ISSN 0827-0384

C.M.O.S. NEWSLETTER/NOUVELLES S.C.M.O.

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

JUNE/JUIN 1992 VOL. 20 NO. 3

The second Toronto Magnetic and Meteorological Observatory. The Meteorological Service of Canada, founded in 1871, was administered from this observatory until 1909. This scene was reproduced from "The Beginnings of Canadian Meteorology" by Morley Thomas. This new book is reviewed by James Bruce on page 11 of this Newsletter.

EDITOR'S COLUMN

The next issue of the CMOS Newsletter **20**(4), August 1992, will go to press on July 20th, 1992. Contributions are welcome and should be sent to me at:-

Institute of Ocean Sciences
P. O. Box 6000
Sidney, B.C. V8L 4B2
Tel. (604)-363-6590
FAX (604)-363-6746

I prefer receiving contributions submitted on floppy disk in a DOS format, however, I can now convert Macintosh files to DOS files. DFO contributors can send ASCII files to me over DFOnet to IOSCCS::HJFREE. Anyone with access to Omnet can send ASCII files to me at IOS.BC, attention Howard Freeland. Internet should be available at IOS by the end of June 1992. If you want to send graphics, then HPGL files can be sent as ASCII files over the networks. It is recommended that whatever software prepares the HPGL file be configured for the HP7550 printer. If you have the option of selecting pen colours, don't.

Do you have an interesting photograph, say, an interesting meteorological or oceanographic phenomenon? If so, write a caption and send it to me for publication in the CMOS Newsletter.

Howard J. Freeland, CMOS Newsletter Editor

WHAT'S GOING AROUND?
by Savonius Rotor

Recently while relaxing one evening I happened upon the annual awards ceremony known as "The Oscars". Of course I was waiting intently for news of this year's winner of that most prestigious award for the "Best Movie on a Meteorological or Oceanographic Theme" which, as you will all know by now was "How Green Is My Plan". Here is a short list of previous winners in this category:-

Lawrence of Montreal
The Currents of Wrath
The Pi Who Came In From the Cold
How Green is my Talley
The Boer Wars
The Greatback
The Gower and the Rory
Hobson's Choice
The Krauel Sea
All Quiet on the Warm Front

and finally the greatest of them all, Gone With the Wind.

Donations to the John P. Tully Fund

The *John P. Tully Fund* was established in memory of the pioneering oceanographer of Canada's Pacific coast John P. Tully. The fund is used to mint medals which are awarded to Canadian oceanographers in recognition of contributions made to oceanography in Canada. Obviously, it costs money to mint medals; recipients are not charged! This money is raised on occasion by appeal to the better sentiments of CMOS members, **particularly oceanographers**. At present, the balance of the *John P. Tully Fund* is low, and a fresh infusion of members' (or non-members') dollars is required.

If you feel the urge to encourage the development and visibility of oceanography in Canada, please consider a donation to the fund. Donations can be used to earn tax credits, since CMOS is registered as a charitable organization. Please make cheques payable to *CMOS/Tully Fund*, and mail to the CMOS Business Office:

Canadian Meteorological and Oceanographic Society,
P.O.B./C.P. 334,
Newmarket, Ontario, L3Y 4X7

Tax receipts will be issued.

Letter to the Editor

I read with a great deal of interest the article in the April 1992 issue of C.M.O.S. Newsletter regarding the "Statement on Atmospheric Change".

One paragraph in this article causes me some concern as it leaves the impression that air pollution was not recognized in Canada until 1970. The paragraph in question starts: "Concern about damage to Canadian ecosystems due to the acidification of precipitation was first raised in the 1970's". Although the term "acid rain (or precipitation)" may have been coined in 1970, the ecological problems associated with air pollution (particularly SO_2) in Canada were recognized much earlier. Staff (Hewson and Gill) of the Canadian Meteorological Service (CMS) were involved in the study of pollution damage to vegetation near the Trail smelters in B.C. in the late 1930s and early '40s. CMS staff (particularly Mukammal) undertook investigations of pollution and leaf fleck in tobacco fields in Southern Ontario in the 1960's.

Air pollution was recognized as a problem by a special subcommittee on agrometeorology established by the National Advisory Committee on Agricultural Services in 1959. Four years later (in 1963) the National Committee on Agrometeorology began discussions on air pollution and encouraged participating members to undertake research on the problem.

Respectfully submitted,

George W. Robertson
Consulting Agrometeorologist
P. O. Box 1120
Kemptville, Ont. K0G 1J0

Reply

You are entirely correct in pointing out that air pollution was an issue in Canada long before the 1970's and that a good deal of pioneering work was consequently done on this topic and its ecological impacts.

The general thrust of the Statement was to focus on the "newly discovered" atmospheric issues that, taken collectively, have given rise to the topic of global change. In that context we wished to draw attention specifically to precipitation acidification (as distinct from the well known issues of direct damage by elevated levels of sulphur dioxide and ozone) as one of the first of these unpleasant surprises which is causing damage to the environment.

We appreciate the interest and the fact that you took the time to correspond with us.

Dr. Ronald Stewart
Chairman, CMOS Scientific Committee

Contributions Requested

Please send climate research-related material to Ross Brown, Canadian Climate Centre, Phone: (613) 996-4488, Fax: (613) 563-8480.

The Joint Scientific Committee of the World Climate Research Programme meets in Victoria

The 13th Session of the Joint Scientific Committee (JSC) for the World Climate Research Programme was held, 23-28 March, 1992, in the very pleasant environment of the inner harbour area of Victoria, British Columbia. The JSC is responsible for the overall scientific planning and coordination of the WCRP and is appointed jointly by the World Meteorological Organization and the International Council of Scientific Unions. Professor Gordon McBean of the University of British Columbia is the Chairman of the JSC and chaired the meeting. Other Canadian participants were Prof. R.W. Stewart of University of Victoria, representing ICSU and IGBP, Dr. D.M. Whelpdale of AES, representing the President, WMO Commission for Atmospheric Sciences, Dr. A. Clarke of Bedford Institute of Oceanography, as Co-Chair of the international Scientific Steering Committee for WOCE and also representing the Committee on Climate Changes and the Oceans, Dr. J.M.R. Stone, Research Director, Canadian Climate Centre and Dr. K. Denman, Institute of Ocean Sciences, Sidney, B.C., who gave one of the special scientific presentations to the meeting. Elizabeth Dowdeswell, Permanent Representative of Canada to WMO, officially opened the meeting.

In all, the meeting was attended by about 30 scientists from around the world, including members of the JSC, representatives of sponsors, chairs of working groups and invited experts. The weather cooperated beautifully and everyone enjoyed their visit. A nice reception was held at the University of Victoria. The JSC reviewed the progress of the main programmes of the WCRP (Climate Modelling, WOCE, TOGA, GEWEX), discussed new areas for possible scientific initiatives (particularly the stratosphere, the Arctic, aerosols) and prepared recommendations. The full report of the meeting will be available in the WCRP publication series.

In the Global Climate Modelling Programme, good progress is being made towards preparing a review of coupled models and establishing procedures for systematic model intercomparisons. New coupled model simulations are generally consistent with each other but the importance of flux corrections is a continuing concern. The Atmospheric Model Intercomparison Project is moving ahead with computer time being allocated at the Lawrence Livermore National Laboratory. This will provide a solid basis for systematic model intercomparison. A project to compare feedbacks in GCMs is underway. NWP models will be compared for cloud and cloud/radiation simulations. Re-analysis projects will be done at ECMWF (1979-94) and NMC (1958-93).

1991 was a pretty good year for the World Ocean Circulation Experiment (WOCE). ERS-1 was launched in July. Nine current meter arrays, 84 floats and nearly 500 WOCE/TOGA drifters were deployed. Several sections of the WOCE Hydrographic Survey were completed and XBT coverage was expanded. The Data Assembly Centres for moorings, floats, upper ocean thermal data, sea level and drifters began operation. The atlas of the Fine Resolution Antarctic Model (FRAM) was published. N. Fofonoff started as new Director of the WOCE International Project Office. There is still concern about full implementation and the observing period has been extended to 1990-1997 (instead of 1995) to allow for completion of some hydrographic sections that cannot be completed in the five year window.

The Tropical Ocean - Global Atmosphere (TOGA) Programme observing system is reaching full implementation status: the Tropical Atmosphere Ocean (TAO) Array was increased from 19 to 40 moorings by February 1992. The TOGA CD-ROM data project has been implemented with more than 500 copies of data distributed. The TOGA Coupled Ocean Atmosphere Response Experiment (COARE) will go ahead in Nov. 1992 - Feb. 1993. Plans for a quasi-operational TOGA prediction centre are developing.

In view of recent space agencies decisions, it was recognized that the Global Energy and Water Cycle Experiment (GEWEX) would have to be delayed into the 21st century. It was agreed that GEWEX would have, for phase I (1992-2000) three major sub-programmes or scientific thrusts:

- radiative properties of clear-air, aerosols(?), clouds and the earth surface
- dynamics of cloud systems
- water cycling in the atmosphere and land, including the GCIP.

Several other initiatives are underway including:

- the International Satellite Cloud Climatology Project (ISCCP)
- the Global Precipitation Climatology Project (GPCP)
- the Global Water Vapour Pilot Project (GVaP)

The WCRP Radiation Budget Project and the Baseline Surface Radiation Network are also making progress but there are still major difficulties with the long-wave flux estimates.

The concept proposal for an Arctic Climate System Study (ACSyS) was approved. ACSyS will involve coupled studies of the Arctic Ocean, sea ice, atmosphere and surrounding land areas. The objective will be eventual inclusion in a realistic way the Arctic region in coupled global climate models. Although it was recognized that the south Polar region has special scientific issues that will need to be addressed in due course, the initial priority will be on the Arctic. Progress has been made in implementing the International Arctic Buoy Programme and Antarctic Ice Thickness Monitoring Project. Polar radiation reference stations are being installed at least 4 locations and the first Arctic Ocean Climate Station has been deployed.

A new programme on the role of the stratosphere and its interactions with the troposphere, in climate was approved (Stratospheric Processes and their Role in Climate, SPARC). The focus would be on understanding stratospheric chemical, dynamical and radiative processes in relation to global climate. The Programme would organize co-ordinated observational and modelling studies and cooperate with WGNE, IGAC, GAW and others. A link with biospheric studies of UV impacts would be established.

The report of the Study Group on the Research Programme on the Variability of the Coupled Ocean-Atmosphere System and

Climate Prediction (CLIVAR) lead to considerable discussion on the time scale for emphasis (seasons to interannual, or to a century) and the scope of the programme. It was emphasized that the programme would focus on the ocean's role in climate variability. The Study Group was given guidance in preparing its report for the next meeting of the JSC.

Prof R. Charlson gave a presentation on aerosols and climate. It was agreed to convene a specialist workshop on the topic to explore possible actions for the WCRP. Dr. K. Denman gave a presentation on the mixed physical, chemical and biological processes of the upper ocean, which will be relevant for the further development of WCRP-IGBP initiatives.

In the next few months, it is expected that the Intergovernmental Oceanographic Commission of Unesco will become a sponsor of the WCRP and the JSC will be expanded to 18 members. In view of this change, it was agreed that the present officers should continue for one more year.

Gordon A. McBean
University of British Columbia

Working Group Formed on Hydrological and Biological Feedback Processes

In response to a recommendation of the Saskatoon Workshop on Land Surface Processes and Climate, the Climate Research Network has initiated a scientific working group to foster research on the incorporation of significant hydrological and biogeochemical feedback processes into GCMs. The idea is to start with a small core group of scientists who will develop their own terms of reference, membership and agenda. Support will be provided through a secretariat in Saskatoon. Dr. Ric Soulis (U. of Waterloo) has agreed to chair the working group. Other members include Drs. D. Verseghy (CCC), G. Kite (NHRI) and D. Vitt (U. of Alberta). The first meeting of the working group is scheduled for early June 1992.

Workshop on Climate Systems Research

The third of a series of workshops to define research activities and foster collaboration within the context of a Climate Research Network was held at the Yorkdale Holiday Inn, Toronto, May 4-5. The workshop focused on three themes: atmospheric chemistry, clouds and paleoclimate. There were 44 invited participants from the universities, federal government, Ontario provincial government and the private sector. The main objective of the workshop was to develop collaborative research proposals which would make a significant contribution to the next-generation Canadian global climate model (GCM) being developed at the Canadian Climate Centre under the Green Plan Global Warming Science Initiative. A number of "straw proposals" were presented and discussed at the meeting, and it is anticipated that several of these will develop into significant multi-sectorial collaborative projects. A major recommendation of all working groups was to establish a "community" GCM in Canada. A more detailed workshop report will be presented in the next CMOS Newsletter. For more information on this workshop contact Ross Brown at (613) 996-4488.

Snow Watch '92: Detection Strategies for Snow and Ice

The Canadian Climate Centre and the World Meteorological Organization (WMO) sponsored a very successful international workshop on snow and lake ice cover and the climate system from March 30 - April 1 at Niagara-on-the-Lake. This was the first specialty workshop following the WMO Expert Meeting on Climate Change Detection hosted by Canada in November 1990. Thirty-five invited experts from Canada, the United States, Finland, Russia and China focused on variations in snow and lake ice cover as potentially effective regional and global change indicators, and their use in detecting significant change.

The workshop brought together representatives from the climate, cryosphere and statistics community. Special emphasis was placed on how to apply statistical procedures to the typically short time-series data available for cryospheric variables. In addition to generating constructive dialogue between disciplines, the meeting emphasized the need to maintain baseline observations, particularly in northern regions. A workshop proceedings is in preparation and will be available shortly. For further information on the workshop please contact Dr. Barry Goodison at (416) 739-4345.

International Workshop on Soil Moisture Modelling and Monitoring

The Canadian Climate Centre and the National Hydrology Research Institute hosted an international workshop on soil moisture modelling and monitoring in Saskatoon in March, 1992. The 45 participants represented government agricultural support organizations, river and weather forecast agencies, and researchers from university and government. The workshop focused on state-of-the-art techniques for soil moisture modelling and for in-situ and remote measurements. The workshop concluded that there was a significant knowledge gap in the ability to monitor soil moisture at farm- and local-scales of a hundred hectares up to 100 square kilometres. Agriculture and hydrology users identified a critical need for more reliable and more detailed precipitation maps and forecasts. The workshop recommended soil moisture models be studied over a broad range of environments (e.g. forests, wetlands etc.) and that techniques be developed for interchange between spatial scales. A workshop proceedings is in preparation and will be available this summer. For further information contact Joe Eley at (306) 975-5685.

C^2GCR 2nd Annual Student Day

The Centre for Climate and Global Change Research (C^2GCR) at McGill University held a very successful student day on May 4, with 26 papers presented covering such fields as; ocean studies and the thermohaline circulation of the North Atlantic, clouds and the climate system, air-sea fluxes, and atmospheric and ocean modelling. For further information on C^2GCR activities contact Dr. Lawrence Mysak at (514) 398-3764.

Impacts of Large-scale Atmospheric Circulation Anomalies on the Indian Monsoon and World Grain Yields

Dr. M.L. Khandekar of the Atmospheric Environment Service and Ray Garnett of the Canadian Wheat Board are collaborating on a project to monitor large-scale circulation anomalies such as ENSO, quasi-biennial oscillation and Eurasian snow cover, to look at possible impacts on the Indian/Asian monsoon and world grain yields. Initial results suggest that large-scale atmospheric anomalies have a definite impact on monsoon (June-Sept.) rainfall over India (and perhaps Southeast Asia), and that monsoon rainfall is highly negatively correlated with U.S. corn yield. Sea-surface temperatures in the equatorial eastern Pacific for June-August were also found to be positively correlated with Canadian spring wheat yield. Khandekar and Garnett are presently analyzing the Pacific North American (PNA) index and its possible connection to spring/summer precipitation over the Canadian prairies and consequently to Canadian wheat yields. Further information on this project can be obtained from Dr. M.L. Khandekar at (416) 739-4913.

Up-Coming Climate-Related Research Meetings in Canada:

Victoria, July, 1992: International Workshop on the Cox-Bryan Modular Ocean Model (MOM). Final date to be announced. Contacts: Dr. Greg Holloway EMAIL ZOUNDS@IOS.BC.CA or Warren Lee EMAIL WARREN@OCGY.UBC.CA.

Toronto, Aug. 10-14, 1992: Workshop on Cloud Microphysics and Applications to Global Change. This workshop, held in conjunction with the Third International Cloud Modelling Workshop, will focus on the relationship between cloud microphysics and global change using measurements taken from around the world. Contact: Dr. George Isaac (416) 739-4605.

Toronto, Aug. 10-14, 1992: Third International Cloud Modelling Workshop. The primary focus will be on the simulation of precipitation processes in cloud-scale and mesoscale systems. Contact: Dr. Harold Orville (605) 394-2291.

Montréal, Aug. 17-21, 1992: 11th International Conference on Clouds and Precipitation. The conference will cover a broad range of subject matter including the radiative effects of clouds, the effects of clouds on global climate, and clouds and precipitation in relation to the hydrological cycle. Contact: Conference Office (514) 398-3770.

Saskatoon, September 1-2, 1992: Regional Evaporation Study (RES) Workshop at National Hydrology Research Centre. The workshop will review the results of the RES-91 field program, discuss collaborative studies and operational concerns, and look at future RES plans. Contact: Dr. Geoff Strong (306) 975-5809.

Victoria, Oct. 13-16, 1992: International Symposium on Climate Change and Northern Fish Populations. Topics will include evidence for changes in climate and the resulting effects in freshwater and marine environments. Contact: Symposium Secretary (604) 756-7260.

Calgary, Sept. 12-18, 1993: The International Society of Biometeorology Thirteenth International Congress of Biometeorology. The theme of this congress is adaptations to global atmospheric change and variability. The congress will address issues of human, animal, plant, invertebrates and microorganisms in relation to climate change and variability. Contact: Dr. N. Barthakur (514) 398-7938.

JGOFS Canada EXECUTIVE DIRECTOR

Applications are invited for the post of Executive Director of the Canadian project of the Joint Global Ocean Flux Study (JGOFS), which has just received funding for an initial three year period. JGOFS is an international research project organized by the Scientific Committee on Oceanic Research (SCOR) under the auspices of the International Council of Scientific Unions (ICSU). The study's aim is to realize a basic comprehension of the fluxes of carbon and related nutrient elements through the oceans and across their boundaries in order to provide some of the knowledge required for an understanding of the role of the oceans in the global carbon cycle and climate change.

The Executive Director will be responsible to a Steering Committee for the day-to-day management of the program and will act as a line of communication between this committee, the Scientific Advisory Committee and the JGOFS Project Leaders. She/he will be responsible for the operation of the JGOFS Secretariat which is based in the Department of Oceanography of Dalhousie University. The successful candidate will be a senior scientist with wide experience in marine research and in the management of collaborative research projects. It is atticipated that a block of time will be available for the candidate's personal research.

Send applications with a curriculum vitae and the names of three references to: Canadian JGOFS Secretariat, Dept. Oceanography, Dalhousie University, Halifax NS B3H 4J1, Canada, Tel. 902-494-3557, FAX: 902-494-3877. Deadline for receipt of applications is July 1, 1992.

In accordance with Canadian immigration requirements, priority will be given to qualified Canadian citizens and permanent residents. Foreign applicants may, however, apply. Dalhousie University is an Employment Equity/Affirmative Action Employer. We encourage applications from qualified women, aboriginal peoples, visible minorities and persons with disabilities.

Ocean Climate Questions and the CO_2 Problem: Transport of CO_2 from the Atmosphere to the Deep Ocean

E. P. Jones
Bedford Institute of Oceanography

A program to measure total inorganic carbon in the North Atlantic and Arctic Oceans and to determine carbon transport through the pycnocline to deeper parts of the ocean has been under way at the Bedford Institute of Oceanography for a number of years. Our program addresses the transport of dissolved inorganic carbon to deeper regions by entrainment and deep convection of upper water masses. Recently, these efforts have been come together under the dual umbrellas of JGOFS and WOCE. While WOCE as a climate program is not specifically designed to address the CO_2 problem or the "Greenhouse Effect", the Canadian WOCE program in the North Atlantic offers an ideal opportunity for gathering data that do address the CO_2 problem. The areas of operation of the ships, the hydrographic and chemical data collected, and the models being developed under the WOCE program when combined with measurements of transient tracers and total dissolved inorganic carbon are almost exactly what is required to carry out a program to measure the sequestering of CO_2 below the pycnocline.

Transient tracer measurements are required to set a time scale to determine rates of transport. Since carbon dioxide has been building up in the atmosphere in significant amounts for many decades, suitable transient tracers should match this time scale. We have developed the capability to measure concentrations of a suite of chlorofluorocarbons, Freon-11, Freon-12, Freon-113, and carbon tetrachloride, whose source functions range from spanning most of this century (carbon tetrachloride) to just this last decade (Freon-113). The WOCE data set together with our additional measurements of carbon and transient tracers form the basis of our JGOFS field program.

The Canadian WOCE/JGOFS at the Bedford Institute of Oceanography includes seven major the North Atlantic Ocean Sections cruises of 30 to 40 days and six additional annual cruises to the Labrador Sea. The annual expeditions to the Labrador Sea are particularly directed towards a comprehensive study of this region where large amounts of water are formed and transported beneath the pycnocline and where the formation of deep water is known to vary considerably from year to year. In 1991, the first of the North Atlantic Sections was carried out. In 1992, we will embark on the third of the Labrador Sea cruises.

A second thrust of the program is in Arctic regions, particularly the Arctic Ocean. This ocean remains somewhat of an unknown in global climate change considerations. There are soundly based arguments that suggest the delicate balance now existing in the fresh water budget of the Arctic Ocean could change and strongly influence deep water formation in the North Atlantic, causing a major disruption in the "conveyor belt" now determining a major portion of the heat transport from equatorial regions to temperate regions. A change in this "conveyor belt" would also impinge strongly on the sequestering of CO_2 to the deep ocean. The role of the Arctic Ocean itself in the global carbon cycle is not well resolved. Thus part of our program is to carry out the same type of measurements in the Arctic Ocean and its marginal seas as we are doing in the North Atlantic. Expeditions to the Arctic Ocean and even to the Norwegian-Greenland Sea region are costly and thus cannot be carried out by us alone. Some of our earlier work on assessing the carbon budget of the Arctic Ocean was based on inconveniently sparse data gathered mostly from a very few ice camps. This past summer, on a major expedition on the Swedish icebreaker *Oden* and collaborating with Swedish colleagues, we obtained a large data set of dissolved organic and inorganic carbon concentrations in the Eurasian Basin which, together with chlorofluorocarbon measurements and other hydrographic data will be used to assess the carbon-climate problem as it relates to the Arctic Ocean.

Progress to date has been mainly in collecting data. The next step in addition to collecting more data is to devise a hierarchy of synoptic scale models that use this data to determine carbon sequestering. These will range from simple conceptual models that can describe and estimate the carbon transport to more sophisticated numerical models based on those to be developed under WOCE. Specific model development directly related to this program is now just beginning and is expected to continue for the next five years.

Applications of inverse methods for the study and modelling of biogeochemical processes in the Canadian JGOFS program

Alain Vézina and Yves Gratton
Institut Maurice Lamontagne

Process models of the physical-biogeochemical systems provide the framework for understanding the carbon cycle and estimating present-day and future carbon fluxes in the ocean. These models are usually approached as a forward problem, that is, a model is developed based on established theoretical principles and simulated forward in time or space from specified initial conditions. The parameters of the model can then be adjusted by comparing the model outputs to real data. However, this procedure is not very precise; most often, it is impossible to ascertain whether the data is sufficient to constrain the model or whether alternative models could fit the data equally well. The relationship of the model parameters to the data can be explored in depth with inverse methods, in a way that is not possible with the forward approach. Inverse methods are already being used to quantify the large scale ocean circulation and biogeochemical fluxes (Wunsch 1977; Wunsch and Minster 1982). In this Canadian JGOFS project, inverse methods are proposed to analyze biogeochemical transformations over smaller scales, in particular biological (food web) transformations in the water column and at the benthic boundary layer and their interactions with the export and accumulation of organic carbon.

The simplest example of an inverse method is a linear regression between two variables. The regression estimates the parameters a and b of a straight line ($y = a + bx$) that minimize the squared deviations between the straight line and

the observations. All inverse methods follow the same principle of minimizing the deviations between model and data, although not necessarily by using least-squares. With regression, the observations are much more numerous than the parameters to be estimated. Inverse methods address the problems where the number of available observations is less than the number of model parameters to estimate. In the former case, the problem is overdetermined whereas in the latter case the problem is underdetermined. The term "inverse methods" is generally limited to techniques that solve the underdetermined problem (Menke 1984).

Food web transformations regulate the fraction of the primary production that settles out to the deep sea or the fraction of the organic carbon settling on the sediment boundary layer that accumulates in the sediments. The problem of specifying these transformations is fundamentally underdetermined. The number of species involved and of possible interactions is bewildering. Even by simplifying the ecosystem, we are still left with a large number of flows (upwards of 20) and the impossibility of measuring them all simultaneously *in situ*. Inverse methods provide the objective mathematical machinery to fill the gaps and develop coherent diagnostic models of food web processes (Vézina and Platt 1988). The inverse models perform several important functions: (1) they reveal the trophic interactions that are most closely involved with the net loss or accumulation of organic carbon, (2) they quantify the degree to which the data constrain the various model parameters, and (3) they identify the additional observations that would most improve the constraints on the parameters. The last two functions are to a certain extent unique to inverse methods and they are crucial because, with underdetermined problems, only some of the model parameters can be perfectly resolved. It is then essential that we identify the process information that can be extracted from the data and the process measurements that can reduce the uncertainty the most.

Another problem to which inverse methods can contribute is that of interpreting stable isotope anomalies in the marine biota and the inorganic environment. ^{15}N and ^{13}C anomalies especially are used to identify the sources and fate of organic materials and to determine the nature and intensity of recycling. Simple forward models have been applied before to interpret ^{15}N anomalies (Altabet *et al.* 1986), but these models addressed only the vertical balance between upward fluxes of new nitrogen and downward fluxes of particulate organic nitrogen. Recent data suggests that complex trophic interactions are involved in determining geographic and seasonal differences in ^{15}N anomalies (Checkley and Miller 1989). As with the food web problem described above, inverse methods can increase the complexity of models fitted to the stable isotope data and add rigour to the interpretations.

Over the short term, the problems described above can be investigated using a discrete inverse scheme already developed. In this scheme, the basic continuity equation for the dynamics of biological materials in the ocean is followed:

$$dq^m_i/dt + \mathbf{V}\cdot\nabla q^m_i - \mathbf{K}\cdot\nabla^2 q^m_i = \Sigma c^m_{ij} q^m_j - \Sigma c^m_{ji} q^m_i - c^m_i q^m_i \qquad (1)$$

where q^m_i is the concentration of material m in compartment i, **V** is the advective velocity tensor, **K** is the eddy diffusivity tensor, ∇ is the gradient operator, c^m_{ij} is the first-order coefficient (T^{-1}) for transfer of material m from j to i, c^m_{ji} is that for the transfer from i to j, and c^m_i is that for the loss of m from the system (dissipation, decay, sinking, etc...). To these equations are appended constraints on the coefficients of the form: $\Sigma g_{kl} c_l \geq h_k$ (2)
where g_{kl} represents the effect of the kth constraint on the lth coefficient and h_k is the bound posed by the kth constraint. Average field estimates for the qmi terms are substituted into the finite difference approximation to Eq. (1), and the equations are weighted by the variance of the measurements. Spatial gradients can be approximated by boxes that reflect the spatial resolution of the data. The transfer coefficients are obtained by a spectral decomposition of Eq. (1) (Singular Value Decomposition or SVD) followed by Quadratic Programming (QP) of the undefined part of the solution to take Eq. (2) into account (Lawson and Hanson 1974). The procedure minimizes the residuals between the observed and predicted values for the left-hand side of (1) (in the cases where the physics of the study region are not well known, one might have to solve for **V** and **K** as well as the transfer coefficients). This solution provides the smallest set of transfer coefficients that satisfies Eqs. (1) and (2); in other words, it is the simplest among all the possible solutions. Equations (1) and (2) can also be solved by linear programming techniques that minimize the absolute deviations between model and data and minimize or maximize a global property of the system such as total flow or the flow through a pathway of particular interest (Menke 1984).

For the longer term, alternatives to the inverse scheme described above should be developed. The discrete inverse method can handle spatial and temporal variability within limits, but variability in the ocean is continuous over the spectrum of length and time scales. Continuous inverse methods offer the possibility to describe variable transformation processes as functions instead of as collections of discrete numbers (Parker 1977). Also, some discrete inverse techniques may yield more information on the resolution and uncertainty of the inverse models. The SVD scheme solves the inverse problem based on examining two properties of its solution: prediction error and solution simplicity. It is possible to shift the emphasis from the estimates of the model to the matrix operator (the Green function of the problem in the continuous case) that solves or inverts the problem. The Backus-Gilbert generalized inverse (Backus and Gilbert 1967) minimizes a linear combination of the measures of data resolution, the model resolution and the covariance of the model parameters. Under certain conditions, this approach should give the same results than the SVD but, according to Parker (1977), it is rather a technique for assessing the significance of a solution and is computationally more difficult. On the other hand, it is especially useful when one is attempting to determine a set of model parameters that represent a discretized version of a continuous function (Menke 1984) because it enables us to completely characterize the trade-off between model

resolution and variance. This technique would be particularly useful when solving for spatially and temporally varying first-order physical and biogeochemical coefficients; although these parameters vary smoothly in space and time, they are necessarily observed as discrete realizations. Exploration of new methods will proceed alongside application of known techniques to insure that inverse theory is used optimally in the development of carbon cycling process models.

To summarize, this project will contribute to the canadian JGOFS program in three ways: (1) provide a service to field investigators for the interpretation of their data, (2) test hypotheses concerning the food web processes that regulate organic carbon loss or accumulation in the ocean, and (3) develop new inverse techniques that can improve our ability to interpret data and test hypotheses. The application of inverse techniques to biological problems is a unique Canadian contribution to the international JGOFS effort and should lead to improved biological models that can eventually be coupled to physical models for regional and global predictions of organic carbon fluxes in the ocean.

REFERENCES

Altabet, M.A., A.R. Robinson and L.J. Walstad. 1986. J. Mar. Res. **44**: 203-225.

Backus, G.E. and J.F. Gilbert 1967. Geophys. J. Roy. Astron. Soc. **13**: 247-276.

Checkley Jr., D.M. and C.A. Miller. 1989. Deep-Sea Res. **36**: 1449-1456.

Lawson, C.L. and R.B. Hanson. 1974. Solving least-squares problems. Prentice-Hall, 340 pp.

Menke, W. 1984. Geophysical data analysis: discrete inverse theory. Academic Press, 260 pp.

Parker, R.L. 1977. Ann. Rev. Earth Planet. Sci. 5: 35-64.

Wunsch, C. 1977. Science 196: 871-875.

Wunsch, C. and J.-F. Minster. 1982. J. Geophys. Res. 87: 5647-5662.

Vézina, A.F. and T. Platt. 1988. Mar. Ecol. Prog. Ser. 42: 269-287.

MEASURING GAS TENSION: A NEW METHOD FOR STUDYING GAS EXCHANGE

Bruce D. Johnson
Dalhousie University

Concerns over global warming have greatly increased our need to understand the dynamics of gas exchange between the atmosphere and the oceans. Such understanding is not limited to the behaviour of CO_2, although transport into the oceans is considered a particularly important sink for this gas. Other trace gases, e.g., methane, oxides of nitrogen, CFC's and ozone, may contribute in total as much as CO_2 to global warming. In addition, dimethyl sulphide produced in the ocean may be important for cloud formation. With the oceans acting variously as a source or sink for these gases, modelling requires that we have a fundamental understanding of the processes that control gas transfer in general. However, gas transfer is a complicated process, involving waves, turbulence in phases above and below the interface, spray and bubble formation, and organized motions such as Langmuir Cells. These processes operate over a wide range of time and space scales, and by themselves are not well understood.

Methods that have been used to study gas exchange are typically specific for a single gas, and with few exceptions provide information that is appropriate for time and space scales that cannot be interpreted in terms of local processes. In addition, some of the methods are specific for exchange in only one direction, and most methods require collection of discrete samples and analysis on shipboard or in a shore-based lab.

Studies of N_2 and O_2 exchange rates are especially important for understanding gas exchange, both, because these gases offer an opportunity to test gas exchange models, but also because they will influence exchange rates of other gases including CO_2. As the major constituents of the atmosphere, N_2 and O_2 are the primary components of bubbles. Thus, their exchange behaviour in bubbles will affect bubble size and residence time, and, as a result, the exchange of trace gases.

Requisite information for proper modelling of the physical process of gas transfer includes continuous measurements of the exchange rate of an inert gas in response to known levels of forcing. We have developed a method that gives this information for the exchange of N_2 - a gas that behaves very nearly as an inert gas in the oceans (Anderson and Johnson, in press in J. Geophys. Res.).

The basis of our method is the observation that N_2 and O_2 comprise 99$^+$% of dry air. In fact, 99.9% of moisture-free air is represented by O_2 and gases that are effectively inert from the standpoint of the oceans. A signal that is then 98% N_2 or 99.9% inert gases is available through the conceptually simple method of measuring gas tension and subtracting O_2 partial pressure and water vapour pressure.

Four field GTD instruments have now been produced and were deployed on two cruises by David Farmer's group at IOS. Results of one October storm event suggest a particularly strong relationship between gas transfer, wind speed and deepening of the mixed layer.

Our current goals are to:

- Improve the field instrument design and collaborate with groups making measurements of bubble populations, fluxes of other gases, and atmospheric and near-surface ocean parameters. We anticipate continuing to collaborate with David Farmer's group at IOS, and to participate in experiments with Owen Hertzman's group at Dalhousie, Doug Wallace at BNL and Bryan Kerman at CCIW.

- Incorporate an O_2 sensor into the GTD package. This development will allow correction of the GTD signal for O_2 partial pressure. With Paul Kepkay of BIO, net respiration will be measured using a microelectrode technique, and phosphate concentrations will be frequently measured to give depth profiles. O_2 flux results, corrected by two independent methods will then provide support for the N_2 results.

- Develop other specific gas detectors for incorporation into the GTD. The GTD method allows measurement in the gas phase - a format for which technology is rapidly developing. We will particularly focus on a CO_2 detector, and will work toward developing a single package that will allow determination of N_2, O_2 and CO_2.

NORTH-PACIFIC WOCE WORKSHOP HELD AT UBC

The Canadian National Committee for WOCE hosted a Workshop devoted to scientific issues of the North Pacific at the University of British Columbia (UBC), 27-28 April 1992. The Workshop was immediately followed by a meeting of the Core Project 1 Working Group (CP-1 WG), also held at UBC.

The North Pacific WOCE Workshop was designed as a regional forum for informal discussion of observations and modelling studies in the North Pacific. Ocean scientists from Canada, China (P.R.C.), Japan, Korea, Russia and the USA contributed to presentations and discussions; many CP-1 WG members were also present for the Workshop (a list of participants may be found below).

The atmosphere of the workshop was informal, with ample time available for questions and digressions. The first session began with Lynn Talley addressing general issues of concern to WOCE, such as sufficiency of data, the assessment of variability, spatial resolution and station spacing and the need to bring together hydrographic data, drifter studies, current measurements and numerical modelling. She continued with a more specific issue: that of ventilation in the north Pacific, discussing the role of the Sea of Okhotsk and of the Sea of Japan in the process. David Musgrave commented that there was also a significant source of fresh water to be found in the Gulf of Alaska, which perhaps contributed to the observed intermediate salinity minimum.

Continuing the discussion of water properties and their distribution, Terry Joyce then presented an analysis of silicate concentrations in the North Pacific, drawing inferences about the deep circulation from the presence of a double maximum with depth over a wide area. A lively discussion ensued regarding the mechanisms responsible for silicate variations and possible local and distributed sources in the vents of the Juan de Fuca Ridge or in the dissolution of sinking diatoms. Greg Johnson expanded on the theme of deep circulation, showing recent results which confirm deep northeastward flow in the Kurile and Alaska trenches and a deep (3,500 m) equatorially trapped jet.

Oceanic variability is of great concern to WOCE. Terry Joyce presented results of work done jointly with Bo Qiu on interannual variability over 22 years along WOCE line PR2 (137°E), noting the direct effect of wind stress variations on fluctuations of the North Equatorial Current and Counter-Current. Kuroshio variations on the other hand were not found to be linked to ENSO events, being rather associated with the state of a large meander off Japan. The area of confluence of the Kuroshio and Oyashio is one of great complexity and interest to which the conversation often returned. Victor Neiman reported on imminent publication of results of a major program, Megapolygon, recently completed under direction of the USSR Academy of Sciences in the Kuroshio/Oyashio confluence. Shiro Imawaki described remote sensing work in the same area, based on GEOSAT altimetry, which revealed numerous eddies, propagating westwards with speeds of several cm/s; his results also showed the coalescence of pairs of cyclonic rings into a single eddy, a phenomenon which he also suggested could be interpreted, given the resolution of the data, as the pinching off of a westward propagating meander. On the following day, Richard Greatbatch described his numerical experiments on interannual variability of the Kuroshio, comparing observations of sea-level change across Tokara Strait to results of a model driven by COADS winds.

Addressing variability in a different areas of the Pacific, David Musgrave reported on results of a mooring at 51°N, 152°W in the Gulf of Alaska, showing that there is little variability at depth (1200 m.) associated with the seasonal fluctuations of atmospheric forcing. Modellers took note with interest. Boris Filjushkin reported his studies of internal wave dispersion in the north Pacific, emphasizing seasonal variability. Long term change in an area of the southern hemisphere, was reported by John Church who compared sections repeated at a 22 year interval in the Tasman Sea. Trends show marked warming in mid-water and a significant decrease in the salinity of subantarctic waters.

Drifter studies of both surface and deep circulation were discussed. Paul LeBlond reported on the Canadian contribution to the WOCE SVP program, reviewing deployments and discussing some of the preliminary analysis of drifter tracks from the point of view of their fractal behaviour. Steve Riser described plans for RAFOS buoy deployments in the northwest Pacific, where 7 moored sound sources will be deployed, with 70 RAFOS floats drifting among them.

The second day of the workshop was devoted in great part to modelling, with Richard Greatbatch leading the day with his work on the Kuroshio, as mentioned above. Josef Cherniawsky discussed the sensitivity of the Kuroshio/Oyashio separation point in the North Pacific Active Layer Model to windstress, surface buoyancy flux and to the opening/closing of straits into the Sea of Japan in the model Geometry. Patrick Cummins reported on work done jointly with Howard Freeland on the examination of current meter observations from the interior of the Alaska Gyre, near station Papa, and modelling of wind-driven currents in the N.E. Pacific. William Hsieh discussed problems of optimal control of ocean boundaries and Greg Holloway presented some recent work by Benyang Tang on adjoint assimilation modelling. Michael Eby demonstrated that incorporating eddy-topography interaction in the GFDL Modular Ocean Model induces many of the characteristics of mid to deep ocean circulation of the Pacific Ocean.

At some point, the meeting spontaneously digressed into a discussion of WOCE hydrographic lines in the North Pacific, with Terry Joyce eager to achieve some coordination of lines P1, P2 and P15.

Howard Freeland introduced evidence for a mysterious mid-water eddy in the northeast Pacific, associated perhaps with a hydrothermal megaplume. Evgeny Kontar described his benthic current measuring array and showed results obtained in the Mediterranean, the Canary Basin and on the East Pacific Rise where evidence of deep turbidity currents and bottom tracking flows was obtained. Dunxin Hu concluded the presentations by describing some aspects of western boundary currents east of the Philippines.

Allyn Clarke led the final wrap-up session, reviewing progress in new techniques, such as ALACE (the Autonomous Lagrangian Current Explorer) and expendable CTD's. He also emphasized the need for greater sharing of data sets; too many people still work in isolation! Discussion ranged over the need to know more about chemical and biological tracers, the role of trenches in the deep circulation of the north Pacific, the necessity of including thermohaline effects in studies of interannual variability, and the pressing need for regional cooperation. The newly-created PICES organization, with secretariat at the Institute of Ocean Sciences (IOS), Sidney, B.C., with its mission to create collaboration between North-Pacific countries would seem to be a useful vehicle for WOCE cooperation.

The workshop closed with cocktails and a salmon BBQ at UBC's Faculty Club, where participants were joined by local university administrators, provincial government science officials and funding agency representatives.

Proceedings of the workshop are being prepared with the help of Dario Stucchi, at IOS; they will appear as a WOCE publication. Thanks to Elsa Traczynski for her work at organizing the workshop logistics.

Participants in the Workshop, listed by country of origin in alphabetical order, included J.Church* (Australia); J.Cherniawsky, A.Clarke*, P.Cummins, K.Denman, M. Eby, H.Freeland, R.Greatbatch, G.Holloway, W.Hsieh, D.Krauel*, P.LeBlond, W.Lee, R.Lueck, G.McBean, D.Stucchi, A.Weaver, F.Whitney (Canada); D.Guo, D.Hu*, L.Wang (China, P.R.C.); F.Schott* (Germany); S.Imawaki* (Japan); C.Kim and H.J. Lie (Korea); B.Filjushkin, E.Kontar, V.Neiman*, G.Yurasov (Russia); R.Pollard (UK); J.Bullister*, P.Chapman, G.Johnson, T.Joyce, R.Lambert*, D.Musgrave, S.Riser, D.Swift, L.Talley* (USA). Names starred are CP-1 members.

CANADIAN WOCE SECRETARIAT MOVES

We remind everyone that as of July 1, 1992, the Canadian WOCE Secretariat will move to Dalhousie University, where Dr. Barry Ruddick will take over as Chairman of the Canadian National Committee for WOCE. Ms. Jackie Hurst will be in charge of the Secretariat. All correspondence with the Canadian WOCE office should be sent to the new Secretariat; mail sent to the present Secretariat will be forwarded starting on that date to the new address:

Canadian WOCE Secretariat
c/o Dr. Barry Ruddick
Department of Oceanography
Dalhousie University
Halifax, N.S. Canada B3H 4J1

OMNET: DALHOUSIE.OCEAN
TEL: 902-494-2505
FAX: 902-494-3877.

CANADIAN WOCE BROCHURE PUBLISHED

A glossy colour brochure describing Canada's contributions to WOCE has been published and distributed widely to Canadian scientists, universities, government departments, schools, the press and the international WOCE community. The brochure was prepared under the direction of the Canadian Committee for WOCE, with major design and translation contributions by the Communications Branch of the Department of Fisheries and Oceans; it is available in French as well as in English. Funding came from the Natural Sciences and Engineering Research Council of Canada, through its grant to CNC WOCE, and the Department of Fisheries and Oceans, through its Communications Branch and through the work of Dario Stucchi of the Institute of Ocean Sciences , who coordinated the preparation of the brochure.

Additional copies of the WOCE brochure may be obtained from the WOCE Secretariat.

New CMOS Members

The following new members were approved at the CMOS Executive meeting 27th March, 1992:

Frederic Frabry	Ste-Anne de Bellevue, Qc.	(student)
James Hamilton	Edmonton, Alberta	(student)
Annie Létourneau	Mont-Joli, Québec	(regular)
Josée Morneau	Outrement, Québec	(student)

Note to Centres and Chapters:
It is important that you make contact as soon as possible with any new members in your area to verify their mailing address and to begin distribution of local Society material. National mailings and publications begin once approved new members are entered in the office computer. This follows the date of the executive or Council meeting shown in this notice.

TOS Third Scientific Meeting

Seattle, April 13-16, 1993
Advance Bulletin

Mark your calendar and start making plans to attend The Oceanography Society's Third Scientific Meeting in Seattle, April 1993.

The unique format of TOS meetings has been widely praised and features multi-disciplinary plenary sessions, posters and exhibits, and plenty of time for peer interaction.

The 1993 TOS Program Chairman, Michael Reeve, is currently developing the scientific themes for the meeting. The final program outline will be available shortly along with a call for papers and registration information. Themes currently under consideration include:

- Challenges in understanding the coastal ocean.
- Where do fish come from? - the physical controls of population dynamics.
- The Arctic - the last ocean frontier.
- Processes at hydrothermal vents.

The Seattle Sheraton Hotel and Towers will serve as the headquarters hotel. For further details watch *Oceanography* magazine or contact The Oceanography Society, 1701 K Street NW, Suite 300, Washington, DC 20006-1509.
Tel: (202)-331-7997 FAX: (202)-466-6073

REVIEW/CRITIQUE

THE BEGINNINGS OF CANADIAN METEOROLOGY
By Morley K. Thomas (1991)
ECW Press, Toronto: Distributed by Butterworths Canada Markham, Ontario 308 pp.

In "The Beginnings of Canadian Meteorology", Morley Thomas, documents carefully the early stages of development of climatology and meteorology in this country and of the Meteorological Service of Canada. This is done with meticulous care based on extensive research. He exhibits remarkable restraint in resisting the temptation to draw parallels between the actions and views of those early days and those of more recent history. However, readers will, as did this one, find it difficult not to have a sense of deja vu about many of the historical events. For example, in 1875, Prof. G.T. Kingston, Director of the Toronto Magnetic and Meteorological Observatory was faced with demands for better storm warnings from the Dominion government represented by the Deputy Minister and Minister of Department of Marine and Fisheries, which provided his funds. The view from Ottawa was why should we provide you (Kingston) with more funds to get telegraphic data from observation stations in the U.S.A. to make more reliable storm warnings when warnings could be obtained from Washington directly. Sound familiar? To his everlasting credit, Kingston was able to persuade Ottawa of the value of an independent "Meteorological Service" and this term came into general use in 1877.

Mr. Thomas documents the beginnings of climate observations in Canada - the earliest nearly continuous ones from 1742 in Quebec City - and the establishment of the Toronto Observatory in 1839 - by the British Royal Artillery led by Lt.C. J. B. Riddell and more vigorously after 1841 by Lt. John Henry Lefroy. Riddell's position as Director of the Observatory reminds one of some of the modern organizational complexities, since he had, in effect, five bosses - two in Britain and three in Canada - as well as being responsible for working out arrangements with the host landowner, the University of Toronto.

However, the real hero of the book is undoubtedly Prof. Kingston who arrived in Toronto in 1855. Kingston's interests were in the science of meteorology, and particularly climatology. In addition to managing the Toronto Observatory, he spend much effort in expanding, consolidating and creating climatological observation networks. After 1871, when a first Dominion "budget" of $5,000 was voted (but only $4,000 provided - yes, this a very old practice!), he set about creating a national Meteorological Service. He was rather reluctantly drawn into the storm warning and forecasting business because he considered, in the early 1870's, that there was insufficient scientific basis for making predictions. However, after telegraphic stations permitted timely reporting and he succeeded in getting enough money for telegraphic exchanges with U.S.A. and for a small central office for a "map drawer", he began issuing "facts" (observations) and "opinions" (forecasts), otherwise know as "probabilities". Thomas offers marvellous insights and many revealing facts about how this was achieved and shows obvious admiration at the way in which Kingston gradually became a skilled bureaucrat, able to increase the budget, expand the climatological program while launching the warnings and probabilities; fight off attempts which he argued would be too costly to have warnings prepared and issued regionally in Montreal, Halifax and Winnipeg; and develop cooperative arrangements with Washington while maintaining an effective independence. For example, Thomas cites an incident in 1878 in which U.S.A. complained about Canadian use of British barometers to which Kingston replied with a paper by Charles Carpmael (Kingston's successor in 1880), which argued that the U.S. Signal Office was using an incorrect method to reduce surface pressure to sea level. Both the British relationships and the U.S. connections to Joseph Henry of the Smithsonian Institution and the U.S. Signal Office when operational meteorology began about 1870, were invaluable to the early development of the Canadian service.

In the latter part of the book there are detailed histories of the early observations in each region of the country from Newfoundland to the Yukon. This covers both sporadic observations by explorers, traders and ships, and the evolution of more continuing ones at Hudson Bay Company posts, schools, churches, lighthouses, and at homes of interested amateurs - an invaluable inventory.

It is a fascinating book for several groups of readers: those interested in the early development of meteorology; those concerned with the history of pre-Confederation and early post-Confederation times; and, those interested in the birth and early days of one of Canada's oldest and most respected governmental scientific organizations, the Meteorological Service.

James P. Bruce

NELSON G. FREEMAN 1944-1992

Dr. Nelson G. Freeman passed away unexpectedly on 9 April 1992 at his home in Nepean, Ontario, Canada. Nelson made significant contributions to ocean science in Canada and internationally, and his presence will be sorely missed.

Nelson was born in Buchaus, Newfoundland on August 16, 1944. He received the B.A.Sc. (1969), M.A.Sc. (1970), and Ph.D. (1982) in Mechanical Engineering from the University of Waterloo, Ontario. He began his career with the Canadian Department of Fisheries and Oceans in 1971.

Before coming to Ottawa in 1981, Nelson was Chief of the Research and Development Division of the Central Region of Ocean and Aquatic Sciences, located at the Centre for Inland Waters, Burlington, Ontario. During this time he managed programs in arctic oceanography and in the Great Lakes. In particular, his Division prepared and published the Great Lakes Coastal Zone Atlas in response to the International Joint Commission Reference on Great Lakes Water Levels. In Hudson and James Bays, he managed the marine science field and modelling programs related to the James Bay hydro-electric development.

From 1985 to 1987, Nelson was the Ocean Applications Coordinator for the RADARSAT Project Office. In this role he initiated and carried out several key research projects in the Canadian offshore. One of the major programs he co-coordinated was the Labrador Extreme Waves Experiment (LEWEX). LEWEX provided key measurements of ocean waves from a surface verification program correlated with overflights by several different active microwave systems. The results have provided key data on SAR imaging of ocean waves, evolution of ocean wave spectra, and the use of these observations in wave models. LEWEX data were also used during the Labrador Ice Margin Experiment (LIMEX) to investigate wave penetration in ice and to examine the SAR wave imaging mechanisms and effects on SAR processing algorithms. Results of the successful experiments carried out by Nelson and his team have proven the utility of remotely sensed data in ocean wave forecasting, and have been instrumental in creating spin-off opportunities to industry, including the creation of the Atlantic Centre for Remote Sensing of the Oceans (ACRSO).

Most recently, Nelson was the Director of the Policy and Program Coordination Branch of the Department of Fisheries and Ocean (DFO) in Ottawa. He was responsible for the corporate planning and policies of the Science Sector of DFO, which includes such major ocean research institutions as the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, the Institute for Ocean Sciences in Sidney, B.C., and the Maurice LaMontagne Institute in Mont Joli, Quebec.

Nelson was selected by the European Space Agency to serve as the Coordinating Investigator for Canadian and U.S. oceans projects under the ERS-1 A.O. Program. He was instrumental in carrying out key calibration and validation experiments in Canada during the commissioning phase of the satellite, the results of which are still being processed. In this role, and as the RADARSAT Ocean Coordinator, he was responsible for generating the Canadian National Data Requirements for oceans research and operations.

Nelson leaves behind his wife and two sons in Nepean. The family has asked that those wishing to make a contribution in his name should direct these funds to the Children's Wish Foundation, Ottawa.

Paris Vachon and I would like to gather contributions in order to make a joint donation. We would also like to prepare a list of contributors and collect together letters recognizing Nelson's contribution to ocean and remote sensing research, and present them to the family. These letters would be particulary important to Nelson's teenage sons. Please address any correspondence or donations (by cheque payable to the Children's Wish Foundation) to either Paris or me, and feel free to give us a call. We would like to assemble these offerings as soon as possible.

Lyn McNutt
Canadian Space Agency
240 Sparks Street, 8th floor W
Ottawa, Ontario, CANADA

K1A 1A1
(613) 998-5916
(613) 990-4994 (fax)
L.MCNUTT/OMNET

Paris Vachon
Canada Centre for Remote Sensing
588 Booth Street
Ottawa, Ontario, CANADA
K1A 0E4
(613) 998-9060
(613) 993-5022 (fax)
P.VACHON/OMNET

Fourth International Conference on Southern Hemisphere Meteorology and Oceanography

Hobart, Tasmania 29th Mar-2nd April 1993

This conference will include invited and submitted oral presentations, public keynote lectures, poster presentations and a panel discussion. There will be a greater emphasis on Southern Hemisphere (SH) oceanography than earlier conferences in this series. Papers are solicited on aspects of SH meteorology or oceanography related to the session topics listed below.

1. General circulation and variability of the SH atmosphere and oceans.
2. Climate change: observations and modelling for the SH.
3. Tropical air-sea interaction and TOGA-COARE.
4. SH aspects of chemical cycles in the atmosphere and ocean.
5. Numerical prediction studies for the SH including new techniques for remote sensing and data analysis.
6. Regional meteorological and oceanographic studies in the SH.
7. Antarctic environment.

For further information contact one of the co-convenors.

Dr. David Karoly
Centre for Dynamical Met.
Monash University
Clayton, Victoria 3168
Australia
Tel: (61)(3)5654413
Fax: (61)(3)5654403
cdm@cyclone.maths.monash.edu.au

Dr. Richard D. Rosen
Atmospheric & Envir. Res. Inc.
840 Memorial Drive
Cambridge, Mass. 02139
U.S.A.
Tel: (617)-547-6207
Fax: (617)-661-6479
rdrosen@aer.com

Abstracts are required by August 1st 1992 and should be sent to both of the co-convenors.

ATMOSPHERE-OCEAN

With the publication of Volume 30 of *ATMOSPHERE-OCEAN* this year and the change in editors, it is appropriate to note some of the changes in this journal over the past years and to list the previous editors. The journal began as *ATMOSPHERE* in 1963, published by the Canadian Branch of the Royal Meteorological Society. The only scientific paper was "Arctic Winter" by B.W. Boville, the president of the Branch. Also in this issue were a review of a scientific paper published in another journal, announcements of meetings and news from local chapters of the Royal Meteorological Society in Canada. The entire issue filled 15 pages.

Sven Orvig of McGill University was the first editor, with James L. Galloway, Walter Hitschfeld and Roy Lee as associate editors. In 1969 Edward J. Truhlar became editor-in-chief, and continued in this position until 1974. He is still on the editorial board, and has been technical editor since 1977, and was appointed as Director, CMOS Publications in 1991. He has guided the journal for twenty-three years.

The size and format changed several times in the first fifteen years, but in 1978, with the publication of Volume 16, the name was changed to *ATMOSPHERE-OCEAN*, and the present format was adopted. The list below shows all editors of this journal since 1963.

1963 - 1966	Svenn Orvig
1966 - 1967	J.A.W. McCulloch, E.J. Axton
1968 - 1969	J.A.W. McCulloch
1969 - 1974	E.J. Truhlar
1974 - 1977	I.D. Rutherford
1977	J. Derome
1977 - 1978	T.R. Oke
1978 - 1979	T.R. Oke, P.H. LeBlond
1980 - 1982	H.G. Leighton, P.H. LeBlond
1983	H.G. Leighton, F.W. Dobson
1983 - 1986	P.E. Merilees, F.W. Dobson
1986 - 1989	G.A. McBean, H.J. Freeland
1989 - 1992	R. Daley, W.R. Crawford

The book reviews, announcements and news of CMOS now appear in the *CMOS Newsletter*, with *ATMOSPHERE-OCEAN* being devoted to publication of original research in meteorology and oceanography. In addition to a technical editor, there are co-editors in meteorology and oceanography.

It is a recent tradition that the editors are appointed to three-year terms. Both Roger Daley and William Crawford will complete their terms this year, to be replaced by Charles Lin and Peter Smith as meteorological and oceanographic co-editors, respectively. Peter Smith will begin his term in June and Charles Lin will begin in September, when he returns to McGill University following his sabbatical year in France. A profile of Peter Smith is presented here, and Charles Lin's will appear in the August issue of the *CMOS Newsletter*, to mark the beginning of his term.

Oceanographic papers submitted to *Atmosphere-Ocean* should now be sent to:

Dr. Peter C. Smith
Atlantic Oceanographic Lab., B.I.O.
P. O. Box 1006
Dartmouth, N.S. B2Y 4A2
Tel. (902)-426-3474
Fax. (902)-426-7827
Omnet BEDFORD.INST (Attn. Peter Smith)

Peter C. Smith

After receiving his Ph. D. in physical oceanography from the MIT/Woods Hole Oceanographic Institution's Joint Program in 1973, Dr. Smith came to Canada to pursue his interests in oceanic bottom boundary currents at the Bedford Institute of Oceanography under an NRC Postdoctoral Fellowship. In 1975, he joined the Coastal Oceanography Division at Bedford and began to work on problems involving continental shelf dynamics. His particular interests in this field lie in the areas of shelf edge circulations, topographic Rossby waves, tidal rectification, wind-driven currents, the structure of the marine planetary boundary layer and multi-disciplinary studies. Dr. Smith has maintained close ties with researchers at Dalhousie University and has participated on numerous committees for Ph. D. students in the Department of Oceanography.

Peter Smith

In recent years Dr. Smith has been involved in directing several major field programs. In 1983-85 he participated as member and chairman of the steering committee for DFO's Fisheries Ecology Program, which was designed to study the ecology of the haddock fish stock off southwest Nova Scotia. In addition to conducting his own research project, he acted as a co-editor for the Fisheries Ecology Program publications appearing in two dedicated issues of the *Canadian Journal of Fisheries and Aquatic Sciences*. Similarly during 1985-89, Dr. Smith acted as co-chairman of the scientific steering committee for the Canadian Atlantic Storms Program (CASP), with overall responsibility for the direction of the oceanographic component of this project. His CASP research was focused on the response of the Scotian Shelf to severe winter storms, including inertial shelf waves, coastal-trapped waves and the structure of the marine planetary boundary layer near the coast. He was also involved in preparing and editing publication of the dedicated CASP issue of *ATMOSPHERE-OCEAN* (Volume 27, No. 1).

Presently Dr. Smith's primary activity is directing the second Canadian Atlantic Storms Program (CASP II), for which he is again co-chairman of the organizing committee. These efforts are complemented by various other interests including the interpretation and validation of satellite remote sensing data, climate studies in the coastal ocean, the ecology of larval herring off southwest Nova Scotia and oil spill trajectory modelling.

He notes that the modern trend in scientific research continues to be toward large-scale, multi-disciplinary research programs, such as CASP or WOCE. In the past *ATMOSPHERE-OCEAN* has benefited from publication of entire issues dedicated to the results from such programs andshould actively solicit similar contributions in the future, particularly those conducted in Canadian territory, such as CASP II, the Ocean Production and Enhancement Network (OPEN), and the Earth-Resource Satellite 1 (ERS-1) calibration/validation.

In addition he would like to see the oceanographic side of *ATMOSPHERE-OCEAN* continue to solicit and publish works from a wide range of oceanographic topics, including air-sea interaction, biophysical interactions, remote sensing, sea-ice research, as well as the traditional disciplines of physical, chemical and biological oceanography.

Volume 30 No 3 September 1992 Septembre

ATMOSPHERE-OCEAN

A comparison of satellite winds and surface buoy winds in the Northeast Pacific. N. Bepple and P. Austin.

On the climatology of persistent circulation anomalies in the atmosphere and in a general circulation model. B. Dugas and J. Derome.

A diagnostic study of the southern hemisphere summer circulation of the CCC general circulation model.
Charles Lin, Lin Su and Steven Lambert.

Implicit normal mode initialization for a global finite-element semi-Lagrangian shallow water model. Luc Fillion, Jean Côté and Michel Roch.

An estimate of several ice-control parameters in a coupled ice-ocean model of the Arctic. Gordon H. Fleming.

A numerical model of the internal tide in Knight Inlet, British Columbia. M. W. Stacey and S. Pond.

Frequency distribution and directional evaluation of the Ocean Data Gathering Program (ODGP) wave spectrum at Hibernia. Barbara-Ann Juszko and Ross Graham.

On the growth rate of wind-generated waves.
D. Schwab and S. Venkatesh.

Measurements of bubble plumes and turbulence from a submarine. T. Osborn, D.M. Farmer, S. Vagle, S.A. Thorpe, and M. Cure.

Volume 30 No 2 June 1992 Juin

ATMOSPHERE-OCEAN

Labrador Ice Margin Expt. - Special Issue

Oceanographic features in the Newfoundland marginal ice, March-April, 1990. C. L. Tang.

Automated sea-ice tracking for LIMEX 1987 and 1989. Thomas Hirose, Lyn McNutt and Michael Manore.

Wave attenuation in the marginal ice zone during LIMEX. Antony Liu, Paris W. Vachon, Chih Y. Peng & A. S. Bhogal.

Sea ice properties off Labrador and Newfoundland during LIMEX 1989. S. J. Prinsenberg & I. K. Peterson.

Detection of the Labrador Current using ice flow movement in synthetic aperture radar imagery and ice beacon trajectories. M. Ikeda and C. L. Tang.

Ice flow collision interpreted from acceleration data during LIMEX 1989. R. F. McKenna and G. B. Crocker.

A simulation of sea-ice motion and distribution off Newfoundland during LIMEX, March 1987. C. Tang & T. Yao.

Volume 30 No 4 December 1992 Décembre

ATMOSPHERE-OCEAN

as of May 20 1992/en date de 20 mai 1992

Measurements of drifter cluster dispersion. Badal K. Pal and Brian G. Sanderson.

Propagation of coastal trapped waves under an ice cover in Hudson Bay. T. Reynaud, R.G. Ingram, H.J. Freeland and A.J. Weaver.

On the interannual variability of Arctic sea-level pressure and sea ice. S. Power and L. Mysak.

Tropospheric low-level temperature inversions in the Canadian Arctic. J. Kahl.

Tropospheric variations in the turbidity of the Arctic atmosphere in Russia. V. Radionov and M. Marshunova.

Using measured variances to compute surface fluxes and dry deposition velocities: A comparison with measurements from three surface types. J. Padro, J. den Hartog, H. Neumann and J. Woolridge.

Volume 26 No 1 April 1992 Avril

Climatological Bulletin
Bulletin climatologique

Soil erodibility and the frequency of freeze-thaw cycles, rainfall and snowmelt on frozen soil in Canada.
H. N. Hayhoe, D. R. Cooke and R. G. Pelletier.

Étude du bilan hydrique des sols au Québec méridional.
P. Rochette et P. A. Dubé

Climatic highlights of 1991 in Canada.
Canadian Climate Centre

WMO Workshop on Cloud Microphysics and Applications to Global Change Toronto, 10-14 August 1992

A WMO Workshop on Cloud Microphysics and Applications to Global Change is being planned for the 10-14 August 1992 in Toronto. It will be held at the same hotel and in the same time period as the Third International Cloud Modelling Workshop, and just before the 11th International Conference on Clouds and Precipitation being planned for Montreal, 17-21 August 1992. This Workshop is being organised by the WMO Panel of Experts/CAS Working Group on the Physics and Chemistry of Clouds and Weather Modification Research. The Canadian Meteorological and Oceanographic Society and the American Meteorological Society are co-sponsors.

It is known that clouds play an important role in controlling the Earth's climate. The main purpose of the workshop will be to collect together measurements made around the world relating to cloud microphysics and their impact on global changes. The measurements will be presented in a format useful to those attempting to predict global changes. The workshop will consist of three parts. First, a series of papers will be presented summarizing various measurement campaigns and demonstrating the relationship between cloud microphysics and global change. Second, measurements from around the world will be summarized using information obtained from a detailed questionnaire completed by participants. Third, panel discussions will be held to discuss such things as gaps in our knowledge and capabilities relating to instrumentation, measurements, and modelling. There will be a workshop report consisting of the workshop papers, the data summaries and the recommendations of the panel(s).

The deadline for submission of papers or data summaries has passed. However, those interested in attending the workshop, and participating in the discussions, are invited to inform the Program Chairman, Dr. G.A. Isaac, Atmospheric Environment Service, 4905 Dufferin St., Downsview, Ontario, M3H 5T4. Tel: (416)-739-4605 Fax: (416)-739-4211.

International Symposium on CLIMATE CHANGE AND NORTHERN FISH POPULATIONS

October 13-16, 1992, Victoria B.C., Canada

OBJECTIVE: This symposium will promote an exchange of information relating to the effect of climate change on fisheries in aquatic ecosystems in northern latitudes.

TOPICS:

- Evidence for changes in climate and the resulting effects in freshwater and marine environments.
- Effects of climate on fish populations.
- Economic impacts of climate change on fisheries
- Preparing for climate change.

PUBLICATION:

Proceedings will be published in the Special Publication series of the Canadian Journal of Fisheries and Aquatic Sciences.

For additional information, please contact the Symposium Secretary, Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C., Canada V9R 5K6 or members of the Coordinating Committee.

Tel: (604)-756-7260 Fax (604)-756-7053

Third International Cloud Modelling Workshop Toronto 10th-14th August, 1992

The International Commission on Clouds and Precipitation of the IUGG is planning to conduct the Third International Cloud Modelling Workshop in Toronto, Canada during 10th-14th August, 1992. The workshop is being cosponsored by the World Meteorological Organization, the American Meteorological Society and the Canadian Meteorological and Oceanographic Society.

The purpose of the workshop is to stimulate co-operative efforts among theoreticians and observers who seek to understand the mechanisms of cloud and precipitation evolution in both natural and cloud seeded situations. The broad goal of the workshop is to promote work that will increase the utility of numerical models in cloud physics, weather modification, cloud chemistry, climate, forecasting and other areas of meteorology that require accurate representation of cloud processes. The primary focus of the Third International Cloud Modelling Workshop will be on the simulation of precipitation processes in cloud scale and mesoscale systems.

Those interested in participating in the workshop are invited to contact:- Dr. Harold Orville, Institute of Atmospheric Sciences, South Dakota School of Mines and Technology, 501 E. St. Joseph Street, Rapid City, South Dakota 57701-3995, U.S.A., Tel. (605)-394-2291, FAX (605)-394-6061, Omnet: H.ORVILLE.

C.M.O.S.

Fourth Workshop on Operational Meteorology
September 15th-18th, 1992
Whistler, B.C., Canada

The Fourth Workshop on Operational Meteorology, sponsored by the Atmospheric Environment Service of Environment Canada and the Canadian Meteorological and Oceanographic Society, will be held September 15th-18th, 1992 at the Whistler Conference Centre. The principal theme of this workshop will be "Forecasting in the Nineties".

For additional information contact either Neil McLennan (Tel. (604)-664-9073, FAX (604)-664-9066) or Gérard Neault (Tel. (604)-664-9052) or see CMOS Newsletter 29(3) June 1991.

S.C.M.O.

Quatrième atelier de travail sur la météorologie opérationnelle
15-18 septembre, 1992
Whistler, C.B., Canada

Le quatrième atelier de travail su la météorologie opérationnelle, parrainé par le Service de l'environnement atmosphérique d'environnement Canada et la Société Canadienne de Météorologie et d'Océanographie, aura lieu du 15 au 18 septembre, 1992, au Centre de Conférence de Whistler. Le thème de l'atelier sera "La prévision du temps durant les années 90".

Pour des renseignements supplémentaires veuillez contacter Neil McLennan (Tel. (604)-664-9073, FAX (604)-664-9066) ou Gérard Neault (Tel. (604)-664-9052) et voir les Nouvelles S.C.M.O. 29(3) juin 1991.

TWENTY-SEVENTH ANNUAL CMOS CONGRESS

The 27th Annual Congress of the Canadian Meteorological and Oceanographic Society will be held at the University of New Brunswick, Fredericton, N.B., Canada from June 8-11, 1993.

The Congress will feature Theme Sessions on:
- Forest and Agricultural Meteorology;
- Biological-Physical Interactions in the Ocean;
- Climate Modelling; and
- Remote Sensing.

Special sessions are also being planned on CASP II, circulation over abrupt topography, modernized weather services, ozone depletion, and tracers in the ocean. In addition, there will be sessions based on contributed papers in other areas of meteorology and oceanography.

Oral and poster papers, and exhibits will be invited in a later announcement with an Abstract Deadline of 29 January 1993.

Vingt-Septième Congrès de la SCMO

Le 27ième Congrès annuel de la Société Canadienne de Météorologie et d'Océanographie se tiendra à l'Université du Nouveau Brunswick, Frédéricton, N.B. Canada, du 8 au 11 juin, 1993.

Le Congrès présentera des sessions thématiques portant sur les sujets suivants:
- Météorologie forestière et agricole;
- Interactions biologiques-physiques dans l'océan.
- Modélisation climatique; et
- Télédétection.

Sont également prévues des sessions spéciales portant sur: PCETA II, la circulation au-dessus de topographies très accidentées, les services météorologiques modernes, l'amincissement de la couche d'ozone et les traceurs dans l'océan. De plus, des sessions sur divers autres domaines de la météorologie et de l'océanographie seront organisées.

Un appel de communications orales, de sessions d'affichage ou de présentation d'exhibits sera lancé ultérieurement. La date limite pour la soumission des résumés sera fixé au 29 janvier, 1993.

For further information, contact:/Pour plus d'information, contacter:

Mr. Dave Daugharty
Chairman, Local Arrangements Committee
Dept. of Forestry Resources
University of New Brunswick
Fredericton, N.B. E3B 6C2
Tel.: 506/453-4501; FAX: 506/453-3538
INTERNET: daug@UNB.ca

Dr. John Loder
Chairman, Scientific Program Committee
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, N.S. B2Y 4A2
Tel: 902/426-4960; FAX: 902/426-7827
INTERNET: jloder@sable.bio.dfo.ca

ACCREDITED CONSULTANTS/EXPERTS-CONSEIL ACCRÉDITÉS

Entries on the following pages are restricted to CMOS Accredited Consultants. The accreditation process started in December, 1986. A complete list of CMOS accredited consultants can be obtained from the CMOS Business Office. Individuals interested in applying for accreditation may contact the CMOS Business Office at the Society's Newmarket address for a copy of the guidelines, and an application form.

As set out in the document, "CMOS Guidelines for Accreditation", the criteria are:

(1) The applicant must possess an appropriate undergraduate degree from a recognized university.

(2) The applicant must possess at least one of the following types of specialised training:

   (i) post-graduate degree from a recognised university in meteorology or oceanography.

   (ii) post-graduate degree from a recognised university in the natural or applied sciences or mathematics specializing in one or more branches of meteorology or oceanography; or

   (iii) three years of on-the-job meteorological or oceanographic experience.

3) Upon completion of the above educational and training requirements, the applicant must have spent at least two years of satisfactory performance at the working level in the field of specialisation included in this document. This should include at least some consulting experience.

Les entrées sur les pages suivantes sont réservées aux experts-conseil accrédités de la SCMO. Le processus d'accréditation a débuté en décembre 1986. Une liste complète des experts-conseil accrédités de la SCMO peut être obtenue du bureau d'affaires. Les personnes désirant l'accréditation doivent entrer en contact avec la Société à Newmarket afin de recevoir une copie de règlements et un formulaire d'application.

Le document "Règlements de la SCMO pour l'accréditation" liste les critères suivants:

(1) L'applicant doit possèder un degré universitaire de premier cycle approprié d'une institution reconnue.

(2) L'applicant doit posséder au moins un des types suivants de formation spécialisée.

   (i) degré de deuxième ou troisième cycle d'une universitaire reconnue en météorologie ou océanographie;

   (ii) dégré de deuxième ou troisième cycle d'une universitaire reconnue en sciences naturelles ou appliquées ou en mathématiques avec spécialisation dans une des branches de la météorologie ou de l'océanographie; ou

   (iii) trois années d'expérience de travail en météorologie ou en océanographie.

(3) Une fois les exigences d'éducation et formation complétées, l'applicant doit avoir au moins deux années de travail, avec performance satisfaisante, dans un champ de spécialisation mentionné dans ce document. Une certaine expérience d'expert-conseil est nécessaire.

ACCREDITED CONSULTANTS/EXPERTS-CONSEILS ACCRÉDITÉS

Mory Hirt
CMOS Accredited Consultant
Applied Aviation & Operational Meteorology

Meteorology and Environmental Planning
401 Bently Street, Unit 4
Markham, Ontario, L3R 9T2 Canada
Tel: (416) 477-4120 Telex: 06-966599 (MEP MKHM)

Tom B. Low, Ph.D., P. Eng.
CMOS Accredited Consultant
Research and Development Meteorology

KelResearch Corporation
850-A Alness Street, Suite 9
Downsview, Ontario M3J 2H5 Canada
Tel: (416) 736-0521

Ian J. Miller, M.Sc.
CMOS Accredited Consultant
Marine Meteorology and Climatology, Applied Meteorology and Climatology, Storms, Waves, Operational Meteorology

MacLaren Plansearch Limited
Suite 701, Purdy's Wharf Tower
1959 Upper Water Street
Halifax, Nova Scotia B3J 3N2 Canada
Tel: (902) 421-3200 Telex 019-22718

T.W. (Terry) Krauss, Ph.D.
CMOS Accredited Consultant
Cloud Physics, Radar, Weather Modification, Storms, Research & Development

Intera Technologies Ltd.
2500, 101-6th Avenue S.W.
Calgary, Alberta T2P 3P4 Canada
Tel: (403) 266-0900

Douw G. Steyn
CMOS Accredited Consultant
Air Pollution Meteorology,
Boundary Layer Meteorology,
Meso-Scale Meteorology

3650 Carnarvon Street
Vancouver, British Columbia V6L 3E4 Canada
Tel: (604) 228-6407 Home: (604) 733-1255

Brian Wannamaker
CMOS Accredited Consultant
Remote Sensing, Instrumentation (oceanography)
Physical Oceanography, Sea Ice/Icebergs

Sea Scan
R. R. #3,
Caledon East, Ontario L0N 1E0 Canada
Tel: (416) 880-0528

R.B.B. Dickison
CMOS Accredited Consultant
Boundary Layer Meteorology, Synoptic Meteorology
Agrometeorology, Hydrometeorology, Forest Meteorology

Atlantic Weather & Environmental Consultants Ltd.
112 Bloor Street
Fredericton, New Brunswick E3A 2K4 Canada
Tel: (506) 450-8802

Mike Lepage, M.S.
CMOS Accredited Consultant
Wind Engineering, Climate Data Management
Air Pollution Meteorology, Climate Research

Rowan Williams Davies & Irwin Inc.
650 Woodlawn Road West
Guelph, Ontario N1K 1B8 Canada
Tel: (519) 823-1311 Fax: (519) 823-1316

1992 MEMBERSHIP APPLICATION FORM-DEMANDE D'ADHÉSION 1992

(Please print in block letters - Lettres moulées s.v.p.)

Title: Dr___ Mr___ Mrs___ Miss___ Ms___
M ___ Mme___ Mlle___

Name/Nom _____

Address/Adresse _____

_____

_____

_____

Telephone/Téléphone res./maison _____ bus./travail _____

Occupation/Emploi _____

For records only: if student, please indicate institution and year studies will be completed.

MEMBERSHIP CATEGORY-CATÉGOIRE DE MEMBRE
ANNUAL FEES - COTISATION ANNUELLES
(Please check one - cochez un s.v.p.)

Regular Régulier	☐	$40.00
Student Étudiant	☐	$20.00
Retired En retraite	☐	$25.00
Sustaining Soutien	☐	$150.00 (minimum)
Corporate Corporation	☐	$200.00 (minimum)

Pour dossiers seulement: l'étudiant(e) doit inscrire le nom de son institution et l'année où il (elle) finira ses études.

PUBLICATION SUBSCRIPTIONS - ABONNEMENT AUX PERIODIQUES

ANNUAL RATES - ABONNEMENTS ANNUELS

		Members Membres	Non-members Non-membres	Institutions Institutions
ATMOSPHERE-OCEAN ATMOSPHERE-OCEAN	☐	$25.00	$35.00	$65.00
Climatological Bulletin Bulletin-Climatologique	☐	$15.00	$20.00	$25.00
Annual Congress Program and Abstracts Congrès Annuel Programme et Résumés	☐	$ 0.00	$15.00	$15.00

NOTE: Students receive one society publication in their annual fee and must indicate free publication desired. All regular Society publications are sent to Corporate and Sustaining Members. Members resident in Canada please add 7% GST to annual rates

NOTE: Les membres étudiant reçoivent une des publications SCMO et doivent indiquer la publication gratuite désirée. Tous les périodiques sont envoyés aux membres corporatifs et soutiens. Les membres qui résident au Canada veuillez ajouter 7% (TPS) à l'abonnement annuel.

PRIMARY FIELD OF INTEREST - SPHERE D'INTÉRÊT PRINCIPAL

Meteorology
Météorologie ☐

Oceanography
Océanographie ☐

SPECIAL INTEREST GROUP - GROUPE D'INTÉRÊT SPÉCIAL

(Indicate group if interested - Indiquez si vous avez des intérêts dans une groupe.)

Hydrology
Hydrologie ☐

Air pollution
Pollution de l'air ☐

Agriculture and Forest
Agricole et Forêt ☐

Operational Meteorology
Météorologie d'exploitation ☐

Floating Ice
Glace dérivant ☐

Mesoscale Meteorology
Météorologie de l'échelle meso ☐

Fisheries Oceanography
Océanographie des pêches ☐

Other (specify)
Autre (stipulez)_____ ☐

See over/au verso

CMOS-SCMO
P.O.Box/C.P. 334
Newmarket, Ontario
L3Y 4X7
Canada

W1028 1
Mr. M.K. Thomas
15 Lewes Cres.
TORONTO ON
M4N 3J1

Please enroll me as a member of the Society. I attach a cheque for $_____ payable to the Canadian Meteorological and Oceanographic Society for membership fee and/or publication subscriptions. I also include a tax-deductible donation of $_____ for (indicate):

☐ The Society's Development Fund

☐ Other (specify) _____

_____ _____
(Signature) (Date)

If applying for student membership, please obtain signature of one of your professors.

_____ _____
(Signature) (Date)

Mail completed form to CMOS at the address above.

Je désire devenir membre de la Société. J'inclus un chéque au montant de $ _____ payable à la Société Canadienne de Météorologie et d'Océanographie pour la cotisation de membre et/ou des abonnements aux périodiques. J'inclus aussi un don déductible d'impôts de $ _____ pour (indiquez):

☐ Le fonds de développement de la Société

☐ Autre (stipulez) _____

_____ _____
(Signature) (Date)

Si vous désirez devenir membre-étudiant, veuillez obtenir la signature d'un de vos professeurs.

_____ _____
(Signature) (Date)

Faire parvenir à la SCMO la demande d'adhésion complétée à l'addresse au dessus.
