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Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

CMOS BULLETIN SCMO

February / février 2013 Vol.41 No.1

NOAA satellite image of Hurricane *Sandy*

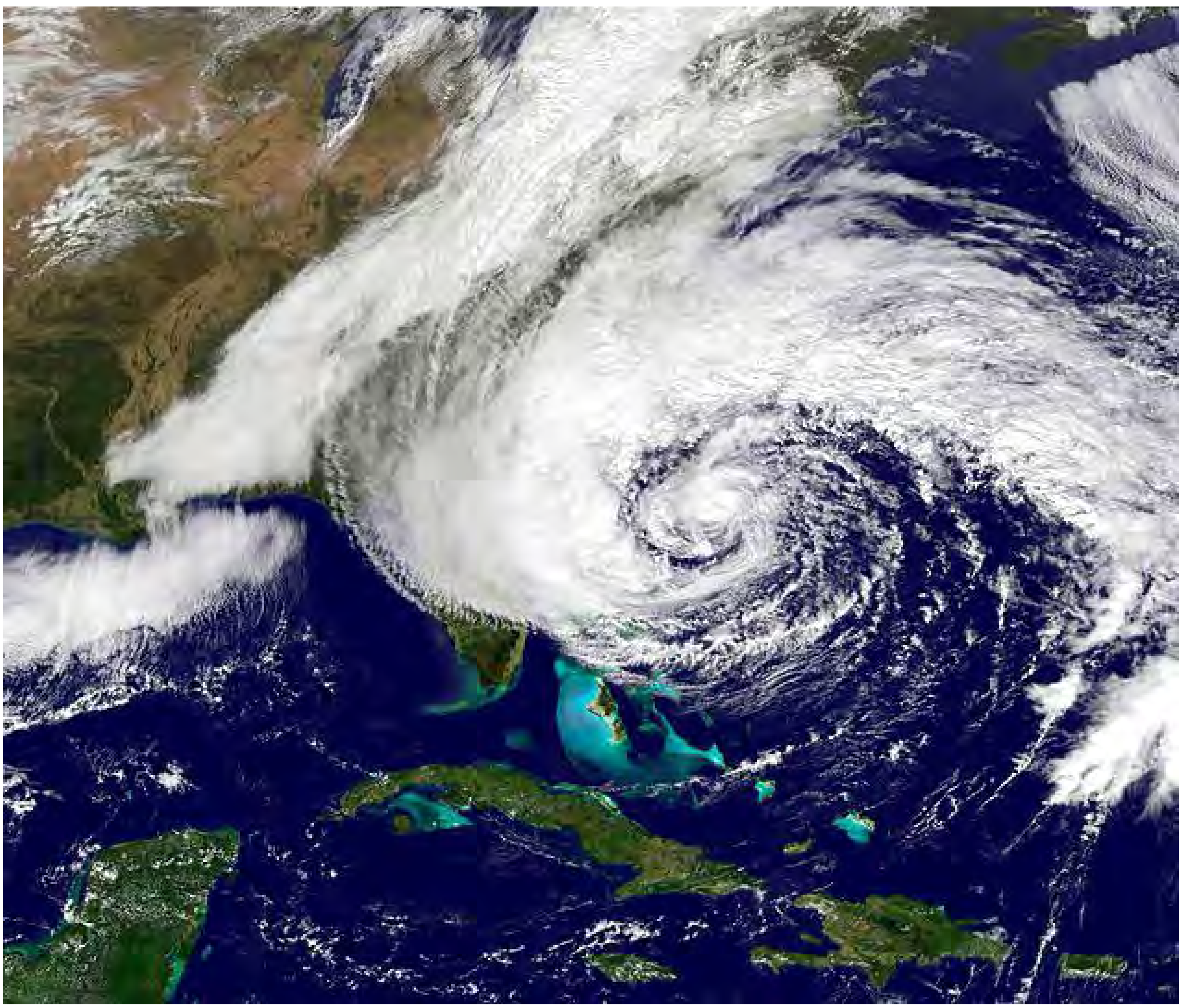
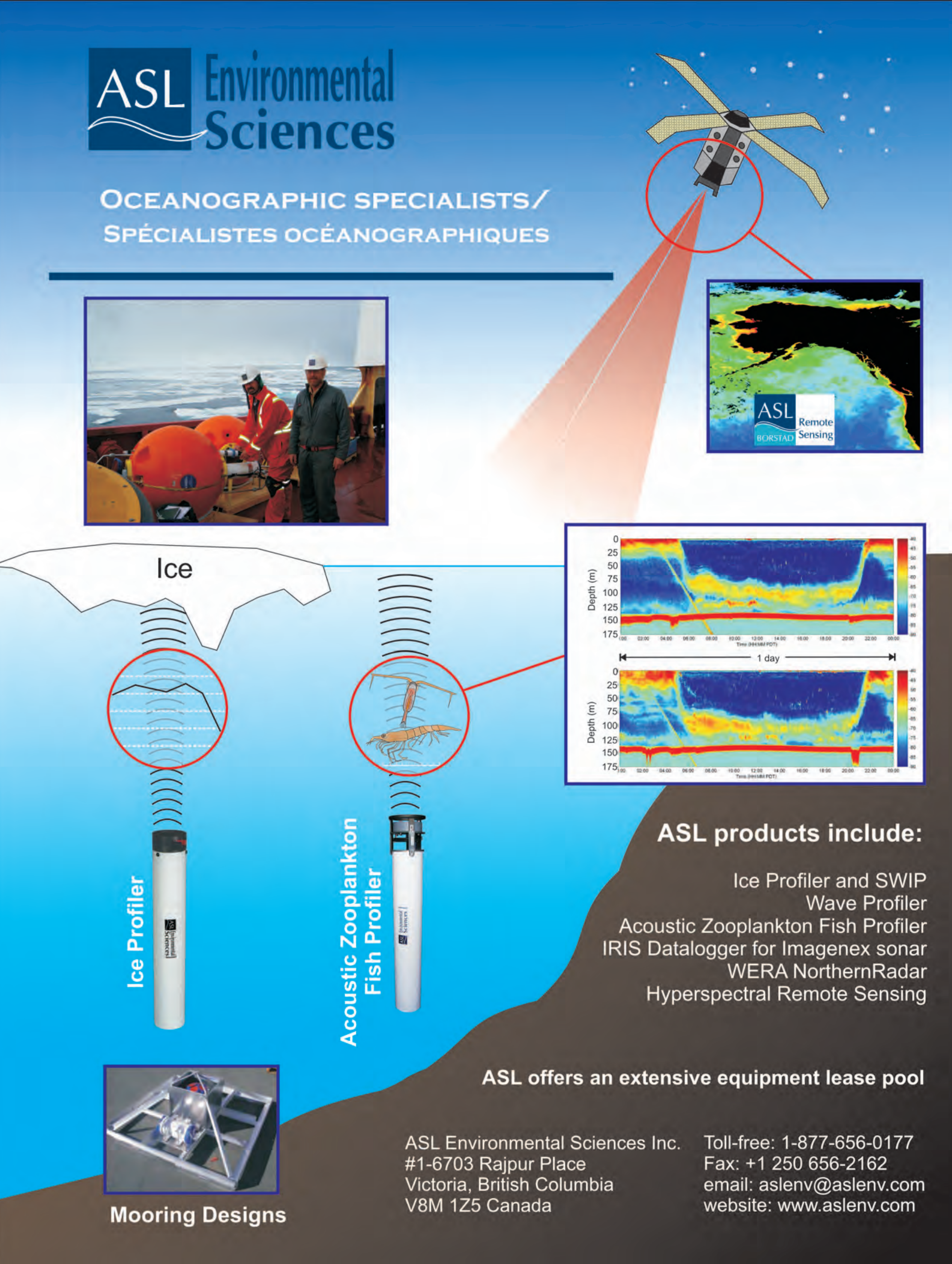


Image satellitaire de l'ouragan *Sandy* pris par NOAA



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....from the President's Desk / Allocution du président

Friends and colleagues:

Peter Bartello
CMOS President
Président de la SCMO

This is the issue of the Bulletin where I should urge all you procrastinators to renew your membership! In addition, it is time for us all to start making arrangements to attend the upcoming Saskatoon congress. It will be a joint meeting with the Canadian Geophysical Union and the Canadian Water Resources Association and will host special sessions dedicated to 2013s identification as the year of Mathematics of Planet Earth. It therefore seems clear it will be another in a recent string of excellent CMOS congresses and I look forward to the stimulating discussion.

In the meantime, I would like to inform the membership that we will soon be required to make some changes to CMOS governance and to start the discussion on what precisely we should do. The reason is that there have been changes to federal legislation on not-for-profit corporations. As you know, we have had a Council composed of all the centre and committee chairs as well as a treasurer, recording and corresponding secretaries, councillors-at-large and the president, vice-president and past-president. As the total number of CMOS Council members is in the mid-thirties, a more compact Executive Committee, composed of the treasurer, the two secretaries, councillors-at-large as well as the three people in the presidential track, does most of the work at the national level. Of course, both the Council and the Executive are wisely guided by our Executive Director and our Director of Publications who are ex-officio members of both Council and Executive.

The new legislation requires that we have a Board of Directors, that there be no ex-officio members and that all Directors must be elected by the membership at large. We need to file new bylaws, describing how all of this would work for CMOS, before late 2014. It is certainly not too early to start since there will only be two Annual General Meetings between now and then.

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

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Inside / En Bref

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

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In this issue: When the year number increases by one on the calendar, it is a usual practice to remember the events of the year that just ended. This February issue respects this rule and we are proud to present the *Top 10 Canadian meteorological stories for 2012*, stories compiled and presented by David Phillips (in English: **page 11**; in French: **page 19**). There is no doubt that one of the major events of the year 2012 was hurricane *Sandy*, as illustrated on cover page; it is the second event in the Canadian list presented by David. This same hurricane rates number one in the American list presented by the magazine *Weatherwise* (**page 23**). It is also worth mentioning that the heat wsave felt last year is present in both lists, rank first in the Canadian list and third in the American; it is also reported in the meteorological review prepared by WMO for the Doha conference (**page 5**). Finally, we present a compilation of the hurricane season prepared by NOAA (**page 22**) with an extensive description of hurricane *Sandy*. In the Climate Change section, John Stone presents a report on the outcome of Doha conference (**page 24**). Enjoy!

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Dans ce numéro: Quand on change l'année du calendrier, il est de coutume de se remémorer les événements de l'an qui vient de se terminer. Ce numéro de février ne fait pas exception à cette règle et nous sommes heureux de présenter les *10 événements météorologiques les plus marquants au Canada pour l'année 2012*, événements compilés et présentés par David Phillips (**page 11** en anglais et **page 19** en français). Un des événements majeurs pour l'année 2012 est sans contredit l'ouragan *Sandy* illustré en page couverture; c'est le deuxième événement dans la liste canadienne de David. Ce même ouragan arrive en première place de la liste américaine présentée par le magasine *Weatherwise* (**page 23**). Il est intéressant également de noter que la vague de chaleur subie l'an dernier est présente dans les deux listes (premier dans la liste canadienne et troisième dans l'américaine); elle est également rapportée dans la revue de l'année météorologique préparée par l'OMM pour la conférence de Doha (**page 5**). Enfin, nous présentons un résumé de la saison des ouragans préparé par NOAA (**page 22**) avec une description plus détaillée de l'ouragan *Sandy.* Dans la section sur les changements climatiques, John Stone nous présente un rapport sur la conférence de Doha (**page 24**). Bonne lecture!

....from the President's Desk / Allocution du président
(Continued / Suite)

The discussion of this at recent Executve meetings shows signs of converging to the idea that we should do away with the Executive Committee and simply get the Council down to a more manageable size. It has been pointed out that the Centre Chairs were added to Council at the time of the creation of the Canadian Foundation for Climate and Atmospheric Science (CFCAS). That organisation was set up with a Board of Trustees and Members who elected them. The Members of CFCAS were by definition exactly those of the CMOS Council, reflecting the clear link between the two organisations. Since CMOS Council members had such an important role to play with respect to CFCAS, the CMOS Council was enlarged to broaden the discussion. Recently CFCAS, now rebranded as the Canadian Climate Forum (CCF), asked their members (the CMOS Council) to approve their bylaws under the new legislation. The two organisations decided to pursue separate futures in that henceforth, CCF will have its own members selected by their Board of Directors. There is therefore no longer this need for CMOS to have a large council. In addition, centre chairs pose a bit of a philosophical problem if they are to remain on our future Board of Directors. In the new rules all Directors must be elected by all the members of CMOS. If one feels the Halifax centre chair should be elected by only members of the Halifax centre, then that person can not be on the Board of Directors. Of course, given the collegial nature of CMOS, this might not be such a difficult problem.

The Vice-President of CMOS has been traditionally charged with maintaining the link with the centres. If we are to remove centre chairs from the Board of Directors, then some mechanism must be devised to relay their concerns and issues to the national Society. This would appear to be via a committee of centre chairs, chaired by the Vice-President, who will certainly be a member of the Board of Directors. That person will need to report to the Board to keep it informed on these issues.

There is also the question relating to committee chairs. While many CMOS committees are active and very important, vacancies on some have been notoriously difficult to fill. I do not believe chairs of these committees should be members of the new Board of Directors. On the other hand, CMOS is a scientific society and we have a Scientific Committee charged with coordinating the formulation of position statements. As I wrote last time in this space, we have all agreed on the need for an ongoing media strategy and these position statements are an integral part of it. I feel strongly that the chair of the Scientific Committee ought to be a member of the Board of Directors.

In closing, it appears some important changes to the way CMOS works are being imposed on us. The discussion above is still in its infancy and many of the opinions are mine alone. We still have to familiarise ourselves with the details of the new legislation and will probably secure the services of a lawyer. In the meantime, feedback from the members on what they feel would work best and how we can use this opportunity to improve the Society, in keeping with the best of its traditions, is more than welcome.

Peter Bartello
CMOS President / Président de la SCMO

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **April 2013.** Please send your articles, notes, workshop reports or news items before **March 1, 2013** to the 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 2013.** Prière de nous faire parvenir avant le **1 mars 2013** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée au haut de la page 2. Nous avons un besoin URGENT de vos contributions écrites.

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

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

Latest News on the 2013 Saskatoon Congress

The Pacific Institute for Mathematical Sciences supports sessions on Mathematics of Planet Earth. See **page 37** for a short description of the activities for 2013 on this particular theme and **page 28** for the call for abstracts for the 2013 Joint Scientific Congress of CMOS, CGU and CWRA..

Dernières nouvelles du Congrès à Saskatoon en 2013

Le *Pacific Institute for Mathematical Sciences* apporte son support pour la tenue des sessions sur les Mathématiques de la Planète Terre. Voir en **page 38** pour une courte description des activités en 2013 sur ce thème particulier et en **page 29** pour la demande de résumés pour le congrès scientifique conjoint 2013 de la SCMO, de l'UGC et de l'ACRH..

CMOS 2013 Photo Contest

All members with a photographic bent are invited to participate in the 2013 Photo Contest. Please submit your own original image files, either in colour or black and white, from scans of prints or digital capture of a meteorological or oceanographic subject, event, or phenomenon. Details on the photo contest can be found on the CMOS Web Page at:

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

Concours photographique 2013 de la SCMO

Tous les membres qui ont une passion pour la photographie sont invités à participer au concours de photographie 2013 de la SCMO. Prière de soumettre vos photos numériques originales, soit en couleur, soit en noir et blanc, à partir de copie papier ou de fichier numérique portant sur des sujets ou phénomènes météorologiques ou océanographiques. Les détails du concours se trouvent sur le site web de la SCMO à l'adresse:

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

Mitacs

Mitacs supports national innovation by coordinating collaborative industry-university research projects with human capital development at their core. Since 1999, Mitacs has been promoting academic-industrial R&D while supporting the development of future innovation leaders. Mitacs has developed a proactive and successful approach to supporting innovation, both directly through collaborative R&D and indirectly through long-term development of skilled human capital.
In particular, Mitacs:

- Helps companies identify their innovation needs and matches them with academic expertise;
- Fosters cutting edge research tied to commercial outcomes;
- Builds international research networks, creating innovation leaders in Canada and abroad; and,
- Provides professional and entrepreneurship skills training for graduate students, so they have the tools to meet emerging innovation needs.

Look for a Mitacs presentation at the upcoming CMOS-CGU-CWRA congress and for more information see www.mitacs.ca.

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ARTICLES

2012: Record Arctic Sea Ice Melt, Multiple Extremes and High Temperatures

Résumé: Les années 2001 à 2011 font partie des plus chaudes jamais enregistrées et, d'après l'Organisation météorologique mondiale, les dix premiers mois de 2012 donnent à penser que selon toute probabilité, cette année-ci ne fera pas exception malgré l'influence, en début de période, du phénomène La Niña qui a normalement pour effet de refroidir le climat.

La déclaration provisoire de l'OMM sur l'état du climat mondial en 2012 fait aussi état d'une fonte sans précédent de la banquise de l'Arctique et d'une multiplication des extrêmes météorologiques et climatiques dans de nombreuses régions du monde. Elle est publiée aujourd'hui (28 novembre 2012) à l'intention des négociateurs qui participent à la Conférence des Nations Unies sur les changements climatiques organisée à Doha.

La période janvier-octobre 2012 se classe au neuvième rang des plus chaudes jamais observées depuis le début des relevés, en 1850. La température moyenne à la surface du globe (terres émergées et océans confondus) pour cette période présente une anomalie estimée à environ 0,45°C au-dessus de la normale calculée pour les années 1961 à 1990 (14,2°C), d'après la déclaration.

L'année a débuté par un épisode La Niña d'intensité faible à modérée, qui était apparu en octobre2011. En début d'année, un tel phénomène a tendance à faire baisser la moyenne mondiale des températures, et 2012 n'a pas fait exception à la règle. Après la dissipation de La Niña, en avril 2012, la température moyenne à la surface des terres et des océans a continué d'augmenter mois après mois, creusant l'écart par rapport à la normale. La moyenne semestrielle pour les mois de mai à octobre 2012 se classe parmi les quatre plus élevées jamais enregistrées pour cette période de l'année.

GENEVA/DOHA, 28 November 2012 (WMO) – The years 2001–2011 were all among the warmest on record, and, according to the World Meteorological Organization, the first ten months indicate that 2012 will most likely be no exception despite the cooling influence of La Niña early in the year.

WMO's provisional annual statement on the state of the global climate also highlighted the unprecedented melt of the Arctic sea ice and multiple weather and climate extremes which affected many parts of the world. It was released today (November 28, 2012) to inform negotiators at the United Nations Climate Change Conference in Doha, Qatar.

January-October 2012 has been the ninth warmest such period since records began in 1850. The global land and ocean surface temperature for the period was about 0.45°C above the corresponding 1961–1990 average of 14.2°C, according to the statement.

The year began with a weak-to-moderate strength La Niña, which had developed in October 2011. The presence of a La Niña during the start of a year tends to have a cooling influence on global temperatures, and this year was no different. After the end of the La Niña in April 2012, the global land and ocean temperatures rose increasingly above the long-term average with each consecutive month. The six-month average of May–October 2012 was among the four warmest such periods on record.

"*Naturally occurring climate variability due to phenomena such as El Niño and La Niña impact on temperatures and precipitation on a seasonal to annual scale. But they do not alter the underlying long-term trend of rising temperatures due to climate change as a result of human activities*," said WMO Secretary-General Michel Jarraud.

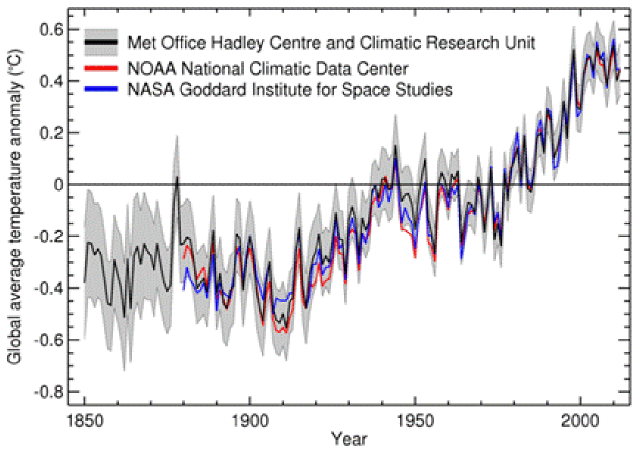
"*The extent of Arctic sea ice reached a new record low. The alarming rate of its melt this year highlighted the far-reaching changes taking place on Earth's oceans and biosphere. Climate change is taking place before our eyes and will continue to do so as a result of the concentrations of greenhouse gases in the atmosphere, which have risen constantly and again reached new records*," added Mr Jarraud.

The Arctic reached its lowest annual sea ice extent since the start of satellite records on 16 September at 3.41 million square kilometres. This was 18% less than the previous record low of 18 September, 2007. The 2012 minimum extent was 49 percent or nearly 3.3 million square kilometres (nearly the size of India) below the 1979–2000 average minimum. Some 11.83 million square kilometres of Arctic ice melted between March and September 2012.

Highlights of 2012 provisional statement

1) Temperatures

During the first ten months of 2012, above-average temperatures affected most of the globe's land surface areas, most notably North America (warmest on record for contiguous United States of America), southern Europe, western and central Russia and northwestern Asia. Much of South America and Africa experienced above average temperatures during the first ten months of the year, with the most anomalous warmth across parts of northern Argentina and northern Africa. Much of Asia had above-average temperatures, with cooler-than-average conditions across parts of northern China. South Asia and the Pacific were also predominantly warmer than normal, except for Australia.



2) Extremes

Notable extreme events were observed worldwide, but some parts of the Northern Hemisphere were affected by multiple extremes during January–October 2012.

3) Heat waves

Major heat waves impacted the Northern Hemisphere during the year, with the most notable in March–May across the continental United States of America and Europe. Warm spells during March 2012 resulted in many record-breaking temperatures in Europe and nearly 15,000 new daily records across the USA. Russia witnessed the second warmest summer on record after 2010. Numerous temperature records were broken in Morocco in summer.

4) Drought

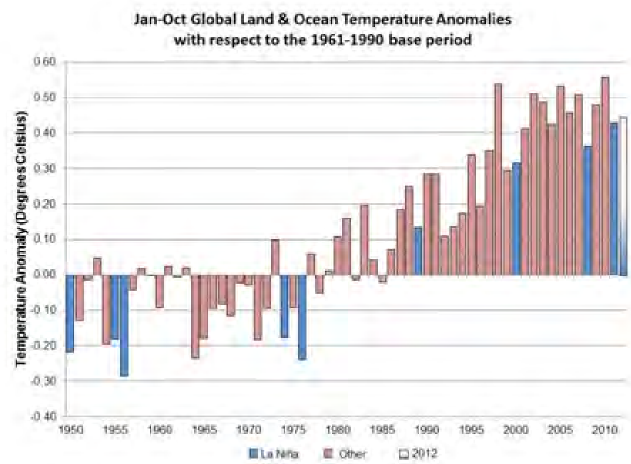
According to the U.S. Drought Monitor, nearly two-thirds of the continental United States (65.5 percent) was considered to be in moderate-to-exceptional drought on 25 September 2012. Drought conditions impacted parts of western Russia and western Siberia during June and July, and Southeast Europe, the Balkans and some Mediterranean countries during summer. In China, the Yunnan and southwestern Sichuan province experienced severe drought during winter and spring. Northern Brazil witnessed the worst drought in 50 years. The April–October precipitation total in Australia was 31 percent below normal.

5) Floods

Many parts of western Africa and the Sahel, including Niger and Chad, suffered serious flooding between July and September because of a very active monsoon. Heavy rainfall from the end of July through early October prompted exceptional floods across Nigeria. Parts of southern China experienced their heaviest rainfall in the last 32 years in April and May. Devastating monsoonal floods impacted Pakistan during September. Central and parts of northern Argentina suffered from record rainfall and flooding in August, and parts of Colombia were affected by heavy precipitation for most of the year.

6) Snow and Extreme Cold

A cold spell on the Eurasian continent from late January to mid-February was notable for its intensity, duration, and impact. Across eastern Russia, temperatures ranged between -45°C to -50°C during the end of January. Several areas of eastern Europe reported minimum temperatures as low as -30°C, with some areas across northern Europe and central Russia experiencing temperatures below -40°C.



7) Tropical Cyclones

Global tropical cyclone activity for the first ten months was near the 1981–2010 average of 85 storms, with a total of 81 storms (wind speeds greater or equal than 63 kilometres per hour). The Atlantic basin experienced an above-average hurricane season for a third consecutive year with a total of 19 storms, with ten reaching hurricane status, the most notably being Sandy, which wreaked havoc across the Caribbean and the USA East Coast. Throughout the year, East Asia was severely impacted by powerful typhoons. Typhoon Sanba was the strongest cyclone, globally, to have formed in 2012. Sanba impacted the Philippines, Japan, and the Korean Peninsula, dumping torrential rain and triggering floods and landslides that affected thousands of people and caused millions in U.S. dollars in damage.

Background notes

The provisional statement is being released at the 18th Conference of the Parties to the United Nations Framework Convention on Climate Change, taking place in Doha, Qatar. Final updates and figures for 2012 will be published in March 2013. It is based on climate data from networks of land-based weather and climate stations, ships and buoys, as well as satellites. The WMO global temperature analysis is thus principally based on three complementary datasets. One is the combined dataset maintained by both the Hadley Centre of the UK Met Office and the Climatic Research Unit, University of East Anglia, United Kingdom. Another dataset is maintained by the National Oceanic and Atmospheric Administration (NOAA), and the third one is from the Goddard Institute of Space Studies (GISS) operated by the National Aeronautics and Space Administration (NASA). Additional information is drawn from the ERA-Interim reanalysis-based data set maintained by the European Centre for Medium-Range Weather Forecasts (ECMWF).

Source: WMO Press Release #966; http://www.wmo.int visited on November 30, 2012.

The World Meteorological Organization is the United Nations System's authoritative voice on Weather, Climate and Water

Determining Cloud Base using an IR Thermometer

by Kenneth A. Devine[1]

While much of the emphasis is on standalone instrumented observations there are still a lot of weather observations taken manually at airports and volunteer climate stations. Small airports are staffed only during the daytime by contract or NavCan observers using the same instrumentation which was used before autostations became common. The determination of cloud bases are an important part of the observation for aircraft flying. For these daytime cloud observations the observers use: estimations from experience, helium filled ceiling balloons, and temperature-dewpoint spread for convective clouds as well as pilot reports if available.

The error in cloud height estimates can vary from ±50% for new observers to ±20% for experienced observers. Balloon measurements during windy days can be impossible or very much in error. The temperature dewpoint spread is quite accurate but only for summertime convective clouds. A simple infrared (IR) thermometer could act as an observer's aid to assist in the measurement of the cloud base during the daytime.

The method consists of taking a horizontal IR measurement of objects in the shade for low level air temperature. This temperature should be similar to the screen temperature. Then take a vertical IR measurement of the cloud base. The difference between these measurements in Celsius is divided by two to determine the cloud base in thousands of feet. 2°C/1000' or 6.56°C/km is very close to 6.5°C/km, the average lapse rate used to determine MSL pressure from station pressure. Early tests of this technique indicate that it is superior to cloud based estimations.

[1] Meteorologist Consultant
Aurora, Ontario, Canada

These IR thermometers are available at automotive stores for under $100 which is a hundredth the cost of a laser ceilometer.

The selected units should have a low end measurement of -40°C or lower. While convenient and inexpensive, there are conditions under which this technique cannot be used. When there is a large surface base inversion, such as in the arctic during the winter, the lapse rate will not be near the average. Still these IR thermometers could be convenient observer aids for determining the ceiling during much of the year if used with discretion.

The IR Thermometer

WMO highlights pivotal role of carbon sinks

Geneva, 20 November (WMO) – The amount of greenhouse gases in the atmosphere reached a new record high in 2011, according to the World Meteorological Organization. Between 1990 and 2011 there was a 30% increase in radiative forcing – the warming effect on our climate – because of carbon dioxide (CO_2) and other heat-trapping long-lived gases.

Since the start of the industrial era in 1750, about 375 billion tonnes of carbon have been released into the atmosphere as CO_2, primarily from fossil fuel combustion, according to WMO's 2011 Greenhouse Gas Bulletin, which had a special focus on the carbon cycle. About half of this carbon dioxide remains in the atmosphere, with the rest being absorbed by the oceans and terrestrial biosphere.

"*These billions of tonnes of additional carbon dioxide in our atmosphere will remain there for centuries, causing our planet to warm further and impacting on all aspects of life on earth*," said WMO Secretary-General Michel Jarraud. "*Future emissions will only compound the situation*."

"*Until now, carbon sinks have absorbed nearly half of the carbon dioxide humans emitted in the atmosphere, but this will not necessarily continue in the future. We have already seen that the oceans are becoming more acidic as a result of the carbon dioxide uptake, with potential repercussions for the underwater food chain and coral reefs. There are many additional interactions between greenhouse gases, Earth's biosphere and oceans, and we need to boost our monitoring capability and scientific knowledge in order to better understand these*," said Mr Jarraud.

"*WMO's Global Atmosphere Watch network, spanning more than 50 countries, provides accurate measurements which form the basis of our understanding of greenhouse gas concentrations, including their many sources, sinks and chemical transformations in the atmosphere*," said Mr Jarraud.

The role of carbon sinks is pivotal in the overall carbon equation. If the extra CO_2 emitted is stored in reservoirs such as the deep oceans, it could be trapped for hundreds or even thousands of years. By contrast, new forests retain carbon for a much shorter time span.

The Greenhouse Gas Bulletin reports on atmospheric concentrations – and not emissions - of greenhouse gases. Emissions represent what goes into the atmosphere. Concentrations represent what remains in the atmosphere after the complex system of interactions between the atmosphere, biosphere and the oceans.

CO_2 is the most important of the long-lived greenhouse gases – so named because they trap radiation within the Earth's atmosphere causing it to warm. Human activities, such as fossil fuel burning and land use change (for instance, tropical deforestation), are the main sources of the anthropogenic carbon dioxide in the atmosphere. The other main long-lived greenhouse gases are methane and nitrous oxide. Increasing concentrations of the greenhouse gases in the atmosphere are drivers of climate change.

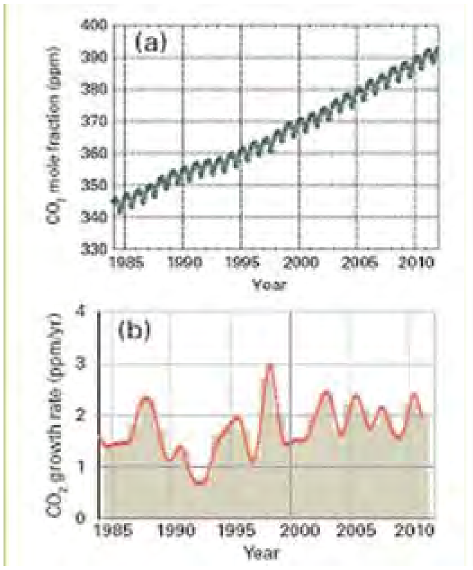
The National Oceanic and Atmospheric Administration's Annual Greenhouse Gas Index, quoted in the bulletin, shows that from 1990 to 2011, radiative forcing by long-lived greenhouse gases increased by 30%, with CO_2 accounting for about 80% of this increase. Total radiative forcing of all long-lived greenhouse gases was the CO_2 equivalent of 473 parts per million in 2011.

Carbon dioxide (CO_2)
Carbon dioxide is the single most important greenhouse gas emitted by human activities. It is responsible for 85% of the increase in radiative forcing over the past decade. According to WMO's bulletin, the amount of CO_2 in the atmosphere reached 390.9 parts per million in 2011, or 140% of the pre-industrial level of 280 parts per million.

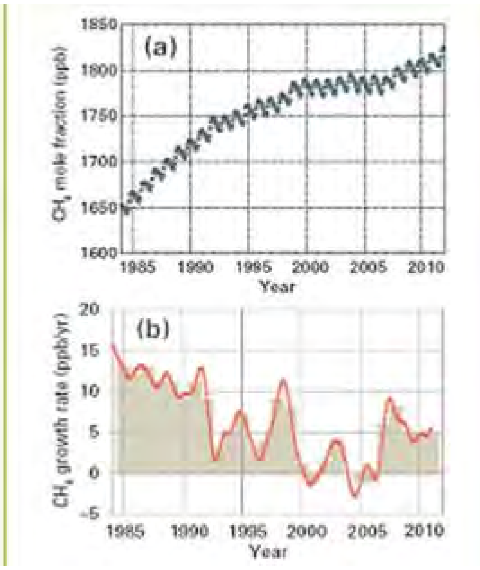
The pre-industrial era level represented a balance of CO_2 fluxes between the atmosphere, the oceans and the biosphere. The amount of CO_2 in the atmosphere has increased on average by 2 parts per million per year for the past 10 years.

Methane (CH_4)
Methane is the second most important long-lived greenhouse gas. Approximately 40% of methane is emitted into the atmosphere by natural sources (e.g., wetlands and termites), and about 60 % comes from activities like cattle breeding, rice agriculture, fossil fuel exploitation, landfills and biomass burning. Atmospheric methane reached a new high of about 1813 parts per billion (ppb) in 2011, or 259% of the pre-industrial level, due to increased emissions from anthropogenic sources. Since 2007, atmospheric methane has been increasing again after a period of levelling-off with a nearly constant rate during the last 3 years.

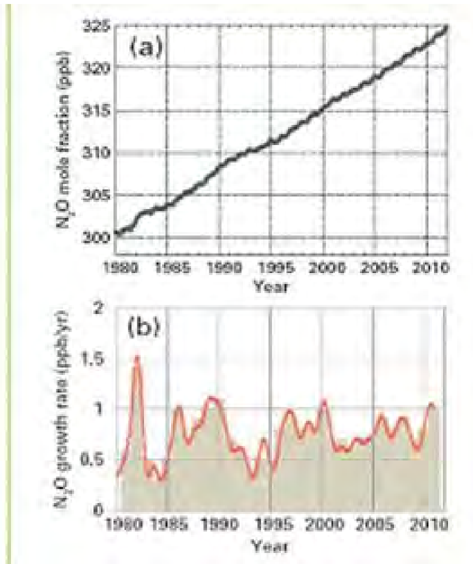
Nitrous oxide (N_2O)
Nitrous oxide is emitted into the atmosphere from both natural (about 60%) and anthropogenic sources (approximately 40%), including oceans, soil, biomass burning, fertilizer use, and various industrial processes. Its atmospheric concentration in 2011 was about 324.2 parts per billion, which is 1.0 ppb above the previous year and 120% of the pre-industrial level. Its impact on climate, over a 100 year period, is 298 times greater than equal emissions of carbon dioxide. It also plays an important role in the destruction of the stratospheric ozone layer which protects us from the harmful ultraviolet rays of the sun.



<u>Figure 1:</u> Globally averaged CO_2 mole fraction (a) and its growth rate (b) from 1984 to 2011. Annually averaged rate is shown by column at (b)
Évolution de la valeur moyenne à l'échelle du globe de la fraction molaire CO2 (a) et de son taux d'accroissement (b). Le taux d'accroissement annuel moyen est représenté sous forme de colonnes en (b)



<u>Figure 2:</u> Globally averaged CH_4 mole fraction (a) and its growth rate (b) from 1984 to 2011. Annually averaged rate is shown by column at (b)
Évolution de la valeur moyenne à l'échelle du globe de la fraction molaire CH_4 (a) et de son taux d'accroissement (b). Le taux d'accroissement annuel moyen est représenté sous forme de colonnes en (b)



<u>Figure 3:</u> Globally averaged N_2O mole fraction (a) and its growth rate (b) from 1980 to 2011. Annually averaged rate is shown by column at (b)
Évolution de la valeur moyenne à l'échelle du globe de la fraction molaire N_2O (a) et de son taux d'accroissement (b). Le taux d'accroissement annuel moyen est représenté sous forme de colonnes en (b)

Notes for Readers

The WMO Secretariat prepares and distributes the annual Greenhouse Gas Bulletin in cooperation with the World Data Centre for Greenhouse Gases at the Japan Meteorological Agency and the Global Atmosphere Watch Scientific Advisory Group for Greenhouse Gases, with the assistance of the NOAA Earth System Research Laboratory.

The Intergovernmental Panel on Climate Change defines radiative forcing as a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. Radiative forcing values are often expressed in watts per square meter.

<u>Source for English version:</u> WMO Press Release # 965, available at www.wmo.int and visited on November 30, 2012.

The World Meteorological Organization is the United Nations System's authoritative voice on Weather, Climate and Water

<u>Source pour la version française:</u> Communiqué de presse de l'OMM # 965, disponible au www.wmo.int et visité le 30 novembre 2012.

Rôle crucial joué par les puits de carbone

<u>Genève, le 20 novembre (OMM)</u> – La teneur de l'atmosphère en gaz à effet de serre a atteint un nouveau record en 2011, d'après l'Organisation météorologique mondiale (OMM). Le forçage radiatif de l'atmosphère par les gaz à effet de serre, qui induit un réchauffement du système climatique, s'est accru de 30% en 1990 et 2011 à cause du dioxyde de carbone et d'autres gaz persistants qui retiennent la chaleur.

Depuis le début de l'ère industrielle, en 1750, quelque 375 milliards de tonnes de carbone ont été rejetées dans l'atmosphère sous forme de dioxyde de carbone (CO_2), surtout à cause de l'exploitation des combustibles fossiles. C'est ce qui ressort du dernier bulletin de l'OMM sur les gaz à effet de serre présents dans l'atmosphère en 2011, qui met spécialement l'accent sur le cycle du carbone. Environ la moitié de ce CO_2 demeure dans l'atmosphère, le reste étant absorbé par les océans et la biosphère terrestre.

"*Ces milliards de tonnes de dioxyde de carbone rajoutées à l'atmosphère vont y rester pendant des siècles, accentuant le réchauffement de notre planète et se répercutant sur tous les aspects de la vie sur Terre, et les émissions futures aggraveront encore la situation*", a déclaré le Secrétaire général de l'OMM, Michel Jarraud.

"*Jusqu'à maintenant, les puits de carbone ont absorbé près de la moitié du dioxyde de carbone que les activités humaines ont rejeté dans l'atmosphère, mais la situation risque de changer. Nous voyons déjà que les océans ont* *tendance à s'acidifier du fait de l'absorption de dioxyde de carbone, ce qui pourrait avoir d'importantes répercussions sur la chaîne alimentaire océanique et les récifs de corail. Il existe par ailleurs de nombreuses interactions entre les gaz à effet de serre, la biosphère terrestre et les océans, et nous avons besoin de renforcer nos capacités de surveillance et d'approfondir nos connaissances scientifiques afin de mieux les comprendre*", a poursuivi M. Jarraud.

"*Le réseau de la Veille de l'atmosphère globale de l'OMM, qui s'étend sur plus de 50 pays, livre des données précises sur les concentrations de gaz à effet de serre, et nous aide aussi à mieux connaître leurs multiples sources et puits ainsi que les transformations chimiques qui se produisent dans l'atmosphère*".

Les puits de carbone jouent un rôle capital dans le bilan global du carbone. Si l'excédent de CO_2 était stocké dans les profondeurs de l'océan par exemple, il pourrait y rester piégé pendant des centaines voire des milliers d'années. Les forêts nouvellement créées, en revanche, retiennent le carbone sur des durées beaucoup plus courtes.

Le Bulletin de l'OMM sur les gaz à effet de serre rend compte des concentrations – et non des émissions – de ces gaz dans l'atmosphère. Par émissions on entend les quantités de gaz qui pénètrent dans l'atmosphère et par concentrations celles qui y restent à la faveur des interactions complexes qui se produisent entre l'atmosphère, la biosphère et les océans.

Le CO_2 est le plus important des gaz à effet de serre persistants, appelés ainsi car ils captent une partie du rayonnement traversant l'atmosphère terrestre qui, de ce fait, se réchauffe. Les activités humaines telles que l'exploitation des combustibles fossiles et les changements d'affectation des terres (le déboisement dans les régions tropicales par exemple) sont les principales sources d'émission de dioxyde de carbone dans l'atmosphère. Les autres grands gaz à effet de serre persistants sont le méthane et le protoxyde d'azote. L'augmentation de la teneur de l'atmosphère en gaz à effet de serre fait partie des causes du changement climatique.

Selon l'indice annuel d'accumulation des gaz à effet de serre (AGGI) de la NOAA, mentionné dans le bulletin, le forçage radiatif de l'atmosphère par les gaz à effet de serre persistants s'est accru de 30% entre 1990 et 2011, le dioxyde de carbone contribuant pour quelque 80% à cette augmentation. Le forçage radiatif total induit par l'ensemble des gaz à effet de serre persistants en 2011 était de 473parties par million en équivalent CO_2.

<u>Note du rédacteur:</u> Voir les graphiques individuels pour le dioxyde de carbone (CO_2), le méthane (CH_4) et le protoxyde d'azote (N_2O) à la page précédente.

Dioxyde de carbone (CO_2)
Le dioxyde de carbone est le gaz à effet de serre d'origine humaine le plus abondant dans l'atmosphère. Il a contribué à l'augmentation du forçage radiatif à hauteur de 85% ces dix dernières années. Comme le souligne le Bulletin de l'OMM sur les gaz à effet de serre, la teneur de l'atmosphère en CO_2 a atteint 390,9 parties par million en 2011, ce qui représente 140% de ce qu'elle était à l'époque préindustrielle (280 parties par million).

La valeur préindustrielle correspond à une situation d'équilibre des flux entre l'atmosphère, les océans et la biosphère, et le taux d'accroissement annuel du CO_2 atmosphérique a été en moyenne de 2 parties par million sur la décennie écoulée.

Méthane (CH_4)
Le méthane est le deuxième plus important gaz à effet de serre. Environ 40% des émissions de méthane dans l'atmosphère sont d'origine naturelle (zones humides, termites, etc.) et 60% d'origine anthropique (élevage de bétail, riziculture, exploitation des combustibles fossiles, décharges, combustion de la biomasse, etc.). Le CH_4 atmosphérique a atteint un nouveau pic en 2011 – 1813 parties par milliard (ppb), soit 259% du niveau qu'il avait à l'époque préindustrielle – en raison de l'accroissement des émissions anthropiques. Après une période de stabilisation, la teneur de l'atmosphère en méthane augmente de nouveau depuis 2007 à un rythme qui est resté pratiquement constant ces trois dernières années.

Protoxyde d'azote (N_2O)
Ses émissions dans l'atmosphère sont d'origine naturelle (environ 60%) et humaine (environ 40%), puisqu'elles proviennent notamment des océans, des sols, de la combustion de la biomasse, des engrais et de divers processus industriels. En 2011, la teneur de l'atmosphère en N_2O était de quelque 324,2 parties par milliard, ce qui représente une progression de 1,0 ppb par rapport à l'année précédente et 120% du niveau qu'elle avait à l'époque préindustrielle. À horizon de 100 ans, l'impact du protoxyde d'azote sur le climat est 298 fois supérieur à celui du dioxyde de carbone, à émissions égales. Ce gaz joue aussi un rôle important dans la destruction de la couche d'ozone stratosphérique qui nous protège des rayons ultraviolets nocifs émis par le soleil.

Notes aux lecteurs
Le Secrétariat de l'OMM élabore et distribue le bulletin annuel sur les gaz à effet de serre en collaboration avec le Centre mondial de données relatives aux gaz à effet de serre, hébergé par le Service météorologique japonais, et le Groupe consultatif scientifique pour les gaz à effet de serre relevant de la Veille de l'atmosphère globale, tout en bénéficiant du soutien du Laboratoire de recherche sur le système terrestre (ESRL) de la NOAA.

Le Groupe d'experts intergouvernemental sur l'évolution du climat définit le forçage radiatif comme étant la mesure de l'influence d'un facteur sur l'altération de l'équilibre entre les énergies entrantes et sortantes du système Terre-atmosphère, et un indice de l'importance de ce facteur en tant que mécanisme potentiel de changement climatique. Il est souvent exprimé en watts par mètre carré.

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

Canada's Top Ten Weather Stories for 2012

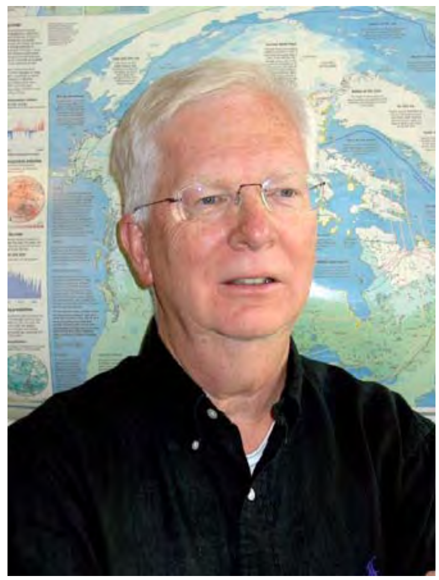
by David Phillips[1]

A Year in Review

Go big seemed to be the theme for Mother Nature in 2012 across North America. Super Storm Sandy was said to be the most powerful and biggest Atlantic hurricane in history. But while Sandy was catastrophic for the United States, she was merely a nasty fall storm in Canada; one with a $100 million price tag! The hurricane was a blockbuster in what was another active season. Oddly, it was the third consecutive year that 19 tropical storms developed in the Atlantic basin, which is nearly double the norm. Across Canada, big storms and floods dominated the landscape from January to December leading to mega-buck losses for businesses, governments and thousands of Canadians. Insurers were hit hard by the wicked weather in 2012, facing more than $1 billion in payouts in three of the past four years – an unprecedented and worrisome trend for the industry.

Hot temperatures also dominated the list of major weather stories in 2012. Globally, it was another in the top 10 hottest years spanning 160 years of records. In Canada, it was spectacularly warm – our 16th year in a row. Nationally, it was the fourth warmest on record and for millions of people in Ontario and Quebec it was the warmest year ever. In addition to higher average temperatures, the year featured a winter that went missing, a March with a record for broken records, and a summer that was the hottest of the hot seasons. The incredibly intense, huge and long-lasting March mildness excited meteorologists but stressed farmers who worried that early blooms could succumb to killer frosts. At the top of Canada, big heat led to a big melt with Arctic ice cover shrinking to its lowest extent since satellite records began 34 years ago. The phenomenon was not confined to the North with Atlantic Canada, the Gulf of St. Lawrence and the Great Lakes practically ice-free throughout the winter.

With melting comes flooding and 2012 was no exception. In British Columbia, the snowpack was among the deepest measured in years. Soaking rains and violent thunderstorms escalated the flood risk. It was a slow continuous threat that occurred over two seasons and was fought on several fronts along at least a dozen rivers from one end of the province to the other. At Johnson's Landing, the excess water mixed with an unstable slope that caused a deadly landslide. Thunder Bay, Ontario lived up to its name when thunderstorms led to a torrential deluge and horrendous flooding. A few days later, elements of the same weather system triggered flash floods in Montreal. With more gully washers in Toronto, Hamilton, Ottawa-Gatineau, Calgary and Edmonton, some insurers referred to it as the year of flooded basements. For residents of Perth-Andover, New Brunswick, it was ice jamming on the Saint John River that brought on flooding – the worst by a metre of any previous river overflow. And for those in western Newfoundland and Labrador and around Truro, Nova Scotia, it was hurricane and tide-related flooding that forced families from their homes.



David Phillips

Geographically, nature seemed to have it in for Calgary. For the third straight year, violent weather struck the city hard. Last year it was powerful winds. This year it was a repeat of 2010 with a monstrous hailer that inflicted multi-million dollar property losses. Bad luck also hit the East, as farmers struggled against killing frosts, lengthy dry spells, torrid temperatures and insect infestations. Western farmers were more fortunate and forever thankful for one of the best years ever and for avoiding the American drought that did not move northward. The luckiest of the lot were vintners who raised a glass to a bountiful harvest following a spell of exceptionally warm, dry and sunny weather. There were no toasts to the weather on the Prairies, however, as residents there faced a summer of near-record numbers of severe weather warnings highlighted by tornadoes, intense rains, strong winds and hailers. For Alberta it was the most active summer storm season in over 20 years and a record for crop losses due to hail. Saskatchewan reported at least 36 tornadoes – its highest number ever. By comparison, Manitoba weather was largely uneventful.

[1] Senior Climatologist, Meteorological Service of Canada, Environment Canada, Downsview, Ontario, Canada.

The following Top Canadian Weather Stories for 2012 are rated from one to ten based on factors that include the degree to which Canada and Canadians were impacted, the extent of the area affected, economic effects and longevity as a top news story:

Top Ten Canadian Weather Stories for 2012

1	**2012: The Big Heat**
2	**Super Storm *Sandy* and Another Active Hurricane Season**
3	**BC Flooding … Large, Longer and Lethal**
4	**March's Meteorological Mildness**
5	**Summer on the Prairies … Warm, Wet and Wild**
6	**The Big Melt**
7	**High and Dry in the East**
8	**The Year of the Urban Flood**
9	**Hail to Calgary … Again**
10	**Historic Ice-jam Flooding on the Saint John River**

1. 2012: The Big Heat

That 2012 was another warm year in Canada – the 16th in a row – was no big surprise. Indeed, in the last ten years there have only been 4 out of 40 seasons that were colder than normal. In 2012 alone, winter, spring and summer were among the top 10 hottest for their respective seasons. Incredibly, each of July, August and September tied or exceeded any previous year for the warmest on record. It follows that July through September was the warmest of any three-month period in Canada in 65 years. From January to November inclusive, 2012 was the fourth warmest since 1948 when record-keeping began on a nationwide basis. Every region felt the warmth, especially the millions of Canadians living in the Great Lakes/St. Lawrence Lowlands who experienced the warmest such period on record.

Globally, it was even more one-sided. The last time there was a cold year globally was 36 years ago. Nearly half the population in the world has never experienced a month that was colder than normal globally. Even more remarkable, according to the US National Oceanic and Atmospheric Administration, September 2012 was the 16th month since 2000 that the Earth has tied or broken a monthly warm temperature record. The last time a cold temperature record was eclipsed was 96 years ago. The World Meteorological Organization reported that despite an early cooling La Niña for half the year, 2012 will likely be in the top ten of the hottest years in more than 160 years.

<u>Canada Left Out of Winter's Cold</u>

In 2012, Canadians witnessed an almost total absence of winter – rain more than snow, green not white and mild not cold. It neither felt nor looked like winter. Temperatures between December 2011 and February 2012 were 3.6°C above normal, making it the third warmest winter on record since nationwide record-keeping began in 1948. Nationally, it was the second driest with only the winter of 1956-1957 being drier. The Prairie provinces experienced temperatures more than 6°C above normal for the third warmest on record and the driest ever. For millions of Canadians in the East it was the second warmest winter on record.

In Toronto, it became the winter that wasn't. The city had five times more rain than snow from November to March, inclusive. Snow was virtually a no-show with a record low of 41.8 cm. There were no days with measurable snow after March 1 and there were only nine days with more than 1 cm of snow from November to April. The average winter temperature in the city was the warmest since 1840 (when record-keeping began). In Montreal overnight lows never dipped below -20°C (the mark of a cold Canadian day), which was a first for the record books. Another sign of an unusually mild winter was the closure of Ottawa's famed Rideau Canal Skateway after only 28 days, marking the second-shortest season in its 42-year history. The average afternoon temperature for Saskatoon in December and January hit -3.2°C, which is about seven degrees warmer than the normal temperature and the warmest it's ever been with records going back to the 1880s. For Calgarians, if the previous winter was remembered as the one that wouldn't end, this year's was the winter that wouldn't start. Yellowknife did not record a single day throughout the entire winter when air temperatures fell below -40°C. Typically the capital city would see 10 such frigid days.

In Winnipeg, organizers of the city's popular winter Festival du Voyageur had to haul snow in from skating rinks and city snow dumps. The unprecedented mildness led to the cancellation of winter carnivals, dogsled races, ice fishing derbies, pond hockey tournaments, and left snow too soggy for sculpting. Across Alberta and Saskatchewan, grass fires not snowbanks occurred with fire crews hosing down wildfires. On the other hand, the unseasonably mild weather was welcomed for its huge energy savings. And for outdoor workers and contractors it was an elongated open season free of costly impediments. The public mindset was that winter was cancelled. For beleaguered retailers, cold weather apparel and goods filled store shelves. Provincial highway departments and municipalities saved megabucks not having to clear as much snow. And, there were fewer traffic accidents and collapsed roofs. Health officials credited the soft winter for a nationwide decline of influenza. For example, Ontario reported only 678 cases of flu – well below the 5,026 cases reported a year earlier.

One Long Hot Summer

Few Canadians dared complain about the summer of summers in 2012. Nationally, June to August was the warmest on record – almost 1.9°C above normal. July to September was even warmer – the warmest of any three months in history. The whole country experienced above-normal warmth, especially Atlantic Canada, the northern Prairies and parts of Nunavut, which claimed their warmest summer ever. Only British Columbia had temperatures that were close to normal. It was so pleasantly warm for so long that many residents either felt guilty or were concerned that they were soon going to pay for such delightful weather. July was especially warm – the hottest month ever on record in Canada. A hot July also contributed to the warmest 12-month period ever from August (2011) to July (2012) for the Great Lakes, St. Lawrence and the entire Prairies. Summer warmth came later in Calgary, but between July and September it experienced its warmest three-month average since record-keeping began in 1881. From the early days of July, when Calgarians melted on Stampede grounds, the heat endured week after week and month after month. In Ontario, hot days above 30°C occurred from the get-go during summer's first long weekend in May right through to Labour Day. In Hamilton, for example, days above 30°C numbered 38 compared to a normal of 10. In Toronto, there were 25 hot days compared to an average of 14. And in Montreal, the city's 20 hot days were twice the norm with half of those days in July, something not seen since 1970. Paramedics were inundated with 10 per cent more calls from people complaining of shortness of breath, dizziness and heat exhaustion. Sports authorities wisely postponed games scheduled in the extreme heat. Many cities also experienced very warm night-time temperatures – part of a long-term trend seen across North America over the past several decades. For instance, Toronto had 16 nights with temperatures that stayed above 20°C compared to an average of 4. At times the air in southern Ontario was not only hot and oppressively humid, it was also dirty. Prevailing southerly winds brought in pollutants, triggering both extreme heat and smog alerts for the region. Some Ontario cities had 15 to 20 days with smog advisories compared to one or two days in 2011.

The warmth was not confined to the air. The temperature of Lake Superior – the coldest, deepest and largest of the Great Lakes – was a stunning 8°C above normal in mid-August, the warmest it's been in a century. Lake Ontario's surface temperatures peaked at 24°C, while Lake Erie's reached 27°C – almost bath water. As a result of the heated lake water, toxic algal blooms thrived, especially in Lake Erie.

2. Super Storm *Sandy* and Another Active Hurricane Season

Forecasters were right on the money when they accurately predicted another active Atlantic hurricane season in 2012. At season's end, there were 19 named storms from *Alberto* to *Tony*, 10 of which became full-blown hurricanes, but only *Michael* logged in as major storm with winds above 178 km/h. The busy storm season reflected a continuation of above-normal activity that began in 1995. Since then, all but two years have been at or above normal. The season began quickly with two tropical storms hitting a week before the official June 1 launch. In August, eight tropical cyclones reached storm intensity breaking the previous record of seven in August 1933 and 1995.

Chris was the Atlantic's first hurricane of the season. In Canadian waters, the storm brought high waves and swells to Newfoundland's Grand Banks on June 22 but negligible rains and winds to the Avalon Peninsula. On September 4, a well-defined low pressure system (including the remnants of Hurricane *Isaac*) made a slow passage across the lower Great Lakes and St. Lawrence River. A general rainfall of about 40 mm fell adjacent to the north shore of Lake Ontario and 50 to 70 mm in southern-most Quebec. Locally, higher amounts in Ontario occurred in Markham (87 mm), Richmond Hill (104 mm) and Point Petre (98 mm), and in Quebec at Frelighsburg (100 mm). Heavy rain in these locations set all-time September records and led to localized flooding.

Hurricane *Leslie* was a large storm more than 800 km in diameter packing loads of rain and powerful winds that hit Newfoundland and Labrador on September 11. Adding to the mess was a trough of low pressure that tapped Leslie's moisture and created problems across the Maritimes. The system stalled over western Prince Edward Island, dumping copious amounts of rain in advance of Leslie's arrival. At Charlottetown, a two-day total of 128 mm of rain was more than the total rainfall in the city in July and August combined. And in Nova Scotia, heavy rains of 100 to 150 mm soaked parts of the province leading to extensive tide-enhancing flooding and forcing evacuations of 50 families along the Salmon and North rivers near Truro when two dykes were breached. The only ones welcoming the rain were apple growers in moisture-starved Annapolis Valley. The remains of Hurricane *Leslie* made landfall in Fortune, Newfoundland and Labrador at approximately 8:30 a.m. on September 11, barrelling along at speeds up to 65 km/h before exiting out to sea north of Gander. Had the storm arrived a few hours earlier at high tide, conditions would have been worse. Before departing, the storm pummelled the Island with several hours of stiff winds and heavy rains. Bad weather and eight-metre waves forced Marine Atlantic to cancel crossings between Nova Scotia and Newfoundland. Higher waves at 15 m occurred along the southern Avalon. Winds east of the storm's centre were fierce, gusting up to 131 km/h, tearing apart roofs, stripping off siding and cladding, toppling trees and fences, overturning trucks and snapping power lines. Parks in St. John's were a mess of fallen branches and uprooted trees. At the height of the storm, approximately 100,000 customers on the Avalon Peninsula lost power. Meanwhile, in western Newfoundland, the challenge was excessive pounding rain with Cow Head recording 108 mm of rainfall. The next month, on October 18, post-tropical storm *Rafael* blew more than 500 km offshore Newfoundland and Labrador but was close enough to whip up wild seas that crashed through a breakwater in Trepassey on the southeastern coast.

A few days later, on October 20, Hurricane *Sandy* was born in the southwest Caribbean Sea from a cluster of powerful thunderstorms. As it churned north and northeastward, ominous warnings started that *Sandy* would do an abrupt and improbable left turn aimed directly at the Jersey Shore and New York City. A massive cold front that was stalled over the lower Great Lakes eagerly drew in *Sandy's* moisture and momentum completing her transformation into a mid-latitude storm. Late on October 29, Storm *Sandy* morphed into an intense post-tropical system no less potent than it had been hours before. The once super-sized hurricane with tropical-force winds that at one point extended across 1,000 km over the open ocean now became even bigger and broader as a hybrid storm with warnings extending over half a continent from Chicago to Halifax and Georgia to Timmins.

In Canada, *Sandy* could be better characterized as a nasty fall storm. Sustained winds of 70 to 80 km/h were reported throughout southern Ontario and Quebec. At its worst, *Sandy's* wind gusts topped 106 km/h on Western Island in Georgian Bay, 100 km/h in Sarnia, 95 km/h near Burlington and 91 km/h at Toronto Island. In Quebec, gusts reached 87 km/h in Laval and 91 km/h at Île d'Orléans. Strong winds also whipped up the Great Lakes, generating waves of up to seven metres at the south end of Lake Huron. Storm surge warnings were issued in the Gaspé and along the north shore of the St. Lawrence River. The storm generated six-metre waves near the West Scotian Slope and Grand Manan Island, and gale-force winds of 70 km/h in the Bay of Fundy. Rainfall totals ranged between 20 and 40 mm across southern Ontario, and in Charlevoix, Quebec totalled 185 mm over 73 hours. Two rivers spilled their banks causing local damage to some municipal infrastructures. Over parts of northeastern Ontario and western Quebec, rain turned to snow, mixed with ice pellets and patchy freezing rain driven by gusts of up to 60 km/h. Out of nowhere, *Sandy* even spawned a weak tornado in Mont Laurier, Quebec on October 31. Twisting winds destroyed an old barn and knocked over road signs. In Ontario, the storm was implicated in two deaths and forced the cancellation of train and air travel. And when all was said and done, upwards of 150,000 customers in Ontario, 50,000 in Quebec and 14,000 in Nova Scotia were left without power. According to Property Claim Services Canada insurance losses from *Sandy* in Canada exceeded $100 million.

3. BC Flooding … Larger, Longer and Lethal

The month of April started with a warning of potential serious flooding across the province by river forecasters in British Columbia. In many areas, spring surveys showed snowcover to be extremely deep – between 120 and 135 per cent of normal across numerous watersheds, including the entire length of the Fraser River. Snowpack was among the deepest measured in years with the fifth highest on record in the Fraser River basin and the second highest ever on the Skeena-Nass. At Roger's Pass, snowfall in March totaled 324cm - 172% above average and the greatest in 47years of records. Adding concern was the loss over years of huge tracts of lodgepole pine decimated by the pine beetle, reducing a watershed's ability to store and slow the release of meltwater. A brief hot spell, augmented by rainfall, led to flooding in late April in the Okanagan and Similkameen regions. With cooler spring weather through April and May, the spring freshet stalled across the province and became unusually long and late. A month later, mountain snowpacks hadn't diminished much but were ripening quickly. And there was more bad news. Widespread June rains and violent thunderstorms enhanced the snowmelt, escalating the flood risk in the Kootenays, Okanagan, along the Fraser River and elsewhere. Floods were being fought on several fronts across the province. Emergency Management BC and municipalities opened 19 local emergency centres and the River Forecast Centre issued high water advisories for at least a dozen rivers from one end of the province to the other. Late in June, a moist weather system anchored off Oregon's coast began soaking much of the province with 25 to 50 mm of rain triggering a new round of flooding. Some communities got as much rain in one day as they would normally see in the entire month, with several reporting double to triple normal amounts and new monthly and yearly records.

Along the mighty Fraser River the threat of breached dikes, endangered livestock, and damage to homes and property loomed large over the entire 600-kilometre stretch between Prince George and the Fraser Canyon. Thousands of worried residents were put on flood alert. In some places, rivers and lakes reached levels not seen in decades, forcing hundreds of residents from their homes, shuttering businesses, and collapsing and closing roadways. Sections of asphalt gave way leaving gaping holes that swallowed dozens of vehicles. Just south of Salmon Arm flash floods on a number of creeks near Sicamous knocked houses off their foundations and crumbled roadbeds, forcing the closure of the Trans-Canada Highway and Highway 97A along Mara Lake. Among those adversely affected, marinas suffered the worst during their high season. Near Nelson, one man drowned when a bridge washed away.

Other weather-related fatalities followed on the morning of July 12 when residents of Johnson's Landing on the scenic shores of Kootenay Lake heard a loud rumbling and felt the ground shake. Forty-five seconds later a massive landslide engulfed the community destroying six homes and killing four people who were buried under tonnes of debris. The 4-m deep field of mud, rock and broken trees extended the length of several football fields cutting a massive swath through the tiny community. The tragedy was triggered by torrential June rains and a late-melting snowpack that also swelled Kootenay Lake to its highest level in 40 years. June rains were monsoonal, with a record 228 mm falling at Nelson and Castlegar just southwest of Johnson's Landing. Prior to the landslide, it had rained on 12 of 13 days and for 7 straight days following. What caused the landslide was both geo-technical and hydrometeorological in nature: a debris flow and flooding across an unstable slope initiated by persistent rains on a deep snowpack that was delayed in melting by weeks of cool weather and a sudden rush of melt waters from higher elevations. Two days after the landslide, emergency officials rushed to Fairmont Hot Springs, 45 km away, after a mudslide forced the evacuation of hundreds of vacationers. At that site, a nearby creek overflowed, sending tonnes of mud, boulders and rocks downhill.

4. March's Meteorological Mildness

A leading American climatologist called the March 2012 heat wave the most extraordinary temperature anomaly in North American history. It was off the scale in every way: intense, huge and long-lasting. The heat eclipsed every previous temperature record and upstaged the winter that wasn't. Around mid-March, temperatures soared throughout central and eastern Canada, with many cities registering the kind of weather reserved for early summer. Record and near-record breaking temperatures (dating back to the start of record-keeping in 1948) dominated two-thirds of North America and contributed to the warmest March on record across the Prairies and in the Great Lakes and St. Lawrence basin.

The warmth resulted from a large low-pressure centre to the northwest of the Great Lakes and a strong stationary high-pressure system in the East. Rotating in opposite directions, the systems acted like two gigantic connecting gears, generating a large surface pressure gradient that maintained moderate winds from the southwest for more than two weeks. Warm air funnelled north between them all the way from the Gulf of Mexico well into Canada, leaving temperatures as warm in Kapuskasing as they were in Corpus Christi. Added to the mix was a historic negligible snowcover; instead of losing energy to melt snow and ice and thaw the ground as it travelled north, the air was able to keep its heat. Also of note, a persistent west-to-east jet stream further north than usual kept cold Arctic winds confined to the upper regions of Canada, enabling warm air to surge northward unhindered.

The following is a sample of the unbelievable Canadian temperature records set during March's heat wave:

• Fort Frances, Ontario, normally frozen solid in mid-March, reached 26°C. On March 19, the town recorded a minimum temperature of 15.1°C; the previous record high for the day was 10°C.

• Winnipeg soared to 20.9°C on March 19 – the earliest-ever temperature above 20°C in a calendar year. Just as crazy, an intense thunderstorm with heavy rain occurred at 7 pm. The next day the temperature topped 23.7°C.

• Windsor had 10 straight days above 20°C – a record for longest duration.

• At Halifax, the mercury reached 27.2°C on March 22, breaking the previous record of 11.8°C set in 1983.

• In Petawawa, the afternoon temperature on March 21 reached 28.8°C, which was almost 17 degrees warmer than the previous record of 12.2°C and the highest temperature ever recorded in Ontario in March.

• When temperatures in Abitibi-Témiscaming exceeded 27°C, it was an incredible 25 degrees warmer than normal.

• Lake Major, Nova Scotia was the nation's hot spot at a remarkable 30°C on March 22.

• Halifax, Charlottetown, Fredericton, Hamilton, Winnipeg, Toronto, Ottawa, Montreal and Quebec City were just a few of the hundreds of stations that broke their all-time March records. For more than half the country, the number of temperature records broken was in the thousands – a record for the number of records broken.

Even with a soft winter, millions of Canadians seemed grateful for an early spring with unusual warmth and abundant sunshine. Runners and cyclists jammed sidewalks and road shoulders; there were huge energy savings for greenhouse growers, homeowners and commercial customers; cities saved millions on snow removal; and several golf courses opened their earliest ever. Even farmers got in on the action, pushing their planting weeks ahead of schedule.

But not everyone was basking in the sunshine. A record-warm March cut the maple sugar season short in Ontario and western Quebec with fewer-than-average yields. The run started early with less than ideal flow weather and ended abruptly when trees started budding, making sap unusable. In Ontario, skating rinks and toboggan and ski runs closed before the profitable March break. In most regions of Canada, pollinating trees and grasses started producing in unison, contributing to an early explosion of pollen. Even people without allergies were experiencing throat tickles and inflammation. In Quebec, flooding was an issue in several areas as the heat melted any snow very quickly. The largest flood evacuation in the province happened between March 22 and 24 when over 700 residents left their homes in St-Raymond de Portneuf. And in Perth-Andover, New Brunswick the abnormal March heat triggered one of the largest ice jams and floods in history. In the Atlantic Ocean, an early loss of ice cover hampered the seal hunt and presented a significant barrier to seal mothers that rely on ice to give birth and nurse their pups.

Fruit trees in the East were particularly impacted by the early warm weather – blooming nearly five weeks ahead of schedule – so when a killing frost hit Ontario, Quebec and New Brunswick orchards in late April the damage was extensive. Apple growers took the biggest hit when temperatures plunged below -5°C for a dozen hours or more in late April. The combination of cold air, light winds and clear skies – deadly ingredients for hoar frost – produced a white sheath on rooftops, windshields and fragile blooms. The catastrophic flash freeze wiped out about 80 per cent of Ontario's apple blossoms and resulted in less than half the yields for tender fruits, with total losses estimated at more than $100 million. Strawberry growers also faced multiple frosts with yields generally 50 per cent less than normal.

5. Summer on the Prairies … Warm, Wet and Wild

Summer on the Prairies started out with short-lived cool temperatures and ended as one of the top ten warmest on record. It followed a spring that was the third wettest and fifth warmest in 65 years of record-keeping. Also of note were frequent summer soakers that eased fears of the drought that was gripping the American Midwest – the worst in 50 years. In southern Manitoba, the skies opened up starting in March, and opened even wider in April and May. Winnipeg's March-to-May precipitation amounted to 181 mm; normal is 112 mm. Saskatchewan was even wetter with twice the normal rainfall in May and June. June is often Calgary's rainiest month and this year was no exception with 133 mm falling – well above the monthly average of 80 mm. At times, flood warnings were issued for several Alberta river basins. It was Edmonton's turn in July when incessant thunderstorms dumped record rains across the Alberta capital. Nearly half the days had thunderstorms for a total of 26 hours. Bouts of heat and humidity that smothered the city fuelled many overnight thunder sessions and one-hour power showers flooded streets and yards. Veteran meteorologists in Alberta couldn't remember the last time parts of the province came under a humidex advisory for two or more days. At construction sites, workers spent hours manning pumps and drying the ground and equipment. Some motorists had to abandon their vehicles and wade into chest-high water. Other Edmontonians were forced from their homes as basements filled with water. Stoney Plain recorded the most rain and had its wettest July ever with 247.3 mm. Among a litany of summer storms, the biggest rain-maker and most damaging storm in years occurred on July 12. Property Claim Services Canada reported that excessive rain, hail and winds caused insured losses of more than $100 million.

Weather forecasters were kept busy on the Prairies with the second most active summer ever for severe convective weather since statistics were first kept in 1991. Summer storms were more frequent and seemed to move slower than usual, taking longer to spread their misery. There were numerous reports of large hail, heavy rain, high winds, frequent lightning and countless localized events including funnel clouds and tornadoes, microbursts, plough winds and gully washers. Of the 63 days between June 13 and August 14 only 11 days were free of severe weather. Among the highlights of summer 2012 were:

• 371 severe events across the Prairies, with Alberta recording its greatest number at 169 and Saskatchewan its second highest total ever with 135.

• Fewer tornado events than normal in both Alberta and Manitoba with only seven reported in Alberta and just three weak ones in Manitoba. The lack of moisture over southern Manitoba limited the number of severe events. In sharp contrast, Saskatchewan reported its highest number of tornadoes ever with 33 touchdowns; normal is 13.

• A very active year for hailstorms – the second highest on record and almost double the average number. In Alberta, it was a record for crop losses. The Crown Corporation insuring farmers since 1938 reported double the payments in excess of $450 million as part of its 11,100 hail claims. Figures do not count losses from hail incurred by private crop insurers, which approached $100 million in Alberta, or non-crop property losses. Such losses in Saskatchewan were even greater.

• A near-record year for wind with 81 events registering gusts above 90 km/h (just one shy of the record in 2007). In Alberta alone there were a record-breaking 41 wind events – beating the previous high of 37 back in 2007.

Despite the frequency and variety of severe weather, farmers growing field crops, except for canola, benefited from some of the best weather in years. According to Statistics Canada, wheat farmers in Manitoba and Saskatchewan harvested more of the grain this year (up 7 per cent from 2011), due to favourable weather. Barley production in all three Prairie provinces was up, with more than double the yields in Manitoba.

6. The Big Melt

The year 2012 will go down as one of extraordinary change across the Arctic, backed up by an ocean of evidence – the Arctic Ocean to be more precise, with sea ice that is becoming dramatically thinner, weaker and younger, and melting more easily. According to the United States National Snow and Ice Data Center, sea ice covering the Arctic Ocean dropped to 3.41 million square km on September 16, the lowest pan-Arctic sea ice extent reached since satellite measurements began in 1979 and down by 18 per cent from the previous low recorded during the historic 2007 melt season. The loss of ice in six months was stunning. The ice extent is now less than one-quarter of the Arctic Ocean and 49 per cent below the 1979-2000 average.

In Canadian waters, scientists with the Canadian Ice Service found that less than 8.5 per cent of the area was ice-covered on September 10, compared with a normal 20 to 25 per cent. In the southern route of the venerable Northwest Passage, there was no sea ice coverage at all. In the northern route, west of Resolute, 14 per cent of the Passage contained bands of hazardous multi-year ice. Everywhere, the ice has become thinner and less resistant to summer melt with the oldest, thickest and toughest ice quickly disappearing. The southern limit of multi-year ice is now only 10 degrees of latitude away from the North Pole. The Arctic's once dominant perennial ice is being replaced by young, thin ice. Bucking the trend this year was Frobisher Bay, where there were significant delays in ice melting. With predominantly southeasterly winds over southern Nunavut, the ice persisted in the Bay until the end of August (setting a record for late ice melt) and along the western shore of Foxe Basin until late September.

Off the coasts of Newfoundland and Labrador it was the third winter in a row with low levels of sea ice. And there was hardly any ice in the Gulf of St. Lawrence. Owing to some unseasonable and lasting warmth, Great Lakes average ice cover in winter 2011-2012 was the lowest on record, dating back to the winter of 1972-1973. In usually ice-covered Lake Erie, only the Western Basin became thinly ice covered this year. Similar conditions on Lake Erie have been seen only in 1998 and 2002.

7. High and Dry in the East

Higher than normal temperatures and a lack of rainfall in Eastern Canada meant a great summer for most outdoor enthusiasts but trouble for some crops and water systems. A year after being doused, farmers were begging for rain in 2012. Although not record dry (of 65 years, 13 summers were drier across the Great Lakes and the St. Lawrence river basin and 8 were drier in Atlantic Canada), the lack of rain and excessive warmth was notable. For example, Atlantic Canada had its driest and fourth warmest spring on record. In southern Ontario and Quebec, winter-spring 2012 was the mildest and driest on record; May to July was near-record hot and there was a stretch of eight weeks between the first week of June and the end of July when some farmers barely saw a thimbleful of rain. When it did rain, it was either too much too fast or too short and too little.Conditions were largely due to a strong stable, high-pressure dome known as a Bermuda High that was positioned over the Atlantic Ocean but reached much further west and north than usual. Its dominance and persistence inland kept rain-bearing weather systems at bay.

In Eastern Ontario, it was both hot and dry. In Ottawa, where records go back to 1889, no July was even remotely as hot and dry. Total monthly rainfall was a paltry 19 per cent of normal and measured 19 mm less than the previous record in 1931. Further, between June 11 and July 31, temperatures reached or exceeded 30°C on 23 days. Known as hot days, Ottawa typically gets 13 of them all year. In Quebec, some regions set new summer temperature records (Gatineau, Sherbrooke, and Gaspé) and it was dry everywhere except in the Lac Saint-Jean and Gaspésie. Atlantic Canada experienced its warmest and driest growing season ever. And at Charlottetown less than 75 mm of rain fell in June and July – the third driest on record.

Heat and drought led to frequent beach closings, water rationing measures and boil water advisories. Water levels in rivers and lakes in the East were at their lowest in over a decade. All of the Great Lakes in October were below their 1918-2011 average levels and lower than they were a year ago. August and September were the driest months ever recorded in the Lake Superior and Michigan-Huron regions. Water in the St. Lawrence River at Montreal fell to record low levels in July and August and measured a metre lower than a year ago. Elsewhere in Quebec, several other large rivers also reached historic lows. For recreational boaters, depressed water levels were a safety hazard. Commercial navigation found low levels a challenge, necessitating loads reduced by 10 per cent to avoid running aground. Hydro-electric generation was reduced due to lower flows – 20 per cent less in July compared with the previous year. And fish biologists in Atlantic Canada were forced to close several world-class salmon rivers when surface water temperatures rose 7°C warmer than normal.

In cities and parkland, the extreme heat and long bout of dryness severely damaged young trees with immature root systems. Farmers in eastern Canada experienced several challenges during the growing season including early frosts, prolonged dryness at crucial growing times and extreme heat that increased insect pressure. Things started well, with farmers taking advantage of an early spring to get seed in the ground sooner than usual. But at the crucial pollination stage from June to early July, crops in Ontario were dangerously parched and stopped growing. Incredibly, even weeds and clover were dying under the soaring heat and dryness. Dried pastures and reduced forage forced livestock farmers in Ontario and in the Pontiac region of Quebec to cull their herds. Even Christmas tree growers were hit, losing thousands of small trees to the ongoing drought. In the end, yields and quality were variable from crop to crop and area to area, but the season ended with a better harvest than initially anticipated. Indeed, Statistics Canada reported that despite extreme weather, Ontario farmers produced the largest soybean and grain corn crops in the province's history. Quebec farmers also boasted record corn production. The lack of rain and high temperatures proved to be a challenge for farmers in Atlantic Canada. In eastern PEI, farmers had to stop irrigating because of water shortages. In the Annapolis Valley, corn growers lamented small cobs with missing kernels. Further, army worms ate their way across the fields. And strawberry growers and orchardists faced a set-back when early warm temperatures were followed by multiple frosts. Yields were generally 40 to 60 per cent of normal, with apple producers faring the worst with between 0 and 20 per cent of their normal crop. Other tree fruit including cherries, peaches, pears and plums also experienced loss due to the freezing temperatures and ended up with yields between 5 and 50 per cent of normal. On the plus side, vintners everywhere were ecstatic. Bringing grapes to maturity is often a challenge but not in 2012. Warm and dry conditions accelerated ripening by three to four weeks, the acidity of grapes was near perfect and the dry weather kept mildew and rot from the vines.

8. The Year of the Urban Flood

While flooding typically hits rural areas hardest, 2012 brought equal opportunity flooding to many urban Canadians. Late on May 26, a low-pressure system that moved from North Dakota sat south of Thunder Bay, Ontario. Over the next two days, waves of thunderstorms – seven hours in total – pounded the city with between 35 and 120 mm of rain (including 71 mm in less than six hours). The ensuing flash flood caused washouts on numerous roads and trails, cut power to homes and businesses, and filled thousands of basements with up to two metres of dirty sewage water. Angry torrents also tore up chunks of asphalt and stalled vehicles on roadways, in parking lots and on bridges. A potential crisis developed when pumps at the city's water treatment plant failed leaving the facility with a massive back-up of brown water. Authorities in Thunder Bay and surrounding areas immediately declared states of emergency and the province later termed it a disaster. Damage to both public infrastructure and private homes and businesses was extensive with initial costs exceeding $100 million. Rainfall in May totalled 206 mm (310 per cent of normal), smashing the previous monthly record set 41 years ago. Half of that amount fell during the May 26 storm on a super-saturated ground that couldn't take any more.

Just three days later, on May 29, a double-header rainstorm pounded the Montreal area. Torrents of water overwhelmed the city's beleaguered sewer system and caused widespread flooding on streets and in public buildings. The storms were part of a sharp cold front that triggered thunderstorms and high winds, and prompted tornado warnings in southwestern Quebec. The rush-hour hits started around 5 a.m. with up to 40 mm of rain during a lengthy and noisy thunderstorm. Twelve hours later a brief but more powerful storm dumped a further 50 to 80 mm of rain on the city. Together, the two events dropped up to 120 mm of rain in the downtown core at a rate approaching a 100-year recurrence. The intense rains turned sloped city streets into waterfalls. Mud and water flowed through windows filling basements to the rafters. Major thoroughfares became canals and intersections formed lakes with water lapping up the door handles of cars. The water rose nearly a metre deep on some streets, blowing manhole covers in geysers two metres high. Afternoon commuters sloshed through massive puddles and waded ankle-deep in smelly sewage at subway entrances only to be faced with a quasi-shutdown of the city's transit system and commuter train service. Water flowed into thousands of buildings across the city – including several schools and colleges, the National Library and the Archives of Quebec – with heavy rains damaging hundreds of works of rare art at one Montreal museum. The storms also caused power failures affecting 28,000 people.

Toronto joined the urban flood club on July 15 when short-lived afternoon thunderstorms left some with nothing more than a wetting while others bailed out basements filled with sewage water to the ceiling. Scarborough received the brunt of the storm with about 88 mm of rain falling over a couple of hours. And on July 22, an intense downpour in Hamilton dumped 140 mm on the city in less than four hours leaving puddles deep enough to row a boat on. Yet amidst reports of hundreds of flooded basements and thousands of fallen trees, some neighbourhoods recorded barely a sprinkle of rain. Later in July, as residents of Steinbach, Manitoba slept, a powerful stationary summer storm set up over the city. Streets, parking lots and yards were turned into rivers and small lakes when the July 25 storm dumped between 80 and 110 mm of rain, most of it in less than hour. Understandably, the city's storm sewer system was overwhelmed by the gully washer, resulting in major flooding at the city's pumping station, along major roads and in numerous basements.

9. Hail to Calgary ... Again

When a monstrous storm pelted parts of Calgary with hailstones larger than golf balls late on August 12 it was shades of 2010 all over again. The storm was briefer and stones smaller than the $400 million dollar disaster that hammered the city's downtown two years ago – the biggest and most damaging urban hailer in Canadian history – but it still left its mark. In a matter of 10 minutes, pounding hail dimpled vehicles and riddled house siding with millions of dents. The only saving grace was that the storm's late evening arrival meant fewer vehicles were exposed to the falling hail. At first light, broken glass from shattered windows and sun roofs littered new car lots across the city. In northeast neighbourhoods, hailstones smashed windows and skylights, flattened flowers and turned backyard vegetable gardens into coleslaw. A parks official said the storm left the worst tree damage he'd ever seen. Hail also penetrated the thick shell of the Calgary Saddledome forcing the building to close to investigate possible leakage.

Two days after the bombardment, temperatures at the airport dropped from 23°C to 11°C in one hour, signalling the arrival of another wicked, fast-moving storm. This time strong winds with gusts of up to 100 km/h, copious amounts of rain and quarter-sized hail piled damage onto damage in Calgary and nearby Airdrie. Largely a wind and rain event, the storm brought down power lines, uprooted trees, pushed over trucks, set off alarms and blew out windows in downtown Calgary buildings. Insurers pegged total damage claims and business losses from the double hit at over $500 million, accounting for half the dollar claims across Canada in 2012.

10. Historic Ice-jam Flooding on the Saint John River

The first days of spring were marked by a mandatory evacuation for 500 residents of Perth-Andover and Tobique First Nation when the Saint John River and several of its tributaries spilled onto nearby fields and roads. With damage to government buildings, the area hospital, two schools, a town hall and the fire station exceeding $25 million, officials declared a local state of emergency. Two days later, flood waters receded on the village's main street leaving truck-sized chunks of ice. Some lodged in trees as a reminder of how high the water levels had climbed. Beleaguered homeowners and small businesses faced a messy and muddy cleanup made worse by unseasonably cold temperatures that created another disaster – unheated buildings with frozen water pipes.

Perth-Andover has endured five major floods in 25 years. This time, water levels reached at least a metre higher than in any previous flood due to unprecedented March warmth. The higher temperatures fast-tracked an unusually early spring thaw and rapid snowmelt in the upper reaches of the Saint John River in New Brunswick, Quebec and Maine. Just days before the flood, St. Leonard, New Brunswick, experienced record warmth above 20°C over three days that assaulted the winter's snowpack from a depth of 60 cm to 7 cm in less than a week. When temperatures zoomed 15 degrees above normal with melting around the clock, nervous residents watched the spring freshet come fast and furious. This included the first ice jam that started up about a kilometre northwest of Perth-Andover at the confluence of the Saint John, Aroostook and Tobique rivers on March 20 and 21. Still, the flood could have been worse if the seasonal snowpack upstream had been more plentiful; the ground frost deeper, which would have allowed less water to percolate instead of running overland; or if there had been a significant spring soaker.

Source: "Top 10 Canadian Weather Stories for 2012", Meteorological Service of Canada - Environment Canada - Government of Canada. http://www.ec.gc.ca/meteo-weather visited on winter solstice day.

Les dix événements météorologiques canadiens les plus marquants en 2012

by David Phillips[2]

Bilan de l'année

En 2012, il a semblé que Dame nature ait opté pour y mettre le paquet dans toute l'Amérique du Nord. De toute l'histoire de l'Atlantique, le « super » ouragan Sandy est considéré comme l'un des plus puissants et des plus importants de sa catégorie. Mais, pendant qu'il était catastrophique aux États-Unis, il n'a été qu'une énorme tempête d'automne au Canada, dont les dégâts, toutefois,

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se chiffraient à 100 millions de dollars. L'ouragan a eu l'effet d'une bombe au cours de ce qui a été une autre saison active. Curieusement, pour la troisième année consécutive, 19 tempêtes tropicales ont sévi dans le bassin de l'Atlantique, ce qui représente près du double de la normale. Partout au Canada, d'importantes tempêtes et inondations ont dominé le paysage de janvier à décembre, ce qui a entraîné des pertes faramineuses pour les entreprises, les gouvernements et des milliers de Canadiens. En 2012, les assureurs, durement touchés par la météo violente, ont dû débourser plus d'un milliard de dollars en réclamations au cours de trois des quatre dernières années; une tendance sans précédent et plutôt inquiétante pour l'industrie.

En outre, des températures très chaudes ont figuré au sommet de la liste des principaux événements météorologiques de 2012. À l'échelle planétaire, l'année se retrouve parmi les dix années les plus chaudes enregistrées depuis 160 ans. Au Canada, les températures ont été particulièrement chaudes pour une 16e année consécutive. À l'échelle nationale, 2012 est arrivé au quatrième rang des années les plus chaudes jamais enregistrées. Pour des millions de personnes en Ontario et au Québec, l'année a été la plus chaude de l'histoire. En plus de la hausse des températures moyennes, l'hiver s'est à peine montré,, le mois de mars ayant battu tous les records, et l'été a été le plus chaud des saisons chaudes. La douceur extrême de longue durée en mars a enthousiasmé les météorologues, mais pas les agriculteurs, car ils craignaient que les floraisons précoces succombent aux gelées meurtrières. Dans la partie supérieure du Canada, les grandes chaleurs ont entraîné une importante fonte de la couverture de glace de l'Arctique, laquelle a été réduite à son plus bas niveau depuis que l'enregistrement des données satellites a commencé il y a 34 ans. De plus, ce phénomène ne se limitait pas qu'au Nord; le Canada atlantique, le golfe du Saint- Laurent et les Grands Lacs étaient pratiquement sans glace pendant tout l'hiver.

La fonte des glaces entraîne généralement des inondations, et 2012 n'a pas fait exception. En Colombie-Britannique, les accumulations de neige figuraient parmi les plus élevées enregistrées depuis des années. Des pluies diluviennes et des orages violents ont contribué à faire augmenter les risques d'inondation. Ils constituaient une menace lente et continue qui s'est échelonnée sur deux saisons, et elle a été combattue sur plusieurs fronts situés le long d'au moins une douzaine de rivières d'un bout à l'autre de la province. À Johnson's Landing, la combinaison d'un excès d'eau et d'une pente instable a causé un glissement de terrain mortel. Thunder Bay, en Ontario, a fait honneur à son nom (baie du tonnerre) lorsque des orages ont entraîné un déluge de pluies torrentielles et d'épouvantables inondations. Quelques jours plus tard, des éléments du même système météorologique ont déclenché des crues soudaines à Montréal. En raison d'une grande quantité de pluies diluviennes à Toronto, Hamilton, Ottawa-Gatineau, Calgary et Edmonton, certains assureurs ont surnommé 2012 l'année des sous sols inondés. Pour les résidents de Perth-Andover, au Nouveau-Brunswick, ce furent des embâcles sur la rivière Saint-Jean qui ont provoqué des inondations; le débordement de la rivière fut le pire, par un mètre, de toute l'histoire. Enfin, les familles habitant l'ouest de Terre-Neuve-et-Labrador et dans les environs de Truro, en Nouvelle Écosse, ont été forcées de quitter leur foyer à cause d'un ouragan et d'inondations liées aux marées.

Sur le plan géographique, la nature a semblé en vouloir à Calgary. Pour la troisième année de suite, le temps violent a frappé la ville durement. L'année dernière, des vents puissants ont sévi. Cette année, on y a observé une répétition de l'année 2010, c'est-à-dire une tempête de grêle colossale qui a engendré des pertes de propriétés se chiffrant à plusieurs millions de dollars. La mauvaise chance s'est également abattue dans l'Est, où les agriculteurs ont fait face à des gelées meurtrières, à de longues périodes de sécheresse, à des chaleurs torrides et à des infestations d'insectes. Pour leur part, les agriculteurs de l'Ouest ont eu plus de chance et seront éternellement reconnaissants pour l'une des meilleures années de leur histoire, ainsi que pour avoir évité la sécheresse des États Unis qui ne s'est pas déplacée vers le nord. Les plus chanceux de tous furent les négociants en vins, qui ont levé leurs verres à une abondante récolte survenue à la suite d'une vague de temps exceptionnellement chaud, sec et ensoleillé. Cependant, aucun toast n'a été porté aux conditions météorologiques dans les Prairies, car les habitants ont connu un été de quasi records en matière d'avertissements de temps violent, où tornades, pluies intenses, vents puissants et averses de grêles étaient les vedettes. Dans le cas de l'Alberta, l'été 2012 fut la saison la plus active de tempêtes estivales en plus de 20 ans, et les pertes de récoltes causées par la grêle atteignirent un record. Quant à la Saskatchewan, on y a recensé au moins 36 tornades, soit le nombre le plus élevé jamais enregistré. En comparaison, la météo du Manitoba fut relativement tranquille.

Les événements météorologiques les plus marquants de 2012 que nous énumérons ci-dessous sont classés de un à dix en fonction de certains facteurs comme le degré auquel le Canada et les Canadiens ont été touchés, l'étendue de la région touchée, les répercussions sur l'économie et la période pendant laquelle l'événement a fait la manchette.

Dix événements météorologiques canadiens les plus marquants en 2012

1	**2012 : Attention! Chaud devant!**
2	**Super *Sandy* et une autre saison active des ouragans**
3	**Les inondations en C-B : importantes, longues et … mortelles**
4	**L'été en mars**
5	**Les Prairies : un été chaud, humide et imprévisible**
6	**L'Arctique fond à vue d'oeil**
7	**L'Est au régime sec**
8	**Des inondations en ville**
9	**Grêle à Calgary …Récidive**
10	**Inondations historiques et embâcles sur la rivière Saint-Jean**

1. 2012 : Attention! Chaud devant!

Les Canadiens ont connu des températures supérieures à la normale ainsi que plusieurs jours où des records ont été battus pendant l'hiver, le printemps et l'été, et ce, d'un océan à l'autre. L'année a été chaude … et la décennie aussi!

2. Super *Sandy* et une autre saison active des ouragans

Les prévisionnistes avaient vu juste lorsqu'ils ont prédit avec précision une autre saison des ouragans active dans l'Atlantique en 2012. À la fin de la saison, on comptait 19 tempêtes, avec des noms qui allaient d'*Alberto* à *Tony*, dont 10 sont devenues de vrais ouragans.

3. Les inondations en C-B : importantes, longues et… mortelles

Des niveaux élevés d'inondations printanières précoces en Colombie-Britannique ont entraîné de l'érosion, des glissements de terrain, des évacuations et des décès.

4.L'été en mars

La vague de chaleur de mars 2012 a été extraordinaire sur tous les plans : intensité, importance et durée. La chaleur a éclipsé tous les records de température précédents et a volé la vedette à l'hiver qui n'en était pas réellement un.

5. Les Prairies : un été chaud, humide et imprévisible

L'été dans les Prairies a commencé par des températures froides de courte durée pour finir parmi les dix étés les plus chauds jamais enregistrés. Il succédait à un printemps qui s'est classé au troisième rang sur le plan de l'humidité et au cinquième sur celui de la chaleur en 65 ans de consignation des données.

6. L'Arctique fond à vue d'oeil

L'année 2012 est à marquer d'une pierre blanche, en raison des changements extraordinaires qui se sont opérés à travers l'Arctique, où la glace devient beaucoup plus fine, plus faible et plus jeune, ce qui fait qu'elle fond plus facilement.

7. L'Est au régime sec

Dans l'Est du Canada, les températures plus élevées que la normale et la faible pluviométrie ont créé des conditions estivales idéales pour la plupart des amateurs de plein air, mais elles ont aussi constitué un problème pour certaines cultures et les réseaux d'alimentation en eau.

8. Des inondations en ville

Alors qu'habituellement les inondations frappent davantage les régions rurales, les tempêtes de l'année 2012 ont comblé l'écart en touchant un grand nombre de villes canadiennes. En mai, Thunder Bay a fait face à une inondation record, alors que Montréal et Toronto ont elles aussi subi des inondations coûteuses quelques semaines plus tard.

9. Grêle à Calgary …Récidive

Une tempête colossale s'est abattue sur certaines parties de Calgary avec des grêlons dépassant la taille des balles de golf en fin de soirée du 12 août. En l'espace de 10 minutes, une pluie battante de grêle a criblé de milliers de bosses les véhicules et les parements de maison.

10. Inondations historiques et embâcles sur la rivière Saint-Jean

Durant les premiers jours du printemps, il a fallu procéder à l'évacuation obligatoire de 500 résidants de Perth-Andover et de la Première Nation de Tobique lorsque la rivière Saint-Jean et plusieurs de ses affluents ont inondé les routes et les champs environnants.

Source: "Les dix événements météorologiques canadiens les plus marquants de 2012", Service météorologique du Canada - Environnement Canada - Gouvernement du Canada. http://www.ec.gc.ca/meteo-weather visité le jour du solstice d'hiver.

Busy 2012 hurricane season continues decades-long high activity era in the Atlantic

Four U.S. land-falling storms include devastating *Sandy* and *Isaac*

November 30 marks the end of the 2012 Atlantic Hurricane season, one that produced 19 named storms, of which 10 became hurricanes and one became a major hurricane. The number of named storms is well above the average of 12. The number of hurricanes is also above the average of six, but the number of major hurricanes is below the average of three.

Based on the combined number, intensity, and duration of all tropical storms and hurricanes, NOAA classifies the season as above-normal. 2012 was an active year, but not exceptionally so as there were 10 busier years in the last three decades.

This season marks the second consecutive year that the mid-Atlantic and Northeast suffered devastating impacts from a named storm. *Sandy*, and Irene last year, caused fatalities, injuries, and tremendous destruction from coastal storm surge, heavy rainfall, inland flooding, and wind. Storms struck many parts of the country this year, including tropical storms *Beryl* and *Debby* in Florida, Hurricane *Isaac* in Louisiana, and Post-tropical Cyclone *Sandy* in New Jersey.

"*This year proved that it's wrong to think that only major hurricanes can ruin lives and impact local economies*," said Laura Furgione, acting director of NOAA's National Weather Service. "*We are hopeful that after the 2012 hurricane season, more families and businesses all along the Atlantic and Gulf Coasts become more "weather ready" by understanding the risks associated with living near the coastline. Each storm carries a unique set of threats that can be deadly and destructive. Mother Nature reminded us again this year of how important it is to be prepared and vigilant*."

An interesting aspect of the season was its early start, with two tropical storms, *Alberto* and *Beryl*, developing in May before the season officially began. Also, this is the seventh consecutive year that no major hurricanes (Category 3, 4 or 5) have hit the United States. The only major hurricane this season was Hurricane *Michael*, a Category 3 storm that stayed over the open Atlantic.

Several storms this year were short in duration, weak in intensity, and went largely unnoticed by the general public because they stayed out over the Atlantic. A persistent jet stream pattern over the eastern portion of the nation helped steer many of this season's storms away from the United States. The number of named storms and hurricanes was higher than predicted in NOAA's pre-season outlook, in large part because El Niño – which likely would have suppressed overall storm activity – never materialized as predicted by many climate models.

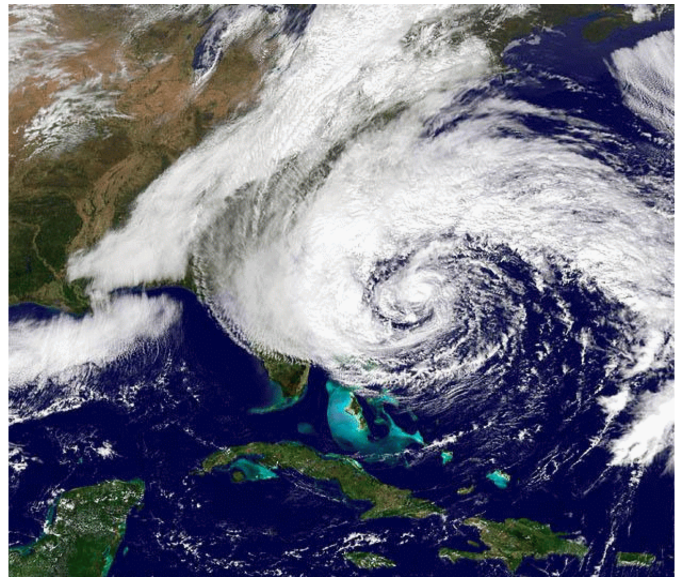

Figure caption: Hurricane *Sandy* made itself felt in the Caribbean as a Category 1 storm that moved through the region dumping rain, lashing out with high winds, and causing the deaths of more than 40 people. After leaving the Caribbean, however, a unique set of conditions and interactions with other weather systems and the jet stream allowed the storm to stay powerful and become a "post tropical cyclone" with New England in its crosshairs. The news media have dubbed *Sandy* the "**Frankenstorm**" both for its proximity to Halloween as well as for the unprecedented combination of factors that made the storm possible. Also shown in colour on cover page.

Hurricane forecasters remind us that a well-established climate pattern puts us in an ongoing era of high activity for Atlantic hurricanes that began in 1995. Since that time, more than 70 percent of seasons have been above normal, including 2012. Historically, Atlantic high-activity eras have lasted 25-40 years, with the previous one occurring from the mid-1930s until 1970. Several inter-related atmospheric and oceanic factors contribute to these high activity years, including warmer Atlantic Ocean temperatures, an enhanced West African monsoon, and reduced vertical wind shear.

Source:

http://www.noaanews.noaa.gov/stories2012/20121129_hurricaneseasonwrapup.html

Weatherwise Magazine Lists the Year’s Top Weather Events

With no big surprise, super storm *Sandy* tops the list of 2012’s Biggest Weather Events.

“Super Storm *Sandy*” had to compete with the most extensive drought in more than half a century and one of the worst heat waves since the 1930s dust bowl but, as the impacts from Sandy kept mounting in its aftermath, this remarkable storm climbed up to the number one spot in *Weatherwise* magazine’s annual tally of the top ten weather events of the year.

Officially known as “post-tropical cyclone *Sandy,*” *“this storm was amazing in so many ways that it had to rank as the number one event of the year*,” according to the compiler of the top ten lists, meteorologist and *Weatherwise* Contributing Editor, Doug Le Comte. There was the extraordinary upper-air weather pattern that caused the hurricane to morph into a nor’easter before landfall in New Jersey, the enormous size of the storm and resulting wind fetch that swamped the Jersey and New York coasts with the 8- to 14-foot wall of water, the timing and date (October 29) that resulted in the storm surge combining with an unusually high tide, the landfall near one of the most populous areas of the world, direct damage exceeding $40 billion that made Sandy one of the three most expensive storms to ever strike the United States, the 132 deaths blamed on the storm, the record snowfall in the Appalachians … this list goes on and on.

But let’s not slight the other big story of the year, the heat and drought that cut the U.S. corn crop by 28% and, according to *Weatherwise* estimates, caused at least $33 billion in agricultural losses. Indeed, severe drought continued to affect crops and pastures in the Great Plains and threaten barge traffic on the Mississippi River into the end of the year.

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Shown below is the table of the top ten US weather events according to *Weatherwise* magazine.

1	Super Storm *Sandy*. October 27-29. One of the three most expensive storms to ever strike the U.S. Far-ranging impacts, but most of the damage concentrated in New Jersey and New York.
2	Midwest Drought. June-December. Some $33 billion in damage to corn, soybeans, and hay.
3	Summer Heat Wave. Late June to early August. Triple-digit record heat Denver to Hartford and north to Bismarck. Made July the hottest U.S. month on record.
4	Southern Tornado Outbreak. March 2. Dozens of tornadoes across 12 states took 40 lives and cost over $4 billion in damage.
5	The Great Derecho of 2012. June 29. The band of rapidly-moving severe thunderstorms from the Midwest to the mid-Atlantic left over 4 million homes and businesses without power during a sweltering heat wave.
6	Hurricane Isaac. August 28-29. Category 1 hurricane brought heavy rain and flooding to Louisiana and Mississippi.
7	March Heat. Simply the warmest March on record across the lower 48 states.
8	Mild Winter. December 2011-February 2012. The fourth mildest such period since 1895. Near record low snowfall.
9	February Tornado Outbreak. February 28-29. One of the deadliest February outbreaks on record, Kansas to Indiana, took 15 lives.
10	Western Drought. Winter-summer. Lack of winter snow and abnormal spring warmth caused severe drought, contributing to record wildfires.

CLIMATE CHANGE / CHANGEMENT CLIMATIQUE

The UN/FCCC COP-18 in Doha ends with a whimper

by John Stone[1]

It all seems such a long time ago. In the mid-1980s a series of scientific meetings were held in the Austrian village of Villach. One of the conclusions was a recommendation that "it is time to start on the long, tedious and sensitive task of framing a convention on climate change". It would be a decade before this recommendation became a reality.

What eventually stimulated governments to act was the release in 1990 by the Intergovernmental Panel on Climate Change (IPCC) of its first comprehensive assessment report. Its findings were, compared to the unambiguity of the science today, somewhat hesitant. While it concluded that global mean temperatures had increased over the last century and that the size of this warming was broadly consistent with the predictions of climate models, it noted that the increase was of the same magnitude as natural climate variability. Nevertheless, when presented at the Second World Climate Conference in Geneva the evidence was sufficiently compelling that governments initiated a negotiation process that was to lead, after a remarkably short period of two years, to the UN Framework Convention on Climate Change (UN/FCCC). It was signed by 154 countries at the UN Conference on Environment and Development in Rio de Janeiro and entered into force in 1992.

Every year governments meet under the umbrella of the Conference of the Parties to the Convention (COP's). At the first in Berlin in 1995 it was decided to strengthen the Convention by negotiating a legally binding instrument; this was achieved after two years with the signing of the Kyoto Protocol. It took eight years, until 2005, before it came into force. The process was already beginning to slow down; much of the time being taken up by negotiating the rules under which the Protocol would function. The most recent Conference of the Parties, the 18th, held in Doha, Qatar (the country with the highest per-capita emissions), concluded just before Christmas. We have now been negotiating for 20 years! During this time atmospheric concentrations of greenhouse gases have continued to rise inexorably.

The gravity of the situation was made clear by several intergovernmental reports issued just before the Doha meetings. The World Bank made its first major foray into the climate change issue with a report written by the Potsdam Institute for Climate Impact Research and Climate Analysis (PIK). The President of the World Bank stated in his introduction that he hoped the report would "shock us into action". The report spells out what a 4 ^{o}C World might look like – a very distinct possibility if we continue on the present track of increasing emissions despite the commitments of some governments. According to the World Meteorological Organization's (WMO) Greenhouse Gas Bulletin, atmospheric concentrations of all gases reached new heights in 2011. Carbon dioxide concentrations are now 40% greater than pre-industrial levels.

The UN Environment Programme also issued its most recent Emissions Gap Report pointing out that we are even further away from achieving the emissions target that would avoid a 2 ^{o}C increase in global mean temperatures. The International Energy Agency (IEA), in its latest World Energy Outlook, put the challenge more simply: "no more than one third of proven reserves of fossil fuels can be consumed if we are to achieve the 2 ^{o}C target". The notion that we are going to have to leave some significant fraction of our fossil fuel reserves in the ground is one that the likes of Jim Hansen have been arguing for some time but it is one which countries that consider themselves energy super-powers clearly consider inconvenient. Nevertheless, this is the measure of ambition that faced governments going into the Doha meetings.

To appreciate the significance of the recent Doha meetings it is useful to recall the recent history of such COP's. The Kyoto Protocol's first commitment period was from 2008-2012. To ensure that there would be a smooth transition to the next commitment period, the COP-11 in Montreal in 2005 set in place a process that was to be completed by COP-15 in 2009. The expectations for the meeting in 2009 in Copenhagen were unrealistic. Not only were these expectations not met but the process collapsed with a serious lack of trust between delegations. A last-minute Copenhagen Accord negotiated outside of the formal process attempted to salvage something form the meeting.

Since the Copenhagen meeting over 85 countries have presented emission reduction pledges but many of these

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are unclear and conditional. On their own, these pledges are insufficient to meet the 2 °C target. To make matters worse, not only did the United States not ratify the Kyoto Protocol but several countries such as Canada, Japan, Russia and New Zealand have since indicated they would not take on further commitments. With developing countries, such as China and India (now amongst the major emitters) not having to take on binding commitments, by 2012 the Kyoto Protocol would only cover about 15% of global emissions.

"*Nous avons de moins en moins de temps*", dit la responsable de l'ONU pour le climat, Christiana Figueres.

The process was becoming increasingly complex with such interim agreements on a Bali Plan of Action, the Durban Platform and now the Doha Climate Gateway. Each of these, as well as several ad-hoc Working Groups, require their own negotiating stream. The timetable of negotiations at the COP's was becoming unmanageable. It was time to refocus and raise the level of ambition. At the previous COP in Durban it was agreed that negotiations would begin on a new global, legally binding regime under the UN/FCCC. The negotiations are to be completed by no later than 2015 and come into force in 2020. This despite evidence that climate change may be accelerating and we are running out of time. The Doha meeting was supposed to launch these negotiations – it was seen as a "transitional" COP.

So what was achieved in Doha? First, there was agreement that the second commitment period under the Kyoto Protocol can provisionally begin in January 2013 and last until 2020. This actually means little more than that the Protocol's accounting rules and flexibility mechanisms can continue. But only industrialized countries that take on commitments will be eligible to trade carbon credits. Restrictions were also placed on what is known as "hot air" where countries such as Russia have seen a dramatic decline in emissions as a result of their economic collapse rather than any climate change policy. The division between developed and developing countries still remains with the continued acknowledgement of "common but differentiated responsibilities"; but there is a tacit agreement that in the future all countries will undertake mitigation efforts. One significant advance was the acceptance that industrialized countries will compensate developing countries for the "loss and damage" caused by their past emissions. There was some disappointment that the promised financial assistance to developing countries was slow in being realized – the target being $100 Billion per year by 2020.

The hope of many at the Doha meetings can be summed up in the intervention of the Philippine delegate: "*Please, let 2012 be remembered as the year the World found the courage to find the will to take responsibility for the future we want. I ask of all of us here, if not us, then who? If not now, then when? If not here, then where?*"

Mitacs

Mitacs appuie l'innovation à l'échelle nationale en coordonnant des projets de recherche collaboratifs, qui mettent en rapport les secteurs industriel et universitaire, et qui visent à la base le développement du capital humain. Depuis 1999, Mitacs favorise la recherche et le développement (R.-D.) universitaires-industriels, en tablant sur le développement des futurs leaders en matière d'innovation. Mitacs a créé un mécanisme proactif qui a fait ses preuves pour le soutien direct et indirect de l'innovation : la R.-D. collaborative et le développement à long terme d'un capital humain compétent.

Notamment, Mitacs s'emploie à :

- Aider les entreprises à déterminer leurs besoins en innovations et à jumeler ceux-ci à une expertise universitaire;
- Favoriser la recherche de pointe commercialisable;
- Construire des réseaux internationaux de recherche, créant ainsi des chefs de file innovateurs au Canada et à l'étranger;
- Fournir une formation professionnelle et entrepreneuriale aux étudiants diplômés, pour leur donner les outils nécessaires, afin de répondre aux besoins émergents en matière d'innovation.

Ne manquez pas la présentation de Mitacs au Congrès SCMO-UGC-ACRH. Pour de plus amples renseignements, consultez le site www.mitacs.ca/fr.

CMOS BUSINESS / AFFAIRES DE LA SCMO

Prière de noter que les versions françaises suivent.

Summer Meteorology Workshop
Project Atmosphere 2013

Call for Applications by K-12 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 K-12 teachers of atmospheric science topics sponsored by the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA). It will take place from **14 to 26 July 2013** at the National Weather Training Center, Kansas City, Missouri.

Expenses during the workshop for the participating teacher (excluding personal expenses) are covered by AMS/NOAA, CMOS and Canadian Geographic, Education (CGE). A total travel subsidy of $600 is provided to the selected Canadian teacher by CMOS (Can$300) and CGE (Can$300).

Previous Canadian participants have found their attendance a very rewarding and significant learning experience. Presentations are made at the workshop by some of the most respected US scientists in the field of atmospheric science. Field trips are included in the program, usually including time at a weather office. Participants return with a wealth of classroom-ready material, resources and teaching modules.

Interested teachers can obtain more information on the workshop and an application form on the CMOS website (www.cmos.ca/ProjectAtmosphere.html). Reports from previous participants can also be found on the CMOS website.

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

Completed application forms can be mailed or faxed to the address below no later than **8 March 2013**. Applicants are encouraged to submit their forms as soon as possible.

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

Summer Oceanography Workshop
Maury Project 2013

Call for Applications by K-12 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 K-12 teachers of oceanographic science topics sponsored by the American Meteorological Society (AMS), the National Oceanic and Atmospheric Administration (NOAA) and the US Naval Academy. This year's workshop takes place from **7 to 19 July 2013** at the US Naval Academy, Annapolis, Maryland.

Expenses during the workshop for the participating teacher (excluding personal expenses) are covered by AMS/NOAA, CMOS and the Canadian National Committee/Scientific Committee on Oceanic Research (CNC/SCOR). A total travel subsidy of $600 is provided to the selected Canadian teacher by CMOS (Can$300) and CNC/SCOR (Can$300).

Presenters at the workshop are some of the most respected American scientists in the field of oceanographic sciences. Field trips are included in the program, usually including time spent on a research vessel. Participants return with classroom-ready material, resources and teaching modules.

Interested teachers can obtain more information on the workshop and an application form on the CMOS website (http://www.cmos.ca/ProjectMaury.html). Reports from previous participants can also be found on the CMOS website.

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

Completed application forms can be mailed or faxed to the address below no later than **8 March 2013**. Applicants are encouraged to submit their forms as soon as possible.

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

Please note that you cannot save a completed copy of this form on your computer, but you can fill it on-screen and print copies afterward.

Please note that the English versions precede.

Atelier d'été en météorologie
Projet Atmosphère 2013

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 **14 au 26 juillet 2013** au centre de formation du National Weather Service à Kansas City au Missouri.

Les dépenses de l'enseignant(e) choisi(e) (à l'exclusion des dépenses personnelles) 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). Une bourse totale de 600 $ sera versée à l'enseignant(e) choisi(e) par la SCMO (300 $ Can) et le CCEG (300 $ Can).

Les ancien(ne)s participant(e)s du Canada ont trouvé leur expérience très enrichissante et stimulante. Les exposés de l'atelier sont présentés en anglais 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, rapport 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 de la SCMO sur la toile à www.scmo.ca/ProjectAtmosphre.html où ils peuvent obtenir un formulaire d'application. Les rapports des années précédentes sont également publiés sur le site web de la SCMO.

Les formulaires dûment remplis doivent être envoyés par courrier ou télécopieur à l'adresse ci-dessous au plus tard le **8 mars 2013.** Les candidat(e)s sont encouragé(e)s à soumettre leur formulaire dès que possible.

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

Atelier d'été en océanographie
Projet Maury 2013

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 US Naval Academy. Il aura lieu du **7 au 19 juillet 2013** au US Naval Academy à Annapolis au Maryland.

Les dépenses de l'enseignant(e) choisi(e) (à l'exclusion des dépenses personnelles) 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. Une bourse totale de 600 $ sera versée à l'enseignant(e) choisi(e) par la SCMO (300 $ Can) et le CNC/SCOR (300 $ Can).

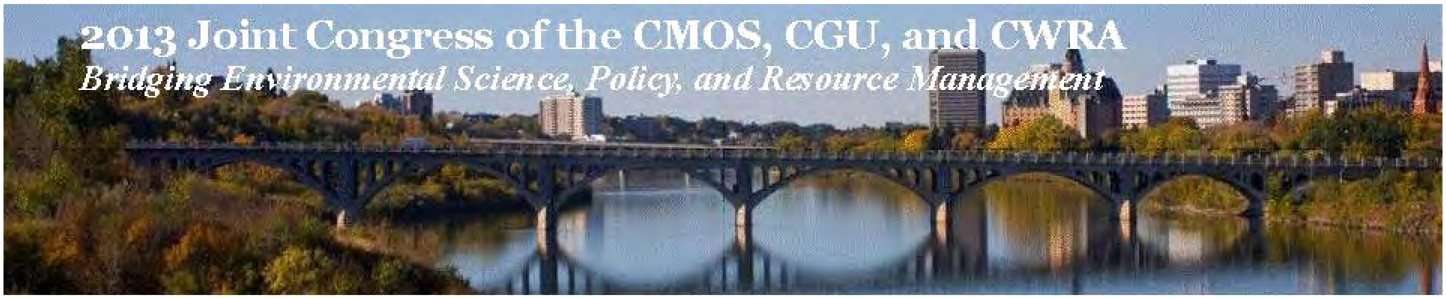
Les ancien(ne)s participant(e)s du Canada ont trouvé leur expérience très enrichissante et stimulante. Les exposés de l'atelier sont présentés en anglais par des experts américains les plus réputés dans les sciences atmosphériques et océanographiques. Les enseignant(e)s sont revenu(e)s avec du matériel, 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/ProjectMaury.html. Si vous êtes intéressés, vous devez télécharger le formulaire de candidature (en format pdf) et, une fois rempli, le poster ou le télécopier à l'adresse donnée ci-bas avant le **8 mars 2013.** Les candidat(e)s sont encouragé(e)s à soumettre leur formulaire dès que possible.

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

Prière de noter que vous ne pouvez pas enregistrer votre formulaire rempli sur votre ordinateur mais vous pouvez le compléter sur l'écran et imprimer des copies par la suite.



Call for Abstracts for the 2013 Joint Scientific Congress of CMOS, CGU and CWRA
26-30 May 2013, Saskatoon, SK

(la version française suit)

The 2013 Joint Scientific Congress of the CMOS, CGU, and CWRA will be held at TCU Place in Saskatoon, SK, 26-30 May 2013. Preliminary programs, registration, hotel, and general information are posted on the 2013 Congress Web site at http://www.cmos.ca/congress2013/index.htm. The theme of this congress is *Bridging Environmental Science, Policy and Resource Management*, and presentations are encouraged for all areas of interest of CMOS (Canadian Meteorological and Oceanographic Society), CGU (Canadian Geophysical Union), and CWRA (Canadian Water Resources Association). The collaboration of these three societies reflects the growing interdisciplinary aspect of all our sciences, and the need to consider novel collective approaches in a world that is changing rapidly due to the combined impacts of global climate variability, evolving global economies, population growth, and overall impacts on or by our atmosphere, water resources, and the solid earth; hence the theme of this congress.

Both oral and poster presentations are encouraged under more than 60 proposed themes within 14 categories. Brief descriptions of each theme are provided on the Congress abstracts submission website (using a pull-down menu under each category) at http://www.cmos.ca/congress2013/index.htm. The proposed categories and themes are as follows:

1. Arctic:
a) Applications of Geophysics and the Environment

2. Atmosphere:
a) Renewable Energy: Role of Atmospheric Science
b) Forecast Improvement with Stratospheric Data
c) Atmospheric Hazards and Extreme Weather
d) High Resolution Atmospheric Modeling
e) Cloud, Aerosol and Radiation Processes
f) Monitoring - Operations and challenges
g) Radar Meteorology and Applications
h) General Atmospheric Sciences

3. Biogeoscience:
a) Response to Climate and Land-use Change
b) Agricultural Land Management and Water
c) Green Mining
d) Northern Ecosystem Response to Stressors

4. CANCID - Agricultural Water Management
a) CANCID: Agricultural Drought and Flooding Events
b) CANCID: Agricultural Water Conservation
c) CANCID: Irrigation and Drainage
d) CANCID: Agricultural Water Quality Management

5. Climate:
a) Climate analysis, Modelling and Prediction
b) Low-frequency Variability and Predictability
c) Climate Change and the Carbon Cycle
d) Supporting Climate Services in Canada and Internationally

6. Geodesy:
a) Time-lapse Monitoring of Geohazard & Geodynamics
b) Gravity, Geoid and Height Systems
c) General Geodesy

7). Hydrology:
a) Groundwater's Role in the Hydrological Cycle
b) Perspectives of Hydrometeorological Extremes
c) Watershed Assessment for the 21st Century
d) Snow, Ice, Permafrost and Cold Regions Processes
e) Stable Isotope Tracers and Climate-Driven Change
f) Anthropogenically Disturbed Peatlands
g) Snow Analyses and Hydrology for Cold Regions
h) General Hydrology

8. Interdisciplinary:
a) Symposium on the Mathematics of Planet Earth (MOPE)
b) Observation and Modeling of Soil Moisture
c) Health Issues of Weather and Climate
d) Heavy Precipitation over Mountains
e) Water Cycle in Integrated Modelling Framework
f) Air Quality Forecasting and Supporting Science
g) Climate & Water Availability Indicators: Challenges
h) Science, Policy and Environmental Management
i) Combatting Aquatic Invasive Species
j) Canada in the Global Agenda
k) Researching for Resilience to Environmental Threats

l) Atmosphere, Ocean, and Climate Dynamics
m) Advanced Geocomputations and Related Web Services

9. Ocean:
a) Renewable Energy Extraction and Impacts
b) Motion of Deep Ocean Currents by Outer Core Heat
c) Processes within the Canadian Arctic Archipelago
d) Operational Oceanography in Canada
e) Coastal Oceanography and Inland Waters
f) General Oceanographic Sciences

10. Other
a) Marketing Communications of Sciences

11. Solid Earth:
a) Structure and Dynamics of Earth's Interior
b) Seismic Hazard Maps for Building Code Use
c) Lithospheric Structure of North America
d) Mining Geophysics
e) High Pressure Geophysics
f) Emerging Technologies and Concepts in Rock Physics
g) Geophysical Applications in CO2 Storage

12. Water Management:
a) Integrated Management of Ground and Surface Water
b) Water Resource Management in Changing Climate

13. Water Policy & Governance:
a) Eutrophication of Lake Winnipeg
b) Water Economics, Policy and Governance Network

14. Water Resources:
a) Water Science in Support of Decision Making
b) Climate Change and Water Resources

There are also at least seven associated workshops planned for the Sunday prior to the official congress start: 1) Finite Element Packages in Geophysics; 2) Climate & Water Availability; 3) Exteme Value Analysis and IDF Curves; 4) Marketing the Sciences; 5) Geophysical Research with Synchrotron; 6) Eutrophication of Lake Winnipeg; and 7) Geoid-based Vertical Datums.

Please submit abstracts electronically at http://www.cmos.ca/congress2013/index.htm between 13 January and the submission deadline of 16 February 2013. You will be requested to indicate your choice of theme and session, and to specify your preference for either an oral or a poster presentation. A non-refundable abstract fee of CAD $50 (payable by credit card) will be charged at the time of submission. Your abstract will be evaluated by the Scientific Program Committee and session convenors, and every effort will be made to respect your preference of session and type of presentation. You will be notified by the end of March 2013 as to the status of your presentation.

We strongly encourage student members of CMOS, CGU, or CWRA to submit papers on their research. Student presenters may apply for a Student Travel Bursary from one of these societies upon submitting their abstract (travel bursary applications will be provided during or after submitting your abstract submission). Student members may later be asked to submit an extended abstract (up to 2 pages) to be considered for a student presentation award by their respective society.

For additional information, please contact one of the Scientific Program Chairs: Geoff Strong (geoff.strong@shaw.ca representing CMOS), Rod Blais (blais@ucalgary.ca for CGU), or Bob Halliday (rhalliday@sasktel.net for CWRA). If you are an exhibitor, an educator, a member of the media, or anyone else with an interest in the meeting, please visit the Congress website (http://www.cmos.ca/congress2013/index.htm) for contacts and further information.

Demande de résumés pour le congrès scientifique conjoint 2013 de la SCMO, de l'UGC et de l'ACRH du 26 au 30 mai 2013, à Saskatoon, en Saskatchewan

Le congrès scientifique conjoint 2013 de la SCMO, de l'UGC et de l'ACRH se tiendra à la TCU Place à Saskatoon, en Saskatchewan, du 26 au 30 mai 2013. Les renseignements préliminaires sur les programmes, l'inscription, l'hôtel et les informations générales sont affichés sur le site Internet du congrès 2013 au http://www.cmos.ca/congress2013/index.htm. Le thème de ce congrès est : *Intégration des sciences de l'environnement, de la politique et de la gestion des ressources,* et les offres de présentations sont encouragées pour tous les domaines d'intérêt de la SCMO (Société canadienne de météorologie et d'océanographie), de l'UGC (Union géophysique canadienne) et de l'ACRH (Association canadienne des ressources hydriques). La collaboration de ces trois sociétés reflète l'aspect interdisciplinaire croissant de toutes nos sciences et la nécessité de considérer de nouvelles approches collectives dans un monde qui change rapidement à cause des répercussions combinées des variations du climat global, des économies mondiales en évolution, de la croissance de la population et des répercussions générales sur notre atmosphère ou de notre atmosphère, nos ressources hydriques, et la croûte terrestre; d'où le thème de ce congrès.

Les présentations orales et par affiches sont encouragées sur plus de 60 thèmes proposés à l'intérieur de 14 catégories. Une description sommaire de chacun de ces thèmes est disponible sur le site web du congrès pour la soumission des résumés (en utilisant un menu déroulant sous chacune de ces catégories) à http://www.cmos.ca/congress2013/index.htm Les catégories proposées et les thèmes sont les suivants:

1. Arctique:
a) Applications géophysiques et environnement

2. Atmosphère:
a) Énergie renouvelable: rôle de la science atmosphérique
b) Amélioration des prévisions grâce aux données stratosphériques
c) Hasards atmosphériques et météo extrême
d) Modélisation atmosphérique et haute résolution
e) Processus des nuages, aérosols et radiation
f) Surveillance - Opérations et défis
g) Météorologie à l'aide du radar et applications
h) Sciences atmosphériques en général

3. Biogéosciences:
a) Réponses au changement climatique et utilisation du sol
b) Gestion des terres agricoles et eau
c) Mines vertes
d) Réponse de l'écosystème nordique aux stresseurs

4. CANCID - Gestiion de l'eau pour l'agriculture
a) CANCID: Sécheresses et inondations en agriculture
b) CANCID: Conservation de l'eau en agriculture
c) CANCID: Irrigation et drainage
d) CANCID: Gestion de la qualité de l'eau en agriculture

5. Climat:
a) Analyse, modélisation et prédiction du climat
b) Variabilité à basse fréquence et prévisibilité
c) Changement climatique et cycle du carbone
d) Support aux services climatiques au Canada et à l'international

6. Géodésie:
a) Surveillance en différé des géohasards et géodynamiques
b) Gravité, géoïde et système d'élévation
c) Géodésie générale

7. Hydrologie:
a) Rôle de l'eau souterraine dans le cycle hydrologique
b) Perspectives des extrêmes hydrométéorologiques
c) Évaluation des bassins versants pour le 21e siècle
d) Neige, glace, permafrost et processus pour les régions froides
e) Traceurs isotopiques stables et influence du climat
f) Dérangements anthropologiques des tourbières
g) Analyse de neige et hydrologie pour les régions froides
h) Hydrologie en général

8. Interdisciplinaire:
a) Colloque sur les mathématiques de la planète terre
b) Observation et modélisation de l'humidité du sol
c) Questions de santé reliées à la météo et au climat
d) Fortes précipitations dans les montagnes
e) Cycle de l'eau dans le système d'un modèle intégré
f) Prévision de la qualité de l'air et son support scientifique
g) Les indicateurs du climat & disponibilité de l'eau: défis
h) Science, politique et gestion de l'environnement
i) Lutte contre les espèces envahissantes
j) Canada dans l'agenda mondial
k) Recherche de la résilience aux menaces environnementales
l) Dynamique de l'atmosphère, de l'océan, et du climat
m) Calculs géophysiques avancés et services web associés

9. Océan:
a) Extraction de l'énergie renouvelable et ses impacts
b) Mouvement des courants marins en profondeur causés par la chaleur du noyau externe
c) Processus dans l'archipel arctique canadien
d) Océanographie opérationnelle au Canada
e) Océanographie côtière et eaux intérieures
f) Sciences océaniques en général

10) Autre
a) Le marketing dans la communication des sciences

11. Terre ferme:
a) Structure et dynamique de l'intérieur de la Terre
b) Cartes des hasards séismiques pour le code du bâtiment
c) Structure lithosphérique de l'Amérique du Nord
d) Géophysique minière
e) Géophysique en haute pression
f) Concepts et technologies émergentes en physique des roches
g) Applications géophysiques pour le captage du CO_2

12. Gestion de l'eau:
a) Gestion intégrée des eaux souterraines et de surface
b) Gestion des ressources hydriques sous le changement climatique

13. Politique de l'eau et gouvernance:
a) Eutrophication du lac Winnipeg
b) Réseau de l'économie, politique et gouvernance de l'eau

14. Ressources hydriques:
a) Aide à la prise de décision à l'aide de la science hydrique
b) Changement climatique et ressources hydriques

De plus, il y a au moins sept ateliers de travail prévus pour le dimanche, avant le début du congrès: 1) Outillage d'éléments finis en géophysique; 2) Climat et disponibilité de l'eau; 3) Analyse des valeurs extrêmes et courbes IDF; 4) Marketing des sciences; 5) Recherche en géophysique avec le synchrotron; 6) Eutrophication du lac Winnipeg; et 7) Système de référence vertical basé sur le géoïde.

Veuillez soumettre les résumés électroniquement au lien qui se trouve sur le site Internet du congrès (http://www.cmos.ca/congress2013/index.htm) entre le 13 janvier et la date limite de soumission, le 16 février 2013. Vous devrez indiquer votre choix de domaine d'intérêt et de séance (détails disponibles plus tard) et spécifier votre préférence pour une présentation orale ou par affiche. Des frais de présentation non remboursables de 50 $ CAN (payables par carte de crédit) seront demandés au moment de la soumission. Votre présentation sera évaluée par le Comité du programme scientifique, et nous ferons tout notre possible pour respecter votre préférence de séance et de type de présentation. Vous serez avisé de la décision prise quant à votre présentation avant la fin du mois de mars 2013.

Nous encourageons fortement les membres étudiants de la SCMO, de l'UGC ou de l'ACRH à soumettre des résumés de leurs recherches. Les présentateurs étudiants peuvent faire une demande de bourse de voyage pour étudiant à l'une de ces sociétés lors de la soumission de leur résumé (des formulaires de demande pour une bourse apparaîtront pendant ou après la soumission de votre résumé). Les membres étudiants peuvent aussi avoir à fournir par la suite un résumé plus long (jusqu'à 2 pages) pour un éventuel prix de présentation pour étudiant par une des trois sociétés.

Pour de plus amples renseignements, veuillez communiquer avec l'un des présidents du programme scientifique : Geoff Strong (geoff.strong@shaw.ca représentant la SCMO), Rod Blais (blais@ucalgary.ca pour l'UGC) ou Bob Halliday (rhalliday@sasktel.net pour l'ACRH). Si vous êtes un exposant, un enseignant, un membre des médias ou une personne intéressée au congrès, veuillez visiter le site Internet du congrès (http://www.cmos.ca/congress2013/index.htm) pour les coordonnées et d'autres renseignements.

Report of the CMOS Nominating Committee

Committee Members:

- Norman McFarlane (CMOS Past-President), Chair
- Peter Bartello (CMOS President)
- Pierre Gauthier (CMOS Vice-President)

(With input from Ian Rutherford, CMOS Executive Director and Louis Lefaivre, Chairperson, CMOS Montreal Centre)

Three members of the current (2012-13) Executive will step down following their current terms of service and their replacements will be appointed at the 2013 Annual General Meeting:

• Norman McFarlane – Completes the current term as Past President and, with that, three terms on the Executive.

• Denis Gilbert – Completes his third term as Councillor-at-Large and has declined to be nominated for another term because of increased responsibilities in his position as a DFO Research Scientist and Leader of the Canadian Argo Programme.

• Kim Strong – Has asked to step down after two terms as a Councillor-at-Large because of additional commitments at the University of Toronto.

Following the usual transition practice, Pierre Gauthier will stand for nomination for the position of President, and Peter Bartello as Past President. Nacéra Chergui will continue as Treasurer, David Huard as Recording Secretary, and André Giguère as Corresponding Secretary.

Well qualified candidates who are CMOS members have agreed to stand for nomination for the two Councillor-at-Large positions and the Vice-President position:

• Vice-President: Dr. Harinder Ahluwalia, President and CEO, Info-Electronic Systems Inc., Montreal, Quebec. - Harinder Ahluwalia is a member of the CMOS Private Sector Committee. He is willing to stand for nomination to serve on the Executive for three years following the usual Vice-President, President, and Past-President succession.

Councillors-at- Large:

• Dr. William Merryfield, Canadian Centre for Climate Modelling and Anaysis, Environment Canada, University of Victoria, Victoria, BC – Bill Merryfield is a research scientist in CCCma, specialized in physical oceanography and ocean modeling. He was Chair of the Scientific Programme Committee for the 2010 CMOS Congress in Victoria. He has agreed to stand for nomination to serve for the usual three successive terms as a Councillor-at-Large.

• Professor Robert Sica, University of Western Ontario. – Bob Sica is a Professor in the Department of Physics and Astronomy, University of Western Ontario. He is a member of the Arctic Special Interest Group. He has agreed to stand for nomination to replace Kim Strong for the 2013-14 term. To preserve the staggering of C-a-L appointments it will be desirable to have him stand for nomination for a further 3-year period of service in 2014.

With these new nominees, the full Executive slate for 2013-14 is the following:

• President: Pierre Gauthier
• Vice-President: Harinder Ahluwalia
• Past-President: Peter Bartello
• Treasurer: Nacéra Chergui
• Recording Secretary: David Huard
• Corresponding Secretary: André Giguère
• Councilors-at-Large (3):
    • Tetjana Ross (Dalhousie University)
    • William Merryfield (CCCma, Environment Canada University of Victoria)
    • Robert Sica (University of Western Ontario)

• Ex-Officio: Ian Rutherford (Executive Director) and Richard Asselin (Director of Publications).

Rapport du comité de mise en candidature de la SCMO

Composition du comité :

• Norman McFarlane (président sortant de la SCMO), président;
• Peter Bartello (président de la SCMO);
• Pierre Gauthier (vice-président de la SCMO).

(Avec la participation d'Ian Rutherford, directeur exécutif de la SCMO, et de Louis Lefaivre, président du centre de la SCMO de Montréal.)

Trois membres de l'exécutif actuel (2012-2013) se retireront suivant leurs conditions de service. Leur remplaçant sera désigné à l'assemblée générale annuelle de 2013 :

• Norman McFarlane termine son mandat actuel de président sortant, ainsi que trois mandats au sein de l'exécutif;

• Denis Gilbert termine son troisième mandat de conseiller et a décliné l'offre de nomination pour un autre mandat, en raison de ses responsabilités accrues en tant que chercheur au sein du MPO et responsable du Programme Argo au Canada;

• Kim Strong a demandé de se retirer après deux mandats en tant que conseillère, en raison de ses activités accrues au sein de l'Université de Toronto.

Selon la pratique courante, Pierre Gauthier se présentera pour le poste de président et Peter Bartello, pour celui de président sortant. Nacéra Chergui demeurera trésorière; David Huard, secrétaire d'assemblée; et André Giguère, secrétaire-correspondant.

Des candidats compétents, membres de la SCMO, ont accepté de poser leur candidature pour les deux postes de conseillers et le poste de vice-président.

• Vice-président : Harinder Ahluwalia (Ph. D.), président et chef de la direction d'Info-Electronic Systems Inc., Montréal (Québec). Harinder Ahluwalia est membre du comité du secteur privé de la SCMO. Il accepte de poser sa candidature pour siéger à l'exécutif pendant trois ans en vertu de l'ordre de succession habituel : vice-président, président et président sortant.

Conseillers :

• William Merryfield (Ph. D.), Centre canadien de la modélisation et de l'analyse climatique, Environnement Canada, Université de Victoria, Victoria (C.-B.). Bill Merryfield est un chercheur au sein du CCmaC. Il se spécialise en océanographie physique et en modélisation de l'océan. Il a présidé le comité du programme scientifique du Congrès de la SCMO, tenu à Victoria, en 2010. Il a accepté de poser sa candidature au poste de conseiller pour une période de trois mandats consécutifs.

• Professeur Robert Sica, Université Western Ontario. Bob Sica est professeur au département de physique et d'astronomie de l'Université Western Ontario. Il est membre du groupe d'intérêt pour l'Arctique. Il a accepté de poser sa candidature pour remplacer Kim Strong en 2013-2014. Pour préserver le roulement habituel des conseillers, il est souhaitable que B. Sica pose en 2014 sa candidature pour une période supplémentaire de 3 ans.

Liste complète des membres de l'exécutif pour 2013-2014, comprenant les candidats nouvellement désignés :

• Président : Pierre Gauthier
• Vice-président : Harinder Ahluwalia
• Président sortant : Peter Bartello
• Trésorière : Nacéra Chergui
• Secrétaire d'assemblée : David Huard
• Secrétaire-correspondant : André Giguère
• Conseillers (3):
    • Tetjana Ross (Université Dalhousie)
    • William Merryfield (CCmaC, Environnement Canada, Université de Victoria)
    • Robert Sica (Université Western Ontario)

• Membres d'office : Ian Rutherford (directeur exécutif) et Richard Asselin (directeur des publications).

Atmosphere-Ocean : 2012 in Review

We completed our second year of partnership with Taylor & Francis, with a bang : a fifth issue for our 50th year. In total, we published 46 research articles plus prefaces and other non-refereed material totalling, 683 pages, definitely an all-time record.

A few years ago, we had instituted an applied research category in order to increase the appeal to operationally oriented scientists. This year, 9 articles were published in that category, while there were 35 classified under fundamental research and two as review articles. Special issues or special sections continued to be a popular and effective way of attracting suitable articles. We invite organisers to propose such special issues.

There is now little doubt that articles published on line attract very wide interest. Since June 2011, many A-O articles have been downloaded (full text) more than 100 times; this statistic is updated daily for each article on the journal site at: http://www.informaworld.com/tato.

There were 72 new articles submitted in 2012, including 29 under applied research, plus 93 revised articles. This volume of submission is both very encouraging and very demanding on the part of our three editors: **Guoqi Han, William Hsieh and Douw Steyn** and their team of associate editors, not to mention referees. The acceptance rate was about 60%.

Council has expressed the goal of reaching 100 articles per year, so we still have a lot more work to do. We accept international contributions with pleasure, but invite CMOS members and colleagues to consider their own journal more frequently and for their best paper. A-O publishes about 2% of the Canadian articles that would qualify for our journal. At a time when research funding is limited, it is important that research conducted in Canada be more easily distinguished by those who control the purse strings.

Richard Asselin
Director of Publications

Atmosphere-Ocean : revue de 2012

Nous avons complété notre deuxième année de partenariat avec Taylor & Francis par un gros boum : un cinquième numéro pour notre 50ème anniversaire. En tout, nous avons publié 46 articles de recherche en plus de préfaces et autres articles non revus par pairs, totalisant 683 pages, un record de tous les temps.

Il y a quelques années, nous avons défini la catégorie de Recherche appliquée afin d'accroitre l'intérêt des scientifiques qui œuvrent en opérations. Cette année, 9 articles furent publiés dans cette catégorie, 35 dans la catégorie de Recherche fondamentale et 2 articles de revue. Les numéros et sections spéciales continuent d'être populaires et une façon efficace d'attirer des articles appropriés. Nous invitons les organisateurs à proposer des numéros spéciaux.

Il n'y a plus aucun doute que les articles publiés en ligne attirent un vaste intérêt. Depuis juin 2011, beaucoup d'articles de A-O ont été téléchargés (texte intégral) plus de 100 fois. Ces statistiques sont mises à jour quotidiennement pour chaque article au site de la revue : http://www.informaworld.com/tato.

En 2012, 72 nouveaux articles ont été soumis, incluant 29 dans la catégorie de recherche appliquée, en plus de 93 articles révisés. Un tel nombre de soumissions est très encourageant et une charge exigeante pour nos trois éditeurs: **Guoqi Han, William Hsieh and Douw Steyn** et leur équipe d'éditeurs associés, sans compter les arbitres. Le taux d'acceptation a été d'environ 60%.

Le Conseil a exprimé l'objectif d'atteindre 100 articles par année, donc nous avons encore beaucoup de travail à faire. Nous acceptons les contributions internationales avec plaisir, mais nous invitons les membres de la SCMO et leurs collègues à considérer leur propre revue plus souvent, surtout pour leurs meilleurs articles. A-O publie environ 2% des articles canadiens qui tombent dans les domaines de notre revue. À un moment où les subventions de recherche se font rares, il est important que la recherche menée au Canada soit plus distinctement visible de ceux qui contrôlent les cordons de la bourse.

Richard Asselin
Directeur des publications

BOOK REVIEWS / REVUES de LITTÉRATURE

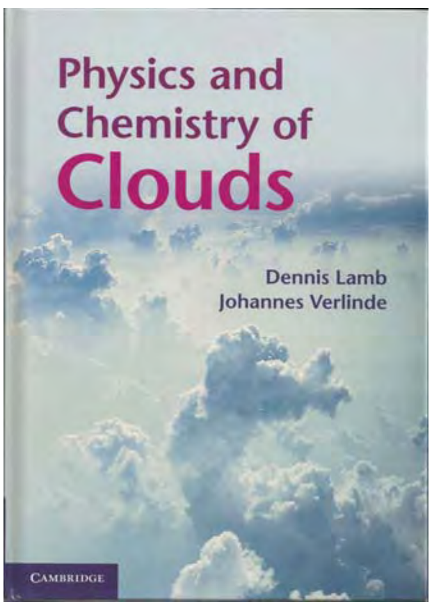
Physics and Chemistry of Clouds

by Dennis Lamb and Johannes Verlinde

Cambridge University Press, 2011
ISBN 978-0-521-89910-9, 584 pages, Hard cover, US$85

Book reviewed by T.W. Krauss[1]

Clouds often are the most dominant contributors to the weather we experience on any given day. Clouds also play very important roles in the global energy and water budget that determines the climate. Yet quantifiable predictions of clouds, whether to forecast the local weather or to predict changes in global climate, continue to be a major scientific challenge. First we must understand how clouds operate in the real atmosphere, where interactions with natural and anthropogenic pollutants are common.



This book developed over many years of teaching at Penn State University and it represents a valuable textbook and reference for advanced students in atmospheric science, meteorology, environmental sciences and engineering, and atmospheric chemistry. The purpose of the book is to provide students with a quantitative understanding of the inner workings of clouds. Comprehensive treatments are given of the mechanisms by which cloud droplets form and grow on soluble aerosol particles, ice crystals evolve into diverse shapes, precipitation develops in warm and cold clouds, trace gases and aerosol particles are scavenged from the atmosphere, and electrical charge is separated in thunderstorms. The physics and chemistry of the atmosphere go hand in hand when developing a complete picture of clouds and how they behave in the atmosphere.

The book consists of five parts. Part I (Chapters 1 and 2) provides background material for those unfamiliar with the atmospheric sciences and require an introduction to concepts and terminology. Part II (Chapters 3 and 4) describes how transformations, both physical and chemical, come about in nature when a system deviates from equilibrium. Part III (Chapters 5 and 6) discusses cloud thermodynamics, formation, and evolution from a macroscopic point of view. Part IV (Chapters 7 to 9) describes the processes responsible for the microstructure of clouds (e.g. nucleation of droplets and ice crystals), vapour growth, collision-coalescence, riming, and aggregation. Part V (Chapters 10 to 14) discusses the evolution of supersaturation, aerosol influences, microphysical and dynamical influences, warm versus cold clouds and the relative importance of liquid droplet and ice crystal growth, the formation of snow and hail, cloud and precipitation chemistry, and cloud electrification.

The book is an excellent source of photos and graphical material, and the research literature has been heavily exploited and used throughout the text. Since the book is designed as a text book, each chapter is concluded with a list of references for further reading and a set of problems. The authors felt that a new textbook was warranted for their graduate level cloud physics course, and that existing texts were somewhat lacking in showing how fundamental physical and chemical processes interact and lead to the phase changes of water in the form of clouds. The authors contend that their book fills a niche between the text by Rogers and Yau (A short Course in Cloud Physics, 3rd edition), and the extensive reference book of Pruppacher and Klett (Microphysics of Clouds and Precipitation, 2nd edition). I believe that this book serves a useful purpose in that it describes cloud macrophysical and microphysical processes in depth and incorporates the progress that has been made by the scientific community over the last twenty years regarding aerosol interactions and cloud chemistry.

[1] President, Krauss Weather Services Inc., Red Deer, Alberta, Canada

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Journée mondiale de l'eau 2013: Coopération dans le domaine de l'eau

Les célébrations de la Journée mondiale de l'eau le **22 mars 2013** auront lieu dans le monde entier sur le thème de la coopération dans le domaine de l'eau. L'UNESCO assurera la coordination des activités et encouragera les parties prenantes aux niveaux international, régional, national et local à mettre en place des actions sur le sujet afin de créer une dynamique qui ira au-delà de l'Année internationale de la coopération dans le domaine de l'eau proprement dite.

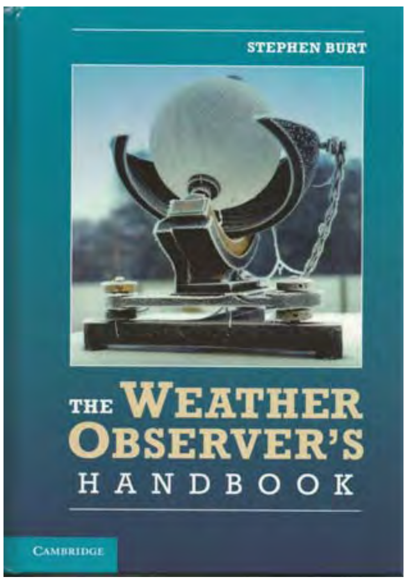
The Weather Observer's Handbook

by Stephen Burt

Cambridge University Press, 2012, ISBN 978-1-107-02681-0, Hardback, 444 pages, US$100.

Book reviewed by: T. Colleen Farrell[2]

When I first saw this title, I thought it might be associated with the "*Observer's Handbook*" published annually by the Royal Astronomical Society of Canada. Not so. Perhaps any confusion is solely regional. This book describes the what, where, when and how of weather observing and discusses "*cradle to grave*" approaches to ensure quality control of data from the point of observation to its eventual storage in an archive.



The author, a Fellow of the Royal Meteorological Society, had worked for the UK Met Office for more than 10 years and ran a meteorological observatory for over 40 years. He admits to picking up the "*weather observing bug*" while still in school. As off-the-shelf weather instruments become more affordable and robust, more and more enthusiasts (to differentiate from "professional" users of weather data) are catching the "*bug*". This book attempts to cater to the needs of both groups, although it is understood that these groups may not be mutually exclusive. Other intended audiences include schools and universities, and organizations involved in weather-dependent activities.

In discussing the development of traditional and modern weather instruments, there is a reasonable balance between covering historical details and the evolution of technology. It makes for a more compelling read than just providing descriptions of the nuts and bolts of the instrumentation. It follows the standards set out by the World Meteorological Organization (WMO), but the author acknowledges that the availability of certain instruments or specific models will vary from country to country outside the UK. He makes a point of defining acronyms when they first appear, as well as having a list of frequently used acronyms at the front of the book, just after the Acknowledgments section.

The first figure in the book is that of an Automatic Weather Station (AWS) installed on the south col of Mount Everest (altitude 8000m ASL) in May 2011. Curious to know what the weather might be like there this morning, I followed the link provided. Unfortunately, the last observation was from November 1, 2011 (Temperature was -28C, RH 14% on that day, by the way). Providing internet links in a book is risky, since that type of information often changes and can quickly become out of date.

The book is divided into three sections followed by four appendices: Part One covers "*The Basics*", Part Two is on the actual "*Measuring the Weather*" and Part Three is "*Making the Most of Your Observations*", which includes data storage and sharing.

The first chapter in Part One documents a history of weather observations. The oldest continuous (more or less) observations come from Uppsala Sweden (1722). Anders Celsius took over responsibility for the astronomical observatory there in 1729. The actual site of observation has changed over the years. Padua Italy was not far behind, in 1725. There is no mention of Canada's meteorological milestone (1871) under the sub-heading of "oldest weather records in North America"; all the sites listed are from the US: Chapel Hill NC (1820), New York's Central Park (1869) and Blue Hill Meteorological Observatory in Massachusetts (1885). There is an extensive reference list for further reading at the end of this chapter.

The Basics go on to include chapters on choosing (Chapter 2), buying (Chapter 3) and siting (Chapter 4) a weather station. The reference section for Chapter 2 consists of a convoluted URL pointing to the 7th edition of WMO's Instruments and Methods of Observation (IMO) Programme's Commission for Instruments and Methods of Observations (CIMO) Guide. I had little interest in trying to type it into my browser, as I had little hope in getting it correct the first time. A better approach might be, if the provision of a web address is dictated, to provide the home page (ex. www.wmo.int) and direct the reader to search for latest edition of the CIMO Guide (in this case, the 7th edition, 2008).

As for the chapter on buying instruments (Chapter 3), details provided on specific models could get dated pretty quickly. Disclaimers note that the prices (in USD) were found using internet searches as of January 2012. The author does go on further to break down what options to look for in systems that range from entry-level to professional instruments. The latter strategy is more useful in providing information with a longer "shelf life".

[2] Environment Canada, Dartmouth, Nova Scotia

Part Two covers "traditional" and "modern" measurement methods, following WMO recommendations for each weather element (as well as any country-specific recommendations for the US, UK and the Republic of Ireland).

The first element covered, and likely one of the most important, is temperature (Chapter 5). Various methods for sheltering from long- and short-wave radiation and precipitation, and screens to allow good contact with the air are described. Chapter 6 covers precipitation, and subsequent chapters go on to cover atmospheric pressure, humidity, wind speed and direction, grass and earth temperatures, sunshine and solar radiation. The topic of calibrating various sensors has its own chapter (15), followed by one on Metadata (what it is and why it's important).

The four chapters (17-20) of Part Three focus on managing, using and sharing the "avalanche" of observations.

Four Appendices finish off the book: The basics of instrument theory (Appendix 1), useful functions for vector mean wind and sunshine records (2), unit conversions for temperature (C / F), precipitation (mm / inches), pressure (hPa / inches) and wind speed (knots / m/s / mph / kmh) (3) and useful sources, such as addresses for Meteorological Societies (ex. CMOS) and suppliers of instruments and software (4).

The strength of this book is that it does a good job of being a handy reference for any of its intended users (from backyard enthusiasts to professionals involved in research), as it has done a lot of the leg work for finding the appropriate instrument for the job. The "one-minute summary" at the end of most chapters gives a quick overview of the content and the extra thought put into making explanations clear and concise will be appreciated. While the author seemed to take great strides in making this book universally applicable, (there are many figures showing examples from the USA and many other parts of the world and approximate prices are quoted in US dollars) some very minor terminology tended to be UK-centric (ex. the term "winter gritting" in the context of road maintenance jumped out at me). If there are any other weaknesses, I would point to any information that may become quickly outdated (ex. specific instrument models, prices and web addresses). Otherwise, I find this to be totally readable resource for anyone interested in the proper way to go about measuring the various elements of weather. With the increasing acceptance of a "network of networks" approach, where data from all manner of weather instrumentation is assimilated with model data to create a denser synoptic picture for forecasters and modelers, the information provided in this book could prove very useful indeed.

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

Latest Books received / Derniers livres reçus

2012-03) *Ocean Dynamics and the Carbon Cycle, Principles and Mechanisms*, by Richard G. Williams and Michael J. Follows, Cambridge University Press, ISBN 978-0-521-84369-0, Hardback, 404 pages, US$ 73.

2012-08) *Dryland Climatology*, by Sharon E. Nicholson, Cambridge University Press, ISBN 978-0-521-51649-5, Hardback, 516 pages, US$150.

2012-10) *Phytoplankton Pigments, Characterization, Chemotaxonomy and Applications in Oceanography,* Edited by Suzanne Roy, Carole A. Llewellyn, Einar Skarstad Egeland and Geir Johnsen, 2011, Cambridge University Press, ISBN 978-1-107-00066-7, Hardback, 845 pages, US$140.

2012-12 *Buoyancy-Driven Flows*, Edited by Eric P. Chassignet, Claudia Cenedese and Jacques Verron, 2012, Cambridge University Press, ISBN 978-1-107-00887-8, Hardback, 436 pages, US$120.

2012-15) *Introduction to the Physical and Biological Oceanography of Shelf Seas*, by John H. Simpson and Jonathan Sharples, Cambridge University Press, ISBN 978-052-1701488, Paperback, 424 pages. US$65.95.

2012-18) *Chemistry and the Environment*, by Sven E. Harnung and Matthew S. Johnson, Cambridge University Press, ISBN 978-110-768257-3, Paperback, 427 pages. CDN$76.95.

2012-19) *Understanding the Earth System, Global Change Science for Application*, Edited by Sarah E. Cornell, I. Colin Prentice, Joanna I. House and Catherine J. Downy, Cambridge University Press, ISBN 978-1-107-00936-3, Hardback, 267 pages, CDN$81.95.

World Water Day 2013: Water Cooperation

Celebrations for World Water Day on **22 March 2013** will take place around the world on the theme of water cooperation. UNESCO will lead the coordination of the activities and will encourage stakeholders at international, regional, national and local levels to take action on the topic so as to create a momentum that goes beyond the Year itself.

BRIEF NEWS / NOUVELLES BRÈVES

International Workshop on Seasonal to Decadal Prediction

The Working Groups on Seasonal to Interannual Prediction (WGSIP) and the Working Group on Climate Modelling (WGCM) are organizing an international workshop on seasonal and decadal prediction (S2D). The workshop will be held in Toulouse, France, from 13 to 16 May 2013, under the sponsorship of Météo-France, CNRS, CERFACS, WCRP, and the fundation BNP-Paribas.

Workshop on Seasonal to Decadal Prediction

The goal of the workshop is to review our current abilities to make skillful predictions on seasonal to decadal (S2D) timescales. The availability of results from the Climate system Historical Forecasting Project (CHFP) and the decadal prediction component of the Coupled Model Intercomparison Project (CMIP5), together with very active investigations in both operational and research communities, support the timeliness of the Workshop. Areas of interest include :

■ Predictability. Studies of where, and to what extent, skillful S2D predictions may be possible and the associated physical mechanisms.

■ Initialization and ensemble generation. The information that is needed to enable prediction on different timescales and the availability and nature of this information for initializing past and current forecasts. Methods of initialization and their effects including full-field and anomaly initialization. The generation of the ensembles needed to characterize the probability distribution of forecasts.

■ Models. The main deficiencies of current coupled models as they affect S2D predictive skill and the prospects for improvement. Information about models that forecast results reveal and the trade-off between resolution, model complexity and ensemble size. The status and use of statistical models for S2D prediction.

■ Bias adjustment, calibration and combination of forecasts. Methods of postprocessing S2D predictions from models including bias adjustment, forecast calibration, multi-model combination etc. The statistical considerations involved in these methods.

■ Forecast quality. Measures of forecast skill and value which are useful and appropriate at S2D forecast ranges. Metrics which asses the contributions of external forcing and initialization to forecast skill, which guide forecast development, suggest regions and mechanisms of untapped skill, and which may be used to assess improvements in prediction methods.

■ Applications. The success and utility of modestly skillful predictions across the S2D timescales. The contributions of S2D forecasts to Climate Services.

Presentations on all aspects of Seasonal to Decadal Prediction are of interest. Please view the Workshop website at:

http://www.meteo.fr/cic/meetings/2013/s2d/

for information. Both oral and poster presentations will be part of the Workshop.

Important Dates

■ Abstract submission deadline: 15 February 2013

■ Acceptance of abstracts: 28 February 2013

■ Draft programme: 31 March 2013

A Workshop report will summarize the results and expert opinions on these topics that are presented at the workshop.

Mathematics of Planet Earth

Dozens of scientific societies, universities, research institutes, and foundations all over the world have banded together to dedicate 2013 as a special year for the Mathematics of Planet Earth.

Our planet is the setting for dynamic processes of all sorts, including the geophysical processes in the mantle, the continents, and the oceans, the atmospheric processes that determine our weather and climates, the biological processes involving living species and their interactions, and the human processes of finance, agriculture, water, transportation, and energy. The challenges facing our planet and our civilization are multidisciplinary and multifaceted, and the mathematical sciences play a central role in the scientific effort to understand and to deal with these challenges.

The mission of the MPE project is to:

■ Encourage research in identifying and solving fundamental questions about planet earth
■ Encourage educators at all levels to communicate the issues related to planet earth
■ Inform the public about the essential role of the mathematical sciences in facing the challenges to our planet

MPE2013 has now reached the breadth of an international year under the patronage of UNESCO. MPE2013 is run by its partners. The partners, mostly scientific institutes, learned societies, international organizations, associations of teachers have committed to organize scientific and outreach activities on the theme. For several years already, an intense planning of scientific activities is taking place all over the world. Many research institutes will host long-term programs, workshops and summer schools throughout 2013. The learned societies or teachers' associations introduce MPE components in their congresses, with related plenary or public lectures, and special sessions. They also organize outreach activities on MPE topics. An international competition of museum quality exhibits (modules) will produce the basis of an Open Source MPE virtual Exhibition, which will be officially launched at the Headquarters of UNESCO in Paris on March 5 2013.

MPE2013 is born from the will of the world mathematical community to learn more about the challenges faced by our planet and the underlying mathematical problems, and to increase the research effort on these issues. Indeed, the recent tendencies have increased the pressure to comprehend the planet and its environment: growing population competing for the same global resources, increased frequency and intensity of dramatic meteorological events, and evidence pointing to longer term patterns of general climate change. Mathematicians have an expertise in modelling and solving problems. MPE2013 creates exceptional opportunities for long-term partnerships, both inside the mathematical sciences and with other related scientific disciplines. It will allow training a new generation of researchers working on scientific problems related to climate change and sustainability.

In parallel to the scientific component, the outreach component of MPE2013 illustrates for the public and for the schools the role of mathematical sciences to help tackling some of the world's most pressing problems. It will permit to motivate kids in schools by providing stimulating answers to questions like "*What is mathematics useful for?*"

The theme "Mathematics of Planet Earth" is interpreted as broadly as possible. In addition to climate change and sustainability, it includes geophysics, ecology and epidemiology, biodiversity, as well as the global organization of the planet by humans. The different topics have been classified into four themes.

The four themes of MPE2013:

■ **A PLANET TO DISCOVER:** oceans; meteorology and climate; mantle processes, natural resources, solar systems
■ **A PLANET SUPPORTING LIFE:** ecology, biodiversity, evolution
■ **A PLANET ORGANIZED BY HUMANS:** political, economic, social and financial systems; organization of transport and communications networks; management of resources; energy
■ **A PLANET AT RISK:** climate change, sustainable development, epidemics; invasive species, natural disasters

Hence, Mathematics of Planet Earth attracts researchers with a very wide range of expertise. Their increased collaboration and efforts in capacity building will last: Mathematics of Planet Earth will continue past 2013.

Source: http://mpe2013.org/about-mpe2013/

Mathématiques de la planète Terre

Des dizaines de societés scientifiques, universités, centres de recherches ont uni leurs efforts pour faire de 2013 une année spéciale des Mathématiques de la planète Terre.

Notre planète est le siège de processus dynamiques de toutes sortes: processus géophysiques dans le manteau, les continents, les océans, processus atmosphériques qui déterminent le temps et les climats, processus biologiques dans l'évolution des espèces vivantes et leurs interactions, processus humains en finance, agriculture, gestion de l'eau, transport et énergie. Les défis auxquels font face notre planète et notre civilisation sont multidisciplinaires et les sciences mathématiques jouent un rôle de premier plan dans l'effort de recherche concerté requis pour les comprendre et trouver des solutions.

La mission du programme MPT est de :

■ Encourager la recherche en identifiant et solutionnant des questions fondamentales sur la planète Terre;
■ Encourager les enseignants à tous les niveaux à communiquer les défis auxquels fait face la planète;
■ Informer le public du rôle essentiel des sciences mathématiques pour affronter les défis auxquels fait face la planète.

MPT comprend quatre thèmes:

■ **UNE PLANÈTE À DÉCOUVRIR:** céans; météorologie et climat; processus dans le manteau, ressources naturelles, systèmes solaires.

■**UNE PLANÈTE SUPPORTANT LA VIE:** écologie, biodiversité, évolution.

■ **UNE PLANÈTE ORGANISÉE PAR L'HOMME:** systèmes politiques, économiques, sociaux et financiers; organisation des réseaux de transport et de communication; gestion des ressources; énergie.

■ **UNE PLANÈTE EN DANGER:** changement climatique, développement durable, épidémies; espèces invasives, désastres naturels.

Source: http://mpe2013.org/fr/about-mpe2013/

The Diamond Jubilee Medal awarded to Diane Orihel

December 17, 2012 (Winnipeg) — On December 16th, 2012, Diane Orihel, founder of the Coalition to Save ELA, was presented with the prestigious Diamond Jubilee Medal. This award recognizes Canadians who have made significant contributions to their communities and who have brought credit to Canada.

"*Through sheer energy and determination, her lone voice ignited a nationwide awareness campaign promoting the importance of not only the Experimental Lakes Area, but of independent science and research in general*." states Pat Martin, MP Winnipeg Centre. "*Diane's effort is a true David and Goliath story which inspires others to stand up for what they believe in, regardless of the odds*."

In May 2012, the Government of Canada announced that it would be closing the Experimental Lakes Area (ELA), a world renowned research facility specializing in freshwater and fisheries research. Since the announcement, Ms. Orihel has worked tirelessly to bring Canadians together in support of keeping the ELA open. A young scientist herself, she has mobilized support from all corners of Canada and from many individuals and organizations worldwide. Her passion for the importance of public science in our society and democracy has been communicated through countless press releases, rallies, petitions, and meetings with Government officials.

Dr. Britt Hall, Associate Professor at the University of Regina, lauds Ms. Orihel's efforts in fighting for the ELA. "*Diane's actions in her fight to save the ELA have motivated Canada's scientists to become advocates for environmental science in general, something Canada sorely needs in the present political climate*."

The Experimental Lakes Area (ELA) is a living laboratory in northwestern Ontario. For the past 40 years, scientists at the ELA have worked with industry and policy-makers to find solutions to the problems of acid rain, reservoir creation, mercury contamination in fish, and algal blooms in freshwater lakes. While the Government has now officially

SAVE ELA
EXPERIMENTAL LAKES AREA

recognized Orihel's efforts with this award, the future of the ELA remains uncertain. Orihel led the Coalition in arguing that science conducted at the ELA was in the public good, and that the Government should continue to operate the station. The Government continues to say that the preferred option is to find a new operator to run the ELA, but the clock is ticking fast toward the March 2013 deadline for closure. Orihel recently stepped down as Director of the Coalition to Save ELA, and has returned to her PhD studies.

The Experimental Lakes Area currently costs the Government of Canada $2 million a year to operate.

Note from the Editor: The Coalition to Save ELA is a nonpartisan group of scientists and citizens concerned about the future of Canada's Experimental Lakes Area. Their mission is to promote awareness and support for the Experimental Lakes Area, and to advocate in the interest of all Canadians for the continuation of this essential research program. ELA's vision is as a world-class research program generating sound, scientific evidence for the development of effective public policy, management strategies, and stewardship activities to ensure the health of Canada's freshwaters and fisheries.

New Development Modules from COMET

The COMET Program has recently announced the development of the following new modules:

1) Satellite Feature Identification: Cyclogenesis. This less than 1-hour module contains four sections and three exercises that guide the learner through basic concepts to use water vapour satellite imagery to identify conditions which make extratropical cyclogenesis possible and recognize cyclogenesis once it has begun. First, through an initial case study, the precursor elements leading to cyclogenesis are identified. Then three conceptual views of different ways cyclogeneisis can evolve are presented along with additional examples to illustrate the concepts. Finally, a series of exercises, again using real case studies, are used to emphasize the important points and provide realistic scenarios describing some of the many ways cyclogenesis reveals itself on satellite imagery. Finally, there is a summary of the main points.

2) Introduction to Climate Models: Have you ever wondered how climate models work? How they can make accurate projections decades or centuries into the future when current weather models struggle to predict the weather next week? Introduction to Climate Models shows how climate models work. Because the modeling of both weather and climate share many similarities, the content throughout this module draws frequent comparisons and highlights the differences between the two. We explain not only how, but why climate models differ from weather models. To do so, we explore the difference between weather and climate, then show how models are built to simulate climate and generate the statistics that describe it. We conclude with a discussion of how models are tuned and tested.

This module is squarely aimed at the weather forecasting community: those who are already familiar with NWP models. However, non-forecasters with an interest in weather and climate will also find the module useful. The content is not overly technical and the goal of this module is not to train people to develop climate models but to highlight the similarities and differences between weather and climate models.

3) Three short modules relating to the impacts of climate change:

i) Climate Change and Regional Impacts: An overview of the different effects climate change has produced in different regions of the United States. In addition, the module presents information on how climate scientists use specialized models and statistical techniques to estimate how regional climates are likely to change in the future and what those projections currently are.

ii) Climate Change and Extreme Weather: Discusses how a changing climate can also lead to changes in local extreme weather events. The role of natural variability is also explained, and the module discusses what changes scientists think are likely if greenhouse gas emissions continue to rise.

iii) Climate Change and Sea Level Rise: Looks at how increasing temperatures due to climate change have affected sea level rise and what effects scientists expect in the future, given rising greenhouse gas emissions. The various mechanisms of sea level rise are discussed, as well as the tools and research used to study this topic. The module also discusses how countries and communities are preparing for future increases.

The modules should be of particular interest to broadcast meteorologists, although operational forecasters and the general public interested in climate change will also find them useful.

4) Satellite Monitoring of Atmospheric Composition. Satellites have become one of the most important tools for developing better understanding of the composition of the atmosphere. Developed in partnership with EUMETSAT, this 1-hour module provides an overview of the main satellite applications in this area, which include monitoring stratospheric ozone and ozone depletion, pollution (including long distance transport), volcanic ash and SO_2, and chemicals important in assessing climate change. In addition, the module discusses the operational uses of satellites in air quality forecasting. A brief history of atmospheric composition satellite missions is provided, along with a look at plans for future research and operational missions.

Please follow this link to the MetEd description page that provides additional information and a link to begin the chosen module:

https://www.meted.ucar.edu/

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Most COMET modules use JavaScript and Adobe® Flash® for navigation, animation, and/or presentation of multimedia elements. Ensure that you have a browser updated to its latest version with JavaScript enabled and the latest version of the Adobe FlashPlayer installed (http://get.adobe.com/flashplayer/). For technical support for this module please visit our Registration and Support FAQs at https://www.meted.ucar.edu/resources_faq.php

Comet welcomes any comments or questions you may have regarding the content, instructional approach, or use of these modules.

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Canadian Water Resources Association
Association Canadienne des Ressources Hydriques

CMOS SCMO
Canadian Meteorological and Oceanographic Society
Société canadienne de météorologie et d’océanographie

Canadian Geophysical Union
Union Géophysique Canadienne