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CMOS

BULLETIN

SCMO

Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

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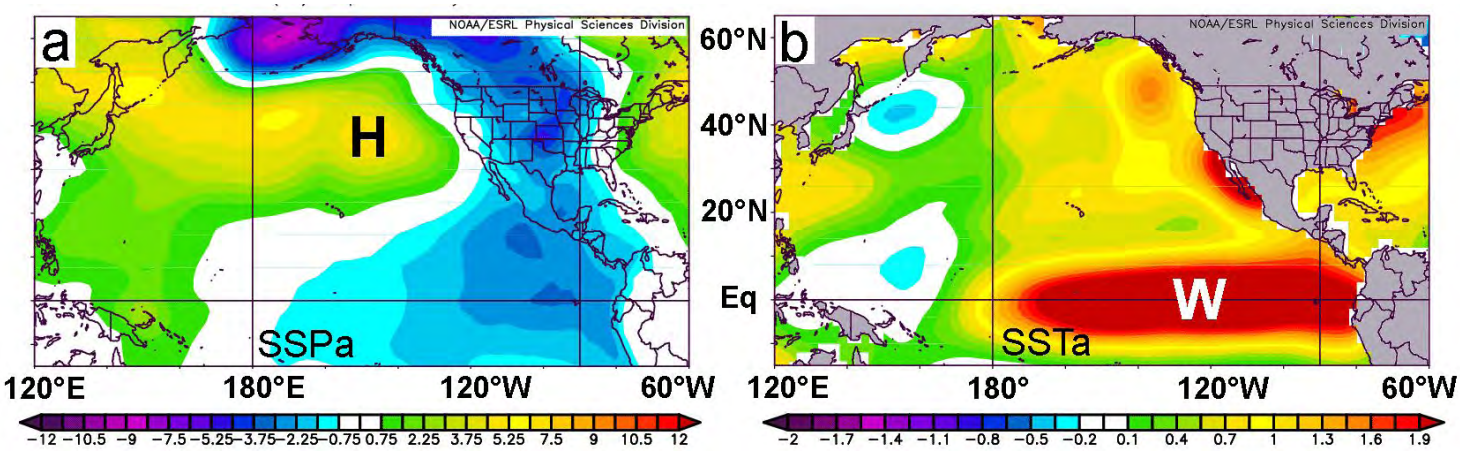
Vol.44 No.1

Sea surface pressure anomalies (a)
Sea surface temperature anomalies (b)
November-December 2015



Anomalies de pression à la surface de la mer (a)
Anomalies de température de la surface de la mer (b)
Novembre à Décembre 2015

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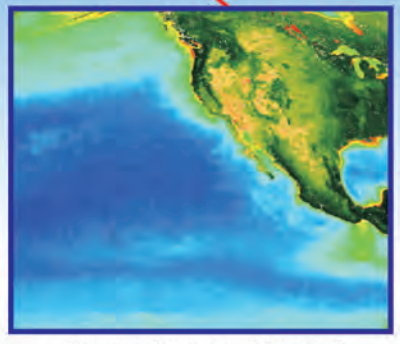
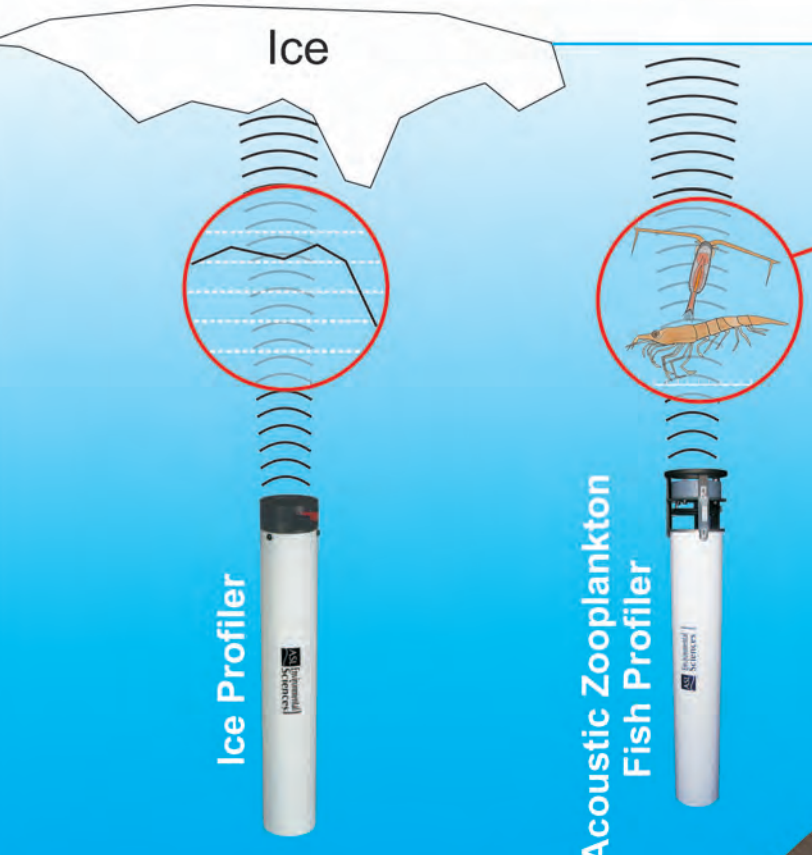
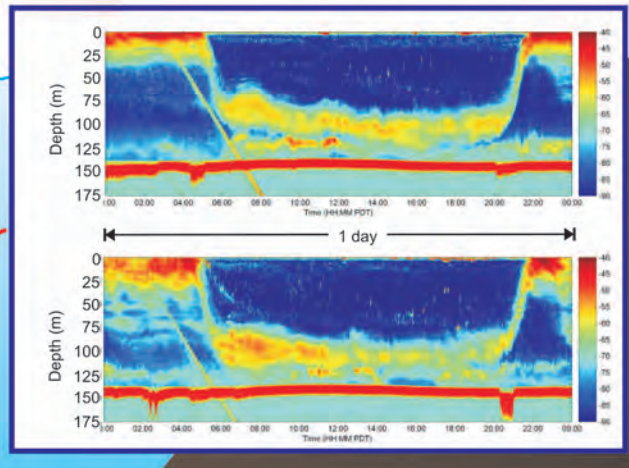


Ocean colours are chlorophyll concentrations and land colours are NDVI





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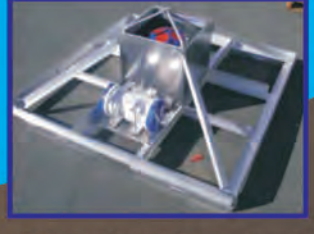

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.... Words from the President

Friends and Colleagues:

Martha Anderson
CMOS President
Présidente de la SCMO

The year 2016 promises to be an exciting one for CMOS. The Congress in Fredericton, N.B. will be our **50th** congress! We hope many of you will be there. The joint congress with the Canadian Geophysical Union (CGU) has the theme of "*Monitoring of and Adapting to Extreme Events and Long-Term Variations*".

Through 2016, we will be preparing for the larger milestone in 2017, the 50th anniversary of the creation of the Canadian Meteorological Society in 1967, and the addition of the oceanographic disciplines in 1977. I welcome ideas from anyone who wants to get involved in planning our celebrations. At congress 2016, we plan to have some visioning and strategic planning sessions about the future of CMOS and our role in promoting the disciplines of meteorology and oceanogaphy in Canada.

Later in the publication, you will find an introduction to our new Executive Director, Gordon Griffith. We are very fortunate to gain his long-time experience from Engineers Canada and other not-for-profit organizations. I would like to profusely thank Bruce Ramsay who stepped in to be interim Executive Director from September to January, which allowed us time to do a thorough hiring process after Andrew Bell departed.

As this CMOS Bulletin is being prepared for publication, myself and our Past-President Dr. Harinder Ahluwalia will be at the American Meteorological Society (AMS) Annual Meeting in New Orleans, where AMS and CMOS are co-hosting the 4th Meeting of the International Forum of Meteorological Societies (IFMS – www.ifms.org). I would like to thank Harinder for taking a leadership role as the coordinator of this event. Many influential persons have been invited to help inform discussions on the future role of meteorological societies in facilitating cooperation in the complex and changing international weather enterprise.

[Continued on page 3]

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Inside / En Bref

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CMOS Bulletin SCMO
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Cover page: Images of (a) sea surface pressure anomaly (SSPa, millibars) and (b) sea surface temperature anomaly (SSTa, °C) in the North Pacific Ocean. Both panels are averages over the months of November to December of 2015. The letter **H** *in the left panel denotes the centre of a region of anomalous high pressure; the letter* **W** in the right panel shows anomalously warm equatorial Pacific waters of the 2015 El Niño. To learn more, please read William Crawford's article on **page 5**. Images are courtesy of NOAA/ESRL Physical Sciences Division.

Page couverture: Cartes des anomalies de pression à la surface de la mer (a) en hectopascal (SSPa) et des anomalies de température de la surface de la mer (b) en degré Celsius (SSTa), dans l'océan Pacifique Nord. Les deux images montrent les moyennes des mois de novembre à décembre 2015. La lettre **H,** à gauche, dénote le centre d'une région de haute pression anormale. La lettre **W**, à droite, indique les eaux anormalement chaudes du phénomène El Niño 2015, dans le Pacifique. Pour en savoir davantage, consultez l'article de William Crawford à la **page 5**. Reproduction autorisée par la NOAA/ESRL Physical Sciences Division.

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

Council / Conseil d'administration

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

CMOS Council is currently considering topics to bring to you, the membership, at the Annual General Meeting (AGM) in late May. CMOS finances are being carefully analyzed to consider if membership dues need to be increased. A key gap that needs to be addressed is the lack of a Communications Officer, to help us achieve our goal of being a voice of scientific authority in Canada. We also have a team preparing options for the future of the Professional Meteorologist (P Met) designation that was suspended by ECO Canada over a year ago.

I have been very pleased to see that membership numbers increased in 2015. After three years of declining numbers, this bodes well for CMOS as our golden anniversary approaches. I believe our efforts to modernize with a new website, using social media, and offering webinars has helped. Membership is made more appealing by having a vibrant and active community at local and national levels. CMOS can always accomplish more with a wide team of enthusiastic volunteers, so please do step forward and do your part.

Martha Anderson, CMOS President

.... Allocution de la présidente

Chers amis et collègues,

L'année 2016 promet d'être des plus passionnantes pour la SCMO. Le Congrès de Fredericton (N.-B.) marquera la 50e édition de cet événement! Nous espérons vous voir en très grand nombre. Le Congrès, organisé conjointement avec l'Union géophysique canadienne (UGC), s'intitule «Adaptation aux événements extrêmes et aux variations à long terme et leur surveillance».

Tout au long de 2016, nous nous préparerons à commémorer un jalon encore plus important en 2017 : le 50e anniversaire de la création de la Société canadienne de météorologie en 1967 et l'ajout de la composante océanographique en 1977. Toutes les idées, venant de tous ceux qui veulent participer à la planification de cette célébration, sont les bienvenues. Au Congrès 2016, nous comptons tenir des séances afin de formuler une vision et un plan stratégique orientant le futur de la SCMO, et définir notre rôle de promoteur de la météorologie et de l'océanographie au Canada.

Plus loin dans ce bulletin, nous vous présentons notre nouveau directeur général, Gordon Griffith. Nous sommes privilégiés de pouvoir profiter de sa longue expérience au sein d'Ingénieurs Canada et d'autres organismes sans but lucratif. Je remercie abondamment Bruce Ramsey, qui a assuré l'intérim au poste de directeur général de septembre à janvier. Sa présence nous a permis de mettre en place un processus de sélection rigoureux à la suite du départ d'Andrew Bell.

Tandis que ce bulletin était en préparation, notre président sortant Harinder Ahluwalia et moi-même sommes allés au congrès annuel de l'American Meteorological Society (AMS) à La Nouvelle-Orléans. L'AMS et la SCMO y ont accueilli conjointement le 4e congrès de l'International Forum of Meteorological Societies (IFMS – www.ifms.org). Je remercie Harinder de s'être porté volontaire pour coordonner cet événement. Bon nombre de personnes influentes ont été invitées pour orienter les discussions sur le rôle futur des sociétés météorologiques en ce qui concerne l'amélioration de la coopération dans le contexte complexe et changeant de l'entreprise météorologique internationale.

Le conseil d'administration de la SCMO examine actuellement des sujets de discussion qu'il présentera aux membres à l'assemblée générale annuelle (AGA), à la fin de mai. Nous analysons en détail les finances de la SCMO afin de déterminer s'il est nécessaire d'augmenter les frais d'adhésion. Reste aussi à combler une lacune majeure : l'absence d'un agent de communication. Cette personne nous permettrait de nous imposer en tant qu'experts scientifiques au Canada. Une équipe travaille aussi sur les options possibles quant au futur de la certification des météorologistes professionnels (Met. P.), qu'ECO Canada avait laissée en suspens, il y a plus d'un an.

J'ai été ravie de noter la hausse du nombre d'adhésions en 2015. Après trois ans de déclin, cette augmentation s'avère de bon augure pour la SCMO, tandis que notre jubilé approche. Je crois que nos efforts de modernisation, comme le nouveau site Web, l'utilisation de médias sociaux et l'offre de webinaires, n'y sont pas étrangers. Grâce au dynamisme d'une communauté active, aux échelons local et national, l'adhésion se révèle profitable. La SCMO peut accomplir encore plus avec une équipe renforcée de bénévoles enthousiastes. N'hésitez pas à vous porter volontaire pour le bien de la Société.

Martha Anderson, Présidente de la SCMO

CMOS/SCMO seeks applicants for the position of Editor of *CMOS Bulletin SCMO*

Responsibilities

The *CMOS Bulletin SCMO* is published six times per year, in both electronic and paper copy versions. The task of publishing each issue takes approximately 40 hours, every second month.

Council is open to considering proposals from a prospective Editor who has the interest and ability to transform the current "magazine" style bulletin to one that will lend itself to web and social media while maintaining the current information content, and remaining attractive to CMOS nmembership.

Editorial tasks include soliciting articles, reviewing the articles for technical content, assembling and formatting the issue, arranging for translation when required, sending issue file to printer.

The Editor works independently, but with support from CMOS office staff and the CMOS Director of Publications.

Required Competencies

- A familiarity with scientific publishing.
- General knowledge of meteorology and/or climatology and/or oceanography.
- Competent user of an electronic word processor such as MS Word or Apple Pages or other publication softwares.
- Fluency in English, though being bilingual would be a significant advantage.
- Ability to self-motivate and work independently.

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La SCMO recherche des candidats pour le poste de rédacteur en chef du *CMOS Bulletin SCMO*.

Responsabilités

Le *CMOS Bulletin SCMO* paraît six fois par année, en versions papier et électronique. La préparation de chaque numéro demande environ 40 heures de travail, tous les deux mois.

Le conseil d'administration de la SCMO est ouvert aux propositions de candidats qui auraient les idées et l'aptitude pour transformer l'actuel bulletin de type «magazine» en une publication qui se prête au format du Web ou des médias sociaux, et ce, sans en diminuer le contenu informatif ni l'attrait pour les membres de la SCMO.

Le rédacteur en chef doit entre autres solliciter des articles et en réviser le contenu technique, assembler et mettre en page les éléments du numéro, organiser la traduction, le cas échéant, et envoyer le fichier à l'imprimeur.

Le rédacteur en chef travaille de façon autonome, mais avec le soutien du personnel du bureau de la SCMO et du directeur des publications de la SCMO.

Compétences nécessaires

- Connaître les rudiments de l'édition scientifique.
- Avoir des connaissances générales en météorologie, en climatologie ou en océanographie.
- Savoir utiliser des logiciels de traitement de texte comme MS Word, Pages d'Apple ou autres logiciels de publication.
- Communiquer en anglais avec aisance bien que la connaissance du français est un atout considérable.
- Savoir se motiver et travailler de façon autonome.

Rémunération

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ARTICLES

Delayed El Niño impacts in the Northeast Pacific Ocean?

by William Crawford[1]

El Niño events are one of the few predictable, seasonal weather anomalies of the globe, warming the central and eastern tropical Pacific with predictions a few months before they arrive. Atmospheric teleconnections spread the warming to higher latitudes and during strong El Niño events the reliability of this teleconnection is impressive. The present El Niño is as strong as the two giant ones of 1983/84 and 1997/98, as measured by the degree of warming of central Equatorial Pacific waters, so Canadians are anticipating the "normal" teleconnections. William Hsieh pointed out in the October 2015 Issue of CMOS Bulletin SCMO that "*During the winter of an El Niño, the air temperature tends to be warm over most of Canada, with the greatest warming centred around Manitoba-western Ontario, where a temperature anomaly of up to +3°C can be found*." The California coast receives heavy rain. As for ocean effects, British Columbia seas tend to be warmer.

The current El Niño began in March 2015, but had not started its teleconnection to the Northeast Pacific by the end of December 2015. Oceans off British Columbia were indeed warm, but the warming began earlier and was due to previous atmospheric and ocean conditions, and the warm anomaly actually weakened in November and December of 2015.

To see how this El Niño in unusual, let's first look at strong El Niño events of the past. The two panels below show atmospheric surface pressure anomaly (left) and sea surface temperature anomaly (right) averaged over the months of November to March for three strong El Niño events of the years 1957/1958, 1982/1983, 1997/1998, as well as the most recent one in 2009/2010.

When averaged over these four events, the east-central equatorial Pacific Ocean warmed from the longitude of 180° all the way to the South American coast. Cooling extended in the west from Indonesia to about 170°E. Normally when temperatures of the Pacific equator increase to this extent, the atmospheric Hadley circulation shifts significantly, leading to a very intense Aleutian low pressure system in the Northeast Pacific Ocean (marked by the letter L in Fig. 1a). This low anomaly persists through the Canadian winter. The Aleutian low grows in strength in almost all winters, so its intensification in El Niño winters lead to much stronger storm winds from the south all along the North American west coast from northern Mexico to Alaska. These winds in turn push warm waters north along the west coast, and also downwell warm coastal waters on the continental shelf. During intense El Niño events, the warm waters of the equatorial Pacific along the South American west coast spread poleward as coastal trapped waves, and once the northern wave reaches California, the southerly winds of the Aleutian low give it an extra push to the north, leading to even more warming along the west coast. This warming can be seen in Fig 1b, extending from Central American to the south coast of Alaska. In deep-sea waters, the anomalous winds stress curl and wind-forced advection of surface waters usually creates a pool of cool surface water, centred near 35°N, 165°W.

The full, North Pacific oceanic response lags the atmospheric changes by months. The Pacific Decadal Oscillation and the North Pacific Gyre Oscillation are two modes of variability that account for many of these additional details of warming and cooling (Di Lorenzo et al., 2013); however, the in-phase winter teleconnection shown in Figure 1 is robust when very strong El Niño warming hits the central and eastern equatorial Pacific. Although the full impact of El Niño normally hits in mid-winter, the teleconnection usually arrives by November and coastal waters warm late in the calendar year.

The warming of coastal surface seawater in British Columbia during recent El Niño events is evident in time series of daily samples of ocean temperature taken at lighthouses along the Canadian west coast. Locations of these lighthouses are marked in Fig. 2, and the Amphitrite Point station is shown on the southwest coast of Vancouver Island.

The monthly temperature anomaly record from Amphitrite Point is shown in Fig. 3 for the years from 1996 all the way to December 2015. Although there are warm seasons that are not associated with El Niño events, warming is significant during each of the 1997/98 and 2009/10 events. The present El Niño presents a curious anomaly. Warming began in mid-2014 well before this El Niño started. This warming is most likely part of the "warm blob" of the Northeast Pacific Ocean that formed late in 2013, and moved onshore in late summer of 2014. (See "Something Odd in the Gulf of Alaska" by Howard Freeland in the April 2014 issue of the CMOs Bulletin SCMO, as well as Bond et al., 2015). This warm blob was by far the warmest mid-ocean patch ever observed off the west coast of Canada and the USA, and was formed under an unusually

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

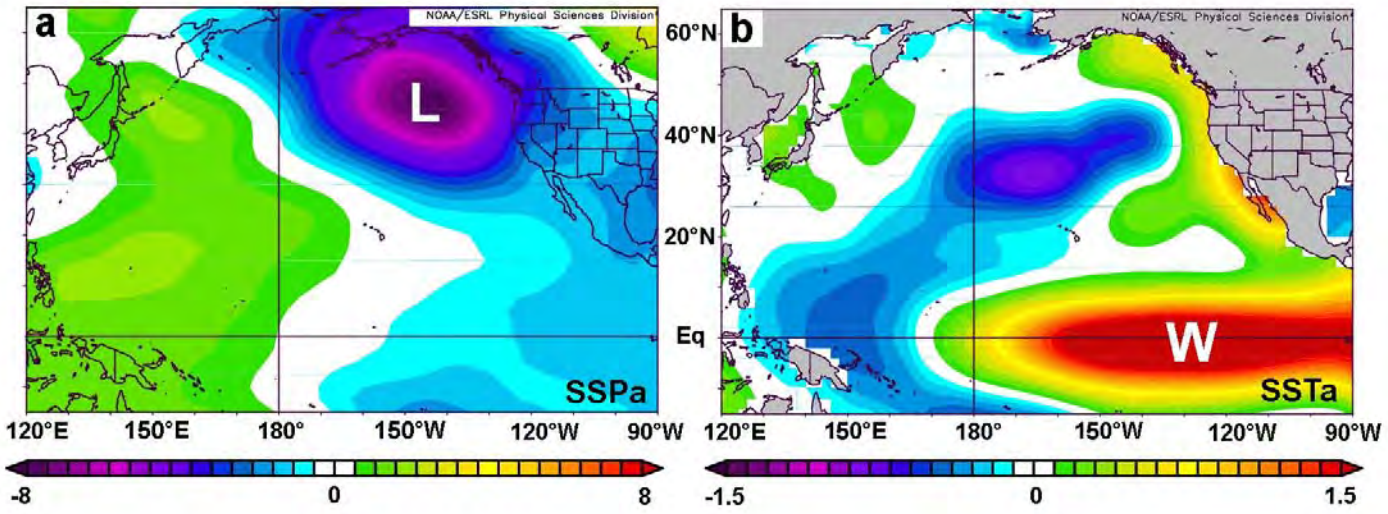

Figure 1. *Images of (a) sea surface pressure anomaly (SSPa, millibars) and (b) sea surface temperature anomaly (SSTa, °C) in the North Pacific Ocean. Both panels are averages over the months of November to March of 1957/58, 1982/83, 1997/98, 2009/10. The letter* **L** *in the left panel denotes the centre of an intense Aleutian low pressure anomaly; the letter* **W** *in the right panel shows anomalously warm equatorial Pacific waters. This image and others are provided by the NOAA/ESRL Physical Sciences Division through its Internet site: http://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl.*

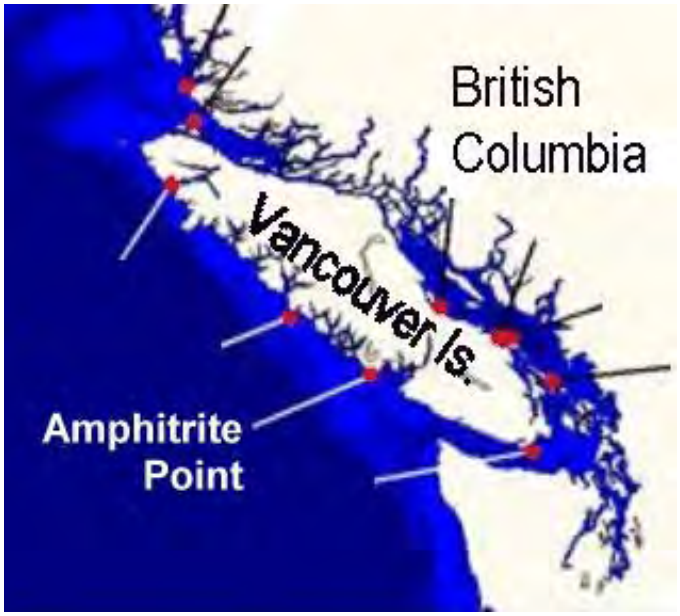

Figure 2. *Locations of daily sampling stations maintained by Fisheries and Oceans Canada on the central and southern British Columbia coast. Amphitrite Point station is at the lighthouse of the same name. More information and time series are provided by DFO at: http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/index-eng.html*

persistent high pressure system in late 2013. Although not entirely the same, the warming in 1997 that began in May 1997 before that El Niño began was also attributed to onshore advection of a patch of warm offshore water that also predated the El Niño event. However, the temperature anomaly of the patch in 1997 was far smaller than found in 2013/15.

The evolution of the warm blob from 2014 to late 2015 can be seen in Figure 4, which shows sea surface temperature anomalies through the Gulf of Alaska at half-year intervals, ending with Nov- Dec 2015, the most recent data available at press time. The warm blob appears as the very red region offshore North America, centred in mid-Gulf of Alaska in Jul-Sep 2014 (Fig 4a). Its temperature anomaly was calculated as 4 standard deviations above normal by Freeland (2014). In the autumn of 2014 when the summer upwelling winds abated, the blob advected to the coast and hugged the coast through the winter (Fig 4b). Summer upwelling winds of 2015 decreased the positive temperature along the coast from BC to Oregon in July and September 2015 (Fig 4c). In late autumn of 2015 the warm blob was expected to again move toward the coast as summer upwelling winds weakened, and coastal warming **should** have increased as the expected El Niño teleconnection arrived. Instead, the temperature anomaly along the Canadian and USA west coast actually decreased in Nov-Dec 2015 from the positive values of the previous summer, as shown in Fig 4d.

Fig 4d reveals that the Gulf of Alaska was still warmer than average in Nov-Dec 2015; however, the decrease in magnitude of the positive temperature anomaly from Jul-Sep 2015 to Nov-Dec 2015 is impressive. The expected warming of the sea surface along the west coast of USA and Canada due to the El Niño teleconnection is not present, as of early 2016.

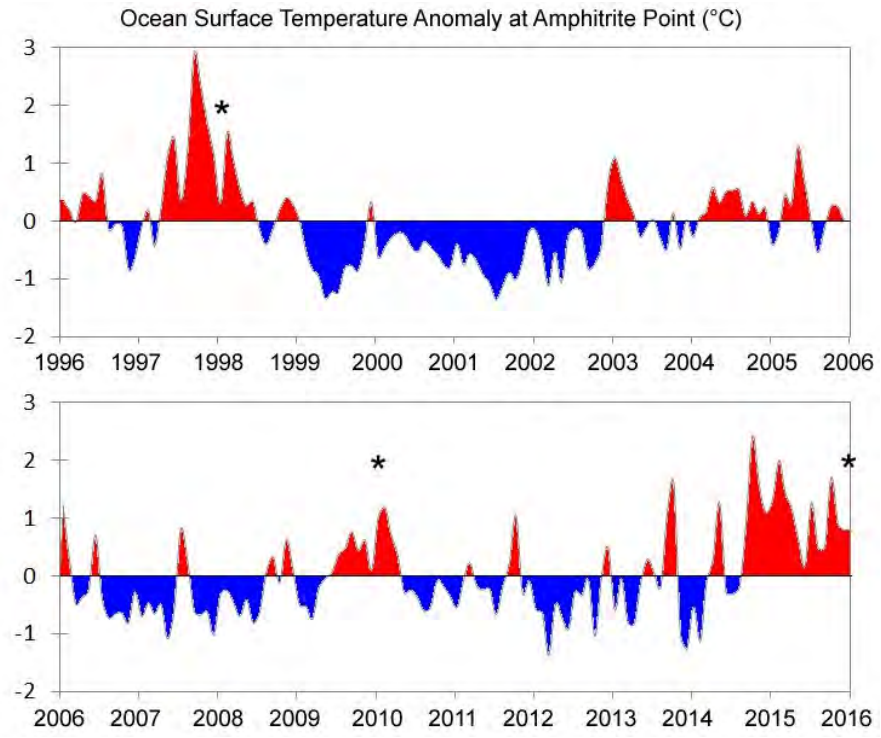

Figure 3 (above).*Monthly temperature anomalies (°C) measured at Amphitrite Point from January 2006 to December 2015. Reference temperature is the annual cycle over 1981 to 2010. The symbol * denotes the month of January during the three strongest El Niño events of this period. Labels on the x-axis denote January of each year. Data provided by Peter Chandler of DFO at the Institute of Ocean Sciences.*

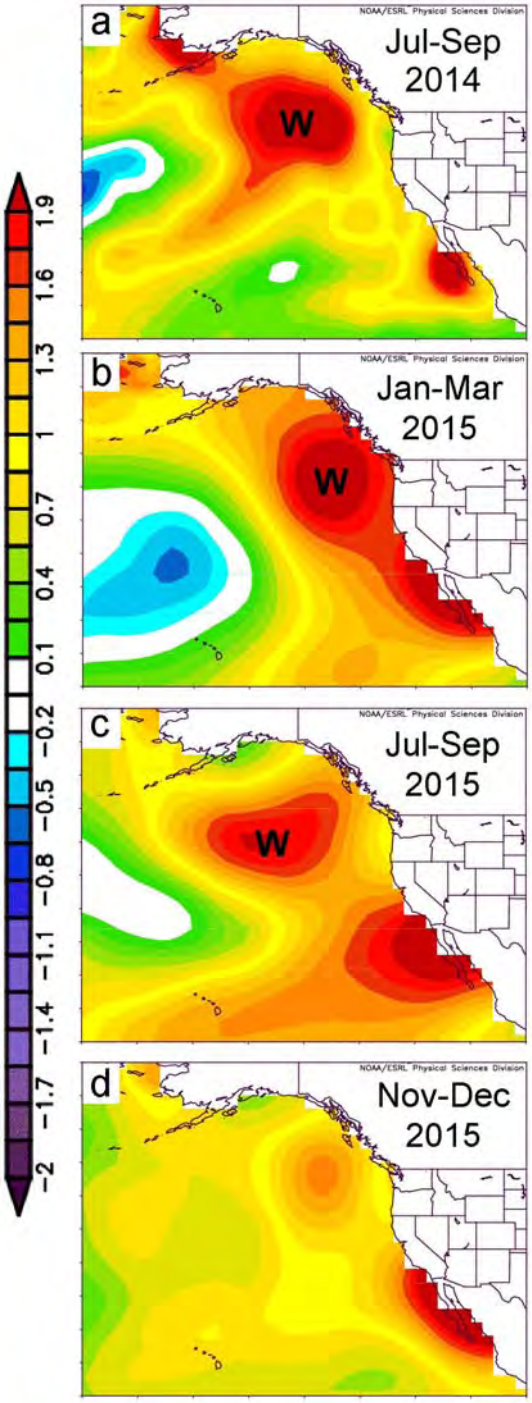

Figure 4 (right). *Sea surface temperature anomalies (SSTA) of the northeast Pacific Ocean in four separate periods from July 2014 to December 2015. The temperature scale in degrees Celsius is at right. The regional extent is from 15°N to 65°N and 180°W to 100°W. The letter* **W** *denotes the centre of the warm blob. Images from NOAA/ESRL Physical Sciences Division.*

To understand why these west coast surface waters actually cooled in autumn 2015, we can examine the pressure and temperature anomalies of Nov-Dec 2015 for the entire North Pacific, shown in Fig. 5. In the Gulf of Alaska where the Aleutian low was expected to intensify we find a local high pressure anomaly, centred at 35°N, 160°W in Fig 5a. The effect of this pressure anomaly would be to weaken the normally strong southerly winds that blow along the coast during autumn storms, and weaken the northward advection and downwelling of warm, coastal waters. These conditions may have caused the decrease in positive temperature anomalies in Nov-Dec 2015, shown in Fig. 4d. This local anomalous high pressure in the Gulf of Alaska shown in Fig 5a was clearly not the expected teleconnection from the tropics, where the warm sea surface temperature had spread all across the central and eastern equatorial Pacific (Fig. 5b).

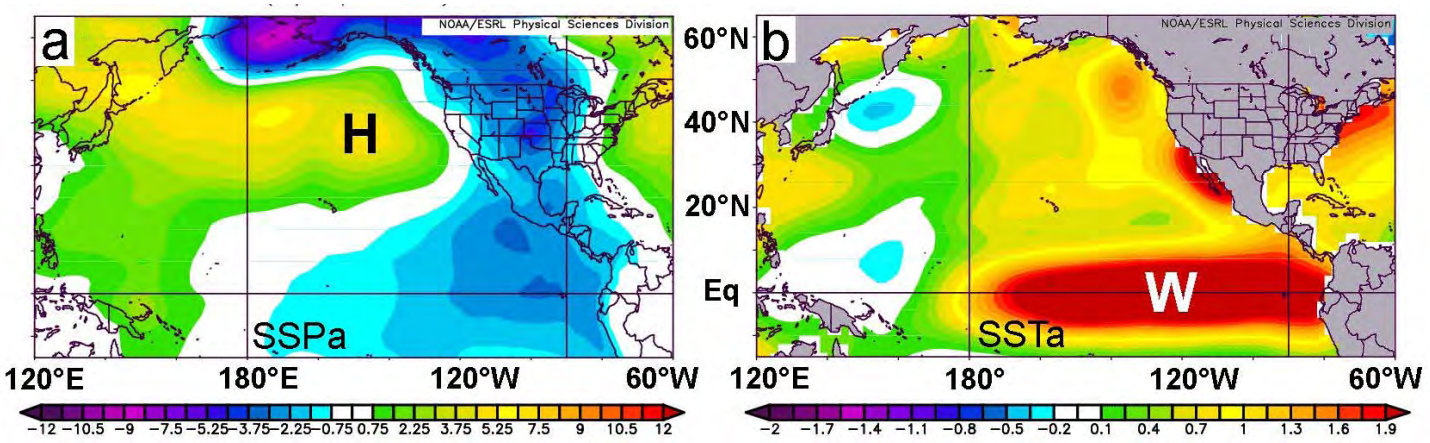

Figure 5. *Images of (a) sea surface pressure anomaly (SSPa, millibars) and (b) sea surface temperature anomaly (SSTa, °C) in the North Pacific Ocean. Both panels are averages over the months of November to December of 2015. The letter* **H** *in the left panel denotes the centre of a region of anomalous high pressure; the letter* **W** *in the right panel shows anomalously warm equatorial Pacific waters of the 2015 El Niño. Images from NOAA/ESRL Physical Sciences Division.*

The El Niño atmospheric teleconnection to the Northeast Pacific Ocean could be delayed to January through March 2016, rather than suppressed for the entire winter. While preparing this article in early January, I noticed that a strong low pressure system had formed in the Pacific Ocean west of Oregon and Washington State, close to the position of the average low pressure anomaly shown in Fig 1a. In addition, the National Weather Service (NWS) had issued flash flood watches for much of the California coast from San Diego to San Francisco, noting that this storm was the strongest of the 2015/16 El Niño season. Despite the flooding of such storms, Californians generally welcome the rain of El Niño winters as needed waters for their reservoirs. By 2015 after many years of California drought, the rains of this winter will be welcomed.

Marine life in British Columbia coastal waters usually shifts in species composition immediately after warm El Niño impacts. For example, sockeye salmon that spawn in rivers draining the west side of Vancouver Island survive to adulthood in greater numbers after El Niño winters. Dr. Kim Hyatt of Fisheries and Oceans Canada has successfully predicted the numbers of sockeye returning to BC waters using an index based on local warming and cooling due to El Niño and La Niña events. Warm coastal waters normally lead to greater mortality of juvenile sockeye entering the ocean in spring following an El Niño winter (Hyatt, 2015). In addition, warmer waters off Vancouver Island generally lead to lower relative biomass of northern species of zooplankton, and poor breeding years for species such as sablefish, some seabirds and coho salmon (Mackas, Batten and Trudel, 2007). Most years from 2006 to 2013 were relatively cool at Amphitrite Point and other west coast locations, favoring the species of fish most preferred by sports fishers and commercial fleets. With possible warming in the 2015/16 El Niño, these waters might see a return to warmer waters species such as giant squid and mackerel that arrived off the Vancouver Island coast in earlier years.

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

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

Presenting the City of Edmonton Weather Radar

by Daniel Jobin[1], Christian Jacques[2], and Steven Chan[2]

On September 24, 2015, the City of Edmonton became the first municipality in Canada and perhaps in North America to acquire its own mini-weather radar for storm water management.

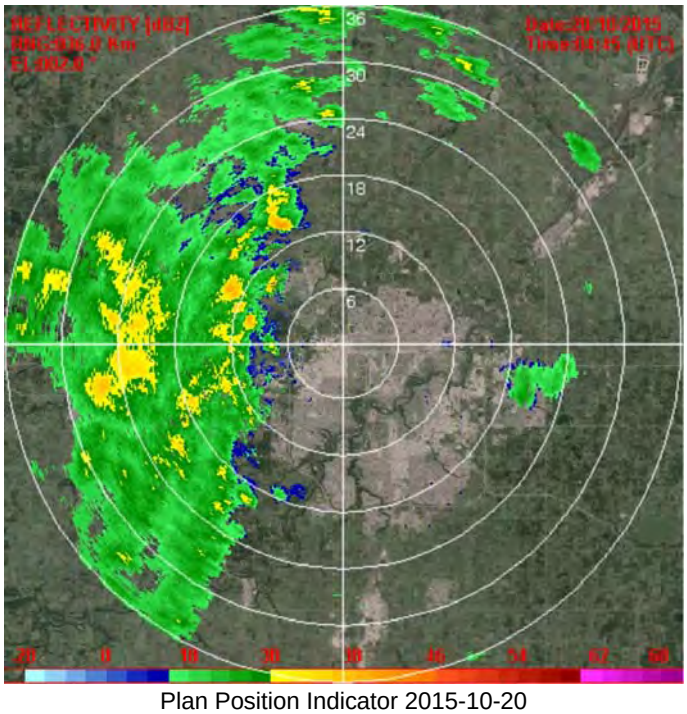
The X-Band system (see photograph below) was supplied and installed by RadHyPS Inc. and is remotely operated for the city under a multi-year agreement. Maintenance is being carried out with assistance from Campbell Scientific Inc. in Edmonton.

City of Edmonton Weather Radar

Although the system has a maximum range of 108 km, it will likely be operated at 22 or 36 km in order to obtain a higher range resolution of better than 150 m; hence, sample size. The system is being commissioned and tested over several months to ensure readiness for the spring of 2016. This includes determining an optimal set of operating parameters such as input data for the statistical clutter filter. Different antenna elevation angle combinations are also being evaluated in order to develop the optimal scanning strategy using the shortest update cycle to generate various products such as Plan Position Indicator (PPI) and Constant Altitude Plan Position Indicator (CAPPI) data.

The following figure shows a PPI product acquired on October 20th. The PPI is for a 2 degree vertical elevation and a maximum range of 36 km with clutter filtering enabled. The azimuthal resolution was set at 1 degree oversampling with a 150 m range resolution. The radar reflectivity data shows a storm front moving from the west toward the City of Edmonton which is located near the center of the image.

The anticipated high spatial and temporal resolution data will help the city to further its urban water resources research and development that was presented in previous CMOS Bulletins (Vol.41 No. 2, 3, 4 & 5). A key objective of the system is to provide the city with improved gauge-adjusted radar rainfall data for utmost rainfall storm characterization.



Plan Position Indicator 2015-10-20

[1] Kije Sipi Ltd - RadHyPS

[2] City of Edmonton

2015 likely to be Warmest on Record; 2011-2015 Warmest Five Year Period[3]

Climate Change Breaches Symbolic Thresholds, Fuels Extreme Weather

2015 sera probablement l'année la plus chaude jamais enregistrée, et 2011–2015 la période de cinq ans la plus chaude

Le changement climatique franchit des caps symboliques et favorise les phénomènes météorologiques extrêmes

Résumé: Genève, le 25 novembre 2015 (OMM) – La température moyenne à la surface du globe, en 2015, devrait être la plus élevée jamais constatée et franchira sans doute le seuil, aussi symbolique que significatif, que constitue un réchauffement de 1 degré Celsius par rapport à l'époque préindustrielle. Cette situation résulte des effets conjugués d'un puissant épisode El Niño et du réchauffement climatique causé par les activités humaines, d'après l'Organisation météorologique mondiale (OMM).

Les années 2011 à 2015 représentent la période de cinq ans la plus chaude jamais enregistrée, de nombreux phénomènes météorologiques extrêmes – en particulier les vagues de chaleur – étant influencés par le changement climatique, selon une étude menée sur cinq ans par l'OMM.

Geneva 25 November 2015 (WMO) The global average surface temperature in 2015 is likely to be the warmest on record and to reach the symbolic and significant milestone of 1° Celsius above the pre-industrial era. This is due to a combination of a strong El Niño and human-induced global warming, according to the World Meteorological Organization (WMO).

The years 2011-2015 have been the warmest five-year period on record, with many extreme weather events - especially heatwaves - influenced by climate change, according to a WMO five-year analysis.

"*The state of the global climate in 2015 will make history as for a number of reasons*," said WMO Secretary-General Michel Jarraud. "*Levels of greenhouse gases in the atmosphere reached new highs and in the Northern hemisphere spring 2015 the three-month global average concentration of CO_2 crossed the 400 parts per million barrier for the first time. 2015 is likely to be the hottest year on record, with ocean surface temperatures at the highest level since measurements began. It is probable that the 1°C Celsius threshold will be crossed*," said Mr. Jarraud. "*This is all bad news for the planet*."

"*Greenhouse gas emissions, which are causing climate change, can be controlled. We have the knowledge and the tools to act. We have a choice. Future generations will not.*"

"*Added to that, we are witnessing a powerful El Niño event, which is still gaining in strength. This is influencing weather patterns in many parts of the world and fuelled an exceptionally warm October. The overall warming impact of this El Niño is expected to continue into 2016,*" said Mr. Jarraud.

WMO issued its provisional statement on the status of the climate in 2015, and an additional five-year analysis for 2011-2015, to inform negotiations at the U.N. Climate Change Conference in Paris.

A preliminary estimate based on data from January to October shows that the global average surface temperature for 2015 so far was around 0.73 °C above the 1961-1990 average of 14.0°C and approximately 1°C above the pre-industrial 1880-1899 period.

This temperature tendency indicates that 2015 will very likely be the warmest year on record. The global average sea-surface temperature, which set a record last year, is likely to equal or surpass that record in 2015. The global average temperatures over land areas only from January to October suggest that 2015 is also set to be one of the warmest years on record over land. South America is having its hottest year on record, as is Asia (similar to 2007), and Africa and Europe their second hottest.

According to preliminary figures as of the end of September 2015, 2011-15 was the world's warmest five-year period on record, at about 0.57°C (1.01°F) above the average for the standard 1961-90 reference period. It was the warmest five-year period on record for Asia, Europe, South America, and Oceania, and for North America. WMO compiled the five-year analysis because it provides a longer-term climate signal than the annual report.

[3] WMO Press Release N° 13 released 25 November 2015

Highlights of 2015

1) El Niño

The full effect of the strong 2015 El Niño on global temperature is likely to continue after El Niño peaks. However, other impacts are already being felt. In early October, NOAA declared that record global ocean temperatures had led to a global coral bleaching event. This began in the North Pacific in the summer of 2014 and spread to the South Pacific and Indian Ocean in 2015.

Consistent with typical El Niño impacts, large areas of Central America and the Caribbean recorded below average rainfall. Brazil, which started the year in drought in southern and eastern areas, saw the focus of the drought shift north with scant rainfall during the dry season over the Amazon. India's monsoon rainfall was 86% of normal. In Indonesia, the low rainfall has likely contributed to the increased incidence of wildfires. Peru was affected by heavy rain and flooding, as was Argentina.

2) Ocean heat and sea level rise

The oceans have been absorbing more than 90% of the energy that has accumulated in the climate system from human emissions of greenhouse gases, resulting in higher temperatures and sea levels. In the first nine months of 2015, global ocean heat content through both the upper 700 meters and 2000 meters of the oceans reached record high levels. The latest estimates of global sea level indicate that the global average sea level in the first half of 2015 was the highest since satellite observations became available in 1993.

Significant warmth was recorded across large areas of the oceans. The Tropical Pacific was much warmer than average, exceeding 1°C over much of the central and eastern equatorial Pacific, consistent with the signature of a strong El Niño. The northeast Pacific, much of the Indian Ocean and areas in the north and south Atlantic were significantly warmer than average. Areas to the south of Greenland and in the far southwest Atlantic were significantly colder than average.

3) Regional temperatures

Significant warmer than average temperatures were recorded over the majority of observed land areas, especially western North America, large areas of South America, Africa, and southern and eastern Eurasia. China had its warmest January-to-October period on record. Russia also had its warmest January-October on record, with average temperatures some 2.10°C above the long-term average. For the continent of Africa, 2015 currently ranks as the second warmest year on record. Australia had its warmest October on record and a heatwave early in the month set new records for early season warmth.

One notably cold area was the Antarctic, where a strong anomaly in atmospheric patterns known as the Southern Annular Mode lasted for several months. Eastern areas of north America were colder than average during the year, but none were record cold. After a warm January to September, Argentina experienced its coldest October on record.

4) Heatwaves

A major heatwave affected India in May and June, with average maximum temperatures exceeded 42°C widely and 45°C in some areas. In southern Pakistan temperatures exceeded 40 °C in June.

Heatwaves affected Europe, northern Africa, and the Middle East through the late spring and summer, with many new temperature records set. In May, high temperatures affected Burkina Faso, Niger, and Morocco. Spain and Portugal also saw unusually high temperatures. July brought heat waves to a large area from Denmark in the north, to Morocco in the south and Iran in the east. In early August, Jordan experienced a heatwave, whilst Wroclaw (Poland) experienced an all-time high temperature of 38.9°C on the 8th August. The heat continued into September, shifting further into Eastern Europe.

During the spring of 2015 in South Africa, record high temperatures were exceeded on a regular basis.

5) Rainfall and drought

Areas of high rainfall included: southern areas of the USA, Mexico, Bolivia, southern Brazil, southeast Europe, areas of Pakistan, and Afghanistan. Heavy rain in January led to flooding in Malawi, Zimbabwe, and Mozambique, and in February it affected Morocco, Algeria, and Tunisia. 2015 saw exceptional seasonal rainfall totals in several parts of Burkina Faso and Mali.

March in Chile saw unusually heavy rains which caused flooding and mudslides. In August, heavy rain in the Buenos Aires province of Argentina saw several monthly and daily rainfall records broken during the month. Mexico had its wettest March on record (since 1941). It was the wettest May on record for the contiguous USA and the wettest month overall in 121 years of record keeping. Between May and October, China experienced 35 heavy rain events. Subsequent flooding affected 75 million people with estimated economic losses of 25 billion dollars.

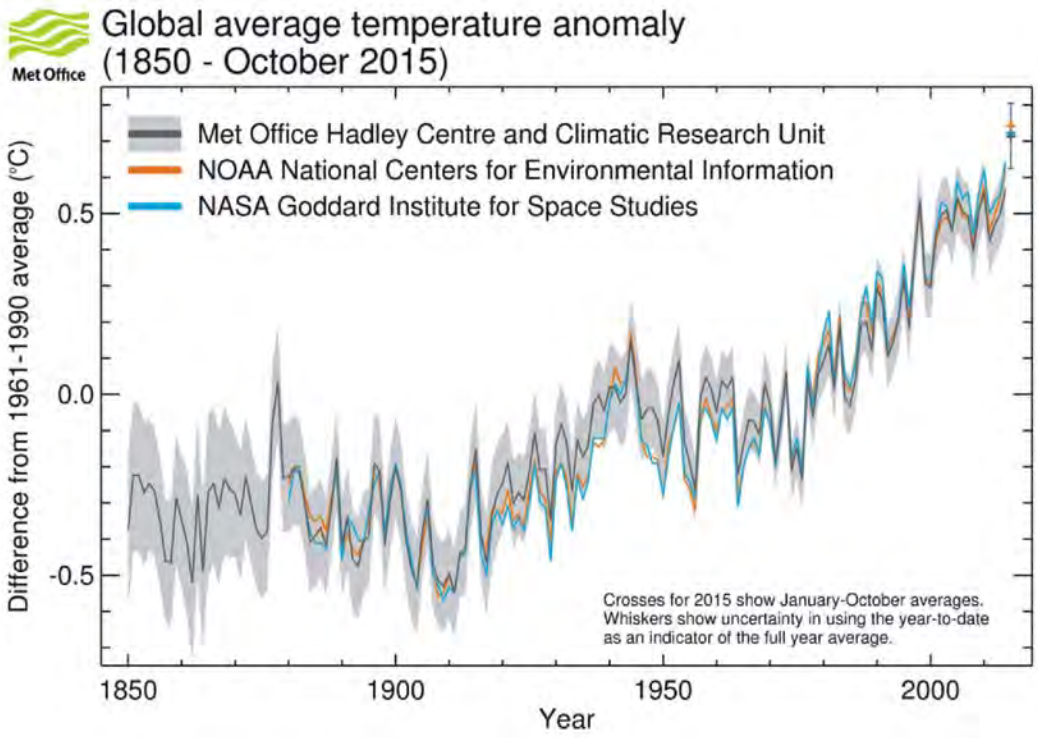


Figure 1: Global annual average near-surface temperature anomalies from HadCRUT4.4.0.0 (Black line and grey area indicating the 95% uncertainty range), GISTEMP (blue) and NOAAGlobalTemp (orange). The average for 2015 is a provisional figure based on the months January to October 2015. Source: Met Office Hadley Centre.

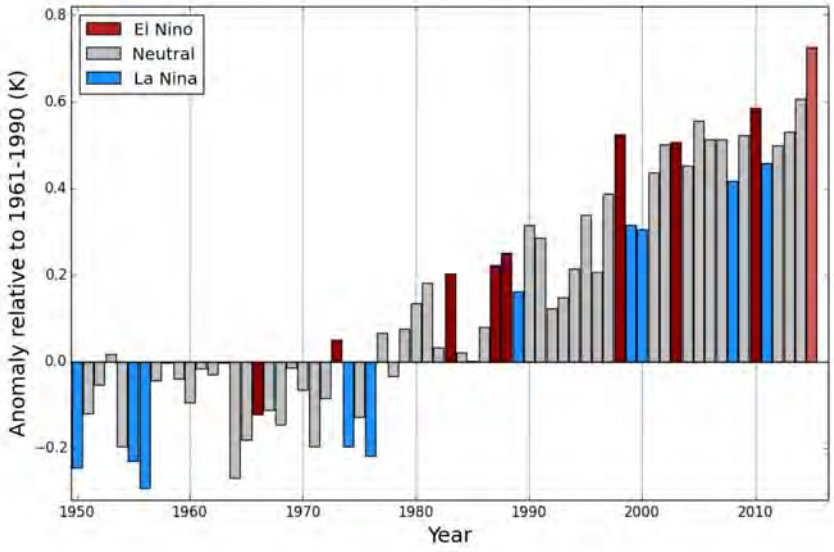


Figure 2: Global annual average temperatures anomalies (relative to 1961-1990) based on an average of three global temperature data sets (HadCRUT.4.4.0.0, GISTEMP and NOAAGlobalTemp) from 1950 to 2014. The 2015 average is based on data from January to October. Bars are coloured according to whether the year was classified as an El Niño year (red), a La Niña year (blue) or an ENSO-neutral year (grey).Note uncertainty ranges are not shown, but are around 0.1°C.

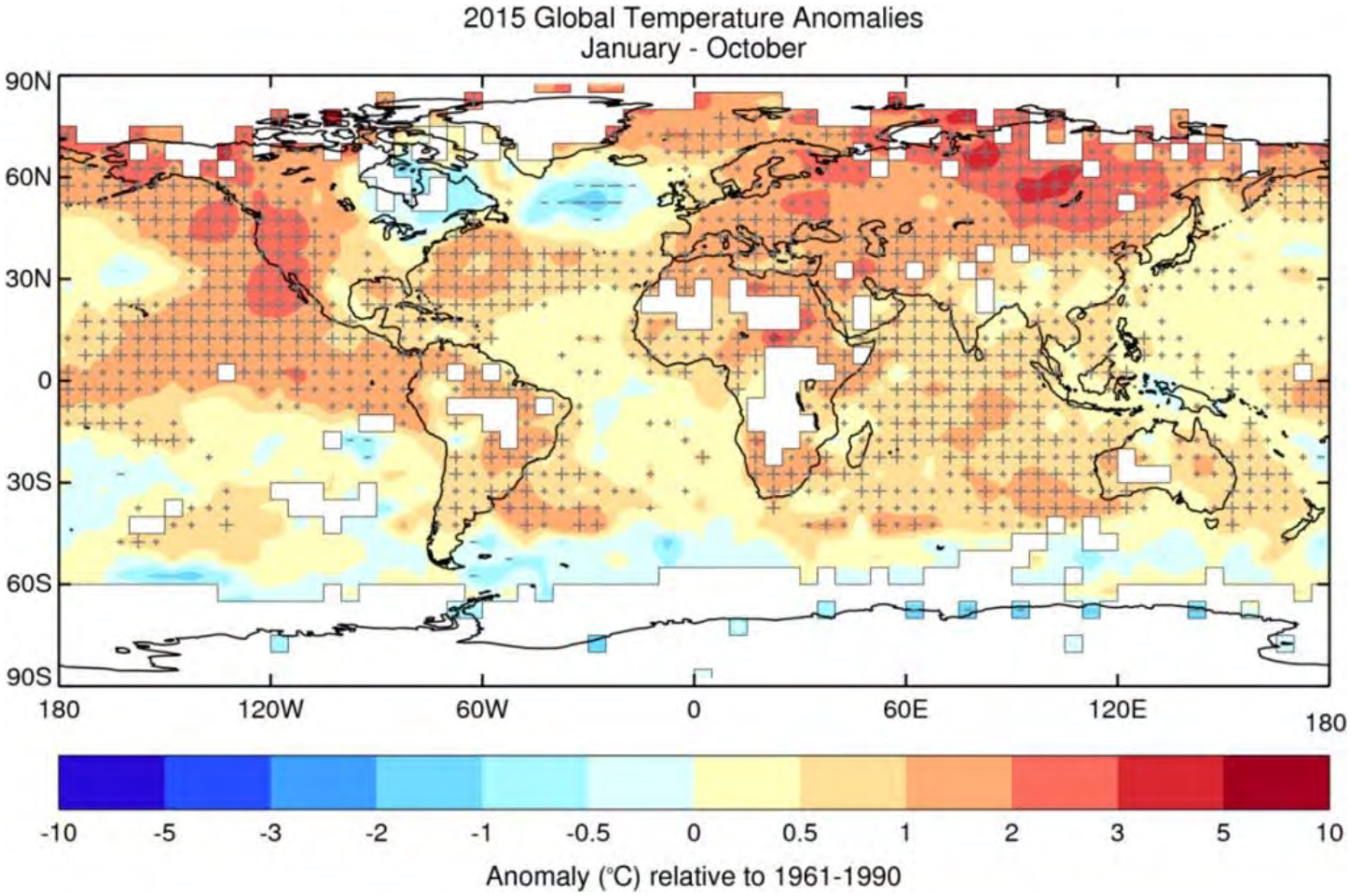


Figure 3: Average temperature anomalies for January to October 2015 from the HadCRUT.4.4.0.0 data set. Crosses (+) indicate temperatures that exceed the 90th percentile, signifying unusual warmth, and dashes (-) indicate temperatures below the 10th percentile, indicating unusually cold conditions. Large crosses and large dashes indicate temperatures outside the range of the 2nd to 98th percentiles. Source: Met Office Hadley Centre.

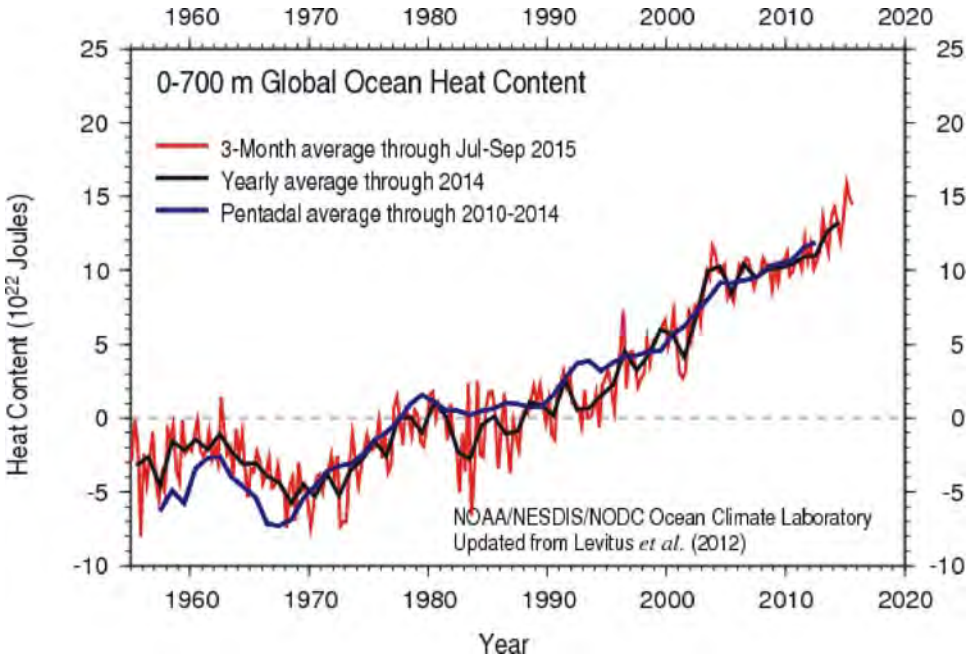


Figure 4a: Ocean heat content down to a depth of 700m. Three-month (red), annual (black) and 5-year (blue) averages are shown. Source: NOAA NCEI

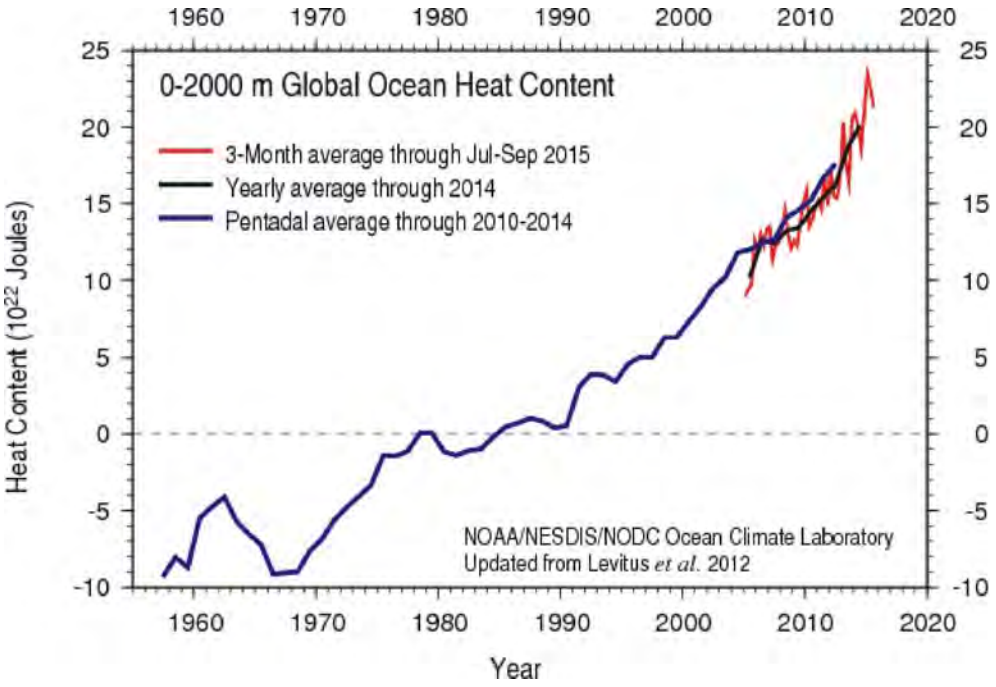


Figure 4b: Ocean heat content down to a depth of 2000m. Three-month (red), annual (black) and 5-year (blue) averages are shown. Source: NOAA NCEI

Long-term rainfall patterns can disguise great variability in short-term totals. There were many instances in 2015 of 24-hour totals exceeding the normal monthly mean. For instance, the Moroccan city of Marrakech received 35.9mm of rain in one hour in August, over 13 times the monthly normal. In Pakistan during the monsoon, one station recorded 540mm of rain in 24 hours; the annual normal is 336mm.

Dry areas included Central America and the Caribbean, northeast South America including Brazil, parts of central Europe, and Russia, parts of Southeast Asia, Indonesia, and southern Africa. In Western North America, long-term drought conditions continued. Basins across the west depend on snowpack as a water resource. On April 1, the snow water equivalent was 5% of normal.

The dry and warm conditions observed across much of the western USA during the year favoured the development of wildfires. In Alaska, over 400 fires burned 728,000 hectares in May, breaking the previous record of 216 fires and 445,000 hectares. Over 700 wildfires were reported in Alaska during July, burning nearly 2 million hectares during the summer. Large fires burned throughout the Northwest in August and Washington State suffered its largest fire on record.

6) Tropical Cyclones

Globally, a total of 84 tropical storms formed between the start of the year and 10 November, compared to the 1981-2010 annual average of 85. Hurricane *Patricia* which made landfall in Mexico on 24 October was the strongest hurricane on record in either the Atlantic or eastern North Pacific basins, with maximum sustained wind speeds of 320 km/hour. In the Northwest Pacific basin, 25 named storms were recorded. Six typhoons made landfall over China, with three leading to combined estimated economic losses of 8 billion dollars.

Four named storms formed in the Northern Indian Ocean. Rainfall associated with tropical storm *Komen* contributed to severe flooding and landslides in Myanmar. Bangladesh also suffered from flash floods and landslides. Yemen suffered from unprecedented back-to-back cyclones in early November, with *Chapala* becoming first tropical cyclone to make landfall, followed by *Megh*.

The South Pacific saw 9 named storms. Tropical cyclone *Pam* made landfall over Vanuatu as a category 5 cyclone on 13 March destroying many homes.

7) Arctic and Antarctic

Since consistent satellite records began in the late 1970s, there has been a general decline in Arctic sea ice extent throughout the seasonal cycle. In 2015, the daily maximum extent, which occurred on 25th February 2015, was the lowest on record at 14.54 million km^2. The minimum sea ice extent was on 11th September when the extent was 4.41 million km^2, the fourth lowest in the satellite record.

In the southern hemisphere, the daily maximum extent of 18.83 million km^2 was recorded on 6th October in Antarctica. This is the 16th highest maximum extent in the satellite record. The minimum extent, recorded on 20 February, was 3.58 million km^2, the 4th highest on record.

8) Climate Change Attribution

Scientific assessments have found that many extreme events in the 2011-15 period, especially those relating to extreme high temperatures, have had their probabilities over a particular time period substantially increased as a result of human-induced climate change – by a factor of 10 or more in some cases.

Of 79 studies published by Bulletin of the American Meteorological Society between 2011 and 2014, more than half found that anthropogenic climate change contributed to extreme events. The most consistent influence has been on extreme heat, with some studies finding that the probability of the observed event has increased by 10 times or more.

Examples include the record high seasonal and annual temperatures in the United States in 2012 and in Australia in 2013, hot summers in eastern Asia and western Europe in 2013, heatwaves in spring and autumn 2014 in Australia, record annual warmth in Europe in 2014, and the Argentine heatwave of December 2013.

Some longer-term events, which have not yet been the subject of formal attribution studies, are consistent with projections of near- and long-term climate change. These include increased incidence of multi-year drought in the subtropics, as manifested in the 2011-15 period in the southern United States, parts of southern Australia and, towards the end of the period, southern Africa. There have also been events, such as the unusually prolonged, intense and hot dry seasons in the Amazon basin of Brazil in both 2014 and 2015 which, while they cannot yet be stated with confidence to be part of a long-term trend, are of considerable concern in the context of potential "tipping points" in the climate system as identified by the Intergovernmental Panel on Climate Change.

WMO Analysis Methods

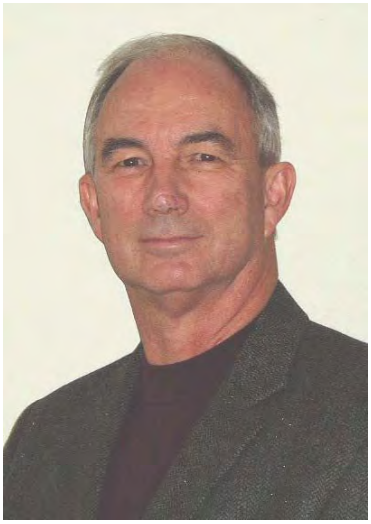
The WMO reports on the Status of the Global Climate are based on contributions from WMO`s 191 Members. The global temperature analysis is principally derived from three complementary datasets maintained by the Hadley Centre of the UK's Met Office and the Climatic Research Unit, University of East Anglia, United Kingdom (combined); the US National Oceanic and Atmospheric Administration (NOAA) National Centres for Environmental Information; and the Goddard Institute of Space Studies (GISS) operated by the National Aeronautics and Space Administration (NASA). Global average temperatures are also estimated using reanalysis systems, which use a weather forecasting system to combine many sources of data to provide a more complete picture of global temperatures. WMO uses data from the reanalysis produced by the European Centre for Medium-Range Weather Forecasts and the Japan Meteorological Agency.

WMO is the UN system's authoritative voice on weather, climate, and water

STOP PRESS!

Canadian Gordon McBean Wins Award from the American Meteorological Society (AMS)

On Thursday January 14, 2016, a Canadian was honoured at the annual awards banquet of the American Meteorological Society (AMS). **Dr. Gordon McBean** was awarded the Cleveland Abbe Award for Distinguished Service to the Atmospheric Sciences. The award is presented for exceptional service to the meteorological community through leadership of national and international programs aimed at advancing the atmospheric and related sciences and their application.



Dr. Gordon McBean

Cleveland Abbe was a pioneering American meteorologist, who was named the first head of the US Weather Bureau upon its establishment by Congress in 1870. Two of his greatest achievements while head were the inauguration of the use of daily weather forecasts and the initiation of the use of time zones in the United States.

Dr. McBean is currently the President of the International Council for Science (ICSU). He previously was an Assistant Deputy Minister in Environment Canada, and Director of Policy Studies at the Institute for Catastrophic Loss Reduction, amongst other prominent roles. He was a member of the team that was awarded the 2007 Nobel Peace Prize for the work of the Intergovernmental Panel on Climate Change (IPCC). He was awarded the Order of Canada in 2008.

Canada's Top Ten Weather Stories for 2015

by David Phillips[1]

2015 - A Year in Review

Canadians had plenty to "weather" in 2015 as Mother Nature either froze, buried, scorched, blew or frightened us at various times throughout the year. We endured weather bombs, nor'easters, a growing super El Niño, deluges, and expensive hailers. Rarely have we seen a year with such a variety of weather contrasts from coast-to-coast. And while property damage from weather cost insurers and governments millions and the economy billions, this year we were spared devastating hurricanes, had fewer tornadoes and experienced less weather-related personal injuries and fatalities.

Among other significant events and weather surprises in 2015 were a no-snow winter in British Columbia, thick ice in the south but thinner in the North, and remnants of Pacific tropical storms that had a much greater impact on Canada than their Atlantic counterparts.

The top Canadian weather stories for 2015 are ranked from one to ten based on factors that include the impact they had on Canada and Canadians, the extent of the area affected, economic effects and longevity as a top news story.

Top Ten Canadian Weather Stories for 2015

1	**Record Cold Winter in the East**
2	**Forests Blazing in the West**
3	**Dry to Almost Disastrous in the West**
4	**Maritime Snowmaggedon**
5	**Record Hot Dry Summer across BC**
6	**The Prairie's Stormy Summer**
7	**Super Bowl/Groundhog Day Storm**
8	**BC's Big August Blow**
9	**Maritime's Valentine Storm … A White Juan-a-be**
10	**January in July for St. John's**

1. Record Cold Winter in the East

For the second consecutive year, Canada's top weather story was a long, cold, snowy winter in the East.

February became "Friguary" with temperatures 7 to 9ºC below normal. Toronto was colder than Edmonton in February and it was the city's coldest month ever with records dating back to 1840. Montréal didn't reach melting temperatures for 43 consecutive days. From the Great Lakes to Newfoundland and Labrador, a record cold winter was one of very few regions in the world that was cold in what was the warmest winter globally in 135 years.

2. Forests Blazing in the West

The wildfire season in Canada began early, ended late and was extremely active, especially in the West; 4,922 fires consumed an incredible 3.25 million hectares of woodland, four times the 25-year average. May and June in British Columbia came close to being the two driest months on record, which started the fire season a month earlier than normal. Firefighting cost the province $300 million - twice the 10-year average – and thick and pungent smoke left thousands of residents gasping through surgical masks. In Saskatchewan, uncontrollable fires prompted the largest evacuation in history, counting more than 13,000 people.

3. Dry to Almost Disastrous in the West

Prairie farmers faced challenging weather this year with killing frosts in May, spring and early summer dryness, and too many hailstorms. During the crucial May to mid-July

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

period, when crops are normally growing feverishly, rains only sprinkled across the bone-dry western Prairies. About 60% of the agricultural landscape was in serious moisture stress to the last week of July. After that time, it almost didn't matter if rain fell. Some rescue rains helped out, but the harvest was delayed and yields were disappointing compared to recent years.

4. Maritime Snowmaggedon

Winter grabbed hold of the Maritimes in January and wouldn't let go until May. Maritimers proved their mettle as a winter people by beating back brutal cold, especially in February, and shovelling and plowing through record snowfalls. January, February, and March were the coldest in 68 years. As for the white stuff, Moncton and Charlottetown – two of Canada's snowiest cities – established all-time records with amounts breaking the 5 m snow mark. "Big storms" numbered seven or more whereas a typical season would feature two or three.

5. Record Hot Dry Summer across BC

Persistently warm "Pacific blob" waters and a large high pressure area off the west coast of North America led to record-breaking warmth and sunny skies over British Columbia for much of 2015. Spring mountain snowpack was less than half of normal, leaving rivers at their lowest recorded flows in 100 years. The prolonged intensity of the spring/summer's heat and the lack of rain concentrated the growing season and drew down water levels on reservoirs to critical marks. An example of meagre summer rains was Victoria where the total rainfall from May 1 to August 31 was 34 mm which is only 30% of normal and the lowest rainfall total in history for the four-month period.

6. The Prairie's Stormy Summer

Most of the weather talk across the Prairies in 2015 was about drought and wildfires. However, summer storms cost more money and disrupted many more lives. Summer severe weather events including tornadoes, heavy rainfalls, strong winds, and hailfalls numbered 307 across Alberta, Saskatchewan, and Manitoba compared to an average of 234. Whereas, tornado occurrences were down everywhere, hail strikes were way up and accounted for 70% of the severe weather. Once again, nature didn't leave

Calgary alone. Over a two-day bout of severe weather in July, storms in that city and across central and southern Alberta and Saskatchewan inflicted $250 million in damages (not including crop losses).

7. Super Bowl/Groundhog Day Storm

On Super Bowl Sunday (February 1), a major winter storm turned out to be the biggest storm of the winter in Ontario with close to 40 cm of snow falling between Windsor and Hamilton. The next morning in Montréal, driving was horrendous with 14 hours of snow and blowing snow powered by wind gusts of 60 km/h in whiteout conditions, and with a dangerous wind chill of -36. The Super Bowl storm became the Groundhog Storm on February 2 and another crippling blast for Atlantic Canada. The tempest had all the elements of a nasty nor-easter with strong winds, limiting visibility, and an assortment of messy precipitation.

8. BC's Big August Blow

After months of record hot, dry weather and massive wildfires in British Columbia, a dramatic shift in the weather in late August brought welcomed rains and slightly cooler temperatures. But the change in weather came at a price. The powerful weather-changer with leftover fuel from tropical storm Kilo became known more for its fierce winds than relief rains. The bashing winds caught everyone off guard, downing transmission lines that left 710,000 hydro customers without power - the largest single outage in BC Hydro's history.

9. Maritime's Valentine Storm … A White Juan-a-be

A hard-hitting nor'easter charged the Maritimes on Valentine weekend, forcing the cancellation of everything from church services and festivals celebrating winter. By storm's end, parts of New Brunswick had received another 45 cm of snow and Prince Edward Island 80 cm. Several Maritimers couldn't resist comparing the Valentine storm with the infamous White Juan blizzard 11 years earlier. On some accounts, the Valentine weekend storm was worse and certainly much longer.

10. January in July for St. John's

A year ago (2014) July St. John's, NL registered its hottest month on record. In 2015, July was one of the coldest! The average afternoon temperature was 15.8°C which was a new low record from observations dating back to 1942 and an unbelievable 10 degrees less than the year before.

Adding to the misery, for the first 40 days of summer, only seven were dry. St. John's total July rainfall of 181 mm made it the second wettest on record.

Note: All photos are courtesy of Environment Canada.

Source: "*Top Ten Canadian Weather Stories for 2015*", Canadian Meteorological and Oceanographic Society. http://cmos.ca/site/top_ten visited on December 30, 2015.

Les dix événements météorologiques canadiens les plus marquants en 2015

par David Phillips[2]

Bilan de l'année 2015

Les Canadiens en ont vu de toutes les couleurs en 2015 : Dame Nature nous a gelés, enneigés, brûlés, emportés par le vent et effrayés à plusieurs reprises tout au long de l'année. Nous avons enduré des bombes météorologiques, des tempêtes du nord-est, un super El Niño qui continue de s'intensifier, des déluges et des tempêtes de grêle catastrophiques. Rarement une année aura été marquée par des conditions météorologiques aussi différentes d'un océan à l'autre. Les pertes en dommages matériels se sont chiffrées en millions de dollars pour les assureurs et les gouvernements et en milliards de dollars pour l'économie. Cependant, l'année a été exempte d'ouragans dévastateurs, a connu un moins grand nombre de tornades et les conditions météorologiques ont causé moins de décès et de blessures liés aux conditions météorologiques.

Parmi les autres phénomènes importants et surprises météorologiques de 2015, soulignons l'hiver sans neige en Colombie-Britannique, la glace épaisse au sud, mais plus mince dans le Nord, ainsi que les vestiges des tempêtes tropicales du Pacifique qui ont eu des répercussions beaucoup plus importantes sur le Canada que ceux des tempêtes tropicales de l'Atlantique.

Les phénomènes météorologiques les plus marquants de 2015 sont classés de un à dix en fonction de facteurs tels que leurs répercussions sur le Canada et ses habitants, l'étendue de la zone touchée, leur incidence économique et la durée de leur couverture médiatique.

[2] Climatologue principal, Service météorologique du Canada, Environnement Canada, Downsview, Ontario.

Dix événements météorologiques canadiens les plus marquants en 2015

1	**Hiver froid record dans l'Est**
2	**Feux de forêt dans l'Ouest**
3	**Temps sec et quasi catastrophique dans l'Ouest**
4	**Tempêtes de neige apocalyptiques dans les Maritimes**
5	**Été chaud et sec record en Colombie-Britannique**
6	**Été orageux dans les Prairies**
7	**Tempête du Super Bowl, puis du jour de la marmotte**
8	**Coup dur en août pour la Colombie-Britannique**
9	**Tempête de la Saint-Valentin dans les Maritimes… Aux allures de « Juan blanc » vécue en 2004**
10	**Janvier en juillet à St. John's**

1. Hiver froid record dans l'Est

Pour la deuxième année consécutive, l'événement météorologique canadien le plus marquant a été l'hiver long, froid et enneigé dans l'est du pays. Le mois de février a été frigorifique avec des températures de 7 à 9 degrés plus basses que la normale. Il a fait plus froid à Toronto qu'à Edmonton en février. D'ailleurs, la ville de Toronto a connu le mois le plus froid de son histoire depuis le début de l'enregistrement des données en 1840. À Montréal, les températures sont restées sous le point de congélation pendant 43 jours consécutifs. La région s'étendant des Grands Lacs à Terre-Neuve-et-Labrador a été une des

seules au monde qui a connu un hiver froid record alors qu'on enregistrait un des hivers les plus chauds depuis 135 ans à l'échelle planétaire

2. Feux de forêt dans l'Ouest

La saison des feux de forêt au Canada a commencé très tôt, s'est terminée tardivement et a été très active, surtout dans l'Ouest. Incroyablement, 4 922 incendies ont ravagé 3,25 millions d'hectares de terrain boisé, ce qui représente quatre fois la moyenne des hectares touchés sur une période de 25 ans. Les mois de mai et de juin en Colombie-Britannique sont presque devenus les deux mois les plus secs jamais enregistrés, et c'est pourquoi la saison des feux de forêt a commencé un mois plus tôt que la normale. Lutter contre ces incendies a coûté 300 millions de dollars à la province, soit le double de la moyenne des coûts sur une période de 10 ans. Par ailleurs, des milliers de citoyens ont dû se servir de masques chirurgicaux pour se protéger de la fumée épaisse et âcre présente dans l'air qu'ils respiraient. En Saskatchewan, des incendies incontrôlables ont suscité la plus grande évacuation de son histoire : plus de 13 000 personnes ont été déplacées.

3. Temps sec et quasi catastrophique dans l'Ouest

Les agriculteurs des Prairies ont connu des conditions météorologiques difficiles cette année : des gels dévastateurs en mai, une sècheresse au printemps et en début d'été et de nombreuses tempêtes de grêle. Pendant la période cruciale de mai à la mi-juillet, lorsque les plantes poussent habituellement avec vigueur, très peu de pluie est tombée sur l'ouest des Prairies déjà desséché. Près de 60 pour cent des terres agricoles souffraient d'un important stress hydrique à la dernière semaine de juillet. Par la suite, qu'il y ait ou non de la pluie n'avait presque plus d'importance. Certes, la pluie qui a fini par tomber a aidé un peu, mais les récoltes ont été retardées et ont donné des résultats décevants par rapport aux dernières années.

4. Tempêtes de neige apocalyptiques dans les Maritimes

L'hiver a commencé de plein fouet en janvier dans les Maritimes et n'a pas lâché prise avant le mois de mai. Les habitants des Maritimes ont fait preuve de persévérance et de détermination en affrontant le froid cinglant, surtout en février, et en déneigeant – à la pelle et à la souffleuse – des accumulations record de neige. Les mois de janvier, de février et de mars ont été les plus froids en 68 ans. De plus, au rang des villes canadiennes qui reçoivent le plus de neige, Moncton et Charlottetown ont établi deux records absolus avec une accumulation de plus de cinq mètres de neige. D'ailleurs, il y a eu au moins sept «grosses tempêtes» alors qu'une saison habituelle n'en compte que deux ou trois.

5. Été chaud et sec record en Colombie-Britannique

La masse d'eau continuellement chaude surnommée le « Blob » du Pacifique et un vaste anticyclone au large de la côte ouest de l'Amérique du Nord ont apporté des températures chaudes record et du temps ensoleillé en Colombie-Britannique pendant une bonne partie de 2015. L'enneigement des montagnes au printemps était de moins que la moitié de la normale, ce qui a fait que les cours d'eau ont présenté leur plus bas débit depuis 100 ans. La période chaleur prolongée du printemps et de l'été ainsi que le manque de pluie, combinés à la demande en eau pendant la période de croissance végétale, a amené une baisse critique du niveau d'eau des réservoirs. La ville de Victoria est un bon exemple des faibles pluies d'été, où les quantités totales de pluie reçues entre le 1er mai et le 31 août ont été de 34 mm, à peine 30 pour cent des quantités normales et le total le plus faible jamais enregistré pour cette période de quatre mois.

6. Été orageux dans les Prairies

La plupart des conversations sur la météo dans les Prairies en 2015 concernaient la sècheresse et les feux de forêts. Toutefois, ce sont les orages qui auront été les plus coûteux et affecté le plus de vies. Le nombre total de phénomènes météorologiques estivaux à fort impact, ce qui comprend les tornades, les fortes pluies, les vents violents et la grêle, s'élevait à 307 pour l'ensemble de l'Alberta, de la Saskatchewan et du Manitoba, alors que la moyenne est de 234. Bien que le nombre de tornades ait été inférieur à la moyenne un peu partout, les événements de grêle ont été beaucoup plus nombreux qu'à l'habitude et représentaient 70 pour cent des phénomènes météorologiques à fort impact. Encore une fois, Calgary n'a pas été laissée pour compte. Pendant deux jours consécutifs en juillet, les orages qui ont frappé la ville ainsi que le centre et le sud de l'Alberta et de la Saskatchewan ont causé 300 millions de dollars de dommages (sans compter les destructions de cultures).

7. Tempête du Super Bowl, puis du jour de la marmotte

Le dimanche du Super Bowl (le 1er février), une importante tempête hivernale s'est révélée être l'une des plus grosses tempêtes de l'hiver en Ontario laissant près de 40 cm de neige entre Windsor et Hamilton. Le lendemain matin à Montréal, les conditions routières ont été horribles à cause de la neige et de la poudrerie qui ont sévi pendant 14 heures sous des rafales de vent à 60 km/h provoquant des conditions de blizzard, sans compter le facteur de refroidissement éolien de -36. La tempête du Super Bowl s'est transformée en tempête du jour de la marmotte le 2 février et a asséné un autre coup dur au Canada atlantique. La tempête présentait toutes les caractéristiques d'une tempête du nord-est avec des vents forts, une réduction de la visibilité et toute une variété de précipitations.

8. Coup dur en août pour la Colombie-Britannique

Après des mois de temps chaud et sec record et de gigantesques feux de forêt en Colombie-Britannique, un changement drastique de la météo à la fin août a apporté des pluies bienfaisantes et des températures légèrement plus fraîches. Par contre, ce changement des conditions météo a eu un prix. Le puissant changement de régime météo,alimenté par les vestiges de la tempête tropicale Kilo, s'est fait connaître davantage en raison de ses vents violents que de ses pluies rafraîchissantes. Ces vents ont pris tout le monde par surprise en rompant des lignes de transport ce qui a laissé 710 000 abonnés privés d'électricité, soit la panne la plus étendue de toute l'histoire de BC Hydro.

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

9. Tempête de la Saint-Valentin dans les Maritimes… aux allures de «Juan blanc» vécue en 2004

Une forte tempête du nord-est a pris d'assaut les Maritimes au cours du weekend de la Saint-Valentin et a forcé l'annulation de toutes les activités telles que les messes et les festivités hivernales. À la fin de la tempête, certaines parties du Nouveau-Brunswick avaient reçu 45 cm de neige supplémentaire et l'Île-du-Prince-Édouard, 80 cm. Plusieurs habitants des Maritimes ont établi un parallèle entre cette tempête et le tristement célèbre blizzard Juan blanc de 2004. Selon certains, cette tempête du weekend de la Saint-Valentin était pire et certainement beaucoup plus longue.

10. Janvier en juillet à St. John's

L'an dernier (2014), St. John's, Terre-Neuve, vivait son mois de juillet le plus chaud jamais enregistré. En 2015, le mois de juillet aura été l'un des plus froids! Les températures moyennes en après-midi ont été de 15,8 °C, ce qui marqua un nouveau record de froid depuis 1942 et constituait une valeur de 10 degrés inférieure à celle de l'année précédente. Pour ajouter au malheur, des 40 premiers jours de l'été, seuls 7 jours ont été sans pluie. Les 181 mm de pluie tombés au total à St. John's en juillet en ont fait le deuxième mois de juillet le plus pluvieux jamais enregistré.

Source: "*Les dix événements météorologiques canadiens les plus marquants de 2015*", Société canadienne de météorologie et d'océanographie- http://cmos.ca/site/top_ten?language=ft_FR& visité le 30 décembre 2015.

WMO Secretariat thanks Michel Jarraud

The World Meteorological Organization (WMO) Secretariat thanks outgoing Secretary-General Michel Jarraud who stands down on 31 December 2015. He devoted more than 21 years to the organization, of which 12 were spent as Secretary-General.

During Mr. Jarraud's tenure, WMO increased its profile as the UN system's authoritative voice on weather, climate, and water. Mr jarraud strengthened WMO's scientific and technical programmes, forged new strategic alliances and partnerships to build capacity and mobilize resources. He increased the transparency and effectiveness of the WMO Secretariat. He also oversaw major events such as the International Polar Year 2007-2008 and the World Climate Conference-3, which led to the establishment of the Global Framework for Climate Services. Mr Jarraud became chair of UN Water in 2012.

Remerciements du Secrétariat de l'OMM à Michel Jarraud

Le Secrétariat de l'Organisation météorologique mondiale (OMM) remercie le Secrétaire général Michel Jarraud qui se retire le 31 décembre 2015, après avoir consacré plus de 21 ans à l'Organisation, dont 12 en qualité de Secrétaire général.

Au cours du mandat de M. Jarraud, l'OMM a affirmé son autorité au sein du système des Nations Unies pour toutes les questions ayant trait au temps, au climat et à l'eau. M. Jarraud a consolidé les programmes scientifiques et techniques de l'OMM et noué de nouvelles alliances et partenariats stratégiques afin de renforcer les capacités et de mobiliser des ressources. Il a fait progresser la transparence et l'efficacité du Secrétariat de l'OMM. Il a également supervisé des événements majeurs, tels que l'Année polaire internationale 2007-2008 et la Troisième conférence mondiale sur le climat, qui a abouti à l'instauration du Cadre mondial pour les services climatologiques. M. Jarraud a pris la présidence d'ONU-Eau en 2012.

CLIMATE CHANGE / CHANGEMENT CLIMATIQUE

The Paris Climate Change Summit

by Professor John Stone[1]

It is certainly premature to declare the end of the fossil-fuel era but what was agreed at the Paris Climate Change Summit at the beginning of December may well lead to such a result.

Why was this such a success in addressing the increasingly urgent threat of climate change whereas the previous attempt in 2009 in Copenhagen was such a failure? Undoubtedly, it was in part due to the skilled organization and chairmanship of the French, in particular the Foreign Minister, Laurent Fabius. Recognizing the shortcomings of the Copenhagen meeting Fabius worked assiduously to ensure that all delegations were involved and their views heard; that the process was as transparent as could be. This included not only the formal meetings but also the intense contact groups that were led by some of the key Ministers (such as Catherine McKenna), and small informal groups working as "*indabas*" – a practice started at the Conference of the Parties (COP) in Durban in 2011. Ministers were personally involved with finalizing the lengthy, heavily bracketed text that had been developed by bureaucrats.

Following intensive and all-night consultations on Thursday and Friday, 10-11 December, the Comité de Paris, established to continue work on the draft agreement and decision text, convened briefly on Saturday morning and again in the evening to adopt the final text of the Paris Agreement and associated decision to COP 21. Sufficient consensus had been achieved in the back-rooms during last hectic few hours that when Laurent Fabius asked the floor if there were any objections he barely lifted his head to survey the room before bringing down his gavel. The reason being: the transparent and inclusive process ensured the Agreement was owned by the Parties.

This was the culmination of the brilliant idea of the French Presidency to bring together World leaders - some 150 Presidents and Prime Ministers, possibly the largest ever gathering of World leaders - at the beginning of the Summit rather than at the end of the meeting for a photo-opportunity signing off ceremony as in Copenhagen. Once the leaders had publically declared their commitment to an ambitious outcome the very idea of failure was no longer an option. The Paris meeting strongly suggests that there is now a broad acceptance by governments, the private sector, and civil society that climate change is a real threat; that the time has come to now address the issue and recognize that we are all in this together. It may not be perfect, it may not be the end but it certainly is an encouraging beginning.

The 21st Conference of the Parties under the United Nations Framework Convention on Climate Change (UN/FCCC) took place from November 29th to December 13th in Paris. There were some 40,000 participants - nearly 23,100 government officials, 9,400 representatives from UN bodies and agencies, intergovernmental organizations and civil society organizations, and 3,700 members of the media. Canada's delegation was the largest in many years providing ample proof that, as Prime Minister Justin Trudeau proclaimed, "***Canada is back"***.

There were two interlinked documents negotiated in this meeting: One was what is referred to as the Paris Agreement which does not contain legally binding language, the second was a supporting set of decisions of the Conference of the Parties under the UN/FCCC (which almost all countries have ratified) and does contain legally binding language. Together the documents consist of 31 pages of dense legal text. At the centre of the Paris Agreement are five-year cycles: each nationally determined contribution cycle is to be more ambitious than the last. A global stocktaking held every five years will inform future collective efforts on mitigation, adaptation, and support and occur midway through the contribution cycle. To track progress, governments are bound to a transparency framework, which represents the legally-binding portion of the Agreement. The communication of Nationally Determined Contributions is legally-binding, but their contents and targets are not which means they do not require governmental ratification (i.e. by the US Senate). The global nature of the bottom-up "pledge and review" approach while not legally binding will hopefully be morally binding on countries (who might well establish their own domestic legislation).

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

Perhaps the most surprising result was the agreement not just to reaffirm a previous decision to hold the increase of global temperatures to well below 2 °C above pre-industrial levels but to pursue efforts to limit the temperature increase to 1.5 °C. This sets an incredibly high level of ambition that was not widely expected at the beginning of the Paris meetings. The drive was provided by Tony de Brum, the charismatic foreign minister of the Marshall Islands, who pulled together a "coalition of high ambition" of rich and poor countries that wanted the 1.5 °C limit on temperatures arguing that a higher level would see many low-lying islands disappear under the waves. The coalition claimed to represent 90-odd governments spanning countries as diverse as Kiribati, Iceland, the US, EU member states, Australia, and Canada. The coalition also included Brazil which forsook the BRICS group (others were Russia, India, China, and South Africa). China wanted the higher level since it would allow them to burn coal longer; India also wanted the higher level because it would give them more time to industrialize; Russia argued that the 1.5 °C was not supported by the science.

Achieving a 1.5 °C target effectively means reaching carbon neutrality by 2050, that is to say to reach net-zero carbon emissions where the amount of carbon being pumped into the atmosphere matches that being taken up by the biology in the oceans and the land. This target is more demanding than others suggested in the past by the science (for example in IPCC Assessment Reports): that to reach the 2 °C target global emissions have to peak and start declining this decade and we will have to keep as much as 80% of the known fossil fuel reserves in the ground. To further illustrate the constraints of the 1.5 °C target, we are already 1 °C above pre-industrial levels (and much of that during my lifetime).

If the Paris Summit is to achieve its goals it will require not only the actions of governments but also non-state players. The Paris Agreement indeed sends strong signals for climate action by all. In Paris a wide range of countries put their names to a communiqué on fossil fuel subsidy reform (something that had been agreed to some years ago at a G-20 meeting). Several countries, including Canada, also signed onto a "Mission Innovation" initiative led by the US. In addition a group of billionaires, led by Bill Gates, announced the creation of a $2 billion *"Breakthrough Energy Coalition*". Maybe that end of the fossil fuel era will come sooner than we may think. Before that happens Canada, for one, has a lot of work to do to translate its promises in Paris into an effective plan. This is something we have attempted before but with insufficient political leadership. Maybe this time will be different.

A few offical reactions to the Paris Agreement

"The Paris Agreement allows each delegation and group of countries to go back home with their heads held high. Our collective effort is worth more than the sum of our individual effort. Our responsibility to history is immense".

Laurent Fabius, President of the COP 21 UN Climate change conference and French Foreign Minister

"You've done it, reached an ambitious agreement, a binding agreement, a universal agreement. Never will I be able to express more gratitude to a conference. You can be proud to stand before your children and grandchildren".

François Hollande, French President

"We have entered a new era of global cooperation on one of the most complex issues ever to confront humanity. For the first time, every country in the world has pledged to curb emissions, strengthen resilience and join in common cause to take common climate action. This is a resounding success for multilateralism".

Ban Ki-moon, UN Secretary General

"*One planet, one chance to get it right and we did it in Paris. We have made history together. It is an agreement of conviction. It is an agreement of solidarity with the most vulnerable. It is an agreement of long-term vision, for we have to turn this agreement into an engine of safe growth."*

"Successive generations will, I am sure, mark the 12 December 2015 as a date when cooperation, vision, responsibility, a shared humanity and a care for our world took centre stage."

"I would like to acknowledge the determination, diplomacy and effort that the Government of France have injected into this remarkable moment and the governments that have supported our shared ambition since COP 17 in Durban, South Africa."

Christiana Figueres, Executive Secretary of the UN Framework Convention on Climate Change (UN/FCCC)

REPORTS / RAPPORTS

Integrated Regional Ocean Policy for the Southeast Pacific

by Savithri (Savi) Narayanan[1]

Comisión Permanente del Pacífico Sur (CPPS) is in the process of establishing an Integrated Regional Ocean Policy within the national jurisdiction of CPPS Member States (Chile, Colombia, Ecuador, and Peru) and adjacent waters beyond national jurisdiction. CPPS Member States recognized the need for such an integrated approach to ocean governance: (a) to ensure sustainable development of their ocean resources taking into account the needs and concerns of all linked sectors avoiding conflicting measures, (b) for countries to join forces for trans-border consistency in policies and resource development initiatives, and effective and unified response to international commitments, (c) to facilitate government, industry, academia, and public sector partnership, (d) to ensure Member States collectively have the necessary infrastructure, skills, and human and financial resources, and (e) to increase 'ocean literacy' in the region.

CPPS was established in 1952 as the maritime organization that coordinates regional maritime policies in order to adopt concerted positions of its Member States in international negotiations, development of the Law of the Sea, International Environmental Law, and other multilateral initiatives. It is also engaged in a capacity-building process at the national and regional levels in the areas of science, socio-economic policy, and the environment. Furthermore, CPPS has been a major driving force and coordinating mechanism for the implementation of numerous scientific and capacity building initiatives in the region in sustainable development, coastal area management, fisheries, and others. Consequently, it has been a strong voice in the international arena for the region. Therefore, it is only natural that CPPS take the lead in the development and implementation of an integrated regional ocean policy.

In order to develop a unified vision for ocean governance in the region, CPPS organized a workshop in Bogota, Colombia from October 28th to 30th, 2015, under the sponsorship of the United Nations Environment Programme (UNEP), the Institute for Advanced Sustainability Studies (IASS), and the Institute for Sustainable Development and International Relations (IDDRI). The workshop also provided the venue to inform the decision-makers of the CPPS Member States on what is happening around the world and why it is important for them to have a unified approach to the governance of their ocean region.

Group photo of *Comisión Permanente del Pacífico Sur* Conference

The workshop was attended by approximately 50 experts from many countries and sectors including those from government and academia in the CPPS region, sponsoring organizations, as well as several others with relevant experience in ocean science, management, and policy. Part of the workshop was devoted to presentations, covering: (a) international and national requirements and policies, (b) institutions and sectors involved in ocean and coastal programs and projects, (c) lessons learned during the development of similar policies elsewhere, and (d) key factors to be considered in a policy for the CPPS region. Presentations by representatives of UNEP, IASS, IDDRI. FAO (Food and Agriculture Organization of UN), DOALOS (Division for Ocean Affairs and Law of the Sea), International Seabed Authority, Convention on Biodiversity and others were invaluable in this context. Presentations from the academic sector and research institutions highlighting the scientific and technical capacity in the region to develop and maintain a skilled workforce were very informative and relevant as well.

As I was invited to speak on the links between Ocean Science and Integrated Ocean Policy, I had the opportunity to stress the importance of science and its key elements such as monitoring, data and information management, scientific research, and products and services that enable the decision-makers to take evidence-based decisions. The region has already been moving in this direction in small steps through support from international organizations,

[1] Co-Editor, *CMOS Bulletin SCMO* and member of CMOS Ottawa Centre

UNESCO (United Nations Educational, Scientific and Cultural Organization) for example for Integrated Coastal Area Management (ICAM).

During the three days of the workshop, the participants: (a) explored the relationships between national ocean policies designed and developed in Chile, Colombia, Ecuador, Panama, and Peru, and their links to global ocean governance programs and commitments; (b) reviewed lessons learnt from integrated ocean policies in other regions and explore their possible application to the South-East Pacific; and (c) adopted unanimously its recommendation, clearly articulating the urgent need for a regional ocean policy for the CPPS region, a vision statement, and a plan for transforming the vision to a policy founded on science and supported at the highest level of government in each of the countries. CPPS expects that the policy will be completed and adopted by 2018.

Considering that the combined ocean area to be managed by CPPS Member States extend all the way from Panama to the southern tip of Chile, an integrated regional ocean policy in the CPPS region will significantly contribute to the global ocean governance and to effectively meeting the international commitments under the various conventions.

More information on CPPS may be found at http://cpps-int.org/

New Weather and Climate Services in Haiti

by Michael Crowe[2]

Tranblemanntè 12 janvye 2010 nan peyi Ayiti[3]

Located in the Northern Hemisphere, 80% of the population of Haiti lives below the poverty line on less than two dollars a day, and 54% of the population lives in extreme poverty on less than one dollar a day. The total population is estimated at more than nine million, with more than 70% in rural areas. Two thirds of Haitians depend on the agricultural sector, which is particularly sensitive to climatic hazards, especially as there is strong dependence on rain fed agriculture and the irrigated land area is very small (903 km^2).

The magnitude 7.0 earthquake that struck Haiti on 12 January 2010 devastated the country. More than 230,000 lost their lives and a further 300,000 were injured. The earthquake crippled Haiti's capital, Port-au-Prince. Damage and economic losses are estimated to have been around US$7.9 billion – equivalent to over 120% of Haiti's 2009 GDP. Most major infrastructure, including that for weather, climate and water monitoring and prediction, and forecasting for early warning of extreme events was destroyed.

As well as being earthquake prone, Haiti is also extremely vulnerable to the impacts of hydro-meteorological hazards and related natural disasters. Lying on the primary pathway of tropical storms and hurricanes, Haiti is hit by a significant tropical storm every 2-3 years and by a major hurricane every 6-7 years. Despite an increase in frequency of hurricanes over the last few decades with accompanying intense rainfall, areas vulnerable to drought are also expanding because of the changing land cover and degradation of the environment. Between 1980 and 2008, more than seven million Haitians were affected by droughts, floods, storms, and landslides. Regionally, changes in temperature and precipitation trends are being observed; the IPCC's (Intergovernmental Panel on Climate Change) Fourth Assessment Report shows the percentage of days with very warm temperatures has increased considerably since the 1950s, with a marked decrease in rainfall over the part of the Caribbean that includes Haiti. Sea-level rise is expected to increase risks of inundation, storm surges, erosion, and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support livelihoods.

The Haitian meteorology and hydrology services - the National Meteorological Centre (CNM) and National Water Resources Service (SNRE) respectively – currently lack capacity at all levels, including premises for their operations and all tools to carry out observations and deliver related

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[3] Free translation from Haitian Creole: January 12, 2010, earthquake in Haiti

information products, and services to Government and communities.

Post 2010 earthquake, the World Meteorological Organization (WMO) and the global meteorological community came together to support Meteorological Services in Haiti. WMO sponsored a damage assessment mission while, for the following four years, decisive support was provided to the Haitian National Meteorological Center by a coalition of WMO Members including Canada, Cuba, Dominican Republic, France, the United Kingdom, the United States of America, and the Caribbean Meteorological Organization. This included providing meteorologists to work out of the MétéoFrance office in Martinique to provide basic warnings during the tropical storm season and providing training to a cadre of Haitian meteorologists to increase the in-country capacity to provide these services.

This was followed by a five year $6.5 million project funded by Environment Canada under the "Fast Start" climate funding program committed to at the Copenhagen UN Conference of the Parties on Climate Change in 2009. Under the coordination and management of WMO, the project aims to re-establish weather, climate, and hydrology forecasting activities in Haiti. This project has four main focus areas that will establish and / or modernize the National Meteorological Service main functions of observations, forecasting, and service delivery:

- Constructing a building to house the National Hydro-Meteorological Services (NMHS) of Haiti. The building will be Net-Zero Energy, as well as earthquake and hurricane proof;

- Undertaking capacity building including ongoing training of both scientific and technical personnel and developing a business plan for the NMHS taking into account all aspects of developing a functioning and modern weather, climate and hydrology service;

- Re-establishing the climatological and hydrological observing networks and implementing a data management system;

- Developing a wide-reaching dissemination system, to inform stakeholders and the general population of climate related risks.

The project duration is set for five years to allow for long term sustainability to be firmly embedded into the functioning of the National Meteorological and Hydrological Services (CNM and SNRE) of Haiti.

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2015 ArcticNet Annual Science Meeting, Vancouver, B.C.

by Helen Joseph[1]

ArcticNet, the Networks of Centres of Excellence that focuses on Arctic science, held its eleventh Annual Science Meeting (ASM) in Vancouver on December 7-11, 2015. The conference was again a great success as it brought together scientists and managers in the natural, human health and social sciences with their partners from Inuit organizations, northern communities, federal and provincial agencies, and the private sector.

ArcticNet has grown over its eleven years to include over 150 researchers and 1000 graduate students, postdoctoral fellows, research associates and technicians, and other specialists from 34 Canadian universities and numerous federal and provincial departments and agencies collaborating together on 41 research projects with more than 150 partner organizations from 14 countries.

I was one of the over 700 participants at this 2015 ASM, which I attended as Chair of the CMOS Arctic Special Interest Group. In this capacity, I was one of seven judges of the student posters in marine science - natural science. There were almost two hundred posters at the ASM with over seventy of them in marine science alone! All of the posters were really well done and the choice of the top three was difficult. After two rounds of judging, the winners of the much appreciated cash prizes were: 1st Prize: **Krista Kenyon**, University of Manitoba, Poster title: Baffin Bay Narwhal Sea Ice Selection and Movement; 2nd Prize: **Isabelle Courchesne**, Université Laval, Poster title: Environmental Control of Primary Production in the Labrador Sea – A Key Process for Climate Regulation; and, 3rd Prize: **Bertrand Charry**, McGill University, Poster title: First Index of Narwhal Newborn Using Definition Aerial Photography.

On behalf of the CMOS Arctic SIG, we greatly appreciated the support from Polar Knowledge Canada as they provided us with space on their exhibit to distribute copies of the newsletter – the Arctic SIGnal. We also distributed pamphlets on the Arctic SIG to help increase awareness of the group and to seek new members.

Dr. Louis Fortier, Scientific Director, ArcticNet opened the conference with remarks that included confirmation that ArcticNet had successfully completed its Mid-term Evaluation and has secured an additional $19M in funding through to Spring 2018. This Mid-term Evaluation was based on two key documents – a Progress Report 2011-2015 and a Strategic Plan 2015-2018. Dr. Fortier then presented highlights from these two documents focusing on

Helen Joseph discussing with Donald McLennan and Jennifer Sokol (POLAR employees) at the ArcticNet Science Meeting in Vancouver. Photo credit to Helen Dewar of POLAR.

the five evaluation criteria of: Research Excellence, Training of Highly Qualified Personnel (HQP), Networking and Partnering, Knowledge Transfer, and Network Management. In the upcoming three years, ArcticNet will have 31 universities participating in 41 projects, with research funding going to 123 Network Investigators. These projects continue to build upon previous ArcticNet research and to expand into new research areas. Within the HQP development, plans to 2018 include funding allocated to Fieldwork Safety and Training, an acknowledged priority to all Arctic researchers.

In regards to Networking and Partnering criteria, ArcticNet continues to be extraordinarily successful in leveraging resources from an array of other Arctic science initiatives. Two of the newest initiatives include the Churchill Marine Observatory and BaySys (a study examining the contributions of climate change and hydro-electric regulation to the variability and change of freshwater-marine coupling in the Hudson Bay system). We look forward to

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having feature stories on both of these initiatives in upcoming Arctic SIGnal newsletters, so stay tuned for more information!

Knowledge transfer has become a criteria that is reflected in most evaluations now and within ArcticNet the key deliverables here are the Integrated Regional Impact Study (IRIS) reports. There are four IRIS within ArcticNet: the Western and Central Arctic; Eastern Arctic; Hudson Bay; and, the Eastern Sub-Arctic. Please refer to the ArcticNet website for more information on the reports coming out of the IRIS work http://www.arcticnet.ulaval.ca/

Plenary speakers provided insightful presentations on a wide range of topics including Michael Byers, University of British Columbia who spoke on Science, Arctic Cooperation, and the Ukraine Crisis. Nicole Biebow, EU-Polar Net provided an update on the efforts to date on this European Union Horizon 2020 (H2020) funded project. EU-Polar Net includes seventeen countries from across the EU and is described in four Work Packages: Management and International Relations and Policy; Scientific Program; Infrastructure Program; and, Stakeholders Program. Ms. Biebow described two upcoming H2020 proposals that will be announced in 2016 that will be of interest to the Arctic science community. These are Blue Growth (BG)-9 -2016 "An Integrated Arctic Observing System" (linking land, ocean, ice, atmosphere, and community based monitoring), as well as BG-10-2016 "Impact of Arctic Changes on Weather and Climate of the Northern Hemisphere". Thomas Armstrong presented on the Arctic Council's Arctic Monitoring and Assessment Program work on the Adaptation Actions for a Changing Arctic initiative. In response to the recognized priority on field safety in the Arctic, Leah Braithwaite, Canadian Ice Service chaired a Plenary Panel on Field Safety in Cold and Remote Environments that included Grant Gilchrist, Environment Canada; Regan Kruger, Search and Rescue, Department of National Defence; and Jack March, OpsMobil Inc. The presentations and discussion reflected their experience in safety operations and how critical preparedness and education are to be safe in working in these very challenging environments.

In addition to these excellent Plenary presentations, there were another 250 science presentations over the three days in a wide range of scientific sessions! Session themes covered natural, human health and social sciences, with some of the sessions entitled: Glacier Change and Ice-Ocean Interaction; The Hudson Bay System; Marine Geochemistry; Arctic Shipping and Navigation; Arctic Seabed Mapping; Arctic Monitoring; Arctic Geotraces; Oceans-Sea Ice-Atmosphere Dynamics; Community-based Monitoring; and many many more.

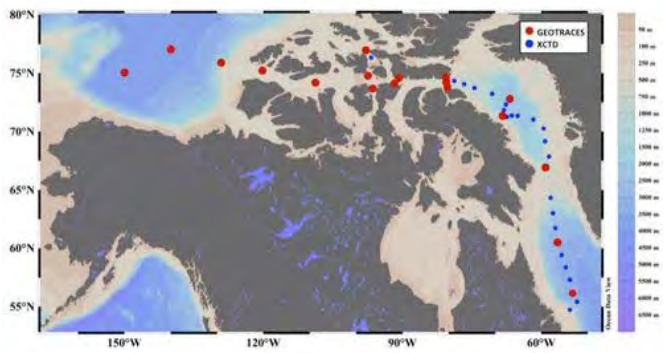
In conclusion, the ArcticNet ASM was again a great success. The CMOS Arctic SIG looks forward to profiling various ArcticNet and other initiatives to you over the coming months, so watch for further information!

Canadian Arctic Programme

Cruise Report

by Roger François and Philippe Tortell[2]

The Canadian Arctic Programme "*A biogeochemical and tracer study of a rapidly changing Arctic Ocean*" consisting of two cruises (July 10 – August 20: Quebec City – Kugluktuk; September 4 – October 1: Sachs Harbour – Resolute) on board the CCGS Amundsen was successfully completed, notwithstanding a two-week hiatus in research during the first leg, arising from the diversion of the CCGS Amundsen to Hudson Bay to open sea lanes for commercial vessels (July 19 – August 3). All planned stations were occupied with the exception of one station in eastern Baffin Bay. This was achieved in large part thanks to our colleagues from the ArcticNet program, who cancelled most of their research planned for this leg to leave us enough time to complete most of our work.



Map showing the sampling stations during the Canadian Arctic Expedition

During the first leg, thirteen stations (two in the Labrador Sea, three in Baffin Bay, eight in the Canadian Arctic Archipelago) were sampled for seawater with a regular and a trace metal clean rosette, and for marine particles with six large volume in-situ pumps. Productivity measurements using multiple isotopic methods and incubation experiments were also conducted, while trace gases measurements and aerosol sampling were performed under way. Twenty three XCTD were also deployed between stations in the Labrador Sea and Baffin Bay to supplement the hydrographic data.

During the second leg, six stations (three in Canada Basin and three in the Canadian Arctic Archipelago) were sampled for seawater and marine particles as during the first leg, and aerosols were sampled underway.

[2] Cruise Chief Scientists, University of British Columbia, Canada.

CMOS BUSINESS / AFFAIRES DE LA SCMO

Prière de noter que les versions françaises suivent.

Summer Meteorology Workshop
Project Atmosphere 2016

Call for Applications by Pre-College Teachers

As in previous years, the Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in PROJECT ATMOSPHERE. This is a summer workshop for pre-college teachers of Atmospheric Science topics sponsored by the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA) of the United States. It will take place from **17 to 29 July 2016** at the National Weather Training Center, Kansas City, Missouri.

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

Previous Canadian participants have found their attendance a very rewarding and significant experience. Presentations are made at the Workshop by some of the most respected American scientists in the fields of atmospheric and oceanographic sciences. Participants have returned with material, resources, and teaching modules readily adaptable to classroom presentations. The successful candidate will provide CMOS with a short report on his/her summer experience which may be published in the *CMOS Bulletin SCMO*.

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

Completed application forms may be mailed or e-mailed to the address below no later than **March 15, 2016**.

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

Summer Oceanography Workshop
Maury Project 2016

Call for Applications by Pre-College Teachers

The Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in THE MAURY PROJECT. This is a summer workshop for pre-college teachers of Oceanographic topics sponsored by the American Meteorological Society (AMS) and the U.S. Naval Academy. This year's workshop is from **10-22 July 2016** at the U.S. Naval Academy, Annapolis, Maryland.

The essential expenses for the participating teacher are paid by AMS, with a contribution from CMOS and the Canadian National Committee / Scientific Committee on Oceanic Research (CNC/SCOR). This does not include the travel to and from Annapolis for which CMOS and CNC/SCOR provide $300 (Canadian) each (total of $600) to the selected Canadian participant.

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

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

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

Interested teachers should download the application form (in pdf format) and mail or e-mail the filled form as soon as possible not later than **March 15, 2016** to the address given below.

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

Please note that the English versions precede.

Atelier d'été en météorologie
Projet Atmosphère 2016

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 **17 au 29 juillet 2016** au centre de formation du National Weather Service à Kansas City au Missouri.

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

Les ancien(ne)s participant(e)s du Canada ont trouvé leur expérience très enrichissante et stimulante. Les exposés de l'atelier sont présentés par des experts américains les plus réputés dans les sciences atmosphériques et océanographiques. Les enseignant(e)s sont revenu(e)s avec du matériel, des ressources et des modules didactiques qu'ils peuvent facilement adapter dans leurs cours. Le/la candidat(e) choisi(e) devra écrire un court rapport pour la SCMO de son expérience estivale qui pourra être publié dans le *CMOS Bulletin SCMO*.

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site de la SCMO sur la toile à http://www.cmos.ca/site/summerworkshops?a=1 Ils/Elles peuvent également obtenir un formulaire en le téléchargeant du même site Web de la SCMO ou en le demandant à l'adresse ci-dessous.

Les formulaires dûment remplis doivent être envoyés par la poste ou par courriel à l'adresse ci-dessous au plus tard le **15 mars 2016.**

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

Atelier d'été en océanographie
Projet Maury 2016

Demande de candidats enseignants de niveau pré-collégial

Comme par les années passées, la Société canadienne de météorologie et d'océanographie (SCMO) a été invitée à choisir un enseignant canadien qui participera au PROJET MAURY. Il s'agit d'un atelier d'été à l'intention des enseignant(e)s de niveau pré-collégial spécialistes en sciences océanographiques; cet atelier est parrainé par l'American Meteorological Society (AMS) et le U.S. Naval Academy. Il aura lieu du **10 au 22 juillet 2016** au U.S. Naval Academy à Annapolis au Maryland.

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

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

Le/la candidat(e) choisi(e) devra écrire un court rapport pour la SCMO de son expérience estivale qui pourra être publié dans le *CMOS Bulletin SCMO*.

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site Web http://www.cmos.ca/site/summerworkshops?a=2

Si vous êtes intéressé(e)s, vous devez télécharger le formulaire de candidature (en format pdf) et, une fois rempli, le poster ou l'envoyer par courriel à l'adresse donnée ci-bas avant le **15 mars 2016.**

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

Call for CMOS Awards Nominations

Deadline: February 15, 2016

February 15th 2016 is the deadline for nominations for the CMOS Prizes and Awards. It may seem far away, but it always seems to arrive faster than we think.

CMOS has a rich history recognizing deserving persons (members and non-members) through its awards programs. But regrettably, there are many deserving candidates who go unrewarded each year because we were too busy to work up a nomination. **Don't wait - do it right now!**

The awards are listed below. Please take a moment to visit http://www.cmos.ca/site/awards for instructions on how to nominate someone and then submit a nomination on behalf of one of your colleagues or students. Note that any inquiries and all nominations are to be forwarded to the CMOS Awards Coordinator (Denis Bourque) at awards-coord@cmos.ca

A - Prizes, Awards, and Recognitions for Society Members
(Awarded to a Society member or members, with no restrictions on residency or citizenship)

1) The President's Prize;
2) The Andrew Thomson Prize in Applied Meteorology;
3) The François J. Saucier Prize in Applied Oceanography;
4) The Neil J. Campbell Award for Exceptional Volunteer Service.

B – Open Prizes, Awards and Recognitions
(Not restricted to Society Members)

1) The Rube Hornstein Medal in Operational Meteorology;
2) The J.P. Tully Medal in Oceanography;
3) The Tertia M.C. Hughes Memorial Graduate Student Prizes ($500);
4) The Roger Daley Post-Doctoral Publication Award ($2,000);
5) Citations.

Appel pour les nominations : Prix de la SCMO

Date limite est le15 février 2016

Le 15 février 2016 est la date limite pour la soumission des mises en candidature pour les prix et honneurs de la Société. Cela peut sembler loin, mais la date arrive toujours plus tôt que tard.

Par ses programmes, la SCMO a une longue histoire de reconnaissance des personnes méritantes (membres et non-membres). Malheureusement, il y a beaucoup de personnes qui méritent d'être nommées et qui ne le sont pas, parce que nous sommes trop occupés. **N'attendez pas - faites-le dès maintenant!**

Vous trouverez la liste des prix et honneurs ci-bas. Veuillez prendre quelques secondes pour visiter http://www.cmos.ca/site/awards?language=fr_FR& pour lire les instructions et prendre le temps de soumettre la nomination d'un de vos collègues ou étudiants. À noter que toutes demandes ainsi que toutes nominations doivent être soumises au Coordinateur des honneurs de la SCMO (Denis Bourque) au coord-honneurs@scmo.ca

A – Les prix et honneurs réservés aux membres de la Société
(Décerné à un ou plusieurs membres de la Société, sans considération de résidence ou citoyenneté)

1) Le Prix du président;
2) Le Prix Andrew Thomson en météorologie appliquée;
3) Le prix François J. Saucier en océanographie appliquée;
4) La Médaille Neil J. Campbell pour service bénévole exceptionnel.

B – Les prix et honneurs généraux
(non réservés aux membres de la Société)

1) La Médaille Rube Hornstein en météorologie opérationnelle;
2) La Médaille J.P. Tully en océanographie;
3) Les Prix Tertia M.C. Hughes pour étudiants diplômés (500 $);
4) Le Prix Roger Daley de publication post-doctoral (2 000 $);
5) Les Citations.

Call for CMOS Fellows and Honorary Fellows Nominations

Deadline: March 15, 2016

March 15th 2016 is the deadline to recognize your colleagues by nominating one or more of them to be a CMOS Fellow or CMOS Honorary Fellow. It may seem far away, but it always arrives faster than we expec.

The titles "**CMOS Fellow**" and "**Honorary CMOS Fellow**" may be granted for exceptional long term service and support to the Society and/or outstanding contributions to the scientific, professional, educational, forecasting or broadcasting fields in atmospheric or ocean sciences in Canada.

Please take a moment to visit http://www.cmos.ca/site/fellows for information about these designations and instructions on how to submit a nomination. **Don't wait - do it now!**

Note that any inquiries and all nominations are to be forwarded to the CMOS Awards Coordinator (Denis Bourque) at awards-coord@cmos.ca

Appel de nominations pour Membres émérites et honoraires de la SCMO

Date limite: 15 mars 2016

Le 15 mars 2016 est la date limite pour la soumission des mises en candidature pour le titre de Membre émérite et Membre honoraire de la SCMO. Cela peut sembler loin, mais la date arrive toujours plus tôt que tard.

Les titres « **Membre émérite** » et « **Membre honoraire** » sont accordés pour des services et/ou soutien exceptionnels à la Société, ou pour des contributions scientifique, professionnel, éducatif, ou en prévision ou présentation, dans les sciences atmosphériques ou océaniques au Canada.

Veuillez prendre quelques secondes pour visiter http://www.cmos.ca/site/fellows?language=fr_FR& pour les instructions, afin de soumettre la nomination d'un de vos collègues. **N'attendez pas: faites-le dès maintenant!**

À noter que toutes demandes ainsi que toutes nominations doivent être soumises au Coordinateur des honneurs de la SCMO (Denis Bourque) au coord-honneurs@scmo.ca

Call for CMOS Post-Graduate Scholarship Applications

Application Deadline: April 20, 2016

April 20th 2016 is the deadline for applications for the CMOS Post-graduate Scholarship. It may seem far away, but it always seems to arrive faster than we think.

CMOS offers one post-graduate scholarship. Your assistance in forwarding this information to family, friends, colleagues, and students would be appreciated. Anyone can apply: applicants do not have to be CMOS members. **Don't wait - do it now!**

The scholarship is described below. Instructions on how to apply are found at http://www.cmos.ca/site/scholarships

Note that any inquiries and all applications are to be forwarded to the CMOS Awards Coordinator (Denis Bourque) at awards-coord@cmos.ca

1) The CMOS - Weather Research House NSERC Scholarship Supplement in atmospheric or ocean sciences (up to $10,000) awarded to a student in atmospheric or ocean sciences who must already be holding either an NSERC Postgraduate Scholarship or an NSERC Alexander Graham Bell Canada Graduate Scholarship.

Appel de candidatures pour les bourses d'études SCMO (deuxième et troisième cycle)

Date limite pour la soumission des applications: 20 avril 2016

Le 20 avril 2016 est la date limite pour la soumission des applications pour la Bourse d'études du deuxième et troisième cycle de la Société. Cela peut sembler loin, mais la date arrive toujours plus tôt que tard.

La SCMO offre une bourse aux étudiants du deuxième et troisième cycle. Nous apprécierions grandement toute assistance de votre part à faire connaissance de ces bourses à vos familles, amis, collègues et étudiants. N'importe qui peux nous envoyer sa candidature : on ne doit pas être membre de la SCMO. **N'attendez pas: faites-le maintenant!**

La bourse d'étude est décrite ici-bas. Pour lire les instructions, visiter

http://www.cmos.ca/site/sholarships?language=fr_FR&

Prière de noter que toutes demandes ainsi que toutes nominations doivent être soumises au Coordinateur des honneurs de la SCMO (Denis Bourque) au coord-honneurs@scmo.ca

1) Le Supplément SCMO – Weather Research House à la bourse du CRSNG pour les sciences de l'atmosphère ou de l'océan (jusqu'à 10 000 $) est décernée à un(e) étudiant(e) dans les sciences de l'atmosphère ou de l'océan détenteur d'une bourse d'études supérieures du CRSNG ou d'une bourse d'études supérieures du Canada Alexander-Graham-Bell - doctorat du CRSNG..

Call for CMOS Undergraduate Scholarship Applications

Application Deadline: March 15, 2016

March 15th 2016 is the deadline for applications for the CMOS Undergraduate Scholarships. It may seem far away, but it always seems to arrive faster than we thought.

CMOS offers three undergraduate scholarships. Surprisingly, we get very few applicants. Your assistance in forwarding this information to family, friends, colleagues, and students would be appreciated. Anyone can apply: applicants do not have to be CMOS members. **Don't wait - do it now!**

The scholarships are listed below. Instructions on how to apply are found at http://www.cmos.ca/site/scholarships

Note that any inquiries and all applications are to be forwarded to the CMOS Awards Coordinator (Denis Bourque) at awards-coord@cmos.ca

1) The CMOS Undergraduate Scholarships ($1,000) are awarded to students applying while in their penultimate undergraduate year at any Canadian University who, in their final year, will be taking four or more half courses in meteorology, oceanography, limnology, hydrology or climatology. Two scholarships can be awarded each year.

2) The CMOS Daniel G. Wright Undergraduate Scholarship ($1,000) is awarded to an undergraduate student applying while in the penultimate undergraduate year intending to enter the final year of a B.Sc. Honours program in Mathematics and/or Physics or a related discipline, with interest in pursuing graduate work in physical oceanography.

3) The CMOS - Weather Network / MétéoMédia Undergraduate Scholarship ($1,500) is awarded to a female student applying while in her penultimate year of an atmospheric science program at a Canadian university who intends to pursue a career in the fields of meteorology or atmospheric science.

Appel de candidatures pour les bourses d'études SCMO **(premier cycle)**

Date limite pour la soumission des applications:
15 mars 2016

Le 15 mars 2016 est la date limite pour la soumission des applications pour les Bourses d'études de premier cycle de la Société. Cela semble peut-être loin, mais il semble toujours que la date arrive soudainement.

La SCMO offre trois bourses aux étudiants du premier cycle. Fait surprenant : nous recevons peu de demandes. Donc, nous apprécierions grandement toute assistance de votre part à faire connaissance de ces bourses à vos familles, amis, collègues et étudiants. N'importe qui peux nous envoyer sa candidature : on ne doit pas être membre de la SCMO. **N'attendez pas : faites-le maintenant!**

Les trois bourses sont décrites ci-bas. Pour lire les instructions, visiter http://www.cmos.ca/site/scholarships?language=fr_FR&

Prière de noter que toutes demandes ainsi que toutes nominations doivent être soumises au Coordinateur des honneurs de la SCMO (Denis Bourque) au coord-honneurs@scmo.ca

1) Les Bourses d'étude de premier cycle SCMO (1 000 $) sont décernées chaque année à des étudiant(e)s dans leur avant-dernière année du premier cycle dans une université canadienne qui, dans leur dernière année suivront au moins quatre cours de 3 crédits chaque dans au moins un des domaines suivants : météorologie, océanographie, limnologie, hydrologie ou climatologie. La Société offre jusqu'à deux bourses chaque année.

2) La Bourse d'étude de premier cycle SCMO Daniel G. Wright (1 000 $) est décernée chaque année à un(e) étudiant(e) qui lors de la soumission de sa candidature est dans l'avant-dernière année du premier cycle qui dans sa dernière année d'un programme du premier cycle poursuivra des études avec concentration en physique, en mathématique et/ou sciences connexes, avec un intérêt à poursuivre des études de deuxième ou troisième cycle en océanographie physique.

3) La Bourse SCMO-MétéoMédia / The Weather Network (1 500 $) est décernée chaque année à une étudiante dans son avant-dernière année d'études en sciences atmosphériques en une université canadienne qui prévoit se diriger vers une carrière dans le domaine de la météorologie.

Next CMOS Congress in 2016

Abstract submissions are now open

The 50th CMOS Congress will be held in Fredericton, New Brunswick, from May 29 to June 2, 2016. This congress will be held jointly with Canadian Geophysical Union (CGU). The theme of this joint conference is: ***Monitoring of and Adapting to Extreme Events and Long-Term Variations.*** The congress will bring together a wide range of scientists and other professionals from across Canada and other countries with a focus on topics in atmospheric, ocean, and earth sciences.

The Congress will feature:

- Plenary presentations by leading researchers;

- Science sessions that highlight top Canadian and international research contributions to biogeosciences, climatology, earth sciences, hydrology, meteorology, and oceanography, as well as the policy implications of research in these fields;

- An evening lecture, of interest to the general public;
- Workshops;
- Student night;
- An icebreaker reception;
- CMOS and CGU award banquets; and
- CMOS and CGU Annual General Meetings.

The abstract submissions period is now open! Please submit abstracts electronically via the link:

http://www.cmos.ca/site/abstracts_submission

before February 15, 2016. You will be asked to select a Broad Theme under which the available Sessions are grouped. Indicate your preference for oral or poster presentation. A non-refundable abstract fee of $50 is required to complete your submission. Note that abstract submission does not constitute congress registration; congress registration will be open early 2016. Your abstract will be evaluated by the Scientific Program Committee and you will be notified by the end of March 2016 of the presentation details, including if your presentation is to be oral or by poster.

Student CMOS members are encouraged to participate and to apply for a Student Travel Bursary when submitting an abstract (up to $500 per student). To apply for a Student Travel Bursary, complete an application form and email it to SPC@cmos.ca

Student CGU members can apply for travel support to attend the annual meeting early in 2016. Please see http://cgu-ugc.ca/awards/studenttravel/ for more information.

Prochain Congrès de la SCMO en 2016

Soumission des résumés est maintenant ouverte

Le 50e congrès de la SCMO se tiendra du 29 mai au 2 juin 2016 dans la ville de Frédéricton, Nouveau-Brunswick. Ce congrès se tiendra en même temps que le congrès de l'Union géophysique canadienne (UGC). Le thème choisi de cette conférence conjointe est ***L'adaptation aux événements extrêmes et aux variations à long terme et leur surveillance***. Le congrès réunira un vaste éventail de chercheurs et de professionnels en provenance du Canada et de l'étranger désireux de se pencher sur des questions d'envergure dans les sciences atmosphériques et de la Terre ainsi que de l'océanographie.

Le congrès comprendra:

- des conférences plénières par des chercheurs de pointe;
- des sessions scientifiques mettant en évidence la recherche canadienne et internationale dans les domaines de la biogéoscience, de la climatologie, des sciences de la Terre, de l'hydrologie, de la météorologie, de l'océanographie, ainsi que sur les implications politiques de la recherche dans ces domaines;
- une conférence d'intérêt général, ouverte au grand public;
- des ateliers scientifiques;
- une soirée étudiante;
- une réception de bienvenue;
- un banquet d'honneur de la SCMO et de l'UGC; et
- la réunion générale annuelle de la SCMO et de l'UGC.

La période de soumission des résumés est maintenant ouverte! Veuillez soumettre vos résumés électroniquement via le lien:

http://www.cmos.ca/site/abstracts_submission

avant le 15 février 2016. Vous devrez choisir le thème principal qui regroupe les sessions disponibles et indiquez votre préférence quant à une présentation orale ou par affiche. Des frais non-remboursables de 50 $ doivent être acquittés afin de compléter votre soumission. Notez que la soumission d'un résumé ne constitue pas l'inscription au congrès; l'inscription au congrès sera ouverte au début de 2016. Votre soumission sera évaluée par le comité du programme scientifique qui vous avisera avant la fin du mois de mars 2016 des détails pour votre présentation, incluant si vous devez le faire oralement ou par affiche.

Les membres étudiants de la SCMO sont les bienvenus et sont encouragés demander une bourse étudiante d'aide au voyage (jusqu'à 500$ par étudiant) lors de leur soumission. Pour faire une demande de bourse de voyage pour étudiants, veuillez compléter le formulaire requis et faites-le parvenir à SPC@cmos.ca.

Les membres étudiants de l'UGC pourront faire une demande d'appui financier au début de 2016. Veuillez visiter le site http://cgu-ugc.ca/awards/studenttravel/ pour plus de renseignements.

New Executive Director of CMOS

Gordon Griffith
CMOS Executive Director
Directeur général de la SCMO

CMOS is very pleased to announce that we have a new Executive Director, **Gordon Griffith**.

Gordon is a licensed engineer in both Quebec and Ontario. After 15 years working as a design engineer in the pulp and paper, aerospace, automotive and biomedical industries he moved to the not-for-profit sector in 2003 supporting the regulatory associations of the engineering profession with Engineers Canada. His not-for-profit experience continues by supporting the Council of Ministers of Education, Canada on a part time basis. Gordon completed his Bachelors of Mechanical and Aeronautical Engineering from Carleton University and a Masters of Engineering in Engineering Management from the University of Ottawa. Gordon is a former board member of the Canadian Network of Agencies for Regulation and is a current board member of the Canadian Massage Therapy Council for Accreditation.

Nouveau directeur général de la SCMO

La SCMO se réjouit de l'affectation du nouveau directeur général, **Gordon Griffith**.

Gordon est un ingénieur professionnel au Québec et en Ontario. Il a travaillé pendant quinze ans comme ingénieur-concepteur dans l'industrie biomédicale, des pâtes et papiers, de l'aérospatiale, et de l'automobile. Puis il s'est dirigé vers le secteur des organismes sans but lucratif (OSBL) en 2003, en soutenant, au sein d'Ingénieurs Canada, les associations de réglementation qui régissent la profession d'ingénieur. Son expérience du milieu des OSBL se poursuit avec sa participation à temps partiel au Conseil des ministres de l'Éducation (Canada). Gordon a obtenu un baccalauréat en génie mécanique et aéronautique de l'Université Carleton et une maîtrise en génie portant sur la direction d'études techniques de l'Université d'Ottawa. Il a siégé au conseil du Réseau canadien des organismes de réglementation et siège actuellement au conseil du Canadian Massage Therapy Council for Accreditation (organisme canadien d'agrément des programmes éducatifs en massothérapie).

CMOS 50th Anniversary

The year **2017** is a special occasion for CMOS!

Throughout the year 2017, we will celebrate the 50th anniversary of the creation of the Canadian Meteorological Society, and the 40th anniversary of CMOS as we know it today.

If you would like to get involved in planning our national celebrations, or you have ideas on how to recognize this special milestone, please contact Martha Anderson at president@cmos.ca

50e Anniversaire de la SCMO

L'année **2017** sera une année spéciale pour la SCMO!

Durant l'année 2017, nous célébrerons le 50e anniversaire de la création de la Société canadienne de météorologie et le 40e anniversaire de la Société telle que nous la connaissons aujourd'hui.

Si vous désirez vous impliquer dans ces célébrations ou si vous avez des idées pour reconnaître dignement cette étape importante, prière de contacter Martha Anderson à President@scmo.ca

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **April 2016.** Please send your articles, notes, workshop reports or news items before **March 4th, 2016** to the electronic address given at the top of page 2. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **avril 2016.** Prière de nous faire parvenir avant le **4 mars 2016** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse électronique indiquée au haut de la page 2. Nous avons un besoin URGENT de vos contributions écrites.

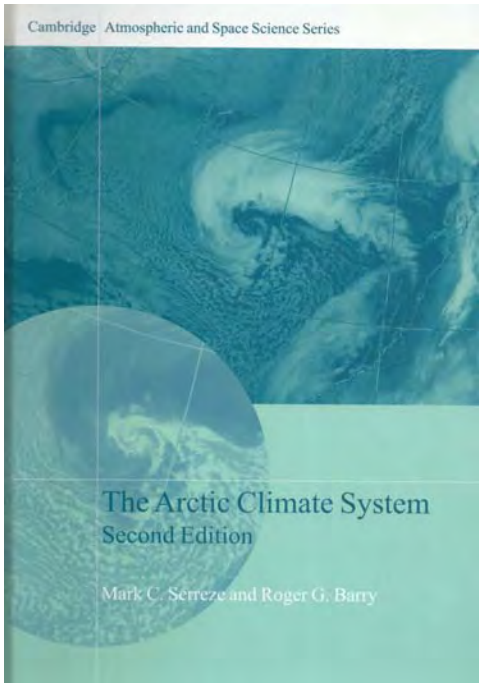
BOOK REVIEW / REVUE de LITTÉRATURE

The Arctic Climate System

by Mark C. Serreze and Roger G. Barry

Cambridge University Press, 2014
Cambridge Atmospheric and Space Science Series
ISBN 978-1-107-03717-5
2nd edition, Hardback, 404 pages, $130.95

Book reviewed by Marek Stastna[1]



This book is the 2nd edition of a book initially published in 2005. As the title suggests, it presents an overview of the Arctic Climate system at the level of a research monograph, albeit one without a high entry price in terms of technical background (i.e. mathematics). The book is structured into eleven chapters, though I would consider the first nine to cover the bulk of the vital content, with the last two (on Arctic Paleoclimates and "the Uncertain Future") providing interesting context and some well-earned speculation on the part of the authors. The book is nicely laid out in terms of type, with black and white figures sprinkled liberally throughout the text. Color figures occupy a central plate section. I found that the black and white figures ranged in quality, though this is to be expected given that a typical chapter had twenty or so figures. Some of the diagrams were particularly well put together. The color plates were perhaps less impressive, including climate model output, a few photographs and in several cases line graphs (which did not seem to require a color plate). I find that seeing the output of climate models in color is a good reminder of just how coarse even the most current climate model integrations are.

The text is well written, if somewhat dry in its style, and the editing is solid with few typos. The experience of the authors comes through clearly in the text, and this is a real strength of the book. I enjoyed the history of the subject, and Chapter 1 especially is something I can imagine being of value as supplementary reading material to many different audiences. I found that the atmospheric/land surface aspects of the Arctic climate system were covered in depth, with the oceanographic aspects of the system being seen through the prism of run-off and ice dynamics, essentially mirroring how a climate model would be laid out. As an oceanographer, this was a bit disappointing, and indeed a quick scan of the Index (which is very good for many topics) indicates that neither the words "gyre" nor "brine" appear, even though both would be considered essential to any oceanographic description of the Arctic Ocean. The lack of discussion of small scale processes in the ocean seemed jarring when contrasted with some smaller scale atmospheric phenomena (e.g. katabatic winds, polar lows) that were well presented.

The reference section is lengthy, with particularly good coverage of older articles. There is a significant amount of material that post-dates the first edition, and the authors suggest that based on classroom use aspects of the first edition (which I have not read) have been dropped in favor of new material. There are some omissions, though this is likely unavoidable. For example, I was a bit surprised that the discussion of the deglaciation, which included coverage of the question of routing of outflow from pro-glacial lakes, did not make the link with modeling studies of the MOC response to an Arctic outflow. However, all authors make tough decisions on what material to leave out and these authors have clearly worked hard to include a variety of points of view.

This book could form the basis of a graduate course in Arctic climate, most comfortably in the setting of an atmospheric science department with geography-type departments also well within the book's comfort zone. Indeed, there are some rather thought provoking problems included throughout the book. There is not enough quantitative material to make the book useful as a textbook in a physics or mathematics setting, though it could provide supplementary reading material for some flavors of graduate course in climate modeling. I suspect that the book's primary audience will be those already studying Arctic climate, and for this audience it is a very useful resource. It would be even more useful to have a companion book (or more likely e-book) that focuses on simple mathematical, or "toy", models of the various processes discussed, along with a collection of relevant data sets, with predefined analysis tools, which would give students the chance to get the hands on experience needed

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University of Waterloo, Waterloo, Ontario

to accompany the broad context provided by the reviewed book. In summary, the book is a useful summary of the present thinking about, and modeling of, the Arctic climate system and deserves its place in any current library section dedicated to climate science.

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

Latest Books received / Derniers livres reçus

2014-1) *Biogeochemical Dynamics at Major River-Coastal Interfaces, Linkages with Global Change*, 2014, Edited by Thomas S. Bianchi, Mead A. Allison, Wei-Jun Cai, Cambridge University Press, 978-1-107-02257-7, Hardback, 658 pages, $146,95.

2014-5) *An Introduction to Ocean Remote Sensing*, by Seelye Martin, 2nd Edition, 2014, Cambridge University Press, ISBN 978-1-107-01938-6, Hardback, 496 pages, $88.95.

2015-3) *An Observer's Guide to Clouds and Weather, A Northern Primer on Prediction*, by Tony Carlson, Paul Knight, and Celia Wyckoff, 2015, American Meteorological Society and distributed by the University of Chicago Press, ISBN 978-1-935-70458-4, Paperback, 210 pages, US$30.

2015-4) Thermodynamics, Kinetics, and Microphysics of Clouds, by Vitaly I. Khvorostyanov and Judith A. Curry, Cambridge University Press, ISBN 978-1-107-01603-3, Hardback, 782 pages, $108.95.

2015-6) Applied Thermodynamics for Meteorologists, by Sam Miller, 2015, Cambridge University Press, ISBN 978-1-107-10071-8, Hardback, 385 pages, $92.95.

2015-8) Radar Meteorology, Principles and Practice, by Frédéric Fabry, 2015, Cambridge University Press, ISBN 978-1-107-07046-2, Hardback, 256 pages, $81.95.

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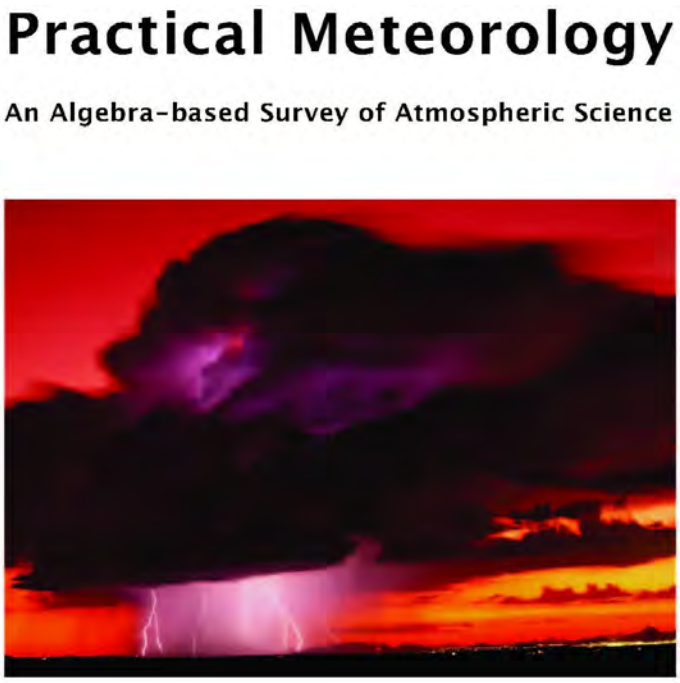

Practical Meteorology: An Algebra-based Survey of Atmospheric Science

by Professor Roland Stull
CMOS Fellow
Department of Earth, Ocean & Atmospheric Sciences
University of British Columbia

This new book is free online to everyone worldwide, with no advertising in it. You can find it at:

http://www.eos.ubc.ca/books/Practical_Meteorology/

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