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## CMOS Bulletin SCMO

"at the service of its members
au service de ses membres"

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**Cover page:** The cover shows a photograph of noctilucent clouds taken at sunset by Tom Eklund on 28th July at Valkeakoski, Finland. These clouds appear near 82 km height in the high latitude summer and the visible banding directly shows the presence of mesospheric gravity waves. The paper by Hamilton et al. (page 40) in this issue discusses a computer simulation of the generation and propagation of small scale gravity waves in the troposphere and their propagation to mesospheric heights. Photo courtesy of Tom Eklund.

**Page couverture:** La page couverture montre une photo de nuages nocturnes lumineux prise au coucher du soleil par Tom Eklund le 28 juillet à Valkeakoski, Finlande. Ces nuages apparaissent à une altitude de 82 km, à l'été, dans les hautes latitudes et les bandes visibles montrent la présence d'ondes de gravité dans la mésosphère. L'article par Hamilton et al. (page 40) dans ce numéro discute d'une simulation numérique de la génération et de la propagation d'ondes de gravité à petite échelle dans la troposphère et leur propagation jusque dans la couche de la mésosphère. La photo est une gracieuseté de Tom Eklund.

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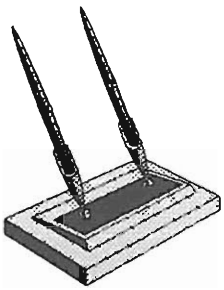
## ....from the President's Desk



CMOS Friends:

Well, here it is. This is my last President's Desk article. My first one started off with a brief summary of the 2001 Congress so I think it is appropriate if I start this one with a brief discussion of our 2002 one.

I am really looking forward to this Congress. As a Canadian, I am always delighted to see attention being given to our North and this year's theme of "The Northern Environment" is perfect. The Rimouski Organizing Committee is envisioning presentations on many aspects of The North including its oceans, ecosystem, surface exchanges, water and energy cycles, chemistry and biogeochemical cycles, and climatic variations. Being from the atmospheric side, I know about some of the climate and weather issues of this region but I have a great deal to learn about the land surface, ocean and sea ice and, in particular, how all of these critical elements interact. Our northern 'canary' region is experiencing many changes in its climate and related features. Do we understand these and what will happen in the future?

I am also delighted to see that, again, the Congress is acting as a focal point for other issues as well. For example, this year there will be a special discussion addressing the place of women in science. It is expected that there will also be special sessions on, for example, operational meteorology and oceanography, regional climate modelling, data assimilation, new observing technologies, coastal and basin oceanography, the North Atlantic Ocean and the sub-polar gyre, clouds and radiation, as well as the Saguenay flood of 1996.

I also look forward to our Congresses because it is THE place to chat with our colleagues from across the country. This is a critical aspect of the Congress as well. We hear about new research opportunities and the latest progress. We also renew our friendships and start new ones as we participate in our "CMOS network" that is acting to promote our sciences in Canada.

As I look back over this past year, I have a sense of satisfaction that this 'keep on track' year (to quote myself in my first President's Desk article) has been quite successful. For example, we have continued to support our top-notch research, we have improved our visibility and impact in several ways, we have finished several long-term efforts, and we have embarked on a discussion of our future. You will find a more detailed summary of such activities in my report contained in this year's Annual Review.

For me, one of the most interesting aspects of the past year has been that I have become much more aware of the actual 'workings' of the Society and its interactions with other groups. For example, I had never even been to the Society Office in Ottawa before and acronyms such as CCR and CGC were unknown to me. As President, I have also been an ex-officio member of the Board of Trustees for CFCAS (Canadian Foundation for Climate and Atmospheric Sciences). This experience has certainly opened my eyes to this activity and the dedicated people behind it.

Although there is a considerable amount of work involved in being President, there has been some fun as well. For example, I 'experienced' the emails from Paul-André Bolduc, our CMOS Bulletin Editor. My advice to all of you is to never get behind on your deadlines that involve Paul-André. In his pleasant manner, you will certainly be reminded that the deadline is looming or, worse, that it has passed. As well, I always enjoyed the reaction to my "too many" phone calls to the Executive Office. Dorothy would always make a big fuss over the fact that "The President" was calling. Actually visiting the Executive Office in the Fisheries and Oceans Building in Ottawa can be an interesting experience. If you arrive at the lobby without the Society Office's phone number, you quickly realize that the security staff have no record of CMOS in their registry and you cannot enter the building. Thank heavens my undergraduate friend, Bob Keeley, works in the building and he was able to let me in.

All in all, I hope that I have helped to move CMOS forward at least a little; it has certainly been an interesting and memorable experience for me. I will soon assume the position of Past President on the Executive and, after that, I expect to continue being an active member of the Society. Thanks to everyone, especially in the Executive Office and on the Executive, for their continued assistance.

Cheers for now,

*Ronald Stewart, President / Président*

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## Books in search of a Reviewer
## Livres en quête d'un critique

*Emissions Scenarios*, Intergovernmental Panel on Climate Change, Cambridge University Press, Paper Cover, 0-521-80493-0, 2000, $44.95.

*Land Use, Land-Use Change and Forestry*, Intergovernmental Panel on Climate Change, Cambridge University Press, Paper Cover, 0-521-80495-7, 2000, $29.95.

*Geosphere-Biosphere Interactions and Climate*, Editors: Lennart O. Bengtsson and Claus U. Hammer, Cambridge University Press, October 2001, Hardback Cover, 0-521-78238-4, $74.95US.

*Polarimetric Doppler Weather Radar, Principles and Applications,* by V.N. Bringi and V. Chandrasekar, Cambridge University Press, Hardback, 0-521-62384-7, $130.00US.

*Synoptic and Dynamic Climatology*, by Roger G. Barry and Andrew M. Carleton, Routledge, Paperback, 0-415-03116-8, $60.00US.

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. Thank you 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-bas. Merci pour votre collaboration.

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## Books Now Being Reviewed
## Livres maintenant en révision

*Scattering of Waves from Large Spheres* by Walter T. Granby, Jr., Cambridge University Press, Hardback cover, 0-521-66126-9, $95.00US. Book being reviewed by **Diane Masson**, IOS, Sidney, BC.

*Climate Change Impacts on the United States*, National Assessment Synthesis Team, US Global Change Program. First published in 2001, Cambridge University Press, Paperback, 0-521-00075-0, 612 pages, $39.95US. Book being reviewed by **William A. Gough**, University of Toronto at Scarborough, Scarborough, Ontario.

*Nonlinear and Nonstationary Signal Processing*, by W.J. Fitzgerald, R.L. Smith, A.T. Walden and P.C. Young, Cambridge University Press, Hardback Cover, 0-521-80044-7, March 2001, $95.00US. Book being reviewed by **Brenda Topliss**, BIO, Dartmouth, NS.

*El Niño and The Southern Oscillation, Multiscale Variability and Global and Regional Impacts*, Edited by Henry F. Diaz and Vera Markgraf, Cambridge University Press, Hardback Cover, 0-521-62138-0, 2000, $90.00. Book being reviewed by **William Hsieh**, University of British Columbia, Vancouver, B.C.

*Methodological and Technological Issues in Technology Transfer*, Intergovernmental Panel on Climate Change, Cambridge University Press, Paper Cover, 0-521-80494-9, 2000, $35.95. Book being reviewed by **Paula Coutts**, SENES Consultants Limited, Richmond Hill, Ontario.

*The Earth's Plasmasphere*, by J.F. Lemaire and K.I. Gringauz, Cambridge University Press, Hardback Cover, 0-521-43091-7, $90.00US. Book being reviewed by **Richard Marchand**, University of Alberta, Edmonton, Alberta.

*Ionospheres, Physics, Plasma Physics, and Chemistry*, by Robert W. Schunk and Andrew F. Nagy, Cambridge University Press, Hardback, 0-521-63237-4, 2000, $100.00. Book being reviewed by **Richard Marchand**, University of Alberta, Edmonton, Alberta.

# Agriculture Research Model Farms

by Henry Janzen[1] and Raymond Desjardins[2]

## Introduction

About seven percent of Canada's landmass supports agriculture. Agriculture accounts for ten percent of Canada's greenhouse gas (GHG) emissions. Unlike other sectors, emissions that agriculture produces are almost completely from non-energy sources. Nitrous oxides from fertilizers, and manure and methane from livestock account for 96 percent of agriculture emissions.

The Government of Canada, through its Action Plan 2000 on Climate Change (**www.climatechange.gc.ca.**), is investing $5 million in Agricultural Research Model Farms, a project that will bridge the basic science and mitigation efforts to reduce GHG emissions.

## Program Description

Through improved management of farms in Canada, it is possible to reduce GHG emissions and mitigate atmospheric carbon dioxide increases by sequestering carbon in soils. This program will quantify the effect of improved practices on carbon sequestration and net GHG emissions in Canadian farming systems using Model Farms, which were referred to as Demonstration Farms in earlier documents. It will draw on findings from studies being conducted by Agriculture and Agri-Food Canada and Environment Canada.

This program will develop simple yet comprehensive techniques to estimate GHG emissions from the main types of farms across Canada. These estimates will allow producers and policymakers to evaluate the benefit of farming practices proposed for reducing emissions and sequestering soil carbon.

This initiative will establish a series of Model Farms, simulated farming systems designed to represent the dominant eco-regions and farming practices in Canada. Analysis of the farms will consider livestock, soils, nutrient management, waste management and energy use to establish the emissions from each element, interaction among individual elements and calculation of net GHG emissions for the whole farming system.

The benefits of this program include the following:

- improved estimates of current emissions;
- estimates of future emissions under various mitigation scenarios;
- evaluation of proposed mitigation strategies before implementation;
- a method of screening farm practices that may look favourable from one perspective, such as carbon sequestration, but have negative effects in other areas, such as methane emission;
- the identification of new farming systems that may reduce GHG emissions; and
- the ability to demonstrate to producers, policy-makers and other decision-makers how proposed policies and practices will affect future emissions.

## Climate Change Measures

The Government of Canada's investment in Agricultural Research Model Farms is one of a series of practical, concrete measures that are part of the $500-million Action Plan 2000 on Climate Change. Over the next five years, the Government will invest $1.1 billion in the Action Plan and other climate change initiatives that, when fully implemented, are expected to take Canada about one-third of the way to the GHG-reduction targets that it agreed to during the Kyoto Protocol negotiations in 1997. At that time, Canada undertook to reduce its GHG emissions to six percent below 1990 levels during the period between 2008 and 2012, about a 26-percent reduction from "business-as-usual" levels.

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[2]Micrometeorologist, Research Branch, Agriculture and Agri-Food Canada; (613) 759-1522

## Les Fermes Modèles de Recherche agricole

par Henry Janzen[3] et Raymond Desjardins[4]

### Introduction

Près de 7 pour 100 des terres du Canada sont cultivées. L'agriculture et la foresterie produisent 10 pour 100 des émissions de gaz à effet de serre (GES) du Canada. Contrairement à d'autres secteurs, les émissions du secteur agricole proviennent presque entièrement de sources non énergétiques. Les oxydes nitreux produits par les engrais et le fumier de même que le méthane produit par le bétail comptent pour 96 pour 100 des émissions du secteur agricole.

Le gouvernement du Canada entend investir 5 millions de dollars dans les Fermes modèles de recherche agricole, dans le cadre de son Plan d'action 2000 sur le changement climatique (**www.changementsclimatiques.gc.ca**). Ce programme permettra d'établir un lien entre la science fondamentale et les initiatives axées sur la réduction des émissions de GES.

### Description du programme

Une meilleure gestion des fermes canadiennes permettrait de réduire les émissions de GES et de limiter l'augmentation du dioxyde de carbone dans l'atmosphère en piégeant le carbone dans le sol. Ce programme a pour but de mesurer les effets de l'amélioration des pratiques sur le piégeage du carbone et sur les émissions nettes de GES par les exploitations agricoles, à partir des Fermes modèles, appelées « fermes de démonstration » dans les documents antérieurs. Il s'appuiera sur les conclusions des études effectuées par Agriculture et Agroalimentaire Canada et par Environnement Canada.

Le programme mettra au point des techniques complètes, quoique simples, d'estimation des émissions de GES par les principaux types de fermes, partout au Canada. Ces estimations permettront aux producteurs et aux décideurs d'évaluer les avantages des pratiques culturales proposées afin de réduire les émissions et de piéger le carbone dans le sol.

Aux fins de cette initiative, on aménagera une série de Fermes modèles où l'on reproduira les systèmes d'exploitation et les pratiques culturales en vigueur dans les principales écorégions du pays. Des analyses effectuées sur le bétail, les sols, la gestion des nutriments, la gestion des déchets et la consommation énergétique permettront de déterminer les émissions imputables à chacun de ces facteurs de même que les interactions de ces derniers, et de calculer les émissions nettes de GES pour l'ensemble des activités agricoles.

Les avantages du programme comprennent notamment:

- de meilleures estimations des émissions actuelles;
- l'estimation des futures émissions en fonction des diverses mesures de réduction;
- l'évaluation des stratégies de réduction proposées avant leur mise en œuvre;
- une méthode d'examen des pratiques culturales pouvant sembler avantageuses à certains égards, comme le piégeage du carbone, mais qui ont des effets néfastes dans d'autres, comme l'émission de méthane;
- la mise au point de nouveaux systèmes d'exploitation susceptibles de réduire les émissions de GES;
- la démonstration aux producteurs, aux artisans des politiques et aux autres décideurs des répercussions de ces politiques et des pratiques proposées sur les futures émissions.

### Lutte au changement climatique

Cet investissement du gouvernement du Canada dans les Fermes modèles de recherche agricole est l'une des nombreuses mesures pratiques et concrètes prévues dans le Plan d'action 2000 sur le changement climatique, doté d'un budget de 500 millions de dollars. Au cours des cinq prochaines années, le gouvernement investira 1,1 milliard de dollars dans le plan d'action et d'autres mesures de lutte au changement climatique dont la mise en œuvre complète devrait permettre au Canada d'atteindre le tiers de l'objectif de réduction des émissions de gaz à effet de serre qu'il s'était fixé lors des négociations du Protocole de Kyoto, en 1997. Le Canada avait alors convenu de réduire ses émissions de gaz à effet de serre de 6 pour 100 par rapport aux niveaux de 1990, à l'horizon 2008-2012, ce qui représente une réduction d'environ 26 pour 100 par rapport aux niveaux qui auraient été atteints si rien n'avait été fait.

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## The Canadian Prairie drought of 2001: a four billion dollar shortfall?

by Ray Garnett[5]

Résumé: La sécheresse de l'an 2001 sur les Prairies canadiennes sera probablement enregistrée comme étant la troisième plus sévère dans les archives depuis 1950. Entre le 1er avril et le 31 juillet de l'an 2001, la Saskatchewan a été plus sèche qu'elle était en 1988 selon l'évaluation du mois de juillet par Ken Rossassin, un économiste agricole de l'université de la Saskatchewan. Seulement les années de 1961 et de 1988 ont été considérées comme une sécheresse plus sévère lors d'une chaleur record qui a eu lieu au mois de juin en Saskatchewan. Les dommages économiques en rapport avec la sécheresse vont probablement se chiffrer entre 4 à 5 milliards de dollars si on applique un effet multiplicateur. Wheaton (1993) a estimé que la production agricole du Canada a diminué de 12,7% en 1988 et on a évalué que la sécheresse avait causé à la production une perte directe de 1,8 milliard de dollars, en dollars de 1981. Garnett (2001) calcule qu'en dollars de 1998, la perte directe de la production agricole aurait été de 3,3 milliards de dollars.

The drought over the Canadian Prairies in 2001 will probably go down in the record books as the third most severe since 1950. Between April 1 and July 31 of 2001, Saskatchewan was drier than it was in 1988 based on an assessment of Ken Rossassin, an agricultural economist at the University of Saskatchewan in July. Only 1961 and 1988 can be considered more severe when record-breaking heat occurred in June in Saskatchewan.

The economic damage as a result of the drought is likely to be in the $4-5 billion range if a multiplier effect is applied. Garnett (2001) shows that during the 1995-1999 period Canada produced 26.4 million tonnes of wheat each year of which 10.2 million tonnes were grown in Saskatchewan. The dollar value of the Saskatchewan wheat crop each year based on 10.2 million tonnes produced during 1995-1999 was $1.65 billion based on an average price for the 1993-1997 period of $162 per tonne. The value of the crop in three low production years (1984, 1985 and 1988) was estimated at $1.4 billion compared to $2.3 billion in three high-production years (1986, 1990 and 1996), a difference of $0.9 billion. The swing in the total value for one crop in one province in Saskatchewan between a low yielding and a high yielding year is thus about $1 billion. This is only one crop in one province. When there is massive drought across the Canadian prairies affecting half a dozen or more crops one can easily arrive at $4 billion worth of damage. Wheaton (1993) estimated that Canada's agricultural production decreased by 12.7% in 1988 and the drought was estimated to have caused a direct production loss of $1.8 billion in 1981 dollars. Garnett (2001) calculates that in 1998 dollars this would have been a direct production loss of $3.3 billion. Finally, a Canadian Wheat Board economist has estimated that a 10 million tonne shortfall at $150 per tonne amounts to a loss of $1.5 billion. After applying an economic multiplier he arrives at a shortfall in economy of $5 billion.

The 2001 drought in Saskatchewan was well forecast with a lead-time of 4-5 months. In May 2001 the Prairie Weather Centre in Winnipeg indicated that overall Canadian prairie soil moisture conditions were poorer than they were in 1988 following a dry fall, winter and spring making June and July rainfall especially critical to farming operations. In March 2001, the new teleconnection index developed by *Hsieh et al.* (1999) suggested that wheat yield in 2001 would be the third lowest since 1960. This teleconnection index indicates the strength of a three-cell pattern in the sea surface temperature anomaly (SSTA) field in the near equatorial and north Pacific.

Similarly, composite analysis of Niño-3 sea surface temperatures done in a Masters Research at the University of Saskatchewan was suggesting that June and July precipitation in Saskatchewan would be in the bottom half of the bottom quartile or less than 100 mm based on data for 1950-1998. Similarly, composite analysis of Niño-4 sea surface temperature anomalies was suggesting that July precipitation would also be in the bottom half of the bottom quartile or less than 38 mm. The writer's own rain gauge recorded 81 mm in June and July and 41 mm in July. An example of the composite analysis used to make the forecast is shown in Figure 1.

The wettest periods in Saskatchewan were: 1991, 1963, 1953, 1993, 1986 and 1954; the six driest were: 1967, 1958, 1961, 1985, 1957 and 1968 while six near the median were: 1972, 1995, 1974, 1981, 1978 and 1983. In the spring months of 2001 this composite was suggesting that the May-July period over Saskatchewan was likely to be among the six driest since 1950. It was. Figure 1 shows that persistent El Niño conditions in the Niño-3 region in late winter and early spring is favourable for precipitation in Saskatchewan while persistent La Niña conditions are unfavourable for the summer rainfall in Saskatchewan consistent with many earlier studies.

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[5]Geography Department, University of Saskatchewan.

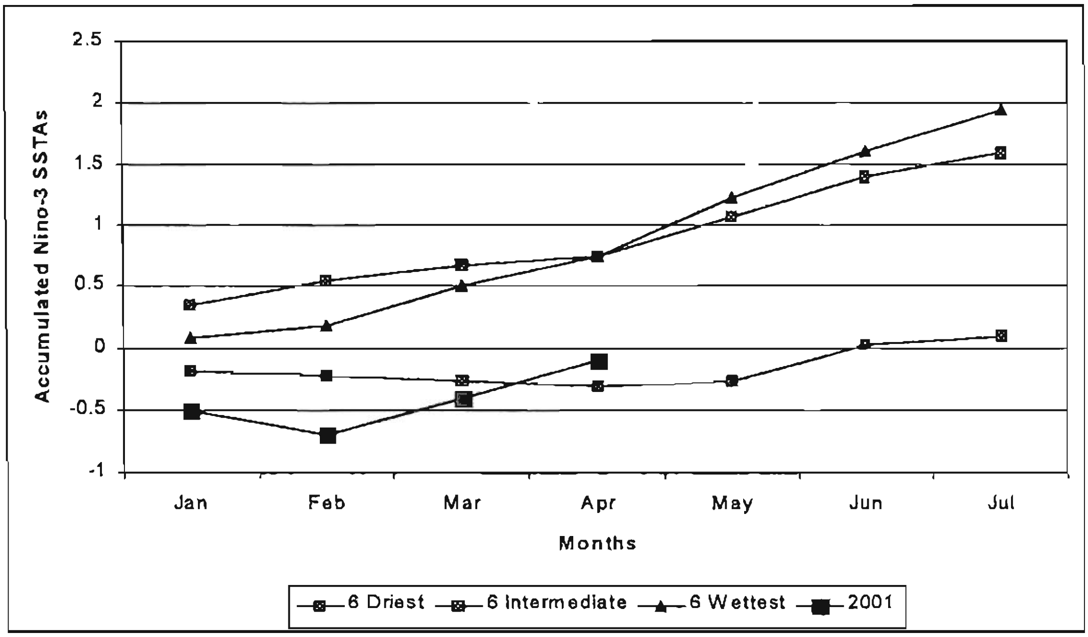


Figure 1 shows the summation of Niño-3 SSTAs during the driest, wettest and intermediate May-July periods in Saskatchewan for the 1950-1998 period. Also shown is the summation for 2001.

This simple empirical technique for forecasting precipitation over the Canadian prairies was first published by *Garnett et al.* in 1998 after discussions with M.L. Khandekar of Environment Canada. It is a simple means of capturing the effect of persistently warm or cold equatorial SSTs on the summer precipitation of the Canadian prairies. It has clear utility for climatologists, economists and grain industry officials in years to come. This and other teleconnection indices such as the Niño-4 SSTAs, Southern Oscillation, and the Pacific North American (PNA) teleconnection index, have been applied for forecasting precipitation in Saskatchewan in Masters work at the University of Saskatchewan. This and other findings will be forthcoming in the proceedings of Long-Range Weather and Crop Forecasting Working Group Meeting IV held in Regina in March of 2001 and Masters Research at the University of Saskatchewan.

As per Environment Canada Climatologist (David Phillips), the drought was very well predicted. Ken Rossassin will concur, having lost a weather bet made in April. Several farmers in the Saskatoon region were able to adopt drought-proofing strategies based on this accurate early warning.

As of January 17, 2002 soil moisture conditions are very low following the drought of 2001. Accumulated precipitation between Sepember 2001 and mid-January are in the 10-20 percentiles or extremely dry as of mid-January 2002 throughout Alberta and most of Saskatchewan.

Based on the publication by *Garnett et al 1998*, PNA index values have been positive three out of the past four months since Sepember 2001 revealing pronounced meridional flow similar to what occurred during the hottest June and Julys on the Canadian prairies between 1964 and 1995. Accumulated Niño-3 anomalies since September 2001 continue to suggest that June and July over the Canadian prairies in 2002 are likely to be very dry or similar to 1967, 1985, 1974 or 1979 which were the driest June and Julys over the Canadian prairies between 1964 and 1995. The writer's preferred analogue is 1979 which experienced the wettest July of the four analogues suggested.

The good news is that Nino-4 has been showing signs of warming which suggests heavy rains bringing relief may occur in July 2002. Also the Walker Circulation or Southern Oscillation is not near as strong as it was a year ago.

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## Rejoice Canadian prairie farmers, El Niño is on the way!

by Ray Garnett[6]

Since the early 1980s it has become apparent that El Niño is the friend and La Niña the foe to grain producers on the Canadian prairies. Various studies by Garnett and Khandekar (1992), Garnett *et al.* (1997), Garnett *et al.* (1998), Hsieh *et al.* (1999) and Garnett (2002) have proven this statistically. In January of 2002 sea surface temperatures (SSTs) at Niño-4 were 1.4 C° warmer than they were in January 2001 signalling a clear onset of El Niño.

Since late 1998 La Niña conditions (cooler than normal SSTs) have prevailed in the central and east equatorial Pacific. Associated with those colder than normal SSTs there has been $1.1 billion along the Appalachian Mountains in 1999, $4.5 billion worth of drought between Texas and southern Alberta in 2000, and $4 billion worth of drought in 2001 over the Canadian prairies. Annual precipitation at several points in Saskatchewan in 2001 has been compared to 1937.

Canadian prairie farmers face many challenges other than variable climate - a rising cost of inputs, low prices, extremely low soil moisture conditions following last years drought, a low Canadian dollar which increases the cost of imported equipment, loss of the Crow freight rate benefit and the absence of government programs such as LIFT (Lower Inventory For Tomorrow) that existed in 1970. The arrival of El Niño, however, is good news, and should mean cooler and wetter summers.

Typically during a strong El Niño when SSTs become warmer than air temperatures in the vicinity of 180°W, there is increased convection in the central Pacific region, upward water vapour flux, an increase in water vapour, clouds, increased zonal flow and a vitalization of the Hadley circulation. There has been an absence of these processes during the past three summers and consequently drought in North America. The key question in 2002 deals with the lags and timing of rainfall. There is not much doubt that the rainfall in 2002 is likely to be greater than it was in 2001 during the May-July period over the Canadian prairies. However, to achieve trend spring wheat yields in 2002 greater than normal precipitation will be required during the growing season to offset the extremely low soil moisture conditions. It is unlikely that timely rains alone will achieve trend yields given the potential problems with germination and tillering.

So amidst all the bad news in agriculture, the good news is that El Niño is on the way and farmers have something to cheer about. Also of a good news is the fact that the summers of 1998, 2000 and to a large extent 2001 over the Canadian prairies were forecast. The skill in seasonal forecasting is improving. Environment Canada is forecasting a wetter than normal spring over the Canadian prairies and flow over the PNA region has been predominantly zonal suggesting a cool July. The index developed by Hsieh *et al.* in 1999 is forecasting much higher yields than it did in 2001. The Walker circulation or Southern Oscillation Index (SOI) is neutral in strength suggesting moderate rains in July. At this time in 2001, the four teleconnection indexes being monitored at the University of Saskatchewan were all suggesting a very dry/warm summer over the Canadian prairies which proved to be true.

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[6] Geography Department, University of Saskatchewan.

# Middle Atmosphere Gravity Waves Generated by Isolated Tropical Convection Simulated in a Cloud-Resolving Model

by Kevin Hamilton[1], V. Balaji[2] and Richard S. Hemler[3]

Résumé: L'importance des ondes de gravité à petite échelle, pour l'équilibre des quantités de mouvement à grande échelle de l'atmosphère moyenne, est maintenant généralement connue. Pour la compréhension et la modélisation de la circulation à grande échelle, on se doit de préciser les sources de telles ondes ainsi que leur propagation et dissipation dans l'atmosphère. On peut en obtenir un aperçu en utilisant une zone restreinte détaillée et une simulation à haute résolution d'excitation et de propagation d'ondes. Parmi plusieurs études qui ont été faites sur le forçage des ondes de gravité stratosphériques générées par des orages de convection isolés, on note un modèle bidimensionnel (2D) par Alexander et al. (1995), et des modèles tridimensionnels (3D) par Piani et al. (2000) et Lane et al. (2001). Récemment, Holton et Alexander (1999, ci-après dénommés HA) ont expérimenté une nouvelle étape dans cette recherche en simulant les ondes d'excitation et de propagation avec un modèle de nuages 2D dont le champ s'étend jusqu'à la mésopause. En particulier, ils ont simulé une ligne de grain aux latitudes moyennes en présence d'un fort cisaillement troposphérique et ont trouvé que les ondes de gravité excitées se sont propagées vers le haut. Les ondes se sont dissipées de façon non linéaire dans la mésosphère et elles ont développé de fortes accélérations dans l'écoulement moyen. Le présent article discute brièvement une simulation similaire des ondes de gravité excitées par convection avec un modèle à haute résolution et qui s'étend jusqu'à la mésopause. Dans cette expérience, on a utilisé un modèle avec la même physique de base que celle de HA, mais la simulation a porté sur un phénomène de convection tropicale isolée se développant rapidement. On retrouve de façon analogue sur plusieurs territoires dans les tropiques de la convection isolée forcée par le réchauffement diurne.

## Introduction

The importance of relatively small-scale gravity waves for the large-scale momentum balance of the middle atmosphere is now generally acknowledged. Characterizing the sources of such waves and their propagation and dissipation through the atmosphere is a key challenge for understanding and modeling the large-scale circulation of the middle atmosphere. Some insight into these issues may be obtained through detailed limited-area, fine-resolution numerical simulation of wave excitation and propagation. Notable in this regard are several studies of forcing of stratospheric gravity waves by isolated convective storms conducted using a 2D model by Alexander et al. (1995) and 3D models by Piani et al. (2000) and Lane et al. (2001). Recently Holton and Alexander (1999; hereinafter HA) opened a new phase of this research by simulating the wave excitation and propagation in a (2D) cloud-resolving model that had a domain that extended to the mesopause. In particular, they simulated a midlatitude squall-line in strong tropospheric shear and found that this excited gravity waves that propagated upward. The waves broke down nonlinearly in the mesosphere where they forced strong mean flow accelerations.

The present paper will report briefly on a somewhat similar simulation of convectively-excited gravity waves in a fine-resolution model extending above the mesopause. This experiment used a model similar in its basic physics to that of HA, but the present simulation was of a tropical, rapidly-developing, isolated convective event. This should be analogous to the isolated diurnally-forced convection that is observed over many land areas in the tropics.

## Model Description

The model is a 2D version of the cloud-resolving model of Lipps and Hemler (1986, 1991), modified to use the full compressible equations in a manner similar to that described by Klemp and Wilhelmson (1978). The model includes a Kessler (1969) type parameterization of the cloud microphysics, with total cloudwater, rainwater and a falling ice phase included as variables. Standard bulk drag laws are used for surface drag and evaporation. A parameterized vertical mixing depending on the resolved Richardson number is included. The present model included only a simple Newtonian cooling parameterization of radiative processes. This should not be much of a limitation given the short integration considered here.

The model is run in this experiment with a horizontal (x) domain of extent 960 km and a grid spacing Delta x equals to 1.5 km. Periodic boundary conditions are used in x, but an arbitrary linear damping is applied to perturbations in a "sponge layer" covering 40 km at each end. The model

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domain extends to a height z equals to 102 km, with grid spacing Delta z equals to 300 m. The upper 10 km of the domain also include sponge layer damping to reduce wave reflection off the rigid lid boundary at the top. The initial conditions for all atmospheric variables were uniform in x, and for temperature they were based on the 10S October climatology of Fleming et al. (1988). Initially there was eastward (i.e. in the +x direction) wind of 5 m-s$^{-1}$ above 10 km which tails off linearly to zero at the surface. The lower boundary was prescribed as completely wet with uniform surface temperature imposed everywhere except in a "hot-spot" of 60 km width in the center of the domain. The model was integrated with a timestep of 1 s. Attention here is restricted to the integration up to 10 hours, which is when the disturbances begin to interact strongly with the side-wall boundaries. At later times the solution would depend significantly on how the sponge layer is imposed.

Intense convection and precipitation developed after a few hours over the hot-spot. The convection persisted for a few hours and then largely subsided. Fig. 1 displays the time-dependence of the vertical velocity variance in the troposphere. The near-stationary, but pulse-like, nature of the simulated convection makes it analogous to the diurnal convection peak observed over many land areas in the tropics.

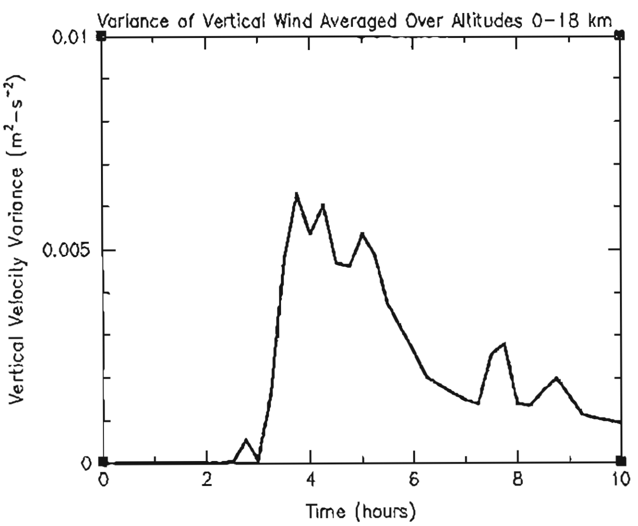


Fig. 1. The spatial variance of the vertical velocity field over the model domain up to 18 km calculated every 15 minutes for 10 hours of model integration.

## Results

Fig. 2 shows a snapshot of the cloud water 5.5 hours into the integration, near the peak time of the convection. Also shown are contours of the vertical wind for a time 3.5 hours later. The convection forces two wedges of gravity waves, one with group propagation upward and eastward, and the other upward and westward. In a fairly wide region directly above the convection there is almost no wave activity

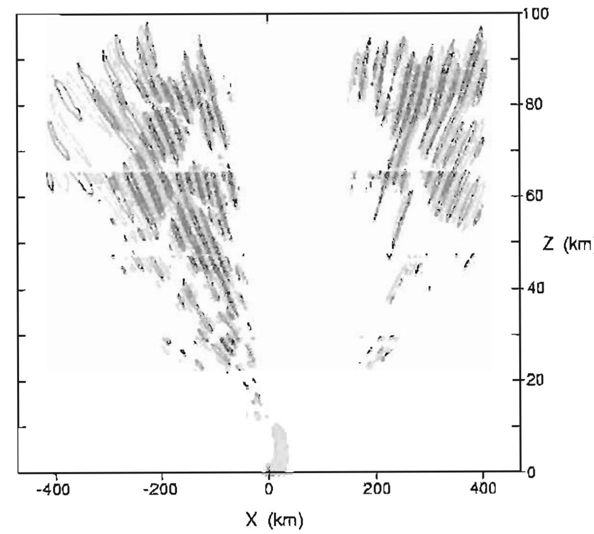


Fig. 2. The solid grey area shows the region with significant condensed water concentration 5.5 hours into the integration. The contours show the vertical velocity 9 hours into the integration. Red contours are for upward velocity and blue for downward velocity. For clarity, no zero contour is plotted. The contour interval is 0.1 m-s$^{-1}$ up to 30 km altitude, 0.25 m-s$^{-1}$ for the 30-48 km altitude range, 0.4 m-s$^{-1}$ for the 48-66 km altitude range, and 1 m-s$^{-1}$ above 66 km. Also shown in colour on inside back cover page.

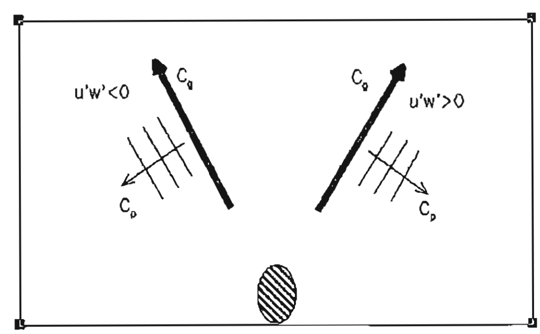


Fig. 3. A schematic diagram showing the properties of the gravity wave field expected above an isolated monochromatic source. Shown are the group velocities, $C_g$, and phase velocities, $C_p$, for eastward and westward propagating waves.

present. The overall picture resembles the idealized solution expected for a localized monochromatic forcing in a stratified fluid. This is shown schematically in Fig. 3 with the disturbances concentrated near lines directed along the group velocity which is oriented at an angle θ to the horizontal, where the sine θ is equal to the ratio of the wave frequency to the Brunt-Vaisala frequency. Phase lines are parallel to the group velocity. Vertical phase propagation is towards the source (i.e. downwards above the source) and horizontal phase propagation is outwards from the source. The full model solution in Fig. 2 has a broader range of propagation directions, reflecting the range of frequencies present in the transient forcing produced by the convection, but it displays the expected orientation of phase and group velocities. The dominant horizontal wavelengths well above the forcing are ~15-30 km. This is interesting since such wavelength disturbances near mesopause levels are ideal candidates to be observed by airglow imaging techniques. In fact, in austral spring 2001 a field experiment was undertaken in Northern Australia to identify the airglow signatures of the waves produced by isolated diurnal convection (Hamilton and Vincent, 2000).

The waves affect the mean flow through their Reynolds stress which is proportional to the correlation of the wave-related vertical, w', and horizontal, u', wind perturbations. For the simple case of a monochromatic plane wave in an incompressible fluid, it is easily shown that u' and w' are either exactly in phase or exactly out-of-phase, with u'w' positive for waves with upward and eastward group velocity and u'w' negative for waves with upward and westward group velocity. This expectation has to be modified somewhat when a compressible atmosphere is considered, but, except for very long vertical wavelength waves, this is not a major correction. Fig. 4 shows snapshots of the wave-related vertical and horizontal winds at a mesospheric level starting at 5 hours into the integration (when significant wave activity is just reaching the level) through 8 hours (near the peak of the wave activity at this level). The u' and w' fields to the east of the convection are almost perfectly correlated, while to the west they are almost perfectly anticorrelated, all consistent with the dominance of upward-propagating wave energy forced locally in the troposphere by the convection.

Fig. 5 shows the horizontally-averaged horizontal wind in the model at 2 hours (virtually unchanged from the initial values), 6 hours, and 10 hours into the integration. The mean flow is rapidly accelerated as the convectively excited waves reach the mesosphere. The relatively weak initial eastward mean wind is apparently enough to introduce significant asymmetry between the eastward and westward propagating components of the wave field, leading to net westward acceleration in the mesosphere. The magnitude of the accelerations is large, equivalent to 10's of m-s$^{-1}$ per day at mesopause heights. Some of the mean flow forcing may result from absorption of waves in the top sponge layer, but most of the realized accelerations are below the sponge and reflect nonlinear breakdown of the waves just as in the earlier HA work.

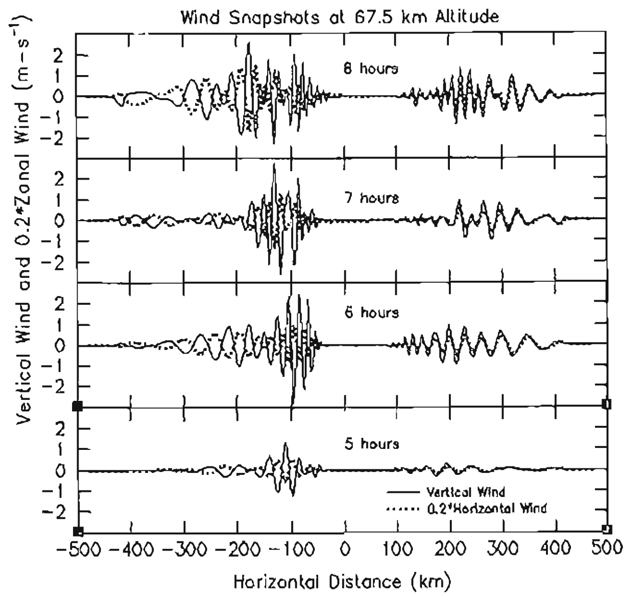


Fig. 4. Instantaneous values of the vertical and horizontal wind at 67.5 km altitude at four times through the integration. The horizontal wind values shown are multiplied by 0.2.

## Discussion

There are obviously very significant idealizations in the experiment described here, but some of the basic results may be applicable in the real world. In particular, the present results suggest that in a domain which is less than 5% occupied by isolated convection, the small-scale gravity waves excited from just a fairly brief pulse of convection can force very substantial mean wind changes in the mesosphere. This has some potentially interesting implications for the interaction between tropospheric convection and the diurnal variability of the atmosphere. There have been earlier studies of how the component of diurnal convective heating that is coherent over relatively large regions can directly force diurnal tidal variations (e.g. Lindzen, 1978, Hamilton, 1981; Forbes et al., 1997). There have also been a number of model studies of the interaction between the vertically-propagating small-scale gravity wave momentum driving and the global-scale diurnal tidal winds (e.g. Hunt, 1990; Miyahara and Forbes, 1991; McLandress and Ward, 1994; Mayr et al., 2001), that have assumed that the tropospheric source of the small-scale waves was independent of the diurnal cycle. The present results raise the possibility of forcing significant diurnal tides through another mechanism, namely the diurnal modulation of the generation of the small-scale gravity wave flux, which in turn would produce a large-scale, diurnally-modulated, travelling momentum source in the mesosphere and higher levels.

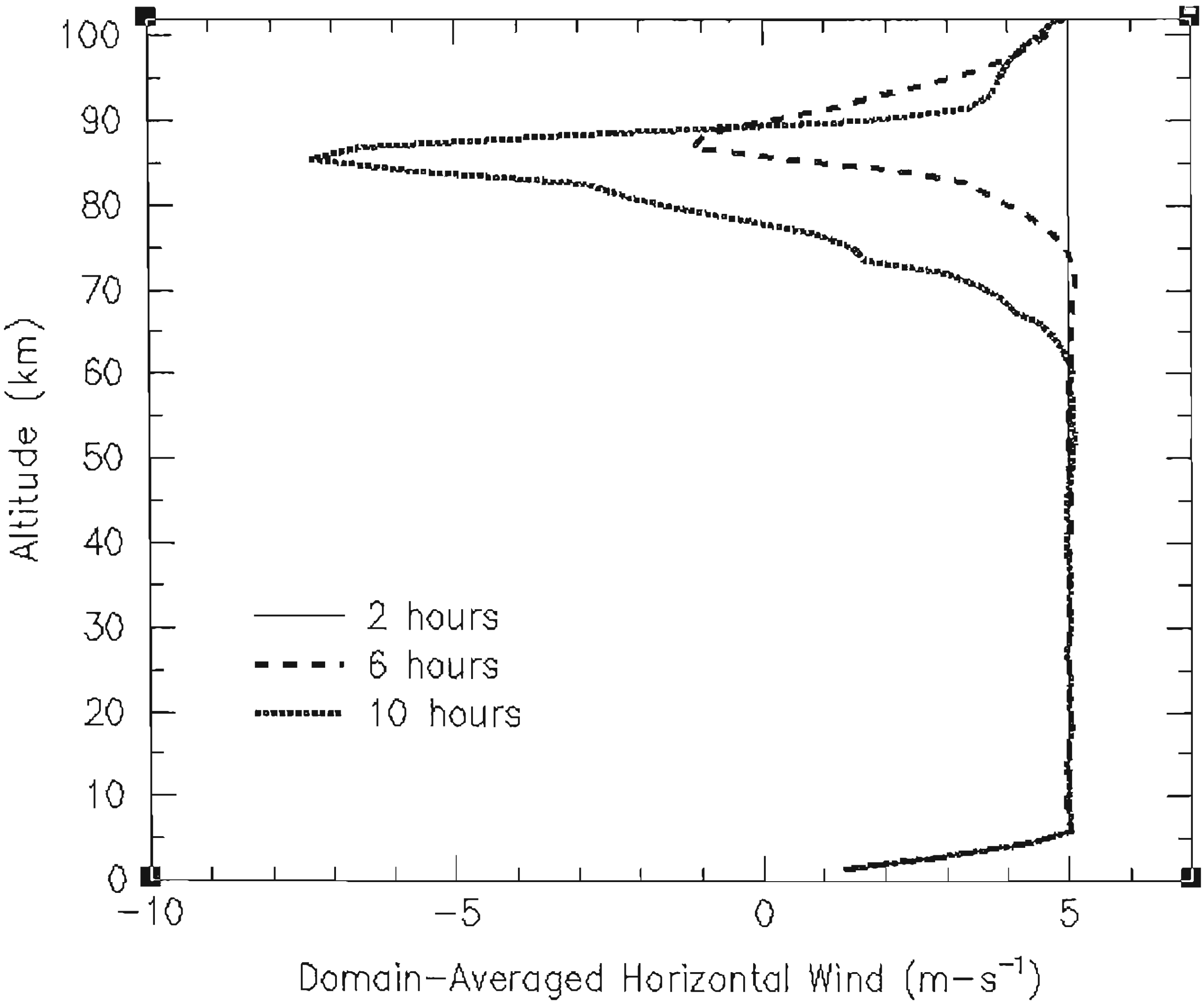


Fig. 5. Evolution of the mean (i.e. domain-averaged) horizontal wind at 3 times during the course of the integration.

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## The International Arctic Buoy Programme (IABP)

by Estelle Couture[1], Ignatius Rigor[2] and Ed Hudson[3]

### What is the IABP?

The International Arctic Buoy Programme (IABP) is a collaborative effort between various international agencies to establish and maintain a network of drifting ice buoys in the Arctic Basin for real-time operations as well as meteorological and oceanographic research. The IABP is recognized as one of the most successful buoy programmes in existence having collected more than 5000 buoy-months of data from over 500 buoys.

The programme was initially established by the Polar Science Center of the University of Washington in 1979 under the name Arctic Ocean Buoy Program to support the Global Weather Experiment. In 1991, the Arctic Ocean Buoy Program was superseded by the IABP, which still maintains the same objectives.

Participants from 18 agencies from Canada, France, Germany, Japan, Norway, Russia, the United Kingdom, the United States and one international organization - World Climate Research Programme, make the program a success via the purchase of buoys, contributing to the purchase of buoys, deploying buoys on ice for themselves and or others, processing buoy data, and providing data communication services. Tim Goos of the Meteorological Service of Canada (MSC) in Edmonton is the Chairman of the IABP and Ignatius Rigor of the Polar Science Center in Seattle is the Coordinator. In Canada, the Meteorological Service of Canada is active in buoy purchase, buoy deployments (with the assistance of Polar Continental Shelf Project, the Canadian Forces, and Canadian Coast Guard) and in processing and inserting processed buoy data onto Global Transmission Service circuit. MEDS (Marine Environmental Data Service) is active in archiving buoy data.

### Operation of the Programme

The IABP strives to maintain a network of at least 25 buoys distributed evenly across the Arctic Ocean. In the past, the IABP had been able to achieve this goal fairly well since the large Beaufort Gyre circulation carried the buoys over the entire basin (Fig. 1a). Recently, it has been more difficult to maintain the network on the Eurasian side of the Arctic because the Beaufort Gyre has significantly shrunk in diameter due to the predominance of the high Arctic Oscillation (AO) conditions (Fig.1b). During high AO conditions, buoys deployed in the Canadian Arctic seldom

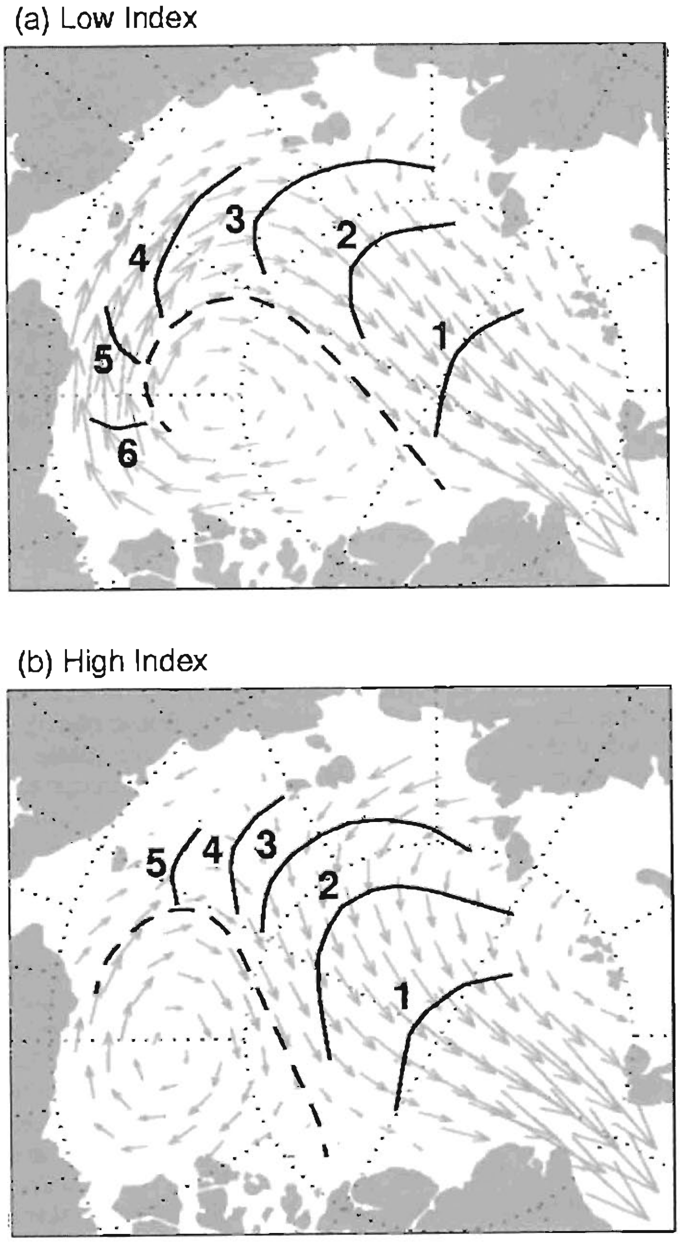


**Figure 1.** Isochrone maps showing the number of years required for a parcel of ice to exit from the Arctic through Fram Strait. (a) Ice Motion during low Arctic oscillation conditions, and (b) Ice Motion during high Arctic oscillation conditions. The dashed lines delimit the area for which the parcels of ice will either re-circulate in the Beaufort Gyre, or drift towards Fram Strait.

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drift into the Eurasian Arctic, and more deployments are required in that area.

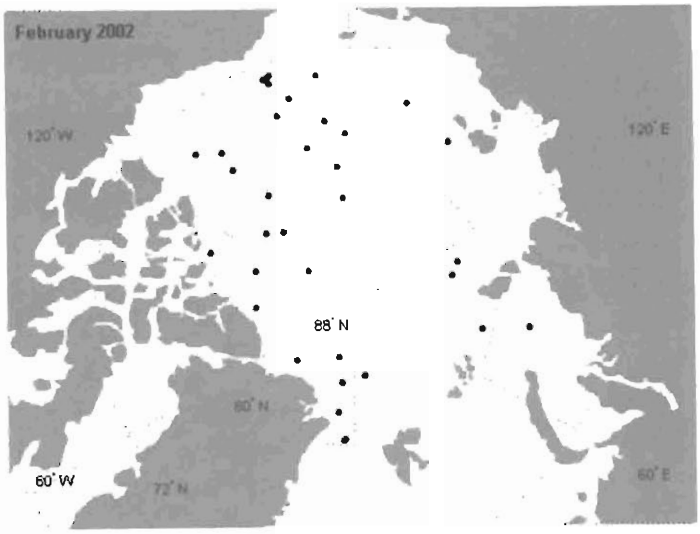


**Figure 2** IABP buoy network as of February 2, 2002

Maintaining the buoy network requires vast amounts of resources since the buoys have limited life spans, usually 1 to 2 years and the logistics required to deploy new buoys in the Arctic are extremely costly. Generally, buoys fail because batteries grow old or sensors fail. Buoys can also be lost due to sinking when ice breaks up and melts or when the general circulation of the ice takes the buoys out of the Basin through Fram Strait (Fig. 1). As of February 2002, the total number of buoys in the IABP network is 35 (Fig. 2).

Deployments of new buoys occur several times per year. Buoys may be deployed either *in situ* or air dropped. When a buoy is deployed in-situ, the buoy is taken by small aircraft or by ship to the deployment position where a specialist places it in the ice (Fig. 3a). Airdrops of ICEX buoys occur annually, usually in August during the White Trident Exercise of the U.S. Naval Meteorology and Oceanography Command (NAVO) where 7 buoys are deployed via Hercules (Fig. 3b). While contributing tremendously to the IABP, NAVO uses these deployments to train American Navy crewmen to execute accurate airdrops for future military operations. The buoy's position is reported immediately after deployment, which makes these airdropped buoys efficient training tools. The ICEX buoys for this summers White Trident exercise are being provided by Alfred Wegener Institute for Polar and Marine Research, Meteorological Service of Canada, Norwegian Meteorological Service, Norsk Polar Institute, US National Ice Center, and U.S. Naval Meteorological and Oceanographic Command. The Canadian Forces also do air drops from time to time for the Meteorological Service of Canada. The type of buoy dropped is a CALIB and these buoys are smaller and have less battery life than the ICEX buoys deployed in the White Trident exercise.

**Figure 3.** a) Twin Otter ice deployment of a buoy for the U.S. National Ice Center. Deployment was performed by MSC in 2001.

**Figure 3.** b) Deployment of an ICEX-AIR buoy via Navy Hercules.

The buoys primarily measure surface air temperature and sea level pressure but other geophysical quantities may also be measured depending on interests of the funding agencies. The ICEX buoys (Fig. 4a), the Sellman/Krauss buoys (Fig. 4b) and the Ice Toga buoys (Fig. 4c) are examples of IABP buoys used to collect meteorological information. Conversely, J-CAD buoys (Fig. 4d) developed and deployed by the Japanese can measure both meteorological and subsurface oceanographic observations down to a depth of 250m. The price of buoys varies widely, ranging from $US 13,000 for an ICEX buoy to $US 350,000 for a J-CAD buoy.

Locations of the buoys are tracked via the Argos system. Each buoy is equipped with an Argos transmitter that continually sends messages to the satellites (NOAA series), which then relay the messages to ground stations. The ground stations then forward the messages to Global Processing Centers in Toulouse (France) and Largo (USA) and to a Local User's Terminal operated by MSC in Edmonton (Canada) who calculate the position of the transmitter using Doppler shift. The data are then distributed in real-time to buoy owners and internationally on the Global Telecommunication System (GTS).

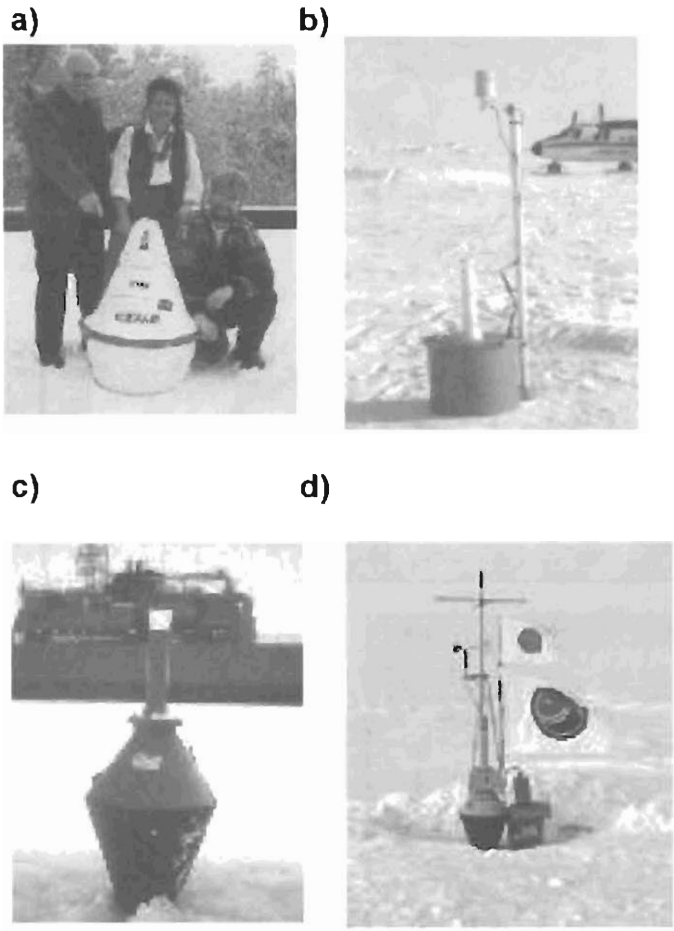

**Figure 4**
a) ICEX buoy developed by ConMar of Christian Michelsen Research.
b) Sellman/Krauss buoy developed by the Alfred Wegener Institute.
c) Ice Toga buoy developed by Metocean.
d) J-CAD buoy developed by JAMSTEC.

## Uses and scientific findings derived from the use of IABP data

IABP data are used for both operations and research, e.g. forecasting weather and ice conditions, validation and forcing of computer models, satellite validation and for studying climate change. In addition to weather forecasting, the ice charting community also uses the IABP buoy data in near real-time. At the U.S. National Ice Center, for example, the observed drift of the buoys on the ice helps Ice Forecasters and Analysts to monitor the movement of multi-year ice in the Beaufort Sea, Baffin Bay, and other ice covered seas. The buoys provide key information in developing more accurate ship routing recommendations for vessel operating in the marginal sea ice zones.

The data are quality controlled and interpolated at the Polar Science Center to three-hour intervals using a polynomial fit algorithm. From these datasets, spatial fields of sea level pressure, surface air temperature, and ice velocity are analyzed using optimal interpolation, with a resolution of 12 hours and 100 km.

Data from the IABP have been crucial in detecting changes in Arctic climate. By taking the difference in sea level pressure from the first and second 8 years of data from the IABP, Walsh et al. (1996), showed that the circulation in the Arctic had undergone a distinct change in the late 1980s. Walsh et al. (1996) showed a cyclonic anomaly in atmospheric circulation, which, in turn, drives a cyclonic anomaly in sea ice motion (Fig. 5). It should be noted that although the anomalies are cyclonic, the mean field of ice motion in the Beaufort Sea remains anticyclonic.

Recently, the IABP in collaboration with the NASA EOS project Polar Exchange at the Sea Surface (POLES), has released a new surface air temperature dataset called IABP/POLES. Using this dataset, Rigor et al. (2000) showed that the warming trends found by others (e.g. Jones et al. 1999) over the northern land masses extend out over the Arctic Ocean (Fig. 6). Warming is found in the eastern Arctic, while a slight cooling is noted in the west. These trends are most significant during spring.

These changes in sea level pressure, ice motion, and surface air temperature are related to changes in the Arctic Oscillation (Thompson and Wallace, 1998). The cyclonic anomaly in atmospheric circulation found by Walsh et al. (1996) matches the spatial pattern of the Arctic Oscillation (Fig. 5). This atmospheric anomaly drives a cyclonic anomaly in ice motion, which increases the divergence of ice in the eastern Arctic and reduces the anticyclonic Beaufort Gyre. These changes increase the drift of ice across the Arctic Basin and through Fram Strait (Fig. 1). The atmospheric anomaly also explains the trends in surface air temperature, i.e. increased ice divergence implies that more heat is released from the ocean by the re-freezing of open leads during winter, and increased warm advection from the Siberian land masses warms the eastern Arctic Ocean. In the west, increased convergence of ice and cold advection cool the western Arctic Ocean.

## Data Management and Information

Proper data management is also one of the key components of the IABP. The IABP ensures that all data are continuously archived at various data centers to prevent any loss of the data that could potentially be caused by damage to the storage medium or rapidly evolving technology.

The Polar Science Center receives the data directly from Service Argos. The data are then archived and periodically submitted to the World Data Center A (Glaciology), which in turn makes the data available to World Data Center B (Sea Ice). The objective of these Centers is to establish a uniform quality controlled database for ice motion and surface meteorology.

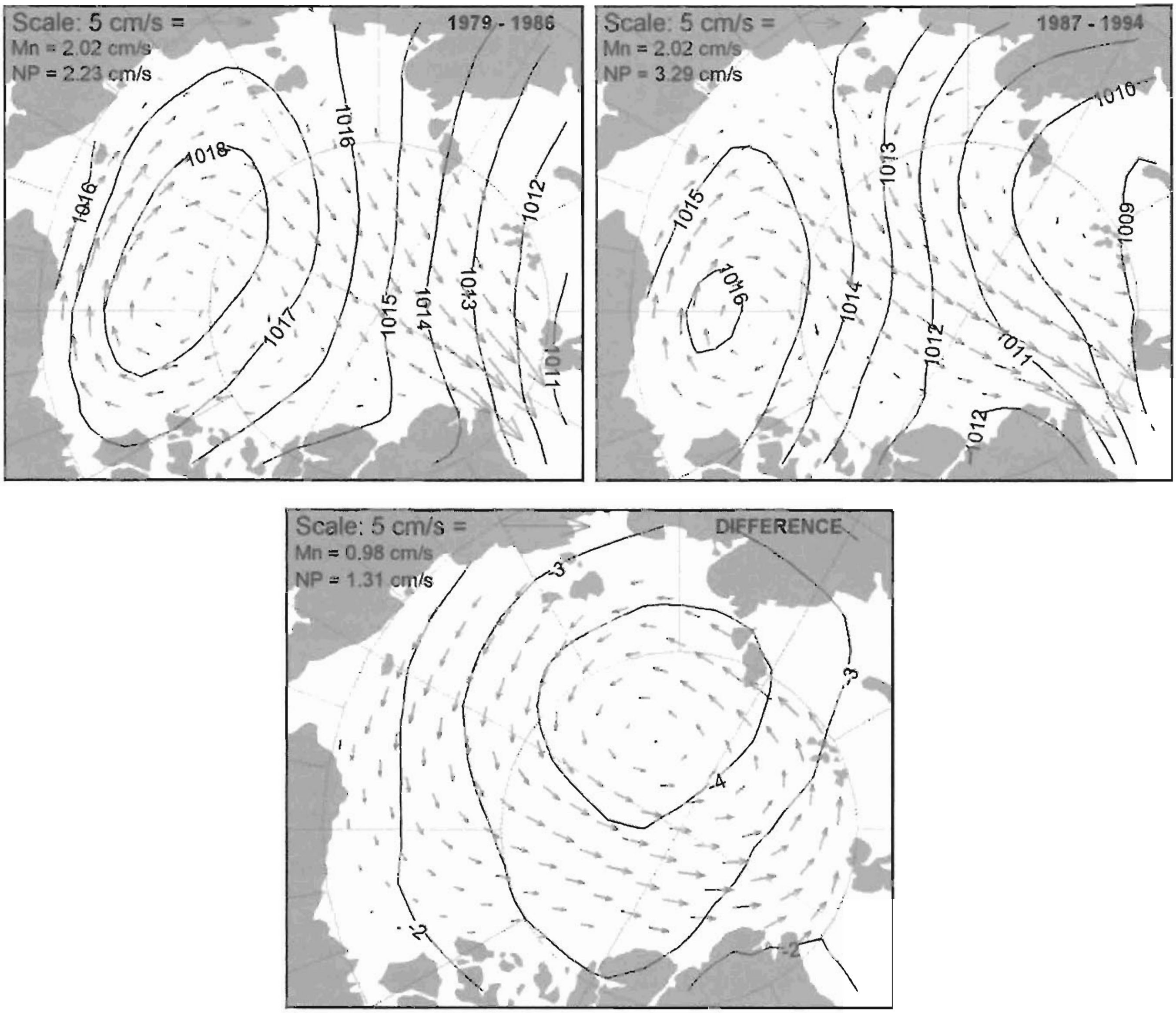


**Figure 5**. Changes in Atmospheric circulation over the Arctic Ocean from 1979-1994. These figures show the mean field of sea level pressure (mb) and ice motion for 1979-1986 (top left), 1987-1994 (top right) and the difference between these two eight year periods (bottom). Adapted from Walsh et al. 1996.

In addition, the Marine Environmental Data Service (MEDS) in Ottawa, as the Responsible National Oceanographic Data Centre (RNODC) for drifting buoy data, archives the data distributed on GTS. MEDS as the RNODC has the mandate to archive and redistribute the data to anyone who makes the request. The data distribution is free of charge. For more information visit the MEDS web site:

http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Databases/DRIBU/drifting_buoys_e.htm.

For the 20th anniversary of the IABP, MEDS published a CD entitled "International Arctic Buoy Programme and Arctic Buoy data" (Fig. 7). The CD is a compilation of the datasets collected since the establishment of the programme, products generated from these datasets as well as a number of relevant documents. To preview the CD go to:

http://www.meds-sdmm.dfo-mpo.gc.ca/alphapro/rnodc/IABP_CD_e.shtml

Free copies of this CD are available upon request from Estelle Couture (couture@meds-sdmm.dfo-mpo.gc.ca).

The next annual meeting of the IABP will be hosted by MEDS in Ottawa and will take place from June 10-12, 2002.

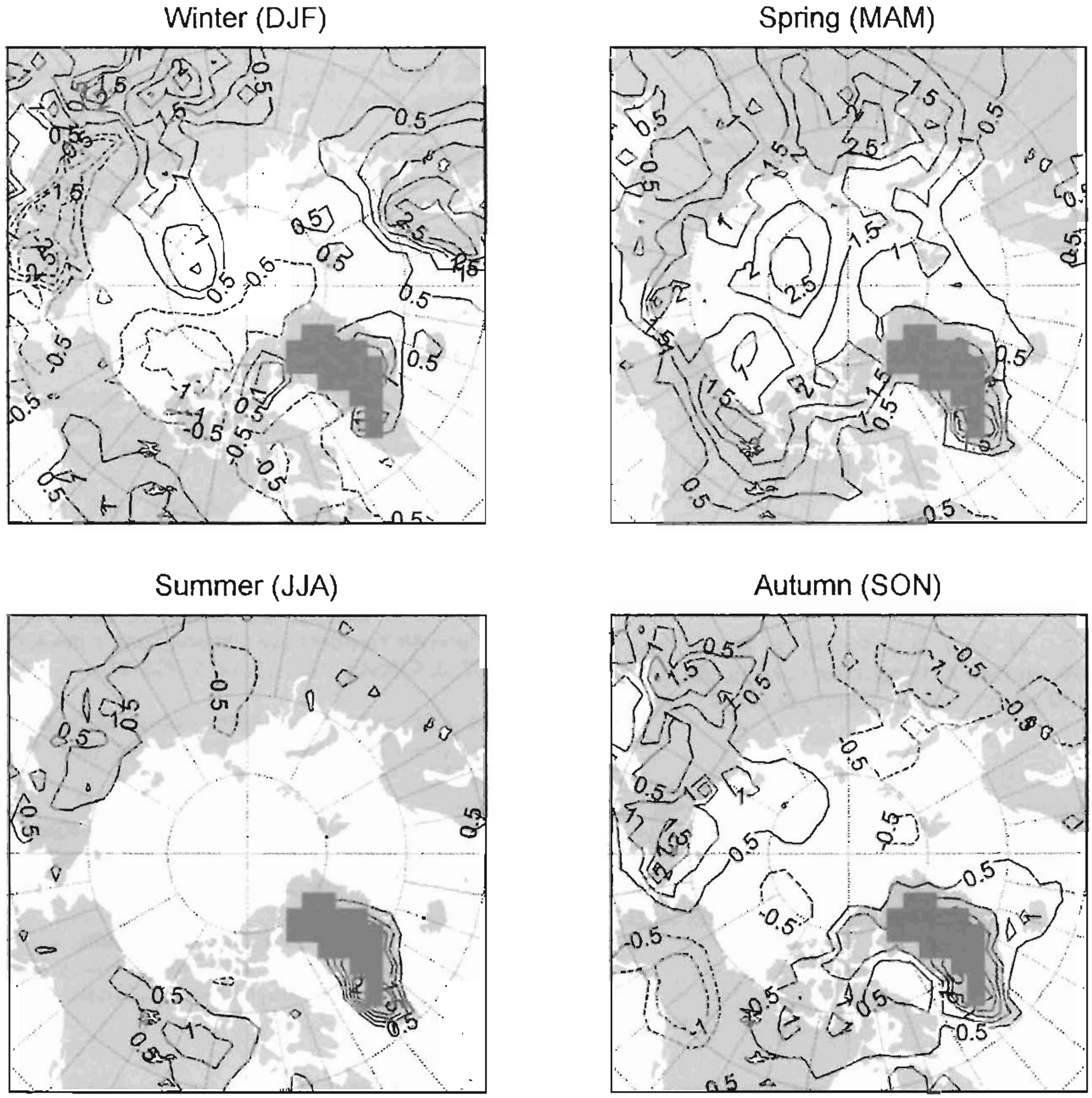


**Figure 6.** Seasonal surface air temperature trends from IABP/POLES data set for 1979-1998. Warming trends are shown as solid lines, cooling trends are shown as dashed lines. (Adapted from Rigor et al., 2000).

The IABP datasets and more information on the Programme are also available at the official IABP web site: http://iabp.apl.washington.edu

## Future Directions

The Arctic Ocean is increasingly being recognized as playing a key role in global atmosphere processes and ocean circulation. While the Arctic climate is one of the most extreme on earth with its limited sunlight and extreme colds, global models have indicated that a small change in the heat budget may have profound effects in the global climate. Due to its sensitive nature, the Arctic climate is considered an indicator of change in the coupled atmospheric-ocean system.

The IABP realizes the importance to further understand the atmosphere-ocean system and therefore recognizes the need to expand the use of meteorological sensors and subsurface oceanographic sensors such as CTDs, anemometers, radiometers and thermistor strings. The cost to attach additional sensors to a buoy is small in comparison to the cost of deploying such buoys, but the benefits to the operational and research communities can be significant.

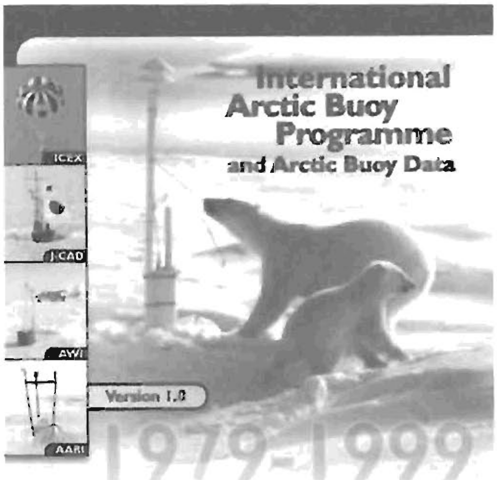


**Figure 7** IABP CD produced by MEDS

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### Next Issue CMOS Bulletin SCMO

Next issue of the *CMOS Bulletin SCMO* will be published in June 2002. Please send your articles, notes, workshop reports or news items at the earliest to the address given on page ii. We have an **URGENT** need for your articles.

### Prochain numéro du CMOS Bulletin SCMO

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en juin 2002. Prière de nous faire parvenir au plus tôt vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page ii. Nous avons un besoin **URGENT** d'articles.

# Runner-up Weather Stories to the Top Ten for 2001

by David Phillips[1]

## Atlantic Canada

### 1) Ice-Packed Atlantic Coast

Northeasterly winds pushed sea ice along Newfoundland's north coast, trapping vessels for long periods and forcing delays to the opening of the lobster and other fisheries. Coast Guard icebreakers had to free several sailing vessels caught in the heavy floes. The seal hunt, however, was deemed a great success.

The Arctic-Atlantic iceberg season was quiet and relatively short, lasting from about April 1 to June 30. There were lots of icebergs, but persistent northeasterly winds ran many aground against the coastline of Labrador and Newfoundland. Very few bergs made it to the Grand Banks to threaten Hibernia or other offshore drilling operations, and none had to be towed away. A much better season than 2000, when 41 icebergs had to be towed away from the eastern Grand Banks.

### 2) Winter Storm After Storm

In the largest single storm in six years, Charlottetown received 43 cm of snow on January 6 & 7. Other parts of the Island got up to 70 cm.

Northeast winds gusting to more than 70 km/h created huge drifts. The same storm dropped 53 cm of snow on Moncton. Another storm dumped a record 47.5 cm on Halifax on January 21.

A mammoth storm dropped 30 to 60 cm of snow on New Brunswick on February 6. On Prince Edward Island, the storm in conjunction with high tides, created a surge of water about 1 m high.

On March 10 yet another storm dumped between 30 and 60 cm of snow on southern New Brunswick. Winds blowing between 60 and 70 km/hr whipped up monster drifts. On March 31, weary New Brunswickers woke up once more to another fresh layer between 20 and 30 cm deep.

### 3) Too Much Rain ...

A storm that stalled south of Nova Scotia on May 14 brought prolonged rains to the Maritimes. A sodden Halifax received 98.7 mm - the highest daily May rainfall since records began in 1871. Moncton was a close second with 98.2 mm, also a record.

On June 30, a brief but nasty thunderstorm with wind gusting up to 100 km/h struck Fredericton, New Brunswick, snapping tree trunks, downing power lines and cutting electricity to 10,000 customers. The heavy rain and strong winds reduced visibility to only a metre in some areas.

### 4) ... Not Enough Rain

The Annapolis Valley and Cumberland County in Nova Scotia received only about one third of their normal rainfall in July and August. For Greenwood, Nova Scotia it was the second driest summer in over 50 years of records, with only 112 mm of rain. Sydney, NS had only 45% of its normal rainfall in July and August.

It is hard to believe, but after a record snowy winter, St. John's suffered moisture shortages in the summer. After a very dry five weeks in July and August, when less than one quarter of the normal rainfall occurred, the city was forced to issue watering bans.

## Québec

### 1) Winter Storms and Traffic Chaos

On February 10, a freezing-rain storm slammed into Southern Québec contributing to traffic accidents that took the lives of six people. Strong winds gusting as high as 120 km/h left 300,000 Québecers without power.

Southern Québec saw more traffic woes on March 22, as another winter storm dumped 20 to 50 cm. of snow. Several highways were closed. In the Trois-Rivières region the storm caused power failures, school closings and hundreds of traffic accidents. More than 40,000 Hydro-Québec customers were blacked out, nearly half for almost 48 hours.

**Note from the Editor**

In the February issue of the *CMOS Bulletin SCMO* (Vol.30, No.1), we presented an article written by David Phillips on the "Top Ten Weather Stories for 2001". This month, we are pleased to present the "Runner-up Weather Stories to the Top Ten for 2001". These stories did not quite make the Top Ten but were in the running until end of December!

Nous allons présenter la version française dans notre prochain numéro du *CMOS Bulletin SCMO.*

[1] Environment Canada, Downsview, Ontario

2) Lac Saint Jean - Québec's Tornado Alley
On June 19, 2001, a weak tornado lasting a mere 30 seconds struck near Alma, in the Lac-Saint-Jean region of Québec. With winds exceeding 180 km/h, the tornado completely destroyed two houses, a barn and a garage. The high winds also damaged several roofs and uprooted trees. Remarkably, no one was hurt. Three weeks later, a second funnel cloud in the same region ripped the roof off a house and knocked out power to several areas.

Ontario

1) Great Lakes Water Levels
Rising water levels on the Great Lakes improved over 2001. Superior was at its lowest in 75 years last winter, but very heavy rainfall and runoff caused a dramatic rise in April. Huron was at its lowest in 35 years through the summer, but heavy rainfall in the early fall pushed it above last year's level.

Erie's level was only a mere 20 cm below average; however, it remained at its lowest in 35 years.

Commercial navigation was brought to a virtual stand-still for two days after a major storm over the Great Lakes on October 25. Sustained southwesterly winds of 75 to 100 km/h reduced the already low water levels by 1.5 m on the St. Clair and Detroit Rivers and the western end of Lake Erie, draining local marinas and causing over 50 ships to drop anchor or remain tied up at docks. Upbound traffic on the Welland Canal was also halted by the high winds.

## 2) Heat Alert

On June 29, Toronto City issued its first ever "heat alert", warning of a 65 to 90% chance of increased mortality due to heat. The program puts emergency services on watch to assist those most vulnerable to heat spells - the homeless, elderly and the infirm. The program was just in time for one of the hottest summers on record for the city. The airport had 24 days above 30°C. More significantly, however, were the hot nights - there were 14 nights when the temperature stayed above 20°C -- the normal is five per year.

Record high temperatures across Ontario also saw the summer become the highest electricity-use season ever, with the top three electricity-use days on record on July 24, August 7 and 8.

## 3) Dry Spell in the South

In the middle of the growing season, from June 23 to August 15, parts of southwestern Ontario experienced their driest eight weeks on record.

Some areas received less than 15% of their normal rainfall during the 54 days. Over a stretch of 82 days, several communities in southern Ontario had no significant rainfall (10 mm or less). To add to their misery, during the same period, some localities had 21 days with temperatures above 30°C, compared to the normal summer total of seven.

During July, the Ottawa Valley recorded less than half its normal rainfall. At the Ottawa Airport, the monthly rainfall was the second lowest on record, only 10 mm above the lowest July amount ever recorded. Summer rains were spotty, meaning one area could be deluged, while next door, the ground remained parched. The Ottawa River, the second longest in Ontario, came within 11 cm of its lowest level in 50 years on August 14.

## 4) Ontario's Worst Storm

On July 31, winds of 100 km/h tore the roof off a community centre in the northwestern Ontario town of Fort Francis. The strong winds, which may have generated a tornado, ripped out hundreds of trees, downed power lines, and beached houseboats. More heavy rains and strong winds led to extensive flooding. Hundreds of cottagers and vacationers north of Rainy River were stranded without electricity.

## The Prairie Provinces

## 1) Wacky weather in Calgary

Drivers between Red Deer and Calgary faced an unusual blackout on May 19, as the wind whipped topsoil off farmers' fields. The blinding wall of soil contributed to a 15-car pileup near Carstairs, about 70 km north of Calgary. Two hours later, conditions went from blackout to whiteout as a freak snowstorm pounded Calgary.

## 2) Summer Storms bring golf-ball-sized hail, floods

On June 27, Neepawa, MB received more than 125 mm of rain in a six-hour period. The deluge created a flash flood emergency that forced the evacuation of 35 residents.

Golf-ball-sized hail fell on Regina on July 14, during a severe, one-hour thunderstorm which packed wind gusts of 107 km/h and dumped 41 mm of rain. The downburst flooded underpasses, roadways and basements.

A once-in-25-years storm in southern Manitoba on July 16 washed out roads, damaged crops and caused flash floods. In Winnipeg, where the northern part of the city received between 60 and 70 mm of rain, the deluge strained sewer systems and flooded streets and basements. The city fielded 150 emergency calls.

On July 28 and 29, a 15-hour storm dumped more than 100 mm of rain in the Edmonton-Leduc area. In Leduc more than 100 basements flooded and roads were under a metre of water. On July 28, at Edmonton Airport, 101.4 mm fell, drowning the previous record of 75.6 mm over 24 hours in 1990.

### 3) Bone-dry and drier still...

For a 12-month period from September 2000 to August 2001, the area encompassing Lethbridge, Medicine Hat, Kindersley, North Battleford, Saskatoon and Yorkton had from half to two-thirds of its normal precipitation. For Kindersley and Saskatoon, it was their driest period on record. Kindersley set a record for the least rainfall ever recorded in August. Only 1.2 mm were recorded for the month, the driest since records began for the site in 1913. Some areas of southern and central Saskatchewan have now not had a good annual soaking in three or four years.

Southern Alberta went through its driest 12-month period (September 2000 to August 2001) on record in the past 50 years. Lethbridge and Medicine Hat had virtually no rain in August 2001. During the growing season of April through August, the sites received about 100 mm of rain, less than half of normal, and a record low for the growing season.

Several stations in Southern Alberta experienced their driest two consecutive years on record. For example, at Taber, Alberta, the 24-month total precipitation was 436 mm, only 54% of the normal amount.

### 4) Late Season Scorcher

From September 24 to 25, a late season heat wave seared Alberta. Seven provincial records were smashed. Temperatures in Calgary reached 31.9°C, breaking the record of 31.1°C in 1922. Lethbridge hit an unbelievable 35.7°C - more than five degrees higher than the previous record. The heat caused premature budding of spruce and pine trees.

## British Columbia

### 1) Gobi Desert Sand Blasts BC

Dust clouds rolled across the lower Mainland of BC and into the interior on the Easter weekend. Incredibly, the fine particles were identified as sand from the Gobi Desert! Winds carried the dust cloud 15,000 km after it was whipped up by a storm in Mongolia and western China during the first week of April.

### 2) Severe Storms

Heavy rains in late June led to several major landslides in the Peace River region. About a month later nearly 200 mm of rain fell in the Fraser-Fort George area of central and northeastern BC. Torrential downpours washed out roads and bridges and stranded campers. In Tumbler Ridge more than 35 tree planters had to evacuate their camp on July 19th when a creek at the edge of town rose suddenly. Flooding, landslides and debris flows continued over several weeks.

### 3) Bugs threaten pine forests

Unusual weather extremes hatched a bumper crop of bugs across Canada in 2001. Fewer wildfires and recent warm winters in British Columbia have enabled the black beetle to inflict enormous damage to the pine forests.

More than 100 million trees or $4 billion worth of timber are at risk. Normally, beetle infestations are wiped out after a few weeks of -40°C temperatures but the last really cold winter in central BC was in 1982.

## The North

### 1) Storm Collapses World's Largest Culvert

The Alaska Highway was closed for two days after heavy rains south of Watson Lake, Yukon, on June 5 caused the collapse of a giant culvert. Installed in September 1998 at a cost of about $11 million, the culvert was heralded at the time as the largest in the world, spanning 23.3 m wide, 8.2 m high and 25 m long.

### 2) Heat Wave in Iqaluit

Not to be outdone by heat-suffering southerners, residents of Iqaluit endured some of the warmest temperatures ever in July. The Arctic heat wave forced a run on electric fans and ice cream. Unfortunately, residents were also gagging on smoke from massive trash fires at the city dump - the after-effects of a three month garbage strike. Rainfall patterns were unusual as well. In over 50 years of records, July was the third driest, with only 14.6 mm of rain, and August the second wettest, with 123.8 mm.

## Data Analysis Methods in Physical Oceanography

William J. Emery and Richard E. Thomson
Elsevier, 2001
Paperbound, 638 pages, $69.00 U.S.
ISBN # 0-444-50757-4

Book reviewed by Paul Myers[1]

This book is a reference guide to data analysis techniques in physical oceanography, although the material will in many cases be applicable to researchers in the atmospheric sciences. It covers both the instruments used to collect data and then the techniques needed to study and understand that data. The approach is mainly statistical and mathematical, reinforced with a large number of examples, usually based on real oceanic cases. Chapter 1 examines data acquisition and recording questions while Chapter 2 considers data processing and presentation. Chapter 3 introduces statistical methods and error handling. Chapter 4 considers the spatial analysis of data fields while time-series analysis methods are considered in Chapter 5. The material is complemented by 7 appendices, which contain material of oceanographic and statistical relevance. A detailed reference list is also provided.

Chapter 1 provides an overview of the questions involved in oceanographic data collection. This includes a detailed overview of oceanographic instrumentation and sensors. The presentation includes an examination of both older instruments whose measurements one will still encounter and need to work with as well as some of the newest and most modern (including satellite measurements). Basic sampling questions are also considered. Chapter 2 examines questions associated with the processing of data. As well, it considers how best to present the data during/after the analysis.

Chapter 3 is a review of some of the basic statistical terminology and concepts that the book uses. Both the necessary equations, as well as the underlying theory, are presented for topics ranging from sample distributions, estimation and regression through to hypothesis testing, despiking and interpolation. Practical details on working with and implementing the procedures are also given. The ideas are well illustrated with reference to real oceanographic problems, although a few more simple, fully-worked-through examples might have been useful.

Chapter 4 is a brief examination of some techniques for spatially analyzing data fields. Empirical orthogonal functions (EOFs) are considered in detail. Sections also present the theory of objective analysis and normal mode analysis. A brief summary of inverse methods is given, but as the authors admit, this section is by no means comprehensive.

The heart of the book is Chapter 5, which is an analysis of the time-series methods. Consisting of ~200 pages (40% of the book), the authors cover this material in great detail. The depth of the coverage can be seen by considering some of the topics covered: Fourier, Harmonic, Spectral and Wavelet Analyses as well as digital filters, plus newer ideas like fractals. The presentation combines both theoretical discussion as well as practical insight gained by the authors from many years of work in the area. Many illustrations and figures are provided to help the reader understand the concepts being discussed.

The book is well laid out, with the content easy to find and access. The statistical presentation, while mathematical, is clear and straightforward, without unnecessary complexity. On the whole, I think this is an excellent book on the topic, and it would be an ideal textbook for a graduate level course on geophysical data analysis. I could also see the book becoming a well referred to reference for researchers working with oceanographic data, whether from actual observations or from the output of numerical models.

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## TSUNAMI: The Underrated Hazard

Edward Bryant
350 pages, soft cover
Cambridge University Press (July 2001)
$27.95 US (softcover); $74.95 US (hardcover)
ISBN # 0-521-77799-X

Book reviewed by Bob Jones[2]

In *Tsunami: The Underrated Hazard (Tsunami used hereafter),* Edward Bryant (not of science-fiction fame) offers a definitely non-science-fiction view of this relatively rare phenomenon. Prof. Bryant, of the University of Wollongong, Australia has spent many years researching all aspects of tsunami and has published over 50 papers in international journals on topics including sea level, beach erosion, coastal evolution over the past 200,000 years, climate change, tsunami dynamics and tsunami as detectable agents of coastal characteristics.

[2] Ottawa Canada; jonesb@igs.net

Edward Bryant is known internationally for his research on catastrophic tsunami, being one of the first researchers to identify a wide spectrum of signatures of such events in the coastal landscape. *Tsunami,* his third book, summarizes many of these papers and related findings. His previous books are: *Natural Hazards: Threat, Disaster, Effect, Response (1991),* and *Climate Process and Change (1997).*

*Tsunami* is very well referenced and globally-researched chronicling a great number of past tsunami events which happened on many coasts from the present to thousands of years ago. While technical aspects are covered, especially in the chapter explaining tsunami dynamics, much of the text is descriptive and explanatory and can be read by anyone with a high school education. The book will appeal to students and researchers in geosciences, natural hazards, environmental science, astronomy and emergency planning, and will also be attractive for the general public interested in unusually large water waves and new developments in science. If there is a specific tsunami of interest, it should be possible to find it here by searching the very complete bibliographical references, tables, illustrations and index.

Prof. Bryant attempts to raise our level of tsunami awareness by giving detailed descriptions of more than ten major tsunami events that have occurred in the past decade which have caused devastation and loss of life. Also described are many particular events linked to earthquakes, volcanoes, submarine landslides, and meteorite impacts. He presents ample evidence of past great tsunami, or "mega-tsunami" discovered along apparently non-seismically-active and protected coastlines. With a large proportion of the world's population living on such coastlines, the threat from tsunami cannot be ignored.

*Tsunami* is divided into four main sections and ten chapters. The main sections are: Tsunami as Known Hazards; Tsunami-Formed Landscapes; Causes of Tsunami; and Modern Risk of Tsunami. Chapters include the following topics: tsunami dynamics; tsunami signatures on coastal landscapes; tsunami generated by earthquakes, landslides, volcanoes, comets and meteorites; and the locations where tsunami risk is highest. The reader is captivated by Prof. Bryant's specific references to places, dates and times, with many of which we have familiarity from either recent events or widely-known world history.

Readers should have a good knowledge of global geography, including especially the Australian coastlines where many of Prof. Bryant's experiments and observations occurred. In the descriptions of past tsunami events he amply proves that the potential hazard is indeed underrated, given the huge death tolls that have occurred. Because of global population increases, especially in coastal zones vulnerable to tsunamis, Prof. Bryant's book should provide ample warning of the disaster to come. Humankind's false sense of security is likened to that of big earthquakes where populations have short memories and think they are immune to a cataclysmic seismic or geological event.

Reviewer's notes:

1. *Tsunami* (not tsunamis) is used in the review as both singular and plural, following the Japanese usage accepted and adhered to by Prof. Bryant.

2. The reviewer for CMOS, Mr. Jones, author of *Canadian Disasters - An Historical Survey*, found an excellent and accurate description of the 1929 tsunami which hit Newfoundland's Burin Peninsula. This is the sole tsunami among his 200 disasters, and is confirmed by Prof. Bryant as a relatively rare event, on the east coast of North America.

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## Physical Principles of Remote Sensing

W.G. Rees

Second Edition

Cambridge University Press 2001

Hardback : 0-521-66034-3 $110.00 US

Paperback : 0-521-66948-0 $39.95 US

Book reviewed by Anthony W. Isenor[3]

The "Physical Principles of Remote Sensing" is a very enjoyable book to read. The target audience is described as undergraduate, graduate and research scientists. For undergraduates to have the proper background for this book, they should be about 3rd year students. For researchers attempting to gain an understanding of remote sensing principles, this is a very good starting point. There is, however, a lack of recent references. This indicates that the book is not going to be useful as a source of current science.

The book table of contents is very detailed. Sections are presented in an order consistent with the view of the sensor. Initial chapters deal with the electromagnetic radiation, interactions between radiation and matter, and propagation in free space. Various systems are described, including photographic, electro-optical, microwave, ranging and scattering. Aircraft, satellite platforms, and orbits are also described. The final chapter deals with data processing.

Chapters two to four cover basic electromagnetic wave theory. Chapter two describes electromagnetic wave propagation. Starting with Maxwells equations the follow-on topics include polarization, spectra, doppler effect and

[3] Ocean Circulation Section, Bedford Institute of Oceanography, Dartmouth, N.S.

diffraction. Chapters three and four extend the electromagnetic radiation theory to consider interactions with matter and the atmosphere. Topics here include dispersion, interaction with plane boundaries, scattering, absorption, reflection and emissivity. For the atmosphere, molecular interactions are considered. On a larger scale, fog, rain, cloud and snow are also briefly discussed.

The mathematics in these initial chapters may intimidate some readers. Bessel functions, quantum numbers and triple integrals may not be useful to everyone. However, those so inclined will enjoy the section's mathematical descriptions. Other more general sections of the book provide a very understandable, non-mathematical description of remote sensing problems and issues.

Chapter five is the first of a series of chapters that deal with individual types of remote sensing. This chapter describes photographic systems. The basics in film development, types, and speeds are presented. Image formation by a lens is also described. Finally, relief and stereophotography are described.

Chapter six examines electro-optical systems. Emphasis here is on visible, near infrared and thermal infrared. Detectors, spatial resolution and applications are described. Under applications there is mention of land-based use for cartography, but there is also discussion on cloud top temperature, phytoplankton concentration and sea surface temperature. In places, sections take on an engineering style. For example, the description of doping for semiconductors.

The next chapter provides a look at passive microwave systems. Antenna theory is described, which then leads into scanning radiometers and phased arrays. Oceanographic applications that are described include sea surface temperature, surface roughness (for determining wind direction and speed) and sea ice. Oddly, the author does not consider remote microwave sensing of sea surface salinity as practical due to antenna size and footprint. There is no mention of current proposals being developed for microwave sensing of sea surface salinity. Over land, there is a brief description of applications for regional surface temperature, soil moisture and superficial snow depth.

Chapter eight examines ranging systems. Radar altimetry is a major topic in this chapter. Receiver power, effects of the earth's curvature, and range accuracy are all described. In applications, sea surface topography, wave height and the implications of ocean currents are considered. Over the land, the use of altimetry to detect ice sheet topology and the associated problems (e.g. steep sloping terrain) are described.

The final systems to be considered are those using active scattering. There is a brief discussion on optical systems for clouds, aerosols and atmospheric constituents. However, most of the chapter concentrates on radar (scattering at microwave frequencies). Microwave scatterometry over the ocean is described and how this is used to determine wind direction and speed.

Chapter 10 examines the platforms for remote sensing. Aircraft are mentioned, but the bulk of the chapter is devoted to satellite systems. Satellite launch issues are described, followed by orbit types. In a natural progression, the chapter ends with a discussion on orbit decay.

Chapter 11 completes the book with an introduction to data processing. Radiometric and geometric corrections, pixel interpolation techniques and contrast stretching are all described. Spatial filtering and clustering techniques for region classification is also discussed.

At the end of each chapter is a section with four to nine problems. Many of the problems are oriented towards transmission of signals through the atmosphere. However, there are problems related to land and ocean targets. For example, determining the minimum size of ice floes in a microwave signal. At the back of the book, solutions or hints are provided.

I have some rather small critical comments. First, the Index could be improved with a more detailed cross-referencing of topics. Some keywords appear in various sections, while the Index does not necessarily direct you to those sections in a straightforward manner. For example, sections on microwave backscattering coefficients and emisivities in the microwave region are not listed in the Index under Microwave. The Index lists these sections under emissivity and backscatter. As well, I believe a glossary of definitions and a list of acronyms would be a useful addition.

Overall, I enjoyed reading this book. I think it would make a wonderful addition to a scientific library or a personal bookshelf.

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## Stop Press: Lectures on The Ocean Carbon Cycle and Climate 5-16 August 2002, Middle East Technical University (METU) Ankara, Turkey

If you would like to participate please contact Mick Follows mick@plume.mit.edu) or Temel Oguz oguz@ims.metu.edu.tr) with a brief (one page) statement of your educational background, current position and scientific interests by May 15th 2002.

**METMEN in Wartime**
**Meteorology in Canada 1939 - 1945**
Morley Thomas
Soft Cover, ECW Press, Toronto, 2001, $19.95
ISBN # 1-55022-448-4

Book Reviewed by Howard L. Ferguson[4]

METMEN in Wartime is the third book in Morley Thomas' history of the Canadian meteorological service from its inception in 1871. This volume covers the period of the Second World War, by far the most hyperactive years of the service, when it underwent a ten-fold expansion.There are 318 pages of text followed by appendices and 28 pages of index divided into two detailed parts: "Names of Persons" and "Places and Subjects".

The first three chapters provide a brief retrospective of material covered in the previous two volumes. Chapter 4 - Making Metmen - describes the recruitment and training of university graduates, primarily to serve the need of the Royal Canadian Air Force (RCAF). These "metmen", officially classified as Meteorological Assistants Grade 3, were also known as "dependent forecasters" to distinguish them from Meteorologists or "independent forecasters" having post-graduate degrees in physics (meteorology). A total of 373 metmen were recruited during the war as temporary employees; about 151 stayed on after the war, serving as Meteorological Officers or obtaining theirs masters degrees to become Meteorologists.

Chapters 5 to 12 describe the national air defence system and its organization and development in eastern and western Canada. Considerable detail is provided on the deployment of various RCAF squadrons and the names and duties of metmen who served them. Most of these metmen were young, single and highly mobile males, some serving in 5 or 6 different locations during the war. There is a brief reference to the Alaska Highway, originally known as the Alcan Military Highway. An engineering marvel, it was built from Dawson Creek, B.C., to Alaska in only 10 months in 1942. The author notes that this road, built mostly by Americans, and the Northwest Staging Route airway from Edmonton to Whitehorse developed by Canada in 1940-41, "opened up the northwestern part of the continent".

Chapters 13 to 15 refer to the British Commonwealth Air Training Plan (BCATP) and the meteorological support provided for the training of Canadian and allied airmen. Various types of aircrew training schools are described, as well as operational training units. RCAF forecast centres and the role of the RCAF Women's Division in providing recruits from training as meteorological observers. The BCATP was established in December 1939 and terminated in March 1945. According to another source, a total of over 130,000 aircrew were trained for service overseas. The BCATP is widely recognized as one of Canada's major contributions to the war effort.

In Chapters 16 to 19 meteorological services to the navy and army are described, together with the development of "Civil Offices", services to the public and to rapidly-expanding civil aviation, the development of observation networks and activities at the Service headquarters at 315 Bloor Street West, Toronto.

Chapter 20 - Planning for Peace - summarizes the situation of the Meteorological Service at war's end and provides a brief glimpse into the following few years.

Illustrative material consists of 10 figures scattered through the text and 13 photographs following Chapter 9. Figures 6 and 7 show the location of Flying Training Schools where metmen were stationed. Unfortunately, of the 40 locations shown, only 7 are named. A larger format, with all stations named, would have been preferable. Figure 10 shows the expenditures on meteorology in Canada rose from about $7 million in 1938 to about $27 million in 1945 before subsiding to about $19 million in 1946.

The text is somewhat repetitious. This may be an advantage to browsers interested in individual sections, which are thus more self-contained.

In this easy-to-read volume, you will find the definitions of EAC, WAC, IAFAC, DAFO and CANOL, as well as information on ditto machines, epidiascopes, meteorographs, fire balloons, the Crimson Route and Exercise Muskox.

This book will be of interest to meteorologists, weather hobbyists and World War 2 history buffs, especially those interested in the RCAF and in aircraft of that era (33 types are identified). To career Meteorological Service employees, this work evokes memories of older colleagues, many of whom became the post-war leaders of the service. Clearly the esprit de corps nurtured during the war was sustained by these leaders and was a hallmark of the Meteorological Service for many subsequent decades.

The author knows whereof he writes. He began his illustrious career as a Metman. As the Meteorological Service historian he has now made another valuable contribution to the Canadian meteorological story.

[4] Toronto, Ontario.

## Scientific Excellence
## DFO Scientists Receive Top Honours
by Anne Henhoeffer[1]

Congratulations to Dr. Savlthri (Savi) Narayanan, Ms. Estelle Couture and Dr. Jake Rice, whose abilities and contributions to the field of marine science have been recognized by the international scientific community through appointment to key positions and an award of appreciation.

Savi, Director, Marine Environmental Data Services Branch at HQ, was elected as one of the co-presidents of the Joint Commission for Oceanography and Marine Meteorology (JCOMM) on June 22, 2001, at the First Session of the Joint Commission for Oceanography and Marine Meteorology in Akureyri, Iceland. Savi also has the distinction of being the first woman to hold such a senior position in the history of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC), two United Nations bodies.

Estelle, an employee from the National Capital Region in the Marine Environmental Data Services Branch, received a plaque of appreciation from the International Arctic Buoy Programme (IABP), in recognition of her significant contribution to the programme. Ms. Couture initiated and produced the CD entitled *International Arctic Buoy Programme and Arctic Buoy Data 1979 to 1999 Version 1.0*. Estelle was able to collect and organize 20 years of IABP research data (1979-1999) onto two user-friendly CDs.

Jake, Coordinator, at DFO's Canadian Stock Assessment Secretariat, was elected by the Science and Advisory Committee Chairs and experts as Chair of the Consultative Committee for the International Council for the Exploration of the Sea (ICES). In addition to his extensive background in fisheries and ecosystem research and management, Jake has been Chair of two different standing ICES Working Groups (Multispecies Assessments and Ecosystem Effects of Fishing) as well as several Study Groups. As Chief Scientist of ICES, Jake will provide coordination and guidance on all aspects of the Council's scientific work.

Savi, Estelle and Jake are respected within DFO and the national and international scientific communities. They exemplify what can be achieved through initiative, leadership, vision, as well as dedication to excellence.

**Note from the Editor**
Both, Savi Narayanan and Estelle Couture, are members of the Ottawa Centre of CMOS.

[1]Anne Henhoeffer is a Communications Advisor, Communications Branch, NCR, DFO.

## New Assistant Deputy Minister, Science
by Wayne G. Wouters[2]

Dr. Wendy Watson-Wright has been appointed to the position of Assistant Deputy Minister, Science, effective December 17, 2001. Dr. Watson-Wright holds a Ph.D. in Physiology/Pharmacology, an M.Sc. in Exercise Physiology and a Bachelor of Physical Education from Dalhousie University, Halifax.

In 1989, Dr. Watson-Wright began her career with the federal Public Service with Fisheries and Oceans Canada as Head, Shellfish Toxin Detection Section in the Inspection Services Branch of the Scotia-Fundy Region. Prior to joining the Department, she was a Post-Doctoral Fellow at the Victoria General Hospital in Halifax.

In 1992, she was appointed as Director of the Biological Research Station in St. Andrews. In August 1997, she undertook an assignment under the EX Bridging Program as Acting Director General, Review Directorate, in Ottawa, and was later officially appointed to the position.

In August 1999, Dr. Watson-Wright joined Health Canada as the Director General, Strategic Policy Directorate, and later became Senior Director General, Population and Public Health Branch. In June 2001, she was appointed as part of the Assistant Deputy Minister, Prequalification Process, to the position of Associate Assistant Deputy Minister, Population and Public Health Branch.

[2]Wayne G. Wouters is Deputy Minister, DFO.

## Excellence scientifique
## Des scientifiques du MPO font l'objet de grandes distinctions
par Anne Henhoeffer[3]

Félicitations à Mesdames Savithri (Savi) Narayanan et Estelle Couture et à Monsieur Jake Rice pour leurs capacités et leurs contributions dans le domaine de la science de la mer. Ils viennent d'être reconnus à cet effet par la collectivité scientifique internationale, comme en attestent leur nomination à des postes clés et la remise d'une prime d'appréciation.

Savi, Directrice du Service des données sur le milieu marin à l'AC, a été élue coprésidente à la Commission conjointe sur l'océanographie et la météorologie marine (JCOMM) le 22 juin 2001, lors de la première séance de la Commission, tenue à Akureyri, en Islande. Savi peut aussi s'enorgueillir d'être la première femme à occuper un poste aussi élevé dans toute l'histoire de l'Organisation météorologique mondiale (OMM) et de la Commission océanographique intergouvernementale (COI), deux organismes des Nations Unies.

Estelle, employée de la région de la capitale nationale à la Direction du Service des données sur le milieu marin, a reçu, de la part des responsables du *Programme international des bouées arctiques (PIBA)*, une plaque de reconnaissance pour sa contribution importante au programme. Estelle a mis en place et a produit le disque au laser intitulé *International Arctic Buoy Programme and Arctic Buoy Data 1979 to 1999 Version 1.0.* Elle a réussi à rassembler et à organiser sur deux disques au laser conviviaux les données de recherches accumulées dans le cadre du *PIBA* pendant vingt ans (1979-1999).

**Note de la rédaction**
Savi Narayanan et Estelle Couture sont toutes deux membres du Centre Ottawa de la SCMO.

[3] Anne Henhoeffer est conseillère en communications, Direction générale des communications, RCN, MPO.

Les présidents et spécialistes du Comité consultatif scientifique ont élu Jake, coordonnateur, Secrétariat canadien pour l'évaluation des stocks au MPO, au poste de président du Comité consultatif du Conseil international pour l'exploration de la mer (CIEM). Jake possède une vaste expérience dans le domaine de la pêche ainsi que dans celui de la recherche et de la gestion en matière d'écosystèmes. Il a aussi été président de deux groupes de travail permanents du CIEM (évaluations plurispécifiques et effets de la pêche sur les écosystèmes) et de plusieurs groupes d'études. À titre de scientifique en chef du CIEM, Jake coordonnera et orientera les travaux d'ordre scientifique du Conseil.

Savi, Estelle et Jake sont respectés au sein du MPO et par les collectivités scientifiques tant au pays qu'à l'étranger. Ils donnent l'exemple des réussites à la portée de ceux qui ont l'esprit d'initiative, la trempe d'un leader, une vision et une passion pour l'excellence.

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## Sous-Ministre Adjointe, Sciences
par Wayne G. Wouters[4]

Mme Watson-Wright a été nommée au poste de sous-ministre adjointe, Sciences. Cette nomination entrera en vigueur le 17 décembre 2001. Mme Watson-Wright détient un doctorat en physiologie et en pharmacologie, une maîtrise en physiologie de l'exercice et un baccalauréat en éducation physique de l'Université Dalhousie, Halifax.

Mme Watson-Wright a débuté sa carrière dans la fonction publique fédérale en 1989, à Pêches et Océans Canada, à titre de chef de la Section de détection des toxines chez les mollusques à la Direction de l'inspection de la région de Scotia-Fundy. Avant de se joindre au Ministère, elle était détentrice d'une bourse de perfectionnement post-doctoral au Victoria General Hospital d'Halifax.

En 1992, elle a été nommée directrice à la Station de recherche biologique de St. Andrews. En août 1997, elle a entrepris une affectation sous l'égide du Programme tremplin des EX, à titre de directrice générale intérimaire, Direction générale de l'Examen, à Ottawa, et a été nommée officiellement au poste par la suite.

En août 1999, Mme Watson-Wright s'est jointe à Santé Canada à titre de directrice générale de la Direction de la politique stratégique, et par la suite, est devenue directrice générale principale de la Direction générale de la santé de la population et de la santé publique (DGSPSP). En juin 2001, elle a été nommée au poste de sous-ministre adjointe déléguée de la DGSPSP dans le cadre du Processus de préqualification des sous-ministres adjoints.

[4] Wayne G. Wouters est Sous-ministre, MPO.

## Overview on ECOR

The Canadian National Committee (CNC) for the Engineering Committee on Oceanic Resources (ECOR) seeks to promote the application of engineering techniques to Canadian marine and fresh water problems. Dedicated to service to government, industry and academia, CNC/ECOR's role includes the technical issues of engineering as well as the related issues of national policy advising and international cooperation.

Canada has been a member of international ECOR since1969. Internationally, ECOR's functions include:

- undertaking a technical program in ocean engineering through working groups;
- cooperating and maintaining links with other international and Intergovernmental organizations on the engineering aspects of oceanic engineering;
- publishing the Oceanic Engineering International (OEI) journal jointly with the Ocean Engineering Research Centre at the Memorial University of Newfoundland;
- publishing technical reports and organizing workshops on selected topics in ocean engineering;
- assisting the engineering profession in matters such as the exploration and exploitation of oceanic resources and enhancement of quality of the marine environment.

### Activities

The OEI journal includes a short section of ECOR news; reviews, which include summaries of ECOR working group reports; refereed full journal papers; refereed technical notes or short papers. The scope of the journal covers the broad interdisciplinary area of oceanic engineering.

The ECOR Working Group on Marine Robotics published two reports. The first summarized the status of technologies related to this aspect of marine robotics. The second, highlighted technological areas requiring more research and development.

The editorial work for the "ECOR Working Group on Wave Energy Conversion, Phase 3" was contracted by ECOR international to complete the draft report. A search for a publisher has now been initiated.

The large scale cleansing of polluted seabeds ECOR Working Group has completed its work, but before the Working Group report can be finalized and published it needs additional scientific comment and revision. Mechanisms are being investigated of initiating a dialogue on the existing report with a view to updating and disseminating the report via the ECOR web site.

CNC/ECOR has hosted an ECOR Council Meeting in Canada, and played a major role in the organization and running of the event. Support has also been provided as required to other ECOR meetings and conferences held in Canada, e.g. Workshop on Marine Robotics in Victoria. Finally, comments and advice are provided on an as-required basis in response to national concerns and issues.

### CNC/ECOR Membership (March 2002)

Mr. James A. Bull, Environment Canada
Dr. Sander M. Calisal, University of British Columbia
Dr. James S. Collins *(Chair in 2002)*, University of Victoria
Ms. Susan Davidson, Sea Science Inc.
Mr. John J. Foster, Aquaprojects Inc.
Ms. Fiona Itamunoala, Baird & Associates
Dr. Jacques Locat, Université Laval
Dr. Derek B. Muggeridge, Okanagan University College
Dr. Charles Schafer *(Chair in 2001)*, Natural Resources Canada
Mr. David Thomas, Axys Environmental Consulting Ltd.
Mr. Dick Stoddart *(Secretary)*
Mr. John Brooke *(ex-officio)*
Prof. Neil Bose *(ex-officio)*, Memorial University of Newfoundland

### Additional information may be found at:

| | |
|---|---|
| ECOR / Canadian National Committee | www.meds-sdmm.dfo-mpo.gc.ca |
| ECOR / International | www.engr.mun.ca |

## ECOR Ocean Engineering International Journal Volume 5, Number 2, 2002

Available from Ocean Engineering Research Centre, Memorial University of Newfoundland, St. John's, Newfoundland, A1B 3X5.

Papers in this issue are:

- Wave effects on structures – an overview, M. Isaacson;
- Oblique ice collision loads on ships based on energy methods, C. Daily;
- Pressures and forces on semi-circular breakwaters due to regular waves, V. Sundar, R. Sundaravadivelu, G. Dhinakaran, K. Roopsekhar, K. Graw;
- Numerical analysis of the steady performance on contra-rotating propellers by lifting surface theory, H. Chun, K. Paik, S. Suh;
- Hydrodynamic model experiments with pod propulsors, J. Szantyr.

## SCOR Call for New Working Groups

SCOR
INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH

The Scientific Committee on Oceanic Research (SCOR) sponsors international working groups to focus attention on important ocean science issues. Working groups are usually formed of not more than 10 members, to deliberate on a narrowly-focused topic and develop a publication for the primary scientific literature. Their work is intended to be completed in 4 years or less. SCOR has sponsored (alone or with other organizations) 120 working groups, including the current ones. See the SCOR Web site for information about past and current working groups: http://www.jhu.edu/~scor/wkgroups.htm

Working group proposals primarily are submitted to SCOR from national SCOR committees and cooperating international organizations. Proposals will be accepted between April 1 and June 30, 2002. After this period, all proposals will be sent from the SCOR Secretariat to all national SCOR committees for comment. Instructions for content of proposals can be found at: http://www.jhu.edu/~scor/wkgrpinfo.htm

Decisions about new working groups will be made at the SCOR General Meeting in Sapporo, Japan on Oct. 1-5, 2002. At least one new group will be approved this year, for work beginning in 2003.

## STOP PRESS: MSC Reply to "A Meteorological Industry Strategy for Canada"

With the last issue of the *CMOS Bulletin SCMO* (Vol.30, No.1) we circulated a copy of "A Meteorological Industry Strategy for Canada" prepared by a Task Force of the CMOS Private Sector Committee. Earlier, MSC and CMOS had agreed that such a strategy was needed. It was prepared with MSC financial assistance. In addition, many private sector members contributed their time, skill and finances to this project. It was formally submitted to MSC in January 2002. In this issue we publish a letter from Dr. Marc Denis Everell, MSC ADM, responding to the Strategy's recommendations. As noted, there will be ongoing interaction with the Task Force. There may be further announcements and there will be opportunities for a full discussion at the Congress in May. Stay tuned.

## Letter to the Executive Director

10 Wellington Street, 4th Floor
Hull, Quebec K1A 0H3

15 March 2002

Mr. Neil J. Campbell
Executive Director
Canadian Meteorological and Oceanographic Society
Ottawa, Ontario

Dear Mr. Campbell:

Thank you for your recent submission of the CMOS private sector task force report, "*A Meteorological Industry Strategy for Canada*".

The growth and development of the meteorological private sector is a central aspect of the MSC vision for the future of meteorology in Canada. The MSC is strongly committed to the development of a strong and vibrant Canadian meteorological private sector, and to that end, we supported and followed with great interest the work conducted by the CMOS private sector task force.

I would like to take this opportunity to briefly outline some of the steps we are taking in addressing this important initiative of the meteorological sector in Canada. In addition to the direct support we provided to the task force, the MSC has been working internally to ensure the necessary components are in place to further this initiative. We have been communicating the process to our internal committees, staff and senior management. We've also been addressing issues, barriers, and conditions necessary to facilitate the growth of this sector and foster better relationships with the private sector.

The industry strategy task force has made a significant contribution and provided valuable information in this strategy document. The MSC agrees in principle with all the recommendations put forward in this strategy. Though we agree, we still need to work out the details and logistics to best achieve the goals of these recommendations. We view the issues of data access as well as devolution and transition of some of our cost recovery activities as the priority areas to address.

MSC has already been making progress on these issues. For example, the recent MSC cost recovery plan provided to the Treasury Board states that it will actively work to devolve some of its tier III cost recovery activities (i.e. not DND, CCG, Provinces, NAV CANADA) to the private sector. In devolving from its value added cost recovered services, the MSC will seek to work with the private sector to develop an action plan to identify areas of priority, timelines, strategies and opportunities for partnerships. At the same time MSC must communicate with stakeholders on this strategy and ensure that client needs will continue to be met and that their input and concerns will be incorporated into any such plan.

In addition, the MSC is committed to providing free or low-cost reasonable access to data as a means of implementing the existing data access policy. The MSC will seek to work and consult with its stakeholders in defining reasonable access while addressing internal issues related to proper infrastructure, equitable and sustainable access, program dependencies, and quality control. As we move to address the issues of devolution and data access, we will also assess employment/training, technology transfer, and marketing opportunities and considerations.

The MSC is establishing an internal process to work with stakeholders to develop a plan for implementing actions in response to the industry strategy including firm timelines, deliverables and milestones. The Industry Strategy has already been presented to MSC's Advisory Board by the CMOS task force. The Advisory Board, comprised of MSC external partners, stakeholders, and clients, generally supported the strategy but indicated that MSC should take the time to carefully develop an appropriate action plan.

As part of this process, we will keep the CMOS private sector task force involved through ongoing dialogue and continuing interaction. I hope that our joint efforts can lead to significant announcements regarding progress on this file at the CMOS congress at the end of May.

Thank you for your report and for the ongoing support from CMOS in this important initiative. I look forward to a continuing and constructive relationship in this effort.

Regards,

Original letter signed by:

*Marc Denis Everell*
*Assistant Deputy Minister*

Note from the Editor: "A Meteorological Industry Strategy for Canada" was distributed with the February issue of the *CMOS Bulletin SCMO*, Vol.30 No.1. The text is also available on the CMOS Website (www.cmos.ca).

La réponse du Service météorologique du Canada sera publiée en français dans notre prochain numéro.

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## Atmosphere-Ocean 40-1 Paper Order

OC-226
Evaluation of the CMC Regional Wave Forecasting System Against Buoy Data by ROOP LALBEHARRY

OC-303
Improved representation of sea-ice processes in climate models by OLEG A. SAENKO, GREGORY M. FLATO and ANDREW J. WEAVER

OC-228
Nutrient Dynamics in Ship Harbour, Nova Scotia by PETER M. STRAIN.

AO-305
Lightning Occurrence Patterns Over Canada and Adjacent United States from Lightning Detection Network Observations by WILLIAM R. BURROWS, PATRICK KING, PETER J. LEWIS, BOHDAN KOCHTUBAJDA, BRAD SNYDER and VIATEUR TURCOTTE.

OC-231
The Heat Flux Across Line-P 1996-1999 by HOWARD FREELAND.

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## Oceanographic Data Management Conference

Under the sponsorship of the Government of Belgium, the Flanders Marine Institute and the Intergovernmental Oceanographic Commission are organizing the next international marine data management conference (in the pentennial series) entitled "Symposium on Oceanographic Data and Information with Special Attention to Biological Data" in Brussels, Belgium, November 25-27, 2002.

The complete announcement can be seen at:

http://www.vliz.be/En/Activ/Cod/cod.htm

A-O

Share the good news!

In 2001, A-O printed 515 pages in the new letter size (8.5 x 11 inch format), which is equivalent to 832 pages of the old format (6 x 9 inch format), a new yearly record. We have received many compliments about the new look. Things should get even better!

Effective as of January 2002, page charges have been reduced to $85.00 per page (that is about $US53!).

Furthermore, a fixed price for colour printing has been approved: the first colour page in a paper will cost $600; the second page $300; each additional page in the same paper will cost $150. This simplification not only facilitates the decision to opt for colour, it makes colour much more attractive than in the past. Note also that all A-O charges are exempt from taxes.

With these changes, we hope to attract even more submissions and serve you and the goals of the Society better. It is true that, currently, A-O is not as widely distributed in libraries around the world as some of the competing journals, but, as one contributor puts it: "All one needs to do is order a few hundred reprints to make up for the fact that the subscription list isn't as big as for AMS and AGU journals. Also, (the A-O) library subscriptions are cheap and I like to support those journals too." It is our hope that as A-O continues to print more papers and to be distributed widely by authors in the form of reprints, more libraries will decide to subscribe to it.

Please contact any of the editors, or myself for comments on the direction of A-O; better still, attend the meeting of the Publications Committee, on 21 May at the Congress in Rimouski.

*Richard Asselin*
*Director of Publications*

## A word on the preparation of figures for the printed versions of papers

ATMOSPHERE-OCEAN cannot make a silk purse out of a sow's ear. It is important that authors submit high quality graphics, in electronic form. Printing graphic figures on an offset press, including grey scale and colour graphics, is a completely different process from printing on a computer printer. To ensure a high quality final product, the resolution, after sizing on the journal page, must be at least 600dpi (dots per inch) for line drawings (preferably 1200 dpi), although photographs may be at 300 dpi. The dimensions of the graphics should be the same or slightly larger than the expected final size. EPS (encapsulated PostScript) (unencoded) or TIFF (tagged image file format) (uncompressed) are the required formats. Note that JPEG (joint photographic experts group) or GIF (graphic interface file), which are good for viewing on the screen and computer printing, are not acceptable for offset printing. Grey tones must be saved as 8 bits grey scale (minimum).

The printing process uses the CYMK (cyan, yellow, magenta, black) colour separation system, which cannot accurately render images provided in the RBG (red, blue, green) system used by the computer monitor. To avoid colour changes due to conversion, the CYMK system should be used from the beginning, if possible.

Image files meeting the above criteria are very large and cannot be accepted in e-mail messages; they must be submitted to ATMOSPHERE-OCEAN on diskette or CD-ROM. Zipping of files is acceptable, but no form of compression should be applied to the graphics. (To preserve quality when exchanging figures between co-authors, FTP (file transfer protocol) can be used; if e-mail is used, the parameters of the e-mail software must be set to ensure no loss of spatial resolution or colour depth.)

A-O

Partageons les bonnes nouvelles!

En 2001, A-O a imprimé 515 pages dans le nouveau format 8.5 x 11 pouces, ce qui équivaut à environ 832 pages dans l'ancien format 6 x 9 pouces, un nouveau record annuel. Nous avons reçu beaucoup de compliments pour notre nouvelle apparence. Et il y a encore mieux à venir!

Depuis janvier 2002, les frais d'auteur ont été réduits à 85,00$ par page (environ 53,00$US!).

De plus, un prix fixe pour imprimer en couleur a été approuvé: la première page couleur dans un article coûtera 600$; la seconde page 300$; toute page supplémentaire dans le même article coûtera 150$. Non seulement cette simplification facilite t'elle la décision de choisir la couleur, elle rend l'option couleur beaucoup attrayante que par le passé. Notez aussi que tous les frais reliés à A-O sont exempts de taxe.

Grâce à ces changements nous espérons attirer encore plus de soumissions et mieux servir les objectifs de la Société. Il est vrai que A-O n'est pas distribué aux bibliothèques internationales autant que certaines des revues rivales, mais, comme le dit un de nos bons auteurs: "Tout ce qu'il faut faire c'est de commander quelques centaines de tirés-à-part pour compenser le fait que la liste d'abonnés n'est pas aussi longue que celle des revues de l'AMS ou de l'AGU. De plus, l'abonnement à A-O est bon marché, et j'aime bien encourager de telle revues." Nous espérons que, à mesure que A-O continuera à imprimer plus d'articles et à être généreusement distribué sous forme de tirés-à-part, plus de bibliothèques voudrons s'y abonner.

Veuillez adresser vos commentaires sur la direction de A-O à un des co-éditeurs ou à moi-même; encore mieux, participez à la réunion du Comité des publications, le 21 mai au Congrès de Rimouski.

*Richard Asselin*
*Directeur des publications*

## Un mot sur la préparation des illustrations pour la version imprimée d'articles.

ATMOSPHERE-OCEAN ne peut pas transformer des roches en pain. Il est essentiel que les auteurs soumettent des graphiques de haute qualité, en format électronique. Imprimer des illustrations sur une presse offset, avec tons de gris ou couleur, est un procédé complètement différent de l'impression sur une imprimante d'ordinateur. Pour obtenir un produit final d'excellente qualité, la résolution, après ajustement de la dimension sur la page imprimée, doit être d'au moins 600 ppp (points par pouce) pour les dessins linéaires (1200 ppp est préférable), quoique les photographies peuvent avoir 300 ppp.

La dimension des graphiques devrait être la même ou légèrement plus grande que la grandeur finale. Les formats requis sont EPS (encapsulated PostScript) (non-codé) ou TIFF (tagged image file format) (non comprimé). Notez que les formats JPEG (joint photographic experts group) ou GIF (graphic interface file), qui sont utilisés pour visualiser sur l'écran ou imprimer à l'ordinateur, ne sont pas acceptables pour l'impression offset. Les tons de gris doivent être sauvegardés avec une échelle d'un octet (minimum)

La méthode d'impression offset utilise le système de séparation de couleurs CYMK (cyan, magenta, jaune, noir), qui ne peut pas rendre parfaitement les images fournies selon le système RBG (rouge, bleu, vert) utilisé pour l'écran de l'ordinateur. Afin d'éviter des changements de couleur dues à la conversion, il est préférable d'utiliser le système CYMK dès le début, si possible.

Les fichiers images qui rencontrent ces exigences sont très gros et ne peuvent pas être acceptés dans des messages de courriel; ils doivent être soumis à ATMOSPHERE-OCEAN sur disquette ou DC. Il est admissible de "zipper" les fichiers, mais il ne faut pas appliquer quelque forme de compression au graphique même. (Afin de conserver la qualité des graphiques lors d'échanges entre les co-auteurs, le protocole FTP (file transfer protocole) peut être utilisé; et si le courriel est utilisé, il faut s'assurer que les paramètres du logiciel de courriel sont choisis de façon à conserver toute la résolution spatiale et l'étendue des couleurs.)

## CMOS-ACCREDITED CONSULTANTS / EXPERTS-CONSEILS ACCRÉDITÉS de la SCMO



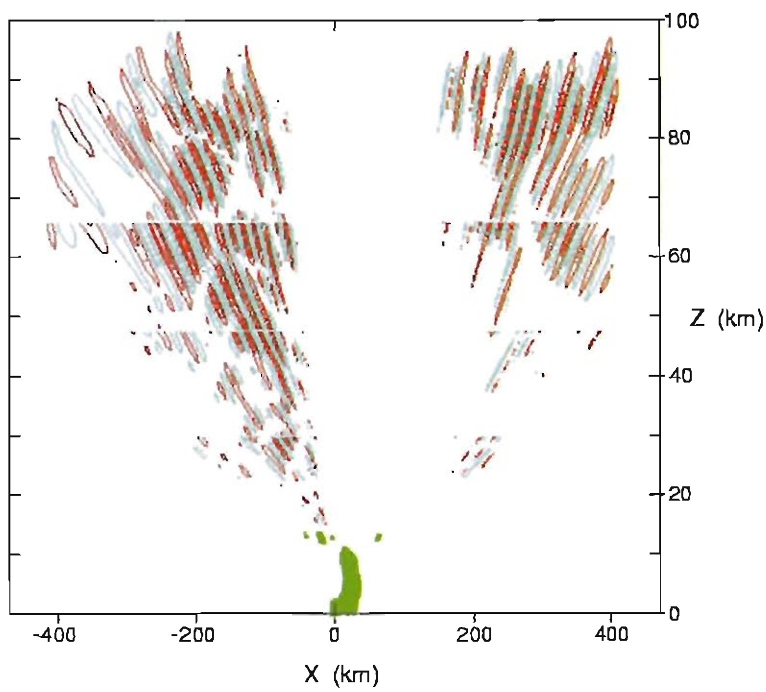
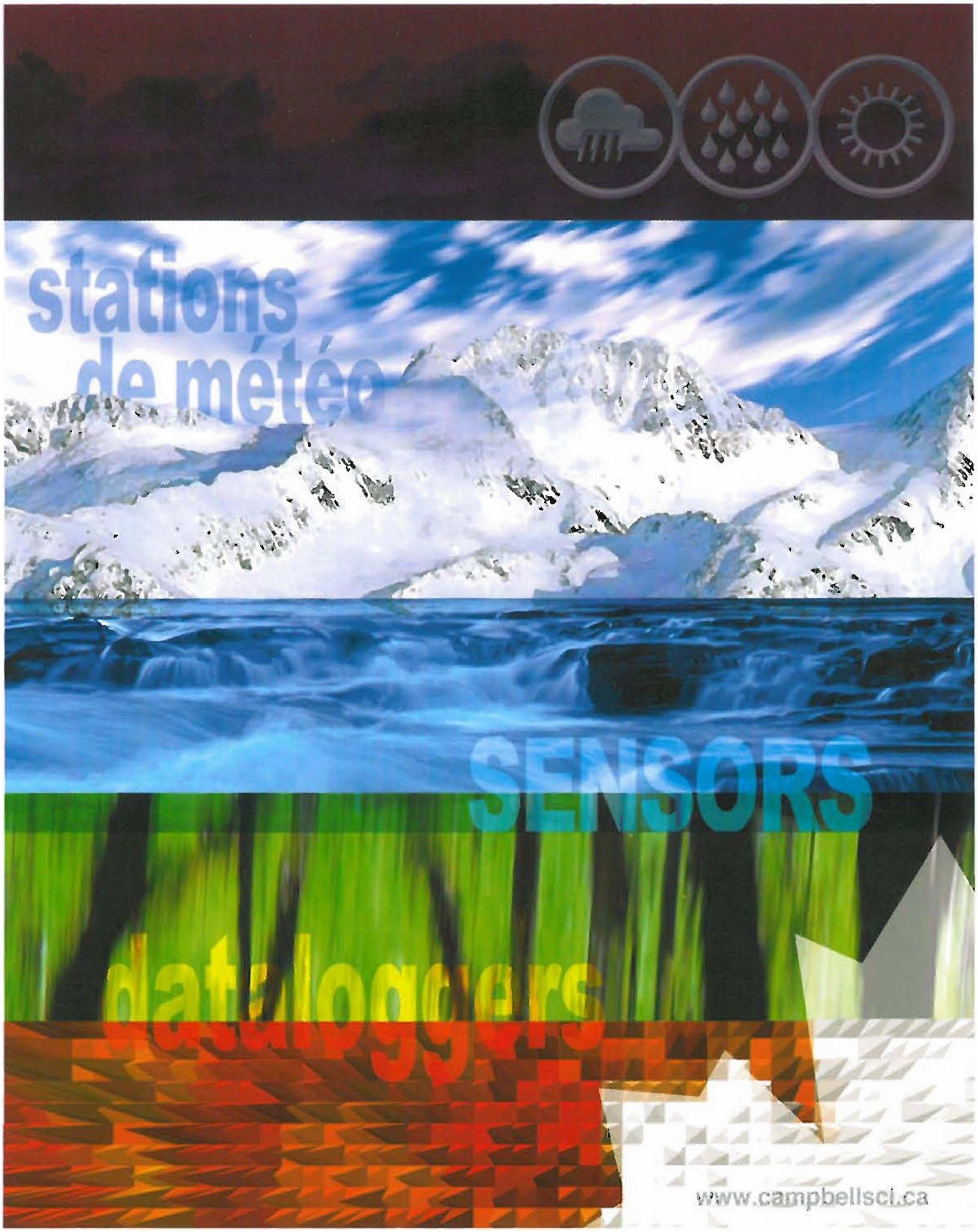



Fig. 2. The solid grey area shows the region with significant condensed water concentration 5.5 hours into the integration. The contours show the vertical velocity 9 hours into the integration. Red contours are for upward velocity and blue for downward velocity. For clarity, no zero contour is plotted. The contour interval is 0.1 $m\text{-}s^{-1}$ up to 30 km altitude, 0.25 $m\text{-}s^{-1}$ for the 30-48 km altitude range, 0.4 $m\text{-}s^{-1}$ for the 48-66 km altitude range, and 1 $m\text{-}s^{-1}$ above 66 km. You can read the article written by Kevin Hamilton, V. Balaji and Richard S. Hemler and entitled "Middle Atmosphere Gravity Waves Generated by Isolated Tropical Convection Simulated in a Cloud-Resolving Model" on page 40.

# Second Nature.

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