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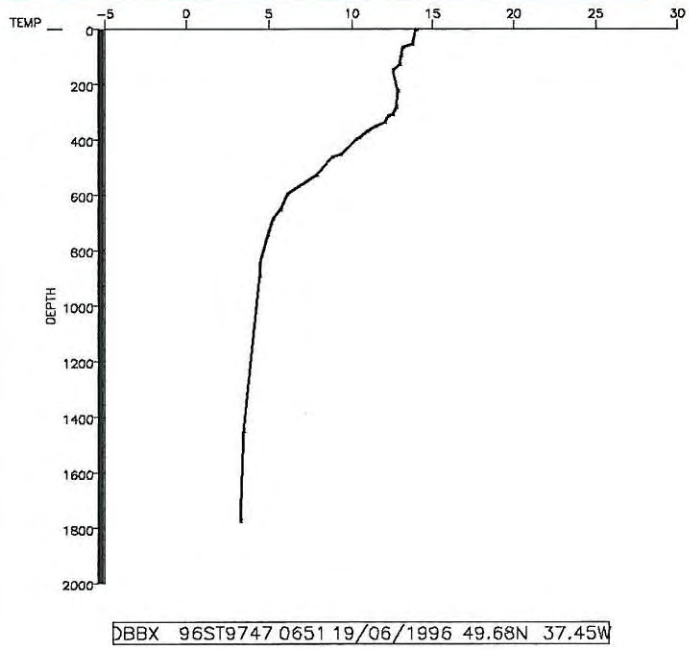

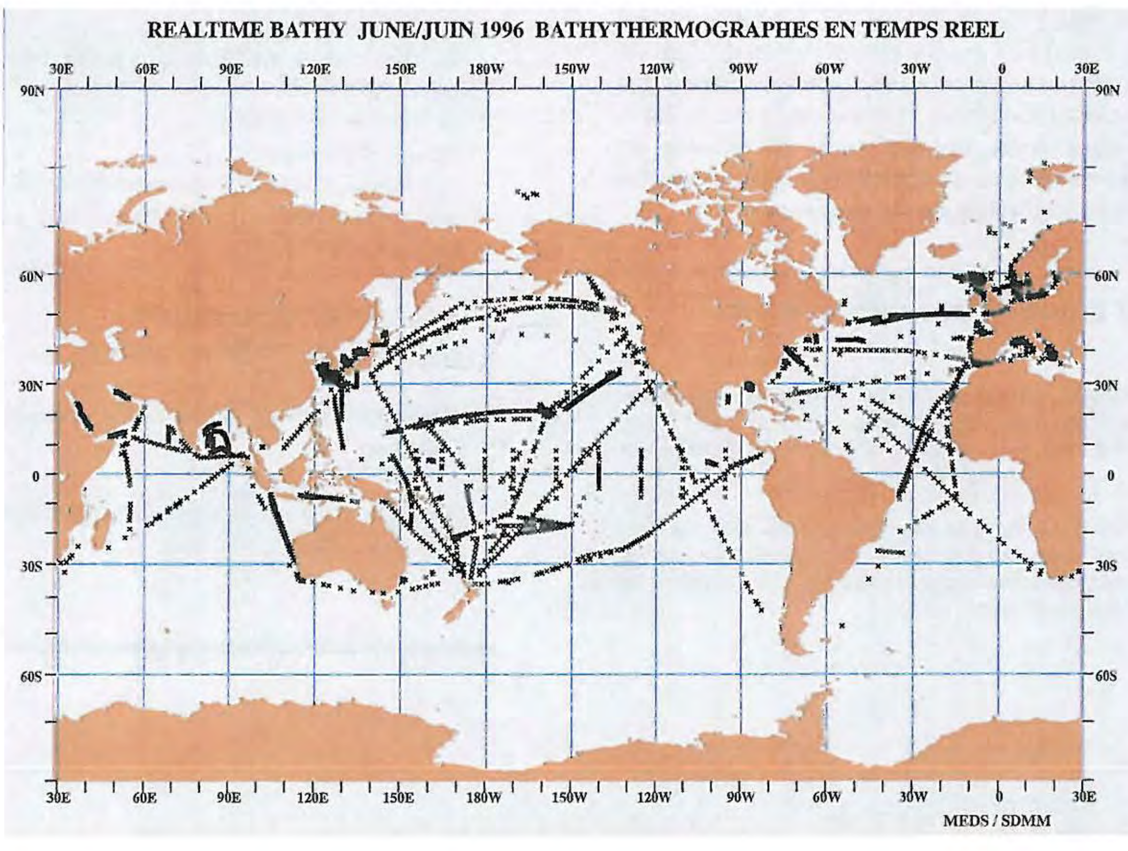

CMOS Bulletin SCMO

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

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Cover page: Real-time exchange of oceanographic data through the Global Telecommunication System (GTS) enables the users of the marine environment (scientific, fisheries, transportation, etc.) to understand the surrounding water mass properties in a timely fashion. Here, a technician launches an expandable bathythermograph (XBT) (top-left photo); the trace (temperature vs depth) is examined to assure the quality of the data (top-right picture); the bottom picture illustrates the total number of XBT drops in a given month over the world's oceans which are transmitted on the GTS. The article that you will find on page 90 discusses in depth the economic benefits in transmitting in real time oceanographic data.

Page couverture: L'échange en temps réel à l'aide du Système mondial de télécommunications (SMT) de données océanographiques aide les utilisateurs de l'environnement marin (scientifiques, pêcheries, transport, etc.) à la compréhension des propriétés des masses d'eau en temps opportun. Ici un technicien lance un bathythermographe largable (XBT) à l'eau (photo du haut à gauche); le tracé (température vs profondeur) est examiné pour assurer la qualité des données (image du haut à droite); enfin l'image du bas illustre la totalité des données prises durant un mois et transmises sur le SMT. L'article que vous trouverez en page 86 discute en profondeur des avantages économiques de transmettre les données océanographiques en temps réel.

Next Issue - Prochain numéro

The next issue of the ***Bulletin 24 (5)***, October 1996, will go to press by mid-October. We need your contributions, short articles, notes, presentations, chronicles, etc., by early October. Don't miss your chance!

Le prochain numéro du ***Bulletin 24 (5)***, Octobre 1996 sera mis sous presse vers la mi-octobre. Vos contributions sont les bienvenues. Veuillez bien me les faire parvenir d'ici le début du mois d'octobre. Ne manquez surtout pas votre coup!

INSIDE / EN BREF

Volume 24 No.4
August 1996 - août 1996

Articles

1) Impacts of climatic changes on the hydrological regime: the Moisie river case revisited by Michel Slivitzky and Guy Morin — p. 77
2) NARSTO-CE: A major tropospheric ozone field study in Eastern Canada in 1996 by Maris Luis — p. 82
3) Avantages économiques du SMISO par R.B.L. Stoddart — p. 86
4) Economic benefits of IGOSS by R.B.L. Stoddart — p. 90

Information

1) Book Review - Revue de littérature — p. 95
2) Corrigendum and Addendum by K. Hamilton — p. 96
3) Workshop of Atmospheric Change and North American Transportation — p. 96
4) Atelier sur les changements atmosphériques et le secteur nord-américain des transports — p. 97
5) Fifth Conference of the Computational Fluid Dynamics Society of Canada — p. 98
6) News from the Canadian National Committee of SCOR — p. 98
7) 30th CMOS Congress by Savonius Rotor — p. 99
8) Skin cancer risk and sun protection education — p.100
9) CMOS and AMOS by Ian Watterson — p.101
10) A short note about oceanographic sampling at B.C. Lightstations by Howard Freeland — p.103

Accredited Consultants - Experts-conseils accrédités — p.104

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Impacts of climatic changes on the hydrological regime: the Moisie river case revisited

by Michel Slivitzky and Guy Morin[1]

Résumé

En 1992 les résultats du modèle de circulation générale (MCG) à haute résolution du Centre climatologique canadien (CCC) ont été utilisés pour estimer l'ampleur des impacts d'éventuels changements climatiques sur le régime hydrologique de la rivière Moisie, sur la côte nord du Saint-Laurent.

Le modèle hydrologique CEQUEAU a été appliqué au bassin versant de la rivière Moisie, pour simuler les débits dans le contexte climatique actuel, et dans ce nouveau contexte climatique de $2xCO_2$ où les précipitations annuelles seraient pratiquement inchangées alors que les températures annuelles augmenteraient de 4°C.

En appliquant aux 24 années (1966-1989), les changements mensuels de précipitation et de température découlant du MCG du CCC, le débit annuel moyen serait réduit d'environ 5%. On assisterait à une modification plus importante dans la distribution mensuelle des écoulements. Les débits moyens des mois d'été (juillet à septembre) seraient réduits d'environ 35% tandis que pour les mois d'hiver les écoulements moyens seraient plus soutenus.

Dans cet article, nous appliquons exactement le même modèle hydrologique et la même procédure d'analyse, mais avec les résultats de trois modèles climatiques transitoires utilisés dans le cadre de la deuxième évaluation par le Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC). À la différence du modèle en régime permanent du CCC, qui suppose une concentration constante de $2xCO_2$, ces modèles couplés océan-atmosphère supposent une augmentation graduelle dans la concentration des gaz à effet de serre. Un ensemble commun de données numériques provenant de ces modèles ont été proposées aux auteurs du Groupe de travail II du GIEC, afin de permettre une évaluation uniforme des impacts de changements climatiques éventuels.

Des données moyennes mensuelles de changement de température et de précipitation sont disponibles pour les trois scénarios climatiques, pour chacune des trois décennies : régime actuel, augmentation moyenne de température de 1.16°C et augmentation de 2°C à 2.5°C.

Alors que les augmentations de températures annuelles pour le bassin de la rivière Moisie sont de l'ordre de 0 à 4°C et les précipitations annuelles de -10mm à +100mm pour ces trois scénarios climatiques, l'écoulement moyen annuel n'est modifié que légèrement (0 à 6%), avec un maximum de 11% pour la décennie 3 du modèle GFDL89.

Au niveau saisonnier les résultats sont similaires à ceux que nous avons observés en 1992 avec le modèle du CCC. Les débits moyens des mois d'été seraient réduits à cause de l'augmentation de la température et de l'évapotranspiration, tandis que pour les mois d'hiver les écoulements moyens seraient plus soutenus, à cause de fontes plus fréquentes au début et à la fin de l'hiver. Les écoulements durant le printemps seraient à peu près les mêmes mais se produiraient plus tôt et sur une période plus courte.

Introduction

In 1992, Morin and Slivitzky (1992) used the output of the Canadian Climate Centre (CCC) General Circulation Model (GCM)(CCC, 1990), coupled with the hydrologic deterministic model CEQUEAU (Morin et al., 1981; Morin and Couillard, 1990) to evaluate the possible impact of a doubling of atmospheric CO_2 on the hydrologic regime of the Moisie river, on the North Shore of the Saint Lawrence river.

Daily temperatures and precipitation for the Sept-Îles and Wabush Lake climate stations were used as input to the CEQUEAU model, to calculate flows for the 1966-1989 period and compare them with observed flows for the same period. Monthly changes in temperature and precipitation, as output by the Canadian GCM under a $2xCO_2$ scenario, were then used to simulate daily flows under changed climate conditions. The values at the grid points of the GCM were interpolated to the Sept-Îles and Wabush Lake stations.

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While calculated, annual runoff was reduced by only about 5%, monthly values indicated much larger variations. Winter flows were significantly increased (from 19% to 210%) due to much more frequent snow melts at the beginning and end of winter, and resulting winter low flows were significantly higher. The monthly spring flow remained unchanged although concentrated in a shorter period. Summer flows (June to October) decreased by 25% to 40% due to increase in temperature and evapotranspiration but were still higher than winter flows.

In 1994 a working paper of the Intergovernmental Panel on Climate Change, Working Group II, Technical Support Unit (IPCC WG II TSU) (Greco et al., 1994), provided a common set of model data that was to be used by all WG II authors in their assessment of climate change impacts. This working paper contains climate change scenarios that were provided for the IPCC WG II writing teams at the request of the IPCC WG II Bureau. These scenarios have been assembled from previously conducted and well-documented transient GCM experiments. It was therefore considered of interest to compare the 1992 results using the CCC GCM, with the results of these new climate scenarios. Conclusions could then be reached under the light of these new scenarios.

The hydrologic model and its application

The reader is referred to Morin & Slivitzky (1992) for a detailed description of the model, the procedures used for calibration of the model and the complete results of the CCC GCM simulations. We will only present here a brief summary.

The CEQUEAU hydrologic model is a deterministic model which takes into account a number of physiographic characteristics of the drainage basin (elevation, percentage of forest and lake area, ...) as defined in a number of square grids. The model uses for input daily minimum and maximum temperatures as well as daily solid and liquid precipitation (rainfall and snowfall).

The CEQUEAU deterministic model uses the degree-days method (USACE, 1960) to estimate daily snowmelt under forest canopy and in the open and Thornwaite equation to calculate daily evapotranspiration, for each square grid of the basin. Daily water budget equations, using linear reservoir storage for soil moisture and ground water storage, are then used on each square grid element to estimate daily runoff production. This daily runoff production on each grid is then routed downstream to the basin outlet.

This model is applied to the drainage basin of the Moisie river on the North shore of the Saint Lawrence river. The Moisie river drainage basin covers an area of 19,248 km^2, and we have used square grids of 20 km by 20 km to model this basin which is roughly oriented North to South with a length of 320 km and a width of 70 km. Climatological information, available at Sept-Îles and Wabush Lake stations, is interpolated to each square grid data element of the drainage basin.

The transient climate models

The climate change scenarios were constructed using results from transient climate change experiments performed with coupled ocean-atmosphere GCMs at three modelling centres :

- the UK Meteorological Office (UKMO) in the UK - model UKTR (Murphy, 1994, Murphy and Mitchell, 1994);

- the Max Planck Institute (MPI) in Germany - model ECHAM1-A (Cubasch et al., 1992);

- the Geophysical Fluid Dynamics Laboratory (GFDL) in the US-model GFDL89 (Manabe et al., 1991, 1992).

The monthly model output data is provided in digital form and can be used to generate GCM data for use in impact models. The monthly average output parameters (mean surface air temperature, precipitation, and downward solar flux) for three selected decades were prepared at NCAR and are available, together with the appropriate software by electronic means (see Note).

The three decades given are Decade 1 for the model control run, Decade 2 when global temperature is up by about 1.16°C, and Decade 3 corresponding to about years 70 to 79 after Decade 1. The middle decade, Decade 2, was chosen to match the definition of warming (1.16°C) for the year 2050 from the simple model (Wigley and Raper, 1992), while Decade 3 has a global warming of about 2° to 2.5°C in all three models.

Results

Before proceeding any further, it is interesting to compare the results of control runs for the three transient scenarios with observed annual climatology for that region. Table 1 presents the annual normals for the Sept-Îles and Wabush climatic stations for the 1951 to 1990 periods, and the results of control runs interpolated to the two climate stations. While the ECHAM1-A and GFDL89 temperatures and the ECHAM1-A precipitation fall within a reasonable range, the GFDL89 control run precipitation is about 30% to 50% wetter than observed climatology. On the other side, the UKTR control run leads to precipitation values that are reasonably close to the observed ones, while annual temperatures are on the average about 3°to 4° colder than observed values.

Model		Temperatures (°C)		Precipitations (mm)	
	Period	Sept-Îles	Wabush	Sept-Îles	Wabush
Normal	1951-1980	1.1	-3.8	1125	895
Normal	1961-1990	0.9	-3.6	1128	881
ECHAM1-A	Decade 1	0.8	-1.7	1074	1012
UKTR	Decade 1	-4.5	-7.7	1109	955
GFDL89	Decade 1	-0.9	-3.4	1447	1365

Table 1: Comparison of station normals with model control runs

For calculating the impact on runoff for the Moisie river basin, this study used exactly the same procedure with the output of these three models as was used in 1992 with the CCC GCM. Monthly changes in temperature and precipitation, as output by the transient GCM's, were used to simulate daily flows under changed climatic conditions.

The values at the grid points of the GCM were interpolated to the Sept-Îles and Wabush Lake stations, with the software provided by NCAR mentioned above. Daily minimum and maximum temperatures and daily solid and liquid precipitation (rainfall and snowfall) for Sept-Îles and Wabush for the 1966-1989 period were then adjusted for the monthly changes from the GCM. The daily adjusted values were interpolated to each grid element of the Moisie drainage basin. Daily water budget, using linear reservoir storage for soil moisture and ground water storage, was then produced on each square grid element, to estimate daily runoff. Daily runoff production on each grid was then routed downstream to the basin outlet.

Table 2 presents the results of the simulation runs for the three transient climate scenarios, the hydrologic control run, as well as the results of Morin & Slivitzky (1992) using the CCC GCM. Columns three to six present the temperature and precipitation differences as output by the climate scenarios while the last columns present the resulting annual average runoff as output by the hydrologic simulation model. While, as mentioned previously, the Canadian GCM produced a reduction in runoff of about 5% for a $2xCO_2$ case, application of the ECHAM1-A model gives an increase of 4.2% for Decade 2 with a decrease of 1.5% for Decade 3. Similarly the UKTR model gives an increase of 5.7% for Decade 2 and 6.3% for Decade 3; application of GFDL89 climate changes increases the average runoff by only 0.6% for Decade 2 and 11.3% for Decade 3.

All these differences, based on the hydrologic control run, are really small and probably within the accuracy of the various interpolation and simulation procedures. We can conclude that, given the regional definitions of the four climate change scenarios that were examined, the long term annual averages of runoff might not be significantly affected not only on the Moisie river watershed but also in similar regions on the North Shore of the Saint Lawrence river.

Morin and Slivitzky (1992) analyzed in detail the monthly changes that might occur under a changed climate under the CCC $2xCO_2$ scenario. The same pattern occurs under the three transient scenarios. Table 3 presents the long term seasonal changes when compared with the results of the hydrologic control run simulation.

Model		Temp. Diff. (°C)		Précip. Diff. (mm)		Runoff	
	Period	Sept-Îles	Wabush	Sept-Îles	Wabush	(mm)	(%)
Base control run	1966-89					715	
CCC	$2xCO_2$	+4.2	+4.2	-1.5 %	+3.7 %	679	-5.0
ECHAM1-A	Decade 2	+0.8	+0.2	+48	-10	754	+4.2
ECHAM1-A	Decade 3	+0.8	+0.3	10	+6	704	-1.5
UKTR	Decade 2	+3.0	+2.8	+61	+63	756	+5.7
UKTR	Decade 3	+4.3	+4.2	+42	+119	760	+6.3
GFDL89	Decade 2	+1.5	+1.5	+7	-14	719	+0.6
GFDL89	Decade 3	+3.4	+3.3	+119	+101	796	+11.3

Table 2: Simulation results

Model		DJF	MAM	JJA	SON
CCC	$2xCO_2$	3.8	13.3	-13.1	-3.9
ECHAM1-A	Decade 2	0.3	2.0	-1.7	-0.7
ECHAM1-A	Decade 3	0.0	1.6	-0.9	-0.7
UKTR	Decade 2	2.5	6.3	-8.1	-0.7
UKTR	Decade 3	4.8	10.0	-13.0	-1.7
GFDL89	Decade 2	1.3	7.7	-7.5	-1.5
GFDL89	Decade 3	3.0	11.8	-12.1	-2.6

Table 3: Seasonal variations as % of hydrologic control run values

Except for the ECHAM1-A scenario which does not show any significant seasonal changes, the December to February (DJF) runoff is slightly increased for the two other transient scenarios. The March to May (MAM) runoff increases by about 10% to 13% for Decade 3, decreases by a similar amount for the June to August (JJA) season and shows slight decreases for the September to November (SON) season.

These results are similar to what we obtained with the CCC $2xCO_2$ scenario. Spring runoff increases are mostly caused by increases in snowmelt from increased winter precipitation while the summer and fall decreases are due to increases in summer and fall temperature and evapotranspiration.

NOTE

Greco and al. (1994) was a working document produced by the Technical Support Unit with limited distribution to IPCC WG II lead authors, and the printed version is no longer available. However, an electronic version of the document, together with the climate change scenarios databases and appropriate software are available on Internet at URL "ftp://ncardata.ucar.edu/pub/ipcc".

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Quotes of the month

"I like the dreams of the future better than the history of the past."
Thomas Jefferson, President of the U.S.A.

"The dreams of the future are improved if they are based on the history of the past!"
G.H.L. Holland, Department of Fisheries and Oceans, Canada, July 1996.

Morin, G., Fortin, J.-P., Lardeau, J.-P., Sochanska, W., Paquette, S. (1981). *Modèle CEQUEAU: manuel d'utilisation.* INRS-Eau rapport scientifique no 93, 449p.

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Merci!

The photograph on the cover page shows Charlie Fitzpatrick, Senior technician of the Oceanography Section at the North-West Atlantic Fisheries Centre, St.John's, NFLD. The photograph was taken by John Walpert.

La photographie sur la page couverture montre Charlie Fitzpatrick, technicien sénior de la section d'océanographie du Centre des pêches de l'Atlantique nord-ouest, St.John's, NFLD. La photo fut prise par John Walpert.

NARSTO-CE: A Major Tropospheric Ozone Field Study in Eastern Canada in 1996

by Maris Lusis[1]

Background

Environment Canada has been interested in the increase in tropospheric ozone, a pollutant hazardous to humans and vegetation, since the early 1970s. When the NOx/VOC Management Plan was instituted in 1990 under Canada's Green Plan, the Atmospheric Environment Service (AES) was given the lead of the Management Plan's Science Program, with the objective of supporting the development of policy to bring all of Canada into compliance with the national objective for ozone, 82 ppb (hourly average). As part of this effort, research work has been ongoing over several years in the areas of modelling of regional ozone formation, transport and deposition; data analysis; air quality measurements; and assessment of the current air quality objective for ozone, from the aspect of health and vegetation effects. Also included in the research program was a major oxidants field study in the Lower Fraser Valley (one of the regions of Canada where the ozone objective is regularly exceeded), called PACIFIC'93. The NOx/VOC Science Program will be delivering a major Assessment on photochemical smog in Canada in the summer of 1996.

The North American Research Strategy for Tropospheric Ozone (NARSTO) is a cooperative effort involving national and regional governments, industry and academia in the United States, Canada and Mexico, all sharing a common interest in the tropospheric ozone problem. AES signed onto the NARSTO Charter on behalf of the Canadian NOx/VOC Science Program in November of 1995.

The ozone field study planned for this summer, called NARSTO-CE, is a coordinated effort in eastern Canada involving AES and several Canadian provincial and municipal agencies, university groups, and industry. It is being planned in close coordination with the United States' NARSTO program. The NARSTO-CE field study will constitute a major Canadian contribution to NARSTO.

Tropospheric ozone partly originates from stratospheric intrusions into the troposphere, but in populated areas, particularly during the summer months, it is generally acknowledged that ozone is largely the result of complicated chemical reactions in the atmosphere, driven by solar radiation, between anthropogenic nitrogen oxide (NOx) emissions and volatile organic compounds (VOCs), of both anthropogenic and natural origin. Many of the details of the formation and transport of ozone are poorly understood, even after more than 25 years of intensive research into the problem (hence the need for NARSTO). Field measurement campaigns are an important aspect of ozone research.

It is now known that ozone formation and transport is a regional rather than a local problem, and the eastern portions of Canada (where two ozone problem areas exist - the Windsor/Quebec Corridor, WQC, and the Southern Atlantic Region, SAR) and the United States are a part of a common airshed. For example, data analysis and preliminary modelling results indicate that many of the ozone episodes in the SAR have their origin in air transported from the east coast States, called the Ozone Transport Region (OTR). To help improve their regional oxidants mathematical models, used in evaluating various emission control strategies, the OTR states are planning a field campaign, called NARSTO-NE, for the summer of 1996. NARSTO-CE will be coordinated with NARSTO-NE.

In Canada, there are two local ozone-related studies that will also be carried out under the NARSTO-CE umbrella, the Southern Ontario Oxidants Study (SONTOS), a Canadian Institute for Research in Atmospheric Chemistry (CIRAC) project, and the Montreal Area Oxidants Study (MAOS), a study involving Environment Quebec, the AES Quebec Regional Office, the Montreal Urban Community and University of Quebec at Montreal, as well as other local organizations. These local studies, and the research campaign planned by AES's Climate and Atmospheric Research Directorate and Environment Canada's Atlantic, Quebec and Ontario Regional Offices, all share two common objectives to elucidate the factors leading to the occurrence of high ozone concentrations, and to provide data for validating and improving regional oxidant models. Coordination of all the above studies will provide a unique data set of surface and upper air chemistry and meteorology measurements for all of the eastern portion of North America.

Goals

The primary goal of NARSTO-CE is to carry out ozone-related air quality and meteorology measurements in order to improve our reliability of simulating source-(Canadian) receptor relationships. Two questions are of particular interest:

1. How accurately do the regional oxidant models developed under the NOx/VOC Management Plan's Science Program represent the atmospheric chemistry of oxidant formation in an Eastern North America setting?

[1]Climate and Atmospheric Research Directorate, Atmospheric Environment Service

2. How well does the MC2 meterological driver in these oxidant models reproduce the dynamics of the nocturnal and the marine boundary layer?

The data generated by the field study will allow Canadian modellers to perform an evaluation of their regional models with a 1996 data set designed primarily to evaluate photochemical models. The data will also support other (non-modelling) types of source-receptor relationship studies for Southern Ontario, the Montreal area, and the Southern Atlantic Region, as well as advancing our understanding of the physics and chemistry of ozone formation in Eastern North America.

NARSTO-CE Planned Activities

The following discussion will emphasize the AES/Climate and Atmospheric Research Directorate portion of NARSTO-CE. Details on SONTOS and MAOS are still being finalized at the time of writing. SONTOS options include surface measurements in southeastern Ontario, and aircraft sampling for ozone, NO_2 and VOCs. The MAOS measurement program is expected to include upper air soundings and a wind profiler, aircraft sampling in the vicinity of Montreal for ozone, particulate constituents and possibly some ozone precursors, and detailed chemistry measurements at L'Assomption, a site to the northeast of Montreal.

The AES contribution to NARSTO-CE will take place in two phases: an intensive sampling period, from approximately mid-June to mid-July, which will include upper air soundings, an aircraft program, and intensified, special chemistry measurements at three surface sites - in southern Quebec (St.Anicet and Mount Sutton) and Nova Scotia (Kejimkujik); and a "low-intensive" period, from May 20 to September 13, which will include relatively detailed chemistry measurements at two of these sites (St.Anicet and Kejimkujik).

Kejimkujik is a site located in a National Park in southern Nova Scotia, and is suitable for background measurements, being free of local anthropogenic sources of pollution. During past ozone pollution episodes, back-trajectories have indicated that the Southern Atlantic Region is frequently situated downwind of the US Ozone Transport Region; therefore, this site is expected to be the one most closely tied to the NARSTO-NE measurement campaign in the OTR.

Mount Sutton is a high-elevation site (845 m) about 80 km to the southeast of Montreal, near the US border. It allows an evaluation of the chemistry in the regional oxidant models without the complications introduced by surface inversions. Back-trajectory analysis has shown it to be impacted on certain occasions by air parcels travelling from the east coast of the United States, though not as frequently as Kejimkujik during ozone episodes.

St.Anicet is located in a rural setting, about 60 km to the southwest of Montreal. For southerly or southwesterly wind directions, it is a good site for making upwind air quality measurements for the greater Montreal area. Most of the oscitancy of the air quality objective for ozone in the Montreal area, however, are associated with flows along the Windsor-Quebec Corridor from the southwest, and thus during most episodes the St.Anicet site is expected to be tied more closely to the SONTOS measurements in southern Ontario than the NARSTO-NE measurements in the OTR.

<u>Low-Intensive (May 20 - September 13)</u>
The overall objective of the low-intensive study is to create a dataset for O_3, NO, NO_y, PAN, HNO_3, CO, VOCs, NH_3 and meteorological parameters in the Southern Quebec and Southern Atlantic Regions, commensurate with NARSTO-NE, and suitable for regional oxidant model evaluation.

Measurement details for the chemistry observable are given in Table 1. These will be collected at Kejimkujik and St.Anicet.

<u>Intensive (June 17- July 12)</u>
Additional measurements will be made during the intensive sampling period at Kejimkujik and St.Anicet, as well as the Mount Sutton site (where the ongoing ozone and meteorological data will be supplemented as discussed below). These measurements will be focused on specific scientific questions regarding oxidant transport and chemistry. An aircraft sampling program will also be carried out, using the NRC Twin Otter, to collect meteorological and boundary-layer physics measurements for evaluation of the MC2 meteorological driver of AES's regional oxidant models.

■ Kejimkujik ■

The overall objective of the 1-month intensive study in the Southern Atlantic Region is to obtain a detailed data set to investigate atmospheric processes that are known to impact on the performance of current oxidant models, and contribute to the question whether these models give the correct answer for the right reason. Three aspects are of particular interest:

1. Ozone transport and the marine boundary layer: to study the role of long-range transport from the U.S.East coast over the ocean, with emphasis on the impact of the marine boundary layer on ozone episodes in the Southern Atlantic Region. This will be investigated by adding tethersonde, radiosonde and ozonesonde measurements at Yarmouth (a coastal site in southern Nova Scotia) and Kejimkujik.

2. Peroxy radical chemistry: to investigate current model representations of peroxy radical chemistry by measuring nocturnal concentration changes of PAN, O_3, NO_y, HNO_3 and organic acids using fast response and high-sensitivity measurements.
3. Ozone levels at Kejimkujik: (1) to assess the relative roles of local photochemistry and breakup of the nocturnal boundary layer in determining morning hour changes in surface ozone, (2) to assess the representativeness of daytime measurements at Keji of regional-scale values, and (3) to determine the impact on ozone of local isoprene and terpene emissions.

In addition to the low-intensive, and intensive-period upper air measurements ongoing at Kejimkujik, high time resolution measurements of HNO_3, H_2O_2, carbonyls and organic acids, VOCs and peroxyacetyl nitrate will be made during the June 17 - July 12 period to investigate questions 2 and 3 above.

■ Mount Sutton ■

Although ozone and meteorological measurements are made year-round at the Mount Sutton site, other measurements will only be added during the intensive, June 17 - July 12 period.

The overall objective of the Mount Sutton intensive is to provide a 1-month dataset on O_3, NOy, NO, NO_2, PAN, HNO_3, p-NO_3, NH_3, VOCs, CO, HCHO, H_2O_2, organic acids, p-SO_4, and meteorological parameters commensurate with NARSTO-NE and regional model evaluation. Data from Mount Sutton will be combined with those from St.Anicet (see below) to investigate nocturnal nitrogen chemistry and boundary layer dynamics.

■ St.Anicet ■

The overall objective of the 1-month intensive study at St.Anicet is to provide a quality controlled data set for ozone-NOy-VOCs for the NARSTO-CE archive, for the development of improved parametrization of the meteorological transport, chemistry and dry deposition modules to be used in Eulerian models. Special measurements will focus on the chemical and physical profile structure of the nocturnal boundary layer during its evolution and dissipation, nighttime nitrogen chemistry, and biogenic hydrocarbons and their oxidation products.

The intensive-period measurements at St.Anicet will include upper-air soundings using ozonesondes, tethersondes and radiosondes. In addition to the 4-month low-intensive chemistry measurements at St.Anicet, the following measurements will be added during the June 17 - July 12 period: H_2O_2, aerosol chemistry and physics, oxygenated hydrocarbons and HCHO. Several techniques for measuring nitrogen oxides will be compared.

Aircraft and Special Meteorological Measurements

As already noted, it is expected that small, instrumented aircraft will be deployed in southern Ontario and the Montreal area as part of SONTOS and MAOS. Described below is the AES/NRC Twin Otter (TO) research aircraft measurement program, and some supporting special meteorological measurements. The work will take place in the greater Montreal area during June 3-28, and has been given the acronym MERMOZ (Montreal Experiment on Regional Mixing and Ozone).

The overall objective of MERMOZ is to evaluate the meteorological driver (MC2) of the Regional Oxidant Models developed as part of the NOx/VOC Science Program.

The objective of the Twin Otter research aircraft program is to investigate the performance of the MC2 model boundary layer formulation by executing a focused aircraft research project in the Montreal area specifically designed to make critical measurements related to boundary layer diffusion. The TO will be flown in the fully instrumented flux mode, including also measurements of O_3 and aerosol number spectra, in a "box" centred on Montreal, topped at 3 km and with sides of approximately 150 km. Five main types of experiments will be attempted:

1. Fluctuations of 3 wind components, temperature and humidity: "curtain" flights over the rural area surrounding Montreal will provide measurements of the boundary layer turbulence structure and vertical flux distributions.
2. Investigation of shallow cumulus interactions: flights on cloudy days will contrast cases of shallow convection with clear air cases as described in 1 above.
3. Regional variation of the boundary layer top: using dolphin flight patterns, the regional distribution of the boundary layer top will be mapped.
4. State of the nocturnal boundary layer at morning transition: vertical profiles of the atmosphere will be taken at a number of points distributed at the boundary of the region of measurements, both at dusk and in the early morning before inception of convection. Radiosonde and tethersonde measurements described above will be used to supplement the TO measurements for this experiment.
5. Verification of parameters critical for model simulation: measurements by aircraft will be made of surface temperature, solar radiation and surface albedo (parameters that critically influence the heat budget at the surface). This will allow assessment and proper initiation of fundamental forcing terms in the MC2 boundary layer simulations.

In addition to the tethersonde and radiosonde measurements already described, there will be additional special meteorological measurements in the Montreal area to support the TO program.

Wind Profiler/Radio Acoustic Sounder System measurements will be carried out at St.Anicet (the use of this site is still to be finalized) and on the McGill University campus to provide winds through the bottom 2-3 km of the atmosphere, monitor the top of the convective boundary layer, and determine profiles of virtual temperature. Wind profiler observations will provide a time series of boundary layer observations at St.Anicet as an "anchor" to the moving observations made by the aircraft.

As part of MAOS, a tethersonde will be used at the L'Assomption site to measure wind speed/direction, relative humidity, temperature, pressure and ozone.

In addition to the above measurement programs, plans are being made to collect emissions information during the study period, develop appropriate databases to accept the results and interface with the US NARSTO-NE database, and to carry out a QA/QC program on the measurements.

It is expected that data from the low-intensive NARSTO-CE measurement program will be available for model evaluation by April 1997. The intensive-period special measurements will take a longer time to process and analyse, before they are available to the research community at large.

Further information on NARSTO-CE can be obtained from the study coordinator, Maris Lusis, at AES Downsview (416-739-4449).

Observable	Method	Frequency
O_3	UV absorption	Continuous
NO, NOy	Chemiluminescence, with Mb converter	Continuous
PAN	On-site GC/ECD analysis	Half-hourly grab sample
HNO_3, NH_3	Filter Pack	4 samples/day (8-12, 12-16, 16-20, 20-8)
CO	NDIR (with enhanced 0 stability and sensitivity)	Continuous
VOC	Cannister sampling, GC analysis	1 sample/day (afternoon)

Table 1: Low-Intensive (May 20 - September 13) Chemistry Measurements at Kejimkujik and St.Anicet

Avantages économiques des données du SMISO[1]
par R.B.L. Stoddart[2]

Introduction

Les océans couvrent la plus grande partie de la Terre et, tout comme l'atmosphère, constituent un espace à trois dimensions. Pendant des années, l'intervention de l'homme dans ce domaine s'est limitée à voyager sur sa surface et à récolter ses abondantes ressources halieutiques. La situation a bien changé. La technologie et l'activité humaine se sont accrues, mais nos connaissances n'ont pas suivi au même rythme.

Nous exploitons aujourd'hui les ressources de la vie océanique, à l'aide d'une technologie moderne capable de repérer et de prendre d'énormes quantités de poissons. Cependant, les complexes facteurs environnementaux qui régissent l'abondance et le recrutement de cette ressource sont encore mal compris.

Notre population, qui continue de s'accroître, préfère vivre sur les côtes aux environnements attirants, leur imposant des contraintes en matière de développement et de déchets qui ont déjà eu un effet néfaste sur les fragiles bordures des océans. D'importants habitats marins ont été affectés, peut-être sans espoir de retour, ce qui menace la biodiversité marine d'une manière que nous ne comprenons pas totalement. Ces mêmes collectivités côtières sont aussi exposées aux ravages de tempêtes, de marées et de vagues dont la science ne peut pas encore prévoir avec exactitude quand et où elles frapperont.

On sait que les océans jouent un rôle dans les conditions météorologiques et le climat de la planète, par l'échange et la distribution de chaleur et de dioxyde de carbone, mais on n'est pas encore en mesure de dire jusqu'à quel point et de quelle manière les changements subis par l'atmosphère influent sur l'océan, et inversement. On ne sait pas non plus à quel point la situation actuelle est stable ou instable aux échelles planétaire ou régionale.

Les ressources minérales du fond marin, tant à proximité des côtes que dans les profondeurs, en sont à des stades préliminaires d'exploitation. Il est donc critique de disposer d'informations sur les conditions opérationnelles en surface et en subsurface (glaces, vagues, courants de fond, etc.). Les mêmes renseignements sur la surface contribuent à la sécurité et à l'efficacité du transport maritime, en permettant d'établir des routes contournant les tempêtes et les zones de conditions défavorables, et d'utiliser les courants pour économiser l'énergie.

Si les connaissances sur le milieu marin et la capacité d'en prévoir les caractéristiques n'ont pas pu progresser davantage, c'est principalement à cause du manque de données qui permettent de lever les incertitudes scientifiques et qu'on puisse utiliser dans les modèles de prévision. Le Système mondial intégré de services océaniques (SMISO) est le seul système mondial assurant la collecte et l'échange opérationnels de ces précieuses informations. La nécessité d'avoir un tel système, et les avantages qu'il offre, sont discutés ci-dessous.

Conditions météorologiques et climat

Les avantages des données météorologiques sont indéniables. Elles ont de nombreux utilisateurs, du grand public qui veut chaque jour savoir comment s'habiller jusqu'à des usagers particuliers qui veulent assurer la sécurité et l'efficacité de leurs activités, comme l'aéronautique. Les principales questions qui se posent aux atmosphéristes dépassent la justification de l'échange de données en temps réel; ce sont plutôt de savoir quelle est la quantité minimale indispensable de données et quelle est la meilleure façon d'intégrer aux modèles de prévision les données prises par télédétection et *in situ*.

Des études économiques ont été effectuées pour certains paramètres. Par exemple, les avions recueillent régulièrement des données atmosphériques pendant les vols transocéaniques, ce qui permet, en donnant une nouvelle route aux autres aéronefs, d'éviter les zones de turbulence et d'économiser du carburant. Selon les estimations de la Federal Aviation Administration (FAA) des États-Unis, 80 % des retards du trafic aérien supérieurs à 15 minutes sont dus aux conditions météorologiques, et se traduisent chaque année par des pertes économiques de 1 milliard de dollars. On s'attend

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1 Rapport original préparé pour la septième session du comité conjoint de la COI et de l'OMM du Système mondial intégré des services océaniques (SMISO) tenue à Paris en novembre 1995.

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à ce que ces pertes atteignent 1,7 milliard de dollars en 2001, dont 423 millions pourraient être économisés par le recours à des services améliorés de météorologie aéronautique (C.H. Sprinkle, NWS/USA, *in* WMO 1994, p. 83-86). Un examen approfondi des avantages économiques et sociaux des services météorologiques et hydrologiques a été entrepris via deux conférences (OMM, 1990 et 1994). Le milieu océanique offre lui aussi la possibilité de telles économies.

Il est facile, par leurs coûts, d'illustrer les dommages infligés par des phénomènes tels que l'El Niño. Une étude (TOGA, 1985) a estimé que les dommages matériels subis par le Pérou et imputables à l'épisode El Niño de 1982-1983 étaient de l'ordre de 649 M$ pour l'industrie agro-alimentaire, 106 M$ pour les pêches, 479 M$ pour l'industrie, 16 M$ pour le secteur de l'énergie électrique, 310 M$ pour le secteur minier, 303 M$ pour les transports et communications, 70 M$ pour le logement, 57 M$ pour les systèmes de santé, d'eau et d'égout et 6 M$ pour le secteur de l'éducation. Des estimations de dommages significatifs liés au même épisode ont été faites pour l'Équateur et la Bolivie. Les téléconnexions des événements El Niño avec la survenue d'autres phénomènes en d'autres régions du globe (Afrique, Amérique du Nord, etc.) sont bien réelles, mais le mécanisme en est mal compris. Des modèles sont élaborés et améliorés par l'entremise de TOGA pour faire avancer la prévision de l'El Niño, et les données du SMISO sont fondamentales à ces prévisions. Tous les pays profiteront des résultats de TOGA, puisqu'il en découlera de meilleurs avertissements de la variabilité climatique, produits à temps pour qu'on puisse adopter les mesures de rechange nécessaires. Un exemple (NOAA/Université de l'Oregon, 1995) d'étude sur les avantages des prévisions; les économistes estiment que, dans le secteur agricole des États-Unis, on pourrait réaliser des économies annuelles moyennes de 235 M$ en disposant de données (dont les données du SMISO) permettant une prévision à indice d'efficacité élevé (exactitude de .8) des épisodes ENSO 9 à 12 mois à l'avance. Avec une prévision à indice d'efficacité moyen (.6), l'économie serait de 211 M$, et une prévision parfaite (1.0) se traduirait par des économies de 284 M$. La valeur actuelle de la capacité de produire une prévision parfaite (en prenant un taux d'escompte prudent de 6 % sur 10 ans) est de 1,8 milliards de dollars.

Pour l'atmosphère, il existe des modèles numériques très complexes et en constante amélioration. La précision des prévisions fournies par ces modèles dépend énormément de la qualité et de la quantité des données d'observation utilisées et en particulier de l'échange mondial de ces données. En règle générale, l'intervention humaine dans la confection de prévisions apporte un gain sans cesse plus petit et de moindre valeur que ce que permet l'utilisation directe des aides numériques. Cependant, pour toutes les applications, il reste possible d'ajouter considérablement à la valeur des prévisions en améliorant continuellement leur précision. Nombre de services météorologiques et hydrologiques nationaux ont entrepris des études en vue d'établir des rapports coûts/avantages leur permettant de justifier leurs programmes. Ces rapports estimatifs varient de 1/7 au Royaume-Uni (S. Teske et P. Robinson, 1994) à 1/10 et plus au Canada (Groupe DPA, 1985) et à 1/20 en Allemagne (Service météorologique allemand, 1995), voire plus dans certains autres endroits.

Le milieu de l'océanographie, pour ce qui est de l'échange de données en temps réel, est en retard de plusieurs décennies sur celui de l'atmosphère. Les raisons en sont simples : i) il n'existe par sur l'océan de population *in situ* pouvant recueillir des données, contrairement à ce qui se passe pour les données météorologiques sur terre; ii) les capteurs de données atmosphériques, comme ceux que portent les aéronefs et les satellites, sont plus courants que les capteurs de données océaniques de subsurface; iii) la majorité des utilisateurs de prévisions météorologiques sont situés sur les terres, mais sont conscients que des ensembles de données à grande échelle, voire mondiaux, sont requis pour les prévisions météorologiques, alors que les utilisateurs de l'océan ont tendance à négliger la nécessité de ces ensembles à grande échelle pour comprendre ou prévoir les conditions locales; iv) en général, le coût unitaire est beaucoup plus élevé pour les données océanographiques que pour les données atmosphériques. Ceci dit, considérant la rareté des données océanographiques, il n'en est que plus économiquement rentable d'échanger le plus possible de données, dans des horizons temporels permettant de desservir tous les utilisateurs potentiels.

Vu la croissance des échanges commerciaux mondiaux, et la montée des préoccupations environnementales concernant le changement et la variabilité climatiques, l'amélioration des prévisions à court et à long terme est de plus en plus tributaire d'une meilleure représentation, par les modèles couplés atmosphère/océan, du stockage et du transport de chaleur dans l'océan, ainsi que des échanges air/mer de chaleur, d'humidité et de quantité de mouvement.

Pêches

Les poissons montrent des préférences en matière de température et de salinité. Les espèces pélagiques comme le saumon, le thon, etc. vivent dans une plage relativement étroite de températures de l'eau, et les données du SMISO, en conjonction avec les données de télédétection, permettent de délimiter, dans le temps et dans l'espace, les zones où ces conditions sont présentes. D'autres caractéristiques (comme la position de la thermocline, les fronts et les zones de convergence), qui peuvent être déterminées à l'aide des données du SMISO, jouent un rôle important dans la répartition des zones de pêche. Il est bien connu que la position de certaines espèces commerciales, comme l'espadon, est fonction de la température; c'est d'ailleurs pourquoi les pêcheurs utilisent en temps réel des thermomètres montés sur la coque avant de placer leurs lignes et hameçons. Les données en temps réel sur les marées et autres données océanographiques sont utilisées à l'appui des activités commerciales d'aquiculture. On n'a malheureusement fait que peu, voire pas, d'analyses pour quantifier la valeur de ces données en temps réel pour les pêches. Pour que soient partagées expérience et occasions, le Canada a accueilli, en collaboration avec la COI et d'autres organismes, le Symposium international sur les applications halieutiques de l'océanographie (ISOFO) en novembre 1989. Deux cent trente (230) scientifiques, gestionnaires, pêcheurs et consultants de trente (30) pays y ont participé et fait part de leurs précieuses expériences sur les interactions entre le milieu océanique et les pêches.

Pendant et après l'ISOFO, le Canada a mené des projets pilotes visant à tester la valeur économique de l'océanographie opérationnelle pour les pêches. Il s'agissait entre autres de mettre sur pied un programme de pêche selon la température de l'eau pour fournir à Fisheries Product International (FPI) une information océanographique en temps réel à l'appui de la recherche au large de Terre-Neuve d'espèces commerciales, en particulier la morue, la plie canadienne et la limande à queue jaune. Deux fois par semaine, le projet pilote fournissait aux chalutiers hauturiers des cartes en temps réel de la température du fond de la mer confectionnées à partir des données en temps réel des capteurs de température placés sur les chaluts, via un lien informatique entre les bateaux et une installation à terre. Bien qu'il se soit montré utile, le système n'a pas été implanté par la suite pour des raisons de coût. Un autre projet du même ordre, à l'appui des recherches sur les pêches à la morue du Nord, consiste à examiner différents types de produits de données océanographiques basés sur la température, la salinité et les courants, qui pourraient être utiles aux pêcheurs et aux scientifiques en permettant de lier les facteurs environnementaux à l'abondance et à la distribution du poisson, et servir dans les évaluations des stocks. Les produits ainsi retenus devraient être générés de façon courante.

On a aussi entrepris certains travaux pour étudier des approches novatrices à la collecte de données du type SMISO à l'appui des pêches. Par exemple, Seakem (1987) a montré la faisabilité de recourir à des aéronefs pour obtenir, plus rapidement et à moindre coût qu'avec les navires de recherche, des données océanographiques destinées à la gestion des pêches, en utilisant des aéronefs de surveillance des pêches et des bathythermographes à tête jetable largables par avion (AXBT).

Transport maritime

Dans les premiers temps, les navires utilisaient la force brute : ils se rendaient du point A au point B en suivant la route la plus directe, tout en mettant à profit les connaissances historiques sur les vents et courants océaniques locaux pour avoir la traversée la plus sécuritaire et la plus efficace possible. Le coût n'était généralement pas un facteur prépondérant; toutefois, maintenant qu'on dispose de la capacité de voir en temps réel les océans à l'échelle du bassin, il est logique de se baser sur les conditions météorologiques et océanographiques en temps réel pour établir les routes des navires. Dooley (1985) a clairement montré les gains de temps et les économies de carburant du routage océanique des navires, en comparant des cas réels de traversée du Pacifique Nord. En fait, il existe des entreprises privées dont c'est la principale activité (Oceanroutes, Kendall, 1990). Le routage des navires constitue un domaine d'application permettant chaque année des gains de 150 M$ à l'économie mondiale. Un service de routage maritimes, qui coûte 800 à 900 $, fait gagner 3 à 4 heures sur une traversée de l'Atlantique et plus de 7 heures sur la traversée du Pacifique (J.C. Thompson *et al.*, 1994).

Un domaine critique de l'océanographie en temps réel à l'appui du transport maritime concerne la recherche et le sauvetage, ainsi que l'intervention en cas de déversement d'hydrocarbures. La grande préoccupation est alors de connaître les courants, soit grâce à des mesures, soit grâce aux prévisions des modèles. En outre, la transmission en temps réel des données sur le niveau marin (marées) a pour le transport maritime de nombreux avantages, qui vont de la prédiction du volet océan des ondes de tempête à des informations en matière de sécurité pour les navires manoeuvrant dans les ports, aux charges de cargaison et tirants d'eau dans les zones sujettes à des fluctuations de niveau dues à la régulation des cours d'eau, à la sédimentation et aux marées.

Défense

Les besoins de la marine militaire en données océanographiques en temps réel sont assez semblables à ceux des flottilles de pêche, sauf qu'on s'y intéresse à la position d'autres navires ou matériels et non à celle du poisson. Outre les besoins normaux concernant le transport et certains besoins océanographiques particuliers, pour la marine militaire, il faut comprendre la structure physique de l'océan tridimensionnel, puisque les caractéristiques acoustiques de l'océan sont fonction de la température, de la salinité, de la profondeur et de la distance.

Le système de diffusion des données océanographiques de la marine et de la NOAA des États-Unis (NOAA NODDS) a entrepris un examen des avantages qu'il offrait pour fournir au secteur privé et aux organismes gouvernementaux un accès aux analyses et cartes prévues opérationnelles et océanographiques du centre de météorologie et d'océanographie numériques des forces navales américaines (FNMOC). Duernberger (1986) a montré que le système sans but lucratif serait un moyen efficace de donner accès à des produits numériques non classifiés, à un coût raisonnable, moyennant des systèmes de communication adéquats.

Dans un monde en évolution, les marines militaires de tous les pays commencent à fournir, via le SMISO, des données qu'elles ont recueillies dans le cours de leurs activités normales. Il devrait en résulter une hausse des retombées économiques pour nombre d'autres secteurs, comme les pêches, etc. On espère, et c'est bien probable, que l'échange de ce genre de données s'accroîtra à l'avenir.

Recherche océanographique

Les données recueillies *in situ* pour le SMISO par des navires océanographiques occasionnels, des bouées dérivantes, etc., jumelées aux données de télédétection qui donnent un tableau synoptique de la surface de l'océan, peuvent aider à diriger les navires de recherche vers les zones les plus intéressantes et à déterminer les futures stratégies d'échantillonnage à mesure que les navires passent d'une masse d'eau à une autre. Les données du SMISO peuvent aider à orienter les efforts de recherche en permettant de modifier les expériences pendant leur déroulement. Des économies de carburant, ainsi que des gains du temps des chercheurs et du personnel de soutien, seront en outre réalisées.

Les chercheurs russes utilisent depuis longtemps les ensembles de données du SMISO pour établir des descriptions de la température de l'eau, de sa salinité, de sa densité et d'autres paramètres connexes à la surface de l'Atlantique Nord (tous les 5 jours) et du Pacifique Nord (tous les 10 jours), ainsi qu'en dessous de la surface de l'Atlantique Nord (tous les mois). Ils utilisent aussi les données SHIP, BATHY et TESAC, ainsi que celles des bouées dérivantes, à des échelles de temps opérationnelles, pour corriger les données satellitaires de la température de l'eau.

Gestion des données

Des ateliers ont été tenus pour examiner la portée, la complexité et la performance d'un certain nombre de systèmes de collecte et de transmission en temps réel des données océanographiques (IEEE-WHOI, 1983). La transmission de données en temps réel permet de détecter les problèmes (mauvais fonctionnement, biais, etc.) des capteurs utilisés à bord de navires océanographiques occasionnels, de plates-formes autonomes, de navires de recherche, etc. On peut ainsi réaliser un gain d'efficacité en les détectant et en les corrigeant rapidement. Ni sur le plan scientifique, ni sur le plan économique, il n'est raisonnable d'attendre qu'un technicien se rende au capteur, simplement pour déterminer que les données recueillies sont erronées; il s'ensuivrait probablement des retards supplémentaires et des pertes de données si le navire devait prendre la mer sans que le capteur ait été réparé ou remplacé. Personne ne peut de nos jours se permettre de laisser passer des occasions de collecte de données.

Conclusion

Les avantages qu'offrent les améliorations de la prévision des conditions maritimes profiteront à un vaste bassin d'utilisateurs. Le Marine Board (National Research Council des États-Unis, 1989) a établi une liste des avantages primaires liés à l'amélioration des prévisions océanographiques :

- pour la navigation : réduction du temps de traversée et de la consommation de carburant;
- pour les activités pétrolières et gazières au large: meilleure efficacité du forage en eau profonde;
- pour les pêches et les loisirs : amélioration de la sécurité des personnes, réduction des dommages à l'équipement et aux bâtiments, hausse des prises, meilleure efficacité économique de la pêche;
- pour l'aménagement et la gestion des zones côtières et de la ZEE : optimisation de l'immersion des déchets, réduction des coûts d'engraissement des plages, amélioration du nettoyage après les déversements d'hydrocarbures, meilleure efficacité des opérations de recherche et de sauvetage.

Il est souhaitable et possible d'offrir aux clients une gamme de services océanographiques, depuis l'échange en temps réel de données à des fins opérationnelles, jusqu'à la fourniture d'information, d'expertise et d'analyses reposant sur les résultats des programmes de recherche. Un certain nombre de pays (DFO/MEDS, 1988) ont entrepris des études exhaustives des besoins et des occasions. Dans bien des cas, les données disponibles sont trop rares dans le temps et l'espace pour qu'on puisse en tirer des produits au moyen de simples outils de calcul de moyenne et d'affichage. La météorologie a mis au point des schémas sophistiqués d'assimilation de données au sein de leur modèles de prévision pour contribuer aux travaux de prédiction; des travaux similaires devront être faits pour les produits océanographiques. On a constaté des succès dans certains domaines, qui sont résumés dans le bulletin sur les produits SMISO COI/OMM (1994). Certains organismes, comme le service météorologique du Japon (1993), préparent des brochures exhaustives présentant les données et produits océanographiques en temps réel disponibles dans leur pays.

L'échange en temps réel de données océanographiques coûte des ressources et du temps. Le plus important avantage qu'on peut tirer de cet investissement en ressources est la compréhension de l'océan, qui permettra un meilleur déploiement des navires, des capteurs et du personnel dans les zones d'intérêt.

Par exemple, il n'est pas économiquement raisonnable d'envoyer des bateaux de pêche dans les zones où les conditions environnementales empêchent les espèces recherchées de se tenir; la même logique s'applique aux campagnes de recherche océanographique, au déploiement de navires de défense, etc.

Une grande partie de cette discussion déborde le cadre de ce que l'on entend généralement par données du SMISO (température subsuperficielle, salinité et courants). L'esprit du présent rapport est de montrer le SMISO comme un programme opérationnel d'océanographie où l'on trouve tout paramètre (niveau de la mer, etc.) et tout capteur (télédétection, etc.) qui peut servir au bien commun de tous ceux qui oeuvrent dans l'environnement marin.

Note de l'Éditeur: Les références utilisées par l'auteur sont indiquées à la suite du texte anglais à la page 94.

Economic Benefits of IGOSS Data[3]
by R.B.L. Stoddart[4]

Introduction

The oceans cover the greater part of the planet's surface and, like the atmosphere, are three dimensional. For years human intervention into this domain was restricted to transportation across its surface and harvesting its abundant fishery resources. Today the situation has changed. Technology and human interventions have increased but our knowledge is lagging behind.

Today we exploit the living resources of the ocean, using modern technology capable of targeting and collecting huge quantities of fish. However, the complex environmental factors dictating abundance and recruitment of those resources are poorly understood.

Our increasing population prefers to live on the attractive coastal environments, imposing developmental and waste impacts that have already adversely affected the quality of the sensitive fringes of the ocean. Important marine habitats have suffered, possibly irreversibly threatening the biodiversity of the sea in ways we do not fully understand. These same coastal communities are themselves at risk from the ravages of storms, tides and waves whose timing and location is still an inexact science.

It is known that the oceans contribute to the world weather and climate through the exchange and distribution of heat and carbon dioxide, but we don't know enough to say how much and how changes in the atmosphere will interact with changes in the ocean and vice versa. We don't know how stable or unstable the present situation is on global or regional scales.

The mineral resources of the coastal and deep ocean seabed are in the preliminary stages of exploitation.

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3 Original report prepared for the seventh session of the joint IOC-WMO Committee for the Integrated Global Ocean Services System (IGOSS) hold in Paris in November 1995.

4 Fisheries and Oceans Science Directorate, Department of Fisheries and Oceans Ottawa, Ontario, K1A 0E6 Canada

Information (ice, waves, bottom currents, etc.) on operational surface and sub-surface conditions is critical. The same surface information is needed for a safe and efficient marine transportation sector, with routing around storms and adverse conditions, as well as utilizing ocean current information for fuel economy.

The biggest drawback to the progress of a well understood and predictable ocean environment has been the lack of data to address the scientific uncertainties and to input into the predictive models. The Integrated Global Ocean Services System (IGOSS) is the only global system dealing with the operational collection and exchange of this much needed information. The need for, and the benefits of, this system are discussed below.

Weather and Climate

Benefits of weather data are indisputable. There are many users, from the general public who want to know how to dress on a day-to-day basis, to specific clients who want to operate safely and efficiently, like the aviation industry. The main questions facing the atmospheric specialists go beyond justifying exchanging data in real time - they deal with issues such as how much data is enough, and how best can remote and *in situ* data be incorporated into forecast models.

Economic studies have been undertaken for some atmospheric parameters. For instance, airplanes routinely collect atmospheric data during trans-oceanic flights so that rerouting of subsequent aircraft can avoid areas of turbulence and ensure fuel efficiency. The Federal Aviation Administration (FAA) of the USA has estimated that 80% of the air traffic delays greater than 15 minutes are caused by weather resulting in an economic loss of $1 billion per year. This economic loss is expected to be about $1.7 billion by year 2001 of which $423 million could be avoidable through exploitation of improved aviation weather services (C.H. Sprinkle - NWS/USA, in WMO 1994, pp. 83-86). A thorough review of the economic and social benefits of meteorological and hydrological services has been undertaken through two conferences (WMO, 1990 and 1994). Similar possibilities for economic savings exist in the ocean environment.

Devastation from events such as El Niño are easily illustrated by their cost. It has been estimated (TOGA, 1985) that the physical damages caused during the 1982-83 El Niño in Peru were of the order of $649M (agribusiness), $106M (fishing), $479M (industry), $16M (electrical energy), $310M (mining), $303M (transportation, communications), $70M (housing), $57M (health, water, sewage systems), and $6M (education). Significant damage estimates from the same event were also made for Ecuador and Bolivia. Teleconnections of El Niño events to other parts of the globe, Africa, North America, etc. are real but imperfectly understood. Models are being developed and improved through TOGA to address the problem of El Niño prediction; IGOSS data is fundamental to these predictions. Countries will benefit from TOGA results through improved warnings of climate variability in time to take alternative actions where appropriate. An example (NOAA/Oregon State University, 1995) of a study on the benefits of forecasting can be found in the USA agriculture sector where economists estimate that $235M per year on average would be saved if data (which would include IGOSS data) were available to permit a high skilled forecast (.8 accuracy) of ENSO events 9 to 12 months in advance. For a modest skill forecast (.6 accuracy) of ENSO events the saving would be $211M while a perfect forecast (1.0 accuracy) would yield $284M in savings. The present value of a high skilled forecast ability (using a conservative 10 year 6% discount rate) is $1.8 billion.

In the atmospheric community very complex numerical models are on a continuous path of improvement. The accuracy of forecasts emanating out of these models is very highly dependent upon the quality and quantity of supporting observed data and particularly dependent upon the global exchange of data. Generally, human intervention in the making of forecasts is gradually providing a smaller and decreasing gain in value beyond that which is obtainable through the direct use of numerical guidance. Nevertheless, all applications show the potential for considerable further growth in forecast value with continued increases in forecast skill. Many national meteorological and hydrological services have undertaken studies to come up with cost/benefit ratios as a means of justifying their programs. These ratios have been estimated to be from 1:7 for the UK (S. Teske and P. Robinson, 1994) to 1:10+ for Canada (The DPA Group, 1985) and to 1:20 for Germany (The German Meteological Service, 1995) and even higher in some other jurisdictions.

The ocean community lags the atmospheric community by decades in exchanging real time data. The reasons are simple: (i) there is no *in situ* population on the ocean to collect data, as compared to weather data over land areas, (ii) atmospheric sounders, such as aircraft and satellite sensors, are more prevalent than ocean subsurface data sounders, (iii) the majority of users of weather forecasts are terrestrially based, but recognize that large-scale or global data sets are required for weather forecasts - the ocean users do not tend to think that large-scale data sets are required to understand/forecast local conditions, and (iv) in general, the cost per unit of data is much higher for oceans data than atmospheric data. That being said, with the paucity of oceans data, it only makes economic sense that as much data as is possible be exchanged in a timely fashion to serve all potential users.

With global commerce continuing to escalate, and environmental concerns such as climate change and variability becoming more apparent, specification of the oceans' heat storage and movement, and the air/sea exchanges of heat, moisture and momentum through coupled ocean/atmosphere models, are becoming more essential to the improvement of short and longer range forecasts.

Fisheries

Fish have temperature and salinity preferences. Pelagic living species such as salmon, albacore, tuna, etc. prefer a relatively narrow range of ocean temperatures, and IGOSS data together with remotely sensed data can help define these areas in time and space. Other features (such as the position of the thermocline, fronts and convergence zones) discernible with the aid of IGOSS data, are important to fisheries distributions. It is well known that some commercial species, such as swordfish, are temperature-dependent since fishermen use hull-mounted temperature sensors in real-time to actually set their hooks and lines. Tidal and other oceanographic real time data have been utilized in support of commercial aquaculture activities. Unfortunately, little if any analysis has been done to quantify the value of real time data to fisheries. In order to share experiences and opportunities, Canada co-hosted, with the IOC and others, an International Symposium on Operational Fisheries Oceanography (ISOFO) in October 1989. Two hundred and thirty (230) scientists, managers, fishermen, and consultants from thirty (30) nations participated and exchanged valuable experiences on ocean environment and fisheries interactions.

During and subsequent to ISOFO, Canada undertook pilot projects to test the economic practicality of operational oceanography for fisheries purposes. One such program was the development of a "Temperature Directed Fisheries System" to provide Fisheries Products International (FPI) with real-time oceanographic information to aid the search for commercial fish off the coast of Newfoundland, specifically cod, American plaice and yellowtail flounder. The pilot system provided biweekly real-time sea bottom temperature maps to the offshore trawlers using the real-time data from temperature sensors on the trawl nets in concert with a computer network between vessels and a shore facility. While proving useful, the system has not been subsequently implemented because of cost considerations. Another project along the same lines, in support of northern cod fisheries research, is the examination of different types of oceanographic data products based on temperature, salinity and currents, that could be useful to scientists and fishermen that would relate environmental factors to fish abundance and distribution, and to stock assessment requirements. The data products thus selected, are intended to be generated on a routine basis.

Some work has been undertaken to examine novel approaches to collecting IGOSS type data in support of fisheries. For instance, Seakem (1987) demonstrated the feasibility of using aircraft to obtain timely and inexpensive, compared to using research vessels, oceanographic data for fisheries management using fisheries surveillance aircraft and air expendable bathythermographs (AXBT).

Marine Transportation

In early days ships plied the seas using the brute force approach in getting from Point A to Point B by taking the most direct route while utilizing historical knowledge of the local ocean currents and winds to ensure as safe and efficient passage as possible. Cost was not usually an over-riding factor; but, with modern capabilities to look at basin scale oceans in real-time, it makes sense to utilize real time weather and ocean conditions to route vessels. Dooley (1985) has clearly demonstrated the fuel cost-savings and time benefits of ship ocean routing by comparing actual vessel transits in the North Pacific. In fact, there are private companies with this as their main objective (Oceanroutes, Kendall, 1990). Ship routing represents an application area with a benefit of $150M annually to the world economy. A ship routing service, which costs about $800-$900, saves 3-4 hours per Atlantic crossing and in excess of 7 hours in crossing the Pacific compared to un-routed ships (J.C. Thomson et al, 1994).

A critical area for real-time oceanography in support of marine transportation relates to search and rescue, and marine spills. The major concern is knowing the currents, either measured or predicted through models. In addition, real-time reporting of sea level (tidal) data has many benefits for marine transportation, ranging from predicting the oceanic component of storm surges, to safety information for ships manouvering in ports, to ship draft/cargo loads in areas subject to water level fluctuations from river regulation, sedimentation, and tidal effects.

Defence

Naval requirements for oceanographic data in real time have some similarities to fisheries needs except that the concerns relate to the location of other vessels and equipment instead of fish. In addition to normal transportation and special oceanographic requirements, the naval requirements are to understand the physical structure of the 3-D ocean since acoustic properties in the ocean are temperature, salinity, depth and range dependent.

The U.S. Navy/NOAA Oceanographic Data Distribution System (NOAA NODDS) undertook a review of the benefits of its system as a method of providing private sector and government agency access to the U.S. Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) operational and oceanographic analyses and forecast charts. Duernberger (1986) determined that the non-profit system should be an efficient method to access unclassified numerical products to users at a fair price, assuming adequate communication systems.

In a changing world, navies world-wide are beginning to provide data through IGOSS that they collect through their normal operational activities. This should result in increased economic spin-off to many other sectors such as fisheries, etc. It is hoped, and likely, that exchange of this type of data will increase in the future.

Ocean Research

In situ IGOSS data from vessels of opportunity, drifters, etc., together with remote sensing data to gain a synoptic picture of the surface of the ocean, can help direct research vessels' areas of direct concern and help in future sampling strategies as the vessel moves from one water mass to another. IGOSS data can help direct research efforts to allow for modifications of experiments as they unfold. Fuel savings, and savings in research scientist and support staff time, will also be accomplished.

Russian researchers have long utilized IGOSS data sets for constructing descriptions of water temperature, salinity, density and other related characteristics on the surface of the North Atlantic (once every 5 days) and the North Pacific (once every 10 days), and below the surface of the North Atlantic (once a month). Also, they have utilized SHIP, drifting buoy, BATHY and TESAC data, in operational time frames, to correct water temperature data collected via satellites.

Data Management

Workshops have been held to review the range, complexity and performance of a number of real-time ocean data collection and transmission systems (IEEE-WHOI, 1983). Troubles (malfunctioning, bias) with deployed sensors on ships-of-opportunity, autonomous platforms, research vessels, etc. can be detected through real-time reporting. Efficiencies can be made through early detection and correction of these problem areas. It does not make any scientific or economic sense to await the visit of a technician to a sensor, just to determine that the data being collected is in error - further delay and lost data would likely result if the vessel has to depart port without the sensor being fixed or replaced. Nowadays one cannot afford to waste data collection opportunities.

Conclusion

Benefits associated with improvements in forecasting marine conditions will be spread over a large sector of ocean users. The Marine Board, USA National Research Council (1989) listed the following primary benefits of improved forecasts related to the ocean:

- shipping: reduced passage time/fuel consumption;
- offshore oil and gas - improved deepwater drilling efficiency;
- fisheries/recreation -enhanced safety of life, reduced equipment and vessel damage, increased fisheries harvest, improved economic efficiency of fishing;
- coastal and EEZ development and management - optimized waste disposal, reduced costs of beach nourishment, improved oil spill cleanup, more effective search and rescue.

A range of oceanographic services for clients is desirable and possible, from real-time exchange of data for operation purposes, to provision of information, expertise and analyses based on the results of research programs. Comprehensive surveys of needs and opportunities have been undertaken in a number of countries (DFO/MEDS, 1988). In many instances the data available is too sparse in time and space to create data products by simple averaging and display tools. Meteorology has developed sophisticated data assimilation schemes within their forecast models to deal with their predictive efforts; similar efforts will have to be done for ocean products. Success has been evident in some areas; these are summarized in the IOC/WMO IGOSS Products Bulletin (1994). Some agencies, such as the Japan Meteorological Agency (1993) prepare comprehensive brochures outlining real-time oceanographic data and products available in their country.

It costs resources and time to exchange oceanographic data in real time. The largest single benefit from this investment of resources is to understand the ocean so as best to deploy vessels, probes and personnel in areas of direct interest. For instance, it makes no economic sense to send fisheries vessels to areas where the desired species cannot exist because of environmental conditions - the same logic applies for ocean research efforts, deployment of defence vessels, etc.

Much of the above discussion goes beyond what is normally thought of as IGOSS data (subsurface temperature, salinity and currents). This report has been prepared in the spirit of viewing IGOSS as an operational oceanography program that looks at any parameter (sea level, etc.) and sensors (remote sensing, etc.) that can be utilized for the common good of all those working in the marine environment.

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The Solar-Terrestrial Environment;
an Introduction to Geospace
by J.K. Hargreaves,
Cambridge University Press, Cambridge,
434 pp., 1992, $37.95 US paperback.

Book reviewed by David P. Steele
Department of Physics and Engineering Physics
University of Saskatchewan, Saskatoon.

This textbook is a revised and expanded successor to the author's earlier book "The Upper Atmosphere and Solar-Terrestrial Relations". The scope of the book is impressive, ranging from the Sun and its electromagnetic and particle radiations, through the magnetosphere and ionosphere to the base of the stratosphere. The author has purposely sacrificed depth of treatment to breadth of coverage, and has produced an introductory work that will reward both the thorough student and the professional seeking information on a specific topic.

The first chapter provides a quick overview of the territory to be covered, and some nomenclature (including the term "geospace"). The second chapter surveys the physics of geospace, devoting the major part to radio and plasma wave propagation through magnetized plasmas. An extensive discussion of techniques for observing geospace follows, covering direct, indirect, and remote sensing methods. The treatment is only as mathematical as necessary and, as in all subsequent chapters, references are given liberally, both to tutorial works and to more detailed review papers.

Chapters 4-9 form the core of the book. Here the author discusses, in turn, the neutral atmosphere, the solar wind and the magnetosphere, and then the intermediate region, the ionosphere, with chapters devoted to both the principles and the phenomena of the ionosphere at middle and low latitudes, and to the high-latitude ionosphere. The coverage is everywhere appropriate to an introductory survey, but the discussion of ionospheric principles in Chapter 6 is particularly thorough. A brief chapter on magnetospheric waves is also included.

The final chapter concerns technical applications of geospace science, including communications, earth current effects, space operations, and activity monitoring and forecasting. This discussion is particularly valuable in light of the steadily increasing social and economic importance of these applications, and will be helpful to anyone wanting to know more about the practical impact of space science.

The book is aimed at upper-level undergraduate and fresh graduate students. Here it succeeds as an introduction, which will leave readers amply prepared for more detailed study using other recent books. Its breadth will also make it useful to professionals qualified in other fields who want information about Sun-Earth relations. The author's perspective and personal tone will (I dare say) make it enjoyable.

Weather Cycles Real or Imaginary?
by William James Burroughs
Cambridge University Press, Cambridge,
Hardcover in 1992
207 pp., 1994, US paperback 92-5296

Book reviewed by R.L. Raddatz
Lead Meteorologist, Prairie Section
Atmospheric & Hydrological Sciences Division
Prairie & Northern Region
Environment Canada

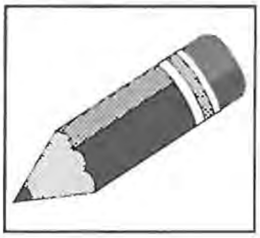
Not the intrigue of a P.D. James murder mystery; nevertheless, a suspenseful read for anyone with an interest in meteorology.

Written with enough mathematics to avoid trivializing this complex problem, the mystery of weather cycles is explored. Instrumental records and time-series of proxy data, distilled down to their power spectra, reveal a plethora of cycles. These cycles are examined in the context of solar and lunar forcing, autovariances within the global climate and chaos theory. A compelling read as evidence is presented as to whether various cycles are real or imaginary. For a cycle to be real, beyond a reasonable doubt, the author rightly demands defensible evidence of a physical cause and effect relationship.

And what is the verdict? Well, I'll leave you in suspense until you have the opportunity to read this well conceived and written book.

Corrigendum and Addendum

by K. Hamilton[1]



In the note "*Do Historical Zero Depth Hydrographic Data Contain Useful Information on Climate Trends?*" (CMOS Bulletin SCMO, Volume 23, No. 6) the last sentence of page 7 should have read "more negative" not "less negative". In that paper I considered the straightforward comparison of the temperatures recorded as "0 m" depth in archives of Nansen cast hydrographic surveys with a smooth analysis based on ships-of-opportunity observations as collected in the familiar COADS data set, with the aim of trying to quantify long-term changes in the biases that may be in the COADS data. I focussed on limited areas in the N. Atlantic. The results were rather disappointing with the expected trend (COADS data having more of a warm bias after WWII relative to pre-WWII due to the introduction of increased numbers of ships using intake temperatures) not clearly appearing. I concluded that the "0 m" data may not be useful without a very specific understanding of nature of the observations in each hydrographic section (such as whether they really represent results from a reversing thermometer tripped just below the surface). In recent correspondence Dr. Gilles Reverdin has pointed out some specific problems that are involved in the interpretation of these N. Atlantic data. He notes that indeed the "0 m" values recorded for Nansen casts were in fact often bucket temperatures (G. Reverdin et al, "Surface salinity of the North Atlantic: Can we reconstruct its fluctuations over the last one hundred years", Progress in Oceanography, 33, 303-346, 1994). He also notes that much of the COADS data in the region 60N-66N 1W-8W originated from Norwegian ships that are known to have used intake temperatures in the period before WWII. Another important issue is the geographical distribution of the hydrographic observations. If there are small-scale SST variations that are not captured in a smoothed analysis of the ships-of-opportunity, then spurious biases are introduced into the comparison and changes in the geographical sampling of the hydrographic data with time could appear as a trend in the SST bias. He suggests particularly that the large negative bias of the hydrographic data seen in the 67N-69N, 12E-18E region could be a result of the hydrographic data being preferentially close to the coast and reflecting fjord conditions more than the ships-of-opportunity data.

[1]: Geophysical Fluid Dynamics Laboratory, NOAA, Princeton University, P.O. Box 308, Princeton, New Jersey 08542, U.S.A.

Meeting Announcement
Workshop on Atmospheric Change and North American Transportation

Beckman Center, Irvine, California

November 17-20, 1996

Objectives

The composition and chemistry of the atmosphere in North America and globally have been significantly altered by human activities. Urban and regional gas and particulate emissions threaten human health, crops, fresh water, soils, and ecosystems. Acids and toxic substances are transported across boundaries. Greenhouse gases (CO_2, CH_4, N_2O), ground level ozone, and aerosols influence the global climate. The 1995 assessment of the Intergovernmental Panel on Climate Change (IPCC) claims that, globally, transportation is responsible for approximately 21 percent of the total contribution to greenhouse warming.

The North American Free Trade Agreement (NAFTA) among Canada, Mexico, and the United States increases dependence on transportation for trade and economic growth. Manufacturing and freight in the transport industry are increasingly integrated in North America. Transportation industries (manufacturing and carriers) are also major sources of employment for all three nations. In the United States, for example, transportation goods and services represent about 11 percent of gross domestic product. Transportation is economically important and a major contributor to greenhouse gases that impact the climate that all three nations share. A three-country assessment of the contribution of the transport sector to atmospheric changes and an analysis of options to control transport impacts on atmospheric changes can assist the three countries in meeting their obligations under the Framework Convention on Climate Change and various regional air quality agreements.

The Mexican Academia de la Investigacion Cientifica, the Canadian Global Change Program Board, the Canadian Climate Program Board, and the Board on Atmospheric Sciences and Climate of the U.S. National Research Council will explore the issues behind such an assessment. Specialists from all three nations will meet to discuss transport contributions to atmospheric change and to learn from each other about potentially successful policies in curbing transportation emissions. Atmospheric scientists will discuss the latest IPCC findings about climate change and the role of transport emissions. Experts in energy and transportation will discuss past experiences with policies such as vehicle emission and fuel consumption regulation, transport infrastructure investment strategies (e.g., highway versus alternative modes), freight regulation (affecting choice of truck versus rail in freight movements), R&D strategies (alternative fuels, battery vehicles) and urban planning to reduce truck and car use.

Expected Outcomes

- Greater understanding of the present and projected role of the transport sector of North America on air quality issues.
- Preliminary understanding of options to reduce transport sector impacts and implications of current trends and actions needed to modify the trends.
- Proposed next steps toward an action plan.

Contact Information

Those interested in participating are requested to contact William A. Sprigg, Board on Atmospheric Sciences and Climate (HA466), National Research Council, 2101 Constitution Avenue NW,Washington, DC 20418-0001; Tel: 1-202-334-3515, Fax: 1-202-334-3825, email: wsprigg@nas.edu.

Annonce d'une réunion
Atelier sur les changements atmosphériques et le secteur nord-américain des transports

Beckman Center, Irvine (Californie)

du 17 au 20 novembre 1996

Objectifs

La composition chimique de l'atmosphère en Amérique du Nord et dans le monde est considérablement modifiée par les activités humaines. Les émissions de gaz et de particules dans les centres urbains et les régions menacent la santé humaine, les récoltes, l'eau douce, les sols et les écosystèmes. Les substances acides et toxiques voyagent au delà des frontières. Les gaz à effet de serre (CO_2, CH_4, N_2O), l'ozone troposphérique et les aérosols influent sur le climat mondial. Dans une évaluation réalisée en 1995, le Groupe intergouvernemental d'experts sur l'évolution du climat (GIEC) souligne que, à l'échelle mondiale, le secteur des transports rejette environ 21 pour cent des gaz à effet de serre.

L'Accord de libre-échange nord-américain (ALÉNA) entre le Canada, le Mexique et les États-Unis contribue à accroître la dépendance envers les transports à la faveur du commerce et de la croissance économique. Les activités de fabrication et de transport de marchandises sont de plus en plus intégrées en Amérique du Nord. Par ailleurs, l'industrie des transports (fabricants et transporteurs) constitue une source majeure d'emploi dans les trois pays. Aux États-Unis, par exemple, les biens et services liés au transport représentent environ 11 pour cent du produit intérieur brut. Cette industrie, qui joue un important rôle économique, produit une grande proportion des gaz à effet de serre rejetés dans l'atmosphère qui est partagé par les trois pays. L'évaluation de la contribution des transports aux changements climatiques et l'analyse des mesures à prendre pour contrôler ces impacts pourraient aider les trois pays à respecter leurs obligations découlant de la Convention-cadre sur les changements climatiques et de diverses ententes régionales sur la qualité de l'air.

La Mexican Academia de la Investigacion Cientifica, le Conseil du Programme canadien des changements à l'échelle du globe, le Conseil du Programme climatique canadien et le Board on Atmospheric Sciences and Climate du National Research Council des États-Unis examineront les enjeux relatifs à une telle évaluation. Des spécialistes des trois pays discuteront de l'incidence des transports sur les changements atmosphériques et des politiques susceptibles de réduire les émissions. Des atmosphéristes échangeront sur les dernières constatations du GIEC concernant les changements climatiques et du rôle des gaz d'échappement. Des spécialistes de l'énergie et des transports se pencheront sur les politiques déjà mises en oeuvre, comme la réglementation sur les gaz d'échappement et la consommation d'essence, les stratégies d'investissement dans l'infrastructure des transports (p. ex., autoroutes par rapport aux modes de transport alternatifs), la réglementation du transport de marchandises (camions par rapport aux trains), les stratégies de R-D (carburants de rechange, véhicules électriques) et l'urbanisme, pour réduire l'utilisation des camions et des voitures.

Résultats prévus

- Meilleure compréhension du rôle actuel et prévu du secteur des transports de l'Amérique du Nord dans le domaine de la qualité de l'air.
- Compréhension préliminaire des options permettant d'atténuer les répercussions du secteur des transports, de l'incidence des tendances actuelles et des mesures requises pour modifier ces tendances.
- Prochaines étapes proposées en vue de l'élaboration d'un plan d'action.

Renseignements

Les personnes désireuses de participer à l'atelier peuvent communiquer avec : William A. Sprigg, Board on Atmospheric Sciences and Climate (HA466), National Research Council, 2101 Constitution Avenue NW,Washington, DC 20418-0001
Tél. : 1-202-334-3515; facsimilé : 1-202-334-3825
Courrier électronique : wsprigg@nas.edu.

PRELIMINARY ANNOUNCEMENT

CFD 97, the Fifth Annual Conference of the Computational Fluid Dynamics Society of Canada, will be hosted at the University of Victoria, Victoria, British Columbia, May 25-27, 1997.

The conference will bring together CFD researchers, developers and users from a wide spectrum of disciplines. Topics of interest include: Algorithms, Atmospheric, Geophysical and Oceanic Flows, Bio-fluid Mechanics, Fluid Dynamics in Engineering Systems, Transport Phenomena, Turbulence, Visualization.

Papers to be presented and to appear in the conference proceedings will be accepted on the basis of reviewed abstracts (500-1000 words plus figures). Abstracts and requests for information should be addressed to:

CFD 97 Conference Secretariat
Centre for Earth and Ocean Research
University of Victoria
P.O. Box 3055
Victoria, B.C. V8W 3P6

Tel: (604) 472-4347 or 721-6034
Fax: (604) 472-4100
E-Mail: cfd97@me.uvic.ca

Additional information may be obtained from:
Andrew Weaver
Tel: (604) 472-4001; Fax: (604) 472-4004
E-Mail: weaver@ocean.seos.uvic.ca

News from the Canadian National Committee (CNC) of the Subcommittee on Oceanic Research (SCOR)

The annual meeting of CNC-SCOR was held on 26 May, 1996, at the University of Toronto in conjunction with the annual Congress of the Canadian Meteorological and Oceanographic Society. We had a long and fruitful meeting and discussed many matters of interest to Canadian oceanologists.

Annual reports describing activities in the Canadian Joint Global Ocean Flux Study (CJGOFS) and Global Ocean Ecosystems Dynamics Research and Monitoring Program (CGLOBEC) were received from K. Juniper and for the World Ocean Circulation Experiment (CWOCE) from A. Clarke. Natural Sciences and Engineering Research Council of Canada (NSERC) funding for Phase II of CJGOFS was about 50% of the amount requested, and will support field studies in the north Pacific Ocean and modelling and data analyses for waters of the Scotia Shelf and Gulf of St.Lawrence, examining among other topics, diagenesis of organic matter and nutrient regeneration in sediments of the continental margin. The field study in the north Pacific Ocean will be along a line from Victoria to Weather Station P, which traverses a region of low chlorophyll and high No_3^{-1} concentrations in near-surface waters where availability of Fe^{+2} may limit phytoplankton production. Recently, an increase in planktonic diatom concentration (relatively large cells) was observed with a concomitant decrease in NO_3^{-1}, an event which may have been triggered by Fe in wind-born dust from the Asian continent settling out on the ocean surface. The proposed focus of field work for Phase III is the central Labrador Sea, where net CO_2 flux to deep water may occur via deep water formation and by sinking organic debris originating in the near-surface food web. Additional information about CJGOFS can be found on the web (http://www.dal.ca./~cjgofs.html), a site which is maintained by the CJGOFS Secretariat. GLOBEC is now part of the International Geosphere-Biosphere Program (IGBP) and is receiving some support from the Department of Fisheries and Oceans (DFO). The primary interest of DFO in CGLOBEC is the ecology of larval marine fish. A major feature of the 1998 CMOS Congress to be held in Halifax, will be an international WOCE conference, a particularly appropriate meeting during the United Nations-sponsored International Year of the Oceans.

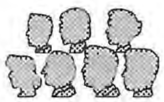
Activities of other initiatives including Land-Ocean Interaction in the Coastal Zone, the Global Ocean Observing System, the Climate Variability and Predictability Research Program and the Global Ocean Euphotic Zone were discussed. Two new working groups on Global Bathymetry and Double Diffusion were approved by the Executive of SCOR during 1995; A. Gargett and B. Ruddick are Canadian representatives to the later group.

An extensive discussion of Canadian participation in the 1998 Year of the Oceans was conducted. It was noted that an international exposition will be held in Lisbon in 1998 and the International Oceanographic Commission (IOC) is considering a global oceanographic cruise, which will include a Canadian leg, in conjunction with the exposition. Production and cataloguing of video clips of oceanographic subjects for schools was also considered. Also, establishment of a World Wide Web page to provide background information on the Year of the Oceans and Canadian involvement was discussed. Certainly, many other potential projects will be examined before 1998.

Louis A. Hobson, Chair, CNC-SCOR
Department of Biology, University of Victoria.

30th CMOS Congress

by Savonius Rotor



Another wonderful Congress! Many thanks to the Toronto Centre Scientific Program and Local Arrangements Committees for their efforts, the presenters for their hard work and the sponsors and commercial exhibitors for their support. The University of Toronto is centrally located in downtown Toronto (at Bloor and just west of Yonge) with excellent facilities for accommodation and gastronomy in the vicinity (ably illustrated in a map attributed to Ted Shepherd). Various committee meetings were held in the University College building on the day previous to the Congress. Some of the meetings were finished in time for committee members and early arrivals to meet for the Icebreaker event.

The Congress was opened the following morning by the Minister of the Environment, The Hon. Sergio Marchi, who welcomed the participants and noted the importance of meteorology and oceanography in the daily lives of Canadians. Prof. J.R.S. Prichard, President of the University, told us about the close association between the weather service and the University during the last 125 years; and welcomed us to use all the facilities of the University. Most days, participants enjoyed morning and afternoon plenary sessions in the Auditorium of the Medical Science Building. From Monday to Thursday, each morning and afternoon had 5 or 6 parallel sessions of the 30 scientific program sessions (from Agriculture and Forest Meteorology to WOCE) in the Medical Science Building. Most people who were heard to comment (I attended mostly oceanographic sessions) that they were truly impressed with the diversity and excellence of the presentations. The last sessions ended on Thursday afternoon about a quarter to five. What a hard-working lot we were!

Speaking of hard work, there was the usual assortment of receptions, sponsored coffee breaks (coffee, juices, pop, delicious muffins, cookies, bite-size chocolates, fruit, yogurt, and granola - thanks to the sponsors and co-sponsors), lunches, banquet and informal pub crawls to satisfy the great scientific thirst for ... knowledge. Monday evening, CMOS delegates were invited to a reception at Hart House honouring Prof. Jim Drummond into the new NSERC Industrial Research Chair in Atmospheric Remote Sensing from Space. On Tuesday, while some participants attended the Patterson Lunch, a good-sized pod of oceanographers continued a firmly entrenched tradition by participating in the third annual "Tully Luncheon" at the Faculty Club Pub. In continuation of the tradition, no awards were presented nor were there any acceptance speeches; however, the return to a liquid environment was ecosystematically appropriate and developed their sustainability requirements. A small but gifted group conducted business at the CMOS Annual Meeting which was held Tuesday evening after the Commercial Exhibitors Reception (a good time was had by all - pick the event!). Wednesday evening was much more serious. A reception and annual banquet was held in Hart House. The food was good, the wine was pleasant (is Canadian wine an oxymoron?- I don't think so), the speeches were short (though the acoustics needed some work) and the company was brilliant. In the near future you will read of the many honours and awards presented to some of the worthy in the Society. All in all, a truly worthwhile and educational Congress: and I encourage all members to present their work and participate fully in next year's 31st Annual Congress in Saskatoon, June 2-6.

Note from the Editor: Contrary to the common belief, Savonius Rotor is still alive and very active. The proof is that he was seen by many attending the last CMOS Congress at the University of Toronto!

Apology

We apologize for the delay in publication of the March issue of Atmosphere-Ocean (Vol.34, No.1) devoted to CASP II. Technical difficulties at the printer with the preparation of the manuscript and delays in receiving author reviews of the page proofs conspired to impede the due process. Revisions are now complete and the issue should be distributed shortly.

Sheila Bourque, Editor of A-O.

Nos excuses

Nous nous excusons du délai de parution du numéro de mars de l'Atmosphere-Ocean (Vol.34, No.1) dédié à l'expérience CASP II. Des difficultés techniques rencontrées dans la préparation du manuscrit lors de l'impression et des délais causés par les auteurs dans la révision de leur manuscrit ont retardé le processus. Les révisions sont maintenant complétées et le numéro devrait être distribué très bientôt.

Sheila Bourque, Éditeur de l'A-O.

Skin Cancer Risk and Sun Protection Education[1]

According to Arthey and Clarke (1995), "at present, the public has been found to have a high level of knowledge on the dangers of overexposure to the sun." However, they concluded "knowledge alone will not necessarily result in changes to behaviour." For example, during a 1992 survey, 45% of Canadians reported they believed sun exposure affected their chances of contracting skin cancer but less than 50% used any of the recommended precautious behaviours.

Some health educators suggest that disease prevention information may have more impact when delivered by someone with the disease, especially a close friend or relative. In a recent study, Dr June Robinson and Dr Alfred Rademaker (1995) examined whether skin cancer patients could become a source of information on risk awareness and a factor in changing attitudes and behaviours toward sun protection for a relative or friend assisting in post-operative care.

The study surveyed 200 patient/helper pairs who completed a questionnaire prior to surgical removal of a nonmelanoma skin carcinoma and again after one year. The questionnaire surveyed:

1) knowledge of skin cancer and sun protection;
2) individual susceptibility as determined by ease of sunburning or tanning;
3) attitudes about self-esteem, sun exposure and beliefs concerning the degree of personal and environmental factors in contracting disease;
4) intentions to use sun protection; and
5) type of sun protection used.

Physicians and nurses directed knowledge concerning skin cancer risk and prevention only toward the patient at two and six months after the surgery. The study examined whether the patient became an effective source of information on the cancer, its risks and causes and methods for sun protection for his/her helper.

The information provided to the patient at each of two sessions consisted of a single written page containing a four-item list of sun protection behaviours which was linked to heightening awareness of the risk of developing skin cancer based upon the individual's ease of burning and failure to tan. This enhanced the chance of an individual making desired choices in sun protection and incorporating them into his/her lifestyle. The learning format also promoted patient assertiveness by giving them the opportunity to be inquisitive about methods of sun protection over at least two visits during the year.

The study showed that the coupling of practical outpatient education sessions with usual post-operative care for skin cancer patients affected not only their knowledge, intentions and behaviour but also affected those of their helpers. Personal behaviour changes to practise sun protection strategies were made even though there was little change in attitude toward sun risk. How this change took place depended on gender. Women expressed a greater likelihood to take precautions preferring to use sunblocks and cease using indoor tanning devices while men preferred wearing hats and reducing sun exposure.

When patients transferred knowledge to their helper, the level of intention to change behaviour as well as the level of behavioural change itself was strongly correlated with an individual's reported susceptibility to sunburn and difficulty in tanning. Despite a willingness to change behaviour, there were no significant changes in attitudes from popularly held beliefs. The study concluded that sun-protection information targeted to high-risk adults with a nonmelanoma skin cancer could change the behaviours in both patients and their helpers.

References:

Arthey, S. and Clarke, V.A., 1995: *Suntanning and sun protection. A review of the psychology literature*. Soc. Sci. Med 40:265.

Robinson, J.K. and Rademaker, A.W., 1995: *Skin cancer risk and sun protection learning by helpers of patients with nonmelanoma skin cancer*. Preventative Medicine 24:333.

[1] Article taken from "The UVB Impacts Reporter", Volume 2, No 4, November 1995. Written and edited by Keith C. Heidorn, PhD, ACM. © 1995. Correspondence may be sent to #304-3220 Quadra St., Victoria, B.C. Canada V8X 1G3. ☎ (604) 388-7847. Note their web site address: http://www.islandnet.com/~see/index.htm

Correction

The list of Accredited Consultants in the 1995 Annual Review (page 32) is in error by listing two companies as accredited in lieu of individuals. Mr. Ian Miller is the accredited representative of Météomédia/The Weather Network, and Dr. Bassim Eid the accredited representative of MacLaren Plansearch (1991) Ltd.

Neil Campbell, Executive Director.

CMOS and AMOS
by Ian Watterson[1]
CSIRO Division of Atmospheric Research

Earlier this year I had the good fortune to attend the conferences and AGMs of both the Canadian and Australian Meteorological and Oceanographic Societies. Having recently been an AMOS Councillor and Centre Chair, I was struck by the similarities between our societies and the issues facing them. I believe we can both benefit from better communication, hence this article which, with the goodwill of the editors, appears in the Bulletins of both societies.

Both CMOS and AMOS evolved from branches of the Royal Meteorological Society. The Canadian branch was formed in 1940 and the independent Canadian Meteorological Society was established in 1967. The society embraced oceanography in 1977. The Australian branch formed in 1974 and it wasn't long before it followed the Canadian lead and became independent, as AMOS, in 1988.

In recent years CMOS has had a membership of around 800, with AMOS at around 450 - as in many things, in rough proportion to the populations of our respective countries. Both societies have a national Council with Centres in the main cities. There are 13 CMOS Centres, but presently only 4 for AMOS. It has only been in the last few years that AMOS has broadened away from the concentration of meteorologists in Melbourne. Both societies maintain several national committees and a few "special interest" groups.

The Bulletins of the societies (in the 24th year for CMOS, and 9th for AMOS) are very similar in appearance and content - although the AMOS version doesn't include any French. CMOS has run its own journal Atmosphere, renamed Atmosphere-Ocean, since 1963. From 1977, AMOS has contributed to the editorship of the Australian Meteorological Magazine, which has been published by the Australian Bureau of Meteorology since 1953.

I return to the subject of this year's conferences. The 30th Annual Congress of CMOS was held at the University of Toronto in May. There were some 350 registrants, and 300 seminars and posters presented over 4 days. There was a wide range of topics in meteorology, climate, fluid dynamics, radiation, chemistry, oceanography and hydrology. The highlight for me was the Annual Dinner in the magnificent Great Hall of Hart House. I recognised several emblems of older Australian universities among those of the Empire depicted at one end of the hall (the "rest of the world" are at the other!).

The 3rd National AMOS Conference was held at the University of Tasmania, Hobart in February. Some 160 people presented 140 papers over 3 days. The Dinner, at the Royal Yacht Club of Tasmania, was likewise very enjoyable (and perhaps had the better wines!). Both conferences enjoyed one day with around 13-degree C maximum!

Issues facing both societies include:
- difficulty in maintaining activities and publications;
- pressures on researchers in an increasingly commercial research environment;
- promotion of our science in schools, universities and the community;
- developing educational material;
- relationships with the media.

Both societies have been broadening their range of interests towards covering the full climate system. At CMOS there has been discussion of a further name change to recognize chemistry and limnology. Sadly the acronyms I saw didn't seem to lend themselves to both A and C, as does the present name!

With the increased ease of global communication through E-mail and the Web, the societies can surely learn much from each other. A "virtual" joint conference in Tahiti perhaps? Meanwhile, perhaps someone will match my feat and attend both the Sydney and Saskatoon meetings of 1997.

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Victoria 3195, Australia
E-mail: igw@dar.csiro.au, ☎: 3-9239-4544

Correction

La liste des experts-conseils accrédités qui a été publiée à la page 32 dans la Revue annuelle SCMO (1995) comporte deux erreurs. La liste mentionne l'accréditation de deux compagnies au lieu des individus eux-mêmes. M. Ian Miller, de la firme Météomédia/The Weather Network et Dr. Bassim Eid, de la firme MacLaren Plansearch (1991), auraient dû voir leur nom publié dans la liste au lieu du nom de leur firme respective.

Neil Campbell, Directeur exécutif

Some current names and addresses: AMOS then CMOS

Table compiled by Ian Watterson

President Président	Kelvin Michael Peter Zwack	kelvin.michael@iasos.utas.edu.au zwack.peter@uqam.ca
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Administration	Val Jemmeson Neil Campbell	vxj@dar.csiro.au cmos@ottmed.meds.dfo.ca
Education Éducation	Matt Tomczak Gerhard Reuter	mattom@es.flinders.edu.au gerhard.reuter@ualberta.ca
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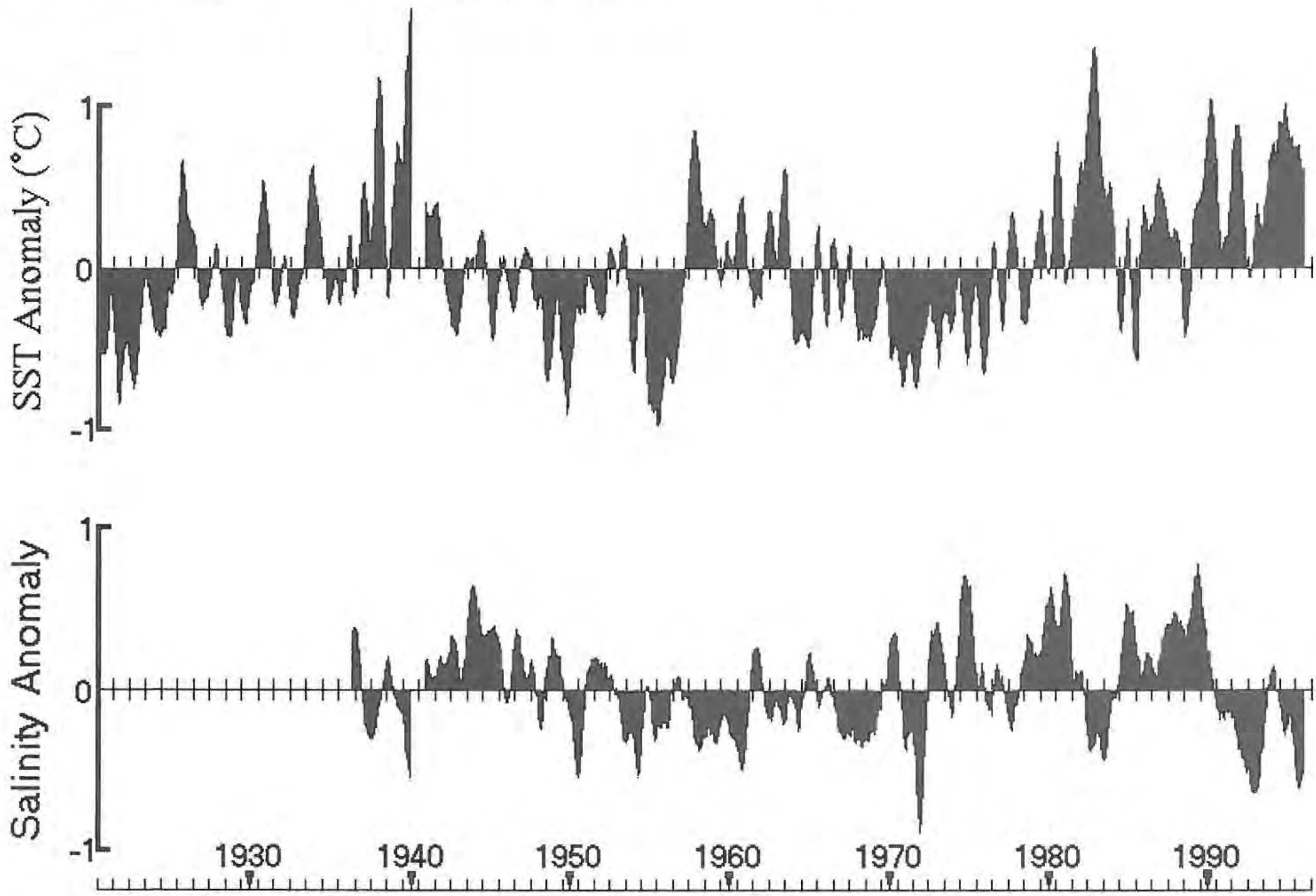
Bulletin editor Éditeur du bulletin	Blair Trewin Paul-André Bolduc	blair@mullara.met.unimelb.edu.au bolduc@ottmed.meds.dfo.ca
Web site editor Éditeur du site Web	Greg Roff Marilyn Court	greg@cyclone.maths.monash.edu.au mcourt@.sympatico.ca

<u>Website</u> **AMOS:** http://www.shm.monash.edu.au/sites/amos/amos.html
<u>Site Web</u> **CMOS:** http://www.meds.dfo.ca/cmos/



Sea Surface Temperature and Sea Surface Salinity Anomalies at Race Rocks, B.C. (see story next page)

A short note about oceanographic sampling at B.C. Lightstations

In climate research one of the problems is getting a suite of good quality measurements over a long period of time without changes in location, protocol etc that may tend to mask the environmental changes that we are trying to observe. In B.C. we are fortunate that some far sighted person long ago began a project to observe the surface temperature and salinity of the waters around British Columbia. The project is paying dividends now largely because it has been maintained for a long time, the lighthouses were remote from human influence when the program started, and remain so to the present. The protocol that was initiated long ago was technologically appropriate, rather low-tech, but easily maintained, and remains appropriate today. Sea surface observations are reported from B.C. lighthouses daily (except when weather or personal health problems interfere, which is rare) and at most locations the observations began in 1935 or 1936. Race Rocks is unusual in that sampling started there as a pilot project in 1921, with daily temperature observations, and salinity was added to the suite of observations in 1936.

The figure found on previous page (page 102) shows an example of the data acquired at the Race Rocks lightstation. The plot shows two time series of sea surface temperature and sea surface salinity anomalies from 1921 to the present time.

Anyone interested in looking at data from the BC lighthouses can do so easily by visiting the appropriate web page at: http://www.ios.bc.ca/ios/sos/bcsop/

Howard Freeland
Institute of Ocean Sciences

List of BC Lightstations

Active Pass	Amphitrite Point
Bonilla Island	Cape Beale
Cape Mudge	Cape St.James
Chrome Island	Departure Bay
Egg Island	Entrance Island
Kains Island	Langara Island
McInnes Island	Nootka Point
Pine Island	Race Rocks
Sheringham Point	Sisters Islets
West Vancouver	

Cette photographie illustre la réception d'une plaque commémorative remise aux gardiens du phare situé à Race Rocks, C.B. Cette citation honorifique sur l'environnement, citation remise en premier lieu au dernier congrès de la SCMO à Toronto, souligne le mérite des gardiens pour la mesure journalière de la température et de la salinité de surface de l'océan depuis 1921. Cette longue série chronologique est presque continue depuis le début. La photo montre Dave Lemon (à droite) remettant la plaque à Mike et Carol Slater de Race Rocks avec en arrière-plan une vue du phare. Cette citation est dédiée à tous les gardiens de phares de la côte ouest mais le prix sera gardé par ceux de Race Rocks. Dave Lemon est le président du Centre de l'Île de Vancouver de la SCMO. La photo fut prise par Dr. Howard Freeland de l'Institut des Sciences de la mer situé à Sidney, C.B.

The above photograph illustrates the reception of a commemorative plaque given to the lighthouse keepers at Race Rocks, B.C. This environmental citation, given at the last CMOS Congress in Toronto, emphasise the merit of the lighthouse keepers who have taken daily sampling of sea surface temperature and salinity since 1921. This long time series is almost unbroken since that time. The photo illustrates Dave Lemon (on the right) giving the plaque to Mike and Carol Slater from Race Rocks with a view of the lighthouse in the background. This environmental citation is dedicated to all lighthouse keepers from the West Coast but the prize will be held by those of Race Rocks. Dave Lemon is the Chairman of the Vancouver Island Centre of CMOS. The photograph is courtesy of Dr. Howard Freeland of the Institute of Ocean Sciences located in Sidney, B.C.

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