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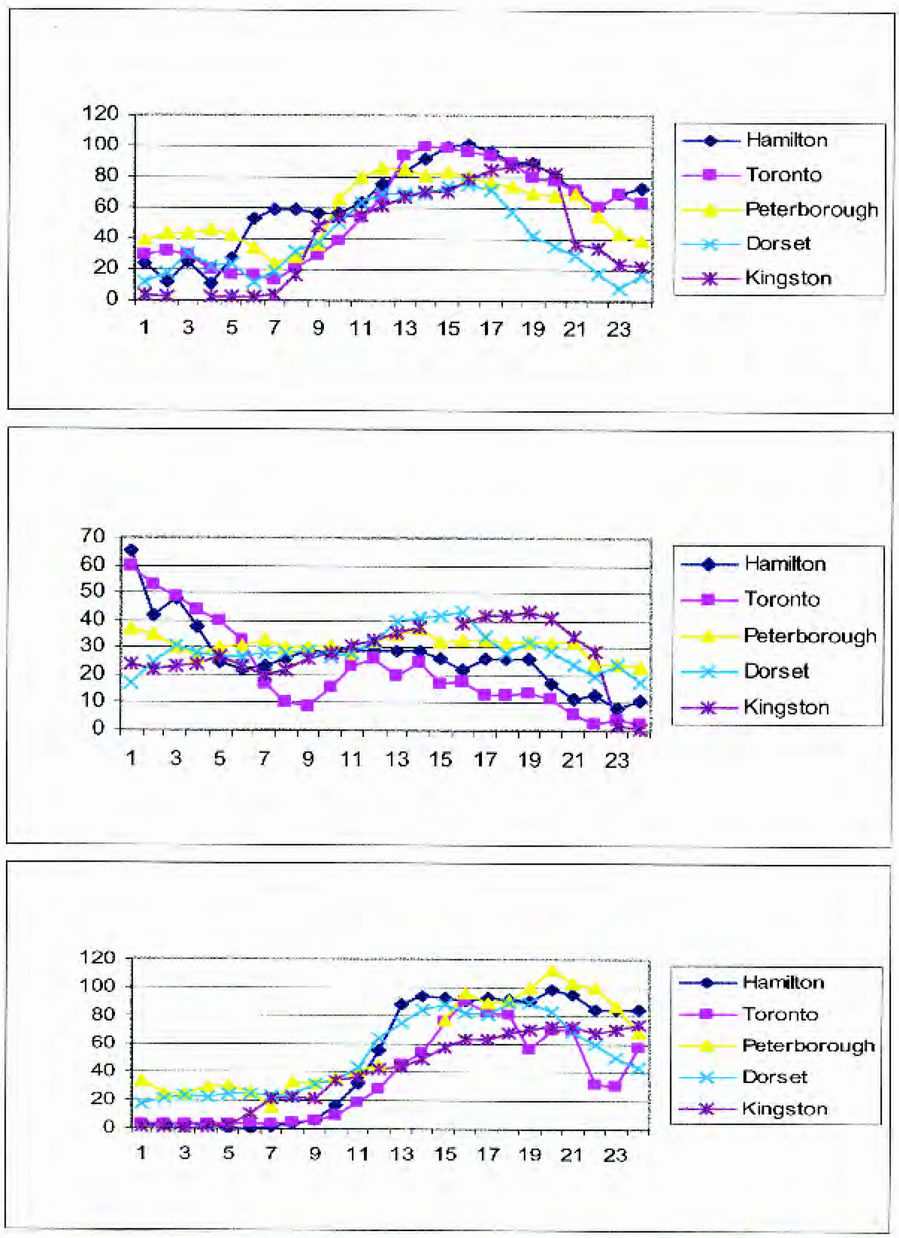

Hourly concentrations of Ozone in ppb during June 23, 24 and 25, 2002

Concentrations horaires de l'ozone en ppb les 23, 24 et 25 juin 2002

CMOS Bulletin SCMO
"at the service of its members / au service de ses membres"

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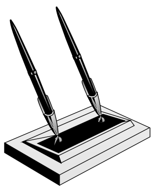
Cover page: The picture shown on the cover page illustrates the daily variations of the ground-level ozone concentrations in ppb for five southern Ontario locations on June 23, 24 and 25, 2002. In this example, the diurnal variation is clearly illustrated for the urban locations and similar ozone variations are seen for all five locations used in this case study. To learn more, please read the interesting article written by Frank Dempsey on **page 133** of this issue.

Page couverture: L'image en page couverture illustre les variations journalières des concentrations d'ozone au niveau du sol en ppb pour cinq sites du sud de l'Ontario pour les 23, 24 et 25 juin 2002. Dans cet exemple, la variation diurne est clairement illustrée pour les régions urbaines et des variations similaires d'ozone sont remarquées pour les cinq sites utilisés dans cette étude. Pour en savoir plus, prière de lire l'intéressant article de Frank Dempsey en **page 133** du présent numéro.

....from the President's Desk

CMOS friends and colleagues:



It is early September as I write this article, not many days since Hurricane Katrina steamrolled over the Gulf States leaving death and destruction in its wake. Those of us who suffered through the wrath of Hurricane Juan just two years ago have, perhaps, some inkling about how difficult it is to clean up after a major catastrophe. However, the damage here was minimal compared to the devastation that we have witnessed in New Orleans. The frequency and intensity of these natural disasters highlight the need for sustained and well-funded research in all aspects of our sciences. In the coming months you will see evidence of the extensive lobby work which is being done this fall by PAGSE (Partnership Group for Science and Engineering), CCR (Canadian Consortium for Research) and CFCAS (Canadian Foundation for Climate and Atmospheric Sciences) to secure more funding for science and technology research and development. I sincerely hope that their efforts are rewarded.

Your national office staff contributes a great deal of time to the smooth running of the Society. We are indebted to Ian Rutherford, Uri Schwarz, Neil Campbell, Richard Asselin, Paul-André Bolduc, Lise Harvey, Dorothy Neale and Bob Jones for their dedication to CMOS. Dick Stoddart continues to run the Secretariat for the CNCs for SCOR and ECOR on behalf of CMOS and DFO and Bill Pugsley keeps on top of data privacy and security issues and is available to our members for the redress of any lapses.

CMOS has supported DFO, EC and NOAA in the logistics of running the JCOMM II Assembly conference in September in Halifax.

Our new Ad Hoc Finance Committee is composed of Richard Asselin, Dan Kelley, Ian Rutherford, Mike Stacey, Dick Stoddart and me. We met in September and have developed a long list of topics to analyze in the coming months. If there are financial issues you would like us to cover, please send me an email at president@cmos.ca.

Have you been considering joining the Royal Meteorological Society (RMetS) http://www.rmets.org/index.php and/or the Canadian Geophysical Union (CGU) http://www.cgu-ugc.ca/? If so, CMOS has negotiated great membership deals for you. CMOS members are eligible for a 25% discount off membership fees for the RMetS and CGU is offering us associate memberships. Members of both these societies are eligible for associate membership in CMOS so please encourage your colleagues in those societies to join CMOS too.

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This publication is produced under the authority of the Canadian Meteorological and Oceanographic Society. Except where explicitly stated, opinions expressed in this publication are those of the authors and are not necessarily endorsed by the Society.

Cette publication est produite sous la responsabilité de la Société canadienne de météorologie et d'océanographie. À moins d'avis contraire, les opinions exprimées sont celles des auteurs et ne reflètent pas nécessairement celles de la Société.

...from the President's Desk (Continued - Suite)

I hope that you are using the CMOS website http://www.cmos.ca/ as a resource tool. It is jam packed full of useful information and updated frequently with important notices of local centre meetings, *What's New* announcements, job postings and much more. The *Members Only* section is a useful resource tool. If you haven't done so already, please take a moment to update your contact information in the members-only directory. Our webmaster, Bob Jones, webmaster@cmos.ca, is always happy to hear from our members.

Our congratulations are extended to Dr. Timothy Oke, urban weather decoder, who is the 2005 winner of the Royal Canadian Geographical Society's Massey Medal for "outstanding achievement in the field of Canadian Geography." http://www.rcgs.org/rcgs/awards/awards_massey05.asp Other CMOS members who have won this award are: James P. Bruce (1996), Dr. Byron Boville (1990), Morley Thomas (1984) and Kenneth Hare (1974). We have received the annual invitation to CMOS for nominations for the RCGS Massey and Gold Medals. CMOS members may wish to visit the RCGS web site (http://www.rcgs.org/rcgs/awards/awards.asp) for information on how to do so.

I hope all CMOS members enjoy a rewarding, successful and profitable fall season.

Susan Woodbury, ACM, FCMOS
President / Présidente

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

The High-Latitude Ionosphere and its Effects on Radio Propagation, by Robert Hunsucker and John Hargreaves, Cambridge University Press, Hardback, 0-521-33083-1, US$140.00.

An Introduction to Ocean Remote Sensing, Seelye Martin, Cambridge University Press, Hardback, 0-521-80280-6, US$75.00.

Flood Risk Simulation, by F.C.B. Mascarenhas, co-authored with K. Toda, M.G. Miguez and K. Inoue, WIT Press, January 2005, ISBN 1-85312-751-5, Hardback, US$258.00.

Climate Change in Prehistory: The End of the Reign of Chaos, by William J. Burroughs, Cambridge University Press, May 2005, ISBN 0-521-82409-5, Hardcover, US$30.00.

Fundamentals of Atmospheric Modeling, by Mark Z. Jacobson, Second Edition, Cambridge University Press, May 2005, ISBN 0-521-54865-0, Paperback, US$85.00.

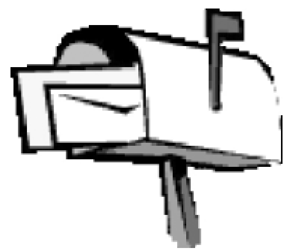
Weather Analysis and Forecasting, by Patrick Santurette and Christo G. Georgiev, Elsevier Academic Press, 2005, ISBN 0-12-619262-6, Paperback.

And Now ... The Weather, with the Weather Doctor, by Keith C. Heidorn, Fifth House Ltd., 2005, ISBN 1-894856-65-1, Paperback.

Letter to the Editor

Date: 14 July 2005

Subject: Reporting of Celsius Temperatures



In the early seventies I welcomed the switch to metric measurements, as I was already involved in laboratory work and familiar with grams and millilitres. The public, for the most part are completely converted to kilometres as speedometers, odometers and road signs have mandated such. The same is true of consumable products which are labeled in grams or litres. The area where there is a mis-step is with the Celsius temperature scale and how it is reported by weathercasters. There was great reluctance on the part of the general public and the media alike to make this switch, so for many years we heard weather reports in both Fahrenheit and Celsius temperature readings. This may have been a parody on the enactment of the Federal bilingualism policy. After about two decades, someone, somewhere, came to his senses and stopped the use of Fahrenheit temperature reporting. But there continued to be, and still does, a "folksy" ambivalence in the way temperatures warmer or colder than 0 degrees are reported.

With Fahrenheit, the terms "above" or "below" preceded the numeric value, which had some logic to it. However, that same logic, as applied to Celsius temperatures, doesn't fly with me. You and I both know, that technically there is no such thing as a"plus" temperature. "Minus" for temperatures colder than the freezing point is both logical and sensible, whereas "plus" for warmer temperatures is neither. I find it particularly annoying to listen to these kinds of weather reports in the spring and the fall, but it is maddening to hear it in the summer when there is virtually no chance of needing to make that "folksy" distinction. I am at a loss to understand why an organization such as yours, as a keeper of our standards, would not have taken action long since to eliminate this erroneous practice. Please, please, give it some thought and institute some direction to this end.

Cliff Robertson
Engineering Technologist (Retired)

Hurricanes and Climate Change

by James P. Bruce[1]

There have been a number of articles in the press including a Globe and Mail editorial, 8 September about whether hurricane *Katrina* was or was not part of a manifestation of climate change or global warming. On the one hand, hurricane forecasters, looking at their records, argue that hurricane activities peak periodically associated with 20 to 40 year cycles of high and low sea surface temperatures, and other favourable conditions in the sub Tropical Atlantic, the Caribbean Sea and the Gulf of Mexico. These periods of high sea temperatures have in the past been followed by periods of lower temperatures and more quiescent hurricane activity and they argue that this will return in the future.

On the other hand, several scientific groups, including those at Massachusetts Institute of Technology, and the Geophysical Fluid Dynamics Laboratory at Princeton (ftp://texmex.mit.edu/pub/emanuel/PAPERS/NATURE03906.pdf), have shown by both theory and evidence that greenhouse gas-forced climate change is resulting in warming of the oceans, and a distinct trend towards more intense and long-lived hurricanes. This trend is unlikely to be reversed this century.

This is a well-entrenched debate between climate and weather specialists with two different perspectives. These perspectives also influence the debate on whether rain intensities and winter storm intensities are on an increasing trend or just fluctuating, as well as the discussion on hurricanes.

To try to decide which point of view is likely to be correct, it is necessary to consider the factors that drive fluctuations and changes in the global climate system. This question has been addressed by a number of scientists. The Intergovernmental Panel on Climate Change in 2001 (Cambridge University Press) assessed and summarized these findings, and even more recent work tends to confirm IPCC's assessment of these results (G. A. Meehl and colleagues in Journal of Climate V. 17.19, entitled "Combinations of Natural and Anthropogenic Forcings in the 20th Century".)

The conclusions reached were that natural forcing factors, including changes in the sun's energy, changes in earth's orbit, changes in earth's reflectivity or albedo, and changes in frequency and intensity of volcanic emissions were more important in changing the climate system, than were increases in greenhouse gases for many millennia prior to the mid-1960s. The past fluctuations in climate and the oscillations in the ocean systems cited by hurricane forecasters, were driven before 1970 mainly by these natural forcing factors.

But these studies summarized by IPCC and by Meehl et al. found that after about 1970, the concentrations of greenhouse gases in the atmosphere had become so great that they overwhelmed the natural forcings. The observed global warming, and other changes in the climate system since then, have been driven increasingly by the rise in the global atmosphere of concentrations of greenhouse gases, carbon dioxide, methane, nitrous oxide and low level ozone driven by human actions. One of the observed changes has been a warming of the world's oceans from the surface down to a depth of 300 metres or so. As greenhouse gas concentrations continue to increase, due to fossil fuel burning and other activities, these trends in warming of the lower atmosphere and the oceans will continue, over this century at least.

To put this another way, we humans have drastically changed the nature of the factors that influence climate changes, and the former kinds of pre-1970 fluctuations and cycles are not very helpful in predicting the future. At most they will be reflected as minor ups and downs on the greenhouse gas-driven trends.

Let us go back to the question about hurricane *Katrina*. It is not possible for a knowledgeable person to say that *Katrina* or any other individual storm is a consequence of climate change. It is, however, possible to say that with continued greenhouse gas increases, oceans will continue to warm. The energy that drives hurricanes is closely tied to ocean surface temperatures. Thus those scientists that have shown a trend towards more intense and longer-lived hurricanes in a globally warming world, are probably correct.

The Intergovernmental Panel on Climate Change (2001) expressed its confidence level in projections of more intense tropical cyclones (hurricanes) this Century as "likely" (66-90% probability) over some areas.

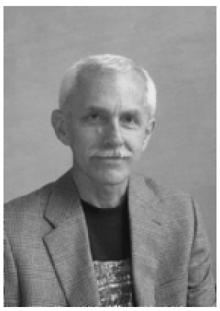
This strongly suggests that in coastal USA and eastern Canada, we should bend every effort to be better prepared for more intense hurricanes for many decades to come. We should also seek to redouble international efforts to reduce greenhouse gas emissions to slow the foreseen changes in climate and its extremes.

[1] CMOS Member, Ottawa Centre

World Year of Physics 2005 / National Public Lecture Tour

The WYP2005 Committee is sponsoring a national public lecture tour which will travel across Canada in the Fall of 2005. The lecture, entitled **"Was Einstein Right?"** will be given by Dr. Clifford Will, Washington University. Dr. Will, who was born in Hamilton, Ontario, started his tour off by giving the Herzberg Memorial Public Lecture at the 2005 CAP Congress in Vancouver, B.C. on Sunday, June 5th in the Chan Centre at UBC. Subsequent lectures will be given in the Atlantic Region, Ontario/Quebec Region, and the Prairies Region starting on October 5, 2005 in Waterloo, Ontario (Perimeter Institute). The list of talk locations will be updated, and added to the Events register on site listed here, as specific details are finalized.

Biography of Dr. Will



Clifford Will is the James S. McDonnell Professor of Physics, and member of the McDonnell Center for the Space Sciences at Washington University in St. Louis. Born in Hamilton, Canada in 1946, he received a B.Sc. in Applied Mathematics and Theoretical Physics from McMaster University in 1968, and a Ph.D. in Physics from the California Institute of Technology in 1971. He was an Enrico Fermi Fellow at the University of Chicago (1972-74), and an Assistant Professor of Physics at Stanford University (1974-81). From 1975 to 1979, he was an Alfred P. Sloan Foundation Fellow. In 1981 he joined Washington University as Associate Professor, in 1985 became Full Professor of Physics, from 1991-1996 and 1997-2002 served as Chairman of the Department, and in 2005 was named McDonnell Professor.

In 1986 he was selected by the American Association of Physics Teachers to be the 46th annual Richtmyer Memorial Lecturer. He was elected a Fellow of the American Physical Society in 1989 and of the American Academy of Arts and Sciences in 2002. In recognition of his theoretical work related to the Hulse-Taylor Binary Pulsar, he was an invited guest of the Nobel Foundation at the 1993 Nobel Prize Ceremonies honouring discoverers Joseph Taylor and Russell Hulse. During 1996-97, he was both a J. William Fulbright Fellow and a Guggenheim Foundation Fellow, and in 1996, he was named Distinguished Alumnus in the Sciences by McMaster University. In 2004 he received the Fellows Award of the St. Louis Academy of Sciences, and was elected President of the International Society on General Relativity and Gravitation.

He has published over 160 scientific articles, including 13 major review articles, 26 popular or semi-popular articles, and two books: Theory and Experiment in Gravitational Physics (Cambridge University Press, 1981; 2nd Edition, 1993), and Was Einstein Right? (Basic Books, 1986; 2nd Edition, 1993). Was Einstein Right? was selected one of the 200 best books of 1986 by the New York Times Book Review, and won the 1987 American Institute of Physics Science-Writing Award in Physics and Astronomy. It has been translated into French, German, Japanese, Italian, Spanish, Portuguese, Korean, Greek, Chinese and Persian. His research interests include tests of general relativity, gravitational radiation, black holes, cosmology, and the physics of curved spacetime.

Abstract of Dr. Will's talk: Was Einstein Right?

How has the most celebrated scientific theory of the 20th century held up under the exacting scrutiny of planetary probes, radio telescopes, and atomic clocks? After 100 years, was Einstein right? In this lecture, celebrating the 100th anniversary of Einstein's "miracle year" and the World Year of Physics, we relate the story of testing relativity, from the 1919 measurements of the bending of light to the 1980s measurements of a decaying double-neutron-star system that reveal the action of gravity waves, to a 2004 space experiment to test whether spacetime "does the twist". We will show how a revolution in astronomy and technology led to a renaissance of general relativity in the 1960s, and to a systematic program to try to verify its predictions. We will also demonstrate how relativity plays an important role in daily life.

https://www.cap.ca/wyp/tourHome.asp

List of Talk Locations and Dates

Note: Please check the calendar on the web for the exact **date and time** in your hometown as this timetable is subject to last minute modification and is not complete.

St-John's, NFLD	October, 24, 2005
Halifax, NS	October 27, 2005
Fredericton, NB	November 8, 2005
Québec, QC	November 9, 2005
Montréal, QC	November 10 & 11, 2005
Ottawa, ON	October, 21, 2005
Toronto, ON	October, 19, 2005
Winnipeg, MA	November 14, 2005
Regina, SK	November 15, 2005
Saskatoon, SK	November 16, 2005
Edmonton, AB	November 17, 2005
Calgary, AB	November 18, 2005

An Example of the Influence of Meteorological Conditions on Ground-Level Ozone Concentrations in Southern Ontario

by Frank Dempsey[1]

Résumé (traduit par la direction): Un exemple de l'influence des conditions météorologiques sur les concentrations d'ozone au niveau du sol est illustré par le graphique montrant les concentrations horaires de l'ozone au niveau du sol et du dioxyde d'azote pour trois jours du mois de juin 2002, pour cinq sites dans le sud de l'Ontario. Dans cette exemple d'une journée d'été suivie par des conditions nuageuses et pluvieuses, la variation diurne et l'interdépendance de l'ozone et du dioxyde d'azote sont clairement illustrées pour les régions urbaines, et des variations similaires d'ozone sont remarquées pour les cinq sites utilisés dans cette étude.

Ce cas est typique lors de chaudes journées d'été sur le sud de l'Ontario, et au cours desquelles le brassage vertical dans la couche limite atmosphérique augmente pendant et après l'affaissement de l'inversion de température nocturne près du sol, se produisant sur plusieurs heures après le lever du soleil. Ainsi, au cours de ces journées chaudes, à mesure que l'affaissement de l'inversion se produit, la concentration d'ozone augmente en raison de la production par réactions photochimiques et de l'augmentation du brassage vertical entre l'ozone et l'abondance d'air au-dessus de la couche limite de mélange. On sait que les concentrations d'ozone tendent à diminuer au cours de la nuit en raison d'une moins grande production et par réaction avec l'oxyde nitreux dans la couche stagnante au moment où l'inversion de température se renforce et s'approche du sol. D'autre part, au cours de la nuit, on y trouve une augmentation correspondante des concentrations du dioxyde d'azote.

Abstract: An example of the influence of meteorological conditions on ground-level ozone concentrations is illustrated with a plot of hourly measured ground-level ozone and nitrogen dioxide concentrations for three days in June, 2002 for five southern Ontario locations. In this example of a summer day followed by a cloudy, rainy day, the diurnal variation and inter-dependence of ozone and nitrogen dioxide are clearly illustrated for the urban locations, and similar ozone variations are seen for all five locations used in this case study.

This case is typical for hot summer days in southern Ontario, with daytime mixing of the atmospheric boundary layer increasing during and following the breakup of a low-level nocturnal inversion several hours after sunrise, and with increasing ozone concentrations due to generation from photolytic reactions as well as from ozone-rich air above the boundary layer mixing down to ground level as the inversion breaks up and mixing increases. Ozone concentrations are seen to diminish during the night due to loss of generation and by titration by nitric oxide within the stagnant layer as the nocturnal inversion strengthens and lowers, accompanied by a corresponding increase in nitrogen dioxide concentrations during the night.

Introduction

Tropospheric ozone is produced primarily from the photooxidation of hydrocarbon compounds in the presence of nitrogen oxides. The formation of photochemical oxidants (including ozone in particular), and other more general aspects of urban air quality, are dependent on the interaction of "precursor" pollutants emitted from various sources with complex chemical and physical processes. While natural sources contribute some of the hydrocarbon precursor compounds, a major component comes from anthropogenic sources that are typical in urban areas with a mixture of industrial and automotive emissions. Much of the ozone and ozone precursors are generally assumed to be transported from upwind sources, such as heavily industrialized regions of the U.S. Midwest and Ohio valley, during days when the airflow is southwesterly into southern Ontario. (Further information about ozone precursor sources for ozone in Ontario has been provided by Yap et al, 1988. A recent update on the state of the science of natural hydrocarbons that contribute to ozone formation has been provided by Fuentes et al, 2000.)

In the example presented in this study, a three day period with a hot, sunny day before and after a cool, cloudy day provided the opportunity to illustrate the dependence of ground level ozone formation on local weather conditions. This dependence is illustrated using measurements of ozone concentrations in the southern, central and eastern Ontario locations of Hamilton, Toronto, Peterborough, Dorset and Kingston, and using measurements of nitric oxide and nitrogen dioxide for the cities of Hamilton and Toronto. The first day of this 3-day case is typical for hot summer days in southern Ontario, with daytime mixing of the atmospheric boundary layer increasing during and following the breakup of a low-level nocturnal inversion several hours after sunrise, and ground-level ozone concentrations increasing due to generation from photolytic reactions as well as from ozone-rich air above the boundary layer mixing down to ground level as the inversion breaks up and mixing increases.

[1] CMOS Member, Toronto Centre

Fig. 1.Map of southern Ontario showing locations of data stations.

The Monitoring Locations

The cities of Hamilton, Toronto and Kingston lie along the Lake Ontario shoreline, while Peterborough lies in central Ontario (Figure 1). Dorset, also in central Ontario, is in a rural environment, while the four cities are distinct urban environments influenced by vehicle traffic, among other sources of ozone precursor substances. The Toronto location used for the source of the Toronto data is known as Toronto North and is near the major intersection of Yonge Street and Finch Avenue, well within the city. The Hamilton location used for the source of the Hamilton data is known as Hamilton Mountain and is outside of the industrial core of the city of Hamilton, and is the most distant of the three Hamilton locations (reported in the Ontario Ministry of Environment's Air Quality Index reporting system) from the steel mills at the Hamilton shoreline.

The five locations are generally considered to be under similar synoptic–scale meteorological conditions, and experience generally similar airmass characteristics during typical summer days. However, during the third day of this case study, hot and sunny conditions returned to four of the five locations (Hamilton, Toronto, Peterborough and Dorset) as a warm front moved northeastward during the day while the easternmost location (Kingston) was still under the cloudiness that affected the second day.

A Review of Relevant Photolytic Ozone Chemistry in the Troposphere

The oxidation state of the troposphere is controlled by an interrelated group of highly reactive free radicals (mainly $O^*\ ^1D$, $O\ ^3P$, OH, HO_2 and RO_2) derived from photodissociation processes of specific compounds which are in abundance in urban atmospheres. The relevant reactions for the production of tropospheric ozone and inter-relationship with oxides of nitrogen have been listed below, beginning with photolytic generation of ozone from NO_2 and then the production of OH radicals from existing ozone (the primary source of OH radicals).

While the photolysis of NO_2 to produce monatomic oxygen followed by combination with molecular oxygen:

$$NO_2 + h\nu\ \ \gamma\lambda < 400\ \nu\mu) \rightarrow NO + O\ ^3P \qquad \text{(Eq. 1)}$$
$$O\ ^3P + O_2 + M \rightarrow O_3 + M\ \ (M = N_2, O_2 \text{ etc}) \qquad \text{(Eq. 2)}$$

could be stated as the primary reaction for the production of ozone, along with the oxidation of NO by ozone:

$$NO + O_3 \rightarrow NO_2 + O_2 \qquad \text{(Eq. 3)}$$

a general equilibrium cycle would result with the net reaction involving the photolysis of NO_2 to produce ozone, which would in turn oxidize the NO to regenerate NO_2 and then the resulting concentrations of NO, NO_2 and would O_3 be determined by the amount of available sunlight.

However, the generation of radicals capable of catalytically generating more ozone requires the inclusion of radical generation and catalytic oxidation cycles to account for observed ozone generation.

In sunlight, with $\lambda < 310$ nm,

$O_3 + h\nu \rightarrow O^{*}\,{}^1D + O_2^{*}$ (Eq. 4)

Although most $O^{*}\,{}^1D$ gets quenched, for some fraction of $O^{*}\,{}^1D$, reaction with H_2O allows formation of OH radicals:

$O^{*}\,{}^1D + H_2O \rightarrow 2\,OH$ (Eq. 5)

For most of the OH radicals generated, reaction with CO and CH_4 allows production of peroxy radicals:

$OH + CO \rightarrow H + CO_2$ (Eq. 6)

followed by reaction with molecular O_2 :

$H + O_2 \rightarrow HO_2$ (Eq. 7)

and:

$OH + CH_4 \rightarrow CH_3 + H_2O$ (Eq. 8)

$CH_3 + O_2 \rightarrow CH_3O_2$ (Eq. 9)

In an urban atmosphere with sufficient NO (mainly as a product of combustion), the peroxy radicals readily oxidize NO to NO_2:

$HO_2 + NO \rightarrow OH + NO_2$ (Eq. 10)

$CH_3O_2 + NO \rightarrow CH_3O + NO_2$ (Eq. 11)

While further significant reactions of the oxy and methoxy radicals (and more generally, peroxy radicals derived from alkyl or more complex hydrocarbons) occur that contribute to ozone production, the significance of the oxidation of NO by the peroxy radicals is the catalytic production of NO_2 (and subsequent ozone formation) and regeneration of the radicals capable of further oxidation. A general representation of the peroxy radical oxidation of NO can be stated as:

$RO_2 + NO \rightarrow RO + NO_2$ (R = H, C or alkyl or acyl groups, etc) (Eq. 12)

Ozone production then follows as in Eqs. 1 and 2. (More extensive treatments of further reaction mechanisms have been provided by Wayne, 2000 and Finlayson-Pitts and Pitts, 1986.)

Cloudy Day Chemistry

Under reduced sunlight and temperature, two significant results on boundary layer ozone chemistry are reduced photolytic production of radicals, and the shift of Eq. 3 toward increased NO_2 concentrations. Both processes result in lower production of ozone.

Nighttime Chemistry

After sunset, photolysis of NO_2 ends, and so Eq. 1 does not regenerate NO and O_3. Eq. 3 proceeds to consume NO and O_3. Without sunlight, and no production of the OH radical, nitrate, NO_3, becomes dominant as a reactive free radical. The primary source of nitrate is the oxidation of NO_2 by ozone,

$NO_2 + O_3 \rightarrow NO_3 + O_2$ (Eq. 13)

Although NO_3 photolyzes rapidly under daylight back to NO_2 or NO, during darkness it is available as an important radical to oxidize hydrocarbons, to initiate oxidation chain reactions that continue to “clean” the atmosphere of pollutants during the night, and to react in many other reactions such as the formation of nitric acid (a significant sink for nitrate radical as well as a source for acidification of the atmosphere) or the formation of dinitrogen pentoxide, N_2O_5, an important “reservoir” allowing temporary storage and transport of nitrate until warmer temperatures or daylight allow conversion back to nitrate radical and degradation into nitrogen oxides). While the significance of the chemistry of the nitrate radical may extend to daytime ozone formation rates the following day (Dimitroulopoulou and Marsh, 1997), the relevant significance of Eqs. 3 and 13, in this study of the chemistry involving measurements only of O_3, NO and NO_2, is the reduction of ozone and NO concentrations in a “closed” chemical system such as the nighttime boundary layer “capped” by a low inversion.

Relevant Meteorological Processes

Some of the meteorological factors that influence ozone chemistry in the boundary layer of the atmosphere (at and just above ground level) include the amount of sunlight available (to cause reactions that proceed under solar radiation), temperature of the air, the dynamics of the boundary layer, and to some extent the amount of water vapour in the air. Ozone concentrations in southern Ontario during summer days generally follow a diurnal pattern of peak ozone during afternoon and minimum ozone shortly after sunrise.

The depth of the mixing layer constrains the concentrations of pollutants near the ground. Mixing layer depths typically vary from several km during convective afternoon conditions to hundreds or tens of metres during night, if clear skies and calm winds allow nocturnal inversions to form. An example of a nocturnal inversion appears in the Buffalo NY sounding for 12z on the morning of June 25, 2002, in Figure 2 (from University of Wyoming). (More extensive explanations of the effects of atmospheric stability on pollutant transport and dispersion have been provided by Jacobson, 2002 and Seinfeld and Pandis, 1998.)

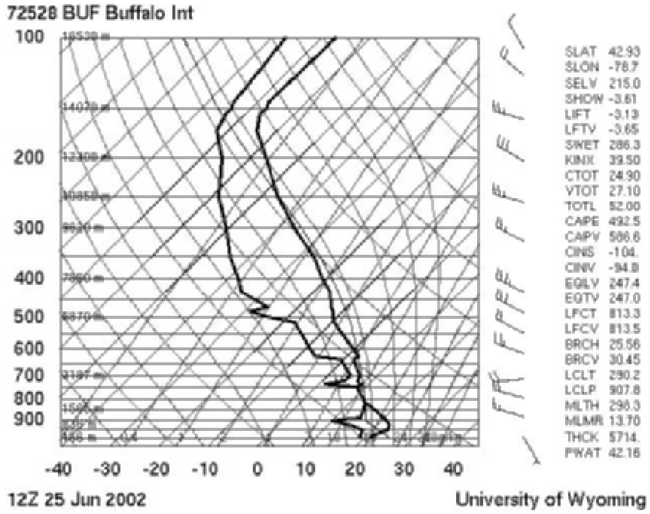


Fig. 2. Upper air sounding from Buffalo NY for 12Z, June 25, 2002 illustrating nocturnal inversion above surface.

Vertical stratification of pollutant concentrations can be influenced by entrainment and fumigation processes in the convective boundary layer. The nighttime mixed layer, in particular, can be shallow enough to allow depletion of ground-level ozone; this depletion may not occur when the nocturnal inversion does not develop. Although the role of vertical mixing in the atmospheric boundary layer is important and complex (see Zhang and Rao, 1999), a comparison between daytime and nighttime effects has been illustrated in this case study. (A more detailed study of the dynamics and interactions of the nocturnal urban boundary layer has been provided by Uno et al, 1992).

Further relations between boundary layer ozone chemistry and meteorological influences include the temperature dependence of photolysis reactions, the dependence of isoprene emission rates (Fuentes et al, 2000), the temperature dependence of evaporative emissions of hydrocarbons (Cardelino and Chameides, 1990), the temperature dependence of the thermal decomposition of peroxyacetyl nitrate (PAN) and other NO_x reservoirs, and the effect of the amount of available water vapour on the formation rate of ozone (by reduction of the production of HO_2 in favour of greater production of hydrogen peroxide, H_2O_2, which is less reactive as an oxidant than HO_2).

Overview of Weather Patterns During June 23-25, 2002
On June 23, a high pressure region over the northeastern USA and a low pressure region over the US Midwest caused a southwesterly flow of warm air across the Great Lakes area, including over southern Ontario. A high pressure region over northern Ontario moved eastward to lie over western Québec by the morning of June 24. A weak, nearly stationary surface frontal boundary, associated with a mid-atmospheric level disturbance, stretched across southern and central Ontario on June 23, with the Toronto area under a warm, hazy and humid airmass. By the evening of June 23, the front was over Toronto. During the morning of June 24, with a high pressure region over Québec, the front was moving southward as a weak cold front to lie mainly over New York State, allowing a flow, from the northeast, of cooler air with cloudiness and moisture over the Toronto region. During the morning of June 25, the frontal boundary was moving northward again as a weak warm front, followed by a southerly flow of humid, warm air and allowing increasing sunshine over Hamilton, Toronto and Peterborough but not over the meteorological stations at Trenton and Kingston.

While the general features associated with a frontal boundary include cloudiness, precipitation to some extent and a shift in wind direction, the main significance in this case was that the front was a boundary between a cool airmass to the north and a hot, humid airmass to the south. Maps showing the upper-level (500 mb) pattern, and surface pressure patterns, over the Great Lakes region for the evenings of June 23 and June 24, appear in Figures 3 and 4. In both cases, the upper air pattern features a warm ridge over southern Ontario, a nearly stationary high pressure region centered over West Virginia, and a surface high pressure region near James Bay on June 23 and over Québec on June 24. Maps of the surface air temperatures (actually, 2 m above surface temperatures) at 14:00 EDT on the afternoons of June 23, 24 and 25 appear in Figures 5-7. The significant feature of June 23 is the very warm air across all of southern and central Ontario. On the afternoon of June 24, the same region was under a uniformly cool airmass. In Figure 7, the frontal boundary during June 25 is indicated by the strong temperature gradient between an axis of warmth (extending from the west end of Lake Ontario northeastward to Peterborough) and cooler conditions remaining closer to eastern Lake Ontario (including the meteorological stations at Trenton and Kingston.

A satellite image showing the cloud cover over western Lake Ontario along the frontal boundary at 10:45 am EDT on the morning of June 24 appears in Figure 8 (from NOAA, which also shows unrelated smoke over the US mid-Atlantic region).

Data and Discussion
Measured hourly concentrations of ozone (measured by the Environmental Monitoring and Reporting Branch of the Ontario Ministry of Environment) for the period June 23-25, 2002 for the locations of Hamilton, Toronto, Peterborough, Kingston and Dorset have been plotted versus time in Figure 10. Several missing data points, for Kingston and Peterborough, cause small gaps in the graphs but have no significant effect on the results being illustrated in this paper.) Hourly concentrations of NO and NO_2 have been plotted for the locations of Hamilton and Toronto to illustrate diurnal trends and differences between “sunny day” and “cloudy day” ground level ozone chemistry in Figures 11-13. Concentrations of NO and NO_2 have not been plotted for the locations of Peterborough, Kingston and Dorset due to absence of NO_x data at some stations, and due to insignificant results from the NO_x data monitored at smaller

cities. Concentrations of NO_x are generally much lower at rural locations than in the larger cities of Toronto and Hamilton. The following discussions for the trends of oxides of nitrogen refer to Hamilton and Toronto. Some 2002 annual NO_2 mean concentrations have been listed in Table 1 for comparison of some urban and rural locations. (Data from "Air Quality in Ontario 2002 Report".)

Location	**Annual 2002 NO_2 Mean Concentration in ppb**
Toronto Downtown	23.3
Toronto North	21.0
Hamilton Downtown	20.9
Hamilton West	19.0
Newmarket	11.5
Peterborough	9.8
North Bay	10.1

Table 1: Some Ontario Urban NO_2 Concentrations in 2002

June 23 Ozone and NO_x Trends:
Ozone concentrations began to increase following minimum concentrations that occurred approximately 2 hours after sunrise (near 06:00 EDT) (Figure 10). Ozone concentrations reached maxima in the range of 75-101 ppb near mid- to late afternoon, and then decreased past sunset (near EDT 21:00). In the urban locations of Hamilton and Toronto, NO_2 concentrations during the morning generally reached maxima near the time of minimum O_3 concentration and then decreased as O_3 concentrations increased (Figure 11). Here, NO (primarily from local emissions) reacted with O_3 as in Eqn 3, producing NO_2 which then dissociated in the afternoon sunlight (Eqn 1) to produce NO and O_3 (Eqn 2), allowing O_3 production to dominate the equilibrium cycle of Eqns 1, 2 and 3.

June 23 Meteorology:
Following a hazy morning, the afternoon became mostly sunny with surface temperatures measured at Toronto (YYZ) reaching 29.6°C at noon and then increasing to a high of 31.7°C at 15:00 EDT and then gradually decreased to 29.0°C at 20:00 EDT, an hour before sunset. Winds during the afternoon were from the west at speeds of 30-40 km/h. Similar warmth was experienced across the southern and central Ontario region (Figure 5). Air parcel back trajectory analysis indicated that air parcels reaching Toronto on the afternoon of June 23 originated during the previous 2 days over northern Illinois and central Michigan (Figure 9, from Draxler, R.R. and Rolph, G.D., 2003). An ozone-rich layer above the nocturnal boundary layer likely provided a source of ozone that mixed downward to the surface as morning convection commenced; this effect accounted for some component of the sharp increase in O_3 concentrations during mid-morning.

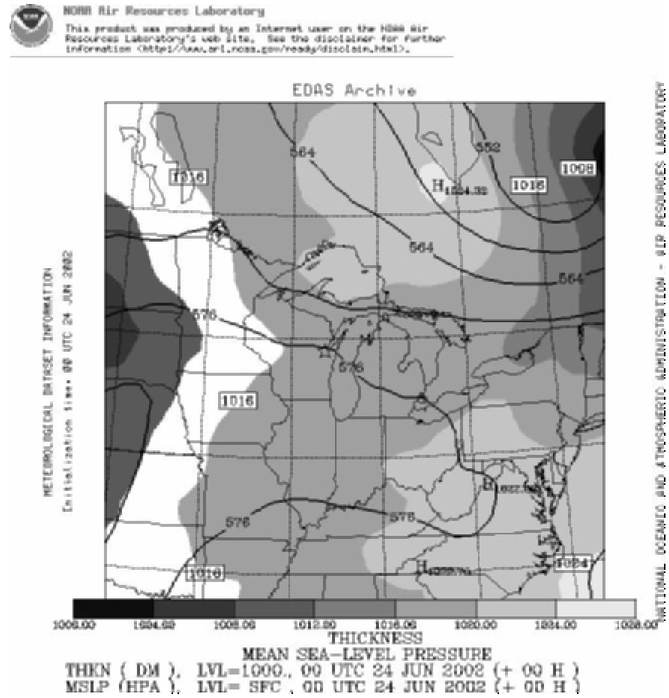


Fig. 3. Upper (500 mb–1000 mb thickness contours) and surface (isobars) chart for evening of June 23, 2002.

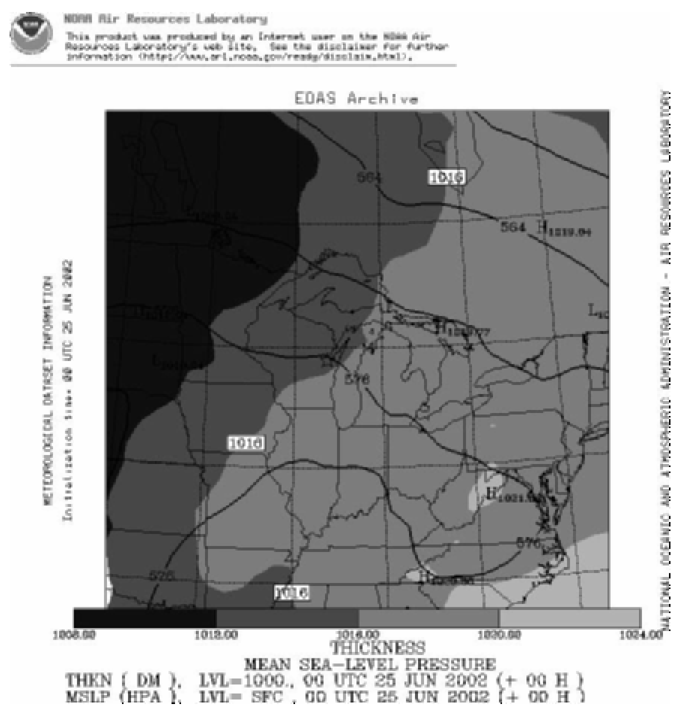


Fig. 4. Upper (500 mb–1000 mb thickness contours) and surface (isobars) chart for evening of June 24, 2002.

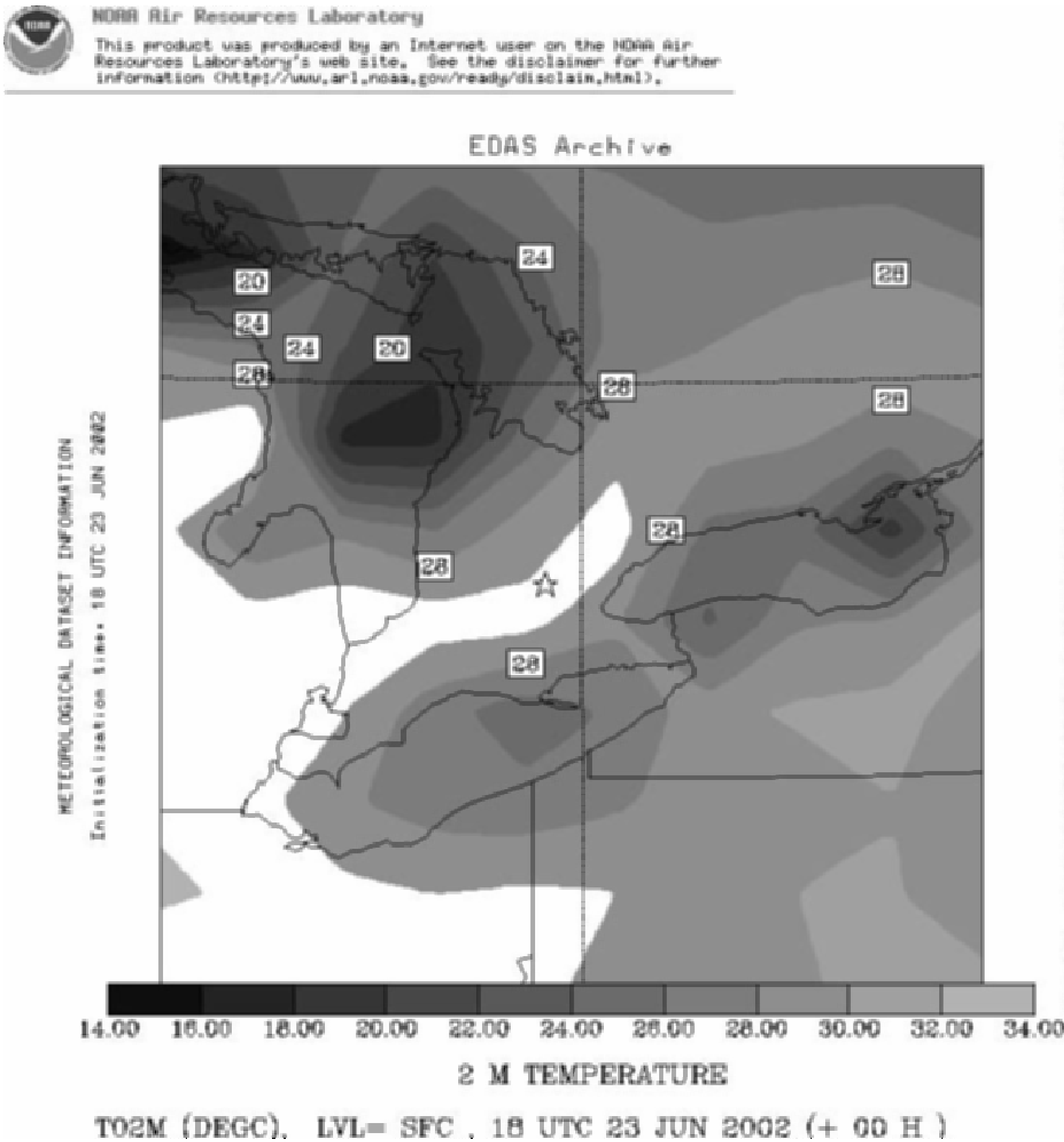


Fig. 5. Air temperatures (deg. C) over the Great Lakes region afternoon of June 23, 2002.

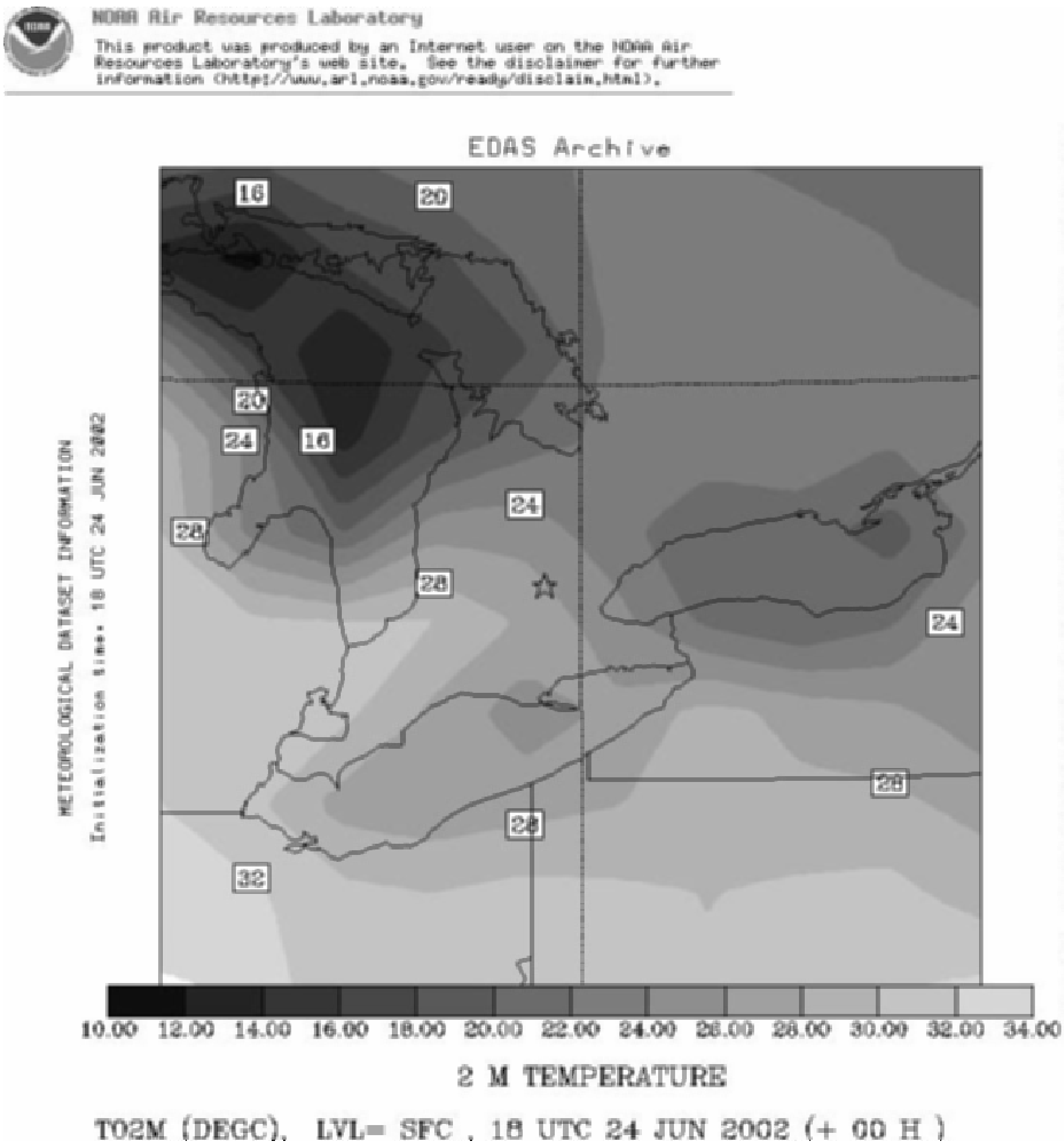


Fig. 6. Air temperatures (deg. C) over the Great Lakes region afternoon of June 24, 2002.

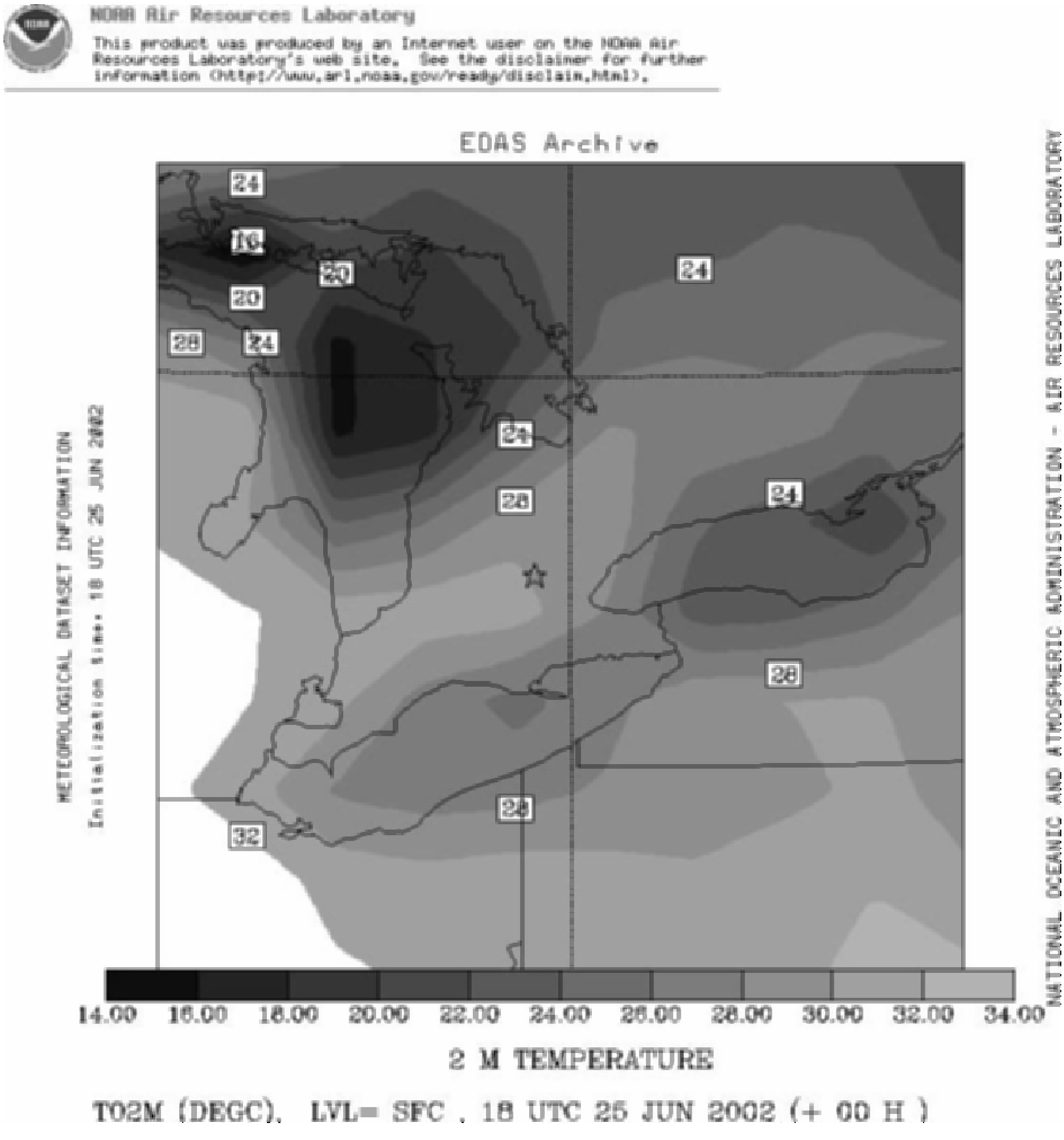


Fig. 7. Air temperatures (deg. C) over the Great Lakes region afternoon of June 25, 2002.

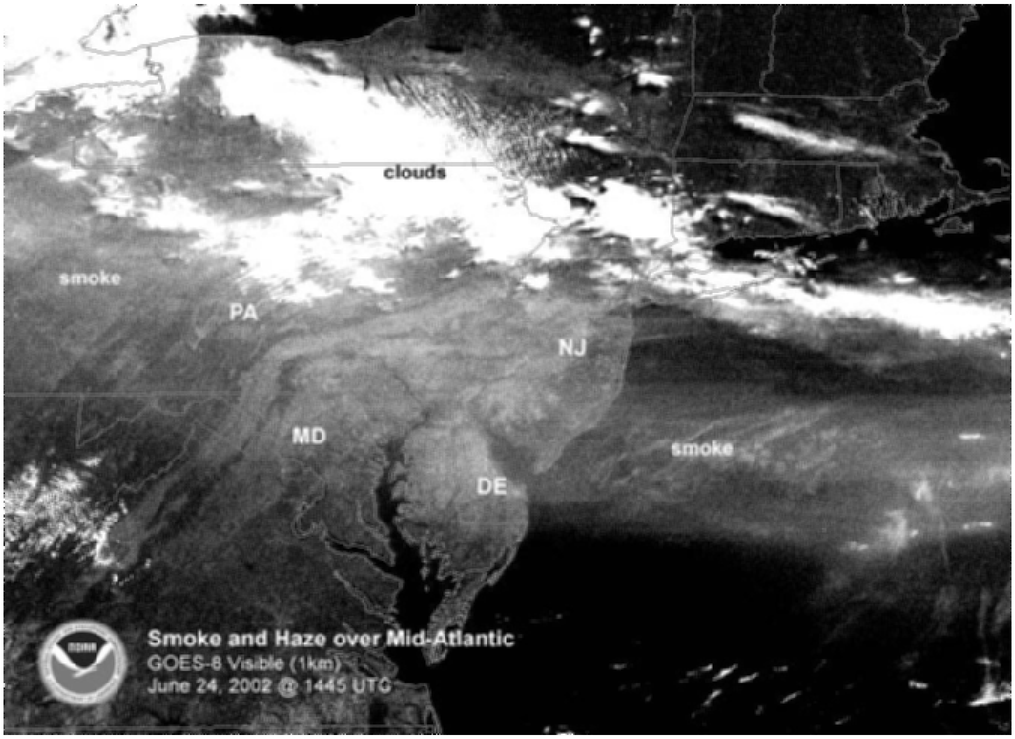


Fig. 8. Visible satellite image of cloud band across western Lake Ontario mid-morning June 24, 2002.

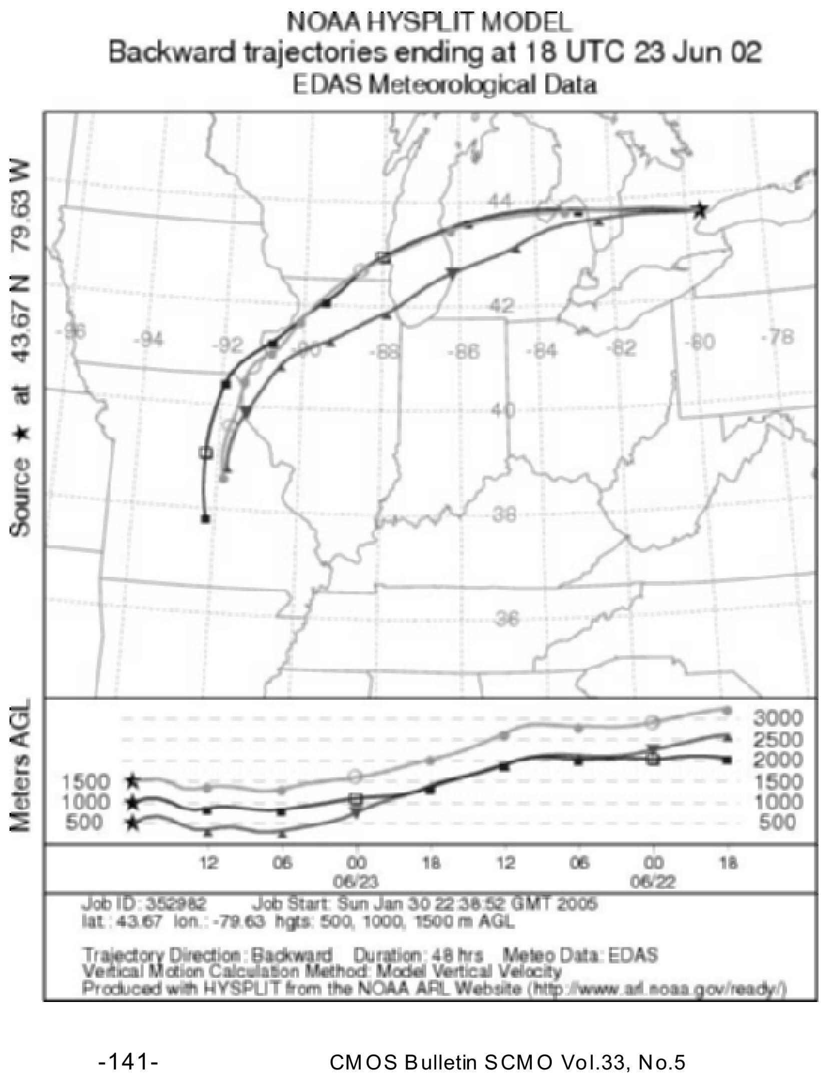


Fig. 9. 48-hr Back trajectory analysis of air parcels arriving at Toronto, June 24, 2002.

June 24 Ozone and NO_x Trends:
Ozone concentrations decreased after midnight to minimum values during the morning and then increased to generally steady values in the range of 20-30 ppb during the afternoon, and then began declining from shortly before sunset until midnight (Figure 10).

Concentrations of NO remained at or below 10 ppb at Hamilton during the day and overnight period while at Toronto, NO concentrations increased to a mid-morning maximum of 43 ppb, decreased to a range of 9-13 ppb during the early afternoon, and then increased to an early evening maximum of 33 ppb, before settling to the range of 20-40 ppb until the following morning.

NO_2 concentrations in Hamilton decreased to a late-morning minimum of 6 ppb and remained less than 30 ppb until increasing during early evening. At Toronto, NO_2 concentrations increased to a late-morning local maximum of 27 ppb and then remained less than 30 ppb until increasing during early evening. NO_2 concentrations in both locations then remained in the 30-50 ppb range during the night and the following morning. Here, the NO- NO_2- O_3 equilibrium cycle of Eqns 1, 2 and 3 favoured much lower O_3 concentrations than during the sunny day of June 23, and the reduced solar insolation allowed Eqns 1 and 2 to maintain more NO_2 and less O_3 production. Local emissions of NO (particularly in Toronto) allowed scavenging of O_3 (Eqn 3) to increase concentrations of NO_2.

June 24 Meteorology:
A mainly cloudy day was recorded, with moderate intensity rain reported at 16:00 EDT (mid-afternoon) with the front over New York State by mid-afternoon. Following a nearly steady overnight temperature at Toronto of 21°C, temperatures decreased gradually to a low temperature of 16°C at 16:00 and 17:00 EDT. Winds were generally from the southeast, diminishing from a speed of 22 km/h at 10:00 EDT to calm winds recorded at 18:00 EDT, followed by light southwesterly winds during the evening. The cloudiness and cooler temperatures were observed across the Hamilton-Toronto-Kingston-Peterborough region during the day. Figure 6 shows contoured surface temperatures plotted for 14:00 EDT. The band of cloudiness across western Lake Ontario can be clearly seen in the satellite image in Figure 8 at 10:45 EDT on June 24.

June 25 Ozone and NO_x Trends:
Ozone concentrations reached minimum values during the early morning or just after sunrise at all five locations and then began a gradual increase to maximum values in the range of 89-113 ppb at four of the locations, and a lower maximum of 73 ppb at Kingston was eventually reached an hour before sunset (Figure 10). The O_3 concentrations at Kingston eventually increased to 83 ppb an hour after midnight after the warm front moved across Kingston. While O_3 concentrations at the other 4 locations were greater than 80 ppb by mid-afternoon (16:00 EDT), the concentration of O_3 at Kingston was only 64 ppb. The afternoon O_3 concentrations increased generally to the high values observed during June 23 but with the trend of increasing ozone concentrations occurring several hours later in the afternoon.

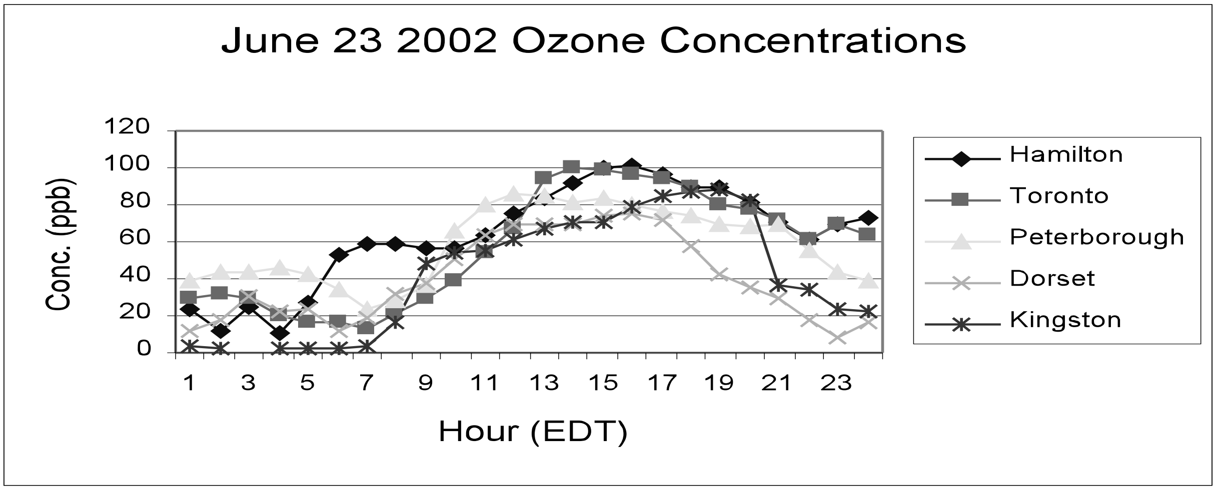
Concentrations of NO increased sharply, beginning at 06:00 EDT in Toronto and at 08:00 EDT in Hamilton, and then decreased to minimum concentrations by mid-afternoon. Generally, NO_2 concentrations at both locations decreased and NO concentrations disappeared almost completely to the 2-3 ppb range as O_3 concentrations reached maxima by mid- to late afternoon and the concentrations of NO, NO_2 and O_3 returned to the equilibrium cycle observed during the sunny day of June 23. After sunset, NO_2 concentrations increased as O_3 concentrations decreased (Figure 13).

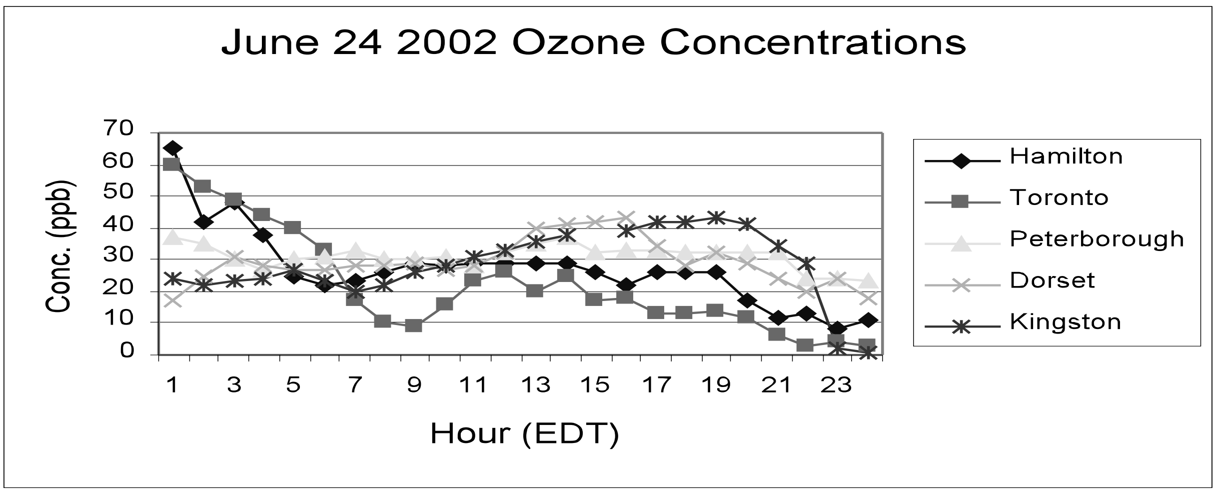
June 25 Meteorology:
At Toronto, following mostly cloudy conditions overnight, generally sunny conditions were experienced during the morning and afternoon, until late-afternoon cloudiness was recorded from 17:00 until 20:00 EDT. Temperatures increased steadily, reaching 25.4°C at noon and a maximum of 31.5°C recorded at 17:00 EDT, followed by a gradual decrease to 28.6°C at 21:00 EDT (sunset). Winds were from the west and southwest during the afternoon, in the 20-25 km/h range between 15:00 and 18:00 EDT. While hot, sunny conditions returned to Hamilton, Toronto and Peterborough, cloudiness remained over Trenton and Kingston as the warm front moved northeastward from Toronto but not across Trenton or Kingston until later during the evening. Figure 7 shows contoured surface temperatures plotted for 14:00 EDT, clearly indicating the sharp northwest-southeast temperature gradient from a Toronto-Peterborough line to a Trenton-Kingston-Ottawa line.

Summary
The effects on measured concentrations of O_3 and NO_x, caused by local variations of temperature, winds, and cloudiness, have been highlighted for the three-day period June 23-25, 2002 during which a frontal boundary drifted south of southern Ontario as a cold front and then northward across southern Ontario as a warm front, allowing examples of sunny-day and cloudy-day ozone chemistry to be displayed.

Sunny day photolytic ozone chemistry in the boundary layer was illustrated by the trends of O_3 at all five locations used in this study and of NO and NO_2 at Hamilton and Toronto during June 23. Ozone concentrations increased in mid-morning and decreased during late afternoon and during the overnight period until reaching a minimum at about sunrise of June 24.

The chemistry of a cloudy day was illustrated during June 24, with O_3, NO and NO_2 concentrations reaching a general equilibrium lasting most of the day at Hamilton and Toronto and with ozone concentrations in all five locations significantly lower than they were during the previous day.





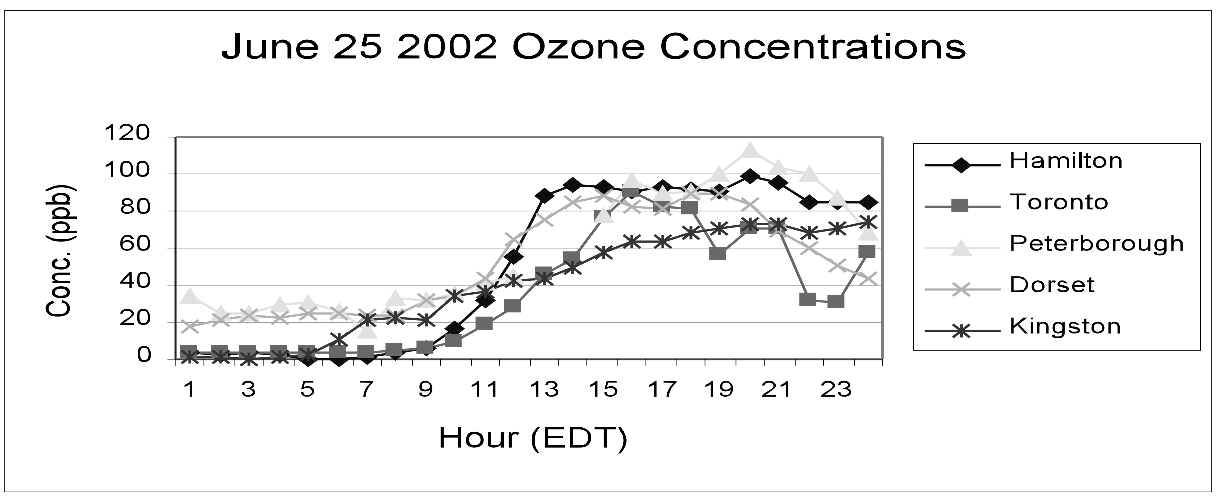
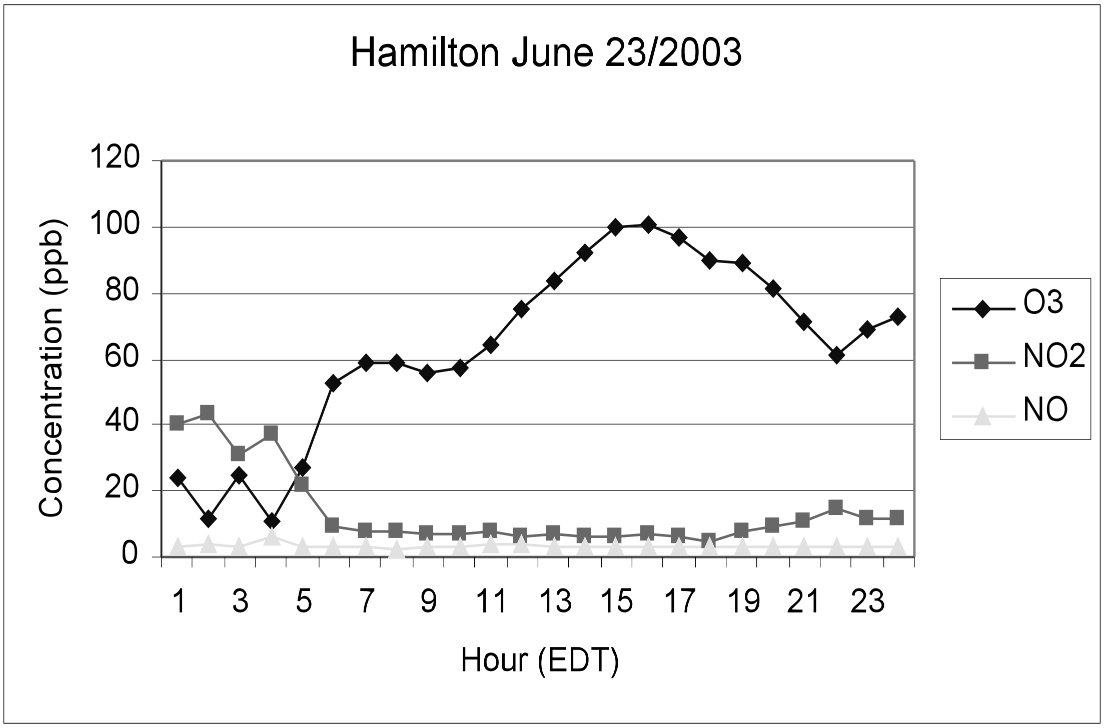


Figure 10. Hourly concentrations of O_3 during June 23, 24 and 25, 2002.



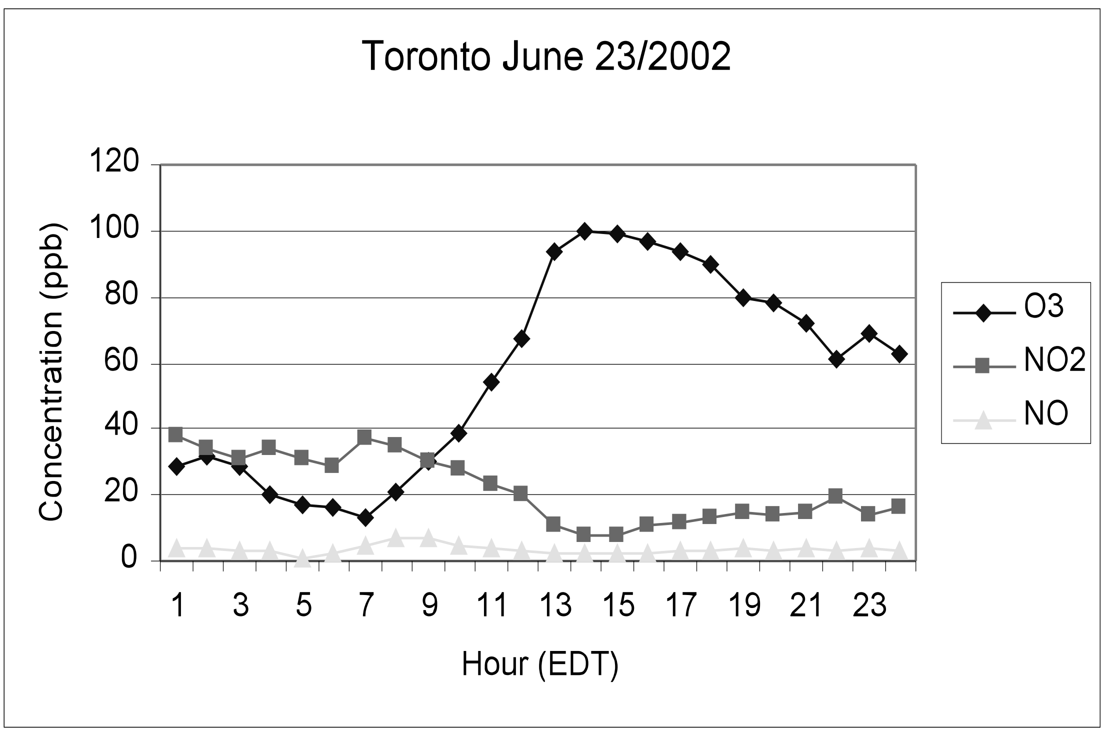
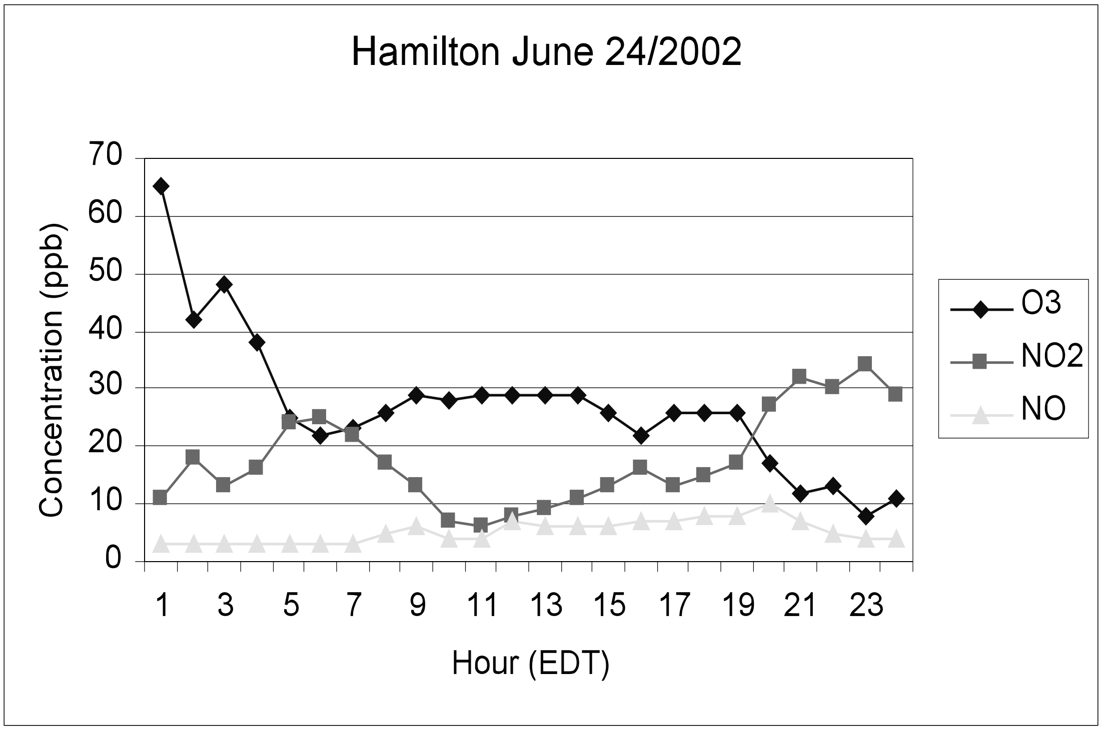


Figure 11. Hourly concentrations of O_3, NO and NO_2 during June 23, 2002.



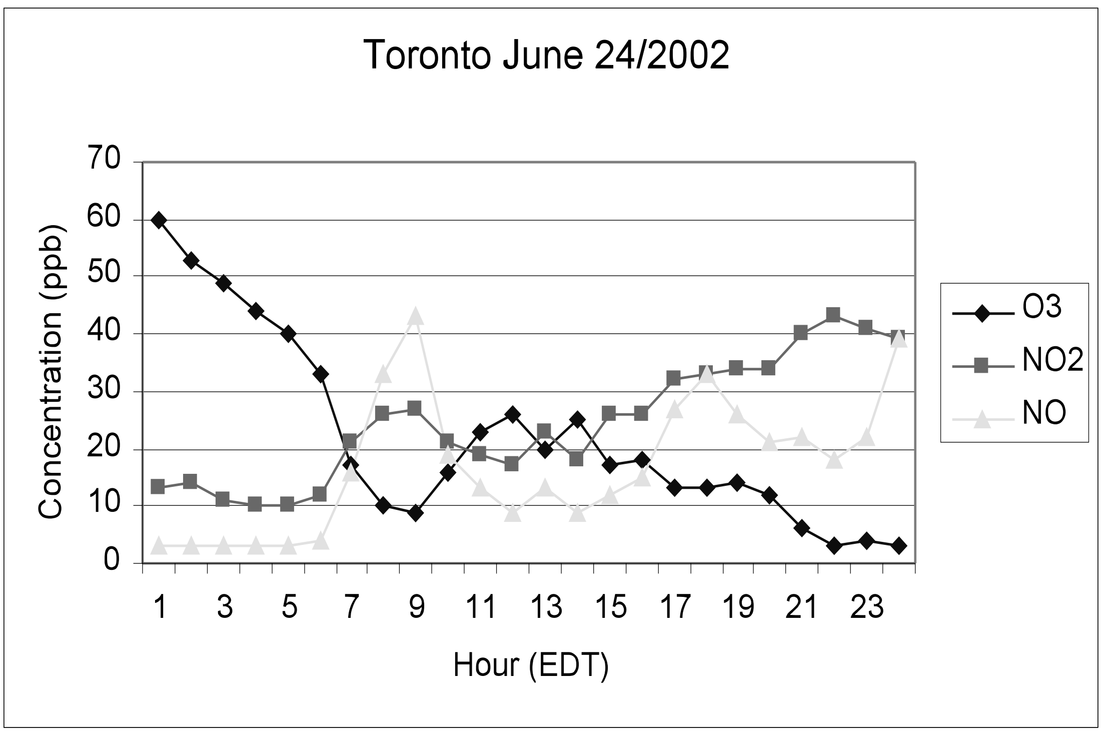


Figure 12. Hourly concentrations of O_3, NO and NO_2 during June 24, 2002.

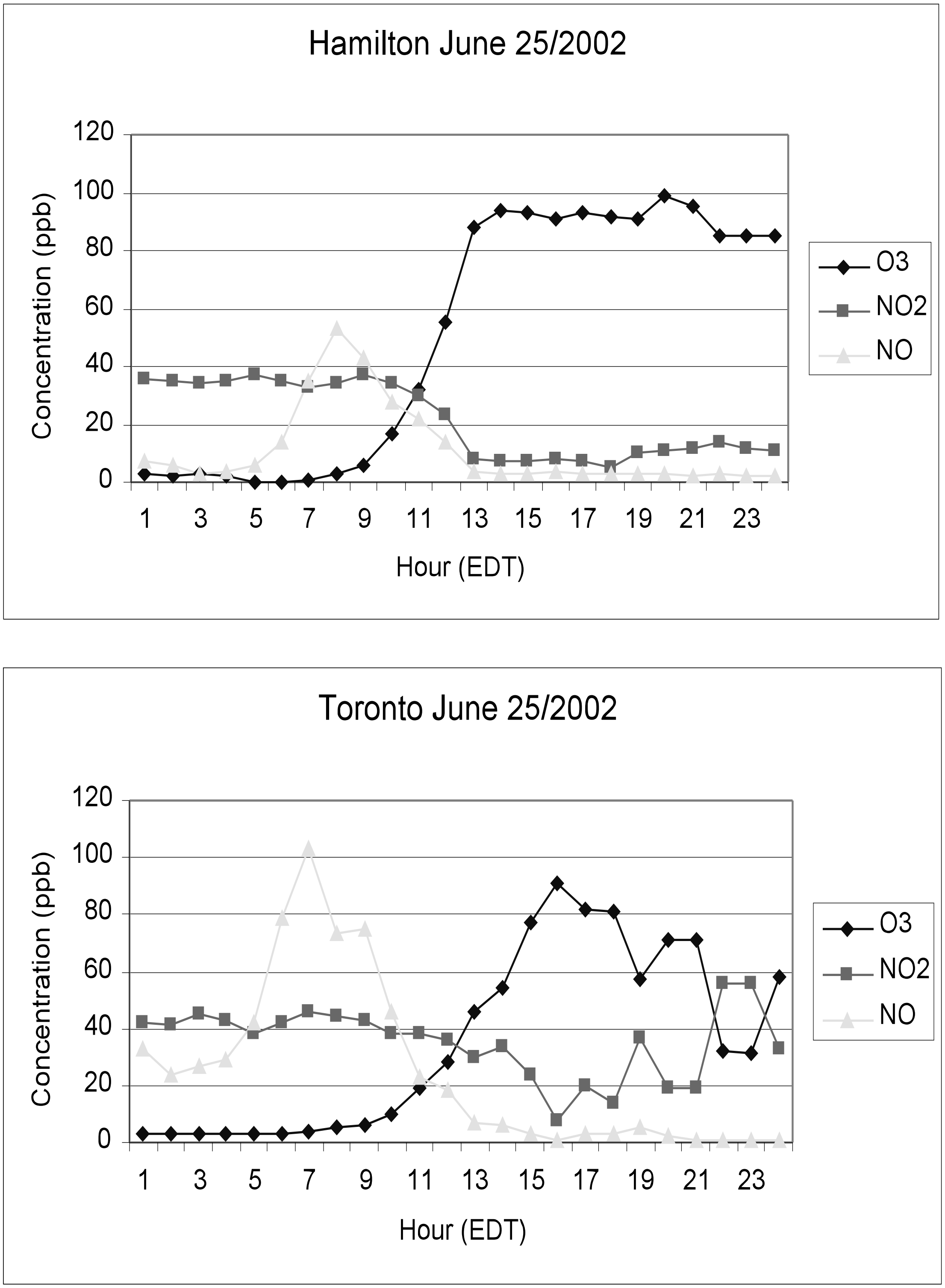


Figure 13. Hourly concentrations of O_3, NO and NO_2 during June 25, 2002.

Day 3 (June 25) showed a return to sunny day chemistry at Hamilton and Toronto along with the return of sunny and hot conditions to southern and central Ontario, and with O_3 concentrations increasing to the high values observed during June 23 but with the trend of increasing ozone concentrations occurring several hours later in the afternoon than during June 23. Kingston remained under cloud during most of June 25, and O_3 concentrations increased to values that were significantly lower than at the other locations, as well as significantly lower than those reached during June 23 at Kingston.

The maxima in NO_x concentrations several hours after the increase of morning vehicle traffic could be seen in data from each of the three days in Hamilton and Toronto, but is most clearly indicated on the data of June 25, and a late-afternoon NO_x maximum was also displayed in the data of June 24.

Overall, ozone concentrations were significantly higher during June 23 and June 25 than during the cloudy day of June 24 at all five locations used in this study, and concentrations of oxides of nitrogen at the urban cities illustrated the chemistry of an urban boundary layer.

Acknowledgements
The author gratefully acknowledges the NOAA Air Resources Laboratory (ARL) for the provision of the HYSPLIT transport and dispersion model and/or READY website (http://www.arl.noaa.gov/ready.html) used in this publication.

The author gratefully acknowledges the helpful comments provided by staff of the Air Monitoring Section of the Environmental Monitoring and Reporting Branch of the Ontario Ministry of Environment.

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Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **December 2005**. Please send your articles, notes, workshop reports or news items before **November 11, 2005** to the address given on page 98. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

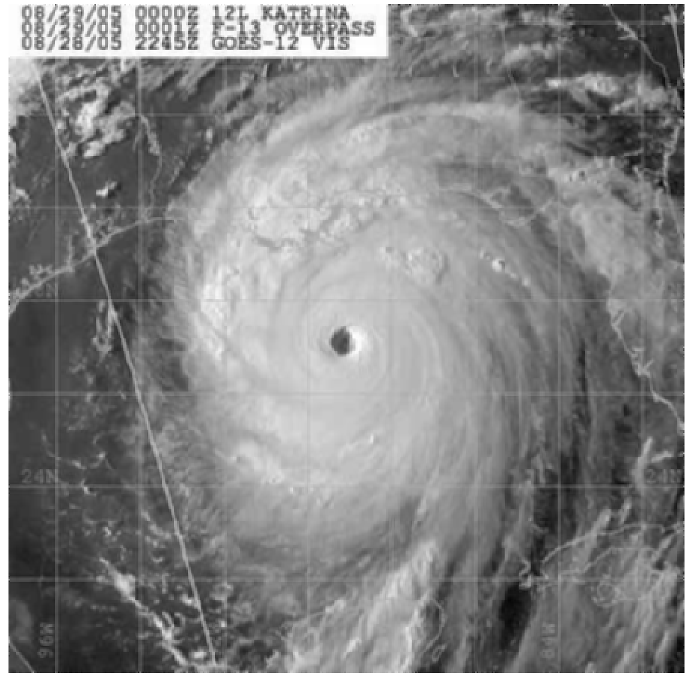
Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **décembre 2005**. Prière de nous faire parvenir avant le **11 novembre 2005** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page 98. Nous avons un besoin URGENT de vos contributions écrites.

Des ouragans de plus en plus intenses

L'intensité de l'ouragan *Katrina*, qui a balayé les côtes de la Louisiane et du Mississippi le 29 août dernier, est lié aux réchauffement climatique. Et, comme la saison des ouragans est encore loin d'être terminée, on peut s'attendre à ce que les prochaines tempêtes tropicales soient aussi destructrices. C'est du moins l'avis de plusieurs chercheurs américains qui se sont prononcés récemment sur ce sujet qui suscite bien des débats parmi la communauté scientifique, aux États-Unis comme au Canada. Une étude, publiée au début du mois d'août dans la revue scientifique *Nature*, indique que la durée et l'intensité des tempêtes tropicales et des ouragans formés dans les océans Atlantique et Pacifique, ont augmenté de 50% depuis les années 70.

L'étude menée par le climatologue de l'Institut de technologie du Massachusetts (MIT), Kerry Emanuel, prend soin de ne pas relier le réchauffement de l'atmosphère à la fréquence des ouragans, de plus en plus nombreux depuis quelques années. Mais le scientifique attribue avec certitude l'intensité des ouragans aux changements climatiques accélérés que nous vivons présentement. Selon Kerry Emanuel, le réchauffement climatique a eu pour effet de hausser la température de surface des océans, qui fournit l'énergie nécessaire à la formation des ouragans. Son étude porte sur l'analyse des données disponibles sur les tempêtes tropicales depuis environ 35 ans.

Un autre scientifique américain, Robert Twilley, directeur du Wetland Biogeochemistry Institute de l'Université de la Louisiane à Baton Rouge, abonne dans le même sens. Selon lui, les changements climatiques amplifient non seulement la vulnérabilité de la Louisiane aux ouragans mais ont un effet indiscutable sur l'intensité des ouragans.



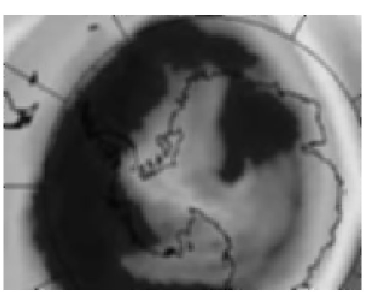
Ouragan *Katrina* fin août 2005 sur le golfe du Mexique

"Le baromètre qui nous permet d'affirmer que la situation est extrêmement grave est la perte progressive des terres marécageuses, des bayous et des îles sablonneuses qui protègent des tempêtes. L'érosion des côtes est un indicateur qui ne trompe pas. C'est cette donnée qui permet de faire un diagnostic de cancer" a conclu le scientifique.

ftp://texmex.mit.edu/pub/emanuel/PAPERS/NATURE03906.pdf.

Un trou grand comme l'Europe

Le trou dans la couche d'ozone au pôle Sud s'est remis à grossir, de façon significative. L'Agence spatiale européenne, à l'aide de son satellite environnemental 'Envisat', estime qu'il atteignait à la mi-août environ 10 millions de kilomètres carrés, soit la superficie de l'Europe.



Les experts croient qu'il continue à prendre de l'expansion et qu'il pourrait atteindre son maximum pour l'année en septembre. Il n'a atteint ces proportions qu'en 1996 et en 2000. Des données récoltées depuis deux ans laissent croire aux scientifiques que les dommages à la couche d'ozone se résorberont à long terme. Toutefois, celle-ci ne sera rétablie qu'aux alentours de 2050.

'Envisat' mesure régulièrement les niveaux d'ozone à l'échelle de la planète et compile les informations depuis le milieu des années 90. Le satellite observe la taille du trou afin de jeter les bases d'un système de prévision dans le cadre d'un protocole de surveillance baptisé Promote, qui regroupe 30 partenaires de 11 pays.

La couche d'ozone de la stratosphère protège la vie sur Terre du danger des rayons ultraviolets (UV). Elle est menacée par la présence de certaines substances chimiques dans l'atmosphère, tel le chlore émanant de polluants dus à l'activité humaine comme les chlorofluorocarbones (composés contenant du carbone ainsi que du fluor et du chlore) appelés CFC. Ces polluants sont bannis par le protocole de Montréal en 1987, ils étaient auparavant largement utilisés dans les aérosols et les réfrigérateurs. Les CFC sont inertes, mais les rayons UV en altitude dans l'atmosphère les décomposent. Une seule molécule de chlore peut détruire des milliers de molécules d'ozone.

Canadian Oceanographic Historical Photos

Report prepared by Dick Stoddart, Secretary for CNC/SCOR[1]

The Canadian National Committee for SCOR www.cncscor.ca is working with the Canadian Meteorological and Oceanographic Society (CMOS) to establish an archive of Canadian oceanographic photographs. The intent is to create an on-line library of historical photos that would parallel those of the Canadian meteorological community. Hopefully submissions will be scanned photos sent by email, but some providers may not have such capabilities. In this case we would have to make arrangements for submission to a third party for scanning and guarantee of return of the originals. A site has been established to post photos; see http://www.cmos.ca/Oceanphotos/photoindex.html

Photos should be reasonably clear so as to be able to identify individuals in the photo, and have a caption that would explain the event (a cruise, conference, university faculty, etc.), a date (year) of the event, and an organized list of (many) of those in the photo. The names associated with the photo should be in a standard format if at all possible, along the lines of "Richard (Dick) BL Stoddart". Obviously we are looking for Canadian content, but international events held in Canada would also be useful if there were several notable Canadian oceanographers in attendance. Realizing the significance of "ships" to oceanographic effort we would also like to get photos of all the Canadian oceanographic vessels as well as photos of people.

General guidelines for input photos are that they should be between 500 KB and 1 MB. The original photo size (e.g. 8x10 or 4x6) is not important; whatever the size of the original is fine. However, a good clear input photo is needed to produce a nice online version. JPEG is the preferred format.

If you are able to help out, it would be appreciated if you could send a few (up to 5) scanned photos to me at your convenience. Additional photos would also be very much welcomed, but you should await confirmation that the first batch has been successfully received – just in case there are multiple emails from others that collectively, with their attachments, end up being too many to handle. You may wish to use the CMOS ftp service if large numbers of photos need to be transferred. Anyone who wishes to use this service should contact the CMOS webmaster, Bob Jones, at jonesb@igs.net

Richard (Dick) Stoddart

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Les photos historiques d'océanographes canadiens

Rapport préparé par Dick Stoddart Secrétaire du CNC/SCOR[1]

Le Comité national canadien du SCOR travaille en collaboration avec la Société canadienne de météorologie et d'océanographie pour créer une archive historique de photographies d'océanographes canadiens. Le but est de créer un album électronique de photos historiques accessible en ligne et comparable à celui produit par la communauté météorologique. Nous souhaitons obtenir des photos électroniques par courriel mais il se peut que certaines personnes n'aient pas la possibilité de produire de telles photos. Dans ce cas on peut faire des arrangements avec une partie tierce avec la garantie de retourner les photos originales une fois numérisées. Un site internet a été établi pour afficher ces photos à http://www.cmos.ca/Oceanphotos/photoindex.html

Les photos soumises doivent avoir une bonne résolution pour pouvoir identifier les personnes sur les photographies et doivent contenir une courte légende expliquant l'événement (une croisière, une conférence, une faculté d'université, etc.), la date de l'événement (année), et une liste ordonnée de ceux qui apparaissent sur la photo. Les noms doivent être indiqués de la façon habituelle comme "Richard (Dick) BL Stoddart". Évidemment, nous sommes intéressés par des événements canadiens mais des événements internationaux tenus au Canada sont également souhaitables si plusieurs océanographes canadiens assistaient à cet événement. Connaissant l'importance des "navires" dans les sciences océanographiques, nous voulons acquérir également une photographie de tous les navires océanographiques autant que les photographies de personnes.

Les lignes directrices générales pour soumettre des photos électroniques indiquent q'elles doivent contenir entre 500 KB et 1 MB. La grandeur de la photo originale est sans importance (e.g. 8x10 or 4x6); toute grandeur de l'original fera l'affaire. Cependant une photo nette est nécessaire pour produire une bonne version électronique accessible en ligne. Le format JPEG est de loin le format préféré.

Si vous pouvez nous aider, il serait apprécié que vous nous faisiez parvenir quelque photos (jusqu'à 5) aussitôt que possible. Vos autres photos sont également bienvenues mais il serait préférable d'attendre la confirmation que les premières ont effectivement été reçues pour éviter la congestion possible avec d'autres envois. Vous pouvez utiliser le site FTP de la SCMO si plusieurs photos doivent être envoyées. Si vous désirez utiliser ce service, prière de contacter le webmestre de la SCMO, Bob Jones, à jonesb@igs.net

Richard (Dick) Stoddart

Report on Attendance at the AMS/NOAA

"Project Atmosphere Workshop 2005"

by Ryan Nugent[1]

(Note from the Direction: Project Atmosphere is the yearly Workshop for Geography Teachers who teach Meteorology as part of their Curriculum. The American Meteorological Society, which holds the Workshop, has been inviting CMOS for a number of years to send a Canadian Geography teacher as a participant. The teacher is selected and financially assisted jointly by CMOS and the Canadian Council for Geographic Education.)

I would like to thank CMOS for providing me with the opportunity to attend the American Meteorological Society's "Project Atmosphere" at the National Weather Service Training Centre in Kansas City, Missouri. It was an exciting experience to participate in the workshop with pre-college teachers from 16 American states, Puerto Rico and South Africa. It provided me with an opportunity to expand my knowledge of weather and obtain classroom instructional materials from NWS scientists and other experts. The purpose of the two-week workshop was to prepare me to peer-train other teachers in my home area on selected weather topics.

Our cohort studied general weather patterns and modern observing techniques including weather satellites and radar. Other sessions focused on El Niño and La Niña, severe weather systems such as hurricanes, tornadoes, thunderstorms and winter storms. Special behind-the-scenes visits to the NWS Forecast Office in Topeka, Kansas, and the NWS Aviation Weather Center provided an opportunity to see applications of technology (including the release of a Radiosonde Balloon) and talk with onsite meteorologists.

Senior NWS administrators provided special lectures for the educators. John Jones, Deputy Director of the National Weather Service provided a general overview of the country's official weather and climate observation and research agency. Dr. Louis Uccellini described the National Center for Environmental Prediction, responsible for much of the nation's forecasting and climate studies. Dr. Joseph Schaeffer explained how the Storm Prediction Center monitors severe weather, especially tornadoes and thunderstorms. Other presentations focused on hurricanes and the Tropical Prediction Center, highlighting the greatest storms on the planet.

Participants also learned about the new technologies used for observing weather from key researchers. Dr. Rod Scofield, National Environmental Satellite and Data Service, explained what we understand using satellite images. Ron Przybylinski, Science and Operations Officer at the NWS St Louis forecast office, described the use of Doppler radar. NWS Training Center instructors demonstrated surface instruments, including the Automated Surface Observation System (ASOS) now operating at most American airports.

"Project Atmosphere" 2005 Class overlooking Kansas City

Highlights from the workshop included: Dr. Rod Scofield and his use of the puppets Fuzzy-Wuzzy and Simba to convey important messages about the weather around us; Ron Przybylinski and his lively discussion of bow echoes and areas of vorticity that can develop into tornadoes; and daily weather briefings presented by Jerry Griffin of NOAA using the Advanced Weather Interactive Processing System (AWIPS). The non-weather field trips were exceptionally interesting and included visits to the Negro Leagues Baseball Museum, the Kansas City Jazz Museum, and the Subtropolis (the largest subterranean storage facility in the world).

I returned from Kansas City with teacher-training materials that will become the basis for classroom investigations about hazardous weather, El Niño and La Niña, weather radar and satellites, clouds and other topics. I intend to act as a weather resource person for the Horizon School Division, and am already scheduled to speak at our annual teachers' conference this fall.

This has been an intellectually stimulating few weeks and has inspired me to continue developing my knowledge in meteorology via the DataStream courses, hopefully beginning this fall.

[1] Lethbridge, AB

Coasts: Form, Process and Evolution

by Colin D. Woodroffe

Cambridge University Press
New York, USA, 623 pp. US$ 50.00
ISBN 0 521 01183 3

Book reviewed by Charles T. Schafer[1]

According to the book's author, this 17 cm wide x 25 cm high soft cover publication " is written for students of coastal geomorphology, coastal environments, and coastal geology, and for all of those with an interest in coastal landforms or who seek insights into the way the coast behaves". After reviewing it over a three week period, my singular conclusion is that Woodroffe is right on the mark. The information consolidated in the text is well organized and is printed on good quality double weight paper that will endure relentless handling. The printing itself is sharp and is presented using a 1.5 line spacing format which makes for exceptionally easy reading. The work consists of 10 comprehensive chapters, an impressive 118 pages of references that include 31 papers published by the author during the last two decades of the 20th century, and a seven page index that is devoted almost exclusively to subject information punctuated by the names of particularly well-known coastal researchers. Each chapter features a moderate number of thoughtfully prepared line drawings and B/W photographs that complement the written material. In its preface, Woodroffe notes that "the book is based heavily on my own research experiences in Australia, Britain, the United States, New Zealand and many islands in the West Indies". This extensive experience can be seen by the reader time and again in clear explanations and in the critical way that some of the more complex topics of coasts are addressed throughout the text. The first three chapters are devoted to a comprehensive introduction, historical and geological perspectives of coasts and a chapter on processes that shape them. The next five chapters take the reader through a rigorous summary of various types of coasts (e.g., rocky, reef, barrier, delta, estuary, and muddy). The last two chapters treat coastal system "morphodynamics" (i.e., the mutual co-adjustment of coastal form and process), human interaction with the coastal zone and future prospects.

[1] Emeritus Scientist, Bedford Institute of Oceanography, Dartmouth, NS., B2Y 4A2

Each chapter begins with a thought-provoking philosophical observation taken from the work of a reputable coastal zone researcher and closes with a concise and forward-looking summary section. The philosophical observation found at the start of Chapter 1 is from a 1925 paper by D.W. Johnson which focuses on the New England – Acadian shoreline and its "mysterious past". An *Historical Perspective* section included in each chapter provides a summary of the research dynamic of the topic under discussion. For example, the historical perspective section of Chapter 8 (Muddy Coasts) details how the "Ecological and sedimentological aspects of muddy coasts have been extensively studied, but only recently from geomorphological perspectives". Historical perspective sections of other chapters give information that explains the development of the field itself (e.g., the observation that the first attempts to explain the way in which coasts evolved preceded both understandings of plate tectonics and concepts of how sea level had changed during the Quaternary). Chapter 1 begins with a reminder of the importance of the 60km-wide coastal zone and that managing its resources in sustainable ways will call upon multidisciplinary and holistic approaches. The coastal geomorphology section of this chapter is subdivided into landforms and "morphodynamics" while the history of coastal research section features a chronology of pre, early, Mid and late 20th century investigations. Research progress is traced from one decade to the next and from one dominating theory to its successor thereby providing the foundation from which marine geology and coastal oceanography were to develop. The remainder of the first chapter explores temporal and spatial scales and coastal systems interrelationships (feedback and equilibrium). Woodroffe examines temporal change using a "hierarchy of time scales" approach ranging from instantaneous (in which the principles of fluid dynamics apply) to geological (reconstructions based on paleoenvironmental evidence). "Engineering" or "historical" time scales (decades to centuries) are considered to be particularly suited to investigations aimed at predicting the prospects for future coexistence of human activity within the coastal zone. In the remainder of this review I emphasize three chapters that should be of particular interest to many of the *CMOS Bulletin SCMO* readership. The chapter on beach and barrier coasts (6) covers coastal situations and settings that are frequently seen in Canada. Chapter 9 (*Morphodynamics of Coastal Systems*) will be of interest to coastal modellers everywhere. The book's final chapter (10) on *Human Activities and Future Coasts* contains provocative ideas that should be of value to environmental managers, coastal engineers, scientists and some geopoliticians alike.

As is the case for virtually all of the other coastal type-specific chapters included in this book, the one on beach and barrier coasts (6) strikes a good balance between beaches, dunes and barriers, and between contemporary and ancient coastal geomorphological settings. Woodroffe describes the basic form of a beach as lag deposit of material that is too large to be susceptible to being winnowed away from the shore. A key characteristic of beaches is their ability to be reshaped into a form that either reflects or dissipates wave energy; this concept emerges as a fundamental criterion in their classification. However, throughout Chapter 6, Woodroffe cautions time and again that it is "unrealistic always to expect a constant and consistent geometric relationship between form and process" and that beach "sediment transport models based on energetics are still not sufficient to predict morphological change or even [to] reliably forecast the direction of transport". He leaves little doubt in the readers' mind that the science of "beach morphodynamics" is, as yet, far from perfect. Near the end of this chapter Woodroffe considers the global picture of shoreline erosion/accretion cycles and the nature and behaviour (dynamics) of coastal barriers and spits in relation to their morphology and composition. This subject is illustrated by a number of thoughtfully-selected figures and draws upon many examples from research carried out on Canada's east coast by government and university-based investigators during the last two decades of the 20^{th} century. In particular, Nova Scotia's rich archive of coastal data brings forth a number of very intriguing observations such as the one that describes how individual drumlins can continue to provide a mixture of both coarse and fine material to adjacent beaches over a period of as much as 2000 years. Many of the morphodynamic models presented in Chapter 6 draw upon data sets collected from Nova Scotia and Newfoundland coastal settings.

Chapter 9 is dedicated to an in-depth review of the morphodynamics of coastal systems and takes a distinctive "modeling" approach. In short, coastal morphodynamics provides a framework that bridges the "dichotomy" between historical (or evolutionary geomorphology) and process geomorphology. The chapter begins with some general information on the use of models in coastal geomorphology research and then moves forward to describe the key categories of models (i.e., physical, conceptual and computational). Gradients of wave, tide or other forces are examined in process operation and linked to landform variation. Once again, Woodroffe cautions that even sophisticated numerical models are "not true representations of reality", but instead are only "simplified tools" that have utility for "experimentation, explanation, prediction, and hypotheses generation". Physical models (e.g., wave tank models) are seen as having major limitations in regard to scaling issues while computational models are viewed as being limited in terms of their predictive capabilities because of stochastic factors and non-linearities that are inherent to coastal systems. Woodroffe emphasizes that coastal systems changes are sometimes triggered by intrinsic factors that are responding to inherent thresholds which cannot be predicted on the basis of external forcing. Inheritance (i.e., the imprint of past events) and convergence (the construction of similar landforms by differing sets of processes) are seen as further impeding the goal of obtaining a complete understanding of a particular coastal system and seem to lead the author to remark that "the pattern of coastal evolution is essentially an historical accident, and [that it] is largely unpredictable, unrepeatable and irreversible". [A philosophy that may some day ring true for some currently perceived global warming predictions]. Convergence is, of course, complimented by "divergence" situations in which coastal systems that have experienced a similar forcing pattern end up in different states.

Responses of coastal systems to changes over time involve perturbations, boundary condition changes and intrinsic changes i.e., abrupt erosional or depositional adjustments that come about as a consequence of accumulated change without specific external stimuli. In Chapter 9, each of these actions is considered in turn using well-prepared diagrams. Another part of this chapter is dedicated to an excellent overview of extreme events in relation to coastal systems that will be of special interest to researchers working on the coastal sedimentary record of tsunamis, cyclones and hurricanes. Woodroffe cautions that it is likely that similar morphology may result from several causes and points to the strategic importance of using a multidisciplinary approach to help to discriminate the agents responsible for a particular deposit. The remainder of the chapter visits the modeling of coastal morphodynamics which includes an extensive and liberally-referenced discussion of multidimensional modeling (e.g., 2D, 3D, 2DV). Despite his earlier cautions, the author concludes that coastal morphodynamic models can provide a framework within which "the most marked variation and complexity of change at particular sites might be understood…." He predicts that, when applied to relatively pristine coasts around the world, models of all types should be of assistance to coastal scientists and engineers in discriminating between natural changes and anthropogenic impacts.

Chapter 10 (*Human Activities and Future Coasts*) begins with a 1973 quote by G. Soucie that places coastal resource exploitation in a realistic perspective. It states: "The real conflict of the beach is not between sea and shore, for their's is only a lover's quarrel, but between man and nature." In this final chapter, Woodroffe addresses several key societal issues such as: (i) human interaction with the coast, (ii) tourism and the resort cycle and (iii) human adaptation to coastal change (e.g., seawalls, groynes and beach nourishment). He evaluates these topics in relation to global environmental change using a framework that categorizes human activities as either: (i) a perturbation to coastal landforms (ii) a boundary condition change or (iii) as an intrinsic component of a coastal system. The author points out that, to date, scientists have not been too productive in establishing geomorphological principles "where earth-moving machinery is the dominant agent of change". One of his most profound observations – and one that is especially applicable to other contemporary natural science issues – reminds the reader that natural change is an *ongoing* [emphasis by reviewer] phenomenon and that society can expect more of it in the future. As such, the scientific community will need to insure that "the previously widespread view that we are in a stable world where [natural] change is neither anticipated nor tolerated" is placed in its proper perspective. In the later parts of this chapter, Woodroffe examines several coastal management issues (e.g., relative sea level rise) noting that often "a static solution is proposed for a dynamic problem" and that resource management decisions often need to be proactive instead of reactive. The author describes a vulnerability-sensitivity-adaptive capacity strategy that he believes has utility for evaluating coastal zone management alternatives.

The last section of Chapter 10 explores "Prospects" for the future. Here Woodroffe offers a number of possible pathways for future research. Woodruffe argues that coastal scientists must continue to test and refine the "practical simplifications" on which models are founded and describes the new suite of research and monitoring tools that are becoming available to the next generation of coastal scientists. Along with all of the other chapters of this comprehensive book, Chapter 10 is liberally sprinkled with cautionary statements [no doubt based on the author's personal research] that warn the reader about the "futility of trying to predict future [coastal/beach] scenarios where there is a large human influence....".

What we glean from this author is the kind of conservative approach that needs to be rekindled among the users of natural science information. Woodroffe is persistent in reminding the reader that the coast is a "complex non-linear system" and that its inherent complexity "makes complete descriptions difficult and accurate predictions impossible". He laments that "linear thinking" is especially entrenched in the approach that policy makers often adopt towards coastal management problems [as well as other environmental *crises*]. Sensitive dependence on initial conditions, taken together with the "stochastic" variability of forcing factors, leads him to conclude that the pattern of coastal evolution is essentially an historical accident, and one that is largely unpredictable, unrepeatable and irreversible. In his view, non-linear responses are the norm; they arise from complex interactions, "feedbacks" and thresholds in the system itself. Added to the complexity of this problem is a human factor that is having an increasing impact on the way in which coasts change.

Weighing in at about 1.8 kg, this book is not easily carried about for casual consultation. However, the publication's appealing format and its clearly written subject matter makes for delightful desk top reading. I believe that it should be considered as a key element of every coastal practitioner's reference collection.

Natural Hazards (second edition)

by Edward Bryant

Cambridge University Press 2005
New York, USA, 312 pp. Soft Cover, US$ 36.99
ISBN 0 521 53743 6

Book reviewed by Bob Jones[2]

Natural Hazards (second edition) is another book in a series on natural disasters by Edward Bryant. Prof. Bryant is Associate Dean of Science at Wollongong University in Australia. Many of Prof. Bryant's books fall into the textbook category and this one is surely a good text for students of natural hazard phenomena. I have not read his first edition, published 15 years ago, but notes in the Preface indicate that his first edition needed updating and that he was encouraged by peers and colleagues to do this rewrite.

Natural Hazards (second edition) is well organized and referenced. The sheer number of topics covered indicates that the author cannot possibly describe the latest science available for each. Had Prof. Bryant been able to include the Asian Tsunami (see also Reviewer's Notes, below) parts of the book would have been altered significantly because of the near-biblical proportions of this event. Nevertheless, the book well covers its subjects, each section / chapter is well presented and contains references and further reading at the end, essential for students who will be using this book as a text.

The book is divided into the three broad areas of Climatic Hazards, Geological Hazards and Social Impact. Climatic Hazards includes all the familiar weather, climate and oceanographic hazards, each with its own chapter. In this section the author attempts to link some of the events to global warming / climate change but, elsewhere (Epilogue, page 290) in the book, he admits that "the climatic consequences of greenhouse gases are speculative and uncertain". Chapters on climate variability, large-scale storms, localized storms, drought, flooding, fires and oceanographic hazards, comprise the Climatic Hazards section. The Geological Hazards section includes chapters on earthquakes, tsunami, volcanoes and land instability. There are good linkages between these phenomena across each chapter. Finally, the Social Impact section covers personal and group response and preparation for natural hazards. The epilogue tries to put changing hazards regimes and the modern consequences of natural hazards into global and historical context. We can only guess how Prof. Bryant would have worded his epilogue had he been fortunate enough to go to press only a few months later.

[2] CMOS Member, Ottawa Centre

Because Prof. Bryant attempts to cover so much material in one book, excellence in references, definitions and organization is a must. He achieves this with a clear table of contents, over 200 figures and tables, many photos and diagrams and several global location maps showing places and occurrences of the major events he describes. At the end of the book, there is not only a good index but also a selected glossary defining terms used throughout the book.

Natural Hazards is very readable at levels from late high school through university undergraduate. In fact, most of the contents have been presented as lecture material and have been critiqued by university students. Like another Bryant book I reviewed, there is some bias toward Australian events and geography, but on comparison (see Reviewer's notes 2.), I feel that the context in *Natural Hazards* sufficiently covers global events to be useful as a textbook anywhere.

<u>Reviewer's notes</u>

1. The reviewer for *CMOS Bulletin SCMO*, Mr. Jones is CMOS Webmaster and author of the on-line publication *Canadian Disasters – An Historical Survey* (ref. Natural Hazards, Journal of the International Society for the Prevention and Mitigation of Natural Hazards, Vol. 5, No. 1, 1992, pp 43-51and also *Canadian Disasters: an Historical Survey*, CMOS Bulletin SCMO, Vol.28, No.2, pp 35-44, http://www.ott.igs.net/~jonesb/DisasterPaper/disasterpaper.html

2. This is the second book written by Prof. Bryant that I have reviewed. The saying "timing is everything" truly applies to some of his publications. My review of an earlier Bryant book, *Tsunami: The Underrated Hazard* appeared in the April 2002 *CMOS Bulletin SCMO*. Just two short years later, the catastrophic Asian tsunami occurred, quickly vindicating much of Prof. Bryant's work. His title alone stands as an amazing predictor of a major tsunami disaster soon to come.

3. There is also interesting timing of publication of this book. *Natural Hazards (second edition)* is dated "2005", but was printed in December 2004, probably just weeks before the December 26, 2004 Asian tsunami. As a result, his Chapter (10) on tsunami as a natural hazard missed this major event. How serious was this omission? On page 220, table 10.6 lists all the major tsunami of the past 2000 years, with the highest death toll of 50,000 in Taiwan in 1792. The recent Asian tsunami killed over 250,000 people and would rise to the top of that list! Also, his list of deadliest natural hazards of all types, page 9, table 1.3, would need revision as the Asian tsunami would be placed among the four worst disasters in recorded history!

Energy at the Crossroads: Global Perspectives and Uncertainties

by Vaclav Smil

MIT Press, 2003, Hardcover, 448 pages
ISBN # 0-262-69324-0

Book reviewed by John Stone[3]

First reading, and certainly the early chapters, of this new book by Professor Smil of the University of Manitoba, suggests that this is a technology-oriented tome. However, while the author seems to have a preoccupation for, and indeed a broad understanding of, energy technologies, his message is more a moral one. He discusses, often using the issue of climate change as an example, our responsibilities for future generations and for the future of the Earth; the common good of mankind that forms the moral foundation of every higher civilization.

Professor Smil questions the goal of energy efficiency, usually regarded as an obvious opportunity for reducing energy demand and the associated greenhouse gas emissions that are affecting the climate, and shows that it has been less than effective. Historical evidence suggests that improved energy efficiencies lead to higher and not lower aggregate energy use. A good example is the case of the U.S. In the twenty years between 1980 and 2000 the energy intensity of the U.S. economy fell by 34%. [Recall that President Bush, having withdrawn from the Kyoto Protocol, set a target for the U.S. to decrease energy intensity by 18% before 2012]. During these twenty years the population increased by 22%. If the average per capita GDP had remained at 1980 levels the energy demand would have dropped by 20%. In reality, average per capita GDP grew and energy demand rose by 55%.

Why is this? One simple economic argument would be that as energy efficiency increases there is a lowering of costs that encourages more energy use. There are plenty of examples of this in the demand for automobiles and houses (and where to live) – a casual waste of resources, displays of ostentatious consumption, and a preference for lower initial costs over life-cycle environmental costs. This observation is not new and the author reminds us of the comment of the English economist, Stanley Jevons, in his 1865 book (i): "It is wholly a confusion of ideas to suppose that the economical use of fuels is equivalent to a diminished consumption".

Energy efficiency, for all the myriad of economically valuable opportunities, is not sufficient on its own. As has been often suggested, our environment does not respond to miles per gallon; it responds to gallons. President Bush's energy intensity target will, in fact, see business-as-usual emissions of greenhouse gases rise by 30% over 1990 levels. Expected trends in lower energy intensity, the gradual de-carbonization of fuel supplies and the slowing down of population growth will not be sufficient to stop greenhouse gas concentrations in the atmosphere rising as shown by the Intergovernmental Panel on Climate Change (IPCC) emission scenarios (ii).

Professor Smil is arguing for a moderation in demand – not just for energy but for all resources. In what is perhaps his credo he says there must be "limits on human acquisitiveness in order to leave room for the perpetuation of other species, to maintain irreplaceable environmental services without whose provisions there could be no evolution and no civilisation, and to keep the atmospheric concentrations of greenhouse gases from rising so rapidly and to such an extent that the Earth would experience global tropospheric warming unmatched during the evolution of our species…".

Thus the author questions the modern economic paradigm of continuous, unlimited growth. He recognizes that this goes against the grain of most people's desires, certainly those living in the developed world. It is an up-hill battle to suggest that a family forgo its aspirations to a "better lifestyle" today to avoid the potential impacts some time in the future. Yet this is the basic compromise that underlies action to tackle climate change.

As the American technologist, Alvin Weinberg (iii), has discussed, the power we generate from the use of fossil fuels provides us with the power to allocate our time. All those so-called energy-saving appliances, which are supposed to make domestic existence easier and to provide us with more free time, actually demand more energy from fossil fuels and seem to lead to more stressful lives. We cannot avoid having to make choices that put us at the very centre of the energy, and hence climate change, debate.

By going on to address the question of equity, Professor Smil explores the possibility of what he calls "a grand energy convergence". The IPCC concluded in its Third Assessment Report that global warming will likely exacerbate the inequality between developed and developing countries, already one of the gravest threats to geo-political security. The author argues that one of the characteristics that qualify us as sapient beings is a concern for the dignity of human life. This implies a responsibility, for example, towards the people of the Arctic and low-lying islands who are already seeing the impacts of climate change. He is under no illusion about the difficulties this entails noting that the global mean per capita energy consumption a century ago would easily satisfy most of the World's essential physical, intellectual and societal needs. However, this would mean that Canadians would have to see our present share decline by 80%.

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[3] Retired meteorologist and adjunct Research Professor in the Department of Geography and Environmental Studies at Carleton University.

We need to understand better the limits of the environment to supply both products as well as services. That means appreciating the limits to the supply of renewable and non-renewable resources whether it's water out of a tap in our homes or gasoline affordably purchased at the pump. Equally, we need to appreciate the limits of the environment to handle our wastes whether they are dumped in the atmosphere as with fossil fuel emissions, in the water as with sewage, or on the land as with over-use of chemicals. We can do without many of our material obsessions but not, for example, without the cellulose-decomposing bacteria that dispose of much of our wastes. Climate change will affect virtually every process in the entire biosphere on which we depend.

My sense is that Professor Smil is basically an optimist who believes that humanity will take advantage of the surprises and opportunities that will inevitably occur. But it will be important to sustain the richness of the natural world and avoid getting too close to thresholds of irreversible change. While we need to take a long-term view, it is imperative to begin immediately and proceed with incremental steps. The only responsible way to act is to minimize risk. The Kyoto Protocol will not lead to stabilization of atmospheric concentrations of greenhouse gases but it is a start; it allows for experimenting with mechanisms such as the use of emissions trading and carbon sinks and it will stimulate technological development and implementation. As the *Economist* magazine argued: "gradualism is the key to doing this intelligently; the time to start is now." Unfortunately, climate change may not be gradual. Just as increasing the pressure on a light switch will eventually lead to a new state, so climate change can have abrupt and possibly irreversible changes. The results of the recent Conference of the Parties under the UN Framework Convention on Climate Change in Buenos Aires would seem to suggest that gradualism proceeds very slowly.

In many countries, Professor Smil notes "there are so many other constant crises, profound concerns, chronic complications and never-ending entanglements claiming limited resources…" How realistic is it then to expect states to engage in an effective quest for a more rational energy future when they are faced with other stresses. Bjorn Lomberg, author of *The Skeptical Environmentalist* has recently concluded an exercise with a team of economists to try to reach a consensus on priorities for development. Climate change came bottom of the list. Although many argue that Lomberg's methodology and even the question were flawed, the result does seem to support Smil's observation. It would also seem to reinforce the recognition that climate change perhaps cannot be solved as a single silo issue but has to be taken into account in every economic, social and indeed energy development decision that we take as individuals, corporations or governments.

Endnotes:

(i) The Coal Questions: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal Mines, W. S. Jevons, Macmillan, 1865.

(ii) Special Report on Emission Scenarios, Intergovernmental Panel on Climate Change, Ed: Nebojsa Nakicenovic et.al., 2000.

(iii) Are the alternative energy strategies achievable? A. M. Weinberg, Energy: **4**, 941-951, 1979.

Note from the Editor: Emission Scenarios has already been reviewed in the *CMOS Bulletin SCMO*. Reference: Emission Scenarios, Special Report by Intergovernmental Panel on Climate Change, reviewed by T. C. Farrell, Vol.32, No.3, pages 88-90.

ATMOSPHERE-OCEAN 43-3
Paper Order (September 2005)

AO-616
Modelling Spatially Distributed Snowmelt and Meltwater Runoff in a Small Arctic Catchment with a Hydrology - Land Surface Scheme (WATCLASS) by S. Pohl, B. Davison, P. Marsh and A. Pietroniro.

AO-617
On the Variability and Predictability of Daily Temperatures in the Arctic by John E. Walsh, Inna Shapiro and Timothy L. Shy.

OC-257
Interdecadal Changes in Mesoscale Eddy Variance in the Gulf of Alaska Circulation: Possible Implications for the Steller Sea Lion Decline by Arthur J.Miller, Emanuele Di Lorenzo, Douglas J. Neilson, Hey-Jin Kim, Antonietta Capotondi, Michael A. Alexander, Steven J. Bograd, Franklin B. Schwing, Roy Mendelssohn, Kate Hedstrom and David L. Musgrave.

OC-259
Spatial Heterogeneity of Sea Surface Temperature Trends in the Gulf of Alaska by Steven J. Bograd, Roy Mendelssohn, Franklin B. Schwing and Arthur J. Miller.

AO-620
Non-iterative Surface Flux Parametrization for the Unstable Surface Layer by K. Abdella and Dawit Assefa.

AO-618
A WEST Wind Climate Simulation of the Mountainous Yukon by J. D. Jean-Paul Pinard, Robert Benoit and Wei Yu.

Call for Papers

40th Annual CMOS Congress

May 29- June 1, 2006
Toronto, Ontario, Canada

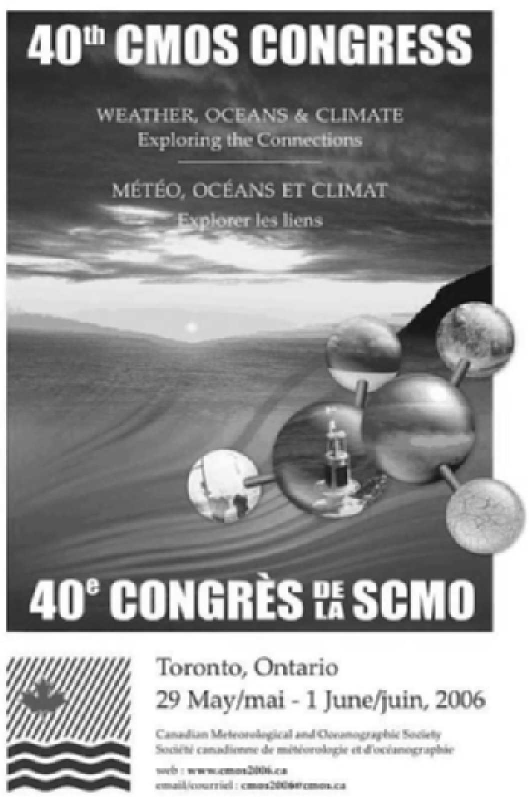
Abstract Submission Deadline: **February 1, 2006**
Early Registration Deadline: **April 15, 2006**.

The Canadian Meteorological and Oceanographic Society (http://www.cmos.ca) will hold its 40th Congress from May 29 to June 1, 2006, at the Sheraton Hotel in downtown Toronto, Ontario, Canada. The Congress website is http://www.cmos2006.ca and the Congress email contact is cmos2006@cmos.ca.

This year's Congress has the theme ***"Weather, Oceans and Climate: Exploring the Connections."***

The Congress will feature:

- Science sessions that highlight top Canadian and international research contributions to meteorology, oceanography, atmospheric chemistry and pollution, remote sensing, climate modelling, and weather and climate forecasting.
- Plenary presentations by leading researchers.
- An evening general-interest lecture, open to the public, on the theme of climate change.
- Outreach sessions that focus on education, on communicating our research results to the media, on policy implications of our research, and on career opportunities for young scientists.
- A banquet, a hosted lunch, awards of CMOS prizes, and the CMOS Annual General Meeting.



Appel de Communications

40e Congrès annuel de la SCMO

du 29 mai au 1er juin 2006
Toronto, Ontario, Canada

Date limite pour la soumission de résumés:
1er février 2006
Date limite pour l'inscription: **15 avril 2006**

La Société canadienne de météorologie et d'océanographie (http://www.scmo.ca) tiendra son 40e Congrès du 29 mai au 1er juin 2006 à l'hôtel Sheraton au centre-ville de Toronto, Ontario, Canada. Le site du Congrès est le http://www.cmos2006.ca et le contact par courriel pour le Congrès est le cmos2006@cmos.ca.

Le thème général du Congrès de cette année est ***"Météo, océans et climat: explorer les liens".***

Parmi les événements qui se dérouleront durant le Congrès soulignons les événements suivants :

- Des sessions scientifiques mettant l'accent sur les meilleures contributions canadiennes et internationales à la recherche en météorologie, océanographie, chimie de l'atmosphère, pollution atmosphérique, télédétection, modélisation du climat et prévision météorologique et climatique.
- Des présentations plénières données par des chercheurs de premier plan.
- En soirée, une conférence d'intérêt général ouverte au public et portant sur le thème du changement climatique.
- Des ateliers de sensibilisation qui mettront l'accent surtout sur l'éducation, la communication des résultats de nos recherches aux médias, les conséquences de nos recherches sur le plan politique et les possibilités de carrière pour les jeunes scientifiques.
- Un banquet, un déjeuner hommage, l'attribution des prix SCMO et l'assemblée générale annuelle de la SCMO.

Please submit abstracts electronically to the Congress website (http://www.cmos2006.ca) before the deadline of **February 1, 2006.** You will be asked to submit your abstract to one of several planned sessions that are listed on the website. Because only a limited number of slots for contributed oral presentations will be available, the Congress will put a strong emphasis on high-quality poster sessions that will take place each afternoon. An abstract fee of $50 will be charged at the time of submission. Your abstract will be evaluated by the Congress's Science Program Committee and you will be notified by mid-March 2006 if your presentation has been accepted for oral or poster presentation.

Student CMOS members are welcomed and encouraged to apply for a Student Travel Bursary when submitting an abstract.

If you are an exhibitor, an educator, a member of the media, or anyone else with an interest in the meeting, please visit the Congress website (http://www.cmos2006.ca) and contact us at cmos2006@cmos.ca for further information.

Veuillez soumettre vos résumés électroniquement via le site web du Congrès (http://www.cmos2006.ca) avant la date limite du **1er février 2006.** Lors de la soumission, vous devrez choisir parmi les sessions affichées. Comme le nombre de plages horaires pour les présentations orales est limité, le Congrès mettra cette année l'accent sur des présentations par affiches de haute qualité qui se tiendront chaque après-midi. Des frais de 50 $ pour le résumé seront débités au moment de la soumission. Votre résumé sera évalué par le comité du programme scientifique du Congrès et vous serez avisé d'ici à la mi-mars 2006 si votre soumission est acceptée pour une présentation orale ou pour une affiche.

Les membres étudiants de SCMO sont les bienvenus et sont encouragés à faire une demande de bourse de voyage pour étudiant au moment de soumettre leur résumé.

Si vous êtes un exposant, un éducateur, un membre des médias ou toute autre personne intéressée par ce rassemblement, veuillez visiter le site du Congrès (http://www.cmos2006.ca) et nous contacter à cmos2006@scmo.ca afin d'obtenir de plus amples renseignements.

Local Arrangements Committee / Comité local d'organisation

David Hudak: Chair / Président (905) 833-3905, ext. 242	**Chris McLinden:** Vice-president and Executive assistant Vice-président et assistant exécutif (416) 739-4932
Sylvie Gravel: Facilities Convenor Responsable des aménagements (416) 739-4126	**Sarah Wong:** Secretary / Secrétaire (416) 739-4426
Paul J. Kushner: Chair Scientific Program Committee Président du comité du programme scientifique (416) 946-3683	**Natasha Ramsahai:** Education Day Coordinator Coordonnatrice du jour pour les professeurs (416) 368-2986
Sarah Scriver: Advertising / Annonces (416) 739-5070	**Oscar Koren:** Exhibits Convenor Responsable des expositions (905) 669-2365
Irene Rubinstein: Local Exhibits Co-ordinator Coordonnatrice locale des expositions (416) 736-0900, ext. 233	**Tom McElroy:** Chairman, Toronto CMOS Centre, Head of Communications Sub-Committee, Head of Sponsorship Sub-Committee (416) 739-4630 Président, Centre de Toronto, Chef des sous-comités des communications et des commandites
Diane Pendlebury: Social Committee Lead Chef du comité des activités sociales (416) 946-7543	**Ron Bianchi, Carr McLeod and Rebecca Wagner:** Member-at-large / Conseiller
Jaymie Gadal: Coordinator / Coordonnatrice	**Heather Mackey and Dawn McDonald:** Communications sub-committee / Sous-comité des communications

RADARSAT International Announces Rebranding Under MDA Name

July 29, 2005, Richmond, BC – RADARSAT International and several other Companies in the MacDonald Dettwiler and Associates Ltd. (MDA) family have been rebranded and are now conducting business under the common brand name "MDA". RADARSAT International belongs to MDA's Geospatial Services business area and is referred to as MDA Geospatial Services International.

Acquired by MDA in 1999, RADARSAT International has over 16 years of experience in providing Earth observation data, products and services to the international geospatial marketplace.

"This rebranding is part of MDA's strategy to bring a number of its business units - that often serve a similar customer base - together under a single, recognizable brand", said Dr. John Hornsby, General Manager of MDA Geospatial Services International.

MDA Geospatial Services International provides Earth observation data, information products and services from the majority of commercially available radar and optical satellites. These products and services are used globally for resource mapping, environmental monitoring, offshore oil and gas exploration, ice reconnaissance, maritime surveillance and disaster management.

MDA holds the exclusive distribution rights to Canada's RADARSAT-1 and RADARSAT-2 synthetic aperture radar (SAR) satellites. MDA will operate the RADARSAT-2 satellite when launched. RADARSAT-2 offers unparalleled imaging flexibility, increased information content with high-resolution, dual polarization and full polarimetric imaging options, and a highly responsive programming and delivery ground segment.

New Publications and Reports

1) L'Oréal's *2004 Sustainable Development Report* (English version) is now available online at: http://www.loreal.com/_en/_ww/dev_dur/home_flash.aspx

2) Le *Rapport de Développement Durable 2004* de L'Oréal (version française) est maintenant disponible en ligne à: http://www.loreal.fr/_fr/_fr/dev_dur/home_flash.aspx

3) The "*Canadian Ocean Science Newsletter*" is available at http://www.cmos.ca/scor/newsletters.htm. It includes articles on the Argo Program, a global project to monitor the climatic state of the ocean using robotic devices launched in all oceans of the world, and the Lunenburg Bay Field Program which aims to develop a real-time prediction capability for the coastal regions of Atlantic Canada.

4) The Pacific Region State of the Ocean report is available at http://www-comm.pac.dfo-mpo.gc.ca/pages/release/p-releas/2005/nr049_e.htm. The report reviews the physical, chemical and biological state of the marine environment to provide a better understanding of marine ecosystems in this area.

5) The National Research Council Canada (NRC) has released the "*Final Report of the National Consultation on Access to Scientific Research Data*". The Report outlines recommendations and guidelines for maximizing the value received from Canada's publicly funded scientific research data. For information, access http://www.nrc-cnrc.gc.ca/newsroom/news/2005/finalreport_ncasrd05-nr_e.html.

Climate Change Action Plan for Newfoundland and Labrador

The Minister of Environment and Conservation has released a Climate Change Action Plan for the Province of Newfoundland and Labrador. The Plan identifies action items to reduce greenhouse gas emissions and initiatives to help the Province adapt to the impacts of climate change. It includes 40 action items that relate to education, transportation, energy efficiency, resource industries, municipalities, industry and the building sector. For information, access http://www.releases.gov.nl.ca/releases/2005/env/0713n03.htm.

Overview of ESSIM Integrated Ocean Management Plan

To facilitate the review process for the draft Eastern Scotian Shelf Integrated Ocean Management Plan, the ESSIM Planning Office has prepared a short overview document entitled *"Working Together for Our Ocean and Our Future*", which explains the rationale behind the ESSIM Plan, summarizes its key components, and describes opportunities for participation in the public review. The document is available at http://www.mar.dfo-mpo.gc.ca/oceans/e/essim/OceanFuture.pdf.

Canada and Denmark Agree on Joint Survey

Canada and Denmark have agreed to team up on an undersea data collection project that will help both countries fulfill international commitments. The surveys will help establish the limits of the undersea continental shelves of both countries, as required under the United Nations Convention on the Law of the Sea (UNCLOS). For more information, please access http://www.nrcan-rncan.gc.ca/media/newsreleases/2005/200557_e.htm.

Retirement of Dr. Allyn Clarke

Dr. Allyn Clarke, distinguished Canadian oceanographer and Research Scientist with the Department of Fisheries and Oceans (DFO) at the Bedford Institute of Oceanography (BIO) in Dartmouth, Nova Scotia, retired from the Public Service of Canada on September 2, 2005 after 35 years of dedicated service.

Dr. Clarke received a BSc (Honours) in Physics and Chemistry (1965) and an MSc in Applied Mathematics (1966), both from the University of Toronto, and a PhD in Physics (Oceanography) from the University of British Columbia (1970). He first came to BIO as a summer student with the Department of Mines and Technical Surveys (DMTS) in 1962. In the following four years he worked in turn with Fred Barber in Ottawa and Cedric Mann and George Needler at BIO as a DTMS summer student, and with Nick Fofonoff at the Woods Hole Oceanographic Institution. He formally joined Ocean Circulation Section, Atlantic Oceanographic Laboratory at the Bedford Institute in September 1970.

He authored and co-authored influential scientific papers on the Gulf Stream system and deep ocean convection, the central themes in his scientific research career. He designed and led major field programs to the Newfoundland Basin, the Labrador Sea, and the Greenland Sea, spending approximately 2½ years at sea on research expeditions.

Dr. Clarke served as Head of Ocean Circulation from 1985 to 1997. He was Acting Manager of Ocean Sciences Division from 1997 until 2002. He is recognized for his timely and scientifically-sound advice as a DFO scientist and manager.

Dr. Clarke played important roles in the World Ocean Circulation Experiment (WOCE) and the Climate Variability and Predictability (CLIVAR) research program as a member, co-chair, and chair of Scientific Steering Groups and working groups. He was a member of the Joint Scientific Committee (JSC) for the World Climate Research Programme (WCRP) and served as vice-chair of the JSC from 1994 to 1996. He also contributed to modern operational oceanography, helping prepare the Global Climate Observing System and serving as co-principal investigator of the Canadian Argo Program.

Dr. Clarke's contributions to Canadian oceanography outside of DFO include terms as President of the Canadian Meteorological and Oceanographic Society (CMOS) and Chair of the Board of the Canadian CLIVAR Research Network. Professional honours include the Government of Canada Deputy Minister's Award of Excellence and the CMOS J.P. Tully Medal in Oceanography.

Dr. Clarke will continue to work with Ocean Circulation at BIO as an Emeritus Scientist.

Dr. Ross Hendry

Deadlines & Events

1) The "Ocean Innovation 2005 Conference and Exhibition" is scheduled for 23-25 October 2005 in Rimouski, Québec. Workshops on Maritime Simulation and Ocean Mapping will take place offsite on 26 October. The theme is Operational Challenges in Northern Waters. Topics include: Opportunities and Challenges of The Northwest Passage as a Shipping Route, Ocean Mapping in the North and Ocean Observing Systems in Canada. For information, access http://www.oceaninnovation.ca.

2) The Newfoundland and Labrador Environmental Industry Association (NEIA) is hosting an Oil Spill Conference and Trade Show in St. John's, Newfoundland and Labrador on 28-29 November 2005. The theme is "An Integrated Approach to Oil Spill Preparedness and Response". The Conference will profile integration models from several countries. It will provide a forum to discuss the models, the importance of public and community stakeholder involvement and the merits of various response operations. For information, including the proceedings of the 2003 Conference, access http://www.neia.org.

3) Canadian Hydrographic Conference 2006 (CHC 2006), 5-9 June 2006 in Halifax, Nova Scotia. For more information, access http://www.chc2006.ca

4) Coastal Zone Canada 2006, 10-14 July 2006 in Tuktoyaktuk, Northwest Territories - http://www.czc06.ca

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