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CMOS
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SCMO

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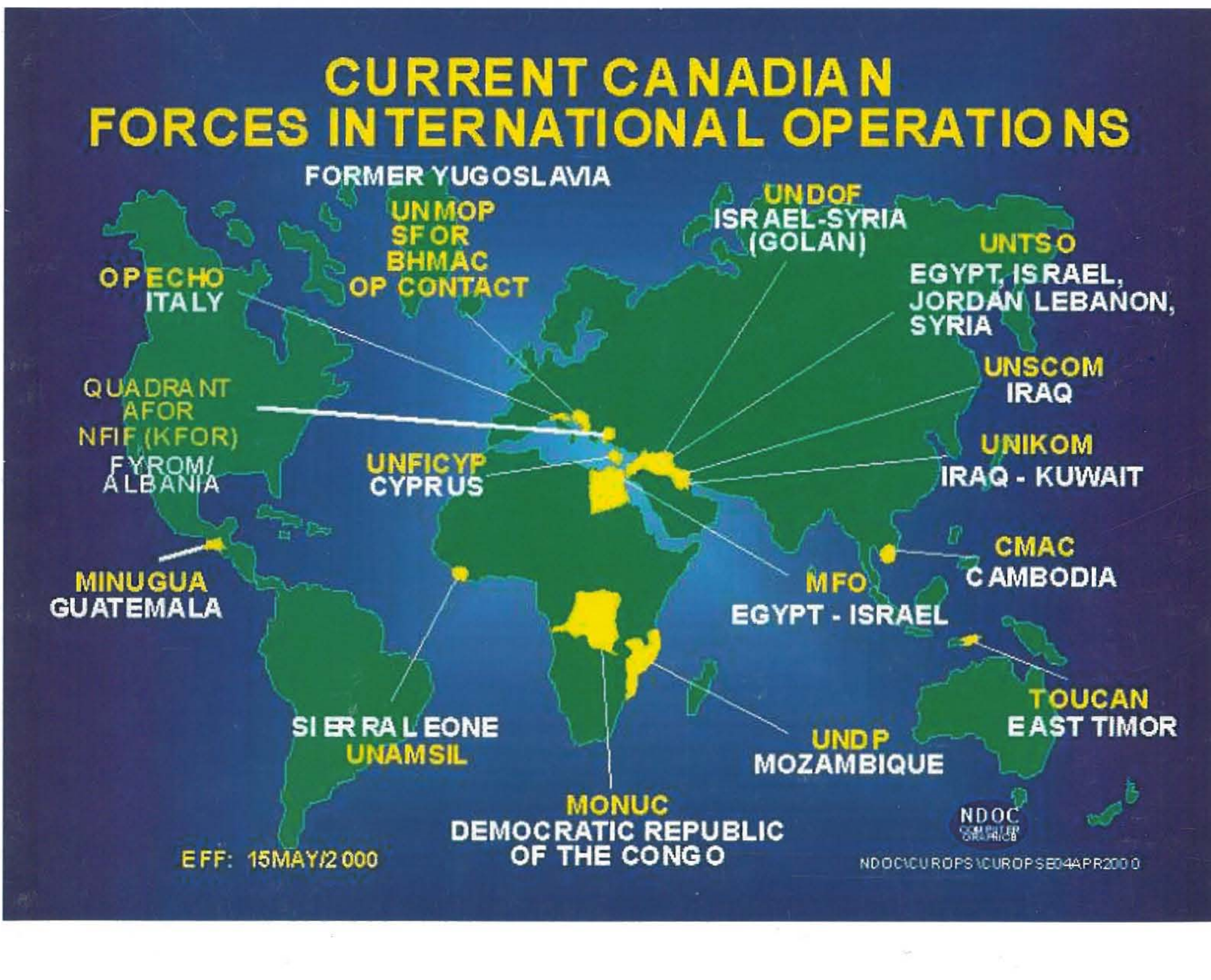

## CMOS Bulletin SCMO

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

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**Cover page:** A typical "day in the life" for Canadian Forces globally deployed operations. These operations require highly specialised, timely, accurate, and relevant weather support. Current operations can be viewed at http://www.dnd.ca/menu/Operations/index_e.htm
To learn more, read the article on page **172**.

**Page couverture:** Jour typique des forces armées canadiennes lorsqu'elles sont déployées globalement. Ces opérations exigent un support météo hautement spécialisé, opportun, précis et pertinent. Les opérations courantes peuvent être visionnées à http://www.dnd.ca/menu/Operations/index_e.htm
Pour en savoir plus, lire l'article en page **172**.


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## Canadian Meteorological and Oceanographic Society (CMOS)

## Société canadienne de météorologie et d'océanographie (SCMO)

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**Inside / En Bref**



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

As I start on this, and file it as PRES5.let, I realise that it will be my penultimate President's letter - time flies when one is having fun as the saying goes. A sobering thought near the start of a new year, and it will soon be time to stop and reflect on what has been achieved in a year as CMOS President.

When I started my term last June, the Canadian Foundation for Climate and Atmospheric Science was just getting under way. The first project grants will be publicly announced in mid-February, although grant recipients are already aware of these awards, and a few network awards should be decided on by the end of March. The Foundation has, wisely I think, made a relatively cautious start on the disbursement of its funds, in order to allow time for well-researched network proposals to be formulated. Some applicants have been somewhat displeased by this but patience and attention to detail in preparing well crafted, well focused applications will pay off for many of them in the not-too-distant future.

Pour le SMC le situation financière est toujours grise, mais, avec de la chance, ou peut-être, avec votre assistance, l'initiative du ministre Anderson pour obtenir les fonds nécessaires pour le renouvellement des installations météorologiques du SMC, sera un succès et nous permettra de faire un pas en avant.

Improved funding for MSC was one of the issues I, and many others, have been encouraging Minister Anderson to devote his attention to and I was pleased to be able to write to him recently to offer CMOS's thanks for following through on his promise to press this issue in the first year of a new (Liberal) mandate. The minister's interview with the Ottawa Citizen has placed this issue on the agenda, but we need to keep it there, and to persuade all MPs, and especially other ministers, that this is an important matter that needs their attention. In the August *CMOS Bulletin SCMO* I wrote, "..... it is important for all of us, as members of the public with special expertise in these areas, to realise and expound the view that cuts in funding to MSC, DFO and provincial agencies are leading to serious stresses in the scientific and technical public service and that they need and deserve better treatment. Write to your MPs and MPPs, harass them at meetings, and lobby!" **NOW IS THE TIME TO DO THIS, especially on behalf of MSC and DFO.**

One of my other concerns, from Day 1 as president, has been to seek ways to improve the climate for Private Sector meteorology and oceanography in this country. As I see it, there should be three legs to the meteorological and oceanographic tables in Canada - Government (primarily federal but with provincial and other governments being involved, especially in air and water quality), the Private Sector, and the Universities. The tables would be more stable with legs of more equal size and strength, and some mutual support between the legs can only help. With the growth of the weather "business", well articulated by Pierre Morrissette of the Weather Network and David Phillips of MSC in a recent (January 2001) CBC Undercurrents programme, there are good opportunities for an expansion of the Private Sector. CMOS, through the Private Sector Committee and members of the Executive Committee, is active in trying to improve the relationship between MSC and private sector meteorological companies and consultants. As many of you will be aware, this has been less than friendly on many occasions and the planned creation of a mutually acceptable "Industrial Strategy" for Meteorology and the Atmospheric Sciences will be challenging. We are hoping to run a special session on this at the Winnipeg Congress.

En janvier, M. Marc-Denis Everell, sous-ministre adjoint du SMC, a donné une conférence au centre SCMO d'Ottawa, concernant la nature des affaires au SMC. Mes collègues m'ont dit qu'il avait une bonne vision de la météorologie au Canada et qu'ils ont été rassurés par sa présentation. J'espère le persuader de donner une conférence sur ce même sujet à Winnipeg, et j'espère que beaucoup parmi vous, les météorologistes et océanographes, pourront assister à cette conférence.

Thinking of the Winnipeg Congress, now is the time to be making your travel and accommodation plans. The last week of May may seem like a long way away, but it will be here as quickly as you can say "mosquito".

*Peter Taylor,*
*President / Président*

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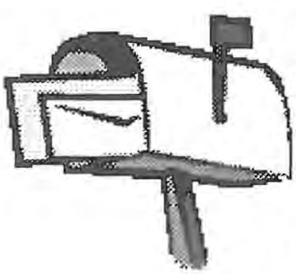
## Letter to the Editor

Date: 29 November, 2000; Subject: Outreach



The October issue (Vol.28, No.5) of the "CMOS BULLETIN SCMO" arrived today. If this response to your request for material for the next issue is too late, it is the best that I could do. I was very sympathetic to Peter's plea (page 129) about outreach, and would like to describe a type of outreach into which I fell. It shows how supportive is Environment Canada (and its "services") for this issue.

I am a member of the Board (and its Registrar) of an organization of seniors in the greater Toronto region, called "Living and Learning in Retirement". We have over 700 members, and offer university-level courses to members in coordination with Glendon College of York University. Each autumn, members suggest topics for the following academic year. Last year, one of the eight topics accepted by our Program Planning Committee was "Environmental Issues for the New Millennium". Against my better judgement, I agreed to try to organize it. (Usually, our course directors are associated with one of the regional universities, and enlist academics to lecture.)

Since we charge very little for our courses, our speakers are offered only an honorarium that does not begin to cover their time for preparation and delivery of the lectures (all declined). Fortunately for me, senior managers in MSC and Ontario Region of Environment Canada were very supportive. We were blessed by speakers who dealt with the really big issues like Henry Hengeveld (Climate Change), Angus Fergusson (Stratospheric Ozone), Don McKay (Atmospheric Pollution), Jeff Brooks (Health Aspects of Pollution), Susan Nameth (Great Lakes), and David Phillips (Toronto's Climate). The Executive Director of the Canadian Environmental Law Association, Paul Muldoon, talked about political issues. Warren Forrester, a retired oceanographer (referred to me by Neil Campbell, and who suggested that I get Neil to give the next lecture) described tides. Heather Auld spoke of how climate records help us plan for the future, and Don MacIver told how biodiversity (or lack thereof) affects us all. Heather and Don, as a wrap-up for the course, will discuss a project that involves them both, and which treats a number of issues at the same time. Its purpose is to ensure that the solution of one does not exacerbate another (such as the substitutes for CFC 11 and CFC 12 being greenhouse gases).

Our members were clearly challenged by the material presented. Many had not studied serious science beyond secondary school, but were absorbed by what was presented. During the course, the newspapers were full of articles on relevant topics, including, of course, "The Hague" conference. One of the most frequent questions was "What can we do?". The underlying messages were two: convey to your elected representatives your concerns for the future; and, in many cases, the answers reside with citizens like you.

I have sworn off adventures like this for the future. Am I sorry that I took it on? - not in the least!

*Jim McCulloch, Newmarket, Ontario.*

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## CMOS Bulletin SCMO
## Next Issue - Prochain Numéro

Next issue of the *CMOS Bulletin SCMO* will be published in April 2001. Please send your articles, notes, workshop reports or news items at the earliest to the address given on page ii. We have an **URGENT** need for your articles.

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en avril 2001. Prière de nous faire parvenir au plus tôt vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page ii. Nous avons un besoin **URGENT** d'articles.

# Tornado-day Climatology of Manitoba 1980-1999

by James Cummine[1] and Michael Noonan[1]

Résumé: Les tornades sont un phénomène relativement fréquent au Manitoba. Entre 1980 et 1999, il y a eu en moyenne 5,1 jours par année avec tornade. Dans cette étude, le nombre de jours avec tornade de 1980 à 1999 a été groupé par la Division de recensement et on y a fait une analyse sur le risque. On a trouvé que la vallée de la rivière Rouge possède la fréquence la plus élevée de jours avec tornade, mais toutes les régions de la province sont des endroits à risque potentiel d'avoir un jour avec tornade. La fréquence d'un jour avec tornade sur un territoire de 10 000 km$^2$ varie de 3,33 à Winnipeg à 0,01 vers l'extrême-nord. Dans la région périphérique de Winnipeg, la fréquence chute à environ un jour avec tornade. Le risque d'avoir un jour avec tornade dans des endroits ruraux de la vallée de la rivière Rouge est de 2 à 5 pour cent de chance sur une superficie de 10 000 km$^2$. La probabilité d'un jour avec tornade dans les régions du nord du Manitoba a été de 0,02 à 0,04 pour cent. La chance d'avoir une tornade typique frappant un endroit dans la ville de Winnipeg est d'environ $10^{-6}$ tandis que pour un endroit dans les régions du nord, la chance baisse à $10^{-8}$. L'observation d'une tornade est fonction de la distribution de la population et du programme de collecte de données d'Environnement Canada. Le fait que l'observation de la présence d'une tornade ne soit pas toujours un événement représentatif, peut avoir un impact significatif sur l'évaluation du risque d'un jour avec tornade sur le Manitoba. La base de données sur les tornades, utilisée dans cette étude, contient le nombre de tornades qui ont été rapportées et en conséquence les données sont probablement biaisées à l'égard des régions peuplées. Une étude provenant de districts additionnels suggère que le nombre de tornades peut être deux à trois fois plus élevé que celui observé.

## 1. Introduction

Although not frequent, tornadoes are common across Manitoba in the summer. There are on average 5.1 tornado days each year in Manitoba. The earliest report of a tornado was in 1868. Tornadoes have been reported as far north as Churchill.

Past studies have determined that tornadoes are a significant public safety and economic concern for society. Analysis of their recent temporal and spatial occurrence update the level of risk for use by many sectors (e.g. emergency preparedness, insurance, general public). Anticipated possible increases in tornado frequency due to climate change (Etkins, 1995) highlight the importance of understanding tornado climatology and the associated risks.

There have been several studies of tornadoes in Manitoba in the last four decades (Lowe and McKay, 1962; Shannon, 1976; Raddatz et.al., 1983; Raddatz and Hanesiak, 1991). These studies suggest that the number of tornadoes reported each year is increasing but the actual occurrence of tornadoes may not. It is generally believed that even today, there are two to three times more tornadoes occurring than are reported. There are several reasons, including: low population density; night-time occurrence; minimal damage; and other tornado data collection issues, such as poor reporting due to lack of or poorly trained observers. Furthermore, few detailed inspections of tornado damage have been undertaken in Manitoba, which leaves considerable uncertainty about the details of each tornado such as time of occurrence, path, duration and intensity.

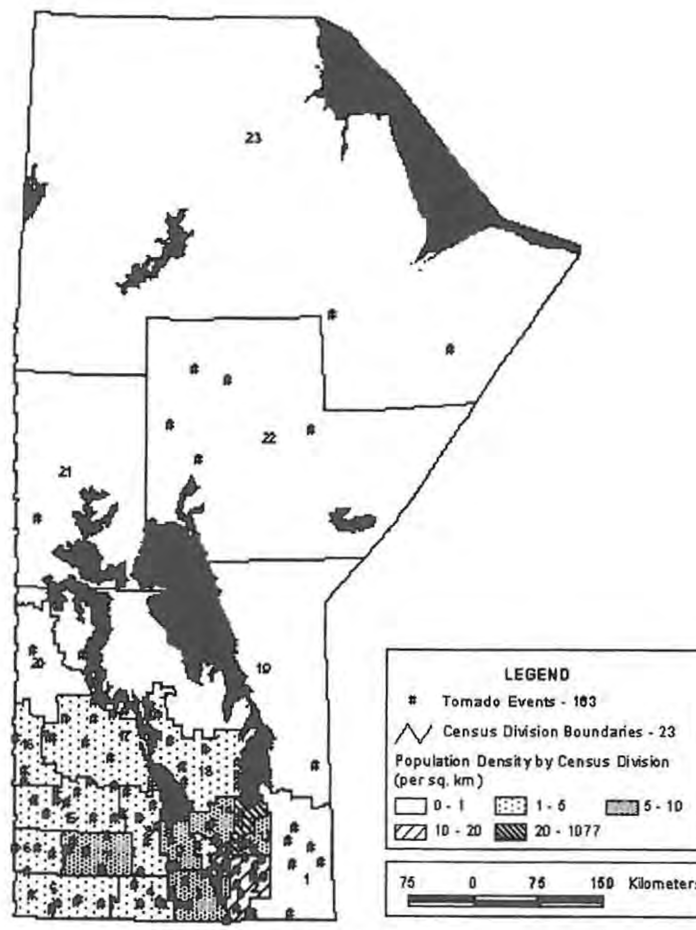


Figure 1. Population Density by Census Division and "Reported" Tornadoes.

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In this study, days with reported tornadoes were used to quantify the tornadic risk in Manitoba. The study focused on tornado days from 1980 to 1999. The days were grouped by Census Divisions and a risk analysis, similar to that done by Raddatz and Hanesiak (1991), was carried out.

## 2. Tornado Database

The Summer Severe Weather reports from the Prairie Storm Prediction Centre (PSPC) of Environment Canada in Winnipeg were used as the primary data source (McCarthy, Program Manager, PSPC personal communication) in this study. The data in these reports come from the volunteer weather watchers and are mainly subjective reports of the severity of extreme weather events and the associated damage. The Summer Severe Weather reports are compiled each year by staff in the PSPC.

Environment Canada began a special Summer Severe Weather Program in the late 1970s, which focused on forecasting summer severe weather. This program involved establishing a network of volunteer weather watchers, who would report the occurrences of severe weather phenomena, like thunderstorms and tornadoes, directly to the forecaster. This program has expanded over the years from a few spotters in the early years to several hundred today. Most of the watchers live in the southern third of Manitoba, as does most of the population of Manitoba (Figure 1). The weather watchers get some basic training in spotting and reporting severe thunderstorms and tornadoes.

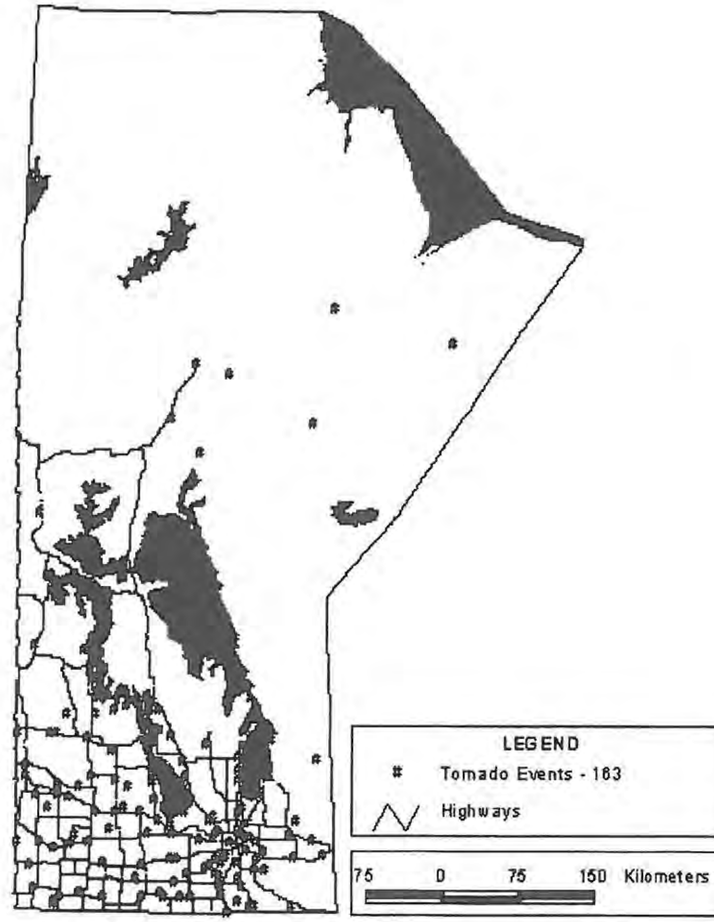


Figure 3. Reported Tornadoes with Major Highways.

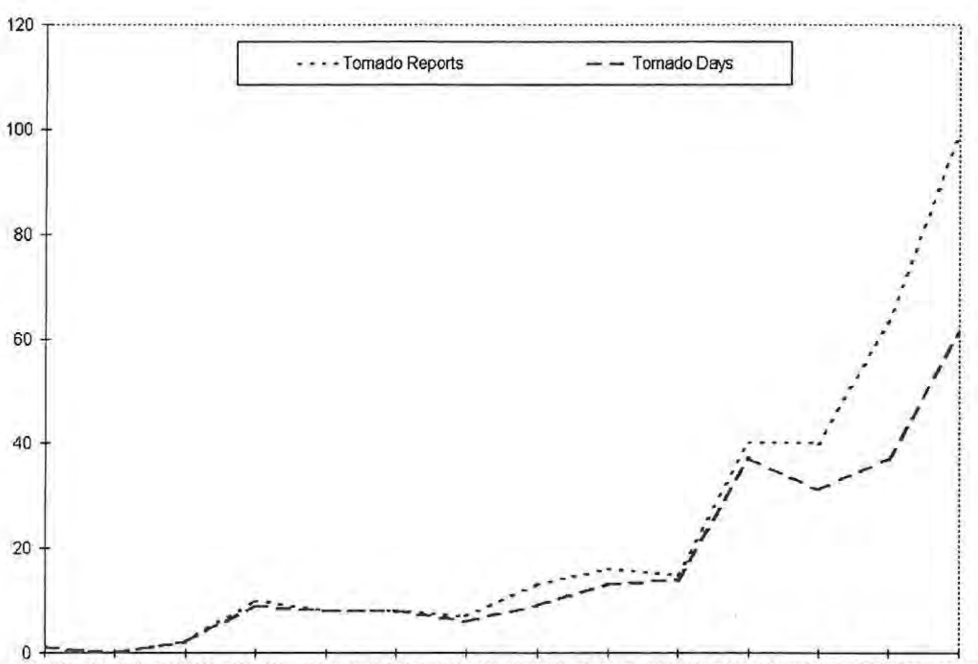


Figure 2. Tornadoes Days and "Reported" Tornadoes by Decade, 1860s-1990s.

| Census Division | A | PD | N | f | R(%) | T (50:50) | T (95:05) |
|---|---|---|---|---|---|---|---|
| 1 | 15,812 | 1.07 | 13 | 0.43 | 0.67 | 1.6 | 7.0 |
| 2 | 4,418 | 10.92 | 9 | 1.02 | 1.60 | 0.7 | 2.9 |
| 3 | 5,336 | 7.61 | 9 | 0.85 | 1.33 | 0.8 | 3.5 |
| 4 | 4,643 | 2.25 | 5 | 0.54 | 0.85 | 1.3 | 5.5 |
| 5 | 8,487 | 1.76 | 6 | 0.36 | 0.56 | 1.9 | 8.4 |
| 6 | 4,073 | 2.62 | 6 | 0.75 | 1.17 | 0.9 | 4.0 |
| 7 | 5,814 | 9.88 | 5 | 0.43 | 0.67 | 1.6 | 6.9 |
| 8 | 6,051 | 2.55 | 10 | 0.86 | 1.35 | 0.8 | 3.5 |
| 9 | 3,239 | 7.67 | 7 | 1.17 | 1.82 | 0.6 | 2.5 |
| 10 | 1,925 | 4.65 | 5 | 1.32 | 2.06 | 0.5 | 2.3 |
| 11 | 583 | 1077.37 | 4 | 3.33 | 5.21 | 0.2 | 0.9 |
| 12 | 1,861 | 10.09 | 4 | 1.05 | 1.65 | 0.7 | 2.8 |
| 13 | 1,878 | 22.05 | 2 | 0.56 | 0.87 | 1.2 | 5.4 |
| 14 | 2,902 | 6.06 | 3 | 0.54 | 0.84 | 1.3 | 5.6 |
| 15 | 9,542 | 2.36 | 9 | 0.47 | 0.74 | 1.5 | 6.3 |
| 16 | 4,936 | 2.17 | 3 | 0.31 | 0.48 | 2.3 | 9.8 |
| 17 | 14,957 | 1.73 | 14 | 0.50 | 0.79 | 1.4 | 5.9 |
| 18 | 15,471 | 1.95 | 11 | 0.48 | 0.75 | 1.4 | 6.3 |
| 19 | 85,672 | 0.23 | 5 | 0.04 | 0.06 | 17.2 | 74.3 |
| 20 | 10,211 | 1.14 | 2 | 0.10 | 0.16 | 7.0 | 30.2 |
| 21 | 60,448 | 0.52 | 1 | 0.01 | 0.02 | 63.7 | 275.3 |
| 22 | 108,534 | 0.37 | 5 | 0.03 | 0.04 | 26.4 | 114.1 |
| 23 | 299,705 | 0.04 | 5 | 0.01 | 0.02 | 67.7 | 292.5 |
| Manitoba | 676,496 | 1.65 | 102 | 0.08 | 0.12 | 9.1 | 39.3 |

Table 1: Total Area, A (km), Population Density, PD (persons/km$^2$), Number of Tornado Days, N, Frequency, f, Risk, R (%), 50% Chance of Recurrence, T(50:50) (years), and 95% Chance of Recurrence, T(95:05) (years) for each Census Division in Manitoba.

A review of the number of reported tornadoes by decade from the 1860s through the 1990s (Figure 2) suggests that they may be increasing in conjunction with Manitoba's population and with the increase in awareness. There was a dramatic increase in reported tornadoes in the 1980s and 1990s, likely due to the increased reporting associated with the Summer Severe Weather program.

Tornadoes are associated with strong thunderstorm complexes. These thunderstorm complexes have been studied over the years to better understand the conditions necessary for their formation. The prime time for thunderstorms in Manitoba is the late afternoon and early evening (Phillips, 1990). However, nocturnal thunderstorms are also quite common although these often go unnoticed. It is often difficult to differentiate between damage caused by a tornado and damage caused by straight line or downburst winds, especially at night. The scarcity of people means that many areas of the province have no-one there to see the funnel and a lack of objects to damage means that tornadoes may occur but leave little or no evidence of their existence. Most assessments of occurrence and rating of severity are based on subjective damage investigations made several hours or days after an event. The damage is not always investigated by PSPC staff in person. As a result, there is uncertainty in the actual number of tornadoes in Manitoba.

Tornado identification and quantification is also hampered by limited road access in Manitoba (Figure 3), which makes it hard, if not impossible, to track all thunderstorms and to investigate the areal extent of all storms and the type of phenomena associated with them. As a result, the tornado database may be skewed by population density, degree of urbanization, transportation routes and public awareness. Given the limitations of the tornado database, only approximate conclusions can be drawn regarding the spatial and temporal risk of a tornado day.

## 3. Methodology

An earlier quantification of tornadic risk in Manitoba was carried out by Raddatz and Hanesiak (1991), who analyzed tornado days for the 1960-1989 period. In their study, a tornado day was defined as a calendar day with at least one report of a tornado. The data were grouped by Statistics Canada Census Divisions. This study updates their work using 1980 through to 1999 tornadoes reported to the PSPC.

The 1980 to 1999 data was grouped by Statistics Canada Census Divisions and was brought to a common area to remove the influence of the size of the Census Divisions. Most of Manitoba's Census Divisions have rural population densities greater than one person per square kilometre, except for the northern divisions which are the largest in area and the least populated (Table 1 and also Figure 1). It was documented (Newark, 1983) that a population density of at least one person per square kilometre was required to have a high probability that either a tornado or its associated damage will be observed. It is likely that some Census Divisions have experienced more tornado days than the number observed. Specifically, Divisions 19, 21, 22 and 23 are likely underestimated, because of their vast area and sparse population (i.e. less than one person per square kilometre).

### 3.1 Tornado Risk Calculations

The risk analysis followed the methodology used by Raddatz and Hanesiak (1991). Geographic Information Systems (GIS) software and the tornado event database for Manitoba between 1980 and 1999 were used to determine the number of tornado days in each Manitoba Census Division. From this, the follow parameters were calculated:

1) the frequency of occurrence of tornado days per 10,000 $km^2$ per season, $f_i$

$$f_i = N_i / (\text{Number of seasons})(A_i/10{,}000\ km^2);$$

2) the risk, $R_i$, that a day will contain one or more tornadic event

$$R_i = f_i / \text{average season length};$$

3) the period during which there is a 50% chance of recurrence, $T(50:50)_i$

$$T(50:50)_i = \ln(0.5) / \ln(1-R_i); \text{ and}$$

4) the period of a 95% chance of recurrence, $T(95:05)_i$,

$$T(95:05)_i = \ln(0.05) / \ln(1-R_i);$$

where the subscript i refers to the $i^{th}$ Census Division with area $A_i$ and $N_i$ tornado days. The number of seasons was 20 and the average season length was calculated to be 64 days.

The frequencies ($f_i$) were used to approximate the annual probabilities of occurrence of a tornado day for each Census Division. The daily risk ($R_i$) of a tornado occurring anywhere within that particular Census Division is then calculated by dividing the annual frequency by the average length of the season. The average length of the season was calculated from each of the twenty seasons (1980 to 1999) in the tornado database. The risk, $R_i$, was then multiplied by 100 to convert to a percentage.

The recurrence periods in years is calculated by dividing the recurrence period by the average season length, 64 days in this case. The frequencies of occurrence and the recurrence periods are per 10,000 $km^2$ for each Census Division.

The 10,000 $km^2$ area for the specification of risk ($R_i$) was arbitrarily chosen to have a common area of risk for all Census Divisions regardless of their size. Otherwise the larger Census Divisions might have had the largest risk simply because they are largest. Now, if the typical tornado has an average area of damage of approximately 0.1 $km^2$ (Raddatz and Hanesiak, 1991), then the probability of a location smaller than 0.1 $km^2$ in that Census Division being hit by a tornado becomes $R_i$/100,000.

## 4. Results

The data was analysed both spatially and temporally. Averages were calculated for Manitoba and values ($f_i$, $R_i$, $T(50:50)_i$ and $T(95:05)_i$) were calculated for each Census Division (Table 1). There is a seasonal distribution as well as a spatial distribution found in the data.

#### 4.1 Annual Occurrence and Seasonal Distribution

Based on the 1980-1999 tornado database, there were, on average, 5.1 tornado days in Manitoba. The season was, on average, 64 days long with a mean first day of June 8 and a mean last day of August 14 (Figure 4). The earliest date of occurrence of a tornado was May 25 (note: the earliest occurrence of a tornado on record is April 17, 1977) and the latest date of a tornado was October 10. The longest season was 135 days while the shortest was zero, as there were no reported tornadoes in 1986. The 1981 season was only one day long. Multiple tornado events do occur in Manitoba, but because of the uncertainty in the reporting of events, the study focused on tornado days. Most of the tornado days occur in either June, July or August (26%, 32% and 31% respectively) (Figure 5). Tornado activity peaks between June 16 and July 15, when over one third (approximately 37%) of the tornado days occur.

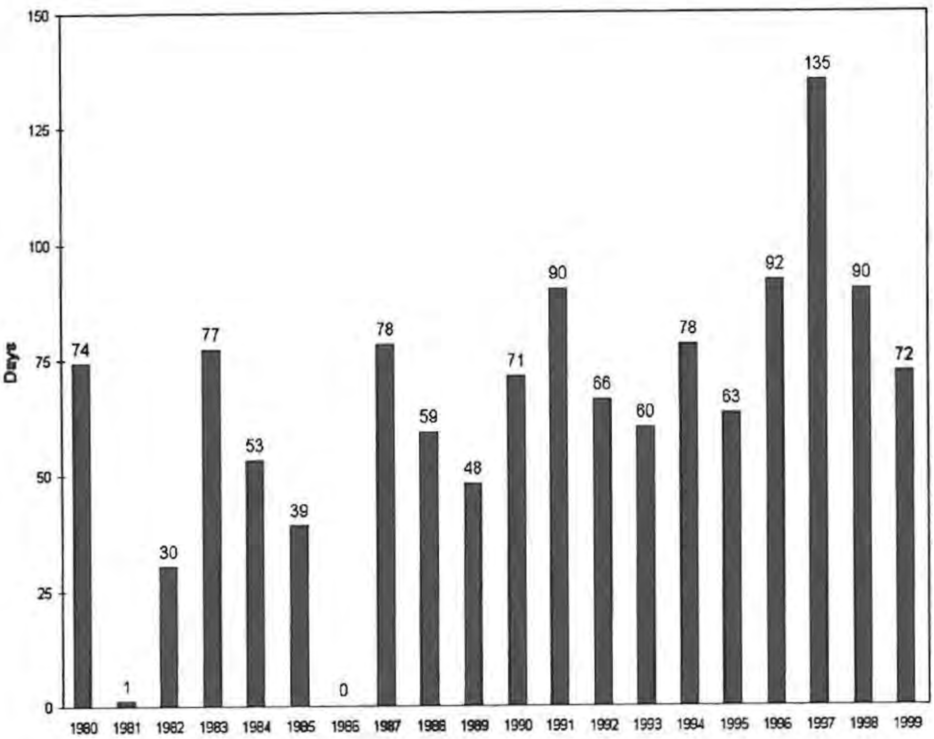


Figure 4. Tornado-Day Season Length.

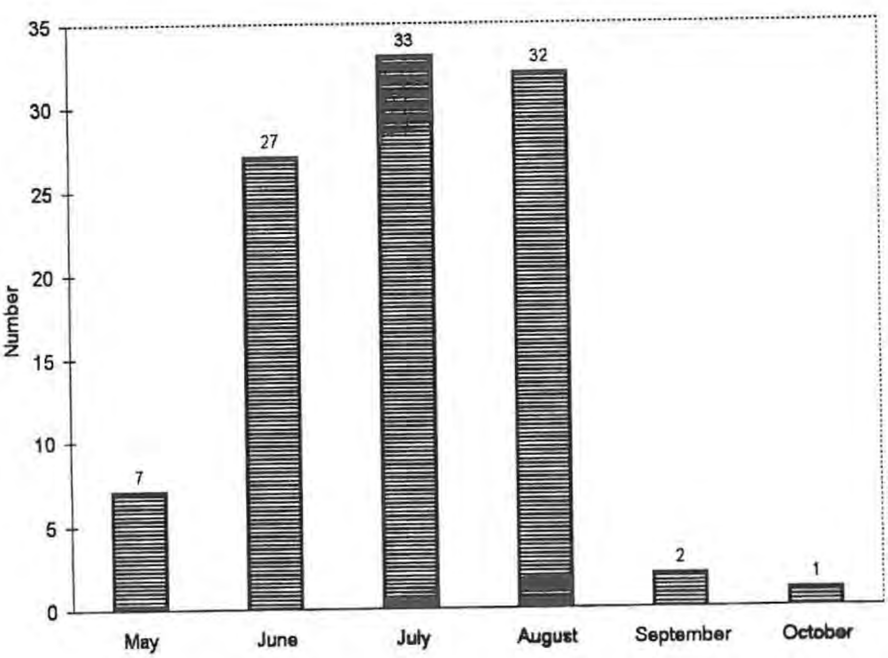


Figure 5. Tornado-Day Distribution by Month.

Since most of the tornado days are concentrated in June, July and August, the risk on each day during the season is assumed to be equal. Based on the occurrence of the meteorological conditions necessary for a thunderstorm to occur, it is likely that the probability of a tornado on a given day in the shoulder months of April, May, September and October is likely smaller because the necessary meteorological conditions occur less frequently in those months. The tornado day database for all the Census Divisions is too small to accurately determine the frequency (and other parameters) for each month, individually.

**4.2 Geographical Distribution**

A spatial plot of the 1980-1999 tornado database indicates that the highest frequency ($f_i$) of tornado days is in the Red River Valley (Figure 6) and the lowest is in the north. This is consistent with studies by others in Canada and United States (Newark, 1983; Grazulis, 1993; Concannon et al, 2000), which have shown an extension of Tornado Alley northward into southern Manitoba. Because of population density and under-reporting of tornadoes in the northern Census Divisions, the tornado frequency in northern Manitoba may be underestimated.

The risk ($R_i$) of a tornado day per 10,000 $km^2$ is highest in the Red River Valley and lowest in the north (Census Divisions 19, 21, 22, & 23). However, the risk of a typical tornado affecting a point within the given Census Division is 100,000 times less, since the damage from a typical tornado is approximately 0.1 $km^2$. The risk to any location in Manitoba ranges from $10^{-6}$% to $10^{-8}$%.

## 5. Summary

Overall, the tornado risk analysis implies that the highest risk of a tornado day is in the Red River Valley then it diminishes east and west across the southern third of the province. The risk in the northern two thirds of the province is significantly lower. This may partially be a result of the population density. Tornadoes have been reported as far north as Churchill which does demonstrate that the phenomena is possible in all parts of Manitoba.

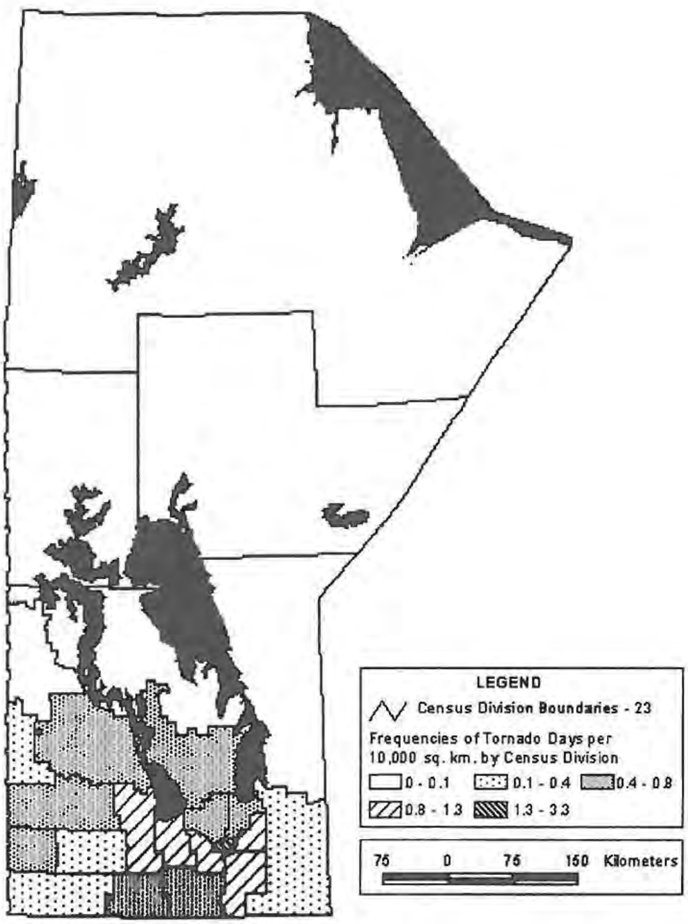


Figure 6. **Tornado-Day** Frequency by Census Division.

The risk of a tornado day at a location in Manitoba ranges from $10^{-6}$% to $10^{-8}$%. Tornadoes are highly localized phenomena but do occur almost every year somewhere in Manitoba. This analysis implies the database is becoming more complete rather than the risk changing over time.

In the southern third of Manitoba, where the greatest number of people live, the occurrence of tornadoes is likely more representative of the actual number of tornadoes than in the northern two thirds of the province. The actual number of tornadoes that occur in northern and eastern areas of Manitoba are likely higher than the number reported simply because of the low population density and lack of infrastructure to damage. Even the number of tornadoes in the populated southern third of Manitoba may be underreported. In the United States, it is believed that the actual number of tornadoes may be three times as high as the official record (Grazulis, 1993).

There has been a steady increase in the number of reported tornadoes in Manitoba from the early 1900s to today. This may be primarily due to increasing population, enhanced public awareness of tornadoes and better data collection programs within Environment Canada. A decade-by-decade summary of tornado days clearly shows the influence of the Summer Severe Weather program , first introduced by Environment Canada in the late 1970s and the impact of the Weather Watcher program in the 1980s and 1990s. The dramatic increase in the number of "reported" tornadoes in the last twenty years is, in all likelihood, primarily because of increased awareness and reporting, and not a change in tornado frequency. The enhanced tornado awareness and data collection programs are especially important if we are to attempt to understand tornado climatology within the context of climate change.

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# WEATHER SUPPORT TO MILITARY CONTINGENCY OPERATIONS: THE CANADIAN EXPERIENCE

by Douglas Bancroft[1]

Résumé: À travers l'histoire, les conditions météorologiques ont influencé de façon significative les opérations militaires. Une connaissance approfondie du temps et l'aptitude à comprendre tous les rouages accroissent l'efficacité tactique et la sécurité des forces armées. Les petites et moyennes nations déploient maintenant de façon routinière, autour du globe, des forces aérienne, terrestre et navale afin d'appuyer les opérations de maintien de la paix de l'ONU et de coalition. Ces déploiements ont souvent lieu, bien à l'extérieur des aires d'opérations normales, dans des régions avec peu ou aucune infrastructure de services météorologiques de la nation hôte. De plus, ces missions sont fréquemment soumises à des conditions météorologiques qui ont des effets défavorables immédiats sur les opérations. Les forces armées de petites nations exigent des méthodes efficaces de rentabilité afin de rencontrer les demandes de services météorologiques dans la zone des opérations militaires. Cet article énumère en détail comment le service météorologique militaire du Canada a rapidement évolué au cours des années antérieures afin de rencontrer les besoins opérationnels autour du globe, dans des endroits tels que le Timor oriental, la Turquie, au Kosovo, au Rwanda, en Haiti et au Honduras, tout en optimisant la rentabilité.

## Introduction

Throughout history, weather has significantly influenced military operations. A thorough knowledge of weather, and an ability to exploit this understanding, enhances tactical effectiveness, efficiency and safety of military forces.

Middle and smaller sized nations now routinely deploy aviation, army and naval forces around the globe in support of coalition and UN peacekeeping operations. These deployments are often well outside of normal operating areas, in regions with little or no host-nation weather support infrastructure. In addition, these missions frequently encounter weather that has immediate adverse impacts on operations. Armed services of small nations require cost effective methods of meeting non-traditional theatre weather support requirements.

This paper details how Canada's military weather support has rapidly evolved over the past few years to meet operational requirements around the globe, in locations such as East Timor, Turkey, Kosovo, Rwanda, Haiti, and Honduras, while maintaining cost effectiveness.

## Outline

This paper will review the following key components of weather support to Canadian military operations:

Deployed Meteorological Personnel;
Telecommunications;
Rear Echelon Support;
Numerical Models;
Software Tools;
Specialized Equipment; and
Weather and Intelligence Operations.

The paper will then conclude with three case studies of weather support to contingency operations in East Timor, the former Yugoslavia, and Honduras.

## Deployed Personnel

Canada is a middle-sized nation with a very small military. Nevertheless, the Canadian Forces Weather & Oceanographic Service (CFWOS) is fortunate to enjoy a Meteorological Technician (MET TECH) uniformed non-commissioned trade. These two hundred personnel are well trained, long serving professionals (vice conscripts). During their career, they progress roughly as follows (duration of major career courses are indicated in parenthesis):

- Private: Recruit, Observer (60 days basic, 100 days weather training);
- Corporal: Journeyman Observer (70 days weather training);
- Master-Corporal/Sergeant: Briefer (90 days weather, 35 days leadership training);
- Sergeant/Warrant Officer: Forecaster/Manager (210 days weather training); to
- Master/Chief Warrant Officer: Senior Manager (30 days leadership training).

MET TECHS are the CFWOS presence at the "sharp end". They deploy in theatre with Army, Navy and Airforce units to provide comprehensive weather services and support. They collect weather data by all means available, provide on scene weather briefings and forecasts, tailor weather products to meet user requirements, and ensure these products are positioned "inside the decision loop" of force commanders. Ultimately, it is essential that weather support be in the proper operational context, in order to

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provide commanders with relevant information. Maximum use of concise, yet complete, weather impact matrices, Tactical Decision Aids (TDAs), etc. is essential. This requires that the MET TECHS be fully aware of the operations they support. They also require an ever-increasing level of computer literacy.

Two MET TECHS are deployed in the Navy aboard each and every destroyer, frigate and replenishment vessel, as well as many others in the Meteorology and Oceanography (METOC) Centres on both coasts. The Army maintains MET TECHS at the national Combat Training Centre (CTC), within all Intelligence Companies at the Division and Brigade level, and within each artillery regiment. The Air Force employs MET TECHS as observers, briefers and short range forecasters at numerous air bases, wings and squadrons across Canada. Finally, there are MET TECHS employed at National Defence Headquarters (NDHQ), and other Operational Level HQs.

## Telecommunications

Historically telecommunications was the weakest link within the CFWOS (as a result of lack of technology). Weather has always been a matter of large amounts of information in, value added, and information out. To no small extent, the unofficial motto of the CFWOS could have been, "give us a communications pipe and we can plug it", in relation to our bandwidth desires and needs. Bandwidth, no matter what type of communications pipe used, is paramount for weather support. Deployed operations periodically experienced insufficient bandwidth (due to lack of technology in mobile communications services). Given the heavy use of graphics for weather charts, radar or satellite imagery, and alphanumeric data, there is a real need for large bandwidth for meteorology (e.g. one high-resolution satellite picture is in the order of a mega-byte in size).

Over the last decade, every aspect of weather services has been drastically affected by the revolution in communications and computers. The CFWOS was no exception, especially as we transitioned from our older HF RATT/FAX and terrestrial Teletype systems, to take advantage of recent major improvements in military and commercial satellite systems. In particular, our experiences with NATO NAMIS, CF MM, and INMARSAT B High Speed Data (HSD) will be reviewed.

Within the NATO European theatre, the Allied Command Europe Weather Exchange (ACEWEX) is the network of national switches and terrestrial point-to-point telecom links. These links have recently been upgraded from tele-type (TTY) technology to 64k lines. Data from the various national switches are shared across ACEWEX. The ACEWEX switch at Traben-Trarbach is where the NATO Automated Meteorological Information System (NAMIS) up-link is located.

NAMIS is a satellite-based meteorological data distribution system. It is primarily a meteorological data broadcast; however, local users can also input data through NAMIS. NAMIS was recently upgraded to 19.2 K, and is made up of various components supplied by NATO nations. NAMIS was originally for fixed use; however, it has recently added portable earth station capabilities in order to support deployments. The NAMIS footprint is restricted to Europe and a small portion of Northern Africa. The NAMIS Personal Earth Station (PES) is a 2.4 metre dish antenna and satellite receiver. A portable version that supports deployable systems uses a 1.2 metre dish. Each NAMIS system is given a code, similar to an ICAO identifier. One difficulty encountered with the portable NAMIS system is the problem of setting up the unit in potentially hostile environments.

For some NATO countries that were just migrating off older TTY circuits, NAMIS was a major improvement for contingency operations. Nevertheless, the Canadian operational experiences to date in European and other theatres have clearly demonstrated the utility of two other communications systems for weather support. The first of these is the Canadian Forces (CF) Military Mobile Satellite Ground Terminal (MM). Each MM includes a ground station, operations vans and personnel, 5 metre antenna dish, and is normally attached to a Brigade level HQ. Each MM has broadband services with the capability to provide voice, fax and data services, and is essentially an extension of the Defence Information Services Digital Network (DISDN). The CF leases bulk bandwidth from Canadian telecom carriers (e.g. Bell, AT&T) in the form of a number of T1 pipes, that connect to CF multi-plexers across Canada, then divides these pipes into voice, data and fax services for various military users. The MM makes a connection from theatre to the Canadian DISDN. A typical configuration would include:

- at least three 32K voice lines;
- eight 8K secure voice lines;
- one 2.4K ADDN line;
- one 64K unclassified Defence Wide Area Network (DWAN) access and one 64K classified DWAN access;
- one CF Supply System data circuit;
- one 64K intelligence circuit;
- one 64K Internet circuit; and
- one 38.4K weather circuit.

Typically the CF/DND contracts through Teleglobe Canada for INTELSAT services (a commercial international satellite service) to provide the MM satellite connections. At any one time, Canada may have up to six MMs deployed overseas, with several more remaining in Canada. The MM makes a connection from theatre to a Canadian domestic DISDN hub. In addition to connecting to CF weather centres over the MM, some NATO Theatre support centres, e.g. the US AF Europe Operational Weather Squadron Sembach, can be accessed through inter-net web services on the CF weather network.

In addition to the MM, the CF makes extensive use of the International Mobile Satellite Organization (INMARSAT) commercial communications satellites for numerous operational deployments, either as back-up to MM and other CF systems, or as a stand-alone system. INMARSAT High Speed Data (HSD) connectivity has up to 64k bandwidth, and has proven to be reliable, flexible and cost effective. Every ship in the Canadian Fleet has, or is getting, HSD. Ground forces have used INMARSAT during disaster relief operations in Turkey, and in Honduras and other theatres, when the MM was not deployed. Our Air Force has used INMARSAT to support Maritime Aviation, and tactical helicopters in the field. Reasons for using INMARSAT, vice MMs, for support to some operations, are reduced size and weight; and elimination of most requirements for dedicated operators.

One potential danger of relying on commercial systems, such as INTELSAT or INMARSAT, is that they are commercial services and not dedicated for military use, and are subject to pre-empting. Nevertheless, as Canada does not have a dedicated military satellite system, Canada will continue to rely on HF, allied and/or commercial satellite communications for delivering operational weather support.

The CF maintains two DWANs, as departmental, fire-walled intra-nets. One handles only unclassified data, the other, up to secret data. A CFWOS Web Service on the DWANs is being developed as the primary means of providing CFWOS-based weather services to domestic and deployed CF operations. Several interim sites are already in place. Overseas access will be via MMs to the DWAN. Providing access to weather support through the DWAN avoids separate communications "stove-pipes" for weather. The CFWOS Web Service is similar in some respects to other weather web sites maintained by OWS and several USN METOC Centers. Currently, there is a standard configuration "Met Circuit" on the MMs when they deploy. If this isn't available, dial services or access through the Internet allows Met personnel to get back to CFWOS web servers quite effectively.

With dedicated web pages established for each specific deployed operation, there is a one-stop shopping solution. All the required information and links are found on one site and the user doesn't have to waste valuable time hunting around for weather information or book-marking site after site. Information links can be widely varied, and not solely limited to "Met" links. In addition, experience has shown that internet E-mail is often a most reliable means of communicating in theatre for easy exchange of non-classified weather information.

## Rear Echelon Suppoort

The CFWOS experience has shown that it is essential for small nations to develop strong partnerships with national civilian weather agencies to achieve the critical mass of science, corporate expertise and training. Without this partnership, it would be impossible for Canada to fully meet global operational weather support requirements, while maintaining cost effectiveness. The importance of ongoing feedback, mutual trust and understanding among all concerned, in making this partnership work, cannot be overstated.

The CFWOS operates in partnership with Canada's national weather service, the "Meteorological Service of Canada" (MSC). MSC is contracted to supply the bulk of North American weather services for domestic CF operations, as well as remotely delivered in-theatre contingency forecasts. This partnership largely eliminates duplications with the civilian meteorology sector. The MSC Canadian Meteorological Centre (CMC) is our national global Numerical Weather Predication (NWP) facility and NATO Weather Analysis Centre. CMC also provides a single national tie-in to the Global Telecommunications System (GTS) weather infrastructure. Canada is a World Meteorological Organization (WMO) member and the GTS is the WMO global data distribution system. GTS is connected between CMC and the US node in Washington.

The MSC Aviation and Defence Services Branch (ADS) operates four Weather Service Centres (WSCs) in Canada, that focus exclusively on military weather products and services. The three coastal WSCs (at Halifax and Greenwood, Nova Scotia and Comox, British Columbia) focus on naval and maritime aviation weather support, while the more central WSC (Trenton, Ontario) concentrates on continental aviation, and support to globally-deployed Army and Air Force contingency operations. Weather services for the latter are provided by the WSC Trenton Special Operations Desk (SOD). Experience has shown that it is very important to hone good SOD and WSC weather support, through repeated exercises, to ensure fast responsive reaction when required. Indeed, short notice, or duration operations are the most challenging in that resources must be compiled quickly so as to meet requirements. Gearing up for these types of operations is never easy, as sometimes, by the time experience and knowledge is gained, the operation can be over.

WSC products are characterized by innovation, and tailoring to meet client requirements. Examples of WSC/SOD products include:

- Contingency "windows" for subjects and objective MSL analysis and forecast chats, anywhere on the planet (and, in the case of the navy, moving to follow fleet movements);
- Subjective wave height forecast charts;
- Specialized remote weather warnings;
- Synoptic scale and meso scale Horizontal Weather Depiction (HWD) charts for aviation use;
- Terminal Aerodrome Forecasts (TAFs); and
- Specialized upper wind charts for long range aviation use.

In numerous instances the CF will deploy and not take MET TECHS. Weather support to these operations is even more difficult, as all support is provided remotely, and often the user has limited knowledge of available met products and/or resources. This makes the one-stop shopping even more important, and the need for a user-friendly (non-technical) interface becomes paramount. In addition, strong mutual understanding between the supporting Centre and the deployed unit is essential.

In addition to WSC weather support, the Navy operates METOC Centres on both coasts. The WSCs are the primary source for weather support, while the METOC Centres provide liaison and coordination, as well as specialized oceanographic and weather support to the fleets. This includes pre-sail weather packages, Tactical Atmospheric Support (TAS) messages (providing electro-magnetic propagation conditions and forecast radar ranges), Optimum Track Shipping Routing (OTSR) advisories and climate based Meteorological Briefing Folders. METOC Centre personnel provide in-port weather training, conduct a Port Meteorological Inspection (PMI) Program, and when required can dispatch mobile teams of METOC personnel ashore or afloat. METOC Centres also ensure the cohesive integration of weather with oceanographic support, to deliver a "seamless characterization of the maritime battle-space environment".

Similarly, the Army Meteorology Centre (AMC) provides liaison and coordination with relevant WSCs that support Army units, as well as specialized weather support, training, and personnel sustainment, in accordance with the Army Meteorological Support Concept (AMSC). The AMSC is based on flexible, balanced and affordable weather support.

Finally, the CF normally operates overseas as part of a coalition. The CF normally uses allied weather centres for operational support, when available. NATO and the US Navy, operate a global network of METOC Centers that are routinely used by the Canadian Navy on deployments. CF ground and air units make use of coalition partner facilities whenever available, e.g. the Operational Weather Squadron Sembach (OWS) operated by USAFE. Canada fully supports the NATO doctrine for contingency operations weather support, i.e. first Host Nation support; if not available, then Allied support in Theatre; if not available, then Reach-Back to National support. Canada also supports the NATO doctrine of "One Theatre - One Forecast". This is at the heart of how Canada prepared and established weather support for operations in the former Yugoslavia.

## Numerical Modelling

The MSC CMC is the Canadian agency that provides super-computer-based NWP products to all Canadian Government Departments. It directly supports CF Operations anywhere in the globe, and routinely opens "windows" to provide specialized support to weather forecasting, plume dispersion, and wave height forecasting.

At CMC, medium and long-range weather forecasts are generated by the global version of the Global Environmental Multi-scale (GEM) model. The GEM enjoys very sophisticated model physics and parameterization, and a Global Variation Assimilation System, with uniform 0.9 degree resolution lat/lon grid, with 28 *eta* vertical levels. It runs out 72 hour forecasts at 12 UTC, 240 hour forecasts at 00 UTC, and 360 hour forecasts weekly. In addition, an ensemble prediction forecast system that uses 16 "perturbed" and one unperturbed (control) is run out to 240-h forecasts once per day, with slightly different models, and model physics parameterization.

## Software Tools

Canadian WSCs use a variety of software tools for production and distribution of weather forecasts. Large efficiencies are obtained between the CF and the MSC by using common weather informatics systems, software and infrastructure. Most WSC forecaster applications operate on high performance UNIX workstations, with large bandwidth connectivity to other centres, CMC, and the global GTS. Standard MSC software tools include Met Manager, and Edigraf.

Met Manager is a proprietary software application developed for the CF and the MSC. It is a vehicle that drives the domestic CF meteorological data distribution network. It is a weather data manager that disseminates, archives and displays weather information. It consists of several modules including Image Manager (IM), for easy handling of meteorological images (e.g. radar, satellite, etc). IM enables user to quickly and simply retrieve, display, manipulate and loop images using a Graphical User Interface (GUI). Met Manager also contains Alphanumeric Manager (AM) for fast handling of alphanumerical data, and Alphanumeric Manager for X Window (AMX). AMX provides a geographical interface to access and overlay global alphanumeric and imagery data (e.g. radar, satellite) in a variety of powerful ways, including the ability to overlay different data sets on the same map so that a wide variety of user-selected elements can be simultaneously viewed.

Edigraf is a powerful graphical forecast work station, that allows forecasters to display, manipulate and work with a variety of meteorological data sets, and to prepare subjective prognostic charts, e.g. Horizontal Weather Depictions.

For NATO operations in Europe, Canada will continue to deploy NAMIS Visualization Software (NVS). NVS is a product of the UK Met Office, and has been upgraded/redesigned to meet NATO user requirements. Configuration changes go through the NAMIS User Group, which reports to the Chair of ACEWEX. Users pay the UK Met Office an annual licence fee for NVS and remote support and upgrades. The visualization part of the NVS uses a geographic map with overlays of the various meteorological data sets. NVS runs on a PC NT machine, and uses Oracle as the data base.

While CF units and garrison forecasters and weather briefing offices will continue to use powerful proprietary applications to disseminate and manipulate weather data, the CFWOS is migrating towards a "web centric" way of supporting deployed operations and CF (non-meteorological) users of weather data. CF Weather Office, and "Commercial Off The Shelf" COTS software and hardware systems (i.e. Microsoft Office and PC/NT computers) dominate current and future development and acquisition plans.

Deployed MET TECHS also use a variety of PC/NT based weather applications, bundled in a CD-ROM library called "Tactical Oceanographic and Atmospheric Support Technologies" (TOAST). The TOAST library of PC based applications seeks to apply an object-oriented style of planning and configuration to the suite of METOC applications so that they share a common framework. It includes such modules for forecasting aircraft icing, performing sunrise/sunset calculators, with low light options for use with passive imaging devices in all weather conditions, ballistic wind calculators, upper air data loggers and display; and miscellaneous smaller modules including pressure altitude, density altitude, windchill and humidex. There is a NATO initiative to create a similar library of applications.

## Specialized Equipments

Upper Air observation data is essential observing for on site forecast support to artillery and aviation, as well as EM propagation predication. Various upper air observation systems are used. The VASAILA MARWIN MW12A upper air sounding system is used in support of Naval and Maritime air operations. A slightly different unit is used for Army operations. The MARWIN uses an omni directional portable antenna, UHF telemetry, GPS (also capable of LORAN C) sondes, and provides accurate vertical profiles of temperature, humidity, wind speed and direction and pressure. It is rugged, and transitions from ship to shore easily to support Joint/Combined operations. They have enjoyed numerous successful deployments.

For Army and Air Force field deployments, MET TECHs use a number of WIN/NT based applications running on a portable notebook (Panasonic CF-27) Personal Computers (PCs). The CF-27 is a very rugged off-the-shelf notebook PC, with a magnesium alloy case, and encased drives and monitor that are vibration/shock resistant. Ports and keyboard are water - and dust -resistant. It is easily man-portable. The CFWOS has been using them for a few years by all our tactical helicopter squadrons, army Intelligence Companies and artillery MET TECHS.

The navy is currently installing a new generation of ship-board weather satellite imagery receiver/processors. These units are based on the WEATHERTRAC WIN32 system. This hardware software package is an ensemble of programs designed to provide imaging functions on a Win32/NT based PC. In addition to NOAA APT image processing, it also manipulates HF WEFAX and HF RATT weather data.

Several quickly deployable Portable automated weather observing met ground stations have been tested by the various elements of the CF, to date with poor results. Currently, the CF is testing a Campbell Scientific Tripod Weather station. This unit provides wind speed and direction, rain fall, temperature, humidity, and pressure. It provides for radio link to remote users, and has a solar cell back-up battery.

## Intelligence Fusion

In addition to direct support to operations, weather information is a key component of overall military intelligence support. Data sharing and fusion with intelligence is important, and is a direct result of meteorological events having a profound impact on a theatre of operations; effects that are potentially disabling for own and opposing forces. Access to local climatology is also important in such diverse areas as Rules of Engagement (ROE) modeling, anticipating threat weapons performance and determining potential adversary tactics, e.g. understanding expected visibility may determine what identification criteria could reasonably be achieved.

In Canada, weather information directly supports Intelligence Preparation of the Battle-space (IPB). Army doctrine places weather and Terrain Analysis within Intelligence Collection & Coordination Centres (ICACCs). Navy doctrine, although less formalized, integrates both the east and west coast naval Meteorology and Oceanography (METOC) Centres within operations support centres that encompass Intelligence, METOC support, and surveillance data fusion, in order to properly support every aspect of intelligence work ashore and afloat.

Further inclusion of weather information in intelligence operations at strategic and operational level HQs in Canada is being actively pursued.

## Case Studies of Weather Support to Contingency Operations

The recent experiences of CF weather support during contingency operations are highly varied. Three interesting and highly varied examples follow.

1) Naval and Maritime Aviation Weather Support in East Timor

In late September 1999, Canada announced the immediate deployment of 600 CF personnel to support INTERFET peacekeeping coalition operations in East Timor. This included a reinforced light infantry company on the ground, Hercules transport aircraft for in-theatre airlift, and a multi role replenishment ship for logistics support. The latter, HMCS PROTECTEUR, carried two Sea King maritime helicopters, and an organic weather office with a senior MET TECH forecaster (Warrant Officer) and junior MET TECH (Corporal). This weather office, though small, was most capable. It enjoyed a Vasaila upper air balloon system, PC based satellite imagery receiver processor, PC/NT computers with specialized weather applications software; and most importantly, a commercial INMARSAT High Speed Data (HSD) satellite communications link (56k) to rear echelon weather centres.

Weather support for this six-month deployment was a total team effort. Prior to sailing, the ship was provided with extensive climate information for mission planning by the military METOC Centre. En-route weather support was provided by the WSC. Around the clock, in situ aviation forecasts and briefings were produced by the ship's team. Coalition partners also provided weather forecasts. Australia had a forecaster with the Joint Task Force Commander at INTERFET HQ, Dili, providing weather forecasts to ground troops. The USN NAVPAC METOCCEN Yokuska Japan and the MARPAC METOC Centre provided rear-echelon communications connectivity, and specialized support.

This deployment represented one of the best efforts to date for provision of weather support to naval operations being conducted in a theatre with no host nation support. Lessons learned highlighted the need for earlier weather support coordination between coalition partners, to ensure that all concerned were fully aware of each other's capabilities, requirements and intentions.

2) Air Force and Army Weather Support in the Former Yugoslavia

The CF has been involved with a variety of operations in the former Yugoslavia to date, with ongoing missions expected for the foreseeable future. Because host nation support was largely not available, Canada intended to use NATO-based theatre forecast support from our Allies through the NAMIS system. Our secondary support was through reach-back to WSC Trenton.

Canada acquired portable NAMIS for supporting operations in the former Yugoslavia, as the primary met support workstation. Connectivity was initially difficult, and in these situations support to deployed forecasters was established through weather circuits on the MM, for reach-back support from Trenton, as well as Internet connectivity into Operational Weather Squadron (OWS) Sembach, where NATO-based met support was provided. This turned out to be most effective in providing mission-specific weather information. More and more, the operators have stated that "web centric" support was quite adequate. Users found the OWS web site was useful for producing briefing products and that specific hyperlinks optimized bandwidth and connection time. The OWS site is well maintained and kept fresh with new products and improving existing ones.

In addition to specialized products, the WSC Trenton web site provided access to the global products, e.g. TAFS and METARS. Deployed operators also downloaded WSC Tenton alphanumeric bulletins (comprehensive METREPS complete with ground and aviation forecasts), prognostic charts, CMC NWP windows, and satellite images. In addition, the WSC Trenton site provided numerous useful links and value-added web pages (e.g. climate information, geo-political reference data, etc.) and a fast FTP capability. The WSC Trenton web site was also heavily used by in theatre personnel.

Finally, deployed forecasters regularly praised MS Office products, e.g. "Power Point", used to integrate weather packages for operations.

3) Army and Joint Weather Support in Honduras

The Canadian Forces maintains a joint Disaster Assistance Response Team (DART). This hundred-person DART and other CF units are routinely deployed overseas in support of international disaster relief operations, e.g. earth quakes in Turkey, or after a hurricane slammed into Central America. In these types of cases the host nation infrastructure could be completely wiped out locally. Immediate commencement of helicopter transportation, fresh water production, Search and Rescue (SAR) and HQ communications missions are paramount.

When the DART was deployed to Honduras to provide disaster assistance and relief following a hurricane, MET TECHS were required to provide on-site weather support to helicopters, and incoming and outgoing heavy airlift, and ground construction and relief forces. Weather during this period was quite bad, with rain, mud, and low ceilings hampering relief efforts.

After arrival on site, the deployed forecaster was not able to secure rear echelon communications support. In addition, host local nation infrastructure was non-existent. Nevertheless, the forecaster was able to find one operational "internet café" that enabled communications connectivity through the MARPAC METOC Centre to the MSC WSC Trenton. SOD products were accessed in real time, as well as a host of other support products, including satellite imagery and allied weather data and products. Again, on-site resourcefulness, internet, COTS technologies and a total team approach allowed for successful weather support to operations.

## Conclusion

Nations with small armed services can provide quality, affordable weather support to operations around the globe. Success is a complex function of personnel, teamwork, material and planning. Key requirements based on Canadian experiences include innovation, partnerships, training, adoption of commercial off-the-shelf communications, software and hardware, and constant feedback from the operational client.

## Acknowledgements

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## NEWS RELEASE

January 8, 2001

### Radarsat International Named USGS/LANDSAT7 Business Partner

Radarsat International (RSI) of Richmond, BC, announced today that it has been officially approved as a United States Geological Survey (USGS) business partner. This partnership allows RSI to commercially distribute North American and International data from the LANDSAT 7 satellite archived at the Ero Data Center (EDC).

"This agreement continues RSI's philosophy of being a one-stop for satellite imagery by augmenting the range of different satellite data available for our clients" says Kevin O'Neill, Sales Director for Western North America.

RSI processes LANDSAT 7 data at its headquarters in Richmond, allowing for fast delivery of data products (in the order of days from receipt of request). "The processing system is set up such that we have the capacity to process in excess of 100 LANDSAT 7 scenes/day," says Don Herriot, Production Manager at RSI. LANDSAT 7 information services are also available from RSI - and include thematic land classification, geological interpretation, forest inventory and agricultural analysis.

RSI (www.rsi.ca), a wholly-owned subsidiary of MacDonald Dettwiler and Associates (TSE-MDA, www.mda.ca), is a worldwide provider of products and information solutions derived from Earth-observation (EO) satellite data.

## Invitation de participer au 35e Congrès de la SCMO

Nous avons le plaisir de vous souhaiter la bienvenue au 35e congrès de la Société canadienne de météorologie et d'océanographie (SCMO) qui aura lieu à Winnipeg du 28 mai au 1er juin 2001. Le thème du congrès portera sur les Conditions météorologiques exceptionnelles". Les prairies canadiennes seront donc un cadre approprié pour un tel congrès puisqu'on y observe souvent ce type de phénomènes: orages en été, tempêtes de neige en hiver, périodes de sécheresse, inondations, vagues de chaleur et coups de froid. Le congrès offrira un programme scientifique stimulant ainsi que les réunions habituelles au cours desquelles les participants pourront se rencontrer pour échanger, retrouver de vieilles connaissances et en faire de nouvelles. J'espère que ce congrès ira au-delà de vos attentes et soyez certain que nous sommes impatients de vous accueillir très bientôt à Winnipeg.

*Jim Slipec, Président du comité local organisateur*
*Président de l'antenne de la SCMO à Winnipeg*

# PROJECT NEPTUNE : An Exciting Deep-Sea Observatory

by Paul LeBlond[2]

Mid-ocean ridges offer some of the sea-floor's most spectacular features. Towering hot springs, active volcanoes and exotic fauna excite scientific as well as public interest and would attract millions of admirers if they were more accessible. The Endeavour segment of the Juan de Fuca Ridge, located within Canada's Exclusive Economic Zone, is one of the oceans' most extraordinary hydrothermal areas. It has received intensive scientific attention and part of it has been singled out as a Pilot Marine Protected Area under Canada's Oceans Act, making it the world's first deep-sea protected area.


Figure 1. Sketch of possible locations of NEPTUNE observatory nodes. The nodes are interconnected by cable with proposed landings in the inner harbour of Victoria, BC and Nedonna Beach Oregon.

As a zone of strong interaction between the Earth's fluid exosphere and its hot rocky interior, deep ocean ridges present an environment of great variability - things happen fast and unexpectedly - volcanoes erupt, springs spring forth, creating new ecologically favourable environments, lava flows blanket earlier features, wiping out biological communities. Our imagination, smothered by the weight and darkness of 2500 m of water, can scarcely appreciate the variability of this chaotic environment.

NEPTUNE (the North East Pacific Time-series Undersea Networked Experiments) is a proposal for an observation system adapted to the highly dynamic ridge environment and extending over much of the Juan de Fuca plate. Continuous monitoring systems, linked to shore observers through high-bandwidth channels, are needed to capture and react to rare and complex events. A network of optical fibers/power cables reaching from the coast to the ridge would in addition allow monitoring of much of the Juan de Fuca plate and of the waters that cover it. A U.S. design study, led by John Delaney of the University of Washington, has identified scientific objectives, technical challenges and educational opportunities <http://www.neptune.washington.edu>. Canada has been invited to become a partner with the U.S. in NEPTUNE.

Canadian interest in NEPTUNE has been spearheaded by the Institute for Pacific Ocean Science and Technology (IPOST), a B.C.-based private organization fostering applied ocean research <http://www.ipost.org>. The Canadian NEPTUNE management board, headed by John Madden, vice-chairman of IPOST, has prepared a background study of costs and potential benefits of a Canadian participation. This study is available on the web at <http://www.neptunecanada.com>. A NEPTUNE science committee, co-chaired by Jeremy Hall of Memorial University <jhall@waves.esd.mun.ca> and Verena Tunnicliffe of the University of Victoria <tunnshaw@uvvm.uvic.ca> is busy gathering scientific support for the proposal.

Scientific opportunities offered by a power source and data link network in the deep ocean are legion. Real-time, close-field monitoring of seismic activity over the Juan de Fuca plate and its boundaries and of volcanic activity at the ridge will bring a dynamic dimension to deep-sea geology. Deployment of special sensors to probe hydrothermal systems and their biota will tell us more about life in extreme environments. Sea-floor-based monitors of ocean currents and other ocean properties, accessible in real-time, will open new windows on ocean exploration.

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[2] Galiano Island. Dr. LeBlond is a Fellow of CMOS, a member of the Board of IPOST, and a member of the Canadian Neptune Management Board; leblond@gulfislands.com

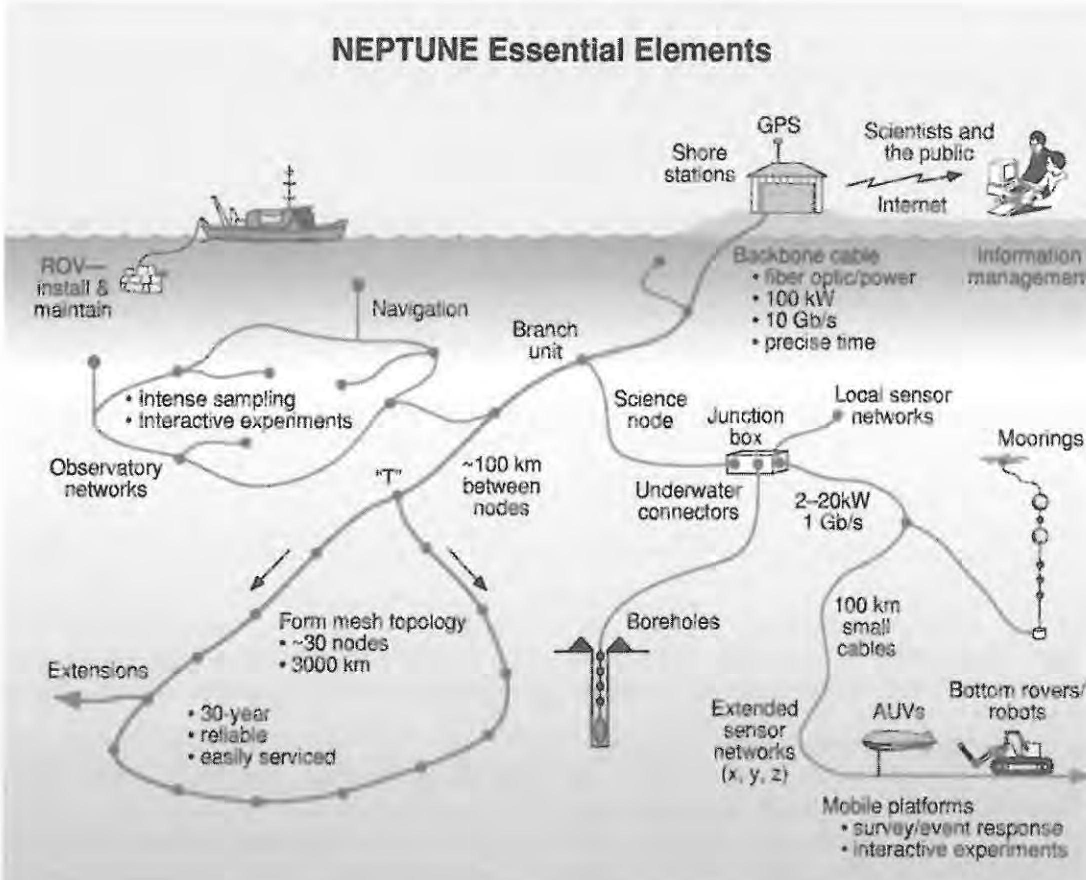


Figure 2. Land-based scientists and the public are linked in real time and interactively with sensors, sensor networks and various mobile sensor platforms in, on, and above the seafloor. NEPTUNE's fiber optic/power cable and associated technology provide the enabling network infrastructure. (Graphic: Paul Zibton).

Practical benefits of Canadian participation include a better appreciation of seismicity within the plate and its boundaries - possibly some early warning of a "megathrust" earthquake; clearer understanding of the biochemical and physical processes involved in ore formation at divergent ridges; a better knowledge of gas hydrates off the continental shelf; strengthened knowledge of ocean circulation and productivity; exciting educational and public awareness opportunities (there is, for example, a proposal for a Victoria Ocean Observatory where access to NEPTUNE information would be open to the public); industrial opportunities for Canadian ocean technology companies.

The IPOST report recommends Canadian participation as a full partner in NEPTUNE at a fair share of infrastructure and experimental costs. The 30% level recommended is thought to be an appropriate level to maximize Canada's scientific and industrial benefits. The next phase of NEPTUNE preparation, consisting of the detailed engineering design and science planning as well as the deployment of pilot observatory networks, amounts to \$15M [all estimates in Yr 2000 CAN\$] over the years 2001-2004. The Canadian share for complete installation (\$40M) and science deployment (\$37M) would be spent over the next few years (2003-2007). Canadian operational costs over the next three decades would amount to about \$4.5M annually.

The IPOST report also strongly recommends that a significant sum (\$9M of the \$15M) be devoted to a program of pilot interactive observatories. This recommendation follows the practice of the space program, where some initiation to the expensive technology to be deployed is deemed necessary to optimize its utilization. In street language: "Flying lessons are a good idea before taking to the air! "Some of these pilot projects could be implemented in shallower water, for example in Juan de Fuca Strait and in the Strait of Georgia. Scientists interested in learning to perform interactive underwater experiments and dealing with the associated high-rate data fluxes are invited to learn more about NEPTUNE. <www.neptunecanada.com>. They may also wish to contact the leaders of the NEPTUNE science committee.

Who will pay for NEPTUNE? Funding for the preliminary study was provided by a group of federal and provincial agencies. The request for continued funding has been addressed to both federal and provincial governments. Anyone interested in helping with NEPTUNE and in learning about its financing plans should get in touch with John Madden, the chair of the NEPTUNE committee <jcmadden@home.com>.

## The Top Ten Weather Stories of 2000[1]

by David Phillips[2]

For the first time in 13 years, a deadly tornado touched down in Canada killing 12 people at Pine Lake, Alberta. The tragedy was the number one weather story in 2000 and one of the year's top news stories.

The new millennium saw the Pacific twins - El Niño and La Niña - finally fade to nothing - La Nada. It was also a year when one of the shortest winters on record matched the shortest summer, if that was really a summer. A series of torrential rain storms from Saskatchewan to Nova Scotia created expensive and nuisance flooding for thousands of residents.

The year also saw a rare landfalling hurricane in Newfoundland and more weather woes for Canadian farmers. The year 2000 was another warm one - the eighth in a row in Canada. As well, fall 2000 marked the 13th consecutive season with higher-than-normal temperatures. In July, tourists on a Russian ice-breaker caused an international stir when they found open water, instead of ice cover, at the North Pole. These events are consistent with what scientists expect from climate change. And, it was a year in which British Columbia, apart from a mid-December wind storm, seemed to escape the wrath of the weather gods.

Here are listed the top ten weather stories of the year 2000 ranked in reverse order by considering factors such as the impact they had on Canadians, the extent of the area they affected and their economic effects.

### 10. Early Start to Winter 2000-2001

The early arrival of a "polar pig" or Arctic outbreak kicked-off the start of winter this past December with a bang. Winter arrived in Canada with face-numbing wind chills in the west, huge dumps of snow in parts of central Canada, and ferocious winds in the Maritimes. Traffic gridlock, cancelled flights and power outages were among the challenges faced by residents across Canada.

### 9. Winter 2000 - Soft and Short

It may be hard to recall but the winter of 2000 only lasted from mid-January to late February - a mere 5 weeks! This marks the fourth warmest winter in over 50 years. There was less snow than normal. Edmonton had its sunniest winter in 81 years. Heating costs were down but snow carnivals and other winter activities took a beating.

### 8. Hurricane Michael and November Gloom

The powerful hurricane Michael touched down over Newfoundland on October 19, a rare occurrence in Canada. Incredibly, there was little damage. November marked new records for continuously overcast skies for the Maritimes. Cape Breton Island experienced 19 days of rain with an accumulation of 400 mm. Flood damage to homes and roads topped $3 million.

### 7. Flash Flood Drowns Saskatchewan Town

Seventh spot goes to one of the largest rainfall intensities ever recorded in Canadian history. The residents of Vanguard, Saskatchewan, one of the driest spots in the country, received in excess of 375 mm in less than eight hours!

### 6. More Weather Woes Down On The Farm

Once again, Canadian farmers had a tough year. Mild winters and wet conditions affected central Canada in the spring and created an ideal breeding ground for insects and diseases. Wet conditions in the Maritimes and southern Manitoba in the fall prevented farmers from completing the harvest on time. While many parts of Canada were soaked, southern Alberta experienced drought conditions not seen since 1918.

### 5. Great Lakes Levels - How Low Will They Go?

Exposed dock supports evidence of low water levels at Maceys Bay on Lake Huron's Georgian Bay

Fifth on the list is the shrinkage of the Great Lakes. Three months of "monsoonal" rainfalls in the Great Lakes Basin was not enough to undo three years of warm-weather drought. Water levels for all the Great Lakes, except for Lake Ontario, are falling. The water levels have fallen further and faster than almost any time in the 20th century.

[1] Source: Environment Canada Web Site: http://www.ec.gc.ca/press/00-12-27_b_e.htm

[2] Senior Climatologist, Environment Canada, Downsview, Canada.

**4. January Storm Surge Wallops Atlantic Canada**

Nova Scotia and Prince Edward Island were hit with 54 cm of snow on January 21. The storm generated an enormous surge on top of the highest tides for the season in Charlottetown. As well, Newfoundland experienced the largest wave since 1929! Fortunately no lives were lost, but it caused millions of dollars of damage to the Maritimes.

**3. Rain Gushers Flood Ontario and Manitoba**

Gully washers (heavy rainfall) poured down upon Ontario in unprecedented numbers even though there were fewer severe weather events this summer. Southern Manitoba also experienced a few gully washers, including a deluge on July 7$^{th}$ that dumped a month's worth of rain (between 75 and 110 mm) in a matter of hours.

**2. "Bummer of A Summer" Across Canada**

The summer without sunshine. Central Canada experienced the wettest start to the season ever recorded. In British Columbia, Victoria set a new record for least amount of sunshine in May. The absence of those hot, humid days meant fewer smog alerts and a more comfortable summer for those with breathing problems.

And the Number One weather event of 2000

**1. First Deadly Tornado in 13 Years**

The Pine Lake killer tornado with winds as high as 330 km/h that spun into the Green Acres campground near Red Deer, Alberta claiming 12 lives and injuring 140 others. Damages have been estimated at $13 million. The Pine Lake tornado is ranked as Canada's fifth deadliest tornado and the deadliest in North America in 2000.

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## Les dix principaux événements météorologiques de l'an 2000[3]

par David Phillips[4]

Pour la première fois en 13 ans, une tornade mortelle a frappé le Canada, tuant 12 personnes à Pine Lake en Alberta. Cette tragédie a été la nouvelle météorologique la plus importante de l'an 2000 et l'une des plus importantes manchettes de l'année.

L'arrivée du nouveau millénaire a vu les jumeaux du Pacifique (El Niño et La Niña) finalement disparaître. Cette année a aussi vu un des hivers les plus courts des annales précéder un des étés les plus courts (si c'était vraiment un été). Une série de tempêtes de pluies diluviennes a frappé le pays de la Saskatchewan à la Nouvelle-Écosse, créant des inondations coûteuses et pénibles pour des milliers de résidents.

Cette année aussi, phénomène rare, un ouragan a touché terre à Terre-Neuve tandis que les agriculteurs canadiens connaissaient d'autres avatars météorologiques. L'année 2000 a été une autre année chaude, la huitième de suite pour le Canada. De plus, l'automne 2000 était la 14e saison consécutive où les températures ont été supérieures à la normale. En juillet, des touristes à bord d'un brise glace russe ont causé tout un émoi au niveau international quand ils ont trouvé une zone d'eau libre au pôle Nord à la place de la banquise. Ces événements sont conformes aux prévisions d'effets des changements climatiques émises par les scientifiques. Cette année a été aussi une année pendant laquelle la Colombie-Britannique, hormis une tempête de vent à la mi-décembre, semble avoir échappé à la colère des dieux de la météo.

Voici donc la description et la liste en rang inverse des dix événements météorologiques les plus importants de l'année 2000 classés en fonction de facteurs comme l'impact qu'ils ont eu sur la population canadienne, leur étendue géographique et leurs effets économiques.

**10. Début précoce de l'hiver 2000-2001**

C'est l'arrivée précoce en décembre d'une coulée polaire. L'hiver est arrivé au Canada avec des refroidissement éoliens terribles dans l'ouest, des quantités massives de neige dans certaines parties du centre du Canada et des vents impitoyables dans les Maritimes. Chaos sur les routes, vols aériens annulés et pannes d'électricité comptent au nombre des défis auxquels les Canadiens ont dû faire face partout au pays.

**9. L'hiver de l'an 2000 : doux et court**

Ce qui a été le plus frappant durant cet hiver a été sa courte duré, seulement cinq semaines et non cinq mois.

[3] Source: Site web d'Environnement Canada: http://www.ec.gc.ca/press/00-12-27_b_f.htm

[4] Climatologue Sénior, Environnement Canada, Downsview, Canada

Dans la plupart des régions, il a été parfaitement concentré entre la mi-janvier et la fin février. Ce quatrième hiver le plus doux en plus d'un demi-siècle a été aussi enneigé que la normale. Edmonton a connu son hiver le plus ensoleillé des 81 dernières années. Si les coûts de chauffage ont été moindres, les carnavals d'hiver et autres activités hivernales ont souffert.

**8. L'ouragan Michael et la déprime de novembre**

Le puissant ouragan Michael a frappé Terre-Neuve le 19 octobre, événement rare au Canada. Il est surprenant que peu de dommages a été enregistré. Le mois de novembre a marqué de nouveaux records de cieux continuellement couverts dans les Maritimes. L'île du Cap-Breton a dû subir 19 jours de pluie ininterrompue, soit une accumulation de 400 mm. L'inondation a causé des dommages aux habitations et aux routes pour plus de 3 millions de dollars.

**7. Une inondation éclair submerge un village de la Saskatchewan**

La septième place va à l'une des plus intenses chutes de pluie jamais enregistrée au Canada. Le village de Vanguard en Saskatchewan, un des endroits les plus secs du pays, a reçu plus de 375 mm en moins de huit heures!

**6. D'autres ennuis météorologiques à la ferme**

Une fois de plus, les agriculteurs canadiens ont connu une année difficile. Un hiver doux et de l'humidité ont influencé le centre du Canada au printemps et ont créé un lieu de reproduction idéal pour les insectes et les maladies. Dans les provinces de l'Atlantique et dans le sud du Manitoba, l'humidité de septembre et d'octobre a empêché les agriculteurs de terminer leur récolte à temps. Si de nombreuses régions du Canada ont connu un temps humide, le sud de l'Alberta a dû faire face à des conditions de sécheresse inconnues depuis 1918.

**5. Jusqu'à quel niveau descendra l'eau des Grands Lacs?**


Les supports de quais visibles à Maceys Bay dans la baie georgienne sur le lac Huron

Cinquième sur la liste se trouve l'amenuisement des Grands Lacs. Trois mois de pluies dignes de la mousson dans la région des Grands Lacs n'ont pas pu pallier trois années de sécheresse causée par du temps chaud. Le niveau de l'eau de tous les Grands Lacs est à la baisse, excepté celui du Lac Ontario. Le niveau de l'eau baisse davantage et plus vite qu'à n'importe quel autre moment du 20e siècle.

**4. Une tempête en janvier ensevelit les provinces de l'Atlantique**

La «tempête du siècle» des provinces de l'Atlantique en janvier a recouvert la Nouvelle-Écosse et l'Île du Prince-Édouard de 54 cm de neige. La tempête a créé une très forte houle qui a grossi la plus forte marée de la saison à Charlottetown. Elle a également produit la plus forte vague à frapper Terre-Neuve depuis 1929. Heureusement, aucune vie n'a été perdue, mais la tempête a causé plusieurs millions de dollars de dégâts dans les provinces de l'Atlantique.

**3. Des pluies diluviennes inondent l'Ontario et le Manitoba**

Des pluies torrentielles sont tombées sur l'Ontario à une fréquence sans précédent, même s'il y a eu moins de phénomènes météorologiques extrêmes cet été. Le sud du Manitoba a aussi connu quelques déluges. Le plus important s'est produit le 7 juillet quand une pluie diluvienne a déversé en quelques heures une quantité d'eau équivalente aux précipitations habituelles d'un mois, soit entre 75 et 110 mm.

**2. Un été décevant dans tout le Canada**

L'été sans soleil. Au centre du Canada, le début de l'été a été un des plus humides des annales. En Colombie-Britannique, Victoria a établi un nouveau record d'absence d'ensoleillement en mai. L'absence de jours chauds et humides s'est traduite par un nombre moins élevé d'alertes au smog et un été plus confortable pour ceux et celles qui souffrent de problèmes respiratoires.

Et, en tête de liste des principaux événements météorologiques de l'an 2000

**1. Première tornade meurtrière en 13 ans frappe l'Alberta**

En tête de liste tourbillonne une tornade meurtrière créant des vents de 330 km/h qui a frappé de plein fouet le camping Green Acres près de Red Deer en Alberta, tuant 12 personnes et en blessant 140 autres. On a estimé les dommages à 13 millions de dollars environ. La tornade de Pine Lake a été la cinquième plus meurtrière de l'histoire canadienne et la plus meurtrière de l'année en Amérique du Nord.

# Neural network codes for nonlinear principal component analysis and nonlinear canonical correlation analysis

by William W. Hsieh[1]

For a set of variables $\{x_i\}$, principal component analysis (PCA) (also called Empirical Orthogonal Function analysis) extracts the eigenmodes of the data covariance matrix. It is widely used to (i) reduce the dimensionality of the dataset, and (ii) extract features from the dataset. When there are two sets of variables $\{x_i\}$ and $\{y_j\}$, canonical correlation analysis (CCA) finds the modes of maximum correlation between $\{x_i\}$ and $\{y_j\}$, rendering CCA a standard tool for discovering relations between two fields. As both PCA and CCA are linear methods, nonlinear relations in datasets cannot be detected correctly.

Neural network models have been widely used for nonlinear regression and classification (with codes available in many computer packages, e.g. in the MATLAB Neural Network toolbox). Recent developments in neural network modelling have further led to the nonlinear generalization of PCA and CCA. A set of codes for performing nonlinear PCA and nonlinear CCA has been prepared at UBC for free distribution to the research community. The codes are written in MATLAB, and the MATLAB Optimization toolbox must also be available to perform the nonlinear optimization. The codes, with accompanying manual and relevant papers are downloadable from our web site: **http://www.ocgy.ubc.ca/projects/clim.pred**.

Whether the nonlinear approach has a significant advantage over the linear approach is highly dependent on the dataset-- the nonlinear approach is generally ineffective if the data record is short and noisy, or the underlying relation is essentially linear. Because of local minima in the cost function, an ensemble of optimization runs from random initial weight parameters is needed, and the best member of the ensemble selected as the solution. There is no guarantee that the best member is close to the global minimum. Presently, the number of 'hidden neurons' and the weight penalty parameters are determined largely by a trial and error approach. Future research will hopefully provide more guidance on their choice.

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## 2001 CMOS Tour Speaker
## Dr. Howard J. Freeland
## Institute of Ocean Sciences
## DFO/Science, Pacific Region

Howard Freeland gained a B.A. from the School of Mathematical Studies, University of Essex, in England, in 1968 and a PhD in Physical Oceanography at Dalhousie University in 1973. He then spent two years as a Post Doctoral Fellow at the Woods Hole Oceanographic Institute and two years as an Assistant Professor at the University of Rhode Island before getting his bearings straight and moving to the left coast of Canada.

Howard has a long-standing interest in Lagrangian measurements - his first publication on things Lagrangian appeared in 1975 - and a long-standing interest in climate change issues, publishing his first paper on that topic in 1977. Since then Howard has published papers on fjord dynamics, coastal physical oceanography, large scale circulation and climate change. At the present time Howard is working on the Line-P data set in the Gulf of Alaska, and managing the development of a Canadian contribution to Argo.

Howard is a member of CMOS and of the International Argo Science Team.

### Agenda of the Tour

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|---|---|---|
| Kelowna | March 16 | Okanagan University |
| Edmonton | March 17 | University of Alberta |
| Saskatoon | March 28 | University of Saskatchewan |
| Winnipeg | March 29 | |
| Toronto | March 30 | MSC Auditorium |
| St-John's | April 2 | Memorial University |
| Halifax/ Dartmouth | April 3 | Bedford Institute of Oceanography |
| Fredericton | April 4 | |
| Mont-Joli/ Rimouski | April 5 | Institut Maurice-Lamontagne |
| Québec | April 6 | Ministère de l'Environnement |
| Montréal | April 9 | |
| Kingston | April 10 | Royal Military College |
| Ottawa | April 11 | |
| Vancouver | April 24 | University of British Columbia |
| Victoria | May | |


### Abstract

"Launching the Argo Armada"

In 2001 the first steps will be taken towards launching an armada of floats that eventually will transform the practice of physical oceanography. When completed the Argo armada will be a global array of profiling floats that will supply deep and surface velocities and temperature and salinity profiles in real time at 10-day intervals.

The talk will outline the changes in physical oceanography that prompted the development of a global program like Argo, will discuss the technology that makes this possible, and will discuss the prospects for achieving global sampling, the objectives and design of the array, the accuracy of sampling and the expectations oceanographers should reasonably have from this array. I will also endeavour to suggest where this technology might lead over the next few years and discuss the challenges that lie ahead both political and technical.

The data flow will begin in 2001 and the complete data sets will have no protection for the scientists who make the deployments, rather, the data will be made available in real-time on both the GTS and on the WWW. Thus, all scientists, whether from countries that contribute to Argo or not, will have available real-time descriptions of the dynamics of the top 2000 metres of the ocean.


## Canadian Oceanographer to received coveted Japan Prize

Dr. Timothy Parsons will be the first Canadian to receive the Japan Prize in the 17-year history of one of the world's most prestigious science awards. The award to Dr. Parsons also marks the first time that the Japan Prize recognizes outstanding achievements in the field of oceanography "to advance the frontiers of knowledge and serve the cause of peace and prosperity for mankind".

After receiving a Ph.D. from McGill University in 1958, Dr. Parsons started his scientific career with the Pacific Oceanographic Group of the Fisheries Research Board of Canada at the Pacific Biological Station, Nanaimo, B.C. This phase of his scientific life included a term at the Office of Oceanography for the United Nations Educational, Scientific and Cultural Organization (UNESCO) in Paris from 1962-1964. From 1972 until his retirement in 1992 he was at the Department of Oceanography at the University of British Columbia in Vancouver, B.C. where he is a professor emeritus. Dr. Parsons was a member of the North Pacific Marine Science Organization (PICES) *Biological Oceanography* Committee from *1992 to 1996*. Dr. Parsons is currently an emeritus scientist *with Fisheries and Oceans Canada*, located at the Institute of Ocean Sciences, Patricia Bay, B.C.

Together with his friend and colleague, the late Dr. John Strickland, he wrote the book on analytical methods for oceanographers. Their publication is still on the benches of virtually every oceanographic laboratory. Dr. Parsons also authored *Biological Oceanographic Processes*, the classic textbook for students of biological oceanography. Dr. Parsons pioneered the "ecosystem" approach to conservation-based fisheries management and pollution studies. Through "controlled ecosystem pollution experiments", he and colleagues from the United States, Germany and Japan, were able to analyze how low levels of pollutants affect the food-web from plankton to fish. Dr. Parsons' research broke new ground and encouraged others to understand how human activity impacts our environment.

The Japan Prize is considered on a par with Nobel awards, in part because four of the laureates later became Nobel Prize winners. Twenty-two Americans, five Japanese, four French and one each from Israel, India, Australia, UK, Germany, Sweden and Belgium have been honoured in the past. On April 27, 2001 Dr. Parsons will receive a Citation for Award, a Japan Prize Medal and 50 million Japanese Yen prize money in a ceremony in Tokyo to be presided by the Japanese Emperor and Empress. He will give a commemorative lecture and participate in a week long program of press conferences, welcome reception, courtesy call on the Prime Minister, Canadian Embassy congratulatory reception, the presentation ceremony and banquet, and academic discussions with eminent scientists.

Submitted by Robin Brown, Peggy Tsang (Fisheries & Oceans Canada) and Skip McKinnell (PICES).

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## CDR M.R. Morgan, PhD, RCN (Retd)

A noteworthy achievement of interest to CMOS is the recent award of the degree of PhD to one of its octogenarian members, CDR M.R. (Dick) Morgan of Dartmouth, Nova Scotia.

After a career as a meteorologist in the British and Canadian naval weather forces which provided him with operational meteorological experience in every ocean of the world, Dick retired from the then Atmospheric Environment Service of Environment Canada as Superintendent of Meteorological and Oceanographic Plans, Requirements and Training at National Defence Heaadquarters , Ottawa in 1977. He was then employed by WMO for the next three years as an advisor in marine meteorology to the Southeast Asian Nations from an office in Kuala Lumpur.

Returning to Dartmouth, NS, he became advisor to marine lawyers and insurers with regard to disasters at sea in the North Atlantic. Due to the collapse of the cod fishery off Labrador and Newfoundland he became involved in climate change in the North Atlantic. In association with Drs Roger Pocklington and Ken Drinkwater at the Bedford Institute of Oceanography, he presented a number of papers in the Bulletin and at CMOS meetings on this topic.

He has contended that current modelling of climate change is unconvincing because of the lack of effort to identify and estimate natural variability, particularly when it is admitted by the IPCC that it could be a major component of change (IPCC 1995 p.11 and 441). Moreover, the IPCC admits that regional climate may differ widely from global change. Hence, until the variability in the natural base-line change is available to measure regional change and the anthropogenic GHG effect, guidance to policy makers and planners has little credibility.

> Did you know that the Gleissberg cycle is an 80-year cycle in sunspot activity which is superimposed on the more familiar 11-year cycle. The Suess cycle is a 200-year cycle in solar activity as determined from carbon 14 measurements of tree ring growth.
>
> Ref: Hanna, E., 1996; *Have long-term solar minima, such as the Maunder Minimum, any recognisable climatic effect?* Part 1: Evidence for solar variability", WEATHER, Volume 51, No 7, July 1996, Page 234.

Dick entered Exeter University in October 1998 to prepare and present a thesis on "Climate Change in the North Atlantic Relative to the Global Warming Hypothesis" and to endeavour to establish an appreciation of the natural variability in regional climate. Exeter was chosen partly because of its strong research programme in paleo-climatology in the Geography Faculty.

Dick was awarded his PhD on 12$^{th}$ July last, just two days before his 83$^{rd}$ birthday. In his thesis he developed the hypothesis that a long term climate appears to be governed by the Gleissberg and Suess cycles of solar variability. As these are expected to reach nadir values by the middle of this century, creating a period of solar quiescence, this would offset the anticipated anthropogenic warming derived from GHG models.

Congratulations Dick from all CMOS Members. Quite an achievement at age 83!

Submitted by David Nowell, CMOS Member, Ottawa.

## An Open Invitation to Attend the 35th CMOS Annual Congress

It is our pleasure to invite you to the 35th CMOS Congress to be held in Winnipeg from May 28th to June 1st, 2001. The theme for this year's congress is Extreme Weather. What better offering of weather extremes than the Canadian prairies, home to summer thunderstorms, winter blizzards, droughts and floods, heat waves and cold snaps. The congress itself will be filled with a stimulating scientific program; as well as social functions where colleagues can come together to learn, share new ideas, renew old friendships and build new ones.

We wish to welcome you to the city at the forks of the Red and Assiniboine Rivers. A vibrant prairie metropolis of 650,000 people, Winnipeg is a city filled with diversity, lush green parks and friendly faces. Aside from the congress itself, we invite you to explore the endless variety of dining and cultural activities, festivals, attractions from sports to the arts, museums and galleries, from the scenic Forks to the bustling downtown.

Jim Slipec, Chair Local Arrangements Committee

## 35th Annual CMOS Congress

### Student Travel Bursaries to Winnipeg, MB
### Last date for submitting application is
### April 1, 2001

Graduate students interested in attending the Congress, should consider submitting an online application for a Congress Travel Bursary. Approximately $5000 is allocated each year to support students up to $500 each.

Preference will be given to students who have not previously received a CMOS Travel Bursary and who are presenting a first-time paper.

Requirements

1. The student or his/her supervisor must be a member of CMOS; and
2. The student must submit a suitable abstract for a presentation at the Congress.

Note: A student who is current recipient of CMOS Graduate Student Prize, or the holder or awardee of a CMOS Scholarship, qualifies for Travel Bursary provided he/she submits a suitable abstract and the application for the Travel Bursary. To obtain an Application Form turn to the CMOS Web page and click on **Student Bursaries**.

## 35e Congrès annuel de la SCMO

### Bourses de voyage pour étudiants pour Winnipeg, MB
### Date limite de remise de la demande:
### 1er avril 2001

Les étudiants diplômés intéressés à participer au Congrès de la SCMO peuvent soumettre une demande électronique pour une bourse de voyage pour le Congrès. Environ 5 000 $ sont remis chaque année afin d'aider les étudiants, qui reçoivent chacun un montant de 500 $.

La préférence sera donnée aux étudiants n'ayant jamais reçu de bourse de voyage de la SCMO et qui présentent une communication pour la première fois.

Exigences:

1) L'étudiant ou son superviseur doit être membre de la SCMO; et
2) L'étudiant doit préparer un résumé approprié pouvant être présenté au Congrès.

Note: Le récipiendaire du Prix de l'étudiant diplômé de la SCMO de cette année, ainsi que le récipiendaire actuel d'une bourse de la SCMO, sont également admissibles pourvu qu'ils ou elles présentent un résumé approprié et une demande de bourse de voyage. Pour obtenir un formulaire d'inscription, veuillez voir le site Web de la SCMO et cliquer sur " Bourses pour étudiants ".

## 35th Congress of the Canadian Meteorological and Oceanographic Society
## May 28 - June 01, 2001
## Winnipeg, Manitoba Canada

### Call for Papers

The 35th Congress of the Canadian Meteorological and Oceanographic Society (CMOS) will be held from May 28-June 01, 2001, at the Sheraton Hotel in Winnipeg, Manitoba, Canada. The theme of 35th CMOS Congress is **Extreme Weather**. Papers are being solicited on all aspects of extreme weather events found globally such as severe thunderstorms, tornadoes, tropical cyclones, flooding, droughts, blizzards, etc. Particular emphasis should be placed on forecasting, impacts, warning and emergency preparedness, remote sensing, numerical, atmosphere-ocean interactions, and climate modelling and variability, as they relate to extreme weather. All presentations relating to this topic and additional related topics which can tie into the overall theme are welcomed. A pre-print volume is being planned which will contain all accepted abstracts. The final date for abstract submission is February 28, 2001. Contributing authors are encouraged to submit as early as possible for this major international conference.

For more information, please contact:
Jay Anderson, Prairie Storm Prediction Centre
Suite 150 123 Main Street
Winnipeg, MB Canada R3C 4W2
phone: 204-984-7923; fax: 204-983-0109
e-mail: jay.anderson@ec.gc.ca

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## 35e congrès de la Société canadienne de météorologie et d'océanographie 28 mai - 1er juin 2001 Winnipeg (Manitoba) Canada

### Demande de communications

Le 35e congrès de la Société canadienne de météorologie et d'océanographie (SCMO) se tiendra du 28 mai au 1er juin 2001 à l'hôtel Sheraton de Winnipeg (Manitoba), Canada. Le thème de ce 35e congrès portera sur les conditions météorologiques extrêmes. Nous acceptons dès maintenant toute proposition de communication traitant d'un ou plusieurs aspects des conditions météorologiques extrêmes dans le monde telles que les orages violents, les tornades, les cyclones tropicaux, les inondations, les tempêtes de neige, etc. L'accent doit être mis sur les méthodes de prévision, les impacts, la diffusion d'avertissements, la capacité d'intervention en cas d'urgence, la télédétection, les données numériques, l'interaction entre l'atmosphère et l'océan, la modélisation du climat ou les changements climatiques, et le sujet doit être traité dans le cadre des conditions météorologiques extrêmes. Toutes communications traitant de ce sujet ou de domaines connexes ayant un rapport avec le thème principal seront examinées. Nous prévoyons publier un volume préliminaire contenant tous les résumés acceptés. La date limite pour la présentation des résumés est fixée au 28 février 2001. Nous conseillons aux auteurs désirant soumettre un résumé à cette grande conférence internationale d'envoyer leur dossier le plus tôt possible.

Prière de contacter Jay Anderson pour plus de renseignements:
Centre de prévision des orages des Prairies,
123, rue Main, bureau 150
Winnipeg (Manitoba) Canada R3C 4W2
Téléphone : (204)-984-7923; Fax: (204)-983-0109
Courriel : Jay.Anderson@ec.gc.ca

Conference announcement and call for abstracts

## Challenges of a Changing Earth

### Global Change Open Science Conference Amsterdam, Netherlands, 10-13 July 2001

The Conference will present the latest scientific understanding of the many facets of global environmental change, it will point towards the novel research approaches needed to study Earth as a system, and it will explore the role of science in the quest for global sustainability. It is jointly sponsored by the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP) and the World Climate Research Programme (WCRP).

The Conference is aimed primarily towards the global change scientific community, including specialists in disciplinary areas of global change research who are keen to set their work in the broader Earth System context. The Conference will also provide an excellent state-of-the-art overview of global change issues for policy-makers and resource managers. A special effort will be made to attract and support scientists from developing countries, Eastern Europe and the New Independent States.

Deadline for Abstract Submission: **31 March 2001.**

Deadline for Registration: **30 April 2001.**

More information on the conference, including online registration and abstract submission is available on the homepage: www.sciconf.igbp.kva.se

Anne Larigauderie, PhD
Environmental Sciences Officer International Council for Science (ICSU)
51, bd Montmorency
75016 Paris FRANCE
Tel: (33 1) 45 25 03 29; Fax: (33 1) 42 88 94 31
e-mail: anne@icsu.org

## CMOS Congress Registration Fees
## Droits d'inscription au Congrès de la SCMO

| Full Registration * / Inscription au Congrès * | | One-day Registration/ Inscription à la journée |
|---|---|---|
| Fees in CDN $<br>Frais en $ CDN | Early ** - Late<br>Tôt ** - Tardive | |
| CMOS Member<br>Membre de la SCMO | **295 - 345** | **100** |
| Non-member<br>Non-membre | **345 - 395** | **125** |
| CMOS Student ***<br>Étudiant SCMO *** | **120 - 120** | **50** |
| Non-member student ***<br>Étudiant non-membre *** | **150 - 150** | **50** |
| Retired member<br>Membre à la retraite | **120 - 120** | **50** |

* Includes icebreaker, banquet and awards luncheon tickets.
* Inclus des billets pour assister à la soirée réception, au banquet et déjeuner de ligne décernement des prix.

** To qualify for early registration fees, payment by cheque, money order or credit card must be received by April 15, 2001. Register by March 15th and be entered into an Early Bird draw sponsored by the Sheraton Hotel.
** Pour bénéficier du taux réduit d'inscription, votre paiement (chèque, mandat de poste ou carte de crédit) doit être reçu avant le15 avril 2001. Si vous vous inscrivez avant le 15 mars, vous pourriez être le gagnant d'un prix offert par l'Hôtel Sheraton Winnipeg.

*** With proof of status as student (i.e. 2000/2001 student card).
*** Avec preuve officielle de votre carte d'étudiant 2000-2001.

**** Make cheques or Money Orders payable to : **CMOS Winnipeg Centre**
**** Faire les chèques ou les mandats de poste: **CMOS Winnipeg Centre**

Fill out, sign and fax your completed form (included in this issue of the CMOS Bulletin SCMO) to the following number:
Une fois remplis et signé, le formulaire (inclus avec ce numéro du CMOS Bulletin SCMO) devrait être envoyé soit par télécopieur au:

**(204) 257-5205**

**or by Post to:**
**ou par la poste à:**

**Frontline Associates**
**100 DeBourmont Bay**
**Winnipeg, Manitoba R2J 1K3**

**e-mail / courriel: carmenn-is@home.com**
**Phone / Tél: (204) 254-2293**

## Summer Meteorology Workshop
## Project Atmosphere

Call for Applications by Pre-college Teachers

As in several previous years, the Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in PROJECT ATMOSPHERE in 2001. This is a summer workshop for pre-college teachers of Atmospheric Science topics sponsored by the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA) of the United States. It takes place July 22 - August 3, 2001 at the National Weather Service Training Center, Kansas City, Missouri.

The expenses for the participating teacher are paid by AMS/NOAA, except for the travel to and from Kansas City. CMOS and the Canadian Council for Geographic Education contribute up to $300 (Canadian) each (total $600) towards the travel expenses.

Previous Canadian participants have found their attendance a very rewarding and significant experience (see *CMOS Bulletin SCMO*, Vol.28, No.5, p.155). Presentations are made at the Workshop by some of the most respected American Scientists in the fields of atmospheric and oceanographic sciences. Participants have returned with material, resources and teaching modules readily adaptable to classroom presentations.

Interested teachers should request, as soon as possible, an application form from the following address:

Executive Director
CMOS - Summer Workshop
Suite 112, McDonald Bldg
150 Louis-Pasteur
Ottawa, ON K1N 6N5
Tel: (613) 990-0300; Fax: (613) 993-4658
e-mail: cmos@meds-sdmm.dfo-mpo.gc.ca

## Atelier d'été en météorologie
## Projet Atmosphère

Demande de candidats de niveau pré-collégial

Comme par les années passées, la Société canadienne de météorologie et d'océanographie (SCMO) a été invitée à choisir un enseignant canadien qui participera au PROJET ATMOSPHÈRE en 2001. Il s'agit d'un atelier d'été à l'intention des enseignants de niveau pré-collégial spécialistes en sciences atmosphériques; cet atelier est parrainé par l'American Meteorological Society (AMS) et la National Oceanic and Atmospheric Administration (NOAA) américaine. Il aura lieu du 22 juillet au 3 août 2001 au centre de formation du National Weather Service à Kansas City au Missouri.

Les dépenses de l'enseignant choisi seront assumées par l'AMS et la NOAA, à l'exception des déplacements à destination et au retour de Kansas City. La SCMO et le Conseil canadien pour l'enseignement de la géographie offrent chacun jusqu'à 300 $ (canadiens), soit au total 600 $, pour les déplacements.

Les anciens participants du Canada ont trouvé leur expérience très enrichissante et stimulante (lire *CMOS Bulletin SCMO*, Vol. 28, No. 5, p. 155). Les exposés de l'atelier sont présentés par des experts américains les plus réputés dans les sciences atmosphériques et océanographiques. Les enseignants sont revenus avec du matériel, des ressources et des modules didactiques qu'ils peuvent facilement adapter dans leurs cours.

Les enseignants intéressés sont priés de demander un formulaire de candidature à l'adresse suivante :

Directeur exécutif
SCMO - Atelier d'été
Bureau 112, Immeuble McDonald
150, rue Louis-Pasteur
Ottawa (Ontario) K1N 6N5
Téléphone: (613) 990-0300; Télécopie: (613) 993-4658
Courriel: cmos@meds-sdmm.dfo-mpo.gc.ca

## Centres, Chapitres et Commités
## RAPPEL *** RAPPEL

Les rapports annuels avec les états financiers lorsque requis sont maintenant dus pour le rapport annuel de la SCMO. Prière de les faire parvenir par courrier électronique au bureau du Directeur exécutif, CMOS@meds-sdmm.dfo-mpo.gc.ca avec une copie à Paul-André Bolduc, paulandre.bolduc@sympatico.ca pour la fin de février 2001.

*Neil J. Campbell,*
*Directeur exécutif*

## Centres, Chapters and Committees
## REMINDER *** REMINDER

Annual reports with financial statements, as appropriate, are now due for the CMOS Annual Review. Please forward them electronically to the Office of the Executive Director, CMOS@meds-sdmm.dfo-mpo.gc.ca with a copy to Paul-André Bolduc, paulandre.bolduc@sympatico.ca by end of February 2001.

*Neil J. Campbell*
*Executive Director*

## Report of the Nominating Committee
## Rapport du Comité de mise en candidature

The attention of CMOS members is drawn to the following report of the Nominating Committee for the elections to CMOS Council and Executive and to By-Law 10 governing the elections to be held at the upcoming Annual General meeting. Members are reminded that they have until March 15 to make additional nominations and they should consult the By-Law for the procedures.

Les membres de la SCMO sont priés de prendre note du rapport du Comité de mise en nominations pour l'élection du Conseil de la SCMO et de son Éxécutif. Ils doivent également tenir compte du réglement # 10 de notre constitution qui régit les élections qui doivent se tenir à l'Assemblée générale annuelle. Les membres doivent tenir compte qu'ils ont jusqu'au 15 mars pour faire des nominations additionnelles et qu'ils doivent consulter nos réglements pour la procédure à suivre.

## Report of the Nominating Committee
## Rapport du Comité de mise en candidature

Members/membres:

Bill Pugsley ; Ian Rutherford (Chair/Président)
Peter Taylor; Ron Stewart

The Committee nominates the following persons for the 2001-02 Council. All nominees have expressed their willingness to serve in the indicated positions.

Le comité met en nomination les personnes suivantes pour faire partie du Conseil d'administration pour l'année 2001-02. Toutes les personnes mises en nomination ont consenti à occuper les postes indiqués.

President / Président

Ronald Stewart
Climate and Atmospheric Research Directorate
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4905 Dufferin St.
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Vice-President/ Vice-président

Ronald Bianchi
Vice-President, Meteorology
The Weather Network
1 Robert Speck Parkway, suite 1600
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Tel: (905)566-9511ext268; Fax: (905)566-5905
E-mail/Courriel: rbianchi@ilap.com

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4905 Dufferin St.
Downsview, ON M3H 5T4
Tel: (416) 739-4254; Fax: (416) 739-4721
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E-mail/Courriel: swoodbury@seimac.com

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(submitted January 30, 2001)

## Motion for a Fee Change in 2002

After an analysis of the financial status of CMOS and expected changes in management, Council on January 25, 2001, approved a motion for a fee increase for most classes of membership in CMOS.

The motion being put forward and seconded by Council to Members to effect this change reads as follows:

Council moves that effective January 1, 2002:

**Corporate members** fees of $225 be increased to $250. (In respect to this increase members of Council recommended that the Executive consider what benefits could be associated with this increase);

**Regular members** fees of $45.00 be increased to $60.00;

**Retired members** fees of $30.00 be increased to $40.00;

**Student Members** fees of $20.00 be increased to $30.00; (Students receive Atmosphere-Ocean and the Bulletin as part of their fees);

**Sustaining Members** fees are to remain at $170.00 with the following benefits: i) permanent listing in each issue of the Bulletin; ii) free listing on CMOS homepage and an ad or link to their own web site;

**Associate Members** fees are to be set at $40.00 for i) reciprocal memberships from other societies and ii) to teachers who are involved in or are associated with the work of the CMOS School and Public Education Committee

**Accredited Consultants** membership fees of $45.00 be increased to $60.00, with an initial accredited application fee of $150.00 and an annual maintenance fee of $20.00. Non-member Accredited Consultant fees will be $100.00 annually.

**Endorsed Weathercasters** membership fees of $45.00 be raised to $60.00 with an initial endorsement fee of $200.00 for TV and $100.00 for radio and an annual maintenance fee of $20.00

**Fellow** is required to remain a member in good standing;

**Honorary Fellow** is exempt from fees.

*Neil J. Campbell*
*Executive Director*

## Proposition de modification des frais d'adhésion en 2002

Après avoir analysé le statut financier de la SCMO et les changements prévus par la direction, le Conseil a approuvé le 25 janvier une proposition afin d'augmenter les frais d'adhésion de presque tous les niveaux d'adhésion de la SCMO.

La proposition mise de l'avant et appuyée par le Conseil à ses membres le lit ainsi:

Le Conseil propose qu'à compter du 1er janvier 2002:

Les frais des **membres corporatifs** passent de 225 $ à 250 $. (En ce qui concerne cette augmentation, le Conseil recommande que des avantages soient associés à cette augmentation.);

Les frais des **membres réguliers** passent de 45 $ à 60 $;

Les frais des **membres retraités** passent de 30 $ à 40 $;

Les frais des **membres étudiants** passent de 20 $ à 30 $; (Les étudiants recevront Atmosphere-Ocean et le Bulletin dans le cadre de leur adhésion.);

Les frais des **membres de soutien** demeurent à 170 $ avec les avantages suivants: i) la liste permanente sera publiée dans chaque numéro du Bulletin; ii) inscription gratuite sur la page d'accueil de la SCMO et une publicité ou un lien à leur propre site Web;

Les frais d'adhésion des **membres associés** soient établis à 40 $ pour i) les adhésions réciproques dans d'autres sociétés et ii) les enseignants qui participent ou sont associés au travail du Comité sur l'enseignement public et scolaire de la SCMO;

Les frais d'adhésion des **consultants accrédités** passent de 45 $ à 60 $, avec des frais initiaux de demande d'accréditation de 150 $ et des frais annuels de maintien de 20 $. Les frais annuels pour les consultants accrédités non membres passent à 100 $;

Les frais des **présentateurs météo agréés** passent de 45 $ à 60 $ avec des frais initiaux d'inscription de 200 $ pour la télévision et de 100 $ pour la radio et des frais annuels de maintien de 20$;

Les **fellows** doivent demeurer membres en règle; et

Les **fellows honoraires** n'ont aucuns frais à débourser.

*Neil J. Campbell*
*Directeur exécutif*

## Canadian Meteorological and Oceanographic Society

### Undergraduate Scholarship

### $500

This year two undergraduate scholarships will be offered by the Canadian Meteorological and Oceanographic Society, valued at $500 each, to successful student applicants planning a career in atmospheric, hydrological, oceanographic or limnological sciences. These scholarships are tenable at any Canadian university.

Applicants must be Canadian citizens or have landed immigrant status and be in their penultimate undergraduate year; the scholarships are to support the students' final university year.

To be qualified, students should be taking half courses in four or more of the following areas in their final year:

- meteorology;
- physical or chemical oceanography;
- hydrology;
- physical or chemical limnology;
- climatology.

Details are to be provided in the application.

Students are required to submit transcripts of academic studies, a statement of interest and intent and details of relevant work experience.

Two sealed letters of recommendation (in confidence) from university professors who are directly acquainted with and knowledgeable of the work of the student are to accompany the application.

Applications (sample copy included in this issue of the CMOS Bulletin SCMO) should be sent to:

Office of the Executive Director
Canadian Meteorological and Oceanographic Society
Suite 112 - 150 Louis Pasteur
Ottawa, ON K1N 6N5
Fax: (613) 993-4658
e-mail: CMOS@meds-sdmm.dfo-mpo.gc.ca

Application forms can be downloaded from the Canadian Meteorological and Oceanographic Society web site at:

http://www.CMOS.ca

Deadline for receipt of application forms is **April 30 , 2001.**

## Société canadienne de météorologie et d'océanographie

### Bourse d'études de premier cycle

### 500 $

Ces bourses d'études de premier cycle, chacune d'un montant de 500 $, seront offertes par la Société canadienne de météorologie et d'océanographie aux étudiants dont la demande a été acceptée et qui planifient faire carrière dans les sciences atmosphériques, hydrologiques, océanographiques et limnologiques. Ces bourses d'études ne sont valides que dans les universités canadiennes.

Les candidats doivent être citoyens canadiens ou détenir le statut d'immigrant admis et être dans l'avant-dernière année du premier cycle; ces bourses serviront à appuyer les étudiants lors de leur dernière année universitaire.

Afin d'être admissibles, les étudiants doivent suivre des demi-cours dans au moins quatre des domaines suivants durant leur dernière année:

- météorologie;
- océanographie physique ou chimique;
- hydrologie;
- limnologie physique ou chimique;
- climatologie.

Les renseignements doivent être indiqués sur le formulaire de demande.

Les étudiants doivent soumettre leurs relevés de notes d'études universitaires, un exposé d'intérêt et d'intention et les détails d'expérience de travail pertinente.

La demande doit être accompagnée de deux lettres de recommandation scellées (à titre confidentiel) de professeurs distingués qui connaissent personnellement le travail de l'étudiant.

Les demandes doivent être envoyées au:

Bureau du directeur exécutif
Société canadienne de météorologie et d'océanographie
Bureau 112 - 150 Louis Pasteur
Ottawa (Ontario) K1N 6N5
Téléc.: (613) 993-4658
courriel: CMOS@meds-sdmm.dfo-mpo.gc.ca

Les formulaires de demande sont affichés sur le site Web de la Société canadienne de météorologie et d'océanographie au:

http://www.SCMO.ca

La date limite de réception des formulaires de demande est le **30 avril 2001.**

## Report on the 9th Great Lakes Operational Meteorology Workshop

The 9th Workshop on Great Lakes Operational Meteorology was held at the Meteorological Service of Canada (MSC) Headquarters in Toronto from 25 to 27 October 2000. There were about 70 attendees mainly from MSC and the U.S. National Weather Service but universities, weather broadcasters and other private meteorologists were also represented.

The history of this Workshop dates back to 1991 as a one-day meeting in Toronto of forecasters from Toronto, Buffalo and Detroit who got together for informal discussions of problems related to lake effect snow forecasting. The following year the meeting was to be held in Buffalo but because of a snowstorm it was postponed until 1993. The current two-and-one-half day format began at the 3rd Workshop, convened by Brian Murphy of the Ontario Weather Centre, in Windsor in 1994. That same Workshop saw the topics expand to include summertime lake effects such as lake breezes and their effects on convection.

Since then the Workshop has been rotating on a three year cycle with two years in the U.S. and one year in Canada. The flavor of the Workshop changes slightly from year to year depending on the location. Some years there have been hands-on labs and in other years only oral presentations. Generally, 30 minutes were allocated for each talk which allowed for a more relaxed presentation compared to most conferences.

This year most of the first day was spent on Lake Effect Snow forecasting and related topics. These talks ranged from Lake Effect Snow around the world, to snow due to the Finger Lakes in New York state, and deep inland penetration of snow bands from Lake Erie into southern Pennsylvania. Other papers dealt with forecasting techniques, regional modelling of Great Lakes snow effects and the use of satellite data for lake effect snow forecasting. This latter paper gave an excellent summary of plans for the GOES Satellite system over the next decade.

The day ended with two interesting talks on Marine Forecasting. The first dealt with the challenging forecast problems in support of a long distance yacht race. The second was a review of the Edmund Fitzgerald storm and lessons learned in marine forecasting since then.

The second day dealt mainly with summertime events. There was an excellent session on heavy rain forecasting with papers dealing both with case studies and modelling. An afternoon session on convective storms discussed tornado detection algorithms, tornadoes and lake breezes, lightning and derechoes. One paper described the new radar processor being developed as part of the upgrade to the Canadian Radar Network. This system was used with great success as part of a forecast demonstration project at the Sydney Olympics.

Normally the Great Lakes Workshop deals only with short-range forecasting but this year we finished the second day with a discussion on possible effects of climate change on the Great Lakes.

The final morning was taken up with papers dealing with presentation methods using improved forecast discussions and Internet visualizations. There were also presentations on the Canadian Graphical Area Forecast project and an objective guidance system for writing TAFs. A highlight of this session was watching Tom Niziol's skilled impersonation of a Lake Erie wave and the display of that wave in real time by Ed Mahoney's prototype wave riding buoy.

No workshop would be complete without some unplanned event throwing a spanner in the works. By mid-morning of the first day we were getting a little behind schedule. At the end of one paper the session chair (Bill Burrows) said "unless you have a burning question, I'd suggest you hold it till the next break". The next break came a bit sooner than expected as the fire alarm went off about 10 seconds later.

The principal sponsors of the Workshop were the Ontario Region and the Meteorological Research Branch of MSC and the U.S National Weather Service. Support was also provided by CMOS and the Weather Network. CMOS sponsored a very popular Pizza night and provided other support as well.

The program and abstracts for the Workshop can be viewed at http://www.msc-smc.ec.gc.ca/GLOMW9/. We are collecting presentations which were made using electronic methods and will make them available at a later date on CD-ROM. For more information contact Pat King (Patrick.King@ec.gc.ca) or Mike Leduc (Mike.Leduc@ec.gc.ca).

Bob Laplante (Robert.Laplante@noaa.gov) of NWS Cleveland has offered to host next year's Workshop.

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### State of the Environment of the Acadian Peninsula

A report entitled "État de l'environnement de la Péninsule acadienne et ses environs" / "State of the Environment of the Acadian Peninsula and its Surrounding Area" is available in both French and English. The report will serve as a working document for a symposium scheduled for 23-25 February 2001 in Tracadie-Sheila. The goal of the symposium is to identify ways for all stakeholders to work together towards healthy communities and the sustainable use of resources. To obtain a copy of the report and for information on the symposium, email Anne Turcotte-Lanteigne at turcottea@mar.dfo-mpo.gc.ca.

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

1) *Scattering of Waves from Large Spheres* by Walter T. Granby, Jr., Cambridge University Press, Hardback cover, 0-521-66126-9, $95.00US.

2) *Does the Weather Really Matter?* The societal implications of climate change by William James Burroughs, Cambridge University Press, Hardback cover, 0-521-56126-4, price unknown.

3) *Numerical Simulations in the Environmental and Earth Sciences*, Proceedings of the Second UNAM-CRAY Supercomputing Conference, Edited by Fernando García García, Cambridge University Press, Hardback Cover, 0-521-58047-1, $69.95US.

4) *The Earth's Plasmasphere*, by J.F. Lemaire and K.I. Gringauz, Cambridge University Press, Hardback Cover, 0-521-43091-7, $90.00US.

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

Si vous êtes intéressés à faire la critique d'un de ces livres pour le *CMOS Bulletin SCMO*, prière de contacter le rédacteur-en-chef à l'adresse électronique mentionnée ci-bas. Bien entendu, le livre vous appartient lorsque vous avez terminé la critique. Les instructions qui doivent être suivies lors de la critique d'un livre dans le *CMOS Bulletin SCMO* vous parviendront avec le livre. Merci pour votre collaboration.

*Paul-André Bolduc*
*Editor / Rédacteur-en-chef*
*CMOS Bulletin SCMO*
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