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CMOS BULLETIN SCMO

La Société canadienne de météorologie et d'océanographie

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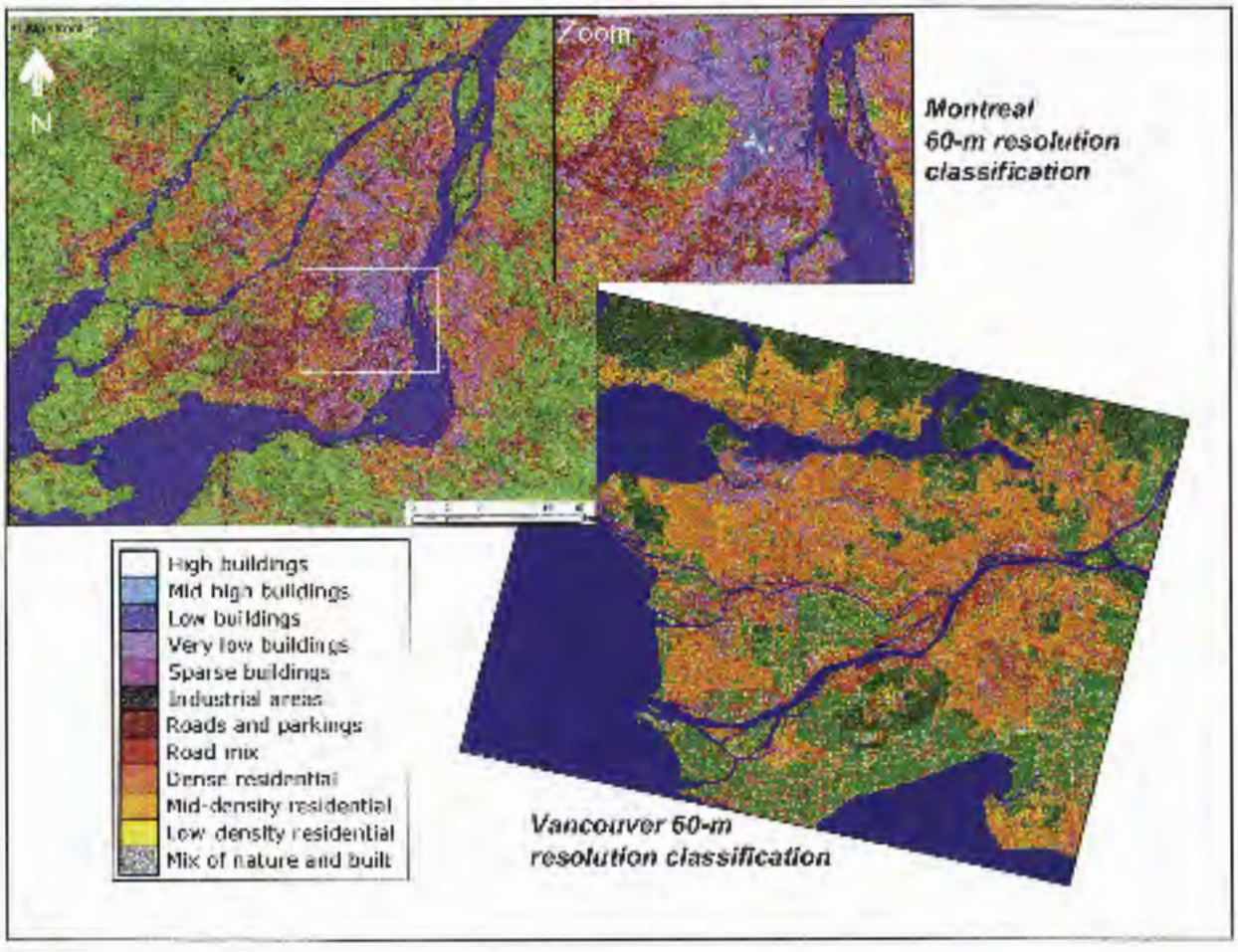


2006 CMOS Photo Contest / Concours photographique 2006 de la SCMO

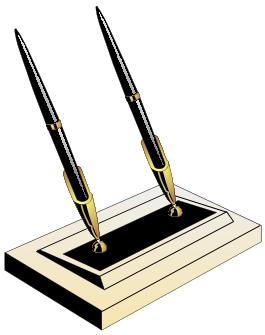
First Prize / Premier prix - *Rainbows* by/par Ed Hudson

Second Prize / Deuxième prix - *Gargen City Nocturne* by/par Dave Sills

Third Prize / Troisième prix - *Pink and Grey Sunrise over White Point* by/par Bill Danielson

....from the President's Desk

Friends and colleagues:



I must confess to a little trepidation in taking on this new task of President at our Toronto Congress. First, it's hard to follow great acts in that position – in most recent years our presidents have been **Susan Woodbury** (2005-06), **Hal Ritchie** (2004-05), **Allyn Clarke** (2003-04), **Ron Bianchi** (2002-03), **Ron Stewart** (2001-02), and **Peter Taylor** (2000-01). On the positive side, it is reassuring to me that these people, and others they followed, are all long-time colleagues and friends with whom I have worked at various times for many years, not just within CMOS, but on various research teams, and even weather forecasting many years ago. Having served CMOS in a number of capacities over the years, I realize that the President's role is not one of management, but rather of working with a democratic team approach to all problems. From my perspective, that is very much like the joy of participating in scientific field research. The smallness of our scientific community and familiarity with most members can be a definite advantage when the same people often come together to address issues in either our science or in the Society.

The Toronto Congress saw an important passing of the torch, with the CMOS Executive moving from Halifax to the prairies. In addition to yours truly, members of the executive are:

New Members –

- *Vice-President: Paul Myers* (Earth & Atmospheric Sciences, Univ. of Alberta, Edmonton);
- *Treasurer: Ron Hopkinson* (Custom Climate Services, Regina);
- *Recording Secretary: Steve Ricketts* (Chief of Prediction Division, MSC, Edmonton);
- *Corresponding Secretary: Bob Kochtubajda* (Hydrometeorology Arctic Lab, MSC, Edmonton);
- *Councillor-at-Large: Bill Hume* (recently retired from MSC, Edmonton).

Returning members of the Executive include –

- *Past-President: Susan Woodbury* (Woodbury Management Solutions Inc., Halifax);
- *Councillor-at-Large: Neil Campbell* (Ottawa);
- *Councillor-at-Large: Fraser Davidson* (Dept. of Fisheries & Oceans, St. John's).

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

Editor / Rédacteur: Paul-André Bolduc
Canadian Meteorological and Oceanographic Society
Société canadienne de météorologie et d'océanographie
P.O. Box 3211, Station D
Ottawa, ON, Canada K1P 6H7
E-Mail: bulletin@cmos.ca; Courriel: bulletin@scmo.ca

Cover page : With the accelerating rate of urbanization across the world, it is becoming increasingly important to represent the effects of major urban agglomerations in meteorological models. The cities' climate has significant impacts on urban heat islands, human health, and pollutant dispersion. To learn more, please read the article on **page 110** of this issue. The cover page picture illustrates the land-cover and land-use classifications at a resolution of 60 meters with twelve (12) urban classes typical of the Greater Montréal and Vancouver areas.

Page couverture: Avec l'accélération du taux d'urbanisation à travers le monde, il devient de plus en plus important de représenter les effets des grandes agglomérations urbaines dans les modèles météorologiques. Le climat des villes a des répercussions significatives sur les îlots de chaleur urbains, sur la santé des citadins et sur la dispersion des polluants. Pour en savoir plus, prière de lire l'article en **page 110** de ce numéro. L'image en page couverture illustre les classifications d'occupation et d'utilisation des sols en milieu urbain, à une résolution de 60 mètres incluant douze (12) classes urbaines, pour les régions métropolitaines de Montréal et Vancouver.

CMOS Executive Office / Bureau de la SCMO

P.O. Box 3211, Station D
Ottawa, Ontario, Canada, K1P 6H7
Fax / Fascimilé: 613-990-1617
homepage: http://www.cmos.ca
page d'accueil: http://www.scmo.ca

Dr. Ian Rutherford
Executive Director - Directeur exécutif
Tel/Tél.: 613-990-0300
E-mail/Courriel: cmos@cmos.ca

Dr. Richard Asselin
Director of / Directeur des Publications
Tel/Tél.: 613-991-0151
E-mail/Courriel: publications@cmos.ca

Ms. Lise Harvey
Office Manager - Chef de bureau
Tel/Tél.: 613-991-4494
E-mail/Courriel: accounts@cmos.ca

... from the President's desk (Continued / Suite)

CMOS faces a number of challenges in the year ahead, both from within and outside the Society. Our membership has already tasked us, through the Toronto Congress AGM, to take a more substantive and public role on scientific issues. This took the form of a motion, passed by the AGM, that states that *Council take a more visible and effective national and political role in support of issues relevant to CMOS and its members. (Moved by Gordon McBean, seconded by Robert Mailhot).* There are other equally important issues for this new Executive to address, together which prompted me to adopt three personal objectives for the year as follows:

1) To ***increase the visibility of CMOS publicly and politically***.
2) To continue to ***make progress on issues of CMOS membership***, in two ways: a) increasing communications with Centres, the life-blood of our Society; and b) providing more visibility and influence for graduate and undergraduate students within CMOS.
3) To ***encourage formal collaboration between CMOS and other relevant societies and scientific groups***, in particular, bringing together the atmospheric, oceanographic and hydrologic sciences.

With climate change impacts becoming more evident every year, and federal government plans for addressing the issues still uncertain at this stage, the first objective will likely have increased importance (and difficulty) in future. On membership, we have already encouraged all of our 14 Centres to elect at least one student on their local executive, who would in turn interact with other students and encourage their participation; and, we have recently approved the formation of a new national *ad hoc* Student Committee, whose chair (Ms. Tiffany Shaw, a graduate student at the University of Toronto) will also sit on Council. And, on collaboration with other groups, *happily*, our next Congress in St. John's will be the first formal joint meeting between CMOS and CGU-Hydrology, along with an AMS group to boot.

We are taking the above challenges very seriously, and over the next few months the issues will be a priority for a new *ad hoc* Strategic Planning Committee formed at the first meeting of our new Executive in June. It is my sincere wish to make real progress on the stated objectives during the next year.

Finally, I would emphasize that CMOS is run entirely by volunteer efforts of members such as yourself. Without volunteers, CMOS could not exist, and then *who would speak for our environment*, unfettered from government policy and politics, economic concerns, and the like? CMOS has the scientific and moral justification for making our views on the environment and like issues known to the public. We urge you to be a volunteer, first by being a member, by participating first in your local Centre activities, and second in annual congresses, by contributing to scientific and informative articles in CMOS publications, and even by participating on the various CMOS committees and Council. I promise you will be welcomed with open arms!

Sincerely,

Geoff Strong
President / Président

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **October 2006.** Please send your articles, notes, workshop reports or news items before **September 1, 2006** to the address given on page ii. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **octobre 2006.** Prière de nous faire parvenir avant le **1er septembre 2006** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page ii. Nous avons un besoin URGENT de vos contributions écrites.

CMOS exists for the advancement of meteorology and oceanography in Canada.

Le but de la SCMO est de stimuler l'intérêt pour la météorologie et l'océanographie au Canada.

Background Information

CMOS 2006 Annual Congress was held in Toronto, Ontario, May 29 to June 1, 2006. During these four days, more than 700 participants from atmospheric and oceanic sciences discussed various issues including climate change and the Kyoto Protocol. At the end of the Congress, the following statement was issued and published by the organizing committee and the participants.

CANADIAN METEOROLOGICAL AND OCEANOGRAPHIC SOCIETY

Congress Statement on Climate Change

The Canadian Meteorological and Oceanographic Society (CMOS) represents Canadian scientists carrying out research on the atmosphere, the oceans and related environmental issues. It has more than 800 members from Canada's major research centres, universities, private corporations and government institutes. CMOS is uniquely positioned to provide expert advice on the issue of climate change. Understanding this complex issue requires atmospheric and oceanic scientists working together with those in related environmental, social and economic disciplines - precisely the goal of this Congress.

At the conclusion of this, our 40th Annual Congress, we are issuing the following statement:

The state of climate change:

- Climate change is happening now, both in Canada and around the world. Most of this change is attributable to human activities that release greenhouse gases into the atmosphere. The effect of these additional greenhouse gases is clearly detectable on continental and global scales.

- Canada's North is experiencing particularly rapid and widespread climate warming. This warming will have significant impact and will accelerate climate change globally.

The urgent need for action:

- We call on all levels of governments to take immediate action. We must both reduce emissions of greenhouse gases and prepare for climate change.

- We congratulate our host city for the Congress, Toronto, on its innovative approaches to reducing greenhouse gas emissions.

On the Climate Convention and its Kyoto Protocol:

- We advocate a co-ordinated, global response to climate change. We urge all governments to work together toward a single international agreement to address climate change, as was recognized in the 1992 U. N. Framework Convention on Climate Change.

- The Climate Convention's Kyoto Protocol is an important first step towards reducing the release of greenhouse gases into the atmosphere. However, the scientific evidence dictates that in order to stabilize the climate, global reductions in greenhouse gas emissions need to go far beyond those mandated under this Kyoto Protocol. We recognize the challenge of implementing the current agreement; nonetheless we urge Canada to contribute effectively to this global effort.

- It is to be noted that Canada also has other obligations under Articles 4, 5 and 6 of the Climate Convention and Article 10 of the Kyoto Protocol regarding research and systematic observations related to the climate system.

On preparing for climate change:

- Canada has no choice but to adapt to present and future climate change. A national adaptation strategy is needed.

- Research is critical for defining options, reducing the effects of climate change and understanding and dealing with its impacts on Canada. This should include more accurate predictions of future climate on seasonal, decadal and century time scales.

Toronto, Ontario
June 1, 2006

Information complémentaire

Le congrès annuel de la SCMO pour 2006 s'est tenu à Toronto, Ontario, du 29 mai au 1er juin. Durant les quatre jours du congrès, plus de 700 participants venus des sciences atmosphériques et océaniques ont discuté de différents enjeux incluant le changement climatique et le protocole de Kyoto. À la fin du congrès, l'énoncé suivant fut émis et publié par le comité organisateur et les participants.

SOCIÉTÉ CANADIENNE DE MÉTÉOROLOGIE ET D'OCÉANOGRAPHIE

L'énoncé du Congrès sur les changements climatiques

La Société canadienne de météorologie et d'océanographie (SCMO) représente les scientifiques canadiens dont les travaux de recherche portent sur l'atmosphère, les océans et d'autres questions environnementales. La Société compte plus de 800 membres des grands centres de recherche, des universités, du secteur privé et des gouvernements. La SCMO occupe une position unique pour faire connaître les avis d'experts sur la question des changements climatiques. Afin de mieux comprendre les enjeux liés à cette question complexe, les spécialistes en sciences de l'atmosphère et en océanographie devront travailler de pair avec les spécialistes des disciplines en environnement, en sociologie et en économie qui y sont liées, ce qui était précisément le but de ce congrès.

En conclusion de notre 40e Congrès, nous avons formulé l'énoncé suivant :

L'état des changements climatiques :

- Les changements climatiques se produisent présentement tant au Canada qu'ailleurs dans le monde. Ces changements sont en grande partie attribuables aux émissions de gaz à effet de serre dans l'atmosphère. Les conséquences de la hausse des émissions de ces gaz sont clairement observables à des échelles continentales et planétaires.

- Le réchauffement observé dans le nord du Canada est particulièrement rapide et répandu. Son impact sera important et va accélérer le changement climatique planétaire.

Il est urgent d'agir :

- Nous invitons tous les paliers de gouvernement à agir immédiatement. Nous devons réduire nos émissions de gaz à effet de serre et nous préparer à faire face aux changements climatiques.

- Nous tenons à féliciter Toronto, notre ville-hôte, pour les mesures innovatrices qu'elle a adoptées pour réduire les émissions de gaz à effet de serre.

La Convention sur les changements climatiques et le Protocole de Kyoto :

- Nous préconisons une réponse mondiale et coordonnée par rapport aux changements climatiques. Nous recommandons vivement que tous les gouvernements travaillent en étroite collaboration afin de conclure un seul accord international tel que proposé en 1992 dans la Convention-cadre des Nations Unies sur les changements climatiques.

- Le Protocole de Kyoto qui découle de la Convention sur les changements climatiques est un premier pas important dans la réduction des émissions de gaz à effet de serre. Cependant, il est prouvé scientifiquement que pour stabiliser le climat, les réductions des émissions de ces gaz devront dépasser largement celles mandatées par le Protocole de Kyoto. Nous reconnaissons que la mise en œuvre de l'accord de Kyoto constitue un défi de taille; néanmoins, nous recommandons vivement au Canada de contribuer de manière efficace à l'effort planétaire.

- Le Canada a aussi d'autres obligations en vertu des articles 4, 5 et 6 de la Convention sur les changements climatiques et de l'article 10 du Protocole de Kyoto en ce qui a trait à la recherche et l'observation systématique du climat.

Se préparer aux changements climatiques :

- Le Canada n'a d'autres choix que de s'adapter aux changements climatiques actuels et futurs. Il est primordial d'établir une stratégie d'adaptation nationale.

- La recherche est essentielle pour définir les options, pour réduire les impacts des changements climatiques ainsi que pour y faire face. Les recherches devraient inclure des recherches qui permettront une plus grande précision quant aux prévisions climatiques futures sur des échelles temporelles saisonnières, décennales et centennales.

Toronto, Ontario
1er juin 2006

Urban modeling at the Meteorological Service of Canada

by Jocelyn Mailhot, Stéphane Bélair, Aude Lemonsu, Linying Tong, Alexandre Leroux, Najat Benbouta, Mario Benjamin, Frédéric Chagnon, Gilles Morneau and Richard Hogue[1]

Résumé: Le Service météorologique du Canada (SMC) s'est engagé récemment dans un programme pour améliorer la représentation des agglomérations urbaines dans les modèles météorologiques canadiens. Ceci s'inscrit dans le cadre d'un projet financé par l'Initiative de recherche et de technologie (IRTC) chimique, biologique, radiologique et nucléaire (CBRN), visant à développer un système intégré de réponse aux urgences environnementales. Ce système sera basé sur un modèle précis et efficace de prévision de la dispersion et des écoulements atmosphériques en milieu urbain pour les grandes villes nord-américaines. Le projet est une collaboration entre plusieurs partenaires gouvernementaux (SMC, Recherche et développement pour la défense Canada, Énergie atomique du Canada limitée) et universitaires (Universités de Waterloo et de Calgary). Le système intégré de réponse aux urgences fournira en temps réel un outil de modélisation et de simulation afin de prévoir les dangers de contamination, de blessures ou de décès pouvant résulter d'émission de substances dangereuses. S'appuyant sur une infrastructure scientifique et technique éprouvée, ce système permettra aussi de minimiser les conséquences de tels incidents dans un cadre décisionnel prédéterminé. La Division de réponse aux urgences environnementales du Centre météorologique canadien prévoit utiliser, en mode quasi-opérationnel, un prototype du système dès l'été 2007.

Introduction

The Meteorological Service of Canada (MSC) has recently launched a program to improve the representation of cities in the Canadian meteorological models. This is part of a larger project funded by the Canadian CBRN (Chemical, Biological, Radiological, and Nuclear) Research and Technology Initiative (CRTI), which aims at developing an advanced emergency response system based on an integrated, multi-scale modeling system for the accurate and efficient prediction of urban flows and atmospheric dispersion over populated North American cities. It involves collaboration among several governmental (MSC, Defence R&D Canada, Atomic Energy of Canada Limited) and academic (Universities of Waterloo and Calgary) partners. This advanced emergency response system will provide a real-time modeling and simulation tool to predict injuries, casualties and contamination due to hazardous material releases, and to make relevant decisions (based on sound technical and scientific grounds) to minimize their consequences based on a pre-determined decision-making framework. A prototype version of this system is planned for quasi-operational runs at the Environmental Emergency Response Division of the Canadian Meteorological Centre in summer 2007.

Overview of the urban modeling system

The MSC contribution to the CRTI project focusses on the meso-γ to micro-α-scale component (grid-size resolutions ranging from 20 km down to about 200 m). The partners will provide CFD microscale models (at the street- and building-scales) and Eulerian or Lagrangian stochastic dispersion models, which will be driven by the "urbanized" mesoscale models. The development of the MSC urban modeling system comprises several aspects: 1) extension of our turbulent diffusion scheme to 3D turbulence, 2) inclusion of urban processes with the Town Energy Balance (TEB) urban canopy scheme (Masson, 2000), 3) generation of new land covers characterizing urban types, and 4) specification of anthropogenic heat fluxes for use in TEB.

1) 3D turbulence

Our current 1D (vertical) turbulent diffusion scheme assumes that mixing of atmospheric properties (temperature, moisture, momentum) is mostly due to the large eddies in the boundary layer. Since high-resolution models (less than 1-km grid size) are starting to resolve those large eddies, one needs adjustments to the diffusion scheme to avoid a "double-counting" of the effects of diffusion. A modified strategy has been introduced, based on quasi-isotropic 3D diffusion. The generalization of the turbulent diffusion includes additional terms for the horizontal (*x* and *y*) contributions of the dynamic Reynolds stress components and of the turbulent diffusion terms. Similar terms have also been introduced in the TKE budget equation. Finally, the formulation for the mixing and dissipation length scales has been modified, using a Smagorinsky-Lilly approach, and depends explicitly on the model grid size. This more general formulation allows for a smooth transition of the intensity of the diffusion scheme as a function of the model resolution and will ease the extension to LES-type applications (with typical resolution of a few tens of metres) in the future.

[1] Meteorological Service of Canada, Environment Canada, Dorval, Québec, Canada

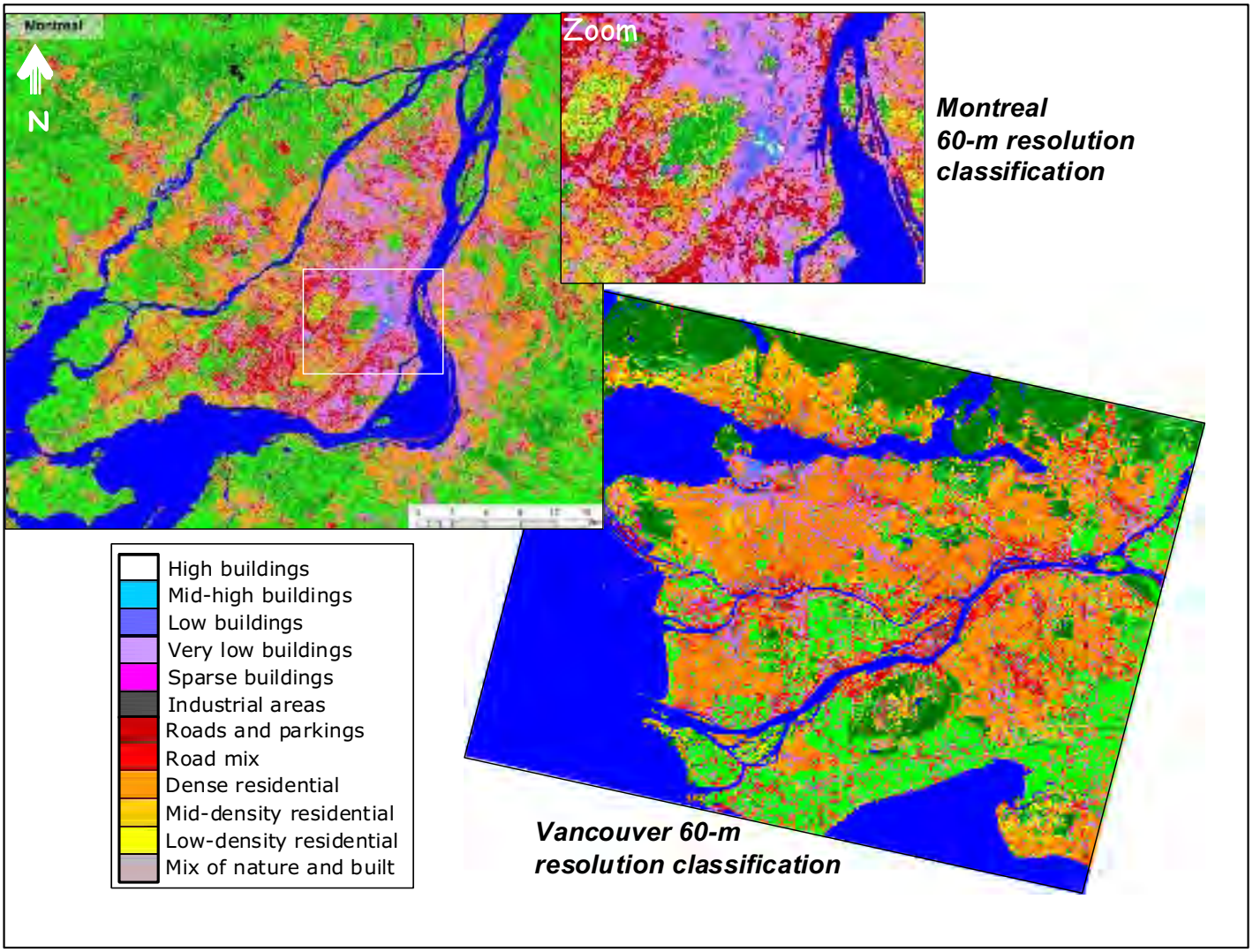

Figure 1. Land-cover classification at 60-m for Montréal and Vancouver, including 12 urban classes and 5 classes of natural covers. Also shown in colour on cover page.

2) TEB urban scheme

The TEB scheme (Masson, 2000) is an urban canopy model, specifically dedicated to built-up covers, parameterizing the energy and water exchanges between urban surfaces and the atmosphere. It represents a city as an ensemble of idealized urban canyons (Oke, 1987) formed of roofs, walls and streets. Separate surface energy budgets are solved for each of these three different canyon surfaces. TEB takes into account the 3D geometry of the urban surfaces for radiative trapping and shadow effects, heat storage, mean wind, temperature and humidity inside the streets, and water and snow on roofs and streets. Additional assumptions are the isotropy of the street orientations, and no crossing streets. TEB has been included for several years now in the French Meso-NH atmospheric model and was recently implemented in the Canadian GEM and MC2 models. TEB has been already tested for several European cities. In particular, summertime episodes have been simulated with Meso-NH for Paris and Marseille (e.g. Lemonsu and Masson, 2002; Lemonsu et al., 2005) and are currently studied for Toulouse, within the framework of the CAPITOUL experiment (Lemonsu et al., 2006a).

3) Urban cover classification

To be able to run atmospheric models with the TEB urban canopy parameterization, the land-use and land-cover classifications must include specific urban covers, the characteristics and properties of which are different from those of natural covers. The Canadian land cover database currently includes only water, ice, and various types of soils and vegetation covers. Therefore, a general methodology has been developed to provide urban land-use classifications in a semi-automatic way for the major North American cities, in order to represent the spatial distribution and the diversity of urban areas. This method is based on the joint analysis of satellite imagery (Landsat-7, Aster) and digital elevation models (SRTM-DEM, NED, CDED1), in order to take both the surface properties and geometric characteristics (building heights) of the urban canopy into

account. The application of a decision tree model then results in the identification of 12 urban classes, allowing a satisfactory representation of urban cover variability. A preliminary methodology has been developed for Oklahoma City and refined for Montréal and Vancouver. Details of the methodology and results are given in Lemonsu et al. (2006b). As an example, Figure 1 shows the resulting urban-cover classification at 60-m resolution for the Montréal and Vancouver regions, which represents in a fairly realistic way the major urban landscapes.

Figure 2. The 20-m telescopic meteorological tower with some of the instrumentation at the MUSE-2005 urban site in Montréal.

4) Anthropogenic fluxes

Another important input to the TEB urban model is the detailed specification of the emissions of heat and moisture from human activities. These anthropogenic fluxes can be of major importance in large North American cities, especially during wintertime. They include several components arising from the traffic of vehicles, energy consumption from commercial and industrial activities and, to a lesser extent, the human metabolism. In addition, the anthropogenic heat profiles must reflect the seasonal, weekly, and diurnal variations characterizing those human activities. A general and practical approach such as the "top-down" methodology proposed by Sailor and Lu (2004) is currently examined to generate the input data needed to quantify the anthropogenic heating. This method has the advantage of using easily available data sources (e.g. census data, transportation statistics, electricity and heating fuel use) and is based on a per capita formulation, non-dimensional load profile and variability of the population density. Work is under way to apply and refine this method for the Montréal area, before it can be used to build a database for other cities across North America.

Validation of the urban modeling system

As a first validation of the urban modeling system, high-resolution simulations are under way to examine the impact of urban processes on the surface energy budget and on the structure of the atmospheric boundary layer. The first case deals with a summertime intensive observational period of the Joint Urban 2003 campaign (Allwine *et al.*, 2004). The Joint Urban 2003 experiment was held in Oklahoma City, OK, USA, during July 2003 and provides a wealth of detailed meteorological observations in a North American urban environment to assess our model simulations. In order to underline the main differences observed between North American and European cities, Lemonsu et al. (2006a) have compared modeling exercises carried out for Oklahoma City and for Toulouse, two cities with comparable populations. Preliminary results indicate that North American and European cities can generate quite different urban heat islands and microclimates, and that TEB shows relatively good performances during nighttime in both cases. However, certain aspects specific to North American city centres, such as daytime maximum air temperatures, are not correctly simulated and adjustments may be needed in TEB.

Montréal Urban Snow Experiments (MUSE)

Two Montréal Urban Snow Experiments (MUSE) were conducted during the cold seasons of 2005 and 2006. The first of these experiments (MUSE-2005) took place between 17 March and 14 April 2005; the second (MUSE-2006) was held between 10 February and 31 March 2006. The main scientific objective of these experiments was to document the evolution of surface characteristics and energy budgets in a dense urban area, in conditions typical of Canadian winters and winter-spring transition, i.e., cold with snow or snow melting. A subsequent objective of the two experiments was to use these observations to evaluate the performance of TEB under those conditions, an aspect that has not been extensively examined with this scheme.

The MUSE urban campaigns were conducted by several partners within MSC, drawing upon the expertise of Profs. Tim Oke (University of British Columbia), Sue Grimmond (King's College London), and Jamie Voogt (University of Western Ontario) in the site selection and observation program design. For each of the two MUSE experiments, a single site in a dense urban area was instrumented to meet the scientific objectives of the project. For reasons unrelated to science or to the quality of the observations, the location of the observation site was changed for the second year. But both sites (i.e., for 2005 and for 2006) are very closely located, and exhibit very similar characteristics (geometry of the streets, height of buildings, orientation of streets, materials of construction, etc). The two measurements sites are located in a homogeneous area with well-defined lines of closely built houses of generally two or three storeys.

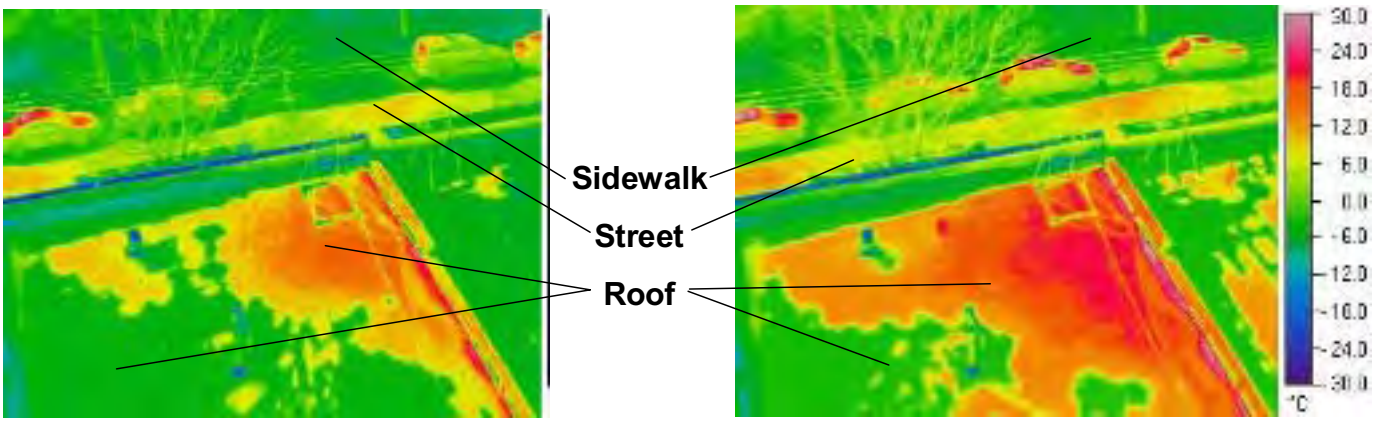

Figure 3. Images obtained from the thermal camera during the early days of MUSE-2005. They indicate a rapid decrease of snow cover on the roof (indicated by the green colour) during this 24-h period.

The instrumentation that was deployed during the MUSE campaigns included a 20-m telescopic meteorological tower that provided observations above the urban roughness sublayer of radiation budgets components and of turbulent fluxes, complemented with radiative observations of roofs, walls and streets, and of snow cover properties. Figure 2 shows the instruments installed at the top of the tower, for the MUSE-2005 experiment. In MUSE-2005, four Intensive Observations Periods (IOPs) were conducted during 24-h-periods, in which measurements of the main characteristics (e.g., depth, albedo, and density) of the snow were obtained manually, together with observations of wall and street temperatures (also obtained manually). In MUSE-2006, all these observations were done in an automatic manner.

Observations from the 2005 experiment are currently being analyzed and already several interesting results have been found. The weather for the first part of the experiment was exceptional, with a continuous series of clear-sky days with a slow but steady decrease of the snow cover in the streets and alleys. Snow on the roofs disappeared rather quickly during MUSE-2005, as evidenced by the thermal image given in Figure 3 in the first days of the field campaign. Early in the experiment, the snow cover was close to 100% on roofs, in backyards, and in the alleys. A few weeks later, the depth and fractional coverage of the snow pack were greatly reduced. This diminution of the snow coverage had a significant impact on the energy balance at the surface. As could be expected, the albedo of the urban surfaces slowly decreased during the experiment, leading to an increase of sensible heat fluxes and of the Bowen ratio (not shown).

Numerical experiments with an off-line version of TEB are currently being prepared to examine the ability of the scheme to capture this evolution of the snow and its impact on the surface energy budget. Work is also under way concerning the parameterization and impact of anthropogenic heat fluxes during the two experiments.

Outlook

The instrumentation and experience acquired during MUSE constitute an interesting starting point for a longer-term, wider effort for urban measurements across Canada that would be done with partners from various organizations. This could provide the impetus for the setup of a national network of continuous urban surface and upper-air profiles measurement sites to monitor and study the urban boundary layer. The long-term goal is to provide Canadian urban residents with better weather and air quality forecasts through development of an urban modeling system optimized for Canadian urban climates. This enhanced forecasting capability would contribute to the safety, health and well being of Canadians through better understanding of heat stress and wind chill, of dispersion of air pollutants in urban environments, and to the better conservation of urban resources.

Acknowledgements

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References

Allwine, K.J, M.J. Leach, L.W. Stockham, J.S. Shinn, R.P. Hosker, J.F. Bowers, and J.C. Pace, 2004: Overview of Joint Urban 2003 - An atmospheric dispersion study in Oklahoma City. *Planning, Nowcasting, and Forecasting in the Urban Zone Symposium*, 84th AMS Annual Meeting, 11-15 January 2004, Seattle, WA, *Amer. Meteor. Soc*.

Lemonsu, A., and V. Masson, 2002: Simulation of a summer urban breeze over Paris. *Bound.-Layer Meteorol.*, **104**, 463-490.

Lemonsu, A., G. Pigeon, V. Masson, and C. Moppert, 2005: Sea-town interaction over Marseille: 3D Urban boundary layer and thermodynamic fields near the surface. *Theor. Appl. Clim*., **84**, 171-178.

Lemonsu, A., J. Hidalgo, S. Bélair, J. Mailhot, and V. Masson, 2006a: Modeling urban processes above North American and European cities: Application to Oklahoma City and Toulouse. Preprints, *6th Symposium on the Urban Environment*, 30 January-2 February 2006, Atlanta, GA, *Amer. Meteor. Soc.*, J1.2.

Lemonsu, A., A. Leroux, S. Bélair, S. Trudel, and J. Mailhot, 2006b: A general methodology of urban cover classification for atmospheric modeling. *J. Appl. Meteorol.*, (submitted).

Masson, V., 2000: A physically-based scheme for the urban energy budget in atmospheric models. *Bound.-Layer Meteorol.*, **94**, 357-397.

Oke, T.R., 1987: *Boundary Layer Climates*, 2nd edn., Methuen, London, 435 pp.

Sailor, D.J., and L. Lu, 2004: A top-down methodology for developing diurnal and seasonal anthropogenic heating profiles for urban areas. *Atmos. Environment*, **38**, 2737-2748.

Figure 4. Photograph of the MUSE-2005 team, on the last day of the experiment. From left to right: Michel Jean, Bruno Harvey, Gilles Morneau, Frédéric Chagnon, Stéphane Bélair, Aude Lemonsu, Mario Benjamin, Stavros Antonopoulos, Najat Benbouta, Olivier Gagnon, Jocelyn Mailhot, and Radenko Pavlovic.

Environment Canada's Meteorological Services Checks out the Weather in Torino, Italy!

by Chris Doyle[2] and Michele d'Eon[3]

As Vancouver/Whistler, British Columbia, Canada prepare to host the 2010 Olympic and Paralympic Winter Games, two Environment Canada specialists of meteorology made an informative and exciting trip to the 2006 Olympic Games in Torino, Italy.

In February 2006, two delegates from Environment Canada's Meteorological Services (MSC) took part in the Olympic Official Observer Program in Torino, Italy, where officials of future games were provided the opportunity to see first hand the technologies used, how to prepare for unexpected situations, and what is required to host Olympic and Paralympic Games. Their first-hand knowledge is an essential part of the planning that will ensure Canada is ready and able to provide the most complete and up-to-date weather forecasting solutions for the 2010 Winter Games.

Al Wallace, a CMOS member and Environment Canada's Director of MSC for the Pacific and Yukon region, along with Chris Doyle, Chief Meteorologist for the 2010 Winter Games, were the delegates from Environment Canada. They met with Olympic forecasters, managers and sports officials on-site in Torino at the 2006 Winter Olympic Games. They spent four busy days visiting the outdoor venues and meteorological operations centres with the Piedmont Regional Weather and Environmental agency of Italy, including the main operations centre of the Torino Organizing Committee (TOROC).

High pressure situations and decision- making are constant at Olympics and Paralympic Games, as the scheduling of outdoor events depends on the input of the forecasters on the scene.

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[2] Chief Meteorologist for the 2010 Winter Games

[3] Communications Advisor Pacific and Yukon Region

Throughout the visit, TOROC's lead meteorologist, Renata Pelosini, and the venue forecasters showed Environment Canada's Wallace and Doyle how weather information was used operationally. Pelosini stressed the importance of routine interaction, the need for good technology and good working relationships between the meteorologists and the officials of all related events. These relationships are essential to a successful Games, and need to be cultivated over a number of winter seasons prior to the main event.

During the 2010 Winter Games in Canada, Environment Canada will play a lead role in providing weather services to many groups including: the Vancouver 2010 Organizing Committee (VANOC), the International Olympic Committee, the International Paralympic Committee, essential federal service providers such as the RCMP and Transport Canada, athletes, spectators, and the general public — with some assistance from the private sector and NOAA, the USA National Weather Service forecasters.

Like the 2006 Winter Games weather forecasting team, the 2010 Winter Games team will face some unique challenges, such as forecasting weather conditions in mountainous terrain which are strongly local and controlled by the underlying topography. As a number of case studies have shown, solutions from numerical models depend on topographic resolutions that do not, in fact, resolve the complexity of the underlying terrain. Hence pure model forecasts are sometimes inadequate. This underlies the importance of developing human forecaster expertise in the particular conditions of each outdoor venue.

During the 2006 Winter Games, the Piedmont Regional Weather and Environmental agency of Italy operated a highly dense network of surface weather stations and upper-atmosphere observing systems, including two nearby Doppler radar units and an automated aerosonde in the Games Area.

The Piedmont Regional Weather and Environmental agency of Italy provided a briefing on their Games forecast production system, which is similar to Environment Canada's semi-automated forecast production system known as SCRIBE. The Piedmont system allows input from a variety of numerical model sources, and they demonstrated how weather information is ported into a Web-based Internet information system (INFO 2006) for use by a wide range of clients, including officials, media, and the general public.

In preparation for the 2010 Winter Games, Environment Canada has been working to install a complementary weather-observing network in British Columbia where the outdoor events will take place — and has already put in place 8 of 20 new stations. Environment Canada is also planning to procure new instrumentation, including radar, wind profilers, radiometers, and possibly a scanning lidar and additional upper-air radiosondes, to assist with observations, and to make a real-time three-dimensional analysis of the atmosphere in the 2010 Winter Games area possible.

This past winter, four Environment Canada forecasters from the Vancouver Storm Prediction Centre produced Games-format forecasts from an office located in the Whistler alpine area where the Downhill, Super G and Slalom events will take place.

From left to right; TOROC Venue Forecaster, Chris Doyle, Al Wallace at the Freestyle venue in Sauze d'Oulx, Italy.

Environment Canada will have on-site forecast training for at least three months each winter over the next four years to ensure that Canada is ready for the 2010 Winter Games. In addition, a first-ever mountain weather course has been developed by Environment Canada and the Cooperative Program for Operational and Meteorological Training (COMET) to upgrade the knowledge base of forecasters destined to work at the games. The prototype course was offered at the COMET facilities in Boulder, Colorado, in March 2006, and will be held at regular intervals over the next four years to complete the training of the forecast team.

Estimating volumes of air through various engines in an urban setting

by Lewis Poulin[1]

Résumé: (traduit par la direction) On a évalué les volumes d'air consommés par différents moteurs et, par la suite, on compare ces volumes avec les 9700 litres d'air requis quotidiennement par un être humain moyen. Pendant une heure de fonctionnement, le moteur typique d'un camion, d'un VUS (Véhicule Utilitaire Sport - "SUV") et d'une automobile compacte requiert respectivement, environ le même volume d'air que 111, 40 et 29 personnes ont besoin pour respirer pendant une journée complète. Pour un avion, suite à un décollage et atterrissage, les moteurs nécessitent un volume d'air qu'environ 8000 personnes ont besoin en une journée pour respirer.

En utilisant des estimés du nombre des moteurs représentatifs d'un jour d'été sur l'île de Montréal, on a calculé la totalité des volumes d`air consommés par les moteurs. Le grand nombre de moteurs à combustion fait de ceux-ci les consommateurs des plus grands volumes d'air. Tous les moteurs fonctionnant au cours d'une journée, consomment environ $3{,}1X10^{12}$ litres d'air, ce qui représente environ 175 fois le besoin en volume d`air quotidien que respirent plus de 1,8 millions de Montréalais.

Les données sur la consommation de volumes d'air peuvent aider à créer des barèmes personnels de consommation d'air ou des affichages sur les tachymètres des véhicules qui indiqueraient les volumes d'air consommés lors de la conduite du véhicule. Les gouvernements pourraient développer des plans pour gérer les polluants en associant la production locale du volume d'air à l'échappement à la prévision des volumes d'air frais nécessaire pour diluer les gaz à l'échappement. Lors de journées avec une mauvaise qualité de l'air, cette façon d'agir pourrait clarifier quelles activités polluantes devraient être réduites.

Des mécanismes d'échanges économiques, semblables aux échanges entres industries et pays pour réduire la production du CO_2, pourraient être appliqués à la réduction de volumes d'air consommés par les moteurs. Ces échanges économiques, soit à l`échelle locale ou globale, serviraient à incorporer dans le marché, les vrais coûts associés à l`usage de l'air par les moteurs de véhicules.

Introduction

Many air quality models parameterize net weights or volumes of pollutants dispersed into the environment. Here it is the volume of air passing through various engines which is estimated and packaged in familiar terms for the public.

First a reference volume of air is defined as the volume one average human needs for breathing during 24 hours. This volume of approximately 9,700 litres/human called here one human-day (hum-day) is derived using an inhaled volume of 0.5 litre per breath x 13.5 breaths/minute x 60 minutes/hour x 24 hours/day (Lough, 1983). Forty human-days of air is the volume forty (40) people need for breathing for one day.

Similarly, one population-day (pop-day) of air is the volume obtained by multiplying one hum-day by the number of people in a population. In this study, the population of the island of Montréal in 2001 is used making one pop-day equal to 1,812,723 people x 9,700 L/person = $1.76x10^{10}$ litres. One hundred (100) pop-days of air is one hundred times the volume of air required for breathing during one day by Montréal's population.

These reference volumes of air will be used later to help present air volume information in terms the public can more easily relate to and as a result may assist in better engaging the public in air pollution prevention activities.

Estimating combustion engine air consumption volumes

Volumes of air passing through combustion engines are estimated using the engine cylinder's displacement in litres (L) x engine rpm x number of minutes of operation.

A 2-stroke engine with displacement of fifty (50) cc (0.050 L) operating for thirty (30) minutes at five thousand (5000) rpm is estimated to consume 0.05 L x 5000 rpm x 30 minutes = 67,500 litres.

4-stroke combustion engine calculations require the rpm be divided by two since air is exhausted from the cylinders every second revolution (Association canadienne des automobilistes, 1983). A 4-stroke engine with one litre displacement operating for 60 minutes at 2500 rpm is estimated to consume 1 L x 2500**/2** rpm x 60 minutes/hour = 75,000 litres of air.

These volumes of air "consumed" by engines also serve as estimates of initial volumes of undiluted engine exhaust.

Cylinder volumes, or displacements, of various combustion engines are listed in column 1 of table 1 for a variety of engines. 2-stroke engine sizes were obtained by noting those available in local hardware stores. 4-stroke displacements were obtained from the many vehicle related advertisements and articles in Montréal's The Gazette newspaper (The Gazette, 2004, 2005).

[1]Canadian Meteorological Centre
Dorval, Québec, Canada

Table 1

Air volume consumption information for combustion engines

Engine Type	(1) Cylinder displacement Litres	(2) rpm in thousands	(3) Operating time minutes	(4) Air volume consumed Litres	(5) human-days of air per hour
2-stroke					
Lawn mower	0.05	5	30	7,700	1.5
Hedger	0.02	5	30	3,000	0.6
Chainsaw	0.04	5	30	6,000	1.2
Jet ski	1.1	4	30	130,000	27
4-stroke Local					
Smart car	0.8	3	60	72,000	7
Compact car	3.1	3	60	280,000	29
SUV	4.3	3	60	390,000	40
School bus	6.6	3	60	600,000	61
Truck	12.0	3	60	1,100,000	111
Truck construction	12.0	3	60	1,100,000	111
4-stroke Highway					
Compact car	3.1	2.5	60	230,000	24
SUV	4.3	2.5	60	320,000	33
Truck	12.0	2.5	60	900,000	93

Table 2

Configuration and air volume consumption data for Airbus A320 airplane

Process	Throttle (%)	Speed (Km/h)	Core airflow kg / s	Rate (L) / s	Minutes	Air Volume consumed (L)	Human-days for 2 engines
During Take-off							
Terminal	40	0	10.65	8,341	30	$1.5x10^7$	3,096
Taxiing	55	10	22.53	17,646	5	$5.3x10^6$	1,091
Runway	90	285	34.2	26,786	1	$1.6x10^6$	331
During Landing							
Landing	60	217	34	26,629	2	$3.2x10^6$	659
Taxiing	55	10	22.53	17,646	5	$5.3x10^6$	1,091
Terminal	40	0	10.65	8,341	15	$7.5x10^6$	1,548
					Total =	**$3.8x10^7$**	

Table 3

Summary air consumption volume estimates for various engines

(1) Category	(2) Consump-tion of air (L)	(3) Units	(4) Number human-days	(5) Total number in city	(6) Total daily consump-tion (L) / category	(7) Number pop-days per day
1 Person	$9.7x10^3$	(L) / day	1.0	1,812,723	$1.76x10^{10}$	1.0
2-stroke						
1 Mower	$7.5x10^3$	(L) / 0.5 hr	0.77	443,947	$3.3x10^9$	0.2
1 Hedger	$3.0x10^3$	(L) / 0.5 hr	0.31	443,947	$1.3x10^9$	0.1
1 Chainsaw	$6.0x10^3$	(L) / 0.5 hr	0.62	88,789	$5.3x10^8$	0.03
1 Jet ski	$1.3x10^5$	(L) / 0.5 hr	13.6	1,421	$1.9x10^8$	0.01
4-stroke local						
Efficient	$7.2x10^4$	(L) / hour	7	1,776	$1.3x10^8$	0.01
Compact	$2.8x10^5$	(L) / hour	29	1,065,473	$3.0x10^{11}$	17
SUV	$3.9x10^5$	(L) / hour	40	710,315	$2.8x10^{11}$	16
School bus	$6.0x10^5$	(L) / hour	61	500	$1.8x10^9$	0.1
Truck	$1.1x10^6$	(L) / hour	111	266,368	$2.3x10^{12}$	131
Truck construction	$1.1x10^6$	(L) / hour	111	10,000	$8.6x10^{10}$	5
4-stroke highway						
Compact	$2.3x10^5$	(L) / 0.75 hr	24	100,000	$1.7x10^{10}$	1
SUV	$3.2x10^5$	(L) / 0.75 hr	33	90,000	$2.2x10^{10}$	1.2
Truck	$9.0x10^5$	(L) / 0.75 hr	93	70,000	$4.7x10^{10}$	2.7
Airplane A320						
Take-off	$4.4x10^7$	(L)	4,600	250	$1.1x10^{10}$	0.63
Landing	$3.2x10^7$	(L)	3,400	250	$8.0x10^9$	0.45
				Total =	**$3.1x10^{12}$ L**	**175**

4-stroke engines were considered either local or highway vehicles and assigned rpm values of 3000 and 2500 respectively. Local vehicles remained in the city while highway vehicles travelled through the city on a main highway.

The goal to calculate a volume of air passing through engines to become undiluted exhaust, assumes consumed air is not re-used by any other engine. It is also assumed that consumed air becomes tainted with combustion fumes and would be unfit for humans to breathe. For this calculation, however, exhaust volumes are not diluted further with ambient air.

Airflow through an airplane engine is also estimated.

The Airbus A320 airplane was considered representative of the majority of planes flying in and out of Pierre-Elliot-Trudeau International Airport in Montréal where there are about 250 daily take-offs and landings (Isaac, 2005).

Operating characteristics of the Airbus A320 CFM56-5A1 turbo fan engines were provided by http://www.flybernhard.de and from personal communication with an airline pilot. Estimates of airflow were obtained from NASA's engine simulator website http://www.grc.nasa.gov/WWW/K-12/airplane/ngnsim.html using configuration information in table 2 and verified with the site's owner (Benson, Thomas,

email communication, 2005).

As seen in Table 2, large volumes of air are used by the plane's engines during idling of engines while waiting at the terminal and taxiing to and from the runway.

Comparing air consumption volumes for various engines
Table 3 presents the summary of engine air consumptions.

Column (2) lists air consumption volumes for individual engines (except for 2 engines in the case of the Airbus) during the associated operating period in column (3).

Column (4) presents volumes of column (2) as multiples of human-days of air.

Individual airplane engines consume the largest volumes of air requiring, per pair of engines, an estimated 8,000 human-days of air from each combination of take-off and landing.

For combustion engines, a local truck consumes approximately 111 human-days of air per hour of operation. A highway truck using a lower rpm value and shorter transit time consumes approximately 93 human-days of air per truck. Local school buses, SUVs and compact cars used 61, 40 and 29 human-days of air per hour respectively. Jet skis, lawn mowers, chainsaws and hedgers consumed 27, 1.5, 1.2, 0.6 human-days of air per hour respectively.

Estimating total engine air consumption volumes for Montréal
Table 3 data can be used to model total air consumption volumes for an urban area. A preliminary scenario is presented here to demonstrate the concept. There is interest in obtaining higher quality data from various municipal databases to feed into this model.

Column (5) of table 3 presents preliminary estimates of the total number of each engine type for the island of Montréal.

For most engine types, multiplying the number of engines in column (5) by the corresponding air consumption rates in column (2) provides estimates of total volumes of air consumed, per day, by engine category. In the case of local trucks and school buses, those engines were operated for 8 and 6 hours per day respectively. Total air consumption volumes per day are shown in column (6).

The sum of numbers in column (6) represents the total volume of air consumed by all engines during one day, i.e. 3.1×10^{12} litres. This total also estimates the volume of undiluted exhaust produced by all engines here for a one-day period.

Trucks, compact cars, SUVs and airplanes are responsible for about 75%, 10%, 9% and 0.7% of the exhaust produced during a one-day period respectively. Truck engines produce the largest volumes of exhaust air.

The number of pop-days of air for each engine category is shown in column (7) and was obtained by dividing values of column (6) by the number of litres in 1 pop-day.

All trucks combined use approximately 139 pop-days of air per day. SUVs and cars combined use about 35 pop-days of air per day. Airplane engines use about 1 pop-day of air per day. All 2-stroke engines use just over 0.3 pop-day of air per day.

Though airplane engines individually consume the most air per engine, trucks and passenger vehicles as a group use far more air than all airplane engines combined.

In total, all engines combined use about 175 pop-days of air per day, i.e. 175 times the volume of air required by Montréal's population for a 1 day period.

Air volume consumption data helps highlight producers of large volumes of exhaust and may assist justifying restrictions on certain activities during smog alert days as a way to more effectively prevent air pollution and protect the public's health.

Air consumption in stagnant air under a summertime ridge
How quickly would a volume of air get converted into exhaust by engines operating under a stagnant high pressure ridge typical of summertime conditions conducive to smog?

First a reference supply of stagnant air is defined as the volume within the boundary layer 1.0 km high over the 500 km^2 area of Montréal island giving a volume of 5.0×10^{14} litres.

If the city's engines produce 3.1×10^{12} litres of undiluted exhaust per day and assuming engines use only clean air at input, it would take about 160 days for all engines to have converted the stagnant boundary layer air into undiluted engine exhaust.

It's important to remember vehicle exhaust should be diluted prior to humans breathing it and for this reason the volume of fresh air used to dilute exhaust should be considered as air impacted or required by engines. Using a first order approximation of diluting each litre of exhaust into 1000 litres of fresh air suggests engines require 1.31×10^{12} litres exhaust + 1.31×10^{15} litres of fresh air per day. Thus when dilution is considered and fresh air considered necessary, then engines effectively consume the reference volume of air in 5×10^{14} / 3.1×10^{15} = 0.16 days.

This back-of-the envelope calculation highlights the volumes of exhaust engines produce and how critically important a source of fresh air is to dilute the exhaust down to safer levels for breathing.

The concept demonstrates the importance of a source of fresh air in the process of exhaust management. Guidelines may be required to help communities pro-actively manage their exhaust-producing activities when stagnant weather systems prevent enough fresh air from diluting the exhaust to safe enough levels for humans.

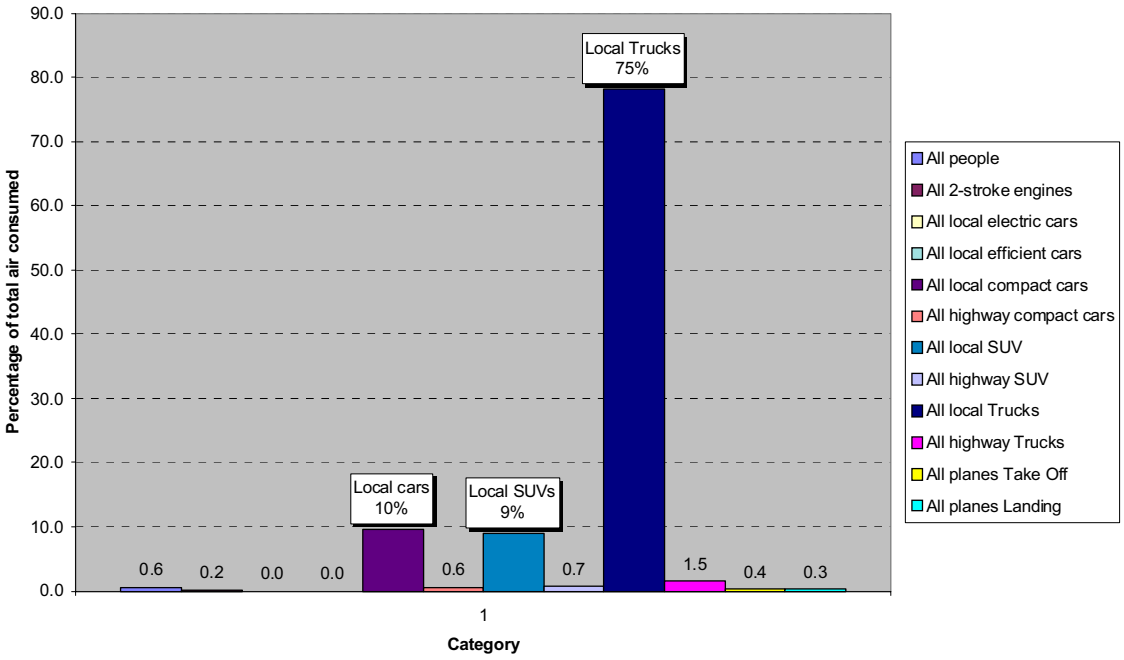

Figure 1: Percentage of total air volume consumed by engine category per day. Trucks consume the most air and as a result produce most of the exhaust per day.

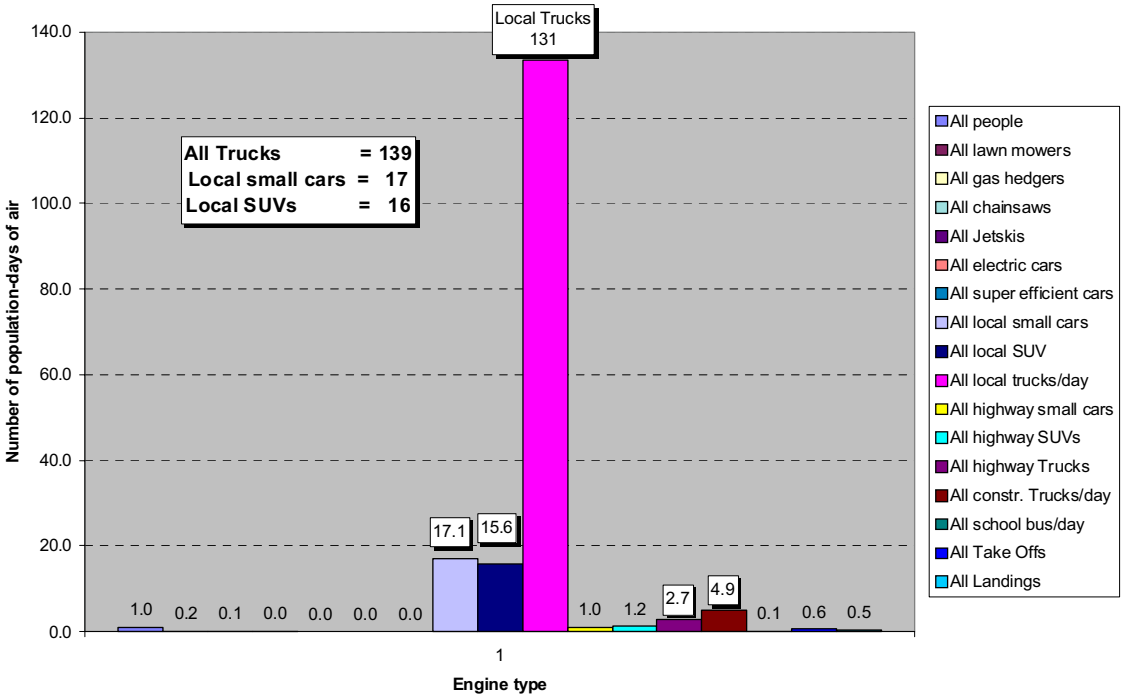

Figure 2: Air consumption volume per engine category expressed as number of population-days of air. All trucks combined produce about 139 pop-days' worth of exhaust air.

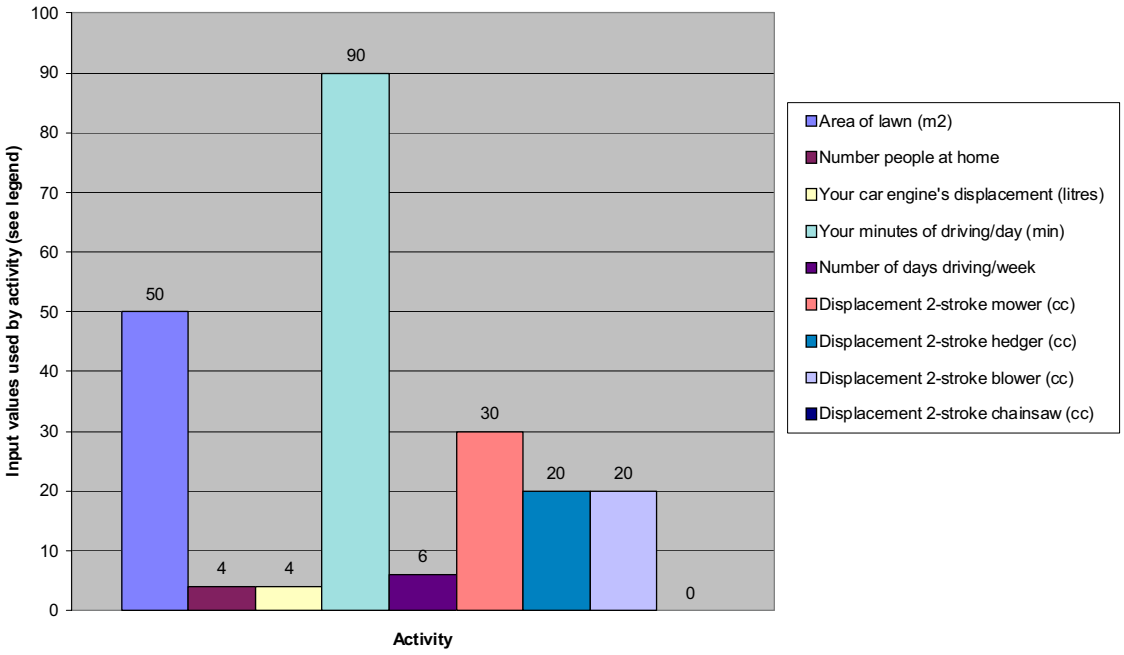

Figure 3.1: Sample input parameters for air volume consumption "footprint" calculations. Net air consumptions calculated using these parameters are shown in figure 3.2

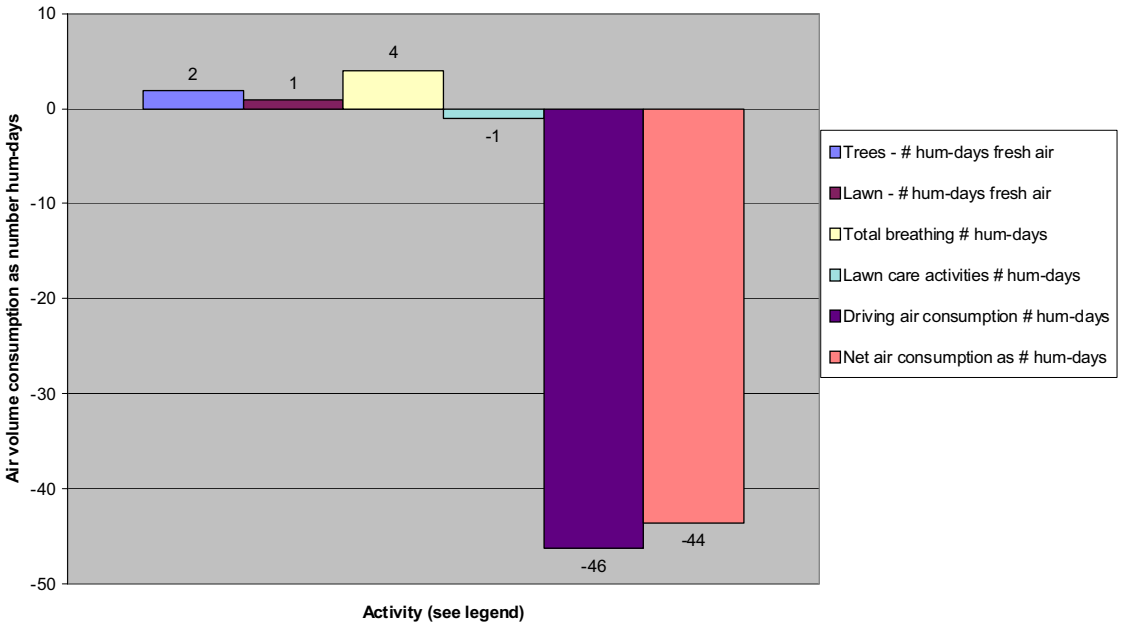

Figure 3.2: Sample estimates of air production & consumption volumes as number of human-days per activity per day based on input parameters of figure 3.1. Positive (negative) values indicate volumes of fresh (tainted) air produced.

Information such as volume of readily available fresh air for dilution or the number of days to full local air consumption by engines may offer greater tools and incentives to governments for discouraging behaviours that pollute the local air supply especially in stagnant air scenarios.

Public education tools promoting air consumption awareness
Since education is often a preferred approach by governments to encourage environmentally-sustainable practices, air volume consumption awareness may be an effective tool.

A web page could allow the calculation of one's air volume consumption "footprint". Users could provide information such as car engine size, driving times, small engines used at home, area of lawn, number of trees, etc. A net balance of air consumed can be calculated and displayed as shown in figures 3.1 and 3.2

Air consumption footprint calculations could assist in rationalizing and personalizing the need to practise less polluting behaviour. It is important to realize especially on poor air quality days, that for each hour of not driving one's car, the air that could be used by more than 30 people to breathe during one day will not be converted into engine exhaust.

Air consumption footprint calculations could be undertaken for city or regional areas using their own local vehicle databases. Knowing how many litres of air per day are locally consumed and tainted allows communities to more clearly set pollution reduction objectives and develop a locally owned and operated air quality management plan. This plan could include an exhaust avoidance approach which prevents certain engines creating exhaust on those days when there is not enough fresh air to dilute the exhaust to safe levels for breathing.

Air volume consumption information could also be added to vehicle dashboard tachometers to remind drivers of the number of human-days of air consumed and exhaust produced while driving. A sample tachometer is shown in figure 4.

Figure 4: A tachometer displaying the number of human-days of air consumed by a 3.5 L engine as a function of rpm. Driving at 2000 rpm for one hour uses 22 human-days of air through the engine and converts that air into exhaust.

Local trading systems to internalize costs of air pollution
Progressive taxation tools are becoming more common to encourage resource conservation and pollution prevention.

Some municipalities are charging citizens for disposing of garbage volumes produced above a certain limit like two bags per week. Water meters are used to encourage water conservation in a user-pay system.

There are precedents in the Canadian Environmental Protection Act allowing for companies to track volumes of exhaust pollutants so they can manage exhaust volumes over a period of time to attain clean air targets for their fleet of vehicles (Canada Gazette, 2003).

Air volume consumption information could be used as a basis for internalizing the cost of air pollution into our economic system. Should one's activities impact on more than an allocated volume of air, users could pay a pre-determined "polluting" fee, or trade, barter or buy volumes of available clean air from others whose activities and lifestyles do not consume as much air.

User fees that more clearly account for the air used in combustion could be incorporated into the price of liquid fuels. For example, a vehicle with a 3.5 L engine operating at 2500 rpm, with a gas mileage of 10 L/100km and taking one hour to travel 100 km would convert (3.5 L x 2500 rpm / 2 x 60 minutes) 262,500 litres of fresh air into exhaust. Dividing by 10, this translates into 26,250 litres of air converted into exhaust per litre of gasoline consumed.

The price of gasoline could also be made to vary in a manner that is inversely proportional to the forecast availability of fresh air, i.e. gas prices could increase (decrease) when the fresh air necessary for diluting exhaust decreases (increases). Ventilation information like that presented in figure 5 could be used to help price fuels in a manner that reflects the atmosphere's ability to effectively dilute the pollution.

The concept of clean air trading could also be applied internationally. Countries with large numbers of combustion engines could pay a "pollution fee" to countries with fewer engines as a way of recognizing the real costs of polluting the global air supply. This provides incentives for polluting countries to reduce their polluting sources and rewards developing countries for practising sustainable development not based on combustion engines. This market-economy approach could assist in reducing the exchange of trans-border pollutants. Market mechanisms such as these are already being used to help reduce production of CO_2 globally.

Conclusion
A ventilation-based accounting of the volumes of exhaust air passing through or consumed by urban engines is presented.

Volumes of fresh air converted into engine exhaust are provided using engine cylinder displacement (L) x rpm[/2] x minutes of operation. The method provides data that could be used for public awareness and economic tools to help internalize, into the marketplace, the cost of air pollution from combustion engines.

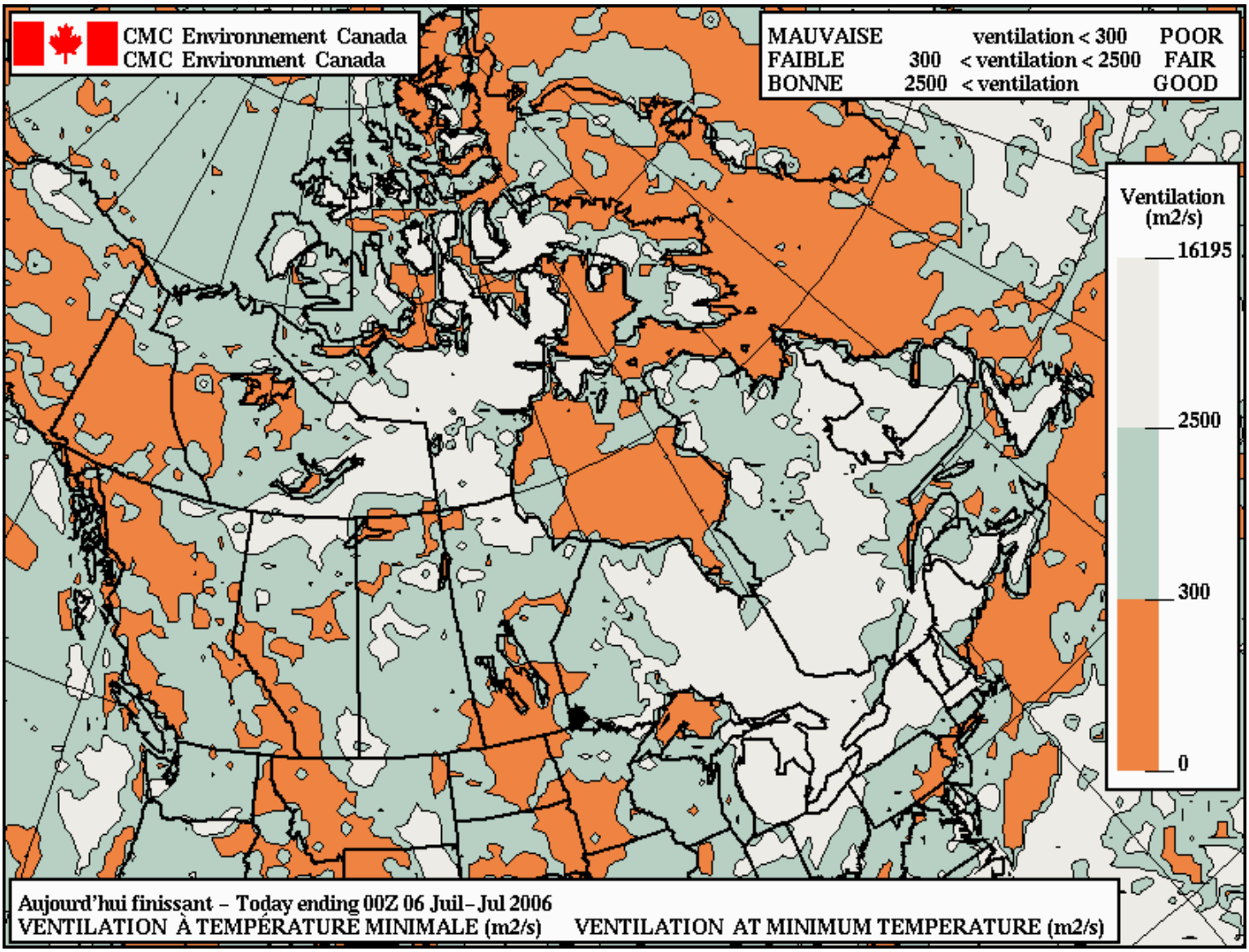

Figure 5: A sample ventilation forecast map indicating the ability of the atmosphere to effectively provide "fresh air" over a given point. Ventilation depends on the mixing layer depth and wind speed within the layer. Areas with poor ventilation (under 2,500 square metres per second) are highlighted on the map. Ventilation maps are available on www.weatheroffice.ec.gc.ca via the Air Quality Forecasts page.

For combustion engines, a truck consumes the most air requiring 111 human-days per hour. Local school buses, SUVs and compact cars consumed 61, 40 and 29 human-days of air per hour respectively. Smaller engines like jet skis, lawn mowers, chainsaws and hedgers consumed 27, 1.5, 1.2, 0.6 human-days of air per hour respectively.

Using estimated numbers of engines on Montréal island, engines consume approximately 3.10×10^{12} litres of air per day which represent about 175 times the volume of air required for breathing by the 1.8+ million people during a 24 hour period.

Under a stagnant ridge of high pressure, it is estimated that all engines would convert the clean air in the 1 km boundary layer into undiluted exhaust in about 160 days. If, however, each litre of exhaust is diluted with 1000 additional litres of fresh air, the air in the boundary layer effectively becomes consumed in less than 1 day as a result.

Air consumption information allows for new types of air-quality-related education tools. A web interface could help users calculate air consumption footprints. Tachometers in vehicles could remind drivers of how many human-days of air are being converted into exhaust while they drive. "What if" scenarios can help individuals and governments evaluate the impact on air consumption of proposed lifestyle changes.

Local clean air trading systems based on the concept of air volume consumption could allow those requiring larger volumes of air to pay for the air they need. Such user-pay systems could be established locally and globally.

Future work includes expanding the list of consumers of air, adding volumetric contributions from post-engine processes such as smog and roadway-generated particulates, determining proper exhaust dilution factors and packaging information so as to allow a variety of users to run their own air volume scenarios.

An easy- to- use and user-friendly mechanism that quantifies how we use the air in our daily lives could help internalize exhaust management into our economic system. Action on

this front is necessary in order to prevent the "tragedy of the commons" as applied to the essential resource that is our shared atmosphere.

References

Association canadienne des automobilistes, *"Manuel complet de l'automobile*", Association canadienne des automobilistes et Sélection du Reader`s Digest Ltée, 1983.

Benson, Thomas J., NASA, email communication, March, 2005.

DeCicco John, Cook James, Bolze Dorene, Beyea Jan, *"CO_2 diet for a Greenhouse Planet: A citizen's guide for slowing global warming*", Audubon Policy Report, National Audubon Society, June 1990.

Hardin, Garrett, "*The Commons and Free Goods*", in Vital Views of the Environment, edited by Mary. E. Hawkins, National Science Teachers Association, 1201 16th street, N.W., Washington D.C., 20036, 1970

Isaac, George, "*Nowcasting Airport Winter Weather*", Internal seminar, Canadian Meteorological Centre 2121 route transcanadienne, Dorval, April 29, 2005.

Lough Marvin, Robert Chatburn, W. Arlen Schrock, "*Handbook of Respiratory Care*", Year Book Medical Publishers, 1983

Poulin, Lewis, "*An educational tool to better estimate local air consumption patterns*", poster #675, presented at Canadian Meteorological and Oceanographic Society (CMOS) Congress, Vancouver, June 2005. See copy of poster at: http://chebucto.ca/Science/AIMET/lewis/air_model

Poulin, Marc, Various personal communications, University of Calgary, spring 2004.

The Gazette, "*Driving Section*", The Gazette publisher, 2004-2005.

Canada Gazette, "*Canadian Environmental Protection Act: On-Road Vehicle and Engine Emission Regulations*", Part II, Vol. 137, No. 1, Queen's Printer for Canada, 2003.

Various other internet sites are available from the author.

Acknowledgements

The author, while not an expert in air quality chemistry, became interested in air volume consumption during his daily walks to and from work. A preliminary poster on air consumption volumes was presented at the Canadian Meteorological and Oceanographic Society (CMOS) Congress in Vancouver of June 2005. That poster data was further consolidated into this publication. Comments from various CMC colleagues, in particular Richard Hogue, and from the Editor of the *CMOS Bulletin SCMO* were very helpful at improving the publication. The author thanks his family for assisting in the development of these concepts.

Note: The above paper was a contribution to Earth Day, April 22, 2006.

Books in search of a Reviewer

Livres en quête d'un critique

The High-Latitude Ionosphere and its Effects on Radio Propagation, by Robert Hunsucker and John Hargreaves, Cambridge University Press, Hardback, 0-521-33083-1, US$140.00.

Flood Risk Simulation, by F.C.B. Mascarenhas, co-authored with K. Toda, M.G. Miguez and K. Inoue, WIT Press, January 2005, ISBN 1-85312-751-5, Hardback, US$258.00.

The Gulf of Alaska, Biology and Oceanography, by Phillip R. Mundy, Editor, Published by Alaska Sea Grant College Program, University of Alaska at Fairbanks, 2005, ISBN 1-56612-090-X, Paperback, US$25.00.

Carbon Dioxide Capture and Storage, Intergovernmental Panel on Climate Change, Cambridge University Press, 2005, pp. 431, ISBN 0-521-68551-6, Paperback, US$70.00.

Extreme Events, A Physical Reconstruction and Risk Assessment, by Jonathan Nott, Cambridge University Press, May 2006, pp.297, ISBN 0-521-82412-5, Hardback, US$70.00.

Statistical Analysis of Environmental Space-Time Processes, by Nhu D. Le and James V. Zidek, Springer Science-Business Media Inc, 2006, ISBN 0-387-26209-1, Hardback, US$79.95.

If you are interested in reviewing one of these books for the *CMOS Bulletin SCMO*, please contact the Editor at the e-mail address provided below. Of course, when completed, the book is yours. Thank you in advance for your collaboration.

Si vous êtes intéressés à faire la critique d'un de ces livres pour le *CMOS Bulletin SCMO*, prière de contacter le rédacteur-en-chef à l'adresse électronique mentionnée ci-dessous. Bien entendu, le livre vous appartient lorsque vous avez terminé la critique. Merci d'avance pour votre collaboration.

Paul-André Bolduc, Editor / Rédacteur-en-chef
CMOS Bulletin SCMO
bulletin@cmos.ca or/ou bulletin@scmo.ca

CMOS 40th Annual Congress | **40e Congrès annuel de la SCMO** | **Toronto, Ontario**

2005 Patterson Medal Award Presentation

TORONTO, Ontario, May 30, 2006 – Dr. Michel Béland, Director General of Environment Canada's Atmospheric Science and Technology Directorate, today was awarded the 2005 Patterson Distinguished Service Medal for outstanding service to meteorology in Canada. This prestigious honour was presented to Dr. Béland at the 40th Annual Congress of the Canadian Meteorological and Oceanographic Society (CMOS) in Toronto.

The Patterson Distinguished Service Medal, first presented in 1954, is considered the pre-eminent award recognizing outstanding work in meteorology by residents of Canada. This award is named in honour of Dr. John Patterson, a meteorologist who was Director and Controller of the Meteorological Service of Canada from 1929 to 1946, a crucial period in the development of Canada's weather service.

Dr. Béland, described by a colleague as "a passionate scientist, his passion being infectious," has made numerous contributions, both nationally and internationally, in advancing the scientific knowledge base in the fields of meteorology and environmental prediction. Dr. Béland was recently elected President of the World Meteorological Organization's Commission for Atmospheric Sciences. He is also the Vice-President-elect of the Inter-American Institute for Global Change Research in the Americas; the Co-Chair of the International Joint Scientific Steering Committee for the International Polar Year; and the Chair of the International Core Steering Committee for THORPEX (The Observing-system, Research and Predictability Experiment), a major global atmospheric research program to improve 1-to-14-day weather forecasts.

Dr. Béland began his career at Environment Canada in 1978 as a research scientist, focussing on atmospheric turbulence, numerical weather prediction and numerical modeling. In 1993, Dr. Béland became Director of the Meteorological Research Branch. In this capacity, he managed a major research program covering most aspects of modern meteorology, from Doppler radars, research aircraft and cloud physics to satellite data assimilation techniques and global numerical weather prediction models on a suite of Canada's most powerful scientific supercomputers. Dr. Béland contributed significantly to positioning the Canadian Meteorological Centre as one of the five best National Centres in the world for the accuracy of its products, a position which it still occupies to this day.

In his current position, which he assumed in 1999, Dr. Béland is responsible for the management and scientific leadership of Environment Canada's research and development programs in air quality, climate and meteorological sciences, as well as adaptation and impacts research and atmospheric science integration and assessment. The program employs more than 325 scientists and support scientists across Canada, with major laboratories in Victoria, Toronto and Montreal and smaller labs in the Arctic (Eureka, Alert), on the East coast (Halifax) and elsewhere in Canada.

A fundamental tenet of Dr. Béland's vision for Environment Canada's science is the concept of a unified approach to weather, climate, air quality and Earth-system prediction systems that eventually will bring together the meteorological, ocean, atmospheric and ecosystem research communities.

Dr. Béland, 57, is a native of Rivière-du-Loup, Quebec. He graduated from Université Laval in 1971 with a B.Sc. in Physics and received his M.Sc. and Ph.D. in Meteorology from McGill University in 1973 and 1977, respectively, in atmospheric dynamics and numerical weather prediction. Vice-President of CMOS in 1994 and President in 1995, he also has memberships in the American Meteorological Society, the Computational Fluid Dynamics Society of Canada and the American Association for the Advancement of Science.

Présentation de la médaille Patterson 2005

TORONTO (Ontario) le 30 mai 2006 – M. Michel Béland, directeur général de la Direction des sciences et de la technologie atmosphériques d'Environnement Canada, a reçu aujourd'hui la médaille de service distingué de Patterson de 2005 pour service exceptionnel rendu à la météorologie au Canada. Ce prestigieux prix a été remis à M. Béland à l'occasion du 40e congrès annuel de la Société canadienne de météorologie et d'océanographie (SCMO), qui s'est tenu à Toronto.

La médaille de service distingué de Patterson, qui a été décernée pour la toute première fois en 1954, est considérée comme le prix le plus important pour la reconnaissance du travail exceptionnel réalisé en météorologie par des Canadiens. Le prix a été créé en l'honneur de M. John Patterson, un météorologue qui a été directeur et contrôleur du Service météorologique du Canada de 1929 à 1946, un période importante dans le développement du service météorologique du Canada.

Les contributions de M. Béland, qu'un collègue a décrit comme étant « un scientifique passionné dont la passion est contagieuse », sont nombreuses, tant à l'échelle nationale qu'internationale, au plan de l'avancement de la base de connaissances scientifiques dans les domaines de la prévision météorologique et environnementale. M. Béland a récemment été élu président de la Commission des sciences de l'atmosphère de l'Organisation météorologique mondiale. Il est également vice-président désigné de l'Institut interaméricain de recherches sur les changements à l'échelle

du globe en Amérique, coprésident du comité directeur scientifique mixte international pour l'Année polaire internationale, ainsi que président du comité de coordination international du noyau de THORPEX (*The Observing-system, Research and Predictability Experiment*), un important programme de recherches atmosphériques globales qui cherche à améliorer les prévisions météorologiques de 1 à 14 jours.

C'est en 1978 que M. Béland entreprend sa carrière en tant que chercheur auprès d'Environnement Canada, où il se penche sur la turbulence atmosphérique, la prévision numérique du temps et la modélisation numérique. En 1993, il accède au poste de directeur à la direction de la recherche météorologique. À ce titre, il gère un important programme de recherche couvrant la plupart des aspects de la météorologie moderne, allant des radars Doppler, en passant par les aéronefs expérimentaux et la physique des nuages, jusqu'aux techniques d'assimilation des données par satellite et modèles de prévision numérique du temps mondial sur les plus puissants superordinateurs scientifiques du Canada. M. Béland contribue de façon importante au positionnement du Centre météorologique canadien parmi les cinq meilleurs centres nationaux au monde pour l'exactitude de ses produits, position que le centre conserve d'ailleurs encore à ce jour.

À son poste actuel, auquel il a accédé en 1999, M. Béland est en charge de la gestion et du leadership scientifiques des programmes de recherche et de développement d'Environnement Canada en matière de qualité de l'air, de climat, de sciences météorologiques, d'adaptation et de recherche sur les incidences, ainsi que d'intégration et d'évaluation des sciences de l'atmosphère. Le programme emploie actuellement plus de 325 chercheurs et scientifiques de soutien dans tout le Canada et possède d'importants laboratoires à Victoria, à Toronto et à Montréal, ainsi que des laboratoires de plus petite taille en Arctique (Eureka, Alert), sur la côte Est (Halifax) et ailleurs au Canada.

Un principe fondamental de la vision de Michel pour la science à Environnement Canada est le concept d'une approche unifiée aux systèmes de prévision météorologique, climatique, de la qualité de l'air et du système terrestre qui réunira tôt ou tard les groupes de recherche en météorologie, en océanographie, sur l'atmosphère et les écosystèmes.

M. Béland, a 57 ans et est né à Rivière-du-Loup, au Québec. Il a obtenu un baccalauréat ès sciences avec spécialisation en physique de l'Université Laval, en 1971, puis une maîtrise en sciences et un doctorat en météorologie de l'Université McGill, en 1973 et en 1977 respectivement, avec spécialisation en dynamique atmosphérique et en prévision numérique du temps. Vice-président, en 1994, puis président, en 1995, de la SCMO, il est également membre de l'American Meteorological Society, de la Société canadienne de CFD et de l'American Association for the Advancement of Science.

Parsons Medal Award Presentation

The Department of Fisheries and Oceans (DFO) established the Timothy R. Parsons Medal to recognize excellence in Canadian ocean sciences. The Timothy R. Parsons medal is awarded to a scientist for distinguished accomplishments in multidisciplinary facets of ocean sciences either during their lifetime or for a recent outstanding achievement, while working for Canadian institutions for the benefit of Canadian science.

The award is named in honour of Dr. Tim Parsons. Dr. Parsons has had a distinguished career in Canadian and international oceanography. Presently he is a Professor Emeritus at the University of British Columbia and an Honorary Research Scientist at the Institute of Ocean Sciences in Sidney, British Columbia. His lifetime work has been to establish a new ecosystem approach for the management of fisheries using oceanographic information.

This year, Dr. Ken Denman and Dr. Trevor Platt were honoured at Timothy R. Parsons Award Ceremony when Dr. Wendy Watson-Wright, Assistant Deputy Minister for Science, presented medals on May 30th 2006, during the 40th Canadian Meteorological and Oceanographic Society (CMOS) Congress in Toronto.

Dr. Ken Denman received the award in honour of his career-long contributions on the influence of physical processes on ocean productivity, and for pioneering integrated physical-chemical-biological oceanographic research. A tireless researcher with a wealth of original ideas, he has many influential publications to his name, notably landmark papers pioneering the study of physical/biological interactions in the lower foodweb and the coupling of climate systems with biogeological cycles. He is a renowned expert in modeling marine ecosystems and climate, with monumental contributions to climate change science through his identification of processes by which marine ecosystems respond to and feed back on climate. Dr. Denman is employed at both the Canadian Centre for Climate Modelling and Analysis at the University of Victoria, and at the DFO Institute of Ocean Sciences in Sidney, B.C.

Dr. Trevor Platt received the award in honour of his outstanding contributions to the fields of biological oceanography and marine ecology, the thermodynamics of the open ocean ecosystem and an ecosystem approach to fisheries management. Dr. Platt is a leader in interdisciplinary oceanographic research, a pioneer of new quantitative methodologies and the use of satellite remote sensing data for measuring ocean processes. He is a prolific scientific author, with over 285 publications. He is a major influence internationally, serving with the International Geosphere-Biosphere Program, the Scientific Committee on Ocean Research, the Joint Global Ocean-Flux Study and the International Ocean Colour-Coordinating Group. Dr. Platt is employed at the DFO Bedford Institute of Oceanography in Dartmouth, Nova Scotia and is an adjunct faculty member at Dalhousie University, Halifax, NS.

Présentation de la médaille Parsons

Le ministère des Pêches et des Océans (MPO) a créé la médaille Timothy R. Parsons afin de souligner l'excellence dans le domaine des sciences de la mer au Canada. Cette médaille sera remise à des scientifiques qui se distinguent dans un domaine multidisciplinaire lié aux sciences de la mer et ayant œuvré au sein d'une institution canadienne, afin de reconnaître l'ensemble de leur carrière ou une réalisation exceptionnelle récente au profit de la science canadienne.

La médaille a été nommée en l'honneur de M. Timothy Parsons, qui a mené une carrière extraordinaire en océanographie, aussi bien au Canada qu'à l'étranger. M. Parsons est présentement professeur émérite à l'Université de la Colombie-Britannique et chercheur honoraire à l'Institut des sciences de la mer de Sidney, en Colombie-Britannique. Au cours de sa carrière, il a mis au point une nouvelle approche écosystémique intégrant des données océanographiques pour la gestion des pêches.

Cette année, les Drs. Ken Denman et Trevor Platt furent honorés à la cérémonie de remise de la médaille Timothy R. Parsons. En effet, le 30 mai 2006, lors du 40e Congrès de la Société canadienne de météorologie et d'océanographie (SCMO) tenu à Toronto, Mme Wendy Watson-Wright, sous-ministre adjointe, Sciences, a décerné une médaille à chacun des récipiendaires.

Cette médaille a été décernée à Ken Denman pour sa contribution, tout au long de sa carrière, à l'étude de l'influence des processus physiques sur la productivité océanique et pour avoir été l'un des premiers à faire des recherches océanographiques physiques, biologiques et chimiques intégrées. Chercheur infatigable débordant d'idées originales, il est l'auteur de nombreuses publications de prestige, notamment des articles qui ont pavé la voie à l'étude des interactions physiques et biologiques aux niveaux inférieurs du réseau alimentaire et le couplage des systèmes climatiques et des cycles biogéologiques. Spécialiste de renom de la modélisation des écosystèmes marins et du climat maritime, il a prodigieusement contribué à la science du changement climatique en identifiant les processus par lesquels les écosystèmes marins réagissent au climat et l'alimentent. Ken travaille au Centre canadien de la modélisation et de l'analyse climatique d'EC, situé à l'Université de Victoria, et à l'Institut des sciences océaniques du MPO, situé à Sidney, en C.-B.

Cette médaille a également été décernée à Trevor Platt pour sa contribution exceptionnelle aux domaines de l'océanographie biologique et de l'écologie marine, de la thermodynamique de l'écosystème de la haute mer et à l'approche écosystémique de gestion des pêches. Trevor est un meneur dans la recherche océanographique interdisciplinaire, un pionnier de nouvelles méthodes quantitatives et de l'utilisation de données satellitaires pour mesurer les processus océaniques. C'est un auteur scientifique prolifique, ayant plus de 285 articles à son nom. Il exerce une grande influence à l'échelon international, ayant participé aux travaux du Programme international géosphère-biosphère, du Comité scientifique sur la recherche océanique, de l'Étude conjointe sur les flux océaniques mondiaux et du Groupe de coordination international des données sur la couleur de l'océan. Trevor travaille à l'Institut océanographique de Bedford du MPO, situé à Dartmouth, en Nouvelle-Écosse et est professeur adjoint à l'Université Dalhousie, située de l'autre côté du bassin de Bedford.

Student Committee News

The Toronto CMOS Congress held May 29-31, 2006, was the site of the first informal meeting of the CMOS Student Committee. The committee was approved by council December 2005 and its purpose is to give a voice to student members of CMOS and will consist, when fully operational, of a national student committee chair who will be a voting member of the CMOS council and a student representative from each of the 14 CMOS Centres. This first meeting saw the election of the first national chair, Tiffany Shaw, of the University of Toronto, and this was approved by Council the same day. All 14 CMOS Centres are being encouraged to choose a student representative to sit on the national student committee.

Some of the issues tabled at the meeting were student travel support, the importance of student feedback, potential involvement in science fairs within CMOS Centres, and the creation of an electronic newsletter. These issues will be discussed at length during the first formal meeting of the committee, which will take place via teleconference in September 2006. Those interested in further information should contact the chair at :

tshaw@atmosp.physics.utoronto.ca

Tiffany Shaw
Chairperson, CMOS Student Committee

REMINDER - REMINDER - REMINDER

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CMOS Prizes and Awards announced at the 40th Annual Banquet

Sheraton Centre, Toronto, Ontario
May 31st, 2006

President's Prize
may be awarded each year to a member or members of the Society for a recent paper or book of special merit in the fields of meteorology or oceanography. The paper must have been accepted for publication in ATMOSPHERE-OCEAN, the *CMOS Bulletin SCMO* or another refereed journal.


Saroja Polavarapu

Awarded for 2005 to **Saroja Polavarapu**, Environment Canada, for her scientific leadership and insight in the emerging field of middle atmospheric data assimilation, and particularly in the development of the first fully coupled chemistry climate simulation model to be run in data assimilation mode. This is described in her thorough and ground-breaking paper "*Data assimilation with the Canadian Middle Atmosphere Model*", co-authored with Ren, Rochon, Sankey, Ek, Koshyk, and Tarasick, and published in ATMOSPHERE-OCEAN (**43**, 77-100, 2005). This paper describes research that is at the forefront of this field and provides an important foundation.

Tully Medal in Oceanography
may be awarded each year to a person whose scientific contributions have had a significant impact on Canadian oceanography.


Jean-Claude Therriault

Awarded for 2005 to **Jean-Claude Therriault,** Institut Maurice-Lamontagne, for his outstanding career as a Canadian marine biologist and his continuing leadership of oceanographic research in Québec. His wide-ranging contributions to the understanding of marine ecosystems, particularly in the Gulf of St. Lawrence, Hudson Bay and the Canadian North, have had significant impact on the conservation and sustainment of living marine resources. He has also played an important operational oceanographic role in Atlantic coastal waters through the Monitoring Program (AZMP) and in the establishment of the Gulf of St. Lawrence Observatory.

Andrew Thomson Prize in Applied Meteorology
may be awarded each year to a member or members of the Society for an outstanding contribution to the application of meteorology in Canada.


Terry Gillespie

Awarded for 2005 to **Terry Gillespie,** University of Guelph, for his outstanding contributions to Applied Meteorology in Canada through research and education in the field of Micrometeorology, in particular, for his work in the field of meteorological influences on plant diseases, which provided a physical basis for explaining the development of disease related to leaf wetness. This has resulted in the development of a detection instrument and the reduction of pesticide use based on better knowledge of meteorological conditions. He has also made important contributions to our knowledge of the meteorological aspects of smog and tropospheric ozone, including the impacts on agriculture.

Rube Hornstein Medal in Operational Meteorology
may be awarded each year to an individual for providing outstanding operational meteorological service in its broadest sense, but excluding the publication of research papers as a factor, unless that research has already been incorporated into the day-to-day performance of operational duties. The work for which the medal is granted may be cumulative over a period of years or may be a single notable achievement.


David Ball

Awarded for 2005 to **David Ball**, Environment Canada, for his passionate devotion to excellence in operational meteorology. David is a leader in operational meteorology striving to develop better tools and training which he innovatively implemented within the operational environment. David then developed new objective approaches to measure the resulting improved performance.

The Prize in Applied Oceanography
may be awarded each year to a member or members of the Society for an outstanding contribution to the application of oceanography in Canada.


James Stronach

Awarded for 2005 to **James Stronach**, Hay and Company Consultants, Vancouver, for his outstanding contributions to applied oceanography in Canada through his development of numerical models of coastal waters, and through application of these models to a wide variety of fields, from Search and Rescue software for the Canadian Coast Guard, to complete sewage outflow modelling for coastal communities, to tsunami and storm surge simulations, river plume and sediment transport, oils spill software and coastal erosion. His models of the Strait of Georgia and the St. Lawrence River and estuary have enabled others to extend these applications to ice forecasting, tidal height prediction and tidal current charts and software.

The CMOS Graduate Student Prizes
may be awarded each year for contributions of special merit by graduate students registered at a Canadian university or by Canadian graduate students registered at a foreign university. One of these prizes should be named the **Tertia MC Hughes Memorial Prize**.


Natacha Bernier

The Tertia M.C. Hughes Memorial Graduate Student Prize for 2005 is awarded to **Natacha Bernier**, Dalhousie University, for her outstanding PhD thesis work at Dalhousie University entitled *"Annual and Seasonal Extreme Sea Levels in the Northwest Atlantic: Hindcasts Over the Last 40 Years and Projections for the Next Century*". This timely research, centered on the frequency of extreme sea levels along the eastern seaboard of Canada, is not only innovative, but has important practical applications in terms of flood-risk assessment.

CMOS Graduate Student Prizes
are awarded for 2005 to:

• **Daniel Deacu**, Memorial University of Newfoundland and
• **Yi Wang**, McGill University.

The Roger Daley Postdoctoral Publication Award
The Roger Daley Postdoctoral Publication Award, valued at $2000, is to be made annually to a candidate who, at the time of nomination, is working in Canada in a non-permanent position as a postdoctoral fellow or research associate, and is within 5 years of having received a doctoral degree. The award is to be based on the excellence of a publication in the fields of meteorology or oceanography that has appeared, or is in press, at the time of nomination. The first award is to be made in 2005, and the awards will continue as long as the fund established by Mrs. Daley, together with other contributions solicited through CMOS, will permit.


Thomas Birner

Awarded to **Thomas Birner**, University of Toronto, for his careful and definitive study of radiosonde temperature and wind measurements, which revealed the existence of a tropopause inversion layer in the extratropics. This novel and pioneering work is described in his paper, "*The fine-scale structure of the extratropical tropopause region*", in press in the Journal of Geophysical Research - Atmospheres. This paper is already generating considerable interest, as the discovery of this layer is of great importance, with implications for dynamics, chemical transport and mixing, and climate.

The CMOS / Weather Network / Météomédia Scholarship
(offered to a Canadian female student enrolled in the 3rd or 4th year of an atmospheric science degree program at a Canadian university and with career aspirations as a forecast meteorologist, on-air meteorologist or meteorological briefer. It consists of a cheque for $1500. The scholarship is funded by an annual donation from, Pelmorex Inc., the parent company of The Weather Network and Météomédia.

Is awarded for 2005 to **Heather Antoniuk**, University of Alberta, for excellence in her studies.

The CMOS Weather Research House NSERC Scholarship Supplement


Betty Ann Croft

(Provides a supplement of $5000 to a holder of an NSERC Postgraduate Scholarship or Canada Graduate Scholarship. It is renewable for a second year provided the Scholarship continues to be held)

Awarded to **Betty Ann Croft**, Dalhousie University

The previous year's winner, **Joshua Nault,** University of Alberta, continues to hold his NSERC scholarship and hence he will also receive a cheque for $5000.

The CMOS SCOR/DFO NSERC Scholarship Supplement
(Provides a supplement of $5000 to a holder of an NSERC Postgraduate Scholarship or Canada Graduate Scholarship. It is renewable for a second year provided the Scholarship continues to be held. This is the first year of this new supplement, established courtesy of the CNC SCOR and DFO)

Awarded to **James R. Munroe**, University of Alberta

Neil J. Campbell Medal for Exceptional Volunteer Service
may be awarded each year to a member who has provided exceptional service to CMOS as a volunteer. The award may be made for an exceptional contribution in a single year or for contributions over an extended period. The contribution should have resulted in an important advancement for CMOS and/or its aims, nationally or locally.


Uri Schwarz

Awarded for 2005 to **Uri Schwarz** for more than 23 years of dedicated service to CMOS. Uri assumed the duties of volunteer Executive Director of CMOS in February of 1983. In this capacity he developed the Society's administration and contributed extensively to making it a mature and well organized society, with members and subscribers in excess of 1000. He is an exemplary volunteer who inspires those who work with him to excel, and has made an extraordinary contribution to the advancement of Meteorology and Oceanography in Canada. On our behalf, he faced problems on a daily basis, but always maintained a level of dignity, grace and friendliness in a gentlemanly manner. When he was followed by Neil Campbell as Executive Director in 1994, Council made him Executive Director Emeritus, a role which he continues to fill to this day. Uri has been a wonderful ambassador for CMOS and has promoted the Society through his many contacts all over the world.

CMOS Citation
may be awarded each year to an individual, group or organization which has, in the previous year, made some outstanding contribution towards promoting public awareness of meteorology or oceanography in Canada.

Awarded for 2005 to **Stephen Mayne**, Lanark Weather, Smith Falls Ontario, for his outstanding contributions to all aspects of the weather community. Stephen's devotion to weather education, severe weather spotting and the safety and security of the public are commendable. Stephen's passionate interest in meteorology is clearly evident in his excellent and informative Lanark Weather website.

CMOS Fellow
The title of CMOS Fellow is conferred on **Theodore (Ted) Shepherd**, University of Toronto, in recognition of his outstanding personal research in atmospheric dynamics, his leadership of collaborative middle atmosphere research and modelling programs in Canada, his mentoring of students and his leading contributions to the World Climate Research Programme and its core project on Stratospheric Processes and their Role in Climate (SPARC).

Professor Shepherd is a world recognized atmospheric dynamicist. He has provided outstanding leadership for the Canadian Middle Atmosphere Modelling and Global Chemistry for Climate Modelling programs. He is a widely cited author and communicator (speaker). His enthusiasm has energized successful collaborations, provided opportunities and mentoring for students and a focus for an unusually wide range of topics from observations to laboratory studies.

Prof. Shepherd was present. This award was announced last year but held over for presentation in Toronto in 2006.


Michel Béland

The title of CMOS Fellow is conferred on **Michel Béland,** Environment Canada, in recognition of his outstanding long-term contributions to atmospheric sciences, particularly as an administrator. With his exceptional leadership and drive, throughout his career Dr. Béland has catalyzed major national and international initiatives that have a strong influence on the advancement of our sciences.

Dr. Béland, who is currently Director General of Environment Canada's Atmospheric Science and Technology Directorate, represents Federal Government interests on numerous review and planning committees and leads many Canadian delegations abroad. In a variety of positions he has been responsible for management and leadership of research and development programs in Meteorological sciences, and more recently Climate, Air Quality, and Atmospheric Impact and Science Integration and Assessment research groups. These activities are tightly coupled with Canadian universities through national networks, foundations, and some private sector supported institutes. He is championing an inter-departmental government and academic initiative that is having a strong influence on both Meteorology and Oceanography in Canada. His recent election as president of the World Meteorological Organization's Commission for Atmospheric Sciences is a tribute to his worldwide leadership. Michel also has served on the National CMOS Executive, being President in 1995.


Geoff Strong

The title of CMOS Fellow is conferred on **Geoff Strong** in recognition of his exceptional long-term service and support to the Canadian Meteorological and Oceanographic Society. His commitment to CMOS is evidenced by the number of positions which he has held and the number of volunteer hours which he has dedicated to the Society.

Geoff was chair of the Scientific Program Committees for two congresses within the last ten years (Saskatoon and Edmonton), has dedicated about a dozen years to chairing CMOS Centres (Saskatchewan and Alberta), has been an active member of several CMOS committees, and is currently serving on the CMOS National Executive.

Dr. Strong is also a recognized national expert on prairie thunderstorms and atmospheric water budgets. He received the CMOS graduate student prize for his M.Sc. thesis in 1974, and his Ph.D. conceptual model continues to be the foundation for thunderstorm research on the Canadian Prairies. His career has taken him across Canada and back as an operational meteorologist and a research scientist. He has offered wisdom and guidance to young people, conveying his enthusiasm about the atmosphere to the next generation. Geoff's service to atmospheric research and CMOS make him worthy of the designation of CMOS Fellow.

CMOS Undergraduate Scholarships
(Provides $500 for students in their penultimate year of studies to support their final year).

are awarded to:

- **Marie-Ève Gagné**, McGill University

- **Bradley E. J. Power**, University of Alberta


Marie-Ève Gagné


Bradley Power

Campbell Scientific Canada Corp. Best Student Poster Prize
Was presented by Claude Labine to **Shannon E. Fargey,** of the University of Calgary and to **Alexander Korobov** of the University of Waterloo.


Shannon E. Fargey


Alexander Korobov

First Annual CMOS Photo Contest

And the prizes go to . . .

✦ First place ($100) – Rainbows by **Ed Hudson**

✦ Second place ($50) – Garden City Nocturne by **Dave Sills**

✦Third place ($25) – Pink and Grey Sunrise over White Point by **Bill Danielson**

Rainbows

First place winner, Ed Hudson, is an Environment Canada meteorologist with 38 years of service primarily as a shift forecaster. Thirty-three of his 38 years have been dedicated to arctic forecasting. His history includes tours of duty ranging from 9 seasons forecasting in support of offshore drilling and island construction from the Beaufort Weather Office in Tuktoyaktuk to 4 partial seasons as a fire weather meteorologist for the Government of the Northwest Territories and 3 weeks on a US icebreaker. Since 1994, Ed has been the MSC science lead for the International Arctic Buoy Programme. He is presently the lead marine forecaster for Prairie and Northern Region and a program manager / forecaster with the Prairie and Arctic Storm Prediction Centre.

In September 2005 Ed participated in the European Polar Low Working Group meeting hosted in Tromso by the Forecasting Division of Northern Norway, Norwegian Meteorological Institute. One of the Tromso forecasters invited meeting attendees to visit her summer place at Sommeroya on the outer coast of Norway. Once there, an invitation was extended to climb the nearby hill. From the top they saw rain showers racing by, followed by bursts of sunshine which provided the meteorology (physics) to give the brilliant primary and secondary rainbows over Sommeroya. Ed uses a CANON G-3 and advises that he lets “auto” do the camera settings.

Garden City Nocturne

Second place winner, Dave Sills, is a severe weather scientist with Environment Canada in Toronto. He has a life-long interest in storms and enjoys creative photography. He has been chasing storms in Ontario and on the US Great Plains and capturing them on film for about 15 years.

Garden City Nocturne was taken late on May 11, 2005, on the second-to-last day of a two-week storm chasing trip. Night had fallen as they approached Garden City, Kansas, but a few storms were still very active. A tornado-warned storm had developed to the south-west of Garden City and was headed right through town. Their chase caravan stopped at a highway gas bar at a safe distance north and west of the storm. Despite a throng of chasers in the area, including a team with a mobile Doppler radar, the storm failed to do much damage at all.

The photo was taken facing east with the lights from the gas bar illuminating the grass near the road. He was using a Nikon EM with a 28 mm lens on a tripod and Kodak Ultra 400 film. The aperture was opened all the way and the exposure time was probably about 10 seconds or so.

The title was inspired by an evocative James Whistler painting called Nocturne in Black and Gold: The Falling Rocket. The painting has a gold foreground, and a background of black and emerald green. The word 'nocturne' refers to a work of art dealing with evening or night.

Pink and Grey Sunrise over White Point

Third place winner, Bill Danielson, says that weather has fascinated him all his life. At Harvard he majored in Astronomy (no meteorology courses there), and he received an M.Sc. from McGill in 1969. He did a hitch as a forecaster in the U.S. Air Force, then spent his career teaching meteorology at the Talcott Mountain Science Center, Hartford College for Women and the University of Hartford, all in Connecticut. He co-authored an earth science textbook (MacMillan) and a meteorology text (McGraw-Hill), and he is looking forward to the launch of “Cape Breton Weather Watching” (Cape Breton U. Press) in October. His pink and grey sunrise photo appears in that book. Since retirement in 1998 he and his wife divide their time between Cape Breton, where they built a house designed for weather watching, and Cape Cod.

He took the photo from the deck of his house in Smelt Brook, Cape Breton Island, Nova Scotia, at 5:15 a.m., ADT, on 27 June 2003, about 6 minutes after sunrise. The water body is Aspy Bay; the land jutting in from the right is White Point. He used a tripod-mounted Nikon D-100 digital camera with a 300-mm zoom lens. Exposure was 1/100 sec at f/5.6 with equivalent ISO at 200. All other settings (white balance, tone and exposure compensations, etc.) were at default values. The weather was cool (13°C), damp and overcast, with southwest winds. The sun’s sliced-and-diced appearance probably is due to anomalous refraction through a low level temperature inversion.

About the contest

Twelve very talented photographers submitted 31 pictures. Thanks are extended to Bill Danielson, Frank Dempsey, Ed Hudson, Bob Jones, Romain Lanos, Stephen Mayne, Bill Pugsley, George Robertson, Uri Schwarz, Igor Shkvorets, Dave Sills, and Richard Verret

for their delightful submissions.

Voting took place at the CMOS Booth at the Toronto Congress, May 28 to June 1. Photos were displayed on a laptop computer and 4" by 6" prints were also available. Ballots were provided in both French and English. Voting was anonymous, that is, people voted for the picture without knowing the photographer's name.

Many thanks go to those people who assisted in the CMOS Booth and particularly to Dorothy Neale who actively encouraged people to sit down and vote.

Keep your cameras at the ready. Plans are under way for the 2nd Annual Photo Contest to celebrate the artistic and creative talents of CMOS members.

Susan Woodbury
Past President

Note from the Editor

The three winning photos can be seen in colour on the inside front cover page.

Les trois photos gagnantes sont imprimées en couleur sur la page couverture intérieure.

The day CMOS took over Toronto City Hall

Prof. Andrew Weaver

The University of Toronto Centre for Global Change Science and The Canadian Meteorological and Oceanographic Society in collaboration with The City of Toronto presented a public lecture entitled *The Science (and Politics) of Global Warming.* Prof. Andrew Weaver from the School of Earth and Ocean Sciences, University of Victoria, presented the lecture on Tuesday, May 30, 2006, in conjunction with the 40th CMOS Annual Congress held in Toronto, Canada.

In February 2007, the United Nations Intergovernmental Panel on Climate Change (IPCC) will release its Fourth Assessment Report on climate change science. Six years will have elapsed since the IPCC released its Third Assessment Report containing the following statement:

There is now new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.

The science leading up to this statement was addressed during the public lecture along with subsequent advances in climate change science. A historical perspective on Earth's climate over the last 400,000 years and the science of global warming over the last 200 years was also offered to the audience. Finally, a discussion of some outstanding uncertainties took place and a look towards the future was presented and discussed with the attendees.

Reported by Paul-André Bolduc
Editor, CMOS Bulletin SCMO

Toronto City Hall, May 30th, 2006

Note from the Editor: The above two photos taken in the Toronto City Hall are courtesy of Yves Pelletier, Environment Canada, Dorval, Québec, Canada.

RAPPEL - RAPPEL - RAPPEL

La SCMO a négocié des tarifs intéressants pour ses membres qui désirent devenir membre de la Société royale de météorologie (RMetS) et de l'Union géophysique canadienne (CGU). Un rabais de 25% est appliqué lorsque vous devenez membre associé de ces deux sociétés savantes. Les membres de ces deux sociétés ont également le privilège de devenir membre associé de la SCMO; dites-le à vos collègues et encouragez-les à joindre la SCMO.

Atmosphere-Ocean Interactions Volume 2

Editor: W. Perrie

WIT Press, 2006
Hardbound, 224 pages, US$142

Book reviewed by Paul Myers[1]

This is the second volume in a series of atmosphere-ocean interactions and focusses on the mechanisms for the development of marine storms. The book is effectively (if not explicitly) divided into two sections. The first grouping of five papers is focussed on marine observations and parameterizing air-sea interactions. The final three papers then consider the implications of the previous work in terms of modeling studies. Each chapter is a contributed paper from a researcher(s) active in the area.

Considering the chapters in more detail, the first (by W.M. Drennan) reviews our knowledge on the parameterization of air-sea turbulent fluxes. The second chapter (by M.A. Bourassa) examines wave-related impacts on surface stress and the near surface atmospheric boundary conditions. Chapter 3 (by Y. Toba et al.) focusses on the transfer of CO_2 between the ocean and the atmosphere and how to improve its parameterization. Chapter 4 (by T.D. Sikora et al.) considers the application of synthetic aperture radar (SAR) to the air-sea interaction question, although I would say this chapter is more of a general review of capabilities for the instrument in question. Chapter 5 (by L.K. Shay and S.D. Jacob) looks at the impact of a passing tropical cyclone on the underlying ocean as well as observationally testing a number of parameterizations. Chapter 6 (by W. Perrie et al.) applies existing air-sea flux parameterations to a case study on Hurricane Gustav. Chapter 7 (by J.L. Evans and R.E. Hart) provides a detailed look at extratropically transitioning cyclones. Finally, Chapter 8 (by X.L. Wang and V.R. Swail) estimate changes in wave heights in the North Atlantic and North Pacific under possible climate change scenarios.

This is a solid volume for scientists interested in the areas it covers. The papers are for the most part well written and seem more than just copies of papers existing in the literature. Many of them are suitable for non-specialists and do a solid job of explaining their key points in a clear and direct manner. However, they are of variable level, with some getting right into the underlying theory while others are on the more descriptive side. Additionally, as I said with my review of Volume 1 (*CMOS Bulletin SCMO*, Vol.31, No.3, June 2003), the title may mislead some people, since I was expecting papers on large-scale coupled modeling, issues of surface boundary conditions, flux corrections in models, etc., from the title Atmosphere-Ocean Interactions. That said, the description on the back of the book is quite accurate and provides all a potential purchaser needs to know about the book's content. In summary, for those researchers who are interested in (or who wish to learn something about) the details of air-sea interaction associated with marine storms, this volume solidly does the task.

[1] Paul Myers
Department of Earth and Atmospheric Sciences
University of Alberta
Edmonton, AL

CLIMATE CHANGE IN PREHISTORY : THE END OF THE REIGN OF CHAOS

by William J. Burroughs

Cambridge University Press, May 2005, Hardback
ISBN: 0 -521-82409-5, 356 pages + xii preface, US$30

Book reviewed by Pat Spearey[2]

The author, a professional science writer who had a 30-year career in UK national government posts in the scientific, energy, and health fields, has produced several books on various aspects of weather and climate. This work continues his recent emphasis on climate change and variability and complements his previous books by concentrating on events during the late stages of the major ice ages, on the challenges that humans had to deal with in a glacial climate, and on the developments that occurred as the climate warmed significantly about 10,000 years ago. In bringing together studies of the climate with anthropological, archaeological and other historical information, *"Climate Change in Prehistory"* interestingly plots the effects of climate on early human development and history.

The first of eight major sections is a short introduction explaining the parameters of the book. This is followed sequentially by sections entitled : The Climate of the Past 100,000 Years; Life in The Ice Ages; The Evolutionary Implications of Living with The Ice Age; Emerging from The Ice Age; Recorded History; Our Climatic Inheritance; and

[2] CMOS Member, Ottawa Centre

The Future. The first four of these sections are the longest and contain the essence of the publication and enable the author to explain clearly the nature and likely past effects of climate variability and infrequent but significant climate changes. Throughout, a few figures and tables complement the narratives.

An appendix discusses dating techniques. Then follow a useful ten page glossary of meteorological, climatological, anthropological, and other scientific terms and names; eighteen pages of wide-ranging references - mostly dated in the late 1990s and early 2000s with some entries dated as late as 2005; five pages of bibliography (1972-2003); and an adequate eleven page index.

The author has drawn assiduously on his numerous referenced sources to embrace virtually all the types and aspects of research into climate history. Genetic mapping, oxygen isotope measurements of ocean sediment cores, dendrochronology, radiocarbon and uranium/thorium dating, and early Stone Age history including anthropology and archaeology are discussed and findings are used to piece together climate history. The development and movement of humans in reaction to climatic influences are well covered in many interesting sub-sections, the titles of some of them conveying the exent of the author's search for material: Walking out of Africa; Life on the Mammoth Steppes of Asia; Three-Dog Nights (Chukchi culture); Of Lice and Men; The Spread of Farming into Europe; The Peopling of The New World; and The Last Saharan Pastoral Idyll.

The analysis in the book extensively covers the Eurasian and North Atlantic areas for which considerable data and research findings are available; however other regions are not neglected. Occurrences and features that have become better known in the past century, such as the El Niño Southern Oscillation, the Intertropical Convergence Zone, and the North Atlantic Oscillation (NAO) are considered in historical contexts, especially the NAO and related effects beyond the North Atlantic.

In the later sections that explore recent millennia, the emergence of civilizations, the development of more productive agriculture, and physiological and health patterns and hazards are linked to natural and at times significant climate variability and to the benefits of temperate zones for human evolution.

When considering the climatic challenges of the future, the author treads very carefully and does not try to draw any firm conclusions from known or possible past events. Rather, he re-emphasizes probable key past climate variability and change related events, ponders if sudden warming of the oceans during the last ice age that significantly altered the thermohaline circulation and climates might recur because of current human activities, wonders whether our much more developed world would be able to react positively to some event recurrences, and reminds readers that historical climate instability is far from fully understood.

The book should appeal and be useful to a general readership on all sides of the climate change debate including the general public, scientists, decision makers, students, and researchers, particularly those who subscribe to the theory that the past is (or may be) the key to the future for climate science. It is well written, easy to read, and the science is presented in an uncomplicated style. As an overview, it fills a gap in climatological publications.

The Weather-Makers

by Tim Flannery

Harper Collins Publishing, 2006, 352 pp, $34.95, Hardcover

Book reviewed by John Stone[3]

Popularizing the science of climate change has become, well, popular if not always accurate. There seems to be a thirst to understand the issue and to come to grips with what can best be described as a threat to our singular and collective livelihoods. Large numbers of people have recently been streaming into cinemas in North America to sit through what is effectively a two-hour science lecture by (the man who used to be the next President of the United States) Al Gore – even on a summer afternoon in generally apathetic Ottawa. With visual aids that any of us who have given similar presentations would envy, he begins by framing the problem in terms of the increase in the atmospheric concentrations of carbon dioxide that has been well established by the measurements first collected by Charles Keeling on Mauna Loa in the 1950s and subsequently corroborated by other measurements including those taken at Alert. Gore suggests that the plot of this inexorable rise in carbon dioxide concentrations marks the beginning of the modern environmental movement (which devotees of Rachel Carson may disagree with).

Gore continually uses the term “global warming” rather than “climate change”. This is not always helpful since the former implies we are only concerned about temperature. His conclusions, however are clear: this is a moral issue that we can and must solve, that we have the technologies today to make a good beginning, and that all we lack is the political will (something which, while some will see as an indication of political ambition, he claims is a renewable resource). In between he takes the audience through a remarkably accessible tour of scientific data, facts and hypotheses. It can be argued that some of his excursions into the science are unnecessary, perhaps even displaying a lack of

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[3] Retired meteorologist and adjunct Research Professor in the Department of Geography and Environmental Studies at Carleton University

modesty and run the danger of losing some of the audience. There are a few minor errors such as having the outflow from Lake Agazzis at the end of the last ice age flow into the St Lawrence rather than, as Dick Peltier has suggested, north into the Arctic Ocean. But these are quibbles and don't take away from the force of his argument. One wonders whether the public attention to this issue may not become something of an inconvenience for those with political agendas who might prefer to have this issue go away.

When asked to recommend a book that those not conversant with the science of climate change may use, I often refer them to the Technical Summary of the Working Group I contribution to the Intergovernmental Panel on Climate Change's (IPCC's) Third Assessment Report. It is on the web and can easily be downloaded. For those who are prepared to spend the money, an alternative is John Houghton's excellent book: "*Global Warming – The Complete Briefing*" (3rd Edition); Cambridge University Press, August, 2004. Even John Houghton, who co-Chaired the first three IPCC Working Group I assessments and ought to know better, uses the term "global warming". However, as good as these references may be, they may both be overshadowed in their impact by "*The Weather Makers"* by Tim Flannery, an Australian biologist and conservationist.

The cover of the Weather Makers comes replete with quotes and praise from the likes of David Suzuki, Ronald Wright and John Polanyi not to mention Tony Blair. But the book is not so much aimed at the converted but at those who are seeking to better understand the issue. Hence it may be significant that the book is claimed to have changed the mind of the Minister of the Environment of Australia, a country that has not ratified the Kyoto Protocol and has initiated the alternative Asia-Pacific Partnership on climate change. The book's title makes the point that humans are now having a significant impact on the climate. Unfortunately, the book is anything but balanced – its approach is more one of alarm. While the evidence that the urgency to address climate change is becoming more obvious, alarmists are often no more helpful in this debate than those who are purposely blind to its reality - the nay-sayers. This point is brilliantly, if not intentionally, illustrated in Michael Crichton's book: "*State of Fear*" (Harper Collins, 2004).

Flannery's book's structure allows him to cover a wide range of scientific material but it is done in a somewhat syncopated style – almost like overhearing a couple of adolescent schoolchildren chatting on the 'bus – such that the lines of argument are developed in an almost impressionistic sense. This may work for those who were educated in more recent times but for those of us whose training was more axiomatic it does tend to annoy. The book, to its credit, not only defines the problem by explaining the science of climate change and describing some of the anticipated impacts, but it also goes on to suggest possible solutions. Flannery is taken by the Gaia hypothesis of Jim Lovelock (who the book narrowly refers to as a mathematician) to explain that we have taken the planet Earth into uncharted territory that has not been experienced for almost one million years. Like Gore, he refers to Keeling's plot as "the *Silent Spring* of climate change".

The author has clearly talked to many experts and has read key papers (many of which are referenced in the Notes section). However, while he gets most of the science right, he is often guilty of being selective in the material he uses and occasionally glides into inaccuracy. For example, it is stated that methane is 60 times more potent as a greenhouse gas than carbon dioxide. While this is true over 20 years, it is significantly less over a 100 year time-frame because it decays faster. And to suggest that "it is this buried carbon [in the Earth's crust] that allows oxygen to exist in our atmosphere", is just too simplified to be useful. Although he later makes the interesting point that "by pilfering this buried bounty we have set ourselves free from the limits of biological production..". Or as he writes later on, our fossil fuel resources are "ancient sunlight". Canadians will be surprised to find that nuclear reactors are being constructed in this country – someone should tell Greenpeace – and that Nortel is a US telecom company.

So, is this book a useful addition to the library of popular texts on climate change? There are simply far too many mistakes to recommend this book to students. For the general public, two hours with Al Gore would be just as effective a means of learning the main scientific arguments – and there are fewer inaccuracies that the climate change deniers could employ. But, if this book can capture the political agenda in Canada, or elsewhere, perhaps that is all that counts.

You wish to do a book review ? Look at **page 124** for a list of books awaiting your review and just contact the Editor at bulletin@cmos.ca

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Vous voulez faire une critique de livre? Consultez la liste à la **page 124** et contactez tout simplement le Rédacteur à Bulletin@scmo.ca

REMINDER - REMINDER - REMINDER

CMOS has negotiated great membership deals for its members. CMOS members are eligible for a 25% discount off membership fees for the Royal Meteorological Society (RMetS) and the Canadian Geophysical Union (CGU) as associate members. Members of both these societies are also eligible for associate membership in CMOS; so please encourage your colleagues in those societies to join CMOS too.

JOHN LEWIS KNOX

1918 – 2006

Canadian Meteorological Service
Atmospheric Environment Service
1941 – 1975

At Toronto, on May 14, 2006, leaving Mary Hardy (Martin) Knox, his wife of 57 years; children Paul (Lesley Krueger), Roger and Sheila (Jim Cobban); grandsons Gabe Knox, Peter Cobban and David Cobban, all of Toronto; sister Peggie (Mrs. Philip Lee) and nieces Robin Lee, Mandy Lee (Greg Patton) and Liz Aldwinckle (John) of Calgary; niece Tamara Knox of Vancouver; sister-in-law Alice Sharpe (Charles) of Lakefield, Ont., niece Jennifer Flatman (Mark) of Haliburton, Ont., nephew Peter Dance (Susan Monk) of Orillia, Ont.; 10 great-nieces and great-nephews; first cousins Lewis Kelley of Deal, Kent, and Philip Kelley of London, England; and cousins in Northern Ireland, Jersey and Australia. Predeceased by his brother David of Vancouver.

Shaped like so many others by the wars of the 20th century, John's life was marked by a passion for science, the public service and family activities. His father, Robert Knox (b. near Irvinestown, Co. Fermanagh, Ireland) emigrated to Canada in 1907 and was commissioned as a major in the Canadian Army in 1914. He met Vera Marks (b. Leicester, England) in London while on medical leave after service in France. Invalided back to Canada, Robert was joined by Vera in Halifax, where they were married in 1917 and where John, the first of their three children, was born on July 28 of the following year. The family arrived in Toronto after sojourns in Saint John, N.B., and Montreal, but owing to Robert's health problems, Vera and the children then spent three years with relatives in St. Helier, Jersey, Channel Islands. They returned in 1929 to Toronto, where John attended the Normal Model School and Jarvis Collegiate. The summers spent on the beaches and tennis courts of Ward's Island were among the happiest times of his adolescence.

John graduated from the University of Toronto in 1939 with an honours BA in mathematics and physics. He worked for the Excelsior Life Insurance Co. but in 1941 seized the opportunity to apply his skills to the war effort, signing up for training as a meteorologist. Posted to Gaspé, Goose Bay and Gander, he served with a corps of forecasters and technicians that provided invaluable guidance to trans-Atlantic flight crews. Several became leaders of Canada's meteorological service in the post-war years. In 1947, John returned to Toronto to join the forecasting staff at Malton (now Pearson International) airport. He completed his MA degree from U of T and also frequented the Bloor Street headquarters of the service. There he met Mary, who had been working as a meteorological technician since university graduation in 1944. They were married in 1948 and moved to Etobicoke, then a rapidly growing suburb.

John's professional achievements included his analysis of the transformation of Hurricane Hazel, which struck the Toronto region with deadly force on Oct. 15, 1954. He was part of the forecast team on duty at the time and later published scientific papers on the subject. He became chief forecaster at Malton and, after the death of his friend and colleague Fred Turnbull, acting director of the Ontario region of the Canadian Meteorological Service (later AES). John appeared on CBC television as a weather analyst and was well known to listeners of radio station CFRB for his daily afternoon weather updates. Cherished memories of his Ashbourne Drive years include the backyard ice rink he kept carefully maintained and available to the neighbourhood, and summer holidays at Sandy Lake in the Kawarthas with sister-in-law Alice and her family.

John moved with his family to Vancouver in 1965 after being named director of the meteorological service's Pacific region. He relished not only the administrative challenge but also the chance to become familiar with weather patterns on the Pacific Coast. Always a keen student of meteorological science, he took early retirement in 1975 and embarked on graduate studies at the University of British Columbia, where he obtained a PhD in 1981. He was a pioneer in using computer analysis to re-interpret decades of observed weather data. His thesis on atmospheric blocking sought to employ these techniques to explain anomalies in the development of weather systems in the Northern Hemisphere. John's awareness of the value of observations taken by human beings led him to champion the cause – ultimately unsuccessful – of saving Ocean Station Papa off the Pacific Coast and the weather ships that kept it running.

Armed with his doctorate, John spent several years as a consulting meteorologist for clients including AES and the U.S. Geological Survey, working on problems such as Arctic temperature variability and drought cycles in the Red River basin. His papers and reviews were published in scientific journals and he contributed to the work of the United Nations Intergovernmental Panel on Climate Change. He was a longtime member of the American Meteorological Society and the Canadian Meteorological and Oceanographic Society. He received the Andrew Thomson prize in applied meteorology in 1982 for his doctoral thesis, and in 1983 was awarded the Patterson Medal for distinguished service to meteorology in Canada.

A lifelong sports enthusiast, John played intramural hockey and squash in university and also enjoyed tennis, racquetball and cycling. With their children grown and flown, John and Mary returned to Toronto in 1982 and spent many happy days in their garden on Deloraine Avenue, where John paid particular attention to his spectacular dahlias. Retirement was enriched by travel, including visits to Jersey and his father's birthplace in Fermanagh, as well as a fascination with computer games and the enjoyment of watching his grandchildren flourish. The frustration of failing faculties was eased greatly by caregiver Ron Andrada and the staff of Fourth Floor East, Isabel & Arthur Meighen Manor, to whom John's family is deeply grateful for their kindness and support.

So long John – we wish you sunny skies, fair winds and safe landings. We miss you already!

Obituary provided by Sheila Knox and published in the Globe and Mail, May 19, 2006.

ANNOUNCEMENT

CMOS-CGU-AMS Congress 2007

May 28- June 1, 2007
St.John's, Newfoundland & Labrador, Canada

Welcome

The CMOS-CGU-AMS Congress 2007 will be held at the St.John's Convention Centre and Delta Hotel from 28 May to 1 June, 2007. The Scientific Program Committee (SPC) aims to develop a unique science program that will cover topics in Earth Sciences. Located in the heart of the easternmost North American historic city of St.John's, the Congress is sure to offer exciting sessions and a relaxing atmosphere. The SPC cordially welcomes your contribution and participation.

Congress Theme

Air, Ocean, Earth and Ice on the Rock

The three Societies cover a wide range of disciplines which are interrelated in many aspects. The theme reflects the Congress objective to explore, link, bridge and integrate the scientific interests of the three societies.

The SPC has developed the following provisional sub-themes, some of which closely link to the key objectives of the International Polar Year.

- Arctic Air-Sea Interactions;
- Atmosphere-Cryosphere-Solid Earth Interactions;
- Climate Variability and Change in the Arctic;
- Cyber Infrastructure and Geocomputations;
- Coastlines and Coastal Ocean Dynamics;
- Connecting Deep and Surficial Earth Processes;
- Coupled Environmental Prediction Systems;
- Data Assimilation in Numerical Modelling;
- Geodynamics and Cryodynmaics
- Humans, Societal and Environmental Changes;
- Hydrology;
- Monitoring Earth System Dynamics from Space;
- Natural Resources, Water and the Environment;
- Oceanography and Meteorology of the Northwest Atlantic;
- Operational Oceanography and Meteorology;
- Polar Environments and Telecommunications;
- Polar Meteorology and Oceanography;
- Snow, Glacier and Ice Sheets.

ANNONCE

Congrès SCMO-UGC-AMS 2007

du 28 mai au 1er juin 2007
St-Jean, Terre-Neuve & Labrador, Canada

Bienvenue

Le congrès SCMO-UGC-AMS 2007 aura lieu à St-Jean au Convention Centre et à l'hôtel Delta du 28 mai au 1er juin 2007. Le comité du programme scientifique (CPS) vise à développer un calendrier unique couvrant plusieurs aspects des sciences de la terre. Situé tout à l'est de l'Amérique du Nord, au coeur de la ville historique de St-Jean, le congrès vous offrira des sessions stimulantes dans une atmosphère de détente. Vous êtes cordialement invité à contribuer et à participer à ce congrès.

Thème du congrès

Air, océan, terre et glace sur le Roc

Les trois sociétés représentent plusieurs disciplines connexes en sciences de la terre. Le thème choisi reflète l'objectif du congrès qui est d'explorer, de rapprocher, d'unir et d'intégrer les intérêts scientifiques des trois sociétés.

Le CPS a établi les sous-thèmes provisoires suivants. Certains de ces thèmes rejoignent les objectifs clés de l'Année Polaire Internationale.

- Interactions air-mer en Arctique;
- Interactions atmosphère-cryosphère-terre;
- Variabilités et changements climatiques dans l'Arctique;
- Infrastructures cybernétiques et géoinformatiques;
- Dynamique des milieux côtiers;
- Connexions entre les processus en profondeur et en surface de la Terre;
- Systèmes couplés de prévisions environnementales;
- Assimilation de données en modélisation numérique;
- Géodynamique et dynamique de la cryosphère;
- Changements humains, sociétaux et environnementaux;
- Hydrologie;
- Monitorage de la dynamique de la terre à partir de l'espace;
- Ressources naturelles, eau et environnement;
- Océanographie et météorologie du nord-ouest Atlantique;
- Océanographie et météorologie opérationnelles;
- Environnements polaires et téléconnexions;
- Océanographie et météorologie polaires;
- Neige, glaciers et calottes glacières.

We solicit your proposals for other sub-themes and welcome contributions on other topics in Earth sciences that are not listed above.

Important Dates:

• 10 August 2006: Call for Session Deadline;
• 15 February 2007: Abstract Submission Deadline.

If you have any suggestions on the science program, please contact:

• Guoqi Han at hang@dfo-mpo.gc.ca
or
• Rod Blais at blais@ucalgary.ca

Scientific Program Committee:

• Guoqi Han (Co-Chair, Fisheries & Oceans Canada)
• Rod Blais (Co-Chair, University of Calgary)
• Mike Alexander (US NOOA)
• Uma Bhatt (University of Alaska Fairbanks)
• Jim Buttle (Trent University)
• Fraser Davidson (Fisheries & Oceans Canada)
• Brad deYoung (Memorial University of Newfoundland)
• Colin Farquharson (Memorial University of Newfoundland)
• Paul Ford (Environment Canada)
• Ken Snelgrove (Memorial University of Newfoundland)
• Taneil Uttal (US NOAA)
• Lucie Vincent (Environment Canada)

Nous sollicitons vos propositions pour d'autres sous-thèmes ou aspects des sciences de la terre qui ne seraient pas listés ci-dessus.

Dates importantes:

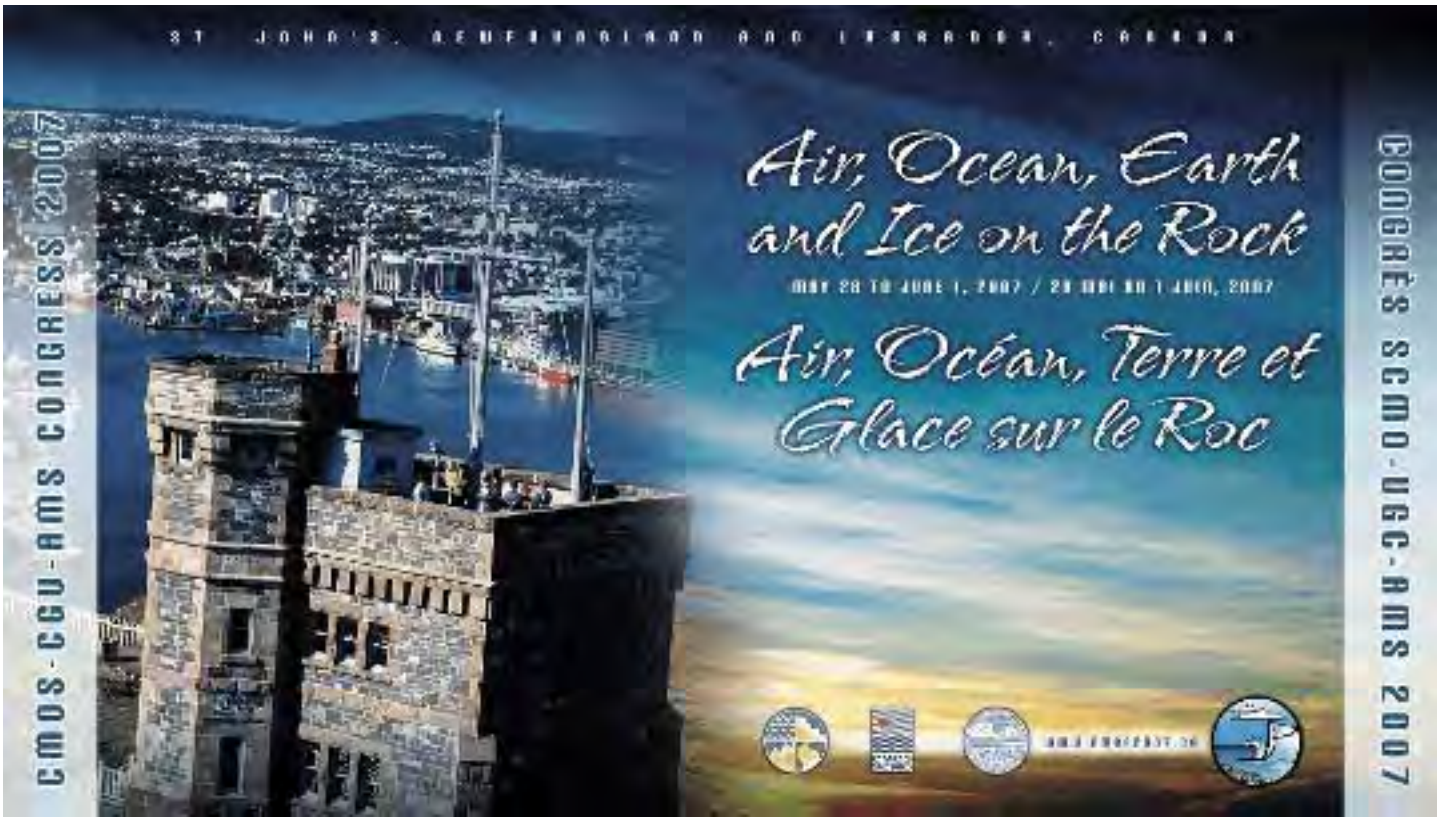
• 10 août 2006; date limite pour soumettre une session;
• 15 février 2007: date limite pour soumettre un résumé.

Si vous avez des suggestions concernant le programme scientifique, prière de contacter:

• Guoqi Han à hang@dfo-mpo.gc.ca
ou
• Rod Blais à blais@ucalgary.ca

Comité programme scientifique:

• Guoqi Han (Co-président, Pêches & Océans Canada)
• Rod Blais (Co-président, Université de Calgary)
• Mike Alexander (É.U. NOOA)
• Uma Bhatt (Université d'Alaska Fairbanks)
• Jim Buttle (Université Trent)
• Fraser Davidson (Pêches & Océans Canada)
• Brad deYoung (Université Memorial de Terre-Neuve)
• Colin Farquharson (Université Memorial de Terre-Neuve)
• Paul Ford (Environnement Canada)
• Ken Snelgrove (Université Memorial de Terre-Neuve)
• Taneil Uttal (É.U. NOAA)
• Lucie Vincent (Environnement Canada)



Highlights of Recent CMOS Meetings

CMOS Council Meeting, Toronto, 28 May 2006 –

• Planning for the next three Congresses all going well and ahead of schedule, including St. John's (2007, joint congress with CGU and AMS), Kelowna (2008), and Halifax (2009).
• First report from the new Finance & Investment Committee received. This new committee was formed by Council in March in order to advise CMOS on finance and investment, and to consider long-term policies regarding the raising of revenue. This committee is chaired by Dick Stoddart.
• Final report from the *ad hoc* Vision Committee presented; among its recommendations, to take this a step forward and create a Strategic Planning Committee for CMOS.
• First report from the new *ad hoc* Student Committee received; Council approved Ms. Tiffany Shaw (Univ. of Toronto) as the first chair of this group.
• Publications: the A-O Editorial Board is studying the feasibility of publishing more operational meteorology papers.
• The Montréal Centre has been resurrected and volunteers for the executive have come forward.
• Council appointed new chairs for the School and Public Education Committee (SPEC- Bill Hume) and the University and Professional Education Committee (UPEC – Robert Mailhot).
• Terms of Reference for the new Flight Service Accreditation Committee were approved.

CMOS Annual General Meeting, Toronto, 29 May 2006 –

• Selections of Kelowna and Halifax for the 2008 and 2009 Annual Congresses approved.
• CMOS Executive was instructed to determine the viability of an *electronic newsletter* for CMOS.
MOTION: *that Council take a more visible and effective national and political role in support of issues relevant to CMOS and its members. (Moved by Gordon McBean, seconded by Robert Mailhot.)* Carried.
• New Executive approved for 2006-07, based in Edmonton.

CMOS Executive Meeting, Edmonton, 30 June 2006 –

• Motion to form an *ad hoc* Strategic Planning Committee to carry forward the work of the previous *ad hoc* Vision Committee. Carried, to be submitted to next Council meeting. Meanwhile, this ad hoc group will meet during July/August to discuss priorities, including the AGM motion above.
• Summary report from 2006 CMOS (Toronto) Congress very positive in terms of scientific feedback, while predicted surplus will be exceeded by a good margin.
• Geoff Strong attended the Canadian Geosciences Committee 'Council of Presidents' meeting in Calgary, 10 June; recommends we continue to participate in these meetings, but to hold off on any formal membership until the goals for the replacement Canadian Geosciences Initiative is clarified.

Next Meetings are:

• *ad hoc* Strategic Planning Committee, July/August 2006 (TBD);
• CMOS Student Committee, September 2006 (TBD);
• CMOS Executive, 20 September 2006;
• CMOS Council, 27 September 2006.

CMOS Accredited Consultants
Experts-Conseils accrédités de la SCMO

Gamal Eldin Omer Elhag Idris, C.Chem., MCIC

Chemical Oceanography,
Pollution Control and Water Technology

211-100 High Park Avenue
Toronto, Ontario M6P 2S2 Canada
Tel: 416-516-8941 (Home)
Email; omer86@can.rogers.com

Douw G. Steyn

Air Pollution Meteorology
Boundary Layer & Meso-Scale Meteorology

4064 West 19th Avenue
Vancouver, British Columbia,
V6S 1E3 Canada
Tel: 604-822-6407; Home: 604-222-1266

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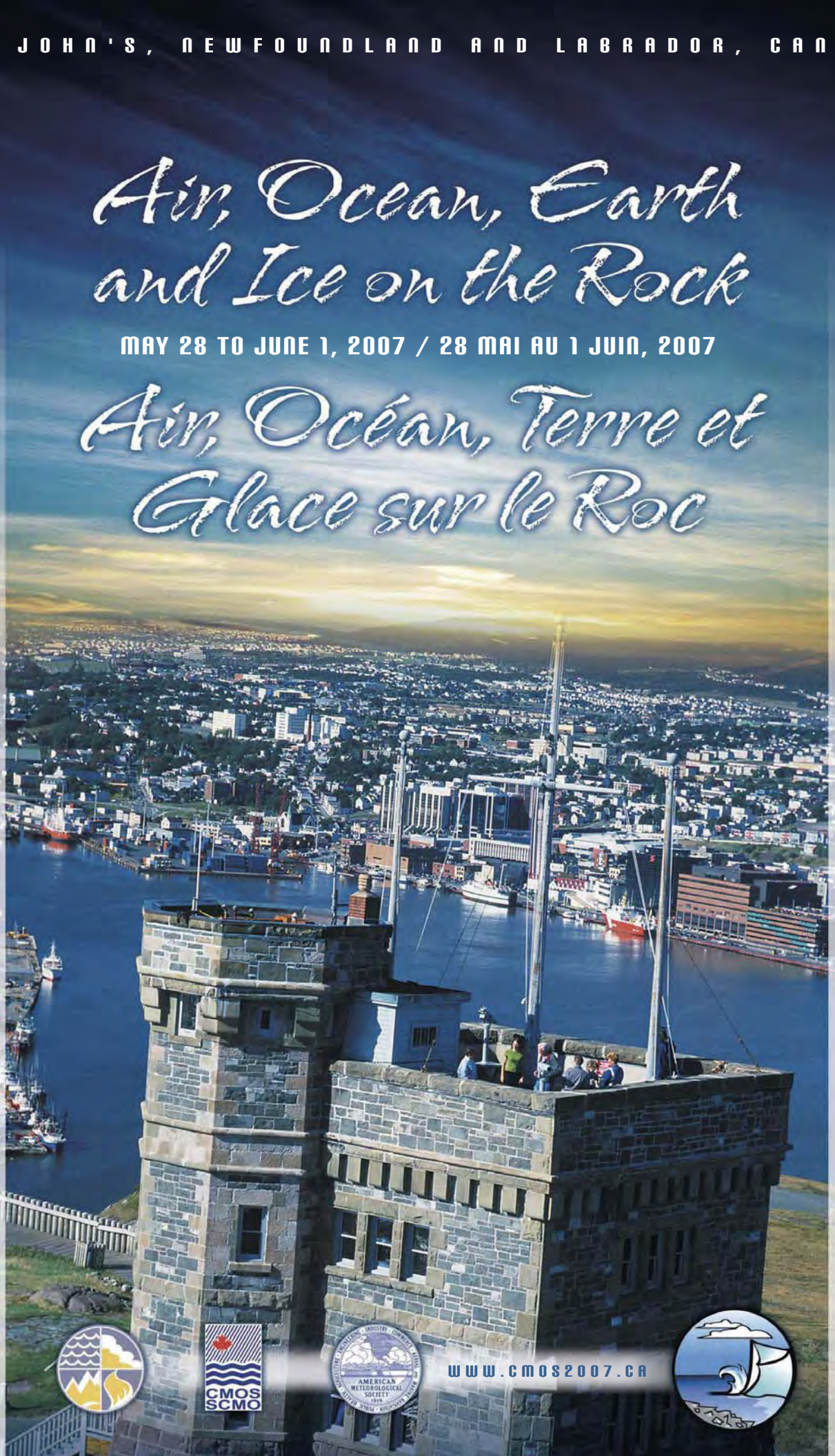
CMOS-CGU-AMS CONGRESS 2007

CONGRÈS SCMO-UGC-AMS 2007



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