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BULLETIN

SCMO

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La Société canadienne de météorologie et d'océanographie

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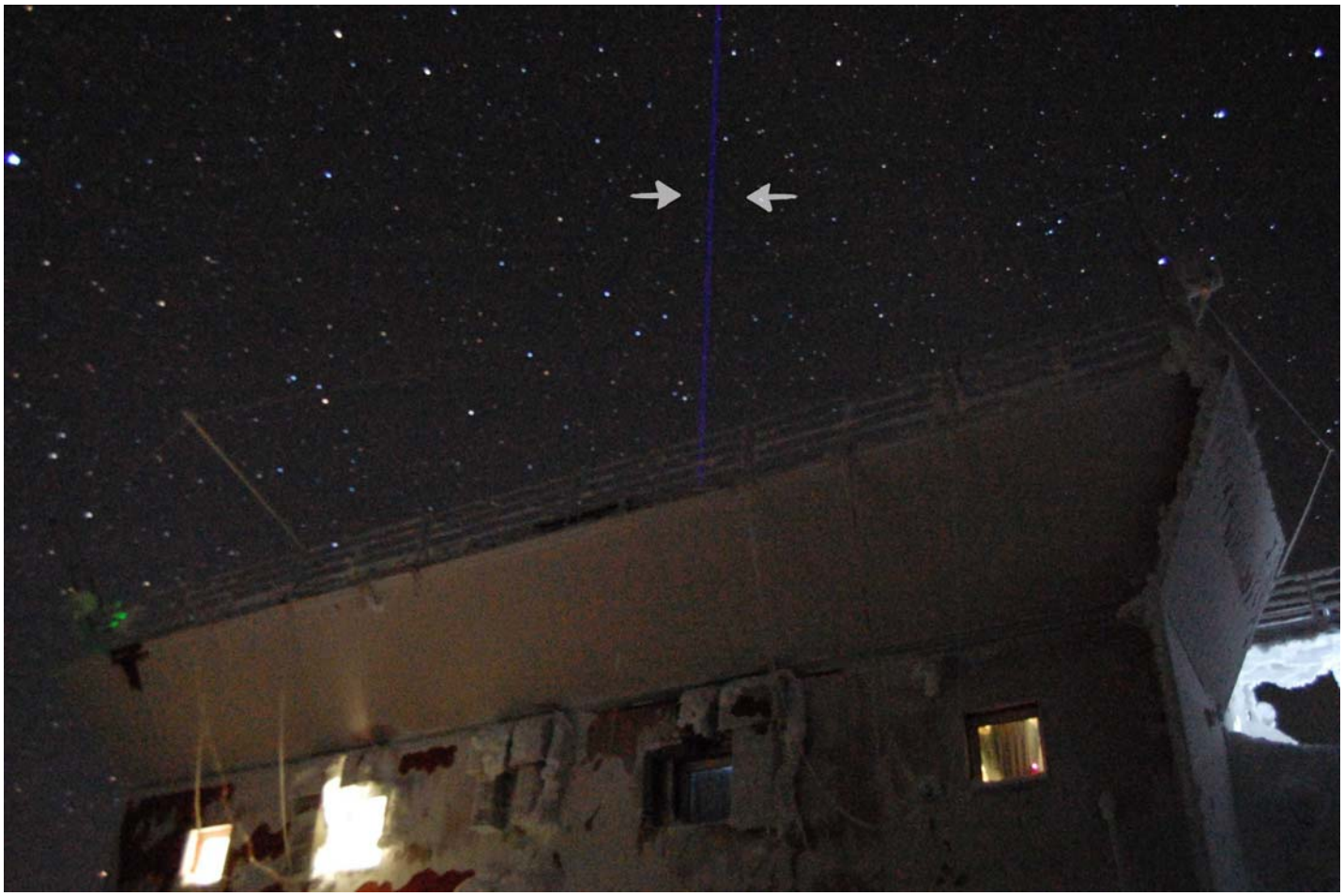
DIAL laser shining up through the Arctic night at Eureka, Nunavut



Faisceau lumineux du DIAL transperçant la nuit arctique à Eureka (Nunavut)

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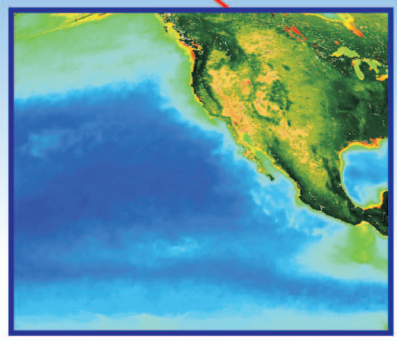
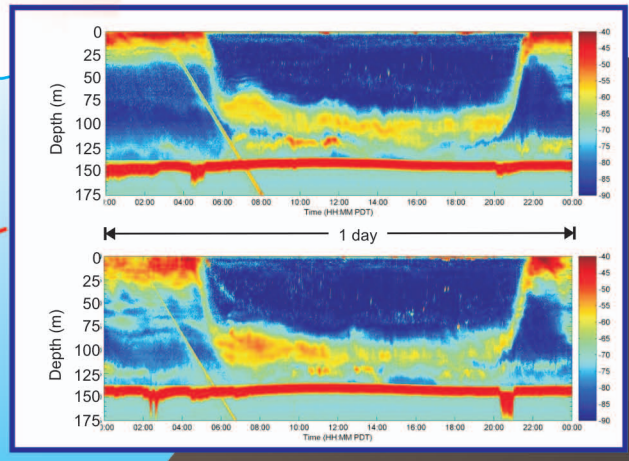
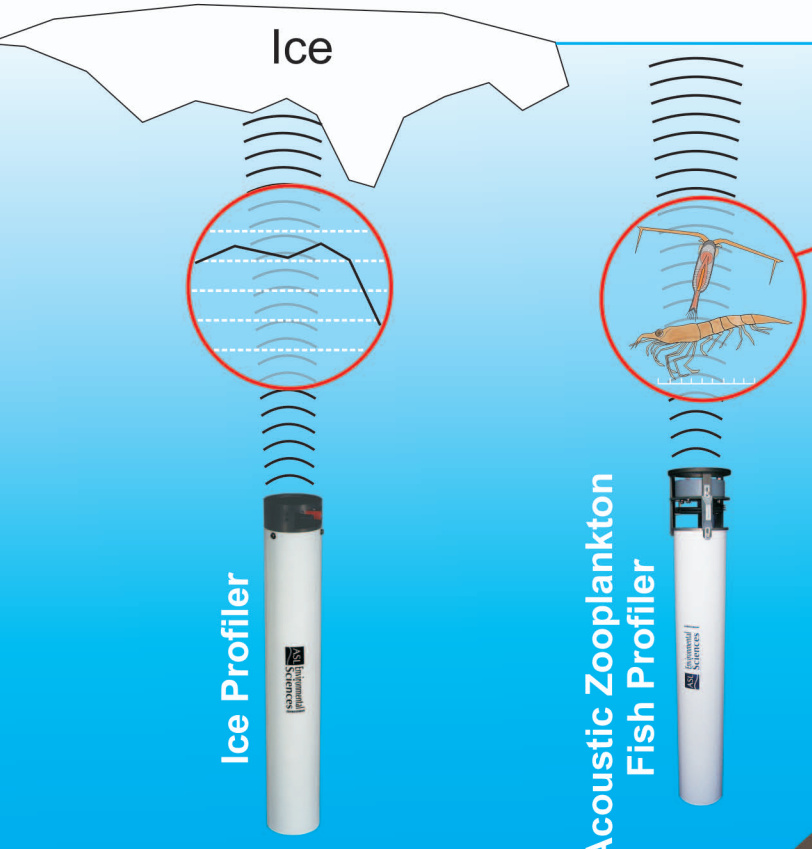


Ocean colours are chlorophyll concentrations and land colours are NDVI





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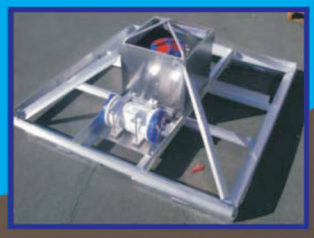

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.... Words from the President

Friends and Colleagues:

Martha Anderson
CMOS President
Présidente de la SCMO

Preparations are well underway for the **50th** CMOS Congress in Fredericton, NB. We hope you will be planning to join us for this event which is a combined venture with the Canadian Geophysical Union (CGU), with the theme "*Monitoring of and Adapting to Extreme Events and Long-Term Variations*".

The search for an Executive Director of CMOS continues since the departure of Andrew Bell in September. Interviews were being conducted as this December edition of the *CMOS Bulletin SCMO* was being prepared for publication. We are very grateful to have **Bruce Ramsay** step in as interim Executive Director from mid-September to mid-January. He has been instrumental in resolving a few critical issues related to congress planning and the society email system. I would like to publicly thank Bruce for stepping up and taking charge. We truly appreciate his expertise, leadership, and commitment.

I have three requests for our members and friends for the month of December:

First, consider the *Canadian Weather Trivia Calendar* as a Christmas gift idea. This year is the 28th edition of the calendar, and for the first time the royalties are coming to CMOS. This very generous gesture by David Phillips is a real bonus for CMOS, so let's be sure to show our support and contribute to making the *Calendar* sales higher than ever.

Second, consider who around you could be deserving of a CMOS award nomination. The details of each category are available on both the CMOS website and this bulletin and the deadline for submissions is February 15. What a great gift for a colleague, to recognize their hard work. Most of us have some quiet time at the office over the holiday season, so let's not wait until the last minute to draft our submissions. We should consider our early and mid career professionals who are making enthusiastic and important contributions to our domains, as well as those who have had long and prestigious careers.

[Continued on page 183]

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

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Cover page: Constructed in the 1990s for ozone and other upper atmosphere measurements, PEARL has been revitalized in 2006 under the auspices of the Canadian Network for the Detection of Atmospheric Change with a mission to explore the whole atmosphere and to support scientific research in one of the few accessible locations in Canada's High Arctic. Picture shows DIAL laser shining up through the Arctic night sky. Although most of the work done at Pearl has been so far done during the day, some of the research starts to be done at night. To learn more, please read James Drummond's article on **page 199**.

Page couverture: Construit dans les années 1990 pour mesurer l'ozone et d'autres caractéristiques de la haute atmosphère, le laboratoire PEARL a été revitalisé en 2006 sous l'égide du Réseau canadien de détection des changements atmosphériques. Sa mission consiste à explorer toute l'atmosphère et à soutenir la recherche scientifique à l'un des rares endroits accessibles dans le Grand Nord canadien. L'image montre le faisceau lumineux du lidar à absorption différentielle (DIAL) transperçant la nuit arctique. Bien que la plupart des travaux exécutés au site du PEARL se soient déroulés le jour, des études ont maintenant été entreprises la nuit. Pour en savoir davantage, veuillez lire l'article de James Drummond à la **page 199**.

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Société canadienne de météorologie et d'océanographie (SCMO)

Council / Conseil d'administration

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

My **third** request relates to the use of the Membership Area of our CMOS website. Only about 10% of our members have agreed to have their names appear in the member directory, which makes it much less useful than intended. For those who may have privacy concerns, this electronic directory is **ONLY** available to CMOS members with a login and password. I encourage you to become part of it. When you are renewing your membership you will be invited to review and update this portion of your member profile, or you can log in any time and chose "*View/Edit my Profile*". If you agree to have your name in the directory, you can also choose what methods of contact will be displayed for your entry: address, telephone, fax, or email. One of the great benefits of membership in a society like CMOS is networking and getting connected to people who share your work interests. I would like to assure you that being in the directory will not expose you to people trolling the internet for contact information, and the list will not be distributed in any other format. Let's make this directory a useful resource for our national membership.

I hope you enjoy this edition of the *CMOS Bulletin SCMO* that focuses on the Arctic. I'd like to thank the CMOS Arctic Special Interest Group for making this theme edition possible. As you read this bulletin, the 2015 Paris Climate Conference (COP21) will be reaching its conclusion, and certainly the Canadian Arctic is one area where the changing climate is starkly evident.

At time of writing we have just learned that Catherine McKenna has been named as the Minister of Environment and Climate Change. Also, Hunter Tootoo has been named Minister of Fisheries, Oceans and Canadian Coast Guard. We are eager to see how the new ministers will address our concerns.

Wishing you a happy holiday season with friends and family,

Martha Anderson, CMOS President

.... Allocution de la présidente

Chers Amis et collègues,

Les préparations du 50e Congrès de la SCMO à Fredericton (N.-B.) vont bon train. Nous espérons que vous comptez déjà participer à cet événement qui est organisé conjointement avec l'Union géophysique canadienne (UGC), et dont le thème est l'« *Adaptation aux événements extrêmes et aux variations à long terme et leur surveillance* ».

La recherche d'un nouveau directeur général de la SCMO se poursuit depuis le départ d'Andrew Bell en septembre. Des entrevues se tenaient tandis que nous préparions ce bulletin de la SCMO. Nous sommes reconnaissants à **Bruce Ramsay** de s'être proposé comme directeur général intérimaire pour la période de septembre à la mi-janvier. Il a été d'une grande aide pour résoudre certaines difficultés concernant la planification ducongrès et le système de courriels de la société. Je tiens donc à remercier publiquement Bruce d'avoir endossé ces responsabilités au pied levé. Nous lui sommes reconnaissants de son expertise, de son leadership et de son engagement.

J'ai trois idées à proposer à nos membres et à nos amis pour le mois de décembre :

En **premier** lieu, je vous demande de penser à offrir l'*Almanach météorologique du Canada* comme cadeau de Noël. Cette année marque le 28e anniversaire de ce calendrier et, pour la première fois, la SCMO en percevra les redevances. Ce geste généreux de David Phillips représente un véritable cadeau pour la SCMO. Je vous prie donc de soutenir ce geste en moussant les ventes de l'*Almanach*.

Deuxièmement, je vous invite à penser à un candidat digne d'une récompense de la SCMO. Le détail de chaque catégorie de prix figure sur le site Web de la SCMO. Les soumissions se terminent le 15 février. Quelle meilleure façon de reconnaître les efforts fructueux d'un collègue? Pour la plupart d'entre nous, le temps des fêtes correspond à une période peu occupée au travail. Profitons-en pour ne pas rédiger nos soumissions à la dernière minute. Nous devrions prendre en considération les professionnels en début ou en milieu de carrière qui fournissent une contribution enthousiaste et considérable à nos domaines d'études, tout comme ceux qui continuent leur longue et prestigieuse carrière.

Ma **troisième** suggestion concerne l'utilisation de la page des membres du site Web de la SCMO. Seulement 10 % des membres ont accepté que leur nom figure dans le répertoire des membres. Cette précaution réduit l'utilité de la liste. Pour ceux d'entre vous préoccupés par la protection des renseignements personnels, sachez que ce répertoire n'est consultable **seulement** que par les membres de la SCMO détenant un compte protégé par mot de passe. Je vous encourage donc à vous y inscrire. Lorsque vous renouvellerez votre adhésion, vous pourrez réviser et mettre à jour cette portion de votre profil. Vous pourrez aussi accéder à votre compte quand il vous plaira et cliquer sur « *Visualisez/éditez mon profil* ». Si vous permettez l'affichage de votre nom dans le répertoire, vous pourrez aussi choisir les coordonnées à afficher : adresse, téléphone, télécopieur ou courriel. Le réseautage et la création de liens avec des gens qui partagent vos intérêts demeurent parmi les grands avantages d'être membre d'une société comme la SCMO. Je vous assure qu'entrer votre nom dans le répertoire ne vous exposera pas à une utilisation malveillante de vos coordonnées et que nous ne

diffuserons pas la liste sous d'autres formes. Il ne tient qu'à vous de transformer ce répertoire en ressource utile pour tous les membres.

J'espère que vous apprécierez ce numéro du *CMOS Bulletin SCMO* portant tout spécialement sur l'Arctique. Je remercie le Groupe d'intérêts spéciaux pour l'Arctique d'avoir rendu possible ce numéro spécial. À l'heure où vous lirez ce bulletin, la Conférence des parties sur les changements climatiques de 2015 (COP21) tirera à sa fin à Paris. Sans nul doute, l'Arctique canadien demeure une région où les effets de ces changements sont brutalement évidents.

En écrivant ces lignes, nous apprenons que Catherine McKenna est maintenant ministre de l'Environnement et du Changement climatique. En outre, Hunter Tootoo a été nommé ministre des Pêches, des Océans, et de la Garde côtière canadienne. Nous sommes impatients de voir comment ces nouveaux ministres aborderont nos préoccupations.

Nous vous souhaitons de très belles fêtes en compagnie de votre famille et de vos amis.

Martha Anderson, Présidente de la SCMO

Weather Guru, David Phillips, Strikes Again

This 28th edition of **The Canadian Weather Trivia Calendar** is brimming with factoids, trivia, and surprising weather stories. Canada's weather guru, David Phillips, knows the power of a good storm story and the history of weather lore in Canada.

The unique feature of *The Canadian Weather Trivia Calendar* is that for every day of the year there is an interesting piece of weather trivia that occurred on that date somewhere in Canada. David has scoured the nation for the best and worst weather moments for a year's worth of trivia.

Did you know that . . .

- A lightning strike can start up battery-operated toys?
- That moose, wolves, and polar bears are not susceptible to frost-bite, even when walking on snow or ice at -70°C?
- That there were 173 hurricane-strength storms in Canada in the twentieth century?
- On New Year's eve, 2013, the Manitoba Museum tweeted it was colder in Winnipeg than on the surface of Mars!

From black blizzards to snow-spouts, white-washers to mauzy days, Canada's curious weather awaits you inside the covers of the 2016 edition of star climatologist David Phillips' award-winning *Canadian Weather Trivia Calendar*.

It should come as no surprise that *The Canadian Weather Trivia Calendar* is Canada's best-selling calendar. After all, Canadians curse, praise, meditate, and carry on about the weather as much or more than any other nationality on the planet. The calendar is always a favourite at home, the office, and in the classroom-kids love it too! Who wouldn't want to know what a vapour explosion effect is, after all?

Please note that with this year's calendar, and for the first time, CMOS will receive all the royalties of the sales, thanks to the generosity of David Phillips.

For more information on how to get the **2016 *Canadian Weather Trivia Calendar***, please consult: www.fifthhousepublishers.ca or phone: 1-800-387-9776.

Note: Don't miss reading the story behind **The Canadian Weather Trivia Calendar** on page 206.

CMOS Bulletin SCMO & Arctic SIG

The Arctic Special Interest Group, known as the Arctic SIG, is celebrating its second year by producing a special issue of the *CMOS Bulletin SCMO* with focus on meteorology and oceanography in the **Arctic** but also with linked information about living carbon clusters as well. You will find in this special issue five articles describing research and/or plan for more research in this nothern Canadian region. Because of time constraint, some major contributions could not meet the deadline, but, be assured, they will be published in future issues of the *CMOS Bulletin SCMO*.

Ann McMillan, Invited Editor
Paul-André Bolduc and Savithri Narayanan, Co-Editors

Le groupe d'intérêts spéciaux pour l'Arctique, connu sous le sigle Arctic SIG, célèbre son deuxième anniversaire en publiant un numéro spécial du *CMOS Bulletin SCMO*. Celui-ci porte sur la météorologie et l'océanographie dans l'**Arctique**, et contient aussi des informations connexes sur des organismes vivants. Ce numéro spécial présente six articles qui décrivent des recherches existantes ou des projets de recherche visant cette région nordique canadienne. En raison d'échéances serrées, certains articles importants ne figurent pas ici. Soyez assurés que ceux-ci paraîtront dans un numéro subséquent du *CMOS Bulletin SCMO*.

Ann McMillan, Rédactrice invitée
Paul-André Bolduc et Savithri Narayanan, Corédacteurs

Incoming Chair of the Arctic Special Interest Group

by Helen Joseph[1]

I am delighted to be taking over the Chair of the Arctic Special Interest Group (SIG). Over my working career, I have had opportunities to work in Arctic ocean and climate sciences as well as had opportunities to travel to the northernmost reaches of Canada and other Arctic nations. This is an area of science that I am passionate about and I look forward to leading the Arctic SIG.

The SIG has got off to a great start under the leadership of **Martin Taillefer**, Maritime Way, as the first ever Chair. I know that Marty has had some excellent guidance from colleagues like **David Fissel**, ASL Environment, **Ann McMillan**, Storm Consulting, and **Doug Bancroft**, EO DVC. As I lead the SIG in the coming years, I am counting on the continued advice from these individuals and others as well.

Helen Joseph, Chair Arctic SIG

One initiative that I will be pursuing is the establishment of an Arctic "Advisory Group" that will be comprised of individuals who have worked or lived in the North. I am hopeful that their advice on the undertakings of the CMOS Arctic SIG will ensure that our activities are relevant and priority actions for Canada's north.

There are several science organizations in Canada that are working on various aspects of Arctic science. I believe that it is important that the CMOS Arctic SIG should develop relationships with such organizations in Canada with interests and mandates in the North therein the interests of CMOS can be promoted and advanced. Examples include: the Canadian Networks of Centres of Excellence, for example, ArcticNet and MEOPAR (Marine Environmental Observation Prediction and Response); the Canadian Climate Forum; Polar Knowledge Canada and others.

If you were at the CMOS Congress in Whistler 2015, then I hope that you were able to attend the panel entitled *"Two Ways of Knowing*" that the Arctic SIG hosted. The following panelists did an excellent job at presenting their views on Arctic science – Bill Williams, DFO Sidney; Hal Ritchie, EC Dartmouth; Baba Pederson, Inuk Ranger, Kugluktuk, Nunavut and Frank Pokiak, Inuvialuit Game Council, Inuvik, NWT. (See photo below of the panelists). We hope to build on the success of the 2015 panel by developing a similar exciting event for the 2016 CMOS Congress in Fredericton next year. Stay tuned for more details in the coming months!

Panelists at the "Two Ways of Knowing" workshop held during the Whistler Congress

Finally, I would like to acknowledge the great work of Ann McMillan as the editor of this Arctic SIG newsletter. It takes a lot of initiative on her behalf to find articles and to pull together the excellent features that we enjoy on aspects of Arctic ocean and meteorological science. I propose to work with the new Advisory Board and others to encourage the expanded distribution of the Arctic SIGnal as an excellent means of promoting knowledge and awareness of Arctic meteorological, oceanographic, and environmental science issues.

As the incoming Chair, I welcome your ideas and thoughts on what the Arctic SIG should be, what initiatives we should be considering, etc. Your input and assistance would be greatly appreciated!

[1] CMOS Ottawa Centre, Helen@hcjconsulting.ca

Trends and projections of acidification and primary production in the Canadian Arctic

by Nadja Steiner[1]

Climate change forces multiple stressors on Arctic marine ecosystems, such as warming, sea-ice retreat, ocean acidification, and enhanced stratification limiting nutrient supply. New stressors, including human habitation, overharvest, industrial, and agricultural activities, anthropogenic contaminants, altered food webs, and the introduction of invasive species put additional pressure on those ecosystems (Meltofte *et al.*, 2013). Many changes are faster and more profound in the Arctic than in any other region of the world ocean. With retreating sea ice in summer exposing the underlying water to solar radiation, sea surface temperatures (SST) and upper ocean temperatures in all the marginal seas of the Arctic Ocean are increasing. These changes have direct and indirect effects on the marine ecosystem including increasing ocean primary production in some regions (Frey *et al.*, 2014) and reduced production in other regions. Allard and Lemay (2012) point out that climate warming, combined with changes in the natural and socio-economic environment, is creating cascading effects on the ecosystem and society with significant impacts on human health and quality of life, particularly via the impacts on food resources. These links to human health and socio-economics as well as sea-ice related prospects for Arctic shipping and resource exploration are what initiated a flurry of assessments, particularly within the Arctic Council's Arctic Monitoring and Assessment Program (e.g., AMAP 2012, AMAP 2013, CAFF 2013), but also within Canada. Latter include the ArcticNet IRIS assessments (e.g., Allard and Lemay, 2012), Natural Resources Canada technical reports (e.g. Warren and Lemmen, 2014) and several recent Fisheries and Oceans Canada technical reports (Steiner *et al.,* 2013b and references therein). Many of the assessments identify the limited availability of baseline observations, particularly but not exclusively of the marine ecosystem, as a severe limitation in establishing trends as well as initializing projections. Hence, with a variety of projects including intense measurement programs, Canada somewhat belatedly struggles to establish some baseline information before potentially irreversible system changes occur (Wassmann *et al.*, 2011). Examples are ArcticNet and several projects within the NSERC Climate Change and Atmospheric Research program. Several projects now include a distinct socio-economic component, e.g., ArcticNet, and the SSHRC (Social Sciences and Humanities Research Council) OceanCanada partnership.

Projecting future ecosystem responses to climate change and other potential stressors requires the application of numerical ecosystem models, the first instance being Earth system models (ESMs, model systems with fully coupled atmosphere, ocean, sea ice, and land components including interactive biogeochemical modules for all components), allowing the study of future projections in the Arctic environment with effects on the marine carbon cycle and ecosystem behavior. However, the still fairly coarse horizontal and vertical resolution of those models restricts the ability to resolve biological or chemical processes happening in the euphotic zone as well as small-scale physical processes important for biogeochemistry. Hence regional climate models and basin scale models need to be developed which utilize the ESM output as boundary conditions. One such model is currently under development within Fisheries and Oceans Canada and preliminary results are presented here. The model is forced with climatological mean forcing combined from the Canadian Earth System Model (CanESM2, Arora *et al*. 2011, Christian *et al.* 2010) and die Canadian Regional Climate Model (CanRCM4, Scinocca *et al*. 2015, Steiner *et al*. 2015) for current (2006-2025) and future (2066-2085) times. The ocean model is based on NEMO (Nucleus for European Modelling of the Ocean) with set up following Hu and Myers (2013) and is currently coupled to the PISCES (Pelagic Interaction Scheme for Carbon and Ecosystem Studies) ecosystem model. For this contribution, I will focus on trends and projections in Arctic primary production and ocean acidification. A full review of observed trends and climate projections affecting marine ecosystems in the Canadian Arctic is given in Steiner *et al.* (2015).

Arctic Ocean acidification trends and projections

Approximately one quarter of the anthropogenic carbon dioxide to date has been absorbed by the ocean worldwide. The uptake has increased the acidity of seawater and reduced its carbonate-ion concentration. Increasing atmospheric CO_2 emissions and consequent ocean uptake further enhance ocean acidification which can significantly affect growth, metabolism, and life cycles of marine organisms (e.g. Gattuso and Hanson 2011). Ocean acidification in the Arctic is intensified due to low temperatures as well as increased freshwater supply from river runoff, ice melt, and Pacific water. Colder water temperatures increase CO_2 solubility, while regional oceanographic features (high freshwater inputs relative to volume into large continental shelf areas) limit the Arctic Ocean's capacity to compensate for increased acidity. For example, the Beaufort and Chukchi Sea continental shelves experience naturally corrosive Pacific seawater inflows with pH as low as 7.6. Changes in sea ice affect the CO_2

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

exchange between atmosphere and ocean either directly (via changes in open water area) or indirectly (e.g., via changes in biological uptake). Cai *et al*. (2014) indicate that while the Chukchi Sea is a dominant site for CO_2 uptake (high nutrient concentrations lead to seasonally high production and subsequent sea surface CO_2 depletion), the Beaufort Sea and Canadian Archipelago take up much less and the latter may even become a weak source during certain times of the year. Local, seasonal effects on the shelves are highly influential: Bates and Mathis (2009) point out that riverine carbon flux in the Arctic Ocean is similar in magnitude to the direct CO_2 flux from the atmosphere to the ocean. Base cations are diluted by inflows from the Mackenzie and Yukon Rivers and from sea-ice melt. High productivity over the shelves in summer, as well as major terrestrial organic carbon supplies from rivers and rapid coastal erosion, ultimately result in further reduction of pH and $CaCO_3$ saturation state (AMAP 2013). Localized upwelling of acidic waters can further increase acidification in surface and near-surface waters (Chierici and Fransson 2009; Carmack and McLaughlin 2011).

Aragonite and calcite are the two forms of calcium carbonate minerals (CaCO3) commonly produced by marine organisms. The saturation state (Ω) of seawater with respect to $CaCO_3$ is a measure of its potential to corrode the $CaCO_3$ shells and skeletons of marine organisms and is defined as the product of the carbonate and calcium concentrations divided by the solubility product. $CaCO_3$ shells start to dissolve when the waters become undersaturated with respect to $CaCO_3$, i.e., when $\Omega < 1.0$. While enhanced primary production can seasonally increase the $CaCO_3$ saturation state, subsequent remineralisation of sinking organic material releases CO_2 which further reduces the saturation state in the subsurface waters (Bates and Mathis 2009; Yamamoto-Kawai *et al.* 2009, 2011; Denman *et al.,* 2011). These combined effects make Arctic waters especially vulnerable to a declining saturation state of $CaCO_3$.

Miller *et al.* (2014) find substantial changes in the marine carbonate system of the western Arctic since the 1970s with upper halocline waters and deep waters now regularly showing aragonite undersaturation. Similar conclusions have also emerged from annual surveys of the Beaufort gyre since 2003, indicating that by 2008, waters at 100 – 200 m depth had become under-saturated with respect to aragonite (Yamamoto-Kawai *et al.*, 2009; 2011). Aragonite saturation (Ω_A) values as low as 0.8 have been recorded in surface and bottom waters of the Chukchi and Beaufort Seas. Measurable downstream effects on seawater chemistry are propagated via M'Clure Strait and Amundsen Gulf into waters of the Canadian Arctic Archipelago and beyond (AMAP, 2013).

So far, model simulations of biogeochemical changes such as future Arctic Ocean acidification are largely limited to global ESMs (e.g., Schneider *et al*. 2008; Steinacher *et al*. 2010; Denman *et al*. 2011, Steiner *et al*. 2014). The ESM results consistently show enhanced ocean acidification in polar regions and suggest Arctic Ocean acidification will continue over the next century with accelerated reductions in calcium carbonate saturation state at least until the sea ice cover reaches a new steady state with largely ice-free summers (Steiner *et al.* 2014). Projections following the Representative Concentration Pathways (RCP) 8.5 (Moss *et al.* 2010) for the Canada Basin show reductions in the bidecadal mean surface pH from about 8.1 in 1986 – 2005 to 7.7 by 2066 – 2085, closely linked to reductions in the calcium carbonate saturation state $\Omega_{A,C}$, from about 1.4 (2.0) to 0.7 (1.0) for aragonite (calcite), which strengthens earlier results based on the Special Report on Emissions Scenarios (SRES) (e.g., Steinacher *et al.* 2009). Simulated changes in the annual mean surface saturation state of $CaCO_3$ over sixty years are about -0.5 for Ω_A and -0.8 for Ω_C and the Beaufort Sea surface is projected to become undersaturated around 2025 (Ω_A) and around 2065 (Ω_C). The top 350 m in the Canada Basin are simulated to become undersaturated with respect to aragonite by 2066 – 2085 (Steiner *et al.*, 2014, 2015). Preliminary results from the higher resolution Canadian Arctic ecosystem model are shown in Figure 1 and indicate a reduction in surface pH in a similar range. An emission scenario with mitigation (RCP4.5) reduces the progress of acidification (pH of 7.9 is reached about 25 years later in RCP4.5 than in RCP8.5). However, the emergence of undersaturated surface waters, which is projected to occur within the next decade, differs little between the scenarios (Steiner *et al.* 2014).

Retreating sea ice is one of the main components leading to increased acidification of the Arctic Ocean, both due to the addition of melt water from multi-year ice and due to the increase in open water areas allowing for enhanced air-sea exchange. The latter leads to a more pronounced seasonality in atmosphere-ocean carbon fluxes with a later maximum uptake in fall, and reduced uptake or even outgassing in summer (Steiner *et al.*, 2013a) when a limit in uptake capacity is reached (Cai *et al.*, 2010). A model study by Yamamoto *et al*. (2012) suggests that future reductions in pH and aragonite saturation states could be significantly faster than previously projected with sea ice reduction occurring faster than simulated.

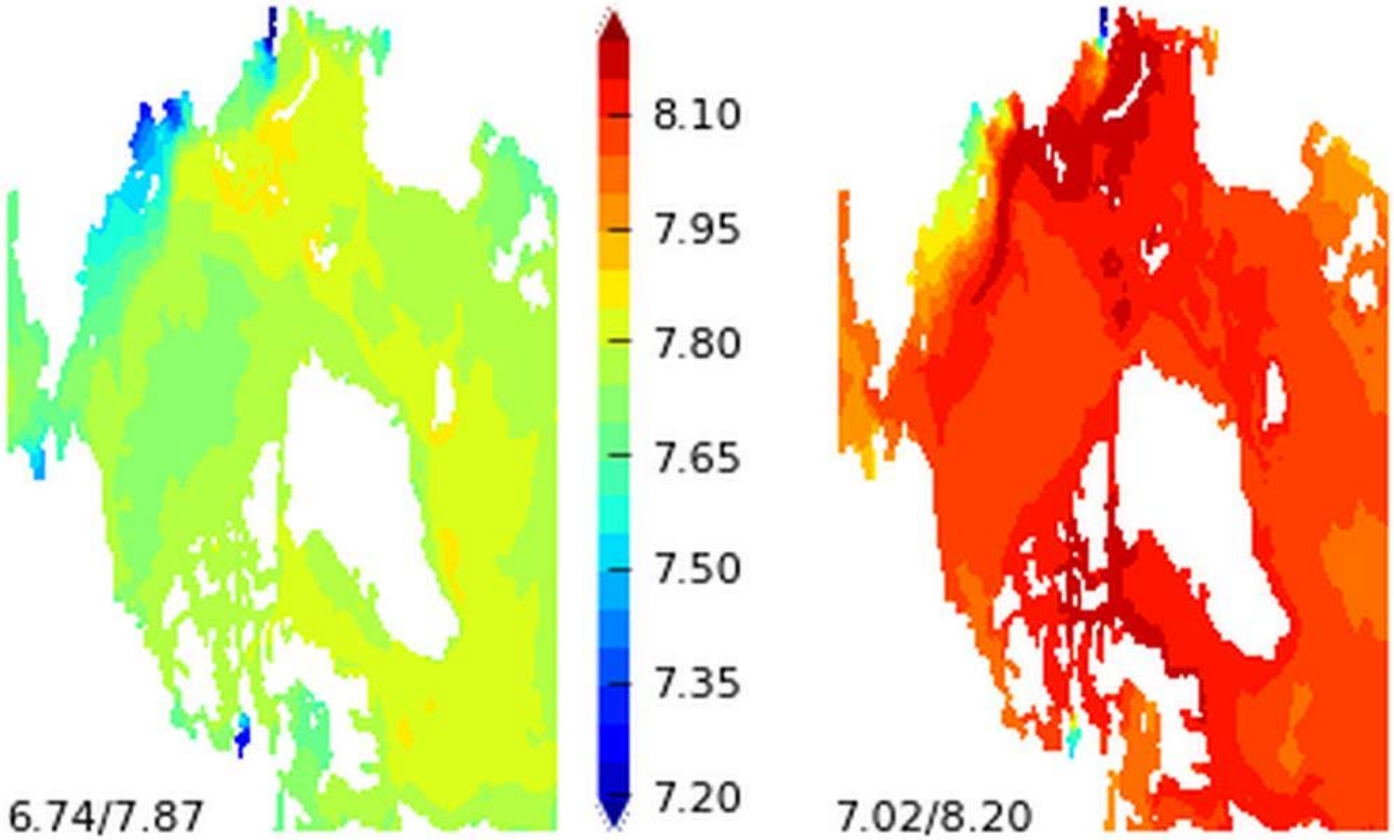

Figure 1: Canadian Arctic Ecosystem Model projections of surface pH: future times (2066-2085) on the left and current times (2006-2025) on the right. Numbers give the minimum and maximum in the area.

Nutrients and primary production trends and projections

Arctic marine ecosystems are hosts to over 2000 species of algae, tens of thousands of microbes, and over 5000 animal species. Numerous smaller domain ecosystems within the larger systems are characterized by unique physical and biological features making them hotspots for marine productivity and biodiversity (Michel *et al.*, 2013). The Arctic marine ecosystem is constituted of benthic, pelagic, and sympagic (ice-associated) ecosystems with different features over shelves or deep water, strong riverine influence and hot spots like polynyas and marginal ice zones. Marine ecosystems in the Canadian Arctic are characterized by a short productive period in spring-summer, driven by the high seasonality in solar radiation and often limited nutrient supply. Nelson *et al.* (2014) summarize the biodiversity and biogeography of the lower trophic taxa in the Pacific Arctic Region with sensitivities to climate change. They indicate that range shifts and changes in the relative abundance of particular taxa have occurred within the last decade and suggest the relative proportions of major bacterial groups could be an indication of recent productivity and be used to track ecological shifts, e.g. associated with climate change.

A recent Arctic data synthesis based on observations from 1954 – 2007 provides a baseline for primary production (Matrai *et al*. 2013; Hill *et al*. 2013) and nutrients (Codispoti *et al*. 2013). Due to the extreme sparseness of the observations both temporally and spatially, the data has been averaged over ecotypological regions (EaseGrid, Matrai *et al.*, 2013). Within the Beaufort Sea summer-time cruise average data have revealed a warming, freshening upper ocean and increasing density stratification; Picoplankton, having a larger surface-area-to-volume ratio and slower sinking rate, do better under these conditions than larger nanoplankton (Li *et al.*, 2009). Meanwhile, total phytoplankton biomass did not change.

Due to the limited observations, publications on climate change driven biological changes in the Arctic marine ecosystem focus on qualitative changes. Observations by McLaughlin *et al.* (2011) showed a decrease in the subsurface deep Chl-a maximum from about 45 m in 2002 to 65 m in 2010/2012 in the Canada Basin. Bergeron and Tremblay (2014) also describe a deepening in the subsurface Chl-a maximum in association with a deepening of the median depth of the nitracline by 3.6 m/yr from 2003 – 2011 in the southeast Beaufort Sea. The position of the

halocline was unaffected indicating a greater vertical extent of

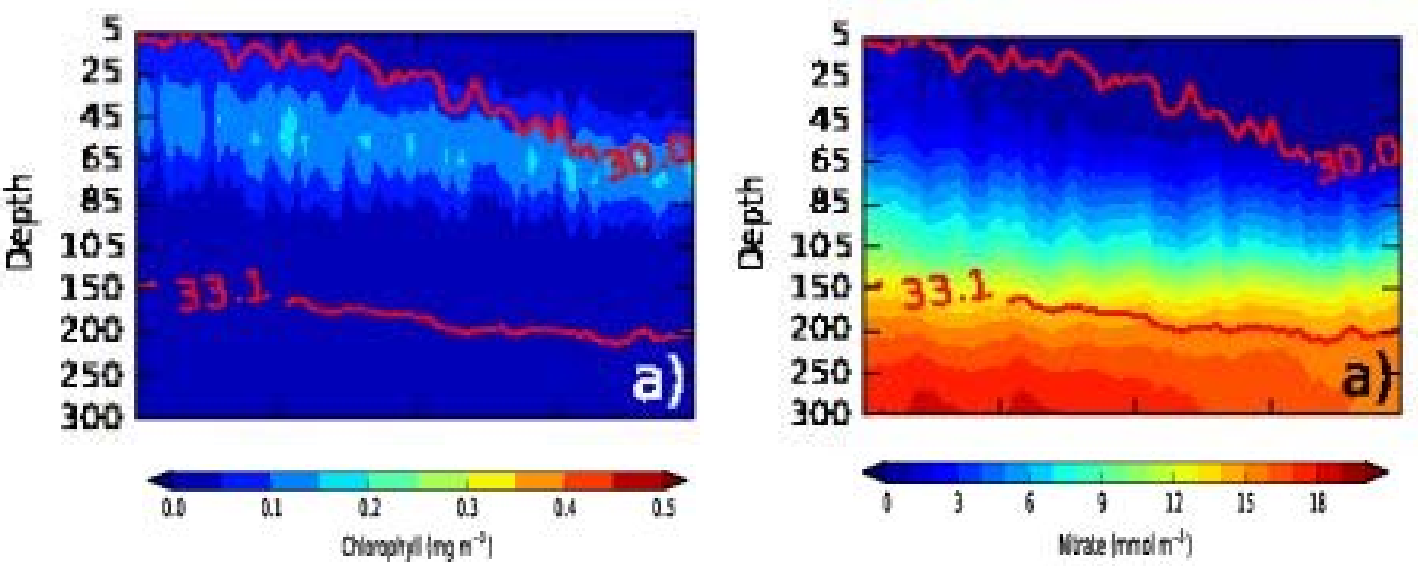

Figure 2: left frame) Projected deepening of the subsurface chlorophyll-a maximum in the Canadian Earth System model CanESM2 in the Canada Basin (140W, 75N); and right frame) corresponding nitrate. Red lines indicate the 30.0 and 33.1 psu isohalines.

biological consumption. Fujiwara *et al*. (2014) find shifts in the algal community composition in relation to the timing of sea-ice retreat and a combined model- satellite observation analysis by Ji *et al*. (2013) indicates a strong correlation between the timing and variability of sea-ice retreat and pelagic production at any specific location. Ardyna *et al.* (2014) identify a recent development of a secondary bloom in the fall coinciding with delayed freeze-up and increased exposure of the sea surface to windstress. Tremblay *et al.* (2012) summarized the current state and recent trend in Canadian Arctic primary productivity in six points:

1: Offshore, the warming and freshening of the surface layer is leading to a displacement of large nanophytoplankton species by small picophytoplankton cells, with potentially profound bottom-up effects within the marine food web.

2: In coastal areas, primary production increases as favorable winds and the deeper seaward retreat of ice promote upwelling.

3: Multiple upwelling events repeatedly provide food to herbivores throughout the growth season.

4: A substantial amount of pelagic primary production occurs under thinning ice (e.g., Arrigo *et al*. 2012) due to enhanced light penetration through the sea ice (Frey *et al.* 2011) and cannot be detected by orbiting sensors. (Changes in irradiance transmitted through snow and sea ice also directly influence the production of sea ice algae with consequences to secondary producers, Leu *et al.*, 2015).

5: Early primary production in spring does not imply a trophic mismatch with key herbivores (publication diverge on this subject, e.g. Leu *et al.*, 2011).

6: The epipelagic ecosystem is very efficient at retaining carbon in surface waters and preventing its sedimentation to the benthos. Tremblay *et al*. (2012) conclude that while enhanced primary production could result in increased fish and marine mammal harvests for Northerners, it will most likely be insufficient for sustainable large-scale commercial fisheries in the Canadian Arctic.

Arrigo *et al.* 2008 suggested that in the Arctic, the loss of ice during spring could boost overall productivity more than 3-fold above 1998 – 2002 levels, potentially altering marine ecosystem structure and the degree of pelagic-benthic coupling. Vancoppenolle *et al.* (2013), in an assessment of projected primary production, nutrient and sea ice concentrations in 11 CMIP5 ESMs, find that despite a good representation of the ensemble mean Arctic-integrated primary production for 1998 – 2005, models neither agree on what limits primary production today, nor on the sign of future change. A balance of a decrease in available nutrients due to increased stratification and increased light availability due to a reduced sea ice cover operates in all models; however it depends on the model if the benefits of the light increase are sufficient or not to overcome the decrease in available nitrate. Steinacher *et al.* (2010) and Vancoppenolle *et al*. (2013) suggest that the main cause for the large intermodel spread is a poorly constrained observational data set of Arctic nitrate concentrations. ESMs projections suggest a sixty-year change in NO_3 with largest change in the central Arctic (-3 mmol m^{-3}) and

smaller losses near the BS coast (-1 to -2 mmol m^{-3}) correlated with changes in sea-ice concentration. The annual mean pattern is dominated by losses in March, the time of maximum replenishment (Steiner *et al.*, 2013b). Focusing on the Canada Basin, figure 2 shows a continued deepening of the subsurface chlorophyll–a maximum as projected with the Canadian Earth System Model (CanESM2), in correspondence with a deepening of the nutricline. The regional model indicates temporal shifts along with the deepening, with earlier ice thinning and break up initiating earlier surface blooms followed by earlier formation of the deep chlorophyll–a maximum.

Summary

Despite large gaps in biogeochemical observations in the Arctic and difficulties in establishing baseline information, observations indicate significant changes within the Arctic marine ecosystem as well as indications of feedbacks to higher trophic levels. Earth system models project consistent ocean acidification as well as a deepening of the chlorophyll-a maximum in the Canadian Arctic, but lack agreement in projected primary production. Inconsistencies are related to a limited nutrient data base and variations in sea-ice projections (affecting stratification). An increased focus on high resolution/basin scale biogeochemical modelling in the Arctic is needed. The Multiple stressor environment for Arctic marine ecosystems which is created by climate change (warming, changing sea-ice, species invasion, acidification) and enhanced human activities (potential pollution and oil spills, overfishing) suggests the potential for reduced resilience of Arctic marine ecosystem components. Latter might need consideration in ecosystem models in order to improve future ecosystem projections.

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Modèle de prévision statistique d'événements dans l'Arctique

par André April[1]

Abstract: This paper presents a statistical event forecast model for the Arctic, based on Fourier transforms and a mathematical filter. The results indicate that this model compares very well with both a multiple regression model and a human-made forecast. In fact, at this time, none of these forecast models allows the prediction of ice conditions far beyond the usual or historical dates, which poses a forecast problem in the Arctic. It is interesting to note however that there seems to be a direct link between the period associated with the dominant spectral peak of the Fourier transform and the ease with which date of events, such as fractures, can be forecasted.

Dans les eaux canadiennes, la prévision d'événements comme le début de la fracturation de la glace ou la prévision d'une région marine qui peut être considérée comme eau libre ou eau bergée, est importante pour le commerce maritime et la garde côtière, afin de planifier le routage des navires ou les plans de déglaçage par exemple. Actuellement, le Service canadien des glaces utilise un modèle de régression linéaire multiple afin de prévoir, de un à trente-six mois à l'avance, la date à laquelle ces événements auront lieu. Par la suite, un prévisionniste expérimenté, utilisant les connaissances du milieu arctique et ses spécifications météorologiques, préparera au début de l'été arctique un aperçu saisonnier de prévision pour les prochains trois mois contenant les conditions glacielles des cinquante-quatre régions marines. Un aperçu de trente jours sera émis par la suite et est réévalué tous les quinze jours pendant tout l'été arctique.

Le nouveau modèle de prévision statistique présenté ici, utilise les dates de ces divers événements depuis le début de la détection de ceux-ci par reconnaissance aérienne ou satellitaire, soit depuis près de quarante-six ans, par le Service canadien des glaces. Ces dates forment une série continue qui est validée à la fin de chaque saison. Ce modèle statistique utilise une série se terminant l'année précédente, afin de faire une prévision des dates d'événements pour l'année en cours. Ce modèle utilise à la fois la transformation de Fourier rapide (FFT) et un filtre numérique (Optimal Filtering Based Model), OFBM. Ce modèle peut donc servir comme outil d'estimation des dates d'événements pour l'année prochaine, avant que le modèle de régression multiple s'avère utile (un à trente-six mois), et avant que le prévisionniste spécialisé puisse utiliser les données de l'atmosphère et de l'océan pour le prochain été arctique.

Méthodologie

Le modèle statistique utilisé ici consiste à effectuer les étapes suivantes. Premièrement, on calcule la transformée de Fourier rapide (FFT – Matlab, The MathWorks inc.) sur les séries des dates d'observations des divers événements (ex. fracture) pour chacune des régions, ex. bras Pond (Pond Inlet). On obtient alors un périodogramme nous donnant la fréquence et la puissance de ce FFT. On inverse la fréquence pour obtenir la période. On obtient donc un périodogramme en année par cycle. Le maximum de puissance nous donne l'indication de la période à laquelle s'effectue le retour des années le plus probable; lors de laquelle, aux mêmes dates, l'événement survient. Pour donner un exemple bien connu, l'activité des taches solaires aux cours des trois cent dernières années est de nature cyclique et la période lors de laquelle elles sont maximums est obtenue à l'aide du FFT. Elle est d'ailleurs de onze années.

Par la suite, on effectue une moyenne mobile sur les dates d'observations, et ce sur un intervalle donné précisément par la période obtenue. Enfin intervient un filtre numérique OFBM. Cet outil a été testé pour faire des prévisions saisonnières de la couverture de glace au Canada et semblait démontrer des performances remarquables. Le premier avantage du OFBM sur les autres modèles statistiques c'est qu'il ne nécessite pas d'information extérieure (ex. une prévision de la température de l'air) puisque la prévision est basée uniquement sur une série temporelle (communication personnelle de Trudy Wohlleben). On retrouvera plus d'information sur l'utilisation de l'OFBM dans Makhoul (1975) et Press *et al.* (1992).

Un exemple des résultats de ce processus sont présentés dans la figure 1.

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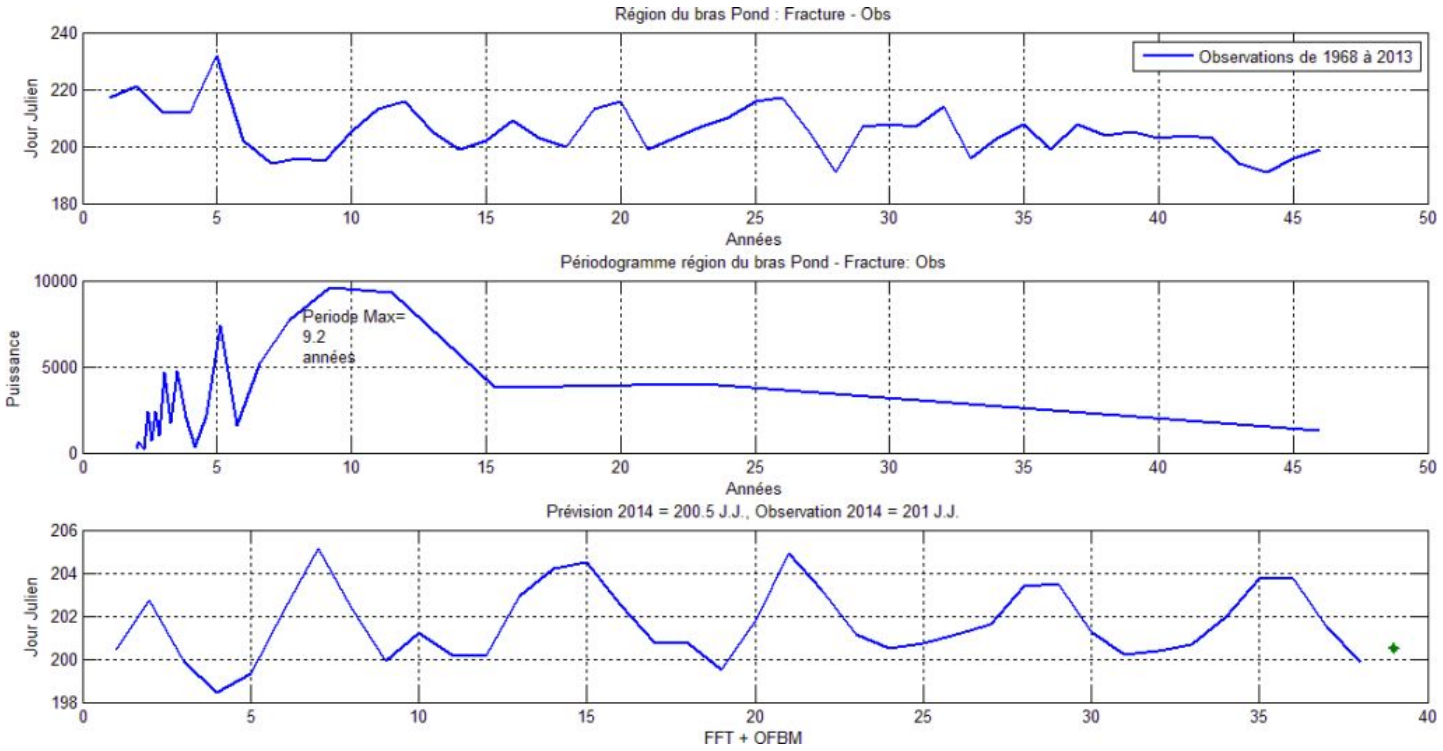


Figure 1: Graphique du haut) Observations des dates de la fracture de la glace près du bras Pond; graphique médian) Périodogramme de la fracture avec sa période maximum pour l'année 2013; et graphique du bas) Résultat du OFBM sur la série à laquelle on a posé une moyenne mobile sur un intervalle donné par la période maximum obtenue par FFT.

Puisqu'on comparera les résultats des prévisions de ce modèle statistique avec le modèle MLR (Multiple Linear Regression), une brève introduction au MLR semble adéquate. Le MLR est un modèle statistique basé sur une régression linéaire des observations qui utilise des prédicteurs extérieurs comme la température de l'air, la pression atmosphérique, la température de l'eau de mer, etc. pour faire une prévision de 1 à 36 mois. Les conditions glacielles sont alors corrélées avec les différentes variables pour différents lag de temps pouvant ainsi créer parfois plus de 1000 prédicteurs. Une régression est alors opérée suivant une technique régression/élimination afin d'éviter une sur-détermination des prédicteurs. Le MLR s'est avéré performant dans la prévision des conditions glacielles pour la baie d'Hudson par exemple (Tivy et al. 2007).

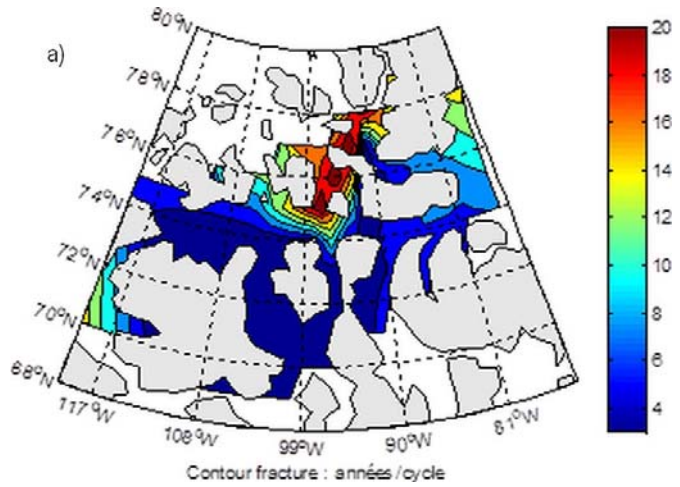
Résultats

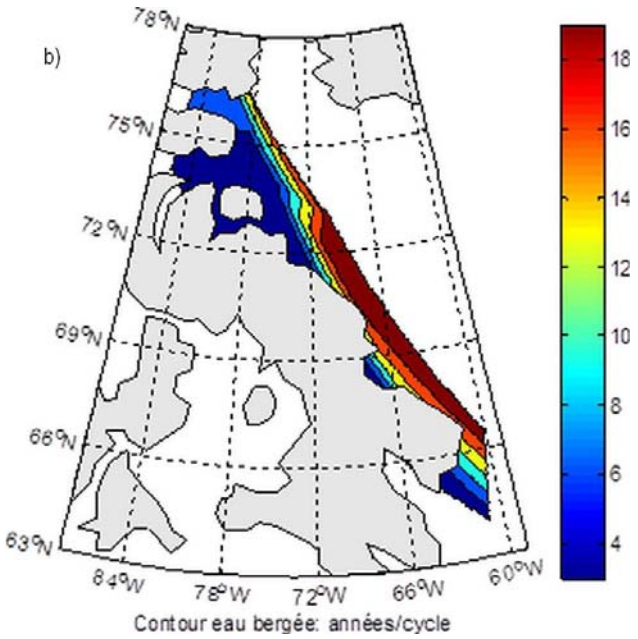
On présente ici les résultats comparant le pourcentage de succès entre le prévisionniste (prévision de 3 mois), le modèle statistique MLR (prévision de 3 mois) et le modèle statistique constitué du FFT et du OFBM (prévision de 24 mois), pour les années 2011-12-13-14, (*voir tableau 1* à la page suivante). On obtient un succès de prévision lorsque la date prévue est à l'intérieur de sept jours de la date donnée par l'observation de l'événement. Remarquons que le modèle statistique FFT + OFBM prévoie aussi bien que les autres modèles à plus courte portée de prévision. On remarque aussi que le modèle statistique MLR possède moins d'événements et que parfois, ce modèle ne peut trouver de prédicteur nécessaire pour faire une prévision. Dans ces cas, aucune prévision MLR n'en résulte. Des résultats quasi-semblables sont obtenus de ces modèles puisque en fait, aucun des types de prévision ne peut prévoir des événements qui ont lieu à des dates extrêmes, i.e. des dates qui sont loin des dates normales due à des causes météorologiques hâtives ou qui repoussent les conditions glacielles loin des dates normales ou historiques.

Saison 2011	Nombre total d'événements	% prévision-niste correct	Nombre total d'événements	% MLR correct	Nombre total d'événements	% FFT + OFBM correct
Baie d'Hudson	13	31%	10	70%	15	33%
Est Arctique	20	40%	13	23%	21	42%
Ouest Arctique	16	44%	11	55%	19	52%
Total	49	39%	34	47%	55	42%
Saison 2012						
Baie d'Hudson	13	38%	10	20%	15	46%
Est Arctique	22	36%	15	53%	21	57%
Ouest Arctique	21	52%	13	54%	19	52%
Total	56	43%	38	45%	55	51%
Saison 2013						
Baie d'Hudson	13	69%	9	89%	15	80%
Est Arctique	21	52%	15	53%	21	47%
Ouest Arctique	21	62%	12	58%	19	68%
Total	55	60%	36	64%	55	65%
Saison 2014						
Baie d'Hudson	13	62%	9	44%	15	46%
Est Arctique	21	43%	13	31%	21	57%
Ouest Arctique	20	70%	10	50%	19	68%
Total	54	57%	32	41%	55	57%

Tableau 1: Pourcentage de succès pour les différents types de prévision pour les années 2011, 2012, 2013, et 2014 pour la baie d'Hudson, l'Est de l'Arctique, et l'Ouest de l'Arctique

Les périodes maximum des événements pour les différentes régions prévues sont présentées à la figure 2 (illustrée à la page suivante). En fait il semble exister une relation directe avec la période maximum et la facilité à laquelle on peut prévoir les dates des événements. On a remarqué que, lorsqu'un événement possédait une faible période maximum, alors il était plus facile d'obtenir un succès de prévision. En fait, lorsque la période est faible, la date de l'événement revient plus fréquemment et il est plus aisé d'en faire sa prévision. Dans le cas de l'est de l'Arctique, la région de la baie Norwegian est une région où aucun succès de prévision a eu lieu pour ces quatre années, et elle correspond à une période maximum de près de 20 ans. Même scénario pour la région de la baie de Baffin et du bassin Foxe près de la baie d'Hudson. Par contre, le détroit d'Hudson possède une faible période maximum et correspond à un taux de succès élevé.





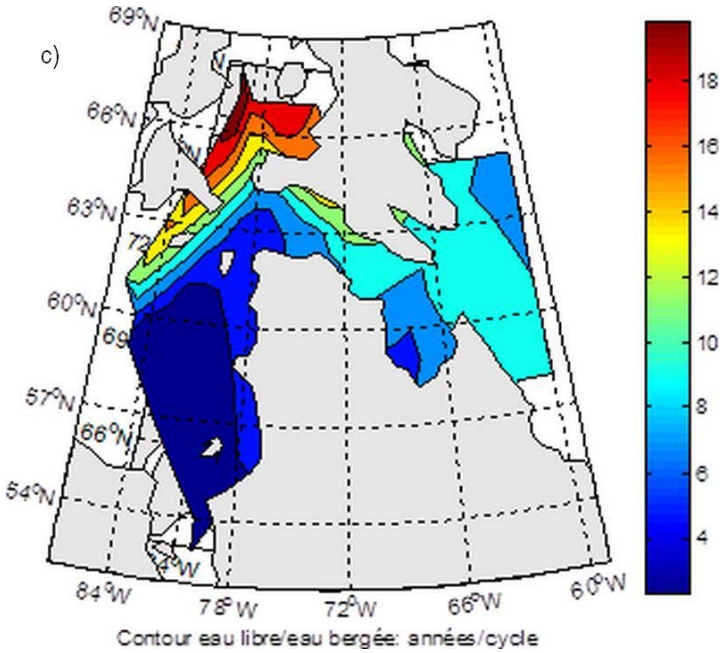


Figure 2: a) contour moyen de la période maximum de fracture en années par cycle pour l'est de l'Arctique; b) contour moyen de la période maximum d'eau bergée en années par cycle pour la baie de Baffin; c) contour moyen de période maximum d'eau libre ou d'eau bergée en années par cycle pour la baie d'Hudson.

Fracture

Par la suite, on présente une étude de cas portant spécifiquement sur les dates de prévision de la fracture de la glace dans l'est de l'Arctique. Les dates correspondent au moment de la fracture complète de la glace dans l'Arctique. Des études de cas sur l'eau libre ou l'eau bergée dans la baie d'Hudson, la baie de Baffin et l'ouest de l'Arctique seront présentées ultérieurement. Puisque nous possédons les dates d'observations de la fracture de la glace et les dates prévues par le modèle statistique FFT+OFBM, il est possible de déterminer l'écart entre elles. La figure 3 présente le nombre de jours entre la prévision et l'observation. Un nombre par exemple de -15 jours, indique que la prévision est 15 jours en avance sur la date d'observation. Un nombre de +10 indique que la prévision est de 10 jours en retard sur la date d'observation. On remarque principalement à l'aide des figures, que 2 régimes distincts des résultats de prévision sont observables entre les années 2011 et 2014. En 2011 et 2012 les dates de prévisions sont en retard, alors que les dates d'observations sont plus tôt. En 2013 et 2014 les dates de prévisions sont en avance, alors que les dates d'observations des fractures surviennent plus tard dans la saison.

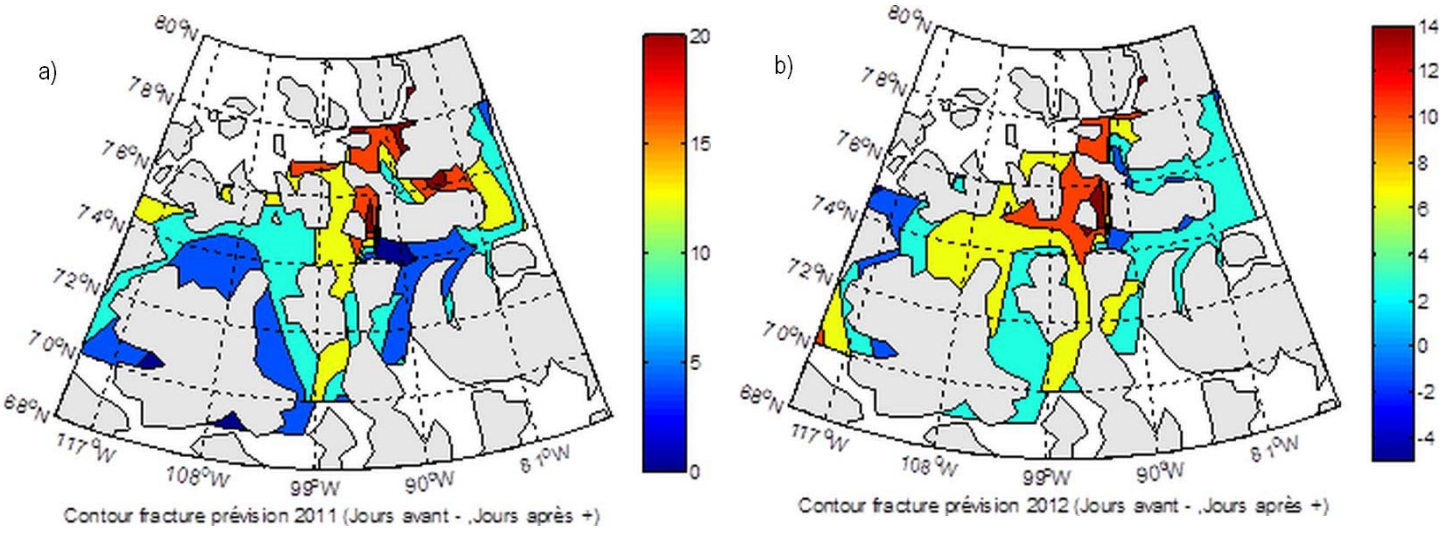


Figure 3: Écarts entre prévision et observation, a) pour 2012; et b) pour 2014

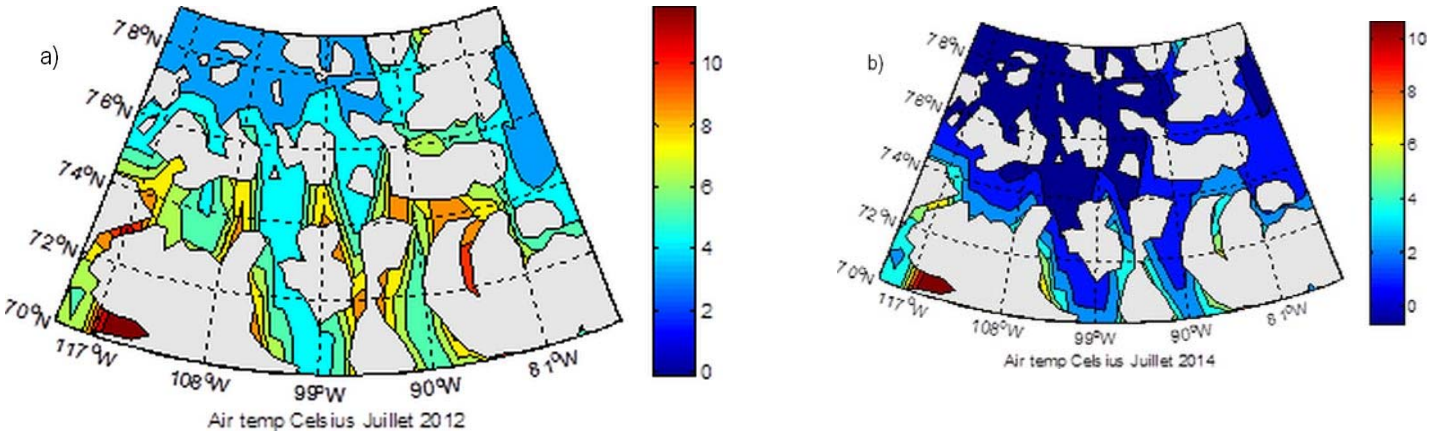


Figure 4: Température de l'air en degrés Celsius pour juillet: a) 2012, et b) 2014

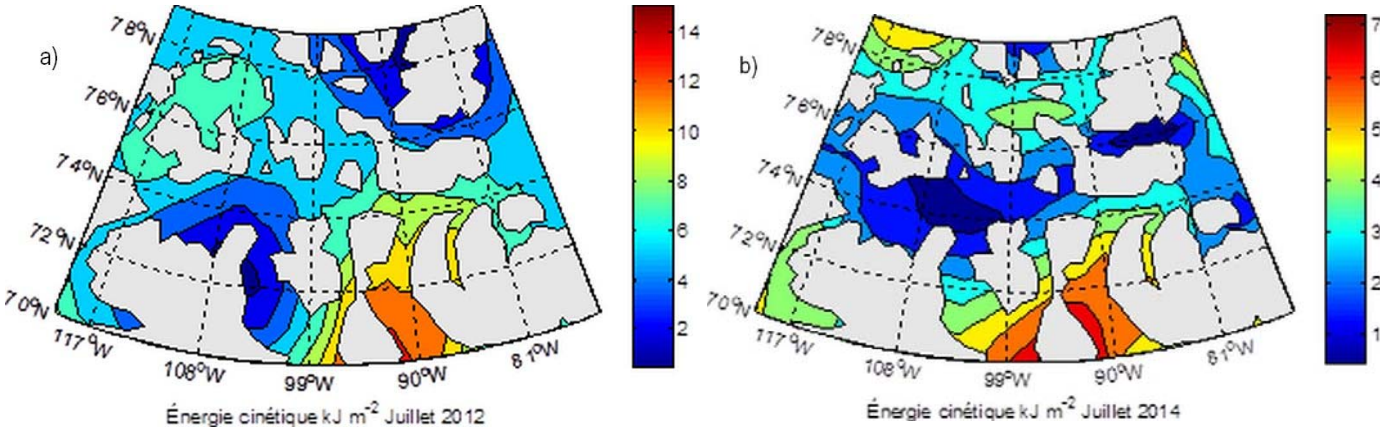


Figure 5: Énergie cinétique en kJ m^{-2} pour juillet: a) 2012, et b) 2014

Il est possible de donner une explication sur la différence entre les dates de prévisions et celles d'observations de fracture pour les années 2011-14 en utilisant les réanalyses pour le mois de juillet de ces différentes années (NCEP-DOE [National Centers for Environmental Predictions-Department of Energy] AMIP-II Reanalysis, 2002). Pour ce faire, nous utilisons la température de l'air à 2 m et la variable d'énergie cinétique. L'énergie cinétique est calculée selon Lorenz (1957) et est proportionnelle à la norme du vent à 10 m fois la pression de surface dans ce cas. On remarque, à l'aide des figures 4 et 5, que la température de l'air au mois de juillet pour l'année 2012 est au-dessus du point de congélation et que l'énergie cinétique est près de 11 kJ/m^2. On remarque aussi que pour l'année 2014, on peut observer que la température de l'air est au point de congélation avec une énergie cinétique moindre de près de 5 kJ/m^2. Si on fait le lien maintenant avec les écarts des dates de prévisions et d'observations de fracture, on remarque qu'en 2012 l'observation des fractures est plus tôt et est favorisée par une température plus chaude et une énergie cinétique plus élevée (donc vent plus élevé) causant des vagues plus importantes et une couverture glacielle fragilisée. Alors qu'en 2014 l'observation des fractures est plus tardive, avec une température plus froide et une énergie cinétique plus faible causant une couverture glacielle plus difficile à briser. Puisque le modèle FFT-OFBM dépend fortement des conditions historiques et normales, des conditions climatiques différentes occasionnent un avancement ou un retard des dates d'observations sur les prévisions.

Enfin, ce modèle statistique permet de donner un aperçu à long terme de certains évènements se présentant dans l'Arctique et peut servir d'indicateur pour une saison des conditions glacielles à venir. Évidemment, il ne remplacera pas les autres types de prévision présentés ici qui sont de plus courte portée et plus près du moment utile pour les utilisateurs. De plus, j'aimerais ajouter que ce modèle statistique a l'avantage de ne pas nécessiter une ressource computationnelle importante.

Remerciement

Je remercie M. Claude Dicaire pour avoir révisé et amélioré cet article.

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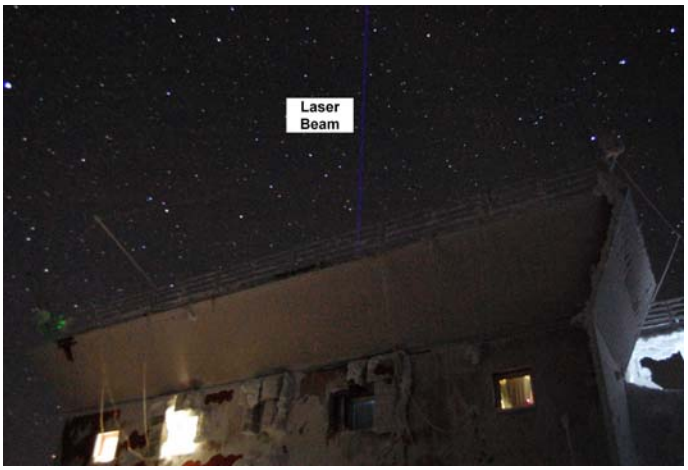
Current Research at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut

by James R. Drummond[1]

PEARL is located at Eureka, Nunavut on the 80°N latitude line, one of the most northerly places in Canada. The laboratory was begun by Environment Canada in the 1990s when the iconic red building was constructed for ozone and other upper atmosphere measurements and was revitalized in 2006 under the auspices of the Canadian Network for the Detection of Atmospheric Change (CANDAC) as PEARL with a mission to explore the whole atmosphere and a desire to support scientific research in one of the few accessible locations in Canada's High Arctic.

An initial tranche of funding from the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), support from the Canada Foundation for Innovation, Environment Canada, and other partners started the research program in three major areas: air quality, climate, and ozone. Research prospered through International Polar Year but with the ending of CFCAS and the lack of significant new environment funding, PEARL was in serious danger of closing until a research team consisting of Kimberly Strong and Kaley Walker at the University of Toronto, Robert Sica at the University of Western Ontario, Alan Manson from the University of Saskatchewan, Norman O'Neill of the Université de Sherbrooke, and myself with numerous government, academic, and international collaborators were successful in obtaining a grant under the Natural Sciences and Engineering Research Council (NSERC) Climate Change and Atmospheric Research (CCAR) under the title "Probing the Atmosphere of the High Arctic" (PAHA). This five year $5M total grant runs from February 2013 to January 2018 and enables a reasonable level of activity at the PEARL site and also funds the accompanying science. This has been in parallel with an NSERC CREATE (Collaborative Research and Training Experience) Training Program in Arctic Atmospheric Science which is run out of the University of Toronto with Professor Strong as the Principal Investigator. That program runs from April 2011 to March 2016.

At present, PEARL hosts some 25 permanent instruments measuring aspects of the atmosphere from the surface to about 100km altitude. Even then there are some notable gaps in the measurement roster and we seek to fill those holes with "guest instruments" and other temporary arrangements. At the moment, PEARL is hosting instruments from Japan, the US, and Europe as well as several instruments from other Canadian groups.



Picture showing DIAL (Differential Absorption Lidar) laser shining up through the Arctic night sky, an example of some of the research starting to be done at night … whereas most of the work at PEARL has always been done during the day

Under PAHA there are three major themes, but since the atmosphere doesn't recognize our divisions many of the measurements at PEARL span several themes. One of the touchstone statements in our PAHA proposal was: "....*the extent to which a comprehensive, well-calibrated set of measurements from the High Arctic will be used in multiple ways to produce multiple outcomes."* The PEARL team strives to produce such measurements and make them available as widely as possible through our website at www.candac.ca and international databases. Thus there are many international collaborations, formal and informal, using the data from PEARL.

The first PAHA theme is on Composition Measurements with sub-projects on *Greenhouse Gases Related to the Carbon Cycle; Ozone and Related Species; Biomass Burning & Continental Influence on the Arctic; and Clouds, Aerosols and Precipitation*. These several sub-projects relate to many important issues of the Arctic atmosphere that we seek to understand, especially as increased activity in the Arctic means that local sources are becoming more important compared to transport in and out of the region.

The second theme is on Polar Night, which is a period that we know relatively little about. Measurements are scarce in the Polar Night firstly because they can be difficult to make without sunlight and in extreme cold and secondly because they can only really be made if there is a permanent presence on the site rather than annual campaigns (which

[1] Dalhousie University, Halifax, Nova Scotia

almost invariably occur in the summer). Polar night at PEARL starts in late October with the final sunset and ends in mid-February with the first sunrise. PEARL aims to operate 365/24 and considerable efforts are being made to extend measurements into the night using starlight and moonlight as well as to automated equipment so that the full instrument suite can be operated even if there are few or no technical staff on the site.

The third theme is Satellite Validation, which is now an increasingly important activity since we are heavily reliant on satellite measurements to give us a global picture of the atmosphere. PEARL is one of the few sites that can accomplish this in the Canadian sector of the High Arctic. Every Spring, with support from the Canadian Space Agency a campaign is run at PEARL to validate atmospheric composition measurements from the Canadian Optical Spectrograph and InfraRed Imaging System (OSIRIS), the Atmospheric Chemistry Mission (ACE) Fourier Transform Spectrometer (ACE-FTS), and the ACE Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation (ACE-MAESTRO) instruments. Many of these measurements are continued through the summer daylight period until polar sunset.

PEARL is truly a collaborative effort and would not be possible without the co-operation of the staff of Environment Canada's Eureka Weather Station who provide us with accommodation, food, and other support. We also share some communications with the Department of National Defence to our mutual benefit. We receive substantial in-kind support from Environment Canada and many Environment Canada scientists are involved in the research at PEARL.

We also receive substantial in-kind support from the Canadian Space Agency. PEARL hosts equipment from the US National Oceanic and Atmospheric Administration (NOAA) and we are part of the International Arctic Systems for Observing the Atmosphere (IASOA) initiative (www.iaosa.org), as well as participating in the Canadian Network of Northern Research Operators (CNNRO) (www.cnnro.ca) and the European International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT) (www.euinteract.org).

We have support from the researchers of CANDAC and PAHA and their students and post-docs who form an enthusiastic team with the ability to make science happen at this remote site on a very tight timetable.

The future for PEARL is unknown at present. We have funding until 2018 but do not know what the future holds after that. There are many exciting possibilities. Studies have been done on the possibility of making astronomical measurements from PEARL. There is a variety of other science that is conducted at the Eureka site and one possibility would be to develop PEARL into a national facility for research in the High Arctic. Eureka and PEARL are unique jewels in the Canadian High Arctic and there is potential for much national and international activity at the site in the future, as the need to measure and understand what is happening in the Arctic becomes ever more important.

Dr. Louis Fortier, Scientific Director of ArcticNet, Nellie Kusugak, Commissioner of Nunavut, Elizabeth Dowdeswell, Lieutenant Governor of Ontario, and Dr. Paul R. Ruest, President of the Royal Canadian Geographic Society

STOP PRESS

Louis Fortier receives the 2015

Northern Science Award

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

Congratulations to Dr. Louis Fortier from the CMOS community.

World Meteorological Organization
Weather • Climate • Water

Climate Services for Polar Regions

Submitted by Leslie Malone[1]

A "*Scoping Workshop on Climate Services for Polar Regions: Establishing Polar Regional Climate Centres – Towards Implementing an Arctic PRCC-Network*" will be held at the World Meteorological Organization (WMO) in Geneva, Switzerland from 17 to 19 November 2015.

This workshop is designed to facilitate the engagement of the user, research, and operational communities to take preliminary steps toward the development of an Arctic Polar Regional Climate Centre (PRCC) or network thereof as a legacy of the International Polar Year (IPY) 2007-2008.

Polar Regions are among the target areas for a Global Framework for Climate Services (GFCS) project funded by the Government of Canada to support the implementation of climate services at regional and national scales. Among the key results of this project is an improved climate service framework across the Arctic Polar Region.

Rationale for implementation of an Arctic Polar RCC
Indigenous peoples and others who live and work at high latitudes are increasingly challenged by a wide range and variations of weather and climate. Over the past century temperatures in the Arctic have been assessed to have increased at almost twice the rate of the rest of the world leading to rapid changes in, inter alia, sea ice, snow cover, and permafrost affecting traditional ways of life and existing infrastructure. These changes coupled with, inter alia, increased tourism and enhanced economic activity are resulting in a growing need for useful and targeted climate information in order to make effective decisions and mitigate risks to people, governments, businesses, and the environment. Moreover, the sensitivity of the Polar Regions is increasingly understood as an issue of global significance. Improved monitoring and long-range projections of polar climate phenomena are a significant contribution to formulation and implementation of climate change policy at national, regional, and global levels worldwide.

While WMO Members in the Arctic polar region are engaged in activities at national levels to support the climate information needs of their communities, they also share many common climate information needs and requirements and there is a demand for information to support climate-sensitive activities that span multiple countries. A networking or regionalized approach across the polar region toward the development of improved climate products, information, and services could be very effective in consolidating mutual strengths, aggregating skills, and investments at the national level, optimizing societal applications of climate information, and providing a mechanism to coordinate, enhance, and in some cases, harmonize products and services requested by relevant stakeholders.

Who will take part
Participants will include various stakeholders in Arctic climate matters that are involved in operational activities and in the development and delivery of products and services, experts in associated research and selected representatives of user sectors and policy domains. The focus on the Arctic requires the participation of the Arctic Council member countries and relevant scientific bodies, international and intergovernmental organizations. The workshop is open also to WMO Members active in Antarctica who wish to explore a similar framework. The programme will include representation from or relevant to:

- WMO experts from the Secretariat and representing GFCS, GPCs (Global Producing Centre for Long-Range Forecasts) and RCCs;
- Global Cryosphere Watch;
- The WMO Environment Canada (EC) Panel of Experts on Polar and High Mountain Observations, Research and Services (EC-PHORS);
- Meteorological services specialists from the Arctic Council countries;
- The Arctic Council;
- The Global Integrated Polar Prediction System (GIPPS) and the Year of Polar Prediction (YOPP);
- The International Polar Partnership Initiative (IPPI);
- Aboriginal Traditional Knowledge (ATK).

Workshop aims
The workshop will explore establishing a PRCC-Arctic and the opportunities and challenges relating to polar climate monitoring, service delivery, and the underpinning data inputs. Discussions will be informed by an analysis of a survey of WMO Members on needs and capacities for Polar RCC services, conducted in February-March 2015 which identified potential priority functions of PRCCs. Recommendations from the workshop will focus on improvements in the framework for climate services across the Arctic Polar Region. The workshop will explore the potential for an Arctic Polar Regional Climate Outlook

[1] Retired WMO Officer, CMOS Ottawa Centre

Forum and modalities for promoting the PRCC concept for Antarctica and the Hindu-Kush Himalayas Karakoram (Third Pole) region.

Workshop background, agenda, Concept Note and other documentation
https://www.wmo.int/pages/prog/wcp/wcasp/meetings/PRCC_Scoping_Workshop2015.html

Background information on WMO and RCCs
• The World Meteorological Organization (WMO), a specialized agency of the United Nations, is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. https://www.wmo.int/

• The National Meteorological and Hydrological Services (NMHSs) of WMO's 191 Member States and Territories contribute substantially to the protection of life and property against natural disasters, to safeguarding the environment and to enhancing the economic and social well-being of all sectors of society.

• In order to strengthen the capabilities of WMO's NMHSs in generating and delivering up-to-date climate information and prediction products for climate services in support of climate adaptation and risk management, WMO's basic infrastructure has been extended to include Global Producing Centres (GPCs) of Long Range Forecasts (LRF) and Regional Climate Centres (RCCs). https://www.wmo.int/pages/prog/wcp/wcasp/RCCs.html

• Both GPCs and RCCs must meet and adhere to criteria for their formal designation and operations, details of which are included in WMO's Technical Regulations through the Manual on the Global Data Processing and Forecasting System (GDPFS). https://www.wmo.int/pages/prog/www/DPFS/Manual/GDPFS-Manual.html

• To address the special needs of the Polar Regions for climate information for climate risk management, WMO recognized a unique opportunity for the NMHSs of its Members to contribute to the legacy of the ongoing International Polar Year 2007-2008 (IPY), to build collaborative mechanisms for generating sustained, practical, operational products and services, including through extending the WMO RCC capabilities to Polar Regions.

Background information on GCW
• The cryosphere is a component of the Earth System that includes solid precipitation, snow cover, sea ice, lake and river ice, glaciers, ice caps, ice sheets, permafrost, and seasonally frozen ground and, as such, is particularly important to all aspects of climate variability and change in the Arctic, Antarctic, and mountain regions.

• WMO's Global Cryosphere Watch (GCW) is an international mechanism for supporting all key cryospheric in-situ and remote sensing observations. The authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere from GCW will be critically important to successful implementation of a pan-Arctic RCC. http://globalcryospherewatch.org/

Background information on the GFCS
The Global Framework for Climate Services (GFCS) is a UN-led initiative, spearheaded by WMO, established to guide the development and application of science-based climate information and services in support of decision-making in climate sensitive sectors. http://gfcs.wmo.int/

STOP PRESS

John Smol receives the

2015 Martin Bergmann Medal

Established by the Royal Canadian Geographical Society in 2012, the Martin Bergmann Medal recognizes excellence in Arctic leadership and science. The 2015 recipient is Dr. John Smol. Dr. Smol is a Professor of Biology and the Canada Research Chair in Environmental Change at Queen's University. True to the spirit of the award, he is well respected in Canada and internationally for his research, his prolific array of publications, his outreach to the public, his mentorship, and as an ambassador of Arctic science.

Congratulations to John Smol from the CMOS community.

Dr. John Smol, internationally renowned ecologist, limnologist, and paleolimnologist, winner of the 2015 Martin Bergmann Medal for Excellence in Arctic Leadership and Science (Photo: Joshua Thienpont)

Arctic Leader - Interview with Russel Shearer[1]

Interview carried out by Ann McMillan[2]

Tell me a bit about yourself, your background. How did you get interested in the North?

I was trained as a marine biologist and got my first job with Environment Canada (EC) in Halifax working on ocean dumping control and marine pollution. I was then posted to Yellowknife as a Senior Environmental Biologist. In the Yellowknife office of EC, I had wide exposure to northern issues including monitoring of offshore oil and gas over the 4 ½ years I was there. Science was often supported with external funds at that time, including the Northern Oil and Gas Assessment Program (NOGAP), Environmental Studies Research Funds (ESRF), and Program of Energy Research and Development (PERD) on northern work. Eventually, I spent ten years as Director, Northern Science and Contaminants Research for Aboriginal Affairs and Northern Development Canada (AANDC).

I have heard you speak several times about the origins and planning of the Northern Contaminants Program (NCP) at what used to be INAC. Can you give me a brief summary of how that happened?

Well, I moved to Ottawa to Indian and Northern Affairs Canada (INAC) just in time for the "stars to align". In the late 1980's, evidence from a number of researcher's such as Ross Nordstrom, Birgit Braune, and Derek Muir identified elevated levels of contaminants in the ecosystem including Arctic marine mammals and seabirds. Initially, DEW (Distant Early Warning) line sites were implicated as a key source until work by Len Barrie identified long range transport of contaminants as an issue. Eric Dewailly, of University of Laval and Quebec health department, took the major step of making the link to human health. He was doing health research on contaminants on fishermen near the St. Lawrence River, initially, and decided to look for a control site in northern Quebec (Nunavik). To his surprise, levels of contaminants in human blood and milk in the north exceeded those along the St. Lawrence River. Suddenly, northern contaminants became a public health issue.

Arctic Leader: Russel Shearer

You have stepped up to ensuring that Canadian policy is informed by the results of the work done. Could you please describe how science from this program has influenced Northern policy and relationships with Northerners?

At the time David Stone and Garth Bangay were the managers at INAC where I reported. Garth identified the policy implications coming out of the science early on, and David and I worked closely to put together the pieces and build the Northern Contaminants Program which was established in 1991, under Canada's Green Plan, and continues today. We knew that we needed world class science to provide a credible basis for Northern policy and that stakeholders would need to be engaged from the beginning.

Monitoring, research and assessment have been the strengths of the Northern Contaminants Program throughout. The North is a place which integrates pollution from global sources. It occurs as a result of the grasshopper effect in which certain pollutants are emitted into the atmosphere from lower latitudes, carried by wind and deposited onto the surface, re-emitted to continue their flow north until the temperature is so cold that they stay deposited long-term. Once in the northern environment, the uptake of contaminants occurs by fish and wildlife and eventually northerners who depend on country foods as a key part of their diets. In the early days, southern based

[1] Chair, ArcticNet Research Committee; Former Chair, Arctic Monitoring and Assessment Programme (AMAP) and Former Director, Aboriginal Affairs and Northern Development Canada (AANDC)

[2] Invited Editor for this *CMOS Bulletin SCMO* special Arctic issue and Chairperson, CMOS Ottawa Centre

scientists initially flew in to sample and present information, they flew out again immediately without establishing strong community relationships. Through a lot of work and good will, the program has come full circle, those who were initially skeptical of INAC and federal government scientists now want other Arctic programs to use a similar partnership approach as the NCP including the use of traditional knowledge. Thus a new way of doing Arctic science nationally and internationally was developed and carried forward into programs such as International Polar Year (IPY), ArcticNet, and the Canadian High Arctic Research Station (CHARS), and now the Polar Knowledge Canada organization. Northern policy has had a continuous feed of science from these programs to support its direction.

Initially, the northern communities were distrustful and in order to address their needs, the NCP established CINE (Centre for Indigenous Nutrition and the Environment) at McGill University with a board made up of Indigenous representatives. Relationships of remarkable strength and longevity were formed during the early stages of the program which are still in place today. The need to work together led to what I feel is one of the most successful components of the overall program – empowerment of Northerners not only in Canada, but in international arenas such as the Arctic Council. This was key as social dimensions entered the discussions where the federal government was initially slow to react. These social questions are long term and questions persist.

Our readers are primarily people interested and involved with atmospheric or ocean science. Have those sciences been important to the Northern Contaminants Program?

The story about long range transport of contaminants to the north through the atmosphere as researched by Len Barrie and more lately by Haley Hung and also through the oceans (Robie Macdonald) prompted looking beyond the north for sources of contaminants. The story was based on basic atmospheric and ocean science including monitoring, modelling, and analysis. It started as an atmospheric science story based on trajectory analysis, but the transport story is more complex on the marine side and equally as important. There are huge reservoirs of material in the oceans and the marine food chains lead to the highest levels of pollution.

Based on atmospheric and ocean science, the issue was multijurisdictional, touching many federal departments, territorial governments, provincial departments of health, Inuit and Aboriginal organizations as well as the academic community with scientists from many disciplines contributing to the interpretation of the basic physical atmospheric and ocean science describing the behavior of contaminants. The NCP has been guided by a series of Blueprints which have focused on the scientific issues. Long term data sets such as that at Little Fox Lake have been supported and their importance recognized. Methodologies have been transferred to Russia and to southeast Asia and it is accepted that all data has to be intercomparable.

And what about internationally, did Canadian science play into the development of international policy?

Internationally at about the same time, scientific results from key program scientists who worked on this issue were recognized. The international Arctic Environmental Protection Strategy began in 1991, which later became the Arctic Council in 1996 under Canada's leadership, and once again the stars aligned. The Arctic Monitoring and Assessment Program (AMAP), initiated in 1991, today is one of the Working Groups under the Arctic Council. AMAP had started Arctic monitoring and assessment work focusing initially on global pollution and later climate change. Garth Bangay knew about acid rain and had good connections such as Hans Martin at Environment Canada who knew about Long-range Transport of Air-Pollutants (LRTAP) issues. The NCP team then worked internationally through AMAP using Arctic data from the NCP to broaden the United Nations Economic Commission for Europe (UNECE) LRTAP agreements to include Protocols on persistent organic pollutants (POPs) as well as Heavy Metals. Also, the global Stockholm Convention on POPs under the United Nations Environment Program (UNEP) was signed and ratified (Canada was first) in 2001 and came into force in 2004. Canada played a leadership role in establishing this Convention through use of data and information from the NCP.

INAC is not a federal "science" department in the same way as, say, Environment Canada. How did INAC become the lead for the Northern Contaminants Program?

The role of INAC, then AANDC, now Indigenous and Northern Affairs Canada (INAC again), has been important as a key manager of northern issues. It is written right in the INAC Act that the mandate is to coordinate Northern science. The NCP remains a significant science program under INAC and is built into several pillars of the Northern Strategy as it deals with healthy, sustainable northern communities. Into the future, the NCP, CHARS, and Polar Knowledge Canada will provide a continued scientific leadership role for INAC in the North.

You retired a couple of months ago, but you don't seem to be slowing down. What are your plans for retirement?

I have had "a great ride" in being one of the pioneers in establishing the NCP and giving the Program a human face while making progress to improve the lives of northerners. I was part of Canada's delegation to global contaminant agreement meetings as well as being head of delegation to AMAP and eventually being the international AMAP Chair from 2009 to 2013. As a result of these efforts, real progress is now being made with levels of legacy POPs coming down in the North and new and emerging chemicals being added to the Stockholm Convention due largely to the use of northern data. Northern science continues to move ahead

to support more effective management of global pollution. A global agreement under UNEP – the Minamata Convention on mercury – was signed in 2013 with the support and leadership of not just myself and the NCP but also Inuit and First Nations peoples. Although retiring from the public service, I want to remain active in Arctic Science and will continue to chair the Research Management Committee of ArcticNet.

Do you have any advice for today's atmospheric and ocean enthusiasts who want to work on Arctic topics? How can they get funding and aspire to leadership roles today?

It will be the twentieth anniversary of the Arctic Council next year. While ArcticNet winds down in 2018 it will leave an unprecedented legacy of Northern Science talent in Canada.

I see a strong need to work with the next generation of northern scientists through the Association of Polar Early Career Scientists (APECS) and other mechanisms. It is a great time for students to choose careers in Northern Science across private, public, and academic organizations. Interest in the Arctic has never been higher internationally, and this is an area where Canada has demonstrated leadership. I am proud and humbled to have been a part of this effort and to have ended my federal career with the NCP, AMAP, and Arctic science issues. I have tremendous faith in the next generation picking up the reigns and I hope to remain active to continue to build on this success.

Arctic-SIG Chair - Departing Words

It is with some sadness that I leave the position of ARCTIC-SIG Chair – yet I am comforted that the SIG will be championed and led by **Helen Joseph** whom many of you know to be very capable and well connected to direct the future endeavors of the Arctic-SIG. The idea of an Arctic-SIG started back in June 2011 where **David Fissel**, **Ann McMillan**, and I formed an internal "*Arctic-Awareness*" Working group. This was a collaboration effort between ASL Environmental Sciences and Maritime Way. As one idea led to another, we found ourselves pitching the working group idea to CMOS Council with the hope to leverage the society's membership. Subsequently, at the Saskatoon Congress in 2013 the Arctic-SIG was officially formed.

Interestingly, almost ten years earlier in September 2004, the CMOS Executive of the day determined that the "Special Interest Groups", once very active in CMOS, were no longer as active and that no new Special Interest Group had emerged in the previous ten years (from 1994 to 2004). They assessed that the existence of the group depended on the enthusiasm of the organizing chairperson. Once he or she departed from the scene, the follow-up failed to carry the Group forward. Hence in 2004, CMOS Council recommended that the Special Interest Groups activity within CMOS and their continued representation in the By-laws should be deleted.

Looking back even further, in 1946, the Canadian Joint Committee on Oceanography (JCO) was formed and renamed in 1959 as the Canadian Committee on Oceanography (CCO). Led by **J.P. Tully**, the intent, at the time was to "*…describe and predict the oceanographic state … and present its information, in suitable terms for fisheries, military and industrial use*" (sic). What is important to note was is that the very active years of the 1960s the CCO's influence in promoting Canadian oceanographic science was considerable. To address this growth the CCO branched out into numerous sub-committees that became pro-active cells of the parent organization. There was a Pacific Sub-Committee on Oceanography (PSCO), an Atlantic Sub Committee (ASCO) and an Arctic Sub-Committee (AcSCO), and many more. But by the late 1970's with the emergence of greater government involvement and the expansion of oceanographic laboratories – the CCO became functionless. It disappeared without being formerly dis-established in the early 1980s. One small remnant of the CCO was the PSCO that continued until 2001. The PSCO survived as an important collaboration link between Department of Fisheries and Oceans, Canadian Coast Guard, Industry, Department of National Defence, and universities of the British Columbia coast.

Why the history lessons on the CCO? It's easy - the history of pro-active sub-committees, like the PSCO, is an important lesson on what works well. Today, in 2015 and beyond, CMOS is struggling to show relevance to Canadian public. In the past fifteen years CMOS has made only ten position statements on a variety of meteorological or oceanographic science. How do we show relevance with only one position statement per year? We can't. CMOS should have been publishing perhaps 100 position statements (ten per year). By reinstating Special Interest Groups (like the Arctic-SIG) we can position ourselves with relevant expertise to address and make scientific statements that are relevant and important to Canadians. Special Interest Groups are your voice within CMOS to articulate a position and a vision for future science and CMOS. We have to change to sustain and grow as a Society that showcases relevance - and the Special Interest Groups can achieve this.

I wish Helen the best of luck in pushing the Arctic-SIG forward, while my support will not be far away.

Martin Taillefer, CMOS Vice-President

REPORTS / RAPPORTS

Story behind the Weather Trivia Calendar

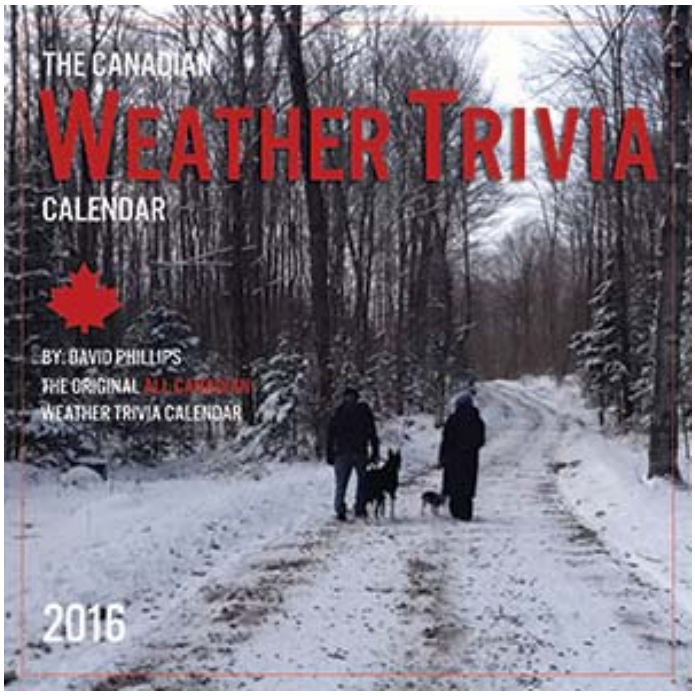
Submitted by David Phillips

During my 45+ years with Environment Canada I have gathered more than 35,000 weather stories and countless weather facts and fancies. It forms the basis for The Canadian Weather Trivia Calendar (CWTC) which is still one of the best-selling calendars in Canada.

Taking off on the trivia craze made famous by Canadians in the Trivia Pursuit game in 1982, I started penning a book of weather lists – the ten largest hailstones in Canada, the ten worst tornadoes, the ten strangest manna from heaven such as lizards, frogs or spider webs.

Don't remember if it was a long traffic tie-up in Toronto or an extra-long shower but I hit upon something with more utility than a book of lists – a calendar with just enough space to note Uncle Harry's birthday or today's dental appointment but then feature a daily weather fact from the past. Not just bare weather facts. The world of weather is filled with little oddities, head-shakers, strange-but-true stories of peculiar weather events and how Canadians deal with them. There's the stuff of Hollywood catastrophes – typhoons, shipwrecks, and infernos; there's the incredible – Niagara Falls drying up or the year without a summer; there's tragedy – the cruelest blizzard in history or the Black Friday tornado; there's intrigue – a secret Nazi weather station; there's mystery – the simultaneous occurrence of noon darkness, lighting, and an earthquake; and there's nudity – a female streaker during the coldest Grey Cup ever.

My motivation for the calendar was the volunteer weather observer. I have always valued the unselfish work of these citizen-observers who trek twice daily to their backyard or farmyard to take the day's temperature and precipitation readings. The billions of observations in the National Climate Archives have enabled us to use the information for a myriad of purposes and to better understand changes in our climate. Instead of a mimeographed Christmas card at the end of the year, I thought a better thank-you present would be a simple weather calendar featuring some of the observations they and their ancestors had taken over past decades. With the help of a colleague in publishing, I prepared two months of calendar grids with sample stories and a suitable picture. Convinced that management would never buy into the concept, I briefed Howard Ferguson of the Canadian Climate Centre. He shocked me by approving, without hesitation, the idea – a modest black and white calendar on glossy paper with stock images from government sources. Several thousand copies of the first edition in 1985 were printed but not enough to meet the demand for volunteers and employees. The CWTC was sold to weather service staff for a nominal fee of $1 and



distributed to a few curious media as information. Before the end of the year in 1984, the calendar was printed three times. A "black market" developed for the calendar among media especially when a Globe and Mail writer of obituaries wrote a story on the calendar that made it to the front page of the newspaper and changed his career from the back pages to the front pages. Canadian Harry Reasoner of 60 Minutes fame wrote a piece on the calendar for his radio commentary. Interest in the calendar in Canada and elsewhere took off. Prime Minister Brian Mulroney upon receiving the calendar from the Environment Minister, with tongue firmly planted in his cheek, said he didn't want this calendar hanging in any trade or tourist offices overseas because it was filled with stories of misery, hardship, and misfortune. What pleased me the most was that weather volunteers appreciated the gesture. Several volunteers wrote saying that the calendar was the greatest weather gift they had ever received. One observer said he had spent three whole days reading the calendar from end to end, almost ruining his Christmas dinner. Several enthusiastic letters came from Canadian academics saying the calendar quotes would brighten up their lectures. One professor said he would put the calendar in the bathroom, the "place of honour" in his cottage.

Two years later the Canadian Government Publishing Centre (CGPC) took over design and publication of the calendar. It was sold in Canadian government bookstores across the country. The calendar brought a large amount of traffic into their stores. Amongst federal publications, the CWTC had the best sales record ever, outdoing by far the previous best seller, "The History of the Kingston

Penitentiary". The big challenge in those early years was getting your hands on a calendar and that only added to its mystique. One woman from Moncton pleaded for me to send her a calendar after a fight broke out over the last copy. The calendar received its greatest notoriety when popular weathercaster, Willard Scott, of the highly rated NBC Today Show gave a three-minute plug for the calendar. At the close, forgetting the forwarding address in Canada, he invited viewers to write in care of the Today Show. Little did he know the response he would receive? They were bombarded with requests. Thousands of letters were forwarded to CGPC in Ottawa who had to hire extra staff to answer the mail. The calendar's image continued to grow, when the Financial Post featured it in an article on unique Christmas presents. The Weather Calendar shared the spotlight with such exotic items as a bagel cutter, and a London Sterling luxury car delivered to one's door Christmas morning with a big red bow.

With no financial return though, Environment Canada lost interest in the calendar and ceased publication with the 1991 edition. In 1995, a commercial publisher from Saskatoon submitted a proposal to take on the publishing, distributing, and marketing. They proposed putting the calendar in all large and independent bookstores across Canada and earning some revenue for the government. Nancy Cutler of the Canadian Climate Centre approved its second coming at least on a year-by-year basis. Now in full colour, slightly larger and with professional marketers and national publicity behind it, the calendar took off. 25,000+ copies was the usual print run and it sold out every year becoming for the past seventeen consecutive years the most popular calendar sold in Canada. Further, it has spawned dozens of national weather calendars around the world.

For about eight weeks early in the year, I pore over my notes from history books, newspaper clippings, Hudson Bay records, ship logs and diaries and communiques from ordinary Canadians to come up with an historical weather fact to match every day of the year and one quiz question per month. The hardest part of putting the calendar together is deciding which stories to leave out, rather, than deciding which stories to use. It is important to change stories and trivia in the calendar. Although I sometimes repeat an event such as one year mentioning historic Hurricane Hazel and the storms destruction and another time when a herd of cows got drunk after eating fermented apples blown down by storm Hazel.

Selection of images has always been a tough decision. I insist on making sure that every region is represented and that there is both a mix of picturesque meteorological landscapes and extreme weather events. That renowned Canadian photographers would go out and shoot pictures intended for the calendar made image selection easier.

Environment Canada has proudly supported the Canadian Weather Trivia Calendar from its inception to the 27th edition. However, its role has diminished recently as the calendar has become commercialized and its association came to an end with the 2015 edition. Environment Canada is pleased that the calendar still gives so many people an opportunity to relive some deep and lasting weather moments. And to keep weather-talking and watching such an engaging activity among Canadians.

Note: To get your own copy of the 2016 Canadian Weather Trivia Calendar, see the ad on page 185 of this issue.

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

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

The Patterson Distinguished Service Medal

2014 Patterson Medal Award Presentation

Submitted by JoAnn Demers[1]

The Patterson Distinguished Service Medal, first presented in 1954, is considered the preeminent award recognizing outstanding work in meteorology by residents of Canada. This award is named in honour of Dr. John Patterson, a meteorologist who was Director and Comptroller of the Meteorological Service of Canada from 1929 to 1946, a crucial period in the development of Canada's weather service.

On October 14, 2015, **David Grimes**, Assistant Deputy Minister of the Meteorological Service of Canada and President of the World Meteorological Organization presented the prestigious 2014 medal to **Dr. Ronald E. Stewart** at the University of Manitoba in Winnipeg, Manitoba.

For almost 40 years, Dr. Stewart has been a leading member in Canadian and International meteorological research. He has had a long and successful career in advancing the science of meteorology through research that has focused on extreme winter and summer weather, precipitation, and regional climate.

Following his valuable contributions that spanned 20 years as a Research Scientist in the Atmospheric Environment Service of Environment Canada, Dr. Stewart moved to a special chair in the Department of Atmospheric and Oceanic Sciences at McGill University in 2002, where he also held the Natural Sciences and Engineering Research Council Industrial Research Chair in Extreme Weather. In 2008, Dr. Stewart was appointed to his current position, Head of the Department of Environment and Geography at the University of Manitoba.

Dr. Stewart's influence has been extensive. He served as chief scientist of the Canadian Atlantic Storms Program (CASP I & II), which significantly improved the understanding of meteorology and prediction of mesoscale features within East Coast storms. He also led or co-led a number of significant projects focusing on high-latitude meteorology, such as the Mackenzie GEWEX Study (MAGS) and the Storm Studies over the Arctic (STAR), as well as conceived the Drought Research Initiative (DRI), a diverse interdisciplinary research network that addresses Prairie drought. Throughout his career he has produced an impressive amount of publications, including 126 scientific published papers, chapters in 21 books, and more than 194 conference presentations.


David Grimes and Dr. Ronald E. Stewart

In recognition of Dr. Stewart's scientific excellence and achievements, he was elected a Fellow of the Royal Society of Canada in 2009 and a Fellow of the Canadian Meteorological and Oceanographic Society in 2010.

Dr. Stewart has been a long-time activist in, and for CMOS. Not only has he served as Chair of the Fellows and the Scientific Committees, but he was the editor of the special Atmosphere-Ocean issues for the Drought Research Initiative, and served as President of CMOS between 2001 and 2002.

On behalf of the Canadian meteorological community, congratulations Dr. Ronald Stewart!

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[1] Meteorological Service of Canada, Environment Canada, Ottawa, Ontario

Project Atmosphere – July 2015

Report by Olivier Laforest

École secondaire Marguerite-de-Lajemmerais
Montréal, Québec

Abstract: Project Atmosphere aims at better equipping teachers of all levels (grade school and high school) to teaching weather related topics. The emphasis is put on awareness, making the seminar accessible to teachers who are not necessarily science savvy.This is both a great social experience and an opportunity to get better acquainted with the reality of atmospheric sciences. Teachers coming out of this seminar will be equipped to share what they learned and efficiently access resources previously unavailable to them.

Trainers and colleagues: an interesting and diversified crew

Introduction

This is it, two full weeks dedicated to atmospheric science, an opportunity to become a master of the topic and becoming a better teacher of it! This may seem intimidating but one needs to remember that this program caters to a very wide audience (more on that below) and the focus is on awareness and knowing who's who so that we can get help later-on.

Accommodation

Before meeting the trainers and colleagues, we are first greeted by the hotel staff and assigned a room. At first, I thought there was a mistake, this was not just a room but a miniature apartment (stove, dishwasher, etc.)! No mistake, this is just one of many examples of how they care for us to be comfortable during our stay. There's also a small swimming pool, a hoop for basketball, and a BBQ in the courtyard. Yes, we are a bit far from the nearest shopping centres, but when hotel transportation is not available, it's a decent 30-min walk on a nice (nothing but grass and trees around), long, calm boulevard to get there. The need for groceries is greatly offset by the morning breakfasts and networking events happening almost every evening in the lobby which easily double as dinner!

The aviation centre: the real deal in action

Demographics

The first official gathering (good luck figuring out who are your colleagues before that!) happens at dinner on the day of arrival. All key trainers/support staff are casually introduced and we are also invited to introduce ourselves in turn. Of the 20 participants this year, the bulk are in their mid to late forties, the youngest being about 30 years old. In the U.S., these seminars are highly sought after. We've got grade school to pre-college teachers. No matter the age, origin, school or speciality, we all have in common our joy to be there, our curiosity, and our care for students.

Arrival at the weather station

Curriculum

Advanced science background participants shouldn't get too ambitious about the curriculum because the main objective is awareness of and building the confidence of teachers with regards to the National Weather Service (NWS), the National Oceanic and Atmospheric Administration (NOAA), and all the agencies that support them.

About 50% of the time is dedicated to meeting high-ranking officials (really important and incredibly smart people) of weather services in the U.S. We get a detailed account of their past experiences and current mandates. These range from local weather sampling to space weather forecast, to improved warning and safety for the population.

In the second half, we delved a bit more in applied sciences. This is mostly done through modules that could be taught in our home school classes or to other colleagues back home. The goal is not to acquire deep earth science knowledge but to visually and manually be able to accurately, by simple means, communicate basic concepts that stem from complex science. Still, there were a few topics aimed at pleasing the more science savvy (like me) participants too. Being proactive with questions about technical content also helps the speakers to re-orient their presentations toward hard science.

BBQ is a local specialty; we added this to our curriculum!

Outings

To make sure our experience also involves some tangible content, we are taken on a trip to visit a weather station about one hour away and a weather aviation centre right in the training centre. These visits allow us to better visualize the reality of the field, the automated process, and the complexity of intricacies behind what appears to be easy to get weather forecast data on a website!

Conclusion

The experience of this workshop goes far beyond acquiring technical knowledge. It provides an opportunity to connect with other colleagues sharing the same passion; it allows us to connect our teaching to the reality of life in the field; and, most importantly, it puts us in touch with several heavy lifters of weather sciences who are all willing to help us teach our students better.

The main take-away concept is the emphasis on the importance of quality science teaching as well as the will of all partners wishing to help us achieve this goal.

Maury Project - July 2015

Report by Kara Lengyel

Naicam School, Naicam, Saskatchewan

On July 12, 2015, I arrived in Annapolis, Maryland to attend the Maury Project – a workshop designed to give science teachers an in-depth study of oceanographic and meteorological subjects including waves, tides, and ocean-atmosphere interactions. The program hosted teachers from 14 different states, one from Guam and one from Canada (me!).

Dr. David Smith, retired professor and former chairman of the Naval Academy Oceanography Department, and Dr. Jim Brey, Education Director of the American Meteorological Society, were co-directors of this summer's Maury Project Workshop. Featured speakers included oceanographers and senior scientists from the National Oceanic and Atmospheric Administration (NOAA), the University of Maryland at College Park, and the United States Navy. Special mention must be made of Don McManus, a retired naval oceanographer who provided most of the hands-on activities in a unique, humorous manner.

Kara conducting a beach elevation study

We spent two weeks together learning about oceanography. I would describe it as intense and fast paced, but interesting and detailed. We covered topics such as coastal upwelling, ocean acoustics, density driven circulation, waves, tides, and all five oceans. Each teacher was also given a demonstration to present to the class – my partner and I presented on measuring sea levels. In between lectures we were fortunate enough to take part in field trips to the Baltimore Aquarium, NOAA, National Centre for Environmental Protection, and National Ice Centre. We also participated in a coastal survey and research cruise, which most agreed was the highlight of the course.

The group on the fantail of the research vessel

For a prairie girl, I found everything about ocean to be new and interesting. I especially enjoyed the way that the Navy lecturers tied their oceanography learning into Navy life, be it hiding submarines in different temperature water or walking on unusual ices while on an arctic deployment.

An unexpected bonus to the whole project was the location. Annapolis is a beautiful, historic city and we were able to walk most places through its canopied and brick lined streets. The Naval Academy was inspiring and impressive – each morning we entered through a secure gate, then were able to watch the plebes (freshmen) raise the flag and learn their formations in the courtyard. We stayed on campus at the lovely St John's College - one of the oldest colleges in the United States. On our one day off, a group of us rented a car and went to Gettysburg, site of the turning point in the U.S. civil war – what an incredible experience to walk the fields and imagine the battles.

This year Saskatchewan is implementing new curriculum in our senior science courses, with a focus on physical and environmental sciences. All of the modules that we studied will fit nicely into one of the new courses and I plan to start introducing our teachers to them in August at our first in service day.

I would like to thank the Canadian Meteorological and Oceanographic Society (CMOS) and the Canadian National Committee/Scientific Committee on Oceanic Research (CNC/SCOR), as well as all those involved across the border – the Naval Meteorology and Oceanography Command, the Office of Naval Research, the National Oceanographic and Atmospheric Administration, the United States Naval Academy, the State University of New York at Brockport, and the American Meteorological Society. This was an amazing once in a lifetime opportunity and I look forward to conducting peer- led training sessions to pass on what I learned from the Maury Project.

Calling all (Cloud) Photographers!

Are you an avid cloud photographer? Now is your chance for international fame and fortune! Ok, maybe just fame!

The World Meteorological Organization (WMO) is updating the International Cloud Atlas (ICA), and is currently looking for new high quality, high resolution, colour images of all types of clouds and other meteors with accompanying metadata. Images of rarer clouds and meteors are more likely to be selected for publication.

The ICA was first published in 1939, with the most recent edition from 1987 containing more than 200 images of the more than 150 classifications of cloud types and meteors.

Images and metadata for consideration by the team of cloud observation experts should be submitted at the following WMO website: **http://wmoica.org/index.php/en/.** Additional details and requirements, including a "most wanted list", are available on this website. Cloud photos will be accepted until at least **December, 2015.**

For more information please contact Shannon deGraaf at: Shannon.degraaf@ec.gc.ca or 905 315 5235.

À l'attention de tous les photographes (de nuages)!

Êtes-vous un photographe passionné par les nuages? Voici maintenant votre chance de devenir mondialement célèbre et riche! OK, peut-être juste célèbre!

L'Organisation météorologique mondiale (OMM) met à jour l'Atlas international des nuages (AIN) et cherche actuellement de nouvelles images couleur de bonne qualité et de haute résolution de tous les types de nuages et d'autres météores avec les métadonnées qui les accompagnent. Les images de nuages et de météores plus rares sont susceptibles d'être choisies pour publication.

L'AIN a été publié la première fois en 1939. Son édition la plus récente (1987) renferme plus de 200 images des 150 classifications et plus de types de nuages et de météores.

Les images et les métadonnées qui seront prises en considération par l'équipe d'experts d'observation des nuages doivent être soumises sur le site Web de l'OMM à l'adresse suivante : http://wmoica.org/index.php/en/. On peut trouver sur ce site plus de détails et de conditions, y compris une liste des « plus recherchés ». Les photos de nuages seront acceptées jusqu'en **décembre 2015** au moins. Pour plus d'information, veuillez communiquer avec Shannon deGraaf à Shannon.degraaf@ec.gc.ca ou au numéro 905 315-5235.

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 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 on **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 8, 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 www.scmo.ca/site/summerworkshops?language=fr_FR&. 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?language=fr_FR&.

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 **8 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 thought.

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, awarded for a "*recent paper or book of special merit in the fields of meteorology or oceanography*".

2) The Andrew Thomson Prize in Applied Meteorology, awarded for "*an outstanding contribution to the application of meteorology in Canada*".

3) The François J. Saucier Prize in Applied Oceanography, awarded for "*an outstanding contribution to the application of oceanography in Canada*".

4) The Neil J. Campbell Award for Exceptional Volunteer Service, awarded for "*exceptional service to the society as a volunteer. The award may be made for an exceptional contribution in a single year or for contributions over an extended period. The contribution should have resulted in an important advancement for CMOS and/or its aims, nationally or locally*".

B – Open Prizes, Awards and Recognitions

(Not restricted to Society Members)

1) The Rube Hornstein Medal in Operational Meteorology, awarded for "*providing outstanding operational meteorological service in its broadest sense, but excluding the publication of research papers as a factor, unless that research has already been incorporated into the day-to-day performance of operational duties. The work for which the medal is granted may be cumulative over a period of years or may be a single notable achievement*".

2) The J.P. Tully Medal in Oceanography, awarded to any person "*whose scientific contributions have had a significant impact on Canadian oceanography*".

3) The Tertia M.C. Hughes Memorial Graduate Student Prizes ($500), awarded to graduate students registered at a Canadian university or Canadian graduate students registered at a foreign university for past *"contributions of special merit*".

4) The Roger Daley Post-Doctoral Publication Award ($2,000), recognizes a candidate who, at the time of nomination, is working in Canada in a non-permanent position as a post-doctoral fellow or research associate and is within five years of having received a doctoral degree. The award is granted for "*excellence of a publication in the fields of meteorology or oceanography that has appeared, or is in press, at the time of nomination*".

5) Citations whereby the Society recognizes the contribution of any individuals, groups or organizations *"which have, in the previous year, made some outstanding contribution towards promoting public awareness of meteorology or oceanography in Canada*".

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 plutôt 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, décerné pour une «*excellente communication ou un livre de grande valeur traitant de météorologie ou d'océanographie*».

2) Le Prix Andrew Thomson en météorologie appliquée, décerné pour «*un travail exceptionnel dans le domaine de la météorologie appliquée au Canada*».

3) Le prix François J. Saucier en océanographie appliquée, décerné pour «*un travail exceptionnel dans le domaine de l'océanographie appliquée au Canada*».

4) La Médaille Neil J. Campbell pour service bénévole exceptionnel, décernée pour «*un service exceptionnel en tant que bénévole à la SCMO. La médaille peut être décernée pour une contribution exceptionnelle dans une seule année ou pour des contributions sur plusieurs années. La contribution devrait avoir fait progresser d'une façon importante la SCMO ou ses buts, au niveau national ou local*».

B – Les prix et honneurs généraux

(non réservés aux membres de la Société)

1) La Médaille Rube Hornstein en météorologie opérationnelle, décerné pour «*un travail exceptionnel dans l'exploitation des services météorologiques, au sens large du terme. Ceci exclut cependant comme critère d'évaluation les publications scientifiques, à moins que leurs résultats ne soient déjà utilisés pour améliorer la performance quotidienne des services d'exploitation. Le travail pour lequel la médaille est donnée peut avoir été réalisé sur plusieurs années précédant l'année en cours ou encore, en récompense d'un accomplissement exceptionnel*».

2) La Médaille J.P. Tully en océanographie, décernée à un individu «*dont la contribution scientifique dans le domaine de l'océanographie canadienne a été jugée exceptionnelle*».

3) Les Prix Tertia M.C. Hughes pour étudiants diplômés (500 $), décernés aux étudiant(e)s diplômé(e)s inscrit(e)s à une université canadienne ou aux étudiant(e)s canadien(ne)s inscrit(e)s à une université étrangère, ayant déjà «*accompli(e) un travail exceptionnel*».

4) Le Prix Roger Daley de publication post-doctoral (2 000 $), décerné à un(e) candidat(e) qui, au moment de la mise en candidature travaille au Canada dans un poste non-permanent à titre de boursier (ère) de recherche post-doctoral ou d'assistant(e) à la recherche et a obtenu son doctorat dans les cinq dernières années. Le prix sera remis en fonction «*de l'excellence d'une publication, dans les domaines de la météorologie ou de l'océanographie, déjà publiée ou en voie de l'être au moment de la mise en candidature*».

5) Les Citations par lesquelles la Société reconnaît les contributions d'individus, de groupes ou d'organisations «*qui ont contribué d'une façon exceptionnelle à éveiller l'intérêt du public au Canada en météorologie ou océanographie durant l'année précédente*».

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 expected.

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

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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 plutôt 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

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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 thought.

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 plutôt 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.

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

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 organizing committee is putting together an exciting program both inside and outside of the congress. We hope to see you all at the Fredericton congress next year!

Prochain Congrès de la SCMO en 2016

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 comité organisateur local met présentement en place un programme tant scientifique que social. Nous espérons tous vous voir au congrès de Frédéricton l'an prochain!

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **February 2016.** Please send your articles, notes, workshop reports or news items before **January 8th, 2016** to the electronic address given at the top of page 182. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **février 2016.** Prière de nous faire parvenir avant le **8 janvier 2016** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse électronique indiquée au haut de la page 182. Nous avons un besoin URGENT de vos contributions écrites.

Atmosphere-Ocean 53-5 Paper Order

Special Issue / Numéro spécial

Aquatic Climate Change Adaptation Services Program (ACCASP)

Programme des services d'adaptation aux changements climatiques en milieu aquatique (PSACCMA)

Editor / rédacteur : Guoqi Han

Atmosphere-Ocean 53-5

Introduction / Abstract

The *Atmosphere-Ocean* 53-5 is a special issue on the Aquatic Climate Change Adaptation Services Program (ACCASP) by Fisheries and Oceans Canada. The special issue includes ten research papers and an introductory article on the ACCASP and the papers. These papers showcase the work that has been accomplished to date through the ACCASP and advance the knowledge of past trends and future projections of key ocean climate variables (such as sea level, temperature, salinity, ice, wave) in Canadian waters.

Atmosphere-Ocean 53-5

Résumé de la présentation

Le numéro 53-5 d'*Atmosphere-Ocean* porte spécialement sur le Programme des services d'adaptation aux changements climatiques en milieu aquatique (PSACCMA) relevant de Pêches et Océans Canada. Dix articles scientifiques composent ce numéro spécial, qui comprend aussi une introduction décrivant le PSACCMA et les thèmes abordés. Les articles mettent en valeur les travaux réalisés à ce jour dans le cadre du Programme et montrent les connaissances ainsi acquises sur les tendances passées et sur la projection de variables importantes (p. ex. le niveau de la mer, la température, la salinité, la glace, les vagues) décrivant le climat marin des eaux canadiennes.

IN MEMORIAM

James Slipec

1960 - 2015

Chairman, CMOS Winnipeg Centre

James Slipec, Chair Local Arrangements Committee, at the 2001 Winnipeg Congress. Photo courtesy of CMOS Photos Archive.

Peacefully with family and friends by his side, Jim passed away at the Concordia Hospital on November 2nd, 2015 at the age of 54.

Jim is survived by his wife of 23 years, Vera (Paley) and sons Jason and Corey. Jim was predeceased by his mother, Sophie (Zgoda), and his father, Edward. He will be lovingly remembered by his sister, Debbie (Young) and Kevin as well as nephew Bryan. His memory will live on for sisters-in-law Sonya (Paley), Rose-Mary (Paley), Theresa (Paley) and Daryl as well as brother-in-law Nick (Paley) and Rose Marie and niece Tamara.

Jim Slipec graduated with a computer engineering degree in 1984 from the University of Manitoba, in his hometown of Winnipeg. After seeing an ad in the newspaper, he began his career with Environment Canada in 1985, being trained as a surface observer and an upper air technician for the Atmospheric Environment Service (AES). From 1986 to 1989, Jim was posted to various isolated posts including Cree Lake, Saskatchewan and in the High Arctic sites of Resolute Bay, Eureka, Mould Bay, and Alert, NWT. It was through these years that Jim formed lifelong friendships with colleagues.

Jim took advantage of education leave to take the Certificate of Meteorology course at York University in 1988-89. He then went on to the AES Meteorologist Operational Course (MOC-11) in 1989. After successfully completing the course, he was posted back to his hometown, arriving at the Prairie Weather Centre in the spring of 1990. He would spend the rest of his career at that office, eventually becoming a Program Supervisor in what is now called the Prairie and Arctic Storm Prediction Centre.

Dr. Peter Taylor, CMOS President, and James Slipec; Jim holds "Meteorology for Scientists and Engineers" written by Roland Stull, no doubt a book Jim read with great attention and enthusiasm. Photo taken in 2001 and courtesy of the CMOS Photos Archive.

Jim was an active member of the Canadian Meteorological and Oceanographic Society (CMOS), after joining in 1995. He soon became chair of the Winnipeg Centre. He enthusiastically continued the Centre's support of the Manitoba Schools Science Symposium, support that has now continued annually for over 40 years. He also chaired the 2001 Local Arrangements Committee at CMOS Congress in Winnipeg. He led the CMOS support for the 2000 Northern Plains Convective Workshop; the only time it has been held outside of the U.S.

Jim loved sports especially hockey, football, and curling. He attended many live events and he curled for numerous years with friends and family. Known for his humour, dedication to the weather service, and helping the next generation of scientists to find careers in atmospheric and environmental science, Jim leaves a noble legacy and will be missed greatly by his many friends and colleagues.

Jim Slipec was indeed an EG (meteorological technician) before joining the meteorologist ranks. By late 1987, when I was stationed in Eureka, Jim was stationed in Alert with Brian Bukoski, Derek Kania, Dwayne Alexiuk.

Interestingly, this entire group of EG's took advantage of the educational leave system at the time and completed Meteorological degrees, and later the Meteorologist Operational Course (MOC) training to become accomplished meteorologists. I would like to say that their time as EG upper air technicians helped to develop their understanding of meteorology and the complexities

between theory and real life.

Jim was still working and when I last spoke with him, was looking forward to retirement early in 2016. Jim was a great person and will be certainly missed among the forecast centre here in Winnipeg, the forecast community as a whole, and the Atmospheric Monitoring Technical Services unit in Winnipeg.

Wayne Emond, Superintendent, Winnipeg Technical Services Regional Networks Operations

BRIEF NEWS / NOUVELLES BRÈVES

Suggestion de cadeau des Fêtes

Les baromètres humains

Éditeur : Québec-Livres
Prix régulier : 29,95$
ISBN: 9-7827640-2490-4
Pages : 256

La météo agit-elle sur nos émotions et sur nos comportements? La réponse est évidente pour la plupart des chercheurs : non seulement le temps qu'il fait affecte notre santé et notre état d'esprit, mais il modifie également les pourboires que nous donnons, notre mémoire, notre capacité de performer et notre propension à faire des erreurs. Même le crime et les tendances suicidaires sont influencés par la température!

Dans ce livre fascinant, **Gilles Brien** révèle les fruits d'une longue enquête sur le terrain de la pluie et du beau temps. Pourquoi grand-maman est-elle la meilleure Miss Météo en ville? Pourquoi les grands compteurs de la Ligue nationale de hockey sont-ils nés en hiver? Quel rôle a joué la météo lors des deux référendums de 1980 et 1995? Et la température a-t-elle exercé une influence sur le printemps érable de 2012? Au Québec, la météo est au centre de tout et ce livre en fait la preuve en démontrant avec talent et humour, que si le coeur a ses raisons, le corps a ses saisons!

Gilles Brien est l'un des rares experts en biométéorologie au Québec. Météorologue à Environnement Canada pendant trente-trois ans, ex-chroniqueur météo à Radio-Canada et ex-président de l'Association professionnelle des météorologistes du Québec, il signe ici son premier livre.

Collaborateur au contenu médical de ce livre et auteur de la préface,le docteur Wilhelm Pellemans est biologiste, antropologue et chirurgien.

www.barometres-humains.com

CAPE TOWN WELCOMES YOU

Participate in the Joint Assembly of IAPSO-IAMAS-IAGA (International Association for the Physical Sciences of the Oceans - International Association of Meteorology and Atmospheric Sciences - International Association of Geomagnetism and Aeronomy) in Cape Town, South Africa, 27 August - 1 September, 2017. See http://www.iapso-iamas-iaga2017.com

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Experts-Conseils accrédités de la SCMO

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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.

2016 Joint Scientific Congress of CMOS and CGU
Congrès scientifique 2016, SCMO, UGC

Monitoring of and Adapting to Extreme Events and Long-Term Variations

L'adaptation aux événements extrêmes et aux variations à long terme et leur surveillance

Photos: City of Fredericton
Art: MCS

Fredericton, NB

29 mai – 2 juin / May 29 – June 2, 2016

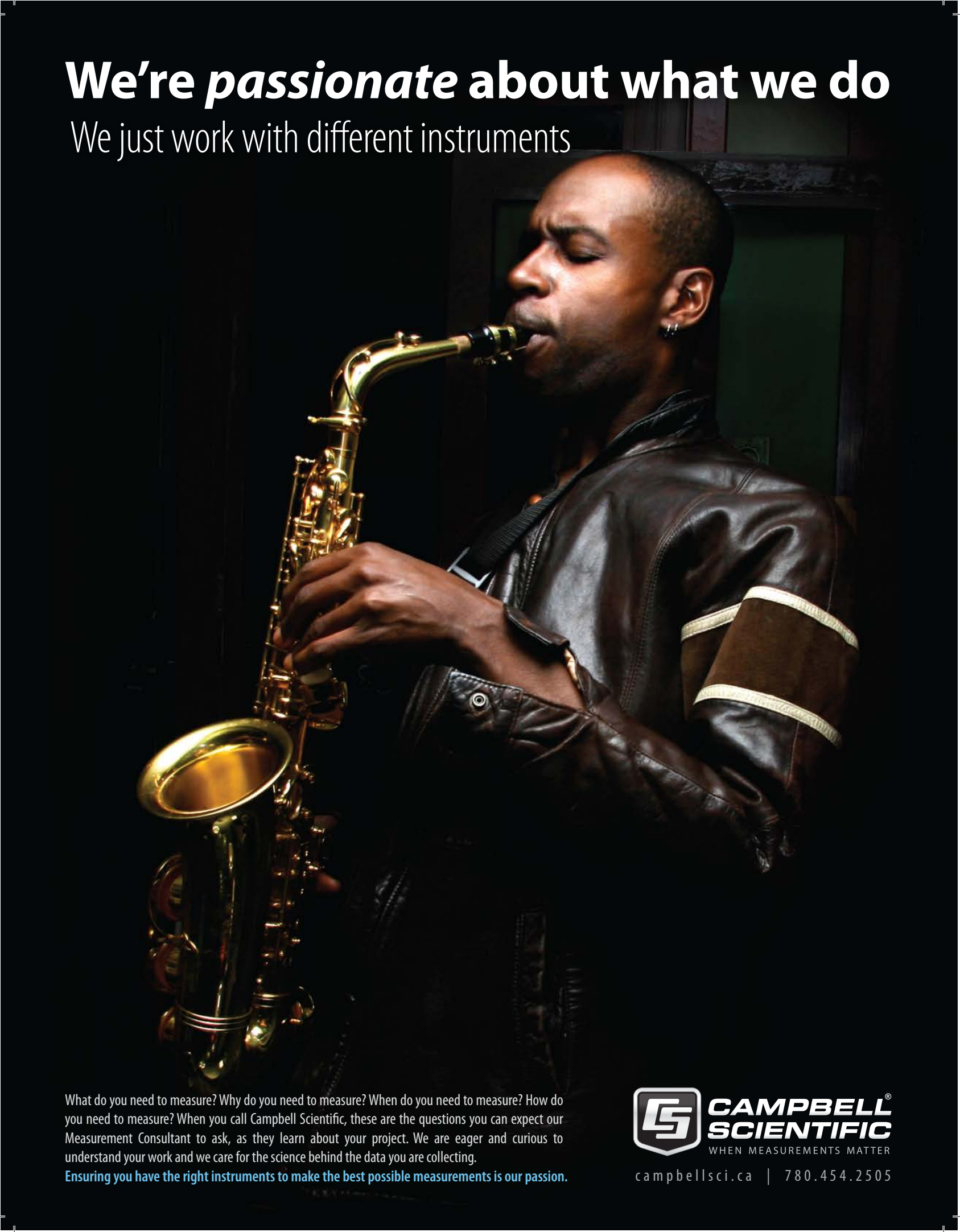
http://congress.cmos.ca

Canadian Meteorological and Oceanographic Society
La Société canadienne de météorologie et d'océanographie

Canadian Geophysical Union
Union Géophysique Canadienne

We're *passionate* about what we do

We just work with different instruments



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