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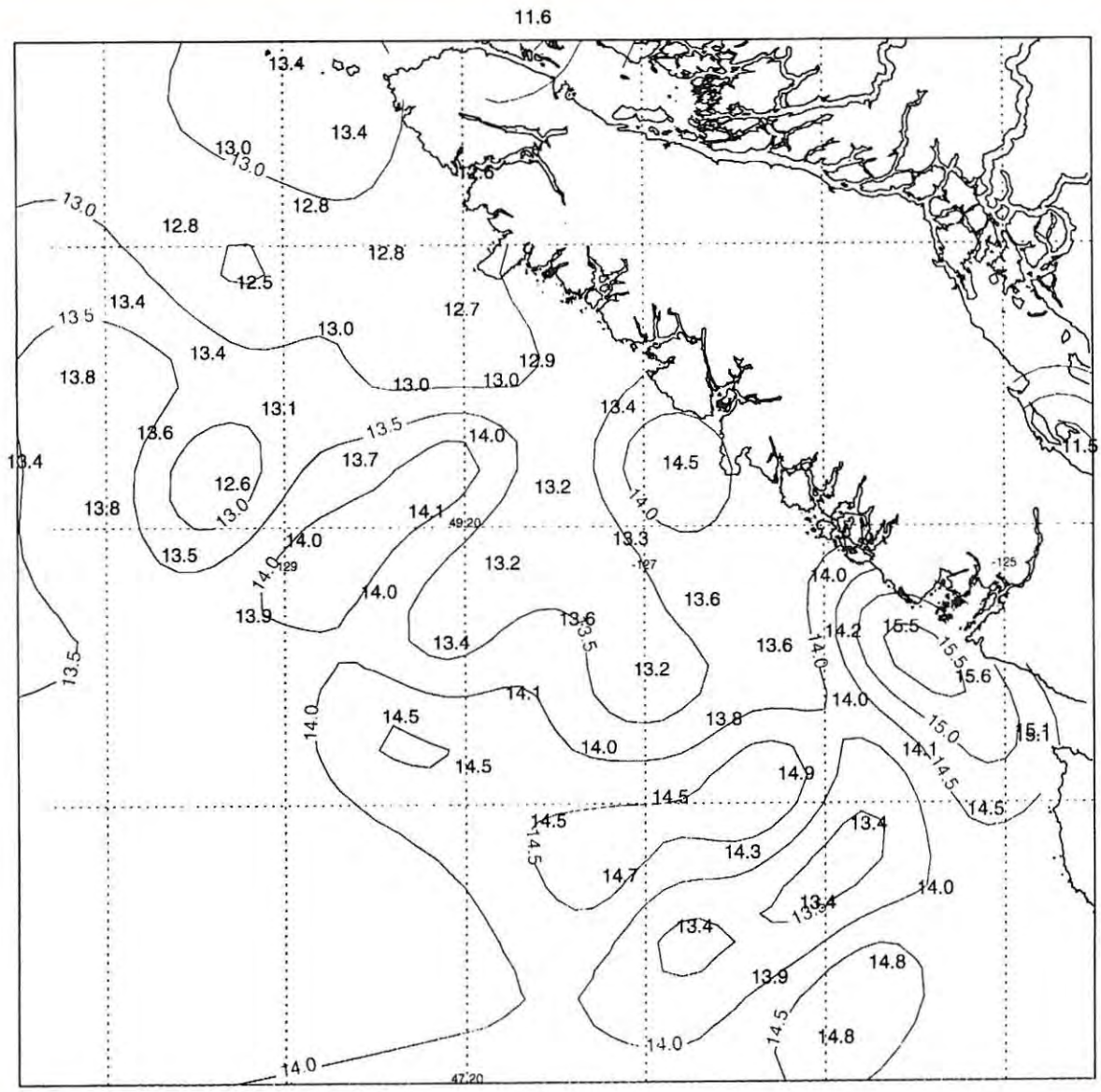

CMOS Bulletin SCMO
"at the service of its members
au service de ses membres"

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Cover page: 1998 is the "International Year of the Ocean". This month we are presenting an article demonstrating the importance of oceanographic conditions analyses and forecasts (p.39). To do this, data from multiple sources must be collected, quality controlled and analysed. We show on front page such an analysis on sea surface temperature where contour lines are drawn for a specific area off the West Coast. The temperature data come from bathies, fixed and drifting buoys, lighthouses, ship reports and high resolution pictures transmitted from satellite. To complement this spring issue, we have published an article relating the recent progress done at CMC on operational 10 km forecasts (p.41).

Page couverture: 1998 est "l'Année internationale des océans". Ce mois-ci, nous présentons un article démontrant l'importance de l'analyse et de la prévision des conditions océanographiques (p.39). Pour effectuer ce travail, des données provenant de sources diverses doivent être recueillies, vérifiées et analysées. Nous présentons en page couverture une telle analyse faite à partir des données de température de surface. Les lignes de contour sont tracées pour une région spécifique de la côte ouest. Les données de température proviennent des "bathies", des bouées fixes et dérivantes, des phares côtiers, des rapports de navires et des images satellites à haute résolution. Pour compléter ce numéro printannier, nous avons publié un article démontrant les progrès récents accomplis par le CMC dans les prévisions opérationnelles à une résolution de 10 km (p.35).

Next Issue

Next issue of the *CMOS Bulletin SCMO* will be published in June 1998. Please send your articles, notes, reports or news items at the earliest to the address given above. Don't miss your chance!

Prochain numéro

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en juin 1998. Prière de nous faire parvenir vos articles, notes, rapports ou nouvelles au plus tôt à l'adresse indiquée ci-dessus. Ne manquez pas votre coup!

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.....from the President's Desk

February's federal budget, as anticipated, provided relief from scheduled cuts for the Granting Councils, returning NSERC's budget to the 1996 level of $494 million, an increase from $434 million in the fiscal year just ended. That was the result of a heavy lobby, and in a letter to the university community NSERC President Tom Brustowski asked the research community to "join me in thanking the PM and the Ministers for the decisions in the 1998-99 budget by writing their own individual letters of appreciation, and writing them promptly. I am sure that the Ministers would be interested to hear about the letter-writer's own research, and about the impact of the support received through NSERC." A letter doesn't have to be eloquent; even a simple letter saying thanks for the increase in granting council funding will help swell the numbers - sufficient because much of politics is a numbers game.

Elsewhere, the 1998/99 Estimates tabled at the end of February show budgets continuing to decline. In Environment the total budget is $494 million, exclusive of other revenues credited to the vote, down from $508 million in 1997/98, $546 million in 1996/97, and $630 million in 1995/96. Fisheries and Oceans shows a decrease to $1,045 million in 1998/99 from $1,096 million in 1997/98, $1,366 million in 1996/97 and $1,398 million in 1995/96.

Beyond the numbers game

One in a recent series of articles in *Science*, on Science and Society, all of which are worth reading, gives a perspective on what it will take to sustain the message on why science should be supported. The article "What We Don't Know Does Hurt Us. How Scientific Illiteracy Hobbles Society" is by Norman Augustine, Chairman of the Lockheed Martin Corporation and a faculty member at Princeton University. You can read it and the other articles in the series on the web at: http:// www.sciencemag.org

"First, we need "rocket science for beginners": It has often been debated whether scientists need to be exposed to the liberal arts; a more compelling need, in my opinion, is for poets to be exposed to physics. In reality, uninformed decisions about scientific issues are the equivalent of denying ourselves the future.

Second, living as we do in a "sound bite" world, scientists must learn to communicate far more effectively with nonscientist audiences. In my judgment, this remains the greatest shortcoming of most scientists and engineers today. The time has arrived when scientists will have to come down from the Ivory Tower and enter the arena of real-world debate, bubbling controversy, and—brace yourselves—politics."

(Continued next page - suite à la page suivante)

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INSIDE / EN BREF

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Lobbying on World Meteorological Day

As our most recent contribution to this effort, your Vice-President, Bill Pugsley, and I met with several MPs on March 23rd to impress on them the importance of our science. Given the day, and ongoing Alternative Service Delivery Study (ASD), we focused on weather services. Our meetings were with Louise Hardy (Yukon), Charles Caccia (Davenport), Bill Gilmour (Nanaimo-Alberni), John Herron (Fundy Royal) and Karen Kraft Sloan (York North).

We asked that the Standing Committee on Environment and Sustainable Development investigate and report on the delivery of public good weather services to Canadians. We were surprised at how few of them were aware of the ASD study and the issues: the role of the government weather service in providing commercial services, in competition with private sector companies; maintaining a sound base of public good service, including monitoring and services for public safety and security; keeping a critical mass of atmospheric research; and ensuring availability of highly qualified scientists and technologists.

Several of the MPs were surprised to learn that the media have no legal obligation to broadcast weather warnings, even though the airwaves are publicly owned. We mentioned our intervention on this at CRTC hearings last December.

Lastly, we took the opportunity to tell them about some of the benefits and opportunities being forgone due to budget cuts in the weather service.

Bill Pugsley is now looking at how to do a similar lobbying effort for Oceans, focusing on the Oceans Strategy Paper. Advice would be welcome.

Alternative Service Delivery Study

A discussion paper "Renewing Environment Canada's Atmospheric Environment Program: Directions for the Future", was recently released. Consultation sessions are scheduled from mid-April to late May. Instructions for registration can be found at: http://www.tor.ec.gc.ca/asd-dmps/ or by calling: Shauna Hayes, Price Waterhouse, 613-238-8200 (phone), 613-238-4798 (fax), or by email: shauna_hayes@canada.notes.pw.com

NSERC Grants and Scholarships

NSERC released the results of the 1998 Grant Selection Committee at the end of March. They are available on the NSERC web site, and, for your information, are printed in this issue of the *CMOS Bulletin SCMO*. Congratulations to our members who received awards. Names of scholarship winners are also on the same web site. Those identified as specifically in atmospheric or oceanographic sciences are: Ronald McTaggart-Cowan (UBC); Dylan Millet (UBC); Heather Hunt (Dalhousie); Connie Lovejoy (Laval); Kristen Beaty (Manitoba); Paolo Petriello Jr. (McGill); Guillaume St-Onge (UQAM); Christopher Scott (York); Phoebe Lam (Harvard); Bruno Tremblay (McGill) ; Diane Coll (UQAR).

New CMOS Accredited Consultant

On March 11, 1998, Darin Borgel (right) was officially presented with his CMOS Accreditation Certificate by Clive Mason, chair of the CMOS Halifax Centre. Members of the Local Arrangements Committee for the 32nd CMOS Congress were present at the ceremony and congratulated Darin on his achievement.

Mr. Borgel is a member of the meteorological team at Seimac Weather Source, the Meteorology Division of Seimac Limited in Dartmouth, Nova Scotia. Mr. Borgel has worked for Seimac since 1992 and has provided forensic meteorological consulting services to lawyers and accident investigators in addition to his regular weather forecasting duties in support of Seimac's marine forecasting service.

Photograph is courtesy of Susan Woodbury, Seimac Limited.

Vers des prévisions opérationnelles à une résolution de 10 km au Centre Météorologique Canadien (CMC)

par Dave Steenbergen[1], Angèle Simard[2] et Pierre Dubreuil[1]

Introduction

Dans un récent numéro du Bulletin de la SCMO, on a rapporté une réalisation importante de Thomas et al. (1997), soit une Prévision Numérique du Temps (PNT) de 24 heures à une résolution horizontale de 10 km, sur l'Amérique du Nord. Leur travail a démontré la possibilité de tourner un modèle continental de 10 km en temps réel sur des superordinateurs couramment disponibles. Dans le présent article, nous fournissons un aperçu des plans qui nous permettront d'introduire des prévisions opérationnelles à une résolution de 10 km, pour le Canada, au CMC.

En termes généraux, trois éléments critiques sont d'une nécessité primordiale pour exécuter des prévisions opérationnelles à fine résolution: un modèle numérique assez efficace pour rencontrer les échéances opérationnelles avec l'équipement informatique disponible; un système d'assimilation de données pour déterminer l'état initial de l'atmosphère; et une représentation appropriée des processus physiques, ainsi que des conditions de surface dans le modèle. Dans les sections qui suivent, nous décrivons brièvement la configuration opérationnelle actuelle, la stratégie générale adoptée au CMC, et les plans actuels pour chacun des trois éléments critiques énumérés plus haut. Cet aperçu omet plusieurs activités plus petites mais essentielles, qui ne peuvent pas être discutées dans un court article comme celui-ci.

Les systèmes actuels de la PNT au CMC

Une description complète des systèmes opérationnels de la PNT au CMC est disponible sur le site Internet du CMC (www.cmc.ec.gc.ca). En résumé, ces systèmes comprennent:

- un cycle global continu d'assimilation de données basé sur un système d'analyse de variation tridimensionelle (3DVAR) et un modèle spectral global (SEF) à une résolution T199 (environ 100 km), exécutés à 0000 UTC pour des prévisions de 10 jours, et à 1200 UTC pour des prévisions de 3 jours;

- un cycle régional d'assimilation de données de 12 heures basé sur le même système 3DVAR et le modèle Global Environnemental Multi-échelle (GEM) à une résolution de 35 km, exécuté à 0000 UTC et 1200 UTC pour des prévisions de 48 heures;

- des prévisions expérimentales GEM de 24 heures à fine résolution (15 km) sur l'ouest et l'est du Canada, exécutées une fois par jour à 0600 UTC avec des conditions initiales interpolées à partir d'une prévision de 6 heures à une résolution de 35 km;

- une grande variété de post-traitement (modèles et statistiques), ainsi qu'une vaste gamme de produits qui ne peuvent faire l'objet, ici, d'une description détaillée.

Stratégie générale : un système unifié

Depuis le début des années quatre-vingt-dix, le CMC et la DRM ont travaillé vers un système unifié pour la prévision régionale et à moyenne échéance. Les objectifs de cette stratégie visent à réduire le coût d'entretien de logiciels d'assimilation de données et de modèles, à utiliser les ressources de la recherche et développement plus efficacement, et à accélérer le transfert technologique aux opérations. L'atteinte de ces objectifs est critique dans le contexte des réductions des ressources humaines et financières.

Pour l'assimilation de données, nous utilisons le même système 3DVAR dans notre cycle global et dans notre cycle régional d'assimilation. Du côté du paramétrage de la physique, un code informatique unifié de la physique qui est utilisé par tous les modèles opérationnels et de recherche, a été introduit au CMC, il y a plusieurs années. (Évidemment, comme on ne peut choisir de façon indépendante la résolution et le paramétrage, ce ne sont pas toutes les mêmes options qui sont utilisées dans les applications locale, régionale et globale.)

Dans le cas des modèles, GEM est un modèle global à résolution variable qui peut être utilisé en mode à résolution uniforme pour la prévision à moyenne échéance ou en mode centré pour la prévision régionale (Côté et al. 1998 a, b). Avec un modèle opérationnel unique, on doit maintenir seulement un code informatique de la dynamique, une interface avec des paramétrages de la physique et un ensemble d'interfaces d'entrée-sortie pour des conditions initiales de surface et de l'atmosphère, des produits de sortie, et des fichiers de redémarrage. Ces

[1] Direction de la Recherche Météorologique (DRM)

[2] Centre Météorologique Canadien (CMC)

aspects comptent pour une grande partie du code d'un modèle opérationnel. Un autre facteur important consiste à développer et maintenir un seul modèle adjoint pour une assimilation de données de variations à quatre dimensions (4DVAR - ce sujet est discuté plus en détail, plus loin).

En février 1997, le modèle GEM a remplacé le modèle régional aux éléments finis (EFR) dans le cycle régional, et dans les prochains mois, on planifie de remplacer le modèle SEF dans le cycle global par le modèle GEM dans sa configuration de résolution uniforme. Une fois le travail complété, les cycles global et régional partageront le même code du modèle, le même paramétrage de la physique et le même code du système d'assimilation de données.

Assimilation de données

Jusqu'à l'année dernière, les systèmes opérationnels de l'assimilation de données au CMC étaient basés sur l'approche de "l'Interpolation Optimale" (IO) qui a placé le CMC à l'avant-garde dans le milieu des années soixante-dix. Au printemps 1997, un schéma d'analyse de variation tridimentionnelle (3DVAR) a remplacé l'IO dans le cycle global et un cycle régional intermittent d'assimilation basé sur le 3DVAR a été implanté à l'automne. Afin de rendre la transition plus facile, la première version 3DVAR qui est actuellement opérationnelle, a été configurée de façon aussi semblable que possible à l'ancienne IO. Cette année, on planifie de mettre en application une version plus perfectionnée du 3DVAR calculant directement l'analyse des incréments aux coordonnées verticales du modèle GEM et utilisant un modèle plus sophistiqué des erreurs de prévision. Une des raisons importantes pour laquelle on s'est orienté vers l'analyse 3DVAR, c'est que celle-ci permet d'utiliser directement les observations qui sont reliées de façon non linéaire aux variables des analyses (comme c'est le cas pour plusieurs mesures satellitaires). En 1999, on bénéficiera de cette flexibilité en assimilant de nouveaux types de données aux opérations. Une seconde raison importante pour laquelle on a choisi de développer un système 3DVAR, c'est que celui-ci fournit la base permettant le développement d'un système d'assimilation de données de variations à quatre dimensions (4DVAR).

Le 3DVAR et l'IO partagent la même approche statistique de base, soient les corrélations des erreurs de prévision calculées à partir d'un grand nombre de prévisions antérieures et une relation d'équilibre simple entre les champs de masse et de vent. Cette approche fonctionne raisonnablement bien, en moyenne, pour les prévisions à l'échelle synoptique. Toutefois, on est loin d'avoir atteint une approche optimale dans n'importe quel cas particulier, et elle échoue lorsqu'on essaie d'assimiler les données à une fine résolution (dans l'espace-temps). Pour éviter les contraintes du 3DVAR et de l'IO, et pour fournir des conditions initiales appropriées pour les modèles tournant à 10 km, on intensifie l'effort de nos recherches sur des approches améliorées de l'assimilation de données 4D tel que le 4DVAR. Ce demier ajuste la "trajectoire" du modèle atmosphérique aux observations distribuées sur une fenêtre temporelle, en tournant le modèle de façon itérative vers l'avant dans le temps, et en projetant vers l'arrière la différence entre l'état du modèle et les observations en reculant dans le temps avec l'aide de "l'adjoint" du modèle. (On peut consulter Errico (1997) pour une introduction compréhensible en rapport avec le modèle adjoint.). Le développement d'un modèle adjoint est un effort important puisque le code adjoint est à peu près de même dimension et de même complexité que le modèle de prévision sur lequel il est basé. La stratégie du modèle unifié nous permettra d'utiliser le même modèle adjoint, à la fois pour les applications globales et régionales, ce qui représente une économie importante. Certains aspects intervenant dans le développement du modèle adjoint semi-lagrangien à résolution variable, comme le GEM, ont été étudiés en détail (Tanguay et al., 1997) et un prototype adjoint au GEM est disponible. Dans l'année qui vient, on utilisera le prototype adjoint au GEM pour des expériences de sensibilité de la prévision (Rabier et al., 1996 ; voir aussi Errico, 1997) et des essais avec le 4DVAR.

Le développement d'un système performant d'assimilation de données 4D jusqu'à ce qu'il soit prêt à devenir opérationnel, va nécessiter beaucoup plus de recherche et développement, ainsi qu'une puissance de calcul impressionnante. Au CMC, nous ne nous attendons pas à atteindre cet objectif avant au moins deux ans.

Le paramétrage de la physique et les conditions initiales de surface

Pour obtenir les pleins bénéfices des modèles numériques à fine résolution, il faudra aborder plusieurs enjeux ayant trait au paramétrage des processus physiques. Les paramétrages des processus, comme la radiation, la formation des nuages et des précipitations, et la convection, sont généralement interdépendants et sensibles aux échelles. Pour le moins, la modification de la résolution d'un modèle opérationnel nécessite un ajustement minutieux et la mise au point de l'équilibre entre ces paramétrages dans un grand nombre de cas pour arriver à des résultats fiables et solides. Les changements importants de résolution, planifiés au CMC, exigeront certains changements de base dans les hypothèses au fur et à mesure que la résolution du modèle s'approche de la dimension d'un orage.

Le paramétrage des interactions entre l'atmosphère et la surface de la Terre et l'estimation des conditions initiales de surface sont aussi des domaines où il y a matière à amélioration. Quelques champs de surface, tels que les températures de la surface de l'eau et la couverture de glace, changent lentement de telle sorte qu'ils peuvent être considérés comme des constantes pour une PNT particulière (au moins pour la prévision à courte échéance). Toutefois, des analyses précises de ces champs (et les données avec lesquelles on prépare les analyses) doivent être disponibles avant qu'on puisse exécuter le modèle. L'estimation de la température et de la couverture de glace de petites nappes d'eau qui sont

perçues par des modèles à fine résolution, atteint déjà les limites des données disponibles. Les flux de chaleur et d'humidité entre la surface et l'atmosphère dépendent aussi fortement de l'épaisseur et de l'état de la couverture de la neige, et de la teneur en eau du sol. Ces paramètres se modifient beaucoup plus rapidement que la couverture de glace et les températures de la surface de l'eau, et les mesures en temps réel sont très limitées. L'addition de ces champs dans le cycle d'assimilation de données est à la fois un potentiel pour l'avenir et un défi majeur.

En rapport avec le paramétrage de la physique, notre priorité à court terme consiste à se préparer pour une augmentation de la résolution du modèle régional opérationnel à environ 22 km. Le travail est en cours pour élaborer un ensemble de paramétrages qui seront propres à cette résolution et qui apporteront des améliorations dans le paramétrage des précipitations. Une fois cette étape terminée, notre priorité pour le développement de la physique sera la mise en application, en 1999, d'un schéma amélioré de l'interaction avec la surface.

Les méthodes numériques et les techniques de programmation

Comme il a été mentionné plus haut, dans quelques mois l'implantation de GEM dans le cycle global complétera notre transition vers un modèle PNT opérationnel unique. En même temps, on améliorera la résolution de GEM dans sa configuration régionale à environ 22 km (pour des prévisions de 48 heures sur l'Amérique du Nord). Après l'amélioration de la résolution du modèle régional, les prévisions de GEM de 24 heures à fine résolution, sur l'ouest et l'est du Canada, atteindront une résolution de 10 km. Les prévisions de 24 heures seront encore exécutées à partir des conditions initiales interpolées de la prévision régionale de 6 heures. Même en l'absence d'assimilation de données indépendantes à résolution fine, ces prévisions continueront de tirer avantage de la topographie à fine résolution et des effets de surface.

Les étapes importantes du CMC vers des prévisions opérationnelles à 10 km

En 1997:
- GEM remplace le EFR à 35 km de résolution, prévisions régionales pour 48 heures sur l'Amérique du Nord.
- 3DVAR dans le cycle global d'assimilation de données.
- 3DVAR dans le cycle régional intermittent d'assimilation de données.
- Prévisions expérimentales GEM à 15 km pour 24 heures sur l'ouest et l'est du Canada

En 1998:
- GEM remplace le SEF pour le système global prévision/assimilation de données.
- Prévisions régionales à 22 km pour 48 heures avec une physique améliorée.
- 3DVAR sur les niveaux du modèle avec des statistiques améliorées des erreurs de prévision.
- Prévisions à 10 km pour 24 heures sur l'ouest et l'est du Canada.
- Version PPM de GEM.

En 1999:
- Prévisions régionales à 15 km pour 48 heures sur le SX-4 multi-noeud.
- Assimilation de nouveaux types de données dans le 3DVAR.
- Amélioration du schéma de l'interaction avec la surface.

En l'an 2000 et au-delà:
- Assimilation de données 4D performante.
- Prévisions régionales à 10 km pour 48 heures avec une physique et des champs de surface appropriés.

Pour atteindre une résolution encore plus fine, on devra pleinement tirer avantage de l'environnement du superordinateur SX-4 NEC multi-noeud qui est en train d'être installé au CMC. Il sera nécessaire de passer à une Programmation à Parallélisme Massif (PPM) afin de concentrer la puissance de plus d'un superordinateur sur l'exécution d'une prévision unique. À l'automne dernier, le CMC et la DRM ont amorcé un projet conjoint pour transférer la connaissance de la programmation PPM, développée par Thomas et al. (1997), au modèle GEM. La version PPM du GEM sera complétée en 1998, préparant ainsi le terrain pour la mise en application en 1999 d'un système de prévision régionale sur l'Amérique du Nord avec une résolution d'environ 15 km. Entre les années 1999 et 2001, les facteurs limitatifs pour une PNT régionale exacte seront la disponibilité des données, l'assimilation de données et le paramétrage de la physique plutôt que la résolution du modèle de prévision.

Dernières remarques

On s'approche de prévisions opérationnelles à 10km à l'échelle continentale, mais il reste un travail considérable à faire. Dans l'encadré, on présente le résumé des étapes importantes. Les activités de recherche et développement seront principalement axées sur l'assimilation de données et le paramétrage de la physique. En même temps, nous aurons besoin de poursuivre plusieurs autres activités telles que l'amélioration des systèmes de vérification et de diagnostics; l'amélioration des systèmes de post-traitement; et l'amélioration des liens entre les modèles PNT et d'autres modèles environnementaux (incluant l'hydrologie, la qualité de l'air, la réponse aux urgences environnementales, l'état de la mer et les océans). Nous continuerons également d'améliorer le système global de prévision/assimilation de données et d'effectuer de la recherche et du développement à des échelles non hydrostatiques. Le monde de la PNT progresse et s'élargit. La PNT deviendra encore plus utile, dans les années à venir, pour fournir des services de qualité aux Canadiens.

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Réflexion

Le 14 avril 1912, le *Titanic*, le plus gros navire de ligne de l'époque avec ses 269 m de longueur, heurta un iceberg au sud-est de Terre-Neuve et coula en moins de 3 heures, entraînant dans la mort 1 522 personnes. En réponse à ce désastre, on créa en 1914 la Patrouille internationale des glaces, chargée de relever la présence d'icebergs et d'en surveiller les déplacements dans les voies maritimes de l'Atlantique nord, et d'effectuer des relevés océanographiques annuels pour aider à prédire les déplacements et la fonte de ces masses de glace.

Erratum

Unfortunately, an error has been found in the February issue of the *CMOS Bulletin SCMO* (Vol.26, No.1). On page 4, in the article entitled "The Role of the Oceans in Climate Change", in the second column, 8th line from the bottom, the words "warm water" were used instead of "cold water". The full paragraph should read as follows:

"The cooling effect of the Arctic winds also results in an increase in density of the surface waters. These cooled surface waters then sink and carry heat with them to the ocean bottom. This sinking process is called deep water formation and is pivotal to global ocean circulation patterns and thus climate. Deep currents carry the cold water towards the Southern Ocean off the coast of Antarctica. Here, this bottom water slowly rises to the surface as it spreads to the Pacific and Indian Oceans; again absorbing heat from the atmosphere in equatorial regions. The warm surface waters eventually return to the North Atlantic where the cycle begins again. The net result is oceanic transport of heat poleward."

We apologize to the author but the error was found too late, when printing was completed.

Correction

Malheureusement, une erreur s'est glissée dans le numéro de février du *CMOS Bulletin SCMO* (Vol.26, No.1). A la page 20, dans l'article intitulé "Le rôle des océans dans le changement climatique", à la première colonne, 8e ligne à partir du bas, les mots "eau chaude" devraient être remplacés par "eau froide". Le paragraphe devrait donc se lire comme suit:

"L'effet de refroidissement des vents de l'Arctique se traduit aussi par une augmentation de la densité des eaux de surface. Les eaux de surface, refroidies, s'enfoncent, en entraînant au fond de l'océan la chaleur qu'elles transportent. C'est ce qu'on appelle la formation d'eau profonde, un élément essentiel du régime de la circulation océanique planétaire, et donc du climat. Les courants des profondeurs transportent l'eau froide vers l'océan Austral au large de l'Antarctique. Là, l'eau de fond remonte lentement vers la surface en se répandant dans les océans Pacifique et Indien, et absorbe de nouveau la chaleur de l'atmosphère dans les régions équatoriales. Les eaux de surface chaudes reviennent par la suite dans l'Atlantique Nord, où le cycle recommence. Le résultat net en est un transport océanique de chaleur vers les pôles."

Nous nous excusons auprès de l'auteur mais l'erreur fut trouvée alors que l'impression était déjà terminée.

Paul-André Bolduc,
Rédacteur / Editor, CMOS Bulletin SCMO

The Oceanographic Work-Station (OWS)

A System For Near Real-time
Analysis, Visualization and Forecasting of Oceanographic Conditions

by Dave Ramsden[1]

Introduction

The Meteorological and Oceanographic (METOC) Centre of the Canadian Maritime Forces Pacific (MARPAC) Headquarters has an ongoing requirement to deliver state of the art oceanographic analyses and forecasts for military and civilian purposes. To this end, the METOC Centre must collect, quality control and analyze data from a multitude of sources to produce twice-weekly oceanographic surface temperature maps and weekly ocean analyses including some three-dimensional (3D) gridded fields. The area of main interest is between 45 to 60 degrees North, and from the Pacific coast out to 160 degrees West.

A system was required to meet ongoing needs, as well as smoothly handle additional requirements. The analysis and prediction program needed to be flexible enough to be adaptable to such things as varying geographic regions, yet simple enough to be used by personnel possessing minimal computer skills. The ability to provide seamless ongoing analysis and archival methodologies was also necessary. Over the last five years, such a system has been developed, and is being used for both routine analyses and specialized support.

Background and Evolution of the System

With the evolution of fast, high end work-stations and the availability of flexible, well-integrated graphical software in the early 1990s, the METOC Centre recognized an opportunity to automate its oceanographic program. Until then this program was centered on subjective hand analyses of data, with virtually no forecast capability. In 1992/93, a task specification and feasibility study were undertaken to determine the eventual form of the automated ocean analysis system. The result of this study was the definition of an "Oceanographic Work-Station" (OWS), which would have at its core a graphical user interface (GUI) written in Interactive Data Language (IDL) on a series of Hewlett Packard series 715/730 and higher work-stations.

IDL was chosen as it is a powerful, self-contained, graphical and mathematical analysis package capable of simultaneously displaying multiple plot and text elements in a 'point and click' manner. It also supports numerous data formats and contains a Fortran interface to utilize more complex mathematical analysis packages. IDL code runs on a multitude of platforms without modification. From 1993 and on, the OWS has taken shape as the METOC Centre's data gathering, analysis, and display needs have become more sophisticated and focused.

Current Status of the System

The METOC Centre currently receives ocean temperature data from a number of sources and sensors. These include expendable bathy thermographs (XBT's), ships' reports, lighthouses, drifting buoys and satellite High Resolution Picture Transmission (HRPT) data along with Levitus (1994) climatological data atlases. Currently, only temperature is analyzed. No real-time salinity data is assimilated or archived.

Twice a week, the available data is entered into the data base part of OWS and a surface temperature analysis is performed. Data quality control is accomplished by producing a series of objective analyses and contouring the analyzed field. Bad or multiple data is culled from the data set and the analysis repeated. When the objective analysis is acceptable, the remaining input data and analyzed fields are archived and distributed. The objective analysis parameters (such as the scale or degree of anisotropy) are under operator control and are adjusted based on the quantity and quality of data available. Weeks with very little data are adjusted to climatology and the previous week's analysis (called the trial field). The result of one such analysis is shown in the accompanying figure, with the plotted domain restricted to a subarea of the total analysis field, another feature of OWS.

When needed, a full 3D ocean temperature snapshot is produced from the XBT data. This is accomplished as a series of 2D objective analyses on standard depths (corresponding to the Levitus climatological depths).To visualize the 3D field, a "data slicer" has been incorporated into the display software. Vertical slices of the predicted field can also be contoured in any horizontal direction. Objective analysis can be performed along vertical sections under great circles.

Once a week, temperature at 150m is determined, along with the sonic (mixed) layer depth and the primary and secondary sound channel axes. Finally, monthly average surface temperatures and anomalies relative to climatology are produced and distributed from all surface data for that month.

At all stages of the analysis, bathymetry and coastal outlines can be overlaid on the data or analyzed fields.

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Data values or simply locations can be displayed with the objective analysis contours, and separate windows control the input and output data flow. The OWS displays dialogue boxes which guide the operator through the analysis procedures in a "point and click" manner. Standard values of operational parameters, such as locale, are defined in a startup file which can be adjusted as needs dictate.

Three OWS systems are operational at present; one at the MARPAC METOC Centre, one at METOC Centre Halifax in Maritime Forces Atlantic Headquarters, and one at the Department of Fisheries and Oceans (DFO) Institute of Ocean Sciences (IOS) in Victoria.

Modelling

At the time of OWS specifications, it was recognized that a predictive capability would be useful, both in its own right and as a method of providing better "trial fields" for the next week's analysis. A number of ocean models were considered. Ultimately, the Princeton Ocean Model (POM) was selected for the first attempt at operational modelling. The POM is a fully prognostic, 3D, primitive equation, sigma coordinate model, well suited to the problems of modelling in areas of rapidly-changing bathymetry and complex coastal processes.

The model has been configured for the same area as the data analysis, and boundary conditions such as tides, heat and moisture fluxes, and wind stresses have been included. The model is initialized with output from the OWS interpolated to the POM sigma grid. Output from a Canadian Meteorological Centre (CMC) atmospheric model is used to provide surface boundary data. Tides come from a global tidal model for the major constituents in the area.

The model was tested in October 1996 by running for seven days from an initial OWS determined state. The model output was compared against XBTs dropped at the end of the analysis period. The model did slightly better than persistence, but not well compared to climatology. The main problem was that the initial state the model ran from was not good enough. This was principally due to an insufficient quantity of initial XBT data to appropriately define the initial state.

Some initial assessment of determining better temperatures in the near surface from high resolution surface data (such as HRPT fields) using vertical expansion of the surface data by statistical methods has been accomplished. Until better initial states are defined, any model will have trouble replicating true ocean evolution.

The recent Maritime Command Operational Training (MARCOT) exercise conducted off Vancouver Island during the week of 12-20 October 1997 has provided a better opportunity to assess the performance of the model. The following figure (also shown in colour on the front page) shows the number of XBTs dropped at the beginning of the exercise in the MARCOT area (which were used to define the initial field). A full ocean prediction was then made for the remainder of the exercise. Evaluation of the model performance continues.

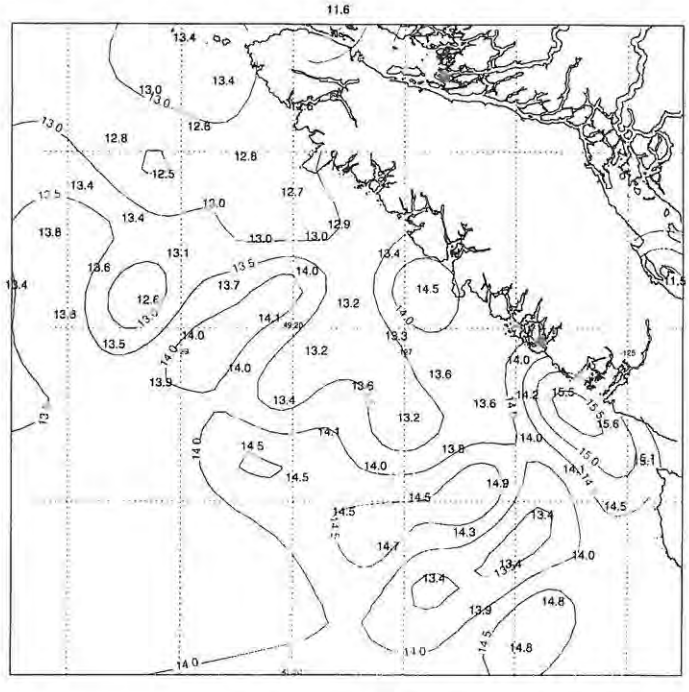
Future Work

In the near future, salinity will become an analyzed field and ongoing improvements will be added to OWS as data-gathering and dissemination technologies evolve. Production of a user manual, both printed and on-line, is anticipated. It is also intended to bring the POM model to operational mode within the OWS. In this way, predictions can then be made after each week's analysis, yielding both a predicted field which can be distributed, and a better trial field for the next week's analysis.

In the longer term, it is planned to convert the OWS methodology to personal computer (PC) based systems with potential gains in compatibility and cost. Also, data assimilation and optimal data-gathering techniques are being considered to improve the amount of information each data point can potentially yield.

Collaboration

Collaboration with other researchers or agencies involved in operational oceanography was most welcome during the development of the OWS and for the future work. Points of contact are: Douglas Bancroft, Senior Staff Officer METOC Development (bancroftd@ios.bc.ca) and Ulrich Suesser, Staff Officer METOC Development (suesseru@yed.ab.ec.gc.ca).



A sample surface analysis for the beginning of the MARCOT exercise is shown. The figure is generated directly from the OWS and illustrates a subarea of the full analysis domain. The surface XBT grid data points are plotted along with the gridded objective analysis contours.

Towards operational 10 km forecasts at the Canadian Meteorological Centre (CMC)

by Dave Steenbergen[1], Angèle Simard[2] and Pierre Dubreuil[1]

Introduction

In a recent issue of the *CMOS Bulletin SCMO*, Thomas et al. (1997) reported on an impressive achievement: a 24-hour NWP forecast covering North America at a horizontal resolution of 10 km. Their work demonstrated the feasibility of running a 10 km continent-wide model in real-time on currently available supercomputers. In this note, we provide an overview of plans to move towards operational 10 km forecasts for Canada at the CMC.

In very general terms, three critical components are needed for operational high resolution forecasts: a numerical model efficient enough to meet operational deadlines on the available hardware; a data assimilation system to determine the initial state of the atmosphere; and an appropriate representation of physical processes as well as surface conditions in the model. The following sections briefly describe the current operational configuration, the general strategy adopted by CMC, and the current plans for each of the three critical components listed above. This overview omits many smaller but essential activities which cannot be covered in such a short document.

Current NWP systems at CMC

A comprehensive description of operational NWP systems at CMC can be found on the CMC WEB site (www.cmc.ec.gc.ca). In summary, these systems include:

- a continuous global data assimilation cycle based on a three-dimensional variational analysis (3DVAR) system and a global spectral model (SEF) at T199 resolution (about 100 km), from which 10-day forecasts are launched at 0000GMT and 3-day forecasts are launched at 1200GMT;

- a 12-hour regional data assimilation spin-up cycle based on the same 3DVAR system and the Global Environmental Multi-scale (GEM) model at 35 km resolution, from which 48-hour forecasts over North America are launched at 0000GMT and 1200GMT;

- experimental high resolution (15 km) 24-hour GEM forecasts over western and eastern Canada, launched once a day at 06GMT with initial conditions interpolated from a 6-hour 35 km forecast; and,

- a large variety of post-processing models and statistics, as well as a huge number of products which cannot be described here in any detail.

General strategy: a unified system

Since the early nineties, CMC and MRB have been working toward a unified system for regional and medium-range forecasting. The goals of this strategy are to reduce the cost of maintaining model and data assimilation software, to use R&D resources more efficiently, and to increase the speed of technology transfer to operations. Achieving these goals is critical in the context of resource and staff reductions.

For data assimilation, we are using the same 3DVAR system in our global cycle and in our regional spin-up cycle. On the physics parameterization side, a unified physics library which is used by all operational and research models was introduced at CMC many years ago. (Obviously, many parameterizations are resolution dependant, so not all the same options are used in global, regional and local applications.)

On the modeling side, in GEM we have a global variable resolution model that can be used in uniform-resolution mode for medium-range forecasting or in focused mode for regional forecasting (Côté et al. 1998a,b). By moving to a single operational model, we have to maintain only one dynamics core, one interface to the physics library, and one set of I/O interfaces for initial atmospheric and surface conditions, output products, and restart files. The latter make up a surprisingly large portion of an operational model code. Another major factor is that we only have to develop and maintain one adjoint model for four-dimensional variational data assimilation (4DVAR - this point is discussed in more detail below).

GEM replaced the regional finite element (RFE) model in the regional cycle in February 1997, and we plan to replace the SEF model in the global cycle by GEM in its uniform resolution configuration in the coming months. Once this is done, the global cycle and the regional cycle will share the same model code, the same physics library, and the same data assimilation system code.

Data assimilation

Until last year, operational data assimilation systems at CMC were based on the "optimal interpolation" (OI) approach which was pioneered at CMC in the mid-70s. A three-dimensional variational (3DVAR) analysis scheme

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1 Meteorological Research Branch (MRB)

2 Canadian Meteorological Centre (CMC)

replaced the OI in the global cycle in spring 1997, and a regional spin-up cycle based on 3DVAR was implemented in the fall. To make the transition easier, the first version of 3DVAR which is currently operational was configured to be as similar as possible to the old OI. This year, we plan to implement a more advanced version of the 3DVAR which calculates analysis increments directly on the GEM model vertical coordinate and which uses a more sophisticated model of forecast errors. One of the major reasons we have invested in 3DVAR is that it allows direct use of observations which are nonlinearly related to the analysis variables (such as many satellite measurements). In 1999, we will take advantage of this flexibility by assimilating new data types in operations. A second major reason we chose to develop a 3DVAR system is that it provides a framework which can be extended to four-dimensional variational assimilation, or 4DVAR. 3DVAR and OI share the same basic statistical approach, based on forecast error correlations calculated from a large number of previous forecasts and on simple balance relationships between mass and wind. This approach works reasonably well on the average for synoptic scale forecasts. However, it is a long way from optimal in any individual case, and it also breaks down as we try to assimilate data at higher resolution (in space or time). To get away from the limitations of 3DVAR and OI, and to provide appropriate initial conditions for models running at 10 km, we are intensifying our research effort on advanced 4D data assimilation approaches such as 4DVAR. 4DVAR fits an atmospheric model "trajectory" to observations distributed over a time window by iteratively running the model forward in time and projecting the difference between the model state and the observations backward in time using the "adjoint" of the model. (Errico (1997) provides a readable introduction to adjoint models). Developing an adjoint model is a major development effort since the adjoint code is about the same size and complexity as the forecast model on which it is based. The unified model strategy will allow us to use the same adjoint model for both regional and global applications, which represents a major saving. A number of the issues involved in development of the adjoint of a semi-Lagrangian variable-resolution model such as GEM have been explored in detail (e.g. Tanguay et al., 1997) and a prototype adjoint of GEM has been completed.

In the coming year, we will begin using the prototype adjoint of GEM for forecast sensitivity experiments (Rabier et al., 1996; see also Errico, 1997) and experiments with 4DVAR. Development of an advanced 4D data assimilation system to the point of operational readiness will require a lot more R&D as well as impressive computer power. We do not expect to reach this point at CMC for at least two more years.

Major CMC milestones toward operational 10 km forecasts.

Year 1997:
- GEM replaces RFE for 35 km, 48 hour regional forecasts over North America;
- 3DVAR in global data assimilation cycle;
- 3DVAR in regional data assimilation spin-up cycle;
- Experimental 15 km, 24 hour GEM forecasts over eastern and western Canada.

Year 1998:
- GEM replaces SEF for global data assimilation and forecasts;
- 22 km, 48 hour regional forecasts with improved physics;
- 3DVAR on model surfaces with improved forecast error statistics;
- 10 km, 24 hour forecasts over eastern and western Canada;
- MPP version of GEM.

Year 1999:
- 15 km, 48 hour regional forecasts on multiple SX-4 nodes;
- Assimilation of new data types in 3DVAR;
- Upgraded land surface interaction scheme.

Year 2000 and beyond:
- Advanced 4D data assimilation;
- 10 km, 48 hour regional forecasts with appropriate physics and surface fields.

Physical parameterization and surface initial conditions

Many issues concerning parameterization of physical processes will have to be dealt with to obtain the full benefit of higher resolution numerical models. Parameterizations of processes such as radiation, cloud and precipitation formation, and convection are generally scale-sensitive and interdependent. At a minimum, changing the resolution of an operational model requires careful adjustment and tuning of the balance between these parameterizations on a large number of cases to achieve robust and reliable results. The large changes in resolution planned at CMC will require some basic changes in assumptions as model resolution approaches the size of an individual thunderstorm.

Parameterizing interactions between the atmosphere and the earth's surface and determining surface initial conditions are also areas in which there is considerable room for improvement. Some surface fields, such as water surface temperatures and ice cover, change slowly enough that they can be treated as constants for an individual NWP forecast (at least for the short range). However, appropriate analyses of these fields (and data on which to base the analyses) must be available before the model can be run. Determining the temperature and ice cover of small water bodies which are seen by higher resolution models is already pushing the limits of the available data. Heat and moisture fluxes between the surface and the atmosphere also depend strongly on the depth and state of the snow cover, and on

the water content of the soil. These parameters change much more rapidly than ice cover and water surface temperatures, and real-time measurements are very limited. Including these fields in the data assimilation cycle is both a potential way forward and a major challenge.

Our short-term priority in physical parameterization is preparing for an increase in the resolution of the operational regional model to about 22 km. Work is under way to produce a package of parameterizations which will be appropriate for this resolution and which will include improvements in the parameterization of precipitation. Once this is delivered, our priority for physics development will be introduction of an upgraded land surface interaction scheme in 1999.

Numerical methods and programming techniques

As mentioned above, implementation of GEM in the global cycle in the next few months will complete our migration to a single operational NWP model. At the same time, we will be upgrading the resolution of GEM in its regional configuration to about 22 km (for 48-hour forecasts covering North America). After the regional model resolution is upgraded, the high resolution 24-hour GEM forecasts over eastern and western Canada will move to 10 km resolution. The 24-hour forecasts will still be launched from initial conditions interpolated from a 6-hour regional forecast. Even without independent, higher-resolution data assimilation, these forecasts will continue to benefit from higher-resolution topography and surface effects.

To go to yet higher resolution we will need to take full advantage of the multi-node NEC SX-4 supercomputer environment that is being installed at CMC. Moving to a massively parallel programming (MPP) approach will be required to concentrate the power of more than one supercomputer on running a single forecast. Last fall CMC and MRB began a joint project to transfer the MPP programming knowledge developed by Thomas et al. (1997) to the GEM model. The MPP version of GEM will be completed in 1998, paving the way for the introduction in 1999 of a regional forecast system over North America at about 15 km resolution.

Between 1999 and 2001, we expect that the limiting factors for accurate regional NWP forecasting will be data availability, data assimilation, and physical parameterization rather than the resolution of the forecast model.

Final comments

We are getting closer to operational 10 km continental scale forecasts, but there is substantial work remaining to be done. The major milestones are summarized in the window insert on Page 42. We will be mainly focusing our R+D on data assimilation and physical parameterization. At the same time, we will need to continue many other activities such as improving diagnostics and verification systems; improving post-processing systems; and improving linkages between NWP models and other environmental models (including hydrology, air quality, environmental emergency response, ocean and sea-state.). We will also continue to improve our global data assimilation/forecast system and to carry out R+D at non-hydrostatic scales. The world of NWP is growing and broadening. It will become even more useful in providing quality services to Canadians in the years ahead.

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Food for thought

On April 14, 1912, the 'Titanic', largest (269 m) ocean liner of its time, hit an iceberg southeast of Newfoundland and sank in less than 3 hrs, with the loss of 1,522 lives. One response to this disaster was the establishment in 1914 of the International Ice Patrol which monitors the presence and movement of icebergs in the North Atlantic shipping lanes and conducts annual oceanographic surveys to help predict the movement and melting of icebergs.

Letters to the Editor

Has the fury of the present El Niño banished the Global Warming Debate ?

The fury with which the super El Niño of 1997-98 struck the coastal regions of the southern U.S.A. has stunned the residents of California, Mexico and Florida, dazzled the meteorologists and operational weather forecasters from coast to coast and has confounded atmospheric scientists, climate modellers and oceanographers alike. The oncoming of the present El Niño was recognized as early as March/April 1997 with the appearance of a warm water anomaly off the coast of equatorial South America, a sure sign of an El Niño arrival. By the end of May 1997, the sea surface temperature anomaly off equatorial South America had reached a value of +2.9^{0}C, highest since August 1983; this prompted meteorologists and oceanographers to speculate that the coming El Niño could be at least as strong as the 1982-83 El Niño which had caused world-wide havoc in terms of torrential rains on the west coast of South America and major swings in world grain yields (the U.S. corn crop was 40 million tonnes below trend and the total world grain yield was reduced by a whopping 55 million tonnes in 1983). By August/September 1997, the warm water of the equatorial eastern Pacific had spread along the coasts of the Americas, stretching from Vancouver Island in the North to the northern shores of Chile in the South. The warm water was already generating heavy rains in coastal regions of Peru and Chile while residents in coastal California and Mexico were bracing themselves for the onslaught of the El Niño.

The early winter (December 1997) storm which brought snow in many parts of Mexico, and the early January (1998) ice storm that paralyzed Montréal and adjoining regions of eastern Canada, were initially blamed on 'Global Warming', but soon it was realized (by meteorologists and weather forecasters) that both the Mexican snow storm and the Montréal ice storm were spawned by the southward extension of the mid-latitude jet stream which pulled in colder air over Mexico and pushed warm and moist air from the Gulf of Mexico to eastern Canada, triggering the ice storm which eventually became the worst natural disaster in Canadian history. The southward extension of the jet stream was caused by the warm waters of the equatorial eastern Pacific associated with the strengthening of the El Niño. The fury of El Niño began in early February (1998) with a series of storms developing over the warm waters of the central equatorial Pacific being steered towards the California coast by the anomalous westerlies at the 850 mb level and further strengthened by the southward extension of the upper tropospheric jet stream. These storms, which were accompanied by high winds and heavy rains, caused extensive damage to properties and claimed several lives in the coastal communitities in California. As these storms moved eastward, some of them re-developed over the Gulf of Mexico producing heavy rains and violent weather (e.g. high winds, tornadoes) along the coastal regions from Luisiana to Florida. A few of the El Niño-driven storms that struck California moved along a northeasterly track producing heavy snowfall and blizzard-like conditions in the adjoining mountainous states of Arizona and Utah. On the plus side of El Niño, western Canada and the Great Lakes region have experienced a much milder winter so far.

The ferocious and dramatic impact of the present El Niño appears to have suddenly pushed the global warming debate to the brink of oblivion. Everyone from the news media to the television weather channels and talk shows is now talking about El Niño and the extreme weather! Before the El Niño's fury began, any unusual weather event, be it a tornado outbreak in Alberta, an extended warm weather spell in southern Ontario or floods in Québec, would somehow be linked to global warming, and the importance of reducing green house gases like carbon dioxide, methane etc. would be exerted on society. Now, all the unusual weather happenings around the world (e.g. warmest February in the Great Lakes region, unusually hot weather in parts of South America and southwest Africa, heavy rains and severe weather in the southeastern U.S.A.), are being linked to El Niño and no-one seems to be overly concerned about global warming at all. It is as if the global warming issue does not exist any longer!

This sudden change in perception about the possible impact of global warming on the climate has raised an interesting question: Is the impact of global warming on the climate being blown away by the fury of the El Niño?

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Note from the Editor: M.L.Khandekar has been until recently a Research Scientist with Environment Canada; he is presently working as a consultant with Baird & Associates, Ottawa.

Do not hesitate to write to your *CMOS Bulletin SCMO* Editor. Share your ideas, express your opinions, let us know your concerns. Other people might be interested to read what YOU think!

N'hésitez surtout pas à écrire à votre rédacteur du *CMOS Bulletin SCMO*. Partagez vos idées, donnez votre opinion, exprimez vos craintes. D'autres sont intéressés à lire ce que VOUS pensez!

Global Warming, the Complete Briefing by John Houghton

Published by Cambridge University Press

Book reviewed by William A. Gough[1]

Global Warming: the complete briefing is published by Cambridge University Press. It is written by Sir John Houghton who is a co-chairman of the Scientific Assessment Working Group of the Intergovernmental Panel on Climate Change (IPCC) and is the lead editor of the two main scientific assessments of climate change in 1990 and 1995. The first edition of this book was published in 1994. The current edition incorporates the comprehensive updating found in the 1995 IPCC reports.

Structure. The book consists of four thematic divisions. The science of global warming is presented in the first five chapters. These chapters cover the physical basis of the greenhouse effect, the changing distribution of greenhouse gases, the use of past climates as an analogue, and the modelling of climate. This is followed by two chapters (6, 7) on climate projections and their impacts based on current climate modelling. Chapters 9, 10 and 11 deal with societal response to these forecasts in the assessment of uncertainties and strategies to mitigate potentially damaging consequences. The final perspective is included in two disconnected chapters, eight and twelve. These chapters place the global warming issue in a broader social, ethical and religious context. The book is concluded by a thorough glossary of global warming jargon and a comprehensive index.

Content. As Houghton is one of the editors of the IPCC Science reports, one might expect from this source a compendium of the executive summaries in the IPCC reports. This is definitely not the case. Although the influence of the IPCC process can be seen in this document, there is a thorough rethinking of the material presentation. What remains is a remarkably lucid and comprehensive overview of the global warming issue. I doubt there is any other document of this size (251 pages) that is as successful at this than this book. A wide range of topics, however, is covered and will take some digestion by the uninitiated reader (although it is well worth the effort). Treatment of material is necessarily brief and at times truncated. One example is the treatment of the carbon cycle in the ocean. Houghton correctly describes the biological pump, but omits the sophisticated biochemistry that leads to the carbonate counter pump. Other examples may exist in areas that I am less familar with. I found the chapters on strategies of mitigation (10 and 11) particularly interesting. Examination of energy supply and alternatives is an essential element to a global warming discussion. His command of the subject, complete with relevant figures and tables, provides the background for useful and realistic discussion of energy issues.

One of the strengths of the book is the inclusion of chapters 8 and 12 which provides a broader social, ethical and religious perspective to the global warming issue. Although this may seem, at first, a little odd to find in a "science" text, it is a much needed perspective. It strikes at the root of much of the environmental problems facing mankind and therefore provides a workable context for its amelioration.

Writing Style/Presentation. The book is written in a clear, elegant style. The prose is punctuated by simple black and white diagrams and tables and by isolated boxes of text which provide supplementary material on ancillary topics. Each chapter is concluded with a series of thought-provoking questions and a list of notes leading to further readings. For the most part, the presentation is easy to follow and quite effective in conveying the main points of the global warming debate. Some figures, however, are a little confusing (e.g. Fig. 5.16). The individual integrity of the author and his conviction that this is a solvable problem permeates the book. This is a refreshing departure from the gloom and doom slant that is all too familar in environmental literature. The severity of the potential impacts, however, is not glossed over. The latter part of the book focuses primarily on the quest for solutions.

Appropriate audience. Although the latest of sophisticated climate change research is reviewed, the author goes to great pains to write to a general audience. For example, there are no equations in the book. This form of representation is replaced with clear description and a generous supply of diagrams and tables. This enables the material to be accessible to the intelligent, though not necessarily mathematically and physically well versed, reader. This type of writing places the author under a tremendous burden, but Houghton is exceptionally successful at it. With the inclusion of discussion questions and up-to-date references, this text is a good fit for university-level courses offered in geography, environmental science and environmental studies programs. As the title suggests, it is also appropriate as a reference for those who do not have the time or expertise to wade through the extremely thorough three volumes of the IPCC 1995 reports. It should be noted that readers who do not have a familiarity with the science of global warming will need to read carefully and thoughtfully; the book is rich in concepts. The author does make an effort to relate material to issues the lay person is likely to be aware of (eg. El Niño).

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In summary, Houghton has produced a well-written overview of the global warming issue and its implications which is accessible to a wide audience. It can serve well, both as an academic text and as a reference book for policymakers and others interested in the environment and the future of the earth.

Antarctic Meteorology and Climatology

by J.C. King and J. Turner
Ice and Climate Division
British Antarctic Survey

Cambridge University Press 1997, 409 p.

Book reviewed by André April[2]

Since the International Year of Geophysics in 1957-58, and the First Garp Global Experiment in 1979, when numerous campaigns were undertaken, massive research efforts have been made to better understand the Antarctic atmosphere. This resulted in technological progresses and theoretical studies into polar atmosphere, and in the realization of the impact this region has on global climate. This book reviews the current knowledge we have of the Antarctic's meteorology and climatology and outlines the research requirements for the future.

Aside from the standard references and index sections, the book is divided into seven chapters and two appendices which list all weather stations and bases spread out throughout the Antarctic and Sub-Antarctic islands.

The introduction succinctly presents the physical characteristics of the Antarctic as well as a brief review of meteorological activities in the area. The second chapter details the observations made, the devices used such as automatic stations, drifting buoys - the observation stations installed and the use of satellite imagery. The Antarctic Meteorological British Survey Web site can be consulted for daily data on this region.

The authors then present the physical climatology and other aspects such as radiation, clouds and precipitation. There is also a well-developed section regarding sea ice and the particular characteristics of the Sub-Antarctic Ocean. The large-scale circulation of the Antarctic atmosphere is well covered. Other important aspects, such as how katabatic winds develop from the plateaus to the shore and the complexity of measuring this wind as well as the water vapour budget are also examined in this section. The section closes with the use of the General Circulation Model (GCM) in the representation of the Antarctic atmosphere.

The authors also discuss the study of meteorological systems at the synoptic level and, in particular, the study of depressions on plateaus and over the ocean. There is also a section regarding the formulation of meteorological analyses and predictions for the Antarctic.

The book then describes mesoscale systems such as mesocyclones and presents an in-depth view of katabatic wind propagation. The authors also discuss boundary layers and wind-blown snow in the Antarctic environment. Finally, the authors close their discussion with the subject of weather changes and variability and tie in correlations with the ENSO (El Niño Southern Oscillation) and the variation in the Antarctic climate due to the greenhouse effect.

The authors purposely omitted discussing the matter of the stratospheric ozone and only briefly mention clear weather precipitation.

This book is of great interest to meteorologists and climatologists specialized in the Antarctic and can also be helpful for those studying glaciers and oceanographic and atmospheric sciences. The reader is informed of the current knowledge regarding this hostile continent where explorers, scientists and technicians of all nationalities cohabit, driven by a common goal: scientific development and protection of this immense nature preserve.

[2] Atmospheric Sciences, Department of Earth Sciences, Université du Québec à Montréal

Note du Rédacteur: La version française de la présentation de ce livre traitant de la météorologie et de la climatologie de l'Antarctique a été publiée dans le *CMOS Bulletin SCMO*, Vol.26, No.1, page 15.

After CMOS Congress in Halifax
Going further afield?

"I have travelled around the globe. I have seen the Canadian and American Rockies, the Andes and the Alps and the Highlands of Scotland; but for simple beauty, Cape Breton Island outrivals them all."

Alexander Graham Bell.

International Year of the Ocean

Did you know that the UN has declared **1998 as the International Year of the Ocean (IYO)** to focus attention on the need to sustain marine resources and to ensure a healthy ocean?

The federal government has set up a small IYO Secretariat to help promote and coordinate activities being planned for the Year. Canada has set the following three objectives for the IYO:

- To increase public awareness of the importance of the ocean to the every day life of all peoples, whether they live on, near or remotely from the coast;
- To bring ocean-related issues to the attention of policy- and decision-makers and decide on courses of action; and
- To engender long-term continuing support for the programs and activities needed to resolve those issues.

How can you get involved in this worthy cause?

If you have, or know of someone who has, a knack for raising awareness of the key issues and challenges facing the World Ocean, please contact the IYO Secretariat and we will add you to our list. The IYO Secretariat is setting up a speakers' bureau for the IYO. This list will include names of scientists (and their favourite topics) who would be interested in speaking on an ocean-related theme to a wide variety of audiences: general public, youth, community groups, schools, Oceans Day events, etc.

If you would like to become involved in our School-Twinning Project, where we link up an inland school, a coastal school and a scientist to conduct scientific experiments relating to the health of the ocean - please contact us for more details. This project also has an international component.

If you are planning any events during 1998 that feature some aspect of the ocean (open house of scientific stations, science fairs, seminar series, etc.) and would like to spread the word across the country and around the world, send us the basic details (what, when, by whom, where....) and we will post it on Canada's official IYO web site @ **http://www.OceansCanada.com/IYO**

If you would just like to know more about IYO please browse the web site mentioned above or contact us at the following address:

Caroline Bookless
IYO Secretariat (Canada)
200 Kent Street, 12th Floor
Ottawa, Ontario K1A 0E6

Année Internationale des Océans

Saviez-vous que l'Organisation des Nations Unies (ONU) a proclamé **1998 l'Année Internationale des Océans (AIO)** afin de souligner l'importance de la préservation des ressources marines et d'assurer la salubrité des océans?

Le Gouvernement Fédéral a fondé le Secrétariat de l'Année Internationale des Océans (Canada), ayant pour but la promotion et la coordination des activités prévues au calendrier pour l'année. Le Canada s'est fixé les trois objectifs suivants pour l'AIO:

- Augmenter la sensibilisation du grand public sur l'importance des océans dans la vie quotidienne de chacun et ce, que l'on habite sur, à proximité ou éloigné du littoral;
- Attirer l'attention des politiciens et autres décideurs sur les problèmes reliés aux océans et décider des actions à entreprendre; et
- Instaurer un support continu et à long terme des programmes et activités nécessaires en vue de résoudre ces problèmes.

Comment vous impliquer dans cette cause honorable?

Si vous, ou l'une de vos connaissances, avez un talent particulier qui permettrait de sensibiliser l'opinion publique sur les questions et défis fondamentaux reliés aux océans, nous vous invitons à contacter le Secrétariat de l'AIO afin de vous inscrire sur notre liste. Le Secrétariat de l'AIO établit actuellement un service de conférenciers pour l'AIO. Cette liste inclura les noms de chercheurs scientifiques (et de leurs sujets d'intérêt principal) qui désirent entretenir un vaste auditoire (tel que le grand public, les jeunes, les groupes communautaires, les écoles, etc.) sur divers thèmes reliés aux océans.

Si vous voulez vous impliquer dans notre projet de jumelage des écoles réunissant une école de l'intérieur, une autre située sur le littoral ainsi qu'un chercheur scientifique en vue d'effectuer des expériences sur l'état des océans, vous n'avez qu'à nous contacter pour de plus amples informations. Veuillez noter que ce projet a également une dimension internationale. Si vous prévoyez organiser tout événement spécial relié de près ou de loin aux océans (par exemple: une journée portes ouvertes d'une station de recherche scientifique, une foire scientifique, un séminaire ou une conférence, etc.) et vous souhaitez diffuser cette information à travers le pays ou le monde, faites nous-en parvenir les éléments essentiels (quoi, quand, par qui, où...) et nous les afficherons sur le site internet canadien officiel de l'AIO: **http://www.OceansCanada.com/IYO**.

Si vous désirez simplement en savoir plus sur l'AIO, vous n'avez qu'à visiter notre site internet ou à nous écrire à l'adresse de Caroline Bookless, chargée de projet.

1998 - International Year of the Ocean - 1998

Facts for March and April (Extracts only)

On March 18, 1967, the tanker Torrey Canyon ran aground near Land's End, England, eventually spilling 117,000 tons of crude oil. This is considered to be the first ship wreck where damage to the environment was worth more than the value of the ship and its cargo.

Estimates of the amount of oil entering the sea annually range from 1.9 million tons to 5.3 million tons. About 0.6 million tons are estimated to come from natural undersea seeps, between 0.06 and 0.15 million tons from offshore oil production, between 1.3 and 2.0 million tons from land sources other than oil refining, between 0.06 and 0.3 million tons from oil refining, about 1.7 million tons from ocean transportation, and between 0 and 0.6 million tons from atmospheric fallout.

On March 23, 1875, the British research vessel Challenger took a sounding to a depth of 8,180m in what we now call the Mariana Trench. This was the deepest ocean depth recorded up to that time. In 1951 another British research vessel, also named Challenger, measured a depth of 10,920m not far away in what is now called the Challenger Deep.

On March 24, 1995, the Japanese unmanned, tethered remotely-operated vehicle Kaiko became the first such vehicle to reach the bottom of the deepest place in the ocean, the Challenger Deep in the Mariana Trench. On that dive Kaiko operated at a depth of 10,910m, controlled by operators at the surface.

A tsunami is a series of long waves generated by an earthquake, volcanic eruption, or landslide beneath the ocean. In the open ocean, tsunamis may have wavelengths of up to several hundred miles and travel at speeds up to 720 km per hr, yet have wave heights of less than 1 m, which pass unnoticed beneath a ship at sea. The period between crests of tsunami waves varies from 5 min. to about 1 hr.

When tsunamis approach shallow water along a coast, they are slowed, causing their length to shorten and their height to rise sometimes as high as 30 m. Waves tend to rise to greater heights along gently sloping shores, along submarine ridges, or in coastal embayments.

On March 27, 1964 an earthquake (magnitude 8.4 on the Richter scale) near Prince William Sound in Alaska resulted in a tsunami that caused millions of dollars of damage in Port Alberni B.C. Port Alberni is at the head of a long narrow inlet. The period between crests of the tsumani nearly matched the resonant period of the fjord, resulting in amplification of the wave to a height of 7m.

Tsunamis principally occur in the Pacific Ocean following shallow-focus earthquakes over magnitude 6.5 on the Richter scale. One of the best means of prediction is the detection of such earthquakes on the ocean floor with a seismograph network.

176 tsunamis were recorded in the Pacific between 1900 and 1970. 35 of these caused damage near their source but only nine created widespread destruction.

On April 1, 1994, the catamaran 'Enza', crewed by Peter Blake and Robin Knox-Johnson, arrived in France to complete its circumnavigation of the globe under sail, non-stop, in 74 days 22 hours.

The Shell Oil Company 'Mars' tension leg offshore oil production platform, installed in April 1996, stands in 896m of water in the Gulf of Mexico. This is the tallest production platform.

The first offshore oil well was drilled in 1896 off the coast of California.

Every day more than 10 billion barrels of oil and gas, about 20% of the world's supply, is taken from seabed wells. This represents more than 90% of the mineral value presently taken from the sea.

The composition of sea water on the very early Earth must have been different from the present because the early atmosphere contained nearly 1000 times more CO_2 than at present. Seawater would have had more bicarbonate, less sulphate, and more iron and manganese.

In April 1935 an Arctic iceberg was sighted at 28°44' North Latitude in the Atlantic Ocean. This is as far south as Miami, Florida.

On April 24 1771, a tsunami, generated by an offshore earthquake, hit Ishigagaki Island, in the Japanese Ryukyu Island chain. Possibly the largest recorded tsunami generated by an earthquake, it tossed an 800 ton block of coral more than 3 km inland, and may have been as high as 85m.

The names "sea" and "ocean" are often used to describe the same thing, but a sea is not quite the same as an ocean. A sea is a body of saltwater.

On April 30, 1894, an Antarctic iceberg was seen in the Atlantic Ocean at a latitude of 26°30'S, approximately the same latitude as Rio de Janeiro, Brazil.

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Capsules pour les mois de mars et avril (quelques extraits seulement)

Le 18 mars 1967, le pétrolier *Torrey Canyon* s'échoua près de Land's End, en Angleterre, où il a fini par déverser 117 000 tonnes de pétrole brut. Ce naufrage est considéré comme le premier où les dommages à l'environnement valaient plus que la valeur du navire et de sa cargaison.

Les estimations de la quantité de pétrole qui pollue les mers annuellement vont de 1,9 à 5,3 millions de tonnes. Voici une ventilation des volumes provenant de diverses sources : 0,6 million de tonnes des émergences naturelles sous-marines, de 0,06 à 0,15 million de tonnes de la production pétrolière en mer, de 1,3 à 2,0 millions de tonnes de sources terrestres autres que le raffinage du pétrole, de 0,06 à 0,3 million de tonnes du raffinage du pétrole, environ 1,7 million de tonnes du transport maritime et de 0 à 0,6 million en retombées atmosphériques.

Le 23 mars 1875, le navire de recherche britannique *Challenger* prit une mesure de 8 180 m de profondeur à un endroit que nous appelons aujourd'hui la fosse des Mariannes. C'était la plus grande profondeur enregistrée jusque là. En 1951, un autre navire de recherche britannique du même nom prit à proximité une mesure de 10 920 m de profondeur dans ce qui est aujourd'hui appelée la fosse Challenger.

Le 24 mars 1995, le véhicule japonais télépiloté et télécommandé par câble *Kaiko* est devenu le premier engin de ce type à atteindre le fond de l'endroit le plus profond de la Terre, la fosse Challenger, élément de la fosse des Mariannes. Lors de cette plongée, le véhicule, contrôlé de la surface, a évolué à une profondeur de 10 910 m.

Un tsunami est une série de vagues longues produites par un tremblement de terre, une éruption volcanique ou un glissement de terrain sous la mer. En grande mer, un tsunami peut avoir une longueur d'onde allant jusqu'à plusieurs centaines de milles et se déplacer à des vitesses atteignant 720 km/h, sans toutefois que l'amplitude de crête à creux ne dépasse 1 m, ce qui fait que les vagues passent inaperçues sous un navire. La période entre les crêtes des vagues d'un tsunami varie de 5 minutes à environ une heure.

Lorsqu'un tsunami s'approche d'un endroit peu profond d'une côte, il ralentit, ce qui fait que la longueur des vagues diminue et que leur amplitude augmente, parfois jusqu'à 30 m. Les vagues ont tendance à atteindre de plus grandes amplitudes sur un littoral à pente faible, le long des dorsales sous-marines et dans les baies côtières.

Le 27 mars 1964, un tremblement de terre près du golfe du Prince-William, en Alaska, d'une magnitude de 8,4 sur l'échelle de Richter, donna naissance à un tsunami qui causa des millions de dollars de dommages à Port Alberni, en Colombie-Britannique. Cette ville est située au fond d'une longue baie étroite. La période entre la crête des vagues correspondait presque à la période de résonance du fjord, résultant en une amplification de la vague jusqu'à une hauteur de 7 m.

Les tsunamis ont surtout lieu dans l'océan Pacifique suite à des tremblements de terre superficiels de magnitude supérieure à 6,5 sur l'échelle de Richter. La détection de tels tremblements de terre sur le fond océanique grâce à un réseau de séismographes est l'un des meilleurs moyens de prédire un tsumani. Jusqu'à 176 tsunamis ont été enregistrés dans le Pacifique de 1900 à 1970. Bien que 35 aient causé des dommages près de leur source, neuf seulement ont été à l'origine d'une dévastation étendue.

Mars, plate-forme de forage pétrolier maintenue en place par un système d'ancrage, a été mouillée dans le golfe du Mexique en avril 1996 par 896 m de fond. Appartenant à la Shell Oil Company, c'est la plus haute plate-forme pétrolière du monde. Le premier puits de pétrole en mer a été percé en 1896, au large de la Californie.

Chaque jour, plus de 10 milliards de barils de pétrole et de gaz, soit environ 20 % du stock mondial, sont extraits de puits sous-marins. Cela représente plus de 90% de la valeur des minéraux extraits de la mer à l'heure actuelle.

En avril 1935, un iceberg de l'Arctique a été aperçu dans l'Atlantique par 28°44' de latitude nord, soit la même latitude que Miami, Floride.

Le 24 avril 1771, un tsunami engendré par un tremblement de terre en haute mer frappa l'île Ishigagaki, dans l'archipel japonais Ryukyu. Peut-être le plus gros tsunami enregistré résultant d'un tremblement de terre, il a projeté un bloc de corail de 800 tonnes plus de 3 km à l'intérieur des terres, et pourrait avoir atteint une hauteur de 85 m.

Une vague engendrée par un glissement de terrain sous-marin frappa l'île Lanai, dans les îles Hawaii, environ 105 000 ans passés. Elle déposa des sédiments jusqu'à une altitude de 380 m.

Le 30 avril 1894, un iceberg de l'Antarctique a été aperçu dans l'Atlantique par 26° 30' de latitude sud, soit environ la même latitude que Rio de Janeiro, au Brésil.

CANADIAN NATIONAL COMMITTEE (CNC)
for the INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (IUGG)

The Canadian Meteorological and Oceanographic Society is quite involved in the conduct of the CNC/IUGG. The purpose of this brief update is to inform CMOS members of the scope and activities of CNC/IUGG and to ask for suggestions on committee activities.

The objectives of the CNC/IUGG committee are to:

- collect and reconcile the many views of the constituent Canadian scientific community on relevant issues;
- identify, represent, and promote the capabilities and distinctive competence of the community on the international stage;
- enhance the depth and breadth of the participation of the community in the activities and events of the IUGG and related organizations;
- establish the mechanisms for communicating to the community the views of the IUGG and information about the activities of the IUGG.

In terms of scope, the CNC/IUGG committee:

- promotes, within Canada, such as to ensure maximum benefits to Canada, international programs in Geodesy and Geophysics and Canadian participation in international activities sponsored by the IUGG, its component International Associations, Inter-Union Commissions and special committees of ICSU which involve the IUGG;
- promotes, within the IUGG, its component International Associations, Inter-Union Commissions and special committees for ICSU which involve the IUGG, those international activities which are relevant, or of special interest, to Canada, and to coordinate all aspects of Canadian participation in the discussion and dissemination of the results of such activities;
- formulates Canadian positions with respect to IUGG activities and those of its component International Associations and of other related committees and commissions and to advise Council on the activities of the IUGG, its component International Associations and the other related committees and commissions, the activities of the CNC/IUGG and of Canadian participation in the same, where appropriate;
- acts as a channel of communication among the IUGG, its component International Associations, other related committees and commissions, Council, Canadian scientific societies, scientists and Canadian industry.

The CNC/IUGG is administered by the Canadian Geophysical Union, in consultation with the Canadian Meteorological and Oceanographic Society and other Canadian scientific organizations including the Canadian Association of Physicists, the Geological Association of Canada, and the Canadian Institute of Geomatics. The IUGG adhering organization for Canada is the National Research Council of Canada.

The membership of the committee is made up of appointments from each of the seven associations of the IUGG as well as Canadian members of some of the other IUGG activities. The seven associations are the International Association of Geodesy (IAG), the International Association of Geomagnetism and Aeronomy (IAGA), the International Association of Hydrological Sciences (IAHS), the International Association of Meteorology and Atmospheric Sciences (IAMAS), the International Association for the Physical Sciences of the Ocean (IAPSO), the International Association of Seismology and Physics of the Earth's Interior (IASPEI), and the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).

CMOS selects four members of the CNC/IUGG to serve as representatives of IAMAS and IAPSO. Currently the members are Peter Taylor (York University) and Ronald Stewart (Atmospheric Environment Service) for IAMAS, and Yves Gratton (Institut national de la recherche scientifique) and Michael Foreman (Institute of Ocean Sciences) for IAPSO. Much of the secretarial support for the committee is provided by the Canadian Geophysical Union.

The chair of CNC/IUGG is selected from its current members and the present one is Ronald Stewart. One of the normal functions of the chair is to act as the head of the Canadian delegation to IUGG General Assemblies.

To realize its objectives, the committee either is or is planning to carry out several activities. The committee has been promoting Canadian participation and leadership in IUGG and its associated conferences, and it is presently considering the preparation of special scientific review articles on topics such as natural hazards and post-Kyoto activities. The committee will soon also start to prepare a summary report on the research carried out in Canada in the fields of geodesy and geophysics to be tabled at the IUGG'99 General Assembly in Birmingham, UK.

If you would like further information on CNC/IUGG, please refer to its home page at www.tor.ec.gc.ca/CNC/CNC.html or access it through the CMOS home page. Questions and suggestions can also be sent directly to Ronald Stewart (Ron.Stewart@ec.gc.ca).

Ronald Stewart,
Chair, CNC/IUGG

Western Canada Weather Workshop - 97 by Roland Stull

During 18 - 19 August 1997, the Western Canada Weather Workshop (WCWW97) was held in the Curtis Law theatre on campus. This workshop was co-organized by Roland Stull of the Atmospheric Science Programme, and Gerard Neault of the Environment Canada Pacific Weather Centre. The conference was attended by 37 people from British Columbia and Alberta, and was a forum for academic, government, and industry weather forecasters to share ideas on operational daily weather forecasting.

The four themes of the workshop were:

(1) new forecast capabilities developed at UBC;

(2) forecast needs in western Canada;

(3) precipitation events during the past year (floods, blizzards, etc.) and the quality of their prediction; and

(4) a hands-on demo session about computer visualization of the UBC forecast products (session conducted in the Geography building).

From UBC, talks were given by Atmospheric Science professors Roland Stull and William Hsieh, graduate students Josh Hacker and Henryk Modzelewski, and undergraduate human-geography major Sarah Lowes. Phil Austin, as president of the local Centre of the Canadian Meteorological and Oceanographic Society, invited attendees to join the local Centre. The local Centre is also commended for sponsoring the coffee breaks.

Two important outcomes of this conference were:

(1) A statement of support for the Canadian MC2 forecast model was written and sent to Gordon McBean and other officers in Environment Canada;

(2) A consortium was formed to financially support the ensemble forecast research led by Stull at UBC. This consortium is being formalized by the University-Industry Liaison office.

It is planned that this Workshop be an annual event, similar to the Pacific Northwest Weather Workshop that is held in Seattle every year.

Climatic Normals Data for Ecodistricts in Canada

A database of climatic normals for the 1961-1990 period has been prepared by Agriculture and Agri-Food Canada through contract with Pole Star Geomatics, Inc., Ottawa. This database contains monthly averages for observed climatic variables such as temperature, precipitation, wind, solar radiation, and humidity, as well as for derived variables such as growing degree-days, potential evapotranspiration and water deficits. The data were interpolated from climate station data to a spatial coverage of 1021 Ecodistricts, which are part of a national framework for Ecological Land Classification in Canada. This database is available on the Internet at the following URL:

http://res.agr.ca/CANSIS/NSDB/ECOSTRAT/DISTRICT/climate.html

The climate normals data for each Ecodistrict are contained in dbf files which can be accessed by various spreadsheet and database software packages. There are also links at this site for downloading spatial coverages of Ecodistricts, which can then be imported into various GIS software packages for viewing the data in its spatial context.

If you need more information, please contact:

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Agriculture and Agri-Food Canada
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Ottawa, Ontario, Canada K1A 0C6
Tel: (613) 759-1526; Fax: (613) 996-0646
Internet: bootsmaa@em.agr.ca

News from the Canadian Polar Commission

The Canadian Polar Commission (CPC) has announced in February the appointment of the Canadian Committee for Antarctic Research (CCAR). The primary responsibility of the CCAR will be liaison between Canada and the Scientific Committee on Antarctic Research (SCAR), the international body that oversees all research in the Antarctic region.

The Committee will be chaired for its first two-year term by Prof. Warwick Vincent of the Centre for Northern Studies (Centre d'études nordiques) at Laval University in Québec City. A biologist specializing in the processes at the base of aquatic food webs, Prof. Vincent has worked in Antarctica as chair of the Long-Term Ecological Research (LTER) Scientific Advisory Committee.

The Committe held its inaugural meeting March 24 and 25 at Université Laval in Québec City. Appointees to the Canadian Committee for Antarctic research (CCAR) are:

Warwick Vincent
CCAR Chair
Département de Biologie
Université Laval
SAINTE-FOY

Olav Loken
CCAR Secretary
Canadian Polar Commission
OTTAWA

Kathleen Conlan
Canadian Museum of Nature
OTTAWA

Stephen deMora
Directeur, Département d'océanographie
Université du Québec à Rimouski
RIMOUSKI

Bonni Hrycyk
Director, Polar Continental Shelf Project
Natural Resources Canada
OTTAWA

Peter Suedfeld
Department of Psychology
University of British Columbia
VANCOUVER

The Committee will replace the existing executive of the Canadian Antarctic Research Program (CARP) and will operate from a secretariat based at the Canadian Polar Commission, Ottawa. Dr. Olav Loken, who has worked closely with the Commission in the development of Canada's Antarctic research program, has been named secretary of the Committee.

As Canada's adhering body to SCAR, the Canadian Polar Commission recently submitted an application for full membership in the organization. The application will be considered by all member nations at the XXV SCAR meeting to be held in Conceptión, Chile, July 20-31, 1998.

CPC Acting Chair, JoAnne Demeron, said the establishment of the CCAR will assist the Commission in carrying out its mandate with respect to both the north and the south polar regions.

"The creation of the CCAR marks an important step in the development of Canada's polar research capability", she noted. "It will provide the Commission with timely and expert advice on antarctic issues, and it will help to highlight the benefits of bipolar studies to Canadian science in the high latitudes. On behalf of the Commission, I would like to extend my thanks to those who have worked hard over the last several years to increase awareness of the importance of Antarctic research in all its forms."

The Canadian Polar Commission is Canada's national advisory agency on polar affairs. It has responsibility for: monitoring, promoting and disseminating knowledge of the polar regions; contributing to public awareness of the importance of polar science to Canada; enhancing Canada's international profile as a circumpolar nation; and recommending polar science policy direction to government.

Alan Saunders
Canadian Polar Commission
(613) 943-8605

In memoriam - Wendell Hewson

Edgar Wendell Hewson (1910-1997), born in Amherst, Nova Scotia, and a graduate of Mount Allison, Dalhousie and Toronto Universities received the prestigious Beit Scholarship for study at Imperial College, University of London, where he received his Ph.D. in 1937. The next year he was awarded the Royal Meteorological Society's Buchan Prize for his papers in the *Quarterly Journal* on the application of wet-bulb potential temperature to air mass analysis.

Joining the Meteorological Division in 1938, he did pioneering work in industrial pollution in the Columbia River vallley of British Columbia and Washington state. This research, to determine the meteorological facts behind air pollution damage to American agriculture, was ordered by the Joint Canadian American Trail Smelter Tribunal. During the war, he instructed student meteorologists and published a textbook with Richmond Longley, *Meteorology: Theoretical and Applied*. Wendell was named the first Chief of the Research and Training section at meteorological headquarters but he left in 1948 for research work at the Massachusetts Institute of Technology. In 1953, he moved to the University of Michigan where he developed the meteorological program at that institution and continued to specialize in air pollution dispersion. Then, in 1969, he moved to Oregon State University where he established a department of atmospheric sciences. He retired in 1981 and moved to Coronado, California, where he died on Christmas Day, 1997.

Many meteorologists today may never have heard of Wendell Hewson and, if they had, probably assumed he was always an American. To the Society's retired members, however, Wendell will be remembered as an important figure in the Canadian meteorological scene for the decade prior to 1948.

Morley Thomas.
Note: Prepared with source material printed in the *Amherst Daily News.*

NSERC Research Grants 1998 Subventions de recherche du CRSNG

Listed below are the recently awarded new research grants from the NSERC Environment Earth Sciences Grant Selection Committee (GSC 09). Owing to space limitation only those awards we judged to be in atmospheric and oceanographic sciences are included. In most cases these are four-year awards. Space did not permit inclusion of equipment grant awards. Some additional or enhanced awards may be made as the funds restored in the February federal budget are allocated.

Abdella, Kenzu
Mathematics and Statistics, Victoria
Boundary layer and cloud parameterization for use in climate models
$17,900

Allen, Susan
Earth and Ocean Sciences, British Columbia
Structure and dynamics of shelf/ocean exchange over realistic topography
$16,000

Barber, David
Geography, Manitoba
The role of snow cover on sea ice in modulating shortwave and conductive fluxes within the marine cryosphere
$24,200

Bell, Trevor
Geography, Memorial Univ. of Nfld.
Late-glacial and holocene relative sea level history, western Newfoundland
$16,900

Black, Andrew
Soil Science, British Columbia
Long-term measurement of the carbon budgets of two Canadian forests
$33,000

Calvert, Stephen
Earth and Ocean Sciences, British Columbia
Geochemistry of marine sediments
$61,000

Chylek, Petr
Oceanography, Dalhousie
Absorption of solar radiation
$45,000

Derome, Jacques
Atmospheric and Oceanic Sciences, McGill
Dynamics of planetary waves
$38,000

Evans, Wayne
Environmental and Resource Studies, Trent
Investigations of atmospheric radiation with ground based and satellite measurements
$30,000

Fabry, Frédéric
Atmospheric and Oceanic Sciences, McGill
Extraction of meteorological information from radar ground targets
$20,000

Folkins, Ian
Oceanography, Dalhousie
The atmospheric chemistry of the tropics
$18,000

Garrett, Christopher
Earth & Ocean Research, Victoria
Physical oceanography
$95,000

Greatbatch, Richard John
Physics and Physical Oceanography, Memorial Univ. of Nfld.
Ocean/climate modelling and variability
$36,000

Gyakum, John
Atmospheric and Oceanic Sciences, McGill
Understanding the northern hemisphere's systems
$22,000

Harvey, Danny
Geography, Toronto
Coupled climate-carbon cycle modelling
$18,000

Hsieh, William
Earth and Ocean Sciences, British Columbia
Forecasting the environment with neural network models
$27,000

Ingram, Grant
Earth and Ocean Sciences, British Columbia
Under ice physical oceanographic processes
$30,000

Isaac, George
Oceanography, Dalhousie
Aircraft in-flight icing
$8,400

Jackson, Peter
Nat Res/Environmtl Studies, Northern British Columbia
Mesoscale atmospheric flows over complex terrain
$16,900

Jenkins, Mary Ann
Earth and Atmospheric Science, York
Coupled atmospheric-fire modelling
$15,000

LeDrew, Ellsworth
Geography, Waterloo
Processes of climate change and variability studied from remotely sensed imagery
$39,000

Leighton, Henry
Atmospheric and Oceanic Sciences, McGill
Modelling and observational studies related to regional radiation budgets
$22,000

Lewis, Marlon
Oceanography, Dalhousie
Optical variability in the ocean
$50,000

Lohmann, Ulrike
Oceanography, Dalhousie
Development of coupled cloud-aerosol modules for use in climate models
$18,000

Luckman, Brian
Geography, Western Ontario
Reconstructing climate variability from treeline sites in the southern Canadian cordillera
$25,000

McCaughey, Harry
Geography, Queen's
Surface-atmosphere interactions in Canadian forests
$19,000

Munro, D Scott
Geography, Toronto
Data input model for glacier surface responses to weather variations
$11,600

Oakey, Neil
Oceanography, Dalhousie
Turbulent mixing in a coastal environment
$8,000

Rouse, Wayne
Geography, McMaster
Modelling energy, water and carbon budgets and impacts of climate change in high latitudes
$41,100

Schuepp, Peter
Natural Res. Sc. (Macdonald Coll.), McGill
Micrometeorological model experiments
$38,000

Straub, David
Atmospheric and Oceanic Sciences, McGill
Moderate Reynolds number behaviour of wind driven ocean models
$21,100

Stull, Roland
Geography, British Columbia
Ensemble mesoscale numerical weather prediction research
$30,000

Sundby, Bjorn
Océanologie, Institut national de recherche scientifique
Early diagnosis and redox chemistry of continental margin sediments
$28,000

Thomson, Richard
Earth and Ocean Sciences, British Columbia
Acoustic time series measurement of deep ocewan zooplankton biomass
$15,800

Waddington, James
Geography & Geology, McMaster
The interactive effects of climate and land-use change on wetland biogeochemistry
$21,100

Whiticar, Michael
Earth & Ocean Research, Victoria
Tracking critical biogeochemical processes in the geosphere-atmosphere by compound specific isotope correlation (csic)
$32,000

Vous trouverez ci-dessus les nouvelles subventions de recherche remises par le Comité de sélection des subventions: sciences de la Terre:environnement (CSS 09). En raison de l'espace restreint, seuls les prix que nous jugeons être en sciences atmosphériques et océanographiques sont énumérés. Dans la plupart des cas, ces subventions sont d'une durée de quatre ans. Le manque d'espace nous empêche d'inclure les subventions d'appareillage et d'infrastructures. Lorsque les fonds récupérés lors du budget fédéral de février seront affectés, il pourrait y avoir de nouvelles subventions ou une augmentation du montant des subventions.

Photographs of the Month / Photographies du mois

Rube Hornstein, Dick Stoddart and Alex Beaton were the three successful winners of the Scholarship Fund Draw held in Ottawa on February 25, 1998. The top photograph shows the presentation of a Corel Word Perfect Suite 8 to Dick Stoddart by our President, John Reid. The bottom photograph shows the reception by Alex Beaton of a one-year subscription to the Canadian Geographic. Ian Rutherford, Ottawa Centre Chairman, is making the presentation. Rube Hornstein, not shown here, was the second winner of the Corel Word Perfect prize.

Rube Hornstein, Dick Stoddart et Alex Beaton sont les trois gagnants du tirage fait le 25 février 1998 à Ottawa à l'occasion de la levée de fonds pour la bourse d'études. La photographie du haut montre la présentation de la Suite 8 de Corel Word Perfect à Dick Stoddart par notre président, John Reid. Le photographie du bas montre la réception d'une souscription d'une année au magazine Canadian Geographic par Alex Beaton. La présentation est faite par Ian Rutherford, président du Centre d'Ottawa. Rube Hornstein (aucune photo) a été le second vainqueur du prix de Corel Word Perfect.

Photographs taken by Richard Asselin / Les photographies ont été prises par Richard Asselin

1998 Advertising Rates in CMOS Publications
Taux pour les annonces pour 1998 dans les publications de la SCMO

Rates are given for one insertion only
Les taux sont donnés pour une parution seulement

CMOS Bulletin SCMO

Size in cm ********** **Advertisement type**	Full Page (19 X 24)	1/2 Page (9 X 24) or 19 X 12)	1/4 Page (9 X 12)	Business Card (9 X 5)
Commercial*	$300.00	$160.00	$100.00	
Position Vacancy	$200.00	$120.00	$ 80.00	
Business Cards (accredited consultants)				$13.67
Employment wanted				Free for members

CMOS Bulletin SCMO

Grandeur en cm ********** **Type d'annonce**	Pleine page (19 X 24)	1/2 page (9 X 24) or 19 X 12)	1/4 page (9 X 12)	Carte d'affaires (9 X 5)
Commerciale*	300,00 $	160,00 $	100,00 $	
Poste vacant	200,00 $	120,00 $	80,00 $	
Carte d'affaires (experts-conseils accrédités)				13,67 $
Emploi recherché				Gratuit pour les membres

* Corporate and sustaining members are entitled to a 20% discount off these rates.

Rates are based on black and white camera-ready copy, subscribed for a minimum of six issues of the CMOS Bulletin SCMO (February, April, June, August, October, December).

Rates for a single issue are 1.5 times the above rates.

Other charges may apply if typesetting, artwork or photography are required. Rates for colour will be quoted upon request.

Canadian residents and businesses must pay the Goods and Services Tax (7%).

Material must be in the hands of the Director of Publications at least two months in advance of printing.

CMOS recommends bilingual advertising, and will provide, free of charge, translation for short texts.

* Les membres corporatifs et de soutient ont droit à une réduction de 20% des taux affichés.

Les taux supposent l'usage d'une copie prête à photographier en blanc et noir et une commande d'au moins six parutions du CMOS Bulletin SCMO (février, avril, juin, août, octobre et décembre).

Les taux pour une seule édition sont 1.5 fois les taux ci-haut.

Des frais additionnels peuvent s'appliquer si de la mise en page, dessin ou photographie sont nécessaires. Les taux pour la couleur seront fournis sur demande.

Les résidents et corporations canadiennes doivent payer la taxe sur les biens et services (7%).

Le matériel doit être reçu par le directeur des publications au moins deux mois avant la date d'impression.

La Société recommande les annonces bilingues et s'engage à faire, gratuitement, la traduction pour les textes courts.

Call for Papers
Arctic Climate System Study
World Climate Research Programme

The Arctic Buoy Program	*Sea Ice Charts of the Arctic*
Scientific Achievements from the first 20 Years	**Scientific Achievements from the first 400 Years**
3-4 August 1998	**5-7 August 1998**

Batelle Seattle Conference Center
Seattle, Washington, USA

The International ACSYS Project Office is now calling for registration and contributions in the form of posters and/or oral presentations for two conferences being held in Seattle, Washington.

1. The Conference on the *Arctic Buoy Program* is convened to celebrate the 20th year of the several arctic buoy programs. The meetings will be an opportunity for the scientific community to make recommendations regarding the future of the International Arctic Buoy Programme (IABP). This conference is sponsored by the International Arctic Buoy Program, the Data Buoy Co-operation Panel and the Office of Naval Research.

2. The workshop on *Sea Ice Charts of the Arctic* is convened to promote the use of ice chart information by the research community. In the last few years, there has been a growing awareness of the value of these data to the climate research community. This workshop is sponsored by ACSYS, Arctic Climate System Study of the World Climate Research Programme and US National Ice Center.

Registration and Fees: The fee covers both meetings, cost of conference room and supplies, lunches and refresments. To aid in conference planning, we ask that you register your intent to participate by immediately notifying Tordis Villinger by e-mail to: tvilling@npolar.no, or by Fax or mail to the number or address shown below. The following registration information is requested:

- Participant name, phone and fax numbers, e-mail and mailing addresses;
- Conference name(s);
- Abstract title(s).

Registration fee is US $ 200 payable in advance by credit card, money order, or bank draft to the local organizers at:

University of Washington
Attn: Peggy Hartman
1013 NE 40th Street
Seattle, WA 98105, USA

Abstract Format and Submission Deadline: The final abstract should not exceed tow (2) pages, including figures, and must contain name and address of author(s), be written with a true-type font, preferably Times New Roman, no smaller than size 10. Page size if 8½X11 or A4 with minimum 1" (2,5 cm) margins all around. Please submit all abstracts electronically in Word or Rich Text Format (RTF) by 30 June 1998 to Tordis Villinger at tvilling@npolar.no, or by mail to the address shown below.

For more information or other inquiries may be directed to:

Roger Colony
e-mail: acsys@npolar.no
Phone/Fax: +47 22 95 9605 / 22 95 9601

or Thomas Thompson
e-mail: ththomps@online.no (Mar-Nov only)
Phone: +47 38 26 9635 (Mar-Nov only)

or check the ACSYS web site at:

http://www.npolar.no/acsys/seattle98/index.htm

Batelle Seattle Conference Center
4000 NE 41st Street
Seattle, WA 98105-5428 USA
Phone: (206) 528-3455
Fax: (206) 528-3554
e-mail: confrenz@battelle.sccd.ctc.edu
Home page: http://www.sccd.ctc.edu/battelle
Room rate single occupancy: US $90 (+ tax)
Room rate double occupancy: US $115 (+ tax)
Battelle Shuttle service to/from Seattle-Tacoma International Airport by advance notice (24-hour service); phone: (206) 622-1424.

Coastal Zone Canada '98

Coastal Communities in the 21st Century
Sharing our Experience
Building our Knowledge

Victoria Conference Centre
Victoria , British Columbia, Canada
August 30 - September 3, 1998

Conference Background

At CZC '94 and '96, scientists, policy makers, community groups, industry and academia worked together to improve planning and decision-making in coastal zone management. A collaborative, community-based approach was recommended as the key to successful, long-term sustainable development. Within this context, cooperative coastal management planning would draw upon scientific knowledge, ensure environmental integrity, promote the economy, inspire enthusiastic community support, and meet the standards of all levels of government.

Several obstacles confront the preparation and implementation of cooperative plans - the gap between theory and practice. For example, appropriate scientific information may not be available for local application; government agencies often do not work cohesively in the coastal zone; many jurisdictions may claim authority over the coastal zone; funding constraints may limit the manager's ability to obtain the necessary information for effective decision-making; or coastal communities do not have the appropriate tools to contribute to coastal management.

Despite these impediments, successful projects continue to develop - in a variety of geographic and socio-economic circumstances throughout the world in both urban and remote settings. Participants are invited to assist in the realization of the CZC '98 goals by contributing case studies for oral presentation; presenting a poster of a local initiative; leading a workshop session; and by participating in the discussion and sharing experiences.

CZC '98 will balance formal presentations with workshops and other methods of stimulating discussion and learning. Mornings will begin with a plenary session followed by five concurrent oral sessions on the day's theme. Afternoons will be spent in small workshop groups exploring the theme through discussions of a set of focussed questions. On the final day, a series of presentations will bring the workshop results together.

Short oral presentations (20 minutes) and posters are invited in the three theme areas. Because the conference will emphasize discussion in workshop settings, posters are encouraged; there will be a relatively small number of oral presentations.

Themes

- Integrating Social, Economic and Ecological Factors - using case studies or practical experience related to aquaculture, awareness and support for coastal management, economics and funding of community groups, habitat protection and restoration, sustainable development ...
- The Need for (and use of) Science in the Coastal Zone - community based data collection, knowledge flows, defining ecologically relevant units, information needs and systems, traditional knowledge, natural constraints to development ...
- Empowering Communities for Coastal Zone Management - experiences of indigenous peoples, coastal-dependent settlements, marine industries, governments, youth, elders ...

A Youth Conference and several pre-conference courses and workshops will precede CZC '98.

CZC Conference President:

Miles Richardson, *Past President, Council of the Haida Nation.*

Other confirmed Keynote Speakers and area of expertise:

- Carole Donaldson, Empowering Coastal Communities;
- Bob Knecht, Coastal Zone Management;
- Jon Lien, Marine Conservation;
- Orrin H. Pilkey, Coastal Processes;
- Bill Rees, Sustainable Regional Development;
- Maurice Strong, Senior Advisor to the President, World Bank;
- Martin Weinstein, Socio-economic Aspects of Fisheries, Wildlife, and Environmental Management.

For detailed conference information, registration forms, guidelines for submitting summaries of oral and poster presentations, field trips, short courses, hotels, travel and tourism, please look around our website or write/e-mail us at the addresses below. The deadline for receipt of summaries of presentations was Friday, February 20, 1998.

Registration Fees: $350 and $400 regular, $150 student, plus 7% GST.

Limited financial support is being planned for students and local and international community based representatives who might otherwise not be able to attend, including the

possibility of waiving registration fees for those whose posters or talks are accepted for presentation. Individuals seeking financial assistance should include a letter of request for funds with their proposed presentation.

COASTAL ZONE CANADA '98
Conference Management
Division of Continuing Studies
University of Victoria
P.O. Box 3030
Victoria, British Columbia Canada V8W 3N6
Tel: (250) 721-8470; Fax: (250) 721-8774
e-mail: czc98@uvcs.uvic.ca
website: http://www.ios.bc.ca/ios/czc98/

Zone Côtière Canada 98

Les communautés du littoral au XXI[e] siècle:
Partager notre expérience
Bâtir notre base de connaissance

Toile de fond de la conférence

Durant ZCC 94 et ZCC 96 des scientifiques, des décideurs, des groupes communautaires, des membres universitaires et ceux de l'industrie ont travaillé la main dans la main afin d'améliorer les processus de planification et les prises de décisions concernant l'aménagement du littoral. Ils recommandèrent alors, comme pierre angulaire d'un développement soutenable et de longue durée, d'adopter une approche communautaire concertée. Dans ce contexte, un aménagement concerté du littoral fera appel à la connaissance scientifique, assurera l'intégrité de l'environnement, stimulera l'économie, inspirera un soutien enthousiaste de la communauté et observera les normes de tous les niveaux de gouvernement.

Les plans concertés se heurtent à une pierre d'achoppement de taille - le fossé qui sépare la théorie (l'élaboration de ces plans) de la pratique (leur mise à exécution). Par exemple, une information scientifique pertinente n'est pas toujours disponible au niveau local ; souvent, les organismes gouvernementaux n'agissent pas de façon cohérente dans la zone côtière ; plusieurs autorités législatives peuvent revendiquer leur autorité sur la zone côtière ; des compressions budgétaires peuvent limiter la capacité du gestionnaire d'obtenir l'information nécessaire pour prendre de décisions efficaces ; ou les communautés côtières n'ont pas les outils adéquats qui leur permettraient de contribuer à l'aménagement du littoral.

Malgré ces obstacles, des projets d'aménagement concerté du littoral, et qui sont couronnés de succès, sont sans cesse mis en oeuvre - sur une palette de conjonctures géographiques, sociales et économiques, et dans des zones rurales et urbaines partout à travers le monde. ZCC 98 invite les participants à l'aider à atteindre ses objectifs en apportant leurs études de cas telles qu'elles sont rédigées; en affichant une initiative locale ; en dirigeant les groupes de travail ; et en participant eux-mêmes aux débats pour partager leurs expériences.

Le format de ZCC 98 s'équilibrera entre des conférences magistrales et des groupes de travail, et différentes méthodes qui mettront l'accent sur des discussions et un apprentissage motivant. Les matinées commenceront avec une séance plénière suivie de cinq séances simultanées qui développeront le thème du jour. En après-midi, la conférence se scindera en petits groupes de travail qui analyseront ce thème, et délibéreront sur un ensemble de questions névralgiques. Le dernier jour, une série de présentations fera la compilation des résultats obtenus par les groupes de travail.

De brèves présentations orales (20 min) et des affichages seront bienvenus aux trois endroits de thèmes. Les affichages sont fortement encouragés, car la conférence mettra l'accent sur les discussions dans les ateliers de travail. Il y aura un nombre relativement restreint de présentations orales.

Thèmes

- Intégration des facteurs sociaux, économiques et écologiques, en se servant d'études de cas ou de connaissances pratiques relatives à l'aquaculture, à la sensibilisation et au soutien de l'aménagement du territoire, à une économie politique et un financement des groupes communautaires, à la protection et la restauration du milieu naturel, à un développement écologiquement viable, etc.

- La nécessité (et l'application) de la science dans la zone côtière: Collecte de données de la communauté, circulations de connaissances, établissement de critères écologiques pertinents, systèmes et besoins d'information, connaissances traditionnelles, obstacles naturels au développement, etc.

- Autonomisation des communautés côtières en matière d'aménagement du littoral - Les expériences des peuples autochtones, les établissements liés à la côte, les industries marines, les pouvoirs publics, les jeunes et les aînés.

Une conférence pour les jeunes, ainsi que plusieurs cours et ateliers, précéderont ZCC 98.

Président de la conférence ZCC:

Miles Richardson, *ancien président du Conseil de la Nation Haida.*

Autres orateurs principaux qui ont confirmé leur présence, avec leur domaine de compétence:

- Carol Davidson, Autonomisation des communautés côtières;
- Bob Knecht, Aménagement du littoral;
- Jon Lien, Préservation de la faune et de la flore marine;
- Orrin H. Pilkey, Processus concernant le littoral;
- Bill Rees, Pour un développement régional soutenable;
- Maurice Strong, Conseiller principal du président, Banque mondiale;
- Martin Weinstein, Les aspects socio-économiques de la gestion des pêcheries, la faune, et l'environnement.

Pour obtenir des renseignement détaillés sur la conférence, les formules d'inscriptions, les directives pour soumettre des abrégés de présentations et d'affichages, les sorties éducatives, les cours de brève durée, les hôtels, le voyage et le tourisme, veuillez consulter notre site Web ou nous écrire (poste ou courrier électronique) à l'adresse ci-dessous. La date limite pour recevoir les abrégés était vendredi, le 20 février 1998.

Frais d'inscription: 350 $ et 400 $, 150 $ pour les étudiants, plus 7 % de TPS.

Les étudiants, ainsi que les représentants communautaires au niveau local et international, et qui autrement ne pourraient assister à cette conférence, peuvent bénéficier d'un appui financier limité. Cet appui comprend la possibilité d'annuler les frais d'inscription pour ceux dont les affichages ou présentations seront acceptés. Les personnes recherchant une aide financière doivent soumettre une requête écrite à ce sujet, jointe à leur proposition de présentation.

Pour contacter ZCC:

Zone Côtière Canada `98
Conference Management
Division of Continuing Studies
University of Victoria
P.O. Box 3030
Victoria, British Columbia Canada V8W 3N6
Courriel: czc98@uvcs.uvic.ca
Téléphone: (250) 721-8470;
télécopieur: (250) 721-8774
Website http://www.ios.bc.ca/ios/czc98/

CMOS Member invited to attend Monsoon Conference in Korea

Dr. Madhav Khandekar, a long-time CMOS member, has been invited to attend the International Conference on Monsoon and Hydrologic Cycle to be held in Kyongju, Korea, 22-25 April, 1998. The conference is being organized by the Korean Meteorological Society in cooperation with the American Meteorological Society, Meteorological Society of Japan, the Australian Meteorological Society and the Canadian Meteorological and Oceanographic Society. At the Korean conference, Dr. Khandekar will be presenting a paper on his recent work on *"Indian Monsoon droughts and floods and their relationship with large-scale atmospheric circulation and anomalies"*. Dr. Khandekar has a long-standing interest in the Indian Monsoon-ENSO (El Niño/Southern Oscillation) connection and its possible impact on climate variability and long-range (or seasonal) weather prediction.

Dr. Khandekar has been a research scientist with Environment Canada (Atmospheric Environment Service, Downsview) for 15 years. He has recently retired and is currently a senior consultant meteorologist with Baird & Associates, a coastal engineering company based in Ottawa. While at Environment Canada, Dr. Khandekar worked on a number of research projects like ocean surface wave analysis and modelling, ENSO and Canadian climate and long-range forecasting. Dr. Khandekar is the recipient of the CMOS Applied Oceanography Award (1994) for his book entitled *"Operational Analysis and Prediction of Ocean Wind Waves"* which was published in 1989 by Springer-Verlag and for his contribution to the development of an operational spectral ocean wave model at the Canadian Meteorological Centre in Montréal.

The Korean Meteorological Society has agreed to provide the travel expenses for Dr. Khandekar's attendance at the conference. CMOS gratefully acknowledges the financial support provided by the Korean Meteorological Society.

32e Congrès Annuel de la SCMO
Dartmouth, Nouvelle-Écosse
1er au 4 juin 1998

Le centre d'Halifax de la Société canadienne de météorologie et d'océanographie (SCMO) sera l'hôte de la 32e édition du Congrès Annuel de la SCMO, qui se tiendra au Holiday Inn à Dartmouth, en Nouvelle-Écosse, du 1er au 4 juin 1998. Le thème du congrès cette année est: "Changement climatique de l'atmosphère et l'océan". Ce thème a été choisi afin de démontrer les efforts de recherches majeurs qui ont été déployés dans ce domaine, tant à travers le pays que dans le monde entier. Des sessions spéciales sont prévues pour la recherche pertinente au Projet Mondial sur la Circulation des Océans (WOCE) ainsi qu'au Projet de Variabilité du Climat (CLIVAR), la chimie des eaux arctiques, le cycle global du carbone, la prévision du système couplé atmosphère-océan, la variabilité climatique des écosystèmes des plateaux continentaux (GLOBEC), et finalement pour la grande tempête de verglas de 1998. Quant aux sessions régulières, elles traiteront de plusieurs autres sujets. De plus, un jour spécial durant le congrès a été désigné Jour de l'éducation, alors qu'un second a été réservé pour les industries, dans le but d'encourager les éducateurs locaux à participer au Congrès et pour promouvoir le travail des industries locales. Veuillez prendre note que le prix d'inscription a été légèrement haussé cette année dû au fait que nous y incluons trois dîners buffets, ainsi que pour suivre le taux courant d'inflation.

Immédiatement avant le Congrès de la SCMO, la Conférence pour le Projet Mondial sur la Circulation des Océans se tiendra à Halifax, Nouvelle-Écosse, du 24 au 29 mai 1998. La plupart des questions que vous pourriez avoir concernant le Congrès de la SCMO trouveront fort probablement leur réponse sur notre site Internet à l'adresse suivante:

http://dfomr.dfo.ca/science/ocean/cmos/congrs98.html

Pour toute autre requête concernant l'enregistrement au Congrès, l'hébergement, etc., veuillez contacter le Dr. Clive Mason (voir dernière page de ce numéro pour les adresses électroniques et les numéros de téléphone du Comité organisateur local.

Lieu du Congrès et hébergement

Le Congrès se tiendra au Conference Centre du Holiday Inn à Dartmouth, Nouvelle-Écosse [Tél: (902) 463-1100]. C'est un endroit particulièrement bien situé, faisant face au pont MacDonald menant à Halifax, tout près du terminus d'autobus et du centre sportif, ainsi qu'à une courte distance de marche du terminus du traversier.

Une section de 125 chambres a été réservée au Holiday Inn jusqu'au 30 avril. Un prix spécial de 89$ par chambre a été fixé pour le congrès. Chaque chambre peut occuper jusqu'à quatre personnes. On recommande que les participants choisissent le Holiday Inn à leur arrivée car cet hôtel est de loin le plus pratique pour les besoins du congrès, et la SCMO pourra bénéficier d'un rabais substantiel si une quantité suffisante de chambres est louée.

Voyages par avion

La ville d'Halifax est desservie par la plupart des grands transporteurs aériens. Le transporteur officiel du Congrès est Air Canada. Si vous choisissez de voyager avec Air Canada, demandez qu'on inscrive le numéro d'événement # 'CV982085' sur votre billet, peu importe la classe, puisque la Société en bénéficie, et ce, sans coût additionnel pour vous. Pour que la SCMO bénéficie de cette prime, rappelez le numéro de "convention" (1-800-361-7585) du lundi au vendredi, de 08:00 à 21:00 heures. C'est la seule manière que vous pouvez obtenir cette prime en réservant vos billets.

Aide aux étudiants

Les étudiants intéressés à assister au Congrès de la SCMO devraient contacter le directeur de leur centre local de SCMO qui pourront leur fournir l'information quant aux possibilités d'aide financière pour le voyage jusqu'à Halifax.

Besoins particuliers

Les personnes devant se déplacer en chaise roulante peuvent emprunter les rampes d'accès menant au Conference Centre et à l'hôtel.

Exposants commerciaux et industriels

Des kiosques pour exposants commerciaux et industriels, ainsi que des commenditaires sont disponibles dans la section Terrace, là ou se tiendront les pauses café et les dîners buffets. Pour de plus amples informations, veuillez contacter Oscar Koren.

Dîners buffets

Le coût des dîners buffets (prévus pour lundi, mardi et jeudi), est inclus dans le prix d'inscription. Ces dîners seront tenus dans la section Terrace et, pour des raisons d'efficacité, seront entourés par les exposants et les posters, avec en prime une vue imprenable du Port d'Halifax.

(Suite à la page suivante pour la description des activités sociales)

32nd Annual CMOS Congress
Dartmouth, Nova Scotia
1-4 June, 1998

The Halifax Centre of the Canadian Meteorological and Oceanographic Society (CMOS) will host the 32nd Annual CMOS Congress at the Holiday Inn in Dartmouth, N.S., during 1-4 June, 1998. The theme of the Congress is "Atmosphere-Ocean Climate Variability", to reflect major national and international research initiatives in this field. Special sessions are presently planned for WOCE/CLIVAR research, Arctic marine chemistry, global carbon cycles, forecasting of the coupled atmosphere-ocean system, climate variability in shelf ecosystems (GLOBEC), and the ice storm of 1998. Regular sessions will cover many more topics. As well, one of the Congress days is designated for Education, and another for Industry, in order to encourage the participation of local educators and to showcase the work of local industries. The registration fees have been raised slightly over last year due to the inclusion of the three lunches and some allowance for inflation.

Immediately preceding the CMOS Congress, the Conference of the World Ocean Circulation Experiment will be held in Halifax, NS, during 24-29 May, 1998. Most questions regarding CMOS Congress '98 may be answered by accessing the web page:

http://dfomr.dfo.ca/science/ocean/cmos/congrs98.html

For other inquiries regarding registration, accommodation, or other local arrangements, please contact Dr. Clive Mason (see last page of this issue for e-mail addresses and phone numbers of the Local Arrangement Committee).

Congress Location and Accommondation

The Congress will be held at the Conference Centre of the Holiday Inn in Dartmouth, N.S.[Tel.:(902) 463-1100]. This is conveniently located at the head of the MacDonald Bridge leading to Halifax, adjacent to the bus terminal and the sports centre, and a short walk from the ferry.

A block of 125 rooms at the Holiday Inn is being held for us until 30 April. The special congress rate is $89/room. The rooms can accommodate 1 to 4 persons. It is recommended that attendees stay at the Holiday Inn as it is by far the most convenient and CMOS will receive a considerable discount on meeting rooms if enough rooms are rented.

Air Travel

The City of Halifax is served by most major airlines. The official airline for the Congress is Air Canada. If you choose Air Canada, be sure to get Event # 'CV982085' onto your ticket no matter what class it is, as the society benefits from this and it costs you nothing. In order to get CMOS credit, call back from Monday to Friday (from 8 am - 9 pm) to the "convention" number (1-800-361-7585). This is the only phone number from which you can credit when booking tickets.

Student Travel and Special Needs

Students interested in attending the CMOS Congress should contact their local CMOS Centre Executive for information regarding travel assistance funding. The Holiday Inn Conference Centre and Hotel are wheelchair accessible.

Commercial Exhibitors

Commercial booths and sponsorships are available in the Terrace area - the site of all coffee breaks and buffet lunches. For more information, contact Oscar Koren.

Lunches and Social Activities

Buffet lunches on Monday, Tuesday and Thursday are included in the full registration price. They are held in the Terrace area, surrounded by the exhibitors and the posters, with a great view of Halifax Harbour. Having them adjacent to the sessions makes for a very efficient schedule.

In addition to the full scientific agenda, this year's program includes an ice breaker, a cash bar reception, and a seafood banquet. There will be a coffee social for accompanying persons on the opening day. Full registration includes three buffet lunch tickets and one banquet ticket. Additional tickets may be purchased with registration. The scientific program has left Wednesday afternoon free for delegates to shop and explore. A special luncheon has been arranged on Wednesday for the awarding of the Atmospheric Environment Service's Patterson Medal for outstanding contribution to meteorology.

(Suite de la page précédente)

Activités sociales

En plus de tout le programme scientifique, on a prévu les activités sociales suivantes: un cocktail de bienvenue, une réception avec bar payant ainsi qu'un banquet de fruits de mer. Il y aura de plus, lors de la première journée, une rencontre qui inclura les personnes accompagnant les conférenciers. Le prix d'inscription inclut les trois billets de buffet et un billet de banquet. L'achat de billets additionnels pourra se faire à l'enregistrement. Les délégués pourront explorer ou magasiner à leur guise mercredi après-midi, où l'horaire a prévu un temps de relâche. Un dîner spécial est prévu mercredi en vue de remettre la médaille Patterson du Service de l'Environnement Atmosphérique pour contribution exceptionnelle à la météorologie.

Hints on Planning your Trip to Congress

If arriving by air, note that the airport bus runs directly to the Dartmouth Holiday Inn.

Congress registration includes lunches on Monday, Tuesday and Thursday, as well as the Wednesday evening Grand Banquet. You can purchase tickets for the Wednesday Patterson lunch, or join the informal Tully lunch gathering or start the free afternoon in the city.

For fine dining nearby, Clive Mason recommends turning right onto Wyse Road from the Holiday Inn, for a healthy walk down by the water to MacAskill's or la Perla.

For something quick, cheap and easy, Dave Greenberg recommends you turn left for an easy walk to Harvey's / Churches, Subway, Kentucky Fried Chicken / Taco Bell, Zellers, or just cross the street to the canteen of the Dartmouth Sportsplex.

We are not sure if the nearby pubs and taverns are recommended for the cream of Canada's elite scientists. Here are Paul Chapman's recommendations for Halifax cheap eats. In Halifax, the Lucky Year restaurant on Quinpool Road offers a tacky exterior but excellent Chinese and Vietnamese food within. Just down the street, you can buy a huge bag of veggie samosas for about $5 from Samosa Plus. On Blowers Street (near the library), the Guru restaurant provides excellent Indian food. Another contender is Curry Village, 5677 Brenton Place, off Spring Garden Road.

For pizza, afficionados recommend Tomaso's Pizza, somewhat more expensive but worth every penny. Their definition of "the works" includes olives. Cheaper, but still good are King of Donair / Pizza Poppa's, and Sicilian.

Something which seems to be unique to the Maritimes is the donair. Unlike donairs in other parts of the world, this is "donair meat" (probably lamb), onions, other vegetables and condiments wrapped in a pita bread. What makes this unique is the sweet sauce. Definitely worth a try. Very messy. Available at every pizza place.

For fancy seafood try: MacAskill's (at the Dartmouth ferry terminal); The Five Fishermen (Halifax, by Province House); McKelvies (Halifax, near the waterfront); Salty's (Historic Properties, on Halifax waterfront); Upper Deck (Historic Properties, on Halifax waterfront).

Other dining experiences: Camille's Fish and Chips (fueling the world's navies for years); The Granite Brewery (a nice atmospheric brew pub in Halifax); Soho Kitchen (Folk art and food, Halifax); Café Chianti (European, Halifax); Fran's (Chinese, Dartmouth); Cheelin (Chinese, Halifax).

The Maritime Museum of the Atlantic

This unique museum, the marine history division of the Nova Scotia Museum, is located on the revitalized Halifax waterfront. It offers visitors many opportunities to discover Atlantic Canada's maritime heritage. The restored ship chandlery of William Robertson and Son, which dates to the late 19th century, is stocked with almost everything from a sailmaker's needle to an anchor. Interpretive staff are located in the store and are happy to share their knowledge about it. The Days of Sail Gallery, above the ship chandlery, focuses on the era of coastal and deep-sea sailing vessels. Exhibits on the Navy, Shipwrecks and Lifesaving, Small Craft, the Age of Steam, and the Halifax Explosion are also features of the Museum.

The 80-year-old vessel CSS Acadia, which charted the Canadian Atlantic coasts for 56 years, is alongside the Museum wharf. Also nearby is the only surviving corvette, HMCS Sackville, carefully restored to her wartime configuration to serve as Canada's Naval Memorial.

Of special interest at present are exhibits related to the Titanic. The Maritime Museum of the Atlantic holds 20 artifacts and dozens of photographs, some of which have never previously been published or displayed. The centrepiece of the exhibit is one of the only known intact Titanic deck chair in the world. The Reverend Henry W. Cunningham was the minister aboard the Minia during the body recovery and was given the deck chair in recognition of his work with burial and memorial services. One of his grandsons donated the chair to the Museum. It bears a carved five-pointed star, the emblem of the White Star Line, and is one of the only intact chairs in the world that matches those visible in Titanic photographs. Made of mahogany and unidentified hardwood, the seat has been recaned.

Other artifacts include lounge panelling, newell post facing, balustrade moulding, a cribbage board; egg and dart detail; and a wireless log kept by Robert Hunston, a wireless operator at Cape Race, Newfoundland, giving a condensed log of Titanic's distress calls the night of April 14-15, 1912.

Shortly after the Titanic sank, the White Star Line chartered four Canadian vessels; two Halifax-based cableships, the MacKay-Bennett and the Minia, a Canadian government vessel Montmagny and a St. John's-based Bowring vessel, Algerine. There were 328 bodies recovered, with 209 being returned to Halifax; the badly damaged, or deteriorated bodies were buried at sea. Of the 119 buried at sea, about 60 were unidentified at the time and 49 remain unidentified. Ultimately, 150 Titanic victims were buried in ceremonies from May 3, to June 12, 1912. Nineteen are in the Mount Olivet Catholic Cemetery, ten are in the Baron de Hirsch Jewish Cemetery, and 121 are in the Fairview Lawn Cemetery. Of these, 42 remain unidentified.

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