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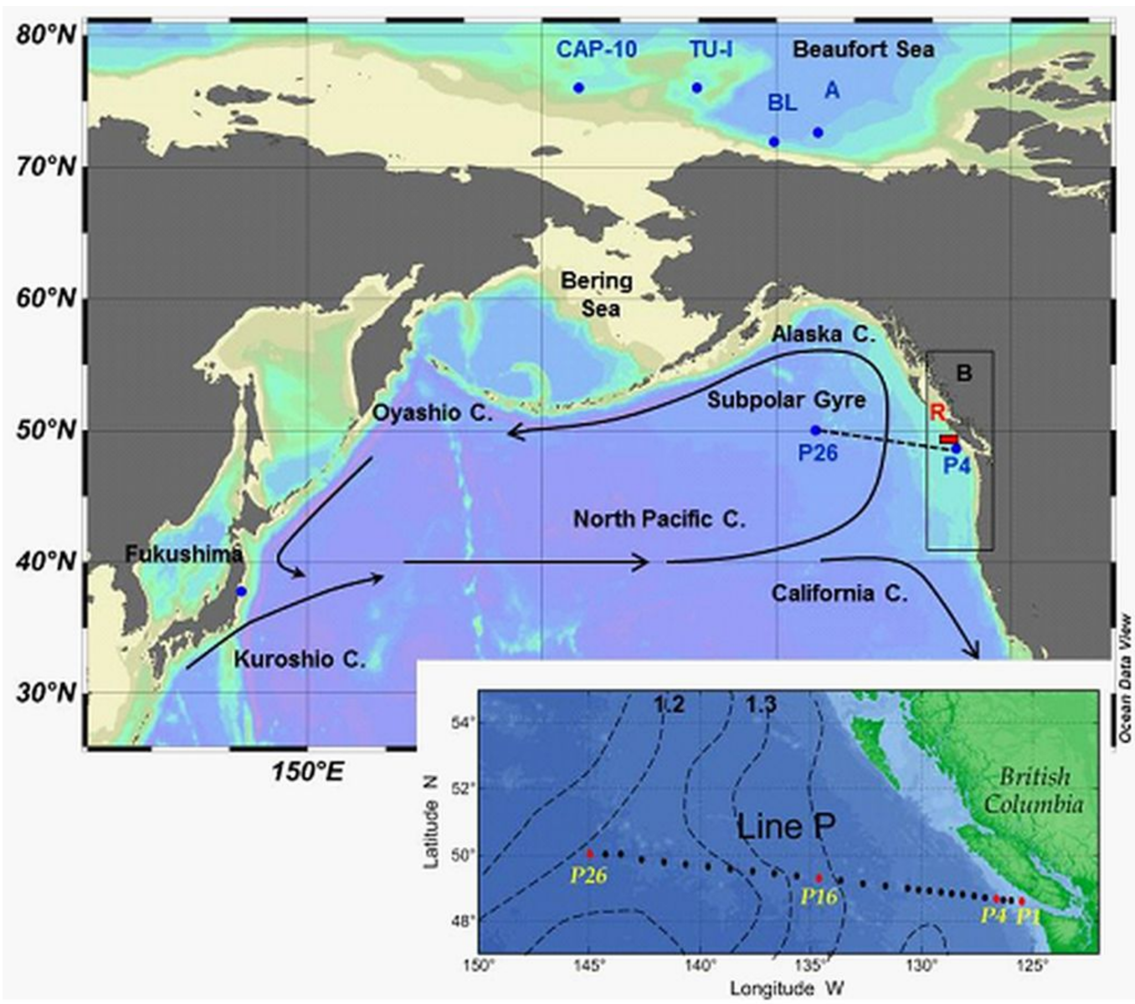
Ocean Current Transport of Fukushima radioactivity to North America



Transport de la radioactivité de Fukushima par courant océanique

.... Words from the President

Friends and Colleagues:

Harinder Ahluwalia
CMOS President
Président de la SCMO

Lessons from the past and preparing for the Future – Weather Ready Society

According to a report I read recently, weather- and climate-related disasters have caused $2.4 trillion in economic losses and nearly two million deaths globally since 1971. Another report states that 2011 was the costliest year on record for disasters with estimated global losses of US$380 billion and beyond 2015, disaster losses are set to outpace economic growth with expected global disaster losses to hit US$500 billion unless we take some important measures.

According to a report by Canadian Climate Forum (CCF), the December 2013 ice storm in southern Ontario and eastern Canada resulted in $200 million in insured losses and pushed the year-end severe weather insured loss total to $3.2 billion, which is the highest in Canadian history. In 2003, Hurricane Juan tore through Atlantic Canada and made landfall near Halifax, Nova Scotia, causing $300 million in damage and killing eight people. Hundreds of thousands of Maritimers lost power as the storm hit. Sustained winds of 151 km/h gusted to 176 km/h, sections of forest were flattened, and waves 10 metres high — as tall as a three-storey building — slammed the shoreline. Some waves were even twice that height.

In the US, hurricane Katrina in August 2004 was the most devastating natural disaster with $151 billion in economic losses and 1833 lives lost. A major part of these losses could have been avoided by routine maintenance on the levees which gave way because of the strength of the waves caused by the hurricane.

For Coastal regions like Atlantic Canada, there is a unique set of risks. Water will reach further inland as the sea level rises: in Nova Scotia, for example, sea level is expected to rise between 70 and 140 cm by 2100, posing a severe threat to low-lying areas.

[Continued on page 43]

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

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Cover page: The large discharge of radioactivity into the northwest Pacific Ocean from the 2011 Fukushima Dai-ichi nuclear reactor accident has generated considerable concern about the spread of this material across the ocean. The map shown here reports of the transport of the Fukushima marine radioactivity to North America at a location 1500 km west of British Columbia, Canada in June 2012, about 1.3 years after the accident. To learn more, please read John Smith's article on **page 51.**

Page couverture: l'important rejet, dans le Pacifique Nord-Ouest, de radioactivité provenant des dommages au réacteur nucléaire de la centrale de Fukushima Dai-ichi, a suscité des préoccupations considérables quant au transport océanique de substances radioactives dans l'océan. La carte montre le transport de la radioactivité marine provenant de Fukushima vers l'Amérique du Nord, à un emplacement situé à 1500 km à l'ouest de la Colombie-Britannique (Canada), en juin 2012, soit environ 1,3 année après l'accident. Pour en savoir davantage, consultez l'article de John Smith, à la **page 51**.

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

An important question is what can we do to reduce these threats and adapt to those which still remain. One important measure is to control activities which are causing climate change. Secondly, looking at the scale of losses around the world and commonality of threats in various regions, cooperative measures are required which could considerably reduce losses both in terms of property and lives by revealing risks, taking measures to reduce them, redefining development, and developing more accurate forecasting techniques.

There must be comprehensive risk assessments and integration of risk reduction measures in place, including mapping out various strategies to reduce future flood and earthquake losses.

One major tool for getting ready to face the impending disaster is "forecasting" and this requires action on two time scales. For example, forecasting specific flooding events, cyclones, tornados, ice storms, etc. can save lives and minimize damage by allowing for evacuation of affected communities. In the case of coastal flooding on the time scale of climate change (decades to centuries), adaptation will require projections of how fast and how much sea level will rise in a particular area, how often such storms will happen, as well as greenhouse gas emission scenarios that influence how severe climate change could be. These forecasts of the future can inform building codes and city planning as well as show where an investment in installing infrastructure such as dykes, will be most worthwhile.

Significant time, effort, and investments are required to plan prospective innovative solutions and technology to solve persistent weather and water related problems and develop prevention/ mitigation strategies. Targeted investments are required for planning, developing, and implementing solutions.

In World Meteorological Organization's (WMO) World Weather Open Science Conference (WWOSC-2014) in August 2014 in Montreal, CMOS and the American Meteorological Society (AMS) were asked to organize three high caliber panels of leaders of weather industry from public, private and university sectors. The purpose of these panels was to discuss and conclude what the "*Future Weather Enterprise* (FWE)" should look like. The panelists agreed that in order to find solutions to the above issues, the three sectors must cooperate fully and National Meteorological Societies (NMS) should act as the glue and arbiters to make FWE work effectively. The other important component which should also be a part of the FWE is users who know best what services are required. In addition, it was stressed that the strategies and technologies required are so complex that no institution or even a country can do it by itself. Collaborations are imperative and the NMS must play a very important role. This will also require collaboration between NMS to make this happen. NMS know their scientists quite well and when the question of collaboration between scientists arises, the NMS can identify people working in the field in question and put scientists from different countries together.
With this in mind, we have signed an MOU with the AMS and are in the process of signing one with the Indian Meteorological Society (IMS). We already have a relationship with the Royal Meteorological Society (RMetS) which we should energize in the same manner as we are currently doing with AMS for which we are going through each clause of the MOU to determine what needs to be done and to ensure that action is taken.

Although bilateral relationships work more effectively than multilateral ones, still there is a need of a multilateral organization to represent the interests of all NMS at WMO. There is such an organization called International Forum of Meteorological Societies (IFMS) which currently has 33 member societies including WMO, CMOS as well as all the Societies mentioned above. *The fundamental goal of the IFMS is very basic; it is to foster and encourage communication and exchange of knowledge, ideas, and resources among the world's more than sixty meteorological societies.* IFMS focuses on advancing the goals and objectives of the world's professional and scientific societies. I believe that IFMS should also be supported to develop and present a unified point of view of NMS to WMO.

We encourage all our members to help develop these relationships and start strong international collaborations. As already mentioned much larger investments are required to manage the effect of natural disasters. Since the National Meteorological Services are quite constrained in their capacity to ask for bigger investment from their Governments, with no direct interest, the National Meteorological Societies are in a better position to convince their Governments to make bigger investments to reduce the devastating aftermath of natural disasters which have a serious effect on their gross national product. These investments will pay back multifold in saving lives and properties of their citizens. This will go a long way to the idea of a "***Weather Ready Society***".

Harinder Ahluwalia, CMOS President

.... Allocution du Président

Chers amis et collègues,

Expériences passées et préparation du futur pour une société résistante aux intempéries

D'après un rapport lu récemment, les désastres dus aux intempéries et au climat ont causé mondialement des pertes économiques de 2,4 mille milliards de dollars et près de 2 millions de décès depuis 1971. Un autre rapport mentionne que l'année 2011 s'est révélée la plus dispendieuse en raison de pertes mondiales estimées à 380 milliards de dollars américains. On estime que, passé 2015, les pertes que causent les désastres devraient dépasser la croissance économique en s'élevant mondialement à 500 milliards de dollars américains, à moins d'un virage important.

Selon un rapport du FCC (Forum canadien du climat), la tempête de verglas ayant touché le sud de l'Ontario et l'est du Canada en décembre 2013 a entraîné des pertes de 200 millions de dollars en biens assurés. Ce montant a fait grimper les pertes totales dues au temps violent à 3,2 milliards de dollars, un record dans l'histoire du Canada. En 2003, l'ouragan Juan a ravagé le Canada atlantique. Il a touché terre près d'Halifax (Nouvelle-Écosse), causant 300 millions de dollars de dommage et tuant huit personnes. Le passage de la tempête a privé d'électricité des centaines de milliers d'habitants des provinces maritimes. Des rafales de 176 km/h accompagnaient des vents soutenus de 151 km/h, des zones forestières ont été aplanies et des vagues de 10 mètres, la hauteur de trois étages, ont frappé la côte. Certaines vagues ont même atteint le double de cette hauteur.

En août 2004, aux États-Unis, l'ouragan Katrina a été le désastre naturel le plus dévastateur, entraînant la perte de 1833 vies et de 151 milliards de dollars. Une grande partie de ces pertes aurait pu être évitée en assurant l'entretien des digues, qui n'ont pas tenu en raison de la force des vagues que l'ouragan a engendrées.

Pour les régions côtières comme le Canada atlantique, il existe des risques particuliers. Les eaux pénétreront à l'intérieur des terres à mesure que montera le niveau de la mer. Près de la Nouvelle-Écosse, par exemple, la mer devrait s'élever de 70 à 140 cm d'ici 2100, posant ainsi une sérieuse menace aux basses terres.

Il importe donc de nous demander ce que nous pouvons faire pour réduire ces menaces et nous adapter à celles qui resteront. Il faut dès lors nous assurer de maîtriser les activités qui génèrent des changements climatiques. De plus, étant donné l'envergure des pertes occasionnées partout dans le monde et la similitude des menaces touchant les régions, il faut coopérer et passer à l'action, afin de réduire considérablement les décès et les pertes matérielles, en déterminant les risques et en prenant des mesures pour les réduire, et ce, en redéfinissant le développement et en améliorant la précision des techniques de prévision.

Il faut analyser à fond les risques et intégrer des mesures de réduction de ceux-ci, y compris la préparation de stratégies diverses visant à diminuer les pertes que provoqueraient les inondations et les tremblements de terre.

La prévision s'avère un outil majeur pour faire face aux désastres imminents. Elle requiert des actions sur deux échelles temporelles. Par exemple, la prévision de cas précis d'inondation, de cyclone, de tornade, de tempête de verglas, etc. peut sauver des vies et minimiser les dégâts en permettant l'évacuation des communautés menacées. Dans le cas d'inondations côtières découlant de changements climatiques (périodes allant de décennies à siècles), l'adaptation nécessitera des projections évaluant la vitesse et l'ampleur de l'élévation du niveau de la mer à un endroit particulier, ainsi que la période de retour de tempêtes, en plus des scénarios d'émission de gaz à effet de serre qui influe sur la sévérité de l'évolution du climat. Ces projections temporelles peuvent étayer les codes de construction et la planification urbaine, et montrer dans quelle infrastructure, par exemple des digues, il importe d'investir pour se protéger.

La planification de solutions potentielles et de technologies innovatrices demande des efforts et un investissement considérables, ainsi que du temps, afin de trouver réponse aux problèmes persistants liés à la météorologie et à l'eau, et pour élaborer des stratégies de prévention et d'atténuation. Des investissements ciblés sont nécessaires pour planifier, concevoir et mettre en œuvre des solutions.

En vue de sa Conférence scientifique publique mondiale sur la météorologie (WWOSC-2014), tenue à Montréal, en août 2014, l'Organisation Météorologique Mondiale (OMM) avait mandaté la SCMO et l'AMS (American Meteorological Society) pour organiser trois panels de discussion de haut calibre, constitués de chefs de file de l'entreprise météorologique, venant des secteurs public, privé et universitaire. Ces panels visaient à discuter de l'« entreprise météorologique future » et à déterminer quelle forme elle devrait emprunter. Les participants ont convenu que les trois secteurs devraient pleinement coopérer, et que les sociétés météorologiques nationales (SMN) devraient assurer la cohésion et faire office d'arbitre, afin de trouver des solutions aux problèmes ci-dessus et de garantir le fonctionnement efficace de l'entreprise météorologique future. Une autre composante importante qui devrait faire partie de l'entreprise météorologique future est la collectivité d'utilisateurs, qui connaissent le mieux quels services ils nécessitent. En outre, il a été souligné que les stratégies et les technologies nécessaires demeurent si complexes qu'il est impossible pour un organisme ou même un pays de s'en tirer seul. La collaboration reste indispensable et les SMN doivent jouer un rôle important. Il faudra aussi établir une collaboration entre les SMN, afin d'aller de l'avant. Les SMN connaissent très bien leurs scientifiques. Quand il est question de collaboration entre ceux-ci, les SMN sont en mesure de déterminer qui travaille sur quoi et de rapprocher les spécialistes de différents pays.

À cet égard, nous avons signé une entente avec l'AMS et sommes sur le point d'en signer une autre avec l'Indian

Meteorological Society (IMS). Nous entretenons déjà des liens avec la Royal Meteorological Society (RMetS). Nous devrions dynamiser cette collaboration comme nous le faisons avec l’AMS, en passant en revue chaque clause de l’entente, afin de déterminer ce qu’il y a à accomplir et de nous assurer que nous prenons les mesures adéquates.

Bien que les relations bilatérales fonctionnent mieux que les relations multilatérales, il faut une organisation multilatérale pour représenter les intérêts de toutes les SMN auprès de l’OMM. Cette organisation existe, elle s’appelle l’International Forum of Meteorological Societies (IFMS). Elle se compose de 33 sociétés membres, y compris l’OMM, la SCMO et les sociétés mentionnées ci-dessus. *L’objectif fondamental de l’IFMS est simple : favoriser et encourager la communication et l’échange de connaissances, d’idées et de ressources entre plus de 60 sociétés météorologiques situées partout sur la planète.* L’IFMS s’efforce d’aider les sociétés professionnelles et scientifiques mondiales à atteindre leurs objectifs. Je crois que l’IFMS devrait être appuyé de façon à élaborer et à présenter le point de vue unifié des SMN auprès de l’OMM. Nous encourageons tous nos membres à développer ces relations et à entamer d’étroites collaborations internationales.

Comme mentionné précédemment, il faut des investissements considérables pour gérer les effets des désastres naturels. Comme les services météorologiques nationaux possèdent des moyens plutôt limités pour demander des investissements accrus de leur gouvernement, les sociétés météorologiques nationales, sans intérêts directs, sont donc mieux placées pour convaincre les gouvernements d’investir davantage pour atténuer les conséquences dévastatrices des désastres naturels, qui ont une incidence considérable sur le produit intérieur brut. Ces investissements produiront des profits substantiels en sauvant la vie et les biens des citoyens. Tout cela constituera un grand pas nous menant vers une “**Société résistante aux intempéries**”.

Harinder Ahluwalia,
Président de la SCMO

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.

Correspondence / Correspondance

From: Ed Hawkins[1], Doug McNeall[2], David Stephenson[3], Jonny Williams[4], Dave Carlson[5]

To: All CMOS Members

Date: November 18, 2014

Subject: The end of the rainbow

An open letter to the climate science community

Dear colleagues,

This is a heartfelt plea.

A plea to you all to help rid climate science of colour scales that can distort, mislead, and confuse. Colour scales that are often illegible to those who are colour blind.

The main culprit is, of course, the ‘rainbow’:

We have all likely used it, and we have all certainly seen it – presentations, posters, papers, blogs, and news articles full of figures with similar colour scales.

However, the most commonly used rainbow colour scales can distort perceptions of data and alter meaning by creating false boundaries between values. There are numerous blogs and published papers from visualisation experts illustrating these issues. In one example, changing to a non-rainbow scale even improved accuracy of heart disease diagnoses.

And, if you use a rainbow colour scale, you will have a friend or colleague that is colour blind and may confuse the colours.

This is not the first such plea.

A decade ago an article appeared in EOS, demonstrating that contrasting red with green can render a figure illegible to the 8% of the male and 0.4% of the female population who are colour blind. The EOS article suggested that journals should do more to improve the colour accessibility of figures.

But, the problem is now worse than a decade ago. Most issues of every major climate journal have figures which are potentially misleading and colour inaccessible. Maps, line graphs, and histograms can all have confusing colour combinations.

Journals, rightly, do not tolerate poor grammar, incorrect spelling, or muddy descriptions of scientific methods. It should be no different for visual communication. We should be equally intolerant to poor use of the grammar of graphics as we are to its written equivalent.

It is not just the journals who need to act. As scientists increase their efforts to make their work accessible to the public through the media, blogs, and social media, there are more opportunities to show poor figures.

What are the possible solutions?

We need to be more willing to discuss and criticize the visualisation of the science as well as the science itself.

Authors should be responsible about the colour choices they make. Journals might add colour accessibility to their existing guidelines for acceptable figure types. Reviewers could recommend revision if such colour scales are used. Editors should not accept papers which use inaccessible and potentially misleading colour scales. And, the media might reconsider using such figures from published work.

We know 'rainbow' is the default colour scale in many commonly used programming languages, but that doesn't make it the best. Resources are easily available to change colour scales for R, IDL (& here), MATLAB, Python (& here) & Ferret.

There are numerous websites and online tools giving advice and recommending safe and better colour scales (such as Color Brewer or HCL Wizard). You can even test online or use an app to see how your figures might appear to those who are colour blind.

Choosing a good colour scale is not difficult – it just takes awareness and a few moments of effort. The best choice will probably depend on the situation, so ask yourself why you have chosen that particular colour scale. Adding different shape markers in line graphs might also aid interpretation.

We take heart from some recent progress.

The Bulletin of the American Meteorological Society (BAMS) recently took a step forward by publishing an article pointing out the flaws with rainbow colour scales. MATLAB have just announced that they are changing the default rainbow colour scale, giving a comprehensive explanation considering colour accessibility and perception issues.

All of us could do more in improving the clarity of our figures, the authors of this open letter included. More needs to be done. And, it needs all of us to do more.

So, we undertake this pledge – to never again be an author on a paper which uses a rainbow colour scale.

If you agree to also make this pledge (or disagree), please comment below this post. Or email us. And tell your colleagues.

We hope that you will join us.

We encourage the climate science community to communicate this letter widely. To spread the word on twitter, please use #endrainbow. Short URL:

http://tiny.cc/endoftherainbow

Endnotes:

1: University of Reading, Reading, U.K.
2: UK Met Office, London, U.K.
3: University of Exeter, Exeter, U.K.
4: University of Bristol, Bristol, U.K.
5: World Climate Research Programme / World Meteorological Organization, Geneva, Switzerland.

Correction

In the David Phillips' *Canada's Top Ten Weather Stories for 2014* published in the *CMOS Bulletin SCMO*, February 2015, Vol.43, No.1, pages 14-24, a revision was made to story number 7: Airdrie to Calgary Hailer. Unfortunately this correction arrived too late for the printed version of the *CMOS Bulletin SCMO.* We publish here the revised version.

7. Airdrie to Calgary Hailer

On the afternoons of August 7 and 8, severe thunderstorms developed along the Alberta foothills and began tracking eastward towards Calgary and Medicine Hat. The storms also produced strong winds, including a brief but intense low-level rotating outflow (a.k.a. gustnado) northeast of Calgary and at Buffalo, AB packing winds of 140 km/h on August 8. The weather was unusual on two fronts – it featured golf ball- to baseball-sized hail driven by strong winds and a storm that's swirling path meant some properties were hit three times in the course of an hour. Further, the impacted area stretched more than 250 km across central Alberta, making it one of the largest hail-stricken areas from a single storm in 20 years. On August 7, the community of Airdrie, 40 km north of Calgary, was hit hardest with six people being injured badly enough by the hail to require hospitalization and almost every household reporting damage. Hailstones broke shingles, punched through siding and eaves, smashed windows and lights, and dented roofs on vehicles and buildings. More than half the damaged vehicles were total write-offs. It also smashed tomatoes, squashed squash, shredded flowers and hanging baskets, and denuded trees. There was so much hail it looked like the ground was covered with snow. Slushy hail drifts piled up along the highways and were still evident the next day. Roadways in some communities were flooded when sewers backed up. According to the Insurance Bureau of Canada, property damage from the intense storm topped $450 million (not including crop claims filed separately to crop insurers and provincial disaster agencies). With some crops smashed right to the ground, many farmers in southern Alberta said this “white combine” was the worst and most damaging in 80 years.

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

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **June 2015.** Please send your articles, notes, workshop reports or news items before **May 1, 2015** to the electronic address given at the top of page 42. We have an URGENT need for your written contributions.

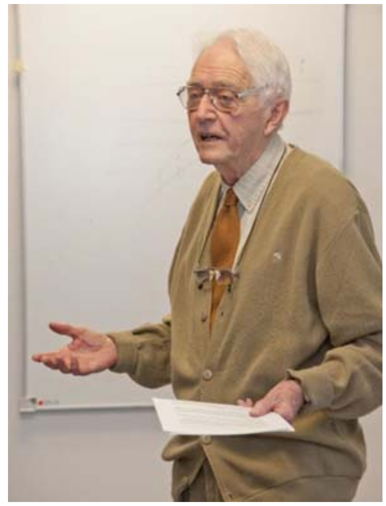
Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **juin 2015.** Prière de nous faire parvenir avant le **1er mai 2015** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse électronique indiquée au haut de la page 42. Nous avons un besoin URGENT de vos contributions écrites.

STOP PRESS

Alan Longhurst Celebrates his 90th Birthday at Bedford Institute of Oceanography

by Bill Li, Bedford Institute of Oceanography



Dr. Alan Longhurst

On March 5, 2015, Dr. Alan Longhurst marked his 90th birthday. During his time at the Bedford Institute of Oceanography (BIO), Alan was Director of Marine Ecology Laboratory (1977-1979), Director-General of DFO Ocean Sciences and Surveys Atlantic/Institute Director (1979-1986), and senior Research Scientist, Biological Oceanography Division (1986-1995). Among Alan's many enduring achievements, two landmarks have eponymous stature: his invention of the Longhurst-Hardy Plankton Recorder, and his intellectual innovation of the Longhurst ocean provinces. Alan is a Fellow of the Royal Society of Canada, and the recipient of the ASLO Lifetime Achievement Award. In retirement, Alan is proprietor of Galerie l'Acadie (Cajarc, France) and continues a remarkable and unabated contribution to the scientific literature. Many friends and colleagues came to greet Alan with best wishes and marvelled at his many accomplishments, past and present. In presenting Alan with a bottle of well-aged malt whiskey from Cape Breton, Michael Sinclair remarked that the gift is to highlight that Alan has become an exceptionally well-aged Nova Scotian.

Articles

Monitoring Climate Change in the Oceans: The World Meteorological Organization Notices a Canadian Ocean Time Series

by Lisa A. Miller[1]

Since 2006, the World Meteorological Organization (WMO) has published an annual bulletin on global distributions and trends in atmospheric greenhouse gases. In 2014, for the first time, the bulletin included a section on ocean acidification that highlighted trends observed in ocean time series around the world (WMO, 2014). Despite different sampling frequencies and seasonal variability at these stations, they all consistently show that CO_2 partial pressure is increasing and pH is decreasing in the surface waters of the oceans.

Nine time series stations were included: two in the North Atlantic, one in the Caribbean Sea, one in the Mediterranean Sea, one in the South Pacific, and four in the North Pacific, including Canada's own Station P (Figure shown on next page). Although Station P is the oldest of these time series, it also has the lowest sampling frequency and, therefore, is not yet long enough to confidently identify a climate change signal, by itself. Nonetheless, the observations at Station P are an integral part of the global observation system, with trends in CO_2 system chemistry that are consistent across the world's oceans.

The first CO_2 system measurements at Station P were alkalinity and pH analyses in August of 1956, as part of the Weathership program (Freeland, 2007), and those measurements were repeated intermittently through the 1960s. With the founding of the Institute of Ocean Sciences in the mid-1970s, consistent (almost monthly) measurements of total inorganic carbon (DIC), alkalinity, and pCO_2 were implemented on the Weathership program, under the prescient leadership of Sus Tabata and C.S. Wong. Modern methods were introduced, largely thanks to the efforts of Keith Johnson, in the 1980s, although by that time, the cruise schedule had been reduced from 12 to only 3 times per year. Routine pH analyses were (re)introduced in 2008. The CO_2 system data from Station P are now archived with the Carbon Dioxide Information and Analysis Center, and the quality controlled data are part of a number of global data compilation products including SOCAT (Bakker et al., 2014), PACIFICA (Suzuki et al., 2013), and now, GLODAP2.

Sustaining this time series at Station P has required a profoundly non-trivial effort by army of people who have organized and conducted the cruises, gone to sea (often over and over again), filled water bottles, and maintained and operated instruments. In addition, the work of quality controlling and archiving the data is a soul-numbing effort, and for much of the time series, it was not until long after the samples were collected and analyzed that the data were fully evaluated and compiled, an effort led by Jim Christian and Sophie Johannessen. Continuing forward, the staff of the Institute of Ocean Sciences, in particular **Marie Robert**, **Kyle Simpson**, **Mike Arychuk**, **Glenn Cooper**, and **Marty Davelaar**, continue to make sure the carbon dioxide program does not falter.

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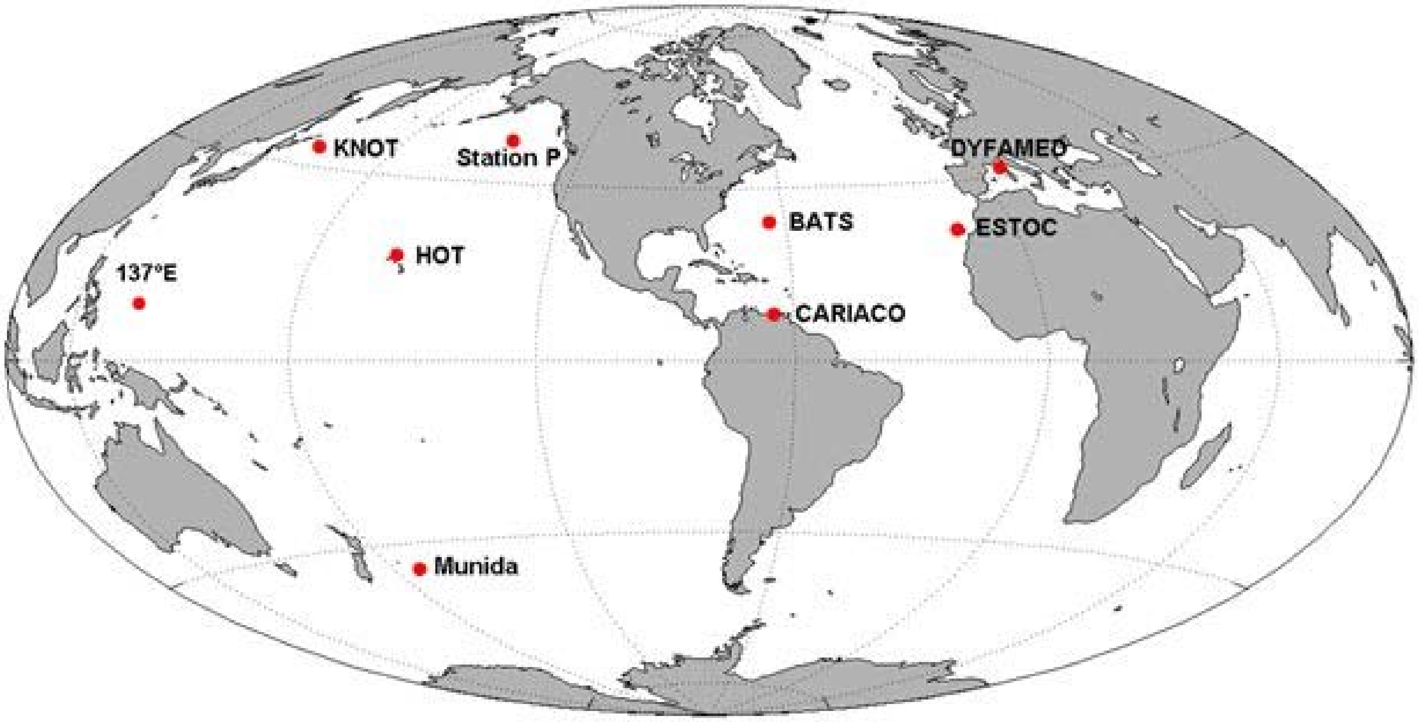

Locations of ocean carbon time series stations highlighted in 2014 WMO Greenhouse Gas Bulletin. Credit: Toste Tanhua.

The winter of 2015

by Chris Murphy, The Weather Network

The winter of 2015
was unlike one we've ever seen.
Many Canadians were heard to scream
"wake me up from this terrible dream!"

In Halifax it was snow then rain then ice,
this made getting around not very nice.
And I lost track how often I had to say
"Going to be minus 40 in Labrador City today".

From Charlottetown to Saint John
the season was especially long;
Snowbanks sky high -
Winter's never going to say goodbye!

Ottawa's Rideau Canal
was a giant frozen well,
And February was brutal to Montreal & Toronto
not a solitary minute above zero!

From Winnipeg to Saskatoon,
Winter can't end too soon,
but in Alberta and B.C
it wasn't nearly as icy!

Calgary was often on the hook
for another warm Chinook,
while those on the West Coast
could certainly boast:
"It's too warm to ski,
better grab my golf tee".

Alas, from Yellowknife to Iqaluit
winter still hasn't quit.
I'm sure there's a blizzard today...
somewhere between Whitehorse & Hudson Bay.

But Spring has arrived again -
open up the windows, let the fresh air in!

Now, watch those pot-holes
and stay off the ice...
you survived another winter
time to rejoice!

Version française en page 62

Event: Summer school on reducing impacts and managing weather related risks

1st CALL

Please send your answers, suggestions, and questions at : ecole@sca.uqam.ca

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Dates and venue: From June 8 to 12, 2015 at UQAM (Pavillon Sherbrooke, SH-4800), Montreal, Quebec.

Organization: The summer school is organized by UQAM in partnership with Environment Canada.

Training objectives: Considering the current state of knowledge in the field of climate change (CC) and the risks associated with changing hydrometeorological hazards and their impacts on humans and the environment, there is a growing need for training to meet the challenges of these issues, to increase people's adaptive capacity, and to optimize the transmission of multidisciplinary information.

In the field of hydrometeorological hazards management, transdisciplinary expertise is necessary to 1) combine the optimal application of forecasts and hydro-climatic projections, and 2) promote the best risk communication practices geared toward populations and policy makers.

Target audiences:

- Graduate students in Engineering, Environment, Geography or Earth and Atmospheric Sciences;
- Public Service employees specializing in public health or safety, meteorology or communication;
- Scientists and researchers working in the field of hydrometeorological risks management.

Format: Presentations and plenaries in the morning (English or French) and workshops in the afternoon (French).

Detailed program and registration information on website.

Website and contact:
www.risquesmeteo.uqam.ca
ecole@sca.uqam.ca

Ocean current transport of Fukushima radioactivity to North America

by John N. Smith[a], Robin M. Brown[b], William J. Williams[b], Marie Robert[b], Richard Nelson[a], and S. Bradley Moran[c]

Résumé: L'important rejet dans le Pacifique Nord-Ouest de radioactivité provenant des dommages au réacteur nucléaire de la centrale de Fukushima Dai-ichi a suscité des préoccupations considérables quant au transport océanique de substances radioactives vers l'Amérique du Nord. Les scientifiques de Pêches et Océans Canada (MPO) ont entrepris la première étude systématique du transport de la radioactivité marine issue de Fukushima dans la portion est du Pacifique Nord. Les séries temporelles de mesures de césium 134 et 137 dans l'eau de mer ont révélé l'arrivée de ces substances radioactives, issues de Fukushima et transportées par les courants océaniques, à un emplacement situé à 1500 km à l'ouest de la Colombie-Britannique (Canada), en juin 2012, soit environ 1,3 année après l'accident. En juin 2013, la radioactivité en provenance de Fukushima avait atteint le plateau continental canadien. En février 2014, elle était passée à 2 Bq/m^3 dans les 150 mètres supérieurs de la colonne d'eau. Les estimations des modèles de circulation océanique qui s'accordent raisonnablement avec nos mesures indiquent que les niveaux futurs totaux de césium 137 (dus à Fukushima et aux retombées) atteindront vraisemblablement, au large des côtes nord-américaines, des valeurs maximales d'environ 3 à 5 Bq/m^3, d'ici 2015-2016. Puis elles retourneront à des niveaux près des niveaux de fond, soit environ 1 Bq/m^3, d'ici 2021. En ce qui concerne la portion est du Pacifique Nord, la hausse des niveaux de césium 137 rejeté par Fukushima élèvera probablement les concentrations aux niveaux qui existaient, en raison des retombées, dans les années 1980, mais ne représente pas une menace pour la santé humaine et l'environnement.

Introduction

On March 11, 2011, an earthquake-triggered tsunami off Japan severely damaged the Fukushima Dai-ichi Nuclear Power Plants resulting in estimated discharges of 10-30 PBq of ^{137}Cs to the atmosphere (1) and the ocean (2) with maximum levels of 68 million Bq/m^3 occurring at one ocean release site on April 6, 2011 (3). The resulting large oceanic plume of radioactivity dissipated rapidly in the energetic coastal waters off Japan under the influence of currents, tidal forces, and eddies, but a significant remnant was transported eastward (Fig. 1) by the Oyashio and Kuroshio current systems (4,5). Ocean circulation models (6-8) predicted that the transport of water borne contamination from Fukushima to the eastern North Pacific would occur on time scales of several years, but there were significant differences in the results for the various models. Shortly after the accident an ocean monitoring program was established to detect the arrival of Fukushima radioactivity in the eastern North Pacific and Arctic Oceans. Measurements of the Cs isotopes, ^{134}Cs and ^{137}Cs were conducted in 2011-2014 during four missions of the *CCGS John P. Tully* on Line P (Fig. 1), an historic series of oceanographic stations extending 1500 km westward from British Columbia into the interior of the North Pacific. Samples were also collected as part of a 2012 mission of the *CCGS Louis S. St. Laurent* in the Beaufort Sea (Fig. 1) to detect any inputs of Fukushima radioactivity transported from the Pacific through the Bering Sea. During each mission, large volume ($\cong$ 60 l) water samples were collected to depths as great as 1000 m and then passed through potassium cobalt ferrocyanide (KCFC) resin columns to selectively extract Cs isotopes from seawater (10). The isotopes ^{137}Cs and ^{134}Cs were subsequently measured on the oven dried, KCFC resins in the laboratory using high purity Ge well detectors (9, 10).

The comparison of the Fukushima radioactivity signal to the fallout background is straightforward, because ^{137}Cs has been tracked quite extensively in the Pacific Ocean since the peak period of atmospheric weapons testing in the early 1960s (11-13). The monitoring of Fukushima radioactivity is also simplified by the fact that the initial ^{134}Cs/^{137}Cs ratio in Fukushima-derived radioactivity was 1 (3). Owing to its short half-life ($t_{1/2}$ = 2.1 y), any residual ^{134}Cs in atmospheric fallout from nuclear weapons testing has decayed. The detection of ^{134}Cs in seawater is therefore an unequivocal "fingerprint" indicator of contamination from Fukushima, which is the only large scale contributor of radioactivity to the Pacific Ocean besides fallout. ^{137}Cs ($t_{1/2}$ = 30 y) concentrations can then be resolved into their Fukushima and fallout components using the initial ^{134}Cs/^{137}Cs ratio and measurements of ^{134}Cs decay corrected to April 6, 2011 which is the time of maximum discharges to the ocean from Fukushima (4). The results outlined below were published in the Proceedings of the National Academy of Sciences (PNAS) in December, 2014. They provide a time series for the arrival of the Fukushima radioactivity signal in the eastern North Pacific and continental waters off North America. These results are compared to ocean circulation model simulations to document the accuracy of model predictions, to infer the range of future levels of Fukushima radioactivity in the eastern North Pacific, and to constrain estimates of radiological impacts on marine organisms.

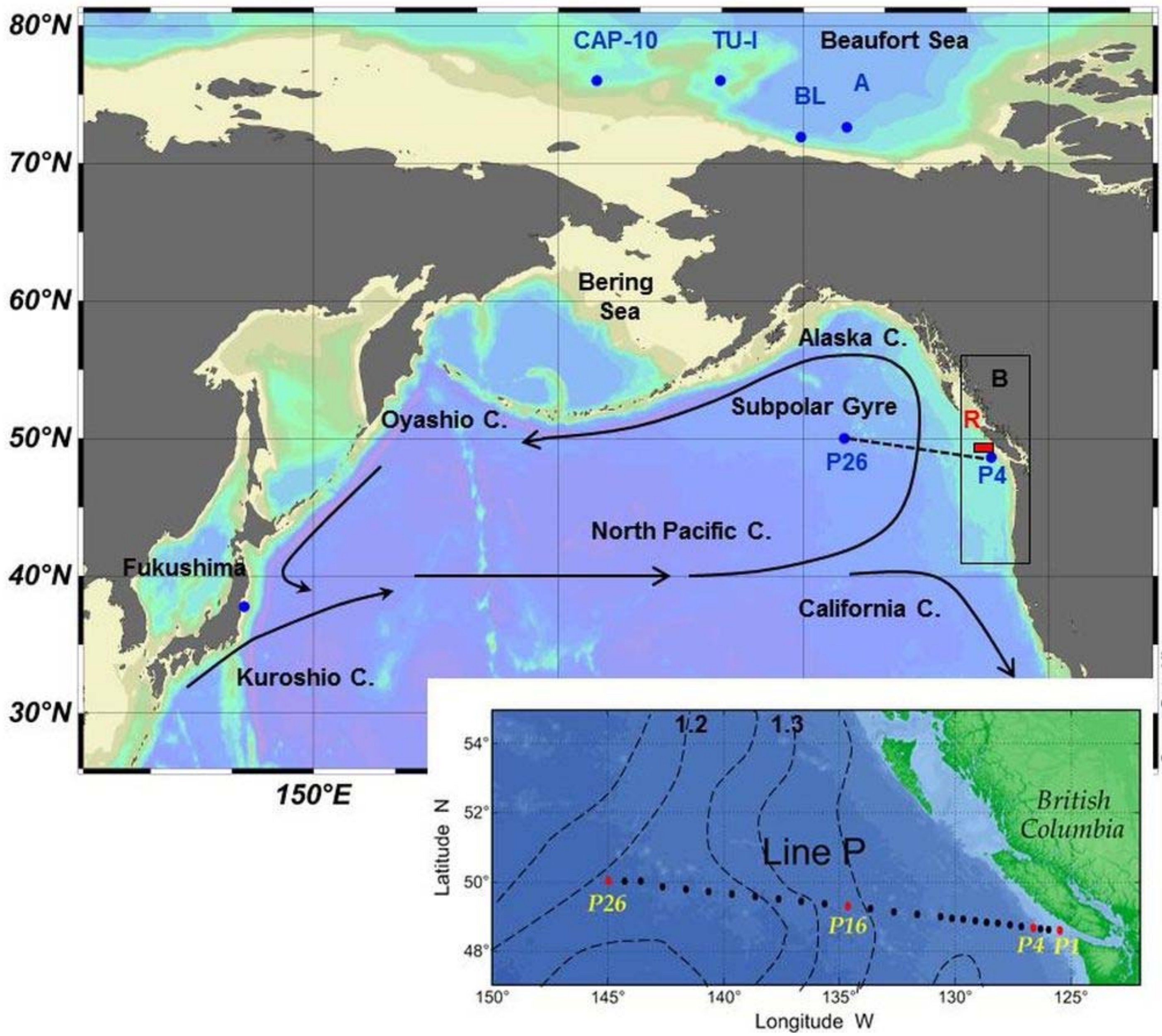

Figure 1. Map showing the location of the site of the Fukushima Dai-ichi Nuclear Power Plant accident in Japan. Stations are indicated at which seawater samples were collected in 2011-2014 on Line P and in 2012 in the Beaufort Sea. Box B represents the model domain for which Fukushima-derived ^{137}Cs time-series concentrations were estimated by Behrens et al. (6). Station R is the cross shelf regime for which the Rossi et al. (7,8) model results apply. Inset shows sampling station locations along Line P. Dashed curves are time-averaged streamlines representing the mean dynamic height field for 2002-2012 indicating the northward geostrophic transport of the Alaska Current across Line P.

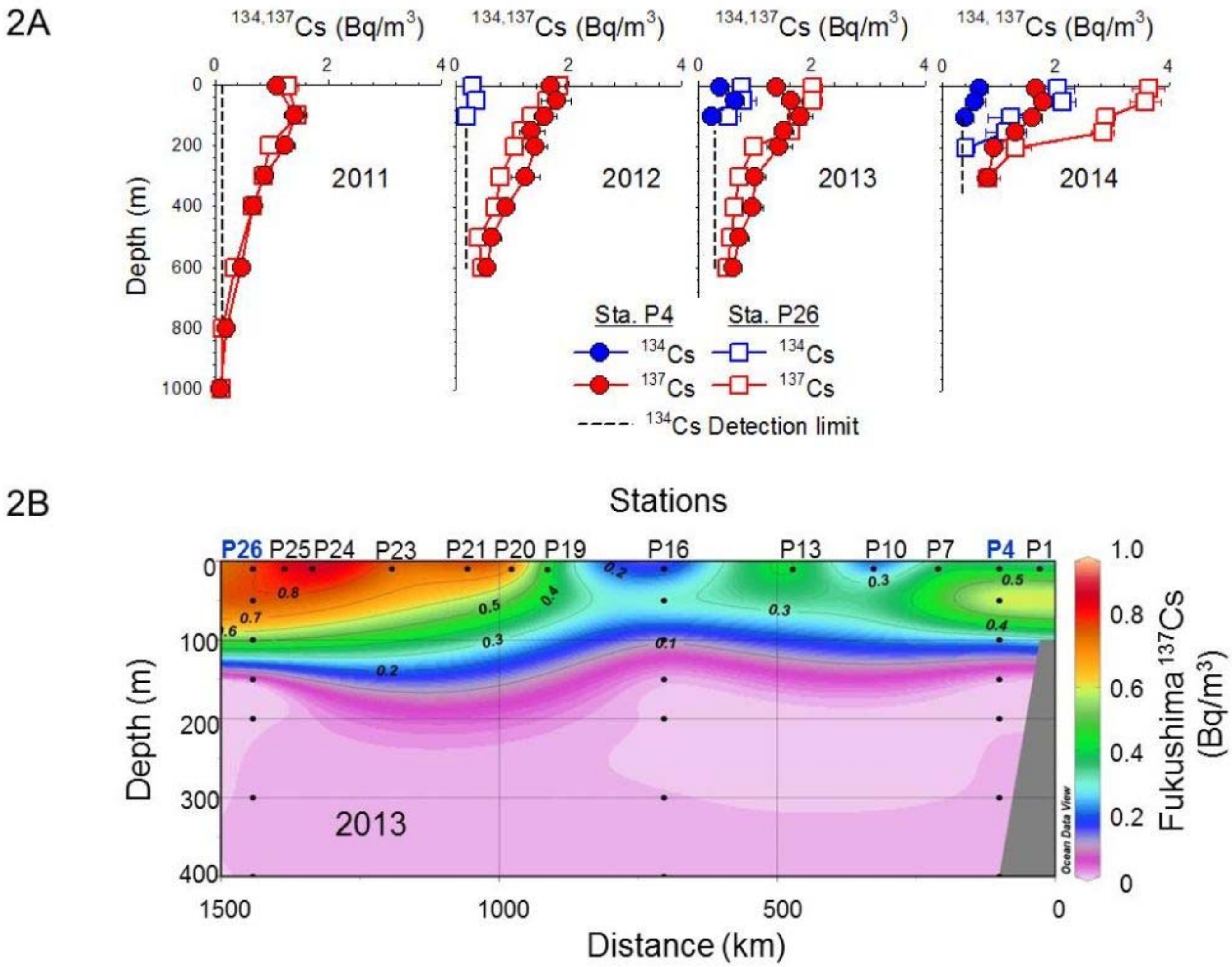

Figure 2A) Water-depth profiles of $^{134,137}Cs$ measured at stations P4 and P26 in June 2011, June 2012, June 2013, and February 2014 (from left to right) illustrate the arrival of ^{134}Cs and ^{137}Cs from the Fukushima accident on Line P. In 2011, ^{134}Cs was below the detection limit (dashed line) at both stations, but was measurable (concentrations and detection limit are decay corrected to April 6, 2011) at station P26 in 2012 and at both stations P4 and P26 in 2013 and 2014.

Figure 2B) Water-depth section of Fukushima ^{137}Cs concentrations (calculated from decay corrected ^{134}Cs concentrations) on Line P in June 2013 shows an eastward, decreasing ^{137}Cs concentration gradient from station P26 to station P1 in the surface mixed layer that reflects ^{137}Cs transport from Fukushima onto the continental shelf. Negligible Fukushima ^{137}Cs had been transported below 150 m by June 2013.

Results

In the present study measurements of ^{137}Cs on Line P, focusing particularly on stations P4 and P26, are intended to intercept the eastward flow of Fukushima radioactivity in the North Pacific and Alaska Currents at the eastern edge of the Subpolar Gyre (Fig. 1). Station P4 is situated at the edge of the continental shelf at a water depth of 1300 m and provides a sampling perspective for flow onto or adjacent to the shelf while station P26, located at a depth of 4250 m, anchors Line P offshore and is the location of a time series site for observing ocean processes.

The distributions of ^{137}Cs concentrations with water depth at stations P4 and P26 for the June 2011 *CCGS John P. Tully* mission are illustrated in Fig. 2A. At both stations, ^{137}Cs concentrations in 2011 were 1-1.5 Bq/m^3 in the upper 100 m of the surface mixed layer, decreasing to values of about 0.1 Bq/m^3 at 1000 m. Levels of ^{134}Cs were below the detection limit of 0.13 Bq/m^3 in all samples indicating that the observed ^{137}Cs was entirely derived from fallout and that no detectable contamination from the Fukushima accident was present at that time. The first observations of detectable ^{134}Cs on Line P were made at Sta. P26 in June 2012 (Fig. 2A). ^{134}Cs levels of 0.2-0.4 Bq/m^3 (decay corrected to April 6, 2011 (4)) were measured in the upper 100 m, clearly indicating the presence of Fukushima-derived radioactivity. By June 2013 ^{134}Cs was detectable in the upper 100 m at all stations sampled on Line P (Figs. 2A,B), thereby signaling the arrival of the Fukushima radioactivity plume of ^{134}Cs and ^{137}Cs in North American continental waters. Since the the initial ^{134}Cs/^{137}Cs ratio in Fukushima-derived radioactivity was 1 (3) then the measured ^{134}Cs concentration on Line P, decay corrected to April 6, 2011, is directly equivalent to the ^{137}Cs concentration discharged from Fukushima and is hereafter referred to as the Fukushima ^{137}Cs concentration. Between June 2013 and February 2014 the Fukushima-derived ^{137}Cs concentration in the surface mixed layer at Sta. 26 continued to increase to a level of about 2 Bq/m^3, resulting in an increase in total ^{137}Cs levels (Fukushima plus fallout ^{137}Cs) to 3.6 Bq/m^3. However, only smaller or even negligible increases were observed in the 2014 Fukushima ^{137}Cs signal at stations such as station P4 (Fig. 2A) that are located proximal to the continental shelf.

The cross sectional distribution of the Fukushima ^{137}Cs concentration along Line P in June 2013 is illustrated in Fig. 2B. The Fukushima ^{137}Cs signal was restricted to the upper 150 m of the water column, the approximate depth of the winter mixed layer in the eastern North Pacific (14). The decreasing gradient in the Fukushima ^{137}Cs surface mixed layer concentration (Fig. 2B) extending from station P26 to station P1 reflects the eastward circulation of Fukushima radioactivity from the ocean interior. However, most of the eastward decrease in the Fukushima ^{137}Cs concentration both in 2013 and 2014 occurred in the region between station P20 and station P16 that is heavily influenced by the northward flowing Alaska Current (Fig. 1).

Line P is situated in the vicinity of the bifurcation of the North Pacific Current, where the large-scale circulation diverges into the northward flowing Alaska Current and the southward flowing California Current (Figure 1). These flows are subject to pronounced variability on interannual to decadal times scales (15). Time-averaged streamlines representing the mean dynamic height field for 2002-2012 calculated from Argo float data (http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/canadian-products/index-eng.html) are illustrated in the inset for Fig. 1 (14). The mean streamlines are concentrated on the western part of Line P (west of station P15), which on average intercepts the northward geostrophic transport of the Alaska Current with flow speeds of 5–10 cm/s. The streamlines diverge markedly on the eastern side of Line P, which lies generally within the bifurcation zone. The flow in this region is highly variable and mean currents are weak and difficult to define. The decreasing ^{137}Cs tracer gradient in surface mixed layer eastward along Line P (Fig. 2B) represents a transition from higher levels in the northward flowing core of the Fukushima tracer plume to lower levels in the weaker, transitional flow field of the bifurcation zone. This slower eastward flow of the Fukushima signal onto the shelf may explain why the Fukushima ^{137}Cs signal had yet to be detected by mid-2014 in Pacific coastal regions off British Columbia by a Woods Hole Oceanographic Institution crowd sourcing program (http://www.ourradioactiveocean.org/). Seasonally variable winds are also a factor in the exchange of water between the open ocean and the shelf resulting in a downwelling regime that dominates through most of the year off British Columbia (16). Downwelling tends to enhance rather than weaken offshore transport and likely does not contribute to the delayed transport of the Fukushima 137Cs signal onto the shelf along Line P.

In contrast to the North Pacific results, ^{137}Cs concentrations measured in Pacific Water collected in the upper 170 m of the Arctic Ocean in September, 2012 were in the range (1.1-1.8 Bq/m3) associated with fallout. ^{134}Cs levels were below the detection limit (0.13 Bq/m3) at all depths at stations A, BL, CAP-10 and TU-1, located in the inflow region for Pacific Water entering the Beaufort Sea (Fig. 1). These results indicate that, as of September 2012, detectable Fukushima radioactivity had yet to reach the Arctic Ocean by ocean current transport through the Bering Sea. This observation is consistent with the view that the Bering Sea is downstream of Line P in the large-scale ocean circulation pathway of the North Pacific sub-polar gyre (17).

Discussion

Ocean circulation models (6-8) indicate that the initial spreading of the Fukushima tracer signal was governed by the large-scale horizontal currents and mesoscale eddy fields off Japan in 2011 resulting in a broadening tracer patch propelled across the central North Pacific at about 40ºN by the North Pacific Current (Fig. 1). The principle component of the tracer field in these simulations reaches the coastal waters of North America in several years and eventually occupies a broad region of the eastern North Pacific from Alaska to California. The Line P time series for surface water concentrations of Fukushima ^{137}Cs at stations P4 and P26 is compared with the results of two model simulations (6-8) of the lateral dispersion of the Fukushima tracer plume off British Columbia in Fig. 3. Behrens et al. (6) predicted Fukushima ^{137}Cs concentrations to first become measurable in the surface mixed layer of the area defined by Box B (Fig. 1) in 2015, two years after Fukushima ^{137}Cs was detected at station P4. In contrast, Rossi et al. (7,8) predicted the arrival of Fukushima ^{137}Cs in surface water at station R, a 300 km wide coastal band at 49ºN (Fig. 1), to occur in early 2013. The model simulation reported by Rossi et al. (7,8) is in good agreement with the timing of the initial detection of the Fukushima ^{137}Cs signal at the nearby location of station P4 (Fig. 3). The Rossi et al. (7,8) time series for Fukushima 137Cs slightly lags the measured values at the ocean interior location, station P26 and slightly leads the time series at station P4. A revised simulation of Rossi et al. (7,8) indicates that a maximum Fukushima ^{137}Cs level of 2.8 Bq/m3 will be attained at Sta. R in 2015.

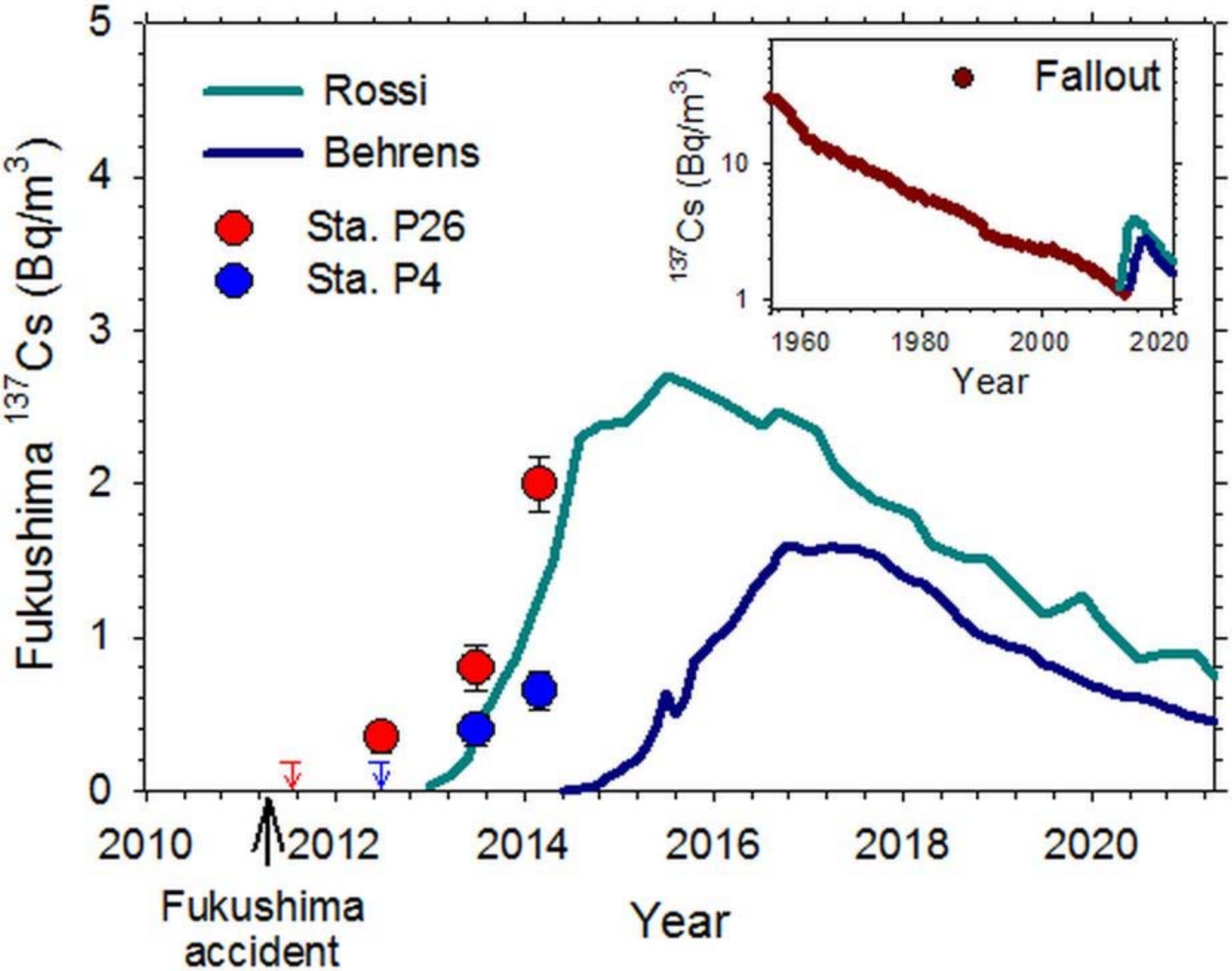

Figure 3. Fukushima-derived ^{137}Cs concentrations in surface water at stations P4 and P26 are illustrated for sampling dates on bottom axis. Fukushima ^{137}Cs was below the detection limit (illustrated by arrows) in 2011, but measurable at station P26 in 2012 and measurable at both stations in 2013. Model results correspond to ^{137}Cs concentrations in surface mixed layer water predicted by Behrens et al. (6) (blue curve) for box B (Fig. 1) and Rossi et al. (7,8) (cyan curve) for cross shelf regime R (Fig. 1). Inset shows the ocean model simulations for ^{137}Cs (including an additional fallout background of 1.2 Bq/m^3) which are compared to the historical record for ^{137}Cs fallout levels (brown symbols) in surface waters of North Pacific Ocean.

Public concerns have focused on the eventual magnitude of the Fukushima radioactivity signal in the ocean and the impact of this radioactivity on marine organisms. Given that the ^{137}Cs fallout background averages about 1.2 Bq/m^3 in surface water on Line P, levels of Fukushima-derived ^{137}Cs in February 2014 can be viewed as ranging from 170% of the fallout background at station P26 to 75% of fallout levels at station P4. Comparison with the history of atmospheric fallout in surface water in the North Pacific (inset, Fig. 3) indicates that total ^{137}Cs values (Fukushima-derived plus fallout ^{137}Cs) predicted for the Behrens et al. (6) and Rossi et al. (7,8) models with maximum values in the 3-5 Bq/m^3 range would return ^{137}Cs levels in continental shelf regimes in the northeast Pacific Ocean to those fallout levels that prevailed during the 1980s. However, these concentrations of ^{137}Cs in the Northeast Pacific Ocean are well below Canadian guidelines for drinking water quality for which the maximum acceptable concentration (MAC) of ^{137}Cs in drinking water is 10,000 Bq/m^3.

The potential impact of these predicted increases in ^{137}Cs seawater concentrations on marine organisms can be evaluated using the concentration factor (CF) approach employed by Kryshev et al. (18) in the post-accident marine environment at Fukushima. Radioactive cesium in fish is excreted through osmotic pressure regulation and elimination so it does not bioaccumulate indefinitely. Instead, the ^{137}Cs concentration in fish tissue attains a steady state value under conditions in which the ^{137}Cs concentration in seawater remains constant. The ^{137}Cs concentration in fish tissue can then be characterized by a concentration factor (CF) which is a dimensionless parameter defined as the ^{137}Cs concentration in the fish tissue divided by the ^{137}Cs concentration in ambient seawater. The recommended literature value for the CF for ^{137}Cs in fish of 100 (19) can be used together with the maximum projected seawater concentration for ^{137}Cs of 5 Bq/m^3 to give a predicted ^{137}Cs concentration in fish of 0.5 Bq/kg (wet weight) or 2.5 Bq/kg (dry weight). This predicted level is several times greater than fallout background levels of ^{137}Cs in fish in the North Pacific typified by the pre-Fukushima value of 1.0 Bq/kg (20) for Bluefin tuna off California. The internal radiation dose rate to fish is the product of the ^{137}Cs concentration in fish and the internal dose conversion factor [1.8 x 10-4 µG/h/Bq/kg (21)]. The internal radiation dose calculated using the above predicted ^{137}Cs concentration in fish for maximum Fukushima levels in seawater yields a value of 4.5 x 10-4 µGy/h. (450 x 10-12 Gy/h) for fish in the eastern North Pacific. This predicted exposure level is many orders of magnitude less than the baseline safe level of 420 µGy/h below which harmful effects are not expected at the aquatic ecosystem and population levels (22). Fisher et al. (23) calculated the effective radiological dose to humans from the consumption of Bluefin tuna having levels of about 6 Bq/kg of 137Cs owing to contamination from Fukushima. They noted that the dose to humans was only about 7% and 0.2% of the dose from the natural radionuclides 40K and 210Po in the fish, comparable to the dose commonly received from naturally occurring radionuclides in many other food items and only a small fraction of doses from other background sources. These results indicate that future projected levels of ^{137}Cs in seawater in the Northeast Pacific Ocean are well below levels posing a threat to human health or the environment.

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Endnotes

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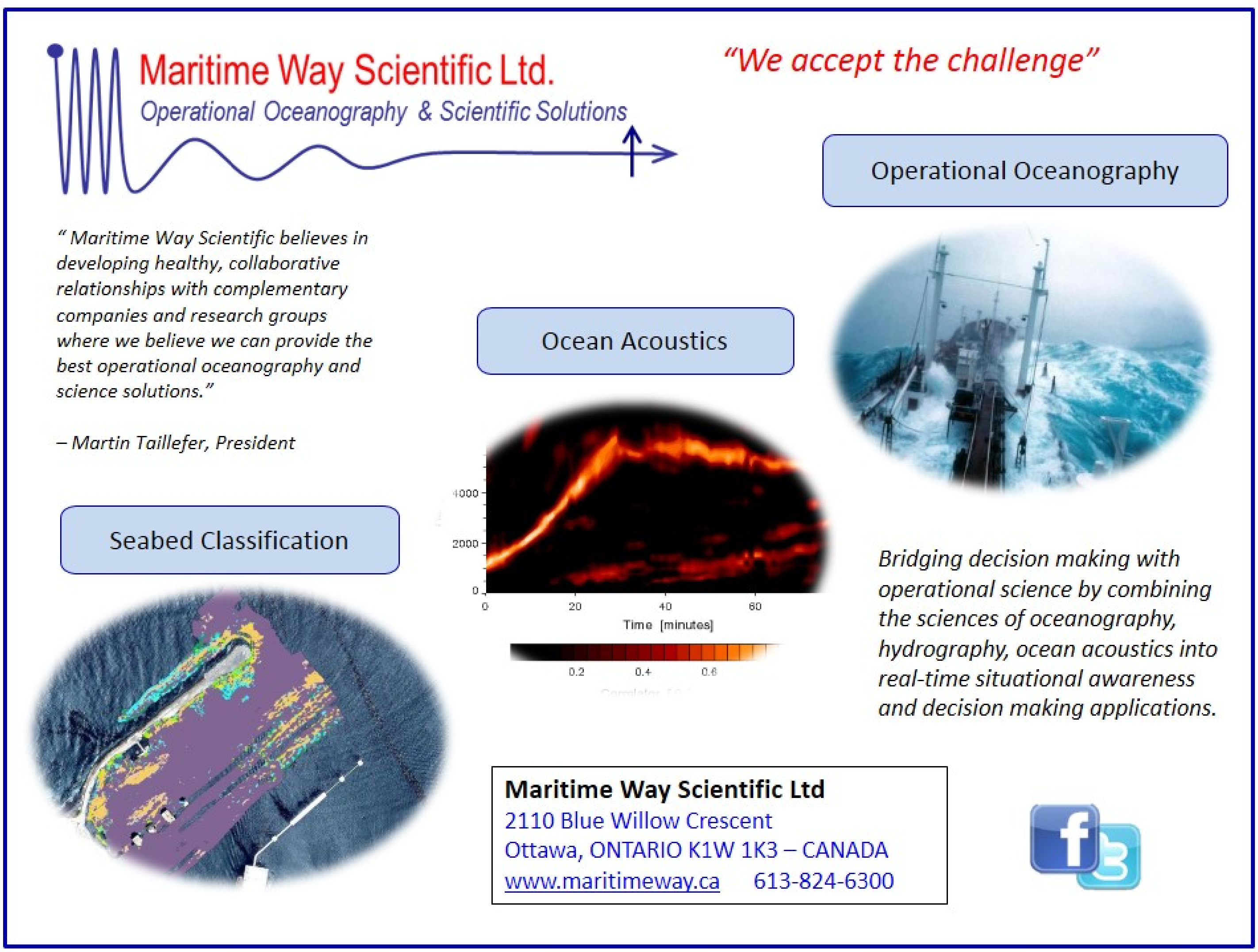

Return to 2014 - Runner-Up Weather Stories for the Past Year

by David Phillips[1]

Note from the Co-Editor: Runner-up stories are weather events that were considered, evaluated, and rated but did not quite make it to the top ten weather events list of the year published in the *CMOS Bulletin SCMO* in February 2015 (Vol.43, No.1, page 14-24).

David Phillips being interviewed by the media

1. Early January Storm Cripples Atlantic Canada

In a winter that was technically just beginning but had already worn out its welcome, there came a powerful Cape Cod storm the day after New Year's that inflicted a crippling blow to Atlantic Canada. The storm began with heavy snow that morphed into a blinding blizzard followed by biting wind chills over the next several days. Precipitation ranged from 40 cm of snow to 47 mm of rain and everything in between, including 5 to 10 mm of freezing rain in some areas of central New Brunswick. Added to the mix were gusting winds of up to 60 km/h that created whiteout conditions, driving rains, and drifting snow that caused more problems than accumulations.

The storm hit Nova Scotia particularly hard, with ensuing store closures, travel delays, flight cancellations, and dangerous driving conditions. Most universities, college campuses, and libraries were also closed, as well as many daycare centres. Buses were taken off the roads and ferry service between provinces was cancelled. Local flooding occurred along Nova Scotia's Atlantic coast near Liverpool because of higher-than-normal water levels and heavy pounding surf. In Prince Edward Island, ice storms left thousands of residents unplugged and in the dark. Once departed, the storm ushered in cold weather with persistent wind chills between -35°C and -45°C, which is unusually cold for the Maritimes. The freezing cold came close to breaking a low temperature record in Saint John on January 2 when the thermometer reached -26.3°C with a wind chill of -39°C, and did set a record in Edmundston when temperatures hit a low of -38.1°C. Record lows were also set in Bathurst, Charlo, St-Leonard, Moncton, and Fredericton.

The bad weather played havoc with New Brunswick's power system as freezing rain, wind, and rain knocked out electricity to thousands of homes and businesses. This was the second major ice storm in two weeks. Combined, the pre-Christmas and post-New Year's storms cost NB Power $12 million in overtime to repair power lines and infrastructure damaged by foul weather. They were the most damaging storms to hit the provincial power grid in decades, and far exceeded the magnitude and cost of the infamous Eastern Canadian ice storm in 1998.

The fierce storm that pounded the Maritimes brought even more weather misery to Newfoundland's Avalon Peninsula in the days that followed. St. John's residents woke up to nearly 40 cm of snow dumped by the big storm. Although it was a hit and run, lingering powerful winds of 111 km/h whipped the snow into monstrous drifts and created blowing snow and whiteouts that resulted in treacherous driving and walking conditions. The storm caused flight cancellations, interrupted public transit and closed roads, government offices, universities and businesses. But it was the power outages that came in the midst of some of the coldest weather in years (-35°C wind chills) that hurt the most. To mitigate the impact, officials opened warming centres across the province. Ironically, in the days leading up to the storm, the provincial power authority had implemented periodic rolling blackouts to avoid crashing the system. So what started as a power-plant breakdown then moved to rolling blackouts and culminated in full-out power outages that left 90,000 customers shivering in the dark and buried in snow for days. At the peak of the power outage, about 190,000 customers were in the dark forcing schools to close for a week.

2. Severe Ice and Higher, Colder Waters on the Great Lakes

With an early onset to winter and the intensity of the cold throughout, it was no surprise that the Great Lakes ice cover in 2013-14 was thick, expansive, and lasted well into spring. The first sign of a thick and early ice season came with the sighting of icebreakers in mid-December – a good two to three weeks earlier than normal. Over the winter, shipping channels became so choked with ice that Canadian and American Coast Guard icebreakers logged four times more hours than average for the same period in recent years. Some breakers worked non-stop for 55 days trying to clear paths for vessels hauling essential cargo such as heating oil, salt, and coal. It was so cold in January

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

that the Great Lakes became a virtual 'ice machine', refreezing as soon as ice breakers opened up leads in ice floes. According to Environment Canada's Canadian Ice Service, it was one of the most prolific ice seasons on record for the Great Lakes with records dating back over 40 years. Statistics attributed to the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory reveal that the Great Lakes reached a high of 92.2 per cent ice coverage on March 6. The last time there was that much ice was in 1978-79 when coverage hit a record high of 94.7 per cent. By comparison, 2012-13 winter's coverage peaked at about 40 per cent. Statistics for the individual lakes included: 95 per cent or more for lakes Superior, Huron, Erie, and St. Clair; 93 per cent for Lake Michigan; and 61 per cent for Lake Ontario. The final sign of a remarkable ice year came in the first week of June when the last of the ice in Lake Superior melted, making it the latest date on record for last ice on the Great Lakes.

Connected to the head of the Great Lakes, the St. Lawrence Seaway was also impacted as its 56th shipping season did not fully open until March 31 – nine days later than the previous winter and its latest start since 2009. Once open, the heavy ice conditions meant it took five more weeks for traffic flow to reach normal levels on Lake Superior. Ports and terminals were also closed longer. The late start added stress and costs on shippers and customers, especially Prairie grain farmers who were eager to begin shipping last year's bumper crop to overseas markets. On a positive note, a thick and stable ice cover helped many aquatic species of plants and animals to survive through winter.

Also positive to many was the continuation of rising water levels in the Great Lakes. Among the contributing factors were: record-setting snowfalls and snowpack; long-lasting intense cold that bred nearly full ice cover; a cold beginning and lukewarm ending to spring; and a cooler-wetter summer. The fact that much of the snow came from outside the Great Lakes watershed also helped boost lake levels. Further, the water content of the snowcover was the highest in a decade on lakes Superior, Michigan, and Huron. And for the first time since 1998, all of the Great Lakes were above their long-term (1918-2013) monthly average levels in September. The most remarkable rebounds were on lakes Superior, Michigan, and Huron, where water levels rose to those not seen since the late 1990s. Given that lakes Michigan and Huron were at record low levels ever in January 2013, a full 72 cm below the 1918-2013 average, the water level rise since has been astonishing as levels reached as high as 17 cm above average by November 2014. Also noteworthy is that the seasonal decline of lakes Superior, Michigan, and Huron water levels, which typically begins in mid- to late-summer, was delayed until late fall on Lake Superior and not seen yet on lakes Michigan and Huron. This was due in part to continued wetter-than-normal conditions. According to Environment Canada, there have only been seven years since 1918 that levels on lakes Michigan and Huron reached their annual peak after September. Among those benefiting from higher water levels were recreational boaters, beach-front cottagers, tourists, commercial fishers, shippers and freighters, and hydro-power authorities. It was also a plus for freshwater habitats and spawning and nursery grounds.

The Great Lakes weren't just fuller than usual, waters were colder too. In the middle of lakes Ontario and Huron surface water temperatures were about 6°C colder on Canada Day 2014 than they were the year before. And on the August long weekend, Lake Superior had surface temperatures of 2.9°C cooler than the previous year.

3. The Return of Sea Ice

After several years of lower-than-average sea ice concentrations along the East coast, the ice was back in a huge way in 2014 as it jammed into the Strait of Belle Isle and extended southward all the way to the mouth of the St. Lawrence River and along Maritime coastlines. On the Atlantic side, the ice extended far out into the ocean from Labrador all the way down to Trinity Bay on the Avalon Peninsula. The last time the Canadian Coast Guard encountered such heavy ice conditions in eastern Newfoundland was in 1993-94. Icebreakers had a difficult time keeping ferries unstuck and allowing commercial ships and oil tankers to continue travelling through ice-infested waters. In mid-February, following weeks of cold and unusual calmness, sea ice began to build up in the Gulf of St. Lawrence where ice thickness ranged from 30 to 75 cm. Prevailing westerly winds shoved the ice against the western coast of Newfoundland in one-metre floes. Such thicknesses hadn't been seen in early March in over 25 years and were 10 per cent more than the 30-year average. At the end of March, the Gulf of St. Lawrence was almost entirely covered by one-metre-thick ice. According to Environment Canada's Canadian Ice Service, 2013-14 had the second highest ice year in 20 years in the Gulf of St. Lawrence. In April, hundreds of passengers aboard ferries off Cape Breton Island became stuck for days by wind-driven ice. It was a tough two weeks of significant delays for Marine Atlantic owing to severe weather systems and heavy ice in the Cabot Strait. In early May, lobster fishermen found it a challenge to set traps. Along the Newfoundland and Labrador coast, a bumper crop of icebergs – the most seen in more than ten years and reaching 500 km further south than normal – excited tourists but worried mariners, especially those hidden in the fog or bobbing up and down in rough seas.

Heading north, summer air temperatures in the Arctic were almost a degree warmer than normal. June was slightly cooler than normal, but July air temperatures rose 2.0°C to 4.0°C above average over the central Arctic Ocean. The excess warmth and favorable winds forced sea ice to retreat rapidly. By the end of July, according to the National Snow and Ice Data Center (NSIDC) in the United States, sea ice extent was the fourth lowest since satellite observations began 36 years ago. Weather patterns changed in August with cooler air conditions and a shift in winds that spread out the ice. NSIDC reported that on September 17 the Arctic sea ice shrank to its sixth lowest extent, reinforcing the long-term downward trend in Arctic ice extent. At this time of minimum extent, Arctic sea ice covered 5.02 million square km. This was 1.6 million square km above the record minimum extent of 2012 and 1.2 million square km below the recent 30-year average minimum or 19 per cent below average. In the Canadian Arctic, Hudson Bay, Baffin Bay, and the Davis Strait were mostly ice-free in mid-summer. In the Parry Channel, there was 64 per cent ice cover – slightly greater than normal and more than in the last ten years. Unlike most recent years, the Northwest Passage remained closed and choked with ice, whereas the Northeast Passage along the coast of Siberia remained open with little ice near most of the shipping channel.

Exciting news for Canadians was the discovery of the HMS Erebus, one of the lost ships from the Franklin Expedition of nearly 170 years ago. Behind the scenes, uncleared sea ice from Victoria Strait played a factor by severely limiting search efforts.

4. Flooding from East to West

In early April, mounds of snow were beginning to melt rapidly, temperatures were rising and rain was on the way, causing major concerns about potential flooding across the Maritimes. Prince Edward Island had received two times the normal amount of snowfall in March, with water content 36 per cent higher than normal for that time of year. And March temperatures five degrees below normal across the three provinces had kept snows from melting onto still-frozen ground with a reduced capacity for absorbing excessive spring rains. By April 9, as ice began moving on most rivers, water levels along the Kennebecasis and Nashwaak rivers in New Brunswick reached flood stage. The sudden spring thaw, spring rains, and flooding led to road closures, filled basements and forced hundreds to leave their home. By mid-April, river water was spilling onto farm fields and into yards, flooding more basements and damaging recreational properties and trailers. Floodwaters also ripped out roadbeds, cut off key arterial roads, and dislodged bridges off their abutments, causing millions of dollars in damage to New Brunswick's highway infrastructure.

Across southern Quebec, April showers with daily amounts of 25 to 45 mm of rain and a rapid snowmelt on still-frozen ground meant huge discharges into rivers and lakes. In the town of Beauceville, where there was a kilometre-long ice jam along the Chaudière River, public safety authorities gave evacuation orders to several dozen residents and businesses. About 100 km north of Montreal, near Morin Heights, a rain-fed landslide destroyed several summer cottages. The hillside terrain became unstable when melting snow and a steady deluge of rain saturated the ground and dislodged massive chunks of earth. In Sherbrooke, the Saint-François River reached a record water level of 7.6 m on April 15, dividing the city. Firefighters suggested 600 people vacate their homes. Flooded downtown streets quickly froze when morning temperatures dipped to -8°C. On April 15, torrential rains caused the Sainte-Anne River in St-Raymond, just west of Quebec City, to rise at breakneck speed, flooding the downtown core.

In southern Ontario, spring flooding was almost a sure bet when a thick layer of pre-Christmas ice coated the ground, followed by deep snows that stayed all winter and cold temperatures that lasted well into spring. When heavy rains fell at spring freshet it was enough to prime rivers into flooding. In April, Belleville and other towns along the north shore of Lake Ontario came under a state of emergency when water levels rose on several streams and rivers, including the Moira, Salmon, and Napanee rivers, and in the Lower Trent and Rideau Valley Conservation regions. During a ten-day flood threat, 1,600 volunteer sandbaggers in Belleville worked frantically as water on the Moira River reached the same levels as 2008 – the last time a major flood occurred. Damage to infrastructure was in the millions of dollars and states of emergency were declared in Central Hastings and Tweed in eastern Ontario. On the swelling Rideau River, water was at its highest level in more than five years. Rising waters also prompted flood warnings on the Grand River in southern Ontario.

Moving to the eastern Prairies, the mid-winter snowpack in southern Manitoba was twice its average but its moisture content was surprisingly low, which minimized the potential risk of spring flooding. Also favourable were the drier than normal soil conditions going into winter that meant the ground had some capacity to absorb spring snowmelt. What worried officials was that the depth of frost had reached almost three metres below the surface – enough to cause overland flooding. Ice jamming was also a worry because river ice was 30 per cent thicker than normal. What saved the day was the cold. Ironically, the frigid temperatures that residents cursed all winter also kept the snow dry and, through sublimation, reduced its water content. Further, cool spring temperatures slowed the rate of the spring melt. In the end, it stayed so cold for so long in Manitoba and Saskatchewan that spring flooding looked after itself. The one exception was the Fisher River that runs through Peguis First Nation. For the seventh time in five years it spilled its banks, swallowing roads, flooding properties, and forcing residents to leave home.

Then there was Alberta. With the one-year anniversary of the province's "flood of floods" just days away, a slow-moving storm on June 17 brought fears of déjà-vu as soaking rains hit portions of southern Alberta. A heavy rainfall warning calling for as much as 200 mm of rain raised the anxiety level in several communities in the area, especially when high streamflow advisories were issued for the Bow, Oldman, Milk, and South Saskatchewan rivers. In the end, storm rainfall totals were less than warned but still high (peak rainfall for the storm reached 175 mm at West Castle) and the area affected was not as widespread as a year ago. While Calgary was spared the deluge, several towns and cities to the south were hard hit. Forty homes were flooded in Claresholm and states of emergency declared in a dozen communities, including Medicine Hat, parts of Lethbridge County, High River, Crowsnest Pass, Willow Creek, and the Blood Indian Reserve. In Lethbridge, rainfall totals exceeded 246 mm between June 10 and 19, with 171 mm falling in three days between June 16 and 18. Lethbridge's average yearly rainfall is 276 mm. As a result, the Oldman River rose 3.5 m and left 350 homes with flooded basements. On the Blood Reserve, 20 families were forced from their homes and 200 homes reported damage, most of which was caused by overland flooding and sewer backup.

5. Wicked Winds across the West

Riding a fast-moving air stream from the Mackenzie Valley, warm Pacific winds pushed across the Prairie provinces in mid-January. The super-charged 'breeze' was a welcome respite to what was becoming an extremely cold winter. Dozens of warm temperature records fell, including ones in Edmonton, Saskatoon, and Winnipeg. At Edmonton, for example, the temperature rose to 9.1°C, breaking the previous record by two degrees. Saskatoon's high of 7.5°C on January 15 was the highest temperature recorded in the city since record-keeping began in 1892. Meanwhile, winds clipped along at hurricane-force speeds of 120 km/h, also breaking records along the way. The wicked winds rattled and broke windows, shook cars, and inflicted millions of dollars in property damages. The blustery blows blew over semi-trailers, tore away signs, and awnings, ripped away downtown building facades, knocked down pedestrians, bent cell towers, crushed grain bins, and twisted traffic lights. Flying debris became a hazard for both motorists and pedestrians on roads and walkways. From northern British Columbia to eastern Manitoba, thousands of customers went without power due to toppled trees that downed power lines. The January thaw was short-lived and the ensuing weather turned into nasty snow squalls, blinding blizzards and freezing rain, with the occasional thunderstorm thrown in for surprise. The unusual weather kept school buses off the roads and students inside for the day. The blowing and drifting snow and slick ice led to numerous highway closures and contributed to two traffic fatalities in Alberta.

6. April Fool's Storm in Atlantic Canada

An end-of-March storm that developed off the Eastern Seaboard of the United States inched its way southeast of Nova Scotia to become an April Fool's storm for those who thought maybe, just maybe, it was spring in Atlantic Canada. New Brunswick residents faced yet another massive power outage with more than 75,000 customers losing electricity due to freezing rain, ice pellets, and heavy snow. Warming centres were opened in several locations and some rural areas experienced water shortages. Fredericton was once again covered in a thick coat of ice that felled trees onto power lines, toppled power poles and blew transformers. Total costs to NB Power exceeded $3 million. By April 1, Fredericton, which would normally have about 5 cm of snow on the ground, had 68 cm – the deepest snow cover ever measured at the capital in April. Plow operators worked around the clock as snowdrifts on some streets measured two metres deep and highway ramps were blocked by snow and stalled transport trucks. Deer were exhausted and weakened trampling through deep crusty snows and became easy targets for predators. In the harbour in Sydney, strong persistent northeasterly winds pushed sea ice up to three metres thick in places delaying Marine Atlantic ferry crossings for days. And for the Cape Breton-Victoria Regional School Board, the 15 snow days this year was nearly double the number from last year.

Prince Edward Island seemed to be the hardest hit, digging out of another record snowfall. The storm pounded the Island for more than 30 hours. Maritime Electric compared this mix of snow and freezing rain to the infamous ice storm that hit the province in January 2008. In 2013-14, the snow dumps were frequent and heavy. Charlottetown had five storms in excess of 25 cm or more in one day, including 48.54 cm on March 26, for a total of four more heavy snow days than average. Across the province, plows were called off secondary roads and schools were closed for a week as blowing snow and ice pellets continued to pelt the Island. In March, some students had more snow days than school days leaving the novelty of a snow day far behind.

The early April blast was also one of the worst in a '"winter of storms"' for Newfoundland and Labrador, generating a prolonged period of strong northeasterly winds with a mix of snow, ice pellets, and freezing rain for southern Newfoundland. Heavy snows combined with strong winds created major drifting and whiteouts. In and around St. John's, treacherous driving conditions led to the closure of many schools and businesses.

7. Severe September Storm in Ontario

Following one of the hottest and most humid summer days on September 5, a severe thunderstorm tracked through southern Ontario from west to east. Trigged by a cold front, it packed heavy rains and strong winds. London took the brunt of the storm, where winds toppled trees and wires, triggering power failures in and around the city. An evening concert was also cancelled when Western Fair organizers shut down the exhibition. Ottawa took a direct hit as well with downed trees, flooded streets and intersections, water-filled basements, and the temporary stoppage of the Ottawa Redblacks football game due to lost power. On Christian Island, northwest of Midland, the storm damage looked suspiciously like a weak tornado that was later confirmed as an EF0 with winds of 90 km/h. Experts also confirmed that an EF1 tornado touched down in Udney, about 20 km east of Orillia, where winds damaged buildings, including a barn, shed, and clubhouse. In Orillia, wind damage was consistent with a downburst as wind blasts felled dozens of majestic trees in the city's downtown lakeside park. In the vicinity of Six Mile Lake, there was also tree damage due to straight-line winds with speeds in the range of 90 to 110 km/h. Recorded peak winds were strongest at Windsor (96 km/h) and Lagoon City (85 km/h).

Rain totals were also a concern, with St. Thomas getting soaked with 75 mm that led to local flooding. Other wet spots with 60 to 90 mm of rain were Grand Bend, Tillsonburg, and Fergus. On a tragic note, the storm was responsible for the loss of two lives – the first happened early in the day when a University of Waterloo student was struck by lightning after taking shelter underneath a tree; the second occurred in Orillia when a cyclist hit by falling tree branches was found unconscious and later died.

Just five days later, on September 10, another powerful storm tracked across the same area and into central and northern Ontario with similar rainfall amounts. After two heavy rainfalls in less than a week, officials issued high water and flood warnings for low-lying areas. High winds also wreaked havoc near and south of London. In Windsor-Amherstburg, with a second storm of 60 to 100 mm of rain, several residents faced a recurrence of wet basements. The deluge of rain also affected London again, swallowing streets, choking traffic, toppling trees, and turning basements into indoor pools. And for a second time, Western Fair officials closed the fair grounds. Combined, the two storms dumped rains of 123 mm in London, 108 mm in Tillsonburg, 117 mm in Waterloo, 126 mm in Fergus, and 113 cm in St. Thomas.

Note du corédacteur: À cause du manque d'espace, la version française paraîtra dans le prochain numéro du *CMOS Bulletin SCMO*. Mille excuses à nos lecteurs francophones.

Call for Volunteers

CMOS is looking for the following Volunteers:

- Chair for the Private Sector Committee;
- Chair for the Audit Committee;
- Coordinator for Webinars.

Volontaires recherchés

La SCMO cherche des volontaires pour les fonctions suivantes :

- Un président du comité du secteur privé;
- Un président du comité de vérification des comptes;
- Un coordonnateur de webinaires.

English version on page 50

Évènement : École d'été sur la réduction des impacts et la communication des risques météorologiques

1e ANNONCE

Merci de bien vouloir adresser les réponses, commentaires et questions à l'adresse de l'École d'été: ecole@sca.uqam.ca

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Dates et lieu: Du 8 au 12 juin 2015 à l'UQAM (Pavillon Sherbrooke, SH-4800), Montréal, Québec.

Organisation: L'école d'été est organisée par l'UQAM en collaboration avec Environnement Canada.

Objectifs de la formation: Considérant l'état actuel des connaissances dans le domaine des changements climatiques (CC) et des risques associés à l'évolution des aléas hydrométéorologiques et de leurs impacts sur l'être humain et son environnement, un besoin de formation grandissant se fait sentir dans le but d'accroître la capacité d'adaptation des populations et d'optimiser la transmission de l'information de nature multidisciplinaire.

Dans le domaine de la gestion des risques hydrométéorologiques, une expertise transdisciplinaire s'avère nécessaire afin de 1) combiner l'application optimale des prévisions et projections hydro-climatiques, et 2) favoriser les meilleures pratiques de communication de risques vis-à-vis des populations et des décideurs.

Publics-cibles:

- Étudiant(e)s des cycles supérieurs en génie, environnement, géographie et sciences de la Terre et de l'atmosphère;
- Employé(e)s de la fonction publique spécialistes en santé et sécurité publique, en météorologie ou en communication;
- Scientifiques et chercheurs œuvrant dans le domaine de la gestion des risques hydrométéorologiques.

Format: Présentations et plénières le matin (anglais ou français) et ateliers en après-midi (français).

Programme et modalités d'inscription en site internet.

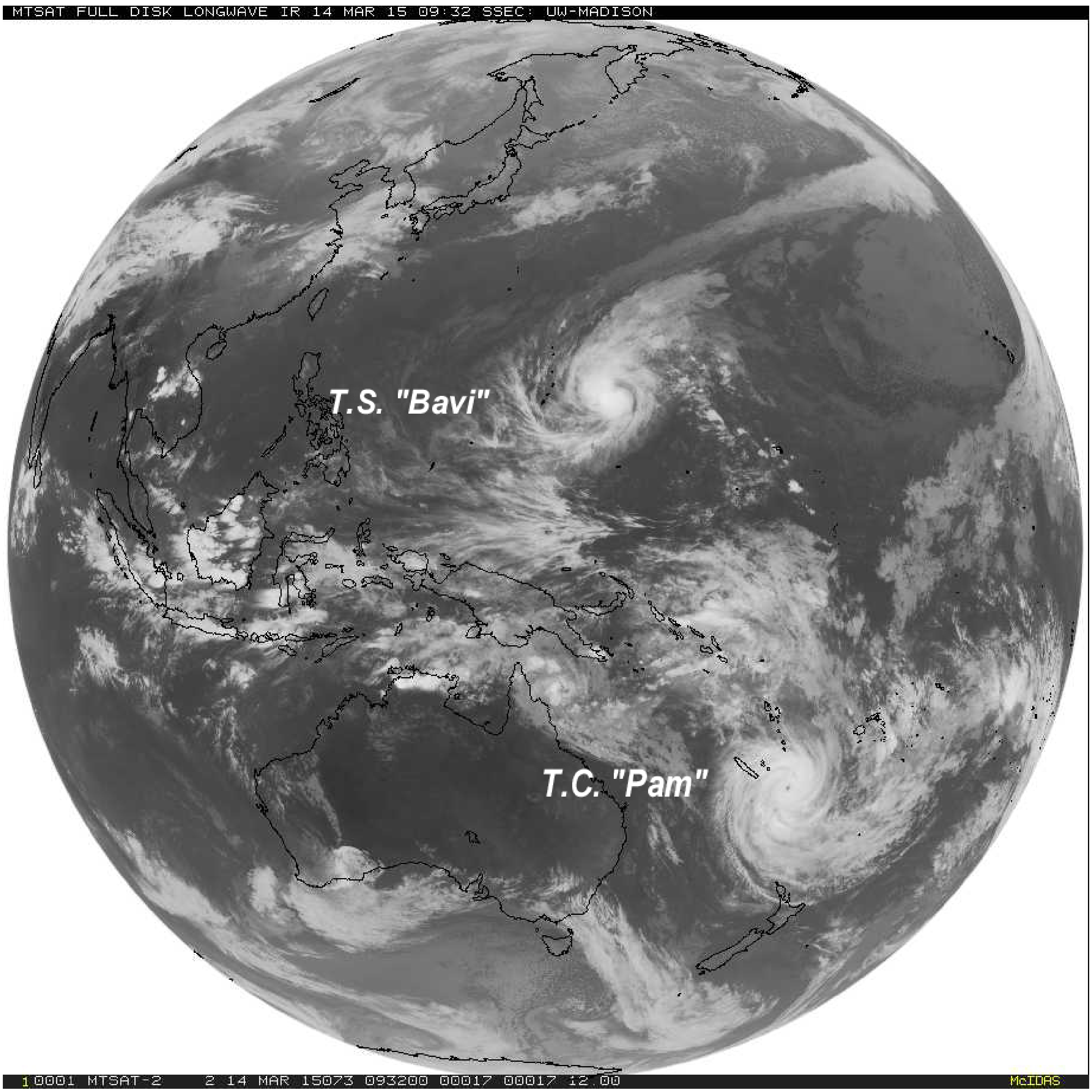
Site internet et contact:
www.risquesmeteo.uqam.ca
ecole@sca.uqam.ca

Image of the Month

by Robert Jones, CMOS Archivist, Ottawa, ON

Shown below is a satellite photo from the *GOES series taken on March 14, 2015, at 0932 GMT, over the Western Pacific Ocean. It shows two cyclones (Tropical storm *Bavi* and Tropical cyclone *Pam*), one in each hemisphere, with their familiar opposite rotation. Because of the season, the northern hemisphere cyclones are usually not seen at this time of the year. In the Atlantic ocean, the cyclones (hurricanes) are rare in the Southern hemisphere, even in season. Tropical Cyclone Pam was a very large (category 5 cyclone) and hit Vanuatu very hard. Vanuatu is an archipelago, in the South Pacific Ocean, over 1700 km east of northern Australia. This photo may be quite rare because it captures tropical storms in both hemispheres in the same general region and at the same time.

* photo courtesy of the Space Science & Engineering Center (SSEC), University of Wisconsin-Madison, U.S.A.



Reports / Rapports

CCORU Ocean Science Roundtable held in Ottawa, October 2014

Submitted by Helen Joseph[1]

In 2012 and 2013, the Canadian Consortium of Ocean Research Universities (CCORU) asked the Council of Canadian Academies (CCA) to undertake two assessments on oceans science in Canada. The first Assessment developed a listing of priority research questions, which were published in a report, entitled: *40 Priority Research Questions for Ocean Science in Canada*. The second Assessment, entitled: *Ocean Science in Canada: Meeting the Challenge, Seizing the Opportunity* examined Canada's needs and capacities with regard to the (previously identified) major research questions in oceans science.

The conclusion of the second Assessment, *Ocean Science in Canada,* identified the following three gaps in the coordination and alignment of ocean science in Canada, which are currently not being addressed:

- The vision gap: the report noted that in contrast to other countries, Canada currently lacks a comprehensive national strategy or vision for ocean science in Canada.
- The coordination gap: the report noted that addressing the 40 research questions requires enhanced collaboration at local, regional, national, and international levels. While noting that there are examples of successful collaboration, there remain important challenges in coordination.
- The information gap: the report noted limitations in, and availability and comparability of, information on key research activities, infrastructure, and other ocean science capacities in Canada.

The CCA *Ocean Science in Canada* report further stated that addressing these gaps is necessary for Canada to meet the growing needs of ocean science with limited resources and to make the best possible use of existing capacities. The report recognized that "none of the current or emerging alignments, consortia, or networks can address these gaps singlehandedly, and that a national effort is required involving the entire community of ocean scientists in Canada, as well as the users of ocean science in government, the private sector, and civil society".

The release of the CCA's *Ocean Science in Canada* report generated considerable discussion across the Canadian ocean science community, with the next question being – how do we, as university, government, and industry working together, address these gaps? In March 2014, a follow-up report was conducted by CCORU, *Investigating the Establishment of a Canadian Organization for the Coordination of Ocean Science Activities in Canada*, to examine what the next steps might be in working together.

As an immediate first step forward in improving the coordination and information sharing of ocean science activities in Canada, the March 2014 report recommended that CCORU host an "Ocean Science Roundtable". It recommended that the Roundtable bring scientists, science managers, and science users together to identify ocean science initiatives that would address information and coordination gaps and would involve government, industry, and university players.

CCORU accepted this recommendation and proceeded with an Ocean Science Roundtable meeting in October 2014 that brought together approximately fifty ocean scientists, science managers, and ocean science users. The participants came from a range of ocean science areas, with many of them involved in the existing Networks from across the spectrum of universities, as well as government and industry.

The discussions over the two days were very productive with excellent engagement from all participants. The Roundtable identified two primary functions as key features for ocean science moving forward:

1) the need for an advocacy role on oceans; and

2) the need for coordination across the many sectors involved in ocean science (e.g. researchers; network leaders; science users for policy/innovation/ commercialization; industry; etc.).

The Roundtable developed a proposed vision, with supporting mission components, for ocean science in Canada. Three actions were also agreed upon as the next steps that should be taken to address the information and coordination gaps of ocean science in Canada. These actions are:

1) Continued Role of the Canadian Consortium of Ocean Research Universities (CCORU);

2) Expanded Canadian Galway Marine Working Group led by Fisheries and Oceans Canada;

3) Emergence of a Canadian Consortium on Ocean Leadership organization.

[1] HCJ Consulting, Ottawa, Ontario

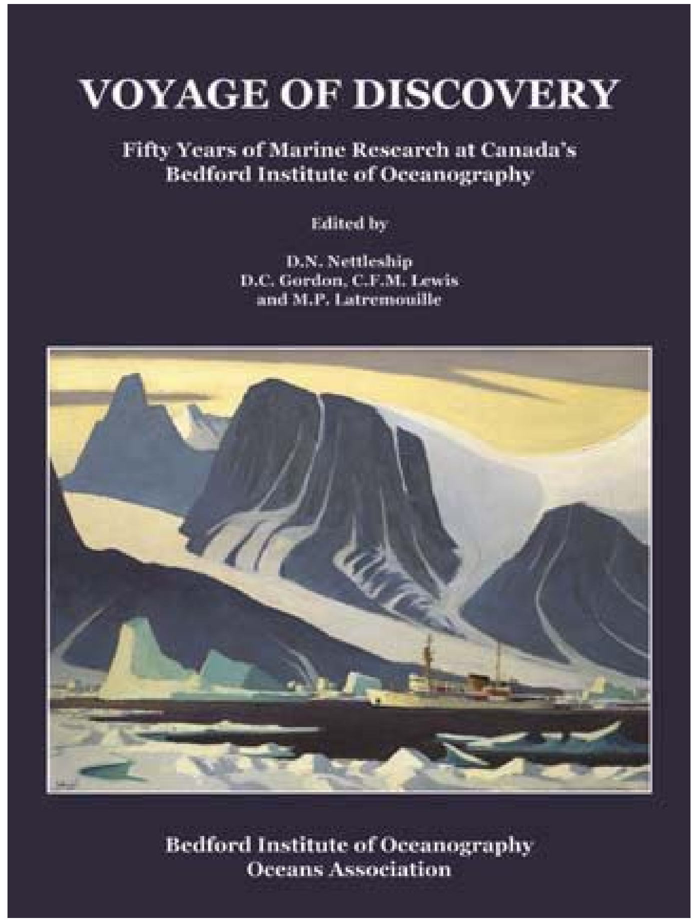
Roundtable discussions, results, and actions are described in the CCORU Ocean Science Roundtable report that has recently been finalized. A session is planned at the CMOS 2015 Congress to present the work to date coming from the Roundtable, and to engage with a broader ocean science community.

Dr. Bob Fournier[2] - Keynote Speaker at the Book Launch: 'Voyage of Discovery'

The BIO-Oceans Association hosted a ceremony at the Bedford Institute of Oceanography (BIO) on 20 November 2014 to celebrate the launch of the book ***'Voyage of Discovery- Fifty Years of Marine Research at Canada's Bedford Institute of Oceanography***'. Dr. Bob Fournier of Dalhousie University was a keynote speaker at the event. Below is a transcript of his remarks.

A Voyage of Discovery

Good Morning. I would like to begin by congratulating my colleagues here at the Bedford Institute for seizing the opportunity to celebrate BIO's first 50 years. The volume *"**Voyage of Discovery**"* provides an important perspective on ocean research but it also reflects the growth of oceanography in Canada. At the risk of appearing presumptuous I assume that another individual, not here today, would also be pleased - Dr. William Van Steenburgh, a major driver in the creation of BIO.



Attempting to understand Dr. Van Steenburgh's motivation, after all these years, could be a fool's errand. However, sufficient information exists to allow a rudimentary placement of that individual in his proper temporal context – the mid to late 1950s. That was a time not so long after World War II when Canadians were flushed with pride and a can-do attitude following unqualified success in that conflict. Keep in mind that World War II was the first amphibious war, with landings in the Atlantic, Pacific, and Mediterranean. The use of the oceans as a launching platform led to increased awareness as to our shortcomings regarding knowledge of the oceans, as well as the realization that Canada was surrounded by three oceans and possessed the longest coastline in the world.

All of these considerations eventually led to a national imperative, widely accepted in many circles, that Canada should become a major player in a comprehensive approach to the study of oceans. This would be an approach securely grounded on the excellent studies carried out by marine scientists in the then Fisheries Research Board of Canada. The plan was to extend those studies beyond fisheries - to cover the full range of oceanographic pursuits.

A further presumption is to suggest that Van Steenburgh's vision emerged from those times and was viewed as moving Canada into its rightful place among nations. From that vision emerged the BIO, 50 years of research, this celebratory event and, of course, the ***Voyage of Discovery****.* My personal view is that BIO contributed to Canada's maturation as a Science & Technology nation – despite the fact that the 1880s saw Nova Scotia as the Clipper Ship Capitol of the world. The implication of that fact is that such a title presumes a high degree of innovation and understanding of a vast array of technologies. One can only presume that Nova Scotian skills were present but quiescent for the early part of the 20th century.

As mentioned earlier the ***Voyage of Discovery*** vindicated the original vision promulgated in the late 1950s and early 1960s. However, we might ask if Van Steenburgh would be pleased with a similar volume – a mirror image of the current book – 50 years in the future? I believe that the answer to that question would be a resounding No! The times are quite different! Canada's needs are different! And

[2] Interim Director of Marine Affairs
and Professor (Emeritus) of Oceanography
Dalhousie University, N.S.

most of all, the oceans are different!

I think that he would agree that the present volume would be the correct starting point but the next volume should reflect a different national imperative. This is no longer about Canada's self-realization, and without being overly dramatic, this is about survival. Since the early 1960s the global population has more than doubled. In fact, during my lifetime it has tripled. Phrases such as Climate Change, Greenhouse Effect, and Global Warming had not yet entered into common usage.

Over the past 50 years – since the Bedford Institute came into existence – the oceans have become warmer, storms are more threatening, there is greater acidification, lower biodiversity, higher sea level, and more pollution. In addition, the ocean's ability to provide services has greatly diminished. For example, 50% of the oxygen we breathe is provided by small plants at the ocean surface, the oceans regulate temperature and moisture in the atmosphere, as well as sequester carbon dioxide and provide genetic resources. The Intergovernmental Panel on Climate Change (IPCC) - a UN organization that utilizes between 1000 and 2000 scientists – has been in existence for nearly 30 years. During that time the IPCC has produced a series of reports, and most recently the fifth offering in the form of three volumes on the subject of Climate Change. Just a couple of weeks ago it produced the fifth synthesis report – a summation of the previous three - in which it offered a dire warning of impending change. One commentator went so far as to declare that "this was a slow train wreck about to happen".

In the Marine Affairs Program at Dalhousie where I am currently the Interim Director, when addressing the changing role of the Oceans we often refer to a quote by E.O. Wilson who wrote in his 1998 book *"Consilience"* that

> "***We are drowning in information while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it and make important choices wisely***".

That comment suggests to me that the balance between basic and applied research has shifted, even though the need for basic research continues. Consider for the moment the Curiosity Rover currently on Mars. The long-term goal of the program within which the Rover operates is to place a human on Mars. However, a great deal of energy has been expended to gain a basic understanding of the atmosphere, soil, and potential for water. I view this as a perfect example of an altered balance between basic and applied research. According to E.O. Wilson sufficient knowledge exists for us to begin the process of implementing our current knowledge. In other words we need to apply what we already know.

I would suggest that the role of all marine scientists over the next 50 years will be to embrace the challenge that faces us all, which is that "**The oceans – they are us**"! In other words we are inextricably linked to the oceans through all the myriad systems that control the habitability of this planet, and are mediated through the oceans.

When I was a graduate student 50 years ago I was told that the research cycle was not complete until publication had taken place. This is no longer true. The new end point comes in the form of a much larger responsibility – to influence human behavior – through public policy, governance, and management. That is not to say that marine scientists should become lawyers, political scientists or policy wonks. But it does suggest that we should find new ways to achieve this new end point – perhaps through collaboration or cooperation.

In closing I believe that Dr. Van Steenburgh would be very proud of BIO and what it has become. It almost certainly reflects his expectations and the ***Voyage of Discovery*** underlines the accomplishments of the past 50 years. Today the times are different. They are no longer about Canada's self-realization or its proper place among nations – since both of those goals have long since been realized. We have a global responsibility to protect the oceans and should soon begin the gradual process of moving toward the second volume of the ***Voyage of Discovery****.*

<u>Note from the Co-Editor</u>

Copies of the book ***Voyage of Discovery,*** can be purchased at $35 plus shipping from BIO-Oceans Association (VOD), c/o Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia, Canada B2Y 4A2.

For more information, please contact BIO-Oceans Association at bio.oceans@bedfordbasin.ca

<u>Note du corédacteur</u>

Copies du livre ***Voyage of Discovery*** peuvent être achetées au coût de 35$ plus transport de BIO-Oceans Association (VOD), a/s Institut océanographique de Bedford, C.P. 1006, Dartmouth, Nouvelle-Écosse, Canada B2Y 4A2.

Pour plus d'information, prière de contacter BIO-Oceans Association à bio.oceans@bedfordbasin.ca

CMOS BUSINESS / AFFAIRES DE LA SCMO

Prière de noter que la version française suit.

Do we need a Canadian Society for the Marine (and Aquatic?) Sciences?

This question was asked – not for the first time – during the 2014 CMOS Congress at Rimouski, both by the CMOS executive, as well as at the meeting of the Canadian SCOR Committee (CNC/SCOR)[1]. After further discussion, the CMOS Executive tasked CNC/SCOR to investigate this issue. However, the members of CNC/SCOR did not feel that they could answer the question on behalf of the community without feedback, so we decided to ask what **YOU** think.

In the opinion of some, the Canadian Marine Science community is fragmented and homeless. It is fragmented in the sense that the community encompasses an unusually broad range of interconnected scientific disciplines, and it is homeless in the sense that none of the existing Canadian societies, in their present configuration, accommodate all these disciplines. As well, this work is carried out in three different sectors: academia, government as well as a growing private sector, that don't always work together in-sync. Thus, many of us have become resigned to present our work, and even meet our Canadian colleagues, at meetings in the U.S. and Europe. This has its advantages and contributes to the high standing that Canadian marine science enjoys internationally. However, since we tend not to present our work at Canadian meetings, it can be argued that Canadian scientists in related fields are not exposed to the accomplishments of their marine science colleagues. Unfortunately, this lack of exposure has reduced our visibility at home and has weakened our ability to compete for resources.

The marine science community is of course "fragmented" only if one uses the values of the traditional disciplines as a measure. There are other measures for evaluating a scientific community, and by these measures, which include community dynamics, cohesion, multidisciplinarity, problem orientation, global vision, training students, etc., our community shines. Regrettably, in Canada, these measures are not always applied when the health and the strength of a scientific community are evaluated. Take NSERC as an example. At the end of three successive evaluations, the now infamous reallocation exercises, the Grant Selection committees that marine scientists depend on for research support (Environmental Earth Sciences and Ecology and Population Dynamics) have arrived on the bottom in the internal ranking system – pecking order if you like – on which NSERC's funding decisions are based. In the most recent description of the Strategic Grants Program, NSERC did not include Marine Science in its criteria for eligibility. There is no reason to believe that any of this is deliberate or ill intentioned; more likely it reflects the lack of visibility of Marine Science within the larger Canadian science community. For example during a panel on research funding at a recent meeting about links with the University Corporation for Atmospheric Research (UCAR) with Canada, the NSERC representative said they like when there is a known body to represent a scientific community, so that NSERC can easily learn what a community is thinking, what are its unique characteristics, needs, etc. Additionally, funding decisions that affect marine scientists in the service of the government, for example the Department of Fisheries and Oceans, are also made on the basis of visibility and perceived importance. There is much to be gained if we can improve the visibility and image of marine science in Canada.

Canadian Meteorological and Oceanographic Society
La Société Canadienne de Météorologie et d'Océanographie

As for marine scientists being homeless, sporadic attempts have been made by CMOS, which seems to work well for Canadian physical oceanographers, to bring the broader marine science community into the fold. Congresses with appropriate foci have held successful interdisciplinary sessions. Other attempts have been less successful. Successful or not, these events have been one-shot deals – forgotten by the time the next congress came around – and have prompted remarks that the "**O**" in CMOS should be written in lower case.

If you feel that Canadian marine scientists need a place they can call their own, then we can start thinking of ways to accomplish it. One possibility is to create a new society, complete with name, acronym, constitution, bylaws, officers, secretariat, meetings, award system, budget, etc. This would be a serious undertaking, so before embarking on this path we have to consider alternatives. One alternative is to make a home for ourselves within CMOS, in effect raising the lower case "**o**" to the upper case.

Can it be done? It may require fundamental changes in the structure of CMOS to ensure that marine science is always represented at the highest level of the organization, but it can be done if the will is there. One could, for example, propose to reorganize CMOS into sections, one for atmospheric sciences and one for marine sciences, that would represent and be responsible for the well-being of their respective communities. They would share a

[1] Canadian National Committee/Scientific Committee on Oceanographic Research

secretariat and annual meetings. With strong support from their members, each section could speak for and make representations on behalf of their communities. The opportunities are endless.

The absence of a representative Canadian marine science organization has created a vacuum that has stifled the development of several worthy initiatives. In 1997, a NSERC funded meeting in St. John’s, Newfoundland, produced a report on the State of Canadian Marine Science. The document contained a lucid statement of the needs and aspirations of the community and concluded with a set of recommendations that are as valid today as when they were written nearly twenty years ago. Among them was a proposal to create a national infrastructure for marine science. The recommendations were never acted on because a mechanism for taking them to the highest level in government did not exist.

Much more recently, the Canadian Council of Academies chaired an expert panel on Canadian Ocean Science, and released in 2013 a report on Ocean Science in Canada. This report highlights the strengths of marine science within Canada. But it also points out a number of issues, many of which come back to the idea of a unified community with a strong national vision. For example, the following comments were all made in the executive summary of the report:

- “Canada’s dispersed network of clusters, however, can create challenges for certain kinds of collaboration, alignment of research strategies, and coordination and use of large-scale infrastructure investments.”

- “Ocean science capacity in Canada is thus not only geographically dispersed, but also distributed across a variety of organizations with diverse mandates and priorities. This adds another dimension to the challenge of coordinating activities and scarce ocean science resources across the country.”

- “The state of human capacity in ocean science cannot be determined because of data limitations. Due to its interdisciplinary character, ocean science draws on highly qualified personnel from many programs and departments, which makes human capacity one of the most challenging categories to assess. This is a particular concern, since human capacity determines the use and productivity of all other elements of ocean science capacity.”

- **“The vision gap**: In contrast to other countries, or other disciplines in Canada, no comprehensive national strategy or vision currently exists for ocean science in Canada. This makes it difficult to prioritize needs and comprehensively plan investments for ocean science.”

- **“The coordination gap**: Addressing the increasingly complex issues of ocean science requires enhanced collaboration at the local, regional, national, and international levels, and across disciplines and sectors. Despite the many instances of successful collaboration in Canada, coordination in key areas, such as ocean observation, is lacking, and support for research networks has often been constrained by temporary funding. More generally, there is no effective national-level mechanism to coordinate the allocation of resources and facilitate the sharing of infrastructure and knowledge among ocean scientists. This also hinders the sharing of resources and knowledge at the international level.”

- **“The information gap**: Limitations in access to, and availability and comparability of, information made it difficult to assess several categories of ocean science capacity (e.g., the number of active researchers, comprehensive data on research spending, or inventories of large instruments relevant to ocean science). While many actors in ocean science maintain inventories for internal use, no existing mechanism or repository systematically collects and regularly updates information on key research activities, infrastructure, and other capacities in ocean science for the entire country.”

The final paragraph from the executive summary of the Canadian Council of Academies report states “Ocean science in Canada is growing at a slower pace than other fields of science in Canada. Canada also has the lowest domestic growth index of the 25 leading countries in ocean science. This implies that ocean science is losing ground relative to other fields faster in Canada than in other countries, which could lead to a decline in Canada’s position in research output and impact.” This should be of concern to everyone working in marine sciences in Canada.

Our community has to be able to tackle challenges such as these, and a strong professional society could be an important step in the right direction. The Canadian SCOR committee is prepared to work on behalf of the community towards a representative Canadian professional organization for marine science, but only if **YOU** believe it needs to be done. We therefore solicit your opinion. You may let us know what you think in any way you like, from sending us a simple e-mail message saying **AGREE** or **DISAGREE**, to writing a letter for the Canadian Ocean Science Newsletter. We are eager to hear from you.

Please send your opinion to Michel Mitchell, Secretary of CNC/SCOR: michel.mitchell@dfo-mpo.gc.ca

Paul Myers, Chair, CNC/SCOR

Rob MacDonald, Past Chair, CNC/SCOR

Michel Mitchell, Secretary, CNC/SCOR

Note: First published in *Canadian Ocean Science Newsletter*, # 80, January 2015.

Please note that the English version precedes.

Une société canadienne pour les sciences de la mer (et aquatiques?) est-elle nécessaire?

Cette question a été posée, encore une fois, par l'exécutif de la Société, au cours du Congrès de la SCMO, à Rimouski, en 2014, et durant la réunion du Comité national canadien du Comité scientifique pour les recherches océaniques (CNC du SCOR). Après d'autres discussions, l'exécutif de la SCMO a demandé au CNC du SCOR de se pencher sur la question. Toutefois, les membres de ce comité ne croyaient pas pouvoir répondre à la question, au nom de la communauté, sans l'avoir consultée. Nous vous demandons donc ce que **VOUS** pensez de cette initiative.

Selon certains, la communauté canadienne des sciences de la mer est fragmentée et sans foyer. Elle est fragmentée, car cette communauté regroupe une gamme exceptionnellement large de disciplines scientifiques interreliées. Elle demeure aussi sans foyer en ce sens qu'il n'existe pas de société canadienne actuellement structurée pour accommoder toutes ces disciplines. En outre, ses travaux s'effectuent au sein de trois secteurs différents, comprenant les universités, les gouvernements et un secteur privé en pleine croissance, qui ne sont pas toujours sur la même longueur d'onde. Ainsi, bon nombre d'entre nous se sont résignés à présenter leurs travaux, et même à rencontrer leurs collègues canadiens, en participant à des congrès aux États-Unis et en Europe. Cette situation comporte des avantages et contribue à la grande renommée internationale dont jouissent les spécialistes canadiens des sciences de la mer. Néanmoins, comme nous avons tendance à ne pas présenter nos travaux dans le cadre de congrès canadiens, tout porte à croire que nos collègues canadiens des domaines connexes ne sont pas exposés à nos réalisations en sciences de la mer. Malheureusement, ce manque de visibilité au pays réduit notre capacité à obtenir des ressources.

La communauté des sciences de la mer est, bien entendu, « fragmentée » si on l'examine uniquement sur la base des disciplines traditionnelles. Il existe d'autres façons d'évaluer une communauté scientifique : dynamisme, cohésion, multidisciplinarité, recherche axée sur les problèmes, vision mondiale, formation des étudiants, etc. Et sur ces points, notre communauté excelle. Cependant, au Canada, on ne tient pas toujours compte de ces points quand vient le temps d'évaluer la force et la vitalité d'une communauté scientifique. Prenons le CRSNG, par exemple. Après trois évaluations successives (les fameux exercices de réaffectation des fonds), les comités de sélection des subventions desquels dépendent les spécialistes des sciences de la mer pour obtenir du financement de recherche (sciences de la Terre — environnement, écologie et dynamique des populations) se sont retrouvés au bas de la liste du système de classement interne, qui est à la base des décisions de financement du CRSNG. Dans sa dernière description du Programme des subventions stratégiques, le CRSNG n'a pas inclus les sciences de la mer comme critère d'admissibilité. Nous ne croyons pas que cette omission soit délibérée ou mal intentionnée. Elle refléterait plutôt le manque de visibilité des sciences de la mer au sein de la communauté scientifique canadienne. Par exemple, au cours d'une discussion sur le financement de la recherche, lors d'une réunion sur les liens entre la University Corporation for Atmospheric Research (UCAR) et le Canada, le représentant du CRSNG a mentionné qu'il préférait qu'un organisme connu représente les intérêts d'une communauté scientifique, de façon que le CRSNG puisse facilement sonder cette communauté et en connaître le caractère unique, les besoins, etc. De plus, les décisions relatives aux subventions qui touchent les spécialistes des sciences de la mer au service du gouvernement, au ministère des Pêches et des Océans, par exemple, sont aussi prises sur la base de la visibilité et de l'importance perçue. Il y a donc fort à gagner à améliorer la visibilité et l'image des sciences de la mer au Canada.

En ce qui a trait au regroupement des spécialistes des sciences de la mer, la SCMO a tenté à l'occasion de rassembler sous son égide la grande communauté de ces spécialistes, ce qui semble avantageux pour les spécialistes canadiens en océanographie physique. En ce sens, des congrès qui proposaient des thèmes pertinents ont inclus avec succès des séances interdisciplinaires. D'autres tentatives n'ont toutefois pas connu autant de succès. Fructueux ou non, ces événements représentent des cas isolés, oubliés sitôt le congrès suivant amorcé. Ainsi, certains ont fait remarquer que le "**O**" de « SCMO » devrait figurer en minuscule.

Si vous croyez que les spécialistes canadiens des sciences de la mer ont besoin d'une association bien à eux, nous pouvons amorcer une réflexion sur la façon d'y arriver. Il serait possible de créer une nouvelle société comptant un nom, un sigle, une constitution, des règlements, des dirigeants, un secrétariat, des assemblées, un système de récompense, une trésorerie, etc. Une telle entreprise nécessiterait des efforts considérables. Avant de nous lancer dans cette voie, nous devons examiner d'autres solutions. Il serait possible d'aménager une place aux sciences de la mer au sein de la SCMO et ainsi donner tout son poids au "**O**" majuscule du sigle.

Est-ce faisable? Cet ajout pourrait nécessiter des modifications fondamentales de la structure de la SCMO, afin de garantir que les sciences de la mer sont toujours représentées au plus haut niveau de l'organisation. Nous pouvons y arriver avec un peu de volonté. Nous pourrions, par exemple, réorganiser la SCMO en deux sections : l'une pour les sciences atmosphériques et l'autre pour les sciences de la mer. Celles-ci représenteraient leur communauté respective et seraient responsables de leur bien-être. Elles partageraient un secrétariat et la tenue d'événements annuels. En mettant à profit le fort soutien de leurs membres, chaque section pourrait représenter sa communauté et se prononcer en son nom. Les possibilités s'avèrent infinies.

L'absence d'une organisation canadienne représentant les sciences de la mer a créé un vide qui a miné le développement de plusieurs initiatives digne d'intérêt. En 1997, une réunion qu'avait financée le CRSNG à St. John's (Terre-Neuve) a produit un rapport sur l'état des sciences de la mer au Canada. Le document contient un énoncé lucide des besoins et des aspirations de la communauté. Il comprend une série de recommandations, qui restent aussi valides maintenant qu'elles l'étaient au moment de leur rédaction, il y a presque vingt ans. Il y est proposé de créer une infrastructure nationale pour les sciences de la mer. Ces recommandations n'ont jamais été mises en œuvre, car aucun mécanisme n'existait pour les faire valoir auprès du plus haut niveau du gouvernement.

Récemment, le Conseil des académies canadiennes a dirigé un comité d'experts sur les sciences de la mer au Canada. Il a publié, en 2013, un rapport à ce sujet. Ce rapport souligne les forces des sciences de la mer au Canada. Il soulève toutefois certains problèmes, dont nombre sont reliés à l'idée d'une communauté unifiée et dotée d'une vision nationale forte. Par exemple, les commentaires suivants figurent dans le sommaire du rapport :

● "Le réseau de grappes dispersées du Canada peut se révéler problématique pour certaines formes de collaboration, l'alignement des stratégies de recherche, et la coordination et l'utilisation des grands investissements en infrastructure."

● "Ainsi, non seulement les capacités en sciences de la mer au Canada sont-elles dispersées géographiquement, mais elles sont réparties entre une variété d'organisations ayant des priorités et des mandats différents. Cela ajoute une autre dimension au défi que pose la coordination des activités et des ressources limitées en sciences de la mer à travers le pays."

● "L'état de la capacité humaine en sciences de la mer ne peut être déterminé en raison des limites des données. [...] En raison de leur nature interdisciplinaire, les sciences de la mer font intervenir du personnel hautement qualifié provenant de nombreux programmes et départements, ce qui signifie que la capacité humaine constitue l'une des catégories les plus difficiles à évaluer. Cela suscite une préoccupation particulière du fait que la capacité humaine déterminera l'utilisation et la productivité de tous les autres volets de la capacité des sciences de la mer."

● "**Un manque de vision** : Contrairement à d'autres pays ou à d'autres disciplines au Canada, il n'y a pas de stratégie ou de vision nationale d'ensemble des sciences de la mer au pays. Cela rend difficiles une hiérarchisation des besoins et une planification minutieuse des investissements en sciences de la mer."

● "**Un manque de coordination** : Pour s'attaquer aux problématiques de plus en plus complexes des sciences de la mer, il faut pouvoir s'appuyer sur une meilleure collaboration aux niveaux local, régional, national et international, ainsi qu'entre les disciplines et les secteurs. Malgré de nombreux cas de collaboration fructueuse au Canada, la coordination dans des domaines clés comme l'observation océanique demeure insuffisante, tandis que l'appui aux réseaux de recherche a souvent été contraint par un financement temporaire. De façon générale, il n'existe pas de mécanisme efficace au palier national pour coordonner l'affectation des ressources et faciliter le partage des infrastructures et des connaissances entre les océanologues. Cela entrave aussi la mise en commun des ressources et des connaissances au niveau international."

● "**Un manque d'information** : Les contraintes liées à l'accès, à la disponibilité et à la comparabilité de l'information ont compliqué la tâche d'évaluer plusieurs catégories de capacités en sciences de la mer (par exemple le nombre de chercheurs actifs, des données détaillées sur les dépenses de recherche, ou des inventaires des gros instruments utiles en sciences de la mer). Bien que de nombreux intervenants en sciences de la mer tiennent des inventaires pour leur usage interne, aucun mécanisme ou registre existant ne recueille systématiquement et ne fait régulièrement la mise à jour des renseignements sur les activités de recherche, les infrastructures et les autres capacités importantes en sciences de la mer pour l'ensemble du pays."

Le dernier paragraphe du sommaire du rapport issu du Conseil canadien des académies affirme : "Au Canada, les sciences de la mer croissent plus lentement que les autres domaines scientifiques. Le Canada enregistre aussi le plus faible indice de croissance parmi les 25 premiers pays en sciences de la mer. Cela signifie que les sciences de la mer perdent plus rapidement du terrain que les autres domaines scientifiques au Canada sur les autres pays, ce qui entraînera à long terme un recul de la position du Canada au chapitre de la production et de l'impact de la recherche." Ce constat devrait préoccuper tous ceux qui travaillent dans le domaine des sciences de la mer au Canada.

Notre communauté devra pouvoir s'attaquer à ces défis. La création d'une société professionnelle forte constituerait un pas important dans la bonne direction. Le comité canadien du SCOR est prêt à travailler au nom de la communauté, afin de mettre sur pied une organisation professionnelle canadienne représentative des sciences de la mer, mais seulement si **VOUS** croyez que celle-ci est nécessaire. Nous sollicitons donc votre opinion. Vous pouvez nous signaler vos préférences de n'importe quelle façon, d'un courriel affirmant simplement "**d'accord**" ou "**pas d'accord**" à une lettre pour le *Bulletin canadien des sciences de l'océan*. Nous attendons impatiemment vos idées.

Veuillez envoyer vos commentaires à Michel Mitchell, secrétaire du CNC du SCOR : michel.mitchell@dfo-mpo.gc.ca

Paul Myers, président du CNC du SCOR

Rob Macdonald, président sortant du CNC du SCOR

Michel Mitchell, secrétaire du CNC du SCOR

Note: Première publication dans le *Bulletin canadien des sciences de l'océan*, # 80, Janvier 2015; traduit par la direction du *CMOS Bulletin SCMO*.

Canadian Authors win ASLI's Choice Award Honourable Mention

Ann McMillan

The book "*Air Quality Management: Canadian Perspectives on a Global Issue*", edited by Eric Taylor (BC Ministry of Environment) and Ann McMillan (Fisheries and Oceans Canada) and published by Springer Netherlands, won honourable mention at the recent meeting of the American Meteorological Society in Phoenix. This award was for bringing together expert views on many aspects of air quality management from a Canadian viewpoint. The award is presented annually by the Atmospheric Science Librarians International (ASLI) which presents awards for the best books of the year in the fields of meteorology, climatology, and atmospheric sciences. Criteria used to judge the books include: uniqueness, comprehensiveness, usefulness, quality, authoritativeness, organization, illustrations/diagrams, competition, and references.

Eric Taylor

The book resulted from a suggestion by Dr. Alan Gertler (Desert Research Institute) at a 2010 air quality conference in Vancouver that a Canadian perspective on air quality management would be of interest. The book, a three-year undertaking, contains 20 chapters written by leading experts on five main air quality topics: air pollution science, impacts of air quality, management of pollutant emissions, policy and planning, and communication of air quality information. A total of 45 lead authors and contributors volunteered their time to produce this unique Canadian book on air quality management. This group was drawn from universities in North America and Europe, the BC and Federal government, Metro Vancouver, Ville de Montréal, US government agencies and private industry.

The complete list of authors and contributors suggests the wide scope of the issues covered.

The book can be found at: http://www.springer.com/environment/pollution+and+remediation/book/978-94-007-7556-5

Next CMOS Congress in 2015

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

Tropics to Poles
Advancing Science in High Latitudes.

Plenary Speakers

• Kurt Salchert, Competing interests between national security planners, political decision-makers, industry, and academic stakeholders in the changing Arctic and polar regions

• David Battisti, *Recent decadal trends in the tropical Pacific and their impact on Antarctic and the Arctic*

• Garry Clarke, *Twenty-first century warming and the deglaciation of Western Canada*

• Nadja Steiner, *Marine biogeochemistry in the Arctic*

• Chris McLinden, *Eye in the sky: Monitoring air pollution from space*

• Elizabeth Barnes, Assistant Professor, Colorado State University, *The impact of Arctic warming on the midlatitude jetstream: Can it? Has it? Will it?*

• Mary-Louise Timmermans, *Arctic Ocean scales of variability and change*

• Marika Holland, National Center for Atmospheric Research, *Factors influencing the surface albedo feedback in coupled climate models*

• David B. Fissel, ASL Environmental Sciences Inc., Victoria BC Canada, *Canadian Arctic Oceanography: present and future research priorities based on lessons from the past*

Prochain Congrès de la SCMO en 2015

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

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

Conférenciers pléniers

• Kurt Salchert, Intérêts divergents des responsables des plans de défense nationale, des décideurs politiques, et des intervenants industriels et universitaires face à l'évolution de l'Arctique et des régions polaires

• David Battisti, *Tendances décennales récentes dans le Pacifique tropical et leurs impacts sur l'Arctique et l'Antarctique*

• Garry Clarke, *Le réchauffement au XXIe siècle et la déglaciation de l'ouest du Canada*

• Nadja Steiner, *Biogéochimie marine dans l'Arctique*

• Chris McLinden, *Du haut des airs : la surveillance de la pollution à partir de l'espace*

• Elizabeth Barnes, Professeure adjointe, Colorado State University, *La transformation du courant-jet des latitudes moyennes résultant du réchauffement de l'Arctique : est-ce possible? Est-ce fait? Est-ce à prévoir?*

• Mary-Louise Timmermans, *Échelles de variabilité et d'évolution de l'océan Arctique*

• Marika Holland, National Center for Atmospheric Research, *Facteurs agissant sur la rétroaction liée à l'albédo de la surface dans les modèles*

• David B. Fissel, ASL Environmental Sciences Inc., Victoria (C.-B.) Canada, *Océanographie de l'Arctique canadien : priorités de recherche présentes et futures selon les leçons apprises*

BOOK REVIEW / REVUE de LITTÉRATURE

The Thinking Person's Guide to Climate Change

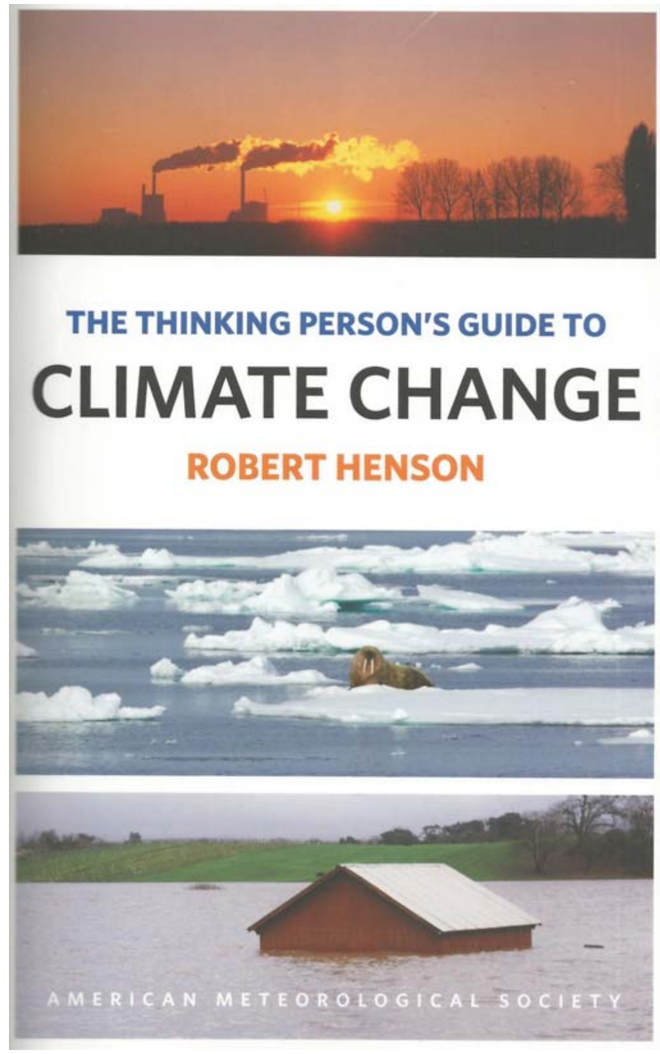
by Robert Henson

American Meteorological Society
ISBN 978-1-935704-73-7
2014, Paperback, xvii + 497 pages, US$35

Book reviewed by J.J.P. Smith[1]

Humanity's imperative in 2015, one that outstrips other global political issues including armed conflicts, refugee and migration problems, and a changing world economy, is the pursuit of acceptable and legally binding measures to control greenhouse gas (GHG) emissions and thereby slow the now-accepted effects of long term climate change. Only by a narrow margin can the human race expect to avoid calamity out of the fragile consensus that emerged from the 20th conference of the parties (COP) to the UN *Framework Convention on Climate Change* (the UNFCCC) held in Lima in late 2014. The result was an *agreement to agree* going into the pivotal 21st COP this year in Paris. The long delay to effective climate change reduction measures across the organized international community has largely been caused by negotiating dynamics among a large number of countries and the inherent limitations of state sovereignty and equality. No longer can scientific uncertainty and caution be considered a part of the glacially slow progress to realizing the UNFCCC's vital goals.

The American Meteorological Society has tangibly advanced the discussion of these matters with its recent publication of Robert Henson's *The Thinking Person's Guide to Climate Change.* The book is thoughtfully written and accessible; a first rate work that demands wide readership across society. This is the proper role of a national scholarly ocean-atmosphere science organization, namely the advancement of science and education of a public through high quality materials. Robert Henson is known to many as a long-time author on the staff of the U.S. National Center for Atmospheric Research. Those familiar with popular meteorological education will recall his *Weather on the Air: A History of Broadcast Meteorology* (2010). The *Thinking Person's Guide to Climate Change* follows his well received *The Rough Guide to Climate Change* (2010). It is a qualitative and comprehensive review of most aspects of science, the international politics, the leading scientific commentators, and measures to counter and adapt to climate change. The success of *The Thinking Person's Guide to Climate Change* lies in its two-fold synthesis of such issues and an engaging readability. Those looking for specific resources on the physics, climate modeling or thermodynamics of climate change, for example, should search elsewhere.



The book is organized into five parts: (i) the basics – global warming in a nutshell; (ii) the symptoms – now and in future; (iii) the science - "how we know what we know about climate change"; (iv) debates and solutions; and (v) what can you do? Several things convey its convincing (but not overly authoritative) tone, including the book's sheer length, the author's obvious knowledge of the subject, candid admissions of the limits of science and scientific uncertainty, and an attractive design presentation. Diagrams, photos, and graphs are evidently well selected, and the use of inset boxes for digressions into case studies and commentaries ("What makes the Arctic so vulnerable?", for example, and "Climate change and the cinema") make the entire book interesting. That the book is decidedly international in its viewpoint and case examples, and not that of an American

[1] McGill and Carleton Universities, and the Government of the Saharawi Arab Democratic Republic.

science academic, adds to its credibility.

In the three chapters that compromise the first part's descriptive review of climate change and global warming, Henson avoids complicated technical explanations. "But there's near unanimous agreement that global climate is already starting to change and that fossil fuels are at least partly to blame … the uncertainty that does exist has played both ways in the political realm." (p. 5). This part presents an efficient plan of the book, from casual understanding, to results (impacts), to steps to reverse climate change. A minor criticism is a too-brief mention of the relationship between stratospheric ozone depletion and climate change mechanisms. A complex phenomena with an attempt to explain that might lose a lay reader, the subject is a useful pedagogical device to illustrate the manifold impacts of human activity on the atmosphere.

The second part ("The Symptoms") occupies one-third of the book. Here, Henson chose issues of human interest which are impacted by climate change: extreme heat; floods and droughts; melting ice covered areas; oceans; hurricanes and other storms; and ecosystems and agriculture. More than a discussion of direct effects, the human costs of climate change are neatly woven together in this part. "Poverty is certainly a major co-factor in heat deaths across the developing world. A blistering two-month long heat wave in 2013 brought major suffering to hundreds of millions of people across eastern China …" (p. 75). (Something this reviewer experienced a year later while in Shanghai at a conference). Chapter 6, "The Big Melt", deals exclusively with the problems of a warming Arctic Ocean region, Henson noting that climate change is not yet a pronounced concern (at least comparatively) in the Antarctic ("Antarctica's ice sheet holds its own"). The illustration on page 119 that depicts the summer 2012 surface layer melting of Greenland's entire ice cap is sobering, reminding the reader of the immediacy of the problem. Sea level rise and changing ocean circulation (for example, a discussion of perturbations in Atlantic meridional overturning circulation) are adeptly treated in chapter 7. All the major recent seemingly climate change-linked ocean storms of recent years – Wilma, Rita, Katrina, Nargis, and Sandy to name some – are discussed in chapter 8. The prospective impacts of global warming and increased atmospheric carbon dioxide (CO_2) on the biosphere are surveyed in chapter 9. Much scientific research remains to be done in the assessment of climate change on agriculture, recalling the revelation in 2014 that increased CO_2 was not only changing temperature and agricultural cycles, but reducing the food quality of some crops. (See *e.g*. Samuel S. Myers *et al*, "Increasing CO_2 threatens human nutrition" *Nature* [May 7, 2014] 13179).

Part three ("The Science") is the educational core of *The Thinking Person's Guide to Climate Change*. Henson's determination to avoid descent into technical discussion is evident. How climate change (*i.e*. increasing atmospheric temperatures) are tracked (chapter 10), the geological timescale perspective of global temperature fluctuations (chapter 11), and how the future arc of climate change can be modeled (chapter 12) feature in this part. The secret of the scientist-climate change commentator lies in a credible interdisciplinarity. Henson carries this out in part four ("Debates and Solutions") with a review of the political, legal, social, economic, and technical contention about climate change that has so blocked progress. "Global warming politics didn't catch fire at first. For the most part, the topic remained in the scientific background until it became clear that the rise in greenhouse gases was real and serious." (p. 319). The discussion of the events and interests that continue to animate public debate is up to date (Henson reviews the popular understanding, for example, of "Supertyphoon" Haiyan in 2013 as climate change exacerbated). This part might have benefited from a more detailed insight into the working of the UNFCCC – the administration of climate change regulation, so to speak – and some comparison of national political cultures. However, that would add to a work already just the right length and which had to leave room for the description of emissions control targets. Chapter 15 is a long exegesis about political solutions ("Kyoto and beyond") that alone should be read as we contemplate COP 21 in Paris. In chapter 16, the book turns to a review of technical solutions and we are here reminded of the limits of human ingenuity in the face of still-increasing uses of fossil fuels over the coming decades.

In part five ("What can you do?") Henson has ensured a wide readership for his book with a thoughtful review of social measures to arrest climate change. His *leitmotif* is the concept of the carbon footprint, a useful rationalizing device for individual action. "Just as new dieters often keep a food diary, an excellent way to start reducing your emissions is by using carbon calculators." (p. 439). The topics of home energy, transport and travel, consumer uses ("shopping"), and carbon offsetting get good treatment here. A discussion of energy efficient building design would have been beyond the scope of the book. Two other modest omissions given their coming salience in national schemes for GHG reduction might have been presented here: carbon taxation (although mentioned earlier) and ethical investing for climate change.

The Thinking Person's Guide to Climate Change is an impressive work, timely and comprehensive in its range of discussion. It is a useful resource for those in earth, environmental and (of course) ocean-atmosphere science, meteorologists, policy-makers, and educators. The book has obvious utility as a text and also as social commentary discussion vehicle. In an age of the immediate availability of internet resources, Robert Henson's book reminds us of the epistemic importance of well-written books of scientific commentary.

Double-Diffusive Convection

par Timour Radko

Cambridge University Press, ISBN 978-0-521-88074-9, Hardback, 342 pages, $125,95.

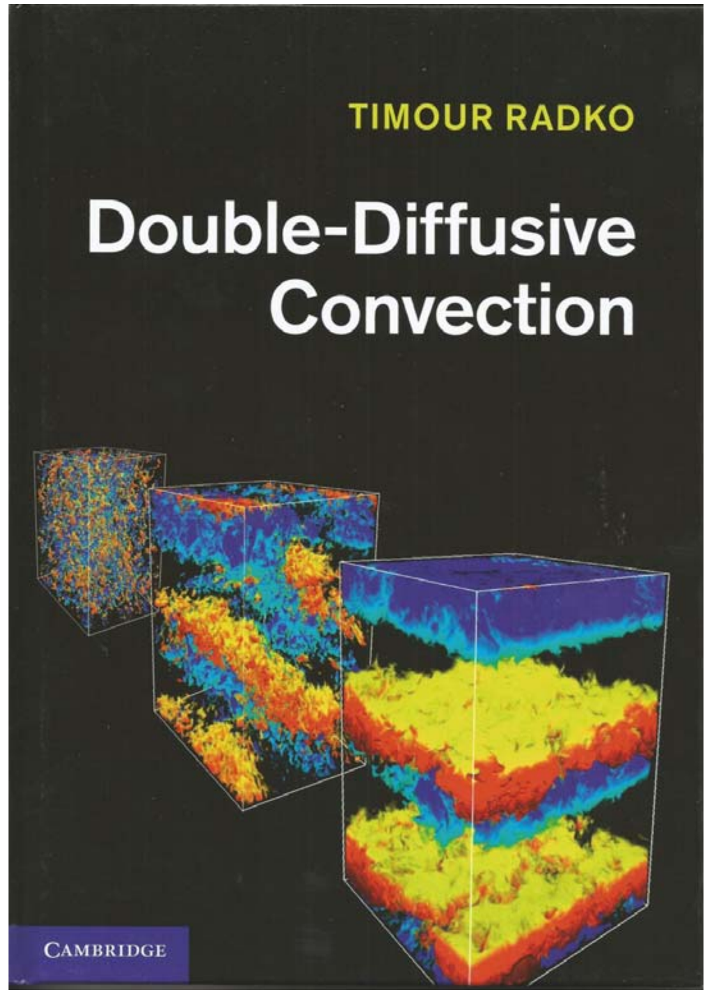
Critique: André April[2]

La convection à double-diffusion est l'un des sujets de la dynamique des fluides les plus intrigants et la manière dont elle a été découverte est l'une des plus inhabituelle. Elle opère d'une façon contre-intuitive; le processus de mélange qui fait qu'un fluide dense devient plus dense et qu'un fluide léger plus léger est conduit par la différence de la diffusivité moléculaire de la chaleur et du sel.

Ainsi, même si un système possède une densité qui augmente vers le bas, de l'instabilité est possible si la densité est contrôlée par la température et la salinité diffusant à des taux différents. Dans l'océan, la température diffuse 100 fois plus rapidement que la salinité et plusieurs régions de l'océan sont des candidats potentiels à de l'instabilité par double-diffusion. Il existe deux formes d'instabilité par double-diffusion, référées comme étant «salt fingers» et «diffusive convection».

Supposons qu'un fluide possède un gradient vertical positif de température et de salinité, mais que le gradient de densité total est négatif, i.e. stratifié de façon stable, comme dans le cas de la configuration d'une couche chaude et salée au-dessus d'une couche froide d'eau plus douce. Lorsqu'une parcelle de la couche supérieure est plongée vers le bas, celle-ci acquiert une flottaison plus grande que l'environnement de la couche inférieure, et tend normalement à remonter vers le haut avant d'atteindre le niveau d'équilibre. Par contre, dans le cas où la diffusion de la température est suffisamment supérieure à la diffusion salée plus faible, la parcelle de fluide plongée vers le bas, et par la suite devenue en équilibre avec son environnement reste encore plus salée que cet environnement, donc possède moins de flottaison et ainsi continuera à chuter sous l'effet de la gravité. Ce processus forme des chutes de filaments salées dans le fluide, appelé communément «salt fingers».

Supposons maintenant qu'un fluide possède un gradient vertical négatif de température et de salinité, mais que le gradient de densité total soit stratifié de façon stable, comme dans le cas de la configuration d'une couche froide d'eau plus douce au-dessus d'une couche chaude et salée. Lorsqu'une parcelle de la couche supérieure est plongée vers le bas, celle-ci absorbe par diffusion de la chaleur via son nouvel environnement et retourne dans la couche supérieure, causant une instabilité sous forme d'oscillation. Ce processus est appelé communément «diffusive convection».



Le volume est constitué de trois parties distinctes. La première partie (chapitre 1 à 5) présente la théorie fondamentale de la convection à double-diffusion pour un non-expert ayant une connaissance des sciences physiques. Le chapitre 1 ouvre le sujet sur la dynamique de la double-diffusion, son histoire et sa découverte. Le chapitre 2 fait un sommaire de la théorie linéaire d'instabilité et son échelle spatiale et temporelle pour cette situation. Même si celle-ci s'opère sur une échelle de quelques centimètres, elle affecte le développement des flux verticaux de température et de salinité sur une beaucoup plus grande échelle. Les chapitres suivants concernent les formulations des flux verticaux dépendant de la géométrie du milieu. Par exemple un milieu sans frontières aux extrémités (chapitre 3), un milieu avec une interface médiane créant un système à deux couches (chapitre 4), enfin un milieu avec frontières aux extrémités (chapitre 5). Pour chacune des situations on compare le résultat analytique avec les observations, les résultats en laboratoire, et la modélisation numérique. Les meilleurs

[2] Service Canadien des glaces, Environnement Canada, Ottawa, ON.

résultats obtenus de double-diffusion sont ceux du milieu sans frontières aux extrémités. Même s'il existe encore des incertitudes dans la formulation des flux, ils sont toujours la clé des modèles paramétriques.

La seconde partie du volume se concentre sur les structures résultant de l'instabilité de la double-diffusion. Le premier cas (chapitre 6) traite de l'excitation des ondes de gravité par un champ homogène et complètement développé de filaments salés. Des expériences en laboratoire ainsi que des simulations numériques directes DNS (Direct Numerical Simulation) semblent confirmer ce cas. Le second cas étudié est les intrusions thermohalines. La génération de structure intrusive horizontale à travers des fronts latéraux de température et de salinité dans un fluide à double-diffusion (chapitre 7) est observée de plus en plus fréquemment dans les divers océans du monde. Il existe tout de même une liste encore incomplète de considération dont on doit tenir compte avant que théories et observations soit en accord. Enfin, dans le chapitre 8, on étudie la structure spectaculaire en escalier de la thermohaline «thermohaline staircases». Elle consiste en des couches remarquablement homogènes et régulières dans les profils verticaux de température et de salinité. Même si ces couches de mélange peuvent atteindre l'ordre du mètre, elles sont créées et maintenues par double-diffusion opérant sur l'échelle du centimètre. Après une discussion sur les observations océanographiques et un sommaire des diverses hypothèses de leur origine, l'auteur expose les différents modèles conceptuels connue jusqu'à ce jour. Cela en fait le chapitre le plus intéressant du volume par son contenu très actuel sur la recherche faite dans les régions nordiques, par exemple. On peut compléter la lecture avec l'article récent de Scheifele *et al*. «Double Diffusion in Saline Powell Lake, British Columbia», JPO novembre 2014, pour le côté observationnel par exemple ou la lecture sur la présence de structure en escalier dans la thermocline du Canada Basin, Timmermans *et al*. «Ice-Tethered Profiler observations of the double-diffusive staircase in the Canada Basin thermocline», JGR vol.113, 2008.

La discussion suivante s'intéresse à l'impact des forçages environnementaux océaniques comme le cisaillement, la turbulence sur les «salt fingers». On est intéressé ici à valider l'idée que la double-diffusion est un processus effectif de mélange des masses d'eau malgré les forçages environnementaux perpétuels. Le chapitre 11 souligne l'intérêt relativement nouveau et de plus en plus intéressant des conséquences du mélange suite à la double-diffusion du point vue climatique et biologique. Pour terminer, on étend l'idée de double-diffusion étudiée en océanographie au domaine de l'astrophysique principalement; on appellera la double-diffusion dans ce cas semiconvection. Ce phénomène pourrait jouer un rôle fondamental dans la dynamique et l'évolution des étoiles massives et planètes géantes. Je laisserai donc le soin aux astrophysiciens de nous expliquer plus en détail les conséquences relatives due à la semiconvection.

Enfin, il faut mentionner l'apport important joué par Melvin Stern dans l'étude de la double-diffusion, aussi bien du point vue conceptuel que théorique, ce que l'auteur n'hésite pas à nous rappeler. Le volume est une ressource essentielle aux chercheurs, professionnels et étudiants gradués qui s'intéressent à la double-diffusion de par son aspect théorique, observationnel et expérimental. Ce volume m'a permis d'approcher la littérature scientifique dans ce domaine; ce qui autrement m'aurait paru trop complexe pour que je m'y attarde. Ainsi, cet ouvrage me paraît donc indispensable maintenant.

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

Latest Books received / Derniers livres reçus

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

2014-5) *An Introduction to Ocean Remote Sensing*, by Seelye Martin, 2nd Edition, 2014, Cambridge University Press, 978-1-107-01938-6, Hardback, 496 pages, $88,95.

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

2015-2) *Climate Conundrums, What the Climate Debate Reveals About Us*, by William B. Gail, Published by American Meteorological Society and distributed by the University of Chicago Press, ISBN 978-1-935-70474-4, Paperback, 235 pages, US$30.00.

2015-3) *An Observer's Guide to Clouds and Weather, A Northern Primer on Prediction*, by Tony Carlson, Paul Knight, and Celia Wyckoff, American Meteorological Society and distributed by the University of Chicago Press, ISBN 978-1-935-70458-4, Paperback, 210 pages, US$30.00.

IN MEMORIAM

Howard L. Ferguson

1930 - 2015

Howard L. Ferguson in 1986

On January 17, 2015, Howard Ferguson passed away peacefully at Sunnybrook Hospital in Toronto. Howard will be missed by his wife Janet, his five sons and eleven grand-children.

Born in 1930 in Guelph, Ontario, Howard Ferguson obtained his BA in Mathematics and Physics from University of Western Ontario in 1952, and then joined the Meteorological Service of Canada (MSC), completing the Introductory Course in Meteorology (#7) the following year. After the course, he worked as a meteorological officer / weather forecaster at RCAF Station Trenton but soon returned to university (Toronto) to complete an MA in meteorology in 1955. Howard then was posted as a meteorologist / forecaster in Gander NL followed by Ontario Weather Centre at Toronto Airport. About 1960, he became an instructor with Training Branch of MSC where he taught applied meteorology for seven years.

In 1966, Howard joined the Hydrometeorology Section, Climatology Division as Head of the Special Projects Unit. Initially, Howard's Unit focused on MSC's contributions to the UN International Hydrologic Decade (IHD), from 1965 to 1974. Regional offices helped to instrument some 60 small river basins, for baseline and research work, with the Water Survey of Canada, Canadian Forest Service and provinces. Howard's Unit oversaw this activity and subsequently published most of the hydromet research results, as well as research on other IHD projects such as formation of anchor ice in the Niagara River which impeded power production.

With the creation of Environment Canada in 1971, MSC became the Atmospheric Environment Service (AES). Howard became chief of Hydrometeorology and Environmental Impacts Research Division and later Director of Air Quality and Envionmental Processes Branch in the Atmospheric Research Directorate. In this capacity, he began to assume increasingly important roles in the scientific / policy issues of acid rain and climate change. A bibliography in 1977 listed 484 papers and publications in hydrometeorology by his staff and by others in closely related areas, many written by or involving Howard. The results had a very positive influence on improving management of Canada's inland waters.

On acid rain, Howard was a member for Canada of the key working group on Strategies Development and Implementation under the 1980 Memorandum of Intent with USA on transboundary air pollution, and later led for Canada, atmospheric transport and deposition studies. These made significant contributions to the later Canada-USA Agreement to control emissions causing acid rain.

When he became Assistant Deputy Minister (ADM) of AES (1986-1989), Howard's experience led to major contributions in understanding climate change. He had participated in the 1985 landmark Villach Conference on greenhouse gases and climate change. In June 1988, he mobilized AES staff and the Canadian government, up to Prime Minister Mulroney, for the major international conference in Toronto, ***The Changing Atmosphere***. Stephen Lewis was general Chair, Prime Minister Bruntland of Norway attended, and then Minister of Environment Tom McMillan was assisted by a young Elizabeth May, giving this conference substantial political support. It was held in the midst of a central North American heat wave, so most of the attention was drawn to climate change. The Conference also dealt with acid rain, ozone layer depletion, and air pollution. The **Conference Statement** (see Note 2, below) made the first international call for greenhouse gas emission reductions, by 20% of 1988 levels before 2005. Howard subsequently represented Canada at the first two meetings of the Intergovernmental Panel on Climate Change (IPCC). For this excellent work, Howard received the Public Service of Canada Merit Award.

Howard retired from AES in 1989 after 37 years of dedicated work in public service. However, he was soon recruited by World Meteorological Organization (WMO) to organize the 1990 Second World Climate Conference in Geneva. Judging by the number of demonstrators carrying signs that labelled world leaders as climate criminals, it was a major success. The scientific sessions, in which 700 scientists endorsed IPCC's first report, was followed by a political event. This featured Prime Minister Margaret

Thatcher (UK), King Hussein (Jordan), and other world leaders. They called for an international agreement to control greenhouse gas emissions. The ensuing Agreement, the UN Framework Convention on Climate Change was signed in Rio (1992) by more than 180 countries.

Howard Ferguson was author or co-author of more than 80 publications and continued to publish more scientific works after leaving public service following the Second World Climate Conference. These included: *Recollections of Hydrometeorology in Canada's Meteorological Service*, 2006. In retirement, he and Janet lived in a rural Ontario country home where he enjoyed his hobbies of photography and music, as well as his continuing interest in atmospheric science. In recent years, he resided at Delmanor Northtown, Toronto, where he invited speakers and organized sessions on computing and meteorology for the residents.

Howard Ferguson, in these many ways, made major contributions in Canada and internationally. His wife Janet, was an important support for him in these endeavours. The meteorological community has lost a scientist and leader of whom we could all feel justifiably proud.

Endnotes:

1. Above with the valuable contribution of *James P. Bruce* and *Bob Jones*.

2. Readers may go to:

http://tinyurl.com/ChangingAtmosphere

to see Howard's personal photos of the ***Changing Atmosphere Conference*** and a link to the Conference Statement, courtesy of WMO.

3. Many other photos of Howard can be easily found in the CMOS Archives at:

http://www.cmosarchives.ca/Metphotos/photoindex.html

by simply entering "Howard L Ferguson" in the search box.

4. CMOS members may also read "*Reflections on the 1988 Toronto Conference on Our Changing Atmosphere - 25 Years Later*", by H.L.Ferguson, *CMOS Bulletin SCMO*, Vol.41, No.5, pages 162-164, and "*Twentieth Anniversary of the Toronto Conference on Our Changing Atmosphere: Implications for Global Security",* by H. L. Ferguson, *CMOS Bulletin SCMO*, Vol.36, No.5, pages 159-161.

Teresa Anne Canavan

1955 - 2015

Teresa Anne Canavan

Teresa Anne Canavan of Bedford, Nova Scotia, passed away in the Victoria General Hospital, Halifax, on March 1, 2015. She was born in Halifax on April 18, 1955 and grew up with her family in Mount Uniacke with special attachments to Hillsvale, Halifax, and Peggy's Cove. After completing school she tried a variety of things and got a job as an upper air technician with Environment Canada on Sable Island where she lived for a few months and sent up weather balloons. To escape isolation, she returned to university to complete a science degree and was the first woman to obtain a Diploma of Meteorology from Dalhousie University. She worked as a weather forecaster for several years before returning to university for her Masters Degree in Atmospheric Science from Dalhousie and was the first woman to complete this degree. This led her to a day job rather than shiftwork. She was very interested in organic gardening, nutrition, and physical activity.

Teresa has been involved in CMOS activities in several ways. Teresa joined the CMOS Halifax executive in March 2001. She was chair from June 2003 to September 2006 and past chair until June 2009. She also attended 2005, 2009, and 2012 CMOS congresses.

She enjoyed social bicycle rides, downhill skiing, skating and swimming particularly at the ocean beaches. She loved music and took some voice lessons later in life. She lived in a small house on Fletcher's Lake for several years where she enjoyed having gatherings of family and friends and songs around the piano. As well, she developed an interest in genealogy begun by her younger sister. She was devoted to her parents, Maynard and Mary, who predeceased her. She is survived by her sister Betty (Bert) Hartnell, Dartmouth; brother Michael (Susan), Fall River; sister Bernadette (Ian) Williams, New Zealand; three nieces, four nephews, one great-niece, and two great-nephews.

BRIEF NEWS / NOUVELLES BRÈVES

New PICES Executive Secretary Mr. Robin Brown

After almost 30 years in Department of Fisheries and Oceans (DFO) and more than 15 years as the Division Manager of the Ocean Sciences Division of DFO at the Institute of Ocean Sciences, Robin Brown is leaving DFO to take up the position of Executive Secretary of PICES, the North Pacific Marine Science Organization (http://www.pices.int), effective February 23, 2015.

The two co-editors, Savi and Paul-André, along with all the members of the CMOS community, wish Robin all the success in his new role as Executive Secretary of PICES. We are certain that Robin will bring to PICES the same leadership, dedication, and sense of humour as he has done with DFO during his distinguished career. Robin replaces Dr. Alex Bychkov who has served PICES as its Executive Secretary since 1999 and has overseen the maturation of PICES as an organization. CMOS members would like to express their appreciation to Alex for his invaluable contribution to PICES and, through this organization, to the wider ocean science community.

About PICES

The North Pacific Marine Science Organization (PICES), an intergovernmental scientific organization, was established in 1992 to promote and coordinate marine research in the northern North Pacific and adjacent seas. Its present members are Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America. The purposes of the Organization are as follows:

- Promote and coordinate marine research in the northern North Pacific and adjacent seas especially northward of 30 degrees North.

- Advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities.

- Promote the collection and rapid exchange of scientific information on these issues.

About Robin Brown

Robin Brown was born in Vancouver, British Columbia, and grew up on the water. During his early years, he and his family spent weekends and vacations traveling up and down the inner coastal waters of the BC coast. In his high school and university years, he became deeply involved in sailboat racing in all kinds of craft from high performance dinghies to offshore racing yachts, culminating in an appointment to the National Sailing Team.

Mr. Robin Brown

Robin attended the University of British Columbia, graduating with a degree in marine biology. In his final year, he was hired by Prof. Tim Parsons as a Research Assistant to assist in operations at the Controlled Ecosystem Pollution Experiment (CEPEX), a large plankton mesocosm facility on the site of the Institute of Ocean Sciences (IOS) in Sidney, BC. This was his first exposure to international science, as the facility hosted investigators from Canada, USA, Japan, Germany, and the United Kingdom.

At the conclusion of the CEPEX project, Robin went to work for a local oceanographic consulting company, carrying out projects in optical remote sensing, physical oceanography and chemical oceanography in diverse Canadian locations, including Newfoundland and the Canadian Arctic. In 1985, he was hired by Dr. Ken Denman into the Department of

Fisheries and Oceans at IOS as a Multidisciplinary Oceanographer. In 1992 he transitioned to the position of Oceanographic Data Manager. In this position, he undertook his first PICES appointment as the first Chairman of the Technical Committee on Data Exchange (TCODE) and has attended every PICES Annual meeting since 1995.

Since 1999, Robin has been Manager of the Ocean Sciences Division of DFO at IOS, responsible for a research group of up to 70 physical, chemical, and biological oceanographers conducting research in the North Pacific and the Arctic. In this period, he also served on a number of PICES expert groups and committees, including TCODE, Science Board, FUTURE Advisory Panel on *Status, Outlooks, Forecasts and Engagement*, the Finance and Administration Committee, and the Governing Council.

In 2012, he was appointed as co-chair of a Canadian Federal-Provincial interagency working group to assess potential impacts of debris resulting from the 2011 Tohuko earthquake and tsunami. In 2013, he was appointed as the lead Canadian Commissioner to the North Pacific Anadromous Fish Commission.

Robin and his wife, Leslie (also a biological oceanographer and a graduate student of Prof. Tim Parsons), live a short distance from the PICES Secretariat at IOS. This allows him to commute by bicycle year-round, which is normal in southern coastal BC, but rare in the rest of Canada. Robin and Leslie are "empty-nesters" with three adult children living in Victoria, Calgary, and Kalamazoo, Michigan (USA).

Journée mondiale des océans est le 8 Juin

Santé des océans, planète saine

Journée mondiale des océans est la journée reconnue par l'Organisation des Nations Unies de la célébration de l'océan et de l'action. Les gens partout dans notre planète bleue organisent fêtes - qui peut être un grand événement dans votre communauté, une annonce spéciale, ou quelque chose entre - pour soutenir l'action pour protéger l'océan. Cette année, le thème est la santé des océans, planète saine, et nous faisons un effort particulier pour arrêter la pollution plastique.

World Oceans Day is June 8th

Healthy oceans, healthy planet

World Oceans Day is the United Nation's recognized day of ocean celebration and action. People all over our blue planet organize celebrations – which can be a huge event in your community, a special announcement, or anything in between – to support action to protect the ocean. This year, the theme is healthy oceans, healthy planet, and we're making a special effort to stop plastic pollution.

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Pollution Control and Water Technology

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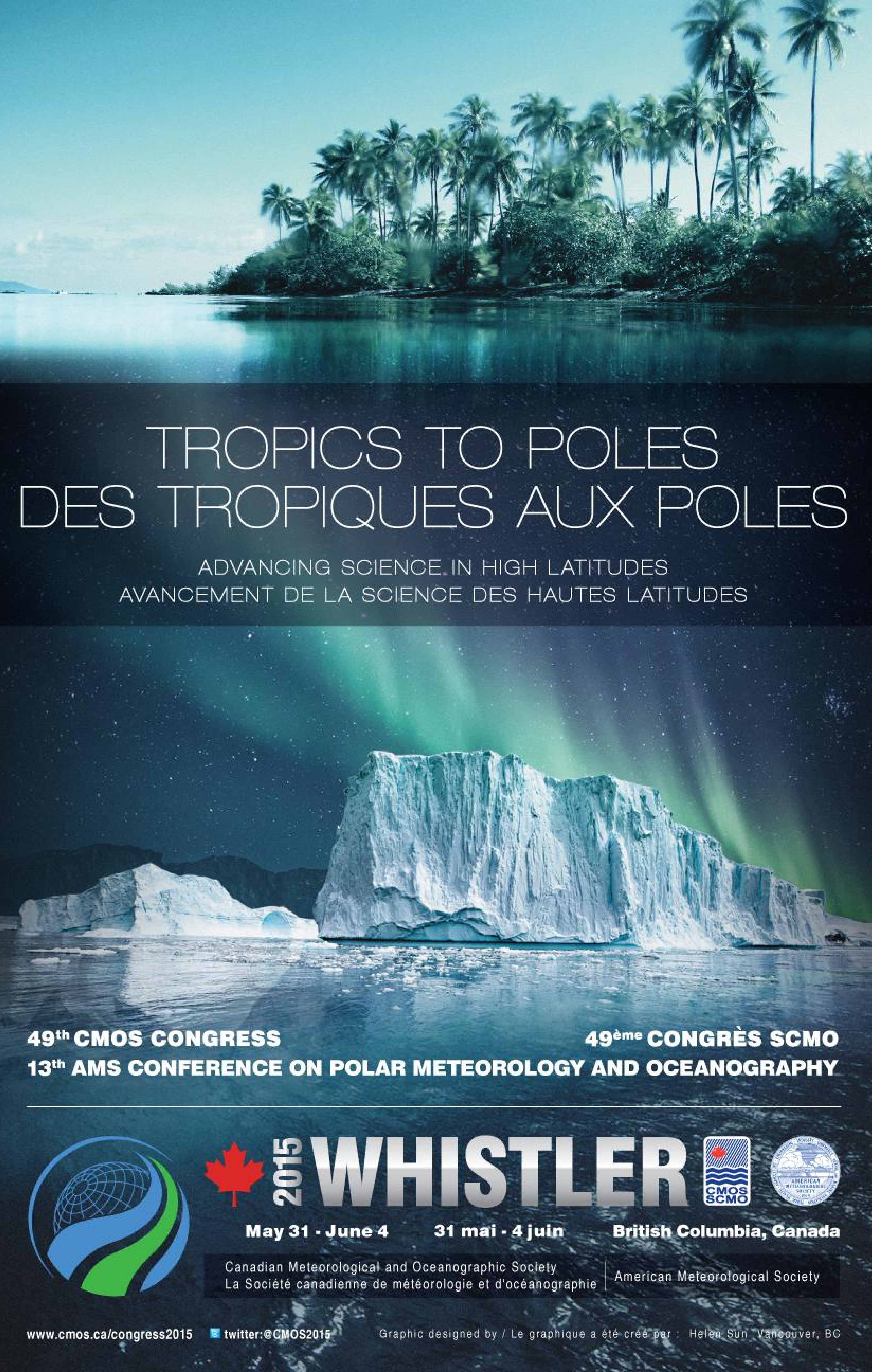
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ADVANCING SCIENCE IN HIGH LATITUDES
AVANCEMENT DE LA SCIENCE DES HAUTES LATITUDES
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