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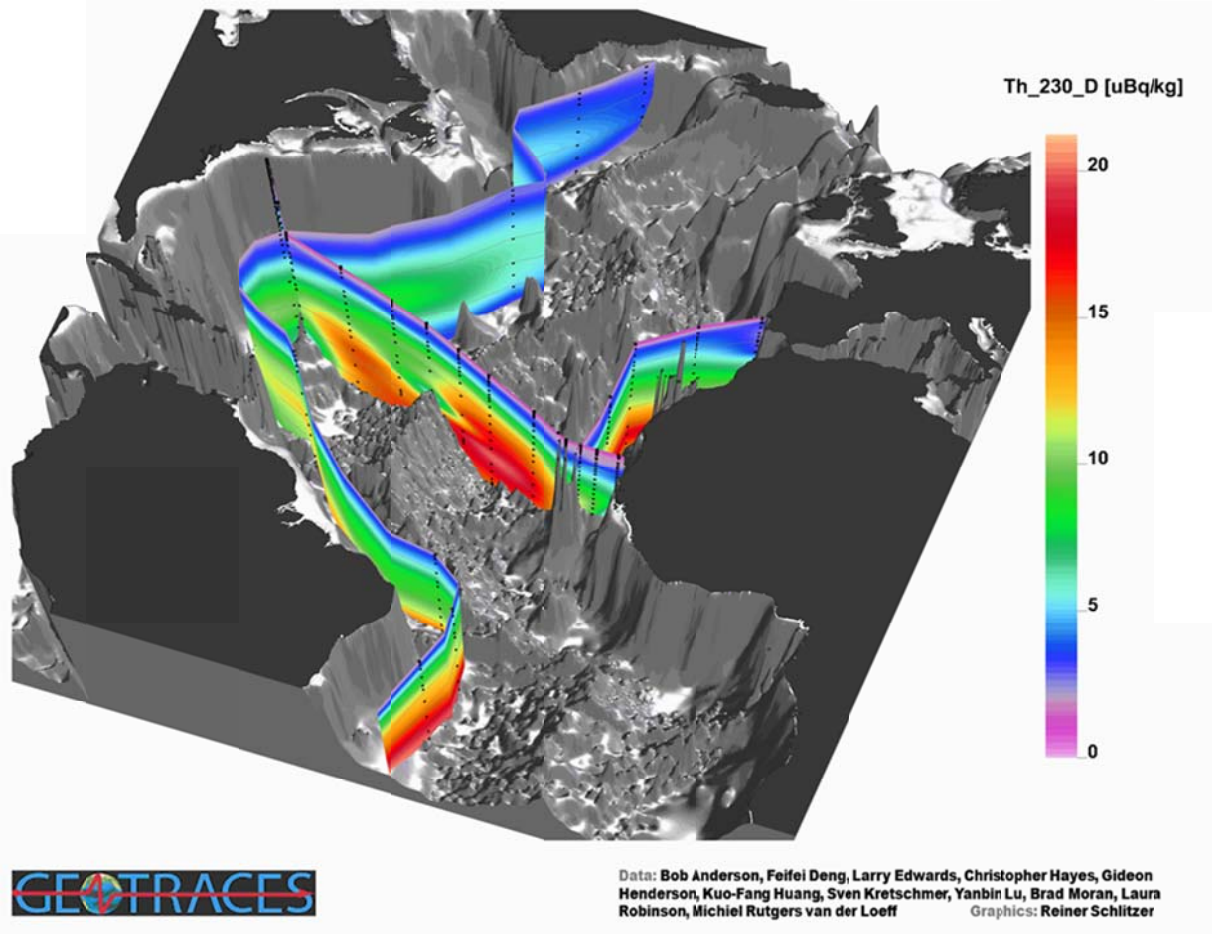
CMOS
BULLETIN
SCMO

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

February / février 2015 Vol.43 No.1

3D scene generated by Ocean Data View and Ocean 3D showing distribution of dissolved ^{230}Th in the North Atlantic



Distribution de ^{230}Th dissous dans l'Atlantique Nord : scène tridimensionnelle générée par le logiciel Ocean Data View et Ocean 3D

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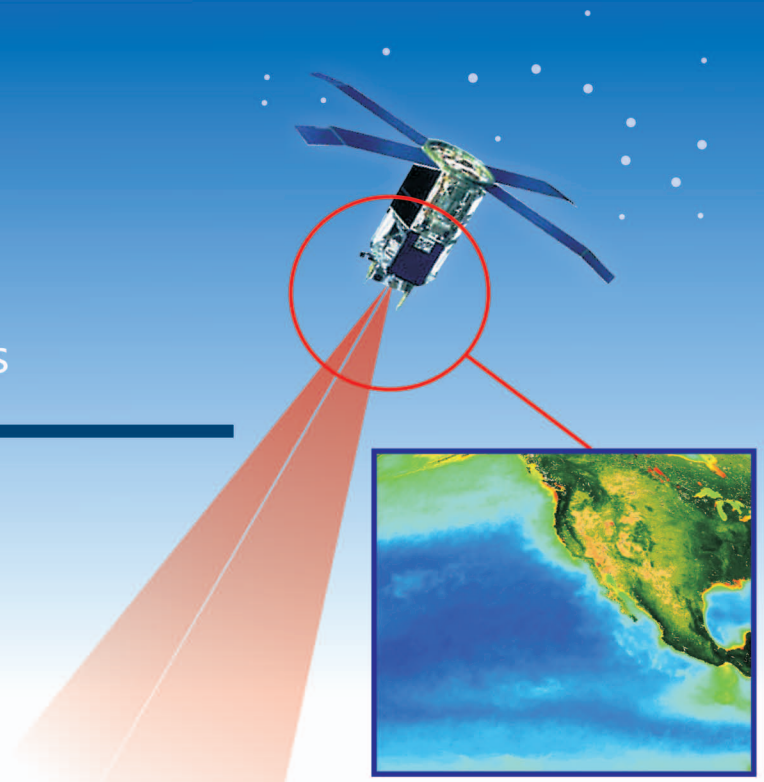
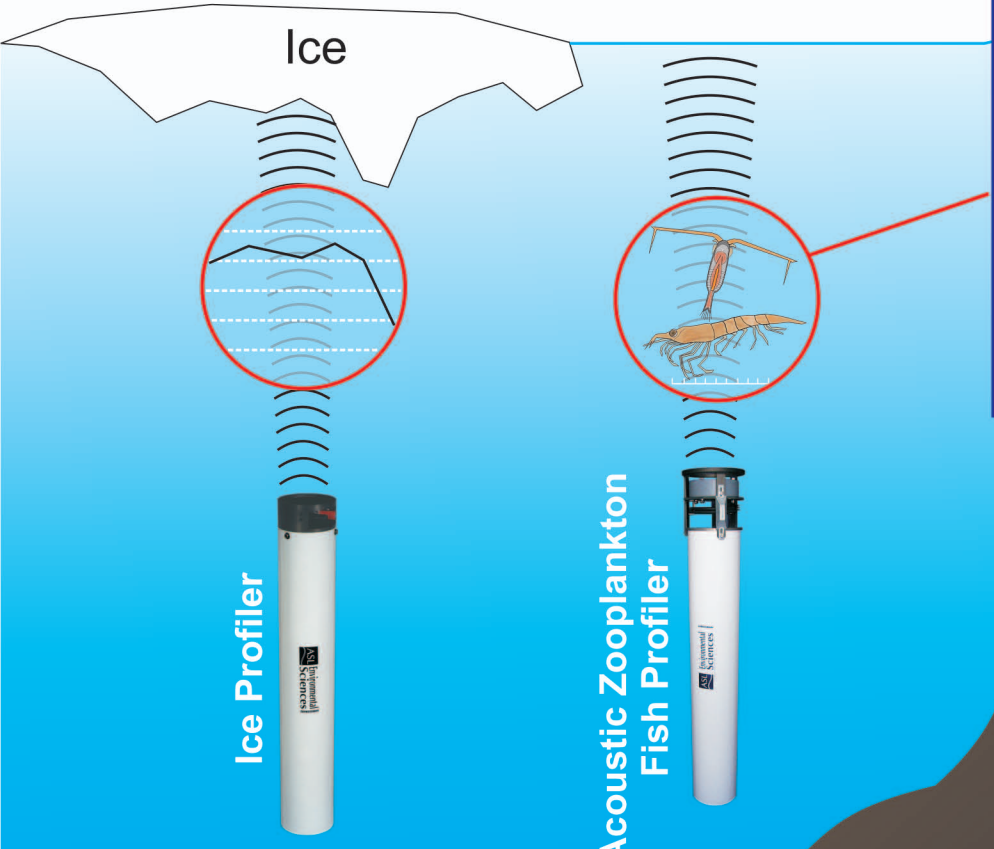
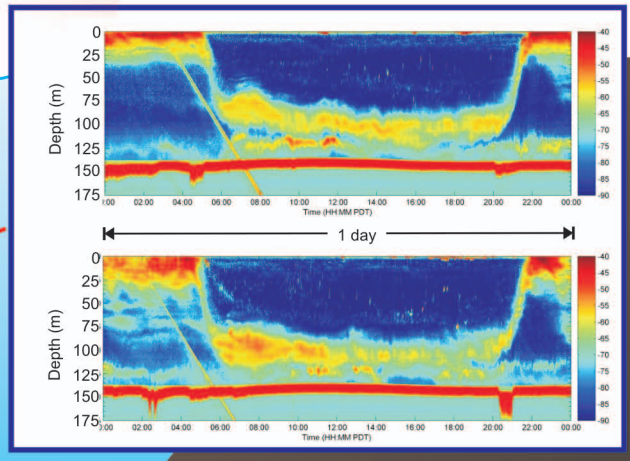


Ocean colours are chlorophyll concentrations and land colours are NDVI





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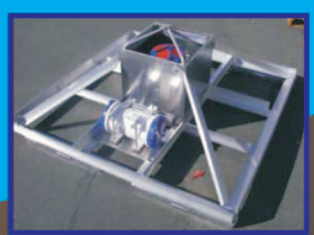

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.... Words from the President

Friends and Colleagues:

Harinder Ahluwalia
CMOS President
Président de la SCMO

First of all, I would like to wish all our members and potential members a very Happy New Year. We hope that the New Year will bring new opportunities for you and for CMOS to grow.

The programs which we would like to strengthen this year include Visibility of CMOS with Media and Public, Webinars on interesting and important topics, Mentoring Program, as well as the development of an Aviation Special Interest Group. In addition, we must recruit large users of meteorology to strengthen our organization. Our New Year resolution is that we would like to be able to implement as many of our programs as possible.

In December 2014, I made a trip to Halifax to make a presentation to the local CMOS Centre. The event was attended by 36 members who gave me a very warm welcome and showed a lot of enthusiasm for helping achieve success in the above mentioned areas. Thanks to Jim Abraham, the Halifax Centre Chair, it was a very heart-warming experience and we were able to achieve a lot in one day. Due to December being exam period for University students, there were very few students and faculty members. Therefore, there is a plan for local people who attended the presentation to make the same presentation at the two Halifax Universities. We hope that all other Centres follow suit because, without their enthusiasm, strengthening and growing CMOS will be a very difficult task.

In August 2014, World Meteorological Organization held a World Weather Open Science Conference in Montreal in which was discussed the "Future Weather Enterprise" for achieving a "Global Weather and Climate Ready Society", ready to respond and resilient. In order to achieve that, we have to do a number of things which include better Forecast and Warnings, extending Forecast and improving its accuracy and consistency as well as its on-time delivery.

[Continued on page 3]

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

Le but de la SCMO est de promouvoir l'avancement de la météorologie et l'océanographie au Canada.

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

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Cover page: Visualization of oceanographic, meteorological, and other geo-referenced data is of prime importance in research. Ocean Data View (ODV) let the users maintain and analyze very large datasets on inexpensive and portable hardware. Various types of graphics can be produced easily. ODV data and settings files are platform independent and can be exchanged between all supported systems. Shown here is a distribution of dissolved ^{230}Th (Thorium) in the North Atlantic as 3D scene consisting of three ODV-generated sections. Creation of the scenes requires separate 3D software not yet integrated into ODV. Positions of the measurements are marked by black dots. To learn more, please read Reiner Schlitzer's article on **page 9**.

Page couverture: la représentation graphique de données géoréférencées océanographiques, météorologiques et autres s'avère de première importance en recherche. Le logiciel Ocean Data View (ODV) permet de gérer et d'analyser de très grandes séries de données à l'aide de matériel informatique portatif et peu coûteux. Il facilite la production de divers types de graphiques. Les fichiers de données et de réglages d'ODV restent indépendants de la plateforme. On peut donc les transférer vers tout système pris en charge. La scène tridimensionnelle illustrée ici à l'aide de trois sections générées par le logiciel ODV montre la distribution de thorium 230 dans l'Atlantique Nord. La création de scènes nécessite l'utilisation d'un logiciel d'affichage tridimensionnel qui n'est pas encore intégré à ODV. Les points noirs marquent la position des mesures. Pour en savoir davantage, consultez l'article de Reiner Schlitzer, à la **page 9.**

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Canadian Meteorological and Oceanographic Society (CMOS)
Société canadienne de météorologie et d'océanographie (SCMO)

Council / Conseil d'administration

.... Words from the President [Continued / Suite]

It was recognized that no single public sector organization, even a single nation can achieve this objective; hence collaboration between nations is necessary. In addition, collaboration between the public, private, and university sectors is necessary. Weather Enterprise was defined as consisting of public, private, and university sectors (referred to as operational sectors) complemented by national meteorological societies such as CMOS, AMS, etc. and NGOs (non-governmental organizations) such as University Corporation for Atmospheric Research (referred to as support sectors).

It was also observed that when the three sectors work together, some level of tension is inherent in this process; therefore, they need a neutral host for resolving conflicts. The national meteorological societies can play an important role as a mediator. The American Meteorological Society stepped up to that task in the U.S. and they formed a Commission on the Weather and Climate Enterprise which helps in collaboration discussions and resolving any conflicts that might arise.

Canada needs to support its private sector to play a similar role to that played by the private sector in the U.S. CMOS can assist in strong collaboration between the three sectors. Similarly, CMOS in cooperation with the local meteorological society can also play the role of a facilitator for international cooperation between the three sectors – especially private sector and university sector. In addition, the "*Global Weather and Climate Ready Society*" requires collaboration between nations which can be facilitated by meteorological societies of respective countries that can play an important role in achieving that collaboration.

With that in mind we are in the process of signing bilateral agreements with some societies. As we have already announced, we have signed an Memorandum of Understanding (MOU) with AMS for collaboration in various areas. We urge our members to take advantage of this MOU and suggest different ways we can improve this collaboration. We are also looking into signing an Agreement between CMOS and IMS (India Meteorological Society) to take advantage of mutual Research and Development capabilities of the two nations.

Another important issue to be brought to the attention of the readers is that the P. Met certification program was established a few years ago. Despite some effort by ECO Canada and CMOS, only 22 people have obtained certification. Therefore, for the time being, ECO Canada has shelved this certification program. We are trying to revive the program but it requires the support of all eligible meteorology professionals to get certified.

Finally, I would like to appeal to all our members to volunteer their services for the advancement of your CMOS.

Harinder Ahluwalia, CMOS President

.... Allocution du Président

Chers amis et collègues,

Tout d'abord, je souhaite une bonne et heureuse année à tous les membres et membres potentiels. J'espère que cette nouvelle année favorisera l'essor de votre carrière et de la SCMO.

Les activités que nous désirons renforcer cette année comprennent l'accroissement de la visibilité de la SCMO auprès des médias et du public, la présentation de webinaires sur des sujets importants et intéressants, le programme de mentorat, ainsi que la création d'un groupe d'intérêts spéciaux lié à l'aviation. En outre, nous devons recruter les grands utilisateurs d'information météorologique, afin de renforcer notre organisation. Notre résolution du Nouvel An consiste à mettre en œuvre le plus grand nombre de programmes possibles.

En décembre 2014, je suis allé à Halifax pour faire une présentation au centre local de la SCMO. Trente-six membres ont assisté à cet événement. Ils m'ont cordialement accueilli et ont manifesté beaucoup d'enthousiasme pour participer au succès des activités mentionnées ci-dessus. Grâce à Jim Abraham, le président du centre d'Halifax, l'expérience s'est révélée agréable. Nous avons beaucoup accompli en une journée. En raison de la période d'examen de décembre, dans les universités, il y avait peu d'étudiants et de professeurs. En conséquence, les personnes ayant assisté à la présentation planifient la refaire dans les locaux des deux universités d'Halifax. Nous espérons que tous les autres centres suivront cet exemple, car sans l'enthousiasme de ceux-ci, le renforcement et la croissance de la SCMO s'enliseront.

En août 2014, l'Organisation Météorologique Mondiale a tenu à Montréal sa Conférence scientifique publique mondiale sur la météorologie, au cours de laquelle il a été question du futur de la météorologie relativement à l'adaptation et à la réaction de la société face au temps et au climat mondiaux. En ce sens, nous devons prendre certaines mesures comme l'amélioration des prévisions et des avertissements, l'extension de la période de prévision et l'amélioration de son exactitude, jour après jour, ainsi que l'amélioration des délais de prévision.

Il est évident qu'aucune organisation du secteur public ni un pays ne peuvent à eux seuls atteindre cet objectif. En conséquence, la coopération internationale demeure essentielle. La collaboration entre les secteurs public, privé et universitaire s'avère aussi nécessaire. L'entreprise météorologique a été définie comme le regroupement des secteurs public, privé et universitaire (appelés les secteurs opérationnels), ainsi que des sociétés nationales de météorologie comme la SCMO, l'AMS, etc., et des organisations non gouvernementales comme l'UCAR (appelées les secteurs de soutien).

Lorsque les secteurs opérationnels travaillent ensemble, on observe le développement d'une certaine tension. Ils ont donc besoin d'un hôte neutre pour régler les conflits éventuels. Les sociétés nationales de météorologie sont en mesure de jouer ce rôle de médiateur. Aux États-Unis, l'American Meteorological Society a endossé cette fonction et a formé une commission sur l'entreprise météorologique et climatologique, qui facilite les discussions au sein de collaborations et règle les conflits éventuels.

Le Canada doit soutenir son secteur privé pour que celui-ci joue un rôle semblable à celui-ci de sa contrepartie américaine. La SCMO peut favoriser une forte collaboration entre les trois secteurs opérationnels. De même, avec le concours de la société météorologique locale, la SCMO peut faciliter la coopération internationale entre ces secteurs, et notamment entre le secteur privé et les universités. Sans compter que l'adaptation de la société face au temps et au climat nécessite la collaboration entre les pays. Celle-ci peut être facilitée par les sociétés météorologiques de chaque État, qui sont bien placées pour jouer un rôle important quant au développement de cette coopération.

En ce sens, nous sommes en train de préparer des accords bilatéraux avec quelques sociétés. Comme mentionné précédemment, nous avons signé avec l'AMS une entente de collaboration couvrant diverses activités. Nous prions nos membres d'en profiter et offrons différentes suggestions pour améliorer cette collaboration. Nous étudions la possibilité de conclure un accord entre la SCMO et l'IMS (India Meteorological Society), afin de tirer profit des capacités de recherche et de développement des deux pays.

Autre question d'importance pour les lecteurs, le programme de certification des météorologistes professionnels, qui a été créé il y a quelques années. Malgré les efforts d'ECO Canada et de la SCMO, seulement 22 personnes ont obtenu la certification. En conséquence, pour le moment, ECO Canada a mis le programme de certification en veilleuse. Nous tentons de raviver ce programme, mais il faudra le soutien de tous les météorologistes professionnels admissibles, qui devront demander la certification.

Finalement, je fais appel à tous nos membres et les encourage à offrir leurs services pour l'avancement de la SCMO.

Harinder Ahluwalia,
Président de la SCMO

Call for Volunteers

CMOS is looking for the following Volunteers:

- Volunteer for coordination of our bilateral relationship with other international societies such as American Meteorological Society, Royal Meteorological Society, Indian Meteorological Society, etc.
- At least three Mentors from each Centre.
- Spokesperson from each Centre for: Weather Events, Climate Issues and Ocean related issues.
- Coordinator for Webinars

We are also prepared to pay a small honorarium if required.

Volontaires recherchés

La SCMO cherche des volontaires pour les fonctions suivantes :

- Un coordonnateur responsable des relations bilatérales avec d'autres sociétés comme l'American Meteorological Society, la Royal Meteorological Society, l'Indian Meteorological Society, etc.
- Au moins trois mentors dans chaque centre.
- Des porte-paroles dans chaque centre pour discuter d'événements météorologiques, et d'enjeux concernant le climat et les océans.
- Un coordonnateur de webinaires.

Nous pouvons offrir une rémunération modique, le cas échéant.

ARTICLES

2014 on course to be one of hottest, possibly hottest, on record

Résumé: L'année 2014 pourrait se révéler l'une des plus chaudes, si ce n'est la plus chaude, qui ait jamais été observée, selon une estimation préliminaire émanant de l'Organisation météorologique mondiale (OMM). C'est dû en grande partie aux valeurs records de la température de surface de la mer à l'échelle du globe, valeurs qui demeureront très probablement supérieures à la normale jusqu'à la fin de l'année. Ces températures océaniques élevées ont contribué, avec d'autres facteurs, à engendrer des précipitations et des inondations d'une ampleur exceptionnelle dans de nombreux pays et des sécheresses extrêmes dans d'autres.

D'après la déclaration provisoire de l'OMM sur l'état du climat mondial en 2014, la température moyenne de l'air à la surface du globe (terres émergées et océans confondus) pour la période janvier-octobre dépassait de quelque 0,57 degré Celsius la moyenne calculée pour la période de référence 1961-1990, qui est de 14,00°C, et de 0,09°C la moyenne des dix dernières années (2004-2013).

Si les mois de novembre et de décembre confirment cette tendance, 2014 sera probablement l'année la plus chaude jamais enregistrée, devant 2010, 2005 et 1998, ce qui confirme la tendance générale au réchauffement sur le long terme. Il est important de noter que les valeurs afférentes aux années les plus chaudes ne diffèrent que de quelques centièmes de degré les unes des autres, et que le classement varie légèrement selon le jeu de données considéré.

La période janvier-octobre a été anormalement chaude malgré l'absence d'un véritable épisode El Niño/oscillation australe (ENSO). Ce phénomène survient lorsque des températures de surface de la mer plus élevées que la normale dans l'est du Pacifique tropical interagissent avec les systèmes de pression atmosphériques et engendrent des rétroactions en chaîne, se répercutant sur les régimes météorologiques du monde entier. Au cours de l'année, les températures de surface de la mer ont augmenté pour atteindre presque des niveaux correspondant à une anomalie El Niño, mais sans qu'il y ait une réaction de l'atmosphère. Il n'empêche que des régimes météorologiques et climatiques que l'on associe en général à un épisode ENSO ont été observés un peu partout dans le monde.

Le Secrétaire général de l'OMM, Michel Jarraud, a déclaré que d'après les données provisoires dont on dispose pour 2014, le XXI^{ème} siècle compte déjà quatorze des 15 années les plus chaudes jamais observées et que le réchauffement du climat ne marque aucune pause.

«*La tendance constatée en 2014 s'inscrit dans la logique d'un climat en évolution. Des vagues de chaleur records combinées à des pluies torrentielles et à des inondations de grande ampleur ont mis à mal les moyens de subsistance des populations et semé la désolation*», a poursuivi M. Jarraud. «*Ce qui est particulièrement inhabituel et alarmant cette année, ce sont les températures anormalement élevées constatées à la surface des océans sur de vastes superficies, y compris dans l'hémisphère Nord.*»

«*Les émissions records de gaz à effet de serre et l'accumulation de ces gaz dans l'atmosphère rendent très incertain l'avenir de la planète, qui risque de devenir beaucoup plus inhospitalière. L'OMM et ses Membres continueront d'améliorer les services de prévision pour aider les populations à faire face à des conditions météorologiques et climatiques extrêmes plus fréquentes et plus destructrices*», a souligné M. Jarraud.

La déclaration provisoire sur le climat a été publiée à l'appui des négociations annuelles sur le changement climatique qui se déroulent en ce moment à Lima. L'OMM a par ailleurs complété sa fameuse série de «bulletins météo de l'avenir» par de nouveaux bulletins de l'an 2050 concernant le Pérou, la France, le Viet Nam, l'Espagne, le Canada et la Norvège. S'appuyant sur les conclusions du cinquième Rapport d'évaluation du Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC), lequel est parrainé par l'OMM et le PNUE (Programme des Nations Unies pour l'environnement), ces scénarios brossent un tableau saisissant de ce que pourrait être notre quotidien sur une planète plus chaude.

Christiana Figueres, Secrétaire exécutive de la Convention-cadre des Nations Unies sur les changements climatiques (CCNUCC), a affirmé que notre climat est en train de changer, et chaque année les risques de phénomènes météorologiques extrêmes s'accroissent, de même que les menaces qu'ils font peser sur les populations.

«*Fort heureusement, le climat politique évolue lui aussi, et les gouvernements, soutenus par les investisseurs, les entreprises et les municipalités s'acheminent vers la conclusion d'un accord universel sur le climat à Paris en 2015, un accord substantiel censé contenir la hausse de la température mondiale en-dessous de la barre des 2°C en ouvrant la voie à une profonde décarbonisation de nos économies et à la «neutralité climatique» – bilan d'émissions nul – pour la deuxième moitié de ce siècle*», a indiqué Mme Figueres.

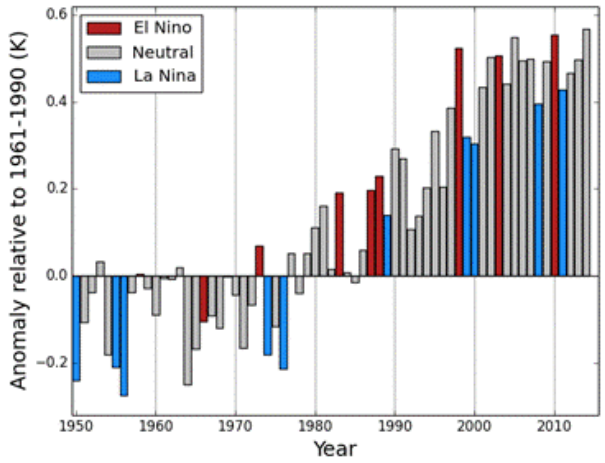
Lima/Geneva, 3 December 2014 (WMO) - The year 2014 is on track to be one of the hottest, if not the hottest, on record, according to preliminary estimates by the World Meteorological Organization (WMO). This is largely due to record high global sea surface temperatures, which will very likely remain above normal until the end of the year. High sea temperatures, together with other factors, contributed to exceptionally heavy rainfall and floods in many countries and extreme drought in others.

WMO's provisional statement on the Status of the Global Climate in 2014 indicated that the global average air temperature over land and sea surface for January to October was about 0.57° Celsius above the average of

14.00°C for the 1961-1990 reference period, and 0.09°C above the average for the past ten years (2004-2013).

If November and December maintain the same tendency, then 2014 will likely be the hottest on record, ahead of 2010, 2005, and 1998. This confirms the underlying long-term warming trend. It is important to note that differences in the rankings of the warmest years are a matter of only a few hundredths of a degree, and that different data sets show slightly different rankings.

The high January to October temperatures occurred in the absence of a full El Niño-Southern Oscillation (ENSO). ENSO occurs when warmer than average sea-surface temperatures in the eastern tropical Pacific combine, in a self-reinforcing loop, with atmospheric pressure systems, thus affecting weather patterns globally. During the year, sea surface temperatures increased nearly to El Niño thresholds but this was not coupled with an atmospheric response. However, many weather and climate patterns normally associated with El Niño/Southern Oscillation (ENSO) were observed in many parts of the world.



Global annual average temperature anomalies (relative to the 1961-1990 average) for 1950-2013, based on an average of the three data sets (GISTEMP, MLOST and HadCRUT.4.3.0.0). The January to October average is shown for 2014. The colouring of the bars indicates whether a year was classified as an El Niño year (red), an ENSO neutral year (grey) or a La Niña year (blue).

"*The provisional information for 2014 means that fourteen of the fifteen warmest years on record have all occurred in the 21st century*," said WMO Secretary-General Michel Jarraud. "*There is no standstill in global warming*," he said.

"*What we saw in 2014 is consistent with what we expect from a changing climate. Record-breaking heat combined with torrential rainfall and floods destroyed livelihoods and ruined lives. What is particularly unusual and alarming this year are the high temperatures of vast areas of the ocean surface, including in the northern hemisphere*," he said.

"*Record-high greenhouse gas emissions and associated atmospheric concentrations are committing the planet to a much more uncertain and inhospitable future. WMO and its Members will continue to improve forecasts and services to help people cope with more frequent and damaging extreme weather and climate conditions*," said Mr. Jarraud. The provisional statement was published to inform the annual climate change negotiations taking place in Lima, Peru. WMO also updated its acclaimed Weather Reports for the Future series, with scenarios for the weather in 2050 based on the Fifth Assessment report from the Intergovernmental Panel for Climate Change (IPCC), which is co-sponsored by WMO and the UNEP (United Nations Environment Programme). Newly added reports are for Peru, France, Viet Nam, Spain, Canada, and Norway, painting a compelling picture of what life could be like on a warmer planet.

Christiana Figueres, Executive Secretary, UN Framework Convention on Climate Change (UNFCCC), said: "*Our climate is changing and every year the risks of extreme weather events and impacts on humanity rise*."

"*Fortunately our political climate is changing too with evidence that governments, supported by investors, business, and cities are moving towards a meaningful, universal climate agreement in Paris 2015 -- an agreement that keeps a global temperature rise below 2.00°C by putting in place the pathways to a deep de-carbonisation of the world's economy and climate neutrality or 'net zero' in the second half of the century,*" said Ms. Figueres.

Highlights from the WMO Statement

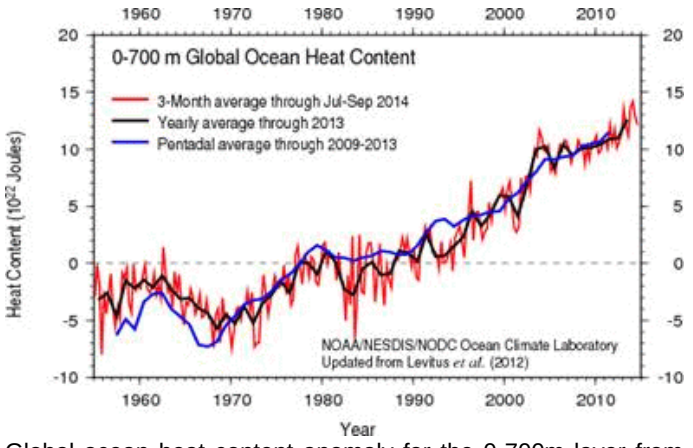
Land surface temperatures
Average surface air temperatures over land for January to October 2014 were about 0.86°C above the 1961-1990 average, the fourth or fifth warmest for the same period on record.

Western North America, Europe, eastern Eurasia, much of Africa, large areas of South America, and southern and western Australia were especially warm. Cooler-than-average conditions for the year-to-date were recorded across large areas of the United States and Canada and parts of central Russia.

Heatwaves occurred in South Africa, Australia, and Argentina in January. Australia saw another prolonged warm spell in May. Record heat affected northern Argentina, Paraguay, Bolivia, and southern Brazil in October. Notable cold waves were reported in the U.S. during the winter, Australia in August, and in Russia in October.

Ocean heat
Global sea-surface temperatures were the highest on record, at about 0.45°C above the 1961-1990 average.

Sea surface temperatures in the eastern tropical Pacific approached El Niño thresholds. They were also unusually high in the western tropical Pacific Ocean, across the north and north-east Pacific as well as the polar and subtropical North Atlantic, southwest Pacific, parts of the South Atlantic, and in much of the Indian Ocean. Temperatures were particularly high in the Northern Hemisphere from June to October for reasons which are subject to intense scientific investigation.



Global ocean heat content anomaly for the 0-700m layer from 1955 to 2014. The red line shows the three month average to July – September 2014. The black line shows the annual average to 2013 and the blue line shows the pentadal average. Figure is from NOAA/NESDIS/NODC (National Oceanic and Atmospheric Administration/National Environmental Satellite, Data, and Information Service/National Oceanographic Data Center).

Ocean heat content for January to June was estimated down to depths of 700m and 2000m and both were the highest recorded.

Around 93% of the excess energy trapped in the atmosphere by greenhouse gases from fossil fuels and other human activities ends up in the oceans. Therefore, the heat content of the oceans is key to understanding the climate system.

Sea level and sea ice

As the oceans warm, their volume increases through thermal expansion. Water from the melting of ice sheets and glaciers also contributes to sea level rise. Local variations in sea level are affected by currents, tides, storms, and large-scale climate patterns like El Niño. In early 2014, global-average measured sea-level reached a record high for the time of year.

Arctic sea-ice extent reached its annual minimum extent of 5.02 million km^2 on 17 September and was the sixth lowest on record, according to the National Snow and Ice Data Center.

Antarctic daily sea ice reached a maximum daily extent of 20.11 million km^2 on 22 September, setting a new record for the third consecutive year. The changes in the atmospheric circulation observed in the past three decades, which resulted in changes in the prevailing winds around Antarctica, are considered by scientists as factors related to this increase. However, it is possible that this increase is due to a combination of factors that also include effects of changing ocean circulation.

Flooding

Twelve major Atlantic storms affected the United Kingdom through the winter 2013/14 and the U.K. winter was the wettest on record, with 177% of the long-term average precipitation. In May, devastating floods in Serbia, Bosnia-Herzegovina, and Croatia affected more than two million people. In Russia, in late May and early June, more than twice the monthly average precipitation fell in Altai, Khakassia and Tuva republics in southern Siberia. In September, southern parts of the Balkan Peninsula received over 250% of the monthly average rainfall and, in parts of Turkey, over 500% of normal. July and August were very wet in France with the two-month total being the highest on record (records begin 1959). Between 16 and 20 September, parts of southern France recorded more than 400mm of rainfall – three to four times the normal monthly average. Heavy rain in central and southern Morocco in November caused severe flooding. At Guelmim, 126mm of rain fell in four days, the monthly average for November is 17mm and the average for the year is 120mm.

The monthly precipitation over the Pacific side of western Japan for August 2014 was 301% of normal, which was the highest since area-averaged statistics began in 1946. In August and September, heavy rains caused severe flooding in northern Bangladesh, northern Pakistan, and India, affecting millions of people.

Buenos Aires and northeastern provinces of Argentina were severely affected by flooding. In February, many stations in northern and central Argentina reported record rainfall totals for the month. In May and June, precipitation totals in excess of 250% of the long term average were recorded in Paraguay, southern Bolivia, and parts of south east Brazil. The heavy rain led to flooding on the Parana River which particularly affected Paraguay, where more than 200,000 people were affected.

On 29 and 30 April, torrential rain fell across the Southeast, Mid-Atlantic, and Northeast of United States causing significant flash flooding. At one location in Florida, the two-day precipitation total was a record 519.9 mm.

Drought

Precipitation in the southern part of Northeast China and parts of the Yellow River basin and Huaihe River basin did not reach half of the summer average, causing severe drought.

Parts of Central America suffered rainfall deficits in the

summer. Parts of eastern and some areas of central Brazil are in a state of severe drought with severe water deficits extending back more than two years. São Paulo city has been particularly affected with a severe shortage of stored water.

As of mid-November 2014, large areas of the western U.S. remained in drought with areas of California, Nevada, and Texas having received less than 40% of the 1961-1990 average. Canada experienced dry conditions at the start of 2014 with many regions only receiving 50-70% of the baseline average in the west and north between January and April.

At the start of the year, northeast New South Wales and southeast Queensland in Australia had long-term rainfall deficiencies.

Tropical cyclones
Until 13 November, 72 tropical storms – storms where wind speeds equalled or exceeded 17.5 m/s (63 km/hr) were recorded, fewer than the 1981-2010 average of 89 storms.

In the North Atlantic basin there were only eight named storms. The Eastern North Pacific basin saw above average hurricane activity, with 20 named storms.

In the Western North Pacific basin, twenty named tropical cyclones formed between 18 January and 20 November, slightly below the 1981-2010 average of twenty-four storms (to the end of November). Ten of the cyclones reached typhoon intensity. Typhoons *Nakri* and *Halong*, contributed to the high precipitation totals recorded in western Japan in August. Typhoon *Rammasun* displaced more than half a million people in the Philippines and China in July.

The North Indian Ocean basin recorded three storms, slightly below the 1981-2010 average of four storms. Two of these storms – *Hud Hud* and *Nilofar* – became very severe cyclonic storms.

Australia experienced a slightly-below-average number of tropical storms in 2014, with four cyclones making landfall.

In the South West Indian Ocean basin, a total of eight named tropical storms formed during the period from 1st January to April. For the full season, which started in 2013, nine storms formed, equal to the long-term average. In the South West Pacific basin, six storms formed in addition to four in the Australian region; the combined total of 10 storms is slightly below the long-term average of 12 storms.

Greenhouse gases
The latest analysis of observations by the WMO Global Atmosphere Watch Programme shows that atmospheric levels of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) reached new highs in 2013. Data for 2014 have not yet been processed.

Globally-averaged atmospheric levels of CO_2 reached 396.0 parts per million (ppm), approximately 142% of the pre-industrial average. The increase from 2012 to 2013 was 2.9 ppm which is the largest year to year increase, with a number of stations in the Northern hemisphere recording levels above 400 ppm. The overall increase in atmospheric CO_2 from 2003 to 2013 corresponds to around 45% of the CO_2 emitted by human activities. The remaining 55% is absorbed by the oceans and the terrestrial biosphere.

CH_4 concentrations in the atmosphere reached a new high of 1824 parts per billion (ppb) in 2013. That is approximately 253% of the pre-industrial level. Global concentrations of N_2O reached 325.9 ± 0.1 ppb, 121% of the pre-industrial level.

NOAA's Annual Greenhouse Gas Index shows that from 1990 to 2013, radiative forcing by long-lived greenhouse gases increased by 34%. CO_2 alone accounted for 80% of the increase.

WMO Analysis Methods
The WMO global temperature analysis is principally based on three complementary datasets maintained by the Hadley Centre of the UK's Met Office and the Climatic Research Unit, University of East Anglia, United Kingdom (combined); the U.S. National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Centre; and the Goddard Institute of Space Studies (GISS) operated by the National Aeronautics and Space Administration (NASA). Global average temperatures are also estimated using reanalysis systems, which use a weather forecasting system to combine many sources of data to provide a more complete picture of global temperatures. WMO uses data from the reanalysis produced by the European Centre for Medium-Range Weather Forecasts.

Reference: WMO Press release # 1009; WMO website visited on December 3rd, 2014.

The World Meteorological Organization is the United Nations System's authoritative voice on:

Weather, Climate, and Water

Data Analysis and Visualization with Ocean Data View

by Reiner Schlitzer[1]

General Overview

Ocean Data View [1] (ODV) is a computer program for the interactive analysis and visualization of oceanographic and other geo-referenced profile, trajectory or time-series data. The software is available for Windows, Mac OS X, Linux, and UNIX systems. ODV data and settings files are platform independent and can be exchanged between all supported systems.

ODV lets the users maintain and analyze very large datasets on inexpensive and portable hardware. Various types of graphics output can be produced easily, including high-quality station maps, general property-property plots of one or more stations, scatter plots of selected stations, section plots along arbitrary cruise tracks, and property distributions on general isosurfaces. Commonly used isosurfaces are constant depth, density or temperature layers. ODV supports display of scalar and vector data by coloured dots, numerical data values or arrows. In addition, ODV includes three different gridding algorithms that calculate fields on automatically generated grids on the basis of the normally heterogeneously distributed data. Gridded fields can be contoured and colour shaded.

ODV has a large user community with almost 40,000 registered users worldwide.

Data Collections

ODV has its own data format (the ODV collection) that is optimized for variable-length, irregularly-spaced profile, trajectory, and time-series data. ODV collections provide dense data storage and very fast data access. ODV collections are extendable and can handle very large datasets for virtually unlimited numbers of stations, samples, and variables. Every station in a collection is described by a configurable set of metadata and may contain data for a configurable set of data variables for a virtually unlimited number of samples. Metadata or data values can be either numeric or UNICODE text. Number and type of metadata and data variables are defined when a collection is created, but can be modified at any time. Different ODV collections may contain different data types, such as profiles, trajectories or time-series.

In addition to the actual numeric or string data values, ODV also maintains 1σ data error values (if available), quality flag values and info strings for every individual data value. Info strings may consist of literal text or represent references to local files or documents on the Internet. Most of the commonly used quality flag systems [2] are supported. Quality flags may be used for data filtering to exclude bad or questionable data from the analysis. Data values, error values, quality flags, and info strings may be edited and modified. All modifications are logged.

ODV collections can be extended by importing new data from a wide range of formats including text spreadsheet files, ARGO profile and trajectory netCDF files [3][4], GTSPP netCDF files [5], SeaDataNet ODV or netCDF files [6], Sea-Bird cnv files, CLIVAR and carbon data in WHP exchange files [7], and World Ocean Database files [8].

netCDF Support

In addition to native data collections, ODV can also access and visualize data in local or remote netCDF files, widely used for platform independent storage of original data as well as model output. ODV requires users to identify key coordinates and variables in the netCDF file via a four-step netCDF emulation wizard. The content of the netCDF file is then presented to the user as if the netCDF file was a native ODV collection. All ODV analysis and visualization options are available for the exploration of the data in the netCDF file. By construction, netCDF files are platform independent and can be used on all ODV supported systems.

Derived Variables

In addition to the basic measured variables stored in ODV collection files, ODV can calculate and display a very large number of derived oceanographic variables, such as potential temperature, potential density, dynamic height (all referenced to arbitrary levels), neutral density, Brunt-Väisälä Frequency, sound speed, and oxygen saturation. Various parameters of the carbon dioxide system in seawater, the saturation concentrations, and partial pressures of many gases and other chemical oceanography variables are also available as derived variables. Commonly used mathematical expressions, such as ratios or integrals and derivatives are also available. The algorithms for calculating derived variables are either hard-coded in the ODV software or defined in user provided macro files or expressions. The macro language is general enough to allow quite complicated formulae and a large number of applications. Expressions and macros allow easy experimentation with new quantities not yet established in the scientific community.

[1] Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Am Alten Hafen 12, 27568 Bremerhaven, Germany

ODV API

An ODV Application Programming Interface (API) providing reading access to existing ODV collections has been released recently for Windows, Mac OSX, and Linux systems [1]. This API is available initially for C++ and Java. Support for other languages, such as Python, Ruby, R, Octave, and Javascript, is possible and can be developed on demand. The ODV API provides a set of classes that can be used in custom C++ or Java applications to open existing Ocean Data View data collections and access metadata and data of arbitrary stations in the collection. Data access is very fast. This opens the way for custom data usage scenarios not already covered by the ODV software itself. Within the European SeaDataNet [6] project, IFREMER is using the ODV API operationally in its OCEANOTRON product to serve data held in ODV collections over the Internet.

Examples

As an use-case for oceanographic sections produced with ODV, Figure 1 shows the distribution of dissolved ^{230}Th along several sections in the North Atlantic as 3D scene. The measurements were conducted as part of the international GEOTRACES programme [9] and the figure is taken from the eGEOTRACES - Electronic Atlas of GEOTRACES Sections and Animated 3D Scenes [10], which exhibits more than 300 ODV-generated section plots and 90 rotating 3D scenes. The distributions along the sections were obtained from the original data points (marked by black dots) using the DIVA gridding software [11] that is built into ODV. The individual section fields were then combined in the 3D scene using additional software. This 3D software is presently not robust enough for general distribution and is not yet integrated into ODV.

^{230}Th in seawater is produced by ^{234}U decay. Concentrations of the mother isotope and the Thorium production rate are quite uniform in the world ocean. If Thorium was a conservative tracer concentrations would be almost the same everywhere. However, Thorium is particle-reactive, and a fraction of the Thorium attaches onto particle surfaces. Together with the sinking particles Thorium is transported into deeper layers. For a resting ocean with uniform particle distribution and homogenous sinking properties one would expect linearly increasing ^{230}Th concentrations with depth.

Figure 1 shows that in the North Atlantic the expected linear concentration increase with depth is indeed observed in the upper 1 500 m of the water column. In some regions like the south-western and central eastern basins the concentration increases continue almost to the bottom. However, significant (and scientifically very interesting) deviations from the expected behaviour occur at the eastern and western boundaries as well as near the bottom in the eastern basin and near the top of the Mid-Atlantic-Ridge. The feature above the ridge is due to hydrothermal activity, whereas the boundary and bottom features are due to circulation effects and enhanced particle concentrations at the boundaries and the bottom (boundary scavenging).

As an example for the use of ODV with atmospheric data, Figure 2 shows the temporal evolution of atmospheric ozone concentrations at Koldewey Station, Ny-Ålesund, Svalbard [12]. The figure shows part of a compilation of 4194 individual vertical profiles reaching altitudes of up to 35km and covering a 17 year period between 1991 and 2006. As in Figure 1 the distribution is obtained using the DIVA gridding software. Clearly visible are the annual stratospheric ozone maxima centered at about 18 to 20 km and the ozone minima ("ozone holes") in the upper troposphere between 5 and 10 km.

As an example of ODV arrow plots, Figure 3 shows the 10-m winds for January 01 2009 based on QuikSCAT observations [13]. The wind data are provided as netCDF files. ODV reads the netCDF file directly; no conversion is necessary.

In addition to oceanographic and atmospheric data, ODV is also used for analysis and visualization of other environmental data, such as marine and lacustrine sediment cores, ice cores, and riverine data. Usage of ODV is free for non-commercial research and teaching activities. Commercial use requires the purchase of a software license.

Acknowledgements

I am grateful to Bob Keeley for constructively accompanying the ODV development for more than two decades and for providing beneficial advice as well as stimulating and sometimes challenging suggestions over all these years. I also thank him for carefully reading and improving this manuscript.

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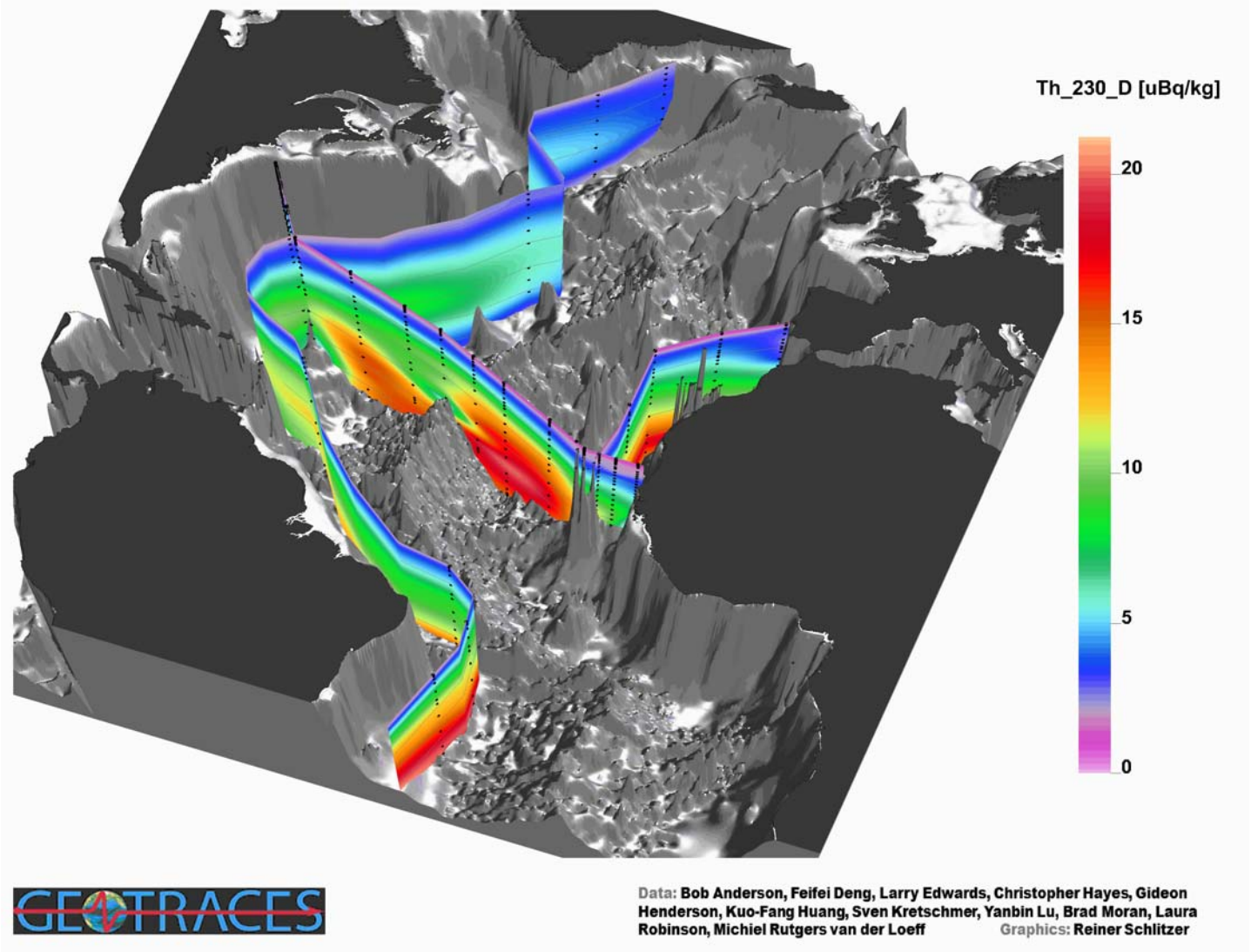


Figure 1: Distribution of dissolved ^{230}Th in the North Atlantic as 3D scene consisting of three ODV-generated sections. Positions of the measurements are marked by black dots.

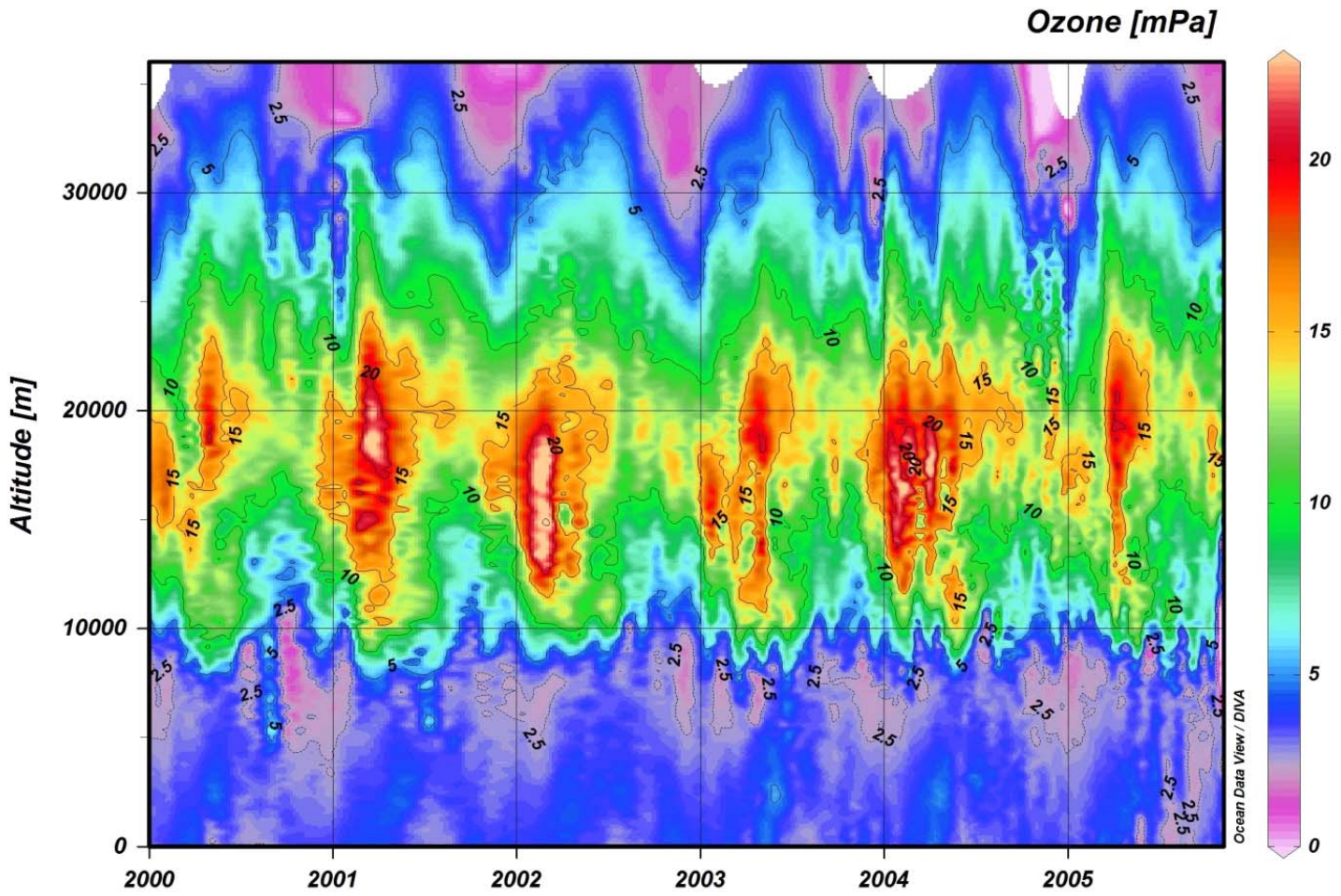


Figure 2: Temporal evolution of ozone in the atmosphere at Koldewey Station Ny-Ålesund, Svalbard. The figure shows only part of the measurements that started in 1992 and are ongoing.

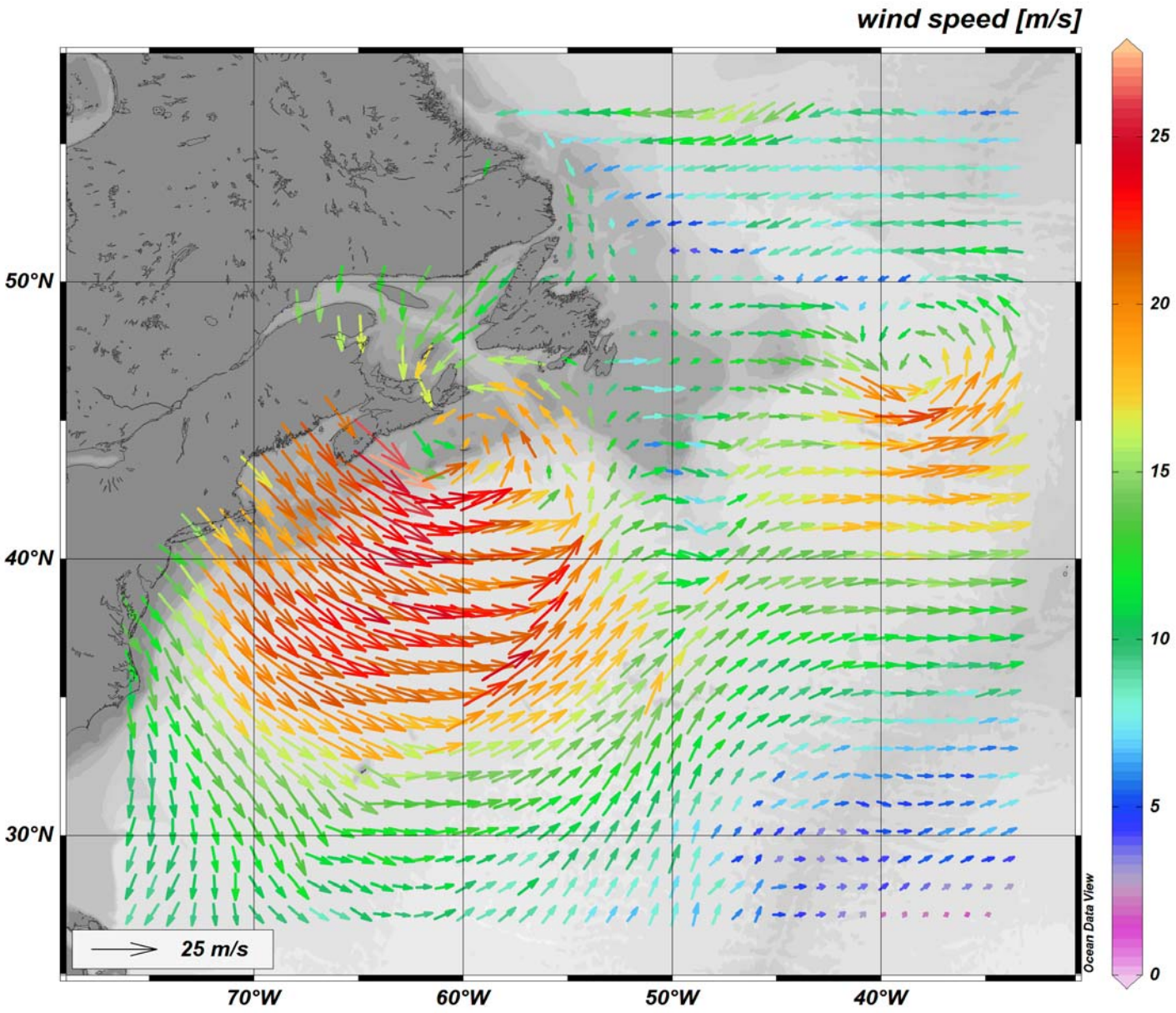


Figure 3: Arrow plot of QuikSCAT winds for January 01 2009.Only every fourth vector is shown to avoid excessive overlap.

Canada's Top Ten Weather Stories for 2014

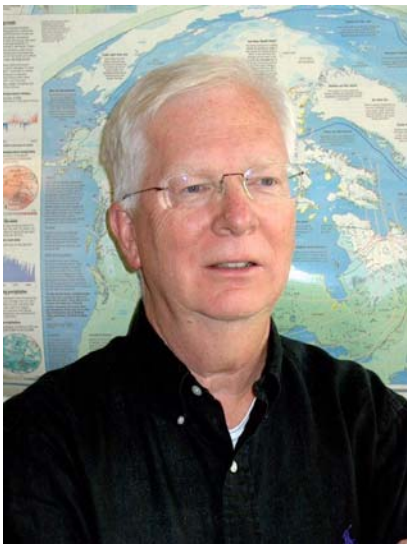
by David Phillips[1]

2014 - A Year in Review

Temperature was a recurring theme in Canada's top weather events in 2014, but unlike recent years, it was intense and long bouts of cold causing frozen ground, thick ice, and a deep snow pack that drew our attention. Nearly everyone could relate to this year's top weather story – Canada's long, cold winter – but for the vast majority, the cold was year-round with no season offering warmer than normal temperatures. It was a cold that even spring and summer couldn't beat back. Stick a thermometer into Canada and it read a measly +0.1°C above normal – the coldest year since 1996 and certainly out of step with the planet, which was on target to being the hottest year since modern records began in 1880. As a result of Canada's trend-bucking cold, the Great Lakes attained 92 per cent ice coverage for the first time in 35 years, with ice still present in June. On the East Coast sea ice was back, and in the Gulf of St. Lawrence sea ice thicknesses in March were the greatest in over 25 years and 10 per cent more than average. Months without a serious thaw left most Canadians begging for spring. But if April is the cruelest month, spring might have been the cruelest season ever this year. Desperate Canadians said they had forgotten what a warm day felt like and were looking forward to their first mosquito or smog day – two sure signs of warmth that failed to materialize. A disappointing spring was followed by a second-rate summer for the nearly two-thirds of Canadians living in central Canada. The substandard season featured chilly air, ice-cold waters, and too many wet days.

Those in the western Northwest Territories and British Columbia were much more fortunate. In coastal BC, it was the summer of summers; the third-warmest summer in 67 years of record-keeping and one of the top ten driest. The only downside was that forest fires were often out of control in the western Northwest Territories, seven times the normal acreage was ablaze - a record for the region. So intense were the fires that smoke spiraled high above Yellowknife and traveled all the way to Portugal, while the flames bred whirls and firenadoes. In British Columbia, fires caused the third biggest loss of timber in the province in 60 years of record-keeping and firefighting costs soared four times over budget.

Another recurrent theme in recent years has been menacing floods. In 2014, flooding made the list again as biblical-sized deluges in the eastern Prairies, initiated by copious rains over three days in mid-June, resulted in one of Canada's few billion-dollar disasters. Also in the costly weather stories category was a storm just before Christmas 2013 that lingered well into 2014 because its impacts were still being tallied a year later. Insurance claims reached a quarter of a billion dollars when snow, ice pellets, rain, and freezing rain plunged parts of central and eastern Canada into days of cold and darkness. Ontario government payouts alone exceeded $200 million and counting, while the cleanup of branches and debris continued throughout the year.



David Phillips

An accurate count of tornadoes is never possible across Canada, but 45 confirmed and possible tornadoes were noted in 2014, which was fewer than normal. All were weak and short-lived except for one in Angus, Ontario that resulted in $30 million in insurance claims. Based on the past five years, no list of significant weather events in Canada would be complete without mentioning Calgary. In 2014, Calgary made the list again; not once but twice. On August 8, a half-billion-dollar hailer pummelled most of Airdrie, Alberta and areas south to Calgary. A month later, the city experienced a surprising summer snowfall that brought down thousands of trees.

In a region that is no stranger to storms, Atlantic Canada got more than its share of nasty hurricanes, nor'easters, and big blows this year. Interestingly, there was no reprieve from wicked weather as every season featured at least one big weather event: winter featured crippling storms in early January; the beginnings of spring brought a nasty April Fool's Day storm that dashed hopes for a warm-up; hurricane season started in summer with Arthur and other named storms making an appearance; and the last two months of the year brought four nasty fall storms that included two powerful nor'easters. The impact on New Brunswick Power was indicative of the widespread fallout

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felt across the region from four seasons of violent storms. The provincial utility had one of its most disruptive and expensive years on record with seven major storms in less than a year knocking out power to hundreds of thousands of homeowners and businesses with costs of more than $40 million.

Among the other weather highlights in 2014 were Prairie and Ontario farmers being faced with challenging weather during growing and harvesting seasons that included floods, heavy and untimely rains, frozen ground, cold weather, harvest frosts, and even summer snows in Alberta. In parts of the North it was the coldest year in 17 years. As a result, September sea ice concentrations grew 1.6 million square km above the record minimum of two years ago. Further south, it was another wet year in the Great Lakes – almost 10 per cent above normal – which meant a continuation of the remarkable rebound in Great Lakes water levels in 2013 and 2014.

On the same week in mid-December powerful storms lashed both coasts of Canada with drenching rains and fierce winds. Flooding, washouts, and power outages occurred along coastal British Columbia from a series of storms hours apart, whereas it was a single, slow-moving nor'easter that inflicted extensive damages in the Maritimes and into Quebec and Ontario. Ironically, at the same time residents on the Prairies basked in record warm temperatures which was a welcome respite from usual December weather.

The following top Canadian weather stories for 2014 are ranked from one to ten based on factors that include the impact they had on Canada and Canadians.

Top Ten Canadian Weather Stories for 2014

1	**Canada's Long Cold Winter**
2	**Summer Flooding in the Eastern Prairies**
3	**Wildfires in the West and Northwest**
4	**The Nightmare Before, During, and After Christmas (2013)**
5	**Summer – Hot on the Coasts, Cool in the Centre**
6	**Hurricane *Arthur* and Others**
7	**Airdrie to Calgary Hailer**
8	**Powerful December Storms on West and East Coasts**
9	**Angus Tornado**
10	**"Snowtember" in Calgary**

1. Canada's Long Cold Winter

Following several mild winters, Canada's reputation as the second coldest country next to Russia was reaffirmed in winter 2013-14. While at times British Columbia and the Yukon were basking in balmy breezes and sunny skies, the rest of us were shivering our way through the coldest winter in 18 years and the third coldest in 35 years. That devilish polar vortex – a circulation of frigid, dense Arctic air - moved much farther south than normal, freezing the heart of North America from Tuktoyaktuk to Toronto to Tallahassee. At the same time, weather systems from the Pacific that help push cold lows back to the north or across to Siberia were scarce. The intensity of the cold was remarkable, but it was its duration that brought us to our knees. In most parts of the country winter came to town early and wouldn't leave, staying from Halloween to beyond Easter. And while January did have a thaw, it was feeble and lasted hours not days or weeks. For millions of Canadians from Windsor to Quebec City, the "normal" winter period from December to February was the eighth coldest ever recorded. Even more revealing, the five months between November and March inclusive were the coldest since the start of national record-keeping in 1948.

And we didn't just feel it; we were surrounded by it in the form of record snowfalls, crippling ice storms and lingering snow cover. Snowfall records were set in Windsor, Calgary, Red Deer, Kenora, and a handful of other cities across Canada. In Saskatoon, there was snow on the ground for six months – likely the longest period with continuous snow cover since 1955 when record-keeping began.

The following is a sampling of how cold and snowy it was:

- According to weather data logged by NASA's Curiosity Rover, residents between Regina and Rouyn woke up some mornings to temperatures colder than those on Mars.

- On January 7 at 2:00 p.m., Canada's most southerly city, Windsor, was -17.4°C – 10 degrees colder than Canada's most northerly city, Iqaluit.

- On New Year's Day, Ottawa went from slushy puddles and melting temperatures to -23°C in fewer than 24 hours. But the city's brutal cold had nothing on locations in Quebec, where the wind chill hit an unbearable -56 °C at Fermont and Normandin and exposed flesh could freeze in under two minutes. Just two days later, at Lac Benoit, the

temperature dipped to a low of -47.4°C.

● February 26 was Hamilton's 47th day under a cold alert, the identical number of cold alert days for the city over the past three winters combined.

● Freezing-degree days below 0°C were 15 per cent higher than average over southern Ontario and Quebec, which explains the unusually thick river and lake ice.

● Toronto experienced its c-cc-coldest winter in 20 years, which prompted the public health office to issue 36 extreme cold alerts compared to nine the previous year. Further, the city had snow on the ground for more than 100 consecutive days on top of a layer of pre-Christmas freezing rain.

● Kenora's winter was the coldest and snowiest since 1938 when record-keeping began, while Kitchener-Waterloo logged 25 days below -20°C; normal is 6.

● Nobody had it worse than Winnipeg, arguably the coldest big city in Canada. No one alive can say they've lived it colder there as residents survived the coldest December to March, inclusive, since 1898 – long before urban heat islands, automobiles, heavy industry and long before global warming. Temperatures averaged -20°C when the normal average is -14.3°C, and there were 30 raw days when the temperature dropped below -30°C versus a typical average of 12. Adding to the misery, the city received an abnormally large amount of snow. The 155 cm that fell was well above the average of 100 cm and the most the city had received since the winter of 1996-97 – enough to bust the myth that it's ever too cold to snow! The only good news was that the cold and snow were so dry it helped minimize the spring flood risk.

The bone-chilling, teeth-chattering weather and lasting snow had a host of negative impacts. A shortage of road salt in parts of central Canada had suppliers scrambling to find extra supplies, and consumers of propane and natural gas fumed at skyrocketing prices. The frigid weather caused record levels of power consumption as customers cranked up the thermostat to beat back the cold, and home and business owners faced up to 20 per cent billing increases. Frequent blackouts just made things worse. For the homeless, the bitter cold made a hard life harder. Hospitals were pushed to handle more cases of frostbite, hypothermia and falls from icy sidewalks and streets, and Canadian Blood Services reported a significant decline in donor numbers. The winter's duration and difficulty also led to increased reports of depression and anxiety. At times, the intense cold created transportation nightmares. Towing companies couldn't keep up with the calls, with waits for roadside service typically reaching five hours or more for low-priority calls. Extreme cold also caused air travel chaos when Canada's biggest airport, Toronto's Pearson International, shut down causing serious ripple effects for aviation across the country.

For plumbers, things couldn't have been busier as they scrambled to thaw frozen hydrants, ruptured pipes, and broken sprinklers. Homeowners flooded city hot lines, complaining about burst water pipes, and frozen toilets. Some residents in Winnipeg lost water for months as persistently cold temperatures froze the ground one or two metres below the surface. The city incurred the highest number of frozen water pipes in more than 35 years. Hundreds of pipes also froze in Thunder Bay and Kenora, leading the latter to issue a citywide boil-water advisory. Frozen pipes, along with big snowfalls and biting wind chills, also contributed to school snow days and event cancellations becoming regular occurrences across eastern Canada.

Brutal winter conditions also took their toll on plants and animals. Winterkill was especially severe across the board with damage to golf courses costing millions of dollars in lost business and repairs. Ontario's wine industry lost millions of dollars after cold killed 60 to 95 per cent of the grape buds. In some communities, biologists reported a record loss of trees and ornamental shrubs from winterkill, salt damage or wind desiccation. On the farm, extreme cold meant that cattle had to eat even more just to stay warm. Bee farmers reported losses in their hives as high as 50 per cent over the past winter. The severe cold and deep snow also contributed to a decline in deer populations, while brown bats literally dropped and died from the biting cold.

2. Summer Flooding in the Eastern Prairies

For the past several years, flooding has been the big story across the Prairie provinces. In 2005, torrential rains produced summer flooding. In 2011, it was the combination of snowmelt and ice jamming that created a massive billion-dollar disaster across Saskatchewan and Manitoba. Last year, the coincidence of rapid snowmelt and heavy spring rains in southern Alberta generated the most disruptive, destructive, and expensive flood in Canadian history – a $6 billion flood of floods. Unfortunately, anyone looking for a break in 2014 was sorely disappointed. This time water problems prevailed across the eastern Prairies just a week before summer began. Excessive rains on soggy ground - too much rain too fast over too many days – led to huge flooding and another billion-dollar disaster.

On June 15, two major slow-moving weather systems, hours apart and more typical of spring or fall, combined to bring a few soggy days to the eastern Prairies. The

prolonged moisture-laden storms moved up from the northern United States and stalled near the Saskatchewan-Manitoba border. Relentless rains turned into biblical-sized deluges over three days. Almost a year's worth of rain fell in some places. Prior to the soaking, three weeks of wet weather meant that the latest rains had nowhere to go but overland. With soil saturated and ditches filled, the water cascaded into channels that rapidly fed into creeks and rivers.

Excess precipitation in the days and weeks leading up to July 1 included:

● The third wettest spring on record dating back to 1892 for Saskatoon. Total spring (April to June) precipitation was 230 mm or 175 per cent of normal.

● Yorkton had 252 mm of rain in June, which was more than triple the normal accumulation and the wettest ever since 1884 when record-keeping began. Nine days in June had more than 10 mm (normal is 2 days) and spring rainfall totalled 357 mm – another record.

● With observations at Brandon dating back to the 1890s, June 2014 was the wettest month ever with 252 mm – three times June's normal total and, incredibly, 34 mm higher than the all-time previous wettest month of August 1980. June had four days with rainfall over 25 mm, including 75 mm on June 19, and three days in a row on the final weekend of the month – all on top of it being Brandon's wettest spring on record.

● One Regina weather site recorded 198 mm of rain in June, which is nearly triple the normal of 70 mm and almost the wettest month on record. Total April-to-June rainfall was 312 mm or 216 per cent of normal, and the second wettest such period with records dating back to 1883.

● To the far west, Lethbridge recorded its wettest June and wettest month ever with 280 mm of rain, which is more rain than the city gets in an average year.

Rains and subsequent flooding at the end of June forced the closure of a hundred highways, including a stretch of the TransCanada east of Regina where dozens of bridges, culverts, and utilities were washed away and dozens of basements were filled. Sections of country roads were under water for days on end. The rains also led to record flows on 17 southern Manitoba rivers and streams. Nearly 100 communities, including the cities of Melville and Yorkton in Saskatchewan, declared states of emergency. Citizen volunteers and a thousand military reservists scrambled to fill hundreds of thousands of sandbags to fend off rising floodwaters. Some 1,000 residents, mainly in southwestern Manitoba, were displaced and faced mucky basements and debris-strewn yards on their return home.

Flooded pastures resembled rice paddies and crop fields featured lakes with whitecaps, leaving some of the best farmland in Canada too soggy to farm. Farmers feared losing their growing season altogether. In Manitoba and Saskatchewan, well over one million acres of seeded fields were flooded or drowned and another two million were left unseeded. As much as six million acres of farmland in the west were damaged, drowned or lying on still-frozen ground. Even though some crops recovered from flooding, their high yields suffered. Total costs from flooding exceeded $1 billion as farmers lost crops and communities mopped up. Weeks later, waves of mosquitoes emerged from the sodden ground and standing waters. Hardship was especially prevalent in several First Nations communities where flooding is becoming a ritual that brings both emotional and physical health issues.

The seeds of this summer's flood started in the fall of 2013, when already saturated soils, combined with high over-winter snowfall covered the eastern Prairies. It was magnified by an exceptionally hard winter with a deep snowpack and a late spring melt that kept soils saturated and potholes filled. Another factor leading to worsening Prairie flooding in recent years that has been brought to light by expert hydrometeorologists is altered drainage patterns on agricultural lands in Saskatchewan and Manitoba and the greater incidence of multi-day rainfalls. Storm rainfalls over larger areas are lasting longer than usual. The network of Prairie potholes and sloughs has already filled to the brim, and now the runoffs are moving overland in a "fill and spill process" that is ripping out roads, inundating homes, and overwhelming sewer networks. Ducks Unlimited said that wetland drainage on the Prairies has increased average flows by more than 60 per cent, and a study by the University of Saskatchewan found changes in wetland drainage over 50 years increased recent flood peaks by as much as 32 per cent.

3. Wildfires in the West and Northwest

While conditions were not favourable for wildfires in most areas of the country in 2014, it was still a huge wildfire year in Canada. According to the Canadian Interagency Forest Fire Centre, although the absolute number of wildland fires was 10 per cent less than the 20-year average, the area burned was three times higher than the 20-year national average (4.6 million hectares vs the normal 1.5 million hectares). So even with parts of Canada being, at times, soaked by heavy rains or underwater from floods, the Northwest Territories and British Columbia made up for it all with exceptional warmth and dryness that brought sparks to infernos in no time flat.

In the Northwest Territories it started with a cold winter and scanty snows that left the ground and forest litter dry. With summer came clear skies and record warm temperatures that optimized already perfect conditions for fires to spread. The principal culprit was a stalled ridge of drying air anchored over the Mackenzie River valley for weeks. Temperatures from Tuktoyaktuk to Yellowknife averaged

well above historic averages. The Mackenzie region averaged 1.6°C warmer than normal – the seventh warmest summer in 67 years. Yellowknife had 22 days in June and July at or above 25°C, compared to an average of eight, and only two days in June and three in July with rain. In a 91-day span, from the May long-weekend onwards, Yellowknife received only one-half its normal rainfall. As further evidence of the dryness, water levels in the Mackenzie River dropped to some of the lowest seen in more than 30 years. So it was no surprise to anyone that the Northwest Territories had its worst fire season in 30 years with nearly 3.4 million hectares razed. That's seven times the normal acreage consumed and six times the size of Prince Edward Island. At the peak of the fire season, smoke, ash, and moisture from intense fires travelled as high as 15 km in the air, easily circling the globe. Some plumes travelled south and east affecting air quality in the northern plains of the United States, the Canadian Maritimes, and even as far as Portugal. The fires caused a host of problems, including highway closures due to reduced visibility, the destruction of fibre optic cables, and the interruption of Yellowknife's main power supply line. Health risks were also a concern as the city's hospital treated twice the usual number of patients for respiratory and allergy issues. Smoke was so thick that, at times, it was hard to breathe indoors with the windows closed let alone venturing outside. Widespread forest fires also stranded visitors and adversely affected busy tourist camps and attractions. In August, firefighters and residents finally got a breather when cooler and wetter weather took hold. Temperatures dropped significantly and rainfall was 50 per cent more than normal for the month.

In British Columbia, an overheated wildfire season scorched the third-biggest loss of timber in the province since authorities began recording wildfire statistics more than 60 years ago. Fires burned more than 338,000 hectares through the province – seven and a half times the normal area charred on average over 20 years. No homes or notable structures were destroyed, but the province more than quadrupled its firefighting budget, spending $266 million. Conditions for the wildfire season started in 2013 when places like Victoria experienced their driest October-to-December on record. Summer perfected conditions for igniting and spreading wildfires as average temperature across coastal and southern portions of the province made for the third-warmest summer over 67 years of record-keeping and one of the top ten driest summers. Record-high July maximum temperatures soared into the low 40s in several interior communities. Some places claimed it was the driest summer in more than half a century. Among the major fires were those that burned in vast dead pine forests killed by mountain pine beetles or on steep, inaccessible terrain, increasing risks and challenges to firefighters and communities.

Nearly 400 firefighters from Ontario, the Maritimes, Alaska, and even Australia pitched in to help. The biggest and most difficult forest fire was near the Chelaslie River south of Burns Lake in northwestern British Columbia. It burned 133,162 hectares, accounting for more than 30 per cent of land burned in the province this year. Another big fire occurred in northern British Columbia near the Alberta border when a lightning strike whipped by strong winds caused 3,800 hectares to burn at Red Deer Creek. And a fire at Smith Creek, west of Kelowna, forced 2,500 people out of their homes. Over the course of the summer a series of smoke advisories and special air quality statements, issued by the province and Environment Canada respectively, were put in place for many regions, including the Okanagan Valley where residents of Peachland were urged to keep small children, the elderly, and pets inside. On occasion, even Vancouver and the Fraser Valley were subject to air quality advisories as smoke plumes hung heavy over the skies.

Fortunately, timely rains and cool temperatures from September through October saved British Columbia from a second disastrous forest fire season and brought much-needed moisture to the somewhat water-starved province. Rainfall in Victoria and Vancouver totalled more than 40 per cent above normal, with Vancouver experiencing its wettest September-October in 10 years.

4. The Nightmare Before, During, and After Christmas

The weekend before Christmas 2013, a vigorous winter storm coated parts of eastern Canada with a thick cocktail of snow, ice pellets, rain, and freezing rain that plunged large parts of the region into days of cold and darkness. Restoration of full utilities and property clean-up continued well into 2014. At the time, a thick glaze left roads and sidewalks slick and dangerous; it also knocked down hydro lines, leaving over 500,000 people without power. In addition to wreaking havoc in Canada's largest city (Toronto), it crippled North American transportation at one of the busiest travel times of the year. As damaging as it was, comparisons to the deadly ice storm that entombed much of Eastern Canada in 1998 weren't even close with the earlier storm killing more than two dozen people and leaving another four million in the dark.

Though picturesque, the Christmas storm created extremely dangerous conditions as fallen hydro lines intertwined with broken tree limbs that dangled across streets and property. The affected area extended from Lake Huron, across the

Greater Toronto Area, east along Highway 401 to Cornwall, through Quebec's Eastern Townships and Montérégie region, and across the central Maritimes centred on the Bay of Fundy. The epicentre of the freezing rain was in southern Ontario between Niagara and Trenton, where between 20 and 30 mm fell – more than two-year's worth in two days.

The complex weather system originated in Texas and sent warm moist air northward above a shallow surface layer of cold air lying in wait across eastern Canada. The first wave spread continuous mixed precipitation into southern Ontario late on December 20 and through the morning of December 21. A few hours of intermittent precipitation followed before a more potent storm tapping loads of moisture from the Gulf of Mexico arrived late in the afternoon and persisted into the next day. At Toronto Pearson International Airport, an impressive 43 hours of freezing rain and drizzle occurred between the evening of December 20 and late afternoon on December 22, while temperatures remained fairly constant hovering around the freezing mark for 60 hours. Trenton registered 55 hours of freezing precipitation, while farther north – between Kincardine and Ottawa – snow and ice pellets fell with peaks of 18 cm of snow in Ottawa and 15 cm of ice pellets in Cornwall.

In southwestern Ontario and along the north shore of Lake Erie, it was all rain with totals between 40 and 70 mm. In Montréal and Saint-Hyacinthe, it was mostly snow totalling 11 cm and 20 cm respectively while the Gaspésie received up to 65 cm of snow with strong winds. Freezing rain totals in Quebec ranged from 15 to 25 mm through the Richelieu Valley and in Sherbrooke. In New Brunswick, freezing rain coated surfaces with 10 to 30 mm of ice, augmented by a series of fierce storms between Christmas and a few days after New Year's that dumped 30 to 70 cm of snow and freezing rain. NB Power called that two-week period of nasty weather the most damaging and challenging in decades.

Because temperatures remained below freezing in the wake of the storm, there was little natural melting. Wind strengths also picked up resulting in ice-ladened tree branches snapping, crackling, and bringing down power lines for a week afterward. Over half of those plunged into darkness were in the Toronto region, with Toronto Hydro calling it one of the largest ice storms in history. The icy weather left the city with a fractured transit system, a water pumping station out of commission, and two major hospitals running on back-up generators. Community centres were opened to warm and feed thousands of citizens, while retailers struggled to remain open through one of the busiest and most profitable shopping weeks of the year.

In Quebec, 54,000 people lost power – most living in the Eastern Townships, Montérégie, and Montréal. In the Maritimes, the hardest hit area centred on Rothesay and St. Stephen. In total, 88,000 residents faced off-and-on power interruptions; some as many as six times. Hydro trucks from Michigan to Maine and as far west as Manitoba arrived to help eastern Canada, but restoring power proved to be slow and difficult as utility crews trudged through deep snow, crossed slippery surfaces or manoeuvred debris piles to reach damaged areas. Full service wasn't back in New Brunswick for 11 days. In southern Ontario, more than 100,000 people in homes, businesses, and farms were still without power on Boxing Day.

The storm was thought to have played a factor in fatalities in Ontario and Quebec, including six fatal highway crashes and five deaths due to carbon monoxide poisoning resulting from unsafe heating methods. Additional costs from worker overtime, spoiled food, and damaged homes, vehicles, and public infrastructure is thought to exceed hundreds of millions of dollars. Irreplaceable is the loss of trees. In Toronto alone, some streets lost between 50 and 80 per cent of their mature canopy leaving large holes in the city's urban forest.

5. Summer – Hot on the Coasts, Cool in the Centre

After enduring one of the harshest winters in recent memory, Canadians figured Mother Nature owed them a break. A sunny, warm summer was top of mind. For some, their prayers were answered. For others, it was yet another seasonal letdown. Actually, the summer was 1.0°C above average making it the sixth warmest since nationwide record-keeping began in 1948. Much of Canada registered warmer than normal temperatures, with five regions (incl. Atlantic Canada, Northern Prairies, BC southern interior, Western NWT, and Pacific Coast) experiencing their top ten warmest on record. The exception was Southern portions of Ontario and Quebec where, ironically, a large percentage of Canadians live. But even there temperatures were only 0.2°C below seasonal values. For a scarce few, a summer without heat, haze, and humidity was perfectly fine. The rest called it a "bummer of a summer" because it just never warmed up.

The Pacific coast featured its third warmest summer in 67 years and the warmest in 10 years at 1.4°C above normal. Besides being spectacularly warm, it was remarkably dry - the seventh driest – with total rainfall 26 per cent below normal and drier than any previous summer that was

warmer. The combination of heat and dry made it arguably the most delightful summer on record. Further, coastal British Columbia didn't get the usual June gloom. Other parts of the province, including the southern mountains and the interior, were similarly warm and dry. In mid-July, interior locations experienced several days above 40°C. The hot spot was Ashcroft at 41.3°C. At the first sign of sunshine in the Lower Mainland and on Vancouver Island, droves of beachgoers raced to the water's edge. On the other hand, the province faced an extensive and expensive wildfire-fighting season. And on Vancouver Island and the Gulf Islands, level 3 drought conditions prompted officials to ask residents to cut water consumption to limit the drawdown on streams and groundwater. But while west coast lawns were brown and garden beds parched, few were complaining. The only other downside to the glorious weather was the need for health officials in Vancouver to warn residents about strenuous outdoor activities when high amounts of ground-level pollutants prevailed.

The west coast summer spilled over into Alberta where July and August featured temperatures almost 2°C warmer than normal and precipitation at about 56 per cent of usual. In July, Calgary had the third warmest month of any month in 72 years. Under unusually high humidity, health authorities issued heat advisories and energy officials pleaded with Albertans to ease off on power consumption.

Atlantic Canada was just as warm as the west coast - 1.5°C above normal for the fourth warmest summer on record. In St. John's, July was the hottest month on record; no month going back 140 years has ever been warmer at 19.7°C or 3.9°C above normal. In total, all but two July days were warmer than normal. Incredibly, St. John's was almost as warm as Toronto and trumped it on its number of hot days with 19 above 25°C. Toronto, Ottawa, and Montreal had fewer days above 25°C than St. John's! Warm, dry conditions left rivers across Newfoundland and Labrador with low water levels and "boiling" temperatures prompting the Department of Fisheries and Oceans to close 63 salmon rivers across the province. But while conditions were dry, the air was not. On July 30, the humidex in St. John's hit a new all-time record when it topped out at 38.7. During July, the high demand for fans and backyard pools stripped store shelves bare of these items, leaving consumers high and dry – and very hot.

Residents in the central part of the country – including western Quebec, Ontario, Manitoba, and parts of Saskatchewan – felt left out in the cold. Days with maximum temperatures above 30°C generally numbered two to four at most. And the lack of sunshine gave the impression of much cooler temperatures. Hamilton saw only one day over 30°C all year and that was on June 17 at 30.3°C. In 2013, there were nine hot days and 25 the year before. Similarly, London counted only one hot day – June 16 – and that was almost a week before the official start of summer. For Windsor, which typically leads the East with the warmest summers, it was the coldest July in 22 years. In southern Ontario, July and August were the second coldest two months in 55 years of records. Only 1992, often referred to in modern weather circles as "the year without summer," was worse. Toronto went eight weeks in the warmest part of the year without registering a temperature at or above 30°C. For stations in southwestern Ontario, it was June that was the warmest summer month; a rare occurrence.

Some Ontario and Quebec residents tried to make good of a lousy situation by claiming they were grateful for a no-smog, energy-saving, mosquito-free, tree-loving kind of summer. True, summer was great for those with breathing difficulties. Cooler temperatures meant much less smog and fewer pollutants in the air. Indeed, Ontario featured an unprecedented zero smog days. Gardens and lawns stayed lush and green and nobody had to turn on the sprinkler. Energy-sucking air conditioners were also often silent, resulting in more than 10 per cent savings. But even the most optimistic of residents had to admit that the weather was lousy for vacationers, day trippers, and beachgoers who faced conditions more conducive to sweaters than speedos. The water was so cold that even kids stayed away. Case in point – the Great Lakes water temperatures were three to six degrees cooler than last year. By Labour Day, most Canadians in the middle of the country were asking the same thing, "What happened to summer?"

6. Hurricane Arthur and Others

The Atlantic hurricane season was quiet as forecasted, with eight 'named' storms forming in the Atlantic basin. While this fell below the recent long-term average of 11, six were hurricanes and two of those – *Edouard* and *Gonzalo* – were considered major. The season's first hurricane, *Arthur*, came relatively early for a significant hurricane, while *Gonzalo*, the last hurricane, marked an early end to the season. Both storms were the most punishing ones of the season in Atlantic Canada.

Arthur developed from a low-pressure centre over the southeastern United States in late June. By July 1, it became sufficiently organized and strengthened to hit tropical storm status. Drifting northward, it reached hurricane strength on July 3, attaining Category 2 status with peak winds of 160 km/h late in the evening. *Arthur* made landfall near Beaufort, North Carolina, then accelerated northward and weakened as it passed by Cape

Cod. Transitioning into a post-tropical storm, it barrelled into the southwestern part of Nova Scotia on July 4 with might. Chris Fogarty, manager of Environment Canada's Canadian Hurricane Centre in Dartmouth, Nova Scotia, called *Arthur* "a nor'easter, with attitude." Its slower speed gave it time to inflict a longer punch – 12 hours to track from just north of Yarmouth to near Prince Edward Island. *Arthur* made landfall near Metaghan, N.S. and moved northeastward to the Fundy coast before crossing into western P.E.I., bringing heavy rains of as much as 150 mm. The remnants of *Arthur* also affected the Gaspésie region of Quebec where soaking rains topped 80 mm and lashing winds reached 100 km/h. The town of Carleton-sur-Mer in Chaleur Bay was especially hard hit with power outages, uprooted trees, damaged houses, and capsized sailboats. In Marsoui, near Sainte-Anne-des-Monts, the river burst its banks, flooding roads and highways and inundating 20 homes.

In New Brunswick, *Arthur's* winds topped 100 km/h and it rained hard. Along the Fundy shoreline in St. Stephen it rained so hard (over 150 mm) that you couldn't see three metres ahead. In Nova Scotia, Greenwood was hit worst with wind gusts close to 140 km/h. On the province's southwestern and eastern shores, five- to seven-metre waves pounded with a huge surf that set off rip currents. Power outages were the lasting impact of *Arthur's* remains. Utility workers in the Maritimes aided by crews from Quebec and Maine faced a herculean undertaking in repairing transmission and distribution systems. Nova Scotia's utility admitted that the damage inflicted by *Arthur* was equal to that left by Hurricane Juan more than 11 years earlier. At the storm's peak in Nova Scotia, the wet and windy wallop toppled trees and knocked out power for more than 144,000 homes and businesses; some lost services for up to eight days. In New Brunswick, the storm took out power for 140,000 NB Power customers - more than 60 per cent of the utility's clientele. It was the third time that there were multiple days with lost power in the last 16 months with Arthur unleashing more damage to infrastructure from rains and winds than any other storm in the utility's history. It took as much as 18 days to reconnect power to all households and businesses.

Arthur was well forecasted, but in the end it had a few surprises – among them the slowness of its departure and stronger winds where the threat is usually rain and more rains where the winds are usually the issue. The storm terminated flights in the Maritimes and forced the cancellation of several festivals and blood donor clinics. Road travel was disrupted because of fallen tree debris and flooded surfaces. Hurricane-force winds and rains beat back some strawberry plants and grain stalks and washed away potato seedlings, although the earliness of the storm allowed some early plantings to avoid the blow-over and drenching. Trees were especially vulnerable due to June's above-average rainfall that meant rootballs were sitting in highly saturated ground from which they could be more easily lifted.

The season also featured other tropical storms. Just ahead of Tropical Storm Bertha on August 8, the Maritimes experienced some strong gusty winds, heavy rain, and pea- to dime-sized hail across parts of Nova Scotia, while a funnel cloud or two made their way across Cape Breton Island. On August 29, Hurricane *Cristobal* tracked northeastward across the southeastern Grand Banks bringing rainy weather to the Avalon Peninsula. Significant rainfall amounts also occurred over the southern part of the Gaspé in Quebec where Chandler recorded 50 mm of rain.

Hurricane *Gonzalo* wrapped things up for the season, starting on October 18 when it launched an hour's-long attack on tiny Bermuda as a Category-3 hurricane. From there, it quickly moved northward over the Atlantic Ocean on a track that took it just 540 km southwest of Cape Race, Newfoundland on October 19 with maximum sustained winds of 140 km/h. Fortunately, it gave the province a pass, staying offshore before racing out into the North Atlantic where it would eventually affect Europe and end in Greece. The Avalon Peninsula got quite a soaking for two to three hours with 50 mm in all. Off the coast of Newfoundland, exploration companies took extra precautions with oil installations, but weather conditions - 10-metre waves and 100 km/h winds - were not serious enough to order worker evacuations. While most Newfoundlanders simply slept through the worst of *Gonzalo*, there were other impacts. Participants of this year's Cape to Cabot half marathon – a race that bills itself as one of the toughest in Canada – faced even tougher conditions, with sections of the hilly terrain washed out and strong in-your-face winds adding to the experience. And on the Atlantic coast of Nova Scotia there were high seas and rip currents from Shelburne to Louisburg.

7. Airdrie to Calgary Hailer

On the afternoons of August 7 and 8, severe thunderstorms developed along the Alberta foothills and began tracking eastward towards Calgary and Medicine Hat. The storms also produced strong winds, including a brief but intense low-level rotating outflow (a.k.a. gustnado) northeast of Calgary and at Buffalo, AB packing winds of 140 km/h on August 8. The weather was unusual on two fronts – it featured golf ball- to baseball-sized hail driven by strong winds and a storm that's swirling path meant some properties were hit three times in the course of an hour. Further, the impacted area stretched more than 250 km across central Alberta, making it one of the largest hail-stricken areas from a single storm in 20 years. On August 7, the community of Airdrie, 40 km north of Calgary, was hit hardest with six people being injured badly enough by the hail to require hospitalization and almost every household reporting damage. Hailstones broke shingles, punched through siding and eaves, smashed windows and lights, and dented roofs on vehicles and buildings. More than half

the damaged vehicles were total write-offs. It also smashed tomatoes, squashed squash, shredded flowers and hanging baskets, and denuded trees. There was so much hail it looked like the ground was covered with snow. Slushy hail drifts piled up along the highways and were still evident the next day. Roadways in some communities were flooded when sewers backed up. According to the Insurance Bureau of Canada, property damage from the intense storm topped $450 million (not including crop claims filed separately to crop insurers and provincial disaster agencies). With some crops smashed right to the ground, many farmers in southern Alberta said this "white combine" was the worst and most damaging in 80 years.

Of the primary severe weather categories for summer – winds, tornadoes, heavy rain, and hail – by far the greatest number of weather events on the Prairies this year involved hail (nearly 60 per cent). In total, there were 187 severe hail events reported: 84 in Alberta; 64 in Saskatchewan; and 39 in Manitoba. The storms were so violent and expansive that, according to the Canadian Crop Hail Association, over 13,300 crop-related hail claims were filed with total payouts of $250 million – 45 per cent more than last year and with average claims also up 42 per cent from 2013.

8. Powerful December Storms on West and East Coasts

During the second week of December, millions of Canadians from the West Coast, Central Canada, and the Maritimes were bombarded by intense pre-winter storms featuring strong winds, drenching rains, flooding, and heavy snowfalls. On the West Coast, a succession of three storms from tropical origins hammered Vancouver Island and mainland British Columbia's central and south coasts with hardly a lull between them. Winds were fierce and rains heavy, but the air was warm. Relentless winds and rain punished the area – especially Vancouver Island's higher westerly facing slopes. The combination of strong winds between 90 to 110 km/h and more than a month's worth of soaking rains led to flash floods, pooling water on roads, washouts near rivers, and slides of mud and rock. Victoria got off lightly, but up-island the communities of Comox, Courtenay, and Port Alberni were hit hard and continuously. Flooding in Courtenay following 250 mm of rain led to a local state of emergency. Some reservoirs were so full on Vancouver Island that they began spilling over. Heavy rains also closed local ski hills that had just opened. The weather led to cancelled ferry sailings on several routes, downed trees, power outages for thousands of homeowners and businesses, and flooded streets and basements everywhere. On B.C.'s lower mainland, the city of Delta also declared a brief state of emergency after winds and waves collapsed a beach wall. On the north shore of Vancouver, there were rain-triggered landslides and rock slides. The B.C. River Forecast Centre issued flood watches for four major rivers on Vancouver's North Shore. Along Marine Drive in Vancouver, crews laid sandbags due to fears that king tides at the zenith of the winter season would inundate roads. And on the Sea to Sky Highway, some residents lost water after days of heavy rain damaged their local water source.

On the East Coast there was just one storm, but its incredible reach, intensity, and slow movement produced widespread damages for residents in six provinces. The powerful nor'easter travelled up the Eastern Seaboard and stalled in the Gulf of Maine where, for three days, it sent out flooding rains, humongous snows, and freezing rain driven by powerful winds and high seas. Rainfall amounts were staggering across all three Maritime provinces, measuring between 100 and 150 mm. Moncton got 142 mm of rain in one 24-hour period on December 10, far exceeding any other single daily rainfall in December since records began in 1881. The deluge of rain also smashed weather records in Grand Manan. Its storm rainfall over 48 hours was 162 mm. The system brought all forms of precipitation depending on the temperature but all were in large quantities. In New Brunswick and Prince Edward Island, any rainfall was a worry because the frozen ground left water having to run off instead of being absorbed. If the storm was stalled, so were residents in all three provinces who faced dangerous conditions out on the roads. At least three deaths were attributed to the storm that caused poor visibility, and washed out bridges and roads from the relentless wind-driven rains. People everywhere reported flooded basements and power outages. Authorities in New Brunswick issued flood warnings on the Nashwaak and Kennebecasis rivers. In the Acadian Peninsula, winds gusting up to 90 km/h blew in between 30 and 40 cm of snow that was then weighted down when the snows turned to rain.

The Cape Cod storm was so far-reaching that its last fling at North America was felt in western Quebec and southern and eastern Ontario. In those regions, winter's first nasty storm was all about snow with between 20 and 30 cm being dumped. That, along with strong winds, caused the usual slow commute and hundreds of accidents.

9. Angus Tornado

Environment Canada confirmed 19 tornadoes in Ontario in 2014; fewer than last year but more than the seasonal average of 12. Most tornadoes were weak and short lived, causing some damage but no deaths. The exception was an Enhanced Fujita Scale 2 (EF2) tornado in Angus, 18 km southwest of Barrie that hit just before the dinner hour on June 17. The storm was an offshoot of a potent weather system that had triggered rare double tornadoes and levelled a town in Nebraska the previous day.

The fast-moving storm raced across southern Ontario, spawning several strong-to-severe thunderstorms that raised anxiety and alertness across the province. Ominous skies and rolling thunderstorms led to tornado warnings in many areas including Hamilton, Barrie, and Newmarket.

Before noon, lightning injured four golfers north of Toronto – one critically – and generated funnel cloud/twister sightings near Walkerton, Hanover, and Angus. Around 5:00 p.m. a line of severe thunderstorms moved into the Lake Simcoe region and ten to fifteen minutes later a tornado tore through the community of Angus. Rated at the high end of an EF2, it featured peak winds between 200 and 220 km/h, a width of 300 m at its widest point and tracked over 20 km. On two streets in Angus, residents were stunned by the carnage that tore neighbourhoods apart. Winds damaged up to 102 homes (14 beyond repair) and left 300 homeless.

The debris field stretched nearly a kilometre, with some houses missing roofs, walls, and even top floors. The swirling mass of punishing winds, thunder, and lightning blew out windows, tore up fences, and sheds, flipped over vehicles, uprooted trees, and tossed hot tubs. At a nearby storage facility, shipping containers weighing 2,500 to 5,000 kg were flipped seven metres in the air. Insurance claims exceeded $30 million but, miraculously, no one was seriously injured and only three people suffered minor injuries. In the wake of the tornado, municipal officials declared a week-long state of emergency.

10. "Snowtember" in Calgary

Snow in September is not rare in Calgary. After all, residents boast that theirs is the largest Canadian city with snow falling every month. But even longtime Calgarians were shocked on September 7 when – in the midst of a sunny 25°C afternoon – they learned the next day's forecast called for freezing temperatures and upwards of 10 cm of snow, with snowfall warnings in effect for a large swath of southern Alberta. And snow it did! For the next three days, Calgary was battered by foul wintry weather that swapped sweat for slush as a 25-degree drop in temperature took hold.

A significant layer of Arctic air, mixed with moisture in unstable air, engulfed Calgary and surrounding areas. When the air was driven upslope over the foothills, even more frozen precipitation appeared. At Calgary International Airport, the three-day snowfall totalled 28.2 cm with amounts between 40 and 45 cm occurring over western portions of the city.

The storm's snowfall was the highest September deposit before the autumn equinox in the last 130 years. And to occur prior to a killing frost and so early in September, when average temperatures range between 18.8°C for daytime highs and 5.2°C for nighttime lows, was highly unusual. In the last six years, Calgary has only seen snow in September on September 17, 2010 when a meager 0.2 cm fell.

The heavy wet snow created huge traffic problems for drivers and inflicted extensive property damage. Trees still flush with green leaves bowed, sagged and snapped from the weight of the sticky snow and fell onto power lines, vehicles and roads, wreaking havoc across the city. When compared with the debris left from last year's flood, the snowfall's impact included thousands more kilograms of vegetative debris at landfills, city drop-off zones, parks and private properties.

Similarly, widespread power outages – which at one point affected up to 74,000 homes and businesses – affected more than two and a half times the number of customers who lost power during last year's flood and emergency services responded to twice the number of calls (a record

27,000 calls in 72 hours). Outside Calgary, from Red Deer to High River, farmers braced against killing frost and heavy, wet snow that beat down crops, smashed stalks and muddied fields with less than one quarter of harvesting completed. Most had to wait until everything dried before getting back on their combines.

Note: All photos are courtesy of Environment Canada.

Source: "*Top Ten Canadian Weather Stories for 2014*", Meteorological Service of Canada - Environment Canada - Government of Canada. http://www.ec.gc.ca/meteo-weather visited on December 28, 2014.

Les dix événements météorologiques canadiens les plus marquants en 2014

par David Phillips[2]

Bilan de l'année 2014

La température a été un thème récurrent dans les principaux événements météorologiques survenus au Canada en 2014 mais, à la différence des dernières années, ce sont les longues périodes de froid intense ayant fait geler le sol et formé des couches de glace épaisse et d'importantes accumulations de neige qui ont attiré notre attention. Presque tout le monde s'est senti concerné par le principal événement météorologique de cette année – le long et froid hiver canadien – mais, pour la vaste majorité d'entre nous, le froid s'est incrusté sans qu'aucune saison n'apporte de températures supérieures à la normale. Un froid que même le printemps et l'été n'ont pas pu faire reculer. La température du Canada a été de 0,1 °C au-dessus de la normale, l'année la plus froide depuis 1996. Cette donnée n'est certainement pas en phase avec le reste de la planète, pour qui l'année était en voie de devenir la plus chaude depuis que la tenue des registres modernes a commencé en 1880. En conséquence de ce froid qui faisait un pied de nez aux tendances, 92 % de la superficie des Grands Lacs a été couverte de glaces pour la première fois en 35 ans, de la glace encore présente en juin. Sur la côte Est, la glace de mer est revenue et, dans le golfe du Saint-Laurent, elle était plus épaisse en mars que ce qu'elle a été en plus de 25 ans et de 10 % supérieure à la moyenne. Des mois sans vrai dégel ont amené la plupart des Canadiens à supplier le printemps de se montrer le bout du nez. Mais, si avril est le mois le plus cruel, le printemps a peut-être été cette année la saison la plus difficile qui ait jamais été enregistrée. Les Canadiens désespérés disaient avoir oublié ce que c'est qu'une journée chaude et attendaient avec impatience leur première journée de smog ou de moustiques, deux indices infaillibles de l'arrivée de la chaleur, mais qui ne se sont pas matérialisés. Le printemps décevant de près des deux tiers de nos concitoyens vivant dans le centre du Canada a été suivi par un été de second ordre. L'air frais, l'eau glaciale et le trop grand nombre de jours de pluie ont caractérisé cette saison qui n'a pas répondu aux attentes.

Les habitants de l'ouest des Territoires du Nord-Ouest et de la Colombie-Britannique ont été beaucoup plus chanceux. Sur la côte de la Colombie-Britannique, ce fut l'été des étés : le troisième été le plus chaud en 67 ans de tenue de registres et l'un des dix plus secs. Le seul inconvénient, c'est qu'on a souvent perdu la maîtrise des feux de forêt dans la partie ouest des Territoires du Nord-Ouest, et que sept fois la superficie habituelle a été la proie des flammes, un record pour la région. Les feux étaient si intenses que la fumée s'est élevée en spirale très au-dessus de Yellowknife et a parcouru tout le chemin jusqu'au Portugal, alors que les flammes donnaient naissance à des tourbillons et à des tornades de feu. En Colombie-Britannique, la perte de bois d'œuvre causée par les incendies est la troisième en importance dans la province en 60 ans de tenue de registres et les coûts de la lutte contre les incendies ont dépassé quatre fois le budget prévu.

Les crues menaçantes ont été un autre thème récurrent ces dernières années. En 2014, les crues se sont encore une fois retrouvées dans la liste des événements marquants, des déluges de proportions bibliques se produisant dans l'est des Prairies par suite de la pluie abondante qui est tombée pendant trois jours à la mi-juin et qui a entraîné une des rares catastrophes à engendrer des pertes se chiffrant en milliards de dollars au Canada. Également dans la catégorie des phénomènes météorologiques coûteux, se trouve une tempête ayant eu lieu tout juste avant Noël 2013 qui s'est prolongée longtemps en 2014 parce qu'on constatait encore ses impacts un an plus tard. Les réclamations d'assurance ont atteint le quart de milliard de dollars après que la neige, le grésil, la pluie et la pluie verglaçante ont plongé des parties du centre et de l'Est du Canada dans le froid et la noirceur pendant des jours. Le gouvernement de l'Ontario à lui seul a versé plus de 200 millions de dollars (et ce n'est pas terminé); le nettoyage des branches et des débris s'est poursuivi tout au long de l'année.

Il n'est jamais possible de compter le nombre exact de tornades dans l'ensemble du Canada, mais 45 tornades possibles et confirmées ont été signalées en 2014, c'est-à-dire moins que la normale. Aucune n'a eu beaucoup de force et toutes ont été brèves, sauf une à Angus, en Ontario, qui a entraîné des demandes d'indemnisation de 30 millions de dollars. Si on se fie aux cinq dernières

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années, aucune liste des phénomènes météorologiques importants au Canada ne peut être complète si la ville de Calgary n'est pas mentionnée. En 2014, Calgary a de nouveau sa place dans la liste, pas une fois, mais deux. Le 8 août, une averse de grêle d'un demi-milliard de dollars s'est abattue sur la plus grande partie d'Airdrie (Alberta) et des régions au sud de Calgary. Un mois plus tard, la ville était frappée par une surprenante tempête de neige estivale qui a fauché des milliers d'arbres.

Le Canada atlantique, une région qui a l'habitude des tempêtes, a eu droit à plus que sa part de dangereux ouragans, de nordets et de grosses bourrasques cette année. La mauvaise température n'a pas laissé de répit, puisqu'il s'est produit au moins un gros phénomène météorologique à chacune des saisons : en hiver, il y a eu les tempêtes paralysantes du début de janvier, le début du printemps a amené, en guise de poisson d'avril, une vilaine tempête qui a mis fin aux espoirs de réchauffement, la saison des ouragans a commencé en été lorsqu'Arthur et ses compères, les tempêtes « baptisées », se sont invités, et les deux derniers mois de l'année ont apporté de violentes tempêtes automnales, y compris deux puissantes venant du nord-est. L'impact sur Énergie Nouveau-Brunswick montre bien les répercussions généralisées sur la région de quatre saisons de tempêtes violentes. L'année 2014 a été l'une des plus perturbatrices et des plus coûteuses jamais vues pour les services provinciaux d'électricité, sept tempêtes importantes en moins d'un an privant d'électricité des centaines de milliers de ménages et d'entreprises et coûtant plus de 40 millions de dollars.

Parmi les autres faits météorologiques saillants en 2014, mentionnons que les agriculteurs des Prairies et de l'Ontario ont été confrontés pendant les saisons de la croissance et des récoltes à des conditions difficiles, y inclus des inondations, de fortes pluies inopportunes, des sols gelés, des températures froides, du gel avant les récoltes et même de la neige estivale en Alberta. Dans certaines parties du Nord, l'année a été la plus froide en 17 ans. En conséquence de quoi, la glace de mer en septembre s'étendait sur 1,6 million de kilomètres carrés de plus que le record minimum d'il y a deux ans. Plus au sud, l'année a de nouveau été humide dans la région des Grands Lacs – dont le niveau était de près de 10 % supérieur à la normale –, ce qui signifie que la remarquable remontée du niveau des eaux des Grands Lacs s'est poursuivie en 2013 et en 2014.

Durant la même semaine de mi-décembre, des pluies torrentielles et des vents violents, causés par de fortes tempêtes, ont fouetté les deux côtes du Canada. Des inondations, des emportements par les eaux et des pannes de courant se sont produits le long de la côte de la Colombie-Britannique à la suite d'une série de tempêtes survenues à quelques heures d'intervalle, alors que c'est une seule tempête arrivant lentement du nord-est qui a infligé d'importants dégâts dans les Maritimes et jusqu'au Québec et en Ontario. Ironiquement, au même moment, les habitants des Prairies jouissaient de records de chaleur, un répit très apprécié, compte tenu de la température habituelle en décembre dans cette région.

Les événements météorologiques marquants de 2014 mentionnés ci-dessous sont cotés de un à dix selon leurs incidences sur le Canada et les Canadiens, leurs répercussions économiques et la durée de la période pendant laquelle ils ont fait les manchettes.

Dix événements météorologiques canadiens les plus marquants en 2014

1	**Un hiver canadien long et froid**
2	**Inondations estivales dans l'est des Prairies**
3	**Feux de forêt dans l'Ouest et le Nord-Ouest**
4	**Le cauchemar avant, pendant, et après Noël (2013)**
5	**Un été chaud sur les côtes, frais au centre**
6	**Ouragan Arthur et autres**
7	**Tempête de grêle d'Airdrie à Calgary**
8	**Début janvier, une tempête paralyse le Canada atlantique**
9	**Tornade à Angus**
10	**Neige estivale à Calgary**

1. Un hiver canadien long et froid

La réputation du Canada comme deuxième pays pour ses grands froids a été confirmée à l'hiver 2013-2014, où la plupart d'entre nous a grelotté tout au long d'un hiver très froid et très long.

2. Inondations estivales dans l'est des Prairies

Les problèmes d'eau ont frappé tout l'est des Prairies une semaine à peine avant le début de l'été. Les précipitations excessives sur des terrains détrempés – trop de pluie trop rapidement pendant trop longtemps – ont causé des inondations encore cette année.

3. Feux de forêt dans l'Ouest et le Nord-Ouest

Même si des régions du Canada étaient, parfois, trempées par les fortes pluies, les Territoires du Nord-Ouest et la Colombie-Britannique ont compensé par une chaleur et une sécheresse exceptionnelles propices à allumer des brasiers en un rien de temps.

4. Le cauchemar avant, pendant et après Noël

La fin de semaine avant Noël 2013, une violente tempête hivernale a fait tomber sur certaines régions de l'Est du Canada un épais mélange de neige, de grésil, de pluie et de pluie verglaçante qui a fait vivre plusieurs jours de froid et de noirceur à une grande partie de la population.

5. Un été chaud sur les côtes, frais au centre

Après avoir subi un des hivers les plus rigoureux des dernières années, les Canadiens ont cru que Dame nature leur offrirait un répit. Pour certains, les prières ont été exaucées; pour d'autres ce fut une autre saison à oublier.

6. Ouragan *Arthur* et autres

Le premier ouragan de la saison, *Arthur*, s'est amené relativement tôt pour un ouragan d'importance et *Gonzalo*, le dernier, a mis une fin hâtive à la saison. Les deux ont été les plus sévères en 2014 dans les provinces de l'Atlantique.

7. Tempête de grêle d'Airdrie à Calgary

Les Prairies ont été davantage frappées par la grêle que tout autre phénomène météorologique violent l'été dernier; la plus grosse tempête a eu lieu le 8 août.

8. Violentes tempêtes de décembre sur les côtes est et ouest

Au cours de la deuxième semaine de décembre, des millions de Canadiens de la côte ouest, du centre du Canada et des Maritimes ont été bombardés par d'intenses tempêtes préhivernales entraînant des vents violents, de fortes pluies, des inondations et des chutes de neige abondantes.

9. Tornade à Angus

Une tornade de force 2 à l'échelle de Fujita améliorée a frappé Angus (Ontario) un peu avant l'heure du dîner le 17 juin. Les vents ont endommagé jusqu'à 102 habitations.

10. Tempête de neige estivale à Calgary

Il n'est pas rare qu'il tombe de la neige en septembre à Calgary, mais même les plus anciens résidents de la ville ont été consternés d'apprendre – par un après-midi ensoleillé affichant 25 °C – que l'on annonçait le lendemain des températures sous zéro et dix centimètres de neige.

Note: Toutes les photos sont gracieuseté d'Environnement Canada.

Source: "*Les dix événements météorologiques canadiens les plus marquants de 2014*", Service météorologique du Canada - Environnement Canada - Gouvernement du Canada. http://www.ec.gc.ca/meteo-weather visité le 28 décembre 2014.

Books in search of a Reviewer (Partial list)
Livres en quête d'un critique (Liste partielle)

Latest Books received / Derniers livres reçus

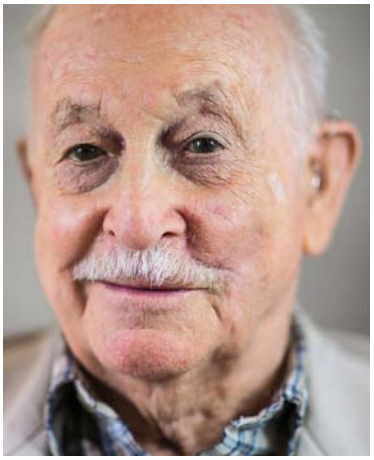
2015-1) *Particles in the Coastal Ocean, Theory and Applications*, by Daniel R. Lynch, David A. Greenberg, Ata Bilgili, Dennis J. McGillicuddy, Jr., James P. Manning, and Alfredo L. Aretxabaleta, Cambridge University Press, 978-1-107-06175-0, Hardback, 510 pages, $130,95.

2015-2) *Climate Conundrums, What the Climate Debate Reveals About Us*, by William B. Gail, Published by American Meteorological Society and distributed by the University of Chicago Press, ISBN 978-1-935704-74-4, Paperback, 235 pages, US$30.00.

CMOS Ottawa Centre Member celebrated his 100th anniversary

The CMOS Ottawa Centre is proud to have as a member George Robertson who turned 100 last December.

Born December 20, 1914, in Strome, Alberta, George Wilber Robertson has obtained a B.Sc in Mathematics and Physics from University of Alberta in 1939 and a M.A. in Physics and Meteorology from University of Toronto in 1948.



George Wilber Robertson

As a teenager, George learned about the effect of climate and daily weather variations including crop production and agricultural economics on his home farm. This interest was confirmed later while studying at the university where two of his professors were interested in problems concerning weather variability and climate. The need for better and timely meteorological services was accelerated by the newly formed Canadian company, Trans-Canada Airlines (TCA). George became aware of the need for meteorological and climatic services by the agricultural industry in Canada while he served on Soil-Climate Sub-Committee of Alberta Soil Survey Group. All these factors made a major impact on George's career.

Among his many postings George worked on the following (from the earliest to the latest):

- On contracts with World Meteorological Organization (WMO) and Food and Agriculture Organization (FAO) in several developing countries;
- Chief of Agrometeorological Section, Research Branch, Canadian Department of Agriculture;
- Research meteorologist, Central Analyses Office, Meteorological Service of Canada (MSC), in Ottawa;
- Aviation and Public Weather Forecaster, MSC, in Edmonton;
- Officer-in-Charge of Meteorological Section, No.2 Air Observer School, British Commonwealth Air Training Plan, in Edmonton;
- Meteorological Assistant in Edmonton.

During his career George Robertson received many honours and awards:

- Honoree, Baier and Robertson Symposium of Modelling and Measurement of Soil Water Content. This symposium was organized by the Canadian Society of Agronomy (CSA) and Canadian Soil Science Society (CSSS) in 1995;
- John Patterson Medal from Meteorological Service of Canada, Environment Canada in 1990;
- Accredited as a Consulting Meteorologist by CMOS in 1987;
- Award in Applied Meteorology by CMOS in 1966;
- Darton Prize by the Royal Meteorological Society (RMS) in 1955;
- President's Prize by the Canadian Branch of the RMS in 1952.

Since retiring in the 1970s, his love of learning hasn't waned. George remains a member of several scientific societies including the Canadian Meteorological and Oceanography Society (CMOS), the American Meteorological Society (AMS), a Fellow of the Royal Meteorological Society (RMetS), and a member of the American Association for the Advancement of Science (AAAS). George also continues to follow the online activities of the International Society for Agricultural Meteorology Information.

As a lifelong learner, George continues to refine and develop new computer programs on his desktop computer using Qbasic as programming language. His most recent effort is a game called Digital Checkers. In 2011, at the age of 97 and in cooperation with his nephew, this program was turned into a gaming app for Apple mobile services called *CheX Challenger*.

Congratulations George!

I am pleased to have the opportunity to congratulate George W. Robertson at the occasion of his 100th birthday. He headed Agriculture Canada's agricultural meteorology section in Ottawa for 18 years from 1951 to 1969. After, he worked two years as a World Meteorological Organization (WMO) consultant in the Philippines and when he returned to Canada in 1971, he headed the agricultural meteorology section in Swift Current for two years. He is the pioneer in agricultural meteorology in Canada. He is recognized worldwide for having developed the Versatile Soil Moisture Budget and the Biometeorology Time Scale. I worked with him as a summer student from 1961 to 1963. I was assigned several interesting projects evaluating instruments that he had developed such as the black porous disc atmometer and a new light spectrometer. He was very instrumental in my decision to study meteorology at the University of Toronto. After my graduation, he offered me a

job as a micrometeorologist in Ottawa. He was my first boss and mentor. Over the years, I have always enjoyed chatting with him and asking his opinion. I want to thank him for setting me up on the path to a wonderful career in agricultural meteorology.

He was the first Agriculture Canada scientist to participate in the Commission of Agricultural Meteorology (CAgM). This Commission, to which most of the world's countries belong, promotes the application of meteorology to enhance world food production. Due to his leadership, Agriculture Canada now has a long history of involvement in CAgM. Wolfgang Baier replaced him in 1979 as Agriculture Canada's representative on the Commission and I replaced Wolfgang in 1990. The three of us attended CAgM meetings in Florence in 1986 and in Cuba in 1990.

After his retirement, he undertook a variety of consulting jobs with WMO and the Food and Agriculture Organization (FAO). His more than 30 years of experience as a researcher, consultant, and coordinator gave him a perspective that few others could match. In 1990, he published a book on A History of Agrometeorology in Canada. He was awarded the Patterson medal, the highest honor for a meteorologist in Canada, for his contribution to agricultural meteorology. Throughout his career, he has worked closely with the Canadian Meteorological and Oceanographic Society (CMOS) and the Canadian Society of Agrometeorology (CSAM) and he has been recognized by both societies for his contributions.

Raymond Desjardins,
Senior Research Scientist
Food and Agriculture Canada

Friends and family honour George Robertson upon his 100th anniversary

I was pleased to represent CMOS at a gathering of family and friends of George Robertson, last December 20th. The photograph shows the five seasoned scientists who were present, from left to right: Raymond Desjardins, Richard Asselin, George Robertson, Jim Bruce, and Con Campbell.

Raymond Desjardins studied for his Masters in Toronto at the same time as I was doing mine in Montreal. We met for the first time in 1989 when I became director of the Land Resources Research Centre of Agriculture Canada, which includes the agrometeorology group. In 1994 he was on a list of people that I was instructed to "release" as part of the Government's budget cut. I am proud to admit that I ignored this unwise instruction and that Ray is still employed there as a senior scientist. Ray is the author of hundreds of publications related mainly to the measurement of fluxes of greenhouse gases from the microscale to the very large scale. His leadership exerts a wide international influence.

George Robertson was involved in the formation of the Canadian Branch of the Royal Meteorological Society back in the 1940s and he has been a member of CMOS since the beginning. His contributions are summarized in the brief bibliography shown on previous page.

Jim Bruce is of course well known to CMOS members as founder of the Canada Centre for Inland Waters, Assistant Deputy Minister for Environment Canada, Member of the International Joint Commission for the Great Lakes, Deputy Secretary General for the World Meteorological Organization, leader in the formation of the International Panel on Climate Change, and continuing scientific involvement in many climate and hydrology organizations and studies. He received the Order of Canada in 1997.

From left to right: Raymond Desjardins, Richard Asselin, George Robertson, Jim Bruce, and Con Campbell. Photo courtesy of George's son, Glen Robertson.

Con Campbell is an emeritus soil scientist internationally known for his studies of soil organic matter; he contributed immensely to the productivity and sustainability of dryland farming by showing how soil organic matter can be conserved and fertility maintained or restored. He received the Order of Canada in 1998. As a Scientist Emeritus, he visits Desjardins' laboratory on a daily basis and he helps mentor the numerous post-doctoral fellows. (Con's work is a complement to Desjardins' work since organic matter lost from soils implies emission of carbon dioxide and other greenhouse gases.)

As for my humble presence among these four stars, I did contribute to the early development of numerical weather prediction in Canada but I view myself more as a facilitator of research and applications.

Richard Asselin
Former Director of CMOS Publications

Arctic Change 2014
Another resounding success

Over 1400 people recently converged on the Ottawa Shaw Centre for the Arctic Change 2014 conference. This was the annual meeting hosted by the Networks of Centres of Excellence – ArcticNet. However, this year's event was much larger as they welcomed participants from around the globe to Canada's capital from December 8 - 12. The conference participation was truly global and reflects a world-wide scientific interest in the Arctic. There were over 300 non-Canadians in attendance, from 22 countries. Nations such as the United States, Germany, Norway, Russia, France, the United Kingdom, Republic of South Korea, and Japan had a presence. In addition, it was truly a pan-Canadian event, as there were over 1,000 Canadians in attendance from all of the provinces and territories. I heard the story that the most common surname amongst the registrants was not Smith, Jones, or even Fortin, rather it was Pokiak! The Pokiak family name is a common one from the region near Inuvik, NWT.

Arctic Change was a resounding success with hundreds of excellent scientific posters, sessions, exhibits, and plenary speakers. The week started off with Student Days where the ArcticNet Student Association organized sessions and hands-on workshops. These ranged from workshops dealing with scientific writing, communicating your science, working with media, to panel discussions on collaboration with communities on Arctic research. During this same time, there were several side-meetings occurring amongst other participants. There was a Canada-European Union (EU) workshop where presentations and discussions explored possible areas of priority and collaboration. This meeting was followed on Tuesday with a broader international workshop where research opportunities were explored between Canada and global partners. Initiatives that were stimulating a lot of excitement included the ongoing work and recent call for proposals from Canadian High Arctic Research Station, as well as the EU funded initiative *EU-PolarNet* that is just getting organized. Several countries presented efforts on current and future Arctic S&T priorities, including the U.S.A, Sweden, Norway, Finland, UK, France, Germany, Italy, Korea, and Japan. It was evident that Arctic research and monitoring is truly a global priority.

All of the above workshops and discussions took place BEFORE the Arctic Change conference even started! Arctic Change was launched on Wednesday, December 10 with morning plenary speakers each day followed by concurrent scientific sessions – in fact, over fifty scientific sessions were held during the conference and over 350 scientific posters were displayed. Topics were wide ranging from education, health and well-being in Arctic communities, to permafrost landscapes in transition, to Arctic security, to wildlife co-management, changing commercial and

subsistence fisheries. Of interest to the oceanographic and meteorological community were the following sessions (just a sampling amongst the dozens that were held): Arctic Ocean Acidification, Arctic Sea Ice, Changing Arctic Atmospheric Composition, Monitoring Arctic Ecosystems, Physical Forcing and Ecosystem Response in the Pacific Arctic Region, Safe and Sustainable Shipping, and Understanding the Role of Ocean, Sea-Ice and Atmosphere in Arctic Climate. There were several sessions on Arctic data management practices and moving from data to knowledge through data archives and online access tools. In addition, the sessions that examined the Changing Practices towards community engagement in Arctic Research were popular as lessons learned and best practices were shared.

As Canada's two-year chairmanship of the Arctic Council comes to an end in April-May 2015, there were discussions of work achieved during this time and the transitioning of the chairmanship to the USA. The forthcoming American chairmanship will work within the theme of *One Arctic: Shared Opportunities, Challenges, and Responsibilities.* The following priorities are emerging within this theme: Addressing Impacts of Climate Change in the Arctic, Stewardship of the Arctic Ocean, and Improving Economic and Living Conditions of Northerners.

After a busy and productive five days, it was evident that our scientific understanding of the Arctic is increasing but that a great deal of research and monitoring needs to continue. The conference provided numerous networking events and opportunities for informal exchange amongst participants. There will no doubt continue to be dialogue and collaborative opportunities emerging over the coming months as a result of the Arctic Change conference.

NOTE: If you enjoyed reading this article, please consider subscribing to the CMOS Arctic Special Interest Group's newsletter for more feature stories on Arctic science. For further information on the newsletter, please contact Ann McMillan at mcmillan@storm.ca

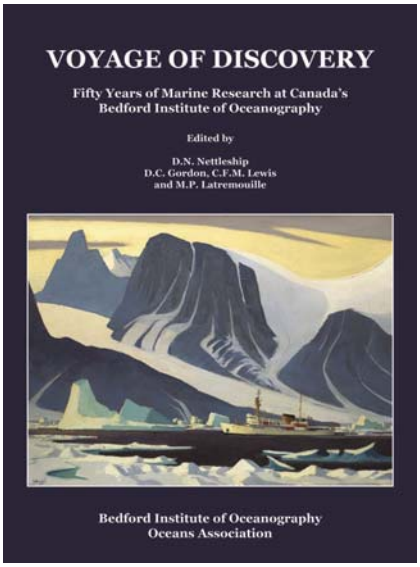
Helen Joseph
CMOS Member, Ottawa Centre

BIO-Oceans Association announces the publication of a major treatise reviewing the history and marine research accomplishments at Canada's Bedford Institute of Oceanography over five decades primarily in the Atlantic and Arctic Oceans

VOYAGE OF DISCOVERY

Fifty Years of Marine Research at Canada's Bedford Institute of Oceanography

Edited by
D.N. Nettleship, D.C. Gordon, C.F.M. Lewis and M.P. Latremouille



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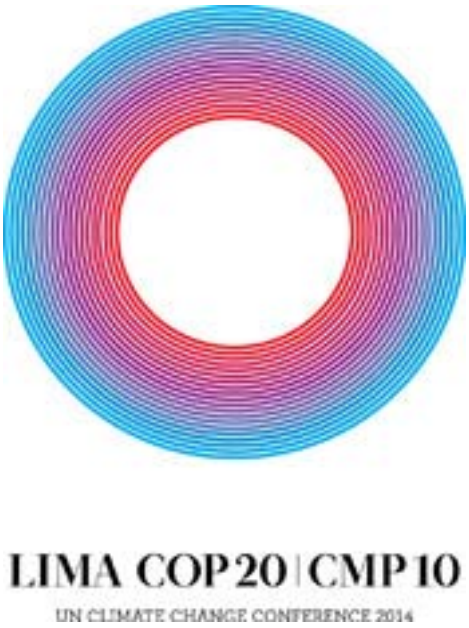
The Road to Paris: Full of Good Intentions

by Prof. John Stone[1]

In 1994 the United Nations Framework Convention on Climate Change (UN/FCCC) came into force, ratified by almost all countries. 2014 marks the 20th anniversary of this global treaty. Every year governments come together at the highest level for what is known as the Conference of the Parties (COP). This year's was held in Lima, Peru, during the first two weeks of December. This meeting was particularly significant because two years ago governments gave themselves until 2015 to come up with a globally inclusive legal regime to address the threat of climate change. Quantitatively this means avoiding what the UN/FCCC refers to as "dangerous interference with the climate system" which governments have determined to be limiting global temperature increases to no more than two degrees above pre-industrial levels. The Lima meeting was the last opportunity for governments to agree to the broad outlines of the new regime before the 2015 COP which will be held in Paris at the end of the year.

In the lead up to the Lima meeting the prospects were encouraging. The European Union set the pace by agreeing to an overall emission reduction of at least 40% below 1990 levels by 2030 and a target of 27% of energy derived from renewable sources. The United States and China, the two largest greenhouse gas emitters, also came to an agreement. The United States intends to achieve a reduction of emissions of 26%-28% below its 2005 level by 2025. For its part China intends to achieve the peaking of CO_2 emissions by 2030 and to increase the share of non-fossil fuel energy to around 20% by the same date. The significance of this agreement cannot be underestimated; both countries are important players in the main negotiating blocs.

The Intergovernmental Panel on Climate Change (IPCC) had also just finalized its 5th Assessment Report. Based on stronger science it states that remaining below the 2°C target will require global greenhouse gas emissions to decline by 40-70% by 2050, relative to 2010 levels, and reach zero or negative levels by 2100. In addition the World Meteorological Organization (WMO) issued a report that 2014 would likely be the warmest year since 1880. There had also been large climate change demonstrations in New York and elsewhere and the UN Secretary General had convened a landmark intergovernmental meeting in September.



Despite the almost 11,000 participants in Lima, or perhaps because of the number, these positive signals did not survive the negotiations which had to be extended by two days (and nights) in order to achieve any agreement. The Lima COP involved an extraordinarily complex set of meetings. The summary report by the International Institute for Sustainable Development (IISD) Environmental Negotiations Bulletin (ENB) is a mammoth 45 pages long. (http://www.iisd.ca/download/pdf/enb12619e.pdf).

What formally came out of the Lima meeting was a five-page text, dubbed the Lima Call for Climate Action (it has become a tradition to give a title to many of the previous COP's conclusions, each conferring a measure of success and recognizing the location of the meeting). The text outlines some of the hoped-for content of the Paris accord although there are many central issues still to be resolved such as the legal form of the new regime. These issues are contained in a 33-page Annex listing options that reflect "*work in progress*" and do not "*indicate convergence on the proposals presented, nor do they preclude new proposals from emerging in the course of negotiations in 2015".*

Central to the Lima agreement is the call for all countries to submit by next March, *"in light of different national circumstances*", their *"intended nationally determined contributions*" to address the threat of climate change. Such contributions can include emission reductions and financing to support clean energy as well as adaptation in poorer countries (not just to future impacts but also to the loss and damage of today's climate change). Implicit in this convoluted language is the preservation of the notion of "*common but differentiated responsibilities"* which was enshrined in the UN/FCCC and recognizes that industrialized countries have made the greatest contributions to the burden of greenhouse gases in the atmosphere and have the richer resources (technology,

[1] Adjunct Research Professor in the Department of Geography and Environmental Studies at Carleton University, Ottawa, ON, Canada. Lead author of the 4th Report (Polar Regions) for the IPCC Fifth Assessment Report.

institutions, and wealth) to address the threat. The Lima text, for the first time, has commitments for all countries. Some see this as a breakthrough; at least an indication of good intentions.

The plan is for the UN/FCCC Secretariat to review these national pledges and estimate whether collectively they are adequate to meet the 2°C target. However, the pledges are not mandatory and the format for submitting them (such as baselines and commitment period) is not fixed. In addition, and importantly, there is no way in which to gauge how achievable these pledges are. These factors suggest that any attempt to follow the Kyoto Protocol's example of a top-down approach has been abandoned.

The Kyoto Protocol had a commitment period of 2008-2012 and it was the intention of the COP held in Copenhagen in 2009 to produce a follow-on regime that would take effect in 2012. However, this high profile event was marked by disputes over transparency and trust and the outcome was the Copenhagen Accord that was noted but not adopted – thus had no legal authority. The Lima meeting was an attempt to resuscitate the UN/FCCC process that had been so badly damaged by events in Copenhagen.

Valuable time is being lost for any accord coming out of the Paris meeting is not expected to take effect until 2020. This leaves a multi-year gap which is being dealt with by the UN/FCCC Subsidiary Bodies through a multitude of negotiation fora. It seems at the moment that there is little chance that current national commitments will be sufficient to meet the 2°C target and that greater ambition is required.

There is still evidence of the lack of trust between countries. One example of this is that rich countries have barely kept to their promise to provide funding, rising from $10 billion in 2014 to $100 billion by 2020, to assist developing countries. Much of the funds are simply re-labelled overseas aid budgets. Building trust will be essential for levering national emission reduction pledges. The lack of trust also surfaced in discussions regarding the relative importance of emission reductions (mitigation), adaptation, and financing. Building trust and confidence for Paris will depend on a meaningful implementation and review of national commitments made subsequent to Copenhagen.

The IISD/ENB summary provides an excellent statement of where we are following the Lima meeting: "*The year of 2015 will be one that defines the true significance of the Lima Climate Conference. Many wonder if the positive "Lima Spirit" can continue in the run-up to Paris. But perhaps more importantly, the question may be if the Lima outcome can enable the construction in Paris of a house where all Parties can co-exist, while keeping in mind that in this process there is one Party that does not negotiate - **Nature***".

International Year of Soils 2015 - IYS 2015

2015
International
Year of Soils

After two years of intensive work, 2015 has been declared the International Year of Soils by the 68th UN General Assembly (A/RES/68/232). The IYS aims to be a platform for raising awareness of the importance of soils for food security and essential eco-system functions.

The objectives of the IYS are:
• to create full awareness of civil society and decision makers about the fundamental roles of soils for human life;
• to achieve full recognition of the prominent contributions of soils to food security, climate change adaptation and mitigation, essential ecosystem services, poverty alleviation and sustainable development;
• to promote effective policies and actions for the sustainable management and protection of soil resources;
• to sensitize decision-makers about the need for robust investment in sustainable soil management activities aiming at healthy soils for different land users and population groups;
• to catalyze initiatives in connection with the Sustainable Development Goals process and Post-2015 agenda;
• to advocate rapid enhancement of capacities and systems for soil information collection and monitoring at all levels (global, regional, and national).

"Soils also host at least one quarter of the world's biodiversity. They are key in the carbon cycle. They help us to mitigate and adapt to **climate change**. They play a role in water management and in improving resilience to **floods** and **droughts**."

- José Graziano da Silva, FAO Director-General

All partners and interested colleagues are invited to submit proposals for activities that could be implemented during the IYS. Please send your ideas, suggestions or contributions to the GSP-Secretariat@fao.org

Note: FAO = Food and Agriculture Organization.

CMOS BUSINESS / AFFAIRES DE LA SCMO

Prière de noter que les versions françaises suivent.

Summer Meteorology Workshop
Project Atmosphere 2015

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 **12 to 24 July 2015** 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. The successful candidate will provide CMOS with a short report on his/her summer experience which may be published in the *CMOS Bulletin SCMO*.

Interested teachers can obtain more information on the workshop on the CMOS website www.cmos.ca/site/summerworkshops. An application form can be downloaded from the same CMOS website or requested by writing to the address below.

Completed application forms may be mailed or e-mailed to the address below no later than **March 15, 2015**.

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

Summer Oceanography Workshop
Maury Project 2015

Call for Applications by Pre-College Teachers

The Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in THE MAURY PROJECT. This is a summer workshop for pre-college teachers of Oceanographic topics sponsored by the American Meteorological Society (AMS) and the U.S. Naval Academy. This year's workshop is on **12-24 July 2015** at the U.S. Naval Academy, Annapolis, Maryland.

The essential expenses for the participating teacher are paid by AMS, with a contribution from CMOS and the Canadian National Committee / Scientific Committee on Oceanic Research (CNC/SCOR). This does not include the travel to and from Annapolis for which CMOS and CNC/SCOR 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.

The successful candidate will provide CMOS with a short report on his/her summer experience which may be published in the CMOS Bulletin.

For further details about the Workshop, please visit http://www.cmos.ca/site/summerworkshops

Interested teachers should download the application form (in pdf format) and mail or e-mail the filled form as soon as possible not later than **March 8, 2015** to the address given below.

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

Please note that the English versions precede.

Atelier d'été en météorologie
Projet Atmosphère 2015

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 **12 au 24 juillet 2015** 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. Le candidat choisi devra écrire un court rapport pour la SCMO de son expérience estivale qui pourra être publié dans le *CMOS Bulletin SCMO*.

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/site/summerworkshops?language=fr_FR&. Ils peuvent également obtenir un formulaire en le téléchargeant du même site Web de la SCMO ou en le demandant à l'adresse ci-dessous.

Les formulaires dûment remplis doivent être envoyés par courrier ou télécopieur à l'adresse ci-dessous au plus tard le **15 mars 2015.**

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

Atelier d'été en océanographie
Projet Maury 2015

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 MAURY. Il s'agit d'un atelier d'été à l'intention des enseignant(e)s de niveau pré-collégial spécialistes en sciences océanographiques; cet atelier est parrainé par l'American Meteorological Society (AMS) et le U.S. Naval Academy. Il aura lieu du **12 au 24 juillet 2015** au U.S. Naval Academy à Annapolis au Maryland.

À l'exception des frais de déplacements à destination et au retour de Annapolis, toutes les dépenses de l'enseignant(e) choisi(e) seront assumées par l'AMS, qui recevra aussi une contribution de la SCMO et du Comité national canadien / Comité scientifique de la recherche océanographique (CNC/SCOR) à cette fin. La SCMO et le CNC/SCOR offrent aussi à l'enseignant choisi 300 $ (canadiens) chacun, soit au total 600 $, pour les déplacements.

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.

Le lauréat devra écrire un court rapport pour la SCMO de son expérience estivale qui pourra être publié dans le Bulletin de la SCMO.

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site Web http://www.cmos.ca/site/summerworkshops?language=fr_FR&. Si vous êtes intéressés, vous devez télécharger le formulaire de candidature (en format pdf) et, une fois rempli, le poster ou l'envoyer par courriel à l'adresse donnée ci-bas avant le **8 mars 2015.**

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

Next CMOS Congress in 2015

The 49th CMOS Congress will be held in beautiful Whistler, British Columbia, from May 31 to June 4, 2015. This congress will be held jointly with the 13th American Meteorological Society's Conference on Polar Meteorology and Oceanography. The theme of this joint conference is:

Tropics to Poles
Advancing Science in High Latitudes.

Program
The Whistler Congress will feature:
- Plenary presentations by leading researchers;
- Science sessions that highlight top Canadian and international research contributions to oceanography, meteorology, climate, and hydrology, as well as the policy implications of research in these fields;
- An evening lecture, of interest to the general public, on the competing interests between national security planners, political decision-makers, industry, and academic stakeholders in the changing Arctic and polar regions;
- Workshops;
- Student night;
- An icebreaker reception, a banquet and a CMOS awards luncheon;
- The CMOS Annual General Meeting.
- Outdoor activities in the Whistler area.

The abstract submissions period began on December 15. Please submit abstracts electronically via the link: http://www.cmos.ca/site/abstracts_submission before February 15, 2015. You will be asked to select a broad Theme under which the available Sessions are grouped (click the requested steps for the session description). Indicate your preference for oral or poster presentation. A non-refundable abstract fee of $50 is required to complete your submission. Note that abstract submission does not constitute congress registration; congress registration opened in January 2015.

Your abstract will be evaluated by the Science Program Committee and you will be notified by the end of March 2015 of the presentation details, including if your presentation is to be oral or by poster.

CMOS student members are encouraged to participate and to apply for a Student Travel Bursary when submitting an abstract (up to $500 per student). To apply for a Student Travel Bursary send an email to the Scientific Program Committee Chair.

Please note that registration started on January 5th, 2015 and that early registration deadline is April 18.

For general information about the 2015 congress in Whistler, please consult the congress website at: http://congress.cmos.ca or contact us for further information.

Bruce Ainslie
Chair of the CMOS 2015 Scientific Program Committee
Bruce.Ainslie@ec.gc.ca

Andrew Roberts
AMS Polar Chair, afrobert@nps.edu

Ken Kwok
Chair of the CMOS 2015 Local Arrangements Committee
Ken.Kwok@ec.gc.ca

Prochain Congrès de la SCMO en 2015

Le 49e congrès de la SCMO se tiendra du 31 mai au 4 juin 2015 dans la magnifique ville de Whistler, Colombie Britannique. Ce congrès se tiendra en même temps que la 13e conférence de l'AMS sur la météorologie polaire et l'océanographie. Le thème de cette conférence conjointe est:

Des Tropiques aux Pôles:
Avancement de la science
des hautes latitudes.

Programme
Le congrès de Whistler inclura:
- Des conférences plénières par des chercheurs de pointe;
- Des sessions scientifiques mettant en évidence la recherche canadienne et internationale dans les domaines de l'océanographie, de la météorologie, du climat et de l'hydrologie, ainsi que sur les implications politiques de la recherche dans ces domaines.
- Une conférence d'intérêt général, ouverte au grand public, sur le thème du conflit d'intérêts entre les planificateurs de sécurité nationale, les décisionnaires

politiques, les industriels et les intervenants académiques au sujet de l'Arctique et des régions polaires en changement;
- Des ateliers scientifiques;
- Une soirée étudiante;
- Une réception de bienvenue, un banquet et un dîner remise des prix de la SCMO;
- L'assemblée générale annuelle de la SCMO;
- Des sorties touristiques dans la belle région de Whistler.

La période de soumission des résumés a débuté le 15 décembre dernier. Veuillez visiter le site de soumissions (http://www.cmos.ca/site/abstracts_submission) et exécuter les premiers pas pour voir la description des sessions. Vous devrez choisir le thème principal qui regroupe les sessions disponibles (cliquez sur les pages indéquées pour la description de la session). Vous pouvez soumettre un résumé préliminaire sur le champ (des frais non-remboursables de 50$ seront exigés) ou abandonner la poursuite à ce moment. Vous pourrez plus tard éditer votre résumé préliminaire (gratuitement) ou soumettre un nouveau résumé avant le 15 février 2015. Vous devez indiquer votre préférence quant à une présentation orale ou par affiche. Notez que la soumission d'un résumé ne constitue pas l'inscription au congrès ; l'inscription au congrès est ouverte depuis janvier 2015.

Votre soumission sera évaluée par le comité du programme scientifique qui vous avisera avant la fin du mois de mars 2015 des détails pour votre présentation, incluant si vous devez le faire oralement ou par affiche.

Les membres étudiants de la SCMO sont les bienvenus et sont encouragés à demander une bourse étudiante d'aide au voyage (jusqu'à 500$ par étudiant) lors de leur soumission. Pour faire une demande de bourse de voyage, veuillez télécharger le formulaire de demande et l'envoyer par courriel au président du comité scientifique.

Les inscriptions au congrès de Whistler ont déjà débuté le 5 janvier 2015 et la date limite pour les inscriptions hâtives est le 18 avril.

Pour des plus amples informations, veuillez consulter le site Web du congrès au : http://congress.cmos.ca ou contactez-nous pour obtenir plus d'information.

Bruce Ainslie
Président du Comité du programme scientifique, SCMO 2015 Bruce.Ainslie@ec.gc.ca

Andrew Roberts
Président du comité polaire de l'AMS 2015 afrobert@nps.edu

Ken Kwok
Président du Comité d'organisation local, SCMO 2015
Ken Kwok@ec.gc.cawww.cmos.ca

Opening Access to Meteorology in the U.S. and U.K.

Did you know that if you are a member of CMOS, you have the following advantages:

- Joining American Meteorological Society (AMS) as Affiliate Member with a subscription to BAMS (Bulletin of the American Meteorological Society, electronic version) at a reduced rate (approximately 66% of Regular Member rate);

- Subscriptions to other AMS journals or books at Regular Member rate;

- Registration at AMS meetings at Regular Member rate;

- Joining Royal Meteorological Society (RMetS) at a reduced rate (25%);

- RMetS Journal subscription at Regular Member rate;

- Registration at RMetS meetings at RMetS Member rates.

So, to be eligible for these benefits, renew your CMOS membership as soon as possible by contacting our office at www.cmos.ca.

Corrections

In John Stone's review published in the *CMOS Bulletin SCMO*, Vol.42, No.6, page 193, the title of Naomi Oreskes's book is misquoted. The book being referenced is *Merchants of Doubt,* written by Naomi Oreskes and Erik M. Conway. The electronic version of the Bulletin has been updated accordingly. Incidently, this book was reviewed in the *CMOS Bulletin SCMO* by Richard Asselin. (See Vol.39, No.5, page 184).

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **April 2015.** Please send your articles, notes, workshop reports or news items before **March 6, 2015** to the electronic address given at the top of 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 2015.** Prière de nous faire parvenir avant le **6 mars 2015** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse électronique indiquée au haut de la page 2. Nous avons un besoin URGENT de vos contributions écrites.

IN MEMORIAM

Richard Michael 'Mike' Eaton

1928 - 2014

Richard Michael Eaton

Richard Michael Eaton, widely recognized as the father of the electronic chart, passed away peacefully at his home in Cole Harbour, Nova Scotia, on Thursday, October 9, 2014. Born in England 1928, he was educated in England and Scotland and joined the British Royal Navy in 1945. For seven of his 12 years in the Navy he did surveying for nautical charts in both home waters and around Zanzibar and Borneo.

In 1957 he left the Navy, immigrated to Canada and joined the Canadian Hydrographic Service in Ottawa. After two years surveying in Hudson Bay he spent five summers on the Arctic Ocean and Archipelago where he developed new methods for the first modern charting of those waters. For this work he was elected a fellow of the Arctic Institute of North America.

He collected some of the Inuit carvings that were just coming to the attention of the outside world. In 1963 he married Rosemary Gilliat, a well-known photographer. In 1965, they moved from Ottawa to a home in Nova Scotia overlooking their beloved Cole Harbour salt marsh.

Mike joined the Bedford Institute of Oceanography (BIO) in 1965 and earned a physics degree from Dalhousie University, graduating in 1970. Satellite navigation and computers were revolutionizing navigation at this time and Mike started a small 'Navigation Group' at BIO and contributed significantly to the development of the Loran-C navaid. He was awarded the Medal of Merit from the International Association in 1983, and the Canada Marine Safety Award from the Canadian Marine Advisory Council in 1988.

By the early 1980s Mike realized that the new Electronic Chart (EC) was a major breakthrough in navigation and he devoted the rest of his career to developing, promoting, and advising on the installation of this system around the world. The EC displays a ship on a digital chart which is positioned by GPS and radar superimposed. He created an electronic chart test program, the results of which laid the foundation for the International Hydrographic Organization's Specifications for ECDIS (Electronic Chart Display and Information System), which in turn formed the basis for the UN International Maritime Organization's ECDIS Performance Standards.

ECDIS shows a vessel's position on an electronic chart, which changes as the ship moves. Its synthesis of information from satellites, radar, database and digital charts replaced traditional navigation instruments, such as chronometers, telescopes, compass and parallel rulers, as well as paper charts.

In a 1994 article in Canadian Geographic magazine, Mr. Eaton described how ECDIS provided greater accuracy and safety. A skipper using it could sail a vessel through narrow passages and dock in zero visibility, using little more than a video screen and a joystick. "*He can walk [the boat] in, just like in a video game,*" he told the magazine.

Reference: Allison Lawlor, *Globe and Mail*, Published Wednesday, November 12, 2014.

His commitment to this work and its contribution to improvements in shipping and safety earned him the Order of Canada. From 1989 until he retired 15 years later Mike was chairman and chief developer for the International Hydrographic Organization's working group on the design of ECDIS display, with the objective of ensuring the mariner sees a clear and uncluttered display of all the vital information needed for safe navigation.

Reference: Canadian Ocean Science Newsletter, # 79, November 2014.

The 2014 Northern Science Award and the Centenary Medal

Thursday, November 20, 2014, 10:31 AM

"Please join me in congratulating Dr. Robie MacDonald on his award of the 2014 Northern Science Award. The medal was awarded last night in Ottawa at the annual awards ceremony and dinner of the Royal Canadian Geographic Society. The Northern Science Award is presented annually by the Canadian Polar Commission to an individual or a group who have made a significant contribution to meritorious knowledge and understanding of the Canadian North and, in the spirit of the last IPY (2007-2008), recognizes the transformation of knowledge into action."

Robin Brown, Manager, Ocean Sciences Division,
Institute of Ocean Sciences, Sidney, B.C.

The International Polar Year, 1882-1883, was the first world-wide co-ordinated scientific enterprise and a significant event in the founding of the science of geophysics. Between August 1, 1882 and September 1, 1883, eleven countries established twelve stations in the Arctic and two in the Antarctic to carry out carefully planned and simultaneous observations in the earth sciences. This extension of scientific field work into the polar regions enhanced the value of the work of already established observatories in the world and permitted the first study of meteorological conditions above the Atlantic Ocean.

Centenary Medal

The Centenary Medal was created to commemorate the 100th Anniversary of the International Polar Year, 1882-1883. The medal, together with a prize of $10,000, is presented as the Northern Science Award (NSA) annually by the Canadian Polar Commission to give prominence to the importance of scientific knowledge and its applications to Canada's North.

Eligibility

Until 1997, the award was presented to an individual who had made distinguished contributions to Northern Canada through their scientific work. In recognition of the contribution of indigenous knowledge to the scientific understanding of the North, the eligibility requirements for the award were expanded to include indigenous groups who themselves possess and share indigenous knowledge for the benefit of all.

Left to right: Dr. Robie Macdonald and His Excellency the Right Honourable David Johnston, Governor General of Canada.
Photo credit: Matt Zambonin, Canadian Geographic

The award is presented annually to an individual or a group who have made a significant contribution to meritorious knowledge and understanding of the Canadian North and, in the spirit of the last IPY (2007-2008), recognizes the transformation of knowledge into action.

Citation

The Canadian Polar Commission is pleased to announce that the recipient of the 2014 Northern Science Award is **Dr. Robie Macdonald**. The award was presented at a ceremony prior to the Annual Dinner of the Fellows of the Royal Canadian Geographical Society, on November 19th in Ottawa, Ontario.

Dr. Robie Macdonald, a marine geochemist, has won international respect for his innovative, rigorous, and groundbreaking research using geochemistry to understand earth and ocean processes.

As Head of Marine Environmental Quality at Fisheries and Oceans Canada's Institute of Ocean Sciences, Dr.Macdonald's work spans a gamut that includes trace metals in lake and coastal marine sediments, chemical and biochemical impacts of underwater mine tailing discharges, the fate of pulp-mill derived dioxins and furans in coastal waters and sediments, and Arctic Ocean hydrography.

Through his extensive and ever-expanding body of work, Dr. Macdonald has enriched our knowledge of Beaufort Sea hydrology through his highly novel application of oxygen isotope analyses in sea ice near the Mackenzie Delta; he has improved our understanding of deep-water circulation in the Canada Basin of the Arctic Ocean; and he has mapped (and continues to map) contaminant distributions across the Arctic through measurements of chlorinated organic compounds, PCBs, and metals including mercury.

His key insights into the cycling of contaminants in the Arctic Ocean have been crucial for northerners who rely on fish and marine mammals for food.

Dr. Robie Macdonald is one the world's leading marine geochemists. Honourable, unassuming, and humble, he is held in great esteem by his peers.

The Martin Bergmann Medal for Excellence in Arctic Leadership and Science

Established by the Royal Canadian Geographical Society in 2012, the medal recognizes achievement for *"excellence in Arctic leadership and science"*. It celebrates "Marty" Bergmann, a public servant with an outstanding talent for networking that led him to connect scientists with resources and technology, to inspire business leaders, explorers and innovators towards new goals and to consider and attempt to meet the challenges inherent in opening up the Arctic, whether these were related to logistics, safety, resources, people, knowledge or will.

The 2014 Martin Bergmann Medal for Excellence in Arctic Leadership and Science recipient is **Dr. Donald Forbes**.

Dr. Forbes has contributed to the Arctic through dozens of studies and mapping projects, and advanced our knowledge of climate change through his own work and by championing interdisciplinary collaborations.

For his lifetime work in Arctic geography, and as a mentor and leader in community adaptation to climate change in coastal Arctic communities, Dr. Donald Forbes of Halifax, received The Martin Bergmann Medal.

Left to right: Paul Ruest, President of the Royal Canadian Geographical Society, Dr. Forbes, and His Excellency the Right Honourable David Johnston, Governor General of Canada and patron of the Royal Canadian Geographical Society. Photo credit: Matt Zambonin, Canadian Geographic

The Martin Bergmann Medal for Excellence in Arctic Leadership and Science

About Martin "Marty" Bergmann

Marty Bergmann was a great Canadian "networker", and the network he built, based on passion for the Arctic, was his greatest career accomplishment. The "Marty network" is composed of scientists, engineers, students, explorers, business, government and native leaders, journalists, ship captains and astronauts and indeed, anyone with whom he could share his passion for the Canadian Arctic. He connected hundreds of people with resources and with each other and in so doing, became a central lynch-pin of Canada's pursuit of northern goals during two decades.

As Director of the Polar Continental Shelf Program of Natural Resources Canada (PCSP), Marty Bergmann was a public servant, dedicated to helping Canada's Arctic realize its true potential by facilitating the visits of hundreds of science and geology professionals to the North. Prior to his work at PCSP, Marty served Fisheries and Oceans Canada, working as Director of the National Centre of Expertise for Arctic Aquatic Research Excellence, (NCAARE) where he managed logistics for Arctic ocean science aboard the Canadian Coast Guard fleet, most notably, Canada's flagship icebreaker, the CCGS Louis S. St-Laurent. However, Marty's contribution to Arctic science is inestimable, far exceeding any public service role he undertook.

At Fisheries and Oceans Canada, Marty was also well known for attracting Peter Mansbridge, host of the Canadian Broadcasting Corporation's "*The National*" to join the CCGS Louis S. St-Laurent for a trip through the Northwest Passage. During the week-long series, The National engaged Canadians in the science challenges facing the Canadian Arctic and set the stage for Canada's International Polar Year science effort. With this initiative, Marty '*put the Arctic on the map*' for a generation of Canadians who had never been exposed to it before. Working for Natural Resources Canada, Marty welcomed thousands of visiting scientists, students and media to Canada's Arctic during the multi-year span of the 4th International Polar Year.

Marty was taken from the family, the work and the country he loved too soon and tragically, at age 55, on August 20, 2011, in a plane crash at Resolute Bay, Nunavut (See *CMOS Bulletin SCMO*, Vol.39, No.5, page 192). He had been scheduled to escort Prime Minister Stephen Harper on a tour of *'his'* facility and was excited about the chance to share his Arctic passion with the Prime Minister.

Regardless of which federal department Marty officially belonged to, he truly was a public servant without borders. He contributed unrelentingly to the government-wide agenda whether at home or abroad. As Canadian astronaut Dr. Steve MacLean, President of the Canadian Space Agency, said in his remarks about him at the inaugural presentation of the medal, "*Marty was in the public service, but he was an innovator and a trail blazer, and never 'just a bureaucrat'."*

Martin "Marty" Bergman in the Canadian Arctic

Here are just a few of his accomplishments:

• The creation of the first fully equipped, operational science lab in Canada's Arctic.

• The establishment of 1,635 aviation fuel caches throughout Canada's Arctic to ensure the safety of aviators and visiting scientists, geological survey crews and defence personnel and in support of Canadian sovereignty throughout his Arctic territories.

• The doubling of the size of the Polar Continental Shelf Program's facility in Resolute Bay, Nunavut to accommodate up to 75 working scientists.

• The creation of a Memorandum of Understanding with the British Antarctic Survey for the use of their fleet of aircraft by PCSP during the Arctic summer/Antarctic winter. The fleet consists of four De Havilland Canada Twin Otters and one De Havilland Canada Dash-7.

• Engaging Young Presidents of Canada to visit the PCSP facility at Resolute Bay. Marty brought some of Canada's most energetic high technology CEO's to Nunavut to engage them in the Northern challenge. The Arctic Research Foundation, and its Arctic research ship were established through these efforts.

• As a leading and relentless evangelist in national and international scientific circles for the establishment of a world-class Canadian High Arctic Research Station.

• "*Canada's Gateway to the Arctic*", a video featuring Marty Bergmann, provides more information about the Polar Continental Shelf Program and its goals.

Needless to say, Marty Bergman was the first recipient in 2012 of the medal bearing his name.

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