ISSN 0827-0384

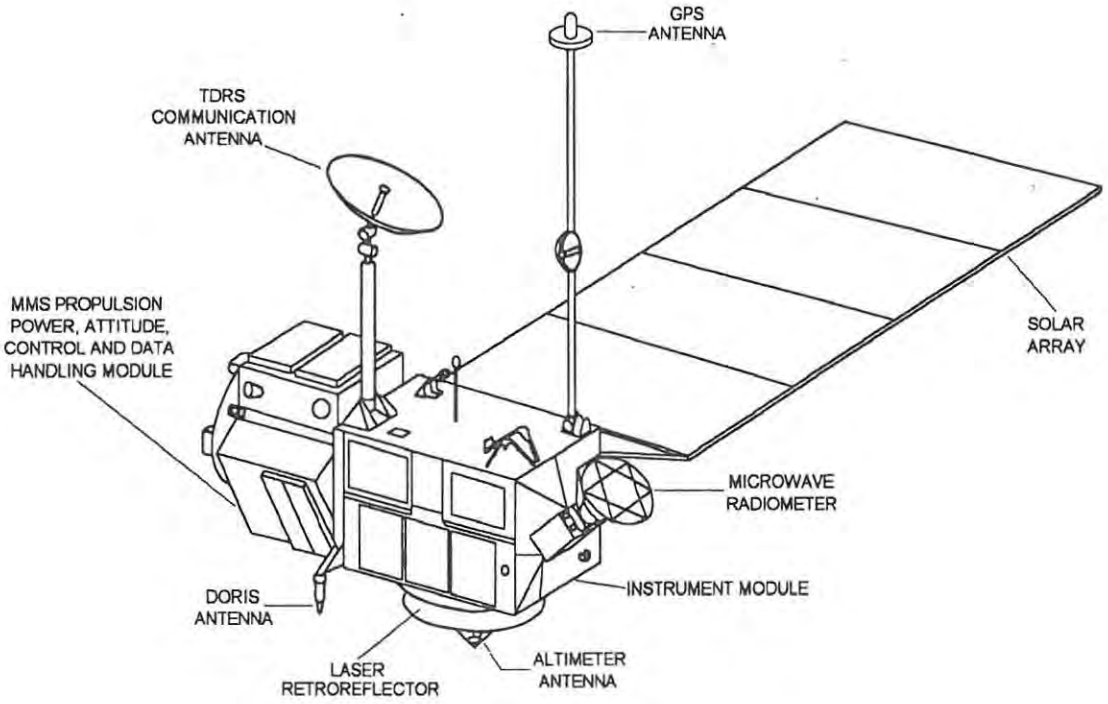
C.M.O.S. NEWSLETTER/NOUVELLES S.C.M.O.

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

OCTOBER/OCTOBRE 1992 VOL. 20 NO. 5

TOPEX/POSEIDON Launched



The TOPEX/POSEIDON satellite was successfully launched by an Ariane 42P rocket from French Guiana on August 10, at 23:08 UTC. See story in WOCE News section of the newsletter, page 19.

EDITOR'S COLUMN

The next issue of the CMOS Newsletter **20**(6), December 1992, will go to press on November 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. ASCII files can also be sent to me via Internet to HJFREE@IOS.BC.CA. If you want to send graphics, then HPGL files can be sent as ASCII files over the networks, any other format will have to be sent on paper or on a floppy disc. It is recommended that whatever software prepares an HPGL file be configured for the HP7550 printer. If you have the option of selecting pen colours, please don't.

Do you have an interesting photograph, say, an interesting meteorological or oceanographic phenomenon? If so, write a caption and send me a high contrast black and white version for publication in the CMOS Newsletter. Savonius Rotor is also looking for assistance from anyone who has an unusual point to make.

Howard J. Freeland, CMOS Newsletter Editor

WHAT'S GOING AROUND?
by Savonius Rotor

Recently Ann Gargett visited the Royal Society of Canada to sign their book of names of Fellows and officially join that group. That was a cause for celebration at IOS with free coffee and cakes made available. After writing the notice about coffee and cakes for Ann Gargett I had a discussion with my PC that indicates a disturbing trend. I am starting to feel that these little grey boxes use the gaps between keystrokes to think their own deep thoughts.

In going through the notice the spelling checker gave me the usual hassle about putting a "u" in honour, and then protesting about "Gargett". It suggested "Garret" instead. I only wanted a spelling check, not its thoughts on alternative candidates. Apart from the double "t", it didn't say which of John or Chris, the two Victoria oceanographic Garretts, it was recommending. I was surprised to find that it had feelings about this! Anyway, I think I have now convinced it that Ann was a good choice.

I don't know what other thoughts of this kind it may have. For some time it has been hinting that my name would be more appropriately "Savannas". It also seems to have doubts about Howard Freeland and a strong aversion to other PCs.

I notice it didn't suggest my name for a fellowship, but then it is only a 286.

Letter to the Editor

The family of the late Nelson Freeman would like to thank the many wonderful people associated with Radarsat in Canada, the U.S.A., and Europe, for their outpouring of love and affection for their friend and colleague who died so tragically on April 9, 1992.

Your letters and phone calls have been warmly received and treasured by Grant, Robert and myself.

The Children's Wish Foundation is very grateful for your generous donations. Due to the recession the fund was quite low and now they are able to grant more "Wishes".

May Nelson's enthusiasm for life, his kindness and gentleness, and his dedication to his work be an example to all of us.

May God bless all of you.

Most sincerely,
Torchy, Grant
and Robert Freeman.

Women in Science and Engineering

The following request has been received by the CMOS Executive. Since CMOS does not distinguish between male and female members on the membership list, we are unable to provide the program with a list of names. Any female member who is willing to have her name placed on the list should make direct contact with Dr. Sherriff.

The Access Program for Women in Science and Engineering was established to encourage women to consider science and engineering when making career choices. To accomplish this mandate, we employ young women undergraduate students to visit schools and talk to students in grades 5 to 12 about science and engineering. The response from the schools in Manitoba has been overwhelmingly positive. Since our inception in May of 1989, we have spoken to over 40,000 students in schools throughout the province.

Presently, we are in the process of compiling a list of women scientists and engineers who would be willing to act as "role models" and talk, about their careers in science, to one or two groups of students over the course of the school year. This list would be circulated to schools as a resource for guest speakers, and would further reinforce our more general presentations.

Dr. Barbara Sherriff Associate Dean
Faculty of Science
The University of Manitoba
239 Machray Hall
Winnipeg, Manitoba R3T 2N2
Tel. (204) 474-8231
Fax. (204) 261-7548

ANNOUNCEMENT
Program in Earth and Ocean Sciences

The UNIVERSITY OF BRITISH COLUMBIA announces the creation of a **Program in Earth and Ocean Sciences**. This new program, under the direction of Paul H. LeBlond, will develop undergraduate and graduate curriculum options as well as research initiatives in integrated studies of the Planet Earth. The program will initially draw on the expertise and resources of the existing departments of the Faculty of Science (Geological Sciences, Geophysics & Astronomy, Oceanography), coordinating its activities with the program in Atmospheric Sciences and the Department of Geography. In broad terms the Program in Earth and Ocean Sciences will stimulate interest in topics such as: Earth Systems Science, biogeochemical cycles, life and climate, global change, etc.., stressing the interconnections between the various compartments into which the study of our planet has traditionally been divided, and examining the relations between global and local phenomena.

George Robertson receives Patterson Medal Award

George W. Robertson recently received the Patterson Medal Award at the 26th Annual Congress of the CMOS held at the Université Laval in Québec in June. This award was established by the Atmospheric Environment Service of Canada (AES) in 1946 in honour of Dr. John Patterson who was the Controller of the Meteorological Service of Canada (MSC) from 1929 to 1946. The award is presented to an individual for distinguished service to meteorology in Canada.

Robertson joined the MSC in 1938 and in 1951 began a career in agrometeorology when he was loaned by the MSC to the Canada Department of Agriculture. During the next 22 years he led the development of agrometeorology in Canada. After retirement from government service he continued a career in agrometeorology as a consultant, mostly at the international level, until 1991. In 1987 he was elected the first Fellow of the Canadian Society of Agrometeorology in recognition of his contribution to the development of Canadian and international agrometeorology. He has recently made a major contribution to the history of the WMO Commission for Agricultural Meteorology (WMO/TD-No. 440) and has completed the manuscript for a "History of Agrometeorology in Canada" for AES (in press).

Research Associate/Physical Oceanography Dalhousie University

The physical oceanography group of the Department of Oceanography, Dalhousie University invites applications for a research associate position in estuarine physics to contribute to problems involving the dynamics of non-linear processes. Projects currently underway, to which a successful applicant would be expected to contribute, involve surface wave dynamics, air-sea interaction, the dispersion, diffusion and mixing of tracers in both coastal and oceanic environments, and deep convection.

Candidates are expected to have a doctoral degree in physical oceanography or physics, with relevant postdoctoral experience.

Please send a letter of application, curriculum vitae, statement of research interests, and names of three references by September 30, 1992 to Dr. Anthony J. Bowen, Chair, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia B3H 4J1.

In accordance with Canadian immigration regulations, priority will be given to Canadian citizens and permanent residents.

Dalhousie University is an Employment Equity/Affirmative Action employer. The University encourages applications from qualified women, aboriginal peoples, visible minorities and persons with disabilities.

An Open Letter to Canadian Hydrologists

The Executive of the Canadian Meteorological and Oceanographic Society has been closely following the discussions of Canadian hydrologists as you look for an organization to replace the recently disbanded NRC sponsored Associate Committee on Hydrology.

CMOS has always taken a keen interest in hydrology and the activities of Canadian hydrologists. Many physical processes are of common interest to us and a detailed study of many of them is more effective with collaboration between hydrologists and meteorologists or hydrologists and oceanographers just as many studies benefit from the joint efforts of meteorologists and oceanographers. This inter-relationship between hydrology, meteorology and oceanography is recognized in the editorial policy of CMOS's scientific journal which states "Atmosphere-Ocean is a medium for the publication of the results of original research, survey articles, notes, and comments on published papers in all fields of the atmos- pheric, oceanographic and hydrological sciences."

CMOS has an active Special Interest Group in Hydrology which currently attracts 117 of our members. Over the years this SIG has been active in issuing newsletters and in organizing meetings, workshops, and scientific sessions at annual congresses. For example, the 27th Annual Congress in Fredericton, New Brunswick next year will feature special sessions on large scale hydrology.

CMOS would like to invite Canadian hydrologists to come together within the Hydrology SIG and take an active role in the affairs of CMOS in general. The Executive would welcome suggestions from you as to how we may proceed to strengthen our partnership. CMOS hopes that the close relationship between hydrologists, meteorologists, and oceanographers will continue for our common benefit within the Canadian Meteorology and Oceanographic Society. Please forward your comments to us.

David P. Krauel, President
Canadian Meteorological and Oceanographic Society

17th Stanstead Seminar
The Role of Large-Scale, Extratropical Dynamics in Global Climate Change

The 17th Stanstead Seminar, held under the auspices of McGill University's Department of Atmospheric and Oceanic Sciences, will be held from 13-18 June 1993, at Bishop's University, Lennoxville, Quebec.

The subject of this year's Seminar is "The Role of Large-Scale, Extratropical Dynamics in Global Climate Change". The program will be structured to allow ample time for discussion and interaction. Principal speakers are G.J. Boer, I.M. Held, R.T. Pierrehumbert, P.H. Stone, and J.M. Wallace. The deadline for receipt of abstracts (200 words) is 15 March 1993. Preference will be given to one-hour presentations, but shorter contributions will also be welcome.

Subject to the availability of funds, a limited number of travel grants and registration fee waivers will be made available to Ph.D. students.

For further information contact Dr. Jacques Derome, RPN--AES, 5th floor, 2121 Trans-Canada, Dorval, Quebec H9P 1J3 (tel.: 514-421-4723; fax: 514-421-2106; Internet: my14@musica.mcgill.ca).

CMOS ANNUAL SPEAKER

The Annual CMOS Speaker tour is being organised at this time. The selection of the individual has not been made as yet. The actual tour normally takes place between January and March.

If there are any nominations for the speaker, please FAX them to myself as soon as possible, along with a proposed abstract and CV.

PARLEUR ANNUEL SCMO

Le Parleur Annuel en tournée du SCMO est présentement dans son stage d'organisation. La sélection de l'individu n'a pas encore été accomplie. La tournée actuelle prend place normalement entre Janvier et Mars.

Si vous avez une nomination, veillez les fax à mois-même le plutôt possible, avec abstrait proposé et résumé.

Douglas Bancroft
Bus: (604) 363-2958
Fax: (604) 363-2132

ENSO (El Niño/Southern Oscillation), Mt. Pinatubo and the Canadian Constitutional Debate - A summer pot-pourri

Has this been a summer of our discontent? In many parts of eastern and central Canada, there was no summer to speak of. For some communities in central and northern Ontario, the summer was so short, it was all but over during an afternoon coffee hour! In Toronto and vicinity, there were 16 consecutive week-ends of cooler and wetter weather, thanks to frequent outbreaks of cold air triggering lake-induced convective activity in and around the Great Lakes region. Overall, the province of Ontario had its coldest July in 100 years. The cooler and wetter weather kept many Canadians indoors resulting in a significant reduction in economic/social activities like week-end at a lake side, fishing, camping, etc.. Interestingly, indoor activities like bowling registered a dramatic increase in some urban areas.

While the impact of cooler and wetter weather on the economic and social activities could be explained by a simple analysis, the actual cause of the unusual summer weather was far from being simple and has baffled climatologists, meteorologists and forecasters alike. The synoptic meteorologists and weather forecasters claim to have a simple explanation for the summer chill, namely a southward shift of the mid-latitude jetstream. But why the jetstream shifted so far southward from its normal position is not clear. The advocates of ENSO-climate interactions are pointing to the lingering effects of the 1991/92 El Niño which created a strong and persistent pressure ridge over western Canada while pushing a tongue of cold air into central and eastern Canada from the Great Lakes to Newfoundland. Atmospheric chemists and aerosol scientists are blaming the volcanic ash from the Mount Pinatubo in the Philippines (which erupted in June, 1991) which purportedly reduced the incoming radiation and brought on the summer chill. These scientists point to the volcanic eruption of Mt. Tambora of Indonesia in 1815 and the "lost summer" of 1816. The volcanic ash theory, however, cannot explain why western Canada, parts of eastern and southern Europe (remember Barcelona Olympics where athletes were sweltering in 38°C weather!) and northeast China experienced hot weather and above normal summer temperatures. The advocates of the greenhouse warming scenario are taking refuge in the volcanic ash to warn that once the ash has settled into the troposphere and scavenged out in a couple of years, the "hot" dog days of summer will return.

To add to our discontent, the Canadian Constitutional squabble dragged on through the summer and the uncertainty in Canada's future lingered on. Now, enter the economists who have been warning us about the impact of the lingering uncertainty on the economy and the recession which has dragged on far beyond the economic forecast. Some of the economists express grave doubts about the economic models which forecast recovery by summer of 1992 but which failed to materialize. Did the cooler weather thwart the predicted economic recovery of summer of 1992? Despite the lack of economic recovery, the Nobel-prize winner Professor Milton Friedman (formerly of the University of Chicago) , still maintains that his monetary and free-market policy will prevail eventually although it has received a setback in the last few years.

The point to be made here is that the science (or art?) of prediction, may it be weather, climate, economy or politics, is being questioned increasingly for its accuracy and effectiveness. While acknowledging significant progress made in short-term (6 to 24-hr) weather prediction in recent years, it must be realized that our understanding of the processes that govern seasons and climate is far from satisfactory. The strange and unpredicted summer of 1992 is casting a doubt (among meteorologists) about the ability of climate models to simulate realistically the evolution of seasons and climate. The impact of lingering recession has left many (frustrated) Canadians doubting the economists and their forecast models. The continuing constitutional debate has made most Canadians lose their faith in politics and the political process.

Is the science of prediction becoming more difficult or is society expecting more than can be delivered by its experts?

Madhav Khandekar
Atmospheric Environment Service
Downsview, Ontario

News from CMOS Headquarters, Council and National Executive

This is the first News from Headquarters since our Quebec City Congress which as I think most of you know, and many personal knowledge, has been very successful. A brief review of its main features is due to appear elsewhere in this Newsletter.

As usual, meetings of SIGs, Committees of the Council and the Annual General Meeting took place during the Congress. The following highlights some of the results of these meetings.

Congresses

The 1993 Congress will take place (for the first time) in Fredericton, N.B. A call for papers is in this Newsletter. In 1994, we will meet in Ottawa, Ontario, and there are plans for an Operational Meteorology Workshop to overlap or follow it. The Society has provided funds to permit attendance to a number of students at this year's and previous Congresses. A need for Guidelines on this subject was felt and they will be prepared by the Executive.

Scientific Issues

The statement on Atmospheric Change prepared by the Scientific Committee was well received and efforts are being made to disseminate it and a summary version for non-specialists as widely as possible. Consultations are taking place with the U.K. Royal Meteorological Society and the American Meteorological Society on the best methods for such dissemination. The Scientific Committee is working on further statements of this kind, including one on Natural Disaster (this being the U.N. Decade for Natural Disaster Prevention) and briefing statements for appropriate Deputy and Assistant Deputy Ministers.

Special Interest Groups

The Operational Meteorology SIG is actively preparing for the 4th AES/CMOS Operational Meteorology Workshop which will take have taken place in Whistler, B.C., by the time this Newsletter appears. A call was made for greater activities by other Groups, in particular the Hydrology Group. The Council was empowered to dissolve Special Interest Groups that have been inactive for two years. Further information on this question will appear in a future Newsletter.

Broadcaster Endorsement

Little progress was reported with this difficult issue. The Council consequently decided to simplify its guidelines which called for endorsement to be based on meteorological knowledge and quality of delivery by deleting the latter requirement. This concentration on purely professional aspects should facilitate progress. Efforts will also be made to help weather broadcasters with inadequate meteorological background to increase their knowledge.

Membership

While we have been holding our own in membership and subscription figures despite the recession, there are still many potential members and subscribers among colleagues and others interested in our sciences. The Centre Chairperson meeting at the Congress has agreed that each Centre should appoint a membership secretary to promote progress. A stronger Society is of particular importance during times when environmental questions are receiving greater attention.

Nouvelles du quartier général de la SCMO du Conseil et de l'Exécutif national

Ce sont les premières nouvelles du quartier général de la SCMO depuis notre congrès tenu dernièrement à Québec qui, à mon avis ainsi que celui de plusieurs personnes qui me l'ont dit, a obtenu un éclatant succès. Une brève revue des événements principaux doit apparaître dans une autre section de ce bulletin de Nouvelles.

Durant le congrès, il y a eu comme d'habitude plusieurs réunions de groupes d'intérêts spéciaux, de comités du Conseil, ainsi que la réunion générale annuelle. Voici un aperçu des principaux résultats de ces réunions.

Congrès

Le congrès de 1993 se tiendra pour la première fois à Frédéricton, N.B. Vous trouverez dans ce bulletin de Nouvelles un appel pour soumettre vos présentations à ce congrès. En 1994, ce sera le tour de la ville d'Ottawa, Ontario, de nous recevoir. On planifie également la tenue d'un atelier sur la météorologie opérationnelle qui se tiendra en même temps ou immédiatement après le congrès d'Ottawa. La Société a fourni des fonds pour permettre à des étudiants d'assister au congrès de cette année ainsi qu'à de précédents congrès. Des lignes directrices sont devenues nécessaires pour continuer cette pratique et l'Exécutif les préparera bientôt.

Questions scientifiques

L'énoncé de politique de la SCMO sur le changement atmosphérique développé par le comité scientifique a très bien été reçu et nous faisons présentement des efforts pour en assurer la diffusion. Nous préparons également une version sommaire pour une audience composée de non-spécialistes. Nous tenons présentement des consultations avec la "U.K. Royal Meteorological Society" et la "American Meteorological Society" pour déterminer la meilleure méthode pour effectuer cette diffusion. Le comité scientifique travaille sur d'autres énoncés de même nature incluant un énoncé sur les désastres naturels (cette décade est celle des désastres naturels telle que proclamée par les Nations-Unies) et sur les énoncés directifs pour les Sous-ministres et les Assistants sous-ministres.

Groupes d'intérêts spéciaux

Le groupe d'intérêt spécial sur la météorologie opérationnelle est à préparer le quatrième atelier conjoint SEA/SCMO sur la météorologie opérationnelle qui aura eue lieu à Whistler, C.-B., au moment de la parution de ce bulletin de Nouvelles. Pour les autres groupes d'intérêts spéciaux, on les a priés d'augmenter leur niveau d'activités, tout particulièrement pour le groupe de l'hydrologie. Le conseil a reçu les pouvoirs de dissoudre des groupes inactifs pour une période de deux ans. Plus d'information sur cette question apparaîtra dans une édition future du bulletin de Nouvelles.

Approbation des diffuseurs

Peu de progrès fut rapporté sur cette question délicate. Le Conseil a donc décidé de simplifier ses lignes directrices qui exigeaient l'approbation basée sur les connaissances météorologiques et de la qualité des messages. Cette dernière exigence a été enlevée. Cette concentration sur des aspects uniquement professionnels devrait faciliter la réalisation d'un certain progrès dans ce domaine. Des efforts seront également entrepris pour aider des diffuseurs de météo qui n'ont pas l'expertise adéquate d'augmenter leurs connaissances.

Plan for the Future

The Executive was charged with preparing a strategic plan for the Society's future. Members will get an opportunity to see and comment on a draft prior to its planned discussion at the 1993 Annual General Meeting.

Finally, I would like to repeat pleas made in recent Newsletter for help in making it interesting and informative to all sections of our Society by providing reports, articles, letters, photos, etc., in English or French. I am sure many members have interesting material to contribute and would like to encourage them to do so soon.

Uri Schwarz
Executive Director

Nombre de membres

Bien que le nombre de membres n'ait pas diminué en dépit de ce temps de récession, il y a encore plusieurs candidats potentiels parmi vos collègues et autres qui sont intéressés par notre domaine scientifique. Il a été convenu au congrès que chaque centre devrait nommer un secrétaire qui aurait pour fonction de promouvoir les buts de la SCMO. Avoir une société plus forte est particulièrement important en ces temps ou les questions environnementales reçoivent plus d'attention.

Plan pour l'avenir

L'Exécutif a reçu comme mandat de préparer un plan stratégique concernant l'avenir de la SCMO. Les membres auront l'occasion de voir et commenter une ébauche avant les discussions prévues au congrès de 1993 lors de l'assemblée générale annuelle.

Enfin, j'aimerais réitérer l'invitation faite à plusieurs reprises lors des dernières parutions du bulletin de Nouvelles à préparer des articles (en français ou en anglais) intéressants et informatifs sur tous les aspects de la Société en soumettant des rapports, des lettres ainsi que des photos. Je suis persuadé que plusieurs membres ont quelque chose d'intéressant à nous communiquer et j'aimerais les encourager à le faire très bientôt.

Uri Schwarz
Directeur Exécutif

David Krauel
Le nouveau président de la SCMO

En 1966, après avoir complété un baccalauréat en Sciences physiques à l'université de McMaster, le Dr. David P. Krauel fut employé pour une période de trois ans comme assistant de recherche à l'institut d'océanographie de Bedford à Dartmouth, Nouvelle- Écosse. Durant ce temps, il compléta sa thèse sur la circulation et le mélange dans les estuaires et reçu une maîtrise en Sciences de l'océanographie physique à l'université de Dalhousie. En 1969, il prit congé pour compléter ses études de doctorat en océanographie à l'université de Liverpool en Angleterre. Après avoir défendu avec succès sa thèse sur la diffusion turbulente dans l'environnement marin en 1972, il retourna à l'institut de Bedford comme chercheur scientifique. En 1974, il accepta de se joindre au collège militaire de Royal Roads à Victoria, Colombie Britannique, pour participer à la planification d'un nouveau programme et à l'enseignement de la physique et de l'océanographie au niveau du baccalauréat. Les premiers cours offerts au collège de Royal Roads débutèrent en 1975. En 1981, le Dr. Krauel fut nommé au poste de Chef du département de physique. Durant les années subséquentes, il a développé un projet pour la création d'un cours en océanographie et acoustique cette fois au niveau de la maîtrise; lorsque le projet fut approuvé en 1987, les premiers cours débutèrent aussitôt. En 1988, le Dr. Krauel fut nommé Doyen des études graduées et directeur des services informatiques, postes qu'il occupe encore présentement. Les projets de recherche du Dr. Krauel incluent l'étude des bouées dérivantes dans l'océan Pacifique, section du nord-est, bouées qui sont suivies par satellite, les applications en océanographie et en acoustique des systèmes d'information géographique (SIG), la modélisation de la diffusion turbulente dans les eaux côtières et la prévision à posteriori des vagues générées par le vent. Le Dr. Krauel a été membre du cours XXXVIII au collège de la Défense nationale à Kingston, Ontario, durant les années 1984-85. A titre de membre canadien, il fait parti du groupe central de travail numéro un portant sur l'étude de la circulation mondiale dans les océans, président du sous-comité pour l'océan Pacifique en océanographie et est membre du comité national canadien pour la recherche scientifique portant sur les océans. Il a été un membre actif au sein de la SCMO en étant président du Centre local pour l'île de Vancouver et il a participé aux comités organisateurs des 13 ième et 24 ième congrès annuels de la SCMO.

THE CANADIAN INSTITUTE FOR RESEARCH IN ATMOSPHERIC CHEMISTRY (CIRAC) A REPORT ON THE 4th ANNUAL MEETING OF MEMBERS.

CIRAC is the major centre for research and education in atmospheric chemistry in Canada. Through research projects involving some 50 member organizations from the private, public and academic sectors including CMOS, plus continuing education and training, CIRAC seeks to improve knowledge and understanding of the processes occurring in our atmosphere and the role of these processes in the economic life and environmental health of Canada. CIRAC is a federally incorporated, non-profit organization.

CIRAC's first major research program, the Northern Wetlands Study has been completed and a promotional video is now available for loan from the CMOS Executive. This study, which involved 8 universities and 11 government agencies in Canada plus 10 universities and 3 government agencies in the United States, found that overall methane emissions from the Hudson Bay Lowlands were twenty times less than previously estimated. This study has made a major contribution to the scientific literature, with 17 peer reviewed papers to be published in a special issue of the Journal of Geophysical Research early in 1993.

CIRAC also prepared a Five Year Research Plan during the past year which provides a focus for their efforts. A major element of this plan is the Canadian Oxidant Research Program (CORP).

Through "The Right Atmosphere", CIRAC has been attempting to keep members informed on a quarterly basis. Copies of this publication can be made available and distributed from the CMOS office should CMOS members wish to be added to the distribution list.

Part of CIRAC's mission is to take a leading role in education. The annual atmospheric chemistry summer course was offered for the 3rd time this year and lasts for one week. It has been attracting students at all levels from coast-to-coast.

CIRAC also undertook in January a joint conference with the Ontario Section of the Air and Waste Management Association. This first Joint International Conference on Atmospheric Chemistry dealt with "The Role of Models in Understanding Atmospheric Chemistry". It attracted about 100 participants plus a large group of senior-level secondary school students who learned, first hand, how scientists and regulators go about their business.

CIRAC continues to be a cosponsor of the Morris Katz Memorial Lecture which in 1992 dealt with indoor air quality.

James W.S. Young, Ph.D., P.Eng.
General Manager, Integrated Environmental Studies
SENES Consultants Ltd

Editor's Note: Dr. Young, a former CMOS President, is a member of CIRAC's board of directors.

Le Congrès de Québec
Un Véritable Succès

Le 26ième Congrès annuel de la SCMO tenue au début juin dans la magnifique ville de Québec a connu un véritable succès.

Le thème du 26ième Congrès était "Météorologie et océanographie à la mésoéchelle". Au total, 213 communications dont 19 affiches ont été présentées au cours de 48 sessions. Près de 62% des communications présentées portaient sur la météorologie et 38% sur l'océanographie. Sept prestigieux conférenciers de grande réputation ont été invités à s'adresser aux participants.

Un total de 308 congressistes sont inscrits. L'exposition commerciale a aussi connu un grand succès avec 15 exposants qui sont venus montrer leurs équipements de tout premier plan.

Au niveau des activités sociales, les congressistes ont bénéficié d'un programme exceptionnel comprenant un cocktail de bienvenue, un concert mémorable et une conférence, lors du banquet, que tous ont grandement apprécié.

Le Comité organisateur est fier de la réussite du 26ième Congrès Annuel et tient à remercier tous ceux qui y ont participé.

New CMOS Members

The following new members were approved at the CMOS Executive meeting 8th June, 1992:

Thurre Christian	UQAM, Québec	(étudient)
Anna Glazer	Montréal, Québec	(étudiente)
Corinne Le Quéré	McGill Univ., Québec	(étudiente)
Rosemary Tabory	Downsview, Ont.	(student)
Sheng Zhang	McGill Univ., Québec	(étudient)

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.

Royal Meteorological Society Calendar

The 1993 meteorological calendar is now ready for distribution. As usual, the photographs are stunning. The calendars cost £4.10 each or £18.00 for five, including postage and handling. They may be obtained by writing to the R.M.S. at:

Royal Meteorological Society
104 Oxford Road
Reading, Berkshire, RG1 7LJ, England

P.S. Howard Freeland has a specimen copy that visitors to his office may examine

---

CMOS CONGRESS 1993
THEME and SPECIAL SESSIONS

Four Theme Sessions are being planned for the 1993 Congress in Fredericton (8-11 June), each starting a different morning with one or two plenary speakers. There will also be a number of Special Sessions on topics of particular interest. These will generally include an invited (non-plenary) speaker, and will run concurrently with other sessions. Topics, descriptions and Convenors of the Theme and Special Sessions are summarized below. The Call for Papers for these and other sessions at the 27th CMOS Congress may be found on page 28 of this issue of the Newsletter. All abstracts are to be submitted to the Program Committee Chairman with an indication of any session preference. Additional requests or suggestions may be directed to the Chairman or appropriate Convenor.

THEME SESSIONS:

BIOLOGICAL-PHYSICAL INTERACTIONS IN THE OCEANS. This session will focus on how the physical environment influences marine organisms and fisheries. Papers describing relationships between the physical environment and the distribution, growth, survival and catchability of marine organisms on spatial scales ranging from individual organisms to populations and on temporal scales of minutes to decades are invited. Papers on other aspects of the session theme are also encouraged (Convenor: Fred Page, St. Andrews Biological Station, 506/529-8854)

CLIMATE MODELLING. This session will focus on modelling and understanding climate and climate change. Relevant studies of the atmosphere, hydrosphere, cryosphere, biosphere and lithosphere are all welcome and studies of coupled systems are particularly encouraged. Process studies aimed at understanding an isolated aspect of the system or providing a parameterization for use in larger scale studies are also welcome. Laboratory and observational studies which may provide motivation for, constraints on or direct input to climate modellers are encouraged. (Convenor: Dan Wright, Bedford Institute of Oceanography, 902/426-3147)

FOREST AND AGRICULTURAL METEOROLOGY. This session will focus on the transfer of research results to operational problems and practice in agriculture and forestry. Papers are particularly solicited on the development of microcomputer-based decision models using weather or climate data for operational use. Papers on other topics related to the theme are also welcome. (Convenor: Bob Dickison, University of New Brunswick, 506/450-8802)

REMOTE SENSING. This session is interested in attracting contributions from a wide range of disciplines. The use of remote sensing techniques in Forestry and Hydrology is one example of the type of contribution sought. There will be several papers on the calibration and validation of ERS-1 data. Meteorologists and oceanographers interested in assimilating satellite or other remotely sensed data into operational and research models are also encouraged to respond. (Convenor: Fred Dobson, Bedford Institute of Oceanography, 902/426-3584)

SPECIAL SESSIONS:

CANADIAN HAZARDS. The International Decade for Natural Disasters Reduction (IDNDR), proclaimed by the United Nations, started in January 1990 and will run through the decade. As a part of the Canadian contributions to this decade, CMOS plans to hold an IDNDR panel discussion every third year during the annual CMOS Congress, starting with the 1993 Congress. After a set of invited talks, the panel

moderator will open the floor for discussion with the audience addressing questions to the panel members. (Convenor: Tad Murty, Institute of Ocean Sciences, 604/363-6311)

CASP II. The Canadian Atlantic Storms Program II conducted an extensive field study of storms over Newfoundland and the surrounding ocean in January-March 1992, and of their influences on ocean conditions and sea ice. This session will present results from the ground-based, airborne and shipborne measurements during the study. It will include case studies of a series of several marine cyclones. (Convenor: Owen Hertzman, Dalhousie Hertzman, 902/426-3683)

THE HYDROLOGICAL CYCLE ON REGIONAL AND GLOBAL SCALES. The importance of the hydrological cycle in the Earth's climate system is being increasingly recognized by atmospheric scientists and oceanographers. This new emphasis has led to large field experiments and modelling initiatives dealing with land surface climate processes and large-scale hydrology. This session is intended to promote discussion among hydrologists, meteorologists and oceanographers interested in the interactions of regional and global scale hydrological systems with the atmosphere and oceans. Contributions are solicited on process, observational and modelling studies of the hydrological cycle and its components. (Convenor: Rick Lawford, National Hydrology Research Centre, 306/975-5775)

MODERNIZING CANADA'S WEATHER SERVICES. The business of weather services in Canada is undergoing modernization at an unprecedented rate. The Atmospheric Environment Service is committed to implementing an ambitious strategic plan while its expanding its role in environmental issues under the Green Plan. Many of the meteorologist's traditional activities are being automated and computerized, both inside and outside of government. This session will focus on some of the recent and upcoming changes in Canada's weather services. (Convenor: Ken Macdonald, Maritimes Weather Centre, 902/426-9200)

OCEANOGRAPHY OF SEAMOUNTS AND BANKS. The interactions of ocean currents with the steep topography associated with large seamounts and fishing banks are believed to generate closed circulation patterns, large amplitude internal waves and intense turbulence that can dominate the biological response. This session will focus on recent experiments designed to explore the physical and biological response to oceanic flow associated with steep topography. (Convenor: Howard Freeland, Institute of Ocean Sciences, 604/363-6590)

OZONE AND THE ULTRAVIOLET. The session will deal with all aspects of atmospheric ozone and ultraviolet radiation. Of particular interest will be measurements and modelling of stratospheric and tropospheric ozone and ultraviolet-B radiation. The session should be timely keeping in mind that the AES monitoring and reporting program for UV-B will have been in effect for one year. (Convenor: Wayne Evans, Trent University, 705/748-1622)

TRACERS IN THE OCEAN. This session will include papers that use tracers to help determine the origin and circulation of water masses and their ages. Papers dealing with rates of reactions or transport of materials are invited. Papers on transient tracers are especially welcome. (Convenor: Peter Jones, Bedford Institute of Oceanography, 902/426-3869)

WOCE: OCEAN CIRCULATION OBSERVATIONS AND MODELS. This session will follow the Theme Session on climate modelling, and will focus on aspects of ocean circulation relevant to climate. Results from projects or observations related to the World Ocean Circulation Experiment are particularly welcome, as are process studies of relevant aspects of ocean circulation. Computer, laboratory or theoretical models, as well as observational studies and interpretations are encouraged. (Convenor: Barry Ruddick, Dalhousie University, 902/494-2505)

Technical Conference on Space-Based Ocean Observations

Bergen, Norway, 5-10 Sept. 1993

First Announcement and Invitation: This "Technical Conference on Space-Based Ocean Observations" is a unique opportunity to build international partnerships for the effective use of satellite-acquired data that are now becoming available to the marine community. The 1990s will witness the most significant change in the observation of the world's oceanic and coastal regions, with new satellite sensors that observe the uppermost levels of the sea's physical and biological characteristics. The programme will cover all major current and planned oceanic satellites including the ERS series, Cosmos series, Canadian, U.S., Japan, France, China and others.

This meeting is sponsored by the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC). Other co-sponsors will include the national and international agencies that provide oceanic and marine satellite systems.

All marine scientists, managers, and operators are invited to attend and participate in bergen, Norway, 5-10 September 1993 at the Hotel Norge.

Goal of the Conference: The goal of the conference is to foster communications between the users and potential users of space-based oceanic observations and the operators/managers of the remote-sensing systems themselves. This will be accomplished through:

- Examination of the applications of oceanic satellite data to meteorological/oceanographic services, marine modelling for climate purposes, and oceanic environmental monitoring;
- Discussion of operational oceanic satellite data management, including processing, access and delivery to users;
- Elaboration of requirements for validation and ocean-truthing of satellite observations with *in situ* data, and examination of the best mix of satellite and *in situ* data for the preparation of blended products; and
- Development of training requirements for marine satellite data collection, management, and applications.

Abstracts of 250 words or less are due by 1st Oct. 1992.

Registration Financial support, on a limited basis, may be available. Advanced registration for the Conference is US$200 if paid by 1 June 1993, and US$250 thereafter.

Further information:

Dr. Johannes Guddal
The Norwegian Meteorological Institute
Division Western Norway
(Vervarslinga pa Vestlandet)
Allegt 70
5000 Bergen, Norway

CANADIAN DISASTERS
AN HISTORICAL SURVEY

METHODOLOGY

The first task was to define a disaster for analysis purposes. This was followed by an intensive literature search. Implications of weather- and/or climate-related phenomena were also noted and recorded during the search. All disasters appeared in at least one reference, except for four recent events in 1988 and 1989. Finally, conclusions were drawn about the weather-related disasters as compared to the other disasters found in the references.

In order to limit the number of events to be included in the survey, the primary disaster criteria were defined as *a single event, occurring at one time (no more than the order of a few days), within Canadian territory out to the 200-mile economic zone offshore, in which loss of life was 20 or more persons.* The search identified and counted all such events except wars and epidemics. The early colonization battles with aborigines and the war of 1812 with the United States were excluded. Several major epidemics were found but not counted in the primary list. The worst of these was the smallpox epidemic of 1885 which killed almost 6,000 in Montreal. In all, 99 disasters were identified which met these criteria.

In a short communication such as this, the scope cannot hope to extend to comparisons of Canadian disasters with those in other countries. Further, the scope did not include a property loss criterion.

DISCUSSION AND FINDINGS

Table 1 lists the 99 Canadian disasters which were found in 13 different references, listed at the end of the paper. Twenty-one of the disasters occurred prior to Canada's Confederation in 1867. It is felt that there may be several unidentified disasters in that early period but, on the other hand, the period from 1867 to date may well include most of the events where at least 20 persons lost their lives. It is worth noting that the significant loss of life in the large number of marine disasters in the period around Confederation was the catalyst which caused the federal government to found the Canadian Weather Service with a grant to Professor George T. Kingston in 1871.

Table 2 lists the 33 disasters which did not meet all the criteria, but were reported in the references, often several times. Several were just short of the 20-death criterion, but were spectacular in nature. Others happened outside the 200-mile limit, but had distinctive "Canadian" characteristics such as the 1985 Air India crash over the North Atlantic Ocean. Still others met the criteria, but occurred over periods of time from a few months to a decade or more.

Given sets of data such as Tables 1 and 2, many conclusions can be inferred. Dealing with the weather-related factor first, half of the disasters were found to be weather-related, whether or not they met the criteria. The Canadian Weather Trivia Calendars were included in the reference material. When the disasters reported only in these Calendars were excluded, one-third of the disasters described in the other references were still found to be weather-related. A strict definition of the weather-related factor is not possible in this examination. Based upon each event description in the references, a subjective decision was made on this factor, depending on the way the incident was described.

There were interesting findings regarding marine disasters. One-third of all the disasters occurred at sea, or on the Great Lakes, and 80% of these were weather-related. As expected, many of these marine disasters did not occur in modern times and, to a degree, aviation disasters are beginning to replace the ship/marine disasters. Clearly, when a number of train and bus accidents are added, transportation has been, and still is, a frequent cause of major disasters.

An attempt was made to examine the rate of change with time of the numbers of people dying each decade in major disasters. It is evident that, although the nation's population has been rising steadily since colonization, the number of people killed in major disasters has been gradually dropping. The very large anomaly in the 1911-1920 decade was caused by the 1917 explosion of a munitions ship in Halifax Harbour and by the collision of two ships off Rimouski.

The *Journal of Natural Hazards* recognizes the following hazards: atmospheric (weather or climatological), earthquakes, erosion, floods, droughts, landslides, man-made/technological, oceanographic (waves/storm surges), snow/avalanches/ice, tsunamis and volcanoes. It is interesting to note that Canada has experienced at least one disaster in each of the categories listed in the Journal, with three exceptions: storm surges, earthquakes and volcanoes, and that the two most common Canadian disasters do not fall exactly into any of the classifications listed. They are shipwrecks and fires. Obviously, the shipwrecks are, in many cases, the result of marine (wave) hazards, but the fires do not seem to have a place in the hazards phenomena. A classification for fire should be added. Table 3 lists the disasters by type.

Table 3: Occurrence of All Canadian Disasters by Type

Shipwrecks/Sea Waves	38
Fires/Explosions	21
Air Transportation	14
Mines	13
Weather/Climate	12
Land Transportation	11
Bridge Collapses	6
Landslides	4
Snow Avalanches	3
Floods	3
Disease	3
Icebergs/Sea Ice	2
Mass Murders	2
Tsunamis	1
Storm Surges	0
Earthquakes	0
Volcanoes	0
TOTAL:	133

Following are other findings of interest from the search:

- Canada's best known and worst disaster in terms of lives lost at one time is undoubtedly the Halifax Explosion of 1917. It had the highest death toll (nearly 2,000), was documented in six of the eight references and was the only disaster meeting the criteria to appear in the Guinness Book of

Records.

- Only two other disasters meeting the criteria killed over 1,000 people. These are the collision of the ships *Empress of Ireland* and *Storstad* near Rimouski in 1914, and a 1775 storm off Newfoundland that reportedly killed 4,000, presumably in the large number of ships which were lost. Unlike the Rimouski collision, the 1775 event is not well documented, being referenced only in the Weather Trivia Calendar.

- A few disasters recurred at the same place. There were two or more disasters at both the Nanaimo and Springhill Coal Mines, in Lower Quebec City due to rock falls, at the site of the Quebec Bridge, and in the Crowsnest Pass, Alberta.

- Twenty-seven people were killed in 1929 when a tsunami struck Newfoundland's Burin Peninsula following an earthquake in the Grand Banks area. This event was Canada's only tsunami or earthquake disaster.

- While there have been many lightning strikes which kill one or two people at a time, there was one major disaster caused by lightning. The Weather Trivia Calendar reports that a freighter, *The John B. King*, loaded with explosives was struck by lightning in the St. Lawrence River in 1930. Thirty crewmen died in the resulting explosion.

- Many of the disasters were reported in several of the references. These are the most familiar "household word" disasters and, in order of date, the ones referenced in four or more of the sources are: Sinking of the Ferry *Victoria* near London, Ont. (1881); The Frank Slide, Turtle Mountain, Alberta (1903); First Quebec Bridge Collapse (1907); Rogers Pass Avalanche (1910); *Empress of Ireland* and *Storstad* Collision (1914); Halifax Explosion (1917); *Princess Sophia* Grounding off B.C. (1918); Laurier Palace Theatre Fire and Panic in Montreal (1927); Hurricane Hazel (1954); two most recent Springhill Mine Disasters (1956 and 1958); Vancouver's Second Narrows Bridge Collapse (did not meet criteria, 18 workmen killed) (1958); Ste. Thérèse DC8 Air Crash (1963); Toronto DC8 Air Crash (1970); the *Ocean Ranger* Sinking (1982); and the *Arrow* DC8 Crash at Gander (1985).

The geographic nature of the disasters was examined. Generally, their locations reflect the population density with the vast majority of the disasters occurring along the East Coast and in the St. Lawrence River shipping lanes. On land, they were centred near the large population centres of eastern Canada. Manitoba and Saskatchewan are the two provinces with the fewest disasters, only one each. Manitoba had a train wreck at Dugald in 1947 which caused 40 deaths, and Regina had a tornado in 1912 which killed 29 persons. This tornado and the 1987 Edmonton Tornado, which resulted in 27 deaths, are the two Canadian tornado events with the highest death tolls. Major Canadian cities which have never had a disaster are Ottawa, Winnipeg, Saskatoon and Calgary. In the North, the Yukon has not yet had a disaster but two occurrences in the Northwest Territories were found in the references, the Rea Point Pan Arctic Electra crash in 1974 in which 32 oil and gas workers lost their lives, and the loss of the Franklin expedition when 129 officers and crew of *HMS Erebus* and *HMS Terror* perished in Canada's Arctic over the two-year period 1847 to 1848.

SUMMARY

Despite the various events uncovered during this research, it is evident from comparisons to other countries that Canada gets off rather lightly in major disasters. Canada has not been subject to the disastrous earthquakes, volcanic eruptions, cyclones, typhoons and floods which still regularly take thousands of lives in countries like China and Bangladesh. Even the United States has more weather-related disasters, being more populous as well as subjected to far more hurricanes than Canada, and being the most tornado-prone country in the world.

Table 1: Canadian Disasters Meeting Criteria

	DESCRIPTION OF DISASTER	REFER. CODE	YEAR	DEATHS	WEATHER FACTOR
1	Wreck of *Delight* off Sable Island	HAT	1583	85	yes
2	Fleet of Ships Aground in Fog, Quebec City	HAT	1711	884	yes
3	Hurricane Hits Grand Banks Area, Nfld.	T	1775	4,000	yes
4	Sloop *Ontario* Sinks in E. Lake Ontario	T	1783	190	yes
5	*Hamilton* and *Scourge* Sink in L. Ontario	CT	1813	53	yes
6	Wreck of *Sovereign* on St. Paul's I., N.S.	C	1814	799	yes
7	Miramichi, N.B. Fire in Hot, Dry Summer	HAT	1825	200-500	yes
8	Rockslide onto Lower Quebec City - I	HA	1841	32	no
9	Hurricane-force Winds on L. Ontario & L. Erie	T	1844	200	yes
10	Hurricane Hits Newfoundland	T	1847	300	yes
11	P.E.I. Gale Sinks 70 U.S. Fishing Vessels	T	1851	150-300	yes
12	*Atlantic* Collides with Ogdensburgh L.Erie	M	1852	130	no
13	Arctic Collides with *Vesta* off C. Race	A	1854	285-351	no
14	Trains Collide, Chatham, Ont.	HA	1854	52	no
15	Irish Ship Runs Aground, St. Paul's I., N.S.	C	1856	72	yes
16	Steamer *Montreal* Fire Near Quebec City	H	1857	253	no
17	Canal Train Bridge Collapse, Hamilton, Ont.	S	1857	60	no
18	Wreck of *Hungarian* off Sable Island, N.S.	T	1860	205	yes
19	Wreck of *Anglo-Saxon* on Cape Race, Nfld.	A	1863	238	yes

20	Richelieu River Bridge Train Wreck, Que.	HA	1864	99	no
21	St-Lawrence R. Floods, Sorel & Trois-Rivières	T	1865	45	yes
22	*City of Boston* Disappears in Storm off N.S.	T	1870	191	yes
23	Wreck of *Atlantic* in Fog off Prospect, N.S.	HA	1873	535-585	yes
24	Coal Mine Fire & Explosion, Westville, N.S.	HA	1873	60	no
25	*S.S. Pacific* Sinks near Victoria, B.C.	BA	1875	236	no
26	Drummond Coal Mine Explosion, Stellarton, N.S	H	1880	44	no
27	Ferry *Victoria* Flips Over Near London, Ont.	SHAT	1881	182	no
28	Forest Fires near Lake Huron after Dry Spell	T	1881	500	yes
29	*Asia* Sinks in Georgian Bay Gale	T	1882	126	yes
30	CPR Ship *Algoma* Sinks in L. Superior	T	1885	48	yes
31	Great Fire of Vancouver	SHB	1886	30-40	yes
32	Nanaimo Mine Disaster - I	B	1887	148	no
33	Nanaimo Mine Disaster - II	B	1888	77	no
34	Champlain Street Rockslide, Quebec City - II	HA	1889	45	no
35	Springhill Mine Disaster - I	SHA	1891	125	no
36	Streetcar Falls from Bridge, Victoria, B.C.	HAB	1896	55	no
37	*La Bourgogne/Cromartyshire* Collision off N.S	A	1898	549	yes
38	Frank Slide, Turtle Mtn., Frank, Alta.	SHATRF	1903	70	no
39	Wreck of *Valencia* off Vancouver Island	T	1906	126	yes
40	First Quebec Bridge Collapse	SHAR	1907	75	no
41	Avalanche in Rogers Pass, B.C.	HACT	1910	62	yes
42	CPR Derailment, (Spanish R.) Sudbury, Ont.	HM	1910	43	no
43	Bellevue Mine Explosion, Crowsnest Pass, Alta.	F	1910	30	no
44	Forest Fire, Porcupine, Ont.	RT	1911	73	yes
45	Regina Tornado	STR	1912	29	yes
46	Thirty-four Ships Sink in Great Lakes Storm	ST	1913	270	yes
47	Coal Dust Explosion, Hillcrest, Alta.	HAF	1914	189	no
48a	*Southern Cross* Vanishes in Storm off Nfld.	H	1914	173	yes
48a	Four Seal Ships Caught in Ice off Nfld.	SHT	1914	77	yes
49	*Empress of Ireland/Storstad* Collision off Rimouski, Que.	SHATR	1914	1,014	yes
50	Britannia Mine Avalanche, Howe Sound B.C.	C	1915	57	yes
51	Forest Fire, Cochrane/Matheson, Ont.	SHA	1916	233	yes
52	Halifax Explosion	SHATGR	1917	1,963	no
53	Coal Mine Explosion, Dominion, N.S.	H	1917	65	no
54	*Princess Sophia* Runs Aground off Nrn. B.C.	SHATB	1918	343	yes
55	Allan Mine Explosion, Stellarton, N.S.	H	1918	88	no
56	Forest Fire, Haileybury, Ont.	R	1922	44	yes
57	Laurier Palace Theatre Fire in Montreal	SHAR	1927	77	no
58	Naval Sloop *Acorn* Sinks off Halifax, N.S.	A	1928	115	*no
59	Tsunami Hits Burin Peninsula, Nfld.	HAT	1929	27	no
60	*John B. King* Explodes and Sinks in St. Lawrence R. after Lightning Strike	T	1930	30	yes
61	Level Crossing Accident, Louisville, Que.	H	1936	22	no
62	Three Great Lakes Ships Wrecked in Storm	T	1940	69	yes
63	Arsonist Sets Hostel Fire, St. John's, Nfld.	HAR	1942	99	no
64	*Truxton* & *Pollux* Aground off Nfld.	AT	1942	204	yes
65	RCAF Bomber Crash, St. Donat, Que.	H	1943	24	*no
66	Dugald Train Wreck, E. of Winnipeg, Man.	S	1947	40	no
67	*Noronic* Burns in Toronto Harbour	SHA	1949	118	no
68	Bomb Explodes on Quebec Air DC3	HA	1949	23	no
69	Trains Collide, Canoe River, B.C.	H	1950	21	no
70	Bus Plunges into Canal, Morrisburg, Ont.	H	1953	20	no
71	Hurricane Hazel	SHATR	1954	83	yes
72	TCA Northstar Crash onto Mt. Slesse, B.C.	D	1956	62	yes
73	Springhill Mine Disaster - II	SHAR	1956	39	no
74	Springhill Mine Disaster - III	SHAR	1958	75	no
75	22 Fishing Boats Sink, Storm, Escuminac,N.B.	HR	1959	35	yes
76	Northwest Air DC7 Crash off B.C. Coast	A	1963	101	*no
77	TCA DC8 Crash, Ste. Thrse, Que.	SHATD	1963	118	*no
78	Severe Winter Storm Hits Maritimes	T	1964	23	yes
79	Apartment Fire, La Salle, Que.	A	1965	28	no

80	Granduc Mountain Avalanche, Stewart, B.C.	CT	1965	26	yes
81	Ore Carrier *D.J. Morrell* Sinks in L. Huron	T	1966	28	yes
82	Ilyushin Turboprop Crash, Gander, Nfld	D	1967	33	no
83	Nursing Home Fire, Notre-Dame-du-Lac, Que.	A	1969	54	no
84	Air Canada DC8 Crash at Toronto Airport	SHAD	1970	109	no
85	Crater Opens, Rainstorm, St-Jean-Vianney,Que.	HA	1971	31	yes
86	*Blue Bird* Bar Fire in Montreal	A	1972	37	no
87	Pan Arctic Electra Crash, Rea Point, NWT	H	1974	32	*no
88	Wreck of *Edmund Fitzgerald*, Lake Superior	AT	1975	29	yes
89	Cell Block Fire, Saint John, N.B.	A	1977	20	no
90	Bus Plunges into Lac d'Argent, Que.	HA	1978	41	no
91	PWA 737 Crash, Cranbrook, B.C.	D	1978	42	yes
92	Social Club Fire, Chapais, Que.	HA	1979	44	no
93	Drilling Rig *Ocean Ranger* Sinks off Nfld.	SHAT	1982	84	yes
94	Charter *Arrow* DC8 Crash, Gander, Nfld.	HATD	1985	256	*no
95	VIA/CN Trains Collide, Hinton, Alta.	HA	1986	26	no
96	Edmonton Tornado	HA	1987	27	yes
97	Air Ontario Crash, Dryden Ont.	DA	1989	24	*yes
98	*Johanna B* & *Capitaine Torres* Sink in Gulf of St. Lawrence	M	1989	39	yes
99	Westray Coal Mine Explosion, Plymouth, N.S.	M	1992	26	no

a The same storm
* Weather-related factor uncertain from description

Table 2: Canadian Disasters which do not Meet the Criteria

DESCRIPTION OF DISASTER	REFER. CODE	YEAR	DEATHS	WEATHER FACTOR
100 Genocide Beothuk Indians by Newfoundlanders	S	1600-1825	1,000	no
101 Two Quebec City Fires, May and June	H	1845	23	yes
102 Loss of Franklin Expedition, NWT.	H	1847-48	129	yes
103 Cape Breton Hurricane Sinks 1,200 Ships	T	1873	"untold"	yes
104 Great Fire of Saint John, N.B.	AT	1877	18-100	yes
105 Lake Ontario Flash Flood	T	1883	18	yes
106 Smallpox Outbreak, Montreal	H	1885	5,864	no
107 *Titanic* Hits Iceberg S. of Grand Banks	ATG	1912	1,513	no
108 Second Quebec Bridge Collapse	SHA	1916	13	no
109 Longest Canadian Summer Heat Wave	T	1936	780	yes
110 Runaway Mine Tractor, Sydney, N.S.	M	1938	16	no
111 *Dirty Thirties* on Canadian Prairies	S	1930-1939	??	yes
112 Lake St. Clair Tornado	T	1946	16	yes
113 MacGregor Mine Explosion, Stellarton, N.S.	O	1952	19	no
114 Red River Flood, Man.	HTR	1950	1	yes
115 Polio Outbreaks Prior to Salk Vaccine	H	1953-4	638	no
116 Freighter Sinks in High Winds in L. Superior	T	1953	17	yes
117 Radiation Sickness from Nfld. Fluorspar Mine	S	1957-78	75	no
118 Second Narrows Bridge Collapse, Vancouver	SHAR	1958	18	no
119 Gas Explosion in Store, Windsor, Ont.	A	1960	11	no
120 Thalidomide	S	1961-2	0	no
121 Chemical Plant Fire, La Salle, Que.	A	1966	11	no
122 CP Air DC8 Crashes on Seawall, Tokyo, Japan	D	1966	64	yes
123 Victoria Hotel Fire, Dunnville, Ont.	A	1969	13	no
124 60-hour Snowstorm Hits Montreal with 70 cm.	T	1969	15	yes
125 Mississauga Derailment, Toronto	S	1979	0	no
126 Fire Aboard Air Canada DC9, Cincinnati, Ohio	D	1983	23	no
127 Tornado Outbreak in/near Barrie, Ont.	HAT	1985	12	yes
128 Air India 747 Crash off Ireland	HA	1985	329	no
129 Trawler *Hosanna* Sinks 400 km off C. Race	T	1987	34	yes
130 *Athenian Venture* Burns 600 km off C. Race	M	1988	29	no
131 Logging Truck Hits Hayride in New Brunswick	M	1989	13	no
132 Gunman Kills Women at U. of Montreal	M	1989	16	no
133 *Protektor* Disappears 400 km E. of Nfld	M	1991	33	yes

REFERENCES AND SOURCE CODE IDENTIFICATION

*Schmidt, R.: 1985, *Canadian Disasters*, Scholastic TAB Publications Ltd., Richmond Hill, Canada. (Code S)

*Raskey, F.: 1970, *Great Canadian Disasters*, Longmans, Don Mills, Canada. (Code R)

Hurtig, M.: 1985, *Canadian Encyclopedia*, Hurtig Publishers, Ltd., Edmonton, Canada, 1st Edit., pp. 496, 497, and 1988, *Canadian Encyclopedia*, 2nd Edit., pp. 601-603. (Code H)

Flatt, J.D.: 1985, *The World Almanac and Book of Facts*, Canadian Edition, Newspaper Enterprise Association Inc., New York, USA, pp. 687, 690-692. (Code A)

*Pethick D.: 1978, *British Columbia Disasters*, Stagecoach Publishing, Langley, Canada. (Code B)

Yates, S.: 1987, *The Canadian World Almanac and Book of Facts*, Global Press, Agincourt, Canada, pp. 473, 474, 477, 478.(Code A)

Phillips, D.W.: 1985-1989, *The Canadian Weather Trivia Calenders*, Min. of Supply and Services, Ottawa, Canada. (Code T)

McFarlan D. and McWhirter N.: 1989, *The Guinness Book of Records*, Guinness Publishing Ltd., p. 213. (Code G)

The Canadian Geographic Magazine: 1983, The Royal Canadian Geographic Society, August-September, p. 41, Feb.-Mar., pp. 24,25, and 1992, Mar.-Apr. pp 64,65. (Code C)

Department of Transport Aviation Accident Records, Aviation Safety Bureau, Aviation Group (AABB), Transport Canada, Ottawa, Ontario, K1A 0N8. (Code D)

Globe and Mail, clippings, various dates (Code M)

Alberta Government, Culture and Multiculturalism Dept. *Fact Sheets* (Code F)

Ottawa Citizen, page A3, May 10, 1992 (Code O)

* Whole Book References, most pages referenced.

Footnotes:

1. Since the final acceptance for publication of this paper, four new disasters meeting the criteria have been added to Table 1. Two were from data contained in *Canadian Geographic*, March 1992, which were shipwrecks on St. Paul's Island in the 1800s causing major losses of life in weather-related marine disasters. Another addition was the 1910 Bellevue Mine Explosion which was found in an Alberta Government Fact Sheet but, curiously, was never mentioned in any of the other references which detailed Canadian mining disasters. Finally, yet another mine disaster, the Westray (Plymouth N.S.) methane gas explosion claimed 26 lives in the late spring of 1992.

2. While no mine disasters have been placed in the weather-related category, current (1992) studies of ambient atmospheric pressure in the areas of mine entrances indicate changing atmospheric pressure may be a contributing factor involved in the build up of methane gas in mines. Methane gas is believed to be the major cause of several coal mine disasters reported in this paper.

3. Also, since publication, minor updates of the tables have been done, primarily from newspaper articles summarizing disasters related to a current incident.

4. No changes in findings or conclusions have been made, but it is hoped that the latest available information will enhance this version published in the CMOS Newsletter.

Robert L. Jones
Atmospheric Environment Service
Planning and Assessment Directorate
373 Sussex Drive, First Floor Block 'E'
Ottawa, Ontario K1A 0H3

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

Workshop on Climate and Statistics

Renaissance Hotel, Toronto, Ont., June 23, 1992

The 5th International Meeting on Statistical Climatology and the 12th Conference on Probability and Statistics in Atmospheric Sciences were held jointly in Toronto from June 22-26. This meeting brought together world class experts in the fields of climatology, meteorology and statistics. The Canadian Climate Centre took advantage of this gathering to host a dinner-workshop on June 23 for invited participants from the conferences including leading experts in the analysis and interpretation of climate data, as well as members of the Canadian statistics community. The meeting was organized by Francis Zwiers and chaired by John Stone.

John Stone opened the meeting by pointing out that there were a number of essential problems that climatologists needed to solve where the statistical community could contribute significantly. He hoped that the statisticians may be sufficiently distracted by some of these problems that they may want to include them in their research agenda. It was indicated that grant or contract money would be available to support statistical research relevant to climate change. Chris Folland was then invited to comment on a similar meeting that the British Met. Office (BMO) had organized on June 8 to look at the use of statistics in the BMO. It was agreed at that meeting that any collaboration between climatologists, meteorologists and statisticians must keep the problems in the atmosphere to the fore (e.g. seasonal forecasting, climate change studies, combination of diverse data sets, data gaps and optimal interpolation) and that statisticians need to have an appreciation of the physical processes underlying climate data sets. A major recommendation was that the two communities needed to get to know one another better, and that this was not going to happen overnight. To help foster this process, the Royal Statistical Society and the Royal Meteorological Society were arranging a meeting of statisticians and climatologists to focus on a series of issues such as how to deal with long range persistence in time series due to non-linear effects. Chris also briefly discussed the UK Science and Engineering Research Council CASE (Cooperative Awards in Science and Engineering) award which enables organizations to bring in researchers to work on specific applied problems.

The meeting was then opened for general discussion which can be summarized into five general areas: (1) the current state of collaboration; (2) data analysis; (3) signal detection; (4) climate forecasting and (5) ways to improve collaboration between climatologists/meteorologists and statisticians.

(1) Current State of Collaboration:
A number of participants highlighted the historical neglect of statistics in the atmospheric sciences. Kevin Trenberth indicated that as a result, many climatologists and meteorologists were poor statisticians. However, he also pointed out that statisticians who ventured into meteorology by themselves often did silly things. The key was to get the two to work together, and to let physical principles guide the inference. In this regard, Kevin argued that the concept of statistical significance may not be relevant because physical significance does not necessarily imply statistical significance and *vice versa*. Francis Zwiers noted that climatologists were often unable to articulate their problems to statisticians. The statisticians concurred, noting that atmospheric scientists had coined their own jargon to describe various statistical concepts.

(2) Data Analysis:
Tom Karl indicated that data analysis drives problem formulation but we don't spend enough effort on it. Numerous areas for improvements in data analysis methods were discussed including: the ability to describe the evolution of complex space-time fields (e.g. combination of different data sets, homogeneity testing, optimal interpolation, missing data); small sample statistics; time-series analysis for long-memory processes; and the effects of inadequate and variable sampling over space and time on statistical inference. Tom Karl indicated that work was also needed on how to apply data e.g. many climate institutions still cling to the concept of 30-year climate "normals".

(3) Signal Detection:
Kevin Trenberth indicated that the long-memory nature of climate data requires new techniques of analysis. He pointed out that many scientists still try to apply linear statistics to non-linear systems. Ben Santer noted that a lot of help was need for the "attribution" question i.e. how to extract the CO_2 signal from other sources such as aerosols. Gerry North pointed out that the issues of "detectability" and "predictability" are related and that the filter allowing you to detect will also allow you to predict and *vice versa*. Phil Jones noted that one of the key problems in detecting climate change from the global instrumental air temperature record was how to take into account the error from inadequate and variable sampling over space and time.

(4) Climate Forecasting:
It was generally agreed that more effort needs to be made in applying statistics to the problem of seasonal forecasting, particularly for precipitation forecasts since in many areas of the world, especially Australia and Canada, precipitation is far more important than temperature in limiting agricultural production. It was agreed that precipitation deserves much more attention in light of its large variability, large uncertainties (in both measured data and in GCM simulations), and the high sensitivity of agricultural production to precipitation changes. Relatively simple regression models were noted to work very well at providing seasonal precipitation forecasts in many areas of the world e.g. Australia, NE Brazil, Sahel, and Southern Africa. However, it was also pointed out that in the long-run, physical models will have a better pay-off as statistical relationships may change over time.

(5) Ways to Improve Collaboration:
Ideas for building collaboration that were discussed included: work terms for statistical students in the Climate Centre; funding opportunities for cross-disciplinary research; visits by climatologists to universities for collaborative "sabbaticals" and *vice versa*; and specialized data analysis workshops. John Stone indicated to the Canadian statisticians that a number of avenues were available for supporting cross-disciplinary collaborative research depending on the nature of the research. These included support through the AES Science Subvention Program, funding of contracts, and the possibility for funding sabbaticals at the Canadian Climate Centre. The discussions emphasized that real productivity between the two communities will only come about from long-term relationships. It was therefore concluded by the workshop participants that methods of improving collaboration should concentrate on building a team.

Land Surface Processes Working Group (LSP/WG)

The working group held its first meeting on July 30, at AES Headquarters in Downsview. Present were Ric Soulis (Chairman, Univ. of Waterloo), Diana Verseghy (AES), Dale Vitt (Univ. of Alberta) and Ross Brown (Secretary, AES). Geoff Kite (NHRI) was overseas and sent his apologies. It was agreed that the group needed to have a clear focus given the diverse nature of land surface processes research, and the profusion of working groups already in existence. It was decided that the main role of the working group was to **stimulate the research necessary to enable adequate land surface process representation to be developed, including both process and model development studies**, and that the main objective was **to provide practical parameterizations of hydrological and biological processes at the land surface for use in GCMs.**

The first activity of the working group will be to develop a database of researchers who could potentially contribute to the above objective, and to communicate the terms-of-reference and objectives of the WG to the research community. The working group also initiated its first research project; a collaborative evaluation of the land surface processes module (CLASS - Canadian Land Surface Scheme) used in the Canadian Climate Centre GCM. The intention is to evaluate CLASS with existing experimental field data for a variety of vegetation covers and temporal and spatial scales (i.e. time periods from a few days to several weeks within all seasons, and spatial scales down to 100 m^2). A letter will be sent out shortly to the research community soliciting data for the collaborative evaluation of CLASS.

Workshop on Ocean-Atmosphere Interactions and Process Studies related to Climate Variability and Prediction.

The fifth of a series of workshops to define research activities and foster collaboration within the context of a Climate Research Network was held at the Bedford Institute of Oceanography in Dartmouth, N.S., on September 3. The main objective of the workshop was to determine how climate research expertise in and around Halifax could best contribute to the objectives of the Green Plan Global Warming Science Initiative. The workshop focused on research in (1) ocean-atmosphere interactions (e.g. development of low-order fully-coupled climate models) and (2) ocean process studies related to climate variability and prediction (e.g. thermohaline convection and air-sea fluxes). A total of 30 scientists participated from the Bedford Institute of Oceanography and local universities. A lively discussion was held on research priorities and the support required to achieve the research objectives. This discussion resulted in the idea of building a collaborative climate research node in the Halifax region around the theme of coupling the hydrological system to ocean circulation models. A full workshop report will appear in the next CMOS Newsletter.

Up-Coming Climate-Related Research Meetings in Canada:

Victoria, October 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.

Fredericton, June 8-11, 1993: Twenty-Seventh Annual CMOS Congress. The Congress will feature a Theme Session on climate modelling. Contact: Dr. John Loder, Chairman, Scientific Program Committee, (902) 426-4960.

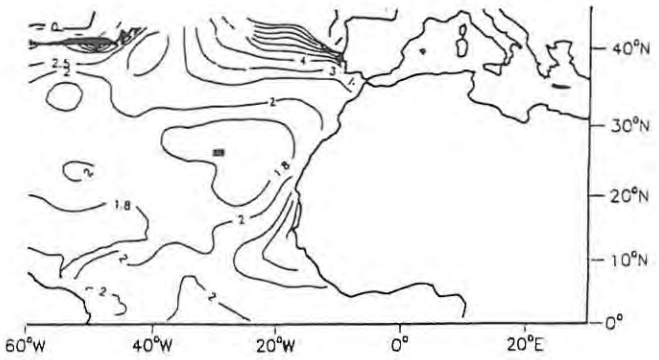
Calgary, September 12-18, 1993: The International Society of Biometeorology Thirteenth International Congress of Biometeorology. The theme of this congress is adaptations to global atmospheric change and variability. The congress will address issues of human, animal, plant, invertebrates and microorganisms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

Montréal, September 23-28, 1993: The Second International Design for Extreme Environments Assembly (IDEEA Two). This conference will bring together professionals from many countries and environmental settings to look at habitats and operations in difficult settings. The environments include Arctic regions, mountains and the oceans, and the conference will emphasize issues such as sustainable development, design/construction, environmental impacts and policy/law. (Although not specifically mentioned, climate change cuts across all these issues). The deadline for abstracts is February 15, 1993. Contact: Centre for Northern Studies and Research, (514) 398-6052.

North Atlantic Tracer Release Experiment (NATRE) Underway

Barry Ruddick (Dept. of Oceanography, Dalhousie University, Halifax, N.S.) Neil Oakey (Bedford Institute of Oceanography, Dartmouth, N.S.) Jim Ledwell (Woods Hole Oceanographic Institution, Woods Hole, MA)

The Site Survey, Tracer and Float Release, and First Sampling of the North Atlantic Tracer Release Experiment, a process study of the World Ocean Circulation Experiment (WOCE) have been succesfully completed. This experiment will directly measure the diapycnal diffusivity in the study area by monitoring the rate of spread of a deliberately-introduced tracer.



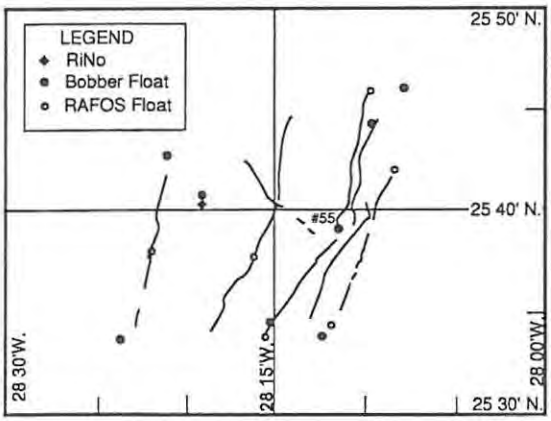


Figure 1. (Top) Contours of the density ratio on the σ_θ = 26.75 surface, adapted from a diagram provided by R. Schmitt, of WHOI. The initial experimental area is shown in black. Inset: Configuration of tracer streaks, Bobbers, RiNo, and RAFOS floats.

In late March, Ray Schmitt, John Toole, Kurt Polzin and company took *R.V. Oceanus* out to the area of the Subduction Experiment in order to perform an extensive site survey with well over 100 casts of the High Resolution Profiler (HRP) (see figure 1 for location). They found density ratios below 1.8 at 300 m in most of the survey area, and as low as 1.6 in the central part. Microstructure observations using probes and calibrations developed in co-operation with Neil Oakey yielded a preliminary diffusivity estimate of 0.1

Figure 2: Pump/injection system during deployment.

cm^2/s near 300 m depth. Internal and semi-diurnal tides with peak to peak excursions as large as 42 m were also discovered.

In late April, the *Oceanus* took Jim Ledwell, Jim Price, Sandy Williams, Barry Ruddick, and others on the injection cruise. A newly-developed pump/injection system (Figure 2) was towed along the 28.5 σ_{300} target isopycnal surface, creating nine tracer streaks in the region between 25° 34′ and 25° 46′N and between 28° 09′ and 28° 23′W over the nights of May 5 to may 13, 1992. The pump/injector atomized 139 kg of sulfur hexafluoride tracer in all, achieving an rms depth deviation from the target isopycnal of only 1.3 m.

This patch of dye was also seeded with eight SOFAR- tracked "Bobber" floats, which periodically levitate between isotherms in order to accurately track lateral motion of water (and dye) on the target isopycnal. These floats will allow investigators to return to the dye patch during the coming year in order to sample it and measure its vertical spread. A Drifting SOFAR Receiver (DSR) was deployed by *Oceanus* on 8 May and recovered by *RRS Charles Darwin* on 28 May. It performed well for nearly 3 weeks, relaying ranges by ARGOS

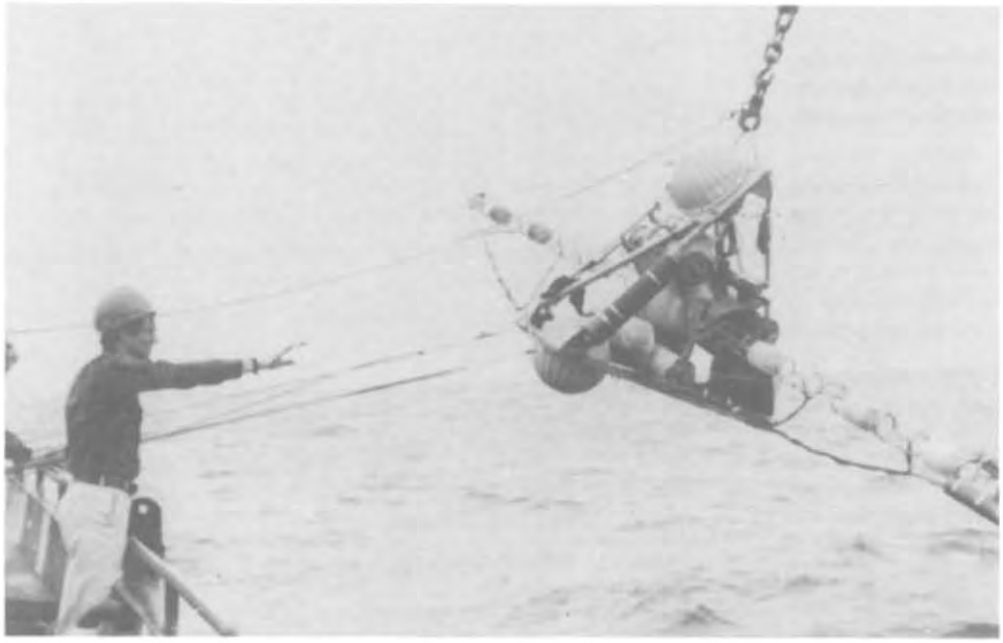


Figure 3: RiNo float during deployment. The instrument reorients from horizontal to vertical in the water.

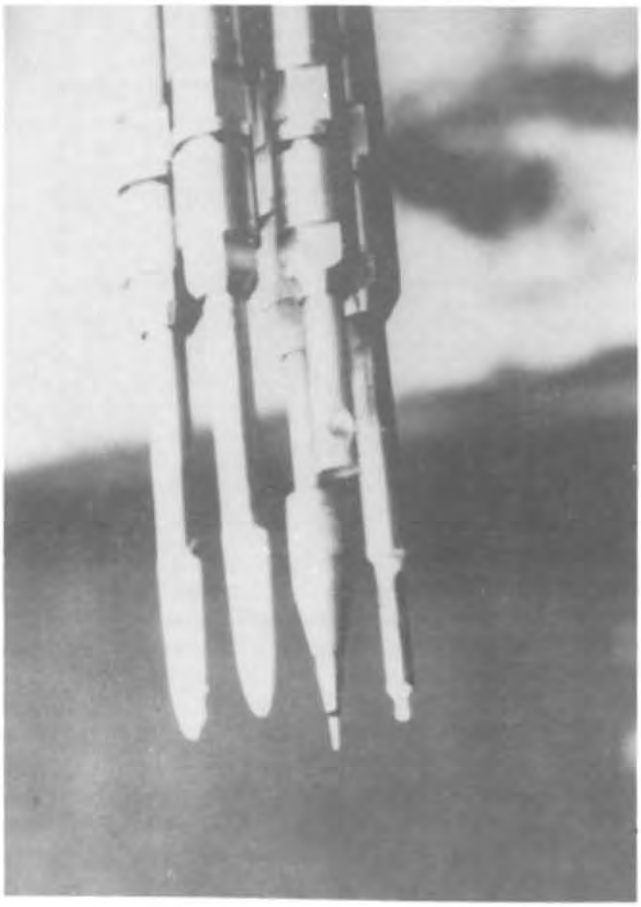


Figure 4: (Left) EPSONDE microstructure profiler. (Right) magnified view of micro-temperature and velocity sensors.

satellite system, until losing its hydrophone just before recovery, perhaps to a shark. It's presence reduced the amount of ship time needed for listening to floats by at least a factor of two. Six RAFOS floats were also deployed in the patch.

During the injection cruise, Sandy Williams, Eric Kunze, and Barry Ruddick deployed "RiNo", a neutrally-buoyant instrument which will measure current shear, temperature, and conductivity over a 5 m vertical depth range while following the tracer (Figure 3). This will give information on the internal-inertial waves and currents which are the main energy source for turbulent mixing.

After the injection was complete, Jim Ledwell transferred over to the Darwin in order to work with Andrew Watson on the first sampling of the dye patch. An array of "integrating samplers" was towed horizontally along the target isopycnal. These samplers allow seawater to flow continuously into a container in order to measure the average tracer concentration along the tow, and so overcome any possible sampling problems associated with the tracer being "streaky". Between 14 May and 31 May, 42 sampling tows were performed, each about 6 km long. Twenty-eight of these tows came up with tracer, the others serving to delimit the patch. The average vertical profile from all the casts is extremely smooth and symmetric, centered 0.84 m below the target isopycnal. The rms width of the average profile was found to be 6.8 m. Later samplings at six and twelve months should show that the tracer will have spread vertically due to vertical mixing processes acting in the main thermocline.

In conclusion, the experiment is off to a very good start. Much of the credit is due to the crews and operating groups of *R/V Oceanus* and *RRS Charles Darwin*. The next cruise is the second sampling cruise, aboard *Oceanus*, planned for Sept 20 to Oct 20, followed by a microstructure survey and mooring deployment, also from *Oceanus*.

Neil Oakey and Scott McLean have been busily preparing EPSONDE (Figure 4) and ELITESONDE (to be used as a backup instrument) for the upcoming microstructure fieldwork in October. A successful test cruise occurred in Emerald Basin off the coast of Nova Scotia, from June 20-23.

Support for the experiment comes from both the WOCE Special Program and the regular Physical Oceanography Program of the National Science Foundation and from the Office of Naval Research in the U.S., from the Natural Environment Research Council of the U.K., and from the WOCE Collaborative Special Program of the Natural Sciences and Engineering Council of Canada.

TOPEX/POSEIDON Launched

The TOPEX/POSEIDON satellite was successfully launched by an Ariane 42P rocket from French Guiana on August 10, at 23:08 UTC. The count-down was perfect and the launch was spectacular. The solar array and the various antennas were deployed immediately after launch. The satellite is currently in its 45-day Engineering Assessment Phase, in which various sensors will be turned on and functionally certified, while the satellite is manoeuvred into its operational orbit. After achieving the operational orbit the Interim Geophysical Data Records will be processed and delivered to the TOPEX/POSEIDON Joint Verification Team and Science Working Team for a 5-month Initial Verification Phase (IVP) study. During the IVP, the various satellite measurements will be calibrated and validated; in the mean time the gravity model to be used for precision orbit determination will be fine tuned. After completion of the IVP, the Geophysical data Records - the main deliverable of the mission - will be made available to the general science community jointly by JPL's Physical Oceanography Distributed Active Archive Center (PO-DAAC) and the French data centre AVISO.

PUBLICITE POUR L'ECOM

Des copies de la brochure préparée pour expliquer la participation canadienne a l'Expérience sur la Circulation Océanique Mondiale (WOCE en français c'est donc l'ECOM) ont été distribuées a la presse dans l'espoir que les journaux et magazines en informeraient leurs lecteurs.

Dans son édition dominicale du 9 août, Le Soleil de Québec présentait une page complète dédiée aux questions climatiques. Claude Tessier, auteur de l'article et contributeur scientifique au Soleil, s'inspira largement de la brochure ECOM et suggéra a ses lecteurs désireux d'en savoir davantage d'écrire au secrétariat canadien. Prés d'une cinquantaine de brochures ont été distribuées dans le public en réponse à l'article du Soleil. Merci a Claude Tessier pour nous avoir aide a faire connaître l'ECOM.

Des brochures ECOM sont toujours disponibles au Secrétariat canadien de l'ECOM, a/s Dr.Barry Ruddick, Dept. d'Océanographie, Université Dalhousie, Halifax, N.E. B3H 4J1.

Newsletter Advertising Rates

Rates are based on black and white camera-ready copy. Sizes (inches) are full page (7.5 x 9.5), half-page single column (3.5 x 9.5), half-page two-column (7.5 x 4.5) and quarter page (3.5 x 4.5). Other charges will apply when typesetting, artwork or photography are required. **Material for inclusion in the CMOS Newsletter should be sent directly to the editor.** Distribution is to CMOS members, and therefore is approximately 1000 for each issue. There are six issues per year and appear in February, April, June, August, October and December.

Advertisement type	Full Page	1/2 Page	1/4 Page
Commercial **	$300.00	$160.00	$100.00
Position vacancy	$200.00	$120.00	$80.00
Employment wanted	----- Free to members only -----		

** Corporate and sustaining members are charged at the position vacancy rate.

OCEANIC UPTAKE OF ATMOSPHERIC CO_2

C.S. WONG
INSTITUTE OF OCEAN SCIENCES

The Centre for Ocean Climate Chemistry (COCC) at IOS focuses on the major scientific goal of Canadian JGOFS: the biogeochemical role of the ocean in modulating the levels of greenhouse gases in the atmosphere. The emphasis is on assessing the oceanic uptake of atmospheric CO_2 from fossil-fuel and wood burning, especially on the strength of the North Pacific oceanic CO_2 sink and the flux of detritus carbon into deep-sea storage. The Centre is contributing to three major global ocean programs: Oceanic CO_2 Monitoring, Biogeochemical Carbon Flux Time-series using moored sediment traps, and a Global CO_2 Survey on WOCE ships and other expeditions. The coverage of COCC expeditions and sediment trap sites are shown in Fig. 1.

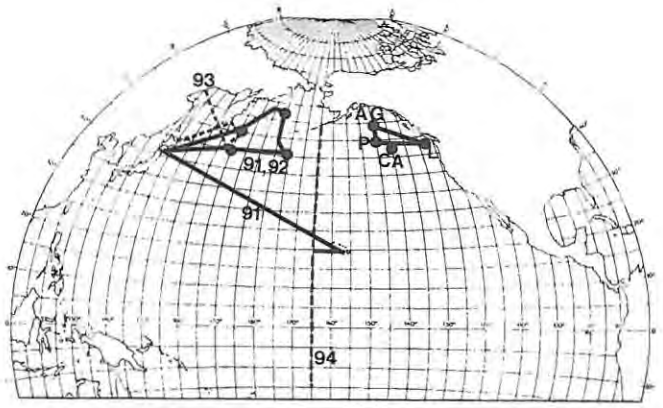


Figure 1: Expeditions and sediment trap sites in the North Pacific Ocean organized by the Centre for Ocean Climate Chemistry at IOS.

———— Expeditions in 1991 and 1992

---------- Future expeditions

• Sediment trap sites

Long-term CO_2 monitoring on decadal time-scales produces important information on the rate of oceanic CO_2 uptake. Time-series measurements of pCO_2 (partial pressure of carbon dioxide) at Station P (50°N, 145°W) assessed the subarctic N.E. Pacific waters to be a weak net CO_2 sink of about 0.7 M m^{-2} yr^{-1}. Air-sea CO_2 flux, simulated as a cooperative study with Garçon of France using her eddy-kinetic energy model which takes into account the physical, chemical and biological processes, agreed with our observations. Preliminary results of pCO_2 monitoring since 1973 to recent years showed the oceanic CO_2 increase to be roughly in tandem with the atmospheric CO_2 rise. We utilized a model-independent approach to obtain the uptake rate from the decadal change in isotopic ^{13}C due to the oceanic absorption of anthropogenic CO_2 with light isotopic composition. Our collaboration with Quay of U.S.A. and Tilbrook of Australia by comparing the ^{13}C of the Canadian HUDSON-70 section along 150°W and recent NOAA expeditions in the Pacific Ocean, yielded a net oceanic CO_2 uptake of 2.1 GtC/Yr (gigatons of carbon per year). This agreed with the results from the Hamburg GCM ocean carbon model of Heimann and Keeling, and the tracer-calibrated model of Sarmiento and Sundquist. Our conclusion (published in Science, 1992) differed sharply from that of Tans, Fung and Takahashi in U.S.A. who suggested the oceans to be a small sink of only 1 GtC/yr, based on a global pCO_2 data set with limited spatial and seasonal coverage.

The seasonal and interannual variability of pCO_2 is important for an accurate assessment of the secular CO_2 increase, defining CO_2 source/sink areas in the oceans, and a better understanding of the large-scale oceanic processes affecting the air-sea CO_2 flux. Our time-series of pCO_2 measured regularly on a container carrier LILLOOET between Vancouver and Australia showed a depletion of nutrients and a decrease of CO_2 evasion in the equatorial waters due to diminished upwelling at the equator during the 1986-87 El Niño. The natural equatorial evasion of CO_2 dropped from about 0.4 GtC/yr in non-ENSO years to 0.1 GtC/yr during ENSO years (in press in TELLUS). A cooperative program is being planned with Japan to use a container carrier to study pCO_2 variability between Tokyo and Vancouver and to assess the long-term change in the N. Pacific CO_2 sink and the effect of El Niño on the CO_2 in subarctic waters, where warming by up to 0.3°C occurred on the North American side but cooling on the Asian side during ENSO years.

An understanding of the detritus carbon fluxes in the oceans is important for assessing CO_2 removal from the upper ocean into storage in the intermediate and deep waters. Time-series measurements of particle fluxes are being carried out in the N.E. Pacific with a spatial variation study with sites at Station P (50°N, 145°W), AG (56°N, 145°W) and CA (50°N, 138°W) in the Alaska Gyre, and a coastal station L (48.5°N, 126.5°W) in the productive La Pérouse waters off Vancouver Island. The particles collected in a moored sediment trap at 3800 m at Station P since 1983 showed very interesting interannual variations, with high fluxes after the 1982-83 El Niño for particulate organic carbon, nitrogen and calcium carbonate. Time-series ocean carbon and productivity measurements were also made at Station P, to find out the cause of the flux variability. Our ^{14}C productivity in 1980's was found to be double that in the 1960's and might be related to the doubling of zooplankton biomass observed by Brodeur and Ware (1990) for the same period. Joint work with Calvert, Harrison and Parsons at DOUBC with their work on ^{15}N flux, regenerated production and N-cycle modelling would be complementary to our carbon work. The isotopic carbon signals, as joint venture with Calvert, showed remarkable seasonal and interannual changes in ^{13}C in the particles, associated with change in productivity possibly related to ENSO events. In the summer of 1990, an extremely high calcium carbonate flux of up to 70% of the

total mass flux was detected at Stations P and AG. Foraminifera dominated in the flux during this episodic event. To obtain measurement of the carbon flux in other productive subarctic waters, we moored four traps for one year in the Bering Sea, the N.W. Pacific Ocean and waters south of the Aleutian Islands and off Kamchatka Peninsula, and successfully recovered these traps in August 1992, as joint work with the Pacific Oceanological Institute at Vladivostok using their research ship VINOGRADOV.

Dissolved organic carbon (DOC) is a major detritus pool for carbon storage. Our measurements at Station P and N.W. Pacific, found the DOC to be 100-200 μM/kg, much lower than the 200-400 μM/kg reported earlier by the Meteorological Research Institute of Japan. Our recent DOC measurements agreed with the preliminary output from an inverse model of the carbon cycle in N. Pacific Ocean in collaboration with Holmen of the Meteorological Institute in Sweden. We also cooperating with Dr. Whiticar of the CEOR at the University of Victoria on attempts to decipher the chemical composition of the DOC in the ocean.

A global CO_2 survey is important for oceanic carbon cycle modelling. This survey is being conducted under the guidance of the CO_2 Panel of JGOFS/CCCO using WOCE ships and other expeditions to create a world CO_2 data set. We are contributing by working internationally in the SCOR Working Group 75, the CO_2 Panel and its sub-Panel on Standards to ensure data quality. Our chemical oceanographic expeditions in the Pacific Ocean include: (1) repeat sections during WOCE using the IOS ship TULLY on Line P between Victoria and Station P, 1991-97, (2) deep-sea sections on the Russian ship VINOGRADOV between Vladivostok and Hilo in 1991, and in subarctic waters off Kamchatka Peninsula and in the Bering Sea, 1991 and 1992, (3) WOCE section P1 from the Siberian side of the Okhotsk Sea to 45°N south of Kamchatka using the Russian ship LAVRENTJEV in 1993, (4) WOCE P15 on IOS ship TULLY along 165°W from the Aleutian Island at 56°N to Samoa at 15°S. Measurements on these expeditions include some or all of the following: O_2, P, N, Si, CO_2, alkalinity, pH, pCO_2, $^{13}C/^{12}C$, $^{18}O/^{16}O$, freons F-11 and F-12, and DOC. These data sets will improve our inverse model of the N. Pacific Ocean. Using these parameters as tracers of the diffusive process of gases into the interior ocean at Station P, repeat freon measurements showed that their contents in the upper ocean were doubled between 1980 and 1992 and the penetration into deeper waters was at about 20 m/yr, the same as the rate tracked by ^{13}C and ^{14}C in the Pacific Ocean in our collaborative work with Quay and Tilbrook. The combination of observational programs of CO_2 parameters, chemical tracers, detritus carbon fluxes and a program of ocean carbon cycle modelling in the North Pacific Ocean is our contribution to the major JGOFS goal of understanding the ocean carbon pump and the global carbon cycle, by clarifying fully the spatial and time-varying changes in oceanic carbon dynamics.

New and Regenerated Primary Production in Coastal and Open North Pacific Ocean Water

P.J. Harrison
University of British Columbia)

Primary productivity by phytoplankton requires carbon dioxide, nutrients and light. The conversion of carbon dioxide into organic carbon is generally regulated by nutrients (especially nitrogen) and in a nutrient-limited ocean, the exported production is equal to the production that is supported by nutrients supplied from outside the photic zone. Conceptually, primary production can be subdivided into two components based on the nutrient supply mechanism. New production is that portion produced from nitrogen supplied from sources external to the system and largely by physical means; vertical diffusion of NO_3^- across the pycnocline is the best example. Regenerated production, on the other hand, is the remaining portion of primary production, produced from nitrogen supplied internally and principally by biological means, for example NH_4^+, excreted by resident biota in the photic zone. It is currently believed that in the steady state, new production is equivalent in magnitude to the export of organic carbon from the surface to the deep ocean; it is this flux that is most critical to understanding the role that ocean primary producers will play in sequestering the increasing atmospheric CO_2. Therefore, it is important to know the amount of new production in order to estimate the export of organic carbon from the photic zone. New production can be estimated from the nitrate flux into the photic zone and by using ^{15}N-labelled nitrate and measuring the amount taken up per unit time by phytoplankton.

Recent studies by Martin and co-workers suggest that parts of the North Pacific (Martin and Fitzwater, 1988) and the Antarctic Oceans (Martin et al., 1990) may be iron-limited. This means that the nitrogen sources in the photic zone are not fully utilized by the phytoplankton and that new production does not reach its maximum. This controversial issue needs to be addressed further in JGOFS studies.

The specific objectives of this project are:

a) To measure the distribution, supply and biological utilization of nitrogen compounds in the North Pacific Ocean with the view of quantifying the relative proportions of new and regenerated production.

b) To determine how this partitioning of primary production varies in space and time and how new production is functionally related to the export of organic matter in both the coastal waters, and in the open North Pacific Ocean.

Vertical profiles of a series of parameters will be measured seasonally during 1992-94 on a transect from Vancouver Island to Stn P. (~500 km west of the Queen Charlotte Islands) and occasionally into the Alaska Gyre. Phytoplankton biomass will be assessed by cell counts, chl-a and particulate carbon and nitrogen. The vertical distribution of several

nutrients (NO_3^-, NO_2^-, NH_4^+, urea, SiO_4^{-4}, PO_4^{-3}) will be useful in assessing which nutrients might potentially limit primary production. Primary production will be determined at 8 light depths and on 3 size fractions (0.2 to 2, 2-18, and >18.5μm). The uptake rates of 3 forms of nitrogen used by phytoplankton (NO_3^-, NH_4^+ and urea) will be determined by using the stable isotope ^{15}N as a tracer. These measurements will produce the estimates of new production (via $^{15}NO_3$ uptake) and regenerated production (via $^{15}NH_4$ uptake) for the water column. These estimates will be compared to direct estimates of new (exported) production obtained from moored sediment traps (C.S. Wong's project).

There is some controversy about which factors control primary productivity at Stn P. Since nutrients such as nitrogen are generally >5 to 15.5mmoles m^{-3}, other factors such as light, iron and zooplankton grazing are thought to be important. Control by light and iron will be explored in special experiments and grazing will be assessed in conjunction with Al Lewis (U.B.C.). These experiments will be important in determining what factors control primary productivity in nutrient (nitrogen) rich environments such as the sub-Arctic Pacific Ocean.

REMOTE SENSING OF PRIMARY PRODUCTION

Shubha Sathyendranath[1,2] and Trevor Platt[3]

[1] Department of Oceanography, Dalhousie University, Halifax, N.S., B3H 4J1

[2] Biological Oceanography Division, Bedford Institute of Oceanography, Box 1006, Dartmouth, N.S., B2Y 4A2.

The first estimates of global ocean primary production appeared in the fifties, before the advent of satellite oceanography. They were based on compilation of data collected over many years. Even then the data were exceedingly sparse, and some daring extrapolations had to be made, from local measurements to regional estimates and from daily measurements to seasonal estimates, to be able to calculate global primary production. Such approaches have limited application in climate change studies: multi-year averages can hardly be used to study inter-annual variations, and a network of primary production stations covering the world oceans would be prohibitively expensive. It is in this context that the prospect of satellite-derived estimates appear to be particularly attractive.

How does one approach this problem? It helps to recall at the outset that estimation of primary production is a problem in plant physiology. This fact remains unaltered, whatever may be the technique used to monitor the process.
It would therefore be unwise to throw away the knowledge gained from physiological studies on the photosynthetic response of phytoplankton to available light, when formulating an approach for application to remotely-sensed data.

Typically, we know that the curve describing primary production as a function of available light shows three phases: an initial phase of linear response at low light levels, a light-saturated phase that shows no increase in production with further increase in available light, and sometimes a third phase at extremely high light levels when production rates are actually inhibited when more light is added. To describe such a photosynthesis-light curve (the P - I curve) using empirical or semi-empirical functions, at least three parameters are required; or just two, if the photoinhibition phase, which often has negligible effect on water-column production, is ignored. The two parameters that are commonly used are α^B, the initial slope of the P - I curve at low light levels, and P^B_m, the assimilation number at saturating light levels. In this notation, the superscript B indicates normalisation to biomass B, which, for convenience, is expressed as concentration of the major phytoplankton pigment, the chlorophyll-a. The primary production rate $P(z,t)$ at any depth z in the ocean, at time t, can then be written as:

$$P(z,t) = B(z,t) f(I(z,t); \alpha^B, p^B_m) \quad (1)$$

where $I(z,t)$ is the light available at that depth, and at that time, and f is a function of available light and the photosynthesis parameters. To obtain the daily, water column production, $P(z,t)$ has to be integrated over depth, and over time. To do this integration, one requires to know $I(0,t)$, the light available at the sea surface, and K, the attenuation coefficient which determines the rate of penetration of light in the water. From dimensional analysis, it can be shown that the solution to the water-column production can always be expressed in the following form:

$$P_{Z,T} = (BDP^B_m/K) p(I_0^m; \alpha^B, P^B_m) \quad (2)$$

where $P_{Z,T}$ is the water-column production integrated over daylength D, I_0^m is the surface light at local noon (which we take to be the reference time for the day), and \$p\$ is another function of available light and P - I parameters. All photosynthesis-light models for daily, water-column production would have this basic structure, even if they do tend to become more complex when additional details are incorporated. For example, the initial slope α^B and the attenuation coefficient K are both known to be wavelength dependent. So these parameters have to be specified for each wavelength, and the production integrated over wavelength. In a vertically-stratified water column, the biomass B and the photosynthetic parameters could vary with depth, and the models would have to account for that as well.

How does remote sensing help to evaluate $P_{Z,T}$? Of the variables and parameters on the right-hand side of Eq. 2, the distribution of biomass B in the near-surface layer of the oceans can be estimated from satellite measurements of ocean colour. Cloud cover data from satellites in combination with radiative transfer models yield information on light reaching the sea surface. In open-ocean waters, the parameter K is largely determined by the biomass B, and so this parameter can also be derived from ocean colour data. The daylength D is easily calculated for any location and date. What is not accessible by remote sensing currently is information on the P - I parameters. Nor does the satellite give any information on the vertical structure of the water column. However, compared to biomass B which has a

dynamic range of about four orders of magnitude in the oceans, the *P - I* parameters are relatively stable properties of the water column; the vertical structure of biomass is also often seen to be stable over long distances and over long periods of time.

The problem thus appears to be manageable: if we combine satellite data on rapidly-changing variables like biomass and available light with ship measurements of the quasi-stable parameters of the *P - I* curve and information on water-column structure, then we would have all the elements necessary for large-scale estimates of primary production. The approach also has the advantage that it makes use of all available information, whether it be from satellites or from ships, and whether it be physiological or oceanographic in nature. This is the approach we plan to pursue under the CJGOFS program.

Preliminary calculations of the annual production in the N. Atlantic have already been made, and a similar attempt is now being made for the Arabian Sea. The problems that remain to be addressed are many fold: The models of light transmission underwater, and of the light response of photosynthesis have to be improved, and optimised for speed and accuracy. Satellite and ship measurements are made at very different space and time scales, and combining them requires formulation of suitable extrapolation schemes. Modelling efforts have to be validated against field data, and data archives of *in situ* and satellite data have to be built.

We will offer an intensive course on "Estimation of primary production from remotely-sensed data on ocean colour" at the Bedford Institute, November 9-12, 1992. All interested scientists are welcome to attend.

Utilization of new and regenerated primary production by planktonic heterotrophs

Don Deibel and Richard Rivkin, Ocean Sciences Centre
Memorial University St. John's, Newfoundland

The fundamental goal of the Global Ocean Flux Study (GOFS) is to quantitatively model the ocean's carbon cycle. The ocean is a sink for 20-50% of the CO_2 released from fossil fuels annually[1]. Therefore, identifying and quantifying the factors regulating the rate of organic carbon production and its subsequent fate in the upper ocean are fundamental to global change programmes.

The conversion of inorganic into organic carbon by phytoplankton drives the "biological pump" that transfers atmospheric CO_2 into the ocean. Although net photosynthesis sets the upper limit to the magnitude of the biological pump, the crucial factor controlling the partial pressure of CO_2 in the upper mixed layer is that fraction of the total organic carbon fixed which sinks or is advected below the permanent pycnocline and is sequestered into the deep ocean. Because production is generally assumed to be nitrogen limited in the sea, in steady state at annual and longer time scales, the amount of biogenic carbon removed from the photic zone must be balanced by "new production" sustained by vertical flux of NO_3 into surface waters. New production is defined as that fraction of the total production supported by all nitrogen sources (i.e. NO_3, NH_4 & urea) which is due to NO_3 alone (this Relative Preference Index is often called the "f" ratio). This paradigm has evolved without considering how, and in what form (i.e. new vs. recycled) biogenic carbon leaves the upper mixed layer. Hence, our ability to understand the mechanisms whereby new nitrogen is converted into sinking flux is limited.

The fate of organic carbon produced by phytoplankton in the upper ocean is dependent on both physical and biological processes. Because organisms produce large numbers of rapidly sinking particles at a greater rate and quantity than is done by chemical and physical processes, the flux of particles to the deep sea is largely controlled by biological processes[2]. Most pelagic primary production is consumed by micro- or macroheterotrophs, resulting in a significant proportion of new production being exported in the form of sinking feces rather than as large phytoplankton cells. Accordingly, the catabolic products of the assimilated portion of new production (e.g. CO_2, NH_4, amino acids, urea, etc.) may be recycled within the microbial loop, contributing to increased partial pressure of CO_2 in the upper mixed layer.

The implications of this "modified paradigm" are profound. What is the relative importance of microbial populations in the sinking flux? Since small particles sink very slowly, they may contribute to the sinking flux only after being repackaged into fecal pellets. Pelagic tunicates ingest a wide size range of particles, from colloids to diatoms[3,4]. The results of a recent steady-state, flow-analysis model[2] suggest that when pelagic tunicates are abundant, sinking of their feces should result in an order of magnitude increase in the fraction of primary production that leaves the euphotic zone. This is apparently due to an increase in the contribution of their bacterial and nanoflagellate prey to sinking flux, in comparison to a "standard" food web composed of net phytoplankton and copepods. This model, although provocative, is entirely without experimental verification.

The conventional view that large, planktonic crustaceans are the most important grazers in the sea is not supported by recent studies showing that under some conditions microzooplankton and pelagic tunicates may be dominant consumers[5,6,7,8,9,10]. This raises important questions about the coupling of microbial and metazoan food webs, and about the role of protozoans, copepods and tunicates in mediating transfer of organic carbon from microbial plankton to the bottom of the sea. The influence of such food web interactions on the biological pump are complex, yet they are crucial to our understanding of the conversion of new production into sinking fluxes. To understand and model the role of the ocean in sequestering atmospheric CO_2 and hence mediating long-term climatic patterns, it will be necessary to measure the fraction of new production ingested by a variety of consumers (including bacteria, microzooplankton, copepods and pelagic tunicates), and the relative contribution of new and regenerated carbon to sinking particles (including picoplankton, microplankton and net plankton cells, and microzooplankton and metazoan fecal pellets).

JGOFS News (Cont.)

To examine the structure of the lower food web and the role of microzooplankton and macrozooplankton in the cycle of new and regenerated primary production, our programme has 5 objectives.

(1) To determine the vertical density and in vivo fluorescence structure, downwelling irradiance and the concentration of dissolved inorganic (e.g. N, P & Si) and organic nutrients (e.g. DOC, amino acids and carbohydrates).

(2) To determine the abundance, distribution and rate of production of bacterioplankton and phytoplankton.

(3) To determine the abundance, size and species composition of micro- and macrozooplankton.

(4) To determine rate of ingestion of phytoplankton and bacterioplankton by microzooplankton, copepods and tunicates.

(5) To determine rate of incorporation, assimilation and defecation of new and regenerated nitrogen and carbon by micro- and macrozooplankton using 15N and 14C dual labelling experiments.

The proposed research will quantify the role of microzooplankton in the microbial loop, and for the first time will quantify the magnitude of coupling of microbial populations to metazoans via a tunicate-mediated shunt. To do this we will determine not only the rate of new and regenerated primary production, but their fate during a "first pass" through microzooplankton and macrozooplankton consumer communities. The results of our studies will complement other projects within Canadian JGOFS dealing with the magnitude and fate of new production and food web partitioning of stable isotopes.

REFERENCES:

1 Tans, P.P., I.Y. Fung and T. Takabashi. 1990. Science 247: 1431-1433.
2 Michaels, A.F. and M.W. Silver. 1988. Deep-Sea Res. 35: 473-490.
3 Deibel, D. and J.T. Turner. Mar. Ecol. Prog. Ser. 27: 67-78.
4 Flood, P.R., D. Deibel and C.C. Morris. 1990. Biol. Bull. 178: 118-125.
5 Alldredge, A.L. 1981. Limnol. Oceanogr. 26: 247-257.
6 Deibel, D. 1985. J. Mar. Res. 43: 211-236.
7 Deibel, D. 1988. Mar. Biol. 99: 177-186.
8 Knoechel, R. and D. Steel-Flynn. 1989. Mar. Ecol. Prog. Ser. 53: 257-266.
9 Paranjape, M.A. 1987. Mar. Ecol. Prog. Ser. 40: 239-246.
10 Paranjape, M.A. 1990. Mar. Biol. 107: 321-328.

This summary has benefited from the input and ideas of Madhu Paranjape, Department of Fisheries and Oceans, St. John's, Newfoundland.

Guidelines for Agrometeorological Autostations

The Expert Committee on Agrometeorology (ECA) has recently published a report entitled "Guidelines for Agrometeorological Autostations". The purpose of this document is to recommend standards and reporting requirements which will satisfy the current and future needs of agriculture and the AES National Archive.

The ECA guidelines may be obtained by contacting:

Mr. Peter Dzikowski, P. Ag.
Chairman, Expert Committee on Agrometeorology
c/o Alberta Agriculture
Room 206, 7000 113 Street
Edmonton, Alberta, T6H 5T6
Tel. (403)-422-4385 Fax (403)-422-0474

Lignes directrices pour les stations agrométéorologiques automatiques

Le comité d'experts en agrométéorologie (CEA) a publié un rapport intitulé "Lignes directrices pour les stations agrométéorologiques automatiques". Le but de ce document est de recommander des normes qui répondront aux besoins en donnés actuels et futurs du secteur agricole et des archives nationales du SEA.

On peut obtenir les exemplaires à l'adresse suivante:

M. Peter Dzikowski, P. Ag.
Président, Comité d'experts en agrométéorologie
c/o Alberta Agriculture
Room 206, 7000 113 Street
Edmonton, Alberta, T6H 5T6
Tel. (403)-422-4385 Fax (403)-422-0474

Volume 26 No 2 August 1992 Août

Climatological Bulletin
Bulletin climatologique

Moisture risk assessment for spring wheat on the eastern prairies. G.H.B Ash, C.F. Shaykewich and R.L. Raddatz.

Potential impacts of CO_2-induced climate change using the GISS, GFDL and CCC scenarios on corn yields in the Essex County region. A. Viau and C. Mitic.

Etude comparative d'approches utilisées pour l'estimation de l'évapotranspiration en régions tropicales.
A. Viau, J. Boivin and B. Singh.

Development of an historical climate database for temperature and other climate elements.
D. Gullett, W. Skinner and L. Vincent.
Canadian Climate Centre

REVIEW/CRITIQUE

Fisheries Oceanography

Published by Blockwell Scientific Publications, Inc.

The first issue of this new journal was available on the stands in March of this year. Published four times annually, it promises to be a valuable addition to your library. It is targeted at fisheries biologists, oceanographers and fisheries managers, and if the first edition is any indication strives to integrate the disparate fields of physical, chemical and biological oceanography.

The editorial board, headed by Tim Parsons at UBC, is composed of the world leaders in oceanographic research and has a truly international flavour - from Japan (the journal is sponsored by the Japanese society for Fisheries Oceanography), through Canada and the U.S. to Europe.

Most of the papers in this first offering were dominated by submissions from the Pacific Rim. This will no doubt change as the journal becomes better known.

An article by Akihide Kasai and his colleagues focuses on the Kuroshio current off Japan and its impact on sardine eggs and larval survival. Through an elegant modelling exercise, they were able to show that the monsoons strongly influence offshore transport of these life forms and thus just where spawning occurred had a significant effect on larval retention in coastal areas and thus recruitment.

There were two papers on Alaskan pollock (which supports the largest single-species commercial fishery in the world). The first by Andrew Vastano and associates described larval dynamics in Shelikof Strait off Alaska, pointing out the importance of eddies and plumes to year class success. The second by Alan Springer, took more of an ecosystem view and described the role of pollock in the food chain. Apparently, many of the species that feed on juvenile pollock such as birds and marine mammals (particularly sea lions) are in decline, as are juvenile pollock. Interestingly it appears that the transfer of energy between the secondary producers and pollock is extremely efficient. They therefore dominate the interaction of the other species that also depend on the secondary producers. For that reason pollock holds a commanding role in the ecosystem. A number of hypotheses were presented which require further research to elucidate.

Rick Brodeur and Dan Ware examined large scale zooplankton temporal (1956-62 vs 1980-89) and spatial (Subarctic Domain of Gulf of Alaska) distribution in association with wind stress data. They observed a positive correlation between zooplankton biomass and winter winds and hypothesized either Ekman pumping in the Pacific Gyre or trophodynamic phasing (increase in mixed layer depths leading to decreased primary productivity, leading in turn to more efficient zooplankton grazing) to account for this. This has implications for global carbon flux as well as the success of Pacific salmon recruitment which migrate through the area.

Jim Simpson provides the last Pacific offering, with an examination of the large-scale structure of the California current during 1940-42 and 1982-83 mid-latitude North Pacific warming events. He presents a very comprehensive analysis of the link between the California Current System and the North Pacific oscillation.

J. Helbig, G. Mertz and P. Pepin offer a timely contribution on the relationship between the marine environment of Newfoundland and Northern cod recruitment. Reviews are provided of the physics, cod early life history and previous attempts to link the two. Correlative studies are criticized and thus the authors take a more mechanistic approach to the problem. Particle flow in the region is modelled and a number of observations made on how atmospheric events such as storms can influence egg and larval drift. They emphasize the need for information on short-time scales, but over a wide area.

This is followed by a refreshing paper by Al Tyler who puts correlative and modelling work in perspective. This is a must read by everyone. He emphasizes the obvious - necessary every so often - that scientific progress is made when empirical study, conceptual planning, field work and modelling work together over the long-term to resolve complicated biological systems. As well, he proposes a step-wise process of conceptualization to assist in the formulation of clear, relevant hypotheses. Highly recommended reading.

The last contribution was that of Carl Walters, Charles Hannah and Keith Thomson. They describe a straight forward PC-based model written in Quick BASIC that combines Lagrangian Particle transport processes (the physics) with fish egg/larval growth/mortality processes (the biology) to provide an exploratory tool of recruitment dynamics during the first 2-3 months of life. The data requirements are relatively easy to satisfy, and while the results are not as precise as more complicated versions, it serves as an excellent means of illustrating the interaction of physics and biology. It will no doubt make its way into university classrooms.

At the end of the issue, a report of the August 1991 Canada-Japan Fisheries Oceanography Workshop is given by Dan Ware, as is a book review by P. Harrison of K. Manin and J. Lazier's new addition entitled "Dynamics of Marine Ecosystems: Biological - Physical Interactions in the Oceans".

In content then, the current issue provides an interesting mix of papers describing the fish-environment interaction. For the future, I hope that submissions appear on not only eggs and larvae, but also on other life stages such as the adults. Many of the immediate impacts of climate change will be first felt by commercial fishermen through changes in fish availability. Let's hope that we have answers when the time comes.

In form, there were some typographic errors which no doubt will be rectified in the future. I might recommend a "next month's issue" page as well as announcements on upcoming conferences and the like.

One can legitimately ask whether this journal fills a necessary gap. There are after all lots of journals currently devoted to Fisheries and Oceanographic issues. However, there are few places where the two disciplines are as closely linked as in this new journal. "Fisheries Oceanography" is certainly emerging as a topical area in the fields of both fisheries and oceanography. The journal will no doubt stimulate thought and multi-disciplinary study in this subject area.

Fisheries Oceanography is all-in-all a valuable new addition. Watch for it.

R. N. O'Boyle, Chief
D.F.O., Marine Fish Division

Volume 30 No 3 September 1992 Septembre

ATMOSPHERE-OCEAN

Volume 30 No 4 December 1992 Décembre

ATMOSPHERE-OCEAN

Scientific Leader
Ocean Circulation Modelling Group of the Canadian Climate Centre

The Canadian Climate Centre (CCC) of the Atmospheric Environment Service of Environment Canada is seeking a scientific leader for the newly established ocean circulation modelling group in Victoria, British Columbia. This group has been formed to undertake research into the development of large-scale ocean circulation/climate models. In September 1993, the CCC will move a group of atmospheric modellers/model developers to Victoria to interact with the ocean modelling group in order to begin the challenge of coupling the CCC atmospheric general circulation model to prognostic ocean and ice models. The goal of this undertaking is the development of coupled ocean-atmosphere-ice models for climate studies. It is expected that the group will reside on the campus of the University of Victoria.

The successful applicant will provide scientific leadership for, and oversee the development of, the new ocean modelling group, and will collaborate with the atmospheric modelling group to facilitate the development of coupled climate models. As an Adjunct Professor with the School of Earth and Ocean Sciences at the University of Victoria, the scientific leader will have the opportunity to supervise graduate students and to interact with faculty there. The scientific leader is also expected to develop collaboration with the ocean modelling groups at the University of British Columbia in Vancouver, and at the Institute of Ocean Sciences of the Department of Fisheries and Oceans in Sidney.

Applications accompanied by a curriculum vitae and the names of four potential references should be sent by December 1, 1992, to:

Dr. John Stone
Director, Climate Research Branch
Atmospheric Environment Service
4905 Dufferin Street
Downsview, Ontario
CANADA M3H 5T4

Salary and appointment date are subject to negotiation. Preference in appointment will be given to Canadian citizens.

UQAR
AUX DIMENSIONS D'AUJOURD'HUI

PROFESSEURES OU PROFESSEURS RÉGULIERS EN OCÉANOGRAPHIE

Le département d'océanographie de l'Université du Québec à Rimouski sollicite des candidatures pour combler immédiatement quatre postes de professeur régulier dans les disciplines suivantes:

OCÉANOGRAPHIE PHYSIQUE DE LA COUCHE LIMITE

La personne retenue devra obligatoirement posséder un Ph. D. ou D. Sc. en océanographie physique, génie ou discipline connexe, préférablement avec une expérience post-doctorale et une solide expérience de recherche et de bonnes connaissances en dynamique des fluides. Elle sera appelée à collaborer aux programmes de recherche multidisciplinaire existants et/ou à élaborer et développer de nouveaux projets de recherche sur les processus hydrodynamiques aux interfaces eau-sédiment et/ou eau-glace.

GÉOCHIMIE ORGANIQUE MARINE

La personne retenue devra obligatoirement posséder un Ph. D. ou D. Sc. en océanographie chimique, chimie ou discipline connexe, préférablement avec une expérience post-doctorale et une solide expérience de recherche. Elle sera appelée à collaborer aux programmes de recherche multidisciplinaire existants et/ou à élaborer et développer de nouveaux projets de recherche sur la composition et la qualité de la matière organique et ses effets sur les processus géochimiques et biologiques.

ÉCOLOGIE DU PHYTOPLANCTON

La personne retenue devra obligatoirement posséder un Ph. D. ou D. Sc. en océanographie biologique ou discipline connexe, préférablement avec une expérience post-doctorale et une solide expérience de recherche. Elle sera appelée à collaborer aux programmes de recherche multidisciplinaire existants et/ou à élaborer et développer de nouveaux projets de recherche sur la production primaire en relation avec les phénomènes physiques.

ÉCOPHYSIOLOGIE DES INVERTÉBRÉS MARINS

La personne retenue devra obligatoirement posséder un Ph. D. ou D. Sc. en océanographie biologique, physiologique ou discipline connexe, avec une expérience post-doctorale et une solide expérience de recherche. Elle sera appelée à collaborer aux programmes de recherche multidisciplinaire existants et/ou à élaborer et développer de nouveaux projets de recherche sur l'effet de la qualité et la quantité de matière organique sur l'assimilation et l'allocation d'énergie, ainsi qu'en écotoxicologie marine.

Fonctions: En plus de ses travaux de recherche, le titulaire de chacun de ces postes dispensera des activités d'enseignement dans sa discipline au niveau des études avancées (maîtrise et doctorat) en océanographie et sera appelé à diriger des étudiants gradués. Il pourra aussi être appelé à donner des cours de premier cycle dans les domaines reliés à sa compétence. Il participera également à différents organismes de l'Université.

Les personnes retenues pourront être intégrées au Centre océanographique de Rimouski regroupant présentement plus de 25 chercheurs de l'UQAR et de l'INRS-Océanologie. Ce centre comprend également près de 70 étudiants de 2e et 3e cycles, des stagiaires, des chercheurs postdoctoraux ainsi que des professionnels. Les recherches entreprises au nouveau Centre porteront sur l'étude des milieux marins côtiers, plus particulièrement sur les interactions entre les composantes physiques, biologiques, chimiques et sédimentologiques de ces systèmes.

La langue de travail est le français.

TRAITEMENT : Selon la convention collective en vigueur.

Selon la loi canadienne, la préférence est accordée aux citoyens canadiens et immigrants reçus.

Toute candidature sera traitée confidentiellement. Les personnes intéressées doivent faire parvenir leur curriculum vitæ ainsi que les noms, adresses et numéros de téléphone de trois références, avant le 15 octobre 1992 à:

Monsieur Mohammed I. El-Sabh, directeur
Département d'océanographie, Université du Québec à Rimouski
300, allée des Ursulines
Rimouski (Québec) Canada G5L 3A1
Tél.: (418) 724-1770 Télécopieur: (418) 724-1842

Université du Québec à Rimouski

CALL FOR PAPERS
27th 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;
- Physical-Biological Interactions in the Ocean;
- Climate Modelling; and
- Remote Sensing.

Special Sessions are also being planned on Canadian Hazards, CASP II, The Hydrological Cycle on Regional and Global Scales, Modernizing Canada's Weather Services, Oceanography of Seamounts and Banks, Ozone and the Ultraviolet, Tracers in the Ocean, and WOCE. In addition, there will be sessions based on contributed papers in other areas of meteorology and oceanography.

Oral and poster papers, and commercial exhibits are invited. Abstracts of papers should be submitted to the Chairman of the Scientific Program Committee by 29 January 1993. Authors are requested to submit both a hard copy and a diskette copy, preferably in Word Perfect 5.1 (or 5.0) IBM format (otherwise ASCII file format). Authors are also requested to indicate any session preference and special audio-visual requirements.

INVITATION A PRESENTER DES COMMUNICATIONS
27ième CONGRES ANNUEL 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 physiques-biologiques dans l'océan;
- Modélisation climatique; et
- Télédétection.

Sont également prévues des sessions spéciales portant sur les phénomènes dangereux au Canada, le PCETA II, le cycle hydrologique à l'échelle régionale et globale, la modernisation des services météorologiques canadiens, océanographie des monts sous-marin et des bancs, l'ozone et les rayons UV, les traceurs dans l'océan, et ECOM. De plus, des sessions sur divers autres domaines de la météorologie and de l'océanographie seront organisées.

On vous invite aussi à présenter des communications orales et des sessions d'affichage ou des exposants commerciaux. Les résumés des documents devraient parvenir au président du Comité du programme scientifique avant le 29 janvier 1993. On demande aux auteurs de soumettre une copie papier et une autre sur disquette (si possible, WordPerfect 5.0 ou 5.1 IBM, sinon fichier ASCII). Les auteurs devront aussi indiquer leur préférence quant á la session et leurs besoins en équipement audio-visuel spécial.

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

Mr. Dave Daugharty, Chairman
Local Arrangements Committee
Department of Forestry Resources
University of New Brunswick
Fredericton, N.B. E3B 6C2
506/453-4501; 506/453-3538 (FAX)
INTERNET: daug@jupiter.csd.unb.ca

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

ACCREDITED CONSULTANTS/EXPERTS-CONSEIL ACCREDITES

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.

La présent section est réservée aux experts-conseils accrédités de la SCMO. Le processus d'accréditation a débuté en décembre 1986. Une liste complète des experts-conseils accrédités de la SCMO peut être obtenue au bureau d'affaires de cette dernière. Les personnes désirant l'accréditation doivent entrer en contact avec la Société à son bureau de Newmarket afin de recevoir une copie de règlements et un formulaire d'application.

Comme il est indiqué dans le document intitulé "Règlements de la SCMO pour l'accréditation", les critères d'adhésion sont:

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

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

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

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

   (iii) trois années d'expérience sur le marché du travail en météorologie ou en océanographie.

(3) En plus des exigences d'éducation et de formation, l'applicant doit posséder au moins deux années d'expérience sur le marché de travail, avec un rendement satisfaisant, dans le champ de spécialisation mentionné dans le document. De l'expérience en tant qu'expert-conseil est nécessaire.

ACCREDITED CONSULTANTS/EXPERTS-CONSEILS ACCREDITES

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

75 Woodfern Drive, S.W.
Calgary, Alberta T2W 4L9 Canada
Tel: (403) 238-5230 (Includes Fax)

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'ADHESION 1992

(Please print in block letters - Ecrire en lettres moulées s.v.p.)

Title: Dr___ Mr___ Mrs___ Miss___ Ms___
Titre: 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.

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

MEMBERSHIP CATEGORY-CATEGORIE DE MEMBRE
ANNUAL FEES - COTISATION ANNUELLE
(Please check one - cochez une case s.v.p.)

Regular Régulier	☐	$40.00/40,00$
Student Étudiant	☐	$20.00/20,00$
Retired Retraité	☐	$25.00/25,00$
Sustaining De soutien	☐	$150.00/150,00$ (minimum)
Corporate Moral	☐	$200.00/200,00$ (minimum)

PUBLICATION SUBSCRIPTIONS - ABONNEMENT AUX PERIODIQUES

ANNUAL RATES - FRAIS D'ABONNEMENT ANNUEL

		Members Membres	Non-members Non-membres	Institutions Institutions
ATMOSPHERE-OCEAN ATMOSPHERE-OCEAN	☐	$25.00 25,00$	$35.00 35,00$	$65.00 65,00$
Climatological Bulletin Bulletin climatologique	☐	$15.00 15,00$	$20.00 20,00$	$25.00 25,00$
Annual Congress Program and Abstracts Programme et résumés du congrès annuel	☐	$ 0.00 0,00$	$15.00 15,00$	$15.00 15,00$

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 étudiants reçoivent une publication gratuite de la SCMO et doivent indiquer celle désirée. Tous les périodiques réguliers de la Société sont envoyés aux membres moraux et de soutien. Les membres résidant au Canada doivent ajouter 7% (TPS) aux frais d'abonnement annuel.

PRIMARY FIELD OF INTEREST - SPHERE D'INTERET PRINCIPALE

Meteorology / Météorologie ☐ Oceanography / Océanographie ☐

SPECIAL INTEREST GROUP - GROUPE D'INTERET SPECIAL

(Indicate group if interested - Indiquez si vous avez des intérêts dans un de ces groupes.)

Hydrology / Hydrologie ☐
Air pollution / Pollution de l'air ☐
Agriculture and Forest / Agriculture et foresterie ☐
Operational Meteorology / Météorologie d'exploitation ☐
Floating Ice / Glaces flottantes ☐
Mesoscale Meteorology / Météorologie à la mésoéchelle ☐
Fisheries Oceanography / Océanographie des pêches ☐
Other (specify) / Autre (spécifiez)_____ ☐

See over/voir au verso

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

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 chèque au montant de $ _____ payable à la Société canadienne de météorologie et d'océanographie pour la cotisation de membre et/ou les frais d'abonnement aux périodiques. J'inclus aussi un don déductible d'impôts de $ _____ pour (indiquez):

☐ Le fonds de développement de la Société

☐ Autre (spécifiez) _____

_____ _____
(Signature) (Date)

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

_____ _____
(Signature) (Date)

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