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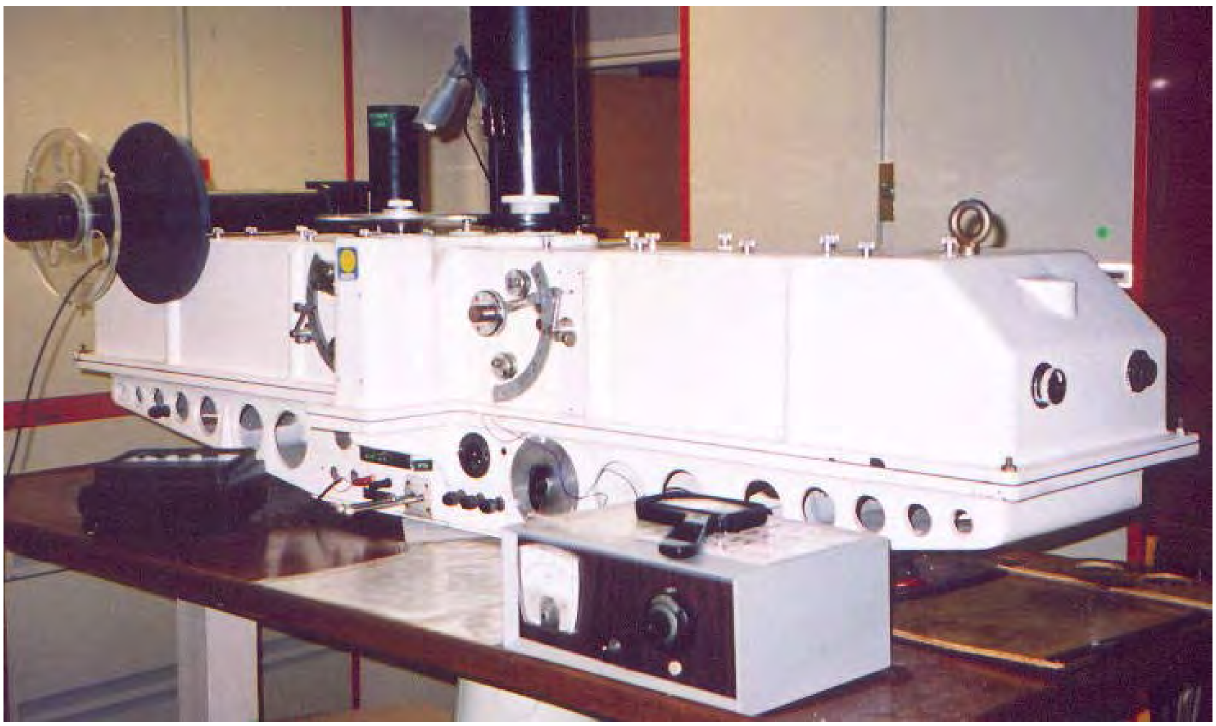
SCMO

Canadian Meteorological
and Oceanographic Society

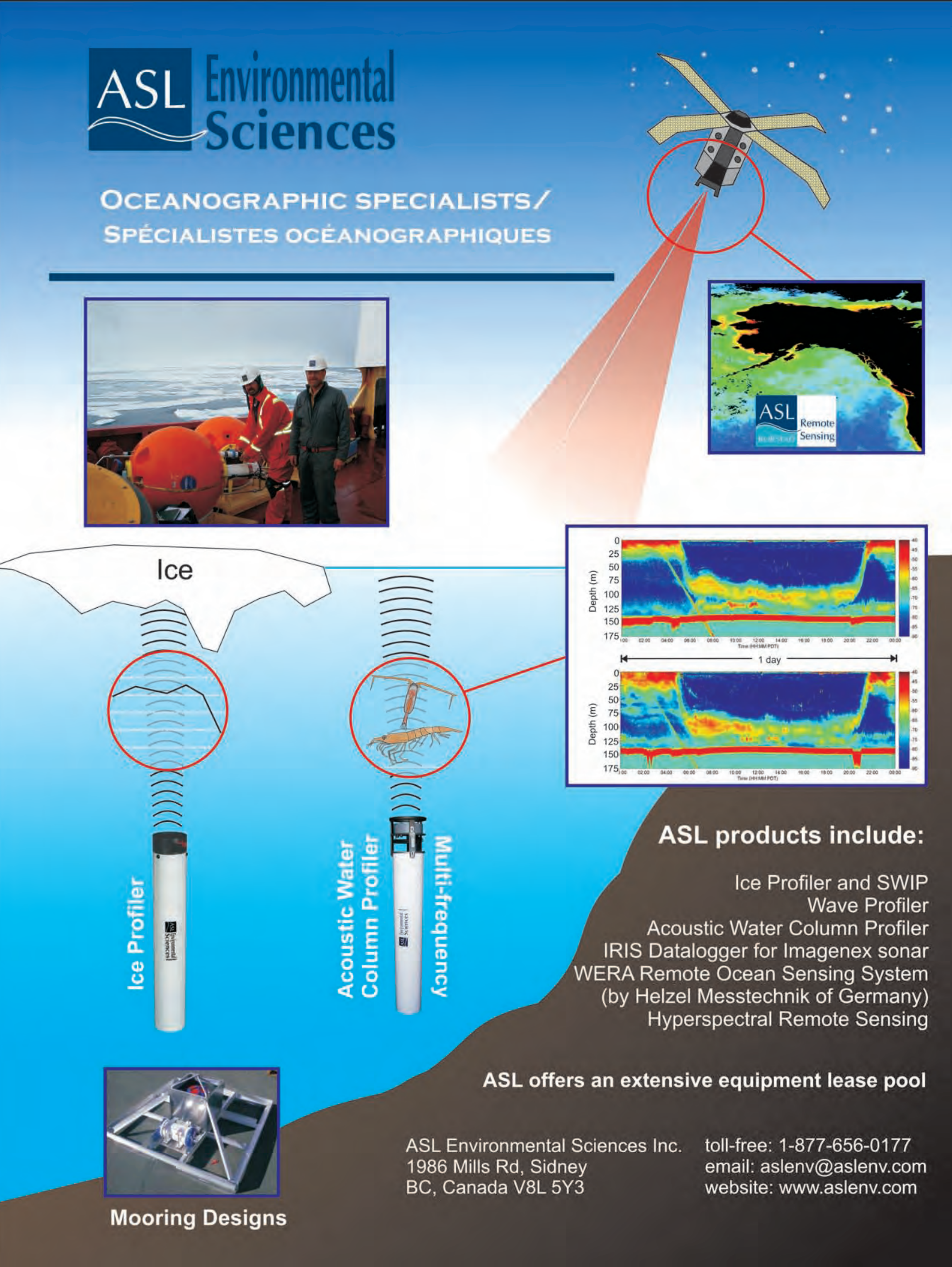
La Société canadienne
de météorologie et
d'océanographie

February / février 2010 Vol.38 No.1



The Toronto Dobson Spectrophotometer

Le Spectrophotomètre Dobson de Toronto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....from the President's Desk

Friends and colleagues:

Bill Crawford
CMOS President
Président de la SCMO

CMOS spans fields of expertise from forecast meteorology to arctic ice and prairie drought. Our one thousand or so members, few in number compared to Canada's population, provide insight, warnings and forecasts in meteorology and oceanography for all Canadians. Members of CMOS dominate the science of climate change, by developing global climate models of the atmosphere and oceans, and by providing insight into the impacts of climate change on Canadians.

Just prior to the December 2009 Copenhagen climate conference, CMOS executive and council endorsed a press release and a letter to all Members of Parliament on the urgency of action on climate change. This letter notes the scientific evidence for human impacts on climate change and the need for Canada to lead efforts to reduce greenhouse gas emissions. Much of the evidence of warming and the role of greenhouse gases was developed by CMOS members. You can view this letter on the CMOS Web page at:

http://www.cmos.ca/ClimateChangeLetter_26Nov09.pdf

This letter was prepared in November 2009 mainly by CMOS members with contributions from the Canadian Geophysical Union. This letter was approved through a vote by members of CMOS Council and Scientific Committee. There are fifty positions in these two groups. Three-quarters of their members voted within a few days. All voted in favour. Four other Canadian scientific societies also endorsed this letter: Canadian Geophysical Union, Canadian Society of Soil Science, Canadian Association of Physicists and Canadian Society of Zoologists. Their councils or general members overwhelmingly approved the letter.

(Continued on page 3 / Suite à la page 3)

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Inside / En Bref

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

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Cover page: The Dobson spectrophotometer shown on cover page is located on the fifth floor of the Environment Canada building in Toronto. Designated as serial number 77 it was purchased by the Meteorological Branch in the early 1960s for the field station at Scarborough. Transferred to Downsview in 1972, it was used operationally and later for comparisons with the Brewer spectrophotometers until April 2008. Light from the sun enters the instrument via the vertical black tube from a hatch in the roof. For more information, please read the article on **page 5**. Photo courtesy of David Devine, 2004.

Page couverture: Le spectrophotomètre Dobson illustré à la page couverture est situé à Toronto dans l'édifice d'Environnement Canada au cinquième étage. Désigné par le numéro de série 77, il fut acheté par Environnement Canada dans les années 1960 pour la station Scarborough. Déménagé à Downsview en 1972, il fut utilisé dans les opérations et, jusqu'en avril 2008, il a servi de comparaison avec le spectrophotomètre Brewer. La lumière du soleil entre par une ouverture du plafond. Pour en apprendre plus, prière de lire l'article en **page 5**. La photo est une courtoisie de David Devine, 2004.

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

Ian Rutherford, our executive director, coordinated the press release and letter to Parliamentarians on 26 November. Past CMOS president Jacques Derome and I were interviewed in French and English respectively. The story was covered in several French newspapers in Québec and by many of the CanWest chain of English papers. The English headline noted these societies have over 3000 members. As you know by now, the Copenhagen Conference ended without a commitment by all nations to greatly reduce greenhouse gas emissions, but the nations do indeed acknowledge the serious impacts of future climate change.

Our CMOS Webmaster keeps members up to date through the "Whats new" web site:

http://www.cmos.ca/whatsnew.html

Why not check this site regularly for updates of happenings? A recent one is the effort to develop **national occupational standards for meteorologists**. A 2005 review identified the need for meteorological certification, given a lack of properly qualified practitioners at entry-level positions and a rising number of retirees in the sector. A feasibility study in 2007 confirmed this recommendation and revealed strong industry support for the development of a certification program. I encourage meteorologists to visit this page on our "'Whats New"' web site and offer your insight.

With this first issue of 2010, I welcome all new CMOS members, and expect you find membership in CMOS rewarding. These are interesting times for meteorology and oceanography, and members of CMOS, although few in number, impact Canada and the world very strongly.

Bill Crawford
President / Président

Highlights of Recent CMOS Executive and Council Meetings

CMOS congresses
The Halifax 2009 CMOS Congress was a great success scientifically and financially. The final surplus to CMOS was about $45,000. The surplus was so large, because suppliers reduced prices, NRC gave financial support, and there were more participants than expected.

The Ottawa 2010 Congress is coming together. There are 69 sessions proposed to date, and abstract submission is scheduled to open in January. Lack of space for exhibitors is a problem, as discussed previously, but the organizers have come up with some creative options for sponsors.

The conference centre and hotels are booked for the Victoria 2011 Congress, and an organizing committee is being assembled. Organizers have been found for social activities and publicity.

The Montreal 2012 congress will be held during the last week of May, 2012.

Because of successful Congresses, CMOS' cash reserves have been building up. Council is considering whether to put some money aside into other funds.

Other Business
The Vice President is working with Centres individually to maintain and recruit new members and to increase links with the private sector. Regular memberships are down this year, although retired memberships are up.

CMOS issued a letter on November 26th, 2009 that encouraged Members of Parliament to take action on climate change. The letter was issued on behalf of Council, after consultation by email with Council members. Most of the Council members replied, and all who replied were in favour of sending the letter. Bill Crawford was subsequently interviewed by CanWest, and there were also media calls in French for stories in *Le Devoir* and the *Gazette*. CMOS has received two replies from members of Cabinet.

The CMOS national office is setting up a Facebook group and a blog for CMOS. Edmonton Centre already has a Facebook page, which is monitored by the national office.

Publications Committee is continuing to consider alternative options for the publication of ATOMOSPHERE-OCEAN. If the committee members recommend transferring the journal to another publisher, there will be a vote to approve this at the June AGM in Ottawa. A-O currently breaks even at about $100K per year.

The Nominating Committee has recommended a slate of candidates for next year's CMOS Executive. See the list of names and the call for other nominations in this issue of the Bulletin.

Sophia Johannessen,
Recording Secretary / Secrétaire d'assemblée

CMOS exists for the advancement of meteorology and oceanography in Canada.

Le but de la SCMO est de stimuler l'intérêt pour la météorologie et l'océanographie au Canada.

Letters to the Editor / Lettres au rédacteur

From: Morley Thomas

Date: December 23, 2009

Subject: CMOS Archives

I have just discovered Emily Bourque's short piece on the CMOS Archives in the December Bulletin. I can't begin to tell you how pleased I am to read that the much needed reorganization and culling have taken place. I was primarily a collector and always wanted to go through the collection to cull and properly organize it but the AES/MSC research, archiving and writing increasingly took my time. Congratulations to whoever sparked and organized the project and of course to those who took part in the work.

From: James McCulloch
Retired MSC/AES/MSC

Date: December 31, 2009

Subject: Commentary on two recent papers in the *CMOS Bulletin SCMO*

I was taken by the contrast between the article by David Sills[1], reporting on a number of meetings involving forecasters from across the country, and the reply by Pierre Dubreuil[2]. I conclude that some things have changed little over the last fifty years. (Like Pierre, I am retired, only in my case, it was over twenty years ago; and, like Pierre, I must state that my views are not condoned by senior management. Also like Pierre, I was responsible for Weather Service Operations across Canada at one point in my career.)

What has not changed over the last fifty years is that forecasters express what they need to do their job, then modelers seem to reply that the forecasters are wrong. Modelers seem to believe that only **they** know what the forecasters need, and that only CMC can supply it. Unfortunately, it is often some time in the future when exactly what "they need" will be available.

I grant that great progress has been made; now forecasters are concerned only with high impact weather. The staff at CMC should be very proud of the advances that they have made. There remains, however, the issue stated in the Sills report that "…an area-based approach would be more intuitive for a forecaster than a point-based approach.".

If senior management would consider some advice from an old hand, I would recommend acceptance of the possibility that CMC may not be the only source for tools useful to Forecasters.

1. BAMS, American Meteorological Society, May, 2009, pp 620-627; and CMOS Bulletin SCMO, Canadian Meteorological and Oceanographic Society, 37(5), October, 2009, pp 147-151.

2. CMOS Bulletin SCMO, Canadian Meteorological and Oceanographic Society, 37 (6), December, 2009, pp 188-191.

11th International Meeting on Statistical Climatology

12-16 July 2010

Edinburgh, Scotland.

11th IMSC will be the latest in a series of meetings that have been held at roughly three year intervals and are designed to promote good statistical practice in the atmospheric and climate sciences and in maintaining and enhancing the lines of communication between the atmospheric and statistical science communities. The key themes for this IMSC will include analysis techniques for multi-model ensembles of climate simulations, understanding recent climate change and predicting the near-term future, extreme events, predictions of climate change relevant for impacts, reconstructing and understanding climate change over the Holocene, and broadly statistical methods for the analysis of climate data. Contributions are solicited for all of these areas, and in statistical climatology more generally, with a deadline for early abstract submission of 31 January 2010. For additional information, please contact the program chairperson, Prof. Gabriele Hegerl (e-mail: Gabi.Hegerl@ed.ac.uk) or consult the meeting web page at http://cccma.seos.uvic.ca/imsc/11imsc.shtml.

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **April 2010.** Please send your articles, notes, workshop reports or news items before **March 5, 2010** to the address given on page 2. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **avril 2010.** Prière de nous faire parvenir avant le **5 mars 2010** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page 2. Nous avons un besoin URGENT de vos contributions écrites.

Development of the Dobson Ozone Spectrophotometer

by Kenneth A. Devine[1]

Ozone in the atmosphere of the Earth was initially discovered by astronomical techniques. In 1878 it was suggested by A. Cornu that the earth's atmosphere caused the ultraviolet (UV) absorption of the solar spectrum. Subsequently W.N. Hartley in 1880 discovered an absorption band between 210 and 320 nm which he attributed to ozone (O_3) in the atmosphere. In 1890 M.L. Huggins revealed UV absorption bands in the spectrum of the star Sirius. Later measurements of the air near the surface by Rayleigh and Götz, indicated very little ozone. Thus the ozone must have existed well above the surface since there is considerable mixing in the troposphere. These UV ozone bands are located between 330 and 200 nm but only those with wavelengths greater than about 290 nm can be observed at the surface. The human eye cannot see wavelengths much below 400 nm whereas birds and reptiles can see down to 300 nm.

In 1913 C. Fabry and H. Buisson using absorption coefficients measured by E. Meyer in 1903 and their own atmospheric measurements, suggested that the ozone layer was equivalent to about 5 mm of ozone. They designed a UV spectrograph in 1920 consisting of two 90-deg refractors in series that displayed the spectrum on a photographic plate. From measurements made at Marseilles that year they found that the total atmospheric ozone amounted to a depth of 2.86 to 3.35 mm. They also suggested that the ozone was about 40 Km above the surface.

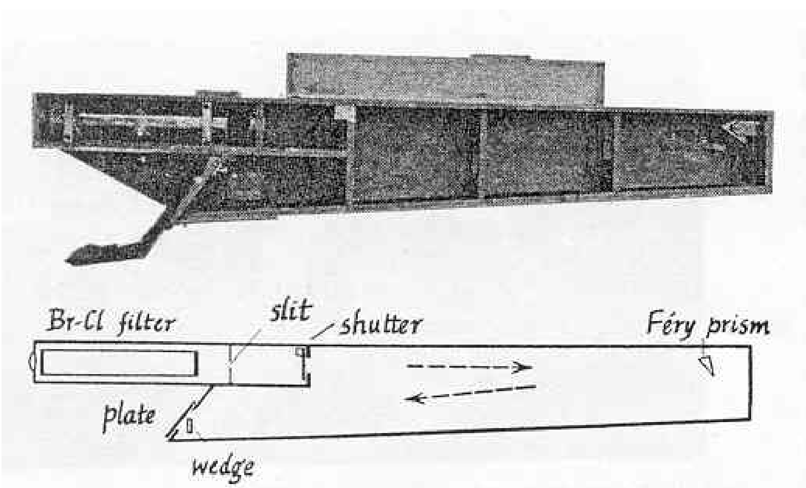

Figure 1: Dobson's 1924 Féry Spectrograph (Dobson, 1968)

In the summer of 1924 G.M.B. Dobson built a portable ultraviolet spectrograph (Harrison & Dobson, 1924) in his home workshop at Oxford which was based on a Féry spectrograph used for chemical analysis. This UV specific design (Figure 1) used: a gas filter, a long baseline, and a reflective prism for the spectrograph. The gas filter consisted of bromine and chlorine vapours in a sealed tube with silica windows to restrict the spectrum to below 330 nm. The reflective prism was a 30-deg prism with a reflective coating on the back surface. A wedge shaped attenuator of gelatin impregnated with carbon was laid over an Ilford photographic plate (9x12 cm) to capture the relative intensities across the UV spectrum. Due to this variable attenuation the height of the photographic image determined the intensity at that wavelength. Additionally the photographic plates were insensitive to red that was partially passed by the gas filter. While the portability due to the wooden case made it easy to use, the chief drawback of the Féry spectrograph was that it required direct sunlight; as well, the processing and analysis was lengthy.

With a grant from the Royal Society five more spectrographs were constructed in Dobson's garden workshop between 1925 and 1926. Another instrument was constructed for the Smithsonian Institute by Hilger Ltd., London and was sent to Montezuma (Chile) where weather conditions allowed yearlong observations. Beginning in 1926 the European locations for the spectrographs were: Oxford (Dobson's original unit), Valencia (Ireland), Lerwick (Shetland Islands), Abisko (N. Scandinavia), Lindenberg (Berlin), and Arosa (S.E. Switzerland). Observations were continued in Arosa with one of these instruments until 1949. After the European measurements were completed in late 1927, the instruments were sent to worldwide locations: Spitzbergen, Helwan (Egypt), Table Mountain (California), Kodaikanal (India), and Christchurch (New Zealand). One of these spectrographs, #4, was sent to Edmonton (maybe after 1942) for E.H. Gowan, a professor at the University of Alberta. In the 1930s he had taken his Ph.D. at Oxford and had worked with Dobson on the scientific explanation for the heating in the mesosphere due to ozone (Gowan, 1936). The Féry #4 was moved to the Meteorological Service of Canada (MSC) headquarters in Toronto in 1957 to support the International Geophysical Year (IGY) and is displayed at the MSC headquarters. This unit has been modified to operate with a photoelectric detector.

The undeveloped plates were shipped back to Oxford in specially marked packages to prevent being opened by customs officers. Those from Germany came in diplomatic pouches since some had been opened. G.M.B. Dobson

[1] Meteorologist Consultant
Aurora, Ontario, Canada

developed the plates using a unique processing bath of his own design. R.W.M. Gibbs analyzed all of the UV spectra using a microphotometer built by Dobson. He determined the relative intensities in the ozone band (309.5 to 297.8 nm) by comparing them with a longer wavelength (323.2 or 326.4 nm) that was not attenuated by the ozone. These ratio measurements eliminated many errors common to absolute measurements and this ratio technique is still in use. With this extensive network Dobson became knowledgeable about the general characteristics and variability of ozone in the stratosphere (Dobson, 1926-1930). The ozone layer began in the lower stratosphere at about 10 Km. Absorption of solar energy by the ozone resulted in the high temperatures in the upper part of the stratosphere and mesosphere (Lindermann & Dobson, 1922). The variation in total ozone values increased with latitude. The original Féry (#1) is at the Science Museum in London and there appears to be another at Oxford.

Ozone (O_3) was discovered in 1839 by a German scientist, Christian Friedrich. The total overhead amount of atmospheric ozone at any location is usually expressed in terms of Dobson units (DU); one Dobson unit is equivalent to 0.01 mm thickness of pure ozone at the density it would possess if it were brought to ground level pressure (1 atmosphere) and 0°C temperature. The normal amount of ozone overhead at temperate latitudes is about 350 DU. If all the ozone were to be brought down to ground level, the layer of pure ozone would only be 3.5 mm thick. At its highest density in the stratosphere there is only about one ozone molecule for every million oxygen molecules. Ozone absorbs ultraviolet radiation in three main regions known as the Hartley band, the Huggins band and the Chappuis bands (Mitra, 1948). The Hartley absorption band is a wide bell-shaped curve from 200 to 310 nm. The Huggins band is a structured region from 300 to 350 nm, and the Chappuis bands are found in the visible portion of the spectrum between 450 and 850 nm. In the thermal bands, ozone attenuates incoming radiation mainly at 9600 nm but also at 14100 nm.

Umkehrs (reversal) are a sequence of special ozone measurements made near sunrise or sunset using a spectrophotometer. Below 85 degrees from the zenith, the ratio of UV to none UV wavelengths actually starts to increase. These measurements require clear skies and provide a crude atmospheric ozone profile, usually at nine levels (0-49 Km). For the calculations it is assumed that there is no ozone variation within each layer and there is none above 50 Km. Systematic uncertainty or bias associated with these measurements is about 15% to 20%. As the result of observations at Spitzbergen, F.W.P. Götz suggested umkehrs as early as 1930 and the World Ozone and Ultraviolet Data Centre (WOUDC) archive which is located in Toronto, has computed these useful profiles from the time of IGY in 1957. Direct ozone profiles were made by Regner in 1934 using a small spectrograph on a balloon but regular in-situ observations had to wait for the development by A.W. Brewer of ozonesondes in the 1960s.

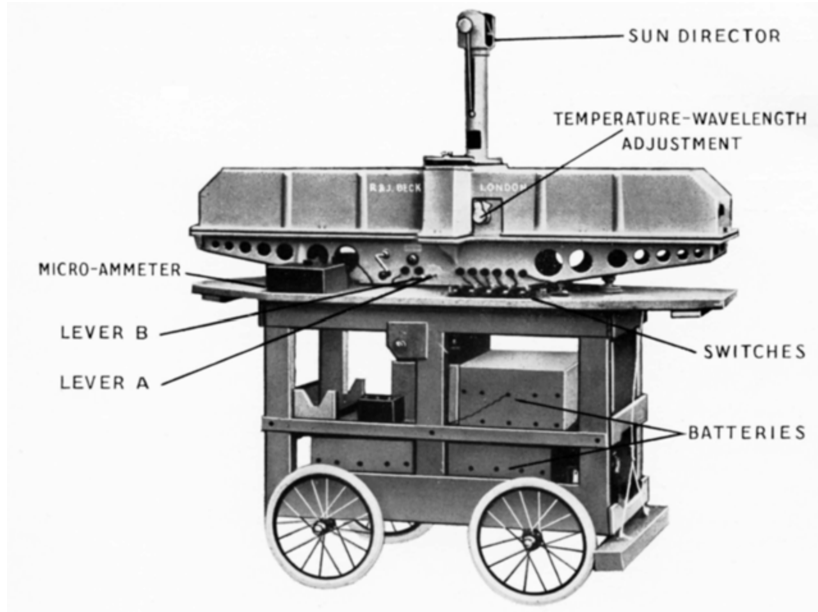

Figure 2: The Photoelectric Spectrophotometer (Beck, 1931)

The first photoelectric spectrophotometer (Dobson, 1931) that could measure total ozone, was produced by G.M.B. Dobson in 1927 again in his own workshop utilizing a wooden case like the Féry and painted white on the outside. This double quartz spectroscope contained two 60-deg prisms each with a reflecting front surface mirror so that the light beam passed back through the prism and thus was refracted four times. Two wavelengths were examined: one at 311 nm that was inside the ozone band and another at 326.5 nm that was hardly affected by ozone. A spring-driven gramophone motor drove a disk that blanked these two wavelengths alternately. An optical wedge of gelatin containing carbon black was slowly rotated in front of the more intense 326.5 nm beam until outputs from both beams were equal. The position of the wedge determined the ratio of the intensities from which the thickness of the ozone was determined. Thus an observation could be completed very quickly (~5 minutes) and the results were immediately available unlike the earlier photographic unit that could take six months since the plates had to be processed in Oxford.

The photocell that detected the beam from the second prism, had a sodium hydride cathode with a silica window. The signal current was then amplified 10^8 times by a shielded amplifier consisting of four triodes. The very low level signals were detected synchronously at 30 Hz using a commutator on the motor shaft. The final output was displayed on a heavily damped microammeter. This spectrophotometer was much more sensitive than the Féry and could be used for ozone measurements from the zenith clear sky and through thin cloud beside direct sun measurements. R. & J. Beck Ltd., a UK instrument company, completed a second instrument (Figure 2) that had a grey case of duralumin alloy (Beck, 1931). All later instruments by Beck used the same case design. At 50 Kgm the entire assembly was much heavier and had to be mounted on a trolley which also housed the batteries and the amplifier. These first two photoelectric instruments were taken to Arosa in 1932 where the average height of the ozone layer was determined to be 22 Km using the Umkehr technique, not 40-50 Km as had previously been thought. A total of nineteen of these instruments were constructed up until World War II with #19 being sent to New York in 1941. MSC attempted to purchase one of these instruments but was unsuccessful due to the war.

Dobson experimented with photomultipliers when they became commercially available after WWII. In 1946 a RCA 1P28 photomultiplier (Figure 3) was installed in instrument #2 that dated from 1931. Most of the previous spectrophotometers (#3 to #19) were subsequently refitted with photomultipliers, updated optics, scanning wheel, and electronics for the detection of four UV wavelengths (Normand & Kay, 1952).

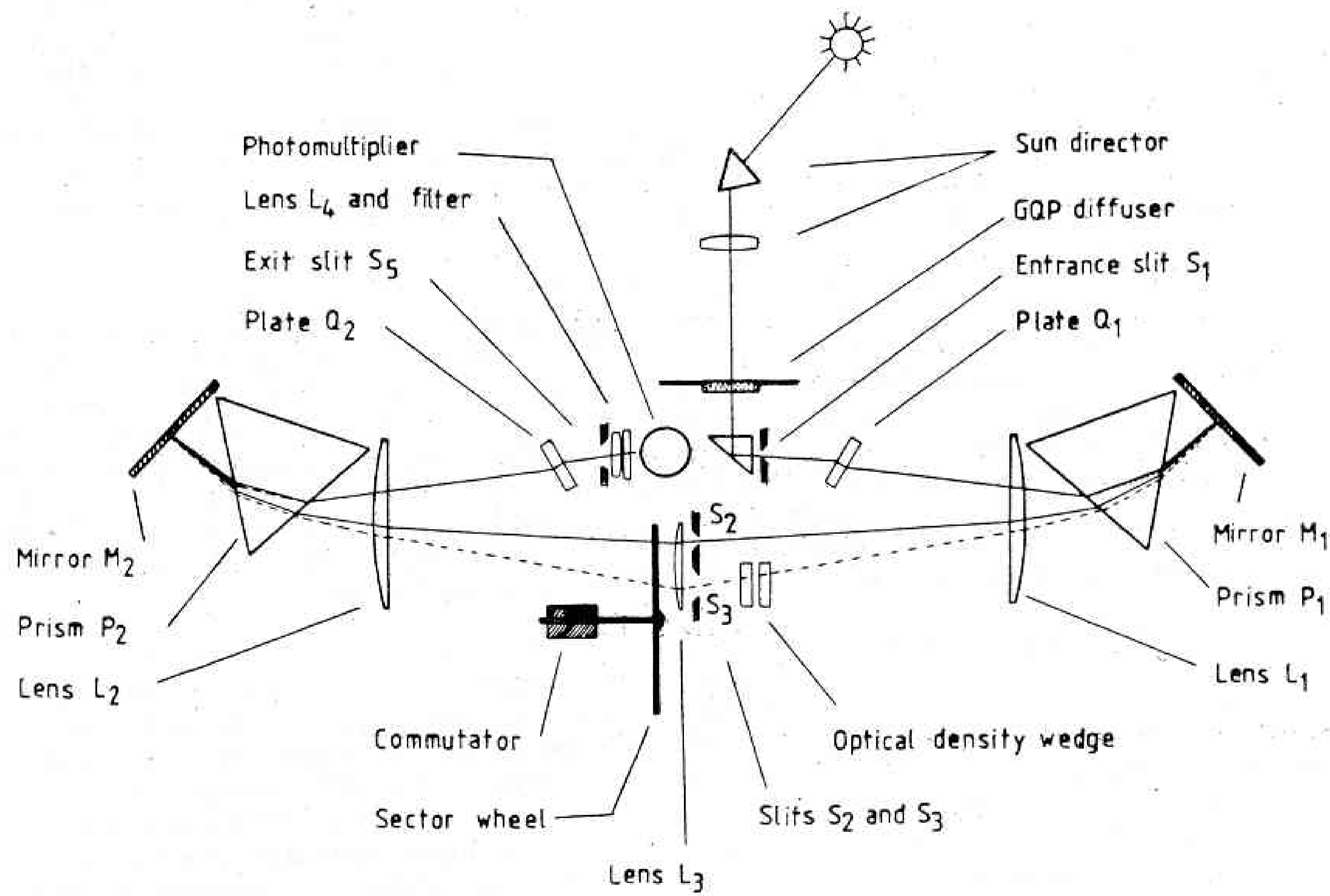

Figure 3: The Optical Path for the later Dobson Spectrophotometers (Basher, 1982)

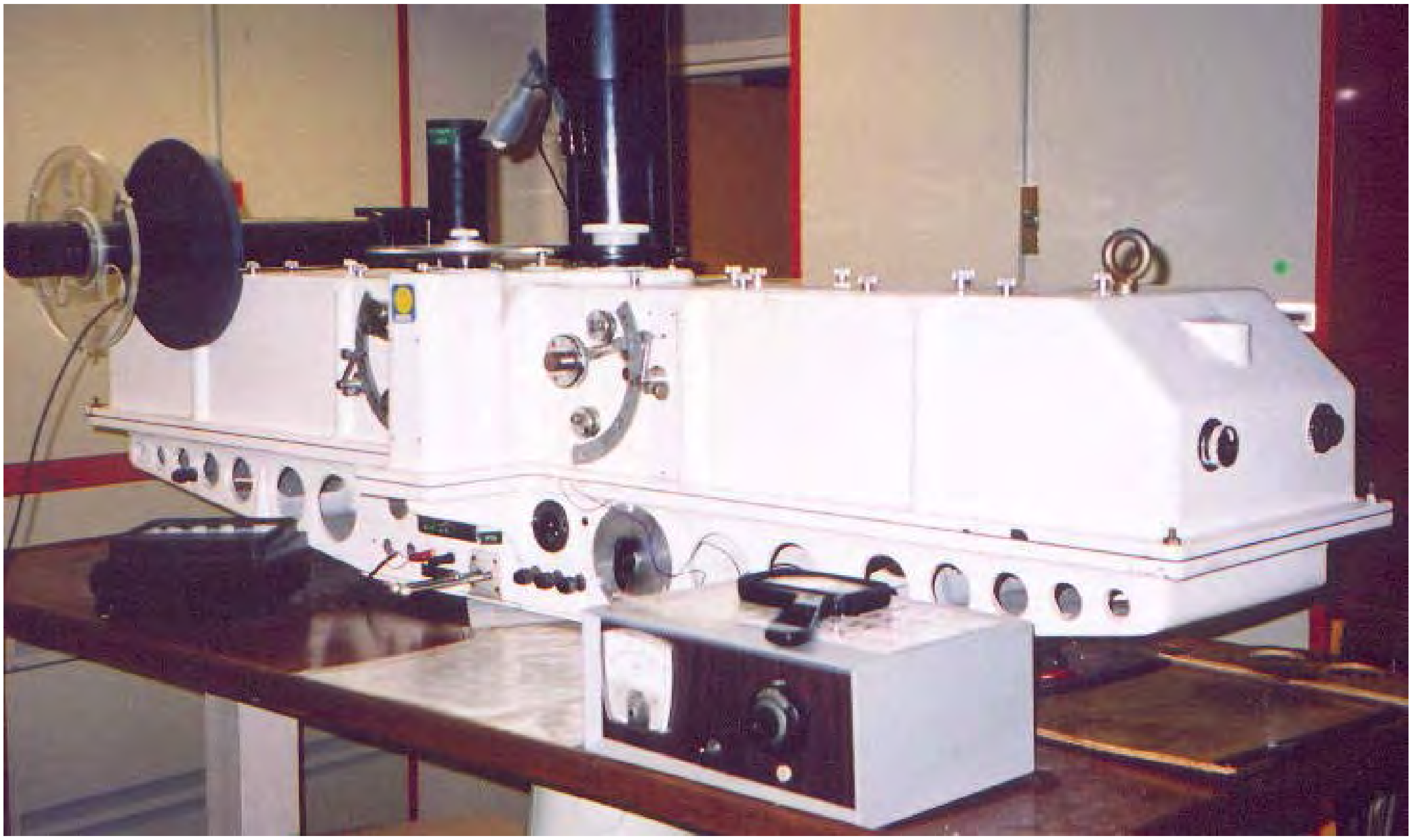

Figure 4: Dobson Spectrophotometer #77 at Toronto (David Devine, 2004)

In 1948 R. & J. Beck Ltd. built the first commercial units of the new design (Dobson, 1957) beginning with serial numbers greater than #30 which incorporated the sensitive photomultiplier and a double monochromator like the earlier units. This was an even heavier unit (75 Kgm) and had a hiduminium alloy cast case painted white. A $NiSO_4$ filter in front of the photomultiplier eliminated any stray visible light. A three pentode amplifier with 22 Hz synchronous detector fed a microammeter to completed the instrument. Most significantly, four UV wavelengths (305.5, 308.8, 311.45 & 317.6 nm) could be measured with this instrument while only one wavelength could be measured by Dobson's prewar unit. Each ozone wavelength was compared to an unaffected wavelength that was attenuated by a two part optical wedge to the same level. While the Dobson had about thirty air-glass interfaces, antireflection coatings were not used. The setting of the optical wedges determined the ratio of these two intensities. Long term measurement accuracy for the Beck spectrophotometer, generally called the Dobson, is estimated to be about 2% (Basher, 1982) for an adequately calibrated instrument. Boulder, Colorado that houses unit #83, is the world standard site for Dobson calibrations.

This spectrophotometer was sensitive enough to allow ozone observations using the full moon and hence to permit observations during the polar winters. Beck instrument #15 was sent to Arosa in August 1949 and eighteen units had been calibrated by January 1951. Instrument #18 was procured by MSC in 1950 and was operated in Edmonton by the University of Alberta under the direction of Professor Gowan as a teaching aid. MSC took over the Edmonton observations in 1957. This prewar Dobson remained at Edmonton (Industrial Airport and Stony Plain) until 1969 when it became a spare and traveling standard. In 1984 it was refurbished and transferred to Kenya where it is still operating. Four more Dobsons were obtained by MSC for the International Geophysical Year (IGY) and later #102 that replaced #18 at Edmonton in March 1969, was purchased. Thus five total ozone stations were operational in Canada with Dobson instruments from the time of IGY until the advent of the Brewer spectrophotometers, namely: Churchill, Edmonton, Goose Bay, Resolute and Toronto.

Forty-four of these instruments were shipped by Beck to countries around the world by 1956. The IGY in 1957 was a major force in the spread of these spectrophotometers for the measurement of total atmospheric ozone. Instrument number 100 was completed in 1967. MSC still maintains Dobson #77 (Figure 4) in Toronto for comparison with the Brewer spectrophotometers. Eventually Beck built up to serial #134 which would imply that a total of 122 units were constructed by Beck not counting Dobson's original. The latter ones were built only by special request making them more expensive. Copies of the Dobson were also built in Japan with serial numbers 57xx and are still in operation.

After IGY MSC agreed to collect and publish daily ozone values for all stations on behalf of WMO (WOUDC). The importance of ozone measurement was re-emphasized by the discovery in 1985 of the Antarctic ozone hole by the British Antarctic Survey using a Dobson. It was suggested as long ago as about 1928 that in high latitudes during the long polar night, stratospheric ozone might disappear altogether (Dobson, 1931). Even with the introduction of the automated Brewer spectrophotometers there were still 66 Dobson's reporting to WOUDC between 2000 and 2005.

G.M.B. Dobson had come to Oxford from research work at Farnborough in 1920 and was a skilled experimentalist. He received his D.Sc. at Oxford in 1925. His mentor at Oxford was Professor F.A. Lindemann, later Lord Cherwell, who was Winston Churchill's science advisor during WWII. In 1921 Lindeman and Dobson working at the Clarendon Laboratory at Oxford University theorized that a layer of ozone caused the temperature in the stratosphere to increase with height. This inversion was the reason that the heavy bombardments during the Great War could be heard at distances beyond 200 km but not between 100 and 200 Km. In 1945 Oxford University conferred upon G.M.B. Dobson the title of professor and he retired from his demonstratorship in 1956. Gordon Dobson wrote a complete account of this development in "Forty Years Research on Atmospheric Ozone at Oxford (1968)". His last scientific paper was written in 1973. Over half of the Dobsons ever built (66 of 122) were still reporting to WOUDC in 2005 which is about the same number of Brewers (67 of 184) which were reporting internationally. It has been about 35 years since the last Dobson was built by Beck. Two of the Canadian Dobsons which were given to other countries are still reporting to WOUDC: #18 from Egypt and #59 from Ethiopia.

Acknowledgement

Archie Asbridge, Dr. Tom McElroy and Dr. David Wardle of MSC are thanked for supplying references, anecdotal information and reviewing parts of this article.

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What Happened in Copenhagen: What Next[1]

by John Stone[2]

1. Where did it all begin:

The United Nations Framework Convention on Climate Change (UN/FCCC) was signed in 1992 as the basis for a global response to the threat of climate change. With 192 Parties the Convention enjoys near-universal membership. It entered into force in March 1994.The ultimate objective of the Convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system. Of course, although science can inform what is "dangerous" it is ultimately dependent on values that must be dealt with through a political process.

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The Convention is complemented by the 1997 Kyoto Protocol, which has 184 signatory Parties. Under this treaty, 37 industrialised countries and the European Community have committed to reducing their emissions by an average of 5 percent by 2012 against 1990 levels. Canada offered to reduce its emissions by 6%. Regrettably, they are now almost 30% above 1990 levels. The Kyoto Protocol entered into force in February 2005 some eight years after it had been signed and the "rule book" negotiated. At the Conference of the Parties (COP) under the UN/FCCC held in Montreal in 2005 two bodies were established to prepare up-dates on both the Convention and the Protocol. These were the Ad-hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) which involves all 192 countries. The other was the Ad-hoc Working Group on Further Commitments for Annex I Parties under the Protocol (AWG-KP) which involves most countries but importantly not the United States. The Kyoto Protocol covers the period from 2008 to 2012.

At the Conference of the Parties in Bali in 2007 a "Road Map" was agreed. The prime aim of the Bali Road Map was to prepare a global regime to follow the Kyoto Protocol. The intention was to complete negotiations by the Conference of the Parties to be held in Copenhagen in December 2009. Despite an almost continuous round of meetings, including at least five in 2009 in Bonn, Bangkok and Barcelona, this proved elusive.

Neither of the Ad-hoc Working Groups was able to complete its work before the Copenhagen meeting. That on the Convention did have a draft negotiating text of some 200 pages with a multitude of "brackets" that covered a shared vision, mitigation, adaptation, technology transfer and, most importantly, financing. The other on the post-Kyoto regime had only a series of "non-papers" which had no official status. Indeed, some of these non-papers were competing texts. Perhaps the largest problem was that there was no consensus on what the legal form of the Copenhagen outcome should be - a new Convention, Conference of the Parties decisions, etc….. At least twelve alternatives were proposed.

The programme for Copenhagen looked demanding from the beginning: in addition to meetings of the two Ad-hoc Working Groups there were the usual meetings of the Convention Subsidiary Bodies on Science and Technology and on Implementation. To complicate matters - and this had really serious implications - there was to be a parallel High-level meeting during the last two days. By the time the meeting began some 115 Heads of State and Governments were expected to attend. Unfortunately, most of them came expecting to sign off on a new legally binding treaty and not to enter into negotiations. They had clearly been poorly briefed by their officials since it had been clear for some months that the negotiations under the Ad-hoc Working Groups were at an impasse that only those with ultimate political authority could resolve.

2. What was the science saying:

There is a growing consensus that we should try to avoid a temperature increase of 2 ^{o}C above pre-industrial levels in order to avoid "dangerous interference with the climate system". We already have seen an increase of 0.7 ^{o}C and models suggest that there is already 0.6 ^{o}C warming in the pipeline because of what we have already done to change the composition of the atmosphere. In order to have a 50% chance of achieving this goal it is estimated that *global* greenhouse gas emissions will have to peak before 2018 and to be at least 50% of current levels by 2050.

These are global numbers and indeed achieving these low-emission scenarios requires a comprehensive global mitigation effort. The IPCC's Fourth Assessment Report contains some estimates of what this would possibly mean for industrialized countries. Countries like Canada would need to reduce their emissions in 2020 by 25 - 40% below

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1990 levels and in 2050 by approximately 80 - 95%. These ranges cover the levels suggested in Bill C-311 which is currently stalled in the House of Commons. Emissions in developing countries, on the other hand, would need to start to be below their current “business as usual” emission pathway by 2020 and be substantially below this pathway by 2050.

There are indications that we are running out of time. Emissions of greenhouse gases continue to rise and are now growing at 3.5% per year. In fact, emissions for the last few years have been larger than the worst case scenario developed by the IPCC in their Special Report on Emission Scenarios in 2000. Currently the concentration of carbon dioxide - the most important greenhouse gas - is almost 390 parts per million which is a 38% increase since pre-industrial times and the highest it has been in almost one million years. Global average temperatures are now outside the range observed over the last 1300 years. The last time the polar regions were significantly warmer than present for an extended period there was little ice at the poles and sea-levels were 4 to 6 metres higher. What is more troubling is that the linear warming trend over the last 50 years is nearly twice that for the last 100 years. In other words, the closer one comes to the present so the rate of increase of global temperatures increases.

And then came Climategate, the criminal hacking into the computer system of the University of East Anglia University and the illegal posting of e-mails of the Climate Research Unit. For once the allusion to the Watergate burglary was appropriate. The timing just before Copenhagen and the eager and selected use of the material by the climate change denier sect to sow doubt on the scientific basis for the threat of climate change was a little suspicious. Happily, this scandal did not seem to affect the discussions in Copenhagen. Even Saudi Arabia who at first brought out arguments they had used some ten years ago quietly shifted to accept the scientific consensus.

However, there may be lessons here for public science. The threat of climate change and, even more so, how we respond, has to be built on solid evidence. The IPCC has played a significant role in building the awareness of the issue and providing governments with accessible assessments of the science. This has been achieved through the scientific integrity of the researchers concerned as well as the open and transparent procedures of the IPCC. Although this incident shows that scientists are human after all and subject to the occasional frustrations, the scientific basis for the threat of climate change has not been undermined. What the incident does show is that most people do not understand how science is conducted. And although they may be aware of climate change they often do not understand its scientific evidence. Scientists, I think, have to spend more time explaining the science so that it becomes owned as much by the public as it is by governments and the scientific community.

3. What was achieved:

Expectations were perhaps always too high for this Conference of the Parties. The last two years of negotiations showed that the positions of national governments were far apart and entrenched. The developing countries, who are anticipated to be amongst the most vulnerable, expected leadership from the more industrialized World which is regarded as being mainly responsible for the greenhouse gases that have already been dumped in the atmosphere - and hence for the changes in climate that have already been observed and can be expected over the next few decades. The developed World was also seen to be wealthier, to have the financial and technological resources to act first. The developing countries also pointed out that their priority was to bring their people out of poverty and had to be allowed to develop. The industrialized, essentially the OECD, countries argued that some of the major emitters were now in the developing World such as China and India (although their per capita emissions are still a fraction of ours) and they argued that these countries should also begin to take on commitments to reduce emissions. This was most strongly held by the US Administration (even though ironically it was not a Party to the Kyoto Protocol and therefore had made no emission reduction commitments itself). It has also been the view of the Canadian government which has in effect ignored Kyoto.

The developing countries were adamant that all elements of the Kyoto Protocol be kept in any new regime. This, they saw, would maintain the obligations of the industrialized countries. It would, incidentally, include the requirement that any emission reductions that were not met during the first commitment period - between 2008 and 2012 - would be transferred to the second commitment period with a 30% penalty. This would really hurt Canada. Not surprisingly, developed countries wanted a completely new accord that did not retain the division between them and developing countries.

Although many matters of principle were stalemated, some countries announced new commitments. The US, for instance, took the target in the House Clean Energy and Security Bill of a 17% reduction by 2020 based on 2005 levels - essentially a 3% reduction from 1990 levels. Australia, who had left and recently re-entered the Kyoto Protocol, proposed a range of between 5 and 25% below 2000 levels - 15 to 33% below 1990 levels. Japan was perhaps amongst the most ambitious in promising a 25% below 1990 levels. Canada’s was amongst the least ambitious of the industrialized countries. China announced that it would reduce its carbon intensity (measured as a fraction of economic growth) by 40 to 45% which may sound a lot but roughly follows current trends. India announced it would reduce its carbon intensity by 20 to 25%. And Brazil announced it would achieve a roughly 30% reduction mostly by reducing deforestation. These were encouraging signs but still left the global total well below that suggested by the IPCC - a goal which it would not be too hard to close (and without ruining the economy of any one country).

What we ended up with was a document referred to as the Copenhagen Accord. The process is as important as the substance. It was crafted through an initiative led by the US President Barack Obama when he arrived on the last day of the Conference and involved the largest developing country emitters: China, India, Brazil and South Africa. Some 19 countries were involved at the beginning – this did not include Canada – but the "deal" was essentially sealed by the five major emitters. It was actually announced by the White House before it was made available to other delegates. The European Union, who could have objected to the process quietly accepted the "deal". Many of the smaller developed countries did object. As a result, the Conference continued through Friday night and ended, after round upon round of informal talks facilitated by the UN Secretary-General Ban K-Moon, around mid-day on Saturday with the delegates "noting" the document. Strictly speaking, this means it is not an official UN document. There is no deadline for transforming it into a binding deal although the UN Secretary General said this needed to be done during next year.

So what does the Copenhagen Accord contain:

■ The Accord "*recognises the scientific view that increases in global temperatures should be kept below 2^oC*" but does not endorse it. The temperature target was one of the most contested issues. Many vulnerable countries believe that this is too high and argued for a target of 1.5 ^oC which would imply much more aggressive emission reductions. Indeed, atmospheric concentrations are such today that it would require an "over-shoot".

■ There is no aggregate target for emissions. Indeed, for the moment two Annexes which are supposed to contain the individual targets for developed and developing countries are blank. However, this Accord, for the first time, does include commitments from developing countries. All countries are invited to spell out by 1st February 2010 their pledges for curbing carbon emissions by 2020.

■ The EU considers this package so weak that it will likely maintain its lower pledge of keeping its emissions 20% below 1990 levels by 2020, rather than 30%. Other countries such as Japan and Australia are also likely to stick with their minimum levels of ambition. This puts the globe more on track to a 3^oC rise.

■ The Accord does not identify a year by which carbon emissions should peak and no long-term goal (i.e. a 50% global reduction of emissions by 2050). The deal does not spell out penalties for any country that fails to meet its promise.

■ The deal promises to deliver $30bn of aid for developing nations over the next three years. It outlines also a goal of providing $100bn a year, drawing on a variety of "public and private, bilateral and multilateral, including alternative sources of finance" by 2020 to help poor countries cope with the impacts of climate change.

■ The pledges of rich countries will come under "rigorous, robust and transparent" scrutiny under the UN Framework Convention on Climate Change (UNFCCC). Developing countries will submit national reports on their emissions pledges under a method "that will ensure that national sovereignty is respected." In the past this was a voluntary obligation.

■ The implementation of the Copenhagen Accord will be reviewed by 2015. This will take place about a year-and-a-half after the next scientific assessment of the Intergovernmental Panel on Climate Change (IPCC). Unfortunately, if in 2015, the science is such that countries want to adopt a new, lower target on global average temperatures, such as 1.5^oC rather than 2^oC, it will likely be too late (or require a gargantuan and expensive effort).

4. What does it mean for the UN/FCCC:

This was an almost impossible event to orchestrate. The numbers alone are staggering. Over the years the number of participants at these Conferences of the Parties has grown. In Bali in 2007 there were some 6,000 - that was the largest attendance ever. Because the organizers in Copenhagen were aware of the importance of this meeting they had arranged for a venue that could hold around 15,000. But even this proved inadequate for the over 40,000 that registered. The actual number of national delegates was relatively small although even African countries such as Senegal had a delegation of 50 or more. What added to the numbers were the more than 21,000 representatives of non-governmental organizations, what is now referred to as "civil society". In addition, there were over 5,000 individuals from the media, a number which expanded greatly when Heads of State and Governments decided to come. This simply overwhelmed the organizers especially when "leaders" arrived and security had to be enhanced. During the final days of the Conference limited numbers of passes were issued to representatives from non-governmental organizations - as few as 300 on the last day. This angered a lot of people even though the organizers arranged for a parallel venue.

What added to the logistical challenges were the number of parallel meetings that were going on all the time and the meeting rooms that had to be arranged. The halls were a constant rush of people moving from meeting to meeting, most existing on too little sleep, food and water to say nothing of time to think. Almost everyone found it extremely hard to keep track of what was going on.

Understandably, the Danes were keen to get a concrete outcome from the Conference and tried to put together draft conclusions from the texts that were being produced by the two Ad-hoc Working Groups. Not surprisingly, they could no better achieve a consensus than the previous two years of negotiations. Various versions of these Danish conclusions were rejected by many delegations who accused the COP

Chair of being biased and forced the meeting to only consider the output from the Ad-hoc Working Groups. Other texts were produced by various groupings of countries which effectively impeded progress even further.

It is questionable if any consensus could come out of a meeting of almost 200 sovereign countries on a subject that has such deep consequences for their societies, economies and ecosystems and where it was sadly obvious that there was a lack of trust. Several countries were variously accused of not really wanting a "deal" at all – including China and the US. This lack of trust, amplified by sensitivities to a perceived lack of transparency and inclusiveness, maybe the most important factors that bedevilled the Conference.

When it came to organizing the High-level meeting on the final two days, things really began to become impossible for the hapless Danes. In the absence of any final document Barack Obama led a small group of key countries in forging what was to become the Copenhagen Accord. This was done in a manner that essentially created a parallel process quite separate from that of the UN/FCCC. It showed the limitations of the current process and perhaps more crucially of those that have been involved. Perhaps, the existing process has reached a "tipping point" and at some stage was bound to fail. We not only have a document with an uncertain relationship to the UN/FCCC process and hence no clear pathway for turning it into an internationally binding treaty, but one which relies not on international law but on individual country commitments backed up by national legislation. Thus, what has suffered immeasurably as a result of Copenhagen is the UN/FCCC itself. It will continue, at least in its present form, for a while - the mandates of the two have been extended – but it will have to change if it is going to be a useful multilateral mechanism.

5. What does it mean for Canada:
Except for receiving several "Fossil of the Day" Awards and the "Fossil of the Year" Award for what the ENGO community saw as our poor record of reducing emissions, a lack of any plan to reduce future emissions and unhelpful contributions to the UN/FCCC process, Canada was barely visible in Copenhagen. The Minister of the Environment attended most of the two weeks of negotiations and reiterated well-known positions. The Prime Minister arrived for the final two days of the High-Level Meeting but was absent from the Conference Centre on the first day, gave no statement and was excluded from the small group of countries that negotiated the Copenhagen Accord (but did attend the dinner given by the Queen of Denmark and the lunch hosted by the Danish Prime Minister). This low level of engagement likely suited the Prime Minister, allowing him once again to "dodge the bullet".

However, Copenhagen illustrated that climate change is a key policy concern of many countries principally because of its security implications and also because of the economic opportunities. There is a lot of work to be done in following up on this Conference of the Parties and the topic can expected to be on the agendas of many bilateral and multilateral meetings. This would seem to include the G-20 (and now to a lesser extent the G-8) which the Prime Minister is to host in Canada this year. It is therefore difficult to see how he can avoid addressing the issue. It is not clear if the US Senate will have passed its climate change Bill by the time of these meetings. It will be interesting to see whether we will have a "made in Canada" plan to show-case to the G-8/20.

What are the geopolitical implications:
With 115 World leaders present and a single issue on the agenda, there has never been a meeting like this. The countries that brokered the text (the US, China, India, South Africa, Brazil and to a lesser extent the EU) reflect a world in which the balance of power has significantly changed in the last 20 years. Indeed, the fact that the two major players were the US and China reflects what we have begun to see in international economic terms: that these two countries have to somehow get on together. In Copenhagen the Chinese, for whom saving face is paramount, were initially taken aback by Obama's rhetoric but eventually came together. I find this immensely encouraging.

At a fundamental level there is no longer any question that climate change is central to the political thinking of every country on the planet. Public awareness has massively increased. The vast campaigns around the world in the run-up to Copenhagen and the media coverage have made addressing climate change widely understood. The other very important change is that, with a few notable exceptions, green growth is now the prevailing economic model of our time. The idea that addressing climate change is bad for business was buried at Copenhagen. Countries from both developed and developing worlds have announced low-carbon economic plans and are moving forward.

Unfortunately, economic opportunities and public pressure were not enough to overcome the concerns over sovereignty that many countries have in the context of international law. The final decision reflects the fact that many countries only want to be answerable to themselves. They will co-operate, but not under the threat of legal sanction. The reference to transparency in the text is significant as it will mean that for the first time actions by countries can be assessed globally.

Conclusions:
It may be that Copenhagen has irreparably damaged the UN/FCCC process: perhaps it could not bear the weight of expectations, perhaps it is just too complex. We will have to see how the experiment of moving away from an internationally binding agreement to one that relies more on country-level targets backed up by national legislations evolves. A similar bottom-up approach has worked in the United States in the context of addressing acid rain and is now under way in several States (including some Canadian

Provinces) through collaborative “cap and trade” initiatives. It may *also* make sense to try to solve parts of the complex problem such as intellectual property rights for climate technologies; flexible, transparent and accessible financial mechanisms; and adaptation.

Many seasoned observers have suggested there has never been an international meeting like this. Like the French Revolution, it is probably too soon to declare a verdict on the place of the Copenhagen Conference of the Parties in the history of our civilization. But in the immediate aftermath it is clear that the Conference created deep divisions between countries. These will have to be addressed sympathetically: the issue will not go away and more delay will raise the costs and the risks. As someone cleverly put it: “***There is no Planet B***”.

Quiet and Gentle Hurricane Season

by David Phillips[3]

Meteorologists foresaw an average hurricane season in the Atlantic Ocean, forecasting between 9 and 14 tropical storms with 4 to 7 reaching hurricane status. As it turned out, the season was the quietest in a dozen years with nine named storms and hurricanes. This was due, in part, to a strengthening warm El Niño that helped suppress tropical storm formation and intensification in the Atlantic Ocean. El Niño’s shearing winds halted the rotation of brewing thunderstorms in the Atlantic, snuffing them out before they could grow. Adding to the suppression of tropical storms, an influx of drier air stunted the growth of would-be hurricanes, and a Bermuda High positioned further east kept tropical systems harmlessly in the open waters where they were not even a danger to fish. Cooler-than-normal water temperatures in the Atlantic Ocean also worked to keep storm development at bay because tropical storms depend on warm water to develop and build up strength. For the United States, Cuba and the Caribbean – countries that suffered mightily from frequent and severe hurricanes in recent years – 2009 was a welcomed reprieve for residents and insurers alike. At season's end, there were nine named storms from *Ana* to *Ida* and three hurricanes. Two, *Bill* and *Fred*, became full-blown major hurricanes with maximum winds above 200 km/h. The last time an Atlantic hurricane season produced only three hurricanes was 12 years ago. Besides fewer storms, they were short-lived compared to recent years. Also unusual this season? The Gulf of Mexico, South Florida and the Carolinas didn't have a decent scare and no hurricane made landfall in the United States, leaving Canada to experience more storm activity than its southern neighbour.

Hurricane *Bill* was the season’s first Atlantic hurricane and the most powerful, reaching Category 4 intensity with winds above 210 km/h. On August 22, its massive reach threatened Bermuda before speeding rapidly toward Nova Scotia at 48 km/h. The hurricane accelerated as it headed across Atlantic Canada, brushing the south coast of Nova Scotia the next day as a marginal category 1 hurricane and making landfall as a tropical storm near the Burin Peninsula of Newfoundland and Labrador early on August 24. By moving faster, it didn’t have time to dump as much rain as it could have on Atlantic Canada, but its arrival coincided with the highest and lowest tides of the year threatening coastal property with storm surges and flooding.

At Halifax, the storm dumped between 60 and 70 mm of rain with overland wind gusts of 87 km/h. Out to sea, a marine buoy off Nova Scotia recorded winds of 130 km/h and another buoy about 200 km southeast of Yarmouth recorded a maximum wave height of 26.4 metres. *Bill's* steady downpour and fierce winds drenched everything in sight and knocked out power to 40,000 residents. More than a dozen flights from Halifax International Airport were cancelled and ferry services were suspended between Nova Scotia and Newfoundland. Its pounding waves crashed into beaches, flooding nearby roads and strewing them with rocks and seaweed. Emergency measures authorities were concerned because, while most residents in coastal Maritime towns and cities hunkered down as the storm passed, many onlookers placed themselves in potential danger hoping to catch a glimpse of crashing waves and surge. In Newfoundland and Labrador there were road washouts and some localized flooding.

A week later, with the ground still well saturated, tropical storm *Danny* dumped buckets of rain on Atlantic Canada causing more flooding and power outages. Storm *Danny* was positioned off the coast of North Carolina on August 29, tracking rapidly northward toward the Bay of Fundy. Before it arrived in the Maritimes, *Danny* fizzled out and was absorbed by a larger low-pressure system following in its wake. The hybrid storm picked up *Danny’s* leftover moisture and dumped in excess of 100 mm in Saint John, Moncton, Charlottetown and Sydney (among other places), swamping streets, cutting power to thousands and forcing residents to evacuate their homes. In the Wreckhouse region of southwestern Newfoundland, *Danny* blew two camper-trailers off the highway when wind gusts topped 152 km/h. Combined insured losses from *Bill* and *Danny* were estimated at $35 million.

The season’s final storm, Hurricane *Ida*, killed hundreds of people and left thousands homeless in Nicaragua, Honduras and El Salvador during the first week of November. It later weakened to a tropical depression, making landfall in Alabama on November 10 and lashing the southeastern United States from Louisiana to Florida with winds and rain. Heavy rains associated with the remnants of Hurricane *Ida* moved through New Brunswick on November 14 and 15 before racing toward Newfoundland and Labrador. Before fizzling out, the storm left anywhere from 50 to 90 mm of rain across parts of Atlantic Canada.

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2000 – 2009, The Warmest Decade

Résumé: L'année 2009 devrait se classer parmi les dix années les plus chaudes depuis 1850, date à laquelle ont débuté les relevés instrumentaux, d'après les données compilées par l'Organisation météorologique mondiale (OMM). La température moyenne combinée de l'air à la surface des terres et de la mer en surface, en 2009 (janvier-octobre), présente actuellement une anomalie positive estimée à 0,44±0,11°C par rapport à la normale calculée pour la période 1961-1990. L'année 2009 se classe provisoirement – il n'est pas tenu compte des incertitudes afférentes aux moyennes annuelles – au cinquième rang des années les plus chaudes. La décennie 2000-2009 a été plus chaude que la précédente (1990-1999), laquelle était déjà plus chaude que la décennie 1980-1989. Des données plus complètes se rapportant à la fin de l'année 2009 seront analysées début 2010, ce qui permettra de mettre à jour l'évaluation actuelle.

Geneva, 8 December 2009 (WMO) – The year 2009 is likely to rank in the top 10 warmest on record since the beginning of instrumental climate records in 1850, according to data sources compiled by the World Meteorological Organization (WMO). The global combined sea surface and land surface air temperature for 2009 (January–October) is currently estimated at 0.44°C ± 0.11°C (0.79°F ± 0.20°F) above the 1961–1990 annual average of 14.00°C/57.2°F. The current nominal ranking of 2009, which does not account for uncertainties in the annual averages, places it as the fifth-warmest year. The decade of the 2000s (2000–2009) was warmer than the decade spanning the 1990s (1990–1999), which in turn was warmer than the 1980s (1980–1989). More complete data for the remainder of the year 2009 will be analysed at the beginning of 2010 to update the current assessment.

This year above-normal temperatures were recorded in most parts of the continents. Only North America (United States and Canada) experienced conditions that were cooler than average. Given the current figures, large parts of southern Asia and central Africa are likely to have the warmest year on record.

Climate extremes, including devastating floods, severe droughts, snowstorms, heatwaves and cold waves, were recorded in many parts of the world. This year the extreme warm events were more frequent and intense in southern South America, Australia and southern Asia, in particular. La Niña conditions shifted into a warm-phase El Niño-Southern Oscillation (ENSO) in June. The Arctic sea ice extent during the melt season ranked the third lowest, after the lowest and second-lowest records set in 2007 and 2008, respectively.

This preliminary information for 2009 is based on climate data from networks of land-based weather and climate stations, ships and buoys, as well as satellites. The data are continuously collected and disseminated by the National Meteorological and Hydrological Services (NMHSs) of the 189 Members of WMO and several collaborating research institutions. The data continuously feed three main depository global climate data and analysis centres, which develop and maintain homogeneous global climate datasets based on peer-reviewed methodologies. The WMO global temperature analysis is thus based on three complementary datasets. One is the combined dataset maintained by both the Hadley Centre of the UK Met Office and the Climatic Research Unit, University of East Anglia, United Kingdom. Another dataset is maintained by the National Oceanic and Atmospheric Administration (NOAA) under the United States Department of Commerce, and the third one is from the Goddard Institute of Space Studies (GISS) operated by the National Aeronautics and Space Administration (NASA). The content of the WMO statement is verified and peer-reviewed by leading experts from other international, regional and national climate institutions and centres before its publication.

Final updates and figures for 2009 will be published in March 2010 in the annual WMO Statement on the Status of the Global Climate.

Regional temperature anomalies

The year 2009 (January–October) was again warmer than the 1961–1990 average all over Europe and the Middle East. China had the third-warmest year since 1951; for some regions 2009 was the warmest year. The year started with a mild January in northern Europe and large parts of Asia, while western and central Europe were colder than normal. Russia and the **Great Lakes region in Canada** experienced colder-than- average temperatures in February and January, respectively. Spring was very warm in Europe and Asia; April in particular was extremely warm in central Europe. Germany, the Czech Republic and Austria reported temperature anomalies of more than +5°C, breaking the previous records for the month in several locations. The European summer was also warmer than the long-term average, particularly over the southern regions. Spain had the third-warmest summer, with hotter summers reported only in 2003 and 2005. Italy recorded a strong heatwave in July, with maximum temperatures above 40°C, and some local temperatures reaching 45°C. A heatwave at the beginning of July affected the United Kingdom, France, Belgium and Germany, and some stations in Norway experienced new maximum temperature records.

India had an extreme heatwave event during May, which caused 150 deaths. A heatwave hit northern China during June, with daily maximum temperatures above 40°C; historical maximum temperature records were broken for the summer in some locations.

In late July many cities across Canada recorded their warmest daily temperatures. **Vancouver and Victoria** set new records, reaching 34.4°C and 35.0°C, respectively. Alaska also had the second-warmest July on record. Conversely, October was a very cold month across large parts of the United States. For the nation as a whole, it was the third-coolest October on record, with an average temperature anomaly of -2.2°C (-4.0°F). Similarly, a very cold October was reported in Scandinavia, with mean temperature anomalies ranging from -2°C to -4°C.

The austral autumn (March to May) was extremely warm in Argentina, Uruguay, Paraguay and southern Brazil. With daily temperatures ranging from 30°C to 40°C, several records were broken during this season. By the end of October, an extreme weather situation affected north and central Argentina, producing unusually high temperatures (above 40°C). Conversely, November was abnormally cold in the southern part of the region, with some rare and late snowfalls.

So far, Australia has had the third-warmest year on record. The year 2009 was marked by three exceptional heatwaves, which affected south-eastern Australia in January/February and November, and subtropical eastern Australia in August. The January/February heatwave was associated with disastrous bushfires that caused more than 173 fatalities. Victoria recorded its highest temperature with 48.8°C. The northern region experienced a cold summer, however, with anomalies reaching -3°C to -4°C in some places. Winter was exceptionally mild over much of Australia. Maximum temperatures were well above normal across the entire continent, reaching 6°C to 7°C above normal in some parts. The national maximum temperature anomaly of +3.2°C was the largest ever recorded for any month.

Severe droughts

China suffered its worst drought in five decades. Water levels in parts of the Gan River and Xiangjiang River were the lowest in the past 50 years. In India the poor monsoon season caused severe drought impacts in 40 per cent of the districts. The north-western and north-eastern parts of the country were badly affected. It was reported to be one of the weakest monsoon seasons since 1972.

In East Africa the drought led to massive food shortages. In Kenya the drought was responsible for severe damage to livestock and a 40 percent decline in the maize harvest.

In North America, Mexico experienced severe-to-exceptional drought conditions by the month of September. In the United States, the western region was the most affected by a moderate-to-exceptional drought by the end of October. Nevertheless, the total area affected by drought in the United States during October was the second-smallest value recorded in this decade.

Drought in Central Argentina caused severe damage to agriculture, livestock and water resources. The situation was most severe at the end of October, with very high temperatures reported as well.

Over the key agricultural areas of the Murray-Darling Basin and the south-western part of Western Australia, rainfall was generally below normal. The passage of another year without any sustained above-normal rainfall has seen long-term rainfall deficits continuing in south-eastern Australia. Sustained dry conditions in the Murray-Darling Basin have now continued for nine years.

Intense storm events and precipitation

At the end of January, Spain and France were severely affected by winter storm Klaus, the worst extra-tropical storm in a decade, with winds similar to a category 3 hurricane. Another winter storm combined with heavy snowfall caused severe damage in western Europe and resulted in serious disruptions of air and rail traffic in several countries. In late spring and summer a large number of thunderstorms with heavy rain, hail and tornadoes caused local flooding and significant damage across Germany. In September, several parts of the Mediterranean region were affected by extreme rainfall events. Total rainfall of more than 300 mm was recorded in less than 48 hours in one location of south-eastern Spain, where the long-term average for total annual precipitation does not exceed 450 mm. During the same month, intense rainfall caused devastating damage to infrastructure in several parts of northern Africa, including Algeria, Morocco and Tunisia. In a similar pattern, the highest September rainfall recorded in 80 years produced severe flash floods in north-western Turkey. November brought severe flooding to northern areas of the United Kingdom, and a new 24-hour precipitation record was set for the country.

During the beginning of the year heavy rainfall was observed in Colombia, producing landslides and widespread floods. North-east Brazil was severely affected by heavy rainfall and flooding in April and May. Later, in July, a severe snowstorm hit the southern part of Argentina; it was the worst snowstorm in 15 years. During the austral spring, particularly in November, continuous heavy and intense rainfall was seen in north-eastern Argentina, southern Brazil and Uruguay, causing flooding in many places and affecting more than 15,000 people. Total monthly precipitation records were broken, with rainfall exceeding more than 500 mm in many locations.

In Canada, **Ontario** experienced a record number of witnessed tornadoes and a record number of related fatalities. Canadian avalanches were almost double the yearly average for the past decade and the worst since 2002–2003. A total of 25 deaths made it one of the deadliest seasons. The northern plains region of the United States was affected by record flooding during the month of March. As a whole, the United States recorded the wettest October in 115 years.

In Central America, an intense storm in El Salvador in November, associated in part with Hurricane Ida, produced deadly floods and landslides that claimed 192 lives.

In Asia, after the weak 2009 monsoon season, southern India recorded severe flooding due to incessant rain in late September and the first week of October, and more than 250 lives were lost. On the other hand, northern China was severely affected by a snowstorm that occurred during the first half of November as part of a strong cold wave. These snowfalls were one month earlier than normal, breaking local weather records.

In western Africa, heavy and intense rainfall in September caused flooding that affected more than 100,000 people. The worst flooding was observed in Burkina Faso, where 263 mm of rain was recorded in less than 12 hours, breaking a record set 90 years ago. Further south on the continent, nearly 1 million people in Zambia and Namibia were affected by torrential rain that caused rivers to overflow their banks, flooding homes and cropland.

Australia was also affected by local flooding. Coastal Queensland and New South Wales were the hardest hit by several heavy rain events, with daily rainfall totals in excess of 300 mm. On the other hand, numerous duststorms affected eastern Australia in the second half of September and early October, as regular strong winds transported dust from northern South Australia over the eastern states. The most severe duststorm occurred on 22–23 September and covered large parts of New South Wales and Queensland, where the visibility was reduced to 100–200 m in both Sydney and Brisbane.

End of La Niña and Development of El Niño

La Niña-like conditions were present in early 2009, followed by the development of El Niño patterns starting in June 2009. During June–September 2009, sea surface temperatures were generally about 1°C warmer than the long-term average across the central and eastern equatorial Pacific. An El Niño event is currently underway, with the early phase of the event holding steady at weak-to-moderate levels through July–September. During October, almost all indicators of El Niño became noticeably stronger.

Tropical cyclone season

The 2009 Atlantic hurricane season closed with the fewest named storms and hurricanes since 1997, most likely due to the unfavourable cyclonic conditions caused in part by El Niño. A total of nine named tropical storms were formed, including three hurricanes, two of which were major hurricanes at Category 3 strength or higher. (The averages are 11, 6 and 2, respectively).

In the East Pacific, 20 named tropical storms were recorded, eight of which evolved into hurricanes and five of which became major hurricanes (The averages are 16, 9 and 4, respectively.)

In the western North Pacific, 22 named tropical storms have been recorded so far, and 13 of them reached the intensity of typhoon, compared to the long-term averages of 27 and 14, respectively. Heavy precipitation associated with typhoons Ketsana and Parma was observed across the south of Luzon Island in the Philippines. The resulting flood disaster caused more than 900 fatalities in total. In August, Typhoon Morakot swept across Taiwan Province of China and caused more than 400 deaths and severe damage to agriculture and infrastructure. Hundreds of roads and bridges on the island were destroyed by floods.

The Australian and South Indian Ocean cyclone seasons recorded near-average activity. In the Australian region, there were 10 systems during this season, with Hamish the most significant one, although it did not make landfall. It reached category 5 intensity and was the most intense cyclone observed off the eastern Queensland coast since 1918.

Third-lowest Arctic sea ice

According to scientific measurements, Arctic sea ice has declined dramatically over the past 30 years at least, with the most extreme decline seen in the summer melt season. Arctic sea ice extent during the 2009 melt season was 5.10 million km^2, which is the third-lowest on record after the 2007 record (4.3 million km^2) and 2008 (4.67 million km^2), since satellite measurements began in 1979.

Information sources

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Global Surface Temperature Trend : Result from three Global datasets: NOAA (NCDC Dataset) , NASA (GISS dataset) and combined Hadley Centre and Climate Research Unit of the University of East Anglia (UK) (HadCRUT3 dataset).

Source: WMO Website http://www.wmo.ch visited on December 12, 2009. WMO Press Release # 869.

The World Meteorological Organization is the United Nations' authoritative voice on weather, climate and water.

Top 10 Canadian Weather Stories for 2009

by David Phillips[1]

Abstract

Nationally, there was nothing exceptional about the temperature or precipitation in 2009. Crunch all the statistics and it averaged a half degree warmer and a meagre two per cent drier than normal. But dig a little deeper – separate those statistics out – and there's nothing "normal" about this year's weather at all. The seasons were out of whack across the country, with new records or near records in every region. Sometimes, the weather was a marvel of contrasts, with some areas experiencing their wettest and driest periods in the same year, floods and droughts, or the warmest season in half a century along with the coldest in a century. If you ask most Canadians, they'll tell you that winter went on far too long. Spring felt more like winter, what summer there was occurred in September and November was the October we never got.

For the second consecutive year, Canada's top weather story was about disappointing summer weather. In 2008, it was the soaker of a summer with record wet conditions in Ontario and Quebec. This year it was the wettest summer ever in Atlantic Canada and uncomfortably cold in central Canada, where it rained hard and often. The forest fire season was one of remarkable contrasts: near-record quiet across Canada and record activity in British Columbia, where costs to fight the wildfires approached $400 million. And for the first time in nine years, multiple deaths from tornadoes occurred in Canada. The year also saw one of the wettest hours in Canadian history – over 100 mm in 90 minutes in Hamilton, Ont. Property damage from weather extremes cost Canadian insurers millions of dollars – one of the most expensive years ever. One of these events, an Alberta hailer, was possibly the second or third most expensive weather event in Canadian history. Also on the list of this year's top Canadian weather events was major ice-jam flooding in Manitoba along the Red River and in New Brunswick along the Saint John River. In the North, the thinning and shrinking of the ice, albeit not as remarkable as in the two previous summers, continued to have a profound impact on the region's people, plants and wildlife alike. Alberta owned several of the year's top weather stories: powerful and deadly winds; devastating hailers in both rural and urban areas; and prolonged cold and drought. For Canadian farm producers, this year's wacky weather was especially nerve-wracking. Their worst enemy – weather – turned out to be their best ally when a September heat wave and dryness in November saved what would have been a crop disaster. To be fair, the news wasn't all bad. Our air was clearer than in most years, there were no summer blackouts and there were fewer West Nile Virus-carrying mosquitoes. Also a plus, this year's hurricane season was quiet and gentle in the Atlantic Ocean and Caribbean Sea, and largely spared Canada apart from some nuisance rains and major soakers.

Unbelievable as it may seem, it was another warm year for Canada – our 13th year in a row – although not as warm as it has been in recent years. Every region was warmer or near normal, especially the Eastern Arctic, which experienced its eighth-warmest January-to-November period on record. In the North, it was the warmest summer on record at nearly two degrees warmer than normal. On the other hand, the Prairies registered the second-coldest summer in 16 years. Globally, it was also another warm year according to the World Meteorological Organization. Surface temperatures averaged 0.44°C above the annual average of 1961-1990, making it the fifth warmest year on record. This decade (2000-2009) was warmer than the last (1990-1999), and was likely the warmest on record. Likewise in Canada, the decade just ending was the warmest by far looking back over the past six decades.

Top Ten Canadian Weather Stories for 2009

1	**Summer of Our Discontent - Too Much Heat in the Far West, Not Enough for All the Rest**
2	**BC Burning Up**
3	**Ontario Tornadoes ... Deadly and Destructive**
4	**Record Ice-Jam Flooding on the Red River**
5	**Cold and Drought Combo Wreak Havoc with Prairies Farmers**
6	**Less Arctic Sea Ice Retreat but No Recovery**
7	**Multi-Million Dollar Hailer Pounds Urban and Rural Alberta**
8	**Hamilton's Record Costly Gully-Washer**
9	**Wind Plough Through Alberta**
10	**Enduring Prairie Cold Ends Dramatically**

The above Top Canadian Weather Stories for 2009 are rated from one to ten based on factors that include the impact they had on Canada and Canadians, the extent of the area affected, economic effects and longevity as a top news story.

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1. Summer of Our Discontent - Too Much Heat in the Far West, Not Enough for All the Rest

This summer had it all! Depending on where you live in Canada it was either too hot, too cold, too dry, too wet or too stormy. All most of us really wanted was average weather. And, believe it or not, when you added it all up that was exactly what we got! Canada, on whole, was less than a half degree warmer-than-normal. Catch all the rain and it totalled only two per cent more than normal. The problem for Canadians was that there was too little weather in the north and far west and too much over the south and east. Parts of the eastern Prairies experienced temperatures more than a degree and a half below normal, making it among the ten coolest summers ever. Atlantic Canada had its wettest summer on record – some 42 per cent more precipitation than normal. The Great Lakes/St. Lawrence basin had its 6th wettest and 12th coldest summer in 62 years. On the other hand, the high Arctic experienced its warmest summer – 1.8°C above normal, and the Pacific coast had its third warmest and third driest summer.

With Canadians craving patio weather, the big talk from Alberta to the Atlantic was: "Where's the heat?" Every conspiracy theory from a quiet sun, to ozone holes, global cooling, volcanism and divine intervention was used to explain the "summer that wasn't". In reality, the culprit was a drop-down jet stream that normally moves west to east across the Territories but instead sank south along the US-Canada border, ushering in waves of Canadian air. East of the Rockies, Canada lay under a persistently cool, unsettled air mass that wouldn't budge. Adding to the meteorological misery was a stubborn upper low, eddying over Ontario or Quebec, spinning a repetitive cycle of rain, drizzle, cloud, fog, cool temperatures and the occasional sunny interval. This cold low blocked any warm American weather from entering the country. By contrast, high pressure in the Pacific – and at times in the North Atlantic – brought warm, sunny, dry weather to British Columbia and the Yukon and, occasionally, to Newfoundland-Labrador and Nunavut.

Some Canadians tried to make good of a lousy situation by claiming they were grateful for a smog-less, energy-saving, mosquito-free, tree-loving kind of summer. Admittedly, energy-sucking air conditioners were silent, resulting in Ontario's energy producers burning 45 per cent less fossil fuel. For downtown Toronto, it was the cleanest year ever for air quality with zero smog days. Residents of "the big smoke" and those in Windsor, who had to endure record-long garbage strikes, were lucky in one regard. The lack of heat kept the stink factor at a minimum. Even the West Nile Virus came and went with only one human case of the mosquito-borne illness in Saskatchewan, compared to 1,422 cases in the province two years earlier. But overall, weather-weary Canadians were hard-pressed to find much advantage from the year summer forgot.

Record wet weather in Atlantic Canada produced a bumper crop of green and rotting strawberries and raspberries. A lack of berries in Quebec increased the number of bear alerts in several communities. Montreal set a record for the least number of hours of sunshine ever recorded for July – a mere 212.5 hours – easily smashing the previous record of 230.8 hours. It wasn't the wettest July on record at Val-d'Or, but with 27 of 31 rainy days it was about as miserable as it gets. In Ontario, it was so cold that even kids stayed out of the water. It was hard to find more miserable summer weather than in Ottawa-Gatineau. With one cloudburst after another, July was the rainiest of any month on record with 243.6 mm, or more than two and a half times the monthly average of 91 mm at the International Airport. Not only did it rain hard and often, afternoon temperatures averaged 3°C cooler than normal. For beach lovers, pool owners, festival goers and patio-bar patrons it was the year without summer. The Prairies lacked so much heat that severe weather couldn't form and frost warnings were issued every month across the three provinces.

On the other hand, the west coast faced an overabundance of summer. Conditions that were too hot and too dry fostered the most extensive and expensive wildfire-fighting season on record in British Columbia. Remarkably, hundreds of daily maximum temperatures were eclipsed across the province. In Vancouver, temperatures above 30°C brought smog warnings and oppressive humidity. The city experiences a hot day at or above 30°C once every five years on average, but in 2009 there were four. Of special note were two excruciatingly hot days: on July 29 Vancouver set an all-time high temperature record when the mercury rose to 33.8°C; the next day that record was broken when the temperature topped 34.4°C. It was the first time Vancouver set records on consecutive days and the residents were feeling the impact of all that heat, humidity and smog given that fewer than 5 per cent of residents have air conditioning. Victoria fared no better. On July 29, the city reached an unbelievable 35.0°C. That Vancouver and Victoria recorded the warmest temperatures this year among major cities in Canada is unprecedented and astonishing. In the nearby Fraser River, water temperatures reached near-record highs – 2.5°C above the average when Sockeye salmon begin to exhibit severe stress and early mortality.

Also of note was the fact that the North was often warmer than the south – especially in July. The historic Klondike town of Dawson City, located about 250 km south of the Arctic Circle, experienced twice the number of hot days (above 30°C) as Toronto; as did Goose Bay, Labrador. On July 29, Whitehorse's high of 32°C put the northern capital on par with Miami and parts of Spain. At the end of July, temperatures more than 12°C warmer-than-normal in Iqaluit forced some Inuit visitors to the city to return to their communities because of the unbearable heat.

2. BC Burning Up

The forest fire season in British Columbia began early in May and exploded in July. According to the British Columbia Ministry of Forests and Range Wildfire Management Branch, the province saw 3,200 fires. Of those, 100 were considered significant with nearly half of those prompting evacuation orders. Wildfires scorched 68,000 hectares of land across the province – almost seven times more than last year's fire season. Costs of direct fire fighting were enormous, close to $400 million or six times that budgeted, surpassing the most expensive season on record in 2003. At times, more than 3,000 fire fighters and 1,000 support personnel battled the flames. Crews included workers from nearly every province and territory in Canada, from the United States and, for the first time, fire specialists from Australia and New Zealand.

All indicators pointed to a heavy forest fire season for the province in 2009. Tinder-dry conditions in forests and parks across the province had fire fighters on high alert throughout the spring and summer. Never had the forests of British Columbia been so dry in winter-spring-summer. A persistent high pressure system, anchored near the Pacific coast for most of April through July, blocked storms from reaching the coast and encouraged a southerly flow with clear skies and record warm temperatures. From December through August, B.C.'s Pacific Coast was the driest in 62 years of records, 24 per cent below normal. Even more telling, nine of the last ten years were drier than normal with five being among the driest ten years. Similarly, in the B.C. Interior, nine of the past ten years were drier than normal and eight were warmer. Beginning in late spring, soaring temperatures sucked moisture from trees and the ground, creating a preheating effect. Low humidity dried up the fuel. A record number of dry lightning flashes sparked fires while gusty winds stoked the flames. Exacerbating the wildfire threat in recent years was the large swaths of beetle-killed timber. At the height of the 2009 forest fire season, virtually every region of British Columbia was ablaze, including a dozen fires threatening nearby communities. Almost 85 per cent of the province was under a high or extreme fire alert with about 100 new fires starting every day. Fire fighters worked feverishly in rugged terrain to control the hot spots. Making things more difficult, water in lakes, rivers and reservoirs reached alarmingly low levels. For example, Okanagan Lake recorded its sixth-lowest inflow on record.

Unlike the wildfires of 2003, residential and business properties were spared in 2009. A credit to the tireless fire fighters, only a few buildings were destroyed compared with 2003 when more than 200 homes were lost. Further, the number of forced evacuations was much lower, with just a few thousands this year versus 50,000 in 2003.

3. Ontario Tornadoes ... Deadly and Destructive

Despite the absence of prolonged heat and humidity this summer, Ontario faced some of the deadliest and most destructive tornadoes in its history. It was a long tornado season, beginning on April 25 and ending on September 28. Ontario witnessed 29 tornadoes in 2009 which tied the record for the most tornadoes in one year set in 2006. On average, the province sees 11 tornadoes each year.

During the swift passage of an intense cold front on the warmest day of the spring in April, a spate of fierce thunderstorms broke out across southwestern, southcentral and eastern Ontario. Winds at Toronto Pearson International Airport gusted to 115 km/h – the strongest wind gust reported since January 1978. Power lines and trees came down across the province, knocking out power to 100,000 customers. Embedded in the thunderstorm cluster were marble-sized hail near Parry Sound, waterspouts in the Ottawa River, straight-line winds and weak tornadoes in Windsor and Ottawa. In Windsor, the roof was ripped off a union hall building with chunks of roofing and shards of glass littering the lawn and front steps. At Ottawa's Rockcliffe Flying Club, tornadic winds damaged 18 planes. Both tornadoes were F0 in intensity with winds of up to 110 km/h.

On June 25, a powerful storm – including an F2 tornado, the strongest to hit the province in three years ripped through southwestern Ontario. Storm damage was reported from Leamington to Cambridge, with the Tillsonburg-Delhi area being hardest hit.

Then, after 14 years with no fatalities, Ontario's tornado season went on to claim four victims. July 9 was the deadliest day with three fatalities in northwestern Ontario resulting from tornadic winds in an area where this weather is relatively rare. Just after 9 p.m. EDT, severe thunderstorms roared eastward into the area producing two separate tornadoes. The second of these struck a fishing and hunting resort on Lake Seul, about 15 km south of Ear Falls. The storm was rated as an F2 tornado with peak wind speeds estimated at between 180 and 240 km/h. The tornado downed several large trees and pulled others out by their roots. It shook buildings and speared roofs with 2-ft. by 4-ft. lumber. Powerful winds lifted two cabins and a dock two metres off the ground and tossed them into the nearby lake, spreading debris along the far shoreline. Ironically, the victims were from Oklahoma's tornado alley, home to some of the deadliest tornadoes in the United States, an area that averages 50 tornadoes a year.

The next fatality hit two weeks before Labour Day, when a highly complex, severe weather outbreak struck the province on August 20. Shortly after noon, a supercell storm developed just south of Lake Huron and tracked northeastward for a remarkable 200 km. The heat and humidity hanging over Ontario increased once the clouds disappeared. A low-level jet stream across the region fed more moisture into the storm; shearing winds helped trigger several violent vortices. At the same time, a squall line developed over Lower Michigan and travelled across Ontario. This system produced straight-line winds from Windsor to northeast of Toronto and destructive tornadoes in Vaughan and Newmarket. While these tornadoes were wreaking havoc just north of Toronto, another series of supercell thunderstorms was spawning tornadoes in portions of Simcoe County and the Muskoka and Parry Sound Districts to the east of Georgian Bay and north towards Lake Nipissing. In total, the day's weather produced at least 18 tornadoes (a record for the most tornadoes in one day in Canada), including: four F0; ten F1; and four F2. That was the greatest number of F2 tornadoes in Ontario in one day since the Barrie/Central Ontario tornadoes of May 31, 1985. From Windsor to North Bay twisters were hopping, skipping and jumping across the province, randomly inflicting violence at one house but sparing the next. Violent winds snapped trees, lifted roofs, flattened cars, mowed down fences, collapsed farm buildings, and inflicted property losses around $100 million.

The first tornado of the day touched down in the town of Durham in Grey County, killing an 11-year-old boy as he left a nearby conservation area day camp. The same storm continued northeast, producing another tornado near Collingwood. Two hours later tornadoes appeared in the City of Vaughan, north of Toronto. About 600 homes, mostly in the communities of Maple and Woodbridge, were damaged. Thirty-eight were demolished and declared unsafe. Lampposts were shorn off and pieces of trees, fences and brick were strewn everywhere. Some houses had gaping holes and exposed roof beams, while others were untouched by the storm. In Toronto there were unconfirmed reports of a funnel cloud near the busy intersection of Yonge and Bloor – a rare occurrence. Major flooding occurred along the lakeshore, and at the peak of the storm Hydro One reported that 69,000 customers had lost power.

The season's final confirmed tornado, an F1, occurred on September 28 in Orono just north of Bowmanville where a barn roof was torn off and the concrete foundation of another barn lifted and ripped up.

4. Recod Ice-Jam Flooding on the Red River

Manitoba's Red River recorded its second highest spring flooding in nearly 100 years. North of Winnipeg at Breezy Point and St. Clements, ice jamming caused the worst flood of the century, forcing full-scale evacuations. At the height of the flood, nearly 3,000 people left their homes – more than half from First Nations communities. Near Morris, the metres-wide Red River grew to 16 km across, submerging rich farmland and highways. Total flood claims exceeded $40 million with 500 homes damaged or destroyed.

Three principal factors led to the spring flooding:

1) Heavy autumn rains, about 43 per cent more than normal, saturated the ground just before freezing in early December, which left little room for absorbing snow melt in the spring.

2) It was a snowy winter in southern Manitoba with some 25 per cent more snowfall than normal. Additionally, heavy snowfalls and copious spring rains – more than double the norm – swelled the critical headwaters of North Dakota sending excessive waters north into Canada via the Red River and its tributaries. Seasonable spring temperatures would have enabled the Red to handle the excessive melting gradually but unfortunately that was not the case.

3) Instead, an unseasonably cold spring slowed basin snow melting, ice decaying in rivers, and overland flow from ditches and culverts. On April 1, officials worried that 90 per cent of culverts east of the Red River were still frozen solid and over half of them to the west were blocked. Ice jamming in the north-flowing Red backed up water, spilling banks and turning the flood of inconvenience into a disaster. Residents living along low-lying areas of the Red and Assiniboine rivers began sandbagging.

In mid-April, a brief warm surge of weather weakened the river ice north of Winnipeg. Massive ice slabs, some the size of cars, became moving ramparts that ripped through properties. Some residents scampered onto roofs to stay dry. Giant pans of ice standing 6 m high were shoved up on the shore and deposited more than half a kilometre from the riverbank. The ice was powerful enough to take out trees and crush and rip apart hundreds of homes and structures with devastating effect. In other places, strong winds pushed the ice at times, raising water levels to flood stage. On April 16, the Red River crested only a half a metre below the level of 1997's "Flood of the Century," which forced 28,000 people from their homes and caused damage in excess of $500 million. This year's flood claimed two lives when an elderly couple's vehicle was swept into the river. Two months after flood waters receded, many municipalities, farmers and homeowners were still cleaning up.

In fact, as the seeding season got under way, many Manitoba fields remained waterlogged. The saturated ground, combined with the extremely wet weather and cold spring temperatures, delayed seeding in most parts of the province. Some producers in the Interlakes never did get onto their fields and 170,000 ha of Manitoba farmland went unseeded. This was one of the largest totals in recent years, triggering $21.5 million in insurance payments. Some farmers were so desperate to plant a crop they resorted to hiring an airplane to broadcast seed on their land from the air.

5. Cold and Drought Combo Wreak Havoc with Prairies Farmers

In sharp contrast to their counterparts in Manitoba, agriculture producers in Alberta and Saskatchewan faced one of the most challenging growing seasons in years with drought, cold, floods and hail. Farmers rarely confront the dual threats of frost and drought at the same time, but parts of the Prairies experienced their driest spring in 50 years and their coldest in 35 years. Cool weather delayed crop development by three to four weeks, and with the risk of frost continuing into July, producers never caught up even when killing cold and the first snows came much later than usual in mid-October. Until the first hint of warmth in mid-June, all the talk was about the cold, especially its duration of six months and counting. When the temperature approached 30°C for a day or two around mid-June, growers realized they were also in the midst of an invisible drought. June always brings some hope because it is often the wettest month. And growers and ranchers were going to need every drop of moisture they could get because 80 to 90 per cent of Alberta, Saskatchewan and B.C.'s Peace River region faced some of the driest conditions in years. Sadly, June rains never came. In a perverse way, maybe it was fortunate that sustained heat didn't happen: increased evaporation would have robbed the soil of even more moisture. Before the first day of summer, dire pronouncements were made on the upcoming growing season. Agriculture and Agri-Food Canada claimed spring 2009 was the driest in 70 years of records, comparable to the drought of 2002, except that this year was larger, more widespread and more severe in places. The Canadian Wheat Board projected lower crop prospects by 20 per cent across the Prairies. With livestock producers already feeding hay to cattle and starting to cull their herds, a dozen counties and municipal districts in Alberta declared a state of drought emergency or disaster.

Alberta and Saskatchewan were especially dry. For example, Saskatoon had less than one-quarter of the usual amount of spring precipitation, making the months of March, April and May the driest since record-keeping began in 1892. Even during the terrible dry years of 2001 and 2002, the spring was wetter and the drought less widespread. However, it wasn't just spring that was dry. The soil moisture recharge period between September 1, 2008 and March 31, 2009 had less than 60 per cent of normal precipitation. To the west in Alberta, conditions were even drier, as illustrated by precipitation amounts in Edmonton, where the 12- month total rain and snow from July 2008 to June 2009 was only 234 mm, less than half of normal and the driest such period with records dating back to 1880. Making matters worse, eight of the last ten years in Alberta's capital of Edmonton had less rain and snow than the 30-year average total, but no year was as scanty as the most recent. Not surprising, the flow of the North Saskatchewan River was at its third lowest level in nearly a century. Rains in July and August helped in parts of Saskatchewan. It was just too late to save parched crops in parts of the western Prairies.

6. Less Arctic Sea Ice Retreat but No Recovery

In Canadian waters, sea ice extent was similar to that of 2008, but its spatial distribution was different. According to the Canadian Ice Service, greater-than-normal concentrations of ice occurred in the southeastern Beaufort Sea under prevailing northerly winds that carried some of the multi-year pack ice southwards. In the central and western parts of the Northwest Passage, thicker and more extensive ice led to delays in navigability of the southern route, while the northern route did not become truly navigable at all. By contrast, both routes were navigable in the summers of 2007 and 2008. Despite the increased ice cover, there was a record number of vessels plying the Northwest Passage – from cruise to cargo ships and a row boat or two – no doubt in response to greater interest by adventurers and commercial concerns. Increasingly, more ice in the Northwest Passage consists of orphaned chunks of the thickest, oldest "multi-year" ice mass that has been steadily disintegrating and flowing more easily into the channels, preventing regular openings. This year, the Northeast Passage along the Siberia coast opened sufficiently that two German heavy-lift ships successfully traversed from Korea to Novyi Port in the Russian Federation with ice-breaker support.

In the eastern Canadian Arctic, ice concentrations were for the most part well below normal while, as the result of summer coolness in central Canada, ice in southern sections of Hudson Bay persisted right until the end of August – a month later than normal. Along the north coast of Ellesmere Island, because no open water leads developed this year, there were no further losses to the ice shelves and no new ice islands. The estimated number of icebergs drifting south of latitude 48°N into the trans-Atlantic shipping lanes was 1204, the most in 10 years, making the iceberg season the eleventh most severe since the tragic loss of the RMS Titanic in 1912.

The Arctic sea ice decline was slowed in 2009 for several reasons. Summer air and surface sea temperatures were still warmer than normal but cooler compared to 2007, especially in the Chukchi and Beaufort seas. Further, skies were cloudier in late summer – which slowed ice loss – and the wind pattern tended to spread the ice pack over a larger region but not export it out of the Arctic Ocean.

According to the National Snow and Ice Data Center in Boulder, Colorado, seasonal ice is now dominating the North, while the traditional thicker, perennial ice has decayed significantly. Today, close to 80 per cent of the Arctic sea ice is new, weaker, salty and less than a year old. Further, old, durable multi-year ice is slowly thinning, is more broken-up and is moving faster which all contributes to melting earlier in the season.

The Arctic's once perennial ice cover is becoming more seasonal and this is having an immediate impact on northern peoples. However, its effects on weather elsewhere are largely uncertain but potentially worrisome. Scientists cannot rule out the effects of vanishing ice on prolonged dryness in North America's Great Plains or cooling of the Gulf Stream. A warmed Arctic Ocean emits heat into the atmosphere that can drastically alter weather patterns. The Arctic is the world's refrigerator and is a key factor in stabilizing global climates. As a greater portion of the ice melts, larger expanses of darker-coloured sea water are exposed, absorbing more sunlight. An increase of just a few degrees – or even a fraction of a degree – can mean the difference between freeze and thaw, amplifying the warming in the North. This is why the Arctic is warming about three times faster than the global rate.

7. Multi-Million Dollar Hailer Pounds Urban and Rural Alberta

Just before midnight on August 2, a powerful storm moved out of the Rocky foothills and tracked southeastward across the province with wind and hail that left a devastating path of destruction to city and country. The main hail zone scarped the extreme northeastern portion of Calgary. Inside the city, hail diameters reached baseball size and wind speeds peaked at 107 km/h. In its wake, the storm left downed trees, broken windows and a swath of damage, knocking out power to several thousand customers. In some places, hail measured 10 cm deep. Parks crews in Calgary spent days cleaning up fallen trees and broken branches that had damaged several houses and vehicles. A direct hit on the city just 20 km to the southwest would have been catastrophic with damage losses in excess of $1 billion. Still, Canadian insurers estimated industry losses at $0.5 billion, which made it the second or third largest catastrophic event in Canadian history. The nearby town of Carstairs was devastated by the battering large hail. Literally every house in town suffered major hail damage. Some looked like they'd been hit by gunfire with gaping holes left in the siding. Repair crews set up mini camps nearby to help repair the damage – a job that is not likely to be completed this year. Hail damage stretched from Olds to Bow Island and was 55 km wide in places. Baseball-size hailstones crunched grain bins and stripped bark off trees, while powerful winds blew over sheds and barns. Some horses and cattle had to be euthanized. The massive hailstorm decimated over 600,000 ha of Alberta cropland spurring 1,500 hail crop damage claims. In total, two-thirds of the year's hail crop losses occurred as a result of the long weekend storm.

8. Hamilton's Record Costly Gully-Washer

On July 26, a huge storm cell stalled over the western end of Lake Ontario dumping copious amounts of rain. As lightning strikes shook the area, a growing deluge knocked out power and flooded streets. Hamilton was hard hit.Waves of thunderstorms pounded the city, leaving citizens with flooded basements and motorists stuck in traffic caused by road closures. The midday downpour turned Red Hill Creek near Stoney Creek into an angry brown torrent that forced the closure of nearby roads and highways. In intersections and parking garages, flood waters rose to the height of vehicle door handles. Water gushed into 7,000 basements and power was shut off to thousands of customers. While the Hamilton Airport observed only 28 mm of rain, radar estimates confirmed rainfall amounts in an unofficial gauge totaling 109 mm in two hours – worse than a 100-year storm and one of the most intense short-duration rainfalls on record in Canada. Conditions were made worse because the ground was super-saturated from storms two days earlier. Flooding turned streets into rivers and insurance losses totalled between $200 and $300 million.

In Toronto, parts of Lakeshore Boulevard near the Exhibition grounds were submerged. To the north, a pair of giant sinkholes swallowed part of Finch Avenue West – big enough to hold a fleet of cars and deep enough to cover a four-storey building. In places, water squirted through basement walls and gushed more than a metre high through manhole covers. In Mississauga, the relentless rains played havoc with the Canadian Open Golf championship for the second year in a row.

9. Winds Plough Through Alberta

On first look, severe summer weather across the Prairies appeared less frequent and less energetic in 2009, especially compared to the previous two very active summers. Undoubtedly, the enduring cold had something to do with it. Westerners witnessed only 17 tornadoes compared to the normal 33. Total severe weather events, including tornadoes, heavy rain, wind and hail, numbered only 189 across the Prairies – less than the recent 20-year average of 221 events, 131 fewer than last summer and less than half the 410 events in 2007. The one exception was severe wind, especially in Alberta, where the number of wind events was more than two times the 20-year average.

Extensive property destruction was the work of violent wind gusts often moving 15 to 20 km ahead of the main storm. Also called plough winds, these strong, sudden downdrafts bring cool, dense air from aloft, rapidly spreading it outward ahead of the thunderstorm or squall line. Plough winds often strike a larger area than tornadoes but can be just as strong. Straight-line winds are fairly common in the west, inflicting more property damage than tornadoes. One such wind blasted through Edmonton on July 18, toppling hundreds of trees and knocking out power to tens of thousands of customers. Wind gusts that clocked at 106 km/h ripped large branches from trees, throwing them about like toothpicks as spectacular lightning zigzagged across the sky and marble-size hail fell. A wind sensor mounted on a tower east of Edmonton recorded a gust speed of 134 km/h moments before snapping the tower in half. Another powerful wind storm on September 28 also took down hundreds of trees in and around the city. It was one of the worst years ever for Edmonton's urban forest. In both storms, city golf courses and parks were closed as crews worked for days clearing downed trees from fairways and trails.

The summer's most spectacular wind storm occurred on August 1 when a 200-km-long weather system, albeit discontinuous, roared across much of Alberta accompanied by heavy rain and hail. Just ahead of the "weather" was a gust front or plough wind packing winds in excess of 100 km/h. Environment Canada issued watches and warnings across central Alberta during most of the day. The strongest reported winds were 141 km/h at Three Hills and 125 km/h at Red Deer. Between 5 p.m. and 6 p.m., "hurricane-like" weather broke loose in Stony Plain west of Edmonton and in Camrose, disrupting outdoor festivals and country concerts. At the site of the Big Valley Jamboree in Camrose, violent winds shook the performance trailers and flattened the main concert stage where up to 100 people stood. Thunder, lightning and heavy rain continued to pummel the site as emergency crews worked frantically to rescue those trapped under twisted lumber and dangling steel. One person died and 75 were injured. First thought to be a tornado because of its sound and force, it was later confirmed as a freakish plough wind. Not finished yet, the same weather system was in Calgary two hours later where it roared through the downtown, scattering debris and cutting power. Wind gusts blew bundles of steel rods from the roof of a construction site 40 m to the street below where it tragically struck a family of four, killing a 3-year-old girl and injuring her brother and father.

10. Enduring Prairie Cold Ends Dramatically

Across the Prairies, winter started out cold and stayed that way with a season that seemed to go on for nine months. Westerners know about cold winter and are largely prepared for it, but when winter carries on through the longest and coldest spring in memory and is followed by a summer that refused to warm up, even the hardiest westerners begin to feel victimized by the weather. Desperate residents said they forgot what a warm day feels like and were looking forward to their first mosquito – a sure sign of warmth.

From December to August inclusive, the Prairies tied for the coldest nine months in 27 years. Every city in Manitoba, Saskatchewan, and central and northern Alberta endured nine straight months with below-normal temperatures. In Winnipeg, for example, there had never been ten consecutive months below normal in a century – possibly the longest stretch since the 1880s.

The following is just a sampling of the long, miserable cold across the West:

■ On March 11, the temperature in Regina dipped to -35.9°C. Not the coldest moment of the winter, but no date in mid-March has ever been colder in the Queen City in 127 years of records.

■ Ten days before spring, Edmonton recorded its coldest temperature of the winter at -42.7°C.

■ On May 15, the ground near North Battleford, Saskatchewan was still frozen rock solid five centimetres below the surface.

■ The Victoria long weekend in May looked more like Christmas morning for most of western Canada. At Grand Beach in Manitoba – a popular getaway for Winnipeg residents – the crowded beach of years past was instead populated by a few stragglers throwing snowballs. In Edmonton, snow fell on the May holiday for the first time in 15 years. In southeastern Saskatchewan, graders plowed area roads and power outages were reported after heavy snow downed power lines.

■ June 6 brought nearly four centimetres of snow to Calgary – the first time in 30 years a measurable amount of snow fell there in June. To the east in Cypress Hills, Saskatchewan, more than 38 cm of snow covered the ground.

■ During the second week of July, there was frost in parts of western Saskatchewan.

Remarkably, the “mini ice age” ended abruptly and dramatically in September. Golfers scrambled to book tee times and farmers laboured 18-hour days to bring in the harvest before the first frost and season's snowfall. In the waning days of summer, Edmonton saw a record-burning high of 32.2°C. Ten other weather records fell in Alberta on September 16, including two that had been held for more than a century. The next day, nine Saskatchewan centres broke record-high temperatures in the September heat wave. Rosetown was the hottest place in Canada with temperatures that soared to 37°C – likely the warmest temperature in Canadian history ever so late in the season! September was literally head and shoulders above the previous warmest, and something never seen before, it was the warmest month of the year. In places like Kindersley and North Battleford, there were more days above 30°C in September than in all of June, July and August. In fact, the seven warmest days in 2009 occurred in September.

On the first full day of fall, the temperature in Edmonton hit 34°C – its hottest day in 2009 and fewer than two degrees from the hottest day ever at the International Airport. At Calgary, the afternoon high peaked at 33.2°C, making it the hottest fall day on record (records go back to 1881) as well as the hottest day in 2009. Not to be outdone, Winnipeg enjoyed the warmest September on record – a full degree warmer than the previous record with observations back to 1872. Adding to the delight, there were only three wet days with a total precipitation of 22.5 mm or 43 per cent of normal. What a dramatic turnaround from one of the coldest summers in 100 years to the warmest September ever. And not just in Winnipeg! Throughout Manitoba, nearly every community established a new record for the warmest September on record. How bizarre was it? They were still doing mosquito fogging in Winnipeg on September 7, which is the latest recorded date this typically early-summer ritual has been done.

Source: “Top 10 Canadian Weather Stories for 2009", Meteorological Service of Canada - Environment Canada - Government of Canada, The Green Lane™ Website, 30 December 2009.

The same source applies for “Quiet and Gentle Hurricane Season” printed on page 14.

Les dix événements météorologiques canadiens les plus marquants de 2009

par David Phillips[2]

À l'échelle nationale, 2009 n'a rien eu d'exceptionnel au chapitre des températures ou des précipitations. En compilant toutes les statistiques, on s'aperçoit que 2009 a été un demi-degré plus chaud et un mince deux pour cent plus sec que la normale. Mais si l'on gratte un peu, si l'on décortique les statistiques, on constate que la météo n'a absolument rien eu de «normal». Le climat était déréglé d'un bout à l'autre du pays, et toutes les régions ont enregistré de nouveaux records ou se sont approchées des records existants. Parfois, la météo était très contrastée. Certaines régions ont connu en 2009 leurs périodes les plus humides et les plus sèches, subissant tour à tour inondations et sécheresses, ou enregistrant leur saison la plus chaude des cinquante dernières années et leur saison la plus froide en un siècle. La plupart des Canadiens diront que l'hiver a duré beaucoup trop longtemps à leur goût. Nous avons eu presqu'aussi froid au printemps que durant l'hiver. L'été s'est fait attendre jusqu'en septembre et le mois de novembre a ressemblé à ce qu'octobre aurait dû être s'il y en avait eu un.

Dix événements météorologiques canadiens les plus marquants en 2009

1	**L'été de notre déplaisir…Trop de chaleur dans l'extrême Ouest, pas assez ailleurs**
2	**La Colombie-Britannique en flammes**
3	**Tornades meurtrières et destructrices en Ontario**
4	**Des embâcles record sur la rivière Rouge**
5	**Le froid et la sécheresse font la vie dure aux agriculteurs des Prairies**
6	**Moins de recul de la glace de mer dans l'Arctique mais pas de reconstitution**
7	**Une tempête de grêle causant des millions de dollars de dommages s'abat sur les régions urbaines et rurales de l'Alberta**
8	**Hamilton - Des pluies intenses fort coûteuses**
9	**L'Alberta balayée par des vents**
10	**Les Praires: fin spectaculaire abrupte d'une longue période de froid**

Pour la deuxième année consécutive, les conditions météo décevantes de l'été ont constitué l'événement météorologique le plus marquant au Canada. En 2008, il a plu tout l'été. Le Québec et l'Ontario avaient enregistré des précipitations records. Cette année, le Canada atlantique a connu son été le plus pluvieux, tandis que la population du centre du Canada subissait du temps désagréablement froid, accompagné des pluies fréquentes et abondantes. La saison des feux de forêt fut tout en contrastes. Dans presque toutes les régions du pays, la situation n'a pratiquement jamais été aussi calme, mais la Colombie-Britannique a connu une année record et le bilan de la lutte contre les incendies de forêt y a frôlé les 400 millions de dollars. Et pour la première fois depuis neuf ans, plusieurs Canadiens ont péri dans des tornades. C'est également cette année que nous avons vécu l'une des heures les plus pluvieuses de l'histoire canadienne, quand plus de 100 mm d'eau se sont abattus en 90 minutes sur Hamilton, en Ontario. Les conditions météorologiques extrêmes ont causé des dommages matériels qui ont obligé les assureurs canadiens à débourser des millions de dollars, faisant de 2009 l'une de leurs années les plus coûteuses. Un des événements en question, une tempête de grêle en Alberta, a peut-être été le deuxième ou troisième événement météorologique le plus coûteux de l'histoire canadienne. Figurent aussi sur la liste des événements météorologiques marquants de 2009 les graves inondations causées par les embâcles le long de la rivière Rouge, au Manitoba, et le long de la rivière Saint-Jean, au Nouveau-Brunswick. L'amincissement et le rétrécissement de la glace de mer dans l'Arctique n'ont pas été aussi remarquables qu'au cours des deux étés précédents, mais ils ont eu un impact marqué sur la population, la végétation et la faune de la région. L'Alberta a connu plus que sa part d'événements météorologiques marquants cette année : des tempêtes de vent mortelles; des tempêtes de grêle qui ont dévasté aussi bien les zones rurales qu'urbaines; et des périodes de froid et de sécheresse prolongées. Les caprices de la météo ont mis les nerfs des agriculteurs canadiens à rude épreuve en 2009. Leur pire ennemi, la météo, a fini par devenir leur alliée la plus fidèle, grâce à une vague de chaleur en septembre puis à un mois de novembre sec qui ont sauvé les récoltes qui s'annonçaient désastreuses. En toute justice, il faut aussi parler des bonnes nouvelles. Notre air a été plus pur que par les années antérieures, nous n'avons pas subi de pannes de courant majeures pendant l'été et il y a eu moins de moustiques porteurs du virus du Nil occidental. Il faut aussi se réjouir que la saison des ouragans de 2009 ait été tranquille dans l'océan Atlantique et la mer des Caraïbes. Elle a en bonne partie épargné le Canada, ne causant que quelques averses gênantes et

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déluges.

Aussi incroyable que cela puisse paraître, ce fut encore une année chaude au Canada, la treizième consécutive, mais tout de même moins chaude que les années récentes. Toutes les régions ont enregistré des températures plus chaudes ou près des normales, particulièrement l'est de l'Arctique, qui a connu sa huitième période consécutive de janvier à novembre la plus chaude. Dans le Nord, le mercure a grimpé de presque deux degrés par rapport à la normale, ce qui en fait l'été le plus chaud jamais enregistré. Par contre, les Prairies ont déploré leur deuxième été le plus froid en 16 ans. À l'échelle planétaire, 2009 a aussi été une année chaude, selon l'Organisation météorologique mondiale. Les températures à la surface des terres ont été supérieures de 0,44 °C à la moyenne annuelle de 1961 à 1990, de sorte que 2009 est la cinquième année la plus chaude jamais enregistrée. La présente décennie (2000 à 2009) a été plus chaude que la précédente (1990 à 1999), et sans doute la plus chaude jamais enregistrée. Ce fut également le cas ici au Canada, la décennie qui s'achève a été de loin la plus chaude des 60 dernières années.

Les événements météorologiques les plus marquants de 2009 énumérés à la page précédente sont cotés de un à dix selon la mesure dans laquelle le Canada et les Canadiens et Canadiennes ont été touchés, les répercussions économiques et la période pendant laquelle l'événement a fait la manchette.

Source: "Les dix événements météorologiques les plus marquants de 2009", Service Météorologique du Canada - Environnement Canada - Gouvernement du Canada, Site web La voie verte[MC], 30 décembre 2009.

2010 International Year of Biodiversity

The United Nations proclaimed 2010 to be the International Year of Biodiversity, and people all over the world are working to safeguard this irreplaceable natural wealth and reduce biodiversity loss. This is vital for current and future human wellbeing. We need to do more. Now is the time to act.

The International Year of Biodiversity is a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on Earth.

The International Year of Biodiversity is a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on Earth.

Biodiversity is life. Biodiversity is our life.

2010 Année Internationale de la Biodiversité

L'Assemblée générale des Nations Unies a proclamé 2010 Année internationale de la diversité biologique (Décision 61/203), ce qui va contribuera à sensibiliser l'opinion publique sur l'importance de la biodiversité dans le monde. Il s'agit d'une occasion de:

- Souligner l'importance de la biodiversité pour notre bien-être;
- Réfléchir sur les actions que nous avons réalisées jusqu'à présent pour protéger la biodiversité;
- Encourager à redoubler nos efforts pour réduire le taux d'appauvrissement de la biodiversité.

Sauvegarder la biodiversité demande des efforts de la part de chacun d'entre nous. Grâce à des activités organisées dans le monde entier, la communauté internationale travaillera de concert pour assurer un avenir durable à l'ensemble de l'humanité.

La biodiversité, c'est la vie. La biodiversité, c'est notre vie.

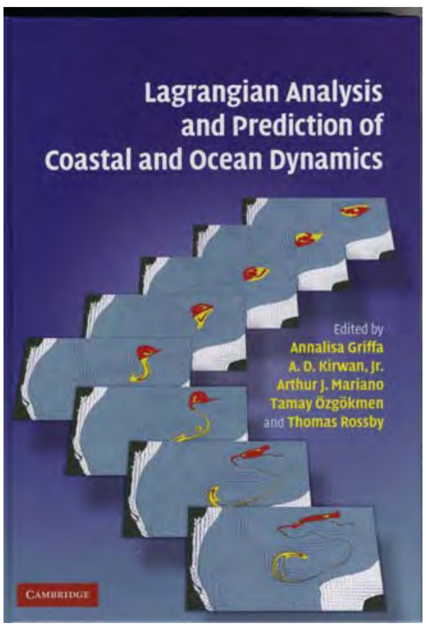
Lagrangian Analysis and Prediction of Coastal and Ocean Dynamics

Edited by Annalisa Griffa et al.

Cambridge University Press, 2007
ISBN-13 978-0-521-87018, pp 487, Hardback US$160

Book Reviewed by Howard Freeland [1]

As we all learned in our introductory lectures on fluid dynamics, there are two distinct approaches to the analysis of velocities in the atmosphere or in the oceans, the Eulerian and the Lagrangian approaches. In oceanography, until recently, the vast majority of velocity measurements have been made using the Eulerian approach, but Lagrangian, or more accurately, quasi-Lagrangian approaches are rapidly becoming more and more popular.



This nice book sets out to review what we presently know. The list of contributors is large (45) but the contributions have been edited by a much smaller group and does manage to convey some systematic approach to the topic. When I first worked with ocean drifters, 35 years ago, we did refer to the SOFAR floats as quasi-Lagrangian devices and I do wish that this concept survived better. In the case of SOFAR floats they were drifting on constant pressure surfaces and so could not accurately track fluid parcels. I note that at the last CMOS Congress in Halifax I took Amy Bower slightly to task. She had explained why she chose to use RAFOS floats for her experiment rather than Argo-type floats, and the reason was that Argo floats are not really Lagrangian. She is absolutely right, Argo floats are not very Lagrangian but I pointed out that her RAFOS floats were also not Lagrangian and when we follow floats as they cross a major topographic change, such as the tail of the Grand Banks, this could be important. In fact I don't believe anyone has ever tried to quantify just how Lagrangian such devices are or need to be, and I don't know how one would go about such a calculation.

There are three major sections to this book, and one minor section. The minor one is good fun; it is a selection of favourite trajectories by many of the authors. I found this section to be extremely entertaining. Interestingly, Argo has a similar section on its web pages, we regularly publish a short article on "the float of the month".

The major sections of the book focus firstly on the hardware with descriptions of the evolution of Lagrangian methods in the oceans. Then, after the favourite trajectories, we move onto the meat of the volume with some very difficult sections on the predictability of Lagrangian motion, methods of assimilating trajectories into ocean models, reviews of the statistics of particle motion, etc. The final section consists of several articles on Lagrangian biophysical dynamics and the importance of a Lagrangian approach to biological oceanography.

Given my own background, it is probably not surprising that I enjoyed the theoretical sections on particle dynamics. It was entertaining to see that, as it was 35 years ago, the starting point for much analysis on the statistics of Lagrangian particles is the seminal paper by G. I. Taylor in 1921. I found the review of turbulence regimes in the oceans by Rupolo to be particularly good, a difficult topic that remained quite readable.

I wish that the editors had created a list of abbreviations. Though I found the chapter on "Predictability of Lagrangian Motion" to be interesting, the constant struggle to track abbreviations made the reading much harder than it should have been. I wonder what a beginner in the topic would make of a major section to this chapter which has the unrevealing title "6.5.2 Comparison of RA with EKF using LSM[2]". As it happens I do know what it means, but I did try that title out on several friends with an interest in this sort of problem, and they all were completely mystified. The topic is actually important. If you are ever at sea and swept off your boat then the Canadian Coast Guard might be out there searching for you. In which case how well the modelling is done could actually be very important to your welfare and could determine whether you live or die.

I also enjoyed reading some of the material on Lagrangian biophysical dynamics, but this is very much outside of my own sphere of interest.

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[1] Research Scientist, Institute of Ocean Sciences, Fisheries and Oceans Canada, Sidney, BC, Canada

[2] 6.5.2 Comparison of Regression Algorithm with Ensemble Kalman Filter using Least Squares Method

This book belongs in any good oceanographic library and the price is about as expected. I checked and discovered that the librarian at the Institute of Ocean Sciences had already decided that we needed this book; it cost her US$156 through a book jobber. I will contribute this review copy to another oceanographic library that so far does not have a copy.

Estuaries: Dynamics, Mixing, Sedimentation and Morphology

David Prandle

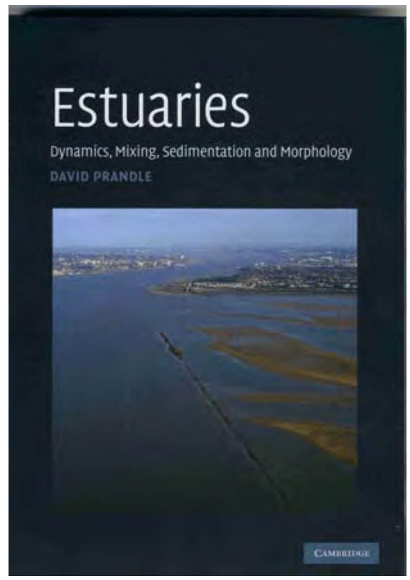
Cambridge University Press, 2009
ISBN 978-0-521-88886-8, pp.236, Hardback, US$130

BookReviewed by Marek Stastna[3]

This monograph is an expression of the author's views on, and experience with, the modelling of the movement of both water and sediment in estuaries. After an introductory chapter, the author presents four chapters covering estuarine hydrodynamics, follows this with three chapters dedicated to sediment motions and estuarine morphology and concludes with a chapter on "Strategies for Sustainability".

The Introductory chapter is a succinct and lucid summary of the results to be presented. It also reveals the U.K.-centric point of view of the book, which is not surprising, given the author's long experience in modelling British estuaries (especially the Mersey) and the large number of estuaries in which there are both substantial measurement records and high enough population to make study of the estuary economically worthwhile. The following three chapters address, in turn, the description of the tides, the details of the currents in the estuary, and the role that stratification due to salinity plays in the dynamics. All three chapters lean heavily towards linearized descriptions with semi-analytical solutions. Chapter 5 builds on the synthesis of currents from chapters 2-4, and develops models of sediment motion, again focussing on simple models solved semi-analytically. Chapters 6 and 7 develop the author's ideas on "synchronous estuaries", with chapter 6 focussing on dynamics and a theory for estuarine bathymetry, and chapter 7 focussing on sediment trapping and sorting. Chapter 8 discusses a case study of the effect of global climate change on the Mersey estuary.

The book is written in clear prose, with many black and white figures which, due to their number, vary in lucidity. On balance, both the text and figures are of good quality, though the index is a bit sparse (the rather detailed table of contents goes some way to remedy this). The book is quite equation heavy, with a tendency to reference previous formulae instead of explaining their role in further derivations. At times, I found this to be distracting, but on balance, the book proved reasonable to follow. Each chapter ends with a list of references. While these are clearly slanted toward works that the author favours, or has been influenced by, I found there to be a commendably wide variety of works referenced, certainly more than I could imagine following up on. Indeed, the author's comments in the text often point to an interesting topic or observation that is discussed further in the provided reference. The diligent reader is thus provided with plenty of fertile ground for exploration, especially given that the book runs less than 250 pages.



The book could be of interest to coastal engineers and oceanographers, though it is difficult for me to see how it could be used as a textbook (except perhaps for a reading course). For the sort of students I interact with (applied mathematicians, mostly), parts of this book could provide a very good read, that impresses both the need for simplified descriptions and reliable data. Students who are timid with mathematics, might have more trouble with the onslaught of formulae and might forget to question the many core assumptions the models must make in order to extract the formulae presented. Personally, I found the book to be oddly formula heavy, yet light on dynamics. While I certainly appreciate the difficulties in formulating models of estuaries, I am not sure whether all models need to be reduced to final expressions involving combinations of simple polynomials, trigonometric and exponential functions in order to be of use. Indeed, while the author discusses detailed numerical models of the Mersey estuary late in the book, I found that by this point I was simply quite tired and any balance between analytical formulae and numerical modelling the author was seeking to convey, was simply lost on me. Moreover, I was quite surprised that internal waves, which are guaranteed to play some role in nearly all estuaries at one point or another are discussed in a single paragraph on a single page with no formulae at all. Thus, while I may not share the author's point of view, I do find myself returning to various places in the book, to re-examine a figure or two and its attendant description, and I suspect that most readers would find their

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University of Waterloo, Waterloo, ON
Canada

experience with the book to be similar. At US$130.00, I probably would not purchase the book personally, but would recommend it to my library.

There is a further interesting point that this book brings up, given the audience of this review. I believe that the methodological choices the author makes are in large part driven by the high and long established population density around most of the estuaries in Britain, and indeed in most of Europe. Canada, with its immense sea coasts has countless estuaries (as well as some large, estuary-like river outflows into the Great Lakes), though comparatively few are "tamed" in the sense of the Mersey or the Thames. Thus, I can imagine that Canadian estuaries might not call for modelling approaches that yield taxonomical classification and ready-to-use bulk formulae at the price of a fuller description of the relevant dynamics, benefiting instead from well constructed numerical case studies and novel remote sensing approaches to data gathering.

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

The Dynamics of Coastal Models, by Clifford J. Hearn, Cambridge University Press, ISBN 978-0-521-80740-1, 2008, pp.488, Hardback, US$100.

Basics of the Solar Wind, by Nicole Meyer-Vernet, Cambridge University Press, ISBN 978-0-521-81420-1, 2008, pp.463, Hardback, US$132.

Mesoscale Dynamics, by Yuh-Lang Lin, Cambridge University Press, ISBN 978-0-521-80875-0, 2008, pp.630, Hardback, US$165.

Chemical Oceanography and the Marine Carbon Cycle, by Steven Emerson and John I. Hedges, Cambridge University Press, ISBN 978-0-521-83313-4, 2008, pp.366, Paperback, US$90.

An Introduction to Ocean Turbulence, by S. A. Thorpe, Cambridge University Press, ISBN 978-0-521-67680-9, 2007, pp.240, Paperback, US$60.

Aquatic Ecosystems: Trends and Global Perspective, Edited by Nicholas V.C. Polunin, Cambridge University Press, ISBN 978-0-521-83327-1, 2008, pp. 482, Hardback, US$160.

Physics of the Earth, by Frank D. Stacey and Paul M. Davis, Cambridge University Press, ISBN 978-0-521-87362-8, 2008, 4th Edition, pp. 532, Hardback, US$80.

Drinking Water Quality: Problems and Solutions, by N.F. Gray, Cambridge University Press, ISBN 978-0-521-70253-9, 2008, 2nd Edition, pp. 520, Paperback, US$70.

Ecological Climatology: Concepts and Applications, by Gordon B. Bonan, Cambridge University Press, ISBN 978-0-521-69319-6, 2008, 2nd Edition, pp. 550, Paperback, US$80.

Beach and Dune Restoration, by Karl F. Nordstrom, Cambridge University Press, ISBN 978-0-521-85346-0, 2008, pp. 187, Hardback, US$140.

Applied Geophysics in Periglacial Environments, Edited by C. Hauck and C. Kneisel, Cambridge University Press, ISBN 978-0-521-88966-7, 2008, pp. 240, Hardback, US$140.

Hydroclimatology, Perspective and Applications, by Marlyn L. Shelton, Cambridge University Press, Hardback, 2009, ISBN 978-521-84888-6, pp.426, US$90.

Managing and Transforming Water Conflicts, by Jerome Delli Priscoli and Aaron T. Wolf, International Hydrology Series, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-63216-4, pp.354, US$140.

Principles of Snow Hydrology, by David R. DeWalle and Albert Rango, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-82362-3, pp.410, US$150.

Atmospheric Thermodynamics, Elementary Physics and Chemistry, by Gerald R. North and Tatiana L. Erukhimova, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-89963-5, pp.267, US$70.

Adapting to Climate Change, Thresholds, Values, Governnance, Edited by W. Neil Adger, Irene Lorenzoni and Karen L. O'Brien, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-76485-8, pp.514, US$125.

Machine Learning Methods in the Environmental Sciences, Neural Networks and Kernels, by William W. Hsieh, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-79192-2, pp.349, US$65.

Heliophysics, Plasma Physics of the Local Cosmos, edited by Carolus J. Schrijver and George L. Siscoe, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-11061-7, pp.435, US$60.

Waves and Mean Flows, by Oliver Bühler, Cambridge Monographs on Mechanics, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-86636-1, pp.341, US$99.

Ionospheres, Physics, Plasma Physics and Chemistry, Edited by Robert Schunk and Andrew Nagy, Hardback, 2009, ISBN 978-0-521-87706-0, pp. 628, US$150.

The Hydrogen Economy, Opportunities and Challenges, Edited by Michael Ball and Martin Wietschel, Hardback, 2009, ISBN 978-0-521-88216-3, pp. 646, US$135.

Integrated Regional Assessment of Global Climate Change, Edited by C. Gregory Knight, Jill Jäger, Cambridge University Press, Hardback, 2009, ISBN 978-0-521-51810-9, pp.412, US$125.

Atelier d'été en météorologie
Projet Atmosphère 2010

Demande de candidats enseignants de niveau pré-collégial

Comme par les années passées, la Société canadienne de météorologie et d'océanographie (SCMO) a été invitée à choisir un enseignant canadien qui participera au PROJET ATMOSPHÈRE. Il s'agit d'un atelier d'été à l'intention des enseignant(e)s de niveau pré-collégial spécialistes en sciences atmosphériques; cet atelier est parrainé par l'American Meteorological Society (AMS) et la National Oceanic and Atmospheric Administration (NOAA) américaine. Il aura lieu du **18 au 30 juillet 2010** au centre de formation du National Weather Service à Kansas City au Missouri.

Les dépenses de l'enseignant(e) choisi(e) seront assumées par l'AMS et la NOAA, avec une contribution financière de la SCMO et du Conseil canadien pour l'enseignement de la géographie (CCEG). Ceci n'inclus pas les déplacements à destination et au retour de Kansas City pour lesquels la SCMO et le CCEG offrent chacun 300 $ (canadiens), soit un total de 600 $, au participant(e) canadien(ne) choisi(e).

Les ancien(ne)s participant(e)s du Canada ont trouvé leur expérience très enrichissante et stimulante. Les exposés de l'atelier sont présentés par des experts américains les plus réputés dans les sciences atmosphériques et océanographiques. Les enseignant(e)s sont revenu(e)s avec du matériel, des ressources et des modules didactiques qu'ils peuvent facilement adapter dans leurs cours.

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site de la SCMO sur la toile à www.scmo.ca/hsworkshop.html où ils peuvent obtenir un formulaire d'application. Ils trouveront aussi sur ce site les rapports des enseignant(e)s qui ont déjà participé à ces ateliers. Ils peuvent également obtenir un formulaire en le demandant à l'adresse ci-dessous.

Les formulaires dûment remplis doivent être envoyés à l'adresse ci-dessous au plus tard le **15 mars 2010.** Les candidat(e)s sont encouragé(e)s à soumettre leur formulaire dès que possible.

SCMO - Atelier Projet Atmosphère
Casier postal 3211, Station D
Ottawa, ON K1P 6H7
Téléphone: (613) 990-0300
Télécopie: (613) 990-1617
courriel: education@scmo.ca

Notez que le cours et le formulaire d'application ne sont disponibles qu'en anglais.

Summer Meteorology Workshop
Project Atmosphere 2010

Call for Applications by Pre-College Teachers

As in previous years, the Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in PROJECT ATMOSPHERE. This is a summer workshop for pre-college teachers of Atmospheric Science topics sponsored by the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA) of the United States. It will take place from **18 to 30 July 2010** at the National Weather Training Center, Kansas City, Missouri.

The essential expenses for the participating teacher are paid by AMS/NOAA, with a financial contribution from CMOS and the Canadian Council for Geographic Education (CCGE). This does not include the travel to and from Kansas City for which CMOS and CCGE provide $300 (Canadian) each (total of $600) to the selected Canadian participant.

Previous Canadian participants have found their attendance a very rewarding and significant experience. Presentations are made at the Workshop by some of the most respected American Scientists in the fields of atmospheric and oceanographic sciences. Participants have returned with material, resources and teaching modules readily adaptable to classroom presentations.

Interested teachers can obtain more information on the workshop and an application form on the CMOS website (www.cmos.ca/hsworkshop.html). Reports from previous participants can also be found on the CMOS website. An application form can also be requested by writing to the address below.

Completed application forms should be submitted to the address below no later than **March 15, 2010**. Applicants are encouraged to submit their forms as soon as possible.

CMOS - Project Atmosphere Workshop
P.O. Box 3211, Station D
Ottawa, ON K1P 6H7
Telephone: (613) 990-0300
Fax: (613) 990-1617
e-mail: education@cmos.ca

Announcement and Call for Papers

CMOS/CGU Joint Congress

The joint CMOS/CGU Congress will be held on May 31 to June 4, 2010 in Ottawa, Ontario at the Crowne Plaza. This will be the 44th Annual Congress of the Canadian Meteorological and Oceanographic Society (CMOS) and the 36th Annual Scientific Meeting of the Canadian Geophysical Union (CGU). This will be the third occasion for a joint Congress between the two societies. The Congress theme for this year will be *"Our Earth, Our Air, Our Water: Our Future*". See

http://cmos.ca/congress2010/indexe.html

The Congress will feature :

● Plenary presentations by leading researchers;

● Science sessions that highlight top Canadian and international research contributions spanning the meteorological, oceanographic, geophysical, climatic and hydrologic sciences, as well as the policy implications of research in these fields;

● An evening lecture of general-interest, open to the public;

● A banquet, a hosted lunch, awards of CMOS and CGU prizes, and the Annual General Meetings of both societies.

Please submit abstracts electronically to the link found on the Congress website

http://cmos.ca/congress2010/abstractse.html)

after January 7, 2010 and before the deadline of February 17, 2010. You will be asked to submit your abstract to one of several planned sessions that are listed on the website and to specify your preference for either an oral or a poster presentation. An abstract fee of $50 will be charged at the time of submission. Your abstract will be evaluated by the Scientific Program Committee and you will be notified of acceptance by **2 March 2010**. Details for your oral or poster presentation will be provided by **17 March 2010**.

CMOS and CGU student members are welcomed and encouraged to apply for a Student Travel Bursary when submitting an abstract; the application form may be found at

http://cmos.ca/congress2010/studentse.html

The deadline for submission is **February 26, 2010**.

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.cmos.ca/congress2010

and contact the Chair of the Local Arrangements Committee for further information.

- *Dick Stoddart* (dick.stoddart@sympatico.ca)
- *Rod Blais* (blais@ucalgary.ca)

Co-Chairs of the Scientific Program Committee for the Ottawa 2010 Congress.

Annonce et appel à des soumissions de résumés

Congrès conjoint SCMO/UGC

Le Congrès conjoint SCMO/UGC aura lieu du 31mai au 4 juin 2010 à Ottawa, en Ontario, au Crowne Plaza. Il s'agira du 44e Congrès annuel de la Société canadienne de météorologie et d'océanographie (SCMO) et de la 36e Rencontre scientifique annuelle de l'Union géophysique canadienne (UGC). Il s'agira de la troisième participation de ces deux sociétés à un congrès conjoint. Cette année, le thème du congrès sera : *"La Terre, l'air et l'eau : Notre avenir*". Visitez

http://scmo.ca/Congress2010/indexf.html

Le congrès comprendra :

● Des conférences plénières réalisées par des scientifiques à la fine pointe de la recherche;

● Des sessions scientifiques accentuant les contributions ultimes de la recherche canadienne et internationale dans les domaines du climat, de la météorologie, de l'océanographie, de la géophysique et de l'hydrologie, ainsi que les implications politiques de la recherche avancée dans ces domaines.;

● Une présentation d'intérêt général dans la soirée ouverte au public;

● Un banquet, un déjeuner inclus, la remise des prix de la SCMO et de la UGC, et l'assemblée générale annuelle des deux sociétés.

Veuillez soumettre vos résumés électroniquement en utilisant le lien sur le site du congrès

http://www.scmo.ca/Congress2010

entre le **7 janvier et le 17 février 2010**. Vous devrez soumettre votre résumé sous une des nombreuses sessions affichées sur le site et spécifier votre préférence quant à une présentation orale ou une présentation affichée. Un frais de $50 sera retenu au moment de la soumission. Votre soumission sera évaluée par le comité du programme scientifique du congrès qui vous avisera de son acceptation le **2 mars 2010**. Les détails pour votre présentation orale ou affichée vous seront communiqués le **17 mars 2010**.

Les membres étudiants de la SCMO sont les bienvenus et ils sont encouragés à soumettre une demande de bourse étudiante d'aide au voyage lors de la soumission de leur résumé; le formulaire d'application se trouve à :

http://cmos.ca/congress2010/studentsf.html

La date butoir pour les soumissions est le **26 février 2010.**

Si vous êtes un exposant, un éducateur, un membre des médias, ou quelqu'un avec un intérêt particulier pour le congrès, veuillez visiter le site Web du congrès

http://cmos.ca/Congress2010/indexf.html

ou contactez le président du Comité des arrangements locaux pour obtenir plus d'information.

- *Dick Stoddart* (dick.stoddart@sympatico.ca)
- *Rod Blais* (blais@ucalgary.ca)

Coprésidents du Comité du programme scientifique pour le Congrès de 2010 à Ottawa.

Call for Nominations for CMOS Prizes and Awards

Background:

The Prizes and Awards Committee is anxious to receive nominations for CMOS awards and offers the following background information for potential nominators. The Committee is made up of meteorological and oceanographic researchers and managers from academia, government and non-government agencies.

1) The Committee requires a nominating letter that should include an up-to-date CV and a summary of the candidate's work that is to be considered for an award. Note that the President's Prize and the Roger Daley Postdoctoral Publication Award pertain to a specified scientific paper, book or other major publication.

2) Letters of support are essential and should indicate the extent of influence of the candidate's work.

3) The Committee prefers that nominations and supporting documentation be submitted in electronic format; however, hard-copy material will be accepted if electronic material is not available.

All Society members are encouraged to consider nominating individuals of the meteorological or oceanographic community who have made significant contributions to their fields. The award categories are:

- The President's Prize
- The J.P. Tully Medal in Oceanography
- The Dr. Andrew Thomson Prize in Applied Meteorology
- The François J. Saucier Prize in Applied Oceanography
- Rube Hornstein Medal in Operational Meteorology
- The Tertia MC Hughes Memorial Graduate Student Prize
- Roger Daley Postdoctoral Publication Award
- The Neil J. Campbell Medal for Exceptional Volunteer Service
- Citations

Nominations received by 15 February by the Executive Director at the address shown on page 2 will be forwarded to the Committee.

Appel de mises en candidature pour les Prix et Honneurs de la SCMO

Préambule:

Le Comité des prix et honneurs de la SCMO attend avec impatience les mises en candidature pour les prix de la SCMO et désire donner l'information pertinente suivante aux personnes faisant des nominations. Le Comité est constitué de chercheurs et gestionnaires en météorologie et océanographie du monde universitaire, du gouvernement et des agences non-gouvernementales.

1) Le Comité demande une lettre de nomination dans laquelle on devrait trouver un curriculum vitae mis-à-jour et un sommaire du travail du candidat qui devrait être considéré pour l'attribution d'un prix. Prière de prendre note que le Prix du Président et le Prix de publication postdoctoral Roger Daley s'adressent spécifiquement à une communication scientifique, un livre ou une publication d'importance.

2) Des lettres supportant la candidature sont essentielles et devraient indiquer l'étendue de l'influence du travail du candidat.

3) Le Comité préfère recevoir les nominations et les documents les supportant sous forme électronique; par contre, des copies papier seront acceptées en l'absence de document électronique.

Tous les membres de la société sont encouragés à présenter des nominations de personnes considérées comme ayant contribué de façon significative dans leur sphère d'activités tant en océanographie qu'en météorologie. Les catégories de prix sont:

- Prix du président
- Médaille de J.P. Tully en océanographie
- Prix du Dr. Andrew Thomson en météorologie appliquée

• Le prix François J. Saucier en océanographie appliquée
• Médaille de Rube Hornstein en météorologie opérationnelle
• Les prix commémoratifs Tertia M.C. Hughes
• Le prix Roger Daley pour une publication postdoctorale
• La médaille Neil J. Campbell pour service bénévole exceptionnel
• Citations

Les soumissions reçues au plus tard le 15 février par le Directeur exécutif à l'adresse mentionnée à la page 2 seront transmises au Comité.

CMOS 2010 Photo Contest

All members with a photographic bent are invited to participate in the 2010 Photo Contest. Please submit your own original image files, either in colour or black and white, from scans or digital capture of a meteorological or oceanographic subject, event, or phenomenon. Details on the photo contest can be found on the CMOS Web Page at:

http://www.cmos.ca/photocontest.html

The deadline for submissions is **May 15, 2010.** If you have any questions please contact Bob Jones at webmaster@cmos.ca.

Concours photographique 2010 de la SCMO

Tous les membres qui ont une passion pour la photographie sont invités à participer au concours de photographie 2010 de la SCMO. Prière de soumettre vos photos numériques originales, soit en couleur, soit en noir et blanc, à partir de copie papier ou de fichier numérique portant sur des sujets ou phénomènes météorologiques ou océanographiques. Les détails du concours se trouvent sur le site web de la SCMO à:

http://www.scmo.ca/photocontest.html.

La date butoir pour les soumissions est le **15 mai 2010.** Pour toutes questions, prière de contacter Bob Jones à webmaistre@scmo.ca.

CMOS on Facebook

Facebook.com is a popular social networking website with over 350 million active users around the world, half of which log on to the site on any given day of the week. In December 2009, a Facebook group for all CMOS members was created and is open to any member that has an active Facebook account (which is free). The group is named the Canadian Meteorological and Oceanographic Society CMOS/SCMO and can be found using the search tool on the Facebook main page. Currently the group website provides information about CMOS, a discussion board and photos. CMOS particularly hopes to see activity on the discussion board, where any member can initiate and participate in discussions related to the fields of atmospheric and oceanic sciences. Another Facebook group specifically for the Alberta Centre has been up and running since summer 2009, providing additional local centre information to group members.

Lesley Elliot
CMOS Office, Ottawa

La SCMO sur Facebook

Le site web de résautage social populaire Facebook.com compte plus de 350 millons d'adeptes de par le monde, dont la moitié visite le site à tout jour de la semaine. Depuis décembre 2009, un groupe Facebook pour tous les membres de la SCMO existe et est ouvert à tout membre ayant un dossier Facebook actif (gratuit). Le groupe, nommé <Canadian Meteorological and Oceanographic Society - CMOS/SCMO> [NDLR: le nombre de caractères alloués pour le nom ne permet pas d'inscrire le nom français au long] se trouve au moyen de l'outil de recherche sur la page principale de Facebook. En ce moment, le site du groupe offre de l'information à propos de la SCMO, une page de discussion et des photos. La SCMO espère voir de l'action sur la page de discussion, où tout membre peut initier et participer à des discussions reliées aux domaines des sciences atmosphériques et océaniques. Depuis l'été 2009, un autre groupe Facebook créé specialement pour le Centre de l'Alberta est en activité, fournissant d'autres informations pour les membres du Centre local.

Lesley Elliott
Bureau de la SCMO, Ottawa

Report of the Nominating Committee

The nominating committee consists of the past-president (Chair), President and Vice-president. So for the present year, the committee consisted of Andrew Bush (Chair), Bill Crawford and David Fissel. We are happy to report the following people have agreed to stand for election to the CMOS executive for 2010-11.

President Président	***David Fissel***, President and CEO, ASL Environmental Sciences Inc.
Vice-President Vice-Président	**Norman MacFarlane**, Term Professor, University of Victoria, Emeritus Scientist, Canadian Centre for Climate Modelling and Analysis (CCCma)
Treasurer Trésorier	***Rich Pawlowicz***, Associate Professor, University of British Columbia
Corresponding Secretary Secrétaire correspondant	***Jane Eert***, Research Scientist, Institute of Ocean Sciences, Fisheries and Oceans Canada
Recording Secretary Secrétaire d'assemblée	***Sophia (Sophie) Johannessen*** Research Scientist, Institute of Ocean Sciences, Fisheries and Oceans Canada
Past President Président d'office	***William (Bill) Crawford***, Head, State of the Ocean Section, Institute of Ocean Sciences, Fisheries and Oceans Canada
Councillors-at-Large (3) Conseillers (3)	• **John Parker**, Environment Canada (MSC) Dartmouth, NS • **Charles Lin**, Director General, Atmospheric Science and Technology Directorate, Environment Canada / Directeur Général, Science et technologie de l'atmosphère, Environnement Canada • To be determined / À déterminer

Rapport du Comité de mise en candidature

Le comité de mise en candidature est formé du Président sortant, du Président et du Vice-Président. Pour cette année, le comité était donc formé de Andrew Bush (Président), Bill Crawford et David Fissel. Nous sommes heureux d'annoncer que les personnes suivantes ont accepté que leur nom soit mis en candidature pour l'élection de l'Exécutif de la SCMO pour 2010-2011 (Voir tableau ci-haut).

Andrew Bush
Chair, Nominating Committee
Edmonton, AB

A-O Abstracts Preview

Avant Première des résumés de A-O

The following abstracts will soon be published in your next ATMOSPHERE-OCEAN publication.

Les résumés qui suivent paraîtront sous peu dans votre prochaine revue ATMOSPHERE-OCEAN.

A Systems Dynamic Modelling Approach to Assessing Elements of a Weather Forecasting System

by V. Rajasekaram, G. A. McBean and S. P. Simonovic

Abstract
The objective of a weather forecasting system is to provide information of maximum benefit to the users. One measure of those benefits is the skill of the forecasting system. Other measures of benefits can be gained through polling and socio-economic analyses. Assuming the benefits can be quantified, the role of management is to make investments in the weather forecasting system such that the benefits are maximized. The system capacity depends on investments in observing, in telecommunication and computing systems, in research and development and in people. In order to study a weather forecasting system from this point of view, a system dynamics simulation model has been developed. The model incorporates different factors that contribute to the quality of a forecast and recognizes that a role of management is to divide the budget into relevant activities. The factors include capital investment, meteorological research, numbers of forecasters, and the number of weather observing stations. The system dynamics modelling technique facilitates a dynamic analysis of impacts due to differential investment options. The cases of changes in allocations of funds from specific activities are analyzed. Typical fund management scenarios based on different policy options are also simulated. Illustrative case studies are shown, recognizing the limitations of the model and the available data.

Résumé
L'objectif d'un système de prévision météorologique est de fournir aux utilisateurs les renseignements les plus utiles possibles. L'habileté d'un système de prévision est une mesure de cette utilité. On peut obtenir d'autres mesures de l'utilité du système par des sondages et des analyses socio-économiques. En supposant que l'utilité peut être quantifiée, le rôle de la direction est de faire des investissements dans le système de prévision météorologique qui ont pour effet d'en maximiser l'utilité. La capacité du système dépend des investissements faits dans l'observation, dans les systèmes de télécommunications et de traitement informatique, dans la recherche et le développement ainsi que dans le personnel. Pour étudier un système de prévision météorologique de ce point de vue, nous avons mis au point un modèle de simulation de la dynamique du système. Le modèle incorpore différents facteurs qui contribuent à la qualité d'une prévision et reconnaît que l'un des rôles de la direction est de répartir le budget dans des activités pertinentes. Les facteurs comprennent un investissement en capital, la recherche en météorologie, le nombre de prévisionnistes et le nombre de stations d'observation. La méthode de modélisation de la dynamique du système facilite une analyse dynamique des impacts des différentes options d'investissement. Nous analysons différentes possibilités de changements dans l'allocation des fonds pour des activités particulières. Des scénarios classiques de gestion de fonds basés sur différentes options stratégiques sont aussi simulés. Nous présentons des études de cas indicatives, tout en reconnaissant les limites du modèle et des données disponibles.

Impact Study with Observations Assimilated over North America and the North Pacific Ocean on the MSC Global Forecast System. Part I: Contribution of Radiosonde, Aircraft and Satellite Data

by Stéphane Laroche and Réal Sarrazin

Abstract
A series of observing system experiments for the two-month period January-February 2007 was carried out to assess the impact of radiosonde and aircraft data available over North America, as well as the impact of satellite data available over the North Pacific Ocean, on the global data assimilation and forecast system of the Meteorological Service of Canada (MSC). The impact is estimated by comparing two data assimilation and forecast cycles: one (control) assimilates all the observations operationally available while the other (experimental) is identical to the control except that the data from the observing network being examined is denied. In the first part of this study, presented in this paper, particular attention is given to the propagation and magnitude of the impact of the data from these observing networks. It is found that the impact on the accuracy of forecasts over the North American continent is not uniform. Radiosonde and aircraft data combined are the main contributors to the skill of short-range forecasts over North America. However, as the effect of satellite observations over the North Pacific Ocean moves downstream over the continent, their impact on forecasts becomes dominant for forecast lengths longer than 36 h over western North America, and longer than 72 h over the eastern part of the continent. The impact of these satellite observations is more important over the continental United States than over Canada. In data-denial experiments, the impact of aircraft data and radiosonde observing networks over southern Canada and the United States used individually is much weaker than their combined impact. For short-range forecasts, the effect of aircraft observations is more important than radiosonde data over eastern North America. Finally, the quality of the forecasts over the Canadian Arctic relies heavily on the radiosonde network.

Résumé
Nous avons mené une série d'expériences sur des systèmes d'observation pour la période de deux mois de janvier-février 2007 afin d'évaluer l'impact des données de radiosondages et d'avions disponibles pour l'Amérique du Nord de même que l'impact des données satellitaires disponibles pour le Pacifique Nord sur le système global d'assimilation des données et de prévisions du Service météorologique du Canada (SMC). Nous estimons l'impact en comparant deux cycles d'assimilation des données et de prévisions: l'un (de contrôle) assimile toutes les observations opérationnellement disponibles alors que l'autre (expérimental) est identique au cycle de contrôle sauf que les données du réseau d'observation examiné sont rejetées. Dans la première partie de

cette étude, qui fait l'objet du présent article, nous portons une attention particulière à la propagation et à l'ampleur de l'impact des données de ces réseaux d'observation. Il ressort que l'impact de ces données sur l'exactitude des prévisions au-dessus du continent nord-américain n'est pas uniforme. Les données de radiosondages et d'avions combinées sont les principaux contributeurs de l'habileté des prévisions à court terme en Amérique du Nord. Cependant, comme l'effet des observations satellitaires dans le Pacifique Nord se déplace en aval sur le continent, leur impact sur les prévisions devient prédominent dans les prévisions ayant un terme plus long que 36 heures dans l'ouest de l'Amérique du Nord et plus long que 72 heures dans la partie est du continent. L'impact de ces observations satellitaires est plus important au-dessus des États-Unis continentaux qu'au-dessus du Canada. Dans les expériences avec données rejetées, l'impact des données avions et des réseaux d'observation par radiosondages dans le sud du Canada et aux États-Unis utilisés séparément est beaucoup plus faible que leur impact combiné. Pour les prévisions à court terme, l'effet des observations par avions est plus important que celui des données de radiosondages dans l'est de l'Amérique du Nord. Finalement, la qualité des prévisions dans l'Arctique canadien est étroitement liée au réseau de radiosondage.

Impact Study with Observations Assimilated over North America and the North Pacific Ocean on the MSC Global Forecast System. Part II: Sensitivity Experiments

by Stéphane Laroche and Réal Sarrazin

Abstract
A series of observing system experiments (OSEs) for the two-month period January-February 2007 was carried out to assess the impact of radiosonde and aircraft data available over North America, as well as the impact of satellite data available over the North Pacific Ocean on the global data assimilation and forecast systems of the Meteorological Service of Canada. This paper presents the second part of the study and examines the validity of the conclusions drawn with respect to the assimilation scheme used (i.e., the three- or four-dimensional variational (3D-Var or 4D-Var) data assimilation scheme) and to the horizontal resolution of the forecast model selected. The effect of the weather regime that prevailed during the evaluation period is also investigated. When radiosonde data are denied over North America, as well as over the globe, the forecast impact over the Canadian Arctic is larger using the 3D-Var scheme than the 4D-Var scheme. This indicates that the 4D-Var scheme is more effective at extracting information from other types of observations from nearby regions. For short-range forecasts, the results are closer to each other when changing the horizontal resolution of the forecast model than they are when changing the assimilation scheme. In order to assess the effect of the weather regime, the individual results for January are compared with those for February. This is possible because the large-scale circulations during these two one-month periods are significantly different. It is found that the large-scale flow has a significant effect on the propagation of the impacts of data denial, leading to noticeable variations of their magnitudes over areas located downstream.

Résumé
Nous avons mené une série d'expériences sur des systèmes d'observation pour la période de deux mois de janvier-février 2007 afin d'évaluer l'impact des données de radiosondages et d'avions disponibles pour l'Amérique du Nord de même que l'impact des données satellitaires disponibles pour le Pacifique Nord sur le système global d'assimilation des données et de prévisions du Service météorologique du Canada. Cet article présente la deuxième partie de l'étude et examine la validité des conclusions tirées relativement au schéma d'assimilation utilisé (c'est-à-dire le schéma d'assimilation variationnelle des données à trois ou à quatre dimensions — 3D-Var ou 4D-Var) et à la résolution horizontale choisie dans le modèle de prévision. L'effet du régime météorologique qui a prévalu durant la période d'évaluation est également étudié. Quand les données de radiosondage sont rejetées pour l'Amérique du Nord, ainsi que pour la planète entière, leur impact sur les prévisions dans l'Arctique canadien est plus grand avec le schéma 3D-Var qu'avec le schéma 4D-Var. Cela indique que le schéma 4D-Var est plus efficace à extraire l'information d'autres types d'observations faites dans les régions voisines. Pour les prévisions à court terme, les résultats sont plus proches les uns des autres lorsqu'on change la résolution horizontale du modèle de prévision qu'ils ne le sont lorsqu'on change le schéma d'assimilation. Pour évaluer l'effet du régime météorologique, nous comparons les différents résultats de janvier à ceux de février. Cela est possible parce que les circulations à grande échelle durant ces deux périodes d'un mois diffèrent de façon importante. Il ressort que l'écoulement à grande échelle a un effet important sur la propagation de l'impact des rejets de données, ce qui occasionne des variations notables dans l'ampleur de cet impact dans les régions situées en aval.

Mark your calendar

World Meteorological Day: **23 March 2010**

World Ocean Day: **8 June 2010**

À inscrire sur votre agenda

Journée mondiale de la météorologie: **23 mars 2010**

Journée mondiale des océans: **8 juin 2010**

Universal Drought Index

Copenhagen, Geneva, 15 December 2009 (WMO) – With climate change, the frequency and magnitude of droughts are very likely to increase. In the "Lincoln Declaration on Drought Indices", fifty-four experts from all regions agreed on the use of a universal meteorological drought index for more effective drought monitoring and climate risk management.

Drought is a protracted period of deficient precipitation with high impacts on agriculture and water resources. The experts considered the different types of droughts: meteorological, agricultural and hydrological droughts. Effective monitoring and early warning systems for these three types of droughts require standardized indices.

Experts participating in the Inter-Regional Workshop on Indices and Early Warning Systems for Drought, held at the University of Nebraska-Lincoln, USA, from 8 to 11 December 2009 made a significant step through a consensus agreement that the Standardized Precipitation Index (SPI) should be used to characterize meteorological droughts by all National Meteorological and Hydrological Services around the world.

The SPI is an index based on the probability of precipitation for any time scale using the long-term precipitation record. A drought event begins any time when the SPI is continuously negative and ends when the SPI becomes positive. Early detection of the onset of drought, and its intensity, through the use of the SPI, will help improve crop insurance schemes for farmers and enhance their livelihoods.

The experts decided to undertake a similar, comprehensive review of agricultural and hydrological droughts in order to develop common indices for better early warnings in the agricultural and water sectors.

The same level of drought severity can cause very different impacts in different regions due to the underlying vulnerabilities. Therefore providers of and end-users of early warning systems need to interact continuously. In this regard, coordination between data monitoring agencies is essential to facilitate effective decision making. A simple, systematic analysis of drought impacts in different sectors should be initiated in all affected countries in order to provide useful decision-making information for policy-makers.

As a next step, WMO will develop a user manual on SPI and will establish two working groups with the objective of recommending, by the end of 2010, indices for global use to cope with agricultural and hydrological droughts.

The Inter-Regional Workshop on Indices and Early Warning Systems for Drought was jointly sponsored by the School of Natural Resources and the National Drought Mitigation Centre of the University of Nebraska, World Meteorological Organization (WMO), the U.S. National Oceanic and Atmospheric Administration (NOAA), the U.S. Department of Agriculture (USDA), and the United Nations Convention to Combat Desertification (UNCCD).

Source: WMO Press Release # 872 available on WMO Website visited on December 16, 2009.

WMO is the United Nations System's authoritative voice on weather, climate and water.

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Indice de sécheresse universel

Copenhague et Genève, le 15 décembre 2009 (OMM) – Sous l'effet des changements climatiques, la fréquence et l'ampleur des sécheresses vont très probablement s'accroître. Dans la «Déclaration de Lincoln sur les indices de sécheresse», cinquante-quatre experts provenant de toutes les régions du monde ont adopté un indice de sécheresse météorologique universel destiné à faciliter la surveillance des sécheresses et la gestion des risques liés au climat.

Une sécheresse est une période prolongée caractérisée par un déficit de précipitations ayant de graves répercussions sur l'agriculture et les ressources en eau. Les spécialistes se sont intéressés aux différents types de sécheresses: météorologique, agricole et hydrologique. Pour assurer l'efficacité des systèmes de surveillance et d'alerte précoce pour ces trois catégories de sécheresses, il faut disposer d'indices normalisés.

Les experts qui ont participé à l'Atelier inter-régional sur les indices et les systèmes d'alerte précoce applicables à la sécheresse, organisé à l'Université du Nebraska-Lincoln (États-Unis d'Amérique) du 8 au 11 décembre 2009, ont pris une décision majeure en adoptant par voie de consensus un indice de précipitations normalisé (SPI) auquel les Services météorologiques et hydrologiques nationaux du monde entier devraient se référer pour décrire les sécheresses météorologiques.

Le SPI est un indice basé sur la probabilité que surviennent des précipitations, quel que soit le laps de temps considéré, par référence aux relevés relatifs à de longues périodes. Une période de sécheresse débute lorsque cet indice commence à être systématiquement négatif et s'achève lorsqu'il devient positif. En permettant de déceler rapidement une sécheresse et de prévoir son intensité, l'Indice de précipitations normalisé contribuera à optimiser les régimes d'assurance-récolte pour les agriculteurs et à améliorer les moyens de subsistance de ces derniers.
Les experts ont décidé de procéder également à une

analyse très complète des sécheresses agricoles et hydrologiques afin de définir des indices communs qui aideraient les secteurs de l'eau et de l'agriculture à mieux anticiper ce type de situation.

Une même intensité de sécheresse peut avoir, selon les régions et leurs vulnérabilités, des conséquences fort diverses. Aussi doit-il y avoir un dialogue permanent entre ceux qui émettent des alertes précoces et ceux qui les utilisent. Il est essentiel dans ce contexte que les organismes chargés de contrôler les données se concertent afin de faciliter la prise de décision et qu'une analyse systématique des incidences de la sécheresse dans différents secteurs soit entreprise dans tous les pays concernés afin de fournir des informations utiles aux décideurs.

L'étape suivante consistera, pour l'OMM, à mettre au point un manuel et à constituer deux groupes de travail qui auront pour tâche de recommander, d'ici à la fin de 2010, des indices à vocation mondiale applicables aux sécheresses agricoles et hydrologiques.

L'Atelier inter-régional sur les indices et les systèmes d'alerte précoce applicables à la sécheresse était co-parrainé par l'École des ressources naturelles et le Centre national d'atténuation de la sécheresse de l'Université du Nebraska, l'Organisation météorologique mondiale (OMM), l'Administration américaine pour les océans et l'atmosphère (NOAA), le Ministère américain de l'agriculture et la Convention des Nations Unies sur la lutte contre la désertification.

Source: Communiqué de presse # 872 de l'OMM disponible sur son site web et visité le 16 décembre 2009.

L'Organisation météorologique mondiale est l'organisme des Nations Unies qui fait autorité pour les questions relatives au temps, au climat et à l'eau.

Costly Lessons for 2009

According to the Insurance Bureau of Canada (IBC), 2009 has been marked by severe weather conditions as costly as unpredictable. These events have brought home the lesson that urgent action is needed throughout the country to manage the impact of climate change.

While severe weather events brought losses to many communities across Canada, IBC cited these three as examples of how costly the insured damage can be:

Alberta windstorms
Deadly windstorms pummeled Alberta August 1-3, resulting in an estimated $365 million in insurance payouts. (Reference: Top Ten Weather Stories # 9 in Environment Canada list shown on page 18).

Ottawa and Hamilton, Ontario rainstorms
Severe storms dumped torrential rains on the Ottawa and Hamilton regions July 24-26 causing $196 million in insurance payouts. Residents and emergency personnel dealt with power outages, fallen trees, damaged roofs and widespread sewer backups. (Reference: Top Ten Weather Stories # 8 in Environment Canada list shown on page 18).

Vaughan, Ontario tornadoes
On August 20 a series of tornadoes struck the Greater Toronto Area terrifying residents, demolishing homes and causing insurance payouts exceeding $76 million. (Reference: Top Ten Weather Stories # 3 in Environment Canada list shown on page 18).

Source: IBC press release published on December 22 and available on the web.

Leçons coûteuses de 2009

Selon le Bureau d'assurance du Canada (BAC), l'année 2009 a été marquée par des conditions climatiques aussi coûteuses qu'imprévisibles. Ces événements nous ont rappelé l'urgence d'intervenir partout au pays pour atténuer l'incidence du changement climatique.

Bien que les événements météorologiques violents aient occasionné des dommages dans de nombreuses collectivités au Canada, le BAC a cité à titre d'exemple les trois événements suivants pour illustrer l'ampleur des coûts liés aux dommages assurés:

Tempêtes de vent en Alberta
De violentes tempêtes de vent ont soufflé sur l'Alberta entre le 1^er^ et le 3 août, occasionnant le versement d'indemnités d'assurance évaluées à 365 millions de dollars. (Référence: Événement météorologique marquant # 9 dans la liste d'Environnement Canada à la page 25).

Tempêtes de pluie à Ottawa et Hamilton, Ontario
Des pluies diluviennes se sont abattues sur les régions d'Ottawa et d'Hamilton du 24 au 26 juillet, donnant lieu à des indemnités d'assurance de 196 millions de dollars. Les résidents et le personnel d'urgence ont dû faire face à des pannes de courant, des arbres tombés, des toitures endommagées et des refoulements d'égouts généralisés. (Référence: Événement météorologique marquant # 8 dans la liste d'Environnement Canada à la page 25).

Tornades à Vaughan, Ontario
Le 20 août, une série de tornades a frappé la région du Grand Toronto, terrorisant les résidents, démolissant des habitations et occasionnant le versement d'indemnités d'assurance de plus de 76 millions de dollars. (Référence: Événement météorologique marquant # 3 dans la liste d'Environnement Canada à la page 25).

Source: D'après un communiqué de presse du BAC publié le 22 décembre 2009 et disponible sur la toile.

Integrated Research on Disaster Risk Programme

China will host the office of a new international programme, Integrated Research on Disaster Risk (IRDR). The International Programme Office for IRDR will be established in Beijing at the Headquarters of the Center for Earth Observation and Digital Earth (CEODE). Gordon McBean is the Chair of the Science Committee for the IRDR for which this International Programme Office is being established. The IRDR will be a 10-year integrated research programme on how to reduce the impacts of hazards – storms, volcanoes, floods, earthquakes, asteroid impact. The IRDR is co-sponsored by ICSU, the International Social Sciences Council and the UN International Strategy for Disaster Reduction. Agreements are also in place for collaborative research and activities with the World Climate Research Programme, World Weather Research Programme, the capacity-building programme START and others. Additional information on IRDR may be found at: http://www.icsu.org/1_icsuinscience/ENVI_Hazards_1.html An announcement will soon go out inviting international candidates for the position of Director of the IPO. Prof. McBean is moving to create a national IRDR committee and hopes that we will have major Canadian scientific participation in this international program. Expressions of interest are welcome.

Lawrence Mysak: Priestley Lecture 2009

Professor Lawrence Mysak

Professor Lawrence Mysak, Department of Atmospheric and Oceanic Sciences, McGill University, and President of International Association for the Physical Sciences of the Oceans (IAPSO) gave the prestigious Priestly Lecture at CSIRO Division of Marine and Atmospheric Research at Aspendale Australia, on Oct. 13, 2009. The Priestley Lecture has been presented in the past by other noteworthy speakers, including: Syukoro Manabe (Princeton), Susan Solomon (University of California), Stephen Schneider (Stanford) and Ronald Prinn (MIT) among others.

Professor Mysak is internationally known for his extensive applications of mathematics to physical oceanography, his basic research on natural climate variability of the Arctic, and the development and application of global earth system models to various climate phenomena. His talk was on *"The Little Ice Age and beyond: simulating long-term changes in climate, sea ice, and the oceans*". He addressed the question: was there more or less sea ice in the Southern Hemisphere during the Little Ice Age? Long term changes in climate, sea ice, ocean properties and wind have been reconstructed using a global reduced complexity climate model to answer this and other questions about past climate change. Additional background on the Priestley Lecture and Professor Mysak's talk may be found on the web at: http://www.csiro.au/resources/PriestleyLecture-flyer.html

New CNC/SCOR Secretary

After nine years on the job, Dick Stoddart will be stepping down as Secretary of CNC/SCOR at the AGM in May. Dick's unceasing efforts have been instrumental in making the organization successful and in building its activities.

Bob Wilson

Bob Wilson will be replacing Dick in the position of Secretary. Some of you will remember Bob from his time at the Institute of Ocean Sciences, between 1985 and 1997. After 15 years at Environment Canada in St. John's and Halifax/Dartmouth, Bob joined DFO at IOS as a science administrator, where he worked mostly on environmental initiatives. He left DFO in 1997 to start a small consulting company, from which he retired at the beginning of this year.

Bob Wilson lives in Victoria, BC where he can be reached by: e-mail: wilson@telus.net, or phone: 250-477-9832, or cell: 250-889-1127.

Bob Wilson has started to shadow Dick's activities so he can be up to full speed next June. As part of the changeover, he will be taking over as editor of the Canadian Ocean Science Newsletter and will produce the next issue.

Mise en candidature pour le prix Timothy R. Parsons pour l'excellence en sciences de la mer

Pêches et Océans Canada a créé un prix visant à rendre hommage à l'excellence dans le domaine des sciences de la mer au Canada. Ce prix porte le nom de Timothy R. Parsons, en l'honneur de la carrière remarquable de ce chercheur du Conseil de recherches sur les pêcheries du Canada, professeur d'université, auteur de publications prestigieuses et lauréat du Prix du Japon en 2001. La médaille Timothy R. Parsons est décernées à des scientifiques canadiens qui se sont distingués dans un domaine pluridisciplinaire lié aux sciences de la mer et souligne l'ensemble de leur carrière ou une réalisation récente exceptionnelle au sein d'un établissement canadien. Pour plus d'information au sujet de Timothy R. Parsons, visitez le site web au : http://www.dfo-mpo.gc.ca/science/award-prix/parsons/index-fra.htm

Critères d'admissibilité
Le prix Timothy R. Parsons est :

- Décerné à un(e) scientifique canadien(ne) qui s'est distingué(e) par sa contribution remarquable dans un domaine multidisciplinaire lié à l'océanographie;
- Décerné pour souligner l'excellence de la carrière ou une réalisation exceptionnelle récente d'un(e) candidat(e), les deux étant admissibles sur un pied d'égalité;
- Décerné pour souligner les réalisations d'un(e) candidat(e) au sein d'une institution canadienne ou au profit de la science canadienne.
- Aucune mise en candidature posthume ne sera acceptée. Il n'y aura qu'un seul lauréat.

Pour soumettre une mise en candidature, veuillez compléter le formulaire sur le site web pour le prix Timothy R. Parsons au :

http://www.dfo-mpo.gc.ca/science/award-prix/parsons/about-apropos-fra.htm

Les mises en candidature doivent être reçues au plus tard **le 28 février de chaque année** et être adressées à :

Comité de la médaille Timothy R. Parsons
Promotion stratégique des sciences
200, rue Kent, poste 8W143
Ottawa (Ontario) K1A 0E6
Tél. : (613) 998-5158; Téléc. : (613) 990-2471
Courriel : sciencebulletin@dfo-mpo.gc.ca

The Timothy R. Parsons Award for Excellence in Ocean Sciences

Fisheries and Oceans Canada (DFO) has established the Timothy R. Parsons Award for excellence in Ocean Sciences to recognize a Canadian scientist for outstanding lifetime contributions to multidisciplinary facets of ocean sciences or for a recent exceptional achievement, while working within a Canadian institution. This award is named after Dr. Timothy R. Parsons, and honours his distinguished career as a Fisheries Research Board of Canada researcher, university professor, broadly read author and recipient of the 2001 Japan Prize. For more information on Dr. Timothy R. Parsons, please visit: http://www.dfo-mpo.gc.ca/science/award-prix/parsons/index-eng.htm

Eligibility Criteria
The Timothy R. Parsons Medal is:

- Awarded to a Canadian for distinguished accomplishments in multidisciplinary facets of ocean sciences.
- Awarded for excellence during the lifetime of the recipient or for a recent outstanding achievement, both being equally eligible.
- Awarded for accomplishments while working for Canadian Institutions or for the benefit of Canadian Science.
- No posthumous nominations are considered. The award will only be awarded to one candidate.

To make a nomination, please complete the appropriate nomination form on the Parsons Award website at:

http://www.dfo-mpo.gc.ca/science/award-prix/parsons/about-apropos-eng.htm

Nominations should be received no later than **February 28** of every year at:

Timothy R. Parsons Medal Committee
Strategic Science Outreach
Stn. 8W143 – 200 Kent Street
Ottawa, Ontario, K1A 0E6
Tel: (613) 998-5158; Fax: (613) 990-2471
Email: sciencebulletin@dfo-mpo.gc.ca

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