ice data assimilation and prediction system, under the auspices of CONCEPTS (The Canadian Operational Network of Coupled Environmental PredicTion Systems). The partnership also includes Mercator-Océan (France) participation, providing some of the fundamental tool sets for the research and subsequent operational products of the Canadian CONCEPTS Core Projects. CONCEPTS R&D also benefits from close links with the university R&D community, including in particular the Global Ocean-Atmosphere Prediction and Predictability Project (GOAPP) funded by CFCAS. This talk will provide an overview of CONCEPTS organization, governance structure, the interdepartmental agreement, the negotiations involved in instituting this international system and the respective activities of the three Canadian government departments spearheading this important operational oceanography initiative.

2B-301.2 ID:2696 **10:45**

Validation and analysis of the ¼-deg global NEMO-CONCEPTS ocean model

François Roy [1], *Youyu Lu* [2], *Jean-Marc Bélanger* [3], *Hal Ritchie* [3]
(Presented by *C. Harold Ritchie*)
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A 1/4-deg global ocean and sea-ice model based on the Nucleus for European Modelling of the Ocean (NEMO) has been tested for applications in the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS). The model is initialized with the data assimilation products from Mercator-Océan of France, and is modified to take the forcing from the numerical weather forecasts of the Canadian Meteorological Centre (CMC). Initial tests show that the 10-day forecasts of the ocean state using the CMC forcing are similar to those using the forcing from the European Centre for Medium-range Weather Forecasts. Simulations lasting a full year (starting from April 2007) are conducted using 3-hourly and 6-hourly CMC forcing. Comparing the two solutions, we examine the influence of the frequency of atmospheric forcing on the ocean kinetic energy and the wind energy input to the near-inertial motions of the global ocean. This research is being conducted within the CONCEPTS project on core CMC systems, coupling and support. Its context in the CONCEPTS key activities will be discussed.

2B-301.3 ID:2706 **11:00**

Inter-annual and decadal sea level variations: a CONCEPTS study based on a coarse-resolution global ocean model

Youyu Lu [1], *Zeliang Wang* [1], *Dan Wright* [1], *Fred Dupont* [2]
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A coarse-resolution global ocean and sea-ice model, developed for the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS), is applied to simulate ocean variations during 1958-2006. The model is able to reproduce the large-scale sea level changes at inter-annual and decadal time scales, as revealed by comparing with available altimeter and island tide gauge observations. A set of sensitivity experiments is conducted to examine the impact of atmospheric conditions felt through the surface buoyancy (mainly heat) and momentum fluxes in driving the sea level changes. Results are discussed in terms of the dynamical processes relevant to heat and wind forced ocean variations. The geographical distributions of the responses to the two forcing effects, and the deviation of the combined influence from their linear summation, are quantified.

2B-301.4 ID:3048 11:15

C-NOOFS: A Canadian pilot project in operational oceanography for the North West Atlantic

Fraser Davidson [1], *Greg Smith* [1], *Andry Ratsimandresy* [1], *Debbie Anne Power* [1], *Adam Lundrigan* [1], *Charles Hannah* [2], *Dan Wright* [2], *Maud Guarracino* [2], *Denis Lefaivre* [3], *Pierre Pellerin* [4]
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To demonstrate the potential benefits of an extended Canadian operational oceanographic capability a pilot project has been into place for the north west Atlantic Ocean entitled the Canada-Newfoundland Operational Ocean Forecast System (C-NOOFS). The ultimate goal of the project is to produce an ocean ice forecast system that can be coupled to the Canadian regional GEM atmospheric forecast system. It is a follow-on project to a regional coupled ice atmosphere ocean forecasting system for the Gulf of St. Lawrence currently running at the Canadian Meteorological Centre. C-NOOFS makes use of the NEMO community ocean model forced by near real time wind forecasts from Environment Canada and provides a six-day forecast on a daily basis. In the initial development phase, boundary conditions are obtained from the 1/4 degree resolution MERCATOR-OCEAN global ocean forecast system and downscaled to 1/12 degree… The latest capabilities of the forecast system are presented along with the challenges faced in downscaling from a Global Ocean Model. The data assimilation approach to be used for the regional forecast system in its second development phase is presented as well as ongoing system validation activities. This includes validation of the ocean forecast system using seal based in-situ ocean observations.

2B-301.5 ID:3047 11:30

Resolution increase in a downscaling ocean forecast system for the North West Atlantic: The C-NOOFS example.

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The development of a pre-operational ocean forecast system referred to as "C-NOOFS" (the Canada-Newfoundland Operational Ocean Forecast System) for the northwest Atlantic has been ongoing for 4 years. The talk focuses on the work done to allow for an increase in resolution from ¼ to 1/12th of degree. This includes model tuning, validation of the boundary conditions and model-data inter comparisons. In particular we focus on the methodology undertaken in maintaining the benefits of higher resolution while still embedding the regional ocean forecast system one-way within the MERCATOR-OCEAN ocean PSY3V2 forecast (a 1/4 degree, data assimilative, global ocean forecast). The purpose is to produce a six day daily ocean forecast system for the North West Atlantic. We will present comparisons of the model results with observations (in-situ and remote sensed) and with result from other operational systems.

2B-301.6 ID:2721 **11:45**

Local refinement in the NEMO2.3 ocean model

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We present two different applications of local grid refinement using the AGRIF (Automatic grid refinement in Fortran) library that is available in NEMO2.3. The first application is a 48 year simulation of the global ocean at one degree nominal resolution with a refined region over the North Atlantic at 1/4 degree nominal resolution. The second application relates to the Gulf Stream separation problem by embedding a 1/12 degree nominal resolution regional Northwest Atlantic ocean into a 1/4 degree nominal resolution North Atlantic ocean. In each case, the results with locally enhanced resolution will be compared to results without the enhancement and to observations in order to assess the benefits of using this approach.

Climate Data Homogenization / Homogénéisation des données climatique et l'analyse des tendances

Room / Endroit (302), Chair / Président (Lucie Vincent), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-302.1 ID:3098 10:30

Impact of meteorological instruments on climate trends

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High quality meteorological data are essential for data users, e.g. forecasters, climatologists. When selecting and integrating new meteorological sensors and systems, it is important to carry out thorough testing to ensure that their uncertainty of measurement lies within acceptable limits. It is equally important to fully understand and document the more subtle biases that instrument changes may introduce into the data set. This is critical to ensuring that data users are fully able to distinguish differences caused by physical factors from those due to instrument changes and performance Canada's vast size along with its diverse and variable climate, combine to present major challenges when selecting meteorological sensors and measurement systems.

To assure the validity and relevance of the meteorological data provided to users, the Meteorological Service of Canada (MSC) has developed and implemented an extensive program for evaluating meteorological instruments and systems. This program combines the activities of calibration, laboratory and environmental testing, and functional testing. MSC conducts functional testing of meteorological instruments at a set of test sites configured specifically for this purpose and selected to provide a range of conditions representative of the various Canadian climate conditions. The tests assess the functional performance of sensors and instruments in an outdoor, natural environment where instruments are expected to operate over a wide variety of meteorological conditions and climatic regimes and help responding to questions like: a) What is the sensor or system accuracy? b) What is the variability of measurements in a network containing such systems or sensors? c) What change, or bias, will be in the instrument data when its siting or location is changed? d) What change or biases are introduced in the data when a new instrument or method of observation replaces an existing one measuring the same weather element(s)?

2B-302.2 ID:2708 10:45

An assessment of the double Alter wind shield for reducing wind bias in snowfall measurements made with the Geonor T-200B

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It is well recognized that the presence of wind during snowfall events results in a negative systematic bias in the gauge measurement of snowfall. Besides wind, the severity of this bias is dependent on several factors including the profile of the precipitation gauge and the configuration of the wind shield. This means that each gauge or wind shield configuration change in an observational program requires

intercomparison with a known reference to minimize data homogeneity issues. Precipitation measured by the Geonor T-200B all-weather precipitation gauge was compared to the WMO Double Fence Intercomparison Reference (DFIR) gauge at the Bratt's Lake SK intercomparison facility. At this site, the Geonor was installed with various wind shield configurations including the standard single Alter, a large octagonal double fence, and the double Alter wind shields. In conjunction with the Bratt's Lake intercomparisons, the relative catch of the single Alter and double Alter shielded Geonor gauges were examined at Thunder Bay and Pickle Lake ON, providing a warmer and less windy venue for intercomparison. The objective of these analyses were two-fold: 1) to determine if the double Alter increased the snowfall catch efficiency of the Geonor and make recommendations as to any revision to the standard single Alter shield configuration, and 2) to develop a wind adjustment curve for the double Alter shielded Geonor. Results showed that the double Alter, as compared to the single Alter, increased the catch of snowfall at each of the three sites. This increase was 54%, 15% and 21% at Bratt's Lake, Pickle Lake, and Thunder Bay respectively with the magnitude of the increase dependent on the relative wind speeds at the sites. At Bratt's Lake, the double Alter was shown to increase the average catch efficiency of the Geonor by 23% (as compared to the reference) but still represented a substantial negative bias of 34%. These results suggest merit in utilizing the double Alter with the Geonor gauge in windy environments but also illustrates that an adjustment for the wind bias is still required.

2B-302.3 ID:3061 **11:00**

Buoy Wind Inhomogeneities related to Changes in Averaging Method and Anemometer Type

Bridget Thomas , *Val Swail*
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This presentation will examine the differences in buoy wind speeds related to changes in averaging method and instrument type, which have the potential to introduce inhomogeneities in the long-term record. The Environment Canada moored weather buoy program began in 1987. There are a number of Canadian buoy stations in both the Pacific and the Atlantic with at least 20 years of data. The standard anemometer through this period is an R. M. Young propeller-vane mechanical anemometer. In recent years testing has begun on use of ultrasonic anemometers. The differences between these sensors are studied using simultaneous wind reports from both types of anemometer on the same buoy for a number of Pacific and Atlantic buoys. Overall differences are found to be small. In the 1990s, the buoy observing program changed from reporting a vector mean to a scalar mean wind speed. Earlier studies with buoy data from the US National Data Buoy Centre found that vector means were several percent lower than scalar means, in winds over 10 m/s. The change in averaging method has the potential to introduce a positive step change in the buoy wind climate record. There is a large data set of simultaneous vector and scalar mean wind speeds on Canadian 3 m Discus and 6 m NOMAD buoys which allows the relationship between these averaging methods to be quantified over a wide range of conditions. Results are slightly different for each hull type. Overall the scalar-vector mean difference for NOMAD buoys with fully

functioning anemometers is only about 2% of the wind speed. Differences increase slightly with wave height. Differences increase substantially for anemometers reporting faulty wind directions. We adjust vector means using the relationships found in this study, and show the impact on the climate record.

2B-302.4 ID:2759 11:15

Homogenization and trend analysis of Canadian near-surface wind speeds

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Abstract Near-surface wind speeds recorded at 117 stations in Canada for the period from 1953 to 2006 were analyzed in this study. First, metadata and logarithmic wind profile were used to adjust hourly wind speeds measured at non-standard anemometer heights to the standard 10 m level. Monthly mean near-surface wind speed series were then derived and subjected to a statistical homogeneity test, with homogeneous monthly mean geostrophic wind (geo-wind) speed series being used as reference series. Homogenized monthly mean near-surface wind speed series were obtained by adjusting all significant mean shifts, using the results of statistical test/modeling along with all available metadata, and used to assess the long-term trends. It has been shown that anemometer height change is the main cause for discontinuities in the near-surface wind speed series, followed by station relocation, instrumentation problems or changes, and observing environment changes. It has also been shown that the effects of artificial mean shifts on the results of trend analysis are remarkable, and that the homogenized near-surface wind speed series share similar trends with the corresponding geo-wind speed series, showing good spatial consistency of trends, which indicates a success in the homogenization of near-surface wind speed data. The homogenized near-surface wind speed series show significant increases in central Canadian Arctic, with significant decreases throughout western and southern Canada (except the eastern maritime provinces in the cold seasons), during the period analyzed (1953-2006).

2B-302.5 ID:2746 11:30

Observed Changes in Daily Temperature and Precipitation Indices for Southern Québec, 1960–2005

Abderrahmane Yagouti [1], *Gilles Boulet* [2], *Lucie Vincent* [3], *Luc Vescovi* [4], *Éva Mekis* [3]
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Trends and variations in daily temperature and precipitation indices in southern Québec are examined for the period 1960–2005. The indices are based on daily temperature and daily precipitation which have been recently adjusted at 53 climatological stations. The adjustments were made for site relocation, changes in observing programs, known

instrument changes and measurement program deficiencies. The results show that the surface air temperature has increased in southern Québec over 1960–2005. Significant warming is evident in the western, southern and central parts of the province but the increasing trends become smaller toward the east. The warming is greater during the winter although many significant increasing trends are found in the summer. The analysis of the temperature extremes strongly indicates the occurrence of more nights with extreme high temperatures in all seasons. The temperature indices also suggest an increase in the number of thaw/frost days during the winter (days with maximum temperature above 0°C and minimum temperature below 0°C), a decrease in the length of the frost season, an increase in the length of the growing season, a decrease in heating degree days and an increase in cooling degree days. The precipitation indices show an increase in the annual total rainfall although many stations indicate decreasing trends during the summer. The number of days with rain has increased over the region whereas the number of days with snow and the total snow amounts have decreased over the past 46 years.

2B-302.6 ID:2739 11:45

Second Generation of Homogenized Temperature for trend analysis in Canada

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Several years ago, a database of long-term and homogenized temperatures was created for the analysis of climate change in Canada. Using a technique based on regression models, the annual means of the daily maximum and minimum temperatures were tested for “relative homogeneity” with respect to surrounding stations. Monthly and daily adjustments were derived from the regression models and were applied to create homogenized temperature datasets at 210 locations across the country. The causes of inhomogeneities were mainly due to station relocation and change in observing time.

A Second Generation of Homogenized Temperature is currently under development. The new homogenized datasets are prepared for a greater number of stations (336 stations). Series are extended to cover the period 1900-2008 as much as possible by joining the observations of two or three nearby locations. New procedures are applied for adjusting the cold bias in the daily minimum temperatures introduced by the redefinition of the climatological in 1961 at synoptic stations. Newly developed techniques based on regression models and surrounding stations are also considered for homogeneity assessment and adjustment of the discontinuities due to station relocation. The methodologies used to generate the new homogenized temperatures will be presented along with the impact of the adjustments on climate trends.

Operational Meteorology (PART 4) / Météorologie opérationnelle (Partie 4)

Room / Endroit (303), Chair / Président (Chris Fogarty), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-303.1 ID:2693 **10:30**

The National Lab for Marine and Coastal Meteorology – Research, Development and Support Assisting Operational Forecasting

Chris Fogarty [1], *Garry Pearson* [2]
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The Meteorological Service of Canada's National Lab for Marine and Coastal Meteorology in Dartmouth, Nova Scotia is actively involved in projects that aim to enhance/improve operationally forecasting in Canada. The Lab focuses on marine forecasting challenges, with various numerical modelling projects involving high resolution regional-scale domains, coupled atmosphere-ice-ocean processes, hurricane extratropical transition, storm surges, ocean waves and fog forecasting. Other areas of focus include the assessment of various observational tools over the ocean and in the coastal zone such as from satellite scatterometers, surface weather station networks and land-based vertical wind profilers.

Activities in the Lab are highly focussed toward developing tools that assist in the forecast production process and enhance the quality of weather forecasts and warnings. Research meteorologists from the Lab communicate with forecasters in the weather office during active weather situations, product evaluation projects, and at staff training seminars. Ongoing two-way interaction between Operations and the Lab is recognized as being an important ingredient for improving the quality of forecast products and the Weather Service's involvement in weather research on an international stage.

This presentation will focus on our role and interaction with forecasters including some examples of products available to the weather offices.

2B-303.2 ID:2769 **10:45**

Canadian coupled atmosphere-ocean-ice forecast system for the Gulf of St. Lawrence: Operational Validation for ice season 2009

Serge Desjardins [1], *Garry Pearson* [1], *Manon Faucher* [2], *François Roy* [2], *Pierre Pellerin* [3]
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Following the successful implementation of the Gulf of St. Lawrence two-way coupled atmosphere-ocean-ice system in an experimental mode at CMC last winter; a second operational validation is simultaneously under way at the Atlantic Storm Prediction Centre, the Newfoundland and Labrador Weather Office and the Quebec Storm Prediction Centre. The impacts of modifications in the coupled system on the atmospheric model, the introduction of a new ice field analysis generated from an ice spin up cycle developed by François Roy, and the evolution in space and time of this coupled ice field are again evaluated with various diagnostic and display tools developed last year. Changes in the surface fluxes caused by the coupling and the impacts of those flux changes on meteorological fields will be studied further. An overview of the validation for this ice season as well as the results of the study on fluxes will be presented.

2B-303.3 ID:2776 **11:00**

Impact study with observations assimilated over North America and the North Pacific Ocean on the MSC global forecast system

Stephane Laroche , *Real Sarrazin*
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A series of observing system experiments for the two-month period of January-February 2007 has been carried out to assess the impact of radiosonde and aircraft data available over North America, as well as the impact of satellite data available over the North Pacific Ocean, in the global data assimilation and forecast system of the Meteorological Service of Canada. The impact is estimated by comparing two data assimilation and forecast cycles: one (control) assimilates all the observations operationally available while the other is identical to the control except that the observing network examined is withheld. A particular attention is given to the propagation and magnitude of the impact of these observing networks. It is found that the impact on the accuracy of forecasts over the North American continent is not uniform. The radiosonde and aircraft data together are the main contributors to the forecast skill on short-range forecasts over North America. However, as the effect of the satellite observations over the North Pacific Ocean move downstream over the continent, their impact on forecasts becomes dominant for forecast lengths greater than 36 h over western North America, and greater than 72 h over the eastern part of the continent. The impact of these satellite observations is more important over the continental United States than over Canada. In data-denial experiments, the separate impact of the aircraft and radiosonde observing networks collocated over southern Canada and the United States is much weaker than their joint impact. For short-range forecasts, the effect of aircraft observations is more important than radiosonde data over the eastern North America. The quality of the forecasts over the Canadian Arctic heavily relies on the radiosonde network. The role of the analysis scheme is also examined by comparing the forecast impacts from the 3D-Var and 4D-Var schemes. The impact of the radiosonde data over the Canadian Arctic is much larger with the 3D-Var scheme. This indicates that the 4D-Var scheme is more effective in extracting the information from the other observations over and nearby that region.

2B-303.4 ID:3005 **11:15**

Severe Thunderstorm and Lightning Climatology in Atlantic Canada

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Severe thunderstorms with large hail, damaging winds, intense rainfall and tornadoes are more common in Atlantic Canada than most people realize. Over the last few years work has been carried out by Environment Canada, as part of the Atmospheric Hazards Network project, to catalogue and analyze the reported severe thunderstorm events over the last 15 plus years in Atlantic Canada. Analysis of the reported events helps establish the climatology of severe thunderstorms in the region. We look at the spatial and temporal distribution of events with specific emphasis on tornadoes (36 in the last 16-18 years). The analysis clearly establishes that severe thunderstorms and tornadoes are more common in some parts of Atlantic Canada than others. It also indicates when the activity is greatest both on a monthly and hourly basis and that this activity has significant variability from year to year and by event type.

Related Atmospheric Hazards work on lightning climatology in Atlantic Canada has also been done. This climatology is based on data from the Canadian Lightning Detection Network and work done by Bill Burrows of Environment Canada in Edmonton. In addition to establishing the seasonal and spatial distribution of lightning in the region since 1998, we take a more detailed look at the monthly and hourly distribution of lightning around the most populated centers in each province and rank them according to frequency.

2B-303.5 ID:3067 **11:30**

Return periods of prolonged fog events in Canada

Bjarne Hansen , *Ismail Gultepe* , *Aaron Mccay* , *Alistir Ling*
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This work presents statistical summaries of prolonged fog events at all major airport locations in Canada based on archives of hourly observations made from 1953 to 2007. It is supported by Environment Canada research projects studying ice fog, freezing fog and warm fog in all regions of Canada. A fog event is defined as a period of consecutive hourly observations of fog with visibility ≤ 1/2 mile. A freezing fog event is defined as having the same conditions with a temperature ≤ 0.0°C. Such events are described with two statistics: 1) average duration of the event, and 2) return period of events of any duration. Summary statistics are prepared for events that are unbroken (i.e., the defining conditions match for each hour) and for events that are almost unbroken (i.e., the defining conditions do not match for short intervals, 1, 2, or 3 hours).

The impact of a weather event depends on intensity and duration. Intensity is determined by single values of weather observations; whereas, duration is determined by a variable series of such values. The intensity of a fog event may be described simply by the minimum visibility in kilometres; whereas, the duration of a fog event depends on at least three values: 1) initial time, 2) final time, and 3) threshold value of visibility to qualify as fog. The analyses describe the following types of events: fog, freezing fog, precipitation (any, freezing, frozen, liquid), no precipitation (drought), blizzard, and flight conditions based on cloud ceiling height and visibility (low IFR, IFR, and VFR). Analyses for approximately 500 airport locations in Canada are posted online at the following location: http://collaboration.cmc.ec.gc.ca/science/arma/duration_statistics.

The results help to improve our understanding of prolonged high-impact weather events. It is suggested that potential prolonged events can be identified through similarities with the climatology, which would trigger operational forecasters to give them increased attention.

2B-303.6 ID:3039 **11:45**

Ongoing Development of Automated Fog and Stratus Forecasts from the GEM Regional Operational NWP Model

Garry Toth , *William Burrows*
MSC
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As part of the FRAM Fog Project, the authors, working in the Hydrometeorology and Arctic National Lab in Edmonton, have built an automated system to forecast dense fog (visibility ½ mile or less) and low stratus (ceiling 500 feet or less). Rules for various fog types have been subjectively developed and applied to the output of the operational GEM regional operational NWP model. A criterion based on the model's bulk Richardson number is used to differentiate between fog and stratus. The forecasts for the various fog types are available on the Web to those behind the MSC firewall at each forecast hour from one through 48 hours from either 00Z or 12Z initialization times. In addition, a single combined forecast is available.

A summary chart showing the observing stations with dense fog or low stratus or low obscured ceilings was also created and has been used in the development of the system and the subjective verification of many cases.

Recent development work includes the addition of model precipitation information to the F/ST charts to forecast the commonly-observed low obscured or low stratus ceilings with falling snow. The authors are also experimenting with areas of expected drizzle or freezing drizzle diagnosed from model output as an indicator of possible dense fog or low stratus. Another new chart for "cold" fog applies some simple rules to come up with potential ice fog areas, and more generally ice crystal fog areas.

The latest development work in this project is in the area of objective verification of the fog and stratus forecasts.

This talk will briefly review the automated fog and stratus forecast system and will describe some of the recent additions and modifications. Subjective verifications of a couple of cases in which the observation and forecast charts are compared will be presented. The talk will conclude with a description of the objective verification procedure along with some of its preliminary results.

Water, Weather and Climate Serving the Energy Sector (PART 2) / Eau, temps et climat servant le secteur énergétique (Partie 2)

Room / Endroit (202), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-202.1 ID:2686 **14:00**

Micro-Scale Wind Modelling for Wind Energy Applications

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MSmicro is a micro scale wind model developed from MS3DJH/3R that applies the effects of terrain elevation and surface roughness. MSmicro has been used to study the surface winds in two regions of Nova Scotia in high resolution. This model has been tested in forecast merging mode as well as a spot specific mode. Over all the spot mode has produced the best results, but problems are still present which are possibly due to how the surface roughness is handled. To make improvements to such modeling a simple analytical model for estimating the velocity change due to surface roughness changes using the inner boundary layer concept will be investigated. First this model will be tested on its own, with hopes to use it as the roughness scheme for MSmicro. The motivation of this work is an upcoming wind assessment/energy project in Lake Ontario near the Scarborough Bluffs starting in the summer of 2009.

2C-202.2 ID:3090 **14:15**

Climate Impacts of Large Scale Wind Energy Production

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Wind energy is the fastest growing non-fossil source of primary energy. As the number and size of wind farms grows, and thus the amount of energy they are extracting from the atmosphere grows, the impact of wind energy on the atmosphere must be considered. Wind turbines 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 reduced wind speeds in the turbine wake. Consequentially, large groupings of wind turbines can also have indirect effects on the

atmosphere by influencing surface fluxes, advection of heat and moisture, and turbulent transport in the boundary layer. Through the development of a wind farm parameterization for mesoscale models, the atmospheric impacts of wind farms can be modeled. The impacts of large scale wind energy production were examined for different seasons; 90 day averages of WRF simulations with and without the existence of large wind energy production were computed. This talk will discuss impacts of wind farms on a seasonal time scale, as well as comparing and contrasting the impacts in fall, winter, spring and summer.

2C-202.3 ID:3064 **14:30**

Atmospheric Hazards and Energy Systems: An Ontario Example

Heather Auld , *Joan Klaassen* , *Robert Morris* , *Sharon Fernandez* , *Neil Comer* , *Brian Mills*
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Atmospheric hazards expose energy systems to risks ranging from long-lasting electrical power interruptions, reduced power outputs, downed wind turbines to ruptured oil and gas distribution systems. Of the energy systems in Ontario, atmospheric impacts to electrical power systems impact all other critical infrastructure components since all require continuous power and energy to operate, whether supporting water and gas distribution, communications or transportation systems. Forensic studies have shown that, above critical thresholds, small increases in weather and climate extremes have the potential to bring large increases in damage to existing infrastructure. As a result, energy infrastructure, wind turbines and the power distribution and transmission lines that service them must be designed and engineered to withstand the extremes of weather, as well as its day-to-day weathering processes. But because failures will occur, communities need to also incorporate the realities of energy interruptions to their emergency and disaster mitigation planning. The changing climate will pose additional risks for energy systems due to potentially changing extremes. Other areas for attention include shifting demand management, management of energy efficiency design over the lifetime of structures and resources for renewable energy technologies. Case studies in Ontario will be presented illustrating that increases in heat waves and potential risks from ice storms and other climatic loads will have significant implications for energy infrastructure and require increased vigilance for disaster management planning.

2C-202.4 ID:2945 **14:45**

Estimation of Energy Demand Taking into Account climate change in Southern Quebec

Diane Chaumont [1], *Georges E. Desrochers* [2], *René Roy* [2]
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In Quebec, the variation of energy demand relative to heating and cooling needs is of major interest when considering climate change impacts. In fact, anticipated warming is expected to reduce and increase energy demand during the winter and summer, respectively. As a result, Hydro-Québec Distribution (HQD) started in 2000 to include temperature change in the estimation of energy demand. With the evolution of knowledge in climate change science and the availability of a larger ensemble of climate projections from Global Climate Models (GCMs), the methodology has progressively improved and uncertainties are now more efficiently taken into account. In this project, an ensemble of 39 climate simulations, produced from the combination of 17 GCMs and 3 emission scenarios, has been analysed to provide a climate warming scenario relevant for the estimation of electric demand in Quebec. Two issues are considered: 1) the redefinition of the reference period for normals to account for a non-stationary climate and 2) the integration of the new climate change scenario in short and medium term planning of electric needs, including a rupture point in the temperature trend as a consequence of anthropogenic warming. Following the analysis, the use of linear temperature increase on a monthly basis is now implemented in HQD operations to address climate change impacts on electric demand. Temperature increases are generally strongest for the winter months.

2C-202.5 ID:2842 15:00

Estimation of Net Basin Supply Components for the Upper Great Lakes using MESH

Vincent Fortin [1], *Murray Mackay* [2], *Erika Klyszejko* [3], *Dorothée Charpentier* [1]
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Hydroelectric power is the most widely used renewable energy source in Canada; however this resource cannot be properly managed without reliable methods to accurately predict water cycle components. The estimation of hydropower potential relies on hydrologic modelling to predict reservoir inflows and in-stream power potential. As part of the International Upper Great Lakes Study (IUGLS), Environment Canada is developing a fully coupled land, lake and atmosphere modelling system which will be used to simulate as well as forecast the individual terms of the water budget of the Laurentian Great Lakes basin. The study focuses on improving estimation of the Net Basin Supply (NBS) and assessing the potential impact of variations in the climate system on future regulation of the upper Great Lakes. The modelling system is comprised of the well establish Global Environment Multiscale (GEM) atmospheric model (for analysis and short-term forecasting) and Canadian Regional Climate Model (CRCM) for climate prediction. Both of these models can be coupled with a land-surface hydrology scheme (MESH). This system will provide decisions makers in the hydropower industry with a means of assessing the potential impacts to supply both in the near and distant future. Once in place, it will be possible to use the modelling system to provide experimental ensemble forecasts of water balance components up to two weeks. A climatology-based procedure will be tested to increase the lead time of the ensemble

forecasts to 30 days.

2C-202.6 ID:2797 15:15

Future Energy development needs and CIS Arctic Sea Ice analysis and prediction

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Environment Canada's Canadian Ice Service (CIS) provides accurate and timely ice information in support of safe navigation in Canadian waters. These products are also of use for sustainable offshore resource development. There has been a significant increase in Arctic offshore exploration and the variable ice conditions make planning for infrastructure development a challenge. To continue to improve ice information products to meet the needs of the resource development industry as well as for marine transportation, CIS is enhancing its ability to analyse and predict Arctic Sea Ice conditions with the use of models and data assimilation techniques. An automated Sea Ice analysis will be shown using 3dvar data assimilation which gives an up-to-date analysis of ice in all Arctic waters. Progress in modelling of ice conditions, as well as iceberg tracking, will be presented. Some of these products are already useful, particularly in helping protect oil platforms off the East Coast of Canada.

A significant portion of funding for the research underlying the production of the ice information presented here comes from the Program of Energy Research and Development (PERD).

Acoustics in Oceanography (PART 2) / L'acoustique en océanographie (Partie 2)

Room / Endroit (203), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-203.1 ID:2795 14:00

Results from the ROSE Seismic Oceanography Experiment

Blair Greenan [1], *Ramzi Mirshak* [2], *Mladen Nedimovic* [2], *Barry Ruddick* [2]
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Seismic oceanography is a new interdisciplinary field of study which combines multichannel seismic (MCS) imaging and physical oceanography. In the summer of 2007, MCS data were collected by the GSI Pacific over the Sohm Abyssal Plain (in the region of the Gulf Stream) with the primary intent to define Canadian jurisdiction of the seabed and its natural resources under Article 76 of the United Nations Convention on the

Law of the Sea (UNCLOS). The Reflection Ocean Seismic Experiment (ROSE) was formed to take advantage of the opportunity by acquiring ancillary, coincident oceanography observations that provided in-situ ground truth for the MCS data. This high-density XBT/CTD survey has been used to produce synthetic seismic images of the water column, which will be compared to the MCS imagery of thermohaline finestructure.

2C-203.2 ID:2827 **14:15**

An Intercomparison of Acoustic Current Meters on the Scotian Shelf

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2C-203.3 ID:3096 **14:30**

Long Wavelength Ripples in the Nearshore

Trajce Alcinov , *Alex Hay*
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Sediment bedforms are ubiquitous in the nearshore environment, and their characteristics and evolution have a direct effect on the hydrodynamics and the rate of sediment transport. The focus of this study is long wavelength ripples (LWRs) observed at two locations in the nearshore at roughly 3m water depth under combined current and wave conditions in Duck, North Carolina. The observed LWRs are straight-crested bedforms with wavelengths in the range of 30-75 cm, and steepness of about 0.1. They occur during the build up of storms, when the incident wave direction is rapidly changing, possibly due to the migration of the center of a storm. A principal goal of the study is to test the maximum gross bedform-normal transport (mGBNT) hypothesis, which states that the orientation of ripples in directionally varying flows is such that the gross sediment transport normal to the ripple crest is maximized. Ripple wavelengths and orientation are measured from rotary fanbeam images and current and wave conditions are obtained from electromagnetic (EM) flowmeters and an offshore pressure gauge array. Tests of the mGBNT hypothesis in which the transport was calculated using a sediment transport model indicate that it is not a good predictor of LWR orientation. The observed LWR orientation seems to be tied to the incident wave direction, with an additional offset the sign of which depends on the sign of the longshore current.

2C-203.4 ID:3103 **14:45**

Velocity Structure and Turbulent Stress above Evolving Sand Ripples: Observations with a New Multi-frequency Coherent Doppler Profiler

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The last two decades have witnessed increasing use of acoustic remote sensing technologies for sediment dynamics measurements in aqueous environments. The approach is driven by the need to minimize disturbances to the fluid-sediment interactions occurring at or close to the mobile bed. This requirement is especially critical in wave-dominated environments, since the wave bottom boundary layer is typically O(10) cm thick, and thus inaccessible to invasive measurement methods during active transport conditions. Previous advances in acoustic profiling techniques have tended to focus either on velocity measurements using a single acoustic frequency, or on suspended sediment concentration and size measurements using multiple frequencies (the latter being required to resolve the size-concentration ambiguity in the backscatter amplitude at a single frequency). Motivated in part by the need to measure turbulent fluxes, and thus to obtain simultaneous, collocated measurements of suspended particle concentration and velocity, we have developed a multi-frequency coherent Doppler profiler capable of resolving the vertical structure of the wave bottom boundary layer on both wave period and turbulent time scales. Results obtained with this new system in oscillatory flow boundary layers over both fixed roughness and evolving sand ripples will be presented.

2C-203.5 ID:3102 15:00

Geoacoustic Inversion of surficial gassy sediment.

Marie-Noel R. Matthews [1], *Alex E. Hay* [1], *Francine Desharnais* [2], *John Osler* [2]
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Geoacoustic parameters of the seafloor in a coastal environment characterized by a surficial gassy sediment layer are estimated using a geoacoustic inversion method. The analysis combines the inversion algorithm called Adaptive Simplex Simulated Annealing (ASSA) with the Fast Gibbs Sampler (FGS) algorithm, which estimates the parameters uncertainty. The propagation model integrated to the algorithms is a parabolic equation model developed by Thomson. The method was tested using simulated data to highlight the advantages and limitations of the technique in isolating the particularly low sound speed and high attenuation of gassy sediment. Results were then obtained from acoustic data recorded in St. Margaret's Bay, N.S., Canada. The underwater acoustic source signature was composed of 5 tones below 500 Hz. It was recorded on a vertical line array of 11 hydrophones located in a range-independent shallow water environment. The seabed in the area of interest was modelled with two sediment layers over a basement, where the geoacoustic parameters of the top sediment layer as well as the thickness of the second layer were estimated through inversion.

2C-203.6 ID:2881 15:15

Assessing uncertainties in underwater acoustic propagation in a tactical environment

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The accuracy of acoustic performance prediction models in littoral environments depends in large part on the input environmental data. The required data includes such parameters as the speed of sound in the local water mass, the bathymetry in the area, and the seabed composition. Through a combination of in-house and contracted research, DRDC Atlantic has been examining the sensitivity of modelled acoustic propagation to these parameters. The objective is to determine, for a given location and time, which parameter(s) will have the greatest impact on the uncertainty in predicted acoustic transmission loss, and how this uncertainty relates to the characteristics of the environmental data. Such characteristics include the natural variability of the parameter and the spatial-temporal sampling frequency of the environmental data. Knowledge of how these characteristics impact the uncertainty in transmission loss can then be used to devise strategies for adaptive sampling of the environmental data and/or the optimal deployment of naval assets for sonar operations. The research includes several initiatives, beginning with the development of theoretical metrics to quantify the sensitivity of the acoustic propagation to the environmental parameters. In addition, several tools have been developed or obtained to aid in the rapid assessment of the environment, including: a database of historical data from DRDC Atlantic sea-trials; forecasts of temperature and salinity from ocean circulation models; and in situ sampling techniques, such as unmanned undersea vehicles for covert sampling and a Moving Vessel Profiler for overt sampling. These advances in theory and environmental characterization are being integrated into a prototype software suite to test and evaluate the uncertainty in acoustic transmission loss due to environmental data characteristics. To illustrate this point, the presentation will include comparisons of measured and modelled acoustic transmission loss from a recent sea-trial.

Atmosphere, Ocean and Climate Dynamics (PART 2) / Dynamique de l'atmosphère, de l'océan et du climat (Partie 2)

Room / Endroit (204), Chair / Président (Marek Stastna), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-204.1 ID:2701 **14:00**

Wave Forcing in the Stratosphere as a Result of Climate Change

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While there is an emerging consensus among modelling groups that one effect of climate change on the dynamics of the stratosphere is an enhancement of the Brewer-Dobson circulation in the NH winter, the processes by which this happens are not yet fully clear, and model results are often clouded by large natural variability at high latitudes. As well, all IPCC-type climate change forcings include the overlapping effects of greenhouse gases and ozone recovery. To better isolate key processes, we bring the question of Brewer-Dobson circulation changes back to a simplified scenario: climate change is represented by doubling of atmospheric CO_2; ozone, while radiatively and chemically interactive, does not undergo catalytic destruction by CFCs; surface temperatures are calculated interactively rather than prescribed. In this process-oriented context, we run a chemistry-climate model (IGCM-FASTOC) coupled to a slab ocean for 100 years at T31 resolution, and 50 years at T42, in timeslice mode. In the NH winter, we find warming to extend into the lower stratosphere at high latitudes and an associated weakening of the polar vortex. The Brewer-Dobson circulation is enhanced as expected. This can be traced to a significant increase in the wave forcing (EP flux convergence) at the lower edge of the polar vortex in (climatological) February, and equally significant wave forcing higher up near the vortex core as early as January. Maximum wave forcing at this height and above leads control values by a month. We see this also in increased occurrences of Sudden Warmings in January and February under doubled-CO_2 conditions. This talk will present the results and their interpretation in terms of the changes in the prevailing tropospheric winds and their impact on vertical wave propagation. Effects of horizontal resolution will also be discussed.

2C-204.2 ID:3078 14:15

On the viability of Lagrangian theories of internal wave spectra

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Our incomplete understanding of the physical dissipation processes within an internal gravity wave field impacts on questions of mixing and momentum deposition in stratified geophysical flows, with enormous dynamical ramifications in the case of the Earth's middle atmosphere. Efforts to solve the puzzle have centered on nonlinear interactions among internal waves, but the inherent complexity has hindered progress. There is a growing body of literature which maintains that this complexity can be circumvented by using a Lagrangian, rather than Eulerian, formulation. I have investigated this proposition with a Lagrangian wave model and wave fields typical of the middle atmosphere; the results raise serious questions concerning the methods and approximations invoked by certain Lagrangian theories of wave spectra, specifically those advanced by Hines, Allen and Joseph and Chunchuzov. They also have serious implications for Hines' Doppler-spread parameterization, which has been implemented in several middle atmosphere general circulation models (GCMs).

2C-204.3 ID:2791 14:30

Two mechanisms for enhanced mixing due to shoaling internal solitary-like waves

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Solitary-like internal waves are coherent, high-frequency motions that are widely documented in coastal oceans and lakes. While ISWs in deep water are typically waves of depression, during shoaling these waves are transformed into waves of elevation which, in turn, grow, break and mix the water column. Based on the results of a combined numerical-experimental study of the interaction of internal solitary-like waves with bottom corrugations that are shorter than the typical horizontal length scale of the waves I will discuss two mechanisms that increase the geographic extent of the region in which shoaling waves mix the water column, and especially, the pycnocline. For situations in which the bottom corrugations reach into, or are very near, the pycnocline, the large waves exhibit a spatio-temporally developing shear instability that takes the form of sizable billows. These billows drain energy from the main wave and partially mix the pycnocline. When the bottom corrugations do not reach the pycnocline, no billows are observed, however, the wave-induced currents generate large vortices over the bottom undulations. These vortices are not fully developed until well after the main wave has passed by. They scour the bottom, deform the overlying pycnocline, and in some instances lead to significant mixing.

2C-204.4 ID:2724 14:45

Mixed bottom-friction-Kelvin-Helmholtz destabilization of source-driven abyssal overflows in the ocean

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Source-driven ocean currents that flow over topographic sills are important initiation sites for the abyssal component of the thermohaline circulation. These overflows exhibit vigorous space and time variability over many scales as they progress from a predominately gravity-driven down slope flow to a geostrophic along slope current. Observations show that in the immediate vicinity of a sill, grounded abyssal ocean overflows can possess current speeds greater than the local long internal gravity wave speed with bottom friction and down slope gravitational acceleration dominating the flow evolution. It is shown that these dynamics lead to the mixed frictionally-induced and Kelvin-Helmholtz instability of grounded abyssal overflows. Within the overflow, the linearized instabilities correspond to bottom-intensified baroclinic roll waves and in the overlying water column amplifying internal gravity waves are generated. The stability characteristics are described as a function of the bottom drag coefficient and slope, Froude, bulk Richardson and Reynolds numbers associated with the overflow and the fractional thickness of the abyssal current compared to the mean depth of the overlying water column. The marginal stability boundary and the boundary separating the parameter regimes where the most unstable mode has a finite or infinite wavenumber are determined. When it exists, the high wavenumber cut-off is obtained. Conditions for the possible development of an ultra-violet catastrophe are determined. In the infinite Reynolds number limit, an exact solution is obtained which fully includes the effects of mean depth variations in the overlying water column associated with a sloping bottom. For parameter values characteristic of the Denmark Strait overflow, the most unstable mode has wavelength of about 19 km, a geostationary period of about 14 hours, an e-folding amplification time of about 2 hours and a down slope phase speed of about 74 cm/s.

2C-204.5 ID:2967 15:00

Zonal versus meridional velocity variance in the World Ocean: order in the chaotic ocean

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Global satellite-based observation of near surface geostrophic currents over the past 13 years has revealed ubiquitous quasi-horizontal eddies in the mesoscale, confirming the view of a highly turbulent ocean suggested by observational programs in the 1970s. Idealized quasigeostrophic turbulence models suggest mesoscale turbulent flow can vary between isotropic, and highly anisotropic zonal jets. We compare the zonal and meridional velocity variance from satellite altimetry, and show that the surface flow is organized into mesoscale patches where either zonal or meridional velocity variance dominates. The patches persist over 13 years, much longer than the turbulent timescale of a few months. Implications include potentially highly anisotropic redistribution of tracers by the mesoscale flow. Zonally averaged velocity variances reveal a slight preference for meridional over zonal velocity variance. Realistic primitive equation models succeed in reproducing both the patchy structure in local preference for either zonal or meridional velocity variance, and the zonally averaged preference for meridional variance. Idealized models of fully developed, quasigeostrophic turbulence fail in both regards.

2C-204.6 ID:3106 15:15

Comparison of modelled and observed sea ice fluxes in the Canadian Arctic Archipelago

David Huard , *Bruno Tremblay* , *Jean-François Lemieux*
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With the foreseeable increase in the strategic and economic importance of the Canadian Arctic Archipelago (CAA), a comprehensive picture of sea ice conditions at present and in the future is needed. However, due to the complex topography of the Canadian Arctic Archipelago (CAA), modelling sea ice fluxes in this area requires considerable spatial resolution. Our group has developed a stand-alone sea ice model based on the viscous-plastic rheology. The model includes both the Arctic Ocean and the CAA at a resolution of 10km, sufficient to resolve most of the channels and straits of the CAA. The model is

driven with NCEP atmospheric winds and temperatures and is being validated with both buoy data and ice covered area derived from satellite observation. This study compares the modelled sea ice fluxes in and out of the CAA with fluxes derived from satellite observations computed by Ron Kwok (JPL), Tom Agnew (EC) and Stephen Howell.

Meteorological Preparations for the 2010 Olympic Winter Games / Préparations météorologiques pour les jeux Olympiques d'hiver 2010

Room / Endroit (205), Chair / Président (Chris Doyle), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-205.1 ID:3062 **14:00**

Weather services for the Vancouver 2010 Olympic and Paralympic Winter Games

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Environment Canada's (EC) Meteorological Service of Canada (MSC) will be the official provider of weather information and forecasts for the Vancouver 2010 Olympic and Paralympic Winter Games. An extensive network of surface and three dimensional real-time weather sensors have been deployed in the Olympic area and are operational at this time. To prepare forecasters for the Game's, a program of forecaster on-the-job training began in Whistler in January 2006 and was completed this year. In addition, a mountain weather forecasting course was developed in cooperation with the Consortium on Meteorological Education and Training, (COMET). Three courses were held in Boulder, CO, and a final course was presented at Whistler in August 2008. . Science and technology for the Games promises to be innovative. EC's Numerical Weather Prediction research unit, RPN, is producing applications including the downscaling of some elements of high resolution NWP, particularly precipitation and wind, and the routine production of NWP at high temporal and spatial resolution. New forecast ensembles will be included in routine operational forecasting. In the interests of short term and nowcasting, a World Weather Research Program recognized Research Demonstration Project underway will include the production of operational short term nowcasting guidance for Olympic venue forecasters. Weather Services support during the Olympic Winter Games, February 12-28 2010 and the Paralympics on March 12-21, will include a fully operational weather forecasting system, including dedicated venue forecasts and end-user targeted tailored products, real time weather forecasts and observed data delivery to proprietary 2010 information systems and the provision of real-time information and professional weather advice to the our Federal partners, VANOC, IOC, Sport and team officials directly at the Venues and within the Game's Main Operations Centre.

2C-205.2 ID:2720 14:15

Thermodynamic, Wind and Liquid Profiling for Olympic Weather Prediction

Randolph Ware [1], *Edwin Campos* [2], *David Hudak* [2], *Paul Joe* [2]
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Met Service Canada will use microwave radiometer and wind radar profilers to obtain thermodynamic, wind and liquid data during the 2010 Vancouver Winter Olympics. These upper air profiles provide continuous information on the state of the atmosphere which is closely linked to local weather. Traditional forecast tools and indices generated by these data can be used for state-of-the-art local weather prediction. In addition, liquid profiles which are traditionally not available from radiosondes, can be used to enhance local precipitation, fog and icing forecasts. Case studies including forecast tools and indices generated from continuous thermodynamic, wind and liquid profile observations during winter snow and convective weather conditions will be presented.

2C-205.3 ID:2786 14:30

An experimental numerical prediction system for the 2010 Vancouver Winter Olympic Games

Jocelyn Mailhot [1], *S. Belair* [1], *M. Charron* [1], *M. Abrahamowicz* [1], *N. Bernier* [1], *B. Denis* [2], *A. Erfani* [2], *A. Giguere* [2], *N. Mclennan* [2], *R. McTaggart-Cowan* [1], *J. Milbrandt* [1], *L. Tong* [2]
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The 2010 Winter Olympic and Paralympic Games will take place in Vancouver, Canada, from 12 to 28 February 2010 and from 12 to 21 March 2010, respectively. In order to provide the best possible guidance achievable with current state-of-the-art science and technology, Environment Canada is currently setting up an experimental numerical prediction system for these special events. This system includes: 1) a regional ensemble prediction system (REPS), 2) high-resolution numerical modeling, and 3) surface modeling at the microscales. The REPS is based on the limited-area version of the Global Environmental Multiscale model (GEM-LAM) with 20 members at 33-km resolution. Initial conditions are provided by the Ensemble Kalman filter (EnKF), and boundary conditions are obtained from the global EPS, both operational at the Canadian Meteorological Centre (CMC), and stochastic perturbations are applied to the sub-grid-scale physical tendencies and to surface parameters. The high-resolution models include 2.5-km and 1-km versions of GEM-LAM integrated for 15h, twice a day, with improved cloud microphysics, geophysical fields, and radiation and cloud-radiation interactions, as

compared with the system (15-km and 2.5-km models) currently operational at CMC. Finally, several new and original tools are used to adapt and refine forecasts near and at the surface. A microscale 2D surface system (with 100-m grid size) covers the Vancouver Olympic venues using forcings from the 1-km model. Based on a similar strategy, a single-point model will be implemented, using surface observations as forcing, to better predict surface characteristics at each station of the special observing network set up for the Vancouver Olympics. The microscale 2D surface models better represent surface processes, and thus lead to better predictions of snow conditions and near-surface air temperatures. The configuration of the experimental numerical prediction system will be presented at the Congress, together with preliminary verification results from the winter 2008.

2C-205.4 ID:2814 14:45

Experimental land surface modeling and assimilation system for the 2010 Vancouver Winter Olympic Games

Natacha Bernier , *Stephane Belair* , *Linying Tong* , *Maria Abrahamowicz* , *Jocelyn Mailhot*
Environment Canada
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Environment Canada's land surface forecast system developed for the Vancouver 2010 Winter Olympics is presented together with an evaluation of its performance for winters 2007-2008 and 2008-2009. The motivation for this work is threefold: it is i) application driven for the 2010 Vancouver Olympics, ii) a testbed for the panCanadian operational land surface forecast model being developed, and iii) the precursor to the fully coupled land-surface model to come. The new high resolution (100m), 2D, and novel imbedded point-based land surface forecast model used to predict hourly snow and surface temperature conditions at Olympic and Paralympic Competition Sites are described. The surface systems are driven by atmospheric forcing provided by the center's operational regional forecast model for the first 48 hours and by the operational global forecast model for hours 49 to 96. The forcing fields are corrected for large elevation discrepancies over the rapidly changing and complex mountainous settings of the Vancouver Olympics that arise from resolution differences. Daily 96h land surface forecasts for 2 winters and snow depth and surface air temperature observations collected at several specially deployed competition sites are used to validate the land surface model. We show that the newly implemented surface forecast model refines and improves snow depth and surface temperature forecast issued by the operational weather forecast system throughout the forecast period.

2C-205.5 ID:3024 15:00

A Canadian regional ensemble prediction system for North America

Martin Charron [1], *Xiaoli Li* [2], *Ronald Frenette* [3], *M. K. (peter) Yau* [2]
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[3] Laboratoire national sur le temps violent

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Two initial perturbation strategies --- moist targeted singular vectors (SVs) and the ensemble Kalman filter (EnKF) --- are compared for the development of a regional ensemble prediction system (REPS) based on the limited area version of the Canadian Global Environmental Multiscale (GEM) model. The impacts of two stochastic model perturbations --- on some physical parameters and on sub-gridscale physical tendencies --- are also investigated under the SV-based and EnkF-based systems. Four systems with different combinations of the abovementioned initial perturbations and model perturbations are designed to perform experiments for one-month winter and one-month summer periods in 2006. The performance of the four systems is validated with probabilistic verification measures. Results indicate that under the condition of using the same model perturbation strategies, the EnKF-based system generally performs significantly better than the corresponding SV-based system for winter and summer periods. The advantage of the EnKF-based REPS comes mainly from its better reliability attribute, which can be characterized by a smaller bias and reduced underdispersion. Results of using different model perturbation methods show that both in the SV-based and EnKF-based systems, the use of stochastic perturbations on model physical tendencies instead of on selected physical parameters can significantly improve the reliability skill of the system, but tends to slightly degrade its resolution. Consequently, the overall better performance is obtained in a system with physical tendency perturbations. Preliminary tests including stochastic perturbations of some initial surface parameters are performed. Results show that surface parameter perturbations can help improving forecast skills of surface variables for the summer period.

2C-205.6 ID:2969 15:15

Science and Nowcasting Olympic Weather for Vancouver 2010 (SNOW-V10) – Overview and First Results

George Isaac [1], *Paul Joe* [1], *Monika Bailey* [1], *Stephane Bélair* [2], *Faisal Boudala* [1], *Stewart Cober* [1], *Chris Doyle* [3], *Ivan Heckman* [1], *Jocelyn Mailhot* [2], *Mathias Mueller* [4], *Roy Rasmussen* [5], *Ron Stewart* [6]

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[2] Recherche en prévision numérique, Environment Canada
[3] Meteorological Service of Canada, Environment Canada
[4] University of Basel, Switzerland
[5] National Center for Atmospheric Research
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Contact: george.isaac@ec.gc.ca

A new World Weather Research Project (WWRP) of the World Meteorological Organization (WMO) is being planned for the Vancouver 2010 Olympic and Paralympic Winter Games. Short term weather forecasting or Nowcasting, which concentrates on 0-6 hr predictions, has been the focus of several WWRP projects associated with the Sydney 2000 and the Beijing (2008) Summer Olympic Games. SNOW–V10 will be the first similar project to look at winter weather. It will produce better techniques to nowcast cloud, fog, visibility, precipitation type and amount, and wind and turbulence in

mountainous terrain. This will be done by using state-of-the-art numerical modeling systems, new on-site surface and remote sensing observing systems, as well as Nowcasting systems which will blend observations and model predictions into improved short term forecasts. The nowcasts will be produced during a 2009 practice session and during the 2010 Olympics. Short term forecasts will be provided to the weather forecasters supporting each venue, and special real-time displays will be produced for each venue manager. An evaluation and impact study will be conducted to determine the effectiveness of the forecast systems. This talk will present an overview of the project and describe some early results.

Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) (PART 2) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE) (Partie 2)

Room / Endroit (301), Chair / Président (C. Harold Ritchie), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-301.1 ID:2846 **14:00**

Recent results from the assimilation of sea ice observations in regional coupled ice-ocean models

Mark Buehner , *Alain Caya* , *Tom Carrieres*
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A variational data assimilation system is being developed at Environment Canada to estimate sea ice conditions by assimilating various types of observations. These observations include manually derived products from the Canadian Ice Service and several types of remotely-sensed data (e.g. passive microwave, visible/infra-red, synthetic aperture radar). The system is based on the variational data assimilation approach and is used in combination with error covariances estimated with an ensemble (Monte Carlo simulation) approach. Recent results from applying this data assimilation system to coupled ice-ocean models of the east coast region of Canada and the Gulf of St. Lawrence will be presented. The results demonstrate the relative improvements in short-range sea ice forecasts from using the data assimilation system as compared with the simpler approaches of direct insertion or nudging.

2C-301.2 ID:2854 14:15

Development of a new ice-ocean prediction system for the Northwest Atlantic

Maud Guarracino [1], *Frederic Dupont* [2], *Fraser Davidson* [3], *Charles Hannah* [1], *Andry Ratsimandresy* [3]
[1] Bedford Institute of Oceanography, Dartmouth, NS, Canada
[2] Dalhousie University, Halifax, NS, Canada
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Fisheries and Oceans Canada (DFO) is developing an ocean-ice pre-operational prediction system for the Northwest Atlantic as a precursor to an operational coupled atmosphere-ice-ocean prediction capability with Environment Canada's Canadian Meteorological Centre. A pre-operational modeling system called C-NOOFS (Canada Newfoundland Operational Ocean Forecast System, www.c-noofs.gc.ca) is being developed based on the NEMO modeling system (www.nemo-ocean.eu). The sensitivity of the sea ice simulation to the use of radiative fluxes directly from the atmospheric model rather than bulk formula will be evaluated as will the sensitivity to including tides. The evaluation will consider the simulation of both the climatological annual cycle and the winter of 2007/08.

2C-301.3 ID:2691 14:30

Heat and wind effects on Arctic sea-ice

Frederic Dupont [1], *Youyu Lu* [2], *Dan Wright* [2], *Zeliang Wang* [2]
[1] GOAPP, Dalhousie U.
[2] Bedford Institute of Oceanography
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Arctic sea-ice changes during 1958-2006 are simulated with a global ice-ocean model with surface forcing given by the Common Ocean-ice Reference Experiments (CORE). Under the standard CORE forcing, the model reproduces a significant portion of the observed interannual changes in September ice area, but overestimates its decline in the final decade. The strongest loss occurs in the Siberian-Pacific sector. Model sensitivity experiments suggest that the variations in total sea-ice area during the past five decades are primarily due to changes in heat forcing, while wind drives non-negligible interannual changes. The comparison between the surface air temperatures from CORE and the International Arctic Buoy Program reveals a significant discrepancy over the past decade. A sensitivity experiment shows that this discrepancy is sufficient to explain the overestimation of the recent decline in September ice area by the model. This emphasizes the need to further assess and improve the accuracy of atmospheric forcing.

2C-301.4 ID:2923 14:45

Observability of large control vector in a 4D-Var ocean data assimilation

Tsuyoshi Wakamatsu , *Michael Foreman*
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Control vector of typical four dimensional ocean data assimilation system consists of initial values, external forcing and model error. Due to sparseness of data, the retrieval of such large control vector is always ill-posed inverse problem. In this presentation, we will address to what extent we can "observe" these control vector given limited number of data using singular value decomposition (SVD) of the observability matrix in a 4D-Var system. In order to demonstrate usefulness of the SVD approach, we perform twin data experiments using a two-layer quasi-geostrophic ocean circulation model. We also demonstrate that the SVD approach makes it possible to conduct hypothesis test on each spectral component of the optimal 4D-Var solution.

Coastal Oceanography and Inland Waters (PART 1) / Océanographie côtière et les eaux intérieures (Partie 1)

Room / Endroit (302), Chair / Président (Guoqi Han), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-302.1 ID:3037 INVITED/INVITÉ 14:00

Satellite Observations of Ocean Processes along the Pacific Coast

Bill Crawford [1], *Gary Borstad* [2], *Angelica Peña* [1], *Nick Bolingbroke* [1]
(Presented by *W.r. Crawford*)
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Satellite images provide the best available views of ocean processes along the West Coast, especially in the numerous regions remote from oceanographic institutes and shipping tracks. Altimetry measurements by radar sensors from space since 1992 have provided nearly continuous measurements and are especially useful in cloud-covered regions because the radar signals penetrate clouds. By referencing these sea level measurements to recently determined dynamic ocean topography, we can observe jets and eddies exchanging coastal and deep-sea waters along the Pacific Coast from California to Alaska. Additional insight is provided by introducing satellite measurements of ocean surface chlorophyll, because chlorophyll patterns reveal smaller-scale processes. SeaWiFS images of chlorophyll reveal significant differences in offshore transport in California, British Columbia and Alaska. Alaskan eddies are largest and most buoyant, penetrating farthest offshore. Eddies and jets off California are smaller and intense, and they tend to sink below the denser offshore waters. Eddies of southern British Columbia are weakest by far, so that nutrients and chlorophyll are retained on the continental shelf and are a factor in the very high fisheries yield in these waters. Chlorophyll distribution along the northern British Columbia coast, measured by

SeaWiFS, shows an annual cycle of mixing and currents not previously realized. Interannual variability of chlorophyll in this region reveals how ocean processes might impact the survival of juvenile seabirds and fish.

2C-302.2 ID:3007 **14:30**

Numerical Study of Three-Dimensional Circulation over Coastal Waters of Nova Scotia during Tropical Storm Alberto using a Five-Level Nested-Grid Ocean Circulation Model

Jinyu Sheng , *Bo Yang*
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A nested-grid coastal circulation modelling system was developed for coastal waters of Nova Scotia based on the high-resolution circulation model for Lunenburg Bay and a prototype shelf circulation forecast system known as DalCoast The nested-grid modelling system has five-level sub-models, with the outermost sub-model of a coarse horizontal resolution of (1/12)o for simulating storm surges over the eastern Canadian shelf and the innermost sub-model of a fine resolution of about 180 m for simulating the 3D coastal circulation over Lunenburg Bay of Nova Scotia in the default setup. The nested-grid system is driven by meteorological and astronomical forcing and used to examine physical processes affecting the three-dimensional (3D) circulation and hydrographic distributions, with a special emphasis on the storm-induced circulation during tropical storm Alberto, over Lunenburg Bay of Nova Scotia. Model results demonstrate that the non-tidal circulation over the inner Scotian Shelf is affected significantly by local wind forcing, remotely generated coastal waves and wind-induced coastal upwelling/downwelling during the study period.

2C-302.3 ID:3055 **14:45**

Principal modes of circulation variability on the shelf seas of eastern Canada

David Brickman [1], *Adam Drozdowski* [1], *Chris Nickerson* [2]
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The existence of “normal year” and various long-term forcing fields allows ocean circulation models to be run under a suite of representative forcing scenarios. A version of the OPA circulation model is setup on a regional domain that includes the Gulf of St. Lawrence, the Scotian Shelf and the Gulf of Maine, and forced using the CORE normal year forcing fields. Daily (and tidally) averaged output is used in an EOF analysis to determine the dominant spatial modes of variability in this shelf region. Results are interpreted with reference to forcing variables and expected shelf model behaviour.

2C-302.4 ID:2697 **15:00**

Modifying a coupled biophysical model to predict the timing of the spring bloom in

Rivers Inlet, British Columbia

Megan Wolfe , *Susan Allen*
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Rivers Inlet is a glacial fjord located on the central coast of British Columbia. Historically, Rivers Inlet was the location of the 3rd largest sockeye salmon run in Canada. The Rivers Inlet sockeye salmon stock fluctuated in the late 1970's and crashed in the early 1990's with returns reaching only 1% of the historical averages. It is believed that a contributing cause for this rapid decrease is changes in the timing of the spring phytoplankton bloom. To investigate historical variations in the timing of the spring bloom in Rivers Inlet, we propose to modify a coupled biophysical model that has been used to successfully predict and to hindcast the spring phytoplankton bloom in the Strait of Georgia (SoG). The physical model is a one-dimensional vertical mixing boundary layer model that is forced with hourly wind, air temperature, cloud fraction and humidity data, along with daily river flux data. It is initialized with profiles of salinity, temperature and fluorescence. Many local parameterizations are needed and must be re-parameterized for Rivers Inlet. Of particular importance are the freshwater fluxes and light absorption. River input forces the freshwater flux and drives the estuarine circulation. Relaxation of light-limitation determines the timing of the spring bloom and so a good model estimation of light absorption including the effect of glacial silt from the rivers is essential. The modified biophysical model will be used to determine the factors driving interannual and decadal variation in the timing of the spring phytoplankton bloom in Rivers Inlet.

2C-302.5 ID:2698 15:15

Assimilation of satellite-derived Sea Surface Temperature into Canadian East Coast Ocean Model (CECOM)

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Abstract

Sea surface temperature (SST) data have been assimilated into the Canadian East Coast Ocean Model (CECOM) used in the BIO forecasting system for eastern Canadian waters. The SST data are the operational product from Canada Meteorological Centre (CMC) and the assimilation scheme is based on the method of the optimal interpolation (OI). The SST data are blended into the model through adjusting/correcting the heat flux between the ocean and the atmosphere on a daily basis. The correction is related to the model and data errors, the SST difference between the model and data, and the local mixed layer depth. To evaluate the performance of the assimilation scheme, SSTs calculated from assimilation and non-assimilation model runs are compared to in situ measurements from Atlantic Zonal Monitoring Program (AZMP). The comparisons show that the assimilation significantly reduces the uncertainties of the model and improve the model SST. To examine the impact of the error parameter on the assimilated SST, two

sensitivity runs were performed. It was found that the model results were more sensitive to the error parameter in summer and fall, while less sensitive in winter and spring.

Extratropical Transition of Tropical Systems / Transition extratropicale des systèmes tropicaux

Room / Endroit (303), Chair / Président (Peter Bowyer), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-303.1 ID:2863 INVITED/INVITÉ 14:00

Hurricanes and Global Warming

Stephen Miller
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The effect of global warming on the frequency and intensity of tropical cyclones is currently a topic of heated debate within the tropical storm research and forecast community. Articles published in recent years in high profile journals such as Nature and Science have attempted to demonstrate a link between anthropogenic climate change and a recent increase in hurricane activity. These articles have drawn a lot of attention with both media and public, especially regarding the hyperactive hurricane season of 2005 in the Atlantic Ocean.

This presentation will review some of the principles of tropical cyclogenesis and discuss how these factors might change in a warmer world. The role of a warmer sea surface temperature and its interaction with changes in the tropical atmosphere will be examined.

The bulk of the talk will present research by others that has been published in the scientific literature. The methods and results from several recent peer reviewed articles on the subject will be presented and discussed. These articles include both observational and modelling studies. The reaction to this research from scientists within the tropical meteorology community will be detailed, and we will discuss what sort of conclusions we can draw from these recent works.

2C-303.2 ID:2890 14:30

A Forecasting Summary of Recent ET Events Affecting Canada since 2006

Chris Fogarty [1], *Peter Bowyer* [2]
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[2] Canadian Hurricane Centre
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There have been many tropical cyclones affecting eastern Canada over the past number of years. These weather systems are invariably undergoing some form of extratropical transition (ET) when they affect our region. In this presentation I will summarize the ET aspect of events over the past 3 hurricane seasons and highlight some of the forecasting challenges associated with them. These events include Post-tropical Storm Noel, Hurricane Kyle and Post-tropical storm Hanna – all having significant impacts in the Maritime Provinces. A subsequent companion presentation will look at the impacts of these and other ET events.

2C-303.3 ID:3027 **14:45**

A Summary of the impacts of ET events affecting Canada since 2006

Peter Bowyer , *Steve Hatt*
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Numerous tropical cyclones, either undergoing or having completed extratropical transition (ET) have impacted Canada in the last three years, each accompanied by damaging winds, rain or waves. This presentation will highlight these events and their impacts in eastern Canada. A preceding companion presentation will look at many of the same ET events from a forecaster's perspective.

2C-303.4 ID:3025 **15:00**

Tropical cyclone rain and wind climatology for Canada – a sneak peak

Peter Bowyer [1], *Alex Donaldson* [1], *Rich Cianflone* [2]
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Contact: peter.bowyer@ec.gc.ca

In 2005, funded by the National Search & Rescue Secretariat's New Initiatives Fund (SARNIF), the Canadian Hurricane Centre published a comprehensive climatology of hurricanes for Canada and her territorial waters in order to quantify the threat. That study reported on the details and statistics of tropical cyclone tracks and impacts. The SARNIF has enabled the study to continue by looking into both the meteorological and oceanic parameters which create the threat to Canadians: wind; rain; storm surge; ocean waves. While this detailed climatology will not be published until March 2010, this presentation will take a sneak peak at the findings of the tropical cyclone wind and rainfall data and will briefly outline the dissemination and communications plan.

2C-303.5 ID:2892 **15:15**

An Overview of Forecast Performance at the Canadian Hurricane Centre

Chris Fogarty [1], *Peter Bowyer* [2]
[1] Canadian Hurricane Centre / National Lab for Marine and Coastal Meteorology
[2] Canadian Hurricane Centre

Contact: chris.fogarty@ec.gc.ca

The Canadian Hurricane Centre has been formally documenting forecast performance over the past number of hurricane seasons using some new software programs developed in the National Lab for Marine and Coastal Meteorology. The new system allows for more direct measure and monitoring of absolute track and intensity forecasting errors for tropical systems affecting Canada. In addition to this quantitative verification, the Centre has been assessing its weather warning program and impact statements through annual storm reports and case studies. This presentation will serve as a highlight of this important aspect of forecasting and summarize areas where we can improve our service.

POSTERS Monitoring the Atmosphere and Ocean / Monitorage de l'atmosphère et de l'océan

Room / Endroit (100), Chair / Président (Al Wallace), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I2.1 ID:2934 15:30

Characterisation of biogenic slicks - using Langmuir films and ellipsometry

Wendy King [1], *Valborg Byfield* [1], *Stanislav Ermakov* [2], *Robert Greef* [1], *Jeremy Frey* [1]
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The sea-surface microlayer (SSM) is a hugely complex system comprised of many different organic materials that has a considerable influence on the physical and chemical properties of the ocean surface. Under certain conditions, involving wind, internal waves and currents, the SSM is compressed and forms biogenic slicks. These biogenic slicks have a wave dampening effect and when using satellite data to monitor the ocean surfaces look indistinguishable from anthropogenic slicks. It is important to understand the physical properties of these biogenic slicks to identify oil pollution. For this project the physical properties of biogenic slicks from the Solent (UK) and the Black Sea (Ukraine) are being investigated. Model compounds that display similar properties to the slicks are also being characterized; these simpler systems are easier to interpret and parallels to the biogenic slicks can be made increasing understanding. The tools used to characterize these Langmuir films involve the analysis of the phase and amplitude change of polarized light upon surface reflection (ellipsometry). The film can be compressed and expanded monitoring changes in surface pressure. In conjunction, ellipsometry can be used to determine optical properties, thickness, phase changes and hysteresis effects of the film, offering both spectroscopic information and images. The changes of the film on compression are important as they mimic natural events that have the potential to be of use in satellite data interpretation. Results show, in images, the domain separation of different chemical species within the SSM and co-existence of phases. Upon compression and expansion of the films, aggregation of the different phases along with hysteresis effects are seen – phenomena that has only been hypothesized to date. Work on the model compounds demonstrates that it is possible to determine thicknesses of thin films at different surface pressures offering valuable information on phase changes.

2D-100-I2.2 ID:2980 15:30

Software Tools to Monitor a Real Time Sunphotometer Network

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A request for near real time inputs of aerosol optical depth measurements into a Canadian air quality model stimulated innovations in the AEROCAN Sunphotometer Network. The automatic CIMEL sunphotometers which comprised the AEROCAN Network were upgraded to collect data at 3 minute intervals and hourly low-data-volume satellite uplinks were replaced by hardwired internet connections. Aerosol optical depth information is now uploaded to a central ftp site and is available for use within 15 minutes. Software has been written to collect the data from across Canada and place it in a MySQL database. Tools for quality control and data network monitoring have been developed to keep the Aerocan network managers up to date on instrument performance and data availability. These tools include dynamically updated web plots as well as a RSS newsfeed. Other tools such as Twitter are also being investigated. In this paper we will provide an overview of our progress and an assessment of their impact on our operational needs

2D-100-I2.3 ID:2865 15:30

The role of Prairie and Northern in the installation and maintenance of Environment Canada's Atmospheric Monitoring Networks

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Prairie and Northern Atmospheric Monitoring Section provides a variety of functions for the Meteorological Service of Canada's atmospheric monitoring networks. This includes installation, repair and maintenance services for networks such as Surface Weather, Upper Air, Radar, Marine as well as support for specialized data networks including Ozone, Solar Radiation and others. Using a Quality Management System framework Atmospheric Monitoring strives to meet the World Meteorological Organization's targets for data accuracy and availability within Canada's Meteorological Service.

2D-100-I2.4 ID:3000 15:30

Initial results from the STAR surface mesonet

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In mid-September 2007 the STAR (Storm Studies in the Arctic) project assembled and installed 10 surface weather stations in Iqaluit and surroundings; 4 of the stations were equipped with Iridium satellite phones to allow daily data transfer to a base station at York University, while data from other stations were retrieved when those stations were removed in April 2008. Statistics of the Wind Speed and Wind Direction data (histograms and Gamma distribution fits plus wind rose plots) illustrate the behaviour of the wind and indicate strong topographic channelling of flow in NW-SE directions along the axis of Frobisher Bay and the Sylvia Grinnell River valley.

POSTERS IPY and related atmospheric, oceanographic, and hydrological studies / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie

Room / Endroit (100), Chair / Président (Bash Toulany), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I3.1 ID:2719 **15:30**

Model validation of cloud and radiation from the Atmospheric Infrared Radiance Sounder (AIRS)

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Hyperspectral radiances from AIRS are used to validate model cloud and radiation for short term forecasts. From model output, equivalent radiance spectra to observed ones are computed. The same retrieval technique is applied to both observed and calculated radiances to derive cloud parameters: height and amount. Synthetic radiances were first used to validate the retrieval technique itself, notably limiting biases which can arise from the difficulty to retrieve boundary layer clouds. The application is global, but with special attention to the Arctic region as part of the IPY effort (notably polar night retrievals). A reliable methodology for the evaluation of the vertical distribution of clouds is the main output of this work. It is also found that the quality of 6-h forecasts is not significantly degraded at 12-h, a good indication that our model does not suffer from a long spin-up problem.

2D-100-I3.2 ID:2736 15:30

Simulating wind channeling over Frobisher Bay in the Eastern Canadian Arctic during the 7-8 November 2006 wind event

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Previous observational and idealized modelling studies have identified wind channeling over Frobisher Bay as the main cause for the occurrence of strong winds at Iqaluit. The 7-8 November 2006 wind event appears to be representative for such occurrences. Our simulations of the event with the GEM-LAM 2.5-km model covering the Southern Baffin Island show the development of wind channeling over Frobisher Bay. It starts as a barrier wind following low-level blocking of northeasterly winds by steep orography near the head of the bay. Later on, it intensifies, being primarily driven by large-scale pressure gradients. The lateral development of the channeled wind across the bay and its interaction with a downslope wind (over the Hall Peninsula) explains the shift in surface wind direction and the high surface wind speeds recorded at Iqaluit. Some of the findings are also supported by data from radiosondes launched at Iqaluit. We also show the impact of using a distributed orographic drag scheme, a modified Lenderink-Holtslag mixing length, and an increased near-surface vertical resolution.

2D-100-I3.3 ID:2853 15:30

Fresh water in the northern East Greenland Current from 1982 through 2005

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We describe the distribution and variability of the Pacific fresh water and total fresh water on the East Greenland shelf and slope in the region west of the Polar Front from Fram Strait to 72ºN. These waters make up a considerable part of the Polar Water leaving the Arctic Ocean through Fram Strait. Data were obtained for most years between 1982 and 2005. We determine the total fresh water and Pacific fresh water fractions using the phosphate and nitrate concentrations together with salinity. During 1993 and 2002, alkalinity values were also determined, which allowed estimates of river water and sea ice melt water fractions as well. Pacific fresh water and river water accounted for almost all of the fresh water in this region in 2002 when data were taken early in spring, while more sea ice melt water was present in 1993 when measurements were done later in the season. In 2004 and 2005 there was almost no trace of Pacific fresh water in the East Greenland Current.

2D-100-I3.4 ID:2944 15:30

Influence of stationary wave field on stratosphere-troposphere coupling response to idealized Eurasian snow forcing

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Observational studies indicate that the correlation between autumnal snow cover anomalies over Eurasia and wintertime circulation anomalies projects significantly onto the Northern Annular Mode (NAM). Years in which there is anomalously high Eurasian snow cover in autumn correlate with the negative phase of the wintertime NAM pointing to the potential utility of snow cover data as a seasonal forecasting tool. Forced general circulation model (GCM) experiments reveal that a large autumnal Eurasian snow forcing generates a stratosphere-troposphere coupling response that propagates down to the surface within several weeks. Contrastingly, this response is not found in unforced GCM runs with seasonally varying snow cover. Potential dynamical reasons for this discrepancy are probed by imposing an idealized snow forcing in a relatively simple dry, hydrostatic, primitive equation GCM. Within the first few days of applying a surface cooling over Eurasia, a surface high and a mid-tropospheric low develop in accordance with the expected direct response to surface cooling. Over several weeks, the forcing generates a weak, positive NAM response, opposite to the negative NAM response to high snow cover anomalies shown in observations. A decomposition of the meridional eddy heatflux response over the first several weeks indicates that the nonlinear contribution produces a positive response in the stratosphere, consistent with an increase in vertical propagation of wave activity; however, large cancellations with the linear terms, i.e. terms that include correlations with the background stationary wave field, yield an overall negative meridional eddy heatflux response to the surface cooling. Negative correlations with the stationary wave field result in a response that is vertically trapped suggesting that the response is localized to the forcing region and that accurate representation of the stationary wave field is likely a critical factor in developing a large-scale response to a Eurasian snow forcing.

2D-100-I3.5 ID:2973 15:30

Coupled hydrologic-land-surface modelling for predicting freshwater flux to the arctic ocean

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The Hydrometeorology and Arctic Laboratory (HAL) of Environment Canada in Saskatoon and Edmonton is a research and development lab dedicated to the improvement of water cycle prediction models and the appropriate use of their simulations. We work in collaboration with environmental scientists, project managers and computer specialists to develop and test experimental versions of numerical weather prediction, land-surface and hydrologic models. The presentation will provide a progress report of the work introduced last year and emphasize how our work will be applied

within the context of the International Polar Year.

2D-100-I3.6 ID:3009 **15:30**

Cross-shelf exchange in the Arctic Ocean

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A IPY-GEOTRACES program has been set up by several Canadian laboratories to investigate the impact of climate change on the nutrient and carbon cycles in the Arctic Ocean using a multi-tracer approach. A cruise is expected to take place in the summer of 2009 in the Beaufort Sea, on the CCGS Amundsen research icebreaker. As part of the GEOTRACES program, our goal is to investigate the controls of air-sea fluxes of CO2 by physical transport and biological processes. The uptake of carbon from the atmosphere, or release from the ocean, is controlled by the gradient of the carbon dioxide partial pressure (pCO2) between the two reservoirs, as well as by climatological factors such as wind speed and ice cover, and by the nature of the air-sea boundary microlayer. In the Arctic, how all these factors combine to limit or enhance air-sea CO2 exchange is poorly understood because the coupling of physical transport processes (convection, stratification, ice cover) and biological processes (CO2 uptake and remineralization) is poorly known. In particular, it is not known whether the receding ice cover in the Arctic Ocean will result in a net source or sink of CO2 to the atmosphere, nor whether the increased discharge of Mackenzie River waters and input of nutrients to the Beaufort Sea will result in increased productivity and a drawdown of mixed layer pCO2 or the input of terrestrial organic matter from the river will sustain greater heterotrophy and lead to metabolic CO2 production. Our work will focus on shelf-open ocean exchange, while colleagues will study vertical transport and in situ biological processes. More specifically, we will evaluate the cross-shelf (lateral) carbon fluxes along two selected transects using radioisotopes techniques. The proposed measurements will allow us to identify the feedbacks of global warming on polar CO2 exchange in the Beaufort Sea as well as estimate the amount of CO2 transferred below the mixed-layer by convective processes and respiration of organic matter exported from the surface to the deep waters.

2D-100-I3.7 ID:3075 **15:30**

Forecasting intercontinental transport of pollution into the Canadian High Arctic using a Langrangian particle dispersion model.

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A forecast system has been developed to interpret measurements at the Polar Environment Atmospheric Research Laboratory (PEARL). PEARL is located in the Canadian Arctic at 610 m above sea level on Ellesmere Island (80oN, 86oW). We have used trajectory and particle dispersion models FLEXTRA and FLEXPART to construct

10-day backward trajectories starting from PEARL and 5-day emission tracer transport forecasts. FLEXPART is a Lagrangian particle dispersion model that simulates the long-range transport, diffusion, dry and wet deposition, and radioactive decay of tracers released from point, line, area or volume sources. FLEXPART was originally developed to simulate the dispersion of dangerous substances from point sources (Stohl et al., 1998), however, it has been used for many other purposes, including studies of intercontinental transport (Damoah et al, 2004), pyro-convection (Damoah et al., 2006) and as a forecast and analysis tool for flight planning (Forster et al., 2004).

For the emission tracer forecasts we have used as emission basis the EDGAR version 3.2 inventory for the year 2000 with a resolution of 1x1 degree, except for most of North America where the inventory of Forst and McKeen (2004) was used. Tracer masses are carried by particles following trajectories calculated using GFS winds from NCEP and stochastic components for turbulence and convection. Tracer forecasts are run separately for anthropogenic emissions from Europe, Asia and North America and their transport to PEARL monitored. Currently, we produce total column of carbon monoxide (CO) tracer; nitrogen oxides (expressed as NO2), and sulfur dioxide (including direct emissions of sulfate) can be included. The species are run as passive tracers for 20 days, after which tracer particles are dropped from the simulation. Using this system, back trajectories from PEARL will be generated to explore possible origins for pollutants that arrive during selected short episodes.

POSTERS Climate Variability and Marine Ecosystems / Le climat et les écosystèmes marins

Room / Endroit (100), Chair / Président (Catherine Johnson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I4.1 ID:2757 15:30

Spatial and temporal distributions of dissolved organic matter and carbon monoxide in Arctic first-year sea ice

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We investigated the spatial and temporal distributions of dissolved organic carbon (DOC), chromophoric dissolved organic matter (CDOM), and carbon monoxide (CO) in first-year sea ice in the southeastern Beaufort Sea from late winter to early summer 2008. DOC, CDOM, and CO in the bottom sea ice followed the evolution of ice algae and were enormously enriched relative to the overlying ice and the underlying seawater during the ice algae bloom. Bottom-ice chlorophyll *a* (chl *a*), DOC, CDOM, and CO during the bloom were higher in landfast ice than in drifting ice. CO significantly correlated with chl *a*, DOC, and CDOM in bottom sea ice but only weakly related to these variables for the whole ice column. Solar-simulated irradiations demonstrated efficient CO photoproduction in sea ice, particularly in the DOM-enriched bottom sea ice. This study suggests that ice algae-associated biological processes are responsible for DOM production in sea ice while both biological and photochemical processes may play important roles in sea-ice CO formation. The accumulation of DOM and CO within sea ice in spring may serve as potentially significant sources of these constituents to seawater, and, in case of CO, to the atmosphere as well, when ice melts in summer.

2D-100-I4.2 ID:2734 **15:30**

Ice-algae modeling in the Canadian Arctic Archipelago

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Sea ice ecosystems play a key role in carbon cycling in the Arctic, and thus can have an impact on climate. Microalgae, represented mostly as diatoms, are important lifeforms in the ice and are the focus of this model study. We investigate the relationships between nutrient and light availability with algal growth using a one-dimensional sea ice model. The sea ice model component is the Huwald multilayer sigma-coordinate thermodynamic model, which is a more complex snow-ice model than what has been used in past Arctic ice-algal model studies. Because of the coordinate transformation and relayering of snow and ice that the model employs, this coupled ice-algae model also has potential in the future for modeling microalgae being advected upward and growing higher in the ice matrix, as observed in the Central Arctic. To start we have followed past studies in the Arctic focusing on biomass accumulation at the bottom of landfast ice. The region of interest is the Canadian Archipelago, and results are compared with data from May to July 2002 at a station near Resolute in Barrow Strait. Results are consistent with previous studies modeling this area, showing a limitation of light for algal growth at the beginning of the bloom, followed by fluctuations between light and nutrient limitation, and finally nutrient limitation as the bloom declines. An advection term in this model used to take into account movement between ice layers naturally handles the expulsion of algae during ice melt, and the loss in biomass triggered by melt at the base is more accurately simulated with this model than in past studies.

2D-100-I4.3 ID:2883 **15:30**

Mesocosm-simulated effects of increasing temperature and ultraviolet-B radiation on the CO2 system in sub-Arctic coastal water

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A mesocosm experiment was conducted in Rimouski, Canada in August 2008 using local coastal water to study the effects of increasing water temperature and ultraviolet-B radiation (UVBR, 280-320 nm) on the CO2 system in sub-Arctic coastal water. Four treatments in duplicate were performed: natural temperature and natural UVB (NT + NUVB, i.e. the control), enhanced UVB (+UVB), increased water temperature (~3°C higher than NT) (+T), and both increased T and enhanced UVB (+T+UVB). Water in each mesocosm was continuously mixed. Samples were taken daily over the 10-day incubation period for determinations of dissolved inorganic carbon (DIC), pH, chlorophyll a (chl-a), and bacteria abundance. The fugacity of CO2 (fCO2) was calculated from DIC and pH. In all treatments DIC and fCO2 decreased and pH increased over the whole incubation period but at greater rates during the bloom. Time-weighted net losses of DIC (ΔDIC) and fCO2 (ΔfCO2) were calculated for the bloom and the whole incubation periods, respectively. In both periods the highest ΔDIC occurred in the +T treatment sequentially followed by the control, the +T+UVB, and the +UVB. ΔfCO2 in various treatments for the bloom period showed the same sequence as ΔDIC. However, for the whole incubation period ΔfCO2 in the control was higher than in the +T treatment, implying that an increase in fCO2 due to higher temperature in the +T treatment overtook the decrease in fCO2 caused by temperature-enhanced biological DIC drawdown during pre- and post-bloom. ΔfCO2 in descending order follows: control > +T (10 % lower than the control) > +UVB (12% lower) > +T+UVB (16 % lower). This study suggests that climatic warming and increasing UVBR tend to diminish the capability of sub-Arctic seawater to sequester atmospheric CO2.

2D-100-I4.4 ID:2911 15:30

Sinking export of organic material in the eastern Beaufort Sea during summer 2008.

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Global warming affects polar region first and foremost, with consequences for the Arctic ecosystem in its entirety, including the physical, chemical and biological environments. The study of the sinking export of organic material is of crucial importance to understanding the biological pump, and impacts of climate change on the drawdown of atmospheric carbon in Arctic marine environments. This investigation was conducted under the Framework of the International Polar Year, Circumpolar Flaw Lead (CFL) system study. Short-term (7-24 h) particle interceptor traps were deployed at 2-3 depths (50, 100 and 150m) on 14 occasions in the eastern Beaufort Sea and Amundsen Gulf, from 10 June to 30 July 2008. Here, we present sinking fluxes of pigments (chlorophyll a and pheopigments), total particulate carbon, particulate organic nitrogen and fecal pellets. Chlorophyll a and pheopigments sinking fluxes ranged from < 0.1 to 3.9 mg m-2 d-1 and < 0.1to 10.6 mg m-2 d-1, respectively. The highest chlorophyll a and pheopigments sinking fluxes were recorded on the eastern side of the Amundsen Gulf and offshore

Cape Bathurst. Pheopigments made up a high proportion of the total pigment sinking fluxes (average = 73.6 ± 10.4%) throughout the study area. These preliminary results indicate that a large fraction of the sinking carbon was exported in the form of fecal pellets in the Canadian Beaufort Sea, during summer 2008.

2D-100-I4.5 ID:2908 **15:30**

Environmental control of continental shelf zooplankton communities

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Continental shelf zooplankton communities in the northwest Atlantic reflect a mixture of indigenous shelf species and transient species transported onto the shelf from upstream and continental slope waters. These communities exhibit both cross-shelf and along-shelf gradients, as well as strong seasonal variability in abundance, biomass, and community composition, driven both by the physiological and life history responses of individual species to their physical and biological environment and by physical transport. Data collected on the Scotian Shelf since 1999 by the Atlantic Zone Monitoring Programme were used to identify the dominant environmental factors contributing to zooplankton community variability. These relationships will be used to evaluate the factors driving interannual changes in the zooplankton community on the shelf.

POSTERS Physical-Biological Interactions in the Ocean / Interactions physiques et biologiques dans l'océan

Room / Endroit (100), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I5.1 ID:2931 **15:30**

Net impact of subtropical cyclonic eddies on regional air-sea CO2 fluxes: CO2 sink or source?

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By comparing the impact of two cyclonic eddies on sea surface pCO2 and air-sea CO2 exchange in the lee of the main Hawaiian Islands in the subtropical North Pacific Gyre, this study confirmed that sea surface pCO2 within the cyclonic eddies is a combined result of upwelling, warming, and biological uptake. Overall, sea surface pCO2 within the eddy core is much higher than the expected values deduced from the sea surface pCO2-SST relationship at stations without the influence of eddies. Therefore, subtropical cyclonic eddies serve as a net CO2 source to the atmosphere. The magnitude of this net CO2 release closely follows the magnitude of expected increase in SST within the eddy center, which is determined by the seasonal heat budget in the mixed layer. This SST increase generally reaches its maximum in summer and minimum in winter. Therefore, with the temporal evolution of a cyclonic eddy, more significant surface warming will also increase sea surface pCO2 and cause more CO2 release.

2D-100-I5.2 ID:2835 **15:30**

Prochlorococcus marinus as a source of marine methyl iodide (CH_3I)

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The ocean is the dominant source of atmospheric methyl iodide (CH_3I) which, through photolytic release of iodine, plays a significant role in stratospheric ozone destruction. The mechanisms of CH_3I production in the marine environment are poorly understood. A previous laboratory and field study suggested *Prochlorococcus marinus*, a ubiquitous marine cyanobacterium, is a globally significant biological producer of CH_3I (*Smythe-Wright et al.,* 2006, *Global Biogeochem. Cycles, 20*). In this study, CH_3I concentrations were measured in cultures of *P. marinus* (MED4) and *Synechococcus*. Cell-normalized production rates in *P. marinus* cultures ranged from 2 to 5 molecules of CH_3I cell^{-1} d^{-1}; these rates were 1000 fold lower than production rates reported for the previous study. Extrapolating CH_3I production rates from the current study yields a global production rate of 0.7 Gg yr^{-1} which accounts for 0.6% of the estimated global CH_3I production, suggesting *P. marinus* is not a globally significant source of CH_3I.

2D-100-I5.3 ID:2897 **15:30**

Parameter Optimization of a Two-Layered Diagenetic Model Through Variational Data Assimilation

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Regional ocean circulation models coupled with biological or biogeochemical routines are instrumental in studying continental shelf and coastal ocean processes, where benthic-pelagic coupling is pronounced, and a significant proportion of nutrient remineralization occurs in the sediment. While coupled models typically use highly simplified linear parameterizations of benthic processes, benthic remineralization pathways are known to vary non-linearly under changing environmental conditions, for example as bottom-water oxygen concentrations approach hypoxia and anoxia. Our objective is to explore the use of a more sophisticated model of benthic elemental cycling (a so-called diagenetic model) for coupling with a biogeochemical circulation model. As is the case for biological and biogeochemical models, diagenetic models require the appropriate tuning of their parameters, many of which are model-specific, and poorly quantified. This can be accomplished by parameter optimization through variational data assimilation – a tuning process by which a model's output is fitted to observed data through the methodic manipulation of the model parameters. We use this technique to optimize the parameters of the Sediment Flux Model (the diagenetic model component in RCA; http://www.hydroqual.com/wr_rca.html) using sediment flux observations made during mesocosm experiments. Once a well-parameterized Sediment Flux Model is coupled to regional implementations of RCA we may be better able to quantify exchange fluxes across the sediment-water interface under varying environmental conditions.

2D-100-I5.4 ID:2948 15:30

Life on VENUS: Characterizing the benthic larval community at depth in Saanich Inlet.

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We are using the Victoria Experimental Network Under the Sea (VENUS) observatory to measure larval supply, settlement, and recruitment of benthic marine invertebrates, employing both high frequency monitoring and responsive sampling. Instruments deployed at 97 m on the hypoxic seabed of Saanich Inlet, British Columbia, continuously monitor environmental parameters, such as temperature, salinity, and dissolved oxygen. We used remotely activated sediment traps to sample larval supply near the benthos and high-resolution still camera shots to monitor larval settlement on substrates with the same planar surface but different complexity (tiles and sponges). Sampling occurred at weekly to biweekly intervals between February 2008 and February 2009. The settlement substrates were retrieved and replaced in September 2008 and February 2009. Preliminary results indicate that settlement is greater on the complex than the simpler substrates. Tube building larvae settled amongst the sponge fibres, while free-living larvae occurred on the surface. No settlers were found on the smooth tiles. Recruits of the squat lobster Munida quadrispina coincided with reduced oxygen levels (0.1 – 0.8 mg L-1) and disappeared when oxygen levels rose to 2 mg L-1. These results suggest that some species can tolerate, perhaps even thrive in, the low oxygen levels at Saanich Inlet and that recruitment patterns may be closely tied to fluctuations in oxygen, the most variable environmental factor at depth.

2D-100-I5.5 ID:3092 15:30

Oceanographic Setting and Variability of Orphan Knoll

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Orphan Knoll is a seamount which rises to 1800 m at the outer edge of Orphan Basin off the Northeast Newfoundland Shelf. It is located in the equatorward western boundary flow of the North Atlantic's subpolar gyre, and also within 100km of the subtropical

North Atlantic Current's meander towards the Labrador Sea. As a result, there are competing influences on its oceanography from these contrasting large-scale current systems, and from its local topography. Fisheries and Oceans Canada is investigating the degrees of connectivity with, and isolation from, similar marine habitats in the NW Atlantic, for input to international governance decisions. Initial results will be presented, based on a dedicated physical-chemical-biological survey of the Knoll in May 2008, hydrographic sections across Orphan Basin extending to Orphan Knoll in 2004-07, and other available data. The latter include temperature-salinity profiles and drift trajectories from Argo floats, and satellite altimetry, ocean colour and surface temperature datasets. The results suggest strong connectivity with waters exiting the Labrador Sea, a tendency for clockwise circulation around the Knoll, and some degree of enhanced retention.

2D-100-I5.6 ID:3081 **15:30**

Solid phase microextraction (SPME) methods for the determination of trace aldehydes and ketones in seawater and ambient air

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Volatile carbonyl compounds (aldehydes and ketones) in surface waters, air and snow are of interest due to being products of dissolved organic matter photochemistry (and thus a sink of dissolved organic matter) or of biological activity, and affecting oxidative processes in the troposphere. Our understanding of their role in these environmental compartments would be facilitated by methods allowing their routine determination in seawater. We here report facile, low-cost, portable methods for C1 - C9 carbonyl compounds in seawater and ambient air, based on derivatization of carbonyl compounds to their pentafluorobenzyl oximes followed by solid phase microextraction (SPME) and gas chromatography (GC). We have achieved low nanomolar or sub-nanomolar detection limits. The method's optimization and application to selected air and surface seawater samples is presented.

POSTERS Numerical Modelling for Research / Modélisation numérique pour la recherche

Room / Endroit (100), Chair / Président (Ronald J. McTaggart-Cowan), Date (02/06/2009), Time / Heure (15:30 - 17:00)

POSTERS Remote Sensing of the Atmosphere and Ocean / Télédétection de l'atmosphère et de l'océan

Room / Endroit (100), Chair / Président (Norman O'Neill and Rong-Ming Hu), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I7.1 ID:2778 **15:30**

A 7-year midlatitude climatology of stratospheric temperature using vibrational-RAMAN LIDAR

Blessing Iserhienrhien [1], *Robert Sica* [2], *Steve Argall* [3]
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The Purple Crow Lidar (PCL) is a large power-aperture product monostatic laser radar located at the Delaware Observatory (42° 52 N, 81° 23' W, 225 m elevation above sea level) near the campus of The University of Western Ontario. It is capable of measuring temperature and wave parameters from 10 to 110 km altitude, as well as water vapor in the troposphere and stratosphere. We use upper tropospheric and stratospheric vibrational Raman N2 backscatter-derived temperatures to form a climatology for the years 1999 to 2007 from 10 to 30 km altitude. The lidar temperatures are validated using coincident radiosondes measurements from Detroit and Buffalo. The measured temperatures show good agreement with the radiosonde soundings. An agreement of ±1 K is found during summer months and ±2.5 K during the winter months, validating the calibration of the lidar to within the geophysical variability of the measurements. Comparison between the PCL measurements and atmospheric models shows the PCL measurements are 5 K or less colder than CIRA-86 below 25 km and 2.5 K warmer above during the summer months. Below 16 km the PCL measurements are 5 K or less colder than the MSIS-90 model, while above this region, the PCL agrees to about ±3.5 K or less. The temperature differences between the PCL measurements and the models are consistent with the differences between the atmospheric models and the Detroit and Buffalo radiosonde measurements. The temperature differences compared to the models are consistent with previous comparisons between other radiosondes and satellite data sets, confirming that these differences with the models are real.

2D-100-I7.2 ID:3001 **15:30**

Temperature and water vapour retrievals from the newly commissioned RMR lidar in Eureka Nunavut.

Jonathan Doyle , *Graeme Nott* , *Chris Perro* , *Thomas Duck*
Dalhousie University

Contact: doylejg@dal.ca

The Canadian Network for the Detection of Atmospheric Change (CANDAC), a collaboration between several universities and government organizations, has established a suite of instruments in Eureka, Nunavut, Canada (79°59'N, 85°56'W). As part of this network, Dalhousie University's Rayleigh-Mie-Raman lidar has been installed at the sea-level atmospheric laboratory, (ØPAL). Three optical scattering mechanisms are used to profile water vapour in the troposphere and aerosols, clouds and temperature from near-ground to the lower-mesosphere. These measurements will form a long term dataset essential to studying the thermodynamic and radiative environments in the high Arctic. Since the commissioning of the lidar in December 2008, significant work has been undertaken to optimize data collection and calibrate the temperature and water vapour retrievals. Radiosondes launched on-site twice daily are used for calibration of each measurement and also allow monitoring any change in instrument response over the longer term. The calibration and associated confidence for different vertical and temporal resolutions will be presented and the effect of different atmospheric conditions on the retrieval discussed. Finally, preliminary analysis of a selected case from the winter campaign will be presented and discussed.

2D-100-I7.3 ID:3073 15:30

Temperature and Ozone Observed by MIPAS/ENVISAT and MLS/AURA: The Global Atmospheric Tides and Comparisons with Model Results

Ding Yi Wang [1], *William Ward* [1], *Michael Höpfner* [2], *Jonathan Jiang* [3]
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MIPAS/ENVISAT and MLS/AURA measure the stratospheric and mesospheric temperature and ozone distributions with nearly pole-to-pole coverage by using limb-viewing infrared emissions and microwaves, respectively. The two satellite instruments are launched on 1 March 2002 and 15 July 2004, in the same sun-synchronous orbit plane (98° inclinations) with a 10:00 AM and 1:45 PM equator crossing time, respectively. A climatology of monthly mean temperatures and ozone mixing ratios are derived from the satellite data. The satellite-measured temperatures are compared with those of the CMAM and other models. In particular, studies of the atmospheric tides at the high latitude are stressed, since the two data sets combined together provide a daily coverage of four local times for Polar latitudes and can be used to derive tidal signatures better than those from the measurements of a single satellite. The aliasing issue of asynoptic satellite sampling will be discussed in detail through the simulation of satellite flights through the CMAM model atmosphere.

2D-100-I7.4 ID:2971 15:30

Stratospheric Aerosols from the 2008 Kasatochi Eruption Observed over Halifax,

Nova Scotia

Lubna Bitar , *Thomas J. Duck*
Dalhousie University
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Kasatochi volcano, located in the Central Aleutian Islands of Alaska (52.17 N, 175.51 W), erupted explosively on 7-8 August 2008 and injected material into the lower stratosphere producing a long-lived stratospheric aerosol layer in the Northern Hemisphere. These volcanic aerosols have been detected by the Dalhousie Raman Lidar situated in Halifax, Nova Scotia (44.64 N, 63.59 W) and observed for weeks following the eruption. Beginning in mid-August, anomalous increases of aerosol extinction were detected in the lower stratosphere whenever clear skies were available, varying in intensity and vertical extent. The lidar measurements reveal the vertical structure, optical characteristics, and temporal evolution of the Kasatochi aerosols. A new high- altitude receiver has been added to the lidar system and is being used to enhance investigation of the Kasatochi plume. An overview of the lidar observations is presented.

2D-100-I7.5 ID:2950 15:30

Comparison of global ACE-FTS observations in the upper troposphere and GEM-AQ simulations

John Mcconnell [1], *Alex Lupu* [1], *Jacek Kaminski* [1], *Kenjiro Toyoto* [1], *Curtis Rinsland* [2], *Peter Bernath* [3], *Kaley Walker* [4], *Chris Boone* [5], *Yy Nagahama* [6], *K. K. Suzuki* [6]
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Hydrogen cyanide (HCN) is a minor constituent of the atmosphere emitted primarily from biomass burning. In the troposphere, it is lost mainly by ocean uptake presumably through biological activity, with a small loss by reaction with OH. We investigate the spatial and temporal distribution of HCN in the upper troposphere through numerical simulations. We compare with HCN observations from a space-based instrument. The simulations were performed with the Global Environmental Multiscale Air Quality model (GEM-AQ), a global, tropospheric chemistry, general circulation model based on the global multi-scale model developed by the Meteorological Service of Canada for operational weather forecasting. Fire emission fluxes of HCN were generated by using year-specific inventories of carbon emissions with 8-day temporal resolution from the Global Fire Emission Database (GFED) version 2. The model output is compared with HCN profiles measured by the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS) instrument onboard the Canadian SCISAT-1 satellite.

2D-100-I7.6 ID:2960 15:30

Comparison of CMAM simulations of carbon monoxide (CO), nitrous oxide (N_2O),

and methane (CH_4) with observations from Odin/SMR, ACE-FTS, and Aura/MLS

Jianjun Jin [1], *Kirill Semeniuk* [1], *Stephen Beagley* [1], *Victor Fomichev* [1], *Andreas Jonsson* [2], *John Mcconnell* [1], *Joachim Urban* [3], *Donal Murtagh* [3], *Gloria Manney* [4], *Chris Boone* [5], *Peter Bernath* [6], *Ace And Smr Team* [7]

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Simulations of CO, N_2O and CH_4 from a coupled chemistry-climate model (CMAM) are compared with satellite measurements from Odin Sub-Millimeter Radiometer (Odin/SMR), Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS), and Aura Microwave Limb Sounder (Aura/MLS). Pressure-latitude cross-sections and seasonal time series demonstrate that CMAM reproduces the observed global CO, N_2O, and CH_4 distributions quite well. Differences between the simulations and the ACE-FTS observations are generally within 30%, and the differences between CMAM results and SMR and MLS observations are slightly larger. These differences are comparable with the difference between the instruments in the upper stratosphere and mesosphere. Comparisons of N_2O show that CMAM results are usually within 15% of the measurements in the lower and middle stratosphere, and the observations are close to each other. However, the standard version of CMAM has a low N_2O bias in the upper stratosphere. The CMAM CH_4 distribution also reproduces the observations in the lower stratosphere, but has a similar but smaller negative bias in the upper stratosphere. The simulated polar CO evolution in the Arctic and Antarctic agree with the ACE and MLS observations. CO measurements from 2006 show evidence of enhanced descent of air from the mesosphere into the stratosphere in the Arctic after strong stratospheric sudden warmings (SSWs). CMAM also shows strong descent of air after SSWs. In the tropics, CMAM captures the annual oscillation in the lower stratosphere and the semiannual oscillations at the stratopause and mesopause seen in Aura/MLS CO and N2O observations and in Odin/SMR N_2O observations. The Odin/SMR and Aura/MLS N_2O observations also show a quasi-biennial oscillation (QBO) in the upper stratosphere, whereas, the CMAM does not have QBO included. This study confirms that CMAM is able to simulate middle atmospheric transport processes reasonably well.

2D-100-I7.7 ID:3017 15:30

First Global Observations of Groundstate CO_2 in the Mesosphere and Lower Thermosphere by ACE-FTS and Analysis Using CMAM Model

Stephen Beagley [1], *Chris Boone* [2], *Victor Fomichev* [1], *Jianjun Jin* [1], *Kirill Semeniuk* [1], *John Mcconnell* [1], *Peter Bernath* [3], *Kaley Walker* [4]

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[4] Department of Physics, University of Toronto, Toronto, Ontario, Canada

Contact: jin@nimbus.yorku.ca

The first global set of observations of the ground state CO_2 in the mesosphere and lower thermosphere (MLT) are obtained by the ACE-FTS instrument on SCISAT-I, a small Canadian satellite launched in 2003. The observations use the solar occultation technique and document the fall off in the mixing ratio of CO_2 in the MLT region. The beginning of the fall off of the CO_2, or "knee" occurs about 78 km and lies higher than in the CRISTA measurements (~72 km) but lower than in the SABER 1.06 (~ 82 km) and the rocket measurements. We have compared the ACE-FTS CO_2 and CO measurements with the simulations from the vertically extended version of the Canadian Middle Atmosphere model (CMAM). Applying standard chemistry we find that we cannot get an agreement between the model results and ACE CO_2 observations although the CO observations are adequately reproduced. There appears to be about a 10 km offset compared to the observed ACE CO_2, with the model knee occurring too high. In analysing the disagreement, we have investigated the variation of several parameters of interest, photolysis rates, formation rate for CO_2, and the impact of uncertainty in eddy diffusion. Our conclusions are that there must be a loss process for CO_2, about 2-4 times faster than photolysis that will sequester the carbon in some form other than CO and we have speculated on the role of meteoritic dust as a possible candidate. In addition, from this study we have highlighted a possible important role for vertical eddy diffusion in 3D models in determining the distribution of candidate species in the mesosphere which requires further study.

2D-100-I7.8 ID:3049 15:30

Characterisation and optimisation of the new CANDAC Raman lidar for lower atmospheric measurements

Graeme Nott [1], *Jonathon Doyle* [1], *Matthew Coffin* [2], *Thomas Duck* [1]
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[2] NATO Undersea Research Centre, La Spezia, Italy
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Dalhousie University has recently completed the installation of the Canadian Network for the Detection of Atmospheric Change (CANDAC) Raman Lidar at Eureka, NU (79°59'N, 85°56'W). This seven-channel lidar uses both ultraviolet and visible radiation to measure aerosols and clouds, water vapour, and temperature profiles from the ground into the stratosphere and mesosphere. This system will allow investigations into both gravity wave propagation and into the important role of water in the radiation budget. The system is housed in a container laboratory at the sea-level facility of ØPAL and is co-located with radars, other lidars, an interferometer, and microwave radiometer allowing exceptional multi-instrument measurements of the Arctic atmosphere to be made.

Over the Arctic winter the system has been optimised and characterised and this paper will present this work with an emphasis on measurements in the lower atmosphere. Low-altitude measurements present a significant challenge to lidars, particularly when measuring temperature. This system was designed to address these challenges and also allow measurements over the full diurnal cycle. Characterisation and assessment of these

features will be presented. The determination of relative humidity requires tropospheric temperature and water vapour and the optimisation of the system for these difficult measurements will also be discussed.

POSTERS Water, Weather and Climate Serving the Energy Sector / Eau, temps et climat servant le secteur énergétique

Room / Endroit (100), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I8.1 ID:2756 **15:30**

Facilitating Effective Co-existance of Wind Turbine Development and Weather Radars

Christine Best , *Lillian Yao* , *Norman Donaldson*
Environment Canada
Contact: christine.best@ec.gc.ca

Environment Canada is a strong supporter of alternative energy sources, including the development of large capacity wind farms. However, wind farm development can pose an unusual risk to the quality of radar data since the windfarms present large targets that cannot be filtered out of the data display at this time. Doppler filters are used to eliminate clutter (weather 'moves', clutter doesn't) to allow forecasters to clearly see the desired targets. Because wind turbines display movement to the radars, they cannot be filtered.

Another complication we are finding is that many of our radars are located in areas of interest for large-scale wind farm development. Many of the conditions favourable for wind energy are also desirable for weather radar placement (relatively high elevation, reasonably remote, but close to power and communications infrastructure). Development close to a radar can create significant beam blockage and scatter. This results in blockage or contamination of all data along the affected azimuth angles, even behind the wind farm.

For the past few years, Environment Canada's radar program has been working with wind energy proponents on a voluntary basis to help locate and design wind farm layouts that will not significantly impact the quality of the radar data required by forecasters.

While beam blockage will always be insurmountable, in future there may be other ways to filter the effects of more distant wind farms out of the radar data. In the meantime ongoing consultation and cooperation has been quite successful.

POSTERS Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE)

Room / Endroit (100), Chair / Président (C. Harold Ritchie), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I9.1 ID:3050 **15:30**

Validation of the Canadian-Newfoundland Operational Oceanographic Forecasting System

Andry Ratsimandresy , *Debbie Anne Power* , *Fraser Davidson* , *Greg Smith* , *Adam Lundrigan*
(Presented by *Fraser Davidson*)
Fisheries and Oceans Canada, NAFC
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To demonstrate the potential benefits of an extended Canadian operational oceanographic capability a pilot project has been into place for the North West Atlantic Ocean entitled the Canada-Newfoundland Operational Ocean Forecast System (C-NOOFS). This poster focuses on the validation of the C-NOOFS with in-situ and remotely sensed systems as well as the presentation of forecast results on www.c-noofs.gc.ca.

POSTERS Weather and Social Science / La météo et la science sociale

Room / Endroit (100), Chair / Président (Rebecca J. Wagner Hochban), Date (02/06/2009), Time / Heure (15:30 - 17:00)

POSTERS Military Meteorology and Oceanography / Météorologie et océanographie militaire

Room / Endroit (100), Chair / Président (Martha Anderson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I11.1 ID:3118 **15:30**

The Joint Meteorological Centre – a new DND/CF and Environment Canada Initiative

Mario Ouellet [1], *Clarke Bedford* [2]
[1] Environment Canada
[2] National Defence
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The Canadian Forces (CF) are required to be able to sustain a number of global deployed operations concurrently as well as the defence of Canada and North America. Weather and oceanographic services are essential to successful military operations. The new Joint Meteorological Centre at CFB Gagetown, NB will create a new team to meet changing and growing military requirements in the 21st century, while making the best use of modern network technologies and numerical weather prediction. The new weather support team will consist of CF Meteorological Technicians and Environment Canada (EC) meteorologists, supported by EC computer science specialists.

This poster will provide an overview of new and emerging military weather support requirements, as well as an understanding of the plan to reach the full operational capability of the Joint Met Centre in late 2012.

POSTERS Global Atmosphere-Ocean Prediction and Predictability / La Prévision et la prévisibilité globale de l'atmosphère-océan

Room / Endroit (100), Chair / Président (Keith R. Thompson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I14.1 ID:2932 **15:30**

Nonlinear Post-Processing of Dynamical Seasonal Climate Forecasts

Joel Finnis [1], *William Hsieh* [2], *Hai Lin* [3], *William Merryfield* [4]
[1] University of British Columbia
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[3] Environment Canada
[4] Canadian Centre for Climate Modelling and Assessment
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General circulation models (GCMs) are commonly used to issue operational seasonal climate forecasts. Unfortunately, the skill in forecasting extratropical seasonal climate remains modest. Upgrades to these forecast systems typically involve increasing model resolution,model complexity, or the size of the forecast ensemble. Instead, we explore processing the raw model forecasts with computationally efficient machine learning techniques to increase forecast skill. By connecting GCM climate forecasts with observed outcomes, regression-based post-processing may correct model biases and separate forced signals from model drift. Machine learning approaches to regression offer several advantages over classical statistical methods in this situation, including nonlinear capabilities and robustness. Here, machine learning based post-processing is applied to ocean and atmosphere forecasts generated by a coupled (atmosphere-ocean) GCM. Results are compared against raw GCM forecasts, forecasts processed with multiple linear regression, and forecasts generated with an uncoupled (atmosphere-only) GCM.

2D-100-I14.2 ID:2733 15:30

Simulation of the Mixed-Layer Depth in the North East Pacific

Shawn M. Donohue , *Michael W. Stacey* , *Jennifer Shore*
(Presented by *Shawn Donohue*)
Royal Military College of Canada
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A 46 year simulation (1960-2006), using the Parallel Ocean Program, of the circulation of the Northeast Pacific (NEP) is used to study the properties of the mixed layer depth (MLD). Spectral nudging is used to prevent model drift from Levitus climatology. The horizontal resolution of the model is 0.25 degrees, and there are 28 unequally spaced vertical levels. The vertical grid spacing in the upper 150 m is 10 m. The model is forced by monthly NCEP windstress, surface heatflux, freshwater flux, and surface pressure. The implementation of spectral nudging greatly improved the simulations. The filter is shown to properly maintain the longterm mean temperature, salinity fields.

The winter MLD is defined as being the depth where sigma-t is 0.1 greater than the surface value. The forcing mechanism for the interannual MLD variability from 1998-2004 was the windstress associated with the Victoria Mode (PDO mode 2) of the Pacific Decadal Oscillation (PDO). Simulated MLD trend maps indicate significant shallowing until 2003 in the Gulf of Alaska (GOA), particularly along the coast, with larger rates in the northern GOA. The rate of shallowing is similar to that found in past studies, and is consistent with the observed freshening and warming of the upper waters in the GOA and along the coast. The simulated low frequency MLD variability is also found to be in good agreement with the available observations.

The observed strong variability and shallowing of the MLD in 2003 and subsequent deepening by 2006 is reproduced by the model. A significant increase in stratification in 2002 resulted in an anomalously shallow MLD in the winter/spring of 2003. Strong and relatively isolated Ekman pumping is shown to be the cause of this shallowing. A large positive salinity anomaly at depth develops along Line Papa in the autumn of 2003. Relaxation of the Ekman pumping later in the autumn and the decay of the Aleutian Low

Pressure System returns the MLD to historical levels by 2006. Evidence and arguments for a Rossby wave contribution to the 2003 shallowing and subsequent deepening are presented.

2D-100-I14.3 ID:3032 15:30

Parameter estimation for data assimilation with a coupled ocean-atmosphere system

Sergey Skachko [1], *Pierre Gauthier* [1], *Jean-Marc Bélanger* [2]
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This project is concerned with the accurate estimation of global circulation within a coupled ocean-atmosphere model. The objective is to examine the impact of coupling the ocean to an atmospheric model on the quality of forecasts from the short to seasonal and interannual timescales. The studies of MJO, ENSO phenomenon, sea-ice interaction and even tropical cyclones also could be tackled within a coupled model framework. The application of data assimilation methods to a coupled system may be beneficial with respect to two aspects. First, data assimilation is driven by short-term forecasts from the coupled model and maintains the system trajectory close to the observations by modifying the model state according to the statistical estimation principles underlying the assimilation. As the coupled system introduces unknown parameters to represent heat, moisture and momentum surface flux exchanges between the ocean and the atmosphere, the assimilation can also use observations to estimate unknown parameters used to model these fluxes. This can be useful to improve the processes of ocean-atmosphere interaction and to reduce biases in the coupled model. A coupled ocean-atmosphere data assimilation system is currently being developed within the GOAPP research network. The atmospheric component is the 4D-Var assimilation scheme driven by the Global Environmental Model, used operationally by Environment Canada. This is coupled to the global NEMO model with its own 3D-Var data assimilation component. The coupled system is using a 6-h assimilation window. As a first step to building this system, the atmospheric 4D-Var data assimilation component is forced by ocean SST, and the turbulent transfer coefficients of heat and momentum are estimated and compared to independent estimates such as SURFA high-resolution NWP fluxes. A parameter estimation scheme is added to the 4D-Var by augmenting the state vector of the atmosphere with model parameters used in the parameterization of heat and momentum fluxes. In this presentation, results will be presented regarding the ability of the assimilation system to retrieve correctly the selected parameters from the available observations. The estimated parameters are then used in a fully coupled ocean-atmosphere system to replace traditional bulk formulation of the turbulent transfer coefficients used in the global NEMO ocean model.

POSTERS Atmosphere, Ocean and Climate Dynamics / Dynamique de l'atmosphère, de l'océan et du climat

Room / Endroit (100), Chair / Président (Robert B. Scott), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I17.1 ID:2947 **15:30**

Influence of Mesoscale Eddies on Internal Waves of Tidal Frequency

Michael Dunphy , *Kevin Lamb*
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This talk will discuss the effect of eddies on the internal tide field. The internal tide constitutes internal waves of tidal frequency and are generated by the interaction of the barotropic tide with topographic features such as ridges, seamounts and the shelf break. These waves have length scales similar to those of mesoscale eddies (50-200 km) and their interaction is a candidate for energy transfer via the non-linear terms in the governing equations. Previous work has looked at the interaction of eddies with a barotropic tide and did not find significant interaction.

Numerical experiments are performed using the general circulation model MITgcm. The internal wave field is simulated by barotropic tidal flow at semi diurnal (M2) frequency over a ridge, and eddies are prescribed by an analytical expression for density surface displacements that are in both hydrostatic and geostrophic balance. The eddies are stationed a few hundred kilometres from the topographic feature (a ridge or seamount). Preliminary results indicate that the presence of an eddy contributes a phase shift to the internal wave field beyond the eddy and results in a small (1-3%) decrease in energy flux. Since typical eddy fields observed in the ocean consist of numerous eddies, the changes in energy flux may be significant when more eddies are considered.

NSERC Town Hall Meeting / Séance de discussion publique avec CSNRG

Room / Endroit (301), Chair / Président (Norman Marcotte), Date (02/06/2009), Time / Heure (17:00 - 18:00)

2E-301.1 ID:3121 **17:00**

NSERC update on International Review and GSC Structure Review

Norman Marcotte
NSERC/CRSNG
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NSERC had commissioned an International Review to assess the merit of its approach to supporting research in the natural sciences and engineering, and the extent to which its Discovery Grants Program fostered and supported research excellence. NSERC also undertook a review of the structure of the discipline-based Grant Selection Committees (GSCs). The GSC Structure Review Committee recommended that NSERC adopt a conference model for the review of applications to allow a much more flexible and dynamic approach to grant review. The presentation will focus on the changes that were implemented in the 2009 Discovery Grants competition and those that will be implemented for the 2010 competition.

Public Lecture / Conférence ouverte au public

Room / Endroit (Maritime Museum), Chair / Président (Stephen T. Miller), Date (02/06/2009), Time / Heure (19:30 - 20:30)

2F-MUSEUM.1 ID:2741 INVITED/INVITÉ 19:30

Canadian Hurricane Centre Reflections: Two Decades of Lessons Learned

Peter Bowyer
Canadian Hurricane Centre
Contact: peter.bowyer@ec.gc.ca

For more than twenty years the Canadian Hurricane Centre (CHC) has been Canada's authoritative source of information on tropical cyclones: past, present and future. During that time there has been a great maturing of both the CHC and the people of eastern Canada in all matters relating to tropical cyclones. On the inside, we are better at observing them, understanding them, predicting them, and communicating about them. On the outside, Canadians are better at being aware of them, preparing for them, and responding to messages about them. This animated presentation will look back over 20-years of CHC enlightenment and enterprise spawned by the "lessons-learned" from 20 different tropical cyclones. The lesson-teaching storms include: Gloria (1985); "The Perfect Storm" (1991); Luis (1995); Hortense (1996); Danielle (1998); Harvey and Gert (1999); Unnamed Storm and Michael (2000); Gabrielle (2001); Gustav (2002); Isabel and Juan (2003); Alex and Frances (2004); Katrina (2005); Florence (2006); Noel (2007); Hanna and Kyle (2008).

2A-GRAND.1 ID:2774 INVITED/INVITÉ 08:30

The Importance of Geostationary Weather Satellites in Tropical Cyclone Forecasting: A Perspective

John Beven II
National Hurricane Center
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The development of the geostationary weather satellite is probably the single most important change that has occurred in the tropical cyclone (TC) forecast process during the past 150 years. By improving the detection and analysis of TCs in data-sparse ocean regions, geostationary satellites and the tools developed to use their data have helped to create a more efficient warning process that has saved countless lives. Improved forecasts and warnings have resulted from both better subjective analysis of TCs and higher-quality data being assimilated into numerical weather prediction models. Moreover, the improved detection capability has impacted TC climatology, as the satellites have observed numerous TCs that would have gone undetected in the pre-satellite era. Geostationary satellite data have also helped document a spectrum of cyclone types and many unusual cyclone events. Finally, future geostationary weather satellites are scheduled to carry improved instrumentation, which should result in additional advances in their TC-related capabilities.

2A-GRAND.2 ID:3120 INVITED/INVITÉ 09:15

Sun, Sea, Dust and Gases. Air-Sea Biogeochemical Interactions in the Tropical Eastern North Atlantic

Douglas Wallace , *(and Sopran Investigators)*
Forschungsbereich Marine Biogeochemie, Leibniz-Institut für Meereswissenschaften, Kiel, Ger.
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The region between Mauritania and Cape Verde is heavily influenced by upwelling and also receives some of the strongest dust deposition in the World Ocean. The region is being intensively studied in the context of the German SOPRAN* programme (www.sopran.pangaea.de), through a combination of cruises as well as long-term observations at Cape Verde and campaigns at the Mauritanian coastline. The presentation will present an overview of recent results including: (1) distribution and air-sea exchanges of key gases; (2) the potential of dust deposition to relieve nutrient limitation of carbon and nitrogen fixation. The presentation will attempt to identify the key questions and unresolved issues arising from these studies and outline opportunities to address them. The latter will include a status report on the Cape Verde Observatory that has been jointly established as part of the international SOLAS programme. * Surface Ocean Processes in the Anthropocene

Water, Weather and Climate Serving the Energy Sector (PART 1) / Eau, temps et

climat servant le secteur énergétique (Partie 1)

Room / Endroit (202), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-202.1 ID:2981 **10:30**

Wind Energy Forecast: New Challenges in Meteorology

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With the sustained growth of wind energy installed capacity for electricity generation, electricity system operators have increasing challenges balancing the electricity grid, notably in regards to minimize the cost of balancing other energy sources. Therefore, there is a pressing need for robust short-term wind forecast models (4 to 48 hrs), and for wind power forecast models, to sustain the integration of wind energy in electricity portfolios of jurisdictions. Indeed, balancing the electricity grid, the transmission load, the power generation dispatch and the energy trades have to be managed according to the demand. Because of the intermittence of the wind, the wind power generation forecast becomes an important issue for the economic viability of wind energy, whether in a regulated market, as in Canada, or in open markets, as in many US states. Since the power forecast is affected by both the intensity and time of the wind, work is needed to assess the uncertainties of models on the amplitude and the phase of wind speed forecasts. This presentation will introduce short-term numerical wind power prediction models, along with uncertainty analysis tools and methodologies used to assess and understand the numerical weather prediction uncertainties. An analysis will be presented for the North Cape (PEI) site where wind data are available from Environment Canada experimental forecasts (GEM-LAM 2.5km), the Wind Energy Institute of Canada (WEICan) anemometer tower data and the PEI Energy Corporation's 10 MW wind power generation data. The objective of the current study is to present a number of possibilities to improve short-term numerical weather predictions and wind power forecasts according to the needs of the wind energy industry. A better knowledge of the wind speed and wind power forecast uncertainties, along with more accurate short-term wind forecast models, will increase the economic value of wind energy on the market.

2B-202.2 ID:2905 **10:45**

A High Resolution Wind Forecasting System for the Wind Energy Sector: An Overview on the Real-Time Tests in Quebec

André Plante [1], *Laurent Chardon* [2], *Sarah Dyck* [2], *Nathalie Gauthier* [2], *Anna Glazer* [2], *Robert Benoit* [3], *Franco Petrucci* [1], *Alain Forcione* [4], *Pierre Dionne* [5], *Julien Choisnard* [6], *Slavica Antic* [6], *Gaétan Roberge* [4]
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Accurate prediction of winds is of critical importance for the electricity grid integration of wind power and daily management of wind farms. Environment Canada (EC) initiated a research project in collaboration with Hydro-Québec (HQ) on the development of a high resolution wind forecasting system: SPÉO (Système de Prévision ÉOlienne). This central part of this system is the GEM-LAM 2.5km. The system is fed with the CMC operational regional forecasts. It is run twice a day (00 and 12 UTC) for a 48-hours forecast horizon at a resolution of 2.5 km.

This experimental forecasting system has been under tests in real-time since May 2007. The meteorologists of EC and HQ evaluate the daily forecasts using real-time observations from both EC meteorological stations and special masts installed in the wind plants, and wind power productions. The hourly forecasts are archived over the last two years and provide a valuable database for analysis of the model's performance and of other meteorological phenomena. This talk will give an overview of the project and some validation results. Research needs for further improvement of this forecasting system will also be discussed.

2B-202.3 ID:2903 11:00

A High Resolution Wind Forecasting System for the Wind Energy Sector: A Focus on Mountain waves Activity

<u>*André Plante*</u> [1], *Wei Yu* [2], *Laurent Chardon* [2], *Sarah Dyck* [2], *Nathalie Gauthier* [2], *Anna Glazer* [2], *Robert Benoit* [3], *Franco Petrucci* [1]
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The GEM-LAM 2.5 km has been running experimentally for more than one year with a grid centered over the Gaspe area in a joint effort between Environment Canada and Hydro Québec to develop and evaluate the performance of the Système de Prévision ÉOlienne (SPÉO). This system uses the Environment Canada operational regional model at 15 km resolution to nest the GEM-LAM 2.5 km. The model is integrated for 48 hours at 00 and 12 GMT.

Wind forecast verifications at wind farms show that the GEM-LAM 2.5 km outperforms the regional 15 km especially during mountain wave events. The physical mechanism behind these events is similar to that of the well-known Cape Breton “Les Suetes”. A diagnostic procedure was developed to detect the mountain wave events from the standard model outputs. More than 80 such events were detected between May 2007 and April 2008. Some cases will be presented along with the scores of the regional 15 km and GEM-LAM 2.5 km against wind farm observations.

2B-202.4 ID:3016 **11:15**

Environment Canada's future role in support of wind and solar energy forecasting

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The emerging solar and wind energy technologies promise to greatly help Canada meet its obligations to reduce GHGs. Compared with conventional sources of energies however, the fuel for wind and solar energy generation is dependant on the weather and is therefore variable. In order for electric utilities to maximize the use and integration of wind and solar into their grids, it is essential that they know in advance and for a certain period of time how much wind and sun they can count on. Therefore, wind and solar energy forecasts are increasingly becoming essential tools for the electric grid operators so that they can make appropriate decisions on how to dispatch other sources of energy when wind and solar are present, etc. For more that two years now, EC has been in collaboration with Hydro-Québec on the development of a complete system to forecast wind energy coming out of wind farms. EC has also been collaborating with CanMET Varennes to provide them with GEM model outputs so that solar radiation forecasts can be derived. In this presentation, the broad lines of these two cooperations will be explained. And given EC's special role as the national weather forecaster, a vision of where wind and solar forecasting could go and the possible contribution that EC could bring to these industries will be presented.

2B-202.5 ID:3087 **INVITED/INVITÉ 11:30**

Is a wind Energy forecast enough?

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With the plan to integrate large amounts of wind energy into the grid, one has to ask the question; is a reliable wind energy forecast enough to operate the future grid? Considerations are now being given to; other types of forecasts, employment of meteorologists in the energy sector, need for “wind-weather” education in the energy sector?. Much like an airline pilot or a ships captain, the electrical system operator will need not only to understand the forecast, but make sense of the weather and have the tools to see it developing. Training and tools to effectively manage the ever increasing supply of Variable wind energy will be needed in the future. This presentation will describe some of the reasons for these future needs.

Acoustics in Oceanography (PART 1) / L'acoustique en océanographie (Partie 1)

Room / Endroit (203), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-203.1 ID:2891 INVITED/INVITÉ 10:30

Doppler sonar and fish: when can you measure fish speeds?

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Doppler current profilers rely on volume backscatter to infer water velocities remotely. Under certain circumstances these instruments receive acoustic backscatter from larger aggregations of zooplankton and isolated or schooling fish. Under these conditions, the resulting velocities are representative of the fish motions but care must be taken in interpreting the data. Fish present the acoustic system with large discrete targets giving rise to higher accuracy speed measurements than is possible from volume backscatter. However, the discrete nature also gives rise to intermittent observations. As a result, where velocities for large highly concentrated fish schools can be extracted using the usual Doppler profiling algorithms, lower concentrations of fish require a different approach. We discuss the processing required for both conditions and provide example of observations from laboratory trials, large fish schools (Norwegian Herring), and discrete fish (Fraser River Salmon, and Atlantic Cod in coastal Newfoundland).

2B-203.2 ID:2942 INVITED/INVITÉ 11:00

Applications of active and passive acoustics to marine mammal ecosystem understanding

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Marine mammals make extensive use of acoustics in realizing their vital tasks to survive, grow and reproduce in the large marine ecosystems they belong to. Man is learning to mimic this general behaviour by using acoustics to determine the keystone characteristics of these ecosystems, understand their functioning in relation to oceanographic processes and forcing at different scales, monitor their utilisation pattern by marine mammals in time and space and study the effects of noise pollution. Examples of such uses are

presented here for the St. Lawrence and Canadian Arctic ecosystems. The Saguenay–St. Lawrence Marine Park (SSLMP) in Eastern Canada is a traditional summer feeding ground for Northwest Atlantic baleen whales. Multifrequency acoustics have been used in the last decade in combination with 3D circulation modeling to demonstrate how this ecosystem "hot spot" is resulting from the two-layer estuarine pumping of krill over a large part of the Gulf of St. Lawrence, their concentration by intensive tidal upwelling interacting with krill behaviour along slopes, and their accumulation in the "dead end" made by the channel head. Along slopes currents, hydraulic jumps over topography, upwelled water fronts and their subduction into the Saguenay fjord generate predictable small-scale structures where krill and fish are trapped and that whales take advantage of. Whale frequentation of this SSLMP ecosystem can be monitored in continue for long periods by detecting and localising their specific vocalisations recorded on hydrophone arrays deployed in the basin. The same acoustic data can be used to measure the shipping noise from the St. Lawrence Seaway, a major continental shipping route, the contribution of the different ship categories, and investigate the impact of this pollution on whale communication. The same acoustic methods were used to demonstrate the mesopelagic nature of the key forage fish species of the Arctic, the arctic cod, and its aggregation in large overwintering concentrations in particular "hot spots" in response to physical-biological coupling, as well as the occupation of the habitat by the marine mammal community over the annual cycle, in response to climate change effect on ice.

2B-203.3 ID:3104 **11:30**

Physical forcing of space-time variation in the copepod prey-field of right whales in Roseway Basin at diel and tidal scales

Kimberley T. Davies , *Douglas J. Schillinger* , *Alex E. Hay* , *Christopher T. Taggart*
(Presented by *Kimberley Davies*)
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Defining the critical feeding habitat for endangered species is the goal of many marine science initiatives. In the pelagic zone, habitat boundaries are difficult to define statically in space because the prey-field is subject to advection and mixing by regional flow fields. Here we address this issue in relation to defining the critical feeding habitat of the endangered North Atlantic right whale. These whales feed on diapausing, lipid rich copepods that are aggregated in high concentrations, near bottom, in the deep (>100m) basins of the Scotia-Fundy region. We ask can variation in the spatial distribution of the right whale prey-field at short (tidal, diel) time scales be explained by variation in the current regime in Roseway Basin. Current speed and acoustic backscatter (zooplankton abundance) data were simultaneously collected using moorings at three locations in the Basin. Two moorings, fitted with upward looking Acoustic Doppler Current Profilers (ADCP; one 300 kHz and one 600 kHz), downward looking Aquadopp profilers, and CTDs (SBE-37), straddled a sloping region on the edge of the Basin where whales feed and were located within one tidal excursion from one another. This ensured a full profile of current and backscatter estimates and measures of the near-bottom hydrographic properties. The third mooring (upward looking 300 kHz ADCP) was located at the deepest portion of the Basin. The area was concurrently surveyed using a ship-mounted

echo-sounder (Simrad, 120 kHz). We illustrate how zooplankton abundance varies in response to tidal advection of water masses and the residual circulation.

2B-203.4 ID:2709 11:45

Long-term broadband acoustic observations of zooplankton scattering layers in Saanich Inlet, British Columbia

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The application of broadband techniques to fish and zooplankton bioacoustics is showing potential to transform the field into one that is much more quantitative. This is because broadband techniques allow the use of the known spectra of organisms or non-biological sources of scattering to distinguish between scatterers, allowing discrimination without the need for extensive groundtruthing. This makes it ideal for remote monitoring of fish or zooplankton assemblages, since continuous net-sampling is often not possible. An upward-looking 85-155 kHz broadband sonar has been collecting data nearly continuously on the Victoria Experimental Network Under the Sea (VENUS) mooring in Saanich Inlet, British Columbia since March 2008. Saanich Inlet is known to have large populations of euphausiids, which create a strong acoustic scattering layer that migrates from depth to the surface and back each day. The spectral response of this layer is examined throughout the annual cycle and the feasibility of using this type of sonar to elucidate changing zooplankton assemblages (due to growth and changing species composition) is assessed.

Atmosphere, Ocean and Climate Dynamics (PART 1) / Dynamique de l'atmosphère, de l'océan et du climat (Partie 1)

Room / Endroit (204), Chair / Président (William J. Merryfield), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-204.1 ID:2798 INVITED/INVITÉ 10:30

The predictability of ocean-modulated westerly wind bursts and the implications for ENSO forecasts

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Westerly wind bursts (WWBs), a significant player in ENSO dynamics, can be modeled using an observationally-motivated statistical approach that relates the characteristics of

WWBs to the large-scale sea surface temperature. Although the WWB wind stress at a given location is a nonlinear function of SST, the characteristics of WWBs are well described as a linear function of SST. Over 50% of the interannual variance in the WWB likelihood, zonal location, duration, and fetch is explained by changes in SST. The model captures what is seen in a 17-year record of satellite-derived winds: the eastward migration and increased occurrence of wind bursts as the western Pacific warm pool extends. The WWB model shows significant skill in predicting the interannual variability of the characteristics of WWBs, while the prediction skill of the WWB seasonal cycle is limited by the record length of available data.

The WWB model can be implemented in stochastic or deterministic mode, where the deterministic mode predicts the ensemble-mean WWB characteristics. Therefore, the WWB model is especially appropriate for ensemble prediction experiments with existing ENSO models that are not capable of simulating realistic WWBs on their own. Here, the WWB model is added to a hybrid coupled model which previously only included a linear statistical atmosphere, thus activating a two-way SST-WWB feedback. An ensemble of retrospective forecasts is performed for the years 1979-2002. In particular, the addition of the WWB model improves the prediction of the onset and the development of the large 1997 warm event, pointing to the potential for ENSO prediction skill improvement using this approach.

2B-204.2 ID:2687 11:00

Global extratropical response to diabatic heating variability of the Asian summer monsoon

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Global teleconnections associated with the Asian summer monsoon convective activities are investigated, based on monthly data of 29 Northern Hemisphere summers that are defined as June, July, August and September (JJAS). Two distinct teleconnection patterns are identified that are associated respectively with the diabatic heating variability of the Indian summer monsoon and the west North Pacific summer monsoon. The Indian summer monsoon convective activity is associated with an equator-symmetric pattern which has a far-reaching zonal connection in both hemispheres, whereas the west North Pacific summer monsoon convective activity is connected to a Southern Hemisphere wave train that influences the high latitude South Pacific and South America. A global primitive equation model is utilized to assess the cause of the global circulation anomalies. The model responses to heating sources of both monsoon systems match well the general features of the observed circulation anomalies. It is found that the response pattern is largely determined by the summertime large-scale background mean flow and the location of the heating anomaly.

2B-204.3 ID:2728 11:15

Land Surface Wind Speed Probability Distribution: A Global View

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Probability distributions of land surface wind speeds (SWS) are needed for applications such as estimating wind power, surface fluxes, dust emission and for extreme wind risk assessments. Three-hourly observations of surface winds from 3734 weather stations and six-hourly multi-level winds from NCEP-NCAR reanalysis during 1979-1999 are analyzed to produce the probability distribution (PDF) of SWS and consider its correlation with free atmosphere winds over global land. It is found that in regions where the surface winds are well correlated with the above free atmosphere winds, the land SWS-PDF is more Weibull-like due to a dominating influence from free atmosphere; however in regions where surface winds is poorly correlated with free atmosphere winds, the land SWS shows non-Weibull behavior due to strong influence from land surface conditions. From observations, the SWS skewness anonymous from its Weibull value becomes larger when free atmosphere winds become smaller. In most cases, SWS-PDF is more skewed when land surface is stable. The observed relationships of SWS-PDF with free atmosphere winds and land surface conditions explain well the seasonal shift and spatial distributions of SWS-PDF over global land. Physical mechanisms of how the free atmosphere and land surface influence the global land SWS probability distribution are further investigated through a CCCMa Single Column Model (SCM) study. Results from both observations and the SCM study will be presented.

2B-204.4 ID:2964 **11:30**

On the Dynamics of Hurricane Secondary Eyewall Formation

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A simple 2D barotropic “dry” model and the high-resolution PSU-NCAR non-hydrostatic mesoscale model (MM5) are used to study the role of hurricane asymmetries on the secondary eyewall formation. The Empirical Mormal Modes (ENM) and the newly developed Space-Time Empirical Normal Modes (ST-ENM) techniques, together with the Eliassen-Palm (EP) flux calculations, are used to isolate wave modes from the model datasets to investigate their impact on the changes in the structure and intensity of the simulated hurricanes. From the ENM diagnostics of the 2D simulations, it is shown that when asymmetric disturbances are placed outside a strong vortex ring with a large vorticity skirt they relax to form concentric rings of enhanced vorticity that contain a secondary wind maximum. The role of internal dynamics on Concentric Eyewall Genesis (CEG) is further evaluated using the full physics MM5 simulation. The leading modes of the ST-ENM diagnostics exhibit mainly characteristics of vortex Rossby waves (VRWs) and their contribution to the EP flux divergence induced two regions of maximum tangential wind acceleration; one inside the primary eyewall which accounts for eyewall

contraction and the other outside the primary eyewall which explains the development of the secondary eyewall. The fact that the critical radius for some of the leading modes is close to the location where the secondary eyewall eventually develops, for the “dry” and the full-physics experiments, suggests that a wave-mean flow interaction mechanism may be suitable to explain important dynamical aspects of the CEG.

Carbon Uptake in the Ocean - Problems of Ocean Acidification and Feasability of Iron Fertilization / Absorption du carbone dans l'océan - Problèmes de l'acidification des océans et faisabilité de la fertilisation avec le fer

Room / Endroit (205), Chair / Président (Kumiko Azetsu-Scott and Paul Lyon), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-205.1 ID:2679 INVITED/INVITÉ 10:30

Acidification of the hypoxic bottom waters in the Lower St. Lawrence Estuary: A history and potential impacts

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Above and beyond the acidification of the surface ocean by anthropogenic CO2, marine waters can be acidified by accumulation of metabolic CO2. In the open ocean, the concentrations of dissolved inorganic carbon (DIC) and protons typically increase with depth below the euphotic zone and reach maxima in the oxygen minimum zone because CO2 production and O2 consumption are linked through the stoichiometry of respiration. Similarly, where bottom waters are not readily replenished in O2 or isolated from the atmosphere, respiration will consume O2, accumulate CO2 and decrease the pH. A recent study has documented the development of persistent, severely hypoxic waters (DO < 62.5 μmol L-1) in the Lower St. Lawrence Estuary over the last 70 years (LSLE; Gilbert et al., Limnol. Oceanogr. v.50, pp. 1654-1666, 2005). The bottom waters of the LSLE are isolated from the atmosphere by a permanent pycnocline, and metabolic CO2 produced in the bottom water or in the sediment accumulates. We reconstructed the temporal evolution of the pH of the bottom waters from historical and recent data as well as from first principles relating oxygen consumption and metabolic CO2 production through

organic matter degradation. Our calculations reveal that the saturation states of the bottom waters with respect to calcite and aragonite have decreased concomitantly with pH over the last 70 years. The bottom waters (below 250 m) in the LSLE remain supersaturated with respect to calcite ($\Omega c \approx 1.03$) but they are now strongly undersaturated with respect to aragonite ($\Omega a \approx 0.65$). Bottom-dwelling, carbonate-secreting organisms (mollusks, bivalves, benthic foraminifera) must now expend more energy to secrete their skeletons, and aragonite shells that settle to the sediment-water interface are now exposed to corrosive waters and less likely to be preserved in the sedimentary record.

2B-205.2 ID:2851 **11:00**

Spatial variability of pH in the Bedford Basin

Darlene Brownell , *Kumiko Azetsu-Scott* , *Dave Slauenwhite* , *Chris L'Esperance*
Bedford Institute of Oceanography
Contact:

The oceanic uptake of atmospheric CO_2 due to increasing anthropogenic emissions is increasing and as a result acidifying the ocean. Acidification in coastal waters is a potential threat to calcifying organisms including commercial species such as shellfish. Therefore, ccean acidification in coastal regions has profound socioeconomic consequences. The need to quantify these changes is important in understanding and predicting future oceanic conditions. Relative to the open ocean, pH variation in coastal waters is more strongly affected by biological and physical processes on smaller spatial and shorter temporal scales. Potential control factors for coastal pH variability include fresh water input with lower pH, lateral transport of water by tide and estuarine circulation and vertical mixing, and high biological productivity. Bedford Basin is one the best studied basin in east coast Canada and physical and biological characteristics are well described. A field survey of measuring pH using both spectrophotometric and potentiometric methods, at approximately 15 stations in Bedford Basin, before, during and after a spring bloom will be discussed. The results of this experiment will provide information on the spatial variability of pH, together with other carbonate chemistry parameters, in a coastal region.

2B-205.3 ID:2810 **11:15**

Temporal variation of pH and TIC/Alkalinity in Bedford Basin

David Slauenwhite , *Kumiko Azetsu-Scott* , *Bill Li*
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As part of experiments to determine the processes affecting pH in the marine environment, a one-year time-series was conducted in Bedford Basin, Nova Scotia, measuring pH, alkalinity and total inorganic carbon as well as other physical parameters at 4 different depths (1, 5, 10 and 60m), weekly over the course of the spring phytoplankton bloom and roughly monthly afterwards. The pH of these waters was found to vary by as much as 0.6 pH units, which represents nearly a factor of 4 difference in acidity. In the waters nearest the surface a rise in pH is attributed in part to annual phytoplankton bloom, which sequesters CO2 from the water and converts it to fixed carbon, and to increased riparian flux and melt water. Another spiked increase in pH at the surface later in the summer appears to be related to physical process, perhaps mixing or diffusion. The pH is lowest in the deepest depth, where mixing is poor and the water sometimes approaching anoxia. The pH at this depth (60m) increased from 7.5 to 8.0 to the peak of the bloom, then steadily declined back to lower value over the next 200 days. Although alkalinity was fairly stable at all depths over the course of the year, there was an inverse correlation with depth. TIC was more variable in time, especially at the shallowest and deepest layers.

2B-205.4 ID:2896 **11:30**

Climate change, ocean processes, and iron fertilization

Kenneth Denman , *James Christian*
(Presented by *Ken Denman*)
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Observations indicate that the rate of increase in concentration of atmospheric carbon dioxide (CO2) is increasing faster than projected in any of the Intergovernmental Panel on Climate Change (IPCC) emission scenarios. Several mitigation measures, referred to as "geoengineering options", have been proposed to remove CO2 from the atmosphere. To be successful, such a mitigation operation must remove "significant" CO2 from the atmosphere for many decades, be verifiable, and not cause deleterious side effects. One option, purposeful addition of iron to fertilize photosynthetic uptake of CO2 by phytoplankton in regions of the ocean where iron is a limiting nutrient, has received considerable scientific attention. In the last 15 years, a dozen small scale open ocean iron fertilization experiments have been performed and a succession of models of large scale fertilization have been developed. As successive models have become more realistic, the amounts of CO2 forecast to be sequestered have dropped, and in all cases are small relative to the amounts of CO2 projected to be released through fossil fuel burning over the next century for any of the IPCC emission scenarios. Possible side effects include a long term reduction in ocean productivity, alteration of the structure of marine food webs, a more rapid increase in ocean acidity, and increased remineralization associated with the increased downward export of organic carbon particles. Associated effects would be a lowering of subsurface dissolved oxygen, and increased production of the third most important long-lived greenhouse gas, nitrous oxide (N2O), the magnitude of which is poorly known.

2B-205.5 ID:2926 **11:45**

Modelling the ocean iron cycle – the major uncertainties

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The importance of iron as a limiting nutrient for oceanic ecosystems is now indisputable. The iron cycle in the ocean impacts the biogeochemical cycles of carbon, nitrogen, phosphorus and silica, but the cycle of iron itself is poorly understood. The sources and pathways by which iron reaches the oceans, cycles within the water column, and ultimately is lost to the sediments, remain uncertain, and in some important areas current data appear contradictory or paradoxical. The rapid disappearance of dissolved iron in open-water fertilization experiments, for example, is difficult to reconcile with scavenging rates that allow deep and mid-depth concentrations to be maintained at observed levels. This talk will identify critical points of uncertainty about iron in the ocean, including the variability and concentration-dependence of scavenging rates, regulation of dissolution of aeolian iron, and lower limits to phytoplankton iron requirements. We will discuss approaches to using models and observations to reduce uncertainty, and approaches to evaluating geoengineering scenarios that are robust to these uncertainties.

Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) (PART 1) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE) (Partie 1)

Room / Endroit (301), Chair / Président (B.J. Topliss), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-301.1 ID:3053 **10:30**

A Framework for Research and Operations on a Global Scale – The Partnerships of CONCEPTS (three Canadian Departments and an International Community of Oceanographers and Meteorologists)

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Environment Canada (EC), Fisheries and Oceans Canada (DFO), and the Department of National Defence (DND) are engaged together in the development of an operational global coupled atmosphere-ocean-ice data assimilation and prediction system, under the auspices of CONCEPTS (The Canadian Operational Network of Coupled Environmental PredicTion Systems). The partnership also includes Mercator-Océan (France) participation, providing some of the fundamental tool sets for the research and subsequent operational products of the Canadian CONCEPTS Core Projects. CONCEPTS R&D also benefits from close links with the university R&D community, including in particular the Global Ocean-Atmosphere Prediction and Predictability Project (GOAPP) funded by CFCAS. This talk will provide an overview of CONCEPTS organization, governance structure, the interdepartmental agreement, the negotiations involved in instituting this international system and the respective activities of the three Canadian government departments spearheading this important operational oceanography initiative.

2B-301.2 ID:2696 **10:45**

Validation and analysis of the ¼-deg global NEMO-CONCEPTS ocean model

François Roy [1], *Youyu Lu* [2], *Jean-Marc Bélanger* [3], *Hal Ritchie* [3]
(Presented by *C. Harold Ritchie*)
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A 1/4-deg global ocean and sea-ice model based on the Nucleus for European Modelling of the Ocean (NEMO) has been tested for applications in the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS). The model is initialized with the data assimilation products from Mercator-Océan of France, and is modified to take the forcing from the numerical weather forecasts of the Canadian Meteorological Centre (CMC). Initial tests show that the 10-day forecasts of the ocean state using the CMC forcing are similar to those using the forcing from the European Centre for Medium-range Weather Forecasts. Simulations lasting a full year (starting from April 2007) are conducted using 3-hourly and 6-hourly CMC forcing. Comparing the two solutions, we examine the influence of the frequency of atmospheric forcing on the ocean kinetic energy and the wind energy input to the near-inertial motions of the global ocean. This research is being conducted within the CONCEPTS project on core CMC systems, coupling and support. Its context in the CONCEPTS key activities will be discussed.

2B-301.3 ID:2706 **11:00**

Inter-annual and decadal sea level variations: a CONCEPTS study based on a coarse-resolution global ocean model

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A coarse-resolution global ocean and sea-ice model, developed for the Canadian

Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS), is applied to simulate ocean variations during 1958-2006. The model is able to reproduce the large-scale sea level changes at inter-annual and decadal time scales, as revealed by comparing with available altimeter and island tide gauge observations. A set of sensitivity experiments is conducted to examine the impact of atmospheric conditions felt through the surface buoyancy (mainly heat) and momentum fluxes in driving the sea level changes. Results are discussed in terms of the dynamical processes relevant to heat and wind forced ocean variations. The geographical distributions of the responses to the two forcing effects, and the deviation of the combined influence from their linear summation, are quantified.

2B-301.4 ID:3048 **11:15**

C-NOOFS: A Canadian pilot project in operational oceanography for the North West Atlantic

Fraser Davidson [1], *Greg Smith* [1], *Andry Ratsimandresy* [1], *Debbie Anne Power* [1], *Adam Lundrigan* [1], *Charles Hannah* [2], *Dan Wright* [2], *Maud Guarracino* [2], *Denis Lefaivre* [3], *Pierre Pellerin* [4]
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To demonstrate the potential benefits of an extended Canadian operational oceanographic capability a pilot project has been into place for the north west Atlantic Ocean entitled the Canada-Newfoundland Operational Ocean Forecast System (C-NOOFS). The ultimate goal of the project is to produce an ocean ice forecast system that can be coupled to the Canadian regional GEM atmospheric forecast system. It is a follow-on project to a regional coupled ice atmosphere ocean forecasting system for the Gulf of St. Lawrence currently running at the Canadian Meteorological Centre. C-NOOFS makes use of the NEMO community ocean model forced by near real time wind forecasts from Environment Canada and provides a six-day forecast on a daily basis. In the initial development phase, boundary conditions are obtained from the 1/4 degree resolution MERCATOR-OCEAN global ocean forecast system and downscaled to 1/12 degree… The latest capabilities of the forecast system are presented along with the challenges faced in downscaling from a Global Ocean Model. The data assimilation approach to be used for the regional forecast system in its second development phase is presented as well as ongoing system validation activities. This includes validation of the ocean forecast system using seal based in-situ ocean observations.

2B-301.5 ID:3047 **11:30**

Resolution increase in a downscaling ocean forecast system for the North West Atlantic: The C-NOOFS example.

Fraser Davidson [1], *Andry Ratsimandresy* [1], *Zeliang Wang* [2], *Dan Wright* [2], *Charles Hannah* [2]

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The development of a pre-operational ocean forecast system referred to as “C-NOOFS” (the Canada-Newfoundland Operational Ocean Forecast System) for the northwest Atlantic has been ongoing for 4 years. The talk focuses on the work done to allow for an increase in resolution from ¼ to 1/12th of degree. This includes model tuning, validation of the boundary conditions and model-data inter comparisons. In particular we focus on the methodology undertaken in maintaining the benefits of higher resolution while still embedding the regional ocean forecast system one-way within the MERCATOR-OCEAN ocean PSY3V2 forecast (a 1/4 degree, data assimilative, global ocean forecast). The purpose is to produce a six day daily ocean forecast system for the North West Atlantic. We will present comparisons of the model results with observations (in-situ and remote sensed) and with result from other operational systems.

2B-301.6 ID:2721 **11:45**

Local refinement in the NEMO2.3 ocean model

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We present two different applications of local grid refinement using the AGRIF (Automatic grid refinement in Fortran) library that is available in NEMO2.3. The first application is a 48 year simulation of the global ocean at one degree nominal resolution with a refined region over the North Atlantic at 1/4 degree nominal resolution. The second application relates to the Gulf Stream separation problem by embedding a 1/12 degree nominal resolution regional Northwest Atlantic ocean into a 1/4 degree nominal resolution North Atlantic ocean. In each case, the results with locally enhanced resolution will be compared to results without the enhancement and to observations in order to assess the benefits of using this approach.

Climate Data Homogenization / Homogénéisation des données climatique et l'analyse des tendances

Room / Endroit (302), Chair / Président (Lucie Vincent), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-302.1 ID:3098 **10:30**

Impact of meteorological instruments on climate trends

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High quality meteorological data are essential for data users, e.g. forecasters, climatologists. When selecting and integrating new meteorological sensors and systems, it is important to carry out thorough testing to ensure that their uncertainty of measurement lies within acceptable limits. It is equally important to fully understand and document the more subtle biases that instrument changes may introduce into the data set. This is critical to ensuring that data users are fully able to distinguish differences caused by physical factors from those due to instrument changes and performance Canada's vast size along with its diverse and variable climate, combine to present major challenges when selecting meteorological sensors and measurement systems.

To assure the validity and relevance of the meteorological data provided to users, the Meteorological Service of Canada (MSC) has developed and implemented an extensive program for evaluating meteorological instruments and systems. This program combines the activities of calibration, laboratory and environmental testing, and functional testing. MSC conducts functional testing of meteorological instruments at a set of test sites configured specifically for this purpose and selected to provide a range of conditions representative of the various Canadian climate conditions. The tests assess the functional performance of sensors and instruments in an outdoor, natural environment where instruments are expected to operate over a wide variety of meteorological conditions and climatic regimes and help responding to questions like: a) What is the sensor or system accuracy? b) What is the variability of measurements in a network containing such systems or sensors? c) What change, or bias, will be in the instrument data when its siting or location is changed? d) What change or biases are introduced in the data when a new instrument or method of observation replaces an existing one measuring the same weather element(s)?

2B-302.2 ID:2708 10:45

An assessment of the double Alter wind shield for reducing wind bias in snowfall measurements made with the Geonor T-200B

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It is well recognized that the presence of wind during snowfall events results in a negative systematic bias in the gauge measurement of snowfall. Besides wind, the severity of this bias is dependent on several factors including the profile of the precipitation gauge and the configuration of the wind shield. This means that each gauge or wind shield configuration change in an observational program requires intercomparison with a known reference to minimize data homogeneity issues. Precipitation measured by the Geonor T-200B all-weather precipitation gauge was compared to the WMO Double Fence Intercomparison Reference (DFIR) gauge at the Bratt's Lake SK intercomparison facility. At this site, the Geonor was installed with various wind shield configurations including the standard single Alter, a large octagonal double fence, and the double Alter wind shields. In conjunction with the Bratt's Lake intercomparisons, the relative catch of the single Alter and double Alter shielded Geonor gauges were examined at Thunder Bay and Pickle Lake ON, providing a warmer and less windy venue for intercomparison. The objective of these analyses were two-fold: 1) to determine if the double Alter increased the snowfall catch efficiency of the Geonor and make recommendations as to any revision to the standard single Alter shield configuration, and 2) to develop a wind adjustment curve for the double Alter shielded Geonor. Results showed that the double Alter, as compared to the single Alter, increased the catch of snowfall at each of the three sites. This increase was 54%, 15% and 21% at Bratt's Lake, Pickle Lake, and Thunder Bay respectively with the magnitude of the increase dependent on the relative wind speeds at the sites. At Bratt's Lake, the double Alter was shown to increase the average catch efficiency of the Geonor by 23% (as compared to the reference) but still represented a substantial negative bias of 34%. These results suggest merit in utilizing the double Alter with the Geonor gauge in windy environments but also illustrates that an adjustment for the wind bias is still required.

2B-302.3 ID:3061 **11:00**

Buoy Wind Inhomogeneities related to Changes in Averaging Method and Anemometer Type

Bridget Thomas , *Val Swail*
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This presentation will examine the differences in buoy wind speeds related to changes in averaging method and instrument type, which have the potential to introduce inhomogeneities in the long-term record. The Environment Canada moored weather buoy program began in 1987. There are a number of Canadian buoy stations in both the Pacific and the Atlantic with at least 20 years of data. The standard anemometer through this period is an R. M. Young propeller-vane mechanical anemometer. In recent years testing has begun on use of ultrasonic anemometers. The differences between these sensors are studied using simultaneous wind reports from both types of anemometer on the same buoy for a number of Pacific and Atlantic buoys. Overall differences are found to be small. In the 1990s, the buoy observing program changed from reporting a vector mean to a scalar mean wind speed. Earlier studies with buoy data from the US National Data Buoy Centre found that vector means were several percent lower than scalar means, in winds over 10 m/s. The change in averaging method has the potential to introduce a positive step change in the buoy wind climate record. There is a large data set of simultaneous vector and scalar mean wind speeds on Canadian 3 m Discus and 6 m NOMAD buoys which allows the relationship between these averaging methods to be quantified over a wide range of conditions. Results are slightly different for each hull type. Overall the scalar-vector mean difference for NOMAD buoys with fully functioning anemometers is only about 2% of the wind speed. Differences increase slightly with wave height. Differences increase substantially for anemometers reporting faulty wind directions. We adjust vector means using the relationships found in this study, and show the impact on the climate record.

2B-302.4 ID:2759 **11:15**

Homogenization and trend analysis of Canadian near-surface wind speeds

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Abstract Near-surface wind speeds recorded at 117 stations in Canada for the period from 1953 to 2006 were analyzed in this study. First, metadata and logarithmic wind profile were used to adjust hourly wind speeds measured at non-standard anemometer heights to the standard 10 m level. Monthly mean near-surface wind speed series were then derived and subjected to a statistical homogeneity test, with homogeneous monthly mean geostrophic wind (geo-wind) speed series being used as reference series. Homogenized monthly mean near-surface wind speed series were obtained by adjusting all significant mean shifts, using the results of statistical test/modeling along with all available metadata, and used to assess the long-term trends. It has been shown that anemometer height change is the main cause for discontinuities in the near-surface wind speed series, followed by station relocation, instrumentation problems or changes, and observing environment changes. It has also been shown that the effects of artificial mean shifts on the results of trend analysis are remarkable, and that the homogenized near-surface wind speed series share similar trends with the corresponding geo-wind speed series, showing good spatial consistency of trends, which indicates a success in the homogenization of near-surface wind speed data. The homogenized near-surface wind speed series show significant increases in central Canadian Arctic, with significant decreases throughout western and southern Canada (except the eastern maritime provinces in the cold seasons), during the period analyzed (1953-2006).

2B-302.5 ID:2746 **11:30**

Observed Changes in Daily Temperature and Precipitation Indices for Southern Québec, 1960–2005

Abderrahmane Yagouti [1], *Gilles Boulet* [2], *Lucie Vincent* [3], *Luc Vescovi* [4], *Éva Mekis* [3]
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Trends and variations in daily temperature and precipitation indices in southern Québec are examined for the period 1960–2005. The indices are based on daily temperature and daily precipitation which have been recently adjusted at 53 climatological stations. The adjustments were made for site relocation, changes in observing programs, known instrument changes and measurement program deficiencies. The results show that the surface air temperature has increased in southern Québec over 1960–2005. Significant

warming is evident in the western, southern and central parts of the province but the increasing trends become smaller toward the east. The warming is greater during the winter although many significant increasing trends are found in the summer. The analysis of the temperature extremes strongly indicates the occurrence of more nights with extreme high temperatures in all seasons. The temperature indices also suggest an increase in the number of thaw/frost days during the winter (days with maximum temperature above 0°C and minimum temperature below 0°C), a decrease in the length of the frost season, an increase in the length of the growing season, a decrease in heating degree days and an increase in cooling degree days. The precipitation indices show an increase in the annual total rainfall although many stations indicate decreasing trends during the summer. The number of days with rain has increased over the region whereas the number of days with snow and the total snow amounts have decreased over the past 46 years.

2B-302.6 ID:2739 11:45

Second Generation of Homogenized Temperature for trend analysis in Canada

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Several years ago, a database of long-term and homogenized temperatures was created for the analysis of climate change in Canada. Using a technique based on regression models, the annual means of the daily maximum and minimum temperatures were tested for "relative homogeneity" with respect to surrounding stations. Monthly and daily adjustments were derived from the regression models and were applied to create homogenized temperature datasets at 210 locations across the country. The causes of inhomogeneities were mainly due to station relocation and change in observing time.

A Second Generation of Homogenized Temperature is currently under development. The new homogenized datasets are prepared for a greater number of stations (336 stations). Series are extended to cover the period 1900-2008 as much as possible by joining the observations of two or three nearby locations. New procedures are applied for adjusting the cold bias in the daily minimum temperatures introduced by the redefinition of the climatological in 1961 at synoptic stations. Newly developed techniques based on regression models and surrounding stations are also considered for homogeneity assessment and adjustment of the discontinuities due to station relocation. The methodologies used to generate the new homogenized temperatures will be presented along with the impact of the adjustments on climate trends.

Operational Meteorology (PART 4) / Météorologie opérationnelle (Partie 4)

Room / Endroit (303), Chair / Président (Chris Fogarty), Date (02/06/2009), Time / Heure (10:30 - 12:00)

2B-303.1 ID:2693 **10:30**

The National Lab for Marine and Coastal Meteorology – Research, Development and Support Assisting Operational Forecasting

Chris Fogarty [1], *Garry Pearson* [2]
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The Meteorological Service of Canada's National Lab for Marine and Coastal Meteorology in Dartmouth, Nova Scotia is actively involved in projects that aim to enhance/improve operationally forecasting in Canada. The Lab focuses on marine forecasting challenges, with various numerical modelling projects involving high resolution regional-scale domains, coupled atmosphere-ice-ocean processes, hurricane extratropical transition, storm surges, ocean waves and fog forecasting. Other areas of focus include the assessment of various observational tools over the ocean and in the coastal zone such as from satellite scatterometers, surface weather station networks and land-based vertical wind profilers.

Activities in the Lab are highly focussed toward developing tools that assist in the forecast production process and enhance the quality of weather forecasts and warnings. Research meteorologists from the Lab communicate with forecasters in the weather office during active weather situations, product evaluation projects, and at staff training seminars. Ongoing two-way interaction between Operations and the Lab is recognized as being an important ingredient for improving the quality of forecast products and the Weather Service's involvement in weather research on an international stage.

This presentation will focus on our role and interaction with forecasters including some examples of products available to the weather offices.

2B-303.2 ID:2769 **10:45**

Canadian coupled atmosphere-ocean-ice forecast system for the Gulf of St. Lawrence: Operational Validation for ice season 2009

Serge Desjardins [1], *Garry Pearson* [1], *Manon Faucher* [2], *François Roy* [2], *Pierre Pellerin* [3]
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Following the successful implementation of the Gulf of St. Lawrence two-way coupled atmosphere-ocean-ice system in an experimental mode at CMC last winter; a second operational validation is simultaneously under way at the Atlantic Storm Prediction Centre, the Newfoundland and Labrador Weather Office and the Quebec Storm Prediction Centre. The impacts of modifications in the coupled system on the

atmospheric model, the introduction of a new ice field analysis generated from an ice spin up cycle developed by François Roy, and the evolution in space and time of this coupled ice field are again evaluated with various diagnostic and display tools developed last year. Changes in the surface fluxes caused by the coupling and the impacts of those flux changes on meteorological fields will be studied further. An overview of the validation for this ice season as well as the results of the study on fluxes will be presented.

2B-303.3 ID:2776 **11:00**

Impact study with observations assimilated over North America and the North Pacific Ocean on the MSC global forecast system

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A series of observing system experiments for the two-month period of January-February 2007 has been carried out to assess the impact of radiosonde and aircraft data available over North America, as well as the impact of satellite data available over the North Pacific Ocean, in the global data assimilation and forecast system of the Meteorological Service of Canada. The impact is estimated by comparing two data assimilation and forecast cycles: one (control) assimilates all the observations operationally available while the other is identical to the control except that the observing network examined is withheld. A particular attention is given to the propagation and magnitude of the impact of these observing networks. It is found that the impact on the accuracy of forecasts over the North American continent is not uniform. The radiosonde and aircraft data together are the main contributors to the forecast skill on short-range forecasts over North America. However, as the effect of the satellite observations over the North Pacific Ocean move downstream over the continent, their impact on forecasts becomes dominant for forecast lengths greater than 36 h over western North America, and greater than 72 h over the eastern part of the continent. The impact of these satellite observations is more important over the continental United States than over Canada. In data-denial experiments, the separate impact of the aircraft and radiosonde observing networks collocated over southern Canada and the United States is much weaker than their joint impact. For short-range forecasts, the effect of aircraft observations is more important than radiosonde data over the eastern North America. The quality of the forecasts over the Canadian Arctic heavily relies on the radiosonde network. The role of the analysis scheme is also examined by comparing the forecast impacts from the 3D-Var and 4D-Var schemes. The impact of the radiosonde data over the Canadian Arctic is much larger with the 3D-Var scheme. This indicates that the 4D-Var scheme is more effective in extracting the information from the other observations over and nearby that region.

2B-303.4 ID:3005 **11:15**

Severe Thunderstorm and Lightning Climatology in Atlantic Canada

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Severe thunderstorms with large hail, damaging winds, intense rainfall and tornadoes are more common in Atlantic Canada than most people realize. Over the last few years work has been carried out by Environment Canada, as part of the Atmospheric Hazards Network project, to catalogue and analyze the reported severe thunderstorm events over the last 15 plus years in Atlantic Canada. Analysis of the reported events helps establish the climatology of severe thunderstorms in the region. We look at the spatial and temporal distribution of events with specific emphasis on tornadoes (36 in the last 16-18 years). The analysis clearly establishes that severe thunderstorms and tornadoes are more common in some parts of Atlantic Canada than others. It also indicates when the activity is greatest both on a monthly and hourly basis and that this activity has significant variability from year to year and by event type.

Related Atmospheric Hazards work on lightning climatology in Atlantic Canada has also been done. This climatology is based on data from the Canadian Lightning Detection Network and work done by Bill Burrows of Environment Canada in Edmonton. In addition to establishing the seasonal and spatial distribution of lightning in the region since 1998, we take a more detailed look at the monthly and hourly distribution of lightning around the most populated centers in each province and rank them according to frequency.

2B-303.5 ID:3067 11:30

Return periods of prolonged fog events in Canada

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This work presents statistical summaries of prolonged fog events at all major airport locations in Canada based on archives of hourly observations made from 1953 to 2007. It is supported by Environment Canada research projects studying ice fog, freezing fog and warm fog in all regions of Canada. A fog event is defined as a period of consecutive hourly observations of fog with visibility ≤ 1/2 mile. A freezing fog event is defined as having the same conditions with a temperature ≤ 0.0°C. Such events are described with two statistics: 1) average duration of the event, and 2) return period of events of any duration. Summary statistics are prepared for events that are unbroken (i.e., the defining conditions match for each hour) and for events that are almost unbroken (i.e., the defining conditions do not match for short intervals, 1, 2, or 3 hours).

The impact of a weather event depends on intensity and duration. Intensity is determined by single values of weather observations; whereas, duration is determined by a variable series of such values. The intensity of a fog event may be described simply by the minimum visibility in kilometres; whereas, the duration of a fog event depends on at least three values: 1) initial time, 2) final time, and 3) threshold value of visibility to qualify as fog. The analyses describe the following types of events: fog, freezing fog, precipitation (any, freezing, frozen, liquid), no precipitation (drought), blizzard, and flight conditions

based on cloud ceiling height and visibility (low IFR, IFR, and VFR). Analyses for approximately 500 airport locations in Canada are posted online at the following location: http://collaboration.cmc.ec.gc.ca/science/arma/duration_statistics.

The results help to improve our understanding of prolonged high-impact weather events. It is suggested that potential prolonged events can be identified through similarities with the climatology, which would trigger operational forecasters to give them increased attention.

2B-303.6 ID:3039 **11:45**

Ongoing Development of Automated Fog and Stratus Forecasts from the GEM Regional Operational NWP Model

Garry Toth , *William Burrows*
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As part of the FRAM Fog Project, the authors, working in the Hydrometeorology and Arctic National Lab in Edmonton, have built an automated system to forecast dense fog (visibility ½ mile or less) and low stratus (ceiling 500 feet or less). Rules for various fog types have been subjectively developed and applied to the output of the operational GEM regional operational NWP model. A criterion based on the model's bulk Richardson number is used to differentiate between fog and stratus. The forecasts for the various fog types are available on the Web to those behind the MSC firewall at each forecast hour from one through 48 hours from either 00Z or 12Z initialization times. In addition, a single combined forecast is available.

A summary chart showing the observing stations with dense fog or low stratus or low obscured ceilings was also created and has been used in the development of the system and the subjective verification of many cases.

Recent development work includes the addition of model precipitation information to the F/ST charts to forecast the commonly-observed low obscured or low stratus ceilings with falling snow. The authors are also experimenting with areas of expected drizzle or freezing drizzle diagnosed from model output as an indicator of possible dense fog or low stratus. Another new chart for "cold" fog applies some simple rules to come up with potential ice fog areas, and more generally ice crystal fog areas.

The latest development work in this project is in the area of objective verification of the fog and stratus forecasts.

This talk will briefly review the automated fog and stratus forecast system and will describe some of the recent additions and modifications. Subjective verifications of a couple of cases in which the observation and forecast charts are compared will be presented. The talk will conclude with a description of the objective verification procedure along with some of its preliminary results.

Water, Weather and Climate Serving the Energy Sector (PART 2) / Eau, temps et climat servant le secteur énergétique (Partie 2)

Room / Endroit (202), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-202.1 ID:2686 **14:00**

Micro-Scale Wind Modelling for Wind Energy Applications

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MSmicro is a micro scale wind model developed from MS3DJH/3R that applies the effects of terrain elevation and surface roughness. MSmicro has been used to study the surface winds in two regions of Nova Scotia in high resolution. This model has been tested in forecast merging mode as well as a spot specific mode. Over all the spot mode has produced the best results, but problems are still present which are possibly due to how the surface roughness is handled. To make improvements to such modeling a simple analytical model for estimating the velocity change due to surface roughness changes using the inner boundary layer concept will be investigated. First this model will be tested on its own, with hopes to use it as the roughness scheme for MSmicro. The motivation of this work is an upcoming wind assessment/energy project in Lake Ontario near the Scarborough Bluffs starting in the summer of 2009.

2C-202.2 ID:3090 **14:15**

Climate Impacts of Large Scale Wind Energy Production

Amanda Adams , *David Keith*
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Wind energy is the fastest growing non-fossil source of primary energy. As the number and size of wind farms grows, and thus the amount of energy they are extracting from the atmosphere grows, the impact of wind energy on the atmosphere must be considered. Wind turbines 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 reduced wind speeds in the turbine wake. Consequentially, large groupings of wind turbines can also have indirect effects on the

atmosphere by influencing surface fluxes, advection of heat and moisture, and turbulent transport in the boundary layer. Through the development of a wind farm parameterization for mesoscale models, the atmospheric impacts of wind farms can be modeled. The impacts of large scale wind energy production were examined for different seasons; 90 day averages of WRF simulations with and without the existence of large wind energy production were computed. This talk will discuss impacts of wind farms on a seasonal time scale, as well as comparing and contrasting the impacts in fall, winter, spring and summer.

2C-202.3 ID:3064 **14:30**

Atmospheric Hazards and Energy Systems: An Ontario Example

Heather Auld , *Joan Klaassen* , *Robert Morris* , *Sharon Fernandez* , *Neil Comer* , *Brian Mills*
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Atmospheric hazards expose energy systems to risks ranging from long-lasting electrical power interruptions, reduced power outputs, downed wind turbines to ruptured oil and gas distribution systems. Of the energy systems in Ontario, atmospheric impacts to electrical power systems impact all other critical infrastructure components since all require continuous power and energy to operate, whether supporting water and gas distribution, communications or transportation systems. Forensic studies have shown that, above critical thresholds, small increases in weather and climate extremes have the potential to bring large increases in damage to existing infrastructure. As a result, energy infrastructure, wind turbines and the power distribution and transmission lines that service them must be designed and engineered to withstand the extremes of weather, as well as its day-to-day weathering processes. But because failures will occur, communities need to also incorporate the realities of energy interruptions to their emergency and disaster mitigation planning. The changing climate will pose additional risks for energy systems due to potentially changing extremes. Other areas for attention include shifting demand management, management of energy efficiency design over the lifetime of structures and resources for renewable energy technologies. Case studies in Ontario will be presented illustrating that increases in heat waves and potential risks from ice storms and other climatic loads will have significant implications for energy infrastructure and require increased vigilance for disaster management planning.

2C-202.4 ID:2945 **14:45**

Estimation of Energy Demand Taking into Account climate change in Southern Quebec

Diane Chaumont [1], *Georges E. Desrochers* [2], *René Roy* [2]
(Presented by *Line Bourdages*)
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In Quebec, the variation of energy demand relative to heating and cooling needs is of major interest when considering climate change impacts. In fact, anticipated warming is expected to reduce and increase energy demand during the winter and summer, respectively. As a result, Hydro-Québec Distribution (HQD) started in 2000 to include temperature change in the estimation of energy demand. With the evolution of knowledge in climate change science and the availability of a larger ensemble of climate projections from Global Climate Models (GCMs), the methodology has progressively improved and uncertainties are now more efficiently taken into account. In this project, an ensemble of 39 climate simulations, produced from the combination of 17 GCMs and 3 emission scenarios, has been analysed to provide a climate warming scenario relevant for the estimation of electric demand in Quebec. Two issues are considered: 1) the redefinition of the reference period for normals to account for a non-stationary climate and 2) the integration of the new climate change scenario in short and medium term planning of electric needs, including a rupture point in the temperature trend as a consequence of anthropogenic warming. Following the analysis, the use of linear temperature increase on a monthly basis is now implemented in HQD operations to address climate change impacts on electric demand. Temperature increases are generally strongest for the winter months.

2C-202.5 ID:2842 **15:00**

Estimation of Net Basin Supply Components for the Upper Great Lakes using MESH

Vincent Fortin [1], *Murray Mackay* [2], *Erika Klyszejko* [3], *Dorothée Charpentier* [1]
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Hydroelectric power is the most widely used renewable energy source in Canada; however this resource cannot be properly managed without reliable methods to accurately predict water cycle components. The estimation of hydropower potential relies on hydrologic modelling to predict reservoir inflows and in-stream power potential. As part of the International Upper Great Lakes Study (IUGLS), Environment Canada is developing a fully coupled land, lake and atmosphere modelling system which will be used to simulate as well as forecast the individual terms of the water budget of the Laurentian Great Lakes basin. The study focuses on improving estimation of the Net Basin Supply (NBS) and assessing the potential impact of variations in the climate system on future regulation of the upper Great Lakes. The modelling system is comprised of the well establish Global Environment Multiscale (GEM) atmospheric model (for analysis and short-term forecasting) and Canadian Regional Climate Model (CRCM) for climate prediction. Both of these models can be coupled with a land-surface hydrology scheme (MESH). This system will provide decisions makers in the hydropower industry with a means of assessing the potential impacts to supply both in the near and distant future. Once in place, it will be possible to use the modelling system to provide experimental ensemble forecasts of water balance components up to two weeks. A climatology-based procedure will be tested to increase the lead time of the ensemble

forecasts to 30 days.

2C-202.6 ID:2797 15:15

Future Energy development needs and CIS Arctic Sea Ice analysis and prediction

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Environment Canada's Canadian Ice Service (CIS) provides accurate and timely ice information in support of safe navigation in Canadian waters. These products are also of use for sustainable offshore resource development. There has been a significant increase in Arctic offshore exploration and the variable ice conditions make planning for infrastructure development a challenge. To continue to improve ice information products to meet the needs of the resource development industry as well as for marine transportation, CIS is enhancing its ability to analyse and predict Arctic Sea Ice conditions with the use of models and data assimilation techniques. An automated Sea Ice analysis will be shown using 3dvar data assimilation which gives an up-to-date analysis of ice in all Arctic waters. Progress in modelling of ice conditions, as well as iceberg tracking, will be presented. Some of these products are already useful, particularly in helping protect oil platforms off the East Coast of Canada.

A significant portion of funding for the research underlying the production of the ice information presented here comes from the Program of Energy Research and Development (PERD).

Acoustics in Oceanography (PART 2) / L'acoustique en océanographie (Partie 2)

Room / Endroit (203), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-203.1 ID:2795 14:00

Results from the ROSE Seismic Oceanography Experiment

Blair Greenan [1], *Ramzi Mirshak* [2], *Mladen Nedimovic* [2], *Barry Ruddick* [2]
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Seismic oceanography is a new interdisciplinary field of study which combines multichannel seismic (MCS) imaging and physical oceanography. In the summer of 2007, MCS data were collected by the GSI Pacific over the Sohm Abyssal Plain (in the region of the Gulf Stream) with the primary intent to define Canadian jurisdiction of the seabed and its natural resources under Article 76 of the United Nations Convention on the

Law of the Sea (UNCLOS). The Reflection Ocean Seismic Experiment (ROSE) was formed to take advantage of the opportunity by acquiring ancillary, coincident oceanography observations that provided in-situ ground truth for the MCS data. This high-density XBT/CTD survey has been used to produce synthetic seismic images of the water column, which will be compared to the MCS imagery of thermohaline finestructure.

2C-203.2 ID:2827 **14:15**

An Intercomparison of Acoustic Current Meters on the Scotian Shelf

Adam Drozdowski , *B. J. Greenan* , *M. D. Scotney* , *J. W. Loder*
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2C-203.3 ID:3096 **14:30**

Long Wavelength Ripples in the Nearshore

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Sediment bedforms are ubiquitous in the nearshore environment, and their characteristics and evolution have a direct effect on the hydrodynamics and the rate of sediment transport. The focus of this study is long wavelength ripples (LWRs) observed at two locations in the nearshore at roughly 3m water depth under combined current and wave conditions in Duck, North Carolina. The observed LWRs are straight-crested bedforms with wavelengths in the range of 30-75 cm, and steepness of about 0.1. They occur during the build up of storms, when the incident wave direction is rapidly changing, possibly due to the migration of the center of a storm. A principal goal of the study is to test the maximum gross bedform-normal transport (mGBNT) hypothesis, which states that the orientation of ripples in directionally varying flows is such that the gross sediment transport normal to the ripple crest is maximized. Ripple wavelengths and orientation are measured from rotary fanbeam images and current and wave conditions are obtained from electromagnetic (EM) flowmeters and an offshore pressure gauge array. Tests of the mGBNT hypothesis in which the transport was calculated using a sediment transport model indicate that it is not a good predictor of LWR orientation. The observed LWR orientation seems to be tied to the incident wave direction, with an additional offset the sign of which depends on the sign of the longshore current.

2C-203.4 ID:3103 **14:45**

Velocity Structure and Turbulent Stress above Evolving Sand Ripples: Observations with a New Multi-frequency Coherent Doppler Profiler

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The last two decades have witnessed increasing use of acoustic remote sensing technologies for sediment dynamics measurements in aqueous environments. The approach is driven by the need to minimize disturbances to the fluid-sediment interactions occurring at or close to the mobile bed. This requirement is especially critical in wave-dominated environments, since the wave bottom boundary layer is typically O(10) cm thick, and thus inaccessible to invasive measurement methods during active transport conditions. Previous advances in acoustic profiling techniques have tended to focus either on velocity measurements using a single acoustic frequency, or on suspended sediment concentration and size measurements using multiple frequencies (the latter being required to resolve the size-concentration ambiguity in the backscatter amplitude at a single frequency). Motivated in part by the need to measure turbulent fluxes, and thus to obtain simultaneous, collocated measurements of suspended particle concentration and velocity, we have developed a multi-frequency coherent Doppler profiler capable of resolving the vertical structure of the wave bottom boundary layer on both wave period and turbulent time scales. Results obtained with this new system in oscillatory flow boundary layers over both fixed roughness and evolving sand ripples will be presented.

2C-203.5 ID:3102 15:00

Geoacoustic Inversion of surficial gassy sediment.

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Geoacoustic parameters of the seafloor in a coastal environment characterized by a surficial gassy sediment layer are estimated using a geoacoustic inversion method. The analysis combines the inversion algorithm called Adaptive Simplex Simulated Annealing (ASSA) with the Fast Gibbs Sampler (FGS) algorithm, which estimates the parameters uncertainty. The propagation model integrated to the algorithms is a parabolic equation model developed by Thomson. The method was tested using simulated data to highlight the advantages and limitations of the technique in isolating the particularly low sound speed and high attenuation of gassy sediment. Results were then obtained from acoustic data recorded in St. Margaret's Bay, N.S., Canada. The underwater acoustic source signature was composed of 5 tones below 500 Hz. It was recorded on a vertical line array of 11 hydrophones located in a range-independent shallow water environment. The seabed in the area of interest was modelled with two sediment layers over a basement, where the geoacoustic parameters of the top sediment layer as well as the thickness of the second layer were estimated through inversion.

2C-203.6 ID:2881 15:15

Assessing uncertainties in underwater acoustic propagation in a tactical environment

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The accuracy of acoustic performance prediction models in littoral environments depends in large part on the input environmental data. The required data includes such parameters as the speed of sound in the local water mass, the bathymetry in the area, and the seabed composition. Through a combination of in-house and contracted research, DRDC Atlantic has been examining the sensitivity of modelled acoustic propagation to these parameters. The objective is to determine, for a given location and time, which parameter(s) will have the greatest impact on the uncertainty in predicted acoustic transmission loss, and how this uncertainty relates to the characteristics of the environmental data. Such characteristics include the natural variability of the parameter and the spatial-temporal sampling frequency of the environmental data. Knowledge of how these characteristics impact the uncertainty in transmission loss can then be used to devise strategies for adaptive sampling of the environmental data and/or the optimal deployment of naval assets for sonar operations. The research includes several initiatives, beginning with the development of theoretical metrics to quantify the sensitivity of the acoustic propagation to the environmental parameters. In addition, several tools have been developed or obtained to aid in the rapid assessment of the environment, including: a database of historical data from DRDC Atlantic sea-trials; forecasts of temperature and salinity from ocean circulation models; and in situ sampling techniques, such as unmanned undersea vehicles for covert sampling and a Moving Vessel Profiler for overt sampling. These advances in theory and environmental characterization are being integrated into a prototype software suite to test and evaluate the uncertainty in acoustic transmission loss due to environmental data characteristics. To illustrate this point, the presentation will include comparisons of measured and modelled acoustic transmission loss from a recent sea-trial.

Atmosphere, Ocean and Climate Dynamics (PART 2) / Dynamique de l'atmosphère, de l'océan et du climat (Partie 2)

Room / Endroit (204), Chair / Président (Marek Stastna), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-204.1 ID:2701 **14:00**

Wave Forcing in the Stratosphere as a Result of Climate Change

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While there is an emerging consensus among modelling groups that one effect of climate change on the dynamics of the stratosphere is an enhancement of the Brewer-Dobson circulation in the NH winter, the processes by which this happens are not yet fully clear, and model results are often clouded by large natural variability at high latitudes. As well, all IPCC-type climate change forcings include the overlapping effects of greenhouse gases and ozone recovery. To better isolate key processes, we bring the question of Brewer-Dobson circulation changes back to a simplified scenario: climate change is represented by doubling of atmospheric CO_2; ozone, while radiatively and chemically interactive, does not undergo catalytic destruction by CFCs; surface temperatures are calculated interactively rather than prescribed. In this process-oriented context, we run a chemistry-climate model (IGCM-FASTOC) coupled to a slab ocean for 100 years at T31 resolution, and 50 years at T42, in timeslice mode. In the NH winter, we find warming to extend into the lower stratosphere at high latitudes and an associated weakening of the polar vortex. The Brewer-Dobson circulation is enhanced as expected. This can be traced to a significant increase in the wave forcing (EP flux convergence) at the lower edge of the polar vortex in (climatological) February, and equally significant wave forcing higher up near the vortex core as early as January. Maximum wave forcing at this height and above leads control values by a month. We see this also in increased occurrences of Sudden Warmings in January and February under doubled-CO_2 conditions. This talk will present the results and their interpretation in terms of the changes in the prevailing tropospheric winds and their impact on vertical wave propagation. Effects of horizontal resolution will also be discussed.

2C-204.2 ID:3078 **14:15**

On the viability of Lagrangian theories of internal wave spectra

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Our incomplete understanding of the physical dissipation processes within an internal gravity wave field impacts on questions of mixing and momentum deposition in stratified geophysical flows, with enormous dynamical ramifications in the case of the Earth's middle atmosphere. Efforts to solve the puzzle have centered on nonlinear interactions among internal waves, but the inherent complexity has hindered progress. There is a growing body of literature which maintains that this complexity can be circumvented by using a Lagrangian, rather than Eulerian, formulation. I have investigated this proposition with a Lagrangian wave model and wave fields typical of the middle atmosphere; the results raise serious questions concerning the methods and approximations invoked by certain Lagrangian theories of wave spectra, specifically those advanced by Hines, Allen and Joseph and Chunchuzov. They also have serious implications for Hines' Doppler-spread parameterization, which has been implemented in several middle atmosphere general circulation models (GCMs).

2C-204.3 ID:2791 **14:30**

Two mechanisms for enhanced mixing due to shoaling internal solitary-like waves

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Solitary-like internal waves are coherent, high-frequency motions that are widely documented in coastal oceans and lakes. While ISWs in deep water are typically waves of depression, during shoaling these waves are transformed into waves of elevation which, in turn, grow, break and mix the water column. Based on the results of a combined numerical-experimental study of the interaction of internal solitary-like waves with bottom corrugations that are shorter than the typical horizontal length scale of the waves I will discuss two mechanisms that increase the geographic extent of the region in which shoaling waves mix the water column, and especially, the pycnocline. For situations in which the bottom corrugations reach into, or are very near, the pycnocline, the large waves exhibit a spatio-temporally developing shear instability that takes the form of sizable billows. These billows drain energy from the main wave and partially mix the pycnocline. When the bottom corrugations do not reach the pycnocline, no billows are observed, however, the wave-induced currents generate large vortices over the bottom undulations. These vortices are not fully developed until well after the main wave has passed by. They scour the bottom, deform the overlying pycnocline, and in some instances lead to significant mixing.

2C-204.4 ID:2724 14:45

Mixed bottom-friction-Kelvin-Helmholtz destabilization of source-driven abyssal overflows in the ocean

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Source-driven ocean currents that flow over topographic sills are important initiation sites for the abyssal component of the thermohaline circulation. These overflows exhibit vigorous space and time variability over many scales as they progress from a predominately gravity-driven down slope flow to a geostrophic along slope current. Observations show that in the immediate vicinity of a sill, grounded abyssal ocean overflows can possess current speeds greater than the local long internal gravity wave speed with bottom friction and down slope gravitational acceleration dominating the flow evolution. It is shown that these dynamics lead to the mixed frictionally-induced and Kelvin-Helmholtz instability of grounded abyssal overflows. Within the overflow, the linearized instabilities correspond to bottom-intensified baroclinic roll waves and in the overlying water column amplifying internal gravity waves are generated. The stability characteristics are described as a function of the bottom drag coefficient and slope, Froude, bulk Richardson and Reynolds numbers associated with the overflow and the fractional thickness of the abyssal current compared to the mean depth of the overlying water column. The marginal stability boundary and the boundary separating the parameter regimes where the most unstable mode has a finite or infinite wavenumber are determined. When it exists, the high wavenumber cut-off is obtained. Conditions for the

possible development of an ultra-violet catastrophe are determined. In the infinite Reynolds number limit, an exact solution is obtained which fully includes the effects of mean depth variations in the overlying water column associated with a sloping bottom. For parameter values characteristic of the Denmark Strait overflow, the most unstable mode has wavelength of about 19 km, a geostationary period of about 14 hours, an e-folding amplification time of about 2 hours and a down slope phase speed of about 74 cm/s.

2C-204.5 ID:2967 **15:00**

Zonal versus meridional velocity variance in the World Ocean: order in the chaotic ocean

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Global satellite-based observation of near surface geostrophic currents over the past 13 years has revealed ubiquitous quasi-horizontal eddies in the mesoscale, confirming the view of a highly turbulent ocean suggested by observational programs in the 1970s. Idealized quasigeostrophic turbulence models suggest mesoscale turbulent flow can vary between isotropic, and highly anisotropic zonal jets. We compare the zonal and meridional velocity variance from satellite altimetry, and show that the surface flow is organized into mesoscale patches where either zonal or meridional velocity variance dominates. The patches persist over 13 years, much longer than the turbulent timescale of a few months. Implications include potentially highly anisotropic redistribution of tracers by the mesoscale flow. Zonally averaged velocity variances reveal a slight preference for meridional over zonal velocity variance. Realistic primitive equation models succeed in reproducing both the patchy structure in local preference for either zonal or meridional velocity variance, and the zonally averaged preference for meridional variance. Idealized models of fully developed, quasigeostrophic turbulence fail in both regards.

2C-204.6 ID:3106 **15:15**

Comparison of modelled and observed sea ice fluxes in the Canadian Arctic Archipelago

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With the foreseeable increase in the strategic and economic importance of the Canadian Arctic Archipelago (CAA), a comprehensive picture of sea ice conditions at present and in the future is needed. However, due to the complex topography of the Canadian Arctic Archipelago (CAA), modelling sea ice fluxes in this area requires considerable spatial resolution. Our group has developed a stand-alone sea ice model based on the viscous-plastic rheology. The model includes both the Arctic Ocean and the CAA at a resolution of 10km, sufficient to resolve most of the channels and straits of the CAA. The model is

driven with NCEP atmospheric winds and temperatures and is being validated with both buoy data and ice covered area derived from satellite observation. This study compares the modelled sea ice fluxes in and out of the CAA with fluxes derived from satellite observations computed by Ron Kwok (JPL), Tom Agnew (EC) and Stephen Howell.

Meteorological Preparations for the 2010 Olympic Winter Games / Préparations météorologiques pour les jeux Olympiques d'hiver 2010

Room / Endroit (205), Chair / Président (Chris Doyle), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-205.1 ID:3062 **14:00**

Weather services for the Vancouver 2010 Olympic and Paralympic Winter Games

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Environment Canada's (EC) Meteorological Service of Canada (MSC) will be the official provider of weather information and forecasts for the Vancouver 2010 Olympic and Paralympic Winter Games. An extensive network of surface and three dimensional real-time weather sensors have been deployed in the Olympic area and are operational at this time. To prepare forecasters for the Game's, a program of forecaster on-the-job training began in Whistler in January 2006 and was completed this year. In addition, a mountain weather forecasting course was developed in cooperation with the Consortium on Meteorological Education and Training, (COMET). Three courses were held in Boulder, CO, and a final course was presented at Whistler in August 2008. . Science and technology for the Games promises to be innovative. EC's Numerical Weather Prediction research unit, RPN, is producing applications including the downscaling of some elements of high resolution NWP, particularly precipitation and wind, and the routine production of NWP at high temporal and spatial resolution. New forecast ensembles will be included in routine operational forecasting. In the interests of short term and nowcasting, a World Weather Research Program recognized Research Demonstration Project underway will include the production of operational short term nowcasting guidance for Olympic venue forecasters. Weather Services support during the Olympic Winter Games, February 12-28 2010 and the Paralympics on March 12-21, will include a fully operational weather forecasting system, including dedicated venue forecasts and end-user targeted tailored products, real time weather forecasts and observed data delivery to proprietary 2010 information systems and the provision of real-time information and professional weather advice to the our Federal partners, VANOC, IOC, Sport and team officials directly at the Venues and within the Game's Main Operations Centre.

2C-205.2 ID:2720 14:15

Thermodynamic, Wind and Liquid Profiling for Olympic Weather Prediction

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Met Service Canada will use microwave radiometer and wind radar profilers to obtain thermodynamic, wind and liquid data during the 2010 Vancouver Winter Olympics. These upper air profiles provide continuous information on the state of the atmosphere which is closely linked to local weather. Traditional forecast tools and indices generated by these data can be used for state-of-the-art local weather prediction. In addition, liquid profiles which are traditionally not available from radiosondes, can be used to enhance local precipitation, fog and icing forecasts. Case studies including forecast tools and indices generated from continuous thermodynamic, wind and liquid profile observations during winter snow and convective weather conditions will be presented.

2C-205.3 ID:2786 14:30

An experimental numerical prediction system for the 2010 Vancouver Winter Olympic Games

Jocelyn Mailhot [1], *S. Belair* [1], *M. Charron* [1], *M. Abrahamowicz* [1], *N. Bernier* [1], *B. Denis* [2], *A. Erfani* [2], *A. Giguere* [2], *N. Mclennan* [2], *R. McTaggart-Cowan* [1], *J. Milbrandt* [1], *L. Tong* [2]
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The 2010 Winter Olympic and Paralympic Games will take place in Vancouver, Canada, from 12 to 28 February 2010 and from 12 to 21 March 2010, respectively. In order to provide the best possible guidance achievable with current state-of-the-art science and technology, Environment Canada is currently setting up an experimental numerical prediction system for these special events. This system includes: 1) a regional ensemble prediction system (REPS), 2) high-resolution numerical modeling, and 3) surface modeling at the microscales. The REPS is based on the limited-area version of the Global Environmental Multiscale model (GEM-LAM) with 20 members at 33-km resolution. Initial conditions are provided by the Ensemble Kalman filter (EnKF), and boundary conditions are obtained from the global EPS, both operational at the Canadian Meteorological Centre (CMC), and stochastic perturbations are applied to the sub-grid-scale physical tendencies and to surface parameters. The high-resolution models include 2.5-km and 1-km versions of GEM-LAM integrated for 15h, twice a day, with improved cloud microphysics, geophysical fields, and radiation and cloud-radiation interactions, as

compared with the system (15-km and 2.5-km models) currently operational at CMC. Finally, several new and original tools are used to adapt and refine forecasts near and at the surface. A microscale 2D surface system (with 100-m grid size) covers the Vancouver Olympic venues using forcings from the 1-km model. Based on a similar strategy, a single-point model will be implemented, using surface observations as forcing, to better predict surface characteristics at each station of the special observing network set up for the Vancouver Olympics. The microscale 2D surface models better represent surface processes, and thus lead to better predictions of snow conditions and near-surface air temperatures. The configuration of the experimental numerical prediction system will be presented at the Congress, together with preliminary verification results from the winter 2008.

2C-205.4 ID:2814 14:45

Experimental land surface modeling and assimilation system for the 2010 Vancouver Winter Olympic Games

Natacha Bernier , *Stephane Belair* , *Linying Tong* , *Maria Abrahamowicz* , *Jocelyn Mailhot*
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Environment Canada's land surface forecast system developed for the Vancouver 2010 Winter Olympics is presented together with an evaluation of its performance for winters 2007-2008 and 2008-2009. The motivation for this work is threefold: it is i) application driven for the 2010 Vancouver Olympics, ii) a testbed for the panCanadian operational land surface forecast model being developed, and iii) the precursor to the fully coupled land-surface model to come. The new high resolution (100m), 2D, and novel imbedded point-based land surface forecast model used to predict hourly snow and surface temperature conditions at Olympic and Paralympic Competition Sites are described. The surface systems are driven by atmospheric forcing provided by the center's operational regional forecast model for the first 48 hours and by the operational global forecast model for hours 49 to 96. The forcing fields are corrected for large elevation discrepancies over the rapidly changing and complex mountainous settings of the Vancouver Olympics that arise from resolution differences. Daily 96h land surface forecasts for 2 winters and snow depth and surface air temperature observations collected at several specially deployed competition sites are used to validate the land surface model. We show that the newly implemented surface forecast model refines and improves snow depth and surface temperature forecast issued by the operational weather forecast system throughout the forecast period.

2C-205.5 ID:3024 15:00

A Canadian regional ensemble prediction system for North America

Martin Charron [1], *Xiaoli Li* [2], *Ronald Frenette* [3], *M. K. (peter) Yau* [2]
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Two initial perturbation strategies --- moist targeted singular vectors (SVs) and the ensemble Kalman filter (EnKF) --- are compared for the development of a regional ensemble prediction system (REPS) based on the limited area version of the Canadian Global Environmental Multiscale (GEM) model. The impacts of two stochastic model perturbations --- on some physical parameters and on sub-gridscale physical tendencies --- are also investigated under the SV-based and EnkF-based systems. Four systems with different combinations of the abovementioned initial perturbations and model perturbations are designed to perform experiments for one-month winter and one-month summer periods in 2006. The performance of the four systems is validated with probabilistic verification measures. Results indicate that under the condition of using the same model perturbation strategies, the EnKF-based system generally performs significantly better than the corresponding SV-based system for winter and summer periods. The advantage of the EnKF-based REPS comes mainly from its better reliability attribute, which can be characterized by a smaller bias and reduced underdispersion. Results of using different model perturbation methods show that both in the SV-based and EnKF-based systems, the use of stochastic perturbations on model physical tendencies instead of on selected physical parameters can significantly improve the reliability skill of the system, but tends to slightly degrade its resolution. Consequently, the overall better performance is obtained in a system with physical tendency perturbations. Preliminary tests including stochastic perturbations of some initial surface parameters are performed. Results show that surface parameter perturbations can help improving forecast skills of surface variables for the summer period.

2C-205.6 ID:2969 15:15

Science and Nowcasting Olympic Weather for Vancouver 2010 (SNOW-V10) – Overview and First Results

George Isaac [1], *Paul Joe* [1], *Monika Bailey* [1], *Stephane Bélair* [2], *Faisal Boudala* [1], *Stewart Cober* [1], *Chris Doyle* [3], *Ivan Heckman* [1], *Jocelyn Mailhot* [2], *Mathias Mueller* [4], *Roy Rasmussen* [5], *Ron Stewart* [6]
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A new World Weather Research Project (WWRP) of the World Meteorological Organization (WMO) is being planned for the Vancouver 2010 Olympic and Paralympic Winter Games. Short term weather forecasting or Nowcasting, which concentrates on 0-6 hr predictions, has been the focus of several WWRP projects associated with the Sydney 2000 and the Beijing (2008) Summer Olympic Games. SNOW–V10 will be the first similar project to look at winter weather. It will produce better techniques to nowcast cloud, fog, visibility, precipitation type and amount, and wind and turbulence in

mountainous terrain. This will be done by using state-of-the-art numerical modeling systems, new on-site surface and remote sensing observing systems, as well as Nowcasting systems which will blend observations and model predictions into improved short term forecasts. The nowcasts will be produced during a 2009 practice session and during the 2010 Olympics. Short term forecasts will be provided to the weather forecasters supporting each venue, and special real-time displays will be produced for each venue manager. An evaluation and impact study will be conducted to determine the effectiveness of the forecast systems. This talk will present an overview of the project and describe some early results.

Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) (PART 2) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE) (Partie 2)

Room / Endroit (301), Chair / Président (C. Harold Ritchie), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-301.1 ID:2846 **14:00**

Recent results from the assimilation of sea ice observations in regional coupled ice-ocean models

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A variational data assimilation system is being developed at Environment Canada to estimate sea ice conditions by assimilating various types of observations. These observations include manually derived products from the Canadian Ice Service and several types of remotely-sensed data (e.g. passive microwave, visible/infra-red, synthetic aperture radar). The system is based on the variational data assimilation approach and is used in combination with error covariances estimated with an ensemble (Monte Carlo simulation) approach. Recent results from applying this data assimilation system to coupled ice-ocean models of the east coast region of Canada and the Gulf of St. Lawrence will be presented. The results demonstrate the relative improvements in short-range sea ice forecasts from using the data assimilation system as compared with the simpler approaches of direct insertion or nudging.

2C-301.2 ID:2854 14:15

Development of a new ice-ocean prediction system for the Northwest Atlantic

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Fisheries and Oceans Canada (DFO) is developing an ocean-ice pre-operational prediction system for the Northwest Atlantic as a precursor to an operational coupled atmosphere-ice-ocean prediction capability with Environment Canada's Canadian Meteorological Centre. A pre-operational modeling system called C-NOOFS (Canada Newfoundland Operational Ocean Forecast System, www.c-noofs.gc.ca) is being developed based on the NEMO modeling system (www.nemo-ocean.eu). The sensitivity of the sea ice simulation to the use of radiative fluxes directly from the atmospheric model rather than bulk formula will be evaluated as will the sensitivity to including tides. The evaluation will consider the simulation of both the climatological annual cycle and the winter of 2007/08.

2C-301.3 ID:2691 14:30

Heat and wind effects on Arctic sea-ice

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Arctic sea-ice changes during 1958-2006 are simulated with a global ice-ocean model with surface forcing given by the Common Ocean-ice Reference Experiments (CORE). Under the standard CORE forcing, the model reproduces a significant portion of the observed interannual changes in September ice area, but overestimates its decline in the final decade. The strongest loss occurs in the Siberian-Pacific sector. Model sensitivity experiments suggest that the variations in total sea-ice area during the past five decades are primarily due to changes in heat forcing, while wind drives non-negligible interannual changes. The comparison between the surface air temperatures from CORE and the International Arctic Buoy Program reveals a significant discrepancy over the past decade. A sensitivity experiment shows that this discrepancy is sufficient to explain the overestimation of the recent decline in September ice area by the model. This emphasizes the need to further assess and improve the accuracy of atmospheric forcing.

2C-301.4 ID:2923 14:45

Observability of large control vector in a 4D-Var ocean data assimilation

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Control vector of typical four dimensional ocean data assimilation system consists of initial values, external forcing and model error. Due to sparseness of data, the retrieval of such large control vector is always ill-posed inverse problem. In this presentation, we will address to what extent we can "observe" these control vector given limited number of data using singular value decomposition (SVD) of the observability matrix in a 4D-Var system. In order to demonstrate usefulness of the SVD approach, we perform twin data experiments using a two-layer quasi-geostrophic ocean circulation model. We also demonstrate that the SVD approach makes it possible to conduct hypothesis test on each spectral component of the optimal 4D-Var solution.

Coastal Oceanography and Inland Waters (PART 1) / Océanographie côtière et les eaux intérieures (Partie 1)

Room / Endroit (302), Chair / Président (Guoqi Han), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-302.1 ID:3037 INVITED/INVITÉ 14:00

Satellite Observations of Ocean Processes along the Pacific Coast

Bill Crawford [1], *Gary Borstad* [2], *Angelica Peña* [1], *Nick Bolingbroke* [1]
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Satellite images provide the best available views of ocean processes along the West Coast, especially in the numerous regions remote from oceanographic institutes and shipping tracks. Altimetry measurements by radar sensors from space since 1992 have provided nearly continuous measurements and are especially useful in cloud-covered regions because the radar signals penetrate clouds. By referencing these sea level measurements to recently determined dynamic ocean topography, we can observe jets and eddies exchanging coastal and deep-sea waters along the Pacific Coast from California to Alaska. Additional insight is provided by introducing satellite measurements of ocean surface chlorophyll, because chlorophyll patterns reveal smaller-scale processes. SeaWiFS images of chlorophyll reveal significant differences in offshore transport in California, British Columbia and Alaska. Alaskan eddies are largest and most buoyant, penetrating farthest offshore. Eddies and jets off California are smaller and intense, and they tend to sink below the denser offshore waters. Eddies of southern British Columbia are weakest by far, so that nutrients and chlorophyll are retained on the continental shelf and are a factor in the very high fisheries yield in these waters. Chlorophyll distribution along the northern British Columbia coast, measured by

SeaWiFS, shows an annual cycle of mixing and currents not previously realized. Interannual variability of chlorophyll in this region reveals how ocean processes might impact the survival of juvenile seabirds and fish.

2C-302.2 ID:3007 14:30

Numerical Study of Three-Dimensional Circulation over Coastal Waters of Nova Scotia during Tropical Storm Alberto using a Five-Level Nested-Grid Ocean Circulation Model

Jinyu Sheng , *Bo Yang*
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A nested-grid coastal circulation modelling system was developed for coastal waters of Nova Scotia based on the high-resolution circulation model for Lunenburg Bay and a prototype shelf circulation forecast system known as DalCoast The nested-grid modelling system has five-level sub-models, with the outermost sub-model of a coarse horizontal resolution of (1/12)o for simulating storm surges over the eastern Canadian shelf and the innermost sub-model of a fine resolution of about 180 m for simulating the 3D coastal circulation over Lunenburg Bay of Nova Scotia in the default setup. The nested-grid system is driven by meteorological and astronomical forcing and used to examine physical processes affecting the three-dimensional (3D) circulation and hydrographic distributions, with a special emphasis on the storm-induced circulation during tropical storm Alberto, over Lunenburg Bay of Nova Scotia. Model results demonstrate that the non-tidal circulation over the inner Scotian Shelf is affected significantly by local wind forcing, remotely generated coastal waves and wind-induced coastal upwelling/downwelling during the study period.

2C-302.3 ID:3055 14:45

Principal modes of circulation variability on the shelf seas of eastern Canada

David Brickman [1], *Adam Drozdowski* [1], *Chris Nickerson* [2]
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The existence of “normal year” and various long-term forcing fields allows ocean circulation models to be run under a suite of representative forcing scenarios. A version of the OPA circulation model is setup on a regional domain that includes the Gulf of St. Lawrence, the Scotian Shelf and the Gulf of Maine, and forced using the CORE normal year forcing fields. Daily (and tidally) averaged output is used in an EOF analysis to determine the dominant spatial modes of variability in this shelf region. Results are interpreted with reference to forcing variables and expected shelf model behaviour.

2C-302.4 ID:2697 15:00

Modifying a coupled biophysical model to predict the timing of the spring bloom in

Rivers Inlet, British Columbia

Megan Wolfe , *Susan Allen*
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Rivers Inlet is a glacial fjord located on the central coast of British Columbia. Historically, Rivers Inlet was the location of the 3rd largest sockeye salmon run in Canada. The Rivers Inlet sockeye salmon stock fluctuated in the late 1970's and crashed in the early 1990's with returns reaching only 1% of the historical averages. It is believed that a contributing cause for this rapid decrease is changes in the timing of the spring phytoplankton bloom. To investigate historical variations in the timing of the spring bloom in Rivers Inlet, we propose to modify a coupled biophysical model that has been used to successfully predict and to hindcast the spring phytoplankton bloom in the Strait of Georgia (SoG). The physical model is a one-dimensional vertical mixing boundary layer model that is forced with hourly wind, air temperature, cloud fraction and humidity data, along with daily river flux data. It is initialized with profiles of salinity, temperature and fluorescence. Many local parameterizations are needed and must be re-parameterized for Rivers Inlet. Of particular importance are the freshwater fluxes and light absorption. River input forces the freshwater flux and drives the estuarine circulation. Relaxation of light-limitation determines the timing of the spring bloom and so a good model estimation of light absorption including the effect of glacial silt from the rivers is essential. The modified biophysical model will be used to determine the factors driving interannual and decadal variation in the timing of the spring phytoplankton bloom in Rivers Inlet.

2C-302.5 ID:2698 15:15

Assimilation of satellite-derived Sea Surface Temperature into Canadian East Coast Ocean Model (CECOM)

Yongsheng Wu , *Charles Tang*
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Abstract

Sea surface temperature (SST) data have been assimilated into the Canadian East Coast Ocean Model (CECOM) used in the BIO forecasting system for eastern Canadian waters. The SST data are the operational product from Canada Meteorological Centre (CMC) and the assimilation scheme is based on the method of the optimal interpolation (OI). The SST data are blended into the model through adjusting/correcting the heat flux between the ocean and the atmosphere on a daily basis. The correction is related to the model and data errors, the SST difference between the model and data, and the local mixed layer depth. To evaluate the performance of the assimilation scheme, SSTs calculated from assimilation and non-assimilation model runs are compared to in situ measurements from Atlantic Zonal Monitoring Program (AZMP). The comparisons show that the assimilation significantly reduces the uncertainties of the model and improve the model SST. To examine the impact of the error parameter on the assimilated SST, two

sensitivity runs were performed. It was found that the model results were more sensitive to the error parameter in summer and fall, while less sensitive in winter and spring.

Extratropical Transition of Tropical Systems / Transition extratropicale des systèmes tropicaux

Room / Endroit (303), Chair / Président (Peter Bowyer), Date (02/06/2009), Time / Heure (14:00 - 15:30)

2C-303.1 ID:2863 **INVITED/INVITÉ 14:00**

Hurricanes and Global Warming

Stephen Miller
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The effect of global warming on the frequency and intensity of tropical cyclones is currently a topic of heated debate within the tropical storm research and forecast community. Articles published in recent years in high profile journals such as Nature and Science have attempted to demonstrate a link between anthropogenic climate change and a recent increase in hurricane activity. These articles have drawn a lot of attention with both media and public, especially regarding the hyperactive hurricane season of 2005 in the Atlantic Ocean.

This presentation will review some of the principles of tropical cyclogenesis and discuss how these factors might change in a warmer world. The role of a warmer sea surface temperature and its interaction with changes in the tropical atmosphere will be examined.

The bulk of the talk will present research by others that has been published in the scientific literature. The methods and results from several recent peer reviewed articles on the subject will be presented and discussed. These articles include both observational and modelling studies. The reaction to this research from scientists within the tropical meteorology community will be detailed, and we will discuss what sort of conclusions we can draw from these recent works.

2C-303.2 ID:2890 **14:30**

A Forecasting Summary of Recent ET Events Affecting Canada since 2006

Chris Fogarty [1], *Peter Bowyer* [2]
[1] Canadian Hurricane Centre / National Lab for Marine and Coastal Meteorology
[2] Canadian Hurricane Centre
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There have been many tropical cyclones affecting eastern Canada over the past number of years. These weather systems are invariably undergoing some form of extratropical transition (ET) when they affect our region. In this presentation I will summarize the ET aspect of events over the past 3 hurricane seasons and highlight some of the forecasting challenges associated with them. These events include Post-tropical Storm Noel, Hurricane Kyle and Post-tropical storm Hanna – all having significant impacts in the Maritime Provinces. A subsequent companion presentation will look at the impacts of these and other ET events.

2C-303.3 ID:3027 **14:45**

A Summary of the impacts of ET events affecting Canada since 2006

Peter Bowyer , *Steve Hatt*
Canadian Hurricane Centre
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Numerous tropical cyclones, either undergoing or having completed extratropical transition (ET) have impacted Canada in the last three years, each accompanied by damaging winds, rain or waves. This presentation will highlight these events and their impacts in eastern Canada. A preceding companion presentation will look at many of the same ET events from a forecaster's perspective.

2C-303.4 ID:3025 **15:00**

Tropical cyclone rain and wind climatology for Canada – a sneak peak

Peter Bowyer [1], *Alex Donaldson* [1], *Rich Cianflone* [2]
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In 2005, funded by the National Search & Rescue Secretariat's New Initiatives Fund (SARNIF), the Canadian Hurricane Centre published a comprehensive climatology of hurricanes for Canada and her territorial waters in order to quantify the threat. That study reported on the details and statistics of tropical cyclone tracks and impacts. The SARNIF has enabled the study to continue by looking into both the meteorological and oceanic parameters which create the threat to Canadians: wind; rain; storm surge; ocean waves. While this detailed climatology will not be published until March 2010, this presentation will take a sneak peak at the findings of the tropical cyclone wind and rainfall data and will briefly outline the dissemination and communications plan.

2C-303.5 ID:2892 **15:15**

An Overview of Forecast Performance at the Canadian Hurricane Centre

Chris Fogarty [1], *Peter Bowyer* [2]
[1] Canadian Hurricane Centre / National Lab for Marine and Coastal Meteorology
[2] Canadian Hurricane Centre

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The Canadian Hurricane Centre has been formally documenting forecast performance over the past number of hurricane seasons using some new software programs developed in the National Lab for Marine and Coastal Meteorology. The new system allows for more direct measure and monitoring of absolute track and intensity forecasting errors for tropical systems affecting Canada. In addition to this quantitative verification, the Centre has been assessing its weather warning program and impact statements through annual storm reports and case studies. This presentation will serve as a highlight of this important aspect of forecasting and summarize areas where we can improve our service.

POSTERS Monitoring the Atmosphere and Ocean / Monitorage de l'atmosphère et de l'océan

Room / Endroit (100), Chair / Président (Al Wallace), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I2.1 ID:2934 **15:30**

Characterisation of biogenic slicks - using Langmuir films and ellipsometry

Wendy King [1], *Valborg Byfield* [1], *Stanislav Ermakov* [2], *Robert Greef* [1], *Jeremy Frey* [1]
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The sea-surface microlayer (SSM) is a hugely complex system comprised of many different organic materials that has a considerable influence on the physical and chemical properties of the ocean surface. Under certain conditions, involving wind, internal waves and currents, the SSM is compressed and forms biogenic slicks. These biogenic slicks have a wave dampening effect and when using satellite data to monitor the ocean surfaces look indistinguishable from anthropogenic slicks. It is important to understand the physical properties of these biogenic slicks to identify oil pollution. For this project the physical properties of biogenic slicks from the Solent (UK) and the Black Sea (Ukraine) are being investigated. Model compounds that display similar properties to the slicks are also being characterized; these simpler systems are easier to interpret and parallels to the biogenic slicks can be made increasing understanding. The tools used to characterize these Langmuir films involve the analysis of the phase and amplitude change of polarized light upon surface reflection (ellipsometry). The film can be compressed and expanded monitoring changes in surface pressure. In conjunction, ellipsometry can be used to determine optical properties, thickness, phase changes and hysteresis effects of the film, offering both spectroscopic information and images. The changes of the film on compression are important as they mimic natural events that have the potential to be of

use in satellite data interpretation. Results show, in images, the domain separation of different chemical species within the SSM and co-existence of phases. Upon compression and expansion of the films, aggregation of the different phases along with hysteresis effects are seen – phenomena that has only been hypothesized to date. Work on the model compounds demonstrates that it is possible to determine thicknesses of thin films at different surface pressures offering valuable information on phase changes.

2D-100-I2.2 ID:2980 15:30

Software Tools to Monitor a Real Time Sunphotometer Network

James Freemantle [1], *Norm O'Neill* [1], *Ihab Abboud* [2], *Bruce Mc Arthur* [2]
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A request for near real time inputs of aerosol optical depth measurements into a Canadian air quality model stimulated innovations in the AEROCAN Sunphotometer Network. The automatic CIMEL sunphotometers which comprised the AEROCAN Network were upgraded to collect data at 3 minute intervals and hourly low-data-volume satellite uplinks were replaced by hardwired internet connections. Aerosol optical depth information is now uploaded to a central ftp site and is available for use within 15 minutes. Software has been written to collect the data from across Canada and place it in a MySQL database. Tools for quality control and data network monitoring have been developed to keep the Aerocan network managers up to date on instrument performance and data availability. These tools include dynamically updated web plots as well as a RSS newsfeed. Other tools such as Twitter are also being investigated. In this paper we will provide an overview of our progress and an assessment of their impact on our operational needs

2D-100-I2.3 ID:2865 15:30

The role of Prairie and Northern in the installation and maintenance of Environment Canada's Atmospheric Monitoring Networks

John Mravnik , *Wayne Emond*
Environment Canada
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Prairie and Northern Atmospheric Monitoring Section provides a variety of functions for the Meteorological Service of Canada's atmospheric monitoring networks. This includes installation, repair and maintenance services for networks such as Surface Weather, Upper Air, Radar, Marine as well as support for specialized data networks including Ozone, Solar Radiation and others. Using a Quality Management System framework Atmospheric Monitoring strives to meet the World Meteorological Organization's targets for data accuracy and availability within Canada's Meteorological Service.

2D-100-I2.4 ID:3000 15:30

Initial results from the STAR surface mesonet

Marna Melzer , *Peter Taylor* , *Mark Gordon* , *Sumita Biswas*
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In mid-September 2007 the STAR (Storm Studies in the Arctic) project assembled and installed 10 surface weather stations in Iqaluit and surroundings; 4 of the stations were equipped with Iridium satellite phones to allow daily data transfer to a base station at York University, while data from other stations were retrieved when those stations were removed in April 2008. Statistics of the Wind Speed and Wind Direction data (histograms and Gamma distribution fits plus wind rose plots) illustrate the behaviour of the wind and indicate strong topographic channelling of flow in NW-SE directions along the axis of Frobisher Bay and the Sylvia Grinnell River valley.

POSTERS IPY and related atmospheric, oceanographic, and hydrological studies / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie

Room / Endroit (100), Chair / Président (Bash Toulany), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I3.1 ID:2719 **15:30**

Model validation of cloud and radiation from the Atmospheric Infrared Radiance Sounder (AIRS)

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Hyperspectral radiances from AIRS are used to validate model cloud and radiation for short term forecasts. From model output, equivalent radiance spectra to observed ones are computed. The same retrieval technique is applied to both observed and calculated radiances to derive cloud parameters: height and amount. Synthetic radiances were first used to validate the retrieval technique itself, notably limiting biases which can arise from the difficulty to retrieve boundary layer clouds. The application is global, but with special attention to the Arctic region as part of the IPY effort (notably polar night retrievals). A reliable methodology for the evaluation of the vertical distribution of clouds is the main output of this work. It is also found that the quality of 6-h forecasts is not significantly degraded at 12-h, a good indication that our model does not suffer from a long spin-up problem.

2D-100-I3.2 ID:2736 15:30

Simulating wind channeling over Frobisher Bay in the Eastern Canadian Arctic during the 7-8 November 2006 wind event

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Previous observational and idealized modelling studies have identified wind channeling over Frobisher Bay as the main cause for the occurrence of strong winds at Iqaluit. The 7-8 November 2006 wind event appears to be representative for such occurrences. Our simulations of the event with the GEM-LAM 2.5-km model covering the Southern Baffin Island show the development of wind channeling over Frobisher Bay. It starts as a barrier wind following low-level blocking of northeasterly winds by steep orography near the head of the bay. Later on, it intensifies, being primarily driven by large-scale pressure gradients. The lateral development of the channeled wind across the bay and its interaction with a downslope wind (over the Hall Peninsula) explains the shift in surface wind direction and the high surface wind speeds recorded at Iqaluit. Some of the findings are also supported by data from radiosondes launched at Iqaluit. We also show the impact of using a distributed orographic drag scheme, a modified Lenderink-Holtslag mixing length, and an increased near-surface vertical resolution.

2D-100-I3.3 ID:2853 15:30

Fresh water in the northern East Greenland Current from 1982 through 2005

E. Peter Jones [1], *Eva Falck* [2], *Gerhard Kattner* [3]
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[2] Geophysical Institute, University of Bergen, Norway
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We describe the distribution and variability of the Pacific fresh water and total fresh water on the East Greenland shelf and slope in the region west of the Polar Front from Fram Strait to 72ºN. These waters make up a considerable part of the Polar Water leaving the Arctic Ocean through Fram Strait. Data were obtained for most years between 1982 and 2005. We determine the total fresh water and Pacific fresh water fractions using the phosphate and nitrate concentrations together with salinity. During 1993 and 2002, alkalinity values were also determined, which allowed estimates of river water and sea ice melt water fractions as well. Pacific fresh water and river water accounted for almost all of the fresh water in this region in 2002 when data were taken early in spring, while more sea ice melt water was present in 1993 when measurements were done later in the season. In 2004 and 2005 there was almost no trace of Pacific fresh water in the East Greenland Current.

2D-100-I3.4 ID:2944 15:30

Influence of stationary wave field on stratosphere-troposphere coupling response to idealized Eurasian snow forcing

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Observational studies indicate that the correlation between autumnal snow cover anomalies over Eurasia and wintertime circulation anomalies projects significantly onto the Northern Annular Mode (NAM). Years in which there is anomalously high Eurasian snow cover in autumn correlate with the negative phase of the wintertime NAM pointing to the potential utility of snow cover data as a seasonal forecasting tool. Forced general circulation model (GCM) experiments reveal that a large autumnal Eurasian snow forcing generates a stratosphere-troposphere coupling response that propagates down to the surface within several weeks. Contrastingly, this response is not found in unforced GCM runs with seasonally varying snow cover. Potential dynamical reasons for this discrepancy are probed by imposing an idealized snow forcing in a relatively simple dry, hydrostatic, primitive equation GCM. Within the first few days of applying a surface cooling over Eurasia, a surface high and a mid-tropospheric low develop in accordance with the expected direct response to surface cooling. Over several weeks, the forcing generates a weak, positive NAM response, opposite to the negative NAM response to high snow cover anomalies shown in observations. A decomposition of the meridional eddy heatflux response over the first several weeks indicates that the nonlinear contribution produces a positive response in the stratosphere, consistent with an increase in vertical propagation of wave activity; however, large cancellations with the linear terms, i.e. terms that include correlations with the background stationary wave field, yield an overall negative meridional eddy heatflux response to the surface cooling. Negative correlations with the stationary wave field result in a response that is vertically trapped suggesting that the response is localized to the forcing region and that accurate representation of the stationary wave field is likely a critical factor in developing a large-scale response to a Eurasian snow forcing.

2D-100-I3.5 ID:2973 15:30

Coupled hydrologic-land-surface modelling for predicting freshwater flux to the arctic ocean

Bruce Davison [1], *Anthony Liu* [1], *Frank Seglenieks* [2], *Brenda Toth* [1]
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The Hydrometeorology and Arctic Laboratory (HAL) of Environment Canada in Saskatoon and Edmonton is a research and development lab dedicated to the improvement of water cycle prediction models and the appropriate use of their simulations. We work in collaboration with environmental scientists, project managers and computer specialists to develop and test experimental versions of numerical weather prediction, land-surface and hydrologic models. The presentation will provide a progress report of the work introduced last year and emphasize how our work will be applied

within the context of the International Polar Year.

2D-100-I3.6 ID:3009 15:30

Cross-shelf exchange in the Arctic Ocean

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A IPY-GEOTRACES program has been set up by several Canadian laboratories to investigate the impact of climate change on the nutrient and carbon cycles in the Arctic Ocean using a multi-tracer approach. A cruise is expected to take place in the summer of 2009 in the Beaufort Sea, on the CCGS Amundsen research icebreaker. As part of the GEOTRACES program, our goal is to investigate the controls of air-sea fluxes of CO2 by physical transport and biological processes. The uptake of carbon from the atmosphere, or release from the ocean, is controlled by the gradient of the carbon dioxide partial pressure (pCO2) between the two reservoirs, as well as by climatological factors such as wind speed and ice cover, and by the nature of the air-sea boundary microlayer. In the Arctic, how all these factors combine to limit or enhance air-sea CO2 exchange is poorly understood because the coupling of physical transport processes (convection, stratification, ice cover) and biological processes (CO2 uptake and remineralization) is poorly known. In particular, it is not known whether the receding ice cover in the Arctic Ocean will result in a net source or sink of CO2 to the atmosphere, nor whether the increased discharge of Mackenzie River waters and input of nutrients to the Beaufort Sea will result in increased productivity and a drawdown of mixed layer pCO2 or the input of terrestrial organic matter from the river will sustain greater heterotrophy and lead to metabolic CO2 production. Our work will focus on shelf-open ocean exchange, while colleagues will study vertical transport and in situ biological processes. More specifically, we will evaluate the cross-shelf (lateral) carbon fluxes along two selected transects using radioisotopes techniques. The proposed measurements will allow us to identify the feedbacks of global warming on polar CO2 exchange in the Beaufort Sea as well as estimate the amount of CO2 transferred below the mixed-layer by convective processes and respiration of organic matter exported from the surface to the deep waters.

2D-100-I3.7 ID:3075 15:30

Forecasting intercontinental transport of pollution into the Canadian High Arctic using a Langrangian particle dispersion model.

Richard Damoah [1], *Asan Bacak* [1], *Thomas Kuhn* [2], *James Sloan* [1]
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A forecast system has been developed to interpret measurements at the Polar Environment Atmospheric Research Laboratory (PEARL). PEARL is located in the Canadian Arctic at 610 m above sea level on Ellesmere Island (80oN, 86oW). We have used trajectory and particle dispersion models FLEXTRA and FLEXPART to construct

10-day backward trajectories starting from PEARL and 5-day emission tracer transport forecasts. FLEXPART is a Lagrangian particle dispersion model that simulates the long-range transport, diffusion, dry and wet deposition, and radioactive decay of tracers released from point, line, area or volume sources. FLEXPART was originally developed to simulate the dispersion of dangerous substances from point sources (Stohl et al., 1998), however, it has been used for many other purposes, including studies of intercontinental transport (Damoah et al, 2004), pyro-convection (Damoah et al., 2006) and as a forecast and analysis tool for flight planning (Forster et al., 2004).

For the emission tracer forecasts we have used as emission basis the EDGAR version 3.2 inventory for the year 2000 with a resolution of 1x1 degree, except for most of North America where the inventory of Forst and McKeen (2004) was used. Tracer masses are carried by particles following trajectories calculated using GFS winds from NCEP and stochastic components for turbulence and convection. Tracer forecasts are run separately for anthropogenic emissions from Europe, Asia and North America and their transport to PEARL monitored. Currently, we produce total column of carbon monoxide (CO) tracer; nitrogen oxides (expressed as NO2), and sulfur dioxide (including direct emissions of sulfate) can be included. The species are run as passive tracers for 20 days, after which tracer particles are dropped from the simulation. Using this system, back trajectories from PEARL will be generated to explore possible origins for pollutants that arrive during selected short episodes.

POSTERS Climate Variability and Marine Ecosystems / Le climat et les écosystèmes marins

Room / Endroit (100), Chair / Président (Catherine Johnson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I4.1 ID:2757 15:30

Spatial and temporal distributions of dissolved organic matter and carbon monoxide in Arctic first-year sea ice

Huixiang Xie , *Yong Zhang* , *Cyril Aubry* , *Michel Gosselin* , *Benoit Philippe* , *C. J. Mundy* , *Xiaomeng Wang*
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We investigated the spatial and temporal distributions of dissolved organic carbon (DOC), chromophoric dissolved organic matter (CDOM), and carbon monoxide (CO) in first-year sea ice in the southeastern Beaufort Sea from late winter to early summer 2008. DOC, CDOM, and CO in the bottom sea ice followed the evolution of ice algae and were enormously enriched relative to the overlying ice and the underlying seawater during the ice algae bloom. Bottom-ice chlorophyll *a* (chl *a*), DOC, CDOM, and CO during the bloom were higher in landfast ice than in drifting ice. CO significantly correlated with chl *a*, DOC, and CDOM in bottom sea ice but only weakly related to these variables for the whole ice column. Solar-simulated irradiations demonstrated efficient CO photoproduction in sea ice, particularly in the DOM-enriched bottom sea ice. This study suggests that ice algae-associated biological processes are responsible for DOM production in sea ice while both biological and photochemical processes may play important roles in sea-ice CO formation. The accumulation of DOM and CO within sea ice in spring may serve as potentially significant sources of these constituents to seawater, and, in case of CO, to the atmosphere as well, when ice melts in summer.

2D-100-I4.2 ID:2734 15:30

Ice-algae modeling in the Canadian Arctic Archipelago

Lynn Pogson [1], *Bruno Tremblay* [1], *Diane Lavoie* [2], *Christine Michel* [2], *Martin Vancoppenolle* [3]
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Sea ice ecosystems play a key role in carbon cycling in the Arctic, and thus can have an impact on climate. Microalgae, represented mostly as diatoms, are important lifeforms in the ice and are the focus of this model study. We investigate the relationships between nutrient and light availability with algal growth using a one-dimensional sea ice model. The sea ice model component is the Huwald multilayer sigma-coordinate thermodynamic model, which is a more complex snow-ice model than what has been used in past Arctic ice-algal model studies. Because of the coordinate transformation and relayering of snow and ice that the model employs, this coupled ice-algae model also has potential in the future for modeling microalgae being advected upward and growing higher in the ice matrix, as observed in the Central Arctic. To start we have followed past studies in the Arctic focusing on biomass accumulation at the bottom of landfast ice. The region of interest is the Canadian Archipelago, and results are compared with data from May to July 2002 at a station near Resolute in Barrow Strait. Results are consistent with previous studies modeling this area, showing a limitation of light for algal growth at the beginning of the bloom, followed by fluctuations between light and nutrient limitation, and finally nutrient limitation as the bloom declines. An advection term in this model used to take into account movement between ice layers naturally handles the expulsion of algae during ice melt, and the loss in biomass triggered by melt at the base is more accurately simulated with this model than in past studies.

2D-100-I4.3 ID:2883 15:30

Mesocosm-simulated effects of increasing temperature and ultraviolet-B radiation on the CO2 system in sub-Arctic coastal water

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A mesocosm experiment was conducted in Rimouski, Canada in August 2008 using local coastal water to study the effects of increasing water temperature and ultraviolet-B radiation (UVBR, 280-320 nm) on the CO2 system in sub-Arctic coastal water. Four treatments in duplicate were performed: natural temperature and natural UVB (NT + NUVB, i.e. the control), enhanced UVB (+UVB), increased water temperature (~3°C higher than NT) (+T), and both increased T and enhanced UVB (+T+UVB). Water in each mesocosm was continuously mixed. Samples were taken daily over the 10-day incubation period for determinations of dissolved inorganic carbon (DIC), pH, chlorophyll a (chl-a), and bacteria abundance. The fugacity of CO2 (fCO2) was calculated from DIC and pH. In all treatments DIC and fCO2 decreased and pH increased over the whole incubation period but at greater rates during the bloom. Time-weighted net losses of DIC (ΔDIC) and fCO2 (ΔfCO2) were calculated for the bloom and the whole incubation periods, respectively. In both periods the highest ΔDIC occurred in the +T treatment sequentially followed by the control, the +T+UVB, and the +UVB. ΔfCO2 in various treatments for the bloom period showed the same sequence as ΔDIC. However, for the whole incubation period ΔfCO2 in the control was higher than in the +T treatment, implying that an increase in fCO2 due to higher temperature in the +T treatment overtook the decrease in fCO2 caused by temperature-enhanced biological DIC drawdown during pre- and post-bloom. ΔfCO2 in descending order follows: control > +T (10 % lower than the control) > +UVB (12% lower) > +T+UVB (16 % lower). This study suggests that climatic warming and increasing UVBR tend to diminish the capability of sub-Arctic seawater to sequester atmospheric CO2.

2D-100-I4.4 ID:2911 **15:30**

Sinking export of organic material in the eastern Beaufort Sea during summer 2008.

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Global warming affects polar region first and foremost, with consequences for the Arctic ecosystem in its entirety, including the physical, chemical and biological environments. The study of the sinking export of organic material is of crucial importance to understanding the biological pump, and impacts of climate change on the drawdown of atmospheric carbon in Arctic marine environments. This investigation was conducted under the Framework of the International Polar Year, Circumpolar Flaw Lead (CFL) system study. Short-term (7-24 h) particle interceptor traps were deployed at 2-3 depths (50, 100 and 150m) on 14 occasions in the eastern Beaufort Sea and Amundsen Gulf, from 10 June to 30 July 2008. Here, we present sinking fluxes of pigments (chlorophyll a and pheopigments), total particulate carbon, particulate organic nitrogen and fecal pellets. Chlorophyll a and pheopigments sinking fluxes ranged from < 0.1 to 3.9 mg m-2 d-1 and < 0.1to 10.6 mg m-2 d-1, respectively. The highest chlorophyll a and pheopigments sinking fluxes were recorded on the eastern side of the Amundsen Gulf and offshore

Cape Bathurst. Pheopigments made up a high proportion of the total pigment sinking fluxes (average = 73.6 ± 10.4%) throughout the study area. These preliminary results indicate that a large fraction of the sinking carbon was exported in the form of fecal pellets in the Canadian Beaufort Sea, during summer 2008.

2D-100-I4.5 ID:2908 **15:30**

Environmental control of continental shelf zooplankton communities

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Continental shelf zooplankton communities in the northwest Atlantic reflect a mixture of indigenous shelf species and transient species transported onto the shelf from upstream and continental slope waters. These communities exhibit both cross-shelf and along-shelf gradients, as well as strong seasonal variability in abundance, biomass, and community composition, driven both by the physiological and life history responses of individual species to their physical and biological environment and by physical transport. Data collected on the Scotian Shelf since 1999 by the Atlantic Zone Monitoring Programme were used to identify the dominant environmental factors contributing to zooplankton community variability. These relationships will be used to evaluate the factors driving interannual changes in the zooplankton community on the shelf.

POSTERS Physical-Biological Interactions in the Ocean / Interactions physiques et biologiques dans l'océan

Room / Endroit (100), Chair / Président (Tetjana Ross), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I5.1 ID:2931 **15:30**

Net impact of subtropical cyclonic eddies on regional air-sea CO2 fluxes: CO2 sink or source?

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By comparing the impact of two cyclonic eddies on sea surface pCO2 and air-sea CO2 exchange in the lee of the main Hawaiian Islands in the subtropical North Pacific Gyre, this study confirmed that sea surface pCO2 within the cyclonic eddies is a combined result of upwelling, warming, and biological uptake. Overall, sea surface pCO2 within the eddy core is much higher than the expected values deduced from the sea surface

pCO2-SST relationship at stations without the influence of eddies. Therefore, subtropical cyclonic eddies serve as a net CO2 source to the atmosphere. The magnitude of this net CO2 release closely follows the magnitude of expected increase in SST within the eddy center, which is determined by the seasonal heat budget in the mixed layer. This SST increase generally reaches its maximum in summer and minimum in winter. Therefore, with the temporal evolution of a cyclonic eddy, more significant surface warming will also increase sea surface pCO2 and cause more CO2 release.

2D-100-I5.2 ID:2835 15:30

Prochlorococcus marinus as a source of marine methyl iodide (CH_3I)

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Contact:

The ocean is the dominant source of atmospheric methyl iodide (CH_3I) which, through photolytic release of iodine, plays a significant role in stratospheric ozone destruction. The mechanisms of CH_3I production in the marine environment are poorly understood. A previous laboratory and field study suggested *Prochlorococcus marinus*, a ubiquitous marine cyanobacterium, is a globally significant biological producer of CH_3I (*Smythe-Wright et al.,* 2006, *Global Biogeochem. Cycles, 20*). In this study, CH_3I concentrations were measured in cultures of *P. marinus* (MED4) and *Synechococcus*. Cell-normalized production rates in *P. marinus* cultures ranged from 2 to 5 molecules of CH_3I cell^{-1} d^{-1}; these rates were 1000 fold lower than production rates reported for the previous study. Extrapolating CH_3I production rates from the current study yields a global production rate of 0.7 Gg yr^{-1} which accounts for 0.6% of the estimated global CH_3I production, suggesting *P. marinus* is not a globally significant source of CH_3I.

2D-100-I5.3 ID:2897 15:30

Parameter Optimization of a Two-Layered Diagenetic Model Through Variational Data Assimilation

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Regional ocean circulation models coupled with biological or biogeochemical routines are instrumental in studying continental shelf and coastal ocean processes, where benthic-pelagic coupling is pronounced, and a significant proportion of nutrient remineralization occurs in the sediment. While coupled models typically use highly simplified linear parameterizations of benthic processes, benthic remineralization pathways are known to vary non-linearly under changing environmental conditions, for example as bottom-water oxygen concentrations approach hypoxia and anoxia. Our objective is to explore the use of a more sophisticated model of benthic elemental cycling (a so-called diagenetic model) for coupling with a biogeochemical circulation model. As is the case for biological and biogeochemical models, diagenetic models require the appropriate tuning of their parameters, many of which are model-specific, and poorly quantified. This can be accomplished by parameter optimization through variational data assimilation – a tuning process by which a model's output is fitted to observed data through the methodic manipulation of the model parameters. We use this technique to optimize the parameters of the Sediment Flux Model (the diagenetic model component in RCA; http://www.hydroqual.com/wr_rca.html) using sediment flux observations made during mesocosm experiments. Once a well-parameterized Sediment Flux Model is coupled to regional implementations of RCA we may be better able to quantify exchange fluxes across the sediment-water interface under varying environmental conditions.

2D-100-I5.4 ID:2948 15:30

Life on VENUS: Characterizing the benthic larval community at depth in Saanich Inlet.

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We are using the Victoria Experimental Network Under the Sea (VENUS) observatory to measure larval supply, settlement, and recruitment of benthic marine invertebrates, employing both high frequency monitoring and responsive sampling. Instruments deployed at 97 m on the hypoxic seabed of Saanich Inlet, British Columbia, continuously monitor environmental parameters, such as temperature, salinity, and dissolved oxygen. We used remotely activated sediment traps to sample larval supply near the benthos and high-resolution still camera shots to monitor larval settlement on substrates with the same planar surface but different complexity (tiles and sponges). Sampling occurred at weekly to biweekly intervals between February 2008 and February 2009. The settlement substrates were retrieved and replaced in September 2008 and February 2009. Preliminary results indicate that settlement is greater on the complex than the simpler substrates. Tube building larvae settled amongst the sponge fibres, while free-living larvae occurred on the surface. No settlers were found on the smooth tiles. Recruits of the squat lobster Munida quadrispina coincided with reduced oxygen levels (0.1 – 0.8 mg L-1) and disappeared when oxygen levels rose to 2 mg L-1. These results suggest that some species can tolerate, perhaps even thrive in, the low oxygen levels at Saanich Inlet and that recruitment patterns may be closely tied to fluctuations in oxygen, the most variable environmental factor at depth.

2D-100-I5.5 ID:3092 15:30

Oceanographic Setting and Variability of Orphan Knoll

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Orphan Knoll is a seamount which rises to 1800 m at the outer edge of Orphan Basin off the Northeast Newfoundland Shelf. It is located in the equatorward western boundary flow of the North Atlantic's subpolar gyre, and also within 100km of the subtropical

North Atlantic Current's meander towards the Labrador Sea. As a result, there are competing influences on its oceanography from these contrasting large-scale current systems, and from its local topography. Fisheries and Oceans Canada is investigating the degrees of connectivity with, and isolation from, similar marine habitats in the NW Atlantic, for input to international governance decisions. Initial results will be presented, based on a dedicated physical-chemical-biological survey of the Knoll in May 2008, hydrographic sections across Orphan Basin extending to Orphan Knoll in 2004-07, and other available data. The latter include temperature-salinity profiles and drift trajectories from Argo floats, and satellite altimetry, ocean colour and surface temperature datasets. The results suggest strong connectivity with waters exiting the Labrador Sea, a tendency for clockwise circulation around the Knoll, and some degree of enhanced retention.

2D-100-I5.6 ID:3081 **15:30**

Solid phase microextraction (SPME) methods for the determination of trace aldehydes and ketones in seawater and ambient air

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Volatile carbonyl compounds (aldehydes and ketones) in surface waters, air and snow are of interest due to being products of dissolved organic matter photochemistry (and thus a sink of dissolved organic matter) or of biological activity, and affecting oxidative processes in the troposphere. Our understanding of their role in these environmental compartments would be facilitated by methods allowing their routine determination in seawater. We here report facile, low-cost, portable methods for C1 - C9 carbonyl compounds in seawater and ambient air, based on derivatization of carbonyl compounds to their pentafluorobenzyl oximes followed by solid phase microextraction (SPME) and gas chromatography (GC). We have achieved low nanomolar or sub-nanomolar detection limits. The method's optimization and application to selected air and surface seawater samples is presented.

POSTERS Numerical Modelling for Research / Modélisation numérique pour la recherche

Room / Endroit (100), Chair / Président (Ronald J. McTaggart-Cowan), Date (02/06/2009), Time / Heure (15:30 - 17:00)

POSTERS Remote Sensing of the Atmosphere and Ocean / Télédétection de l'atmosphère et de l'océan

Room / Endroit (100), Chair / Président (Norman O'Neill and Rong-Ming Hu), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I7.1 ID:2778 **15:30**

A 7-year midlatitude climatology of stratospheric temperature using vibrational-RAMAN LIDAR

Blessing Iserhienrhien [1], *Robert Sica* [2], *Steve Argall* [3]
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The Purple Crow Lidar (PCL) is a large power-aperture product monostatic laser radar located at the Delaware Observatory (42° 52 N, 81° 23' W, 225 m elevation above sea level) near the campus of The University of Western Ontario. It is capable of measuring temperature and wave parameters from 10 to 110 km altitude, as well as water vapor in the troposphere and stratosphere. We use upper tropospheric and stratospheric vibrational Raman N2 backscatter-derived temperatures to form a climatology for the years 1999 to 2007 from 10 to 30 km altitude. The lidar temperatures are validated using coincident radiosondes measurements from Detroit and Buffalo. The measured temperatures show good agreement with the radiosonde soundings. An agreement of ±1 K is found during summer months and ±2.5 K during the winter months, validating the calibration of the lidar to within the geophysical variability of the measurements. Comparison between the PCL measurements and atmospheric models shows the PCL measurements are 5 K or less colder than CIRA-86 below 25 km and 2.5 K warmer above during the summer months. Below 16 km the PCL measurements are 5 K or less colder than the MSIS-90 model, while above this region, the PCL agrees to about ±3.5 K or less. The temperature differences between the PCL measurements and the models are consistent with the differences between the atmospheric models and the Detroit and Buffalo radiosonde measurements. The temperature differences compared to the models are consistent with previous comparisons between other radiosondes and satellite data sets, confirming that these differences with the models are real.

2D-100-I7.2 ID:3001 **15:30**

Temperature and water vapour retrievals from the newly commissioned RMR lidar in Eureka Nunavut.

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The Canadian Network for the Detection of Atmospheric Change (CANDAC), a collaboration between several universities and government organizations, has established a suite of instruments in Eureka, Nunavut, Canada (79°59'N, 85°56'W). As part of this network, Dalhousie University's Rayleigh-Mie-Raman lidar has been installed at the sea-level atmospheric laboratory, (ØPAL). Three optical scattering mechanisms are used to profile water vapour in the troposphere and aerosols, clouds and temperature from near-ground to the lower-mesosphere. These measurements will form a long term dataset essential to studying the thermodynamic and radiative environments in the high Arctic. Since the commissioning of the lidar in December 2008, significant work has been undertaken to optimize data collection and calibrate the temperature and water vapour retrievals. Radiosondes launched on-site twice daily are used for calibration of each measurement and also allow monitoring any change in instrument response over the longer term. The calibration and associated confidence for different vertical and temporal resolutions will be presented and the effect of different atmospheric conditions on the retrieval discussed. Finally, preliminary analysis of a selected case from the winter campaign will be presented and discussed.

2D-100-I7.3 ID:3073 15:30

Temperature and Ozone Observed by MIPAS/ENVISAT and MLS/AURA: The Global Atmospheric Tides and Comparisons with Model Results

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MIPAS/ENVISAT and MLS/AURA measure the stratospheric and mesospheric temperature and ozone distributions with nearly pole-to-pole coverage by using limb-viewing infrared emissions and microwaves, respectively. The two satellite instruments are launched on 1 March 2002 and 15 July 2004, in the same sun-synchronous orbit plane (98° inclinations) with a 10:00 AM and 1:45 PM equator crossing time, respectively. A climatology of monthly mean temperatures and ozone mixing ratios are derived from the satellite data. The satellite-measured temperatures are compared with those of the CMAM and other models. In particular, studies of the atmospheric tides at the high latitude are stressed, since the two data sets combined together provide a daily coverage of four local times for Polar latitudes and can be used to derive tidal signatures better than those from the measurements of a single satellite. The aliasing issue of asynoptic satellite sampling will be discussed in detail through the simulation of satellite flights through the CMAM model atmosphere.

2D-100-I7.4 ID:2971 15:30

Stratospheric Aerosols from the 2008 Kasatochi Eruption Observed over Halifax,

Nova Scotia

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Kasatochi volcano, located in the Central Aleutian Islands of Alaska (52.17 N, 175.51 W), erupted explosively on 7-8 August 2008 and injected material into the lower stratosphere producing a long-lived stratospheric aerosol layer in the Northern Hemisphere. These volcanic aerosols have been detected by the Dalhousie Raman Lidar situated in Halifax, Nova Scotia (44.64 N, 63.59 W) and observed for weeks following the eruption. Beginning in mid-August, anomalous increases of aerosol extinction were detected in the lower stratosphere whenever clear skies were available, varying in intensity and vertical extent. The lidar measurements reveal the vertical structure, optical characteristics, and temporal evolution of the Kasatochi aerosols. A new high- altitude receiver has been added to the lidar system and is being used to enhance investigation of the Kasatochi plume. An overview of the lidar observations is presented.

2D-100-I7.5 ID:2950 15:30

Comparison of global ACE-FTS observations in the upper troposphere and GEM-AQ simulations

John Mcconnell [1], *Alex Lupu* [1], *Jacek Kaminski* [1], *Kenjiro Toyoto* [1], *Curtis Rinsland* [2], *Peter Bernath* [3], *Kaley Walker* [4], *Chris Boone* [5], *Yy Nagahama* [6], *K. K. Suzuki* [6]
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Hydrogen cyanide (HCN) is a minor constituent of the atmosphere emitted primarily from biomass burning. In the troposphere, it is lost mainly by ocean uptake presumably through biological activity, with a small loss by reaction with OH. We investigate the spatial and temporal distribution of HCN in the upper troposphere through numerical simulations. We compare with HCN observations from a space-based instrument. The simulations were performed with the Global Environmental Multiscale Air Quality model (GEM-AQ), a global, tropospheric chemistry, general circulation model based on the global multi-scale model developed by the Meteorological Service of Canada for operational weather forecasting. Fire emission fluxes of HCN were generated by using year-specific inventories of carbon emissions with 8-day temporal resolution from the Global Fire Emission Database (GFED) version 2. The model output is compared with HCN profiles measured by the Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS) instrument onboard the Canadian SCISAT-1 satellite.

2D-100-I7.6 ID:2960 15:30

Comparison of CMAM simulations of carbon monoxide (CO), nitrous oxide (N_2O),

and methane (CH_4) with observations from Odin/SMR, ACE-FTS, and Aura/MLS

Jianjun Jin [1], *Kirill Semeniuk* [1], *Stephen Beagley* [1], *Victor Fomichev* [1], *Andreas Jonsson* [2], *John Mcconnell* [1], *Joachim Urban* [3], *Donal Murtagh* [3], *Gloria Manney* [4], *Chris Boone* [5], *Peter Bernath* [6], *Ace And Smr Team* [7]

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Simulations of CO, N_2O and CH_4 from a coupled chemistry-climate model (CMAM) are compared with satellite measurements from Odin Sub-Millimeter Radiometer (Odin/SMR), Atmospheric Chemistry Experiment Fourier Transform Spectrometer (ACE-FTS), and Aura Microwave Limb Sounder (Aura/MLS). Pressure-latitude cross-sections and seasonal time series demonstrate that CMAM reproduces the observed global CO, N_2O, and CH_4 distributions quite well. Differences between the simulations and the ACE-FTS observations are generally within 30%, and the differences between CMAM results and SMR and MLS observations are slightly larger. These differences are comparable with the difference between the instruments in the upper stratosphere and mesosphere. Comparisons of N_2O show that CMAM results are usually within 15% of the measurements in the lower and middle stratosphere, and the observations are close to each other. However, the standard version of CMAM has a low N_2O bias in the upper stratosphere. The CMAM CH_4 distribution also reproduces the observations in the lower stratosphere, but has a similar but smaller negative bias in the upper stratosphere. The simulated polar CO evolution in the Arctic and Antarctic agree with the ACE and MLS observations. CO measurements from 2006 show evidence of enhanced descent of air from the mesosphere into the stratosphere in the Arctic after strong stratospheric sudden warmings (SSWs). CMAM also shows strong descent of air after SSWs. In the tropics, CMAM captures the annual oscillation in the lower stratosphere and the semiannual oscillations at the stratopause and mesopause seen in Aura/MLS CO and N2O observations and in Odin/SMR N_2O observations. The Odin/SMR and Aura/MLS N_2O observations also show a quasi-biennial oscillation (QBO) in the upper stratosphere, whereas, the CMAM does not have QBO included. This study confirms that CMAM is able to simulate middle atmospheric transport processes reasonably well.

2D-100-I7.7 ID:3017 15:30

First Global Observations of Groundstate CO_2 in the Mesosphere and Lower Thermosphere by ACE-FTS and Analysis Using CMAM Model

Stephen Beagley [1], *Chris Boone* [2], *Victor Fomichev* [1], *Jianjun Jin* [1], *Kirill Semeniuk* [1], *John Mcconnell* [1], *Peter Bernath* [3], *Kaley Walker* [4]

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The first global set of observations of the ground state CO_2 in the mesosphere and lower thermosphere (MLT) are obtained by the ACE-FTS instrument on SCISAT-I, a small Canadian satellite launched in 2003. The observations use the solar occultation technique and document the fall off in the mixing ratio of CO_2 in the MLT region. The beginning of the fall off of the CO_2, or “knee” occurs about 78 km and lies higher than in the CRISTA measurements (~72 km) but lower than in the SABER 1.06 (~ 82 km) and the rocket measurements. We have compared the ACE-FTS CO_2 and CO measurements with the simulations from the vertically extended version of the Canadian Middle Atmosphere model (CMAM). Applying standard chemistry we find that we cannot get an agreement between the model results and ACE CO_2 observations although the CO observations are adequately reproduced. There appears to be about a 10 km offset compared to the observed ACE CO_2, with the model knee occurring too high. In analysing the disagreement, we have investigated the variation of several parameters of interest, photolysis rates, formation rate for CO_2, and the impact of uncertainty in eddy diffusion. Our conclusions are that there must be a loss process for CO_2, about 2-4 times faster than photolysis that will sequester the carbon in some form other than CO and we have speculated on the role of meteoritic dust as a possible candidate. In addition, from this study we have highlighted a possible important role for vertical eddy diffusion in 3D models in determining the distribution of candidate species in the mesosphere which requires further study.

2D-100-I7.8 ID:3049 15:30

Characterisation and optimisation of the new CANDAC Raman lidar for lower atmospheric measurements

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Dalhousie University has recently completed the installation of the Canadian Network for the Detection of Atmospheric Change (CANDAC) Raman Lidar at Eureka, NU (79°59'N, 85°56'W). This seven-channel lidar uses both ultraviolet and visible radiation to measure aerosols and clouds, water vapour, and temperature profiles from the ground into the stratosphere and mesosphere. This system will allow investigations into both gravity wave propagation and into the important role of water in the radiation budget. The system is housed in a container laboratory at the sea-level facility of ØPAL and is co-located with radars, other lidars, an interferometer, and microwave radiometer allowing exceptional multi-instrument measurements of the Arctic atmosphere to be made.

Over the Arctic winter the system has been optimised and characterised and this paper will present this work with an emphasis on measurements in the lower atmosphere. Low-altitude measurements present a significant challenge to lidars, particularly when measuring temperature. This system was designed to address these challenges and also allow measurements over the full diurnal cycle. Characterisation and assessment of these

features will be presented. The determination of relative humidity requires tropospheric temperature and water vapour and the optimisation of the system for these difficult measurements will also be discussed.

POSTERS Water, Weather and Climate Serving the Energy Sector / Eau, temps et climat servant le secteur énergétique

Room / Endroit (100), Chair / Président (Anne-Marie Valton), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I8.1 ID:2756 **15:30**

Facilitating Effective Co-existance of Wind Turbine Development and Weather Radars

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Environment Canada is a strong supporter of alternative energy sources, including the development of large capacity wind farms. However, wind farm development can pose an unusual risk to the quality of radar data since the windfarms present large targets that cannot be filtered out of the data display at this time. Doppler filters are used to eliminate clutter (weather 'moves', clutter doesn't) to allow forecasters to clearly see the desired targets. Because wind turbines display movement to the radars, they cannot be filtered.

Another complication we are finding is that many of our radars are located in areas of interest for large-scale wind farm development. Many of the conditions favourable for wind energy are also desirable for weather radar placement (relatively high elevation, reasonably remote, but close to power and communications infrastructure). Development close to a radar can create significant beam blockage and scatter. This results in blockage or contamination of all data along the affected azimuth angles, even behind the wind farm.

For the past few years, Environment Canada's radar program has been working with wind energy proponents on a voluntary basis to help locate and design wind farm layouts that will not significantly impact the quality of the radar data required by forecasters.

While beam blockage will always be insurmountable, in future there may be other ways to filter the effects of more distant wind farms out of the radar data. In the meantime ongoing consultation and cooperation has been quite successful.

POSTERS Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS) / Réseau Opérationnel Canadien des Systèmes Couplés de Prévisions Environnementales. (ROCSCPE)

Room / Endroit (100), Chair / Président (C. Harold Ritchie), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I9.1 ID:3050 **15:30**

Validation of the Canadian-Newfoundland Operational Oceanographic Forecasting System

Andry Ratsimandresy , *Debbie Anne Power* , *Fraser Davidson* , *Greg Smith* , *Adam Lundrigan*
(Presented by *Fraser Davidson*)
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To demonstrate the potential benefits of an extended Canadian operational oceanographic capability a pilot project has been into place for the North West Atlantic Ocean entitled the Canada-Newfoundland Operational Ocean Forecast System (C-NOOFS). This poster focuses on the validation of the C-NOOFS with in-situ and remotely sensed systems as well as the presentation of forecast results on www.c-noofs.gc.ca.

POSTERS Weather and Social Science / La météo et la science sociale

Room / Endroit (100), Chair / Président (Rebecca J. Wagner Hochban), Date (02/06/2009), Time / Heure (15:30 - 17:00)

POSTERS Military Meteorology and Oceanography / Météorologie et océanographie militaire

Room / Endroit (100), Chair / Président (Martha Anderson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I11.1 ID:3118 15:30

The Joint Meteorological Centre – a new DND/CF and Environment Canada Initiative

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The Canadian Forces (CF) are required to be able to sustain a number of global deployed operations concurrently as well as the defence of Canada and North America. Weather and oceanographic services are essential to successful military operations. The new Joint Meteorological Centre at CFB Gagetown, NB will create a new team to meet changing and growing military requirements in the 21st century, while making the best use of modern network technologies and numerical weather prediction. The new weather support team will consist of CF Meteorological Technicians and Environment Canada (EC) meteorologists, supported by EC computer science specialists.

This poster will provide an overview of new and emerging military weather support requirements, as well as an understanding of the plan to reach the full operational capability of the Joint Met Centre in late 2012.

POSTERS Global Atmosphere-Ocean Prediction and Predictability / La Prévision et la prévisibilité globale de l'atmosphère-océan

Room / Endroit (100), Chair / Président (Keith R. Thompson), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I14.1 ID:2932 15:30

Nonlinear Post-Processing of Dynamical Seasonal Climate Forecasts

Joel Finnis [1], *William Hsieh* [2], *Hai Lin* [3], *William Merryfield* [4]
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General circulation models (GCMs) are commonly used to issue operational seasonal climate forecasts. Unfortunately, the skill in forecasting extratropical seasonal climate remains modest. Upgrades to these forecast systems typically involve increasing model resolution,model complexity, or the size of the forecast ensemble. Instead, we explore processing the raw model forecasts with computationally efficient machine learning techniques to increase forecast skill. By connecting GCM climate forecasts with observed outcomes, regression-based post-processing may correct model biases and separate forced signals from model drift. Machine learning approaches to regression offer several advantages over classical statistical methods in this situation, including nonlinear capabilities and robustness. Here, machine learning based post-processing is applied to ocean and atmosphere forecasts generated by a coupled (atmosphere-ocean) GCM. Results are compared against raw GCM forecasts, forecasts processed with multiple linear regression, and forecasts generated with an uncoupled (atmosphere-only) GCM.

2D-100-I14.2 ID:2733 15:30

Simulation of the Mixed-Layer Depth in the North East Pacific

Shawn M. Donohue , *Michael W. Stacey* , *Jennifer Shore*
(Presented by *Shawn Donohue*)
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A 46 year simulation (1960-2006), using the Parallel Ocean Program, of the circulation of the Northeast Pacific (NEP) is used to study the properties of the mixed layer depth (MLD). Spectral nudging is used to prevent model drift from Levitus climatology. The horizontal resolution of the model is 0.25 degrees, and there are 28 unequally spaced vertical levels. The vertical grid spacing in the upper 150 m is 10 m. The model is forced by monthly NCEP windstress, surface heatflux, freshwater flux, and surface pressure. The implementation of spectral nudging greatly improved the simulations. The filter is shown to properly maintain the longterm mean temperature, salinity fields.

The winter MLD is defined as being the depth where sigma-t is 0.1 greater than the surface value. The forcing mechanism for the interannual MLD variability from 1998-2004 was the windstress associated with the Victoria Mode (PDO mode 2) of the Pacific Decadal Oscillation (PDO). Simulated MLD trend maps indicate significant shallowing until 2003 in the Gulf of Alaska (GOA), particularly along the coast, with larger rates in the northern GOA. The rate of shallowing is similar to that found in past studies, and is consistent with the observed freshening and warming of the upper waters in the GOA and along the coast. The simulated low frequency MLD variability is also found to be in good agreement with the available observations.

The observed strong variability and shallowing of the MLD in 2003 and subsequent deepening by 2006 is reproduced by the model. A significant increase in stratification in 2002 resulted in an anomalously shallow MLD in the winter/spring of 2003. Strong and relatively isolated Ekman pumping is shown to be the cause of this shallowing. A large positive salinity anomaly at depth develops along Line Papa in the autumn of 2003. Relaxation of the Ekman pumping later in the autumn and the decay of the Aleutian Low

Pressure System returns the MLD to historical levels by 2006. Evidence and arguments for a Rossby wave contribution to the 2003 shallowing and subsequent deepening are presented.

2D-100-I14.3 ID:3032 15:30

Parameter estimation for data assimilation with a coupled ocean-atmosphere system

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This project is concerned with the accurate estimation of global circulation within a coupled ocean-atmosphere model. The objective is to examine the impact of coupling the ocean to an atmospheric model on the quality of forecasts from the short to seasonal and interannual timescales. The studies of MJO, ENSO phenomenon, sea-ice interaction and even tropical cyclones also could be tackled within a coupled model framework. The application of data assimilation methods to a coupled system may be beneficial with respect to two aspects. First, data assimilation is driven by short-term forecasts from the coupled model and maintains the system trajectory close to the observations by modifying the model state according to the statistical estimation principles underlying the assimilation. As the coupled system introduces unknown parameters to represent heat, moisture and momentum surface flux exchanges between the ocean and the atmosphere, the assimilation can also use observations to estimate unknown parameters used to model these fluxes. This can be useful to improve the processes of ocean-atmosphere interaction and to reduce biases in the coupled model. A coupled ocean-atmosphere data assimilation system is currently being developed within the GOAPP research network. The atmospheric component is the 4D-Var assimilation scheme driven by the Global Environmental Model, used operationally by Environment Canada. This is coupled to the global NEMO model with its own 3D-Var data assimilation component. The coupled system is using a 6-h assimilation window. As a first step to building this system, the atmospheric 4D-Var data assimilation component is forced by ocean SST, and the turbulent transfer coefficients of heat and momentum are estimated and compared to independent estimates such as SURFA high-resolution NWP fluxes. A parameter estimation scheme is added to the 4D-Var by augmenting the state vector of the atmosphere with model parameters used in the parameterization of heat and momentum fluxes. In this presentation, results will be presented regarding the ability of the assimilation system to retrieve correctly the selected parameters from the available observations. The estimated parameters are then used in a fully coupled ocean-atmosphere system to replace traditional bulk formulation of the turbulent transfer coefficients used in the global NEMO ocean model.

POSTERS Atmosphere, Ocean and Climate Dynamics / Dynamique de l'atmosphère, de l'océan et du climat

Room / Endroit (100), Chair / Président (Robert B. Scott), Date (02/06/2009), Time / Heure (15:30 - 17:00)

2D-100-I17.1 ID:2947 **15:30**

Influence of Mesoscale Eddies on Internal Waves of Tidal Frequency

Michael Dunphy , *Kevin Lamb*
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This talk will discuss the effect of eddies on the internal tide field. The internal tide constitutes internal waves of tidal frequency and are generated by the interaction of the barotropic tide with topographic features such as ridges, seamounts and the shelf break. These waves have length scales similar to those of mesoscale eddies (50-200 km) and their interaction is a candidate for energy transfer via the non-linear terms in the governing equations. Previous work has looked at the interaction of eddies with a barotropic tide and did not find significant interaction.

Numerical experiments are performed using the general circulation model MITgcm. The internal wave field is simulated by barotropic tidal flow at semi diurnal (M2) frequency over a ridge, and eddies are prescribed by an analytical expression for density surface displacements that are in both hydrostatic and geostrophic balance. The eddies are stationed a few hundred kilometres from the topographic feature (a ridge or seamount). Preliminary results indicate that the presence of an eddy contributes a phase shift to the internal wave field beyond the eddy and results in a small (1-3%) decrease in energy flux. Since typical eddy fields observed in the ocean consist of numerous eddies, the changes in energy flux may be significant when more eddies are considered.

NSERC Town Hall Meeting / Séance de discussion publique avec CSNRG

Room / Endroit (301), Chair / Président (Norman Marcotte), Date (02/06/2009), Time / Heure (17:00 - 18:00)

2E-301.1 ID:3121 **17:00**

NSERC update on International Review and GSC Structure Review

Norman Marcotte
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NSERC had commissioned an International Review to assess the merit of its approach to supporting research in the natural sciences and engineering, and the extent to which its Discovery Grants Program fostered and supported research excellence. NSERC also undertook a review of the structure of the discipline-based Grant Selection Committees (GSCs). The GSC Structure Review Committee recommended that NSERC adopt a conference model for the review of applications to allow a much more flexible and dynamic approach to grant review. The presentation will focus on the changes that were implemented in the 2009 Discovery Grants competition and those that will be implemented for the 2010 competition.

Public Lecture / Conférence ouverte au public

Room / Endroit (Maritime Museum), Chair / Président (Stephen T. Miller), Date (02/06/2009), Time / Heure (19:30 - 20:30)

2F-MUSEUM.1 ID:2741 INVITED/INVITÉ 19:30

Canadian Hurricane Centre Reflections: Two Decades of Lessons Learned

Peter Bowyer
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For more than twenty years the Canadian Hurricane Centre (CHC) has been Canada's authoritative source of information on tropical cyclones: past, present and future. During that time there has been a great maturing of both the CHC and the people of eastern Canada in all matters relating to tropical cyclones. On the inside, we are better at observing them, understanding them, predicting them, and communicating about them. On the outside, Canadians are better at being aware of them, preparing for them, and responding to messages about them. This animated presentation will look back over 20-years of CHC enlightenment and enterprise spawned by the "lessons-learned" from 20 different tropical cyclones. The lesson-teaching storms include: Gloria (1985); "The Perfect Storm" (1991); Luis (1995); Hortense (1996); Danielle (1998); Harvey and Gert (1999); Unnamed Storm and Michael (2000); Gabrielle (2001); Gustav (2002); Isabel and Juan (2003); Alex and Frances (2004); Katrina (2005); Florence (2006); Noel (2007); Hanna and Kyle (2008).

3A-GRAND.1 ID:2760 INVITED/INVITÉ 08:30

The Atlantic Meridional Overturning Circulation: A Fluid Particle's Perspective

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The oceanic Meridional Overturning Circulation (MOC) is a global circulation pattern that redistributes heat and freshwater over the largest spatial scales. Some have argued that a significant change in the strength and/or pathways of the MOC could accompany an abrupt change in Earth's climate, especially over the continents surrounding the North Atlantic. An abundance of schematic diagrams have emerged to describe the MOC, but in the effort to develop a simplified conceptual model, our attention can be drawn away from some important features of the MOC. We will examine some recent results from Lagrangian studies of the North Atlantic using subsurface floats and simulated "e-floats" from a numerical model. Floats are an ideal tool for investigating the dominant pathways of the MOC. In one case, we will show that cold Labrador Sea Water being exported from the subpolar region follows an interior, rather than western boundary pathway through the subtropics. In another case, we will describe how topography impacts the pathways of warm shallow waters heading for the Nordic Seas, where they will be cooled and transformed into deep and intermediate waters. In both cases, the turbulent nature of the ocean circulation, and its role in the MOC, will be discussed.

3A-GRAND.2 ID:2949 INVITED/INVITÉ 09:15

Variability of climate and ocean at high northern latitudes: evidence from sedimentary archives

Anne De Vernal , *Claude Hillaire-Marcel*
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During the last millions of years, the Earth has experienced extreme climate situations. For instance, particularly warm climate conditions have been recorded during the early Holocene (about 8000 years ago) and the interglacial episodes of stages 5e and 11 of the marine isotope stratigraphy (around 125 000 and 400 000 years ago, respectively). These episodes cannot be considered as analogues of the future in a perspective of global warming because forcings were different. Nevertheless, they provide some clues on the dynamics of the ocean and ice under warmer conditions than at present and provide exclusive information about inherent variability in key parameters of the climate system acting at geological time scales. The reconstruction of climate and ocean conditions (air and sea-temperatures, sea-surface salinity, sea-ice cover, productivity, etc.) is also relevant as a means for evaluating the sensitivity of various climate parameters and testing the ability of models to reproduce climatic conditions under different stresses and boundary conditions. Based on time series from the Western Arctic and subarctic seas, we show that the "modern climate state" (i.e., the second half of the 20th century) at high latitudes of the northern Hemisphere is unique. As an example, the spatial distribution of temperature, salinity and sea-ice in the Arctic and subarctic was different than modern during the early Holocene, with significantly warmer conditions to the east, but lower salinity to the west due to higher export of Arctic sea-ice meltwater along continental margins of Greenland and eastern Canada. Sedimentary archives also show that conditions much warmer than the present ones prevailed in the northwest North Atlantic during the early Holocene and several earlier interglacial stages. They demonstrate that convection and deep/intermediate-water formation in the Labrador Sea started only about 7000 years ago, and rather seem to be an exceptional feature of the ocean thermohaline circulation. Beyond indicating distinct ocean sea-surface temperatures and circulation patterns during each interglacial stage, records show that the climate of amphi-Atlantic regions was marked by important changes. As an example, the Greenland Ice Sheet volume was probably reduced during several interglacials, notably those of stages 5e and 11, which contrasts with its relative stability during the Holocene.

Paleo-Oceanography and Paleo-Climatology / Paléo-océanographie et paléo-climatologie

Room / Endroit (202), Chair / Président (Markus Kienast), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-202.1 ID:2682 **10:30**

A re-examination of Paleocene-Eocene thermal maximum carbon emission estimates

David A. Carozza , *Lawrence A. Mysak*
(Presented by *David Carozza*)
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Near the boundary between the Paleocene and Eocene, approximately 55 million years ago, an unprecedented amount of light carbon was abruptly released into the exogenic carbon cycle. This event, known as the Paleocene-Eocene Thermal Maximum (PETM), is documented by large negative carbon isotope excursions, ranging from 2.5 to 6‰, in both oceanic and terrestrial environments, as well as by a variety of large-scale environmental changes. A number of theories, which include the dissociation of methane hydrate, formation and release of thermogenic methane, and the oxidation of terrestrial biomass, have been proposed to explain this anomalous period in the Earth's history. Based on carbon isotope records and other proxies, models have been applied to constrain the rate and amount of carbon added to the atmosphere-ocean system during the PETM and thus determine the cause of the event. However, due to differences in the types of models and proxies that may be employed, estimated emission amounts have ranged from 840 to 6800 Pg C. In this study, the Walker-Kasting box model of the global carbon cycle is revisited and, after re-evaluation of its stable carbon isotope equations, it is used to resolve some of the discrepancies between previous emission estimates. This resolution leads to an improved evaluation of the carbon source and thus the cause of the PETM. Furthermore, an intercomparison of conceptual and intermediate-complexity model

results (from GENIE, a U.K. EMIC) tests the scientific value of simpler models in the investigation of paleoclimatic perturbations of the carbon cycle.

3B-202.2 ID:3020 **10:45**

Nitrogen isotope evidence of a mid-Holocene deepening of the western equatorial Pacific thermocline ?

Markus Kienast [1], *Moritz Lehmann* [2], *Axel Timmermann* [3], *Eric Galbraith* [4], *Claire Normandeau* [1], *Carlo Laj* [5]
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Sedimentary nitrogen isotope (d15N) records from the oligotrophic western equatorial Pacific (WEP) off Mindanao show that late Holocene sedimentary d15N is substantially lower than that of the early Holocene, following a gradual >3 ‰ decrease that occurred between 7 and 3 kyrs ago. Analyses of modern day nitrate isotope profiles from the same region indicate the sensitivity of the WEP N pools towards 1) the advection of 15N-enriched nitrate from the Eastern Equatorial Pacific (EEP) by the North Equatorial Current (NEC) and the Mindanao Current in subsurface waters and, (2) at shallow depths, the input of new and 15N-depleted nitrate through N2 fixation. We suggest that the Holocene decrease in sedimentary d15N reflects a diminished relative input of 15N-enriched nitrate to the surface biota, either through an increase of regional nitrogen fixation, a change in nitrate consumption along the advective path of nitrate supply, or a decrease in the vertical supply of 15N-enriched nitrate from the NEC. The latter mechanism is consistent with a Holocene deepening of the WEP nitracline/thermocline.

3B-202.3 ID:2699 **11:00**

New dinoflagellate and isotopic evidence for Lake Agassiz drainage along the northeastern Newfoundland Shelf

Elisabeth Levac [1], *Ann A.l. Miller* [2], *C. F. Mike Lewis* [3], *Lloyd Keigwin* [4]
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[3] Geological Survey of Canada Atlantic
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The drainage of glacial Lake Agassiz could be responsible for the 8.2 ka event recorded in the Greenland Ice Sheet and tentative links with the Preboreal Oscillation have been made. Recent studies show clear evidence for drainage of large volumes of meltwater through Hudson Strait and Coriolis deflection predicts a southward flow over the Labrador shelf.Indeed, detrital carbonate (DC) beds in cores from the Labrador and Newfoundland shelves suggest that plumes of suspended DC sediment were carried

through Hudson Strait into the Labrador Current, and as far south as Grand Bank at least. We are presenting new isotopic evidence for sea surface salinity in Notre Dame Channel, over the Northeast Newfoundland Shelf, where such detrital carbonate layers were found. Oxygen isotope analysis was performed on calcareous dinoflagellate Thoracosphaera heimii from Notre Dame Channel core 87-033-19. Dinocyst assemblages support our hypothesis that the Outer Labrador Current was significantly enhanced and cooled by the dramatic outflow from Lake Agassiz. Detrital carbonate layers show increased proportions of Spiniferites elongatus and Impagidinium pallidum, indicating cooler sea surface conditions. Overall, dinocyst assemblages suggest stronger vertical stratification, and hence reduced surface salinity. Detailed reconstructions will allow us to quantify the reduction in sea-surface salinity and temperature.Detrital carbonate intervals in core 87-033-19 have been dated and correspond with known periods of meltwater flow out of Hudson Strait. We re-evaluated the correction for radiocarbon dates from the Labrador Shelf to range up to -730 years. The correction varies as pre-bomb numbers and/or ice cover duration change. Onshore-offshore correlations of dated palynological records from Newfoundland and the Newfoundland shelf are used to verify our dating scheme and to lend support to the corrections we propose. We are able to demonstrate that the 8.2 cal ka cooling can indeed be correlated with meltwater drainage from Lake Agassiz.

3B-202.4 ID:2965 11:15

Evaluation and calibration of coral Sr/Ca proxy SST records accounting for seasonal effects

Robert Scott [1], *Kristine Delong* [2]
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Proxy SST temperature records from coral reefs have the potential to provide monthly resolved time series over several decades from throughout the Tropics, and throughout the late Quaternary. Proxy records based upon stable oxygen isotope (d18O) concentrations are difficult to interpret due to both temperature and salinity affecting d18O. A possible solution is found in trace element concentration ratio Sr/Ca, which is believed to depend primarily upon temperature. Yet the high correlation between Sr/Ca ratio and SST is known to arise from the strong seasonal cycle in both. Is Sr/Ca correlated to SST on longer timescales? This is a critical question since we need proxy SST records to evaluate interannual to decadal climate processes. But it’s also a difficult question to address with statistical significance, requiring records much longer than the instrumental record. We present an empirical study assessing the value of the Sr/Ca ratio in coral records from 18 different published records. Statistical significance is obtained by combining multiple records. We also find calibration between Sr/Ca and SST obtained with and without the seasonal cycle is much different. The artificially high SST variability inferred from some proxy records may be an artifact of the seasonal variability confounding the calibration.

3B-202.5 ID:2963 11:30

Trigger of stochastic resonance for the onset of El Niño

Zhiyong Huang , *Hiroshi Morimoto*
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In this study, short-term climatic transitions within Quasi-Biennial (QB) cycles are considered “noise” for El Niño/Southern Oscillation (ENSO). The noise characteristic is represented by the Hurst coefficient H. Fractal dimension analysis and stochastic resonance (SR) are adopted to cope with the roles of noise for ENSO. The oscillation of H of Nino3.4 SST mostly corresponded with the development of El Niño, particularly during two strong Tropical Pacific Decadal Oscillation (TDO) periods of 1894 to 1923 and 1978 to 2000. This represents a stochastic resonance mechanism in the internal Pacific ocean-atmospheric system that is when a positive-phase noise overlaps with a stronger positive-phase TDO, SST easily exceed the critical state to launch an El Niño. This mechanism gives the condition whereby the onset of El Niño is more sensitive to noise. IOD and noise in DMI (high frequencies of IOD) are two external triggers of ENSO and affect ENSO through the SR mechanism. Phase-lead is an important feature as a trigger in an SR system. When the noise in DMI leads (lags) noise in a Niño3.4 SST, the correlation between IOD and ENSO increases (decreases) after 1910s. SR explains how external noise set out an El Niño. Noise in DMI influencing ENSO progressively advances from that of DMI, after the 1930s.

3B-202.6 ID:2772 **11:45**

A review of the case for global cooling this century

Dick Morgan
Retired
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Models predicting global cooling as the major feature of climate change this century have recently been issued by three widely acclaimed centres of solar science expertise.These are the Harvard Smithsonian Center for Astrophysics, NASA GISS and the Russian Atmospheric Observatory in St.Petersberg,

In the last CMOS Conference held in Halifax and in the next three across Canada subsequently, Morgan and Pocklington presented a climate change prediction model based on the harmonic derived from the combined periodicities and amplitudes of the Schwabe,Hale, Gleissberg and and Suess cycles. Being contrary to the models being approved by the IPCC, at that time, this model was rejected.

The compilation of the Morgan/Pocklington model will be reviewed and up-dated now that it has received confimation from more presigious solar research centres which are issuing contrary predictions to that favoured by the IPCC in its Assessment Guidance Reports.

Numerical Modelling for Research (PART 1) / Modélisation numérique pour la recherche (Partie 1)

Room / Endroit (203), Chair / Président (Xin Qiu), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-203.1 ID:3063 INVITED/INVITÉ 10:30

Use of observations to constrain projection for future climate

Xuebin Zhang
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Human induced warming of the climate system is now affecting many physical and biological systems on all continents, resulting in an urgent need to adapt to the changing climate. A key question decision makers need to ask before commencing on an adaptation measure is what climate they should adapt to? There is, unfortunately, no easy answer to this question as uncertainties related to the projected changes in the climate and climate extremes that are the most relevant to the impacts of climate change are very large. Projections from GCM simulations are the main source of future climate change information. This talk presents a framework that uses observed climate to first validate GCM simulations and then to constrain projected future scenarios that are derived from simulations. Canadian temperature is used as an example. We found that extreme temperature at local scale is significantly affected by large scale temperature variation. We also found that observed large-scale temperature change can be attributed to anthropogenic influence by comparing observations with GCM simulations. However, the observed temperature change was under estimated from the simulations conducted by the GCMs participating the IPCC AR4 assessment. This under estimation was considered and used to adjust model projected future changes when assessing the changes in the risk of extreme temperature for the future.

3B-203.2 ID:2966 11:00

Vertical structure of horizontal currents in global eddying OGCMs

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Global eddying ocean circulation models now display impressively realistic surface kinetic energy levels. However the skill in reproducing deep and abyssal flows is not as good. Comparison with thousands of current meter records at various depths and from across the World Ocean reveals that several global, high-resolution models generate too

weak flows below the surface and the bias increases with depth below the surface. We explore this bias from the point of view of the model energetics and global mechanical energy budget of the ocean.

3B-203.3 ID:2900 11:15

Using Space Filling Curves to Generate Rectangular Grids with Varying Resolutions for Ocean Modeling

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The simplest and still most widely used grids in ocean modeling are rectangular. A rectangular grid is straightforward to generate; it features orthogonal coordinates and trivial relationships among neighboring grid points. However, a single rectangular grid cannot support multiple spatial resolutions. In order to have a finer resolution for a target area within a model domain, one has to nest a finer grid inside a coarse one while still staying within finite difference modeling family. Dynamic nesting of grids as a function of model solution requires a systematic and automatic procedure. We will report how we can use a space-filling curve as a generating system to create a rectangular grid, which not only can vary its resolution spatially for initial setup, but also can dynamically adapt its resolution to model solutions while executing. We will also report that organizing model grid points along a space-filling curve can be good to run models efficiently in terms of memory cache efficiency and workload balancing among different processors.

3B-203.4 ID:2845 11:30

Verification of the latent heat flux predicted over the Lake Superior simulated by the Coupled Environmental Model MEC

Dorothée Charpentier [1], *Vincent Fortin* [1], *Chris Spence* [2], *Peter Blanken* [3], *Newell Hedstrom* [2]
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As part of the International Upper Great Lakes Study (IUGLS), Environment Canada is developing a fully coupled land, lake and atmosphere modelling system MEC which will be used to simulate as well as forecast the individual terms of the water budget of the Laurentian Great Lakes basin. The study focuses on improving estimation of the net basin supply (NBS) and assessing the potential impact of variations in the climate system on future regulation of the upper Great Lakes. The modelling system is comprised of the well establish Global Environment Multiscale (GEM) atmospheric model (for analysis and short-term forecasting) and the Canadian Regional Climate Model (CRCM) for climate prediction. Both of these models can be coupled with a land-surface hydrology scheme (MESH). In order to estimate the net basin supply in the upper lakes, one needs to have an evaluation of the evaporation, which is one of the three major components of

the water balance. This work focuses on the verification of the latent heat flux predicted by MEC over Lake Superior, where, since June 2008, 30-minutes observations are available from Stannard Rock Lighthouse. We also compare the predictions made by MEC to predictions made by NOAA's Great Lakes Environmental Research Laboratory (GLERL) between 2004 and 2008. Compared to observations, MEC overestimates condensation in summer, and does not producing any evaporation. For the rest of the year, MEC overestimates the evaporation, especially in fall and winter when the amplitude of the latent heat flux is larger. In this presentation, we assess the sensitivity of MEC predictions to the atmospheric forcings and to surface water temperature, and to the method used to estimate the roughness length and the friction velocity.

3B-203.5 ID:2869 11:45

An improved technique for modeling evapotranspiration on the prairies

Julian Brimelow [1], *John Hanesiak* [1], *Richard Raddatz* [1], *Masaki Hayashi* [2]
(Presented by *Julian Charles Brimelow*)
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The Jarvis-type approach for modeling ET is frequently used in numerical weather prediction models. A critical constant used in this technique is the minimum stomatal resistance term (r_min). However, field observations show that r_min varies on daily, intra- and inter-seasonal time scales. The inability of the Jarvis technique to mimic this variability in r_min limits the accuracy with which one can model ET. In this study, we use eddy covariance data from two sites (short-grass prairie and barley) in southern Alberta as input for the inverted Penman-Monteith equation to estimate the near-noon canopy resistances. As expected, the canopy resistances observed over the grasses are higher than those over barley, even when soil moisture is abundant. In addition, we observe a marked intra- and inter-seasonal variation of the canopy resistance term over the native grasses for three contrasting growing seasons (i.e., drought, near normal and wet). We also compare the ability of the prairie agrometeorological model (PAMII) to simulate the observed resistances and attendant ET at these sites. We find that while the model is skillful at capturing the salient features of ET at both sites, it displays a systematic negative bias. Comparison of the modelled canopy resistances with observations shows that this is probably on account of the model's tendency to overestimate the canopy resistance because PAMII uses an aggressive soil moisture stress function. We implemented two improvements to PAMII: (1) A dynamic minimum stomatal resistance term which varies day-to-day depending on the vapour pressure deficit, and (2) A logistic soil moisture stress function, which simulates the reduction of ET based on several field and laboratory studies of how vegetation responds to soil moisture stress. Incorporating these changes into PAMII greatly improves the modelled canopy resistances and also reduces the magnitude of the systematic negative bias.

Recent progress with the GEM-LAM 2.5km Model / Progrès récents avec le modèle GEM-LAM 2.5km

Room / Endroit (204), Chair / Président (Serge Desjardins), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-204.1 ID:2893 **10:30**

An overview of recent developments of the GEM-LAM 2.5 km model

Jocelyn Mailhot [1], *A. Erfani* [2], *B. Denis* [2], *A. Giguere* [2], *A. Glazer* [1], *N. Mclennan* [2], *R. McTaggart-Cowan* [1], *J. Milbrandt* [1]
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This presentation will provide an overview of recent developments of the Limited-Area version of the GEM model (GEM-LAM) run experimentally at CMC since 2006 (4 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 and radiation schemes, 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 model configuration for high-resolution forecasting and operational strategy for the future will be addressed. An overview of GEM-LAM applications to several projects (such as UNSTABLE, ABCANZ, and the Vancouver 2010 Olympics) will also be presented.

3B-204.2 ID:2808 **10:45**

An update on the GEM-LAM at 2.5 km horizontal resolution windows running across Canada

Amin Erfani [1], *Jocelyn Mailhot* [2], *Andre Giguere* [1], *Jason Milbrandt* [2], *Ron Mc-TaggartCowan* [2], *Andre Plante* [1], *Neil Mclennan* [1], *Bertrand Denis* [1]
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Currently there are four experimental GEM-LAM windows at 2.5 km horizontal resolution running operationally at the Canadian Meteorological Centre (CMC). They cover southern British Colombia and parts of Alberta, southern Ontario and Quebec, parts of the Baffin Island and part of the Maritime Provinces. The research and development (R & D) of these windows has been ongoing at CMC and Recherche en Prévision

Numérique Atmosphérique (RPN). This work has been performed in collaboration with the regional representatives and the national labs across the country. This presentation will provide the recent development and changes to the GEM-LAM windows at 2.5 km and will highlight some of the future R & D work.

3B-204.3 ID:2859 11:00

LAM2.5 development: Usefulness of feedback and evaluation by operational meteorologists

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The development of the LAM 2.5 in Canada followed new development in the research community at the Canadian Meteorological Centre but also was highly correlated with the feedback and assessment given by the operational community. This is a unique mode that was started in 2006 which was coordinated by the chief of the Analysis and Prognosis section at CMC. Every forecast region was involved to a certain extent. During this presentation, the evaluation set-up, the findings of the operational forecasters and the evolution of the LAM 2.5 km from 2006 to today will be presented. The value of such an endeavour will also be stressed, in the light of the discussion on the future role of the forecaster.

3B-204.4 ID:2875 11:15

Comparing GEM Regional, GEM-LAM 2.5 and RUC Model Simulations of Mesoscale Features over Southern Ontario

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A variety of different numerical weather prediction models are used at the Research Support Desk at the Ontario Storm Prediction Centre to provide guidance for mesoscale analysis and nowcasting. Included among these are:

• the regional version of Environment Canada's Global Environmental Multiscale (GEM) model with 15 km horizontal grid spacing,

• the limited-area version of the GEM model (GEM-LAM) with 2.5 km horizontal grid spacing, and

• the US Rapid Update Cycle (RUC) model with 13 km horizontal grid spacing.

Both the GEM-LAM 2.5 model and the RUC model are expected to have advantages over the regional GEM model. The high-resolution employed by the GEM-LAM 2.5 model should provide more accurate solutions than the regional GEM model in areas

with complex topography such as southern Ontario. The RUC model is run hourly with a fresh set of initial conditions that should effectively 'nudge' the model solution closer to reality than the regional GEM model.

To test these hypotheses, the three models were evaluated quasi-daily at 18 UTC for southern Ontario and surrounding areas beginning in June 2008. Surface winds from the models were compared to winds from surface weather stations, as well as radar data and satellite imagery. The model solutions were then ranked according to their success at simulating observed mesoscale features such as lake breezes and land breezes, and the mesoscale details of synoptic-scale features such as fronts and low centres.

Preliminary results suggest that the GEM-LAM 2.5 model and the RUC model are indeed better at simulating mesoscale features, with the relative rank of these two models depending on the feature type and the time of the year. Examples from several days will be presented.

3B-204.5 ID:2888 11:30

The GEM LAM2.5 – Operational Applications and Cases from the Maritimes Region – 2008-2009

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Forecasters at the Atlantic Storm Prediction Centre continued to evaluate the performance of the 2.5-km GEM LAM domain over Nova Scotia and Prince Edward Island. The model has proven to be a valuable learning tool for local weather effects and has provided information that has been factored into some forecasts and forecast amendments over the past year-and-a-half. In this presentation I will highlight some of these cases and also discuss the newly-expanded model domain for eastern Canada, which is sure to expand our understanding of local affects in these areas.

3B-204.6 ID:2979 11:45

Short-term verification of GEM Regional and GEM-LAM model parameters in the context of significant weather events at CYYZ for the Canadian Airport Nowcasting (CAN-Now) project

Monika Bailey [1], *Janti Reid* [1], *George Isaac* [1], *Faisal Boudala* [1], *Norbert Driedger* [1], *Marc Fournier* [2], *David Sills* [1]
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The Canadian Airport Nowcasting Project (CAN-Now) is developing a prototype nowcasting system for forecasting all-season weather at major airports. It is currently being tested at Toronto Pearson International Airport (CYYZ). Data from multiple

sources are used by the system: model data, hourly meteorological observations, radar, satellite, and high time-resolution measurements from a large suite of on-site instruments measuring parameters such as visibility, precipitation, ceiling and winds. The study presented here compares the MOLTS output from the GEM Regional and GEM-LAM models with nowcasts obtained from measurements from on-site instrumentation at CYYZ. It expands on earlier work in which verifications were performed on the entire data set or on data stratified by season and instead focuses specifically on significant weather events observed at CYYZ. Data collection for CAN-Now began in February 2007 and a two year archive is now available for such studies. The study is organized as follows. (1) Definition of significant aviation related weather scenarios in terms of observables such as winds, temperature, relative humidity, occurrence of precipitation, ceiling and visibility. (2) Extraction of hourly surface observations from the Environment Canada archives and identification of the start and end times of significant events. (3) Extraction of high time-resolution data from the archive of on-site instrument data for these times. (4) Verification, separately for each scenario, of forecasts of temperature, relative humidity, winds and precipitation occurrence. The forecasting performances of the GEM models, of extrapolated observations and of persistence are compared for forecasts at short intervals to 1 hour and then at 1 hour steps out to 6 hours. The implications of these results for forecasting derived variables such as visibility and ceiling are discussed.

IPY and related atmospheric, oceanographic, and hydrological studies (PART 1) / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie (Partie 1)

Room / Endroit (301), Chair / Président (Zhenxia Long), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-301.1 ID:2766 **10:30**

The Polar Continental Shelf Program's support of International Polar Year research activities in the Canadian Arctic

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The Polar Continental Shelf Program (PCSP), part of Natural Resources Canada, provides logistical support to Canadian Arctic researchers from federal and territorial government organizations, universities, independent groups and foreign agencies. Each

year, the PCSP supports up to 165 projects involving over 1100 scientists who conduct field work at locations throughout the Canadian Arctic. Services provided include air transportation to and from remote field camps, accommodation at the PCSP facility in Resolute, Nunavut, and loans of field equipment.

In 2008, the PCSP celebrated its 50th anniversary, which coincided with the most recent International Polar Year (IPY). The PCSP supported 25 IPY research projects in 2007 and 42 projects in 2008, which accounted for 25% of all supported projects during these two years. Also, through the federal IPY program office's initiative to support logistics for health and safety during IPY, the PCSP received funds to purchase equipment and position fuel caches. This support enhanced the PCSP's ability to prevent and respond to emergency situations.

The PCSP's operations are highly dependent on having access to accurate information about current weather and ice conditions. As observational information is limited in the region, the PCSP relies on data products developed from weather station data and satellite imagery. This information allows PCSP personnel to make informed decisions regarding aircraft dispatch and other operational requirements. Ice information is particularly important for servicing PCSP-supported sea ice field camps, including the major camps of Canada`s UNCLOS program. With changing environmental conditions in the Canadian Arctic, it has become more difficult to forecast weather and ice conditions, and there is much need for high-quality data products and proper training in their use. The PCSP works with the Canadian Ice Service and the Meteorological Service of Canada to obtain the best ice and weather data products available to support PCSP's operations.

3B-301.2 ID:2750 **10:45**

The Storm Studies in the Arctic (STAR) Project: Recent Progress

John Hanesiak [1], *Ronald Stewart* [1], *David Barber* [1], *Gordon Mcbean* [2], *Kent Moore* [3], *Peter Taylor* [4], *Walter Strapp* [5], *Mengistu Wolde* [6]
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The Storm Studies in the Arctic (STAR) is a four year CFCAS funded research Network (2007-2010) that conducted a major meteorological field project between October 10 – November 30, 2007 and in February 2008, focused on southern Baffin Island, Nunavut, Canada, a region that experiences intense autumn and winter storms. This project is concerned with the documentation, better understanding and improved prediction of meteorological and related hazards in the Arctic including their modification by local topography and land- sea-ice-ocean transitions, and their impact on local communities. STAR has obtained a variety of surface-based and unique research aircraft field measurements, high-resolution modeling products and remote sensing measurements (including CloudSat) as part of its science strategy, and has the first Arctic CloudSat validation data set to date. A number of synoptic and mesoscale features were sampled such as fronts, upslope/terrain-enhanced precipitation, convective precipitation, boundary layer cloud/precipitation as well as targeted CloudSat missions. The talk will highlight recent findings and focus on specific major case studies including a research flight into the remnants of Hurricane Noel, convection and upslope precipitation events, warm frontal structures and CloudSat validation.

3B-301.3 ID:2732 11:00

Thorpex Arctic Weather and Environmental Prediction Initiative (TAWEPI): an update on modelling and data assimilation activities

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TAWEPI is a science and research project partly funded by the Government of Canada Program of the International Polar Year (IPY). The primary objective of TAWEPI is to develop and validate a regional Numerical Weather Prediction model over the Arctic during the IPY observational period. The proposed research model, called Polar-GEM, is a “twin” of the Environment Canada (EC) operational regional GEM (Global Environmental Multiscale) model, used for one- to two-day weather forecasts. This initiative includes modelling and data assimilation studies taking place in various research divisions of EC, in collaboration with the Canadian Meteorological Centre, the Canadian Ice Service, the Department of Fisheries and Oceans, various Canadian universities and other IPY projects. TAWEPI's research activities started in April 2007. A research version of the model, covering the Arctic basin and surrounding is being used to study the representation of radiative and cloud processes in weather forecasts. A multi-layer snow model coupled to sea-ice and blowing-snow parametrizations, describing processes over the various types of surfaces of the Arctic environment, was tested and evaluated. Using a stratospheric extension of the GEM model, analyses of the stratosphere were generated for the period of Feb 2007 to Feb 2008, including estimates of the ozone field. A methodology to validate model forecasts of cloud and radiation using satellite hyperspectral radiances was developed. Climatology of the sensitivity of the Arctic weather to disturbances originated elsewhere was generated and archived for the IPY period of 2007/2008. A state-of-the-science sea-ice model is being adjusted to improve the sea-ice representation in the Arctic. A brief account of these activities and plans for the future will be presented.

3B-301.4 ID:3094 11:15

Analysis of a Warm Front Over the Hudson Strait During the STAR Campaign

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The Storm Studies in the Arctic (STAR) is a four-year research Network (2007- 2010) involving a wide range of activities on the part of researchers from five Canadian universities and Environment Canada. The project is concerned with the documentation, better understanding and improved prediction of meteorological and related hazards in the Canadian Arctic. As part of the project, a major meteorological field campaign took place from October 10 – November 30, 2007 and in February 2008 and was focused on southern Baffin Island, Nunavut, Canada. During the fall study period of the campaign, a major storm event occurred over the southern Baffin Island region from 16-19 November, 2007. During the system's passage over the Hudson Strait, a flight through the system's warm front was made and several drop sondes as well as radar measurements were taken. This talk will provide an overview of the structure of this system as revealed by these measurements. As well, we will discuss a comparison of model output to the measurements.

3B-301.5 ID:2690 11:30

Meteorological analysis of an extreme Beaufort coastal storm surge event

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The coastal community of Tuktoyaktuk on the Beaufort Coast of the Northwest Territories has experienced significant damage from storm surge events over the last several decades. The most dramatic impacts are observed during storm surge events that occur during periods of intense and persistent northwesterly winds in the early fall (late July through early October) when the winter sea ice coverage has given way to large areas of open water. Scientific and anecdotal evidence both suggest that the storm surge event of September 1999 was particularly damaging. Strong and persistent northwesterly winds produced significant coastal erosion and saltwater intrusion that poisoned ground water supplies and killed trees and other vegetation in the Mackenzie River Delta. This study presents a detailed meteorological investigation of the atmospheric conditions that helped to produce such a devastating event. Approximately one week before the storm surge began, a deep cyclone formed over the Gulf of Alaska and moved north over the coastal mountains towards the interior of Alaska. The subsequent weakening of the low and redevelopment to the north of the mountain range resulted in strong easterly winds favorable for upwelling along the Beaufort Coast A polar low then formed in the strong baroclinic zone that developed along the coast, producing strong northwesterly winds that eventually led to the actual storm surge. After the polar low moved ashore and decayed to the east of Tuktoyaktuk, a large cold air mass associated with an anticyclone to the north moved south and became trapped to the north of the coastal Brooks Range. The cold air and rising geopotential height produced a pressure gradient and stratification favorable for northwesterly geostrophic winds aloft to be mixed to the surface. The implications for predictability of such a multi-faceted event are discussed.

3B-301.6 ID:2955 11:45

The synoptic and planetary scale environments associated with strong wind events

along the Beaufort Sea coast

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Strong winds along the Beaufort Sea coast force ocean waves and contribute to storm surges and coastal erosion. Coastal communities in this region depend on the ocean and the integrity of the shoreline. Strong winds can also damage structures and cause extreme wind chills over the long winter. As sea ice extent in the Arctic diminishes, the presence of conditions conducive to large, wind forced ocean waves may increase. In an attempt to further our understanding of strong wind events in this region, their characteristic environments at the synoptic and planetary scales are defined using global reanalysis data and are discussed in the context of teleconnection patterns and climate change. Preliminary results indicate a dependency on an enhanced or suppressed Aleutian Low which produces either a strong southeasterly or northwesterly 1000 hPa geostrophic wind event.

Coastal Oceanography and Inland Waters (PART 2) / Océanographie côtière et les eaux intérieures (Partie 2)

Room / Endroit (302), Chair / Président (Ram Rao Yerubandi), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-302.1 ID:3042 INVITED/INVITÉ 10:30

Development and applications of Canadian East Coast Ocean Model (CECOM)

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The Canadian East Coast Ocean Model (CECOM) is a coupled ice-ocean model for Canada’s east-coast oceans developed at BIO. The ocean component of the model is the Princeton Ocean Model and the ice component is a multi-category ice model coupled to the ocean dynamically and thermodynamically. The model domain extends from the Gulf Stream to Baffin Bay and from the coast to 42 deg W. Owing to the large north-south span, the rotated spherical coordinates are used to reduce the impact of converging meridians. The history of model development, boundary conditions, temperature-salinity data base, assimilation schemes for sea surface temperature and sea-ice data are reviewed. The applications of the model include basin-scale and shelf circulations, operational ocean forecasting, seasonal variation of ice cover, deep convection, wave-current coupling and surface trajectory, optical heating of the upper ocean, and storm-induced changes in phytoplankton distribution. Selected model results will be presented.

3B-302.2 ID:2990 11:00

An FVCOM model off Newfoundland and Labrador

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In this study we investigate monthly-mean circulation and tidal currents using a finite-volume coastal ocean model (FVCOM) off Newfoundland and Labrador. The FVCOM uses unstructured grid in the horizontal and allows efficient use of the grid resolution to resolve important coastal and shelf-scale features. The model results are evaluated against current meter measurements, vessel-mounted ADCP data and tide-gauge observations. We also compare the FVCOM results with those from an earlier finite element model.

3B-302.3 ID:2994 11:15

Short Term Forecasting of Sea Surface Temperature Off Canada's East Coast

Keith Thompson [1], *Yimin Liu* [1], *Serge Desjardins* [2], *Chris Jones* [1], *Darryl Williams* [3]
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The DalCoast coastal prediction system has recently been one-way coupled to an atmospheric forecast model run operationally by Environment Canada. In addition to forcing by air pressure and wind stress, the coastal ocean model is now forced by heat and freshwater fluxes that are calculated "online" using forecast atmospheric state variables. In this presentation we quantify the improvements in forecast skill of the coastal model, focusing on sea surface temperature and lead times of 1 and 2 days. The validation data includes surface temperature measured by moored buoys and satellite observations. Forecast error statistics calculated from a 3 year run of the system in forecast mode, and results for representative events, show that the one-way coupling has led to a significant increase in forecast skill in some regions and at certain times of the year. Preliminary results from the assimilation of satellite based sea surface temperature will be described.

3B-302.4 ID:3015 11:30

The Amundsen Gulf Eddies

Yves Gratton [1], *Louis Prieur* [2], *Jean-Éric Tremblay* [3], *Alfonso Mucci* [4]
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The source of freshwater, nutrients, dissolved and particulate material found in the Amundsen Gulf can be both local and remote. One coherent feature that can transport freshwater, mass and even complete ecosystems over large distances is the eddy. Canada Basin eddies have been recently observed to last for months. They can be generated in late fall or winter as far as the shelf break in the Chukchi Sea or formed locally at freezing time and / or melting time. One eddy was observed in Franklin Bay in December 2003 during CASES (Canadian Arctic Shelf Exchanges Study) and two more were observed in the Amundsen Gulf in January and March of 2008 during CFL (Circumpolar Flaw Lead Study). The 2003 eddy was probably generated locally while the 2008 eddies may have drifted in from the Canada Basin. In this paper, we discuss the properties of the observed Amundsen Gulf eddies and speculate on their possible generating mechanisms.

3B-302.5 ID:2982 11:45

Process Study of Hydrodynamics over the Pearl River Estuary Using a Nested-grid Coastal Circulation Model

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Seven tropical cyclones made landfall in Guangdong Province, China in 1993. Five of them were typhoons and four occurred between late June and mid-September. A nested-grid coastal ocean circulation modeling system is used to examine the main physical processes affecting the three-dimensional (3D) circulation and hydrographic distributions in 1993 over the Pearl River Estuary (PRE) of Guangdong Province, with a special emphasis on the storm-induced circualtions during typhoon Koryn in late June. The nested-grid system is based on the Princeton Ocean Model (POM) and has three downscaling submodels. The outer-most submodel of the system has a coarse horizontal resolution of ~7 km for simulating storm surges and barotropic depth-mean currents over the Bohai Sea, the Yellow Sea, the East China Sea and the northern South China Sea. The inner-most submodel has a fine resolution of ~1.2 km for simulating the 3D coastal circulation and hydrography over the PRE and its adjacent coastal waters. The model results demonstrate that the coastal circulation and hydrographic distributions over the PRE are affected significantly by tides, winds, and river discharges. The coastal circulation in the PRE is significantly affected by wind during storm conditions. The simulated estuarine plume front aligns roughly from the northeast to the southwest inside the PRE in winter months of 1993, which is in good agreement with observations. In summer, the plume front spreads to the adjacent coastal waters and turns eastward upon exiting from the PRE due to the southwesterly monsoon.

Radiation, Aerosols and Cloud (PART 1)/ Radiation, aérosols et nuages (Partie 1)

Room / Endroit (303), Chair / Président (Jiangnan Li), Date (03/06/2009), Time / Heure (10:30 - 12:00)

3B-303.1 ID:2674 INVITED/INVITÉ 10:30

Radiative forcing by ice crystals from remote blowing snow events at Eureka

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Ice crystals are suspended in the boundary layer during most of the Arctic winter at Eureka in the Canadian far north. Occasionally ice crystal events occur with optical depths in excess of 2.0 even in the absence of liquid water clouds. Four case studies of high optical depth ice crystal events at Eureka during the winter of 2006-07 are presented. AERI measurements coupled with the SBDART radiative transfer model show that the ice crystal infrared downward radiative forcing at the ground ranged from 8 to 36 W/m2 in the wavelength band from 5.6 to 20 microns corresponding to visible optical depths from 0.2 to 1.7. MODIS infrared and visible images and the operational radiosonde wind profiles were used to show that these high optical depth events originated from surface snow blown off the tops of 600 to 800 m high mountain ridges about 20 to 30 km northwest of Eureka. The ice crystals, a residual of the remote blowing snow, were advected by the winds at around 600 m height towards Eureka as they settled towards the ground within the highly stable and quiescent boundary layer. This source of boundary layer ice crystals is distinct from the classical diamond dust phenomenon and requires some reinterpretation of the role of ice crystals in radiative forcing and dehydration in the Arctic winter.

3B-303.2 ID:2984 11:00

Aerosol-Ice Relations in Arctic Clouds

Michael Earle [1], *George Isaac* [1], *Shao-Meng Li* [2], *Stewart Cober* [1]
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The relationship between atmospheric aerosol particles and the formation and properties of ice clouds is not well understood, and thus represents a key uncertainty in weather and climate forecasting models. Though their concentrations are typically low, aerosol particles acting as ice nuclei can modify the characteristics of mixed-phase and ice clouds through so-called glaciation indirect effects. Observations of aerosols and ice crystals in glaciated Arctic clouds present an opportunity to study aerosol-ice relations under relatively stable atmospheric conditions, and in doing so, to establish a fundamental basis for understanding these relations in more complex cloud systems. This work presents analysis from in situ measurements obtained during the First ISCCP (International Satellite Cloud Climatology Project) Regional Experiment – Arctic Cloud Experiment

(FIRE.ACE), conducted over the Arctic Ocean during April, 1998. Aerosol concentration and size measurements were obtained using a PMS PCASP-100X probe, and ice crystal size spectra were obtained from PMS 2D-C and 2D-P probes. Complementary composition analysis was derived from high volume filter samples. Two disparate regimes of aerosol and ice properties are readily identified from the measurements. The composition analysis suggests that the differences between the regimes can be attributed to the relative concentrations of water-soluble organic carbon (WSOC) and water-insoluble carbon (WIC). In the first regime, WIC predominates, indicating that the carbonaceous composition is made up of more primary material, such as black carbon. In the second regime, WSOC predominates, suggesting the prevalence of secondary organic aerosol (SOA). The second regime is associated with higher concentrations of aerosol particles and ice crystals than the first, as well as smaller particle and crystal sizes. These results show a direct correlation between the aerosol and ice crystal properties in the respective regimes, and indicate the dependence of these properties on the aerosol composition.

3B-303.3 ID:2764 **11:15**

A Convective Parameterization with Trimodal Convective Outflow

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Our ability to forecast rainfall in the tropics is compromised by our inability to properly represent many of the large moving coherent waves that produce the majority of the rainfall in the tropics. It is commonly believed that this inability arises from weaknesses in convective parameterizations, and in particular, the trimodality of convective outflow in the tropics. Convective outflow is not uniformally distributed with height, but instead is preferentially distributed into a deep (10 km - 17 km), congestus (4 km - 8 km), and boundary layer (1 km - 2 km) modes. I will discuss a new convective parameterization that exhibits these three modes. I will also discuss the ability of the model to simulate the diurnal variation in total rainfall and congestus rainfall over the tropical oceans.

3B-303.4 ID:2681 **11:30**

Important CH4 Shortwave Radiative Forcing in GCM

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IPCC AR4 GCM models inter comparison shows that CH4 could have solar radiative forcing about 1 W/m2 on the surface. However so far there is no single GCM model has considered CH4 effect in solar spectrum range. Solar radiative effect due to CH4 is difficult to be incorporated in climate models, since about 70% of CH4 solar effect occurs in the visible range whereas 30% occurs in the infrared range. Therefore the full solar spectrum from 0.2 - 100 micro-meter has to be considered. However most GCM radiation algorithms only take into account the solar spectrum up to 4 - 5 micro-meter. A

strategy has been developed to handle this difficulty. The CH4 solar forcing obtained by the proposed method is very consistent with line-by-line result. Interesting climate response is also shown with inclusion of the CH4 solar effect.

3B-303.5 ID:2710 **11:45**

A simple lidar-derived sulphate index for the Arctic: meaning, validation and importance for thin ice clouds study.

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Datasets from the CALIPSO lidar backscattering and the CloudSat radar reflectivity measurements provide a new perspective on Arctic atmospheric features, as well as on the way they interact. Especially, the links between the cloud ice crystal size and the surrounding aerosol field may be further investigated, in an attempt to find a signature of the Arctic haze effect on the dehydration efficiency of air masses during the polar night. In this study, the satellite observations are used to identify thin ice clouds (TIC of type 2B) which, we have reasons to think, are particularly affected by the sulphate field. Moreover, a new sulphate index based on the lidar backscattering and color ratio of the sampled volumes is used for identifying haze in cloud-free regions. The index is compared against sulphate concentrations from in-situ measurements (at Zeppelin, Norway and PEARL, Canada) and numerical simulations (using NARCM). Moreover, statistics from about 12 million profiles over the Arctic during the months of January 2007 and January 2008 reveal geographical patterns in the TIC-2B cover and haze occurrence. Results are interpreted in terms of a sulphate-induced freezing inhibition (SIFI) effect.

Argo in Ocean and Climate Sciences / Argo dans les sciences de l'océan et le climat

Room / Endroit (202), Chair / Président (Denis Gilbert), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-202.1 ID:2692 **13:30**

Separating the Steric and Eustatic Contributions to Global Sea-Level Rise

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It is well known from observations by the altimetric satellites (predominantly Topex-Poseidon and Jason-1) that global sea-level is rising. What is less well known is exactly how the observed sea-level rise is partitioned between a steric contribution (sea-level

rises because of changes in ambient temperature and salinity) and a eustatic contribution (the addition of new water mass to the oceans). Strictly, such a separation is not possible because of the nonlinearity in the equation of state for seawater, but in practice the nonlinearities are sufficiently small to allow this separation as a very good first approximation.

A careful comparison of the WOCE one-time survey with recent observations by the Argo array indicate a steric component to sea-level rise of 1.8 ± 0.7 mm/year between the early 1990s and the present time. The altimetric satellite time series indicates a total sea level rise rate of 3.2 ± 0.4 mm/year over this period. The difference is 1.4 ± 0.8 mm/year which, if supplied entirely by melting ice on land, translates into a melt rate of 515 ± 300 km3/year.

3C-202.2 ID:2864 **13:45**

Estimating climatologies for the Argo period: Dealing with noise due to mesoscale variability

Simon Higginson , *Keith Thompson* , *Yimin Liu*
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Temperature and salinity (TS) climatologies are of fundamental importance in descriptive oceanography and are also used, for example, to quality control observations and to initialize, nudge and validate numerical ocean models. Existing climatologies are smoothed mean fields based on many decades of observations, but the ocean is a non-stationary system with significant low frequency variability. For many applications it is more appropriate to define the mean for shorter periods (e.g. a decade) but often the available observations are too sparse to allow this. With the Argo network measuring approximately 100,000 TS profiles annually it is becoming possible to define a climatology relating solely to the Argo period; however, the Argo observation density is still too sparse to define a reliable seasonal climatology. One way to deal with the data sparseness is to remove the "noise" due to mesoscale variability, which is reduced in traditional analyses by averaging over long periods. We describe a simple, physically-motivated scheme (based on Cooper and Haines, 1996) to "de-eddy" Argo profiles using satellite altimeter observations. Reducing the sample variance of the Argo TS observations by 50% using this technique is equivalent to increasing the sample size by a factor of 4. We demonstrate the technique using Argo observations from the northwest Atlantic to produce mean temperature and salinity fields for the 8-year Argo period. Comparison with the Levitus climatology shows good agreement overall but, based on comparisons with independent observations, it is shown that the new fields eliminate a significant TS bias and also provide a more-accurate representation of temperature, salinity and dynamic height in the Gulf Stream region. The limitations of the technique and its use in constraining and validating ocean models are also discussed.

3C-202.3 ID:3099 **14:00**

Seasonal Cycle and Interannual Variability of Temperature and Salinity in the

North Atlantic

Igor Yashayaev [1], *Michael Dunphy* [2]
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[2] University of Waterloo
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Argo floats provide real-time monitoring of temperature and salinity in the upper 2000 m layer in critical basins of the world ocean. In the northern North Atlantic, and particularly in the Labrador Sea, the continuous Argo observations resolve seasonal cycle of key seawater properties and reveal major water-mass developments.

Regional time series of vertical temperature and salinity distribution based on the Argo measurements are extremely useful for analysis of convective processes. These series clearly show how convection progresses during a cooling season and how it changes its strength and duration from year to year. The Argo observations are also used to identify the spreading pathways and transit times of newly-formed water masses.

The recent measurements have revealed a disruption in continuing warming of the intermediate waters in the North Atlantic. This cold anomaly reaching as deep as 1600 m was caused by deep convection in the Labrador Sea in the winter of 2007-2008.

Annual cycles of regional heat and freshwater content derived from massive Argo data are consistent with annual curves of cumulative heat transfer through the sea surface. The Argo-based estimates combined with the net surface fluxes provide a means for inferring horizontal advection of heat and freshwater in the ocean.

3C-202.4 ID:2672 14:15

Survey of the Gulf Stream northern recirculation gyre with temperature, salinity and oxygen data from Argo floats

Denis Gilbert
Institut Maurice-Lamontagne, Pêches et Océans Canada
Contact: denis.gilbert@dfo-mpo.gc.ca

The northern recirculation gyre of the Gulf Stream, also known as the Slope Water region, is under the influence of cold, fresh, well oxygenated waters from the Labrador Current and warm, salty, less oxygenated waters from the Gulf Stream. I will present temperature, salinity and oxygen statistics at fixed depths and on isopycnal surfaces for this region (35°N to 48°N, 45°W to 75°W) calculated exclusively from data collected by PALACE and Argo floats between 1998 and 2009. In addition, I will present maps of winter mixed layer depth for this region. I will also try to determine whether the present spatial coverage of the Argo array is sufficient to reliably track interannual changes in the proportions of Labrador Current Water (LCW) and North Atlantic Central Water (NACW) in the Slope Water region. Finally I will present maps of dynamic height, calculated from a reference depth of 1000 m to the surface, indicating the mean path of the Gulf Stream.

3C-202.5 ID:3089 **14:30**

Impacts of ARGO Observations on the Pacific Ocean Data Assimilation

Youmin Tang
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An assimilate system has been developed for Argo and XBT observations using local Ensemble Kalman filter (LEnKF), where the temperature and salinity were assumed to be uncorrelated in prediction covariance matrix. With this assimilation system, Argo temperature-salinity (T-S) profiles from the surface to the depth of 1800 meters were assimilated into an oceanic general circulation models for the Pacific Ocean (120E-70W, 60S-60N), accompanying with the assimilation of XBT observations, for the period from 2005-2007. The preliminary results show that Argo T-S profiles significantly improved the simulation of temperature and salinity, especially for the southern Pacific Ocean. More sensitivity experiments are being performed to further investigate the impact of Argo observations on the assimilation. A better assimilation scheme considering T-S coherence is also under the way.

3C-202.6 ID:2910 **14:45**

Development and Evaluation of Ice-Ocean Reanalyses using the S(T) Assimilation System

Greg Smith [1], *Keith Haines* [2], *Ruth Mugford* [2], *Alastair Gemmell* [3], *Dan Bretherton* [3]
(Presented by *Gregory Smith*)
[1] Fisheries and Oceans Canada
[2] UK National Centre for Earth Observation
[3] University of Reading e-Science Centre
Contact: Gregory.Smith@ec.gc.ca

Our focus is on improving the realism of ocean data assimilation schemes and using assimilation to investigate ocean climate signals. Using observations from the Argo array, we demonstrate the benefit of combining temperature (T) and salinity (S) assimilation methods and of assimilating S(T) as the observable property. This allows us to exploit the larger spatial and temporal decorrelations of this quantity, compared with S(z), allowing flow dependent assimilation and recovery of water mass information.

The S(T) algorithm has been implemented into the NEMO global ice-ocean model and two reanalyses have been made: a 50-year reanalysis at 1° resolution, and a 21-year reanalysis at 1/4° resolution. Overall, the assimilation is able to prevent drifts in many ocean metrics, and brings the model in better agreement with accepted values. An evaluation of water mass properties in various ocean syntheses (e.g. ECCO, MERCATOR, ECMWF, SODA) with Argo observations, performed as part of the CLIVAR-GSOP intercomparison, shows that the S(T) reanalyses provide excellent agreement with in situ observations.

Numerical Modelling for Research (PART 2) / Modélisation numérique pour la recherche (Partie 2)

Room / Endroit (203), Chair / Président (Xin Qiu), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-203.1 ID:2957 **13:30**

The second generation of the Global Mars Multiscale Model (GM3)

Ayodeji Akingunola [1], *John Mcconnell* [2], *Rastgar Farahnaz* [2], *Di Wu* [2], *Jacek Kaminski* [2]
[1] Canadian Space Agency, Saint-Hubert, QC
[2] York University, Toronto, ON
Contact: Deji.Akingunola@asc-csa.gc.ca

The Global Mars Multiscale Model (GM3) is a General Circulation Model (GCM) developed for studying the atmosphere of Mars. The model consists of a set of physical parameterizations peculiar to the Martian atmopshere, built on the dynamical core of the Canadian operational weather forecast Global Environment Multiscale (GEM) model and its associated libraries and tool, with appropriate modifications for the Martian environment. The model is capable of reproducing many of the observed features of the atmosphere of Mars, such as the annual CO2 and water vapour cycles among others. Current model activity includes mesoscale simulation of selected regions of interest on Mars, and the development of dust lifting and transport mechanisms in the model.

3C-203.2 ID:3072 **13:45**

The Staggered Hybrid Vertical Coordinate in GEM

Vivian Lee , *Andre Plante* , *Claude Girard* , *Lubos Spacek*
Environment Canada
Contact: Vivian.Lee@ec.gc.ca

One of the latest developments in GEM has been implementing a staggered vertical coordinate in order to eliminate numerical modes produced by the model. The project started at least 5 years ago but it did not really take off until 3 years ago when the dynamic core of the model was developed. Then 2 years ago, more work was done to complete this model by adjusting the physics interface, refining the input and output mechanics and the nesting part of LAM. The principle discussion here will focus on the sensitivity of the different interfacing approaches to the physics.

3C-203.3 ID:2927 **14:00**

An Application of the CMAQ Modelling System to Determine the Impact of Marine Emission Controls over the Pacific Northwest – Air Chemistry.

Colin Di Cenzo [1], *Xin Qiu* [2], *Robert Nissen* [1], *Michael Van Altena* [2], *Wayne Boulton* [2]
[1] Environment Canada
[2] RWDI Air, Inc.
Contact: colin.dicenzo@ec.gc.ca

A comprehensive modelling study was undertaken over coastal British Columbia to assess the impacts of reasonable marine emission reduction strategies on ambient air quality. The Community Multiscale Air Quality chemical transport model (CMAQ 4.6) with the SAPRC-99 chemical mechanism was applied at high resolution (4km) over the complex topography and marine environments of the Pacific Northwest. The modelling system and emission reduction strategies will be described, and results will be presented showing the impacts on levels of ozone and fine particulate matter for a typical summer and winter period.

3C-203.4 ID:2922 **14:15**

An Application of the CMAQ Modelling System to Determine the Impact of Marine Emission Controls over the Pacific Northwest - Meteorology.

Robert Nissen [1], *Xin Qiu* [2], *Colin Di Cenzo* [1], *Wayne Boulton* [2], *Michael Van Altena* [2]
[1] Meteorological Service of Canada
[2] RWDI AIR Inc.
Contact: robert.nissen@ec.gc.ca

A comprehensive modelling study was undertaken over coastal British Columbia to assess the impacts of several marine vessel emission reduction strategies on ambient air quality. Crucial to this assessment was the development of accurate meteorological data fields to drive the chemical transport model (CMAQ). The complex terrain within the domain necessitated a high resolution for the met fields, thus the Global Environmental Multiscale Limited Area Model (GEM LAM) was employed at 2.5-km horizontal resolution for both a typical summer and winter period. The generation of the GEM LAM fields, and the reformatting challenges overcome for their successful ingest to CMAQ, will be described.

3C-203.5 ID:2961 **14:30**

An Application of the CMAQ Modelling System to Determine the Impact Marine Emission Controls over the Pacific Northwest - Emissions

Xin Qiu [1], *Wayne Boulton* [1], *Michael Vanaltena* [1], *Colin Di Cenzo* [2], *Robert Nissen* [2]
[1] RWDI AIR Inc.
[2] Environment Canada
Contact: xin.qiu@rwdi.com

A comprehensive modelling study was undertaken over coastal British Columbia to assess the impacts of reasonable marine emission reduction strategies on ambient air quality. Crucial to this assessment was the development of accurate, highly resolved emission datasets both spatially, and in time. The emissions data were compiled for the offshore, the Canadian inshore, and the American inshore. The development of these datasets and their successful integration into the modelling system will be described along with an overview of the tools and techniques used to develop hourly, SMOKE model-ready emission inputs for ocean-going marine vessels.

3C-203.6 ID:2713 **14:45**

A Sensitivity Study of Using High Resolution WRF Model to Forecast Winds over Southern Alberta

Yan Shen
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Contact: Yan.Shen@jacqueswhitford.com

Meteorological inputs play a vital role on regional air quality modeling. Among most common used meteorological parameters, wind speed and direction are within most interested things. As the next generation community mesoscale model designed to enhance collaboration between the research and operational sectors, the Weather Research and Forecasting (WRF) model will eventually replace MM5 as the primary community mesoscale model. However, there is a critical challenge for air quality/meteorological modeler to determine which WRF model configuration options are best to address winds forecast concern.

The purpose of this study is to investigate the WRF model sensitivity with different planetary boundary layer schemes, different vertical resolutions and different initializations (NAM 12km or NAM 40km data). The experiment ran from 1 July 2007 to 31 August 2007. The forecasts of wind speed and direction will be compared with both airport weather stations data and available on-site winds tower data. Results of WRF 4km/1km simulations from different combinations of model configurations will be presented. Also for air quality modeling purpose, a preliminary determination will be made for a very best WRF model configuration for predicting winds in Southern Alberta mountainous area.

Military Meteorology and Oceanography / Météorologie et océanographie militaire

Room / Endroit (204), Chair / Président (Mario Ouellet), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-204.1 ID:2779 **13:30**

Military Weather Services Transformation Overview

Martha Anderson
National Defense
Contact: Martha.Anderson@forces.gc.ca

The Canadian Forces are required to be able to sustain a number of deployed operations concurrently as well as the defence of Canada and North America. Weather and oceanographic services are essential enablers to military operations. Serious deficiencies have been identified in the ability of the Canadian Forces Weather and Oceanographic Service (CFWOS) to provide the required domestic and deployed specialized weather support for CF capabilities. The CFWOS has embarked on a modernization and transformation to meet present and anticipated demands.

This talk will provide an overview of the weather service activities undertaken by the CFWOS, the growing demand for support, and the proposed way ahead to meet these demands through a $25M capital project.

3C-204.2 ID:2781 **13:45**

The New Canadian Forces Joint Meteorological Centre

Martha Anderson [1], *Clarke Bedford* [2], *Abdoulaye Harou* [3], *Lt.-Col. Paul Kearney* [4]
[1] National Defense
[2] National Defence
[3] Environment Canada
[4] National Defence / Canadian Forces
Contact: Martha.Anderson@forces.gc.ca

The Canadian Forces are required to be able to sustain a number of deployed operations concurrently as well as the defence of Canada and North America. Weather and oceanographic services are essential enablers to military operations. Serious deficiencies have been identified in the ability of the Canadian Forces Weather and Oceanographic Service (CFWOS) to provide the required domestic and deployed specialized weather support for CF capabilities. The CFWOS has embarked on a modernization and transformation to meet present and anticipated demands.

The cornerstone of the CFWOS revitalization is the creation of a Joint Meteorological Centre, where teams of CF Meteorological Technicians (Met Techs) can properly prepare for deployments, centralized weather information delivery will be provided using modern communications technologies, and Environment Canada meteorologists and IT specialists will provide support and undertake applied science development projects. The CFWOS Transformation Steering Committee has determined that the best location for the Joint Met Centre is the Army Met Centre at CFB Gagetown near Fredericton, NB. This main Land Forces base provides a venue where CF Met Techs can best prepare for their diverse deployed roles. An Interim Joint Met Centre was created in summer 2008, in anticipation of the approval of a capital project in early 2009.

3C-204.3 ID:2837 **14:00**

Dust Storms vice Snowstorms - The Challenges of Forecasting for Kandahar Afghanistan (as part of a NATO combined effort).

Don Clark
EC- MSC-ADS (Aviation and Defence Services)

Contact: Don.Clark@ec.gc.ca

To support NATO operations in Afghanistan, weather and weather forecasting are critical elements to the success and safety of deployed operations. As part of Canada's contributions to the NATO led mission, the Aviation and Defence Services - Weather Services Centre (WSC) in Trenton was called upon by the Director of Meteorology and Oceanography (DMetOc), to provide aerodrome forecasts for Kandahar Afghanistan. Meteorologists in Trenton work collaboratively with Met personnel in Kandahar, as well as meteorological staff with the US Air Force, to provide ongoing aviation forecasts for Kandahar. Forecasting for such a unique environment, using a variety of different data sources, and numerical products, poses unique challenges. This talk will provide an overview of the challenges of forecasting weather for Kandahar Afghanistan, and in particular the efforts made to work collectively with allied countries in providing meteorological support for deployed military operations.

3C-204.4 ID:2785 14:15

Mesoscale GEM-LAM modeling of RF/IR propagation and refractivity in the littoral zones

Anna Glazer [1], *Jocelyn Mailhot* [2], *Stephane Gaudreault* [2]
[1] Environment Canada / MRD / RPN
[2] Environment Canada / MRD / RPN
Contact: jocelyn.mailhot@ec.gc.ca

Littoral radio frequency and infrared (RF/IR) propagation is strongly impacted by the structure of the coastal marine atmospheric boundary layer (MABL) which can create anomalous propagation conditions. Observations and numerical weather prediction (NWP) modeling have shown that littoral RF/IR propagation conditions rapidly change during transitions due to diurnal, mesoscale, or synoptic-scale circulations, leading to enhanced or attenuated naval surface sensor and communication system performance. Mesoscale NWP has the potential to allow allied navies to exploit the MABL environment by providing an initial awareness capability in order to redeploy sensor and communication systems accordingly.

The ABCANZ (America/Britain/Canada/Australia/NewZealand) RF/IR Working Group has established a need for diagnostic and prognostic 3D refractivity modeling capabilities to support littoral naval operations. Since 2007, a mesoscale modeling collaboration between these countries has been going on to develop such capabilities that would be exploitable by all ABCANZ countries and, in particular, that should benefit the operations of the Canadian Navy.

The presentation will highlight our current work within the ABCANZ Group using the GEM-LAM model at mesoscale resolutions to simulate several days of the Wallops 2000 MPME (Microwave Propagation Measurement Experiment) where detailed meteorological observations and RF propagation data were obtained. Another project aims at modeling the New Zealand Sea Breeze Trial that took place in February-March 2009. Comparison between the observed and modeled refractivity and propagation properties will be discussed.

3C-204.5 ID:2811 **14:30**

An Overview of MetOc Halifax ocean products and services

Darryl Williams
DND MetOc Halifax
Contact: Darryl.Williams@forces.gc.ca

Recent initiatives at MetOc Halifax have contributed to improved operational support for the Canadian Forces in Atlantic Canada. The principal operational products include the Ocean Features Analysis (OFA) Chart and 3D temperature gridfield messages generated by the Dalcoast ocean model for inclusion in acoustic range prediction systems. The Dalcoast model has been upgraded with an improved visualization package for viewing and exporting animations of currents, salinity, and temperature at various depth levels. A particle tracking algorithm has also been incorporated that can be run both forwards and backwards in time. The next phase of development for Dalcoast is the assimilation of sea surface temperature from AVHRR satellite data.

MetOc Halifax is involved with two major projects - Polar Epsilon (PE) and the Spaceborne Ocean Intelligence Network (SOIN). PE is providing an X-band receiver for the reception of ocean colour satellite data while SOIN is a CSA sponsored GRIP project to identify ocean features from Radarsat 2 data.

The creation of GIS products for display on Google Earth is the way of the future within DND and MetOc Halifax is leading the way with the creation of compatible products.

3C-204.6 ID:2914 **14:45**

Incorporation of winds from the Canadian Ensemble Forecast System into the CANSARP software pacakage for the determination of target search areas for search and rescue operations.

Syd Peel
Meteorological Research Division/Environment Canada
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In the wake of a maritime disaster timely calculation of the most likely position of survivors in the water is clearly of critical importance, but such a determination is fraught with uncertainties, some of which can be difficult to quantify. A particularly important factor in the determination of likely target positions is the wind. While forecasts of this element are certainly available, as with any output of a numerical weather prediction model the error intrinsic to wind forecasts can vary considerably with time, location, model run, and forecast lead time. The Canadian ensemble forecast system attempts to quantify these errors in the modelled winds by producing a range of forecasts of their most likely values. This set of forecast winds was used as input to CANSARP, a sophisticated computer package supplying operational guidance for search and rescue operations in Canada. From these wind inputs CANSARP in turn generated a set of possible target positions, from which were constructed probabilistic models for the search area. These probabilistic models will be discussed, along with the metrics used to gauge their performance. Some preliminary results obtained for a set of field trials conducted off the coast of Newfoundland will be presented.

IPY and related atmospheric, oceanographic, and hydrological studies (PART 2) / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie (Partie 2)

Room / Endroit (301), Chair / Président (William Allan Perrie), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-301.1 ID:3060 **13:30**

Arctic blizzard prediction by nonlinear statistical downscaling of GFS Reforecast model outputs

Zhen Zeng [1], *William Hsieh* [1], *William Burrows* [2], *Andrew Giles* [2]
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Blizzards have been identified as hazardous weather events with the greatest impact on human activity in the Arctic, and as the greatest forecast problem there. For the purpose of improving Arctic blizzard forecasts, two nonlinear statistical forecast models -- Bayesian neural network (BNN) and support vector regression (SVR) -- in addition to linear regression (LR), were developed to forecast wind speed at 12, 24, 48 and 72 hr forecast lead times by downscaling the daily reforecast data from the NCEP Global Forecasting System (GFS) nearest to two stations (Clyde River and Paulatuk) in the Northwest Territories and Nunavut regions in Canada, with the 5 winters of 2000-2005 used for forecast validation. After recalibrating the forecasted wind speed from the various models by the cumulative probability distribution, we compared the correlation, the mean absolute error and the extreme dependency score. At Clyde, which has more complicated topography than Paulatuk, the nonlinear models provided slightly better wind speed forecasts than the LR model, while at Paulatuk there was little difference between the nonlinear and linear downscaling methods, though they all dramatically improved on the raw GFS forecasts.

3C-301.2 ID:3019 **13:45**

Long-Term Changes in Summer Meteorological, Sea Ice and Oceanographic

Conditions in the Beaufort Sea

David Fissel [1], *Todd Mudge* [2], *Mar Martinez De Saveedra Alverez* [2]
[1] ASL Environmental Sciences Inc
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Contact: dfissel@aslenv.com

In recent years, changes in the Arctic Ocean weather and ice regime have received widespread attention in terms of the possible link to Green House Gas (GHG) induced effects on the polar climate and the implications of these changes on Arctic regional and oceanographic conditions.

In this paper, we examine trends in summer meteorological and sea-ice conditions on the continental shelf and slope regions of the Canadian Beaufort Sea. The trend analysis was conducted using data collected over the past 30-50 years for selected measurement quantities. The interannual variability for many of these quantities are very large which leads to statistical uncertainties in the statistical significance on the derived trend results. Air temperatures have clearly risen by 2-4 °C according to the measurement location and month of the year. The trends in the monthly surface winds are relatively small in relation to the large degree of interannual variability. Computed trends in sea ice concentrations vary considerably with location. The trends in the fast ice concentrations (early summer and fall) are larger than those in the outer shelf and slope regions. In the latter areas, the regional winds are a major determinant in advection of sea ice, especially from the main Arctic pack ice to the north. The implications of the long-term trends on the regional oceanography are discussed.

3C-301.3 ID:2952 **14:00**

Cloud and Precipitation Features over the eastern Canadian Arctic as Inferred from CloudSat and Aqua

Alex Laplante [1], *Ronald Stewart* [2], *William Henson* [1]
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The capability of researching clouds and the corresponding precipitation fields varies from region to region depending on the remoteness of the area and the accessibility of various technologies. Compared to the mid-latitudes, gathering observational information on weather systems is extremely difficult across the Canadian Arctic.

In an attempt to resolve this issue, the current research aims to improve our understanding of clouds and precipitation over southern Baffin Island and the adjacent oceanic regions. To achieve this, satellite data obtained from CloudSat and Aqua is primarily used for analysis and encompasses a time period from October 1, 2007 through November 30, 2007, corresponding with the Storm Studies in the Arctic (STAR) field research project in Iqaluit. In total, data from 105 orbital passes are available.

With the available satellite data, a two-month climatology of clouds and precipitation features was carried out within which a total of 5 events and the remnants of Hurricane Noel were studied in greater detail. Preliminary results indicate that most storms over the region are deep (>7 km cloud tops), single layer cloud systems. However, multiple layers (up to 4 layers) sometimes occur. Elevated reflectivity values above the surface (sublimation/evaporation) and on the windward side of mountain chains (orographic precipitation) are also evident along with strong vertical and horizontal variations in reflectivity and water content. These and other results will be discussed in the presentation.

3C-301.4 ID:2726 **14:15**

Variability of freshwater pathways in the Arctic Ocean

Alexandra Jahn [1], *Bruno Tremblay* [1], *Marika Holland* [2], *Robert Newton* [3], *Lawrence Mysak* [1]
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The main freshwater (FW) sources for the Arctic Ocean are river runoff and the inflow of low salinity Pacific water through Bering Strait. Changes in the pathways of liquid FW from these different sources can affect the strength of the surface stratification in the Arctic Ocean, with important implications for the sea-ice cover in the affected regions. In addition, changes in the Arctic Ocean liquid FW pathways can influence the magnitude of the liquid FW export through Fram Strait and the Canadian Arctic Archipelago (CAA), which can affect the rate of deep water formation in the northern North Atlantic, with possible far-reaching climatic effects. We present a comparison of climatological FW pathways in the Community Climate System Model (CCSM) version 3 and observational tracer data from Lamont Doherty Earth Observatory, followed by a detailed analysis of the simulated variability of FW pathways in the Arctic Ocean in a present-day equilibrium simulation with the CCSM3 that includes passive tracers for liquid FW from different sources. In particular we show how the contribution of FW from different sources to the liquid FW export through Fram Strait and the CAA changes during strong positive and negative phases of the Arctic Oscillation. Given that climate models predict large changes in the FW budget of the Arctic Ocean during the 21st century, a better understanding of the variability of the liquid FW pathways in the Arctic Ocean is very important.

3C-301.5 ID:2742 **14:30**

Carbon Cycling in the Arctic Archipelago: The Export of Pacific Carbon to the North Atlantic

Elizabeth Shadwick [1], *Tim Papakyriakou* [2], *Friederike Prowe* [3], *Doris Leong* [1], *Stephanie Moore* [1], *Helmuth Thomas* [1]
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The Arctic Ocean is expected to be disproportionately sensitive to climatic changes, and thought to be an area where such changes might be detected. The Arctic hydrological cycle is influenced by: runoff and precipitation, sea ice formation/melting, and the inflow of saline waters from Bering and Fram Straits and the Barents Sea Shelf. Pacific water is recognizable as low salinity water, with high concentrations of dissolved inorganic carbon (DIC), flowing from the Arctic Ocean to the North Atlantic via the Canadian Arctic Archipelago. We present DIC data from an east-west section through the Archipelago, as part of the Canadian International Polar Year initiatives. The fractions of Pacific and Arctic Ocean waters leaving the Archipelago and entering Baffin Bay, and subsequently the North Atlantic, are computed. The eastward transport of carbon from the Pacific, via the Arctic, to the North Atlantic is estimated.

Altered mixing ratios of Pacific and freshwater in the Arctic Ocean have been recorded in recent decades. Any climatically driven alterations in the composition of waters leaving the Arctic Archipelago may have implications for anthropogenic CO2 uptake, and hence ocean acidification, in the subpolar and temperate North Atlantic.

3C-301.6 ID:3091 14:45

CO2 exchange between Arctic sea ice and the atmosphere: a second look.

Tim Papakyriakou [1], *Lisa Miller* [2], *Brent Else* [1]
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Independent observations using chamber and eddy covariance techniques involving open-path infrared CO2 analyzers, have shown that considerable CO2 is taken into sea ice throughout the winter to summer seasonal transition. This finding had ramifications on both our understanding of the Arctic marine ecosystem and the region's carbon budget. However, growing concern in the flux community that cold weather CO2 flux measurements associated with open-path CO2 analyzers often give an apparent ecosystem CO2 uptake, where such fluxes would be highly unlikely, prompted an investigation into the behaviour of the gas analyzer. A source of potential bias associated with cold- weather CO2 flux measurements using open-path eddy covariance systems was in fact identified, and in light of this finding, data sets of Arctic sea ice – atmosphere CO2 exchange from three different experiments were reanalyzed. The results indicate a low level CO2 efflux from Arctic sea ice, punctuated by short periods of uptake thought to be associated with a sea ice carbonate pump and photosynthetic uptake. The results contradict earlier reports from different labs of prolonged periods of CO2 uptake by sea ice.

Coastal Oceanography and Inland Waters (PART 3) / Océanographie côtière et les eaux intérieures (Partie 3)

Room / Endroit (302), Chair / Président (Jinyu Sheng), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-302.1 ID:2751 INVITED/INVITÉ 13:30

An oxygen budget for the Strait of Georgia from ferry-based (and other) measurements

Rich Pawlowicz
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One goal of the STRATOGEM program was to determine the physical circulation of the Strait of Georgia, British Columbia. A model for this circulation (Pawlowicz et al., Atmos. Ocean 45, 2007, pg. 173-193) adequately explained seasonal variations in heat, salt, and fresh-water budgets, and suggested a rate at which dissolved oxygen was used up in the deep water, but provided no explanation for this rate. In addition, STRATOGEM hydrographic observations of near-surface oxygen levels showed variations over an unexpectedly wide range, from 80% to 150% of saturation. In order to better understand these and other observations a food web/carbon flow analysis was carried out on observations from 2002-2005, and an oxygen sensor was added to an existing suite of instruments on a ferry crossing the Strait 8 times a day for a 9 month period in 2006. The carbon flow analysis suggested that the deep oxygen decay was primarily due to respiration of diurnally migrating zooplankton. The ferry dataset confirmed previous observations of seasonal variations near the surface, and in addition showed that oxygen levels were surprisingly variable on even very short time scales, with daily oscillations of as much as 20% of saturation. A scaling analysis of the oxygen budget suggests that air/sea fluxes are not an important component of the budget, but that over short time scales the major terms in the budget are biological productivity, respiration, and the storage of oxygen in the stratified upper waters. Over longer time periods advective effects arising from the estuarine circulation are more important than air/sea fluxes. Further analysis suggests that we can separate primary productivity and respiration by comparing nighttime-only and daily oxygen variations, and by examining daily variations derive in-situ growth versus light curves for the autotrophic community.

3C-302.2 ID:3052 14:00

Improve the utility of a coastal circulation model by assimilating hydrographic observations into the model momentum equation

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A numerical scheme is presented to assimilate hydrographic observations into the momentum equation of a limited-area coastal ocean circulation model. This new scheme has an advantage that hydrographic assimilation is only made in the model momentum equations and the model temperature and salinity equations are fully prognostic. The performance of this new scheme is assessed using a nested-grid coastal circulation model developed for Lunenburg Bay of Nova Scotia, Canada. Model results demonstrate that this new scheme improves significantly the performance of the coastal circulation model in simulating the temperature and salinity distributions and circulation over coastal waters.

3C-302.3 ID:2705 14:15

A high-order numerical study of western boundary current separation along a curved coastline

Derek Steinmoeller , *Francis Poulin* , *Serge D'Alessio*
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Western boundary currents, such as the Gulf Stream and the Kuroshio, are of great interest because they contribute significantly to the pole-ward transportation of heat, chemistry and biology in the world's oceans. The dynamics of these currents are highly nonlinear and thus numerical simulations are perhaps the best tool available to study them. Recent advances in understanding the separation process of western boundary currents are due to simulations that integrated the barotropic Quasi-Geostrophic model using low-order numerical methods such as finite differences or the finite element method as in [1].

The goal of our study is to use a high-order spectral method to study the evolution of western boundary currents since they can better resolve the Munk layer that arises along the coastline. This is important because the boundary-layer dynamics are fundamental to the flow separation phenomenon. Results will be given for coastlines of various curvatures and for a wide range of Reynolds number and non-dimensional beta parameters. The previous aforementioned study focused on the separation of the time-averaged flow. This study is complementary in that we instead analyze the transient separation that occurs for relatively short times.

1. Munday, D. R., and D. P. Marshall, 2005: Separation of western boundary currents from a cape. J. Phys. Oceanogr., 35, 1726-1743.

3C-302.4 ID:2694 14:30

Hydrodynamic Modeling of Lake Ontario: An intercomparison of three hydrodynamic models

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The Laurentian Great Lakes have horizontal scales of hundreds of kilometres and depth scales of hundreds of meters. The lakes have a profound influence on the local weather. Currently, the lake-ice component of the operational atmospheric system in the Canadian Meteorological Centre is treated as static, with the water surface temperature values being specified based on observations for determining heat fluxes into the atmosphere at the surface of the lake. However the air-lake interface is dynamic with momentum exchange, heat exchange and moisture/water exchange. Recognizing these needs Environment Canada in collaboration with other agencies started developing a framework for coupling of weather prediction models with hydrological and lake models. As part of the project three existing lake models namely, Princeton Ocean Model (POM) and Estuary Lake Coastal Ocean Model (ELCOM) and Canadian Version of DieCAST (CANDIE) will be applied to the lower Great Lakes. An intercomparison of these models with the time series observations of circulation and temperature from April to October, 2006 has been carried out in Lake Ontario. In this paper, we describe preliminary results of temperature and circulation obtained from these three hydrodynamic models in Lake Ontario.

3C-302.5 ID:2985 **14:45**

Internal wave generation in the St. Lawrence Estuary

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Mixing in coastal environments is a process affecting many branches of oceanography; it contributes to fluxes of heat and salt, and redistributes chemical and biological tracers. Internal waves are a common feature in the stratified ocean, and are believed to be an important contributor to mixing. Recent and ongoing studies in the St. Lawrence Estuary have identified regions of internal wave propagation and dissipation, but to date little has been done to examine the generation phase. Fieldwork performed in the summer of 2008 identified a potential source region for internal waves, and data were collected to characterize the physical properties of the water column and tidal flow. This presentation will focus on shipboard and moored ADCP time series, echosounder transects, and CTD data as they relate to several different theories for wave generation.

Radiation, Aerosols and Cloud (PART 2)/ Radiation, aérosols et nuages (Partie 2)

Room / Endroit (303), Chair / Président (Jiangnan Li), Date (03/06/2009), Time / Heure (13:30 - 15:00)

3C-303.1 ID:2860 INVITED/INVITÉ 13:30

Aerosols, clouds, and their effects on climate and ecosystem

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Understanding climate factors that control interannual variability of the terrestrial ecosystem provides more confidence in the long-term projections of human-induced global changes on the ecosystem. The impact of aerosols and clouds on CO2 uptake and water use efficiency has been studied by using collocated turbulent flux and radiation measurements. By analyzing the 1992-2004 record of CO2 flux at a deciduous forest in New England, we found that cloudiness, combined with the effect of antecedent accumulated precipitation from late January, plays a key role in controlling interannual fluctuations of the steady-state GEE and NEE among other environmental factors. Two factors account for 81% of the interannual variability of forest carbon uptake for the steady-state, and 58% for the entire growing season, respectively. This suggests that clouds play a pivotal role in driving the interannual variability of terrestrial carbon uptake by this forest and are an important mechanism of carbon cycle/climate interaction.

3C-303.2 ID:2676 14:00

An evaluation on global aerosol simulation in CCCma AGCM4 model

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The CCCma AGCM4 model is run to simulate global cycles for five major aerosol species, including sulphate, sea salt, mineral dust, organic carbon and black carbon. The model approach accounts for emissions, advection, sulphate gas-phase and in-cloud production, sedimentation, and dry and wet deposition of aerosol. Some of the parameterizations were recently updated. Masses and optical depth at 550nm for each aerosol species are diagnosed in the model. The burdens for different aerosol species agree well with the results of other models which participated in the AEROCOM aerosol model intercomparison project. Furthermore, results from different satellite systems were used to validate model results for aerosol optical depth.

3C-303.3 ID:3083 14:15

Global Simulations of Aerosol Size-Dependent Impaction Scavenging in the ECHAM5-HAM GCM

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Wet scavenging processes are highly efficient in the removal of aerosols from the atmosphere, and thus strongly control the global 3-dimensional distribution of aerosols, and their impacts on Earth's radiation budget. In this study, aerosol size-dependent below-cloud, and in-cloud impaction scavenging is introduced into the ECHAM5-HAM general circulation model. In separate sensitivity studies, the revised impaction scavenging is combined with both a diagnostic, and a prognostic nucleation scavenging parameterization. The physically detailed representation of the collision processes between aerosols, and the various hydrometeors (rain, snow, cloud droplets, and ice crystals) is compared to the current approach, which uses fixed coefficients for the impaction scavenging.

In-cloud impaction scavenging is found to account for nearly 10% of the global and annual mean mass removal of dust and black carbon, which can be hydrophobic on emission, but only 1% for sea salt. Whereas, below-cloud scavenging is found to account for nearly 20% of the annual and global mean mass removal of sea salt and dust. This study quantifies the relative importance of impaction versus nucleation scavenging in the upper troposphere, where black carbon has an important warming effect. Comparison with different observations is also presented. Impaction scavenging is shown to be an important process controlling modeled global aerosol profiles.

3C-303.4 ID:3113 14:30

MAESTRO Measurements of Atmospheric Aerosol Extinction

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Aerosols in the atmosphere both scatter and absorb light. Uncertainty in the magnitude of these effects on atmospheric radiation is one of the biggest uncertainties in estimates of the radiative forcing of climate. The Measurement of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation (MAESTRO) experiment on the Atmospheric Chemistry (ACE) satellite is making measurements of optical depth in the atmosphere which are analyzed to produce aerosol extinction profiles. The instrument and the retrieval technique will be described and some extinction profiles will be presented.

3C-303.5 ID:2667 14:45

Evaluation of CRCM output during the 1999-2004 Canadian Prairie drought

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The information from the Canadian Regional Climate Model (CRCM) can be applied to

improve prediction of Prairie drought in order to reduce its devastating environmental, societal, and economical effects. One can, for example, use the CRCM to investigate the importance of certain feedbacks in maintaining the drought. A necessary step before using the CRCM for such purposes is to establish how well the model reproduces observed features of the drought. In this study, satellite and surface station data from the recent and severe Canadian Prairie drought of 1999-2004 are used to compare with the model output. The absolute data fields examined include precipitation, cloud distributions, surface albedo, and top of atmosphere albedo. Cloud amount-Standardized Precipitation Index (SPI) correlations, and top of atmosphere (TOA) albedo-SPI correlations are also compared. Overall, the CRCM performs well in the areas examined and gives confidence in its usefulness as a tool to understanding Prairie drought.

POSTERS Air Quality: Delivering the Right Message / Qualité de l'air: délivrer le bon message

Room / Endroit (100), Chair / Président (Doug Steeves), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-A4.1 ID:2717 **15:00**

Ambient total gaseous mercury, NO_x and SO_2 signatures from coal-fired power plants in the Lake Wabamun area of Alberta, Canada

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The Lake Wabamun area, in Alberta, is unique within Canada as there are four coal-fired power plants within a 500 km^2 area. This poster will describe the results from continuous monitoring of ambient total gaseous mercury (TGM) concentrations at two sites in the Lake Wabamun area, Genesee and Meadows. Five years of data were analyzed in an attempt to characterise the effect of the coal-fired power plants on the regional TGM. Mean concentrations of 1.57 ng/m^3 for Genesee and 1.50 ng/m^3 for Meadows were comparable to other Canadian sites. Maximum concentrations of 9.50 ng/m^3 and 4.43 ng/m^3 were comparable to maxima recorded at Canadian sites influenced by anthropogenic sources. The TGM data were analysed in conjunction with NO_x and SO_2 concentrations, as well as wind direction. Distinct episodes of high TGM, NO_x and SO_2 emerged from the dataset and ratios of NO_x/TGM and SO_2/TGM were calculated for those episodes. Compared to the entire dataset, analysis of the episodes originating from the direction of the coal-fired power plants showed modest increases in TGM, with more substantial increases in NO_x, SO_2, NO_x/TGM and SO_2/TGM ratios. AERMOD modeling of the coal-fired power plants under normal operating conditions predicted hourly ground level TGM concentrations ranging within 0.46-1.19 ng/m^3. The combination of episode

analysis and AERMOD modeling allowed for the characterization of a coal-fired power plant signature based on high TGM, NO_x and SO_2 concentrations and northwest wind directions. Additionally, electricity production data were analyzed with the TGM episodes and the results provided evidence that ambient TGM levels rise prior to start-up of an electricity generating unit. As of January 2009, speciated mercury data is being collected at Genesee to supplement the findings of this study. Preliminary results from the speciated monitoring program will be presented.

3D-100-A4.2 ID:2731 **15:00**

Assessing the penetration of stratospheric air in the foothills of the Canadian Rockies

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Due to the need for improvement in the capability of identifying and estimating the influence of stratospheric ozone intrusions in the foothills east of the Canadian Rocky Mountains, coincident high O3 and Be-7 concentrations from late March to early June of 2004 are investigated at a high altitude site in Harlech Alberta. Three possible stratospheric intrusion events are identified in the dataset. To further understand these events, the operational Lagangian dispersion model of the Canadian Meteorological Centre (CMC) was executed in inverse mode, using the operational numerical weather analyses available for this time period. Be-7 is a radioactive isotope produced in the upper layers of the atmosphere by the impact of cosmic rays on nitrogen and oxygen atoms. Many studies show that Be-7 can be used as a tracer for stratospheric air, but also describe problems associated with this method. The present study is subject to similar problems; however based on the modelling results, it can be shown that the high Be-7/O3 events were most likely due to the penetration of stratospheric air into the boundary layer. The modelling results indicate that some of the events identified in the dataset can be related to more than one intrusion occurrence, which take place at large distances away from where the high Be-7/O3 concentrations are measured at the surface. The dispersion model can also be used to estimate Be-7 concentrations in the stratospheric air, upon entrance in the troposphere. The study finds that the main features characterizing stratospheric intrusions into the troposphere are captured by the CMC objective meteorological analyses. Suggestions on the application of the method in an operational setup are presented.

3D-100-A4.3 ID:3023 **15:00**

Troposphere Climate Change and Associated Impacts on Air Quality in Ontario. Part 1: Climate changes as revealed by NARR data

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[2] Environmental Monitoring and Reporting Branch, Ontario Ministry of the Environment

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There is a two-way interaction between air quality and climate change. During the past few decades, research has been focused on one side of this interaction, i.e., impacts from air quality on climate change. However climate change does have significant impacts on air quality. The issue we are starting to address is whether climate change trends over Ontario and upwind US states will significantly affect the air quality in Ontario? What are the percentage impacts of climate change on air quality constituents such as ozone, PM2.5 and NO2? The primary objectives are to better understand how the climate in Ontario and upwind US states has changed during the past 30 years and how these climate changes impact the air quality during the same time period. Once this is understood we can investigate how projected changes in the climate by 2050 will affect air quality in Ontario. This will require modelling including both projected emission changes and climate changes by 2050. We will report climate change trends within the troposphere over Ontario and upwind US (source) states, as revealed in the 3-hourly (8 times daily) high resolution (32km) North America Regional Re-analysis (NARR) data from NOAA (1979-2007). Further work will focus on analyzing air quality change trends, their correlation with climate change trends, and the physics behind these correlations.

3D-100-A4.4 ID:2962 15:00

Evaluation and impacts of an online biogenic emission model in GEM-AQ using summertime ozone episodes in North America

Kenjiro Toyota , *Alexandru Lupu* , *Jacek Kaminski* , *John C. Mcconnell*
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GEM-AQ is an online multiscale air-quality model for simulating tropospheric gaseous oxidants and aerosols from regional to global scales. The model is built on Environment Canada's weather forecast model, GEM (Global Environmental Multiscale model), to which we have implemented models of gas-phase chemistry and aerosol microphysics. We are currently upgrading GEM-AQ to include the online terrestrial biogenic emission model MEGAN (Model of Emissions of Gases and Aerosols from Nature) and to account for day-to-day as well as interannual variability in the emissions of isoprene and other volatile organic compounds and even for its future projection under global warming. Simulated biogenic emissions and their photochemical impacts are evaluated for global model runs at moderate spatial scale and for regional model runs focusing on air quality in Ontario by using OMI satellite measurements of HCHO column densities and aircraft measurements of trace gases. Impacts on simulated surface ozone levels in North America and some implications for future projection under global warming will be addressed.

3D-100-A4.5 ID:2997 15:00

Impact of a New Lightning NOx Parameterization in GEM-AQ

Lori Neary

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In the upper troposphere, NOx (NO+NO2) plays a major role in the generation of ozone where it behaves as a greenhouse gas. The main sources of NOx in the upper troposphere are lightning and transport from the boundary layer associated with deep convection. Measurements from satellite and aircraft can contribute to a quantitative understanding of the budget but it is still not well determined as convective activity appears to have different characteristics in different regions of the globe. Thus there is some uncertainty as to the amount of that is emitted, but recent estimates suggest it is between 2 and 8 Tg nitrogen per year.

In this study, a parameterization for LNOx has been implemented in the Global Environmental Multiscale model with on-line Air Quality processes (GEM-AQ) (Kaminski et al., 2008). The parameterization is based on the method by Price and Rind (1994) which uses convective cloud top height as an indicator for lightning. Results from a global 1.5x1.5 degree resolution simulation will be presented. Lightning flashes are compared with a climatology from the Optical Transient Detector (OTD) and Lightning Imaging Sensor (LIS) satellite instruments and atmospheric trace gases are examined using measurements from the INTEX-A aircraft campaign.

3D-100-A4.6 ID:2788 **15:00**

New parameterizations for air-sea exchange and dry deposition of slightly soluble gases for regional and global AQ models over coastal water and ocean.

Alain Robichaud
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Dry deposition is an important removal mechanism for many trace gases influencing the net regional and global chemistry budgets. Even small uncertainties in air-sea exchange rates may produce significant consequences on ozone and other constituents over coastal water and ocean and therefore affect tropospheric chemistry budget. At high wind speed and long fetch conditions, the air-sea exchanges are augmented by about one order of magnitude giving dry deposition for ozone up to 0.25 cm/s for example. At low winds speeds and/or small fetch situations, the high variability of dry deposition reported in observations performed within the marine boundary layer could be better explained by the knowledge of marine chemistry. For example, ozone deposition is enhanced in the presence of iodide associated with algae and phytoplancton. Currently Canadian air quality models (CHRONOS, GEM-MACH, GEM-AQ and AURAMS) treat the air-sea exchange coefficient with a simplistic approach based on a constant value for the surface resistance. In this paper, new approaches involving wave analysis charts and proxies for relevant marine chemistry effects are discussed with the goal of better representing air-sea exchange and surface resistance for slightly soluble gases in both regional and global models.

POSTERS Operational Meteorology/ Météorologie opérationnelle

Room / Endroit (100), Chair / Président (Paul Ford), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-A5.1 ID:2688 **15:00**

Study of cold lows in Arctic observed and simulated by GEM models

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The increase in greenhouse gas allowed to put in the foreground the importance and the influence of the polar regions in the global climatic system. Lately, the majority of the scientific community admitted that climatic changes are more intense in Arctic and Antarctic than anywhere else. The warming caused by greenhouse gas is twice greater in Arctic than for the rest of the Globe as mentioned by the Arctic Climate Impact Assessment (ACIA, 2004). Why do we have interest in cold lows in Arctic ? First of all, all climatic models predict the higher increase for the temperature in winter in Arctic but data from surfaces and satellites show a diminution in temperature in several regions. These contradiction can be explain by the fact that Dehydration Greenhouse Feedback (DGF) effect implies a cooling in the atmosphere caused by a cyclic feedback. And the cold lows are one of the most important elements to cause these cooling. Indeed, cold lows allow the rise of moist air supporting the nucleation of big ice crystals who will precipitate and in result dehydrate the atmosphere. The dehydration cause a cooling by loosing of long waves from the ground. The goal of these work is to confirm these feedbacks by comparing GEM models with three different alternatives (global, limited area and stretched) and the data from reanalysis and at the end to check what kind of elements can reduce the difference between models and data from observations. These elements are certainly the boundary conditions and the resolution of model but the important fact is to determine their influence on output data from GEM model. In order to measure the representation of cold low by GEM model, it will be interesting to compare the years where the NAO index is negative from positives NAO. These comparison will take into account the extreme periods allowing to emphasize more easily the variations. The parameters used will be the temperature, pressure, heights at several levels and the relative humidity. The resolutions used for the GEM models are 2 degrees for the global model and 0.5 degree for LAM and stretched models.

3D-100-A5.2 ID:2885 **15:00**

UMOS-AQ: Forecasting O_3, PM_{25} and NO_2 three-hourly spot concentrations using an updatable MOS methodology - Latest developments

Stavros Antonopoulos
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The UMOS-AQ system produces one equation per station, per predictand, per model run and per forecast hour. It has been forecasting pollutant concentrations on an experimental level for the last twelve months with a significant improvement over the model's direct forecast.

Over the course of several months further additions and improvements were made in order to make UMOS-AQ an important tool in AQHI forecasting.

The latest updates include, among others, the addition of nitogen dioxide (NO2) as a predictand and the expansion of the number of air quality stations used in the forecast.

An overall description of the UMOS-AQ system will be highlighted. Seasonal and global verification results will be presented that demonstrate the value of UMOS as an air-quality forecasting tool.

3D-100-A5.3 ID:2912 15:00

Development of Verification Macros to support the CMAC Performance Measurement Feedback Program

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We all realize that verification is an essential tool for forecast improvement.

Over the past 4 years CMAC-West (Canadian Meteorological Aviation Centre) has developed a Performance Measurement Feedback Program for operational forecasters. The need for this feedback program in CMAC was driven by the certification process for the ISO standard of continual improvement.

The statistics for all of the TAF sites for the month are computed by the Aviation TAF Performance Measurement group in Toronto and put on their web page (http://performance.ec.gc.ca/aviation/main_e.html). The verification people in the office pull the stats off of that page and cut out the stats for the various TAF sites in their sector. In the past it took a fair amount of time and work to organize the data and then analyze it. Each sector did it slightly differently for their report. Some sectors required more work than others.

I decided to make a macro to do the repetitive work of cutting the same rows and columns out and added a colour code to aid in interpretation. I also made macros for the other sectors to develop some standardization in our reports across sectors. These macros are now used by all sectors in CMAC-West.

Now, instead of an hour of cutting, pasting, and colouring, we use control-k, and the work is done in seconds.

This tool gives the office several things: • Standardization of the verification report tables between sectors • Much less repetitive work each month • High "glance value" • Ease of seeing poor scores • More time to delve into the reasons for poor scores (if statistically significant) • We can compute and add other statistics that we find useful • We can tailor the report for the way we like to see it

3D-100-A5.4 ID:2929 15:00

Évaluation de la passe en parallèle Gulf du modèle Régional Gem / Evaluation of Gem Reg parallel run Gulf

Catherine Vallières
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Une procédure d'évaluation scientifique a été mise en place au début janvier 2009 au CPIQ en ce qui à trait au couplage entre le modèle atmosphérique et un modèle océanique permettant de faire évoluer le champ de glace sur le Golfe du St-Laurent. Cette vérification concerne les différences pour les nuages bas, les précipitations, la température, les vents et le champ de glace. Les différences entre la passe en parallèle du Régional GEM et le GEM régional seront soulevées et les résultats de cette vérification qualitative et quantitative sur différents champs météorologiques seront analysés.

A scientific evaluation method has been created in the beginning of january 2009 at QSPC for the two-way coupled atmosphere-ocean-ice system in the gulf of St-Lawrence. The verification concerns low-level clouds, precipitations, temperature, winds and ice fields. Differences between Gem Reg parallel run and Regional-GEM will be mentionned and verification results will be analyzed.

3D-100-A5.5 ID:2970 15:00

Vertical Reflectivity Profiles of Precipitation During the STAR Field Campaign

William Henson [1], *Ronald Stewart* [2], *David Hudak* [3]
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Storms and precipitation in the Arctic are of immense importance. Over the past few decades, there is evidence that the occurrence of severe storms has increased over the Arctic, and further changes are expected with anticipated climate change. The recent Arctic Climate Impact Assessment (ACIA) highlighted significant changes in Arctic weather and climate patterns and a need for more research into extreme and adverse weather/climate processes, including high-resolution modeling and field experiments. During the autumn of 2007, a major field campaign in the Canadian Arctic was conducted. The aim of the Storm Studies in the Arctic (STAR) project, as a whole, is to focus hazardous Arctic storms and provide a better understanding of the physical features

of Arctic storms and their hazards, the processes controlling them, and our predictive capabilities for them. In order to make progress on this critical issue, STAR focused on storms that occur in or near Iqaluit, the capital of Nunavut in southern Baffin Island. STAR brought together many university and government researchers with expertise encompassing the study of the atmosphere, surface-atmosphere interactions and predictive aspects of storms. The goal of the current research is to examine precipitation events that occurred over Iqaluit during STAR. The emphasis is placed on events that had significant precipitation accumulation. This examination is carried out using Doppler radar data, ground based precipitation gauge data and surface observations. It was found that there were three significant precipitation events during the STAR period. These precipitation events accounted for 65% of the precipitation that occurred during STAR, they nonetheless had low reflectivities and accumulation (maximum of 29 dBZ and a maximum of 8 mm daily accumulation, liquid water equivalent), there were at times several cloud layers (as many as 5) and there were significant changes in both reflectivity and average fall speed with height during the events. These and other results will be discussed in the presentation.

3D-100-A5.6 ID:3004 **15:00**

The Ontario-Quebec Wind-profiler network (OQNet)

Peter Taylor [1], *Shama Sharma* [1], *P-Y Li* [1], *Wayne Hocking* [2]
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Following initial deployments at University of Western Ontario and McGill University, WindTtracker VHF wind profilers have been operating at Walsingham and Harrow, Ontario for several years. Additional units are now operating at three other locations including the Environment Canada site at Egbert, Ontario. At the Harrow location we also have a surface weather station reporting 10-m winds and we ran a sodar unit to obtain winds in the lowest few hundred meters during January-April 2008 for comparison with the VHF data. Differences between winds at various levels will be discussed. Case studies using data from several profilers will be used to illustrate detection and tracking of meteorological features across southern Ontario.

POSTERS Radiation, Aerosols and Cloud / Radiation, aérosols et nuages

Room / Endroit (100), Chair / Président (Jiangnan Li), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-A6.1 ID:2940 **15:00**

A Statistical Model for Use in Large Scale Models

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Presented in this thesis is a new probability distribution function(PDF) for conserved atmospheric variables that is required in the implementation of the statistical cloud scheme. The PDF is developed by analysing existing observational cloud data obtained from aerial runs through cumulus and stratocumulus clouds. It is demonstrated that, the proposed PDF exhibits most of the observed characteristics of the cloud data including variation in skewness, uni and bi modality and variation in the location and magnitude of the maximum frequency. The model parameters appearing in the PDF are successfully determined by matching with the observed data. The cloud fraction and the liquid water contents are then consistently predicted by integrating the appropriate formulation described by the statistical cloud scheme. It is demonstrated that the new PDF provides cloud simulations that are both qualitatively and quantitatively consistent with the observed data.

POSTERS The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) / Les Orages Violents compréhensifs et L'Expérience de la couche limite Albertaine

Room / Endroit (100), Chair / Président (Neil Taylor and David Sills), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-A7.1 ID:3018 **15:00**

Examination of moisture and density gradients observed by the FCA during UNSTABLE

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During July 2008 as a part of the UNderstanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE), a subset of 20 weather stations in the mesonet known as the Foothills Climate Array (FCA) were used to take one-minute observations of temperature and relative humidity in an area between Calgary and Edmonton. An analysis of this data was performed to identify and track the motion of

drylines within the mesoscale station array. Severe weather associated with dryline activity was also noted and compared to characteristics of the two air masses that compose the dryline. Density of the air masses was analyzed for identified drylines and compared to Southern Great Plains dryline climatology. A strong density gradient, indicative of a density current and consistent with Southern climatology, was identified, but severe weather was not recorded. Density reversals were also identified and paired with severe weather suggesting that preexisting buoyancy of the western boundary layer better facilitates convective initiation.

Dryline and severe weather events recorded were also compared to mesoscale model simulations to test the skill of mesoscale models in recreating observed weather associated with drylines. Moisture gradients were found to be consistently less than observed. Low mixing ratio values in the western boundary layer indicate model deficiency in capturing low level moisture likely tied to intensity of evapotranspiration in the model.

POSTERS Meteorological Preparations for the 2010 Olympic Winter Games / Préparations météorologiques pour les jeux Olympiques d'hiver 2010

Room / Endroit (100), Chair / Président (Chris Doyle), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-A9.1 ID:2737 15:00

Whistler Mountain Climatology: Temperature Lapse Rates in Complex Terrain for the 2010 Olympics

Lisa Erven , *Ian Mckendry*
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Temperature lapse rates on highly sloping terrain deviate greatly from those expected over idealized flat surfaces due to the effects of shading, aspect, and localized channeling through valleys. At Whistler, British Columbia, the installation of a wide array of meteorological instrumentation in connection with 2010 winter Olympics has created an unprecedented opportunity to investigate such phenomena. Here, we conduct a set of observations designed to examine temperature structure with a high resolution profile of temperature and humidity sensors installed on the mountain slope. The goal of this research is to characterize lapse rate evolution patterns under various synoptic conditions and investigate the influences on mid-mountain cloud formation (an acknowledged problem for ski operations on Whistler/Blackcomb Mountain). The findings of this

project will aid in a forecaster's ability to predict an upcoming low-visibility event which impact safe management of ski hill activity.

Instrumentation consists of five Environment Canada weather stations recording hourly temperature, pressure, humidity and wind speed; three weather stations run by Whistler Mountain recording temperature, relative humidity and wind; both of which are further supplemented by the installation of five Hobo data loggers in order to provide higher resolution temperature and relative humidity measurements in the zone critical to the analysis of mid-mountain cloud formation. In addition to these automated systems, a series of web cameras will provide visual verification of cloud formation while a ceilometer will measure cloud base heights. Initial results will be presented from the complete instrumentation array.

3D-100-A9.2 ID:2988 **15:00**

Strong outflow wind events affect the Callaghan Valley Olympic venues

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During the years leading up to the 2010 Winter Olympics, Olympic Forecasters have been on-site supporting local venue operations and competitions. Each forecast practicum presents different challenges and lessons that are taken back to be shared with the rest of the forecast team. So far, the forecast team has amassed a better understand of the local weather patterns under a variety weather regimes present along coastal British Columbia. However, Mother Nature still tends to throw a few surprises into the mix now and again.

Strong outflow conditions present during the period of December 13th to December 18th, 2008 and again in late January, 2009 have unveiled a local wind regime that has the potential to impact ski jump events leading up to and during the 2010 Olympics. By inter-comparing these events, a conceptual model for this wind regime has been developed to help forecasting efforts of future events.

3D-100-A9.3 ID:3114 **15:00**

Operational evaluation of GEM-LAM 2.5 km and 1.0km models in view of the Vancouver 2010 Games.

Andre Giguere , *Ron McTaggart-Cowan* , *B. Denis* , *A. Erfani* , *N. Mclennan* , *J. Milbrandt*
Environment Canada
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During the winter of 2009, GEM-LAM 2.5 and 1.0km models with domains specifically designed for the 2010 Winter Olympic and Paralympic Games were integrated twice daily, starting at 09 and 21Z for 17 hours for the 2.5km model, and at 11 and 23Z for 15 hours for the 1.0km model. These LAM runs were using initial conditions of the 06Z and 18Z GEM-Regional runs (same day).

The last Practicum period for the 2010 Olympic Forecast Team in view of next year's events was held from January to March 2009. It provided the ultimate opportunity to test these models in an operational setting. This presentation will focus on some specific weather events that challenged these LAM models, and on the input of the forecasters involved in the Practicum period that could lead to model improvement before the 2010 Vancouver Olympic and Paralympic games.

3D-100-A9.4 ID:2866 15:00

Ensuring a quality Weather Services program for the 2010 Olympic Winter Games

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As part of the process of ensuring the provision of a quality weather services program for the 2010 Olympic Winter Games, we have made a point of gathering, throughout the practicum period, feedback from our Olympic weather services clients. These are usually (but are not limited to) the managers of the various outdoor sports venues. Other sources of feedback include the Vancouver Organizing Committee Sports Vice-president, International Sports Federation visitors and other officials who have come to Vancouver to participate in and sometimes operate various sporting test events in preparation for the winter Olympics next year. MSC's role in 2010 includes weather support to essential Federal services agencies like the RCMP. As these agencies' Games-ready units have only recently been formed and tested, feedback is sparse. To compensate for this, MSC has played an active role in the Olympic security exercises that have taken place and will take place prior to Game's time. Feedback and lessons learned from practicum weather services operations and exercise participation will be discussed, as will actions taken in response.

POSTERS Paleo-Oceanography and Paleo-Climatology / Paléo-océanographie et paléo-climatologie

Room / Endroit (100), Chair / Président (Markus Kienast), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-C2.1 ID:2683 15:00

A carbon cycle box model study of the role of methane during the Paleocene-Eocene thermal maximum

David A. Carozza , *Lawrence A. Mysak*
(Presented by *David Carozza*)
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The Paleocene-Eocene Thermal Maximum (PETM) was a period of intense climate change set off by the release of unprecedented amounts of isotopically light carbon. Although the source of this carbon is still being investigated, terrestrial and ocean temperatures are estimated to have increased from 3 to 9°C in only a few thousand years, while precipitation in high latitudes is thought to have increased dramatically. Methane is now thought to have played a pivotal role during the PETM. Two prominent theories of the cause of the PETM propose that large amounts of methane were released into the exogenic carbon cycle, while evidence of enhanced methane production in wetlands points to high background methane concentrations as well as a positive methane feedback. Modeling work has also shown that significant additions of methane can generate PETM latitudinal temperature profiles without the need for high concentrations of carbon dioxide. In this study, the two-box atmospheric methane model due to Schmidt and Shindell is coupled to the carbon cycle box model of Walker and Kasting to explore the role of methane in the PETM. Previous studies have suggested that a part of the methane released in the ocean is not oxidized there and is quickly transferred into the atmosphere. Methane that is oxidized in the ocean creates an enhanced flux of carbon dioxide from the ocean to the atmosphere. This latter flux is calculated and can be used, along with measured carbon isotope excursions, to constrain possible PETM emission hypotheses.

3D-100-C2.2 ID:2770 15:00

Glacial maximum to Holocene contrasts in the dynamics of the eastern equatorial Pacific

Nathalie Dubois [1], *Markus Kienast* [1], *Stephanie Kienast* [1], *Claire Normandeau* [1], *Timothy Herbert* [2]
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The eastern equatorial Pacific (EEP), due to strong climatic asymmetries and very dynamic ocean-atmosphere linkages, is a critical region for the understanding of past global climate changes. Here we present new alkenone-based sea-surface temperature (SST) estimates for the last 30kyrs and combine them with recently published records to reconstruct the spatial SST pattern in the EEP during the last glacial maximum. Alkenone-based SST estimates show a greater glacial cooling in the upwelling environment of the cold tongue than in sites located further north in the equatorial front and Eastern Pacific Warm Pool. This result supports the paradigm of stronger glacial winds, increased upwelling, steeper zonal thermocline tilt and stronger advection of cold water in the Peru Current. Furthermore, we show that changes in sea surface salinities linked to a southward shift of the Intertropical Convergence Zone could explain contrasting reconstructions based on planktonic foraminifera $\delta^{18}O$ and Mg/Ca. Ocean upwelling dynamics will be discussed drawing on records of glacial-interglacial changes in surface ocean productivity and nitrogen isotopes.

POSTERS Climate Data Homogenization / Homogénéisation des données climatique et l'analyse des tendances

Room / Endroit (100), Chair / Président (Lucie Vincent), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-C3.1 ID:2763 **15:00**

Canadian special metadata database for climate data homogenization

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The accuracy and homogeneity of climate data are very important in many aspects of climate data application. In particular, long-term, homogeneous time series of climate data are essential for the assessment of climate trends and variability. Unfortunately, many kinds of changes (such as instrument/observer changes, and changes in station location/exposure, observing practices/procedure, etc.) that took place in the period spanned by a climate data time series could cause non-climatic changes in the time series. Such artificial changes should be eliminated, to the extent possible, from the time series prior to its application, especially its application in climate trend assessment. To this end, it is of crucial importance to develop a special metadata database that records all kinds of changes, and only changes, during the lifespan of each station of long-term climate data, because reliability/confidence of climate data homogenization increases significantly with historical metadata support. Canadian special metadata database is developed for use in climate data homogenization. This database is a "purified" version of the voluminous Station Inspection Reports (SIRs) and other metadata sources; it contains only information related to changes in the observation history that may cause non-climatic changes in the climate time series. In this presentation, the sources and the structure of this metadata database are addressed; a few examples of queries from the database are shown to illustrate how to get user desired information.

3D-100-C3.2 ID:3043 **15:00**

Systematic Errors in Reported Mean Sea Level Pressure for Canadian Stations Resulting From Potentially Different Applications of the Plateau Correction.

Christopher Hampel
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In 1886, Ferrel postulated that observed amplifications in the annual variation of MSL

pressure for elevated stations are primarily due to differences between annual variations in temperature observed at land stations and the actual variations that would be observed in free air in the absence of a mountain or plateau. He introduced the so-called plateau correction to account for this effect. The Smithsonian tables represent the correction mathematically in Ferrel's original form as a pressure correction that is linearly proportional to the product of the station elevation and the deviation of the station virtual temperature from its annual mean. In Canada, the plateau correction is applied differently as recommended in the WBAN as a correction to the mean virtual temperature in the dry-air hypsometric equation in the form of a function of the 12-hour mean station temperature. In Canada, the plateau function is expressed as a simple quadratic; is determined uniquely for each station using a Cressman weighted average of nearby plateau stations; and is applied at elevations both above and below 305 gpm. Based on the climatology of 300 Canadian stations, we present the results of a mathematical and geographical comparison of these methods and by implication present an estimate of the possible systematic differences in MSL pressure that can result from the use of different versions of the plateau correction both within Cananda and across the Canada-US border.

3D-100-C3.3 ID:3088 15:00

The proposed replacement of Liquid in Glass thermometers by digital technology in meteorological networks.

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Earth surface air temperature measurements are critical in meteorological observations. When taken for extended periods of time they provide an indicator for climate change studies.

Mercury Liquid in Glass (LiG) thermometers are being used by volunteer climate observers and in manned surface observing stations. The desire to eliminate use of mercury, the need for automation and for traceability of temperature measurements led to an investigation of LiG replacement. Development of technical and functional requirements for a network-wide LiG replacement program had to consider the homogeneity of climate observations.

The presentation will outline two options being considered: local to the temperature screen and wireless. In wireless solution, through an internet interface, remotely received temperature measurements can be automatically disseminated and archived. Despite advances in measurement and communication technologies, it is difficult to find products meeting functional networks requirements. Evaluation results to date will be presented.

POSTERS Climate Change and Extreme Events / Le changement climatique et les évènements extrêmes

Room / Endroit (100), Chair / Président (Chad Shouquan Cheng), Date (03/06/2009), Time / Heure (15:00 - 16:30)

POSTERS Regional Climate Modelling / Modélisation Régionale Climatique

Room / Endroit (100), Chair / Président (Laxmi Sushama), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-C5.1 ID:2954 15:00

Climate change impact on water balance components of North American river basins - Canadian RCM projections and their uncertainty

Marco Braun [1], *Laxmi Sushama* [1], *Daniel Caya* [2]
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Water availability is determined by the important hydro-meteorological variables like precipitation, evapotranspiration, snow water equivalent (SWE) and runoff. In order to understand the impact of a changing climate on the water balance, the effect on each of those components needs to be assessed. Regional Climate Models (RCM) with their complete closed water budget are ideal tools for the assessment of climate change impacts on water resources. The Canadian Regional Climate Models (CRCM) realism in simulating surface and subsurface climate has recently been improved with the implementation of the physically based Canadian LAnd Surface Scheme CLASS. This significantly refined the representation of fluxes at the land surface determining the water balance. Using an ensemble of Canadian RCM current and future climate simulations over North America, hydro-meteorological surface fields are studied for the large North American Basins of Mackenzie, Fraser, Columbia and St Lawrence. Projected changes to the annual and monthly climatological precipitation, evapotranspiration, SWE and runoff are presented. Such projections however are subject to various sources of uncertainty. One important source of uncertainty in climate change projections is attributable to the internal variability of climate models, both regional and global. The uncertainty resulting from internal variability of the RCM is addressed by the investigation of CRCM twin simulations that are identical except for slightly different initial conditions. The uncertainty resulting from internal variability in the driving data is assessed by the investigation of CRCM simulations driven by different ensemble members produced by

the Canadian Coupled Global Climate Model (CGCM).

3D-100-C5.2 ID:2782 15:00

Assesment of climate change impacts on Canadian rivers flows using Regional Clmate Model projections

Vincent Poitras [1], *Laxmi Sushama* [1], *Frank Seglenieks* [2], *Eric Soulis* [2]
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Climate change will have significant impacts on water resources around the world due to close connection between climate and the hydrological cycle. Since Canada has some of the largest freshwater reserves in the world, the stability of these reserves to regional climate change is clearly an important concern for Canada requiring detailed and reliable information. The focus of this presentation will be on the climate change impacts on river flows, although some connections will be made with other hydro-meteorological variables. Regional Climate Models (RCMs) with their complete closed water budget including both the atmospheric and land surface branches are ideal tools for this purpose.

The climate change signal is evaluated comparing streamflow simulations for current climate with streamflow simulations for future climate. Prior to this evaluation, a preliminary investigation of the performance (due to internal dynamics and physics of the RCM) and boundary forcing biases (due to a General Circulation Model (GCM) driving) will be done. To route the runoffs generated by the RCMs, the routing scheme WATroute is used. Since it is expected that climate change will affect the intensity and frequency of extreme events more than the mean values of climatic variables, low flows and high flows will be carefully studied.

3D-100-C5.3 ID:2765 15:00

Sensibility of precipitation to horizontal resolution in the Canadian Regional Climate Model (CRCM)

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The new generation of regional climate models now allows an increase in horizontal and vertical resolution which is expected to lead to a better representation of the atmosphere. Using the fourth generation of the Canadian Regional Climate Model (CRCM4), this study investigates the impact of increasing the horizontal resolution on the precipitation field by focussing on the intensity and frequency of precipitation since these are the characteristics that should change the most with an augmentation of horizontal resolution. In order to do that, CRCM4 simulations are performed over two different regions of Canada: 1) the province of British-Colombia and 2) the province of Quebec. For each region, two 4-year-long simulations nested at their boundary by the reanalyses NCEP

NRA-2 are analyzed. These two simulations consist of one 15 km horizontal resolution run with a 5-min time step and one 45 km horizontal resolution run with a 15-min time step. The simulated precipitation coming from the 15 and 45 km horizontal resolution simulations is then compared to observations, which are made up of a series of land stations measuring the hourly accumulated precipitation.

3D-100-C5.4 ID:2767 15:00

Evaluation of the Internal Variability in the Canadian Regional Climate Model over an Arctic domain using the Big-Brother Experiment approach

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The Arctic region shows large vulnerability to anthropogenic climate changes. The circumpolar circulation in this area provides a long residency time to air parcels inside the region, which affects the control exerted by lateral boundary conditions in simulations of nested Regional Climate Models (RCM). It has been shown that the residency time is highly correlated to the internal variability (IV) for RCM simulations in mid-latitudes (Lucas-Picher et al. 2007). The sensitivity of the results to the domain size is a well known phenomenon too (Leduc et Laprise, 2008). To investigate the IV of RCM and the impact of the domain size over the Arctic, we use the Big-Brother Experiment (BBE) approach (Denis et al. 2002). The advantage of the BBE is the possibility to study small-scale climate features that constitute the added value of RCM, as they are not comprised in the LBCs, and to investigate the nature and magnitude of IV for an Arctic domain. BBE allows here to compare simulations performed over two different domain sizes and study how this affects the simulated results. IV has been studied by introducing small differences in initial conditions in an ensemble of twenty simulations for each domain size. The biggest IV has been found over the larger domain of integration, and the magnitude of the IV over the Arctic region is greater than that characterizing mid-latitude domains, in general. Over the larger domain, the ensemble average of the transient-eddy component strongly underestimates the variance comparing to that of the ensemble members. However, this is not the case over the smaller domain of integration. On the other hand, model simulations over the smaller domain underestimate small-scale features, especially at altitude in the region characterized by the strongest winds along the storm track.

3D-100-C5.5 ID:2822 15:00

Atmospheric water budget study by scale decomposition with the Canadian Regional Climate Model over North America

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Water plays a major role in climate. Its various radiative effects and latent heat release account for an important fraction of the energy involved in the climate system. Therefore to better understand climate change requires to better understand the hydrological cycle. This study is focusing on the atmospheric branch of water cycle by means of two 30-year simulations run over North America with the Canadian Regional Climate Model. One represents the current climate, the other a future one (IPCC SRES-A2 scenario). The aims are: 1) to better understand the atmospheric water budget by isolating contributions from different scales, 2) to address its potential change in a future climate, and also 3) to assess the added value of fine scale relative to coarser scale simulations. In these simulations a Discrete Cosine Transform (Denis et al 2002) is operated on every water budget variable in order to separate small from large scales of the fields. A special attention is paid to moisture flux divergence, which is decomposed in terms of three scales of wind and moisture to provide nine interaction terms. Statistics of these fields and their different scales are studied for winter and summer seasons. The water budget and the evolution of each variable in a future climate are investigated. It is found that while small scales contribution to averaged fields is limited, their contribution to variability is comparable to the large scales' one, or even greater during summer. An inspection of the interaction terms of the moisture flux divergence also shows that only some of them are responsible for most of the climate signals.

3D-100-C5.6 ID:2855 15:00

CRCM projected changes to the characteristics of precipitation extremes over Canada

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Changes to the intensity and duration of hydrometeorological extremes may have significant impacts on various sectors associated with water resources. This paper will focus on the validation of the Canadian RCM simulated precipitation extremes (1-, 2-, 3-, 5-, 7- and 10-day events) over Canada, by comparing simulated precipitation characteristics to those observed. Changes to the intensity and duration of multi-day precipitation extremes over Canada are also assessed using regional frequency analysis (RFA) and individual grid-box analysis (GBA) and these results will also be presented.

3D-100-C5.7 ID:2921 15:00

Projected (1990-2060) Changes in Surface Winds over Southern British Columbia Using a Regional Climate Model

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Future changes in surface wind (SW) over Southern British Columbia were investigated using output from the Canadian Regional Climate Model (CRCM4). According to the CRCM, annual mean SW changes are in the -6% to +10% range, with increases generally north of the Fraser Valley, and decreases to the south. In coastal areas, SW changes are confined to the range +2-10%. Much of the BC interior, including the Fraser and Okanagan Valleys, is projected to have negligible or slightly decreasing annual mean SW in future. Changes are statistically significant at the 95% level over ~40% of the region, with the areas of significant change mostly along the Strait of Georgia, the Fraser Plateau, and the Columbia Mountain Range. In individual months, the largest changes are seen in June (+32%, in the Coastal Range) and July (-19%, north of Howe Sound). Generally speaking, future SW tends to increase in winter, already the period with the highest winds. In the summer, when winds are typically calm, SW is expected to decrease. However, numerous exceptions to this general behavior are seen at particular locations. Changes in 90th percentile SW were also examined, with the areas of significant change even more confined to the coast, and mostly showing increases in extreme SW. In addition, the model results were constrained by a statistical downscaling method whereby regression fits were constructed at locations with long-term meteorological observations. The range of SW changes derived from downscaling at these stations is generally smaller than that projected by the CRCM directly, with a broad consistency from season to season, but with conflicting results at certain stations. The latter may be due to the heterogeneous nature of the region, where topography and land-sea contrast strongly influence the observed climate.

POSTERS Carbon Uptake in the Ocean - Problems of Ocean Acidification and Feasibility of Iron Fertilization / Absorption du carbone dans l'océan - Problèmes de l'acidification de l'océan et faisabilité de la fertilisation avec le fer

Room / Endroit (100), Chair / Président (Debby Ianson), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-O2.1 ID:2758 **15:00**

Saturation states for aragonite and calcite in the deep convection region in the Labrador Sea

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Deep convection in the polar oceans contributes not only to the global thermohaline circulation with heat and salinity transport, but also to the transport of carbon dioxide to the intermediate and deep ocean. Labrador Sea Water (LSW) is produced in late winter by one of the deepest convections in the world and occupies central depths in the Labrador Sea. Below the LSW, North East Atlantic Deep Water (NEADW) and Denmark Strait Overflow Water (DSOW), produced by the winter convection in the Nordic Sea, flow into the region. These water masses have very young ventilation ages (less than 15 years old) and inventory of anthropogenic CO2 is non-proportionally high in the Labrador Sea. The combination of uptake of anthropogenic CO2 and inflow of the Arctic Water makes the Labrador Sea especially vulnerable to ocean acidification. Time series studies since 1996 to present show the steady increase of CO2 concentration due to the uptake of anthropogenic CO2 from the atmosphere in newly ventilated LSW. This increase resulted in the decrease in the saturation states (Ω) with respect to aragonite and calcite. If this decreasing trend continues at the present rate, this water mass will become under-saturated with respect to aragonite around 2070 and to calcite around 2010. A part of the newly ventilated LSW is incorporated into the North Atlantic Deep Water (the lower limb of the global thermohaline circulation) and the remainder spreads to the intermediate depths in large area in the North Atlantic. Therefore changes in the saturation state of the newly ventilated LSW need to be monitored closely with populations of marine calcifying organisms.

3D-100-O2.2 ID:2801 15:00

Strong seasonal pH variablility in coastal upwelling regions at temperate latitudes

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Dissolved inorganic carbon and surface partial pressure of CO2 (pCO2) in coastal upwelling regions exhibit tremendous spatial and temporal variability. For example, surface pCO2 can be be lower than 200 ppm and higher than 600 ppm at the same location in the space of a week or less. A recent field study has shown that on the west coast of North America, at times the high end of this pCO2 range is associated with pH low enough to cause surface waters to be under-saturated with respect to aragonite, potentially endangering organisms that form aragonitic structures. This exposure to potenitally corrosive water is expected to be intermittent. The seasonal cycle in pH, and more importantly the variability, remains unknown, as there are few data. I use a simple two-dimensional box model to make a first estimate of the pH cycle for a typical year in the upwelling region off the west coast of Canada. Results from both the surface mixed layer and the lower layer over the shelf will be presented, focusing on variability and timing of low pH events. The model shows that pH is low in the surface waters for brief periods in the summer. However, during winter the pH is consistently low because at these latitudes light is limiting to biological production at that time of year. These results will be discussed with reference to organisms common to the study area that are expected to be most affected by low pH.

3D-100-O2.3 ID:3068 **15:00**

An automated experimental system for the simultaneous measurements of potentiometric and spectrophotometric pH in seawater.

Chris L'Esperance [1], *Kumiko Azetsu-Scott* [2], *David Slauenwhite* [2], *Darlene Brownell* [1]
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pH is an oceanographic variable whose measurement is fundamental to the understanding of acid-base equilibria in seawater, in particular, the carbonate system. The measurement of pH provides an indication of biological processes (photosynthesis / respiration), as well as allowing one to determine the saturation state of seawater with respect to various biologically important carbonate minerals, thus providing key information regarding carbonate mineral precipitation / dissolution.

Devolopments associated with experimental methods of pH determination over the past 10 - 20 years have brought the analytical precision associated with the technique to better than ± 0.005 pH units \textit{Dickson et al., 2007} from it's historical precision (potentiometric technique) of approximately ± 0.02 units. Out of necessity, the present analytical precision allows the anthropogenic CO_2 signal to be determined. Aside from improvments associated with the interpretation and meaning of pH as measured \emph{potentiometrically}, considerable work has been conducted on the developement of \emph{spectrophotometric} techniques, to which the increase in analytical precision is largely attributed.

An overview of an experimental system that automates both potentiometric and spectrophotometric techniques of pH determination in seawater is presented. The development of a modular spectrophotometer-based measurement system for pH is particularly worthwhile considering that various other carbonate system variables (total inorganic carbon, total alkalinity) are routinely measured using similar spectrophotometric techniques.

POSTERS Coastal Oceanography and Inland Waters / Océanographie côtière et les eaux intérieures

Room / Endroit (100), Chair / Président (Guoqi Han), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-O3.1 ID:2806 15:00

Simulating transport in tidally-averaged flows: Sources and scales of errors

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Transport of biota and contaminants in the ocean are often modeled using tidally-averaged flows. Drift pathways and retention times are estimated by numerically integrating the Lagrangian residual velocity. However, this method has been improperly applied in several published studies. Without a quantitative understanding of these errors, it is not possible to understand their relative influence on model results.

Here, we review the derivation of the Lagrangian residual velocity, and demonstrate that appropriate choice of time-step is critical to calculation of transport. Errors are introduced when model time steps are too large or too small, and this is illustrated using simplified 2D flow fields. We develop a metric to characterize regions of the flow field where these errors are significant. This metric is then applied to realistic flows for the Gulf of Maine and tested empirically using particle-tracking simulations. The relative scale of errors due to use of incorrect time step is compared with those due to use of residual versus time-varying flows. Finally, we discuss how this error contributes to model uncertainty and make recommendations about how to accurately simulate transport.

3D-100-O3.2 ID:2871 15:00

Current variability on North-East Newfoundland shelf from historical VM-ADCP data.

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Vessel mounted Acoustic Doppler Current Profiler (VM-ADCP) data has been collected along several standard survey transects on the North-East Newfoundland shelf since 1992. For the 'AZMP Bonavista Section' the seasonal, temporal and spatial variability of currents over a 15 year period is examined. Additionally an emphasis is placed on the inshore branch of the Labrador Current where VM-ADCP data at several points of interest is compared with moored current meter measurements as well as other oceanographic parameters.

3D-100-O3.3 ID:2936 15:00

What is the fate of the riverine freshwaters of Hudson Bay?

Pierre St-Laurent [1], *Fiammetta Straneo* [2], *Jean-Francois Dumais* [1], *David Barber* [3]
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The river input into Hudson Bay is a significant fraction of the total runoff in the Arctic region (635km^3 per year, or 12%). This net freshwater input is eventually exported into the North Atlantic but the processes which control the timing and magnitude of the export flux, or, more generally, the pathway of the freshwaters, are presently unclear. This pathway is non-trivial since, amongst other things, a substantial fraction of the freshwater is transformed (stored) into sea ice during winter. The sea ice may drift over large distances before melting, in early summer, thus contributing to the freshwater transport, as well as influencing the shape of the freshwater export pulse from Hudson Bay. We examine these questions using a high-resolution, regional numerical model forced with realistic river and atmospheric fluxes. The model allows us to track freshwater contributions from different sources (rivers, precipitations, ice melt, or freshwater coming in from the surrounding basins). The numerical simulations allow us to quantify the residence time for the various freshwater sources, the different freshwater pathways within the basin and, in particular, their contribution to the formation of the winter ice cover. Recent measurements from cruises and from satellites are used for comparison with the numerical results, and to complement the analysis.

POSTERS Acoustics in Oceanography / L'acoustique en océanographie

Room / Endroit (100), Chair / Président (Tetjana Ross), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-O4.1 ID:2790 **15:00**

Diurnal to seasonal variability of an Arctic zooplankton community as estimated from moored acoustic Doppler current profiler backscatter data

Kate Collins , *Jim Hamiliton* , *Simon Prinsenberg*
Department of Fisheries and Oceans
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Echo intensity data from 300kHz Broadband ADCPs moored in Barrow Strait, in the Canadian Arctic Archipelago, are used to investigate the resident zooplankton population. The resulting year-long time series provide an opportunity to investigate different time scales of variability. Diel vertical migration is evident in the backscatter data throughout the deployment, while changes over scales of days to weeks are observed in response to meteorological forcing. Variability over longer time scales is highlighted by seasonal differences in abundance and behaviour.

3D-100-O4.2 ID:2904 **15:00**

Assessing the isotropy of turbulence using broadband acoustics

Doris Leong [1], *Tetjana Ross* [1], *Andone Lavery* [2]
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Acoustic backscatter returns from turbulent oceanic microstructure have the potential to remotely describe temperature and salinity variations and identify turbulent dissipation rates. Oceanic turbulence models that relate acoustic backscatter levels to turbulence parameters generally assume that turbulence is isotropic at the smallest scales, and there is a lack of experimental data to confirm or dispute this. Verifying isotropy or anisotropy is crucial to refining turbulence models and advancing reliable measurements of turbulence.

Broadband (150-600kHz) acoustic scattering measurements were performed over the New Jersey continental shelf, observing the passage of internal waves and their turbulent wakes. To address scattering anisotropy, the instrument can sample vertically or horizontally through the water column while tracking a wave train.

Along the pycnocline, differences in the spectral frequency response of horizontally and vertically observed scatter show evidence of general scattering anisotropy, but it is uncertain if this is due to physical or biological sources of scatter. Acoustic inversions of turbulence spectra were performed to yield estimates of turbulent dissipation rates. A statistical comparison between estimates in both instrument sampling modes suggests that turbulence is indeed isotropic at the smallest scales.

POSTERS Argo in Ocean and Climate Sciences / Argo dans les sciences de l'océan et le climat

Room / Endroit (100), Chair / Président (Igor Yashayaev), Date (03/06/2009), Time / Heure (15:00 - 16:30)

3D-100-O5.1 ID:3097 **15:00**

An interactive tool for real-time monitoring and exploration of ocean basins (ArgoBrowser)

Michael Dunphy [1], *Igor Yashayaev* [2]
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The Argo data Browser (ArgoBrowser) is a multi-purpose MATLAB-based application for quality control, analysis and visualization of oceanographic data from various platforms including profiling floats, ships and moorings. ArgoBrowser includes a download manager, database builder, data post-processor, profile browser, vertical section tool and time series tools. The download manager can be configured to perform automated visits to the World Data Centers as well as other off-site data collections and transfers newly found data to the ArgoBrowser server. The database builder reads, filters and indexes all available measurements and produces an internal homogeneous data structure for quick, easy and reliable manipulation of the acquired data. The data post-processor is a multifunctional tool for quality control, editing (both manual and automated), calibration and cross-comparison of Argo data with other data. For example, salinities from an individual Argo float can be validated/calibrated using nearby shipboard and/or Argo measurements. The vertical section tool operates with three types of coordinates to connect a certain data point with an arbitrarily chosen section line (position of the point on the line and the distance to the line). The first set of coordinates is defined by using the shortest horizontal distance or direct projection method, the second set is based on following bathymetric contours from the measurement location to the section line, and the third and most effective type of section-based coordinates is defined through a weighted combination of the direct and bathymetry-following coordinates. The time series tool creates time series of seawater properties, estimates seasonal cycle, removes data outliers, and depicts short and long term variability at various locations and depths.

Argo Town Hall Meeting / Réunion générale sur Argo

Room / Endroit (202), Chair / Président (Denis Gilbert), Date (03/06/2009), Time / Heure (16:30 - 17:30)

3E-202.1 ID:3117 **INVITED/INVITÉ 16:30**

Argo Town Hall Meeting

Denis Gilbert [1], *Howard Freeland* [2]
[1] Institut Maurice-Lamontagne, Pêches et Océans Canada, Mont-Joli, Québec
[2] Institute of Ocean Sciences, Fisheries and Oceans Canada, Sidney, B.C.
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The initial Argo objective of deploying 3000 profiling floats measuring temperature and salinity between 2000 m and the sea surface in the global ocean was reached in November 2007. While this represents a huge success, Argo is still in its infancy and many problems remain to be solved. In this Town Hall meeting, we will report on the current state of Argo activities in Canada and abroad. This discussion will be partly based on the outcome of the third Argo science workshop (Hangzhou, China, 25-27 March 2009), where participants were requested to assess the adequacy of the present Argo sampling scheme for research and operational needs. We will also seek the input of the growing Canadian Argo users community to hear directly from them what changes they would like to make to the Argo program so that it may suit their research or operational needs better.

4A-GRAND.1 ID:2935 INVITED/INVITÉ 08:30

Sun, Snow and Satellites: Remote Sounding in a Cold Country

James Drummond
Dalhousie University
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The last several decades have seen satellite remote sounding grow from a precocious child, through a troublesome adolescence, to a new maturity. As the strengths and limitations of satellite techniques have become apparent, a marriage has come about: The new satellite measurements joined with more traditional, but much-updated, ground-based techniques to provide a comprehensive, reliable picture of the atmosphere.

This has particular importance for Canada whose vast land area, part of it frozen, presents special challenges and special opportunities for remote sounding. Cold places tend to be somewhat neglected and much effort in the satellite community is devoted to lower – and warmer – latitudes. But Canadians are tough, and neither the cold of space nor the cold of the Arctic are sufficient to deter them.

So we will talk of many things: Of satellites and their measurement techniques, of ground-based measurements, of putting the two together and how they are beginning to be incorporated into models. Finally we will look at how a melding of techniques can provide the basis for a 21st century view of our unique and continually surprising atmosphere.

4A-GRAND.2 ID:3119 INVITED/INVITÉ 09:15

Plenary to be Given by CMOS President's Prize Winner

Tbd ..
(Presented by *James Tba*)
TBD
Contact: greenanb@mar.dfo-mpo.gc.ca

TBD

Air Quality: Delivering the Right Message (PART 1) / Qualité de l'air: délivrer le bon message (Partie 1)

Room / Endroit (202), Chair / Président (David Waugh), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-202.1 ID:2899 **10:30**

Climatology of Air Quality Health Index on the Canadian Prairies

Brian Wiens [1], *Wally Qui* [2], *Allen Pankratz* [1], *Lisa Avis* [2]
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The Canadian Prairie Provinces have typically been perceived as having some of the best air quality in Canada. Analysis of historical air quality measurements using the metric of combined pollutants in the Air Quality Health Index (AQHI), indicates a significant number of days with elevated risk. As AQHI forecasting is implemented across the Prairies it is vital to understand the historical context to guide both the forecast process and to inform dissemination. This presentation will summarize conditions in six cities where forecasts are anticipated and several comparison sites.

4B-202.2 ID:2878 **10:45**

A Look at the AQHI over Atlantic Canada during the 2002 Quebec Forest Fire Episode

Doug Steeves , *David Waugh*
Environment Canada
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Forest Fires in northern Quebec darkened skies over eastern Canada and northeastern United States in early July 2002. At that time forecasts of the air quality index (AQI) in Atlantic Canada only took ground level ozone into account. A running three hour average of PM2.5 concentrations exceeded 100 ug/m3 at Fredericton on July 8th and at Corner Brook on July 10th. Values of the AQHI computed for this time period were well into the high risk category for some locations. Given that current operational air quality models do not incorporate forest fires into their prediction, this case reveals a need to develop techniques for predicting the individual AQHI pollutants associated with forest fire smoke.

4B-202.3 ID:2669 **11:00**

Case study of smog event in the perspective of the new Canadian Air Quality health Index (AQHI), 4 to 7th November 2008 over Saint-Lawrence valley in Quebec region

Jacques Rousseau
Environnement Canada
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In Canada most of the poor air quality occurs during the hot summer season mainly associated with the photochemical production of ozone. The second peak season of pollution over eastern part of Canada happens in winter while people use wood burning to heat there house during the cold season. In this case the PM2.5 (Particle Matter with diameter less than 2.5 mm) becomes the main pollutant of poor air quality. The

November 4 to 7th, 2008 smog episode is special in a sense that ozone is almost absent at this time or the year and the main sources of PM2.5 for this event did not come from wood burning due to the mild weather condition at that time. During the first week of November 2008 all southern Québec experienced mild temperature from 10 to 17oC prevailing most of the use of wood heating. During this episode on the November 6, the AQHI rose to a maximum pick value of 12 or very high health risk in Montréal areas and a maximum AQHI of 7 over Québec City and 6 over Ottawa the national capital.

Hourly ozone concentrations were most of the time below 15 ppb during the entire episode accounting for less then one unit of the AQHI value over Montreal area. Meanwhile, the hourly PM2.5 concentrations started at 30 µg/m3 on November 4th to increase steadily and reached a maximum of 95 µg/m3 at the peak value of AQHI on the November 6th accounting for about 4.5 units of the AQHI. But the main pollutant driver during this episode was certainly the NO2. The hourly concentrations of NO2 were around 25 ppb prior to the episode and reached a maximum of 90 ppb on the November 6th at the same time of the PM2.5 peak. On this occasion the NO2 concentration accounted for 7.8 units of the AQHI.

Weather conditions played a significant part in the development of this episode. During the period, the synoptic pattern was set up such as disturbances were moving across the southern U.S. and central Canada. Subsequently, there were minimal dynamics to promote vertical mixing and dispersion of pollutants in the atmosphere. At the surface, high pressure over much of the eastern U.S. resulted in light winds, stagnant conditions, and the build-up of pollutants. These conditions, combined with high particle carryover from day-to-day accumulation and local emissions such as transportations contributed to this episode.

4B-202.4 ID:2974 **11:15**

Satellite remote sensing of the Air Quality Health Index

Randall Martin [1], *Aaron Van Donkelaar* [1], *Lok Lamsal* [1], *Xiong Liu* [2]
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We describe the development of a satellite-based Air Quality Health Index (AQHI). The satellite observations are tropospheric NO2 and O3 columns from the OMI instrument, as well as aerosol optical depth (AOD) from the MODIS and MISR instruments. Local scaling factors from a chemical transport model (GEOS-Chem) are used to relate the space-based column observations (AOD, tropospheric NO2, and tropospheric O3) to ground-level concentrations (PM2.5, NO2, O3). A surprisingly high degree of consistency is found been the satellite-derived and in situ ground-level O3 estimate; an explanation is proposed. We evaluate the satellite-derived AQHI throughout North America with in situ measurements of the AQHI and find a significant relationship in summer.

4B-202.5 ID:2884 11:30

Long-term exposure of fine particulate matter at high resolution from satellite observations

Aaron Van Donkelaar , *Randall Martin*
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Fine particulate matter (PM2.5) is a major component of the Canadian AQHI due to its negative effects on human health. Yet measurements remain sparse in Canada and throughout the world. Aerosol Optical Depth (AOD) has been shown to be related to PM2.5 concentrations. The Moderate Resolution Imaging Spectroradiometer (MODIS) and Multiangle Imaging Spectroradiometer (MISR), onboard the Terra satellite, have been measuring AOD since mid-2000 and provide the possibility of estimating global exposure to PM2.5. Both instrument accuracy and the AOD-PM2.5 relationship, however, vary by region. We use a chemical transport model, GEOS-Chem, to estimate the AOD-PM2.5 relationship and apply it to filtered MODIS and MISR AOD at a resolution of 0.1o by 0.1o. Using observations from the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) and Aerosol Robotic Network (AERONET), our satellite-derived PM2.5 is estimated accurate to within 5 µg/m3 ± 25% globally. We find significant agreement with coincident measurements over North America (slope = 1.01, r = 0.80, n = 941), with 97.8% of data within our error estimate, suggesting satellite-derived PM2.5 will be a valuable asset in the assessment of Canadian air quality.

Monitoring the Atmosphere and Ocean (PART 1) / Monitorage de l'atmosphère et de l'océan (Partie 1)

Room / Endroit (203), Chair / Président (Al Wallace), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-203.1 ID:3109 INVITED/INVITÉ 10:30

Meteorological Service of Canada: Weather and Environmental Monitoring

Jim Abraham
Environment Canada
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The Meteorological Service of Canada (MSC) is responsible to monitor the weather and climate to meet a wide variety of internal and external priorities. As well, the Water Survey of Canada within MSC measures water levels and calculates flows at approaximately 2700 locations in Canada. With limited resources, strategies need to be developed to situate stations in appropriate locations; station design and life-cycle

management must ensure the quality and reliability is achieved to meet the nees of the clients, and the data must be acquired and managed in a manner that facilitates access and use. This presentation will give an overview of the MSC monitoring program, and discuss the challenges and opportunities related to meeting the needs of a variety of clients. Ths overview will provide context for subsequent presentations in this session.

4B-203.2 ID:3056 **11:00**

A Strategic Plan for Environment Canada's Weather and Environmental Monitoring Program

Michael Manore
EC - Meterological Service of Canada
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Environment Canada (EC) operates a diverse set of observing networks for weather, climate, water quantity, and air quality to support its mandate. These include surface and upper air stations, weather radars, hydrometric gauges, and satellite reception systems among many. A period of significant financial challenge and a recent audit of EC's Severe Weather Program has prompted the development of new Strategic Plan for EC's weather and climate monitoring activities. The plan identifies key areas of action and specific initiatives to guide network configuration and investment decisions, with the goals of meeting diverse user requirements in a technically and financially sustainable fashion. The plan first identifies the requirement to validate, stabilize, and enhance the data management practices of the existing networks. Beyond this, the plan calls for a leadership role for EC in the development of a Canadian 'network-of-networks' for weather and climate data. This is intended to enable EC and others to benefit from the explosion of observations becoming increasingly available from networks operated by other jurisdictions, volunteers, and by private enterprises. The presentation will summarize the goals of the Strategic Plan, highlight its key initiatives, and discuss implementation challenges.

4B-203.3 ID:3110 **11:15**

Moving Towards a Water Cycle Prediction System in Canada

Alain Pietroniro , *Paul Whitfield* , *Jean-Francois Cantin* , *Russell Boals*
Environment Canada
Contact: al.wallace@ec.gc.ca

The National Hydrometric Program delivered through the Water Survey of Canada provides for the collection, interpretation, and dissemination of real-time and historical surface water level and flow data to Canadians. Since 1975, the program has been carried out under formal cost-shared agreements signed between Environment Canada and each of the provinces, and Indian and Northern Affairs representing the territories, under the Canada Water Act (1970). It utilizes a centralized, standardized approach to data collection, processing, and distribution and the Federal component of the collective partnership is commonly known as the Water Survey of Canada. The program has been continuously operated, in general, by the federal government (i.e., Water Survey of

Canada) since 1908, except in Quebec, where the province took over the responsibility in 1963.

Water level, flow data and hydrological information serve to generate products in support of a wide range of water resources management, design and development activities. As most sectors of our economy must rely on water as a fundamental asset on an ongoing basis, hydrometric information and information about the distribution of water on the landscape are therefore essential to the economic and ecosystem sustainability of Canada.

This paper provides and overview of current hydrometric network in Canada and recent developments in both technology and research to development a coherent approach to understand the distribution and availability of water on the Canadian landscape. Considerable progress is being made in the development of an integrated service delivery framework. The WSC has been an active partner, with Universities, Canadian Meteorological Centre (CMC) and the Hydrometeorological and Arctic Weather Laboratory (HAL) and the National Water Research Institute (NWRI) in the development of the first phase of an operational water cycle prediction system that will soon allow for the simultaneous forecasting of weather and hydrological and hydraulic conditions in many regions of Canada. This work, through our partnership with our provincial and territorial colleagues, has focused mostly on the coupling of atmospheric and surface water components of the hydrologic cycle but also on the operationlization of hydraulic model in some of our major basins. A description of these initiatives in the context of our national monitoring programs, along with results from some key scientific studies is presented.

4B-203.4 ID:2857 **11:30**

The challenges of maintaining automated weather stations.

Darren Tessmer
Environment Canada
Contact:

Each year Prairie and Northern Atmospheric Monitoring has encountered unique challenges maintaining automated stations. With increasing pressures to maintain timely and accurate data, technicians, first, have to ensure the data is accurate and secondly, can the problems be repaired remotely. If unable to fix remotely the technicians must visit the site and initiate repair. This presentation will show some of challenges that we have encountered. Challenges include flooding, man-made errors, cold, wildlife, and extreme snow and wind events.

4B-203.5 ID:2862 **11:45**

The role of Prairie and Northern in the installation and maintenance of Environment Canada's Atmospheric Monitoring Networks

Wayne Emond , *John Mravnik*
Environment Canada

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Prairie and Northern Atmospheric Monitoring Section provides a variety of functions for the Meteorological Service of Canada's atmospheric monitoring networks. This includes installation, repair and maintenance services for networks such as Surface Weather, Upper Air, Radar, Marine as well as support for specialized data networks including Ozone, Solar Radiation and others. Using a Quality Management System framework Atmospheric Monitoring strives to meet the World Meteorological Organization's targets for data accuracy and availability within Canada's Meteorological Service.

Climate Change and Extreme Events (PART 1) / Le changement climatique et les évènements extrêmes (Partie 1)

Room / Endroit (204), Chair / Président (Chad Shouquan Cheng), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-204.1 ID:3069 10:30

Incorporating Climate Change in Integrated Forest Management

William Richards [1], *Josh Noseworthy* [2], *Marie-France Jutras* [2], *Courtney Ruelland* [2], *Cory Hughes* [2], *Mitch Baker* [2], *Zander Ryerson* [2], *Shaun Dombroskie* [2], *Monica Mckendy* [2], *Chris David* [2], *Peter Wright* [2]
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Climate change is likely to impose significant challenges to forest management. A team of senior undergraduate forestry students at University of New Brunswick were challenged to devise a management plan for the Acadia Research Forest (ARF) that would address changes of climate, growth and yield, species shift and changing risks due to natural disturbances such as fire, insects, disease and extreme weather. Three scenarios were modelled: (i) status quo, (ii) evolution of the forest under a changed climate and (iii) a forest in which interventions were made to bring about the objective of a diverse Acadian Forest type. This presentation will illustrate the complex challenges faced by forest managers in a changing environment and what interventions may be necessary to facilitate adaptation.

4B-204.2 ID:2870 10:45

Drought characterization using observed relationships between plant physiology and plant available soil moisture

Julian Brimelow , *John Hanesiak* , *Richard Raddatz*

(Presented by *Julian Charles Brimelow*)
Dept. of Environment and Geography, Centre for Earth Observation Science, University of Manitoba
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There are a wide range of tools and methods used to identify, quantify and track drought conditions on the Canadian prairies. Some examples include use of drought indices such as PDSI and SPI, spatial mappings of precipitation anomalies, as well as different model outputs (e.g., soil moisture). A brief overview of applying these tools to characterize the 1999-2003 drought will be presented. In this presentation we propose a unique method for tracking drought. Specifically, we demonstrate the utility of employing the prairie agrometeorological model (PAMII) in tandem with known physiological responses of vegetation to soil moisture stress to identify those areas on the Canadian prairies which are likely experiencing severe soil moisture stress (i.e., agricultural drought). Comparison with remotely sensed data suggest that integrating the number of days during the growing season when the modelled plant available water is less than 30% is skilful at identifying those areas where plants are experiencing significant moisture stress.

4B-204.3 ID:2886 **11:00**

Diminished Windstorm Frequency in Southwest British Columbia and a Possible Association With the Pacific Decadal Oscillation Regime Shift of 1976-77

Wolf Read
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All discrete windstorm events with wind >47 km/h (>25 knots) were isolated in the 1953-2007 wind record at Vancouver International Airport (CYVR). Of the 367 individual events, 157 occurred during the Jun 1962 to Jul 1992 period that the U2A anemometer was in operation, with a sensor height of 10 meters. During the U2A era, a distinct downward shift in the frequency and magnitude of windstorms occurred after 1975. This windstorm dearth appears to be bounded by the years 1976-1989, inclusive. Some 96 events occurred during the 14 years 1962-75 (on average 6.9 windstorms per year), with 61 occurring during the 17 years 1976-1992 (3.5 events per year). Closer examination reveals a very sharp reduction in windstorm frequency from 1983-1989, a 7-year span that had just 18 events (2.5 events per year) with the strongest at 52 km/h, barely above the minimum wind cutoff. Isolating the high-wind storms with wind >62 km/h, during the U2A era also accentuates this trend. Sixteen high-wind events occurred before 1976, with nine producing maximum winds in the range of 68-77 km/h. Just 4 high-wind wind events occurred after 1975, all with maximum wind speeds of 63-67 km/h, and three happened after 1989. Examination of the U2A wind record at other nearby stations, such as Abbotsford (CYXX) and Victoria (CYYJ) also reveal a reduction in windstorm frequency post-1975, with perhaps an even stronger effect in Victoria. The Pacific Decadal Oscillation (PDO), an ocean-atmospheric pattern that shares some similarity to the El Nino-Southern Oscillation (ENSO), has phases that tend to persist for approximately 20-30 years. A well-established PDO regime-shift from cool-phase to warm-phase occurred in 1976-77, a transition that has been associated with significant climatic and ecosystem changes in the North Pacific Ocean. The PDO phase shift of

1976-77 is proposed as a possible explanation for the reduced windstorm frequency in parts of southwest BC from 1976-1989. Further evidence is explored.

4B-204.4 ID:2762 11:15

Possible Impacts of Climate Change on Wind Gust over Ontario under Downscaled Future Climate Conditions

Chad Shouquan Cheng , *Guilong Li*
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The overarching purpose of this study was to estimate changes in occurrence frequency of future wind gust events under downscaled future climate conditions over Ontario. Hourly wind gust factors were employed to simulate hourly wind gust based on hourly wind speed. Regression-based statistical downscaling methods were used to downscale nine GCM U-wind/V-wind outputs (five Canadian, two US, and two German GCMs with IPCC SRES A2, B1, and B2) to each of the selected cities. Then the wind gust simulation models were applied with downscaled future GCM wind speed data to estimate future wind gust in terms of occurrence frequency and magnitude of the events. Downscaling transfer functions and wind gust simulation models were validated using a cross-validation scheme and comparing data distributions and extreme-event frequencies derived from downscaled GCM control runs and observations over a comparative time period 1961–2000. The results showed that the models for all variables used in the study performed well. By comparing the current average conditions for the period 1994–2007, the future wind gust events are projected to increase with a varying relative increase magnitude across the different strengths of wind gusts. Generally, the stronger the wind gust is, the greater the relative increase magnitude.

This talk will introduce this research project and outline the modeling exercise and result verification process. The major findings on future wind gust estimates from the study will be summarized in the presentation as well. One of the major conclusions from the study is that the procedures used in the study have the potential to be incorporated into municipal/community emergency response plans to reduce wind damage. The implementation of the significant increases in future wind gust risks should be taken into consideration when revising engineering infrastructure design standards (including infrastructure maintenance and new construction) and developing adaptation strategies and policies.

4B-204.5 ID:2815 11:30

A total linear response (TLR) model for assessing climate change impact on annual runoff over large river basins

Lei Wen [1], *Charles Lin* [2], *Zhiyong Wu* [3], *Qi Li* [4]
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In this study, we use a simple Total Linear Response (TLR) model to calculate annual runoffs over China. The model is based upon the multiple input and single output approach, and was developed at National University of Ireland (Galway) in the 1980s. First, we calibrate the TLR model over the Wangjiaba Basin (30,500 km2) using observed annual precipitation, mean temperature and runoff from 1976 to 1996. For demonstrating our view point, the Variable Infiltration Capacity (VIC) macroscale hydrology model is also calibrated on the same basin. VIC is applied over a grid of 50 points with a resolution of 30 km × 30 km, and is driven by the same observed dataset at a daily time step for the same period. Both calibrated TLR and VIC are then forced by observations to calculate Wangjiaba annual runoffs for the period 1961 to 2000. The two simulated annual runoff time series are inter-compared and also compared with observation. The result indicates that both models simulate well Wangjiaba annual runoffs as revealed by the Nash-Sutcliffe coefficients of 0.89 for TLR and 0.90 for VIC respectively. This encouraging result demonstrates the potential of using TLR model for annual runoff calculation over large river basins. Second, we use the TLR model driven by an ensemble of 17 GCM simulations to calculate annual runoffs over China for the period 2011 to 2050. The mean climate for annual runoff is determined by observations for the period 1981 to 2000 as used in the latest IPCC report. TLR is applied over 14 surface water function regions covering the entire country. The calibration and validation periods are from 1956 to 1979 and 1980 to 2000 respectively, and TLR is driven by observations for both periods. Robust results are obtained for both model calibration and validation periods as revealed by the Nash-Sutcliffe coefficients of over 0.7 and relative absolute errors of less than 15%. Detailed discussions on TLR projected annual runoffs over the 14 regions for the period 2011 to 2050 are also reported on.

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) (PART 1) / Les Orages Violents compréhensifs et L'Expérience de la couche limite Albertaine (Partie 1)

Room / Endroit (205), Chair / Président (Neil Taylor and David Sills), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-205.1 ID:2847 **10:30**

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) 2008: Project Overview

Neil Taylor [1], *David Sills* [2], *John Hanesiak* [3], *Jason Milbrandt* [4], *Craig Smith* [5], *Geoff*

Strong [6], *Susan Skone* [7], *Patrick Mccarthy* [8], *Julian Brimelow* [3]
[1] Hydrometeorology and Arctic Lab, Environment Canada
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The Canadian Prairies are subjected to numerous severe thunderstorms with an average of 222 severe weather reports received by Environment Canada each summer. The Alberta foothills are a favoured region for thunderstorm development with more thunderstorm days occurring there than anywhere else within the Prairie Provinces. Most storms developing there move eastward to affect the Edmonton – Calgary corridor. This is 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 thunderstorms. Its close proximity to the Rocky Mountains, limited knowledge of local boundary layer processes, and a scarcity of observations contribute to the challenges in forecasting for this region.

Various severe weather studies have stressed the importance of mesoscale convergence boundaries and boundary-layer water vapour in thunderstorm development. However, these boundaries and associated small-scale processes cannot be adequately resolved using existing synoptic-scale surface and upper-air observation networks on the Prairies. Previous thunderstorm research in Alberta has focused largely on storm structure and larger-scale upper-air processes. Conceptual models for severe storm outbreaks in Alberta are nearly 20 years old and do not focus explicitly on mesoscale boundaries that are known to be important for convective initiation (CI). Gradients in latent and sensible heat fluxes arising from contrasting areas of soil moisture or vegetation cover have the potential to influence the development of mesoscale boundaries and CI in this region.

In 2008, Environment Canada researchers and scientists from academia conducted a pilot field experiment over the Alberta foothills to investigate boundary-layer processes associated with CI and severe storms. The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) focuses on three main areas related to improved forecasts of CI; ABL water vapour and convergence boundaries, land surface processes (i.e., sensible and latent heat fluxes) and associated circulations, and application of high-resolution numerical models as a forecast tool. The goals of UNSTABLE 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. Overall, it is hoped that results from UNSTABLE can be used by forecasters to assist them in issuing the most timely and accurate severe weather watches and warnings possible.

UNSTABLE consists of two field campaigns and associated modeling studies. During the summer of 2008, a pilot UNSTABLE field study was undertaken that included a two-week intensive observation period. Measurements from a special network of surface (fixed and mobile), upper-air, and airborne instruments, in combination with existing observing networks, were used to characterize processes associated with CI in the Alberta foothills during the peak summer severe weather season. Results from the pilot will be used to refine measurement and other strategies for a full-scale UNSTABLE experiment in 2011. An overview of the project and operations from the summer of 2008 will be presented.

4B-205.2 ID:2826 10:45

Mesonet Observations during the 2008 Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE)

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Various severe weather studies have stressed the importance of mesoscale convergence boundaries and boundary-layer water vapour for thunderstorm development. However, such boundaries and boundary-layer processes cannot be adequately resolved using existing synoptic-scale surface and upper-air observation networks on the Canadian Prairies. This scarcity of observations, along with the close proximity to the Rocky Mountains and poor understanding of boundary-layer processes in this region, makes severe weather forecasting particularly challenging.

The overall goals of Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) are to:

• better understand the processes leading to the development of severe thunderstorms,

• refine conceptual models related to convective initiation (CI), and

• assess the utility of mesoscale numerical models to resolve physical processes over the Alberta foothills.

To begin to address these objectives, scientists from Environment Canada and several Canadian universities conducted a pilot field experiment over the Alberta foothills during the summer of 2008. During the two-week intensive observation period, measurements from a special mesoscale network of surface (fixed and mobile), upper-air, and airborne instruments, in combination with existing observing networks, were used to characterize processes associated with CI in the Alberta foothills during the peak summer severe weather season. The network was designed to have sufficient spatial (~10 km) and temporal (1 s to 1 min) resolution to resolve important boundary-layer processes related to convective initiation and severe storm development.

Preliminary results from the UNSTABLE mesonet will be discussed, with emphasis on measurements made by fixed and mobile surface stations. In particular, the success of the mobile instrumentation in characterizing various mesoscale boundaries, including the dryline, will be described.

4B-205.3 ID:2933 **11:00**

Moisture Cycling and Urban Dry Islands in Thunderstorm Environments

Geoff Strong [1], *Danny Brown* [2], *J. Hanesiak* [3], *J. Brimelow* [3], *C. Smith* [4], *D. Sills* [4], *N. Taylor* [4]

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Fixed and mobile surface transects conducted during UNSTABLE, DRI, and AGAME field studies provide data on two related areas of moisture cycling with respect to thunderstorms. The first considers the comparative role of regional evapotranspiration (ET) from grain crops. This daily cycling of moisture into the boundary layer beneath a capping lid is thought to be a major factor in storm initiation as the moisture converges over the foothills with easterly boundary layer flow. This can occur during cyclogenesis events, the resulting ascent eventually weakening the lid. The second area explores the role of drylines, caused by dry air subsiding from the Rockies with southwest flow aloft. Under certain conditions, a dryline also helps initiate foothill storms through increased convergence as it advances eastward from the opposite side of the capping lid.

Data from fixed and mobile surface transects and radiosondes provide estimates of daily moisture loading of the boundary layer from local ET. The transects also reveal dryline mixing ratio gradients exceeding 3.5 g kg-1 in 100 m. We speculate on an analogous role (to drylines) that may be played out by dry air over drought-stricken regions, which may assist in the initiation and/or maintenance of a storm skirting the drought region. The tragic Pine Lake tornadic event of July 2000 is used to suggest that a severe prolonged drought south of the storm track may have contributed to the storm intensification as it moved off the foothills. A fortuitous side study provided by the mobile transects across small towns reveals urban ‘dry’ islands in an otherwise sea of boundary layer moisture in surrounding rural areas.

4B-205.4 ID:2789 **11:15**

Exploring surface linkages to convection and convective boundary layer thermal characteristics on the Canadian Prairies

John Hanesiak [1], *Julian Brimelow* [1], *Shannon Moodie* [1], *Jeremy Kusyk* [1], *Ronald Stewart* [1], *Bob Kochtubajda* [2], *Jason Milbrandt* [3], *David Sills* [4], *Craig Smith* [5], *Neil Taylor* [2], *Geoff Strong* [6]

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The Earth's surface and its vegetation can play a significant role in day to day weather as well as seasonal and longer time scales. This is particularly true for a mid-continental environment like the Canadian Prairies during the warm convective precipitation season. Research within two parallel studies associated with the Drought Research Initiative (DRI) and Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) is the focus for this talk. Preliminary DRI work is using gridded root-zone soil moisture, evapotranspiration and lightning flash data to elucidate linkages between lightning characteristics over significant wet/dry regions over the Prairies. Initial results suggest a positive feedback between thunderstorm activity and soil moisture, especially over drought areas. Given that 80-85% of the summer Prairie precipitation occurs due to convective processes, this internal feedback is an important process during drought. During the UNSTABLE field project, an opportunity to investigate thermodynamic variations across cropped versus forested (foothill) regions occurred on July 20, 2007. Preliminary analysis of enhanced rawinsonde, surface mobile transects and aircraft measurements suggests significant variations in low level moisture across these areas. In contrast, measurements of temperature along the same transects show smaller variations. Spatial variations in soil moisture and evapotranspiration can play in integral role in surface-based convective processes. The goal of both projects is to improve our understanding of surface-atmosphere couplings and convective processes during the warm season.

4B-205.5 ID:2707 11:30

Evaluating GEM-LAM precipitable water vapour output using the southern Alberta GPS network during UNSTABLE 2008

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Environment Canada currently runs a high-resolution (2.5-km grid-spacing) limited-area model (LAM) version of the GEM forecast model, commonly referred to as the GEM-LAM-2.5 configuration, on four experimental domains in Canada. Meteorologists and atmospheric scientists have shown that the GEM-LAM-2.5 is a useful tool for both local forecasting and for examining mesoscale atmospheric processes. The substantially higher horizontal resolution of GEM-LAM-2.5, compared to the 15-km regional configuration (GEM-REG) used for short-term (48 h) forecasts, increases the model's capability of representing local scale topography, land cover and smaller scale meteorological processes.

During the UNSTABLE 2008 intensive operation period (IOP), researchers at Environment Canada ran a special real-time 1-km version of the GEM-LAM over the UNSTABLE study region of south-central Alberta. In addition to GEM-REG, output from the GEM-LAM-2.5 and 1-km versions was used both as forecasting tools and for guidance in mission logistics. Post-IOP, GEM-LAM output will be used for multiple research purposes making model validation a necessity. Extensive observational data sets produced during the UNSTABLE IOP will be valuable for model validation and improvement.

In a previous study (the Alberta GPS Atmospheric Moisture Evaluation), data from the southern Alberta GPS network was compared to conventional radiosondes and shown to be useful for identifying biases in PWV output from the operational GEM-REG model. During UNSTABLE, hourly PWV data, following post-processing of the dual frequency GPS signal is available at 10 locations within the project study area. This data set is used here to assess any increased accuracy in the GEM-LAM for resolving PWV.

4B-205.6 ID:2848 11:45

Characterization of the dryline in Alberta on 13 July 2008 using observational data from UNSTABLE 2008

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The dryline has long been recognized as a focusing mechanism for convective initiation (CI) on the US plains. More recently, this feature has also been identified as a CI mechanism on the Canadian prairies, most predominantly in Alberta. Previous studies related to the dryline in Alberta have relied largely on sparse surface observations, remote sensing, and NWP data. Local fixed and mobile surface observations collected during the Alberta GPS Atmospheric Moisture Evaluation (A-GAME) experiment in 2003 and 2004 provided the first indications of the actual strength of the moisture gradient across the dryline in Alberta.

During the summer of 2008, scientists from Environment Canada and academia conducted field operations for the Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE). UNSTABLE 2008 employed a variety of fixed and mobile, surface and upper-air instrumentation platforms to characterize atmospheric boundary layer (ABL) processes associated with CI over the Alberta foothills. A major component of UNSTABLE 2008 was the investigation of mesoscale convergence boundaries with the dryline being given special consideration.

On 13 July 2008 a dryline developed in the UNSTABLE study domain and was targeted for measurements by mobile observation teams. The development, evolution, and surrounding environment were sampled via fixed and mobile surface, radiosonde, aircraft, and other instrumentation platforms prior to and leading up to CI. At the surface, the strongest dewpoint change across the dryline was measured to be ~ 5 °C over 179 m yielding a gradient of ~ 27 °C/km or 11 g/kg/km. Radiosonde and aircraft observations are consistent with key features identified in the widely accepted conceptual model for the dryline in the U.S. These and other observational data will be used to characterize the near-dryline environment, moisture and other gradients at the surface boundary, and their evolution. Some comparisons with output from Environment Canada's Global Environmental Multiscale (GEM) Limited Area Model (LAM) will also be presented.

IPY and related atmospheric, oceanographic, and hydrological studies (PART 3) / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie (Partie 3)

Room / Endroit (301), Chair / Président (Thomas Duck), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-301.1 ID:2937 **10:30**

The Polar Environment Atmospheric Research Laboratory (PEARL) during International Polar Year and Beyond

James Drummond [1], *Kimberly Strong* [2], *Jim Sloan* [3], *Tom Duck* [1], *William Ward* [4], *Candac/pearl Science Team* [5]
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PEARL is located at Eureka on Ellesmere Island, Nunavut at 80o 3' 11.75"N, 86o 24' 59.41"W and is thus one of the few installations north of 80N. The complex houses a large number of atmospheric instruments that probe the atmosphere in the range 0-100km above the observatory. During IPY just ended, PEARL has been the site of intense activity with a number of projects involving radiation, composition, transport and dynamics. This paper will serve as an introduction to some of those projects that will be detailed further in other papers in this and other sessions.

Besides the scientific program, there have been numerous educational and informational outreach efforts that have resulted in contacts with a wide range of peoples both in the Arctic and in Southern Canada. These will be briefly discussed.

As IPY winds down, there is the question of "where from here?" The federal government has expressed an interest in scientific research in the Arctic. An IPY objective is to "Leave a legacy of observing sites, facilities and systems to support ongoing polar research and monitoring". How does PEARL fit into these interests? In this talk we hope to be able to provide some insight into the future of PEARL and its research program.

PEARL is supported by the Canadian Foundation for Innovation (CFI); Canadian Foundation for Climate and Atmospheric Science (CFCAS); Canadian Space Agency (CSA); Environment Canada (EC); Government of Canada IPY funding; Indian and Northern Affairs Canada (INAC); Ontario Innovation Trust (OIT); Natural Sciences and Engineering Research Council (NSERC); Nova Scotia Research Innovation Trust (NSRIT); Ontario Research Fund (ORF); and the Polar Continental Shelf Program (PCSP).

4B-301.2 ID:3066 10:45

Long range atmospheric transport of Aerosols: First Arctic measurements using Quadruple Aerosol Mass Spectrometer

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Atmospheric aerosols can directly affect climate by scattering and absorbing solar radiation, thereby modifying the radiative balance of the atmosphere. Aerosols can also act as cloud condensation nuclei which alter cloud properties and precipitation rates, thereby indirectly influencing the climate. Aerosol surfaces are a medium for heterogeneous reactions and carry many different compounds which naturally affect their properties. Since aerosol lifetimes in the troposphere are on the order of days to a week, they are transported throughout the atmosphere. To study this transport, we installed a Q - AMS in the Polar Environment Atmospheric Research Laboratory in August, 2006. The laboratory is located on the Arctic island, Ellesmere (80°N 86°W) at 610 m above sea level. It provides a unique location for observing transport to the sensitive ecosystem because it is far from anthropogenic sources of contamination.

In this presentation, we will report the analysis of aerosol mass concentrations, size, and chemical compositions covering the time period from August, 2006 to May 2009. Our measurements show that sulphate dominates the aerosol composition most of the time, with a maximum concentration of 0.655 μg/m3 and minimum concentration of 0.030 μg/m3. The second most abundant species was organic aerosols, with concentrations in the range from 0.440 μg/m3 to 0.050 μg/m3. Although the sulphate dominates in general, plots of concentration time series show a seasonal change in the relative concentrations of sulphate and organic species. Relatively lower concentrations of nitrate and ammonium species were detected during the period of our observations. Occasional episodes of concentrations up to 0.050 µg/m3 nitrate and 0.080 µg/m3 ammonium were detected; otherwise these were below our detection limit (0.009 µg/m3). In addition to the above results, we will briefly report the ionic components and discuss possible aerosol transportation routes determined with the semi-Lagrangian trajectory model, FLEXPART.

4B-301.3 ID:2975 **11:00**

Tropospheric Particles Observed in the High Arctic at Eureka

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A climatology of tropospheric particles measured with a lidar and radar during winter from the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut Territory (80N 86W), are presented. The combined measurements from the Arctic High Spectral Resolution Lidar (AHSRL) and the CANDAC (Canadian Network for the Detection of Atmospheric Change) millimeter-wave cloud radar (MMCR) allow estimates of particle effective radius. Four different categories of scatterers were considered: aerosols, ice clouds, mixed-phase clouds, and boundary-layer ice crystals. The largest ice crystals originate from ice clouds, whereas the smallest are in the boundary layer and are mostly due to topographic blowing snow residuals. Ice cloud crystals have depolarization and size decreasing with height, and sometimes precipitate to ground. Water clouds are constrained to the lower troposphere and are associated with the surface inversion layer depth. The measurements fill a gap in our measurement record during winter at high latitudes, and have implications for the Arctic radiative transfer problem.

4B-301.4 ID:2941 **11:15**

Stratospheric Trace Gas Measurements at Eureka, Nunavut During IPY and Comparisons with the Atmospheric Chemistry Experiment on SCISAT

Rodica Lindenmaier [1], *Rebecca Batchelor* [1], *Kimberly Strong* [1], *Kaley Walker* [1], *Gloria Manney* [2], *William Daffer* [2]
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The process of rapid stratospheric ozone loss in the polar regions begins during the polar winter, when dynamical and chemical conditions lead to the formation of reactive chlorine and bromine radicals. Long-term data sets of Arctic chemical composition measurements are needed to better understand the process of ozone loss, the links between ozone depletion and climate change, and the future evolution of ozone. For this purpose, a high-resolution Fourier transform infrared spectrometer was installed at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut in

July 2006. Since then, this instrument has been used to measure solar absorption spectra in the mid-infrared. Using the optimal estimation technique, total columns and some vertical profile information are retrieved for a suite of trace gases that are involved in the process of stratospheric ozone depletion. Total columns of O3, HCl, ClONO2, HNO3, and HF will be presented, with a focus on three Canadian Arctic ACE Validation spring campaigns that took place in 2007, 2008, and 2009. Very different dynamical situations were observed over Eureka during these three spring periods: the impact of these conditions on the trace gas measurements will be shown. SCISAT, also known as the Atmospheric Chemistry Experiment (ACE), is a Canadian satellite mission for remote sensing of the Earth's atmosphere and was launched on August 12, 2003. Its primary instrument is a high spectral resolution Fourier Transform Spectrometer (FTS) measuring sequences of atmospheric absorption spectra in solar occultation. From these spectra the vertical distribution of trace gases can be determined. Results of the Bruker 125HR comparisons with the ACE-FTS, made with the purpose of the validation of the satellite measurements, will be also shown.

4B-301.5 ID:3086 11:30

The Waves and Coupling Processes Theme at the Polar Environment Atmospheric Research Laboratory (PEARL): The First Year of Observations and Science

William Ward [1], *Alan Manson* [2], *Young-Min Cho* [3], *Sam Kristoffersen* [1], *Chris Meek* [2], *Dragan Veselinovic* [1], *Ding-Yi Wang* [1], *Tom Duck* [4], *Marianna Shepherd* [3], *Robert Sica* [5], *Kevin Strawbridge* [6], *Kimberly Strong* [7]
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[2] ISAS, Department of Physics and Engineering Physics, University of Saskatchewan
[3] CRESS, York University
[4] Department of Physics & Atmospheric Science, Dalhousie University
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Observations from the full suite of instruments relevant to the Waves and Coupling Processes Theme at the Polar Environment Atmospheric Research Laboratory (PEARL) in the Canadian Arctic (Eureka, Nunavut, 80N, 86W) started during the winter of 2007/2008 and have continued during this past winter 2008/2009 albeit with the usual teething pains associated with a new observatory. The instrumentation includes the E-Region Wind Interferometer, the meteor radar, the Spectral Airglow Temperature Imager SATI), the PEARL All-Sky Imager, the ozone and Rayleigh/Mie/Raman lidars, the VHF and cloud radar, the Fourier Transform Spectrometer and the Atmospheric Emitted Radiance Interferometer. These provide observations on the background constituent, temperature and wind profiles and the wave environment above Eureka. By combining this information with contextual information on the large scale state of the Polar atmosphere, the coupling of the dynamics between atmospheric layers in the high northern latitudes and between the Polar atmosphere and other geographical locations can be studied. The contextual information is provided through collaborations with modelling groups, other ground based observatories in the Arctic, and satellite teams. In this paper we describe the capabilities of the instrumentation involved in these studies, outline the

scientific approach and present some results from the past two winters (including results from the major stratospheric warmings).

4B-301.6 ID:3070 11:45

Meridional Coupling of temperature between middle and high arctic latitudes during stratospheric warming events – the SATI and COSMIC perspective

Marianna Shepherd , *Young-Min Cho* , *Gordon Shepherd* , *Brian Solheim*
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Airglow mesospheric temperatures near 87 km altitude at Eureka/PEARL (80°N, 274°N) and CRESS Observatory (44.3°N, 279°E) have been measured using a Spectral Airglow Temperature Imager (SATI). Comparison with radio-sonde temperatures in the stratosphere at 22.5 km at high latitudes has shown a correlation between the two regions in the sense that winters that are warmer (or colder) than normal in the stratosphere are also warmer (or colder) than normal in the mesosphere. This correlation is explored further using correlative SATI and radio-sonde observations at mid-latitudes, MLS-Aura and COSMIC/ FORMOSAT-3 satellite temperature data during the Arctic winters of 2007-2008 and 2008-2009 at 60°N-80°N and 40°N-50°N. The correlative temperatures are also analysed in search of planetary wave signatures. The results obtained are presented and discussed in the context of the dynamical coupling between the lower stratosphere and the mesosphere/lower thermosphere region and between middle and high arctic latitudes.

Climate Variability and Marine Ecosystems (PART 1) / Le climat et les écosystèmes marins (Partie 1)

Room / Endroit (302), Chair / Président (Christine Michel), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-302.1 ID:3003 INVITED/INVITÉ 10:30

Climate-driven changes in the biological productivity of the Arctic Ocean

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Assessing the current and future productivity of the marine ecosystem is a major challenge for Arctic oceanographers. Remote sensing is useful to monitor large-scale patterns in the productivity of the upper euphotic zone, but is ill-equipped to monitor key events that occur in and underneath seasonal sea ice or at the base of the euphotic zone

during the ice-free period. Our ability to detect trends and measure change is also hampered by the lack of in situ time series that include quantitative indicators of the timing, functional composition and yield of primary production in addition to routine physical parameters. This presentation offers a reflection based on historical data and recent process-oriented research and monitoring initiatives in the western Arctic. Ten years ago, a synthesis of data published since the 1950's suggested a positive, spatial correlation between pelagic primary production and the duration of the ice-free period, which might be caused by systemic differences in the availability of photosynthetically-active radiation (PAR) and/or nutrients. A new, stringent re-analysis of this literature highlights how the most productive systems are currently located in peripheral Arctic seas or polynyas that are susceptible to nutrient supply by lateral advection, convection and wind-driven mixing or upwelling. Less productive sectors of the Canada Basin will not acquire this susceptibility simply because multi-year ice vanishes or the lifetime of seasonal ice declines. The results obtained during the programs NOW, CASES, ArcticNet and IPY-CFL indicate that large variations in nitrate-based new production are not primarily explained by differences in cumulative exposure to PAR. A hierarchy is proposed, whereby order-of-magnitude differences in primary productivity at the pan-arctic scale are controlled by the nature of episodic nutrient subsidies and smaller, 2-3 fold increases within a given region are due to synergistic interactions between PAR, periodic nutrient inputs and biological processes at the base of the euphotic zone where deep chlorophyll maxima persist.

4B-302.2 ID:2664 11:00

Contributions from DMS and ship emissions to CCN observed over the summertime North Pacific

Lisa Phinney [1], *W. Richard Leaitch* [2], *Ulrike Lohmann* [3], *Nicole C. Shantz* [4], *Douglas R. Worsnop* [5]

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Measurements of cloud condensation nuclei (CCN) made over the remote North Pacific Ocean in July 2002 are analysed with concurrent measurements of aerosol number, mass and composition. Overall the CCN are controlled by the sulphate, including one case of particle nucleation and growth resulting from dimethyl sulphide oxidation that enhanced CCN concentrations. Hourly CCN concentrations are correlated with concentrations of sulphate plus methanesulphonic acid (MSA) over the entire study period ($r^2 = 0.43$ and 0.52 for supersaturations of 0.34% and 0.19%, respectively), and are not well correlated with other organics ($r^2 < 0.2$). One case study reveals elevated mass and number concentrations of ultrafine and fine organic particles due to regional ship emissions, during which organic mass concentrations are correlated with CCN values ($r^2 = 0.39$ and 0.46 for supersaturations of 0.19% and 0.34%, respectively). The evolution of the time series and mass distributions of organics, sulphate and MSA over this timeframe indicate

that the regional distribution of small, diffuse ship-sourced organic particles act as condensation sites for sulphur species, resulting in a subsequent increase in number concentrations of CCN. Direct emissions of organic particles may exert a strong control on marine CCN concentrations once diffused into the marine atmosphere by acting as condensation sites for biogenic and anthropogenic sulphur species.

4B-302.3 ID:2946 **11:15**

Phytoplankton production and export in the Hudson Bay system.

Amandine Lapoussiere [1], *Christine Michel* [2], *Michel Gosselin* [1], *Michel Poulin* [3], *Jean-Éric Tremblay* [4], *Yves Gratton* [5]
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The Hudson Bay system (i.e., Hudson Bay and Hudson Strait) is particularly vulnerable to climate change. Recent studies highlight an increase in annual mean sea surface temperature, a decrease in sea-ice cover extent and duration, and a decrease in river runoff in this system. In this paper, we will discuss patterns of production and export in the Hudson Bay system, based on results obtained in September-October 2005. Our results showed that Hudson Strait and eastern Hudson Bay were more productive regions than western Hudson Bay. This can be explained by higher nutrient concentrations linked to oceanic circulation and vertical mixing in Hudson Strait and to river runoff in eastern Hudson Bay. In both regions, the suspended carbon biomass was dominated by diatoms. The organic carbon sinking flux was dominated by amorphous detritus and intact cells in Hudson Strait, and by fecal pellets in eastern Hudson Bay. Export ratios (i.e., sinking export to primary production ratio) were low (<0.3) in these two regions, which is contrary to expectations in an environment where large cells dominate the suspended biomass. In western Hudson Bay, ciliates and choanoflagellates dominated the suspended biomass and the sinking material was mainly in the form of amorphous detritus and bacterial carbon, suggesting an environment of high recycling. Export ratios were high (on average 0.55) in this region. These results highlight that, in early fall, the Hudson Bay system shows strong regional patterns in production and export linked to surface hydrographic conditions and nutrient distribution. These results can be construed in terms of potential effects of climate change on physical and chemical conditions and on consequences for organic matter production and export in this subarctic inland sea.

4B-302.4 ID:2727 **11:30**

How will short-term variability affect a coastal ecosystem subject to climate change?

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Climate change is generally considered in terms of the drift in average conditions, but organisms experience and respond to variability about those means, in addition to abrupt changes. Climate models predict an increase in the frequency and magnitude of extreme events. In the Strait of Georgia, short-term events include storms, blooms and fluctuations in river runoff on the timescale of a few days. These events can then affect productivity, turbidity, light climate, organic carbon cycling and oxygen depletion. We have deployed two moorings, one in the central Strait of Georgia, under the Fraser River plume, and the other in the northern Strait, in an area of high primary productivity. Each mooring comprises sequential sediment traps, a current meter, a CTD, a fluorometer-turbidity meter, and an oxygen sensor. Paired sediment traps at 50 m collect samples at 12-day and 2-day intervals, to evaluate the contribution of short-term events to the monthly, seasonal and annual average fluxes. Preliminary data show abrupt excursions in oxygen concentration apparently linked to water mass changes. The observed variability in oxygen concentration crosses biological effects thresholds for periods of up to a week. Such changes are missed by periodic sampling and representations of average conditions.

4B-302.5 ID:2695 **11:45**

Effects of local and global change on an inland sea: the Strait of Georgia, British Columbia

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Global changes manifest in coastal waters depending on local oceanography and ecosystems. Here we consider the Strait of Georgia as a case study. After examining physical and chemical processes and trends, we discuss consequences of change on geochemical cycling and biota. Several components of the system are vulnerable. Declines in pH and O2 of basin waters, partly imported from the shelf and partly supported by carbon cycling within the Strait, would reduce benthic and pelagic habitat. Sea-level rise and storms will interact with coastal development to place critical habitat, such as low-lying estuaries, intertidal zones and mudflats, at risk. The decrease and earlier peak in zooplankton biomass may lead to changes in the foodweb that cascade to higher trophic levels such as fish and birds. Anadromous fish, already showing declines, are vulnerable to ocean regime shifts, increasing river temperatures, habitat destruction, harvesting and contaminants. For southern resident killer whales, a species at risk, decline in Chinook salmon, their major source of food, together with marine traffic and biomagnifying contaminants will lead to extirpation if no action is taken. The biota of coastal regions worldwide are subject to multiple stressors. Some of these can be controlled only through international action to mitigate climate change. However, we do have local control of many stressors, including fishing, habitat destruction, release of some contaminants and, to some extent, river flow and temperature. Acting to control what we can will support resilience of biota in the face of inevitable global changes.

Composition, Variability and Circulation of Seawatwer: Bays to Basins (PART 1) / Composition, variabilité et circulation de l'eau de mer: de baies à bassins (Partie 1)

Room / Endroit (303), Chair / Président (Igor Yashayaev), Date (04/06/2009), Time / Heure (10:30 - 12:00)

4B-303.1 ID:2752 **10:30**

Salinity, Chemical Composition, and Conductivity of Natural Waters

Rich Pawlowicz
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Although conductivity is an indispensible tool in oceanographic and limnological studies of natural waters, surprisingly little work has been done in understanding the relationship between conductivity and chemical composition since the adoption of PSS-78. In this talk I will (ab)use a recently developed theory that links conductivity and composition (Pawlowicz, Limnol. Oceanogr.:Methods 6, 2008, 489-501), to estimate the partial equivalent conductivities of seawater with respect to various ions over a range of salinity and temperature, and to determine the sensitivity of seawater conductivity to changes in pH and carbon content.

4B-303.2 ID:3041 **10:45**

Updated Representations of the Thermophysical Properties of Seawater: A New Standard for Oceanography

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The SCOR/IAPSO Working Group 127 (WG127) was formed three years ago to examine advances in the representations of the thermodynamic properties of seawater that have occurred during the 30 years since the last major evaluation and update was done. WG127 is now preparing to make its recommendations to the scientific community, journals and international bodies; these recommendations are expected to modify current oceanographic practice. In particular, use of a Gibbs function formulation for the consolidated and consistent representation of the thermodynamic properties of pure water and sea water (including liquid, vapour and solid forms) will be recommended by WG127 as well as the use of Absolute Salinity rather than (solely) Practical Salinity as the salinity variable to be used in scientific publications. The effect will be to improve the accuracy and consistency of how we deal with the thermodynamics of seawater.

Background information, planned changes and the proposed timetable for adopting these changes will be presented.

4B-303.3 ID:2856 **11:00**

Numerical Study on Circulation in St Margaret's Bay by a Nested-grid Ocean Model

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A general ocean circulation modeling system is used to study the circulation in St Margaret's Bay in Nova Scotia, Canada. Local wind-forcing, tides, remotely generated waves, and buoyancy forcing in the summer and fall of 2007 are used to drive the model. The model, known as NCOPS - Nested-grid Coastal Ocean Prediction System, is composed of five relocatable submodels, with the coarse level submodel providing boundary conditions for the next high-resolution level submodel. The outermost submodel covers the Eastern Canadian Shelf and has a coarse horizontal resolution of $(1/12)^0$ for simulating storm surges and barotropical shelf waves over the Eastern Canadian shelf. The innermost submodel covers the whole St Margaret's Bay and has a fine horizontal resolution of about 200m for simulating the 3D coastal circulation in the Bay. Quantitative comparisons between model results and observations, including sea level, temperature, salinity and currents, demonstrate good agreements. Salient circulation characteristics in the Bay have been successfully simulated, including wind-induced upwelling and down welling. Numerical results reveals the spatial and temporal variability of temperature and salinity in the Bay during the study time period is mainly driven by wind stress, sea surface heat-flux, fresh water runoff from the connecting rivers, and the vertical mixing in the Bay, with some contribution from tidal circulation and mass exchange between the Bay and the outer sea.

4B-303.4 ID:2787 **11:15**

Mozambique Channel eddies: A Source of heat and salt for the Agulhas Current and beyond

Neil Swart [1], *Johann Lutjeharms* [2], *Herman Ridderinkhof* [3], *Wil De Ruijter* [4]
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The flow in the Mozambique Channel is dominated by large southward propagating anticyclonic eddies, as opposed to a steady western boundary current. The Mozambique Channel eddies feed their waters into the Agulhas Current, where they are thought to have a significant influence on Agulhas Ring shedding, and thus on the Indo-Atlantic exchange. However despite their importance, only the simplest geometric and flow speed information has been reported for these eddies. Here we use the hydrographic and nutrient data together with satellite altimetry and surface velocity profilers (SVPs) to provide a detailed characterization of the Mozambique Channel eddies. Two warm eddies in the Channel at 20°S and 24°S had diameters of 220 and 240 km respectively. They rotated anticyclonically with a speed of over 0.5^{-1} m.s, with some qualitative agreement between satellite measurements, SVPs and geostrophic calculations. Relative to the surrounding waters, the eddies were warm and saline. Their total heat and salt anomalies are computed relative to reference stations close by, but outside the eddies. At 24°S the total anomalies were 4.6×10^{20} J and 5.1×10^{12} kg respectively, being on a par with Gulf Stream and Agulhas rings. The passage of four Mozambique Channel eddies per year thus has the potential to form a major contribution to the Southward eddy heat flux in the Agulhas Current. We also present novel calculations of nutrient and oxygen anomalies for the two eddies. The features had large negative nutrient and oxygen anomalies, which we propose are significant enough to impact on local ecosystems. The large magnitude of the water mass anomalies within the eddies suggests that interannual variability in Mozambique Channel eddy numbers would have a significant impact on downstream watermass characteristics in the Agulhas Current and Atlantic Ocean.

4B-303.5 ID:3101 **11:30**

Variability in Deep Convection in the Labrador Sea in Recent Years

Igor Yashayaev , *Yongsheng Wu* , *John Loder* , *Charles Tang* , *Simon Prinsenberg*
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The causes, strength and consequences of the deep convection that produces Labrador Sea Water (LSW) are analyzed by interpreting hydrographic, moored and profiling float measurements in conjunction with ocean-ice model simulations with realistic atmospheric forcing. Significant changes in the winter atmospheric forcing over the Labrador Sea are (or appear to be) able to explain most of the observed variability in the properties and volumes of the newly-formed year classes of LSW. The evolution of this water mass along its exit pathways and the associated signal transfer/transit rates will be described.

High-resolution model runs simulating the changes in sea ice and convection will be analyzed and used to examine the relative effects of variable freshwater flux and variable winter air temperature and winds on the simulated ice cover, convective mixing and water mass production in the Labrador Sea. Preliminary results suggest that both increased ice cover and enhanced LSW production in the winter of 2007-2008 were caused by high surface heat losses associated with extremely low air temperatures. That winter was indeed reported as the coldest regionally and globally over at least 7 years preceding 2008. We will also report on anomalously fresh near-surface water in the Labrador Sea in the second half of 2008 and examine its origin and impact on subsequent convection.

4B-303.6 ID:2986 **11:45**

Model study of the Labrador Sea Water formation and spreading

Entcho Demirov , *Jieshun Zhu*
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Results from eddy permitting model simulations of the Labrador Sea will be present. The ocean model is NEMO, which is implemented for the region of the North Atlantic with 1/4 degree horizontal resolution and 46 vertical levels. The surface atmospheric forcing is calculated with NCEP atmospheric reanalysis for the period of time from 1948 to 2005. The model results about the Labrador Sea Water formation and spreading are studied. In this talk, results about interannual and interdecadal changes in the LSW characteristics and transport will be present

Air Quality: Delivering the Right Message (PART 2) / Qualité de l'air: délivrer le bon message (Partie 2)

Room / Endroit (202), Chair / Président (Doug Steeves), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-202.1 ID:2996 **13:30**

Lidar Profiling of Biomass Burning, Pollution, and Volcanic Aerosols from Halifax

Thomas Duck [1], *Lucy Chisholm* [1], *Lubna Bitar* [1], *Steve Beauchamp* [2]
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The Dalhousie Raman Lidar has operated in Halifax, Nova Scotia, as part of a three-year study of transboundary aerosol transport. The measurements have shown frequent examples of aerosols transported from forest fires to the West. In the summer of 2007 alone, biomass burning aerosols from five different sources were identified: Quebec, Northwest Territories, Idaho/Montana, Utah, and Mongolia. Biomass burning aerosols are typically elevated and so don't have a large effect on surface air quality. Frequent episodes of pollution transport from industrialized Eastern North America are apparent, and these extend from the surface to over two km in altitude. The highlight of the 2008 summertime measurement campaign was the detection of a high-altitude plume from the Kasatochi volcano in the Aleutian Islands of Alaska. The measurements are being used to construct a climatology of the vertical distribution of continental aerosol export. Models have been used to simulate the various events to help identify sources, and satellite imagery provides the horizontal extent of the aerosol plumes.

4C-202.2 ID:2829 **13:45**

Lake Breezes in Southwestern Ontario and Their Influence on Air Quality During BAQS-Met 2007

David Sills [1], *Jeffrey Brook* [2], *Katherine Hayden* [2], *Paul Makar* [2], *Peter Taylor* [3], *Lesley Hill* [1]
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Southwestern Ontario, located in the southern Great Lakes region, is frequently affected by lake-breeze circulations. These circulations, driven by the thermal contrast between warm air over land and cool marine air over Lakes Erie, Huron and St. Clair, can penetrate well inland and dominate boundary-layer flow when they occur. They can also serve to both suppress thunderstorm activity near the lakes and initiate thunderstorms, including severe storms, inland. In addition, the proximity of southwestern Ontario to significant local and regional emissions sources, both within Ontario and across the border in the United States, often results in compromised air quality. Lake-breeze circulations are believed to have an important influence on both chemical processing and pollutant transport in the region.

The Border Air Quality and Meteorology Study (BAQS-Met) was a measurement-intensive field campaign conducted during the summer of 2007 to investigate the impact of mesoscale weather phenomena, and particularly lake-breeze circulations, on air pollution in southwestern Ontario. Intensive observations were made between June 20 and July 9, while limited observations were made from June through August. Meteorological data were collected via a number of different fixed and mobile platforms, including a mesoscale network of more than 30 surface stations. Operational radar data, satellite imagery, and radiosonde data were also obtained.

Preliminary analysis of BAQS-Met meteorological data shows that, while a wide range of synoptic-scale flow directions and speeds were observed, the region was not often directly affected by significant synoptic-scale disturbances during the intensive observation period (IOP). This provided conditions very conducive to the development of lake breezes. In fact, lake-breeze circulations were identified on all 20 days during the IOP. Conditions were also favourable for poor air quality and strong to severe thunderstorms on a number of days. Integrated analysis of surface observations, satellite imagery, and radar data was used to identify lake-breeze fronts and their movement each day during the field campaign. Data from the IOP will be used to demonstrate the complexity of lake-breeze interactions in the region and discuss impacts on air chemistry and convective weather.

4C-202.3 ID:2809 14:00

Sable Island Air Monitoring: Perspectives on local and long-range pollutant sources and transport.

David Waugh [1], *Tracey Inkpen* [2], *Michael Hingston* [2], *Stephanie Keast* [2], *Lisa Phinney* [1], *Colleen Farrell* [1], *Gerry Forbes* [1], *Doug Worthy* [3], *Senen Racki* [3], *Fran Di Cesare* [4], *Rob*

Tordon [1], *Steve Beauchamp* [1]
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Continuous air quality monitoring on Sable Island commenced in June of 2003 and is ongoing with the aim of evaluating ambient air quality attributable to contaminant emissions from offshore oil and gas activities in relation to long range transport and natural sources. Sable Island's location, downwind of the North American (NA) continental emission sources, makes it a prime observing site for examining continental outflow and long term trends in air quality related to NA emission sources as well as influences of local oil and gas exploration and development activities taking place adjacent to the island. The site is also designated as a Global Atmospheric Watch (GAW) site for greenhouse gas monitoring. On-going ground-based monitoring includes ground-level ozone (O3), fine particles (PM2.5), NO, NO2, SO2, H2S and greenhouse gases (CO, CO2, and CH4).

Analysis of criterion air pollutant measurements from 2003-2006 indicate that elevated levels of O3, PM2.5 do occur on an episodic basis and can often be traced to broader scale continental emissions. High concentrations of fine particulate aerosols have not been conclusively attributed to sea salt, ubiquitous around Sable Island, as their temporal and spatial variability, and that of biogenic aerosols, are not yet fully understood. It is difficult to quantify the influence of local sources, including offshore oil and gas activity, at this time due to a lack of information on specific local activities and emissions.

4C-202.4 ID:2995 14:15

Off-site fate and transport of airborne arsenic-laden PM2.5 from a historic gold mine tailings site to nearby properties in Nova Scotia

Mark Gibson [1], *Judy Guernsey* [1], *Louise White* [2], *Tony Knafla* [3], *Michael Parsons* [4], *Ewa Dabek-Zlotorzynska* [5], *Valbona Celo* [5], *Gavin King* [1]
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There are few reported investigations of the off-site fate and transport of airborne arsenic (As)-laden fine particulate matter (PM2.5) from localized gold mine tailing sites. The purpose of this pilot study was to examine off-site migration of arsenic from a historic gold mine site to surrounding property in a Nova Scotian community. At this site, the two main mechanisms for tailings associated As-PM2.5 suspension and subsequent advection from the site to nearby properties are wind and all terrain vehicle/dirt bike activity. There were 17 sampling sessions conducted from the 26 September 2008 to 24 November 2008

that comprised 8 weekday (Monday to Friday) samples and 9 weekend (Friday to Monday) samples. Duplicate gravimetric PM2.5 samples were collected onto Teflon filters at two sites 500m (site 1) and 600m (site 2) from the tailings. Real-time (1-min) measurements of PM10 and PM2.5 were made using Dust Trak nephelometers at site 1. A fully equipped weather station was located at site 1. Comparison of the real-time and gravimetric data at site 1 provided an R2 of 0.9 with a gradient of 2.2. The Gravimetric PM2.5 ranged from 1.0 to 18.0 micro g/m^3 with a mean and C.I. of 7.0 ± 0.25 micro g/m^3. One of the duplicate Teflon PM2.5 filter samples will be analyzed for metals by ICP-MS. The second of the duplicate Teflon filter samples will be analyzed by atomic force microscopy to determine the mineralogy of the As-PM2.5 samples which in turn will aid source apportionment of the sample. Dispersion modeling of the fugitive As-PM2.5 onto local area was also completed. This study provides valuable new insights into the source apportionment and dispersion of As-PM2.5 from a contaminated mine tailings site

4C-202.5 ID:2901 14:30

Wood stove replacement scenarios: modelling the impact on air quality in the Greater Montreal area with AURAMS

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Residential wood smoke has been identified as a serious health issue in urban areas of southern Quebec by Public health authorities because of its negative impact on air quality. According to the most recent 2006 Canadian inventory of criteria air contaminants, residential wood combustion emissions in Quebec account for 27% of primary $PM_{2.5}$ emissions, all sources included. The number of wood stoves or fireplaces may be as high as 1000 units per squared kilometre in some residential areas of Montreal. In 2006, a residential suburb of Quebec city experienced 40 days with poor quality in five winter months. In order to help in the elaboration of programs aimed at improving air quality in wintertime, modelling of wood stove change out programs was performed to assess the impact on air quality. Several surveys and the 2006 census of population were used to distribute spatially the number of wood appliances by type and to estimate the annual wood consumption. With the collaboration of the City of Montreal, the accurate location of wood appliances over the Greater Montreal area was obtained from real estate appraisals. The temporal disaggregation of the annual emissions followed the profile obtained from PAHs and $PM_{2.5}$ concentrations at a location highly influenced by wood stove emissions. The modelled scenarios ranged from the replacement of 25% to 100% of conventional stoves and fireplaces by advanced technology appliances, then by natural gas appliances. During the modelled episode of November 2006, the maximun decrease in $PM_{2.5}$ concentrations occurred between 10PM and 2AM at night. During this period of the night, $PM_{2.5}$ concentrations dropped by as much as 50% when all wood appliances are replaced by natural gas stoves, and by about 5% when 25% of conventional stoves are replaced by advanced technology appliances. Future improvement to the modelling system will also be discussed.

Monitoring the Atmosphere and Ocean (PART 2) / Monitorage de l'atmosphère et de l'océan (Partie 2)

Room / Endroit (203), Chair / Président (Pierre Pépin), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-203.1 ID:3006 **13:30**

Latest progress in building the world's first regional cabled ocean observatory: NEPTUNE Canada

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NEPTUNE Canada (NC) will install the world's first regional cabled ocean observatory by late 2009 off Canada's west coast, comprising: five observatory nodes (100-2700m water depths), 800km backbone cable delivering 10kVDC power and 10Gbps communications bandwidth to hundreds of sensors, with a 25-year design life. Infrastructure funding ($100M) and initial operational funding ($20M) is secured. UVic leads a consortium of 12 Canadian universities, hosts the coastal VENUS cabled observatory, with Ocean Networks Canada providing management oversight. Over 130 instruments will be deployed in subsurface (boreholes), on seabed, and buoyed through water column, including tethered crawler and 400m vertical profiler. Experiments will address: earthquake dynamics and tsunami hazards; fluid fluxes in ocean crust and sediments, including gas hydrates; ocean/climate dynamics, including acidification and nutrient fluxes; deep-sea ecosystems dynamics; and engineering and computer science research. The observatory architecture has a trunk and branch topology; the backbone cable (installed 2007) loops from/to UVic's Port Alberni shore station. Backbone equipment has all been qualified and installed; shore station is complete; junction boxes are manufactured; network backhaul link (shore station to UVic) provides 10Gbps/10yr service. Nodes and instruments will be deployed July-September 2009; instruments to one node probably deferred until 2010. NC's software system interfaces between users and cabled observatory, with three-fold mandate: acquire data from instruments/sensors underwater; provide life-time storage and redistribution capabilities for data; allow authorized users to remotely and interactively control experiments. Data Management and Archiving System is developing a modern user environment: data access, data processing and experimentation control within a Web 2.0 environment, with social networking within NC's Oceans 2.0 environment. The observatory is designed to be expandable in its footprint, nodes and instruments and provides a magnificent facility for testing prototypes of new technologies monitored/demonstrated in real-time. NC invites new scientific and industrial participation, experiments, instrumentation and data

services.

4C-203.2 ID:3105 13:45

Interaction of Deep Ocean Currents with the Juan de Fuca Ridge Topographic Complex –NEPTUNE Canada Science

Steven Mihaly [1], *Richard Thomson* [1], *Russ Mcduff* [2]
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The dynamics of oceanic motions interacting with the rugged topography of a mid-ocean spreading centre are examined using an array of single-point current meters and acoustic Doppler current profilers. The dynamics are analysed at two spatial scales. The effects on the currents due to small scale topography and heat flux from hydrothermal venting within the axial valley of the Endeavour Segment of Juan de Fuca Ridge and the effects due to the large-scale multi-segmented Juan de Fuca Ridge in the form of internal tidal waves, inertial waves, and topographically trapped waves. It is shown that hydrothermal venting is the primary driving mechanism for mean flow in the axial rift valley. Tidal currents are modified by the topography of the ridge, with both diurnal and semidiurnal bands amplified with proximity to the ridge crest and then rectified and diminished within the 100m deep rift valley. Wind-driven inertial currents propagate to the crest of the ridge where they constitute a large portion of the kinetic energy of the horizontal currents, but cannot propagate into valley. Measurements above the ridge indicate an area of enhanced internal tide and nonlinear interaction among tidal, inertial and other internal wave components. This study was partially motivated to inform the placement and recording parameters for a long-term (25-year) regional circulation monitoring array, a component of the “Monitoring Endeavour – Middle Valley Hydrothermal Systems” a community experiment hosted by the NEPTUNE Canada regional cabled observatory.

4C-203.3 ID:3077 14:00

Real Time Water Quality and Synoptic Weather Measurements from a Buoy station in the Fraser River Estuary

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An innovative project was initiated to monitor water quality and environmental conditions in the Fraser River Estuary as a joint initiative between Environment Canada and the British Columbia Ministry of Environment. This station has recently passed its first year monitoring real-time water quality and meteorological parameters. We will review overall operational successes and limitations.

The challenging station location and multi-parameter sampling protocols utilized a customized three meter Oceanographic-Data-Acquisition-System (ODAS) buoy. This

platform proved capable of surviving freshet conditions, winter ice pans, vegetative debris and ship traffic in the Fraser Estuary. The platform was modified to integrate standard meteorological sensors, water quality sensors, a refrigerated whole water sampler and an INFILTREX SPE sampler. The use of an EVDO CDMA modem as the principal telemetry conduit has enhanced the remote data management of the station, as well as significantly increasing the data bandwidth to allow the integration of an IP camera transmit to imagery of local conditions annotated with live data. The system was able to provide adequate power to meet the rigorous sampling requirements of scheduled samples (every 10/60 minutes), biweekly sampling and event driven episodic samples over the entire year. A review of all individual station elements will be discussed.

The primary system elements have proven successful with >95% of data being collected/transmitted. In addition to the primary science program, the data is also being used by various maritime user groups who access the station data from either a live project web site or direct AIS transmissions for operational considerations.

4C-203.4 ID:2821 **14:15**

Implications of analyzing short-timescale sea surface temperature changes using ship and buoy observations

Rick Danielson
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The International Comprehensive Ocean-Atmosphere Data Set (ICOADS) is a compilation of the world's in situ surface marine observations and represents a culmination of efforts to digitize, assemble, and reconcile information collected by various countries. An important and growing component of ICOADS is ancillary information such as measurement method, by which a better understanding of systematic and random observational errors is being obtained. Both sea surface temperature (SST) and its measurement method are examined in this work. A simple method of interpolation is employed to explore short-timescale SST changes beneath developing cyclones of the western North Pacific. Implications and difficulties of analysis using SST observations from in situ (and other) platforms in such a harsh marine environment are discussed.

4C-203.5 ID:3012 **14:30**

Representing Radar Quality for Weather Radars: Data validity

Norman Donaldson
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Applications for weather radar data are becoming more both more diverse and sophisticated, so a better representation of data quality is needed within Environment Canada's radar data handling system. One major way radar data differs from more traditional weather observations is the numerous ways that data can become either invalid or partially valid. At least five types of validity can occur with a gridded radar dataset: 1)

Valid non-zero measurement, 2) Below minimum detectable signal, 3) Not sampled , 4) Censored and 5) Corrupted data and 6) Substituted . The “Not sampled” can in turn be subdivided into two subcategories 3A) outside the sampled area and 3B) in area known a priori to be impossible to sample. Censoring can also be either “hard” or “soft” depending on whether it is irreversible. Unfortunately many existing data management systems confound these categories. The talk will present the validity categories in more detail, and give examples how different applications might handle them.

4C-203.6 ID:2989 **14:45**

Development of image metric techniques to track changes in visibility

Andrew Teakles
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As part of a Visibility Monitoring Pilot Study, the Air Quality Science Unit in Pacific and Yukon Region has been investigating strategies for monitoring visibility. The primary difficulty in monitoring visibility is that no one instrument can directly, objectively, and quantitatively measure visibility degradation as the human observer experiences it. Ideally, a host of instrumentation is needed to quantify various aspects of visibility. It is also common to supplement these quantitative instruments with camera systems to provide a visual record of the scenes and to facilitate public outreach efforts. However, the digital photographs captured by these camera systems can also provide a more direct means of measuring perceived visibility.

Currently, efforts are underway to develop objective metrics of visibility using image analysis techniques of digital photographs. Presented here, is an overview of those efforts, highlights of the progress made in linking digital images with public perception and the challenges that remain in evaluating how specific pollutants influence perceived visibility.

Climate Change and Extreme Events (PART 2) / Le changement climatique et les évènements extrêmes (Partie 2)

Room / Endroit (204), Chair / Président (William G. Richards), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-204.1 ID:2794 **13:30**

An Evaluation of the NARR Precipitation Analyses Over Southwestern British Columbia

Steven Lambert
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Even though precipitation is an important climatological field, it has proved difficult to observe and to analyze as a result of its fine scale structure. Rain gauge observations are generally considered the best estimate of precipitation. Unfortunately, the spatial disrtibution of rain gauges is very inhomogenious and large areas of the earth's surface are not observed. High resolution analyses based on satellite data have become available in the last decade in the tropics. There is a need to have reliable estimate of precipitation in extratropical regions. The global reanlysis precipitation fields are generally too coarse to be useful in diagnostic applications. Recently, NCEP has completed a regional high resolution reanalysis dataset, the North American Regional Reanalysis (NARR). In the production of these data NCEP paid particular attention to the precipitation field. This talk will present an evaluation of the NARR precipitation field over south-western British Columbia in order to begin to evaluate its reliability for diagnostic applications.

4C-204.2 ID:2919 13:45

Increasing trend of synoptic activity and its relationship with extreme rain events over central India

Ajayamohan Ravindran , *William Merryfield* , *Viatcheslav Kharin*
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The nature of the increasing frequency of extreme rainfall events (ERE) in central India is investigated by relating their occurrence to synoptic activity. Using a long record of the paths and intensities of monsoon synoptic disturbances (low pressure systems and depressions), a Synoptic Activity Index (SAI) is defined whose interannual variation correlates strongly with that in the number of ERE, demonstrating a strong connection between these phenomena. SAI furthermore shows a rising trend statistically indistinguishable from that in ERE, indicating that the increasing frequency of ERE is likely attributable to a rising trend in synoptic activity. This synoptic activity increase results from a rising trend in relatively weak low pressure systems (LPS), which outweighs a declining trend in stronger LPS.

4C-204.3 ID:2761 14:00

Possible Impacts of Climate Change on Rainfall Extremes over Ontario under Downscaled Future Climate Conditions

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The overarching purpose of this study was to estimate changes in occurrence frequency and magnitude of future heavy rainfall events under downscaled future climate conditions for four selected river basins in Ontario. Automated synoptic weather typing (principal components analysis, average linkage clustering procedure, and discriminant function analysis) integrating with regression analyses (cumulative logit regression and nonlinear regression) was employed to simulate occurrence and intensity of daily rainfall events. Regression-based statistical downscaling methods were used to downscale five GCM outputs (three Canadian, one US, and one German GCMs) to each of the river basins. Then the rainfall simulation models were applied with downscaled future GCM climate information to estimate future weather types as well as occurrence frequency and magnitude of future daily rainfall events. Downscaling transfer functions and rainfall simulation models were validated using a cross-validation scheme and comparing data distributions and extreme-event frequencies derived from downscaled GCM control runs and observations over a comparative time period 1961–2000. The results showed that the models for all variables used in the study performed well. By comparing the current four-river-basin average for the period April–November 1961–2002, the number of days with measurable rainfall (≥0.2 mm), ≥15, and ≥25 mm are projected to increase by about 10–20%, 25–40%, and 30–50% over the present century under the downscaled climate conditions, respectively. The corresponding increases for seasonal rainfall totals are projected to be about 20–35%.

4C-204.4 ID:3046 **14:15**

Climatology of Significant Ice Storms in Atlantic Canada

William Richards [1], *Allison Dawe* [1], *Dermott Kearney* [2], *Bruce Whiffen* [2]
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At up to 160 hours per year, parts of Atlantic Canada have the highest incidence of freezing precipitation in North America. We researched and ranked significant ice storms by radial equivalent thickness (REQ), duration, and by socio-economic impact. An impact rating scale was devised to classify ice storms from notable to extreme. The relationship between impact and REQ was weak due to variable vulnerability. A stronger association was found between duration and impact. Storm tracks associated with significant events were derived and displayed by location, REQ and impact. To visualize the synoptic pattern responsible for significant events we transposed 55 category III and above events to a single location. Three main patterns were identified: (i) disturbances which move from west to east just south of the target location, (ii) storms which meander about 500 km south and (iii) storms moving from southeast to northwest.

4C-204.5 ID:2771 **14:30**

Solar magnetic cycles and temperature variability

Dick Morgan
Retired
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Solar irradiation varies only slightly yet it will be shown to be remarkably well correlated to the Northerh Hemisphere temperature normal trend over the past 200 years and in

proxy data during the past millennium.

The significant quasi-decadal frequency in tempeature change ranges, particularly in the Arctic, and their relevance to sun-spot activity will be presented. The latter is associated with the variation in the solar magnetic field from a poloidal to a toroidal distribution then back again to poloidal with a reverse in polarity establishing the so called Schwabe and Hale solar cycles.

The importance of this solar contribution to climate change is made apparent in these two cycles and even moreso in the longer Gleissberg cycle.

The Understanding Severe Thunderstorms and Alberta Boundary Layers Experiment (UNSTABLE) (PART 2) / Les Orages Violents compréhensifs et L'Expérience de la couche limite Albertaine (Partie 2)

Room / Endroit (205), Chair / Président (Neil Taylor and David Sills), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-205.1 ID:2803 **13:30**

Triggering Mechanisms for the 17 July 2008 Hailstorms

Daniel Brown [1], *Gerhard Reuter* [1], *Geoff Strong* [1], *Craig Smith* [2], *John Hanesiak* [3], *Dave Sills* [2], *Neil Taylor* [2]
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The 2008 UNSTABLE field project was undertaken to investigate the initiation of convection near the foothills in Alberta. On 17 July 2008, a moisture boundary formed and triggered convection at several locations. The UNSTABLE network of instrumentation captured the evolution of these events. We synthesize the measurements from soundings, radar, satellite, surface network, and instrumented vehicles to produce a comprehensive picture of the triggering and evolution of the storms.

A steep gradient of surface humidity was evident as the water vapour mixing ratio changed from 5 to 8 g kg-1 within a distance of 3 km, yielding a gradient of 1 g kg-1 km-1. The dryline formed at 1100 MDT, and persisted until 1400 MDT when the initiation of deep convection occurred along the dryline. Hail with sizes up to 2 cm and cyclonic rotation were observed. Vertical profiles of area-averaged vorticity, divergence and mesoscale vertical motion, and vertical cross sections were estimated based on the network of soundings at 2 hourly time intervals. The results suggest that the quasi-stationary large scale flow conditions supported the convective outbreak over southern Alberta.

4C-205.2 ID:2876 13:45

Convective Wind Event over Southeastern Alberta – 15 July 2008

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On the afternoon of July 15th, 2008 several thunderstorms developed along the Alberta foothills south of Calgary within the secondary UNSTABLE domain. These cells tracked southeastward exhibiting supercell characteristics early in the storms life cycle. An F1 Tornado was confirmed 5 km east of Vulcan two hours after the storms initiation. As the line of storms continued to tracked southeastwards there were widespread reports of wind damage, several severe hail reports (up to softball) and a few more tornadoes. In addition, a meso vortex became evident as the complex tracked into Doppler coverage of Schuler radar causing the meteorologists of the PASPC to trigger the Emergency Public Warning System (EPWS) for areas just south of Medicine Hat. From the post-storm investigation F1 damage was reported through much of southeastern Alberta, however localized F2 damage was also found. Surface wind reports up to 139 km/h were recorded (plus a measured wind gust of 214 km/h 80 meters above the ground). The survey revealed no confirming evidence of tornado damage as the complex tracked through southeastern Alberta. The survey team was able to verify a damage swath of F1 or greater which measured approximately 140 km in length and 31 km in width. The potential damage length would approach 250 km using the Vulcan Tornado as an originating point.

4C-205.3 ID:2675 14:00

Modeling maximum hail size for Alberta storms

Gerhard Reuter , *Fusheng Jia*
(Presented by *G.w. Reuter*)
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A time-dependent cumulus model coupled with a hail growth model is developed to simulate hail growth and forecast maximum hail size. Observed soundings were used to initialize the coupled cumulus-hail model to simulate hailstorms for three summers. For each day, the forecast hail size on the ground was compared with daily observations of maximum hail size collected within the Alberta Hail Project area.

The cumulus-hail model was skillful in forecasting the occurrence and size of hail. The forecasting of maximum hail size was improved by including the parameterization of precipitation in the cumulus model. Overall, the model improved forecasting of

maximum hail size compared against the operationally used method, HAILCAST, which was based on a steady-state cloud model. This improvement was attributed to the employment of the time-dependent cloud model as the evolution of the fields of cloud water and updraft provided more realistic surrounding conditions for hail growth.

4C-205.4 ID:2671 **14:15**

Mixing heights and convective cloud base heights

Gerhard Reuter [1], *Olga Stachowiak* [2]
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This investigation calculates the mixing height depths from sounding data for the summer of 2006 and 2007. Three different methods are used: the temperature inversion method (Heffter), the parcel method (Holzworth), and the humidity lapse rate method (Lyra). We establish criteria for using these methods appropriate for the mid-latitude continental conditions.

The mixing heights at Stony Plain varied from 400 m to 4400 m based on the Temperature Inversion Method. The average mixing height was 1300m for 2007 and 2000 m for 2006. Using the other two methods resulted lower mixing height depths. The mixing heights at The Pass are found to be slightly lower than at Stony Plain and ranging from 300 m to 3500m.

Comparisons were made between the Convective Condensation Levels (CCL) and observed convective cloud base levels. For CCL calculations we used the surface parcel, the 50mb mixed layer parcel, and the moist mixed layer parcel. The CCL's agreed well with the observed cloud bases when the mixing heights were below 1500m. For higher mixing heights the spread between the observed value and calculated value was large. These findings suggest the surface based parcel is likely more representative of the actual parcel associated with convection in the Prairie region.

4C-205.5 ID:2800 **14:30**

Lightning Climatology at 20 Km^2 and 1 Km^2 Resolutions for Canada From CLDN Observations

William Burrows [1], *Bob Kochtubajda* [2]
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Cloud-ground lightning has been detected across the southern part of Canada since February 1999 with a network of ground-based sensors known as the Canadian Lightning Detection Network (CLDN) installed by Environment Canada. A lightning climatology for Canada calculated on a 20 km^2 grid by Burrows et al. (2002) revealed a complex pattern of lightning occurrence with strong diurnal, seasonal, and geographical dependence. Updated climatologies of cloud-ground lightning for Canada for 1999-2008 and cloud-to-cloud lightning 2006-2008 calculated at 20 km^2 and 1 km^2 resolution will be discussed. Results at 20 km^2 resolution show the large-scale patterns of lightning occurrence found in the original study with 3 years' data remain largely the same when 10 years' data are used. Results at 1 km^2 resolution show the effects of terrain variation on lightning location are profound within many regions.

4C-205.6 ID:2849 **14:45**

Using GEM output for forecasts of convective initiation on the Canadian prairies: Experimental techniques under development in the Hydrometeorology and Arctic Lab (HAL)

Neil Taylor [1], *William Burrows* [2]
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Upper-air climatology studies over the western Canadian Prairies and the U.S. Plains show that, during the summer months, the troposphere is conditionally unstable on most days. This highlights the importance of Atmospheric Boundary Layer (ABL) evolution for the initiation or inhibition of deep convection. Recent observational and modeling studies suggest that improved understanding of small-scale processes related to ABL water vapour, convergence, and lower tropospheric vertical wind shear is necessary for improved forecasts of convective initiation (CI). These processes are not readily resolved observationally by existing synoptic-scale networks.

Operational forecasters routinely utilize NWP output to complement a thorough analysis of observational data, calculate derived stability and other parameters, and fill in data-void areas. A multitude of model-derived fields, parameters, and indices are available to characterize the evolution of the troposphere and environments favourable for thunderstorms. Few of these, however, focus on ABL processes, and fewer still on the problem of CI specifically. As part of Environment Canada's Research Support Desk (RSD) initiative, the Hydrometeorology and Arctic Lab (HAL) have designed and are evaluating a suite of experimental model fields in an effort to improve forecasts of CI. These fields are derived using full-resolution (58 eta levels, 15 km horizontal spacing) hourly output from the Canadian Meteorological Centre's Global Environmental Multi-scale (GEM) Regional model. The fields were designed to focus specifically on processes related to ABL water vapour, convergence, and lower-tropospheric wind shear. During the summers of 2007 and 2008, the experimental (and other severe weather) fields were made available to forecast operations via an RSD webpage. Forecasters were invited to explore them on an experimental-only basis and provide feedback directly to the HAL.

Objective evaluation and refinement of the experimental CI fields is underway. Given the sizeable area of the PASPC forecast domain, only partial radar coverage, and limitations of satellite imagery and manned observations, lightning data was selected to be used for field evaluation. As a first step, model fields were interpolated in space and time for all

CG flashes from May through September 2007. After quality control of the data, a set of 517 209 flashes and over 22.75 million parameter values were considered for evaluation. Selected parameters were examined over the entire set of CG flashes for their relationship to the occurrence of lightning. Results have been used to define preliminary thresholds for display and interpretation of model fields.

Further investigation has involved attempts to define appropriate thresholds for storm initiation. A method was developed to objectively determine the first flash for a given storm to be used as a proxy for direct observations of CI. Each flash was evaluated against surrounding flashes using spatial and temporal constraints to identify the first flash, or 'CI flash', for each storm. Consideration of convective mode and storm motion was included in the analysis to attempt to account for their influence on the distribution of lightning for varying storm type. Comparison of CI and non-CI flashes was used to further refine suggested parameter thresholds and develop combined fields leading to objective forecasts of CI. Descriptions of selected experimental model fields and results from their evaluation will be presented.

IPY and related atmospheric, oceanographic, and hydrological studies (PART 4) / AIP et les études reliées à l'atmosphère, l'océanographie et l'hydrologie (Partie 4)

Room / Endroit (301), Chair / Président (Steven Solomon), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-301.1 ID:2977 **13:30**

River-ocean interaction during spring break-up at the mouth of the Mackenzie River, Northwest Territories, Canada

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Breakup of northerly draining Arctic rivers is forced by seasonal climatic conditions well to the south of their receiving basins. This leads to dramatic increases in river discharge while the river mouths are still encumbered by thick ice. The Mackenzie River is the largest northerly draining river in North America both in terms of discharge and sediment. Proposed hydrocarbon developments have instigated studies to understand the interaction between rising discharge and sea ice at the river terminus in the Beaufort Sea.

Satellite-based observations were combined with data from in-situ sensors and helicopter-borne reconnaissance to document the progression of spring breakup in 2007 and 2008. Synthetic Aperture Radar (SAR) was used to map the development and distribution of bottomfast sea ice (BFI) and data from optical sensors (MODIS and MERIS) were used to map the progression of river overflow and subsequent drainage. BFI was found to play a critical role in controlling the timing and location of overflow early in the breakup season. Overflow velocities over the surface of the ice were on the order of several metres per second and overflow depth increased from zero to 30 cm in 15-30 minutes. Overflow water drains through flaws at the edges of the BFI where extensive fields of drainage vortices ('strudels') were encountered. Probing and acoustic surveys from boats have documented strudel scours off the Mackenzie delta up 1.5 m deep and 15 m in diameter. In 2007 the scours persisted at least until August when the surveys were undertaken, whereas, in 2008, scours mapped in June had disappeared by August. These observations indicate that mediation of discharge by sea ice in shallow nearshore waters can have significant impacts on the seabed with implications for human activities such as pipeline operations and dredging.

4C-301.2 ID:2673 13:45

Ice and Snow observations made during the IPY Circumpolar Flaw Lead (CFL) program in the eastern Beaufort Sea using helicopter and sled logistics.

Simon Prinsenberg[1], *Ingrid Peterson*[1], *Scott Holladay*[2]
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Helicopter-borne sensors have been used in Canada since 1991 to collect ice properties to validate ice signatures seen in satellite imagery. The Electromagnetic-Laser system has evolved into a fixed-mount operational four frequency sensor that provides real-time ice thickness data. The additional video-laser system provides independently video frames and high frequency surface roughness data as well as lead and floe size distributions. Since 2006, a Ground-Penetrating-Radar-laser system has been tested to collect snow depth as well as freshwater ice thicknesses. Ice and snow property data was collected along helicopter flight paths over the mobile pack ice in the eastern Canadian Beaufort Sea in April 2008 using a Canadian Ice breaker CCGS Amunsden while she over-wintered in the mobile Arctic pack ice during the IPY-CFL program. In comparison to the 2004 observations, the land-fast ice extent and thickness were less. Mobile ice was thinner and the thin ice extent (0-20cm thick ice) that rarely was present in 2004 was extensively found in 2008 with areas of up to 50km in width. In addition, the 2008 pack ice (lower ice extent) was more mobile under the wind forcing and an flaw ridge 18km wide and 60cm thick was ridged into a ice rubble field of over ten meter thick.

4C-301.3 ID:2894 14:00

Identification, characterization and change of the near-surface temperature maximum in the Canada Basin, 1993-2008

Jennifer Jackson[1], *Susan Allen*[1], *Eddy Carmack*[2], *Fiona Mclaughlin*[2], *Grant Ingram*[1]

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Summer sea ice in the Canada Basin of the Arctic Ocean has rapidly declined over the past decade. A near-surface temperature maximum (NSTM) that had been previously observed at depths of 25 – 35 m has strengthened and shallowed. We investigated the formation mechanisms, seasonal evolution and correlations with sea ice for the NSTM. Year-round Ice Tethered Profiler (ITP) data from 2005-8 and summer ship-based CTD data from 1993-2007 was evaluated and showed that the NSTM forms from mid-June through mid-July when sufficient solar radiation penetrates the sea ice to warm the upper water. From mid-July through late August, thermal convection cools the top of the NSTM, and then haline convection deepens the NSTM through the fall. The NSTM can persist until the following summer if strong stratification prevents the deepening of the winter mixed layer. From 1993-2008, the NSTM warmed, expanded northwards and shoaled. The increased temperature of the NSTM was well correlated with local sea ice concentrations, especially north of 75N. Results from a 1-D vertical model were used explore the dynamics of the NSTM. This work shows that the the NSTM reflects the decrease in sea ice cover and albedo feedback effect and thus may be important in climate models.

4C-301.4 ID:2840 14:15

Decadal simulations of Arctic sea ice

Zhenxia Long [1], *William Perrie* [1], *Charles Tang* [1], *Ewa Dunlap* [1], *Jia Wang* [2]
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Observational studies suggest there is high variability of Arctic sea ice, in particular the sea ice in the Beaufort and Chukchi Seas. Until recently, it has been a challenge for an ice-ocean model to reasonably represent the variability. In this study, a Coupled Ice-Ocean Model (CIOM) is implemented for the Arctic region to simulate annual, interannual and decadal variations of Arctic sea ice. CIOM consists of two components, the POM (Princeton Ocean Model) and Hibler ice model. NCEP reanalysis provides CIOM with 2-m air temperature, 2-m specific humidity, precipitation rate, total cloud amount, sea level pressure and 10-m wind. There is no surface heat flux correction or nudging to sea surface temperature. After an initial ten years of integration using monthly climatology of NCEP reanalysis, CRCM is run for the period 1977-2008 using daily NCEP reanalysis. In this presentation, the analyses will only focus on the data from 1979-2008. Comparisons between model simulations and observations suggest that CIOM simulates ice variability reasonably well. Consistent with observations, the whole Arctic is covered with ice in winter while we can see some open water in Chukchi and Beaufort Seas in summer. In addition, CIOM well reproduces the interannual variations of ice concentration, in particular in the Chukchi and Beaufort Seas. For example, CIOM well simulates the reduced cover in September 1979, 1999 and 2007. Moreover, the model simulations clearly show a retreat in ice during last decade. Further discussions will be

given to understand the mechanisms behind the very low ice cover in 2007.

4C-301.5 ID:2956 **14:30**

Study of blowing snow in Iqaluit

Sumita Biswas [1], *Mark Gordon* [2], *Peter Taylor* [1], *Marna Melzer* [1]
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A field study was conducted in Iqaluit from October, 2007 to April, 2008 to characterize blowing snow events. Different parameters such as wind speed, temperature, humidity, pressure, snow particle counts, visibility and electric field were measured. A camera system was used to measure the size distribution of blowing snow particles. Around thirty blowing snow events occurred during this study period. Wind direction was mainly from North West side with some occasional wind from south-east direction. The threshold wind speed for the initiation of blowing snow ranged from 5 ms-1 to 11 ms-1 . It has been observed that the threshold wind speed depends on temperature; time elapsed between two consecutive blowing snow events and the availability of loose snow on the ground. The average surface roughness length calculated from wind profile was 40 mm and the threshold friction velocity was from 0.20 ms-1 to 0.50 ms-1. Particle number density was calculated from the output of particle counters. A good correlation (r=0.8) is found between particle number density and visibility sensor data at the same height. A comparison of the snow particle counters data showed that the output of all the counters were not same at the same height. So work has been done on the particle counter circuit to ensure that all counters give identical results under same condition and also to improve the performance and reliability of the counters in cold temperature.

Climate Variability and Marine Ecosystems (PART 2) / Le climat et les écosystèmes marins (Partie 2)

Room / Endroit (302), Chair / Président (Angelica Pena), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-302.1 ID:2917 **INVITED/INVITÉ** **13:30**

Responses of marine ecosystems to climate change and variability

Kenneth Denman
(Presented by *Ken Denman*)
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Marine ecosystems and the climate system are complex systems, meaning that we expect ecosystem responses to climate forcings to be nonlinear, at times abrupt, and difficult to predict. In addition, natural climate variability on timescales from years to decades may mask the underlying trends associated with global warming. A warming climate is expected to produce observable physical changes in the upper ocean, especially at higher latitudes. The upper ocean should become more stratified, causing a more stable light climate for phytoplankton and less exchange of dissolved materials between the surface layer and the layer immediately below. We might therefore expect decreases in dissolved nutrients in the surface layer and in dissolved oxygen in the layer immediately below. Biogeochemical changes will have profound effects on marine ecosystems. As more CO2 enters the ocean from continued increases in fossil fuel burning, the ocean will continue to become more acidic with a total decrease in surface pH of as much as 0.35 by the end of this century. Calcareous organisms will be at risk, altering the structure of marine planktonic ecosystems. On continental shelves characterized by wind-driven upwelling, 'preconditioned' upwelled waters with lower dissolved oxygen and pH might locally generate both more corrosive conditions and hypoxic events, due to a speed up of the cycling of the planktonic foodweb in warmer waters, in particular the respiration or remineralization of organic matter below the surface layer. Proposed geoengineering measures to mitigate climate change, such as ocean iron fertilization and injection of sulphate aerosols into the stratosphere, have potentially known and unknown effects on marine ecosystems. Assessing the effects of all these changes on ecosystems is currently difficult, and in many cases impossible, because we lack basic biological knowledge of the adaptability or plasticity of most marine organisms.

4C-302.2 ID:2882 14:00

Climate change and carbon and oxygen cycles on the Vancouver Island shelf

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In this study we focus on the carbon and oxygen cycles in the wind-driven upwelling margin of Vancouver Island in Western Canada. This shelf region has been observed to absorb atmospheric carbon dioxide during summer and release it in winter, resulting in little net annual flux. Furthermore, the proximity to an Oxygen Minimum Zone offshore and the observed decline of oxygen in the Northeast Pacific make this shelf a candidate for hypoxia events. Some of the questions that climate change raises for this region are: How will air-sea carbon dioxide fluxes be modified? Will hypoxia become more frequent or severe? What will the associated changes in ocean acidification be? To address these issues, we are using the Regional Ocean Modelling System (ROMS) in a quasi-2D configuration of the shelf (across-shore section with uniform properties alongshore). The model is coupled to a biogeochemical module with carbon, oxygen, and nitrogen as state variables, and includes cycling of dissolved organic matter. Environmental changes (e.g., increased air temperature, higher atmospheric carbon dioxide) will be imposed to understand their effects on the carbon and oxygen cycles.

4C-302.3 ID:2868 14:15

Temperature, timing and growth: Implications for outbreaks of a marine invader

Megan Saunders , *Anna Metaxas* , *Ramón Filgueira*
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Outbreaks of the introduced bryozoan *Membranipora membranacea* in Nova Scotia have occurred periodically since it was first observed in the early 1990s. Heavy encrustations of the bryozoan on laminarian algae defoliate kelp beds, thus facilitating the invasion of other benthic species. To determine whether warmer temperatures are responsible for outbreaks of this species, we constructed an individual-based model using temperature-dependent settlement and growth rates. The model was forced using temperature data from St. Margarets Bay, NS, from January to August 2005-2008, and validated using field estimates of *M. membranacea* from August 2005-2006. The model successfully simulated the timing of onset of settlement, number of adult colonies, maximum colony size, and relative interannual patterns of abundance. We explored the effect of temperature on the population by varying the 2005 data-series and found a non-linear relationship; a 1-2 ºC increase in daily temperature caused a 3-8 fold increase in the number of colonies, and a 10-100 fold increase in the colony cover. The timing of onset of settlement was determined by the temperature in winter and spring; however, cover of colonies on kelps was most affected by the temperature in summer. Our results suggest that outbreaks of this ecologically damaging species will be more pronounced if climate change causes local warming. Future directions include modeling the population dynamics during the autumn, which will require further information on kelp-bryozoan interactions and seasonal variations in mortality rates.

4C-302.4 ID:2678 14:30

Coherent change in multiyear trends of phytoplankton and bacterioplankton

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The effects of climate variability and change on pelagic marine ecosystems are often sought in signal propagation from primary producers to secondary and higher producers. Yet the space and time scales of direct interaction between phytoplankton and other parts of the food web are much smaller than those of climatic drivers. A question arises whether trophic linkage can be discerned at multiyear scale. We demonstrate from local and regional studies that long term changes in phytoplankton biomass are accompanied by changes in bacterioplankton that are dampened in amplitude but coherent in the direction of change. The coherent departure from norm, both positively and negatively, of both microbial primary and secondary producers provides evidence of directed system level change.

Composition, Variability and Circulation of Seawatwer: Bays to Basins (PART 2) / Composition, variabilité et circulation de l'eau de mer: de baies à bassins (Partie 2)

Room / Endroit (303), Chair / Président (Charles G. Hannah), Date (04/06/2009), Time / Heure (13:30 - 15:00)

4C-303.1 ID:3093 13:30

Currents and Hydrographic Variability in Orphan Basin

John Loder , *Yuri Geshelin* , *Igor Yashayaev*
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Orphan Basin is a deep sedimentary basin adjacent to the Northeast Newfoundland Shelf where there is active interest in petroleum exploration. The basin is also an important region for monitoring ocean climate variability since it lies in the exit pathway of some of the waters from the Labrador Sea which contribute to the North Atlantic's subpolar gyre and Meridional Overturning Circulation. Since 2004 the Bedford Institute of Oceanography, with support from the Program on Energy Research and Development (PERD) and industry, has been carrying out a moored measurement and survey program to describe and understand currents and hydrographic variability in the area. The moored measurements have largely confirmed the expectation that low-frequency currents and drift are generally weak and equatorward across the basin. There is some near-bottom intensification of the flow associated with the Deep Western Boundary Current and a stronger barotropic intensification associated with the Labrador Current over the slope. The measurements have also identified two energetic and unexpected current features at high frequencies. Isolated eddies that extend over the entire water column have been observed drifting with the flow in water depths of 2200-2800m, with radii of order 20 km, peak (cyclonic) currents of about 0.5 m/s at mid depths, and a local occurrence rate of about one eddy every few months. Intermittent upper-ocean inertial oscillations penetrating to 300m depth have also been found, with near-surface speeds up to 1 m/s, persistence over periods up to 10-30 days, and horizontal coherence over distances exceeding 80 km. These features will be described in more detail, and their origin and significance will be discussed.

4C-303.2 ID:3111 13:45

Current and Hydrographic Structure across Orphan Basin and Knoll in 2007 and 2008 from ADCP-CTD surveys

Yuri Geshelin , *Igor Yashayaev* , *Blair Greenan* , *John Loder*
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Orphan Basin (with water depths of 1500 to 3500m) is located north of the Grand Bank of Newfoundland, and Orphan Knoll is a seamount rising to within 1700m of the surface at the outer edge of Orphan Basin. Current and hydrographic variability in the region is important to petroleum exploration, ocean climate issues such as the fate of Labrador Sea Water, and the connectivity and uniqueness of different marine habitats. Since 2004, the Bedford Institute of Oceanography (BIO) has carried out a spring oceanographic survey across Orphan Basin with Conductivity-Temperature-Depth (CTD) and Acoustic Doppler Current Profiler (ADCP) systems. Since 2007, a new Ocean Surveyor Vessel-Mounted (VM) ADCP system with improved capabilities has been used, and in 2008, the survey was extended to include a focus on Orphan Knoll. The results of quantitative analyses of data from the 2007 and 2008 will be presented. Emphasis will be placed on the VM ADCP data which provides coverage of the top 800-m portion of the water column and hence previously unavailable information on eddies and other current features. Some issues with the use of CODAS3 software for processing the VM ADCP data will be discussed. The measured currents normal to the transects will be compared and correlated with the geostrophic estimates from CTD and XBT surveys. The current structure will be discussed in terms of features of the North Atlantic subpolar gyre and topographic influences over Orphan Knoll. Preliminary findings from a planned survey in May 2009 may be presented if available, including changes in the presence of Labrador Sea Water on the section among the three years.

4C-303.3 ID:3100 14:00

Origin and Variability of the Deep and Abyssal Waters of the Northwest Atlantic

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The two dense water overflows that cross the Greenland–Scotland Ridge via the Denmark Strait and Faroe–Shetland Channel form the Denmark Strait Overflow Water and Northeast Atlantic Deep Water, respectively, filling the deep and abyssal reservoirs of the subpolar North Atlantic. Changes at depths greater than the limits of open-ocean deep convection (2300 m or so) are primarily controlled by the processes involved in the formation and subsequent modification of these waters, starting with the overflows themselves. Each of the constituent water masses that form the original overflows will carry with them the imprint of time-varying climatic forcing in their source regions and of modifications en route. Their properties will also be subject to alteration by the processes of horizontal and vertical exchange from their spillways to the Labrador Basin and further downstream. The purpose of this presentation is to identify from the hydrographic record those locations that are of primary importance for the transfer of ocean climate 'signals' into and between the two spreading overflow plumes, and if possible to trace the influence of these changes downstream to the Newfoundland Basin and beyond in the Deep Western Boundary Current.

4C-303.4 ID:3115 **14:15**

Interdecadal Variability along 38°N North Atlantic

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Variability of North Atlantic water masses along 38°N is examined based on data in the International Council for the Exploration of the Sea (ICES) hydrographic database. Data is extracted from 1908 to 2004, but the main focus is on variability post 1950. An objective analysis approach in an isopycnal framework is used to project data onto 38°N, using a longitudinal resolution of 1/3 degree and the 55 isopycnal layers of variable thickness. Long term mean temperature and salinity fields are produced, as well as 5 year-running mean triad analyses (from 1950 to 2004). Extensive multi-decadal variability is observed, in both shallow and deep layers. The phase of the variability is different between layers, and also changes as one moves west to east across the basin. Important water masses showing significant variability include those of the Deep Western Boundary Current (DWBC) and the Mediterranean Water (which may be also showing a long term salinification signal). Strong correlations (maximum at a lag of 18 years) are seen between the variability in the DWBC and North Atlantic Oscillation. A long term freshening of these deep waters is also observed.

4C-303.5 ID:3054 **14:30**

Interannual and decadal sea level variability in the Northwest Atlantic

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Satellite altimeter data are used to study temporal and spatial sea level variability in the Northwest Atlantic. The altimetric results in the deep ocean are compared with steric height calculated from a temperature and salinity climatology and from ARGO data. The altimetric sea levels along the Atlantic Canadian Shelf are compared with tide-gauge data. The study shows significant interannual and decadal variability and prominent regional differences, and implications for large-scale atmospheric and oceanic variability.

4C-303.6 ID:2711 **14:45**

Numerical and observational study of circulation in the Intra-Americas Sea: connection between Gulf of Mexico Loop Current intrusion and throughflow transport variability

Yuehua Lin [1], *Richard Greatbatch* [2], *Jinyu Sheng* [1]
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Significant correlation between temporal variations of sea surface height anomalies in the Loop Current region and transport variations through the Yucatan Channel in the Intra-

Americas Sea is found based on the analysis of numerical model results and satellite-altimeter data. Transport in the model is found to be a minimum when the Loop Current intrudes strongly into the Gulf of Mexico, typically just before a ring is shed, and to be a maximum during the next growth phase in association with the build up of warm water off the northwest coast of Cuba. Numerical experiments show that the transport variations result from the interaction between the density anomalies associated with Loop Current intrusion and the variable bottom topography. A proxy for low-frequency transport variations through the Yucatan Channel is then proposed, which compares well with the 2-year transport estimates for the Yucatan Channel during the CANEK program (10 September 1999 to 31 May 2001). A 10-year comparison between the transport proxy and the cable data sheds light on the influence of Loop Current intrusion on the Florida Current between Florida and the Bahamas.

Air Quality: Delivering the Right Message (PART 3) / Qualité de l'air: délivrer le bon message (Partie 3)

Room / Endroit (202), Chair / Président (Randall Martin), Date (04/06/2009), Time / Heure (15:30 - 17:00)

4D-202.1 ID:2873 **15:30**

GEM-MACH15, a new Canadian air-quality forecast model

Donald Talbot , *Mike D. Moran* , *Sylvain Menard* , *Ping Huang* , *Paul A. Makar* , *Wanmin Gong* , *Hugo Landry* , *Sunling Gong* , *Sylvie Gravel* , *Veronique Bouchet* , *Alexander Kallaur* , *Mourad Sassi*
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Abstract Operational AQ forecasting began in Canada in 2001 with the implementation by Environment Canada (EC) of a continental-scale, 21-km, ozone-only version of the off-line regional CHRONOS chemical transport model. The meteorological driver used was the regional configuration of EC's operational GEM weather forecast model. Operational CHRONOS forecasts of PM2.5 and PM10 using a simple 2-bin sectional representation of the PM size distribution followed in 2003.

Work on a new operational AQ forecast modelling system started at EC in 2006. The goal of this project is to replace CHRONOS with a limited-area version of GEM-MACH, an in-line chemical transport model embedded within GEM. A number of AQ process representations from EC’s AURAMS chemical transport model have been implemented in GEM-MACH, including gas-phase, aqueous-phase, and heterogeneous chemistry and aerosol processes. GEM-MACH15, a regional forecast configuration of GEM-MACH, uses a continental-scale domain with 15-km grid spacing. Like CHRONOS, GEM-

MACH15 employs a 2-bin representation of the PM size distribution, but PM chemical composition is treated in more detail and additional processes affecting PM concentrations have been included. The SMOKE emissions processing system is used to produce input anthropogenic emission files on the GEM-MACH15 rotated latitude-longitude grid from initial versions of the 2005 Canadian and U.S. national inventories. Biogenic emissions are estimated on-line using the BEIS v3.09 algorithms.

This presentation will provide an overview of GEM-MACH and GEM-MACH15. Some results of performance evaluations of GEM-MACH15 for both summer and winter periods versus both measurements and CHRONOS will also be presented.

4D-202.2 ID:2951 15:45

GEM-AQ simulation of fine-mode aerosol optical events observed in the Canadian High Arctic at Eureka

John Mcconnell [1], *Alex Lupu* [1], *Norm O'Neill* [2], *Jacek Kaminski* [1], *Lori Neary* [1], *John Mcconnell* [1], *A. Saha* [2]
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Fine-mode aerosol events that could be traced back to forest fires in Siberia, Russia and Northwest Territories, Canada were observed during the summer of 2007 and spring of 2008 at the Polar Environment Atmospheric Research Laboratory (PEARL) located at Eureka on Ellesmere Island. The simulation of these events was performed with the Global Environmental Multiscale Air Quality model (GEM-AQ), a global, tropospheric chemistry,general circulation model based on the global multi-scale model developed by the Meteorological Service of Canada for operational weather forecasting. The model output is compared with vertical profiles from the Arctic High Spectral Resolution Lidar (AHSRL) and with spectral sunphotometer data acquired at Eureka, as well as with MODIS, CALIOP and OMI products over the Arctic

4D-202.3 ID:3038 16:00

Evaluation of the GEM-AQ model during the INTEX-A field campaign

John Mcconnell [1], *Jennifer Mclarty* [1], *Thomas Bulteau* [2], *Alex Lupu* [1], *Lori Neary* [1], *Jacek Kaminski* [1], *Tom Sobeiraj* [1], *John Mcconnell* [1]
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The Global Environmental Multiscale Air Quality model (GEM-AQ) is a tropospheric chemistry, general circulation model based on the global multi-scale model developed by the Meteorological Service of Canada for operational weather forecasting. We present an evaluation of GEM-AQ against observations made during the first phase of the Intercontinental Chemical Transport Experiment (INTEX-A) campaign, which was conducted during the summer of 2004 mostly over North America and the North Atlantic.

GEM-AQ was run on a global variable-resolution grid with a 0.5-degree uniform core domain covering Eastern Canada and United States, and 28 hybrid levels extending from the surface up to 10 hPa. The model output is compared with measured mixing ratios of O3, NO, NO2, HNO3, H2O2, CO, CH3OH, HCHO, C5H8, C2H6, and HCN to evaluate the representation of biogenic, biomass burning and anthropogenic emissions in the model as well as transport processes such as mixing in the PBL and large scale convection.

4D-202.4 ID:2702 **16:15**

Descent of deep stratospheric intrusions in the troposphere

Michel Bourqui , *Pier-Yves Trépanier*
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Stratosphere-troposphere exchange is a key process affecting the vertical distribution of the chemical composition and its variability in the troposphere and the stratosphere. Several recent studies have suggested that some exchange events can extend deep in the troposphere, and inject stratospheric air into the lower troposphere within time scales of a few days. Such events may bring very high concentrations of ozone to the planetary boundary layer, and consequently may lead to large scale ozone "pollution" events. Besides global climatologies that have been estimated from re-analysis data in recent studies, not much is known on the details of this deep vertical transport, such as in particular about the dispersion and subsequent dilution of the stratospheric air in the troposphere during its descent, and the conditions favouring/hindering the injection of compact stratospheric air masses at low tropospheric levels.

In this study, we use the Global Environmental Multiscale (GEM) mesoscale model in the limited area mode with Environment Canada's analyses as initial and boundary conditions to represent meteorological conditions during the summer 2006. Kinematic trajectories are calculated using the model's hourly winds and are used to detect and analyse deep stratosphere-to-troposphere transport events. The analysis shows that the descent may lead to a rapid dispersion around 700hPa in some cases, while in other cases, the descent can continue further down without significant dispersion. A discussion of the dynamical conditions leading to these two different types of descent will be presented.

Monitoring the Atmosphere and Ocean (PART 3) / Monitorage de l'atmosphère et de l'océan (Partie 3)

Room / Endroit (203), Chair / Président (Al Wallace and Pierre Pépin), Date (04/06/2009), Time / Heure (15:30 - 17:00)

4D-203.1 ID:2992 **15:30**

State of the Canadian Reference Climate Station Network

John Macphee , *Brain Howe* , *Bill Scott* , *George Weaver*
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This presentation will look at the state of the Canadian Reference Climate Station Network and present a plan for the near future.

4D-203.2 ID:2906 **15:45**

New methods for measuring precipitation (solid and liquid) at automatic stations

Rodica Nitu , *Kai Wong*
Environment Canada
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Over the past decade, the transition from manual to the automatic observation of precipitation has accelerated in many countries. The migration from human to automatic observations has introduced new challenges with respect to the quality, consistency, compatibility, and representativeness of hydro-meteorological measurements.

The number of human observations at Surface Weather and Reference Climate Stations in Canada has decreased significantly since 1990's and are being replaced by automated stations. A number of initiatives have been taken in Canada and abroad to improve the representativity of precipitation related measurements, solid precipitation in particular, at automated stations. Solid precipitation, although simple to be observed by humans, is one of the more complex parameters to be measured using automatic means.

The presentation will include the results of the work conducted by Environment Canada on the evaluation of measuring precipitation parameters (rain and snow) using new systems.

4D-203.3 ID:2907 **16:00**

Reference Climate Station Operational Precipitation Algorithms

Hagop Mouradian
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Precipitation is one of the most important atmospheric variables, as change in precipitation has a major impact on hydrology, climate, and ecosystems. It is also one of the key components in hydrological modeling and process studies.

Accurate precipitation measurement is of utmost importance to Environment Canada's Reference Climate Stations (RCS). Through years of scientific research and field testing, Environment Canada has implemented a national standard for collecting and processing precipitation data.

RCS installations primarily rely on weighing gauge sensors for rain intensity and amount, and sonic sensors for snowfall rate and depth. Both the rain and snow sensors provide high precision readings, but are also subject to noise and other limitations. To maximize measurement accuracy, processing algorithms have been developed for each type of precipitation sensor.

This presentation will summarize the precipitation algorithms currently implemented in the RCS operational networks.

4D-203.4 ID:3123 INVITED/INVITÉ 16:15

Oceanographic Constraints on Living Marine Resources: Early Results from the Ocean Tracking Network on the Halifax Line

Peter Smith , *Blair Greenan* , *Murray Scotney*
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The Ocean Tracking Network (OTN) is an international project designed to detect the behaviour and movement of certain key species of marine animals by surgically implanting unique "acoustic tags" in individuals, then recording the presence of those individuals as they cross strategically-placed lines of detectors, known as "acoustic curtains". The deployment of the inaugural OTN curtain in Canada is planned for the Halifax Line, which crosses the Scotian Shelf at Halifax. Early results from a "pilot" version of that line, composed of roughly 30 bottom-mounted hydrophones from the coast to roughly the 100 m isobath, indicates the eastward transit of a number of Atlantic salmon from rivers in the Gulf of Maine and western Scotian Shelf regions*. The concentration of detections, in both time and space, suggests possible physical oceanographic constraints on the salmon migration pattern. This talk will explore that hypothesis.

* OTN detection data compliments of M. Stokesbury and R. Branton, Dalhousie U., also NOAA, USGS, and DFO.

4D-203.5 ID:3124 INVITED/INVITÉ 16:30

Aspects of DFO's NW Atlantic Ocean Monitoring Programs

Michel Mitchell [1], *Eugene Colbourne* [2], *Ross Hendry* [1], *John Loder* [1], *Brian Petrie* [1]
[1] Bedford Institute of Oceanography
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Selected aspects and recent results from ocean monitoring programs being carried out off Atlantic Canada by Fisheries and Oceans Canada (DFO) will be described. The "Atlantic Zone Monitoring Program (AZMP)" was implemented in 1998 with the aim of collecting and analyzing biological, chemical and physical data to detect and monitor seasonal and interannual variability in eastern Canadian waters. It focuses on the continental shelf

from Labrador to the Gulf of Maine, and includes sampling along cross-shelf sections (1-3 times per year) and at fixed stations (every 2 weeks, conditions permitting) as well as use of remote sensing data. AZMP is a cooperative effort of the four Atlantic DFO regions and data and products are available from a program website managed by DFO's Integrated Science Data Management group http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/azmp-pmza/index-eng.html AZMP is complemented by monitoring of key off-shelf waters in the NW Atlantic through the "Atlantic Zone Off-shelf Monitoring Program (AZOMP)". It includes an annual physical, chemical and biological survey along the AR7W line across the Labrador Sea, and an offshore extension of the AZMP Halifax section at least once annually to include deep-water stations across the Deep Western Boundary Current. These programs are Canadian contributions to the international Global Ocean Observing System (I-GOOS).

Climate Change and Extreme Events (PART 3) / Le changement climatique et les évènements extrêmes (Partie 3)

Room / Endroit (204), Chair / Président (Chad Shouquan Cheng), Date (04/06/2009), Time / Heure (15:30 - 17:00)

4D-204.1 ID:2783 **15:30**

The First 21st Century Extreme Climatic Event and its Impact on Six Canadian Prairie Communities

Virginia Wittrock [1], *Suren Kulshreshtha* [2], *Elaine Wheaton* [3]
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The 21st century began with much of the southern portion of Canada in drought conditions (Wheaton et al. 2008). The Canadian Prairies were the most severely impacted. The Institutional Adaptation to Climate Change project and the Canadian Atmospheric Hazards Network are investigating the impacts of extreme climatic events including droughts. This paper examines drought impacts on six rural communities in Saskatchewan and Alberta and their adaptation options and differences.

All of the communities (Cabri, Stewart Valley, Outlook, Taber, Hanna and the Kainai Blood Indian Reserve) had different degrees of exposure to the drought of 2001 and 2002. Some of the bio-physical impacts of the drought were decreased stream flow and minimal recharge of groundwater and dugouts. Economic impacts included decrease in total crop revenues and decrease in non-agricultural business due to negative impact on the agricultural sector. These impacts are a reminder that water scarcity is a critical limiting factor to productivity, growth and quality of life. Lessons for improving

adaptation to water scarcity were a benefit from the extreme climatic event.

4D-204.2 ID:2983 15:45

Water budget and Drought in Central Southwest Asia

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The goal of this study is to compute the water budget terms of Central Southwest Asia (CSWA) and discuss the drought areas in the regions. We used National Centre for Environmental Prediction (NCEP) reanalysis data for 60-years from 1948-2007 and European Centre for Medium-Range Weather Forecasts (ERA-40) reanalysis for the 48-year period from 1958-2001. Global Prediction Climate Centre (GPCC) version4 data which seems to be realistic rainfall fall data of this region are used for comparison of both reanalysis data sets. The domain used is 45-75E and 25-40N including parts of Iran, Afghanistan, Pakistan, Iraq and Kazakhstan which faced severe drought from 1999-2001. Only land area is used. ERA-40 computes more evaporation than precipitation, suggesting that evapotranspiration might have been overestimated in the system. NCEP computes more precipitation than evaporation with moisture flux into the area providing the balance. This suggests that the ERA-40 data set is not suitable for drought studies in this particular area. It is observed that rainfall significantly decreases after 1980. Moisture flux convergence is computed by using four daily readings (00, 06, 12 and 18z) up to 300 hPa. The domain is sub-divided into six groups by using Principle Component Analysis (PCA). We find the least rainfall regions and discuss the monthly average rainfall for each group. The whole area except for the southeast portion is under the influence of weather systems that move in from the west and rainfall over the southeastern portion comes mostly from the southwest monsoon in the months of July-Aug. We will also discuss the classification of drought regions for the study domain.

4D-204.3 ID:2718 16:00

An Assessment of Mid-Tropospheric Circulation Patterns Associated with Canadian Prairie Droughts

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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 been affected by droughts, southern regions of the Canadian Prairies are more susceptible mainly due to their high variability of precipitation in time and space. During the past two centuries, at least 40 droughts have occurred in western Canada with multi-year episodes being observed in the 1890s, 1930s, 1980s, and the most recent 1999-2004 event. Research has shown that the major factor in the onset and

perpetuation of major Prairie droughts involves anomalous circulation patterns in the mid to upper atmosphere during both the cold and warm seasons. However, little is known about the frequency and sequencing of various circulation types that influence drought conditions. This presentation assesses the mid-tropospheric circulation patterns associated with historical Canadian Prairie droughts using climatological synoptic typing of daily 500mb geopotential heights over the Prairie region. Results indicate that for the summer season, major Prairie droughts were associated with significantly higher frequencies of synoptic types that included distinctive ridging patterns over the Prairie region, and lower incidences of zonal and mid-tropospheric troughing patterns. Extreme wet summers had opposite responses. Cold season drought years were influenced by higher frequencies of synoptic types that favoured warm air incursions from the south, and fewer patterns with cold-air invasions from the north. Evidence also suggests that the sequencing of these synoptic patterns plays an important role in the initiation, persistence, and termination of droughts on the Prairies. Results from this analysis have increased the understanding of synoptic-scale controls of major drought periods on the Prairies which may aid in the better prediction of future events.

4D-204.4 ID:2818 **16:15**

Extreme Precipitation Events and the Recent Drought over the Canadian Prairies

Hannah Carmichael [1], *William Henson* [1], *Ronald Stewart* [2]
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The climate system is characterized by extremes in the hydrological cycle. Occurrences of drought and catastrophic precipitation are inherent manifestations of this. Though drought is characterized by a general trend of dryness in a region, the reality is that both extreme precipitation and extreme dryness can occur in close proximity. This work focuses on extreme precipitation events occurring during the recent multi-year catastrophic drought over the Canadian Prairies (1999-2005). Its objective is to better understand the occurrence of heavy precipitation occurring during a multi-year drought. Data from 14 weather station sites throughout the Prairie Provinces were examined from 1960 to 2006 to place this recent drought into perspective. Extreme precipitation events were identified by their accumulated precipitation in comparison to the monthly average precipitation at that site. Only events in which the associated precipitation was greater than the monthly average were considered. The accumulations achieved in some of these events can be 2-3 times the monthly average. It was found that, according to this definition, extreme precipitation events did occur slightly more often during the recent drought than expected from climatology. The characteristics of these extreme precipitation events were examined in detail using a number of different observational and model datasets. Some events were mainly long-lived stratiform events, whereas others were short-lived and mainly convective. The seasonal occurrence of these events was investigated as well as the severity of the drought when the events occurred. These and other results will be presented.