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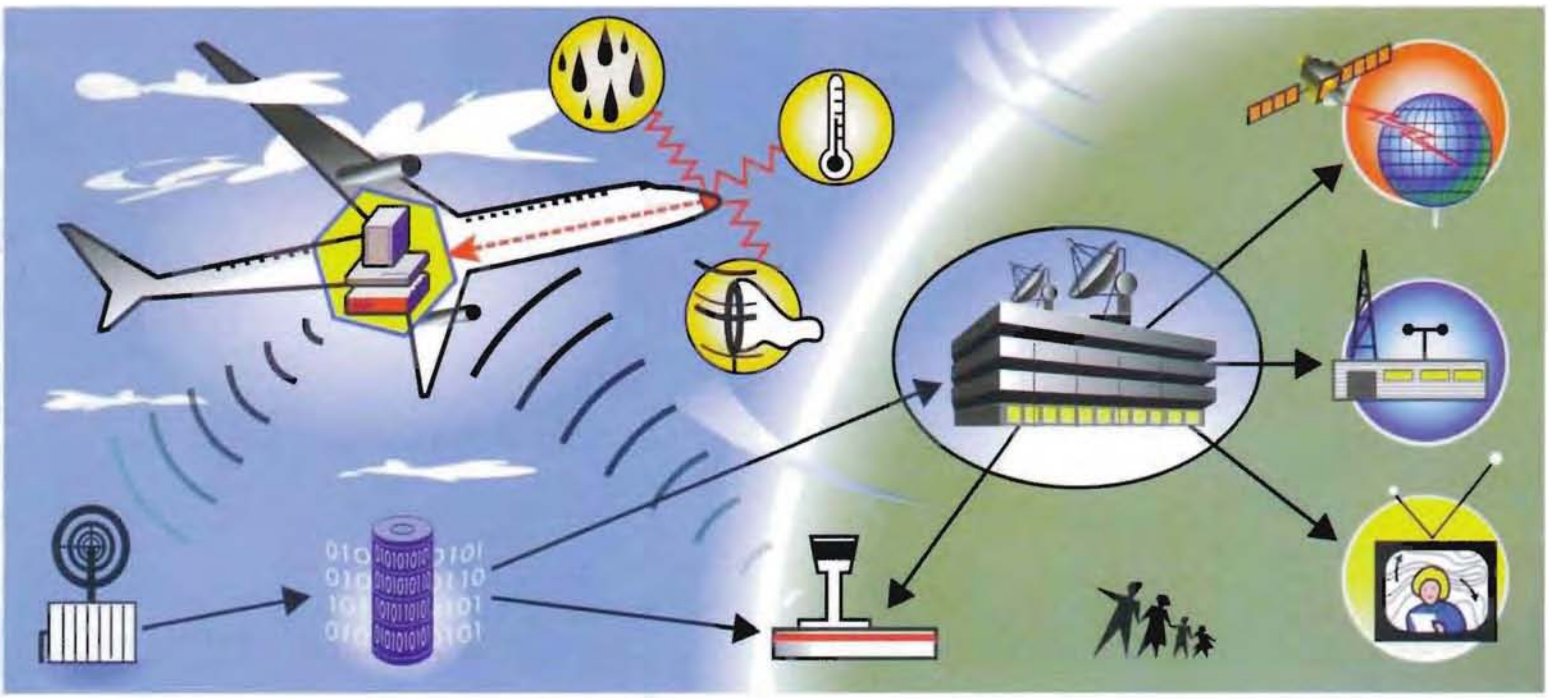

CMOS Bulletin SCMO

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

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Cover page: The figure shown on the Cover Page illustrates the transmission of important data such as airplane's position, altitude, speed and estimated time of arrival. Under the AMDAR system, aircraft will automatically report winds and temperatures without pilot intervention. These data will be incorporated into weather-prediction computer systems. To learn more, read the article on page **72**. See also note at bottom of page **71**.

Page couverture: La figure qui apparaît sur la page couverture illustre la transmission d'importantes données telles que la position de l'avion, son altitude, sa vitesse et son heure prévue d'arrivée. Avec le système AMDAR, l'avion rapportera les paramètres du vent et de la température sans aucune intervention du pilote. Ces données seront incorporées dans les ordinateurs perfectionnés servant à prédire le temps. Pour en savoir plus, lire l'article en page **74**. Voir aussi la note au bas de la page **71**.

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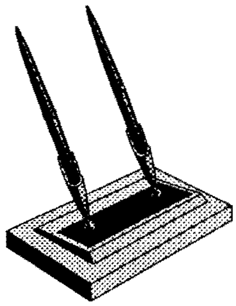
....from the President's Desk



CMOS Friends:

I am starting to write this note in the Sheraton Hotel in Winnipeg on the Wednesday evening after the banquet of our 35th Congress. I am delighted by the success of this conference. The presentations have been enjoyable and stimulating. Well done, Jim Slipec and colleagues in Winnipeg!

The Congress also represented an opportunity to present and discuss some visionary presentations for meteorology and the private sector in Canada. The Assistant Deputy Minister for the Meteorological Service of Canada, Marc Denis Everell, and Ambury Stuart on behalf of the Private Sector, both spoke of their vision for Canadian meteorology. Both visions, while differing somewhat at this stage, of course, foresaw a strong Canadian effort encompassing government, academia and the private sector. CMOS, with its roots in all those areas, can and continues to help to make those visions happen.

I have taken the opportunity to chat informally with a number of people here at this Congress in regard to CMOS and our fields of interest. One cannot help but be struck by everyone's commitment. In general, the mood is rather upbeat, although there are certainly many issues of concern. People often identified specific items that they'd like to see addressed as well.

Some common themes, said in many different ways, include:

- To continue to enhance our research and development, as well as their application. Obviously, progress has been and continues to be made but there are lots of ups and downs that we need to deal with. For example, it is not clear that we yet have a Canadian-style 'balanced' approach that recognizes our many strengths but also recognizes that we're part of a much larger international community.

- To better inform ourselves (in-reach) and others (out-reach) of our science and our fields. We need to increase our own awareness of our Canadian efforts and we need to increase our visibility with the Canadian public. For instance, I suspect that most undergraduates in the physical sciences in Canada are either unaware of or only vaguely aware of our fields. As well, we need to better publicize our policy statements and other activities and we need to encourage our involvement in educational activities; Project Atmosphere Canada is one example of the latter. On a larger scale, almost all Canadians are interested in the weather, our climate and our oceans. I really don't think that we're tapping this incredible interest. Perhaps we should think about, for example, more CMOS speakers for the general public and co-activities with the media.

- To ensure that our CMOS efforts are sustained and expanded. Our membership is increasing and we need to continue adding benefit to our members through, for example, more information on our web site and more specific activities to address crucial concerns of our members. The private sector effort is one good example of this latter category; others can be initiated as well.

Progress in these, inter-related themes can also contribute to the realization of the visions described earlier. An important aspect of such visions is that they are beyond the reach of any of the individual components; one has to work together to reach the goal. That's a key ingredient of a successful network.

In fact, networks is a word that we all seem to hear and use a great deal these days. I would say that CMOS itself is a good example of a successful network in that it brings us together under a common theme, allows us to do our individual activities better, and allows us collectively to go beyond our individual efforts.

It may be that CMOS and our fields can move ahead by taking advantage of external factors. I was intrigued by an article in the Globe and Mail on May 26, 2001. Paul Martin, the Minister of Finance, wants to develop environmental indices measuring the health of our water, air and forests, in addition to economic indicators. That's a good sign that the environmental issues have reached the highest levels of government. Let's also hope that Toronto is able to land the 2008 Olympic Games. This could be used as a vehicle to provide the 'world's best regional and local forecasts'.

What do I see over my 1-year term? I feel that it needs to be a more or less 'keep on track' year. The Society is already involved in many activities and there have been major changes within our community over the last few years. Nonetheless, this may also be a good time to step back a bit and reflect on our Society's goals and activities to be sure that we are satisfactorily moving ahead in all the critical areas as a sustainable, active Society. It is possible that new initiatives may be suggested as part of this exercise. In any event, the CMOS Council, Executive and I will certainly be updating you on all CMOS activities and asking for your advice and input.

In summary, I look forward to serving you over the next year. My job has certainly been made easier because, over the last year, Peter Taylor (President), Ian Rutherford (past-President), and many others on the Executive and on Council have helped me to 'gear-up' for the Presidency. Enjoy your summer.

Ronald Stewart, President/Président

Letter to the Editor

15 June 2001

For global warming you may have to look below the surface.

The existence of global warming and prediction of its future magnitude are issues of importance that ought to be discussed scientifically within CMOS. In that spirit we wish to comment on the Letter to the Editor by Dr. M.R. Morgan dated 26 January 2001. His statements regarding the Hadley Centre's lack of confidence in sea-surface temperature (SST) data and a revision of their observationally-based global warming estimate appear to be at odds with recently published work. As discussed in the IPCC Third Assessment Report and in a paper to appear in EOS, researchers from the Hadley Centre and the US National Climatic Data Center find that the trend in global temperature from 1901 to 2000 estimated using *either* SST or nighttime marine air temperature (NMAT) are indistinguishable. Both approaches yield a trend of 0.57±0.17°C/century. Although it is true that during the past decade there is a tendency for NMAT to increase at a slower rate than SST in the southern hemisphere (NMAT and SST estimates are consistent in the northern hemisphere), these same researchers point out the NMAT estimates are likely to be *less* reliable and less representative than the SST estimates due to sampling problems and recent increases in ship thermometer screen height. Their global warming estimate has accordingly *not* been revised.

The observed warming of the ocean extends well below the surface. Recent analysis of observations for the last 45 years of ocean temperatures down to 3000m depth shows general warming over the global oceans well down into the ocean interior (Levitus et al., 2000, Science, 287, 2225). Since Dr. Morgan's letter was written, two studies with global climate models have shown that warming of the ocean interior consistent with the Levitus et al. observations can be obtained only when the models include the effects of greenhouse gases and sulphate aerosols (Levitus et al., 2001, Science, 292, 267; Barnett et al., 2001, Science, 292, 270) in addition to natural forcing. These studies further concluded that the likelihood that the observed temperature increases in the ocean interior occurred from natural forcing alone is very small. Furthermore, over the last 45 years, estimates based on observations of the heat stored in the atmosphere, the heat absorbed by melting glaciers, and the heat required for the reduction in thickness and extent of sea ice – all were more than an order of magnitude less than the heat flux into the oceans over the same period. A succinct two-page commentary on these studies has recently appeared in the June 2001 issue of Physics Today (pp. 19-20).

Scientists associated with the IPCC and with climate centres around the world are trying to understand and forecast climate change not just because the sea surface temperature appears to be increasing but because many other types of evidence point to warming. For example, ice core records indicate that over the last 400,000 years, the concentration of CO_2 in the atmosphere varied over a range of about 100 ppm but did not exceed 300 ppm. Human activity over the last 150 years, primarily burning of fossil fuels and deforestation, has increased the concentration of CO_2 in the atmosphere from 280 to 370 ppm, and it is still increasing at over 1 ppm/yr. Climate scientists are not "trying to make a silk purse out of a pig's ear" but are trying to use all available data sources to understand what the response of the climate system will be to this unprecedented (greenhouse) forcing. That seems to be a worthwhile effort.

Signed by: *Kenneth Denman, Greg Flato, Andrew Weaver and Francis Zwiers*, School of Earth and Ocean Sciences and Canadian Centre for Climate Modelling and Analysis, University of Victoria.

Aspects of Toronto's Climate: Heat Island and Lake Breeze

by William A. Gough[1] and Yuri Rozanov

Résumé : Nous avons examiné l'îlot de chaleur et la brise de lac à Toronto, en Ontario, à l'aide des moyennes climatiques mensuelles et des relevés climatologiques historiques. Les données sur deux sites ruraux, l'aéroport Pearson et Vineland, en Ontario, montrent un îlot de chaleur marqué avec une pointe de 3°C la nuit, qui s'est accru d'au moins 1°C entre 1930 et 1980. L'effet d'îlot de chaleur durant le jour, en été, à Toronto, est atténué par la présence d'une brise de lac. La comparaison avec les données similaires pour Montréal semble montrer que la brise de lac produit, en moyenne, un refroidissement de 1,3°C.

1. Introduction

Toronto, Ontario is located at 42 °N in the middle of the North American continent on the shore of one of the Laurentian Great Lakes (Lake Ontario). The climate of Toronto results from local, regional and larger-scale influences. Locally, the climate record is affected by local topography and the heat island resulting from urbanization. Regionally, the proximity of Lake Ontario and the other Great Lakes influences the climate. Regional topography such as the Niagara Escarpment modifies local precipitation pattems. Larger-scale influences include circulations associated with prevalent air masses, El Niño/Southem Oscillation (ENSO), the North Atlantic Oscillation (NAO) and global warming. In this work, we focus on the local and regional-scale influences.

In climatological terms Toronto has a Koppen Dfb climate. This is a climate that is moist with cold winters. The average of the coldest month is -3°C or less and the average temperature of the warmest month is greater than 10°C. All seasons are wet and the summers are long and cool (average temperature of all months below 22°C, and 1 to 3 months with an average above 10°C). In classical meteorological air mass analysis, Toronto is located near the moving boundary between continental polar air which originates in northem Canada and maritime tropical air which forms over the Gulf of Mexico. The latent energy in the latter air mass fuels the succession of mid-latitude cyclones that form along the boundary of these two air masses, the polar front, and which characterizes much of the weather that Toronto experiences. Occasionally, extended periods of high pressures, referred to as blocking highs, interrupt this dominant pattern (Gough and Lin, 1988).

The larger-scale flow is modified by the presence of the Great Lakes. Scott and Huff (1996) quantify temperature and precipitation changes that result from these Lakes. In general, temperatures are warmer in the winter and cooler in the summer. Precipitation patterns are dramatically changed producing extensive snow belts. Due to its location on the northwest shore of Lake Ontario and the cradling effect of the Niagara Escarpment to the west and south, Toronto is shielded from the brunt of the lake effect snow. However, on rare occasions, when a low centre passes to the south of Toronto, winds from the east and southeast pass over a long fetch of Lake Ontario and this results in a significant snowfall in Toronto. Four such successive storms inundated Toronto during January of 1999 (Gough, 2000).

Munn et al. (1969) provides a detailed look at local influences on Toronto's climate. They used four years of local data to examine local influences on climate. They identified that the prevailing wind, the heat island, the lake effect and local topography influence the spatial distribution of temperature. The heat island effect arises due to urbanization. It results from the urban reduction of evapotranspiration (due to pavement and less vegetation), heat storage in buildings and pavement, artificial generation of heat, and snow removal (reduction of albedo). Oke (1973) linked the heat island temperature change to the logarithm of the population using observations from a number of Quebec communities. The scaling coefficient, however, does appear to vary with location (Torok et al. 2001). The biggest temperature difference is in daily minimum temperature (typically occurring at night). A lake breeze arises due to the temperature contrast between the city and Lake Ontario directly to the south of the city. The temperature contrast changes diumally as well as seasonally and thus influences the direction and magnitude of the lake breeze.

Munn et al. (1969) binned climate data according to season and wind direction and magnitude. Two seasons were defined, the warm season occurring when land temperatures exceed lake temperatures and a cold temperature when the opposite prevails. Wind regimes were defined as off shore and on shore with 5 m/s as the threshold for light and strong winds. This provided eight 'pre-stratified' categories. An urban heat island was clearly apparent with varying magnitudes. The influence of the lake was felt in two ways. One was the modification of regional scale prevailing on-shore winds, the other was the formation of a lake breeze especially under conditions of weak regional off-shore winds. This is a thermally-induced

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circulation arising from strong temperature contrast which occurs during the summer season. This circulation enables the intrusion of cooler air up to 0.5 km in land. Local topography played a role in the large spatial variation in temperature distribution. For on-shore breezes the impact of air flowing up the Humber River and Rouge River valleys was particularly notable. The Oak Ridges moraine to the north of the city blocks the northern penetration of cool lake winds. Along the Lake Ontario shore the Scarborough Bluffs rising 100 m above the lake level acts as an effective block to on-shore breezes.

In this work we re-visit the quantification of the urban heat island and lake breezes which influence the climate of Toronto. This is done by comparing data collected at the downtown campus of the University of Toronto with that collected at Pearson Airport, on the periphery of the city. In addition, a longer temperature record from Vineland, an agricultural community south west of Toronto, is used. Comparison with Montréal climatological data provides an estimate of the summer time impact of lake breezes on Toronto.

2. Data and Analysis

Climatological data from five sites are used: Toronto (downtown), Toronto (Pearson airport), Vineland (Ontario), Montréal (downtown), and Oka (Québec). Climatological means and time series of climate records were obtained from the Meteorological Service of Canada (Environment Canada). Times series of Toronto and Vineland data are taken from the rehabilitated climate record (Vincent and Gullett, 1999).

Two approaches are taken to assess the urban heat island. First, climatological thirty year means (1960-1990) for Toronto (downtown) and Toronto (Pearson) are compared. Both the maximum and minimum monthly temperatures are compared. As indicated by Munn et al. (1969) the downtown station is located in the centre of the heat island. The Pearson airport is located on the periphery of the Greater Toronto Area. Although this area is not precisely rural, it is well displaced from the heat island. A second approach is to compare downtown Toronto with another rural site, Vineland, Ontario which is located southwest of Toronto, on the southwest side of Lake Ontario. This site was chosen because it has remained rural and has a longer record than the Pearson airport site. Two periods of time were selected 1926-1936 and 1977-1987. The comparison of the two indicates the increase of the urban heat island over this fifty-year period.

To quantify the lake breeze, Toronto climate data are compared to corresponding data from Montréal. Montréal belongs to the same Koppen classification (Dfb) and has approximately the same number of inhabitants but is not located in close proximity to a Great Lake. Thus, larger-scale and the heat island for this city should be similar to Toronto. The absolute value of climate means are, however, different. To compare the cities, seasonal differences in the minimum and maximum temperatures are used.

3. Results

i) heat island

The heat island for Toronto is illustrated by examining the minimum and maximum temperature differences between downtown Toronto and Pearson airport. Minimum and maximum temperature differences are depicted in Figure 1. Minimum temperatures are warmer in the downtown throughout the year by approximately 3°C while maximum temperature differences do not have as pronounced a difference and vary seasonally, results similar to other recent urban heat island analyses (Runnalls and Oke, 2000; Comrie, 2000; Klysik and Fortuniak, 1999; Magee et al., 1999; Montavez et al., 2000; Stewart, 2000). In fact, several months during the summer, downtown is cooler than the airport, a point explored in more detail in the next section.

The time evolution of the heat island is illustrated by comparing for two different periods (1926-1936 and 1977-1987) the minimum temperatures of downtown Toronto and Vineland. This is shown in Figure 2. For the earlier period Vineland was marginally warmer than Toronto with some seasonal variation. The difference between locations has a minimum in May which is likely due to the delay of the onset of spring along the Niagara peninsula (Krueger, 2001). However, fifty years later Toronto has substantially warmer temperatures although the seasonality remains intact. Annually, the increase is more than 1°C. During this period, especially post World War II (after 1945) Toronto became considerably more urbanized. Magee et al. (2000) report a 0.4°C enhancement of the heat island of Fairbanks, Alaska from 1949 to 1997.

ii) lake breeze

The lake breeze experienced in downtown Toronto is discernible in the maximum temperature difference between downtown Toronto and Pearson airport. During the summer the downtown maximum temperatures are cooler downtown, an effect not seen in the summer minimum temperatures (which typically occur at night). During the day in summer, the city warms faster than the lake to the south. Air rises over the city inducing the on-shore lake breeze which cools the downtown. The magnitude of this effect is best illustrated by comparing this temperature difference with that of Montreal which is not located near a lake the size of Lake Ontario. The difference between Montréal (downtown) and Oka (rural) is shown in Figure 3. Similar to Toronto, the urban heat island is more pronounced at night (minimum temperature) than during the day. The Montréal heat island appears to be about 0.5°C stronger than Toronto's. This is likely the result of the more rural location of Oka compared to Pearson airport. To quantify the lake breeze we compare the maximum

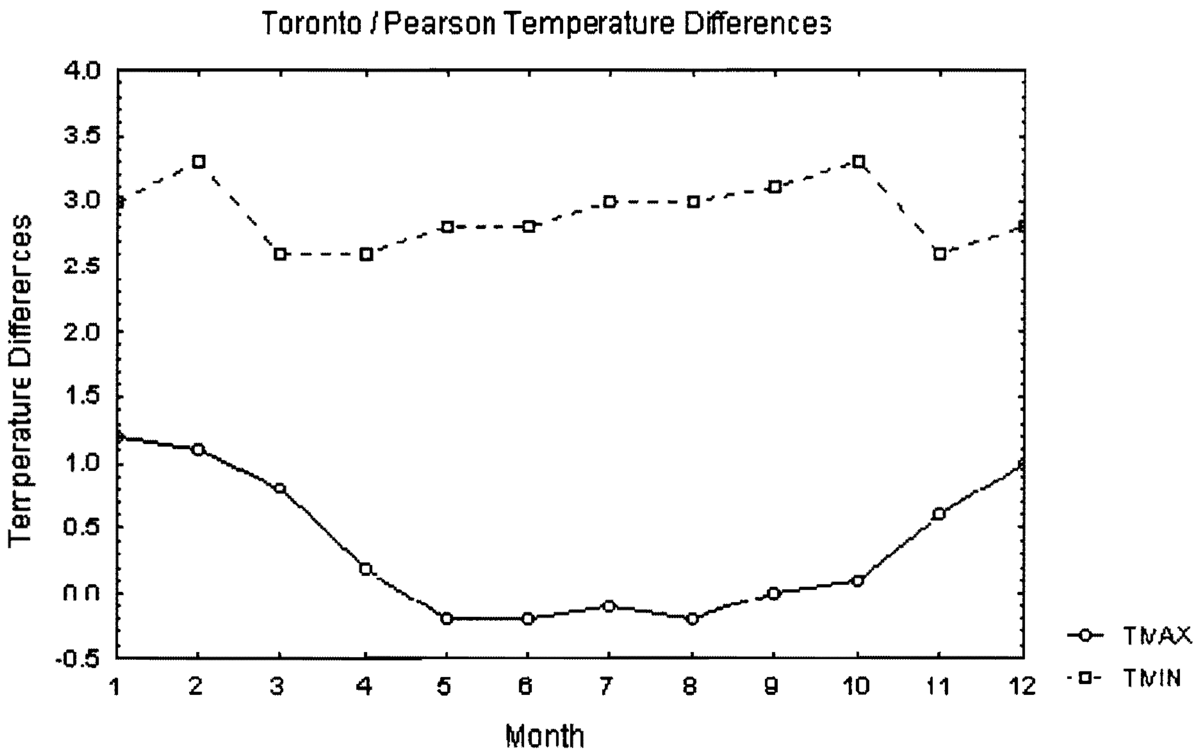

Figure 1. Difference between Toronto (downtown) and Toronto (Pearson airport) for monthly mean daily minimum and maximum temperatures. The means are calculated using data from 1960 to 1990.

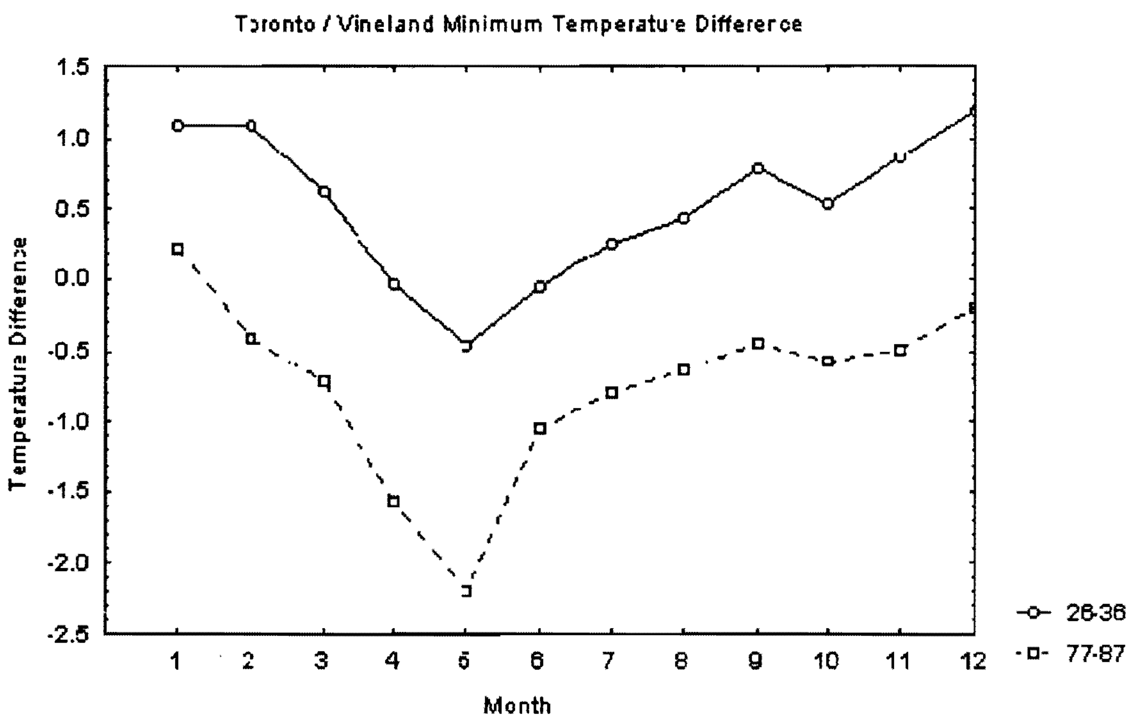

Figure 2. Difference of monthly mean minimum daily temperatures between Vineland and Toronto for 1926-1936 and 1977-1987.

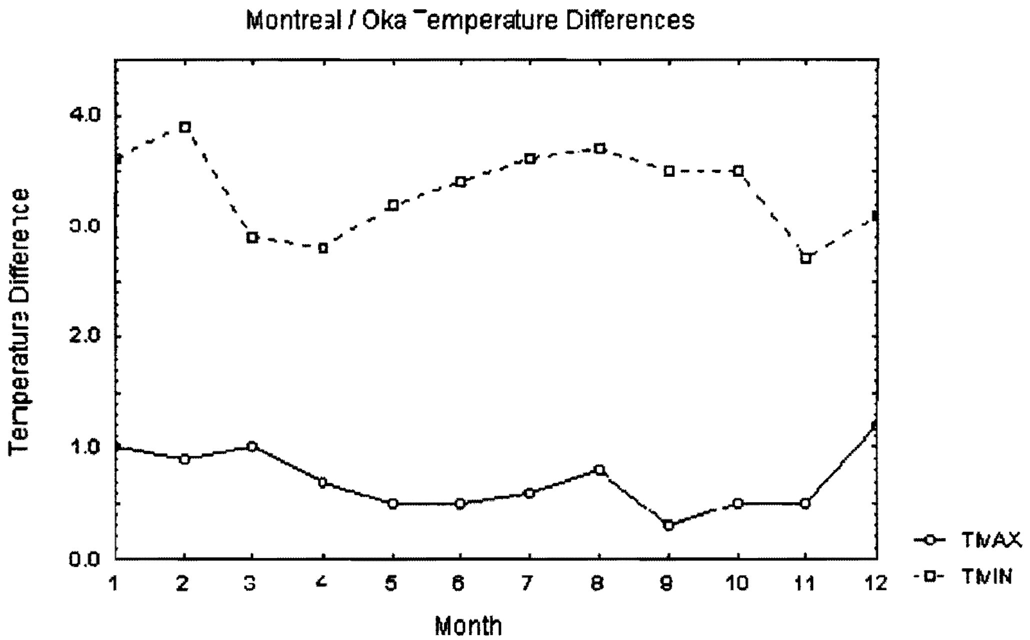

Figure 3. Difference between Montréal (downtown) and Oka for monthly mean daily minimum and maximum temperatures. The means are calculated using data from 1960 to 1990.

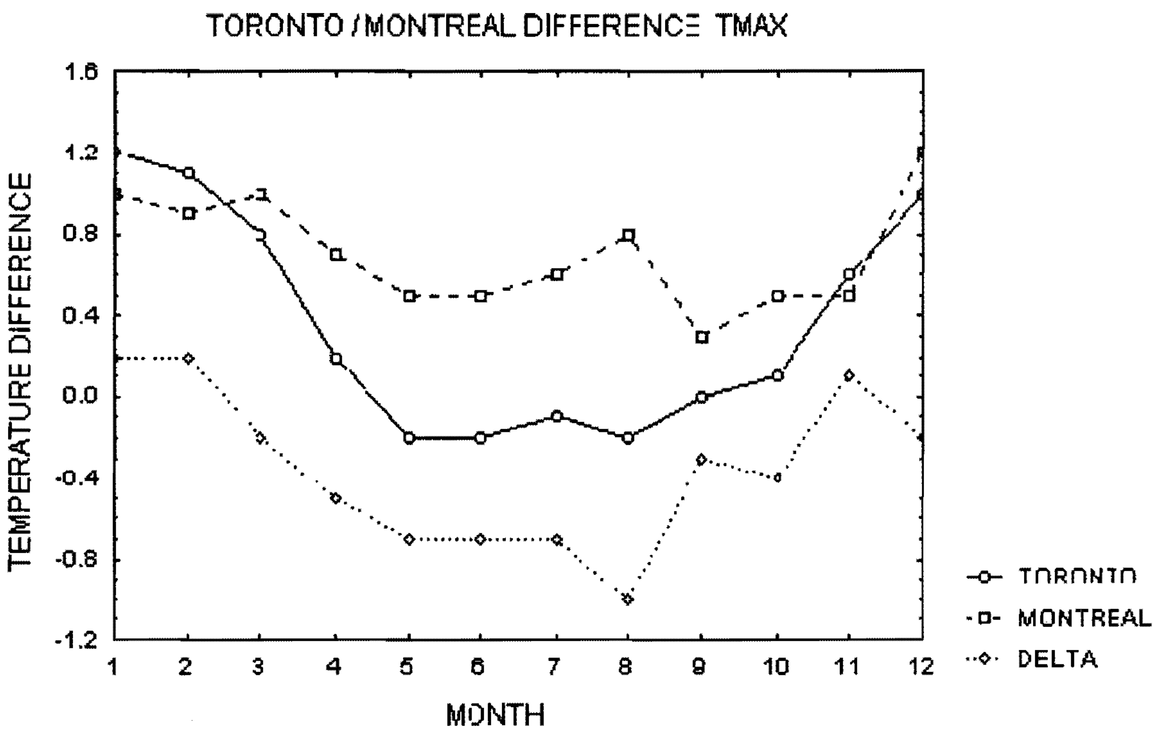

Figure 4. Heat island temperature difference between Toronto and Montréal. These values are calculated using monthly maximum temperature means taken from Figures 1 and 3. DELTA represents the difference between these two curves.

temperature differences of the two cities. This difference in temperatures is shown in Figure 4. The difference in the maximum temperatures between the cities varies seasonally with the maximum difference in the summer months. This can be attributed to the cooling effect of Lake Ontario, i.e. the lake breeze, in Toronto. The magnitude of this difference peaks at 0.8°C. Adding to this a further of 0.5°C due to the more rural location of Oka, gives an estimate of 1.3°C for the cooling effect of the lake breeze. Runnalls and Oke (2000) report a similar, although unquantified, day-time summer cooling effect in Vancouver, British Columbia due to marine advection.

4. Conclusions

In this work we have examined the urban heat island and lake breeze in Toronto, Ontario. The urban heat island as measured using climate normals from a weather station in downtown Toronto and one at Pearson airport, shows a 3°C warming in the minimum (night time) temperature and less so during the day. The mitigation in the heat island effect during the day is aided by the presence of a thermally-induced lake breeze. This lake breeze is clearly shown by comparison to a similar heat island analysis for Montréal. From this comparison a cooling effect of 1.3°C for the lake breeze during the day in summer is estimated.

Examining the climate record at the rural station of Vineland shows the heat island effect increased by at least 1°C from 1930 to 1980 as determined by comparison to the minimum temperature increases in Toronto.

Acknowledgment

We wish to thank Lianne Bellisario and Nataliya Mulyar for supplying the climatological data. The data are part of an archive that was prepared by the Analysis of Urban Extremes in Canada project funded by Emergency Preparedness Canada.

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La figure apparaissant à la page couverture est une courtoisie du Magazine EnRoute, revue mensuelle d'Air Canada. Elle a parue dans l'édition de février 2001 à la page 103. La reproduction a été faite grâce à l'aide d'Estelle Couture, Service des données sur le milieu marin. Mes remerciements à Estelle et au magazine EnRoute pour l'aide précieuse apportée.

Thanks

The figure shown on the Cover Page is courtesy of the EnRoute Magazine, a monthly publication by Air Canada. It appeared in the February 2001 issue on page 103. The reproduction was accomplished with the help of Estelle Couture, Marine Environmental Data Service. Thanks to Estelle and to the Magazine EnRoute for their valuable collaboration.

Fast Flying Weather Reports (Airplanes and Weather Forecasts)[1]

by Doug Morris[2]

What do airplanes and computerized weather forecasts have in common? Up until now, not much. Indeed those overseas 'met' reports sent every ten degrees of longitude are utilized, but if Environment Canada gets their way this will only be the tip of the iceberg.

Most upper air data used to drive weather models and to churn out forecasts are obtained from weather balloons launched twice a day from over eleven hundred sights around the globe. However, these are costly and have many inherent restrictions. Air Canada and Air Nova will soon implement a new system called **AMDAR** (Aircraft Meteorological Data Relay) to provide much needed data to drive the computer models. Many countries have been utilizing this system for several years. For example, in the United States, approximately 60,000 daily observations (primary wind and temperature) have been obtained from six participating airlines.

Ironically, Air Canada has had the capability of disseminating weather data for years through datalink. In fact, approximately 400 pieces of information are transmitted, unfortunately the specific weather data can't be separated with the current data links. Modifications must be made to send only the weather parameters to the weather service. (Altitude/wind/temperature/co-ordinates). This is where slight problems come into play. If an aircraft were taken off line for the 'mod' it would cost nearly $50,000. If it's done during other avionics upgrades, possibly during a 'C' check, the cost would hover near $5,000. The good news is all newly purchased aircraft parked on the ramp will come with the upgraded packages.

Aircraft must be equipped with sophisticated flight management, navigation, communications and sensing systems. This means all of Air Canada's fleet is AMDAR compatible except for the DC-9s and 737s. Aircraft will report a minimum of wind and temperature although down the road turbulence reports will be included. The intensity of turbulence can be calculated by applying an algorithm from data obtained from vertical accelerations.

Another parameter Environment Canada would like to see is moisture. Moisture information now provided by radiosondes (Upper air balloons) is an extremely important parameter needed by the prediction models. At present this would entail boring a hole into the fuselage. In order to avoid this a single sensor measuring both temperature and moisture is being developed.

Weather information will be available throughout the descent/ascent at a higher frequency than at cruise level. The data will be sent to a ground station and then sent to Environment Canada. A direct line of this information would be available to Air Canada. When aircraft are out of VHF range and instead of using expensive satellite communication, data will be stored and then transmitted when in range. Part of the deal will mean Environment Canada will pay for the transmissions. Quality control is done and then the data are inputted into numerical weather prediction products. The future will eventually allow to 'uplink' commands to ***close and open the taps*** of information. Incidentally, if erroneous data is detected then that particular aircraft can be flagged and the erroneous source can be fixed.

Air Nova is a major player with AMDAR for several reasons. They fly to more remote areas where crucial data are needed. Plus, they are presently upgrading their Dash 8s with ACARS thus the expensive modifications are already implemented. (Eventually all of the connectors will join in).

Cost per AMDAR sounding would be about $1.80 to $2.90 whereas the cost of radiosondes is about $350 per sounding. But don't think weather balloons are a thing of the past. This is because they have moisture-sensing capability and they climb to nearly 30,000 metres compared to the 12,000 metres of airliners.

AMDAR is a means of augmenting weather balloon data providing more frequent soundings from aircraft ascents and descents at locations where radiosonde data are not readily available and at a much lower cost! Users from around the world have benefited through better predictions of high winds, wind shears, precipitation, ceiling height, turbulence and fog dissipation. Although Air Canada is satisfied with these parameters they would like to see advancement in the reporting of the onset and intensity of turbulence. AMDAR will help fill the void particularly in sparsely settled areas and do it more frequently. With the onset of polar navigation this will even better the situation. Ironically the former USSR, the largest country in the world, has reduced the use of upper air balloons by nearly

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[1] Reprint from "Flying" magazine with permission of the Author and the Editor. The same article has appeared in a slightly different form in the "EnRoute" magazine published by Air Canada under the title "Weather Watch".

[2] Doug Morris is a pilot for Air Canada and has worked for Environment Canada as a certified meteorologist.

seventy percent and isn't using AMDAR at this time. However, more and more countries (airlines) are signing up.

With AMDAR up and running, future flights with Air Canada and its connectors will be ***flying disseminators of weather data***.

With this system up and running, it will significantly reduce the inaccuracies of weather forecasting. Perhaps it will also reduce the sometime derogatory comments aimed at weather forecasts by pilots. After all, it will be their aircraft's data that will drive the computerized weather forecasts.

TROIS POSTES DISPONIBLES

1. GÉRANT(E) DE RÉSEAU/CHERCHEUR SCIENTIFIQUE:
Le Réseau de Recherche en Variabilité Climatique (REVAC) recherche un gérant pour l'administration quotidienne du réseau, composé de dix-sept scientifiques oeuvrant dans six universités canadiennes et trois laboratoires du Gouvernement fédéral. Le REVAC est financé pour un minimum de trois ans par le Conseil de recherche en sciences naturelles et en génie, par la Fondation canadienne pour le climat et les sciences atmosphériques et par l'Institut canadien pour les études climatiques, pour effectuer des recherches sur la variabilité climatique couvrant des échelles de temps allant des saisons aux siècles.

Les fonctions du gérant incluront l'organisation d'ateliers, la gérance du budget, la rédaction des comptes-rendus des réunions du Conseil d'administration et du Comité scientifique, la rédaction d'une brochure d'information sur le réseau, la mise à niveau périodique de la page Web du réseau et la préparation, en collaboration avec le responsable du réseau, des rapports d'étapes. Ces tâches administratives laisseront amplement de temps pour poursuivre un programme de recherche en collaboration avec le responsable du réseau. La recherche portera sur la dynamique des fluctuations interannuelles et leur prédictibilité. Le candidat idéal aura un doctorat en sciences atmosphériques ou domaine connexe et une certaine expérience en recherche. Les candidats possédant une maîtrise seront aussi considérés. Le salaire sera fonction de l'expérience acquise, surtout en recherche.

Le poste est à l'Université McGill, à Montréal. Le candidat choisi devrait être disponible le 1er septembre, 2001. La langue de travail sera l'anglais, mais une connaissance du français sera un atout. Les candidats devront soumettre un curriculum vitae, une description de leurs intérêts et expérience de recherche, et faire parvenir trois lettres de recommandation au Professeur Jacques Derome, responsable du REVAC, à l'adresse indiquée ci-dessous. Courriel : jacques.derome@mcgill.ca. Internet : www.meteo.mcgill.ca/derome.

2. POSTE POSTDOCTORAL EN MODÉLISATION DES INTERACTIONS AIR/MER/GLACE:
Un poste de trois ans est disponible à l'Université McGill au sein du REVAC pour effectuer des recherche en collaboration avec le Professeur L.A. Mysak. Le projet consiste à développer un modèle couplé incluant un modèle EMBM (Energy-Moisture-Balance-Model) ainsi qu'un modèle de glace et de circulation océanique. Le but est d'étudier l'Arctique présent et la variabilité climatique future aux hautes latitudes sous un scénario d'une baisse à long terme de la couverture de glace polaire. Le poste sera disponible le 1er septembre 2001 au salaire annuel de $40,000. Faire parvenir un curriculum vitae, une description d'intérêts de recherche ainsi que trois lettres de recommandation au Professeur Lawrence A. Mysak, à l'adresse indiquée ci-dessous. Courriel : mysak@zephyr.meteo.mcgill.ca. Internet : www.meteo.mcgill.ca/mysak.

3. POSTE POSTDOCTORAL EN DYNAMIQUE OCÉANIQUE/TURBULENCE:
Un poste est ouvert à l'Université McGill pour un chercheur postdoctoral intéressé à la dynamique des fluides géophysiques et à la turbulence avec applications à l'océanographie. Le projet envisagé a pour but de mieux comprendre la dissipation d'énergie dans des situations où le forçage se trouve principalement aux grandes échelles. Ce travail devrait nous éclairer sur le lieu et la façon dont l'énergie est dissipée, et à un meilleur paramétrage des effets sous-maille dans des modèles de circulation océanique de type " eddy-revealing ". Le projet est financé en partie par le REVAC. Le candidat choisi travaillera sous la direction conjointe de Dr. David Straub du Département des Sciences atmosphériques et océaniques et de Dr. Peter Bartello du même Département ainsi que du Département de Mathématiques et statistiques. Les candidats devraient contacter l'un ou l'autre à l'adresse ci-dessous ou, préférablement, par courriel: straub@zephyr.meteo.mcgill.ca, bartello@zephyr.meteo.mcgill.ca. Internet: www.meteo.mcgill.ca/straub ou www.meteo.mcgill.ca/bartello.

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Des observateurs météo en altitude (Avions et prévisions météorologiques) [3]

par Doug Morris[4]

Qu'ont en commun les avions et les prévisions météorologiques par ordinateur? Jusqu'à maintenant, peu de chose. Certes, on utilise ces données météo " d'outre-mer " envoyées tous les 10 degrés de longitude, mais si Environnement Canada réalise son projet, ce ne sera là que la pointe de l'iceberg.

La plupart des données aérologiques (en altitude) introduites dans les modèles météorologiques pour produire les prévisions proviennent des radiosondages réalisés par ballons, deux fois par jour, à 1100 sites d'observation autour du Globe. Toutefois, ces données coûtent cher et sont soumises à plusieurs contraintes. Air Canada et Air Nova implanteront bientôt un nouveau système, appelé **AMDAR** (Aircraft Meteorological Data Relay), qui fournira une bonne part des données requises par les modèles informatiques. Plusieurs pays utilisent déjà ce système. Aux États-Unis, par exemple, six transporteurs aériens fournissent environ 60 000 données par jour (vent et température surtout).

Ironiquement, Air Canada peut, depuis des années, transmettre des données météo par le réseau Datalink. De fait, environ 400 éléments d'information sont transmis, mais on ne peut pas isoler les données météorologiques du flot de données. Il faut apporter certaines modifications pour que les services météorologiques puissent recevoir seulement les données météorologiques (altitude, vent, température, coordonnées). Mais cela ne va pas sans heurt. S'il faut clouer un avion au sol pour faire les modifications, il en coûte près de 50 000 $. Cependant, si le travail est fait à l'occasion d'une mise à niveau de routine, le coût n'est plus que de 5 000 $. Quant aux avions nouvellement acquis, ils incorporent déjà la technologie AMDAR.

Les avions doivent être dotés de systèmes perfectionnés de gestion de vol, de navigation, de communications et de détection. Ceci signifie que toute la flotte d'Air Canada est compatible avec l'AMDAR, sauf les DC-9 et les 737. Les avions signaleront au minimum le vent et la température et, s'ils rencontrent de la turbulence, en feront un compte rendu. L'intensité de la turbulence peut être déterminée à partir des données d'accélération verticale.

L'humidité est un autre paramètre auquel s'intéresse Environnement Canada. Les données sur l'humidité, que fournissent aujourd'hui les radiosondages, sont un facteur extrêmement important dans les modèles de prévision. À l'heure actuelle, il faudrait percer un trou dans le fuselage pour y fixer un capteur. Afin d'éviter cette opération, on travaille à la mise au point d'un capteur unique pouvant mesurer la température et l'humidité.

Pendant la descente et la montée, les données météo seront communiquées à un rythme plus rapide qu'à l'altitude de croisière. Les données seront transmises à Environnement Canada via une station réceptrice au sol. Air Canada aura directement accès à ces données. Lorsque l'appareil se trouvera hors de portée radio, les données seront stockées, puis transmises dès la sortie de la zone de silence, ce qui évitera les coûteuses communications par satellite. Selon l'entente envisagée, Environnement Canada défrayera le coût des transmissions. Après un contrôle de la qualité, les données seront incorporées dans les modèles météorologiques. Plus tard, il sera possible de commander à partir du sol ***l'ouverture et la fermeture des canaux*** d'information. On pourra aussi détecter une donnée erronée et identifier l'avion en cause pour que la source de l'erreur soit corrigée.

Air Nova est un joueur important dans le système AMDAR car ses avions volent dans des endroits éloignés où des données importantes sont requises. Air Nova est en train d'installer le système ACARS dans ses Dash 8, ce qui fait que les modifications coûteuses seront déjà réalisées. (Éventuellement, tous les transporteurs correspondants feront de même.)

Le coût unitaire d'un sondage AMDAR devrait varier entre 1,80 $ et 2,90 $ alors que le coût d'un radiosondage est d'environ 350 $. Malgré tout, les ballons météo ne sont pas choses du passé; ils sondent l'humidité et peuvent monter jusqu'à 30 000 mètres, au lieu de 12 000 mètres pour les avions de ligne.

L'AMDAR fournit un moyen d'acquérir à faible coût des données aérologiques lors des fréquentes montées et descentes des avions, notamment là où peu de données de radiosondages existent. Partout dans le monde, les utilisateurs ont bénéficié de meilleures prévisions de vents en altitude, de cisaillement du vent, de précipitations, de hauteurs de plafonds et de dissipation du brouillard. À ces paramètres, Air Canada aimerait voir s'ajouter l'apparition de la turbulence et son intensité.

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[3] Reproduit du magazine "Flying" avec la permission de l'auteur et du rédacteur. Le même article a paru sous une forme légèrement différente dans le magazine EnRoute publié par Air Canada sous le titre "L'air du temps".

[4] Pilote d'Air Canada, Doug Morris a été météorologue à Environnement Canada.

L'AMDAR aide à pallier le manque de données, en particulier dans les régions inhospitalières, et le fait fréquemment. La navigation polaire, qui gagne en importance, est un atout de plus dans sa manche. Curieusement, l'ancienne URSS, qui a diminué de presque 70 % l'emploi de ballons aérologiques, n'utilise pas l'AMDAR. Néanmoins, de plus en plus de pays y ont recours.

Avec la mise en place de l'AMDAR, les futurs vols d'Air Canada et de ses correspondants assureront une ***diffusion aérienne de l'information météorologique***. Le système contribuera à l'exactitude des prévisions. Il pourrait peut-être même adoucir certains commentaires défavorables des pilotes sur les prévisions météorologiques. Après tout, les prévisions météorologiques par ordinateur seront produites à partir des données fournies par leurs avions.

THREE POSITIONS AVAILABLE

1. Network Manager/Research Scientist:

The Canadian Climate Variability (CLIVAR) Research Network, composed of seventeen researchers from six Canadian Universities and three Federal Government laboratories, has received funding for at least three years to conduct climate research on interannual to century time scales. The Network seeks a manager who will be responsible for the day-to-day administration of the Network. The duties will include: managing the budget, organizing workshops, acting as secretary to the Board and the Scientific Committee, preparing/updating an information brochure and a Web page on the Network activities, assisting the Network Principal Investigator in the preparation of progress reports to the funding agencies. These administrative duties will leave ample time to work on research projects in collaboration with the Network Principal Investigator. The research will focus on climate variability on the interannual time scale, and, in particular, on seasonal predictability. The ideal candidate will have a Ph.D. in atmospheric sciences or related discipline and some research experience. Candidates with a Master's degree will also be considered. Salary will depend on qualifications, especially the research experience.

The position will be held at McGill University, Montreal, with a starting date of 1 September, 2001. The working language will be English, but a command of French would be an asset. Interested candidates should send a c.v., a statement of research interests and three letters of recommendation to Professor Jacques Derome, PI, Canadian CLIVAR Network at the address given below. E-mail: jacques.derome@mcgill.ca - Web: www.meteo.mcgill.ca/derome

2. Postdoctoral Position in EMBM-Sea Ice Ocean Modelling

A three-year postdoctoral position is available at McGill University as part of the Canadian CLIVAR Network, to work on the following project:

To develop a global coupled EMBM-sea ice-ocean circulation model for the purpose of investigating present-day Arctic and high latitude sea ice and climate variability and future high latitude climate scenarios under a prescribed long-term decreasing sea ice cover. The position is available from Sept. 1, 2001, and the starting salary will be $40,000 per year. Please send a CV, statement of research interest, and three letters of reference to Professor Lawrence A. Mysak at the address given below. E-mail: Mysak@zephyr.meteo.mcgill.ca - Web: www.meteo.mcgill.ca/mysak

3. Post-Doctoral position in Dynamical Oceanography/Turbulence

A position is open at McGill University for a post-doctoral researcher interested in geophysical fluid dynamics and turbulence, with application to the oceans. The project envisioned aims to better understand pathways by which energy is dissipated in situations where the forcing is primarily to large scale, balanced modes. It is hoped that this will lead to a better understanding of how and where mechanical energy is dissipated in the oceans and, ultimately, to improved parameterizations for subgridscale processes in "eddy-revealing" models of ocean circulation. The project is partially funded by the Canadian CLIVAR Network and will be jointly supervised by David Straub (Atmospheric and Oceanic Sciences) and Peter Bartello (AOS and Mathematics) of McGill. Interested persons should contact either David Straub or Peter Bartello at the address below or (preferably) via email at straub@zephyr.meteo.mcgill.ca and/or bartello@zephyr.meteo.mcgill.ca for further details. Web: www.meteo.mcgill.ca/straub or www.meteo.mcgill.ca/bartello

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A Vision for Meteorology in Canada

by Marc Denis Everell[1]

Before getting to the meat of the presentation, I wanted to say that I feel a sense of awkwardness and obligation. I've only been in my present position for 10 months, but as the head of the Meteorological Service of Canada, I feel obligated to show some leadership in beginning the process of defining a vision for meteorology in Canada. Thank you for providing the opportunity to bring a vision forward and the venue in which we can begin discussing a vision and plotting a path forward.

Meteorology represents an enormous world of service and science and is easily integrated with other scientific disciplines. I wanted to start off by quickly demonstrating the breadth of meteorology. Then I will put a vision on the table which I offer as a guide to the public, private and academic sectors in developing meteorology in Canada.

But before positioning meteorology for growth, we need to understand and have some strategies to get around the challenges and take advantage of the opportunities. After that, I will put my MSC hat back on and identify MSC's positions on the issues and the commitments that MSC will make towards implementing the strategies.

The Enormous Breadth of Meteorology

Before sharing my vision with you, I wanted to take a couple of minutes to remind you of the enormous breadth of meteorology.

Linking the land, ocean and atmosphere, meteorology can help meet the science and service needs of Canadians and their businesses as well as the science, service and policy needs of various levels of government. For example, it can help clients understand and respond to:

- environmental issues (e.g., reducing the use of road salt in sensitive areas, or managing the decline, invasion and adaptation of species due to climate variability and change);
- economic issues (e.g., increasing the economic efficiencies of farms and just-in-time delivery systems, reducing the loss of valuable forests to fire, insect and disease);
- social issues (e.g., mapping flood plains, ensuring the integrity of Canada's built environment -- homes, malls, hydro and telecommunications towers, bridges, etc.); and,
- policy issues (e.g., climate change, the "ozone hole", bulk water exports).

The list of applications is endless -- limited only by the ability of the meteorological players to:

- develop the private sector markets;
- show the relevance and cost effectiveness in responding to a public sector need; and,
- ensure the applications are built on a strong knowledge base including R&D, highly trained people who can work in multidisciplinary areas and quality data.

Right now, meteorological capacity in Canada could be represented by a very small "pie". Working together, the private, public and academic sectors need to build a much bigger "pie". Meteorological capacity is much bigger in the US, Europe and Asia so if we do not act quickly, others may benefit at the expense of Canada's meteorology sector.

A Vision for 2011

This vision is not a policy statement by the Meteorological Service of Canada. Instead I hope you see it as a starting point for the private, public and academic sectors to steer the growth of meteorology in Canada over the next 10 years.

By 2011, meteorological services and science will be a basis for solutions for:

increasing economic efficiency, productivity and competitiveness in Canada;

- decreasing social and economic vulnerability to weather and environmental hazards;
- supporting sound government policies, international protocols and monitoring their impact; and,
- providing alternatives to legislation in addressing global and local environmental issues.

In realizing this vision, there will be great opportunities for the private and academic sectors to prosper by growing the meteorological sector, not just in Canada, but extending their reach into the global economy. I see the public sector

[1] Assistant Deputy Minister, Meteorological Service of Canada, Ottawa; presented at the CMOS Annual Congress in Winnipeg, May 29, 2001.

as a strategic partner and catalyst in the growth.

Needs and Results of Realizing the Vision

In realizing the vision, the private, public and academic sectors will meet the growing needs of Canadians, their businesses and the needs of Canadian governments in addressing:

- safety and security of life, property and business;
- quality of life;
- economic prosperity; and,
- a healthy environment.

Social and economic losses from environmental hazards will be minimized. At the same time, meteorology can optimize economic efficiency and competitiveness in Canada. About $140 billion of Canada's economy is weather-sensitive so there are lots of opportunities to increase efficiency and lots of business opportunities to grow Canada's private, public and academic capacity in meteorology.

Sometimes the increase in economic efficiency results in an environmentally sound decision which takes me to the next point. Let's say the private sector creates a meteorological application (e.g., a blight or pest forecast) which helps farmers minimize the use of pesticides. Pesticide applications are very expensive, so now the new meteorological service increases the efficiency and competitiveness of the farm and reduces damage to the environment. Most of the pesticide, in fact, runs off, where it gets into the water supply and cannot be filtered out. There is even a social benefit here since people will be less exposed to pesticide in the air, ground and water. Now we've responded to three policy issues -- sustainable development, clean water and toxic substances.

The blight or pest forecast has social, economic and environmental benefits -- that's a step towards more sustainable farming practices. And meteorology is the key.

Where We Are Today
Opportunities and Challenges

The enlightened client knows that weather and environmental factors affect their bottom line and wants solutions that fit their decision-making processes. One challenge is for the private, public and academic sectors to meet that growing need. However, there are many potential clients who remain unenlightened. Another challenge is to convince potential clients of the cost effectiveness of meteorological services to their particular industry and their company. If they don't want the benefit of your services, perhaps their competition might!

The number of weather derivative deals has exploded 15 times in the last two years. Several key industrial groups are involved in this new approach to risk management such as energy, insurance, agriculture, entertainment, transportation and consumer products. Don't forget that about $140 billion of Canada's economy is weather-sensitive. So without support to their decision making processes, this part of the economy remains vulnerable, less productive and less competitive.

The reinsurance industry is very aware of the increasing vulnerability of our social and economic systems to weather and environmental hazards. It is a fundamental role of sovereign governments to protect their citizens from weather and related environmental hazards and the public trusts that this will happen. Obviously warnings are not enough. We are all challenged to find ways of creating more resilient communities.

As I mentioned earlier, meteorological capacity in Canada can be represented as a very small pie. The meteorological capacity in other countries is much larger and growing rapidly. For example, the value-added sector in the US doubled in the last 10 years. The challenge is to grow Canadian meteorological capacity so the private and academic sectors can also harness the global economy. Perhaps one of the applications or technology developed by the private and academic sectors to increase economic efficiency will also help address global environmental issues such as climate change or ozone depletion. Remember, whatever goes up a smokestack or gets dumped into a river or landfill represents wasted money and inefficient processes, as well as pollution.

When people find out that their health or the health of their families are threatened, they take action. People want UVB and smog forecasts, they want wind chill and heat stress products. They are also beginning to see that what they put into the water, atmosphere and landfills can affect human and ecosystem health and impact the economy. We are challenged to build on these linkages, developing business, public policy and science opportunities to benefit the health of the economy, environment and Canadians.

There are some synergies now in the public, private and academic sectors, but I think we can go much further. I have given a few examples of initiatives where there are benefits to the private, public and academic sectors. We should challenge ourselves to find more opportunities to work together on these issues, where all parties benefit.

Another challenge is data. Data are everywhere, but not always accessible or usable beyond their original purpose. To complicate matters, we are on the cusp of a data explosion through new remote sensing technologies. The challenge is to improve the quality, the usefulness and accessibility of data. Within the MSC, we have another challenge and it is to overcome rust-out and technological obsolescence issues and develop the access capability through Internet initiatives such as e-government.

Multidisciplinary problems need multidisciplinary solutions. The challenge is to bring physics, chemistry, biology and other needed disciplines together to develop the solutions needed by the private, public and academic sectors.

Strategies to Address Issues and Move Towards the Vision

I have offered a vision and identified some issues facing us today. So how do we overcome today's challenges, take advantage of the opportunities and start moving towards the vision?

We need to build a strong foundation for meteorology as a knowledge-based business. The essence and soul of meteorology is data and scientists. Without those, nothing else matters. Here are some strategies for consideration.

We must build data and science networks across the private, public and academic sectors. The networks will provide powerful synergies for building meteorological capacity in Canada. We've made a few starts, but need to do much more.

We must create consistent data protocols, implement strict quality control mechanisms and improve access to data so scientists and application makers have easy access to the data and can build the links between the databases and the science that the data represent.

As meteorology lends itself to other disciplines such as oceanography, engineering, forestry and hydrology, meteorologists and research scientists in general must be capable of working in multidisciplinary environments - something to keep in mind as you develop hiring and training plans and discuss those plans with the academic sector.

Finally, we must create a culture of innovation, and reward innovation to attract and retain key skill sets. Innovation will be critical to the development of the science, technology, software and applications needed to provide meteorological solutions to clients.

Second, we need to sell the private and public sector on the benefits of meteorological science and services. Canada's economic and industrial sectors will be interested in the ability of meteorology in:

- increasing the efficiency of industrial processes. There is a bigger payoff if these efficiencies translate into less waste and a reduced risk of fines;
- increasing productivity and competitiveness; and
- reducing their vulnerability to environmental hazards.

And, governments will be interested in the ability of meteorology in:

- supporting the government's environmental policy objectives;
- increasing the efficiency of tax dollars at work; and,
- improving Canada's knowledge base in science and high tech areas. There will be a bigger payoff when that knowledge base can be translated into services and technology which can be exported by the private and academic sectors.

The last high level strategy is to build a global reputation. This means:

- researching meteorological applications in other countries so you can build on their successes and define your niche market;
- marketing the benefits of meteorological science and service abroad; and,
- tapping into the data and science networks in other countries celebrating successes.

MSC's Position and Commitments

So what is MSC's position on the issues and strategies? What will MSC commit itself to doing?

We want to build stronger relations with the private and academic sectors. This means:

- Increasing your access to MSC data and, where possible, the data of our partners, becoming a catalyst and strategic partner in meteorological ventures and less direct competition with the private sector. I believe the private sector should develop the overall strategy for each economic sector and the value-added market applications.
- Where possible, MSC will support you, especially when the final objective represents a shared goal or involves a public policy issue.
- Building science networks with universities and agencies external to government where there are mutual benefits through shared agendas

Over the next several years, MSC will implement life cycle management for its data networks and ensure full data quality. This means we will:

- address the rust-out and technological obsolescence issues; and,
- become a Canadian authority and resource for data and data quality issues in the areas of the atmosphere, hydrosphere and cryosphere.

MSC commits to increasing the visibility of meteorology by:

- supporting studies on the social and economic benefits of meteorological applications provided they result in a journal article or a published thesis; and,

- lobbying at national and international fora (including the WMO, UNEP, IPCC), pushing for recognition of the value of meteorology to human, economic and ecosystem health.

Finally, MSC is committed to becoming a recognized Canadian authority and resource on weather and related environmental hazards where public safety is at risk. With the increasing vulnerabilities that the reinsurance industry has told us about, obviously warnings are not enough. MSC needs to:

- build partnerships with the media, communities, emergency preparedness agencies and others in the private sector to build more resilient communities; and,
- engage the academic community to help us understand the antecedent conditions and the development of severe weather and environmental hazards.

The speed and overall scope of how the MSC will tackle these issues will be limited only by the resources available, and we're working on that. So this is not a plan, but it is a very clear direction for us to move towards.

Next Steps

The first step is the discussion and feedback today and to engage people in the vision.

Work with clients and partners in addressing MSC's issues and identifying specific actions needed to move towards the vision.

The future for meteorology in Canada looks very promising. I hope to see the value of *Canadian-based* meteorological services increase many times over the next 10 years, not just in Canada, but around the world. The potential is there. For example, in 1998, US Secretary of Commerce William Daley stated, "Weather is big business. It can help or hurt a community. One seventh of our economy – about $1 trillion a year – is weather-sensitive. Weather has a serious impact on multi-billion dollar industries like tourism, transportation, construction and agriculture."

In Canada about $140 billion of our GDP is weather-sensitive. Clearly, weather and environmental prediction are very important to Canada's economy.

There are a tremendous number of studies around the world on the value of meteorology to various industries. Each of these studies represents an opportunity to develop a reputation for innovative solutions and increase Canada's competitiveness.

But before we can develop those innovative solutions for decision-makers and tap into the global economy, we need to:

- Develop a strong foundation for meteorology as a knowledge-based business;
- Sell economic and industrial sectors and governments on the benefits; and,
- Build a global reputation.

That is my vision for meteorology in Canada. And shortly we will see another vision based on a study team from the private sector. I expect we will find some common ground to begin growing Canada's meteorological sector.

Photographs, courtesy of Uri Schwarz, Executive Director Emeritus, (from left to right, top to bottom)
1: CMOS exhibit booth at the Winnipeg Congress; 2: CFCAS exhibit booth at the Winnipeg Congress;
3: Jim Slipec, Chair, Local Arrangements Committee at the registration desk;
4: Gilles Simard welcoming CMOS Members to next year's Congress in Rimouski.

Photographs, courtesy of Uri Schwarz, Executive Director Emeritus, (from left to right, top to bottom)
1: Part of the audience at the CMOS Congress Banquet in Winnipeg; 2: Dr. Ron Stewart, incoming President, delivering his first speech at the Banquet; 3: Marc Denis Everell delivering his keynote speech at a plenary session at the Congress (see page 76); 4: Jim Slipec addressing the participants at the Banquet.

A Meteorological Industry Strategy for Canada
Initial Thoughts for Discussion

by R. Ambury Stuart, Ph.D.[2]

I want to say first of all that it is an honour to follow Dr. Everell in this session of the Canadian Meteorological and Oceanographic Society, and to recognize and affirm the new directions that he is urging for Canadian meteorology. Unlike the other sessions of this Congress where we will be looking at highly specialized academic studies, this session is trying to look at the BIG picture, the overall policies and ideas that will shape Canadian meteorology for the next ten years. In a moment I will try to respond to Dr. Everell's vision of this future, and I will do so from my limited perspective as a member of the private sector community of meteorologists.

First though, I think we need to understand again how we all participate in the BIG picture. I have participated in conversations among government, university and private sector scientists long enough to know that whenever we approach these discussions we all make sure that we have our government, university or private sector hats firmly attached to our brains. Often these hats become football helmets as we bash into one another. I would like to suggest another approach. We all work for a single corporation which I will call Corporation Earth. Those of us in this room work for two different branches of Corporation Earth which are the Atmosphere Branch and the Oceans Branch. We live and work in a geographical area called Canada, but you don't have to work in either the Atmosphere Branch or the Oceans Branch for very long before you realize how secondary and irrelevant these human divisions into nation states really are. The atmosphere and the ocean don't give a fig for national boundaries. It is the most natural thing in the world for us to think hemispherically or globally when we do our work. Does it make any sense, for example, to have a Canadian global climate model or a Canadian global weather prediction model? Maybe a made in Canada meteorology or oceanography is just as unrealistic and finally unworkable as made in Canada oil prices that the government tried to achieve with the National Energy Program in the 80s. Anyone who has been to a gas station recently will know that that program failed. Surely the flow of atmospheric and oceanic currents across national boundaries is just as disrespectful of these boundaries as the economic forces of the global energy market for oil and gas. Why don't we stop trying to kid ourselves and join forces with our counterparts in the United States?

For most of us in this room these ideas are a kind of heresy that we reject right away. "Things are different here in Canada", we argue with varying degrees of conviction. "We might just as well become the 51st state and be done with it". This Society - The CANADIAN Meteorological and Oceanographic Society - exists to promote the advancement of meteorology and oceanography in Canada. These dangerous and crazy ideas would suggest that this Society become a branch of the American Meteorological Society - just as we started out as a branch of the Royal Meteorological Society over 50 years ago.

Let me say right now that I too reject these heresies. I, like most of you, sense a value of being part of our profession in this country, but I think we must admit that our position is becoming harder and harder to defend. The world is becoming smaller, national economies are being merged as large trading blocks in Europe and North America are being formed. If we are going to maintain our separateness as Canadian meteorologists and oceanographers, then we need to work harder at doing this than we ever have before.

I think we must begin by learning to work together more effectively. If we don't hang together, then we'll hang separately! Those of us who work in the private sector believe independent companies have strategic and tactical advantages over government organizations and universities in the application of private capital investment to meteorology. We would like to exploit these advantages and grow our companies, but over the past five years or so it has been almost impossible to do this for reasons that most people understand very well. Some companies have closed their doors, others have given up on Canada, and still others have given up on meteorology. However, now it seems the wind has changed. There seems to be a new interest in MSC to revisit the idea of partnerships in more meaningful ways. And we in the private sector welcome that change - first with scepticism and now with optimism.

Today I am going to report to you on a unique new attempt to build a Meteorological Industrial Strategy for Canada. Notice that this strategy still believes in a distinctively Canadian approach to this issue and for this reason alone it has value, not only to the private sector but also to everyone who wants to maintain a unique Canadian profession.

The purpose of this talk is to present initial thinking on an industrial strategy for the "weather" commercial sector, where weather includes meteorology, climatology, air

[2] Presentated on behalf of the CMOS Private Sector Task Force at the CMOS Annual Congress in Winnipeg, May 29, 2001.

quality and hydrology. You need to know that this strategy has been developed by a Task Force made up mostly of members of the CMOS Private Sector Committee, and while we are grateful to MSC for helping us with the funding to do this study, we need to emphasize that none of the views to be presented here necessarily reflect the views of Environment Canada. We are here to seek your feedback both in this session and the panel discussion after the coffee break, and to move forward to take advantage of opportunities.

We all know why weather is important from a commercial sector perspective - most of our industries in Canada are affected by the weather, either directly or through transportation and energy costs. As our technological capacity improves, we need to know weather information will become more and more important.

Climate as well - especially climate change and variability - has important commercial sector implications, especially in long-range planning and infrastructure decisions.

Despite its importance, the commercial weather sector today is quite small - $65 Million - which includes MSC commercial activities outside intergovernmental "sales" like the large contracts with Nav Canada, Defence, Coast Guard and the provinces. Together, the private sector and MSC generate more than $130 Million in revenue. In the U.S., commercial services have a value of $1 Billion. There are about 100 firms in commercial services in Canada including traditional weather services, environmental science and policy and instrumentation and software. Most are small with the exception of the Weather Network which accounts for about half of the non-MSC revenues in the commercial weather sector.

These details don't matter very much. There are two players in the commercial weather sector today - Pelmorex and MSC who together have about 70 per cent of the market and who have been responsible for virtually all of the growth in the past decade.

Times are changing though. Government spending constraints have reduced contracts to private companies for research and services, forcing those companies to look elsewhere for revenues. Some of the survivors and newer companies as well, are moving into value-added weather and climate services to non-government clients. The Weather Network has become the prime Canadian source of weather information through the mass media including the Internet. The MSC is refocusing on its core services most of which are in the public sector as opposed to the commercial sector. Finally, the communications revolution is having its impact on commercial weather services in a variety of ways. The availability of information of all kinds has stimulated increased demands for weather information so that is a plus. However, the ease of access of Internet communications has also increased the number of providers of this information and greatly increased the competition. Like Corporation Earth, the Internet also has no respect for national boundaries.

MSC has announced that it needs more money for key infrastructure improvements, but it will have to compete with all the other demands for government money, including, for example, the demand for reduced taxes so that doctors, nurses, scientists, engineers and mobile high-tech industries don't leave the country for more after-tax dollars in other jurisdictions. Without new revenues, MSC services will deteriorate which will in turn make them vulnerable to suggestions that everything except the raw observations be done south of the border. If the new infrastructure investment can be secured, however, public good needs will be better met, and we have a chance to develop a commercial sector industry that returns strong economic benefits to industries that operate in Canada and who have to deal with Canada's weather. With growing international competition, these weather-sensitive companies will need all the help they can get, and governments at all levels will value the expertise that provides this help.

So our vision for the future is the development of a uniquely Canadian public-private partnership so that all citizens and organizations have instant access to critical weather and climate information they need, when they need it and wherever they need it, from Canadian suppliers, so that the Canadian economy knows about and adapts to the weather-related risks and opportunities better than any other country in the world. This, as I see it, is our response to the homogenizing effect of globalization that would submerge our Canadian ship into a global sea. We are different up here because our weather and its related risks and benefits are different. Also, it is not just a matter of dollars and cents. If we plan our commercial and recreational activities with more attention to the weather, then we will expend less energy and pollute less. If we use less pesticides on a field because we better understand the winds, then less pesticides will end up in the ground water. We have unique weather challenges in Canada that would not be a priority in a U.S.-led initiative either in the private or public sector.

What are the outcomes of such a vision?

- Canadian weather-sensitive organizations will be more efficient economically and they will pollute less.
- Canadians will have access to information that is specifically tailored to Canadian conditions.
- The Canadian financial sector will discover the weather derivatives market and will open up even more opportunities for weather expertise.
- Public services will also be improved - things like improved highway weather forecasting will be better.

In addition to advantages to Canadians and Canadian business, the commercial weather itself will become a valuable part of Canada's high-tech sector.

- It will lever Canada's advantages in research, technology, communications and resources.
- It will develop leading edge content for Canada's Internet agenda.
- It will provide growth opportunities in the information, high tech and science sectors and the career opportunities that go with that.
- It will grow very rapidly as new high tech initiatives often do from about $70 Million now to $500 Million in 2011 which is about half the size of the current U.S. industry.

So how do we do this?

From government we need a collaborative weather network that collects timely, high-quality weather information, forecasts and weather services, both for public good and as input for private sector commercial products. By "collaborative", we mean a weather network where many players assist Environment Canada in gathering the core information from which all participants benefit.

From universities we need training of the required professionals and cutting-edge research that serves both government and industry requirements.

From the private sector we need a weather industry that is recognized around the world as innovative and competitive.

And now we get to the tricky part. We don't have an adequate commercial services sector now and if we are going to get one then things have to change. Change is always difficult and difficult to negotiate. In order to begin this process, the Task Force has planted some seeds in the form of questions to begin discussion.

We need a new partnership model if we are going to be successful.

What could be a redefined role for MSC? Is it possible for them to focus on core infrastructure collecting and analyzing activities that only they can do in gathering and analyzing weather and climate information? Is it possible that they could provide data outputs at little or no cost to stimulate new products and services?

How might the academic sector provide more qualified people and more targeted research products? Is it possible that the private sector might become more actively involved in the allocation of government R&D grants to universities?

How might the commercial sector outside MSC quickly expand its capacity for value-added services? Is it possible or realistic to envision the private sector taking on more/most commercial weather activities?

We need to expand the private sector.

What are the barriers? Is growth being blocked by small Market size? Do we lack Investment Capital? Are we short of talented People? What commercial services should be targeted first? How should the commercial services people in Environment Canada respond to the need to expand the private sector? Are there better ways to distribute data? What other government agencies outside Environment Canada might be helpful? Should the weather industry be better organized? How would we do this?

We need rapid transfer of data and the results of relevant research.

How can we encourage this? What are the barriers? Is it Investment capital? Organizational issues? What other areas of science and technology need to be brought into play? Where is the expertise for that? Who in the government/university/industry mix does what? How do we deal with legal issues around intellectual property?

We need qualified and energetic people.

Can future demands be met with current educational institutions? Can we coordinate with Environment Canada's hiring needs better? Should there be an accreditation standard for meteorologists? Should there be a sector council to oversee growth? How can we tap expertise in Human Resources agencies in federal and provincial governments?

Finally, there are marketing issues.

What are the market opportunities? What kinds of products and services are needed? How do we get the word out? Would an industry-wide web site be useful? Who would run it?

Where do we go from here?

Following our discussions today, we intend to hone our thinking and carry out appropriate economic research in Canada and elsewhere before completing our report in the Fall.

The Task Force is grateful to MSC for support for this work. We have presented a private sector perspective on what the future of our industry should look like if it is to become an effective player in the Canadian economy. We believe that with more effective use of weather information, improved efficiencies will also result in less waste and environmental degradation. This is truly a win/win situation which will enhance the environment and will at the same time ensure that those of us who consider the environment to be so important that we have dedicated our working lives to it to be able to continue our work in Canada, whether it be as a public servant, an academic or an entrepreneur.

Thank you.

Note:
Dr. Stuart's talk was accompanied by a slide presentation. If you would like further information on this presentation or would like to provide feedback to the Private Sector Task Force, please contact one of the co-chairs of the Task Force, Susan Woodbury swoodbury@seimac.com or Ian Rutherford ian@houlerutherford.com

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Speaking Notes CMOS Banquet May 30, Winnipeg

by Peter Taylor
Outgoing CMOS President

Since this is my last chance to address you as President, and there is some hope that you will listen when I speak, let me make a few remarks, based on thoughts from the Congress, that strike me as important. After tonight my words may carry less weight so I have to take advantage of this opportunity.

My theme is Extreme Weather and Automation, prompted by Marc Denis Everell's remarks on automation, the PSPC (Prairie Storm Prediction Centre) weather office visit and the conference session on hurricanes. Models (automation) are great but they are just models. When I submit my taxes I am quite happy to do this electronically; automation is OK. On my flight home I will check in automatically, expect the pilots to have many automatic facilities, but I want them there and available in case of problems. Henk Tennekes (former head of KNMI - the Netherlands meteorological service) wrote an article some years ago comparing weather forecasters and pilots. Neither is really needed on benign days, but is crucial for severe weather. So we should worry about possible cutbacks in staffing the desks. More computer GUIDANCE by all means to improve the input, but get the right man/machine mix. Do not rely totally on models, use the current data as in Project Phoenix - highlighted in Jay Anderson and Pat McCarthy's conference-opening performance, and as implied in the Maritimes severe weather papers.

I want to send some messages.

- First for Marc Denis Everell - who I know is not here tonight, but I will send it to him. You should spend time in some forecast offices (maybe Winnipeg in mid-summer, Atlantic in the September hurricane season, Montréal in February); listen directly to the people on the desks and find out what they have to do. Respond to their enthusiasm and be aware of their concerns. Do not make decisions on input from CAs and Ottawa bureaucrats without input from the shop floor. Dollars are, unfortunately, important but so are people and the service that they provide - do not ignore them.

- Second, a message for the Weather Network, and some other sections of the media, based on what seems to me like a legitimate concern expressed in our public sector forum. Give MSC more credit for the data you use - make the public aware that yours is a cooperative venture.

- Third, two messages for operational forecasters. Join, and be active in CMOS, use us as an organisation to support your goals and expand your professional horizons. Also, recognise the need for flexibility. These are times of change - take the opportunity to propose changes that will improve and reinforce the ways in which you can continue to deliver quality weather services.

- And a message for CMOS members. MSC, Marc Denis Everell and Minister Anderson need your help in securing increased funding for MSC. Lobby your MPs, write to the newspapers - especially local ones but go national if you have something topical and pertinent. The issue of extreme weather is a good one. More (or new) equipment and no reductions in personnel are critical to maintain and improve service levels, and government has to be reminded of this, often. The bean counters always want more with less - sooner or later even they must realise that this is a fantasy, and that reinvestment is desperately needed.

As an additional thought, and following Andrew Weaver's example in today's plenary talk, let me recommend two books to read to your children or grandchildren. Mordechai Richler's book, "Jacob two-two and the Dinosaur" has a Prime Minister who surrounds himself with "yes" men, and "yes" women, and including tame scientists. A dangerous thing to do. I have probably noted this before, but Salman Rushdie's book, "Haroun and the Sea of Stories", set on Earth's second moon, Kahani, has much to say about the way we "eggheads" sometimes treat the public at large. On Kahani the scientists in P2C2E (process too complicated to explain) house believe that their technological fixes are fine, and too complicated for mere mortals to understand. We mustn't fall into their trap. Outreach communications with the public, schools and media, is something we should all be prepared to spend time on.

It has been an interesting year. To make a Lord's prayer analogy, I probably need some forgiveness for some things done and especially for things left undone! I hope I will be forgiven. You and they are probably tired of hearing my thanks to the staff of the Ottawa executive office but Neil et al (Dorothy, Uri, Richard, Paul-André and Bob) are the foundation on which our Society rests and the tasks of the Executive Committee would be much more difficult without them! In terms of the executive committee most of us are continuing, with the addition of Ron Bianchi as vice-president - welcome Ron. It is, however, appropriate to say a special word of thanks to Ian Rutherford, our retiring Past-President - whose position I am about to fill. My year as President has been relatively quiet compared to his and we have continued to benefit from his wise counsel. Finally the Winnipeg Centre, Jim Slipec, Jay Anderson, Pat McCarthy et al. All congresses are different - this was rather special as it had rather strong emphasis on a theme. I am certainly enjoying it, and hope you are too. See you all next year in Rimouski!

Student Travel Bursary Recipients Bénéfiaires des bourses de voyages d'étudiant

CMOS Annual Congress 2001 Congrès Annuel de la SCMO 2001, Winnipeg, Manitoba

1) Alain Beaulne, Étudiant en Maîtrise, Département des Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, (UQAM).
Application of a Monte Carlo radiation scheme to the retrieval of cloud optical depth using the Barker-Marshak Method.

2) Dorothy Durnford-Sutton, MSc candidate in Meteorology, McGill University.
Analyses of Montréal's record-breaking heavy rainfall event of 8-9 November, 1996, and its associated analogues.

3) Stephen Déry, McGill University
A numerical study of a severe Arctic ground blizzard.

4) Jason Milbrandt, McGill University.
The explicit predictions of Alberta Hailstorms using a double-moment bulk microphysics scheme.

5) Jiaxiong Pi, Physics Department, Dalhousie University.
Anthropogenic aerosol effect on Arctic precipitation - A case study with the GESIMA Model.

6) Nicole Plette, Masters student, McGill University.
A case study of the CAGES Hailstorm at Fort Simpson, Northwest Territories.

7) Tetjana Ross, Department of Physics and Astronomy, University of Victoria.
Chaos or Critters?

8) Wladylaw Rudzinski, Department of Earth and Atmospheric Sciences, University of Alberta.
Numerical modelling of freezing rain accretion on H.V. insulators of electrical power transmission lines.

9) Alyssa Young, MSc student, Department of Mathematics, University of Victoria.
Anomalous atmospheric circulations forced by volcanic aerosols.

10) Natacha Bernier, Department of Oceanography, Dalhousie University.
Sensitivity of storm surges to the maximized January 21 2000 storms.

CMOS 35th Annual Congress Closing Poem by Jim Slipec, Chair LAC

The 35th Congress is nearly done
and I hope that everyone had a lot of fun.
The days were filled with papers diverse
the nights filled with mosquitos, Winnipeg's curse.

The week went by quick, that's for sure
Session upon session, each with an allure
From hurricanes raging just off-shore
To tornadoes ripping off barn doors.

Is the climate changing we might ask?
Will it be the beach of Churchill where we'll bask?
Will storms rage harder and flood the fields?
Will crops drought to death without any yields?

Some of the answers this week came
Many more questions however remain
But thanks to the work of CFCAS
Someday this area won't be such a guess.

We are nearly done, only one day to go
If this were in January, we'd be freezing cold
But "the Peg" did us proud all week long
Sunshiny days and winds that blew strong.

Our thanks to you all for coming this year
To visit Winnipeg and drink Fort Garry beer.
For making the Congress a wonderful success,
Good health to you all, we wish you the best.

To Rimouski we go next, in two thousand and two.
Where they want to see every last one of you
To continue the tradition of Congresses great
But whatever you do... Don't register LATE!

Byron Walter Boville[3]
1921 - 2001

Barney Boville passed away Friday aftemoon, June 1, around 5:30 hrs lying in full view of his beloved Lake Simcoe with all of his family present. He was in his eighty-first year.

Bamey was one of the "metmen" recruited during the War and trained in meteorology in a crash course to forecast weather for cargo planes flying out of Gander to the European front lines.

After the war, he completed his doctorate and eventually became Chair of Meteorology at McGill. He then became Director of Research at AES (now once again MSC) and served as a consultant with the WMO in Geneva where he started the World Climate Programme. He was recruited by York University to help set up the Atmospheric Science stream and later he served as Chair of the Department of Earth and Atmospheric Science. During his tenure as Chair, Gary Klassen and Mary Ann Jenkins were appointed and Peter Taylor was hired as his successor as Chair. It is worth mentioning that Bamey's Ph.D students include such luminaries of Canadian meteorology as André Robert, Phil Merilees, David Davies, Richard Asselin, Ian Rutherford, Mike Kwizak and many more. For many years Bamey was the organiser of the McGill-Stanstead summer school seminars in meteorology which brought many intemationally-known experts to Canada and stimulated a great many Canadian students. Barney started the Canadian climate modelling effort in the '70s and founded the group now known as CCCma. He was also the founder of the Canadian Climate Centre, the Canadian Climate Program Board, and as a result of all these activities he was asked to go to Geneva to set up the World Climate Program.

His scientific work on atmospheric dynamics and the ozone layer and climate led to his election as a Fellow of the American Meteorological Society and the award of the Patterson Medal of MSC and the Massey Medal of the Royal Canadian Geographical Society. He was also President of the Canadian Branch of the Royal Meteorological Society from 1962 to 1964, CMOS being formed much later in 1967.

Among his three children, Susan, Jo-Anne and Byron, two followed him into meteorology. His daughter Susan was an in-line forecaster in Montréal before becoming a senior planning officer at McGill and she later served as a sessional lecturer in meteorology at York. His son Byron is a senior research scientist at NCAR in Boulder, Colorado.

[3] Contribution from several CMOS members including Doug Smylie, Ian Rutherford and Bob Jones.

Until his death, he was enjoying his retirement at Lake Simcoe with his second wife Flora. A Memorial service was held at the United Church in Orillia, Ontario.

Tributes from CMOS Members

From Peter Scholefield

I was surprised to hear about Bamey Boville. I remember him best as the first director of the newly established Canadian Climate Centre (CCC) in 1978 where I was fortunate to be appointed the head of the Climate Program Office and subsequently worked closely with Bamey in establishing and implementing the CCC and the Canadian Climate Program. I had the highest admiration for him as an academic and a leader as well as a caring and nurturing person. We got along extremely well together both in the office and outside as we were both keen tennis players.

Shortly after he left AES for WMO in 1979, he arranged for me to come to Geneva for two weeks in January 1980 to prepare a report which led to the establishment of the INFOCLIMA climate data referral system within the Word Climate Programme. When I told him that I would like to bring my wife Heather with me to Geneva, he kindly invited us to stay with him and his wife, Grace, in a lovely old home within walking distance of the WMO Secretariat. One evening, he invited Mike and Leslie Malone over for supper which was the beginning of a long and close association with the Malones who both eventually came back from Downsview to work with me at the WMO Secretariat in the summer of 1999.

In retrospect, that initial WMO experience laid the basis for my carreer change from AES to WMO as Chief of the World Climate Data and Monitoring Programme Division from 1993 through to my recent retirement in December of 2000.

I have much to be thankful for from my association with Bamey.

From Morley Thomas

Barney was on the short course after me, course No. 5 in early 1942; very soon after he took the advanced course and then spent his forecasting days in Newfoundland forecasting for either the RCAF convoy patrols or Ferry Command. I think he was one of the first meteorologists to be posted to the new Central Analysis Office when it started about 1950 in Ottawa. Then, and once again from memory, I think he was one of the two, Dick Douglas was the other, who were sent to McGill to get a PhD and to instruct in the new department. A few years later they left the Met Service and joined the McGill staff. Stewart Marshall and Ken Hare launched the McGill department and were followed by Walter Hitschfeld and Svenn Orvig. Douglas went to Macdonald College (still part of McGill) and Barney soon became the senior man in the Department of Meteorology. He resigned and came to 4905 in about 1973 and became the director of an Atmospheric Research branch following Godson when the latter succeeded McIntyre as Director General in about 1976. Then, in 1978 he became director of the new Canadian Climate Centre we set up that spring. He retired in September 1979 (I moved from CSD to the CCC - had both for 6 months - stupid of me) and went to Geneva on contract for a year or so, I think, before going to York. I remember one excellent presentation he made in the AES auditorium to a select group including the Madame Jeanne Sauvé (then the Governor General) and another time when during a presentation to TB or DOE brass of our computer needs in the 1980s he produced and displayed a chart showing the need curve going right off the paper. He was right!

From George Robertson

It was a shock to learn of Barney's passing. I did not know him well but our paths crossed a few times: at HQ in Toronto; at CAO in Ottawa; at WMO in Geneva; to name a few.

Some facts I gleaned from Morley Thomas's latest book "METMEN IN WARTIME" are:

- Barney graduated from Short Course No. 5 in May 1942 and it appears that his first assignment was at No. 10 Air Observers School at Chatham, NB as a MetMan. In 1944 he was moved to Botwood as a meteorologist so he must have picked up his MA degree in Meteorology sometime between 1942 and 1944.

- He joined the CAO staff in Ottawa in 1951 just shortly before it was moved to Dorval. He was Shift Supervisor there until about 1954 when he joined the Meteorological Group at McGill University. I was one of the originals at CAO but stayed behind to work with the Department of Agriculture so lost track of him for several years until we met again at WMO in Geneva about 1978 when he started work with the World Climate Programme.

Books in Search of a Reviewer

The Earth's Plasmasphere, by J.F. Lemaire and K.I. Gringauz, January 1998, Cambridge University Press, Hardback Cover, 0-521-43091-7, 350 pages, $90.00US.

Climate Change Impacts on the United States, National Assessment Synthesis Team, US Global Change Program, First published in 2001, Cambridge University Press, Paperback, 0-521-00075-0, 612 pages, $39.95US.

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
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Correction

In the April issue of the *CMOS Bulletin SCMO*, Vol.29, No.2, a mistake was made in spelling the name of one of our devoted contributors. In the Note from the Editor, page 39, Mr. Loken's name was incorrectly spelled. Our sincere apologies to Mr. Olav Loken.

Paul-André Bolduc, Editor
CMOS Bulletin SCMO

CMOS Bulletin SCMO
Next Issue - Prochain Numéro

Next issue of the *CMOS Bulletin SCMO* will be published in August 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 août 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.

Numerical Simulations in the Environmental Earth Sciences: Proceedings of the Second UNAM-CRAY Supercomputing Conference

Edited by F. Garcia Garcia et *al.*
Cambridge University Press, 1997
Hardback, 283 pages, $69.95

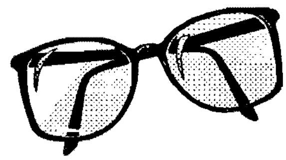
Book reviewed by Paul Myers
Memorial University of Newfoundland
myers@physics.mun.ca

This book is a collection of papers that summarize the highlights of the material produced at the second UNAM-CRAY conference, held in Mexico in 1995. The goal of this meeting was to highlight the problems in the numerical modelling of the atmosphere, ocean and geophysics that could be addressed with the use of modern supercomputers. As stated in the introduction, "advances in the capability and performance of supercomputers have allowed researchers to tackle larger problems with fewer approximations, finer meshes and more realistic models".

The proceedings are organized into four parts: The first section considers general circulation models (both coupled and for the atmosphere or ocean alone) and some of their possible applications. The second section presents atmospheric modelling papers on a variety of space and time scales. The third section considers geophysical data assimilation, while the fourth section covers general computational and mathematical methods with geophysical applications. In all chapters, some of the papers consider ways of efficiently applying models to supercomputers while others detail results of experiments performed on the same supercomputers. With the conference being held in Mexico, the majority of the applications discussed in the various papers are concerned with tropical, Latin and South American research questions.

The general circulation models and global change chapter contains 11 papers that range from computational techniques to studies on the impacts of global change. The lead 2 papers discuss the methodology of running a general circulation model (GCM) on a supercomputer and aspects of distributed computing. A further paper discusses building a parallel ocean GCM. Further papers consider systems for digital image processing and land cover classification from satellite imagery. Applications papers include those on the role of equatorial climate asymmetries and the causes of precipitation anomalies over Mexico. Two papers examine the impact of increased CO_2 concentrations on the Pacific region and Latin America. The last two papers consider the impact of sea surface temperatures on the Gulf of Mexico and on Ecuadorian marine productivity.

The dispersion and mesoscale modelling chapter contains 11 papers on a diverse range of atmospheric modelling topics. The lead paper reviews the environmental applications of mesoscale modelling, presenting a wide range of applications. The bulk of the remaining papers in this chapter are related to pollution and air quality modelling. The numerical development paper considers adaptive finite element meshing for pollutant problems while other papers consider the modelling of air pollution in Los Angeles and the Valley of Mexico, as well as the impact of fuel consumption and air quality. More process related studies examine the diffusion of pollutants in the atmospheric boundary layer, dispersion in urban canyons and the coupling of an urban dispersion model to an energy budget model. The final set of papers consider varied topics, such as windflow in the Valley of Mexico, 3-D semi-lagrangian cloud modelling and large eddy simulations of stratocumulus clouds.



The geophysical data assimilation chapter contains 7 papers, mixed about equally between techniques for assimilation and application papers. The sections start with a discussion of some computational aspects of Kalman filtering, using a simple linear shallow water model. It is followed up by a description of the NASA/Goddard Space Flight Centre's Physical-Space Statistical Analysis System, designed to be an incremental improvement over their optimal interpolation scheme. Efficient methods for the solving of eigenvalue problems from linear stability analysis is also discussed. Rainfall patterns in northeast Brazil are examined by using singular value decomposition and canonical correlation analysis in a pair of papers. The last 2 works in this chapter consider a scheme for the automatic identification of the ITCZ from satellite imagery and a test case for the assimilation of acoustic tomography into a simple ocean model.

The methods and applications in geophysics chapter contains the final 4 papers in the book. Two papers consider techniques for model parallelization, one based on domain decomposition and the other Th-collocation. The final two papers are related to traditional geophysics, with one considering the impact of man-made obstacles on P-waves during earthquakes while the final submission examines unsteady-state multiphase flow through porous media.

"Does the weather really matter? The social implications of climate change"
by William James Burroughs
Cambridge University Press, 1997, 230pp, Hardcover.

Book Reviewed by Keith C. Heidorn, PhD
The Weather Doctor
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In the preface to "Does the weather really matter? The social implications of climate change", author William James Burroughs analyzes his title question and tells us that his focus will be on "the weasel word" "really:"

The whole issue of the potential impact of climate change, whether natural, or as the result of human activities, depends on how sensitive our economic and social structures are to such changes. ... What is at stake both in the potential cost of action and inaction and the benefits flowing from the correct choices is far too great to allow the issues to be over simplified."

His overall treatment of the topic of climate and weather impacts on society is to discuss, not the question of whether climate change or extreme weather (which for brevity I will call "extreme weather" hereafter) will happen, but the question of whether such events may really have a long-term negative effect on civilizations and society.

Burroughs develops his arguments in the first few chapters by looking at the evidence of impacts of extreme weather swings on human affairs from the ancient to the recent.

For example, Chapter 2 "The historical evidence" looks at the correlations between extreme conditions in the proxy climate data with the rise and fall of ancient civilizations and with weather-induced subsistence crises in more recent centuries. Chapter 3 "Cold winters" focuses on some of the extremely cold winters in the last century to see how they affected industrialized societies, particularly those of Europe and Britain (where Burroughs resides).

In both chapters, he concludes that although extreme weather conditions had compelling and definite adverse impacts on society, the effects could not be totally divorced from the overall economic, social and political "climate" of the time.

In Chapter 4 "Storms, floods and droughts" the author addresses the issue of extreme weather and our ongoing concern over how such weather impacts present and future social conditions.

Along the way, he asks the central question of whether we are entering a period of truly extreme weather events (compared to the past century or so), or are just becoming more vulnerable to even "run-of-the-mill" extreme events. Is it the weather elements that have become more extreme, or is it the price tag of storm damage that has become extreme?

Having looked at the social factors affected by weather extremes, Burroughs asks in Chapter 5 "How much do we know about climate change?" Here he looks at the current scientific understanding (circa 1996) of what causes extreme events and how well the future occurrence of events be predicted. Having concluded in Chapter 5 that we may not be able to predict future climate with the degree of accuracy required by economic models, Burroughs now looks at specific climate and weather models and their weaknesses. After a short discussion of economic models, he all too briefly discusses the melding of economic and climate models to determine what of importance they may show us relevant to social planning and climate change interventions.

The final chapter "Consequences of forecasting" asks whether, from an economic point of view, "forecasting is a good thing, or whether it does more harm than good." It concludes with a discussion of whether the money put into improving forecasts is "really good value for money" (again, asked from a social, economic, political perspective).

Burroughs concludes that although "extreme weather events and longer term climate change have both exerted substantial influences on economic and social history and played a fateful role in other aspects of history. ... What really matters is whether our social structures are becoming more, or less, vulnerable to inclement weather."

Although he appears to take the central position in the "climate change" debate, I am sure his conclusions will anger many. I sense (perhaps due to my own bias) a leaning to the "right" by suggesting we be more reactive to the changes as they come rather than proactive in trying to mitigate change. His support for "gradualism" in present responses to the threat of global warming is counter to the "immediate response" calls of scientists such as Stephen Schneider.

While you may not agree with all that Burroughs says in "Does the weather really matter?" I think you will find it stirs debate — if only in your mind with the author. "Does the weather really matter?" is clearly written and an easy read. It should appeal to the lay reader and the professional who is not deeply involved in the study of climate change. The climate change professional may find the book too general or lacking in depth on various issues; however I do not sense they were the author's intended audience.

The Tornado: Nature's Ultimate Windstorm[1]

by Tom P. Grazulis
University of Oklahoma Press, Norman, OK,
352 pp, ISBN 0-8061-3258-2.

Book Reviewed by Keith C. Heidorn, PhD
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see@islandnet.com

As I have written elsewhere, Tom Grazulis is a different breed of storm chaser. Rather than ply the highways and dusty country roads of Tornado Alley, hoping to encounter an emerging funnel, he combs the dusty archives of libraries, government agencies and newspaper offices for the accounts of tornadic storms long dissipated. His landmark tome Significant Tornadoes 1680-1991 is the most encyclopedic reference on American tornadoes available. As co-founder of The Tornado Project, he has also produced or consulted on many of the best tornado video productions to date.

Therefore, as I began to read Grazulis' most recent book The Tornado: Nature's Ultimate Windstorm, I had high expectations. In addition, I was once told that he intended this book to be a sequel of sorts to Snowden D. Flora's 1953 classic Tornadoes of the United States, also published by the University of Oklahoma Press. Fortunately, my high expectations for this book were fully realized. Grazulis has again produced a reference on tornadoes that will surely sit next to Flora's classic and with its newer information will surely replace Flora as the best general book on tornadoes available to the lay audience.

In the "Preface," the author states his goal has been "to write a book for the general public that touches on the full scope of tornado studies and answers most of the commonly asked questions. "I have tried to set the record straight about tornado 'risk,' the Fujita Scale, the number of tornadoes that touch down annually, and certain myths that will not go away. I have tried to shed light on misconceptions and contradictory ideas about tornadoes."

Grazulis has succeeded, in my opinion, in achieving these goals. The Tornado: Nature's Ultimate Windstorm is a book written in an easy, flowing style, comprehensible to the lay audience yet technically meaty enough for the rabid tornado-phile. It is fairly well illustrated (though there are spots where additional figures would be helpful) and has a good selection of material for further reading.

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The book covers topics such as:

- The history of tornado research;
- The life cycle of tornadic storms;
- How tornado forecasts and warning systems have developed;
- How the Fujita Scale was developed and what it really means;
- Tornado climatology: where, how often, how strong;
- Tornado risk and safety;
- Significant tornado histories;
- Tornado events outside the United States;
- Tornado myths.

In covering these topics, the author interweaves his information with relevant accounts of real storms and the people they affected. Most importantly, he takes great strides in dispelling many of the major misconceptions and myths about tornadoes that have been given us through the media, motion pictures and "bad science" over the years. As examples: trailer parks do not attract tornadoes; opening windows will not keep a house from exploding due to the low pressure within a tornado (in fact, houses do not explode but are torn apart from within when high winds enter broken or open windows, thus lifting the roof and pushing out walls); a highway overpass is not a safe haven if caught on the roads; and the southwest corner is not the safest location in a house.

Some may criticize this book for its lack of storm-chaser drama and vivid funnel cloud photographs, but if that is the reader's only interest, there are many alternate choices out there. Rather than be another "oh-wow" fluff book of pictures and little substance that abound today, "The Tornado: Nature's Ultimate Windstorm" is a serious look at the tornado and all its impacts written for the general audience. While author Tom Grazulis fully appreciates the awesome power and beauty of the tornado, he has more important issues to discuss and concerns to raise than to devote this work fully to sensationalistic accounts.

There is, however, much in this book to learn. Even an old meteorologist like me can come away with new knowledge and added wisdom concerning the tornado and its impacts. Tom Grazulis has again provided an important work in the field of tornado knowledge and awareness, particularly with regard to storm risk and safety concerns. Hopefully, "The Tornado: Nature's Ultimate Windstorm" will become a best seller and top borrowed book in libraries. Those of us will also find benefit from reading this book, particularly if tornadoes are a part of our weather concerns.

Not only do I highly recommend "The Tornado: Nature's Ultimate Windstorm" to all interested in weather, natural disasters and tornadoes, I strongly urge everyone living in tornado-prone regions to read this book. It might save your life!

Scanning The Skies: A History of Tornado Forecasting[2]

by Marlene Bradford
University of Oklahoma Press
Norman, OK, 2001, ISBN 0-8061-3302-3

Book Reviewed by Keith C. Heidorn, PhD
The Weather Doctor
see@islandnet.com

The tornado is likely the most feared of North American weather's deadly moods. Its very nature -- short-lived and small-scale -- makes the tornado a difficult entity to predict. Even today, pinpointing the occurrence of a tornado within a 100-square mile block and less than an hour before touchdown is one of the most difficult tasks facing a severe weather forecaster. Modern weather radar systems, almost instantaneous communications networks and dedicated teams of storm spotters and chasers have, however, dramatically improved tornado warning systems and saved countless lives over the past few decades.

In "Scanning The Skies: A History of Tornado Forecasting", Marlene Bradford highlights the development of the US tornado forecast and warning systems from the earliest inception to the modern, multi-component, highly technical system in place today.

Ms Bradford begins the book with the historical background into the theories of tornado formation and the early attempts to predict tornadoes in the United States. The major focus of the story, however, begins a little more than a century ago when the first scientific inquiries and debates as to the nature and causes of tornadoes began. Much of the limited early debate appears to have focused on the negative aspects of tornado forecasts, even speculating that more would die from panic or illnesses contracted while huddled in damp storm cellars than from the storms themselves! The US Weather Bureau, recognizing the difficulties in forecasting tornadoes and fearing public panic from any such forecasts, actually forbade use of the word "tornado" in any forecast until 1938.

When the author reaches the state of tornado knowledge during and just after the World War II years, she reaches the true heart of the story. Bradford gives us a well-documented account of the friction between military and civilian storm forecasters in the post-war years that was sparked by the first storm warnings produced within the US military weather service. She takes us from the events leading up to the first "official" tornado warning forecast of Major Ernest Fawbush and Captain Robert Miller issued on March 25, 1948 to the modern forecast and warning system used today by the US Storm Prediction Center.

Having brought the warning system development to the new century, Bradford concludes the book with a chapter on the evaluation of the effectiveness of the integrated tornado warning system over the past several decades. Her analysis shows a difficulty in proving the question as to whether such a system has saved enough lives for the cost of development, implementation and function.

I personally believe that the true nature of the question is always unanswerable in a true scientific analysis: there are too many variables. But I find it hard not to conclude that the tornado warning system has saved countless lives over the past decades and will continue to do so into the future. No system can be 100 percent effective, particularly as population density grows in susceptible areas. Bradford concludes similarly: "Although the ultimate goal of the integrated tornado warning system, preventing loss of life from tornadoes, becomes less achievable as Americans continue to move into tornado-prone areas of the country, improvements in tornado forecasting and the tornado warning system and public education should continue to lower the number of tornado fatalities."

I have no real criticism of "Scanning The Skies". Readers looking for more technical material on the scientific aspects of the history of tornado forecasting may be disappointed in this book as it only briefly and superficially discusses scientific advances that lead to improvements of the tornado warning system (such as the development of Doppler radar). Recognizing that the book is intended to present the history of the process of developing a tornado warning system and not about the science behind it, I feel a little more attention could have been given to some of the more relevant scientific aspects with a few diagrams for clarification as to what forecasters look for when developing a tornado watch or warning forecast.

If you are interested in tornadoes or in disaster prevention and warning programs, I think you will find "Scanning The Skies" an enjoyable and informative read. "Scanning The Skies" is a well-written historical account of the rise of the modern tornado forecasting and warning system as well as a peek at the workings within government as agencies vie for control and funding while simultaneously trying to avoid criticism.

Did you know ?

"There is now new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." IPCC Third Assessment Report, Shanghai, January 2001.

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The Long-Range Weather and Crop Forecasting Workshop

Since 1993, an ad hoc group of experts and interested parties have met periodically to examine how seasonal climate forecasting can benefit agriculture, power generation and freshwater resources. This year's meeting, held in Regina, Saskatchewan on March 5-6, 2001, represented the fourth meeting of this group in the past eight years.

On the first day, nine scientific papers were presented on the latest progress in seasonal forecasting in Canada and the USA, and two on the paleoclimatic history of drought on the Canadian Prairies. On the second day, three papers assessed the impact of climate change on seasonal forecasting, followed by presentations on the application of seasonal climate predictions for agriculture, water resource management, applied research and government agency use. The meeting concluded with round table discussions on research and operational usage priorities.

The Regina event was the largest of the four meetings to date, with more than 80 registrants and speakers, including top scientists and forecast providers from Canada and the United States. Institutional end users such as agri-insurance, research bodies, crop marketing companies and water resource managers were participants. A new addition to this latest meeting was the involvement of agricultural producers. Producers were invited in an effort to broaden the scientific and technical understanding and usage of seasonal climate forecasts by the agricultural end user.

The workshop was a great success. There were many opportunities for interaction and cross-disciplinary communication. Not only did the participants learn about the latest developments in the science but also they were encouraged by the promise that long-range forecasting research could be a key tool for managing the risk of climate variability to agriculture and other weather-affected industries.

The meeting was funded through registration fees and the generous support of sponsors. The National Council of CMOS was a sponsor of the workshop, providing funds toward the cost of the meeting room. This event was hosted by the Prairie Agroclimate Unit (PAU) of the Prairie Farm Rehabilitation Administration (PFRA), in collaboration with the Long-Range Weather and Crop Forecast Working Group and CMOS Saskatchewan Centre. Although we also participated on the organizing committee, the primary role of our Saskatchewan Centre was that of banker for receipt of funds and payment of expenses.

The Proceedings will be available in the near future in a printed format and on the PFRA web site.

Ron Hopkinson Chair, CMOS Saskatchewan Centre

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Project Atmosphere Canada (PAC) is a collaborative initiative of Environment Canada and the Canadian Meteorological and Oceanographic Society (CMOS) to foster the teaching of atmospheric sciences and related topics in Canada across the grades K-12.

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Feedback on the Project Atmosphere Canada modules with respect to utility, meeting course expectations, reading level for teachers and students and ease of use should be sent to Eldon Oja at Eldon.Oja@ec.gc.ca

Les Modules du PAC sur la toile WWW

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Prière de faire parvenir tout commentaires sur la pertinence des modules du Projet Atmosphère Canada, les attentes du cours, la capacité de lecture des enseignants et des étudiants et la facilité d'utilisation à Eldo Oja à l'adresse Eldon.Oja@ec.gc.ca

Earth System Science[3]

by John Lawton[4]

One of the great scientific challenges of the 21st century is to forecast the future of planet Earth. As human activities push atmospheric carbon dioxide (CO_2) and methane concentrations far beyond anything seen for nearly half a million years (prompting the strongest statement yet from the Intergovernmental Panel on Climate Change that human activities are warming the world), we find ourselves, literally, in uncharted territory, performing an uncontrolled experiment with planet Earth that is terrifying in its scale and complexity.

Wrestling to understand these challenges is the young, and still emerging, discipline of Earth System Science (ESS). Polar-ice and ocean-sediment cores (the Vostok ice core from Antarctica, for example) provide a picture of the last half-million years of Earth's history unimaginable.even two decades ago, and mark the emergence of ESS as the discipline that deals with our planet as a complex, interacting system. ESS takes the main components of planet Earth--the atmosphere, oceans, freshwater, rocks, soils, and biosphere--and seeks to understand major patterns and processes in their dynamics. To do this, we need to study not only the processes that go on within each component (traditionally the realms of oceanography, atmospheric physics, and ecology, to name but three), but also interactions between these components. It is the need to study and understand these between-component interactions that defines ESS as a discipline in its own right.

Physicists have long understood the "Goldilocks effect"--why, in general terms, Earth's natural blanket of atmospheric CO_2 and distance from the Sun make the planet "just right" for life, neither too hot (like Venus) nor too cold (like Mars). James Lovelock's penetrating insights that a planet with abundant life will have an atmosphere shifted into extreme thermodynamic disequilibrium, and that Earth is habitable because of complex linkages and feedbacks between the atmosphere, oceans, land, and biosphere, were major stepping-stones in the emergence of this new science. We still do not understand all these feedbacks and cannot, yet, build a model that reproduces changes in Earth's temperature and atmospheric composition revealed by the Vostok ice core, but these problems now hold center stage in ESS.

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[3] This Science article can be found at http://www.sciencemag.org/cgi/content/summary/292/5524/1965

[4] John Lawton is a professor at the Centre for Population Biology, Imperial College, Silwood Park, and chief executive of the UK Natural Environment Research Council.

There are also numerous other interrelated challenges for this emerging discipline. Do species' identities matter in biosphere-geosphere interactions, or is life simply "green slime"? What are the main feedbacks influencing planetary inorganic-organic carbon dynamics? How does human domination of the global nitrogen cycle, or rapid urbanization, impact on other components of the Earth system? How do we link models of geophysical processes to those describing human socioeconomic activities? The time scales involved in such questions range from hundreds to hundreds of millions of years, and involve processes that are highly nonlinear, presenting considerable challenges for modelers.

The greatest challenge for the new discipline, however, is to provide prescriptions that will reverse current human abuse of planet Earth, signposting routes to a sustainable future. The biggest barriers to rapid progress are institutional. Comparisons between ESS and medical science are telling. Scientists and engineers from many disciplines routinely work together within institutions and organizations to improve human health. We would be startled if it were not so. The health of the planet is a different story. Although a few pioneering individuals and institutions around the world recognize the need for the strong interdisciplinary work that defines ESS, in the main we lack the organizations to nurture this new discipline. There are, as far as I am aware, no undergraduate degree courses in ESS. A mere handful of U.S. and European institutions (including Penn State, the University of California at Irvine, the University of Maryland, the Danish Centre for Earth System Science, the Potsdam Institute, and ETH in Zurich) offer graduate programs and the kind of interdisciplinary working environments that are essential for the rapid development of ESS. The International Geosphere-Biosphere Programme (IGBP) serves as a pioneering focus for ESS, but lacks the resources to do more.

Funding agencies, compartmentalized into traditional disciplines, are ill-equipped to rise to the new challenges posed by ESS. It is hard to imagine a more important discipline than Earth System Science. We urgently need to overhaul our thinking and rejig our institutions to allow this crucial new science to flourish.

Submitted to the CMOS Bulletin SCMO by
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Canadian Institute for Climate Studies

How are Hurricanes Named?

Hurricane names are chosen from a list selected by the World Meteorological Organization. The Atlantic Ocean is assigned six lists of names, with one list used each year. Every sixth year, the first list begins again. Each name on the list starts with a different letter; for example, the name of the very first hurricane of the season starts with the letter A, the next starts with the letter B, and so on. The letters "Q", "U", "X", "Y" and "Z", however, are not used.

Often when an unusually destructive hurricane hits, that hurricane's name is retired and never used again. Since 1954, forty names have been retired. In 1996 Hurricane Luis was retired. Is your name among the currently used or retired hurricane names for the next two years?

2001	2002
Allison	Arthur
Barry	Bertha
Chantal	César
Dean	Diana
Erin	Edouard
Felix	Fran
Gabrielle	Gustav
Hugo	Hortense
Iris	Isidore
Jerry	Josephine
Karen	Klaus
Luis	Lili
Marilyn	Marco
Noël	Nana
Opal	Omar
Pablo	Paloma
Roxanne	René
Sébastien	Sally
Tanya	Teddy
Van	Vicky
Wendy	Wilfred

When the names are underlined, it indicates that this name has been retired since 1985. Therefore, Hugo has been replaced by Humberto, Luis by Lorenzo, Marilyn by Michelle, Roxanne by Rebekah, Diana by Dolly and Klaus by Kyle.

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