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Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

June / juin 2011 Vol.39 No.3

Numerical Simulation of the Tohoku tsunami (11 March 2011) propagating into Juan de Fuca Strait

Simulation numérique du tsunami Tohoku (11 mars 2011) se propageant dans le détroit Juan de Fuca

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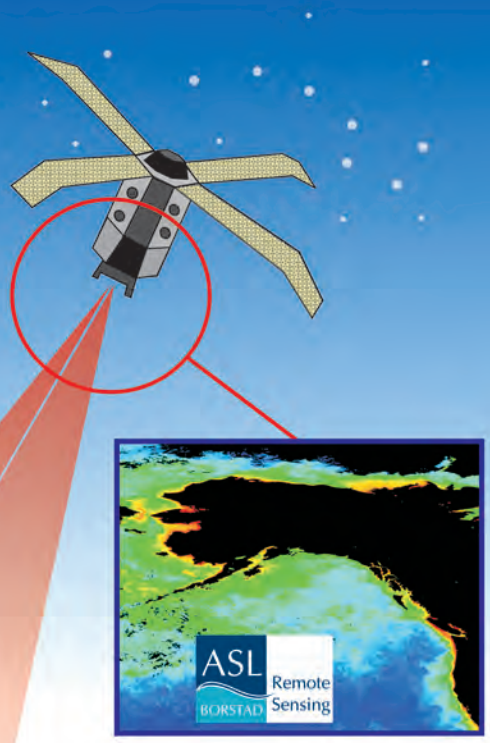

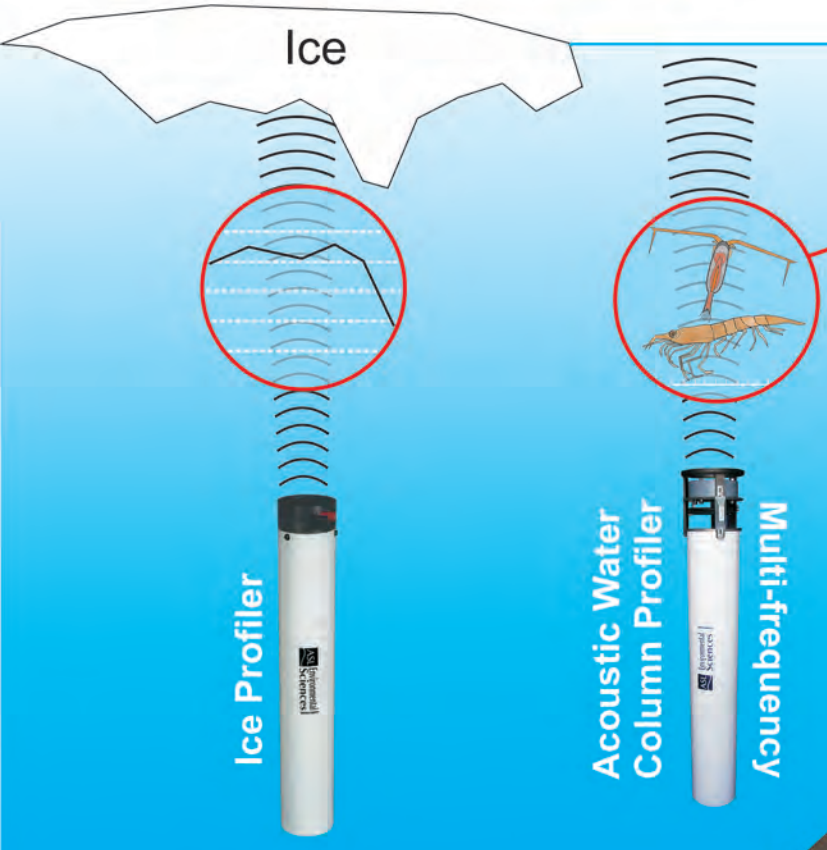

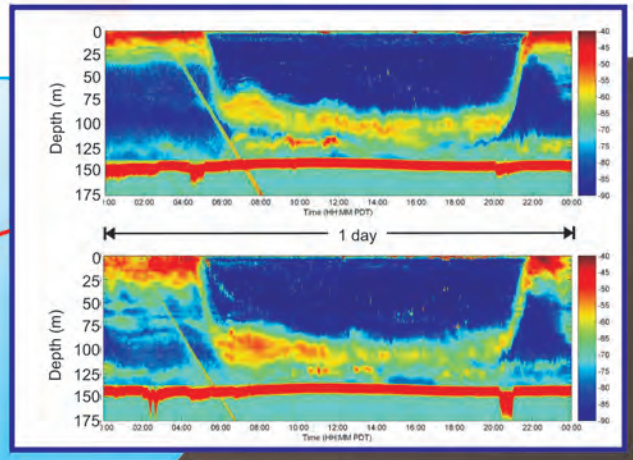

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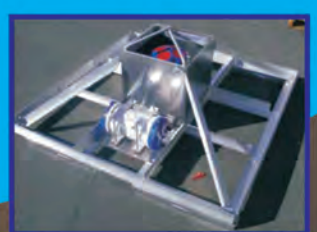

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....from the Presidents' Desks

Friends and colleagues:

David Fissel
Outgoing CMOS President
Président sortant de la SCMO

This issue of the *CMOS Bulletin SCMO* will arrive just as 45th Annual CMOS Congress gets under way in Victoria B.C. Our Annual Congress promises to be a busy week and a great time to learn from the hundreds of papers presented and through the many other events being held. Our congress chairs, Nathan Gillett and Bill Merryfield, along with the dozens of volunteers and CMOS staff are making this Congress into a memorable one for CMOS.

In late May of 2012, the CMOS Congress will move to Montreal under the leadership of Louis Lefaivre, Local Arrangements Committee Chair and Pierre Gauthier, Scientific Program Committee Chair. The 46th Annual CMOS Congress will be conducted jointly with the 25th Conference on Weather Analysis and Forecasting and the 21st Conference on Numerical Weather Prediction organized in cooperation with the American Meteorological Society.

A year has passed by since I took on the role of President of CMOS in June of 2010 in Ottawa. The year has been a very rewarding experience with CMOS becoming stronger with improved financial reserves, a vibrant membership base, a wide range of successful program activities, and an impetus for change and growth for our scientific journal ***Atmosphere-Ocean***.

I will pass the President's gavel to Vice-President Norm McFarlane during the CMOS evening Banquet at the Victoria Congress, as part of a tradition going back to the beginnings of CMOS. I would like to thank our CMOS Executive over this past year including Norm, Past President Bill Crawford, Recording Secretary Sophie Johannessen, Corresponding Secretary Jane Eert and Treasurer Rich Pawlowicz, as well as our councillors-at-large Kent Johnson, John Parker and Charles Lin for their exemplary efforts over this past year.

(Continued on page 83 / Suite à la page 83)

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Inside / En Bref

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

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

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Cover page: The figure on the cover page is from a numerical simulation of the Tohoku tsunami (11 March 2011) for the West Coast of Canada at the time when the tsunami began propagating into Juan de Fuca Strait. Circles denote offshore bottom pressure recorders; squares denote tide gauge stations. To learn more please read the article by Thomson et al. on **page 85**.

Page couverture: L'image en page couverture a été produite à partir d'une simulation numérique du tsunami Tohoku (11 mars 2011) pour la côte Ouest du Canada lorsque le tsunami commence à se propager dans le détroit de Juan de Fuca. Les cercles indiquent les instruments de mesure de pression au large, en profondeur; les carrés indiquent l'emplacement des stations de mesure de la marée. Pour en apprendre plus, prière de lire l'article de Thomson et coll. en **page 85**.

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....from the Presidents' Desks (Continued / Suite)

Norm and Peter Bartello, of McGill University, our nominee for Vice-President, will lead us towards a transition in the location of the National Executive from Victoria to Montreal by mid-2012. Sophie, Jane, Rich and I will continue on the executive for one more year and we will be joined by new Councillors at Large Denis Gilbert and Kim Strong. Finally, my special thanks go to my predecessor as president, Bill Crawford, (presently Past President) along with John Parker and Kent Johnston, who will depart the executive in June.

And now, over to Norm McFarlane….

David Fissel,
Outgoing President / Président sortant

Dear Friends and Colleagues

Norman McFarlane
Incoming President CMOS
Nouveau président de la SCMO

Over the last year of participating in activities and actions of CMOS as Vice President I have had a "front-row" view of the demands and challenges that the President must face. I am pleased to thank David Fissel for his efforts and achievements in serving as CMOS President. David has served CMOS with wisdom and dedication that I can only aspire to emulate in the coming year. I will certainly need to rely on his advice and insights in his role as Past President. I echo David's thanks to Bill Crawford for his contributions in that role over the past year and add that I have also benefited from Bill's mentoring in learning and preparing for the challenges of being President of CMOS.

Being Vice-President has also given me a new appreciation of the profoundly important role of the Executive Office in the life of CMOS. It is very reassuring to know that we can continue to rely on the experience and dedication of Ian Rutherford as Executive Director and Richard Asselin as Director of Publications. Ian's wise advice and direction are critical underpinning for decisions and actions of the CMOS Executive and Council. In addition, he capably represents CMOS and acts on our behalf in a wide range important discussions and interactions with other institutions, agencies, professional and learned societies.

During the past year Richard has provided critical supervision and support for the successful transition of the publication of *Atmosphere-Ocean* to the Taylor and Francis publishing firm. He is now spear-heading efforts to increase the numbers of manuscripts submitted for publication and the impact of *Atmosphere-Ocean.* This is an important effort that will also engage my attention during the coming year. Under the capable editorship of Paul-André Bolduc, the *CMOS Bulletin SCMO* continues to be an excellent and informative publication featuring interesting, high quality contributions.

I have come to appreciate Qing Liao's quick, helpful, and courteous responsiveness as the Office Manager. Bob Jones continues to provide dedicated service as the CMOS Webmaster. CMOS could not function, let alone continue to be a vital Society, without the dedicated and able service provided by the Executive Office.

I am looking forward to working with my long-time friend and colleague, Peter Bartello, nominee for CMOS Vice President. I am also anticipating the continued pleasure of working with executive members Rich Pawlowicz, Jane Eert, Sophia Johannessen, and Charles Lin and with newly nominated Councillers-at-Large, Kim Strong and Denis Gilbert.

In the coming year CMOS will be engaged with some issues of great importance to members and their professional and academic communities. One of these is the impact that may be associated with the expiring of Federal Government support of the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS). Over the past ten years CFCAS has been Canada's leading agency for supporting university-based research on weather and climate. During this period CFCAS has enabled many notable leading edge research activities to flourish in Canada.. CMOS is the founding member of CFCAS and has some CFCAS governance responsibilities as well. Many CMOS members, as well as their national and international colleagues, have been involved in CFCAS-funded projects and activities. The vital role that CFCAS has played in Canadian research is in jeopardy if its mandate is not renewed or replaced by an equivalent source of reliable and sustained funding.

As I write this column, preparations are nearing completion for the CMOS 2011 Congress in the Victoria Conference Centre. With the excellent local arrangements and an exciting program, this promises to be another outstanding CMOS Congress. I echo David's thanks to Nathan Gillett and Bill Merryfield and their colleagues in the Local Arrangements Committee and the Scientific Program Committee, as well as the large number of

dedicated volunteers who are working to make the Congress a success. I am looking forward to seeing a large number of you, readers of the *CMOS BulletinSCMO*, in Victoria in June!

Norman McFarlane
Incoming President / Nouveau Président

Highlights of March Council and April Executive Meetings

Congresses

Victoria, June 5-9, 2011
The Victoria Congress has received 480 abstracts, which have been scheduled into seven parallel oral sessions and a poster session that will include about 100 posters. However, government travel restrictions have reduced the number of attendees by about 100, mainly from the Meteorological Service of Canada. The Local Organizing Committee may have to merge or cancel some sessions, depending on how many presenters withdraw. It would be best if presenters who cannot attend find other people to give their presentations. A sponsored ice-breaker will be held in the First Peoples Gallery at the Royal BC Museum, and other social events have been booked. Cash sponsorships for this Congress have exceeded the target, in addition to in-kind sponsorship from DFO and EC. There will be separate French and English programme books this year.

2012 Montreal (May 29 – June 1, 2012)
The theme of the Montreal Congress will be: "***The Changing Environment and its impact on climate, ocean and weather services***." The LAC expects 700-800 people to attend this Congress. The hotel is booked, and plans for the banquet and other functions are in progress.

2013 Saskatoon (May 25-30, 2013)
The 2013 Congress will be co-hosted with the Canadian Water Research Association and the Canadian Geophysical Union. The LAC expects about 1100 delegates from the three societies. Four hotel contracts are finalized, and the LAC is still looking for more rooms. The contract with the conference centre is in place.

Other General Issues

CFCAS
There was no direct funding for CFCAS in the federal budget that was tabled before the recent election, although there was $35M over 5 years for NSERC for climate and atmospheric research funding. CFCAS had asked for $50M over five years. CFCAS' last year of funding began on April 1st, 2011, using remaining funds. Next year CFCAS will cease operations, unless there is some new funding.

Atmosphere-Ocean
The first issue of A-O published by Taylor & Francis is out and under distribution. It includes six papers. The new review process is working, but there has not been any less work for the Director of Publications so far. Forty-five papers have been submitted to Atmosphere-Ocean this year, including 36 for Special Issues. We aim to increase the number of papers published in A-O each year to 100. A-O is looking for high-quality articles. Please consider publishing your next paper in Atmosphere-Ocean, CMOS' own scientific journal.

Speaker Tour
Dr. Tom Pedersen has completed his 2011 CMOS Speaking Tour. His presentation, with its message about adaptation to climate change, was well-received and attracted positive media attention across the country.

Sophia Johannessen,
Recording Secretary / Secrétaire d'assemblée

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **August 2011.** Please send your articles, notes, workshop reports or news items before **July 6, 2011** to the address given on page 82. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **août 2011.** Prière de nous faire parvenir avant le **6 juillet 2011** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page 82. Nous avons un besoin URGENT de vos contributions écrites.

ARTICLES

The 11 March 2011 Tohoku Tsunami

by Richard Thomson, Alexander Rabinovich and Isaac Fine[1]

Résumé: Après le séisme de magnitude de 9,5 au large de la côte du Chili en 1960 et celui de magnitude de 9,2 au large de l'Alaska en 1964, le méga-séisme de magnitude 9,0 dans la région de Tohoku qui a eu lieu au large de l'île de Honshu au Japon le 11 mars 2011, a été le troisième phénomène tsunamigénique des plus puissants dans l'océan Pacifique. Le phénomène du tsunami générant des vagues a déferlé sur la côte du Japon et s'est propagé à travers l'océan Pacifique à de grandes vitesses atteignant l'Amérique du Nord en sept heures environ. Dans la ville de Crescent en Californie, on a rapporté les plus hautes vagues sur la côte Nord-Américaine, soient des vagues de plus de 4,5 m qui ont entraîné la mort d'un homme; on rapporte aussi des vagues de plus d'un mètre qui se sont produites à différents endroits le long du rivage extérieur de la Colombie-Britannique. Des documents historiques montrent que le dernier phénomène de tsunami provoqué par un méga-séisme a eu lieu il y a 311 ans le long de la zone de subduction de Cascadia entre l'île de Vancouver et le nord de la Californie et on s'attend que la région soit affectée à nouveau. Selon la plupart des experts, la question n'est pas de savoir «**si**» mais «**quand**» un phénomène comme celui que le Japon vient de connaître frappera la côte ouest de l'Amérique du Nord.

The powerful images from Japan of the extensive devastation caused by the March 11, 2011 Magnitude (Mw) 9.0 Tohoku earthquake and tsunami are a stark reminder of the possible consequences of living near major subduction zones along the coast of the World Ocean. Peru, Chile, Indonesia, the Kuril Islands, the Kamchatka Peninsula, and the west coast of North America are among the many areas of the Pacific Ocean vulnerable to such megathrust events. The 2011 event in Japan follows the catastrophic tsunami caused by the magnitude 9.2 earthquake off the coast of Sumatra in December 2004 in the Indian Ocean and the more recent South Pacific tsunamis generated by the 8.8 Samoan earthquake of September 2009 and the 8.9 Chilean earthquake of February 2010. Earthquakes of these magnitudes generate trans-oceanic tsunamis that wreak havoc over large areas of the ocean, but even moderate earthquakes can trigger submarine landslides which cause regionally destructive waves, as occurred on 17 July 1998 in Papua New Guinea following a local magnitude 7.1 earthquake. The high velocity flooding waters of tsunamis can surge far inland from the coast and are responsible for strong and rapidly changing currents that do major damage in ports and harbours along the coast. For example, most of the damage to southern California arising from the February 2010 Chilean tsunami was due to tsunami-induced currents in the harbours.

The Tohoku earthquake occurred at 05:46:23 UTC (14:46 local time) at a depth of 32 km at 38.322°N, 142.369°E, roughly 130 km seaward of the northeast coast of Honshu Island, Japan. It is in this region that the Pacific plate is subducting below a "finger" of the North America Plate. The first tsunami waves generated on the western side of the rupture zone reached the coast of Japan within a few tens of minutes. Maximum waves in excess of several metres arrived at the coast about an hour later causing wave run-up of 10 to15 m and pronounced inland inundation. Waves emanating from the rupture zone spread out over the open Pacific at jet-like speeds of up to 800 km/hour and began reaching the mainland coast of North America about 7 hours later. The first wave hit Amchitka in the Aleutian Islands around 0930 UTC and the southeast coast of Alaska (e.g., Yakutat and Sitka) about four hours later. Waves then arrived on the north coast of Vancouver Island, British Columbia at 1440 UTC (0640 local time) and the south coast of the island and north coast of Washington State about an hour later (Figure 1a,b). The tsunami entered Juan de Fuca Strait about 1540 UTC and started propagating up-strait, arriving at tide gauges located at Victoria, Patricia Bay (Saanich Inlet), and Metro Vancouver at 1630, 1722, and 1750 UTC, respectively. Waves also propagated into Puget Sound, arriving at Seattle and Tacoma at 1734 and 1750 UTC (i.e., 11 h 48 min and 12 h 04 min after the earthquake), respectively. Due to multiple reflections from large-scale topographic irregularities in the ocean, significant tsunami waves associated with the event kept arriving along the west coast of North America for the next 6 hours.

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

Waves of 25 cm amplitude were recorded in the offshore region by high-resolution, real-time reporting bottom pressure recorders maintained by NEPTUNE Canada at 2600 m depth in Cascadia Basin. These waves were then amplified as they shoaled within coastal waters to over 100 cm height (trough to crest) at Henslung on the northwest coast of the Queen Charlotte Islands, 155 cm at Winter Harbour on northwest coast of Vancouver Island, and 130 to 135 cm at Tofino and Port Alberni on the southwest coast of the island (Figure 2). Tsunami waves of 115 cm were recorded at Port Angeles (eastern Juan de Fuca Strait), over 50 cm at Victoria (and nearly 100 cm in the nearby Gorge waterway, both in the eastern strait), 11 cm at Pat Bay in Saanich Inlet north of Victoria, and 7 cm near Vancouver. Even Tacoma and Seattle within Puget Sound observed waves over 10 cm. The highest waves on the west coast of North America were recorded at Crescent City, California where wave heights were in excess of 4.5 m and one person was swept to his death trying to take pictures of the incoming tsunami.

A magnitude 9.0 megathrust earthquake in the Cascadia Subduction Zone extending from northern Vancouver Island to northern California is expected to cause a tsunami very similar to that which occurred in Japan with the first waves arriving from the source region striking the nearby coast within 15 to 20 minutes of the earthquake. The Pacific west coast is the home of tens of thousands of residents and is visited by hundreds of thousands of tourists every year. Based on experience from the 26 December 2004 Indian Ocean event, people living near to the coastline now know to get to higher elevation once the ground starts shaking. The recent event off Japan has now made people living along the coast even more concerned about what is likely awaiting them in the future. Japanese historical records show that the last megathrust earthquake and tsunami event along the Cascadia subduction zone occurred over 311 years ago on 26 January 1700 and many scientists believe the region is overdue for another major event. The magnitude 9.2 Alaska earthquake on March 27, 1964 that caused major damage along the west coast of North America, including an approximately 8 m tsunami in Port Alberni on the west coast of Vancouver Island, is a reminder that the subduction zone off the Aleutian Islands and Alaska (which has been relatively quiet for the past 47 years) is another possible source region for a megathrust earthquake and tsunami. As many experts keep reminding us, it is not a matter of "**if**" but a matter of "**when**". Although such events cannot be avoided, we can find ways to mitigate their catastrophic impacts.

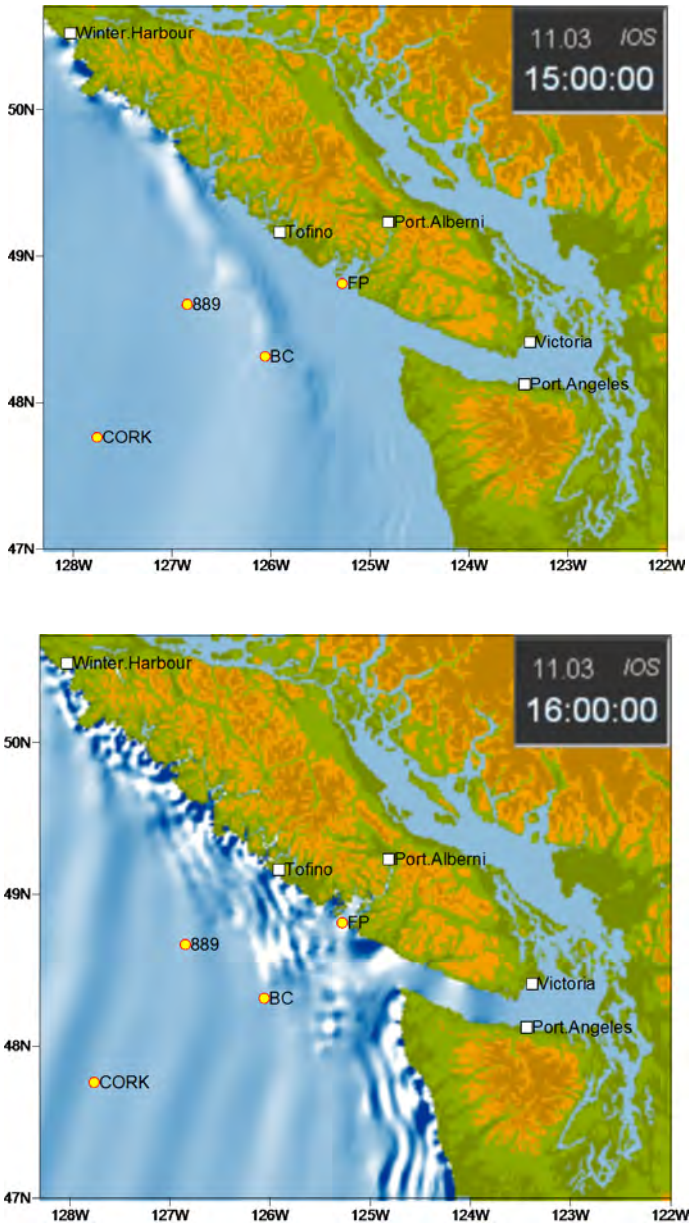


Figure 1. Numerical simulation of the 11 March 2011 Tohoku tsunami arriving at Vancouver Island on the west coast of British Columbia and then propagating southward to Washington State and into Juan de Fuca Strait (Institute of Ocean Sciences, regional tsunami model). (Top) Tsunami at 1500 UTC and (Bottom) at 1600 UTC on March 11. Wave crests are shown in white and wave troughs in dark blue. Note waves entering Juan de Fuca Strait in bottom frame. Circles denote offshore bottom pressure recorders; squares denote coastal tide gauge sites.

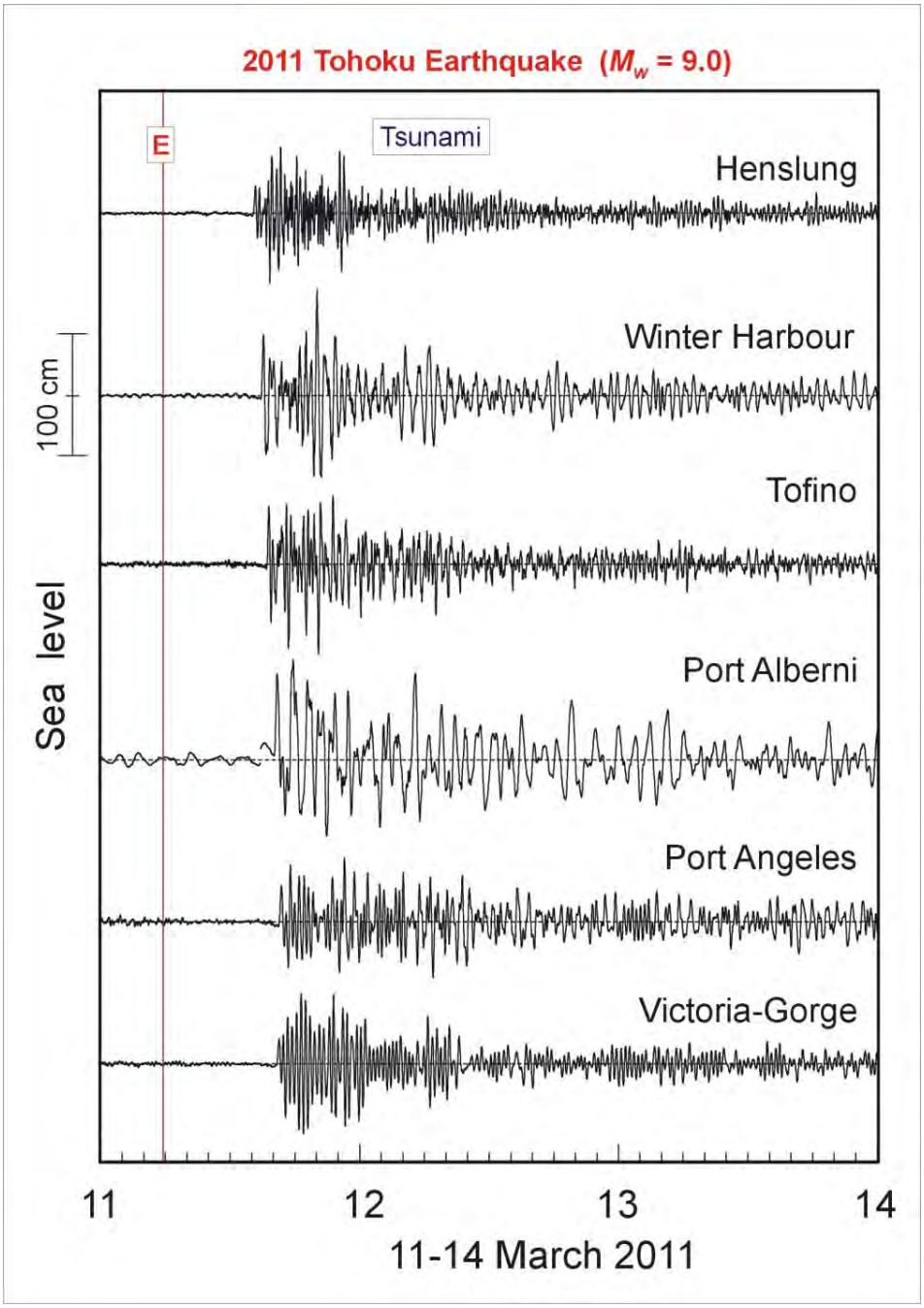


Figure 2. Plots of detided, low-pass filtered water levels recorded by selected coastal tide gauges on the west coast of Canada and United States for the period 11 to 14 March, 2011. Henslung (Langara Island) is located off the northwest coast of the Queen Charlotte Islands; Winter Harbour, Tofino, and Port Alberni are on the west coast of Vancouver Island, and Port Angeles and Victoria are located at the eastern end of Juan de Fuca Strait. The letter "E" denotes the time of the earthquake in Japan. Wave heights are in centimetres.

Eastern Pacific Ocean Temperature Anomalies in 2010 to 2011

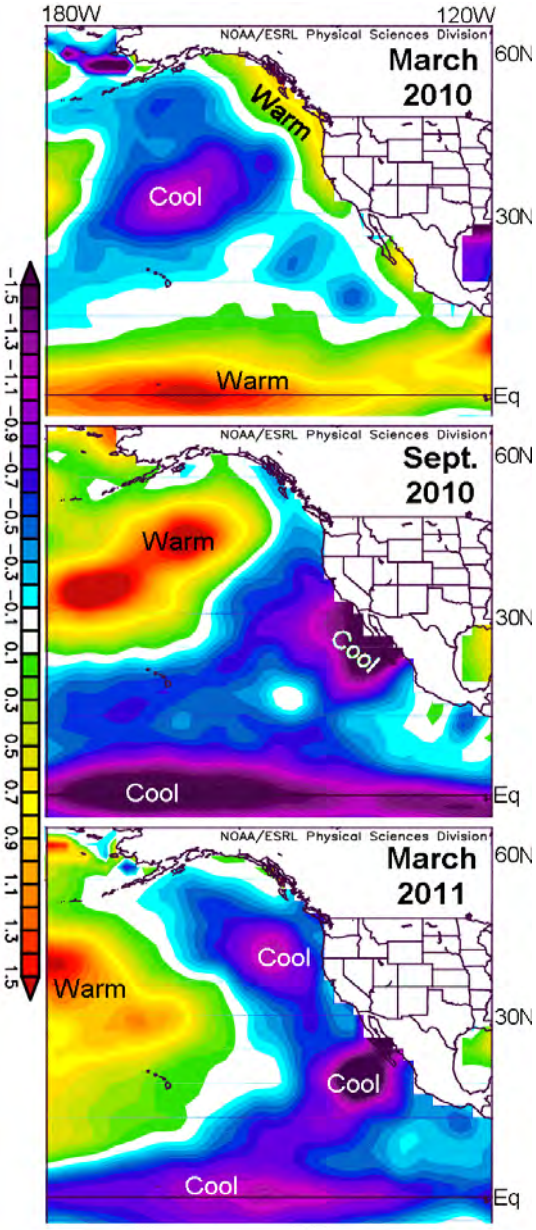
by Bill Crawford[1]

The recent changes of ocean temperatures in the eastern Pacific Ocean can be seen in the three panels of the figure below. Colour shading indicates the temperature relative to the 1971-to-2000 average of that month. The relatively warm oceans west of North America in March 2010 were part of the coastal warming due to stronger southerly winds of this El Niño winter. The warm anomalies gave way to cooler anomalies in September 2010, due to persistent and strong northerly winds along the west coast in summer. By March 2011 relatively cool waters were present all along the west coast and Equator, in response to La Niña winds.

El Niño is part of a Pacific-wide pattern of winds and temperatures. It is formally defined by the ocean temperature along the Equator in the Pacific Ocean and is present when these temperatures exceed 0.5°C above normal for several seasons. This warming is present in the top panel, showing temperature anomalies of March 2010. La Niña events take place when temperatures fall to more than 0.5°C below normal, as in September 2010 and March 2011 in the bottom two panels of the figure at right.

Temperatures along the Equator and North American west coast in March 2011 were similar to those of March 2008 and 2009, and were typical of winters with La Niña conditions in the Pacific Ocean. These ocean temperatures are usually set up by stronger northeast trade winds over the tropical North Pacific Ocean and stronger westerly winds in the subarctic Pacific. Similarly, Pacific Ocean temperatures of early 2010 were typical of El Niño winters, with warm oceans along the North American west coast. As of early April 2011 the existing La Niña was predicted to continue into late spring 2011. Readers can track future La Niña conditions and predictions at this site: NOAA ENSO News.

The link between ENSO events (a term that includes both El Niño and La Niña) and winds and temperatures in western North America was noticed several decades ago. Its impact was modulated by the Pacific Decadal Oscillation (PDO), a pattern of ocean temperature variability in the North Pacific. Through the 1960s and mid-1970s the PDO was in its negative phase with cool waters west of Canada. It shifted in 1976 and remained positive until 1998, with warmer oceans off North America. Since 1998 the PDO has shifted more frequently in phase and has usually reinforced the impact of ENSO on temperature of the surface ocean off USA and Canada.



(See figure caption on next page)

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

This report is based on information in annual research documents prepared by more than 30 scientists, to share their recent observations of ocean conditions and marine life. These reports are available at:

http://www.pac.dfo-mpo.gc.ca/science/psarc-ceesp/osrs/index-eng.htm

Figure caption: **Ocean temperature anomalies** in the Pacific Ocean for March 2010 (top), September 2010 (middle), and March 2011 (bottom). The map extends from North America west to the International Dateline, and from 5°South to 65°North. The Equator is marked by the horizontal black line near bottom of each panel. The temperature anomaly scale in °C is at left. Positive and negative temperature anomalies are labelled warm and cool, respectively. Images provided by NOAA.

A provocative surprise: The Return of the Sockeye

by Paul LeBlond[2]

Résumé: Après plusieurs années de montaisons désappointantes, l'arrivée de plus de 30 millions de saumons rouges à l'embouchure du fleuve Fraser a fait la joie des pêcheurs, mais laisse les scientifiques de plus en plus perplexes et très conscients de leur manque d'information et de compréhension de l'écosystème océanique. Comme quoi même une bonne surprise peut s'avérer très stimulante.

People dislike surprises, especially unpleasant ones: an unexpected rain storm; coastal flooding by an unannounced tsunami; an unanticipated volcanic eruption. The list of unpleasant or even lethal natural hazards is a long one and most of the predictive efforts of Earth scientists focus on averting such surprises. Meteorologists have achieved a high level of short-term predictive ability thanks to intensive data-gathering and modeling. Oceanographers have had great success with tidal prediction but are still struggling with understanding and forecasting other phenomena. While meteorologists mostly leave the matter of impacts on terrestrial ecosystems to other specialists, physical and chemical oceanographers are still closely linked to marine biology and its practical application to fisheries science.

That is where the most striking surprises take place. My topic here is a rarity: a surprise which is both pleasant and highly thought-provoking: the massive, unexpected 2010 Fraser sockeye salmon migration.

Sockeye salmon spawn in lakes and streams around the North Pacific but spend much of their life in the ocean. After hatching, fingerlings grow for a few weeks to a year in their freshwater habitat before migrating to salt water. They return on the average four years after their parents, struggling upriver to the very stream where they were born, expiring in the effort. The spawning migration represents a net biomass transfer from the open ocean to land ecosystems, benefiting flora and fauna as well as people, who love the rich red and oily flesh of sockeye salmon, a major fishery resource.

The Fraser River and its tributaries are home to many sockeye populations. The past decade has seen most of these populations suffering from a significant decline, a situation which has caused enough hardship among fishing communities and headaches for fisheries managers to cause the federal government to launch a judicial enquiry into the matter, especially after the particularly disappointing returns of 2009.

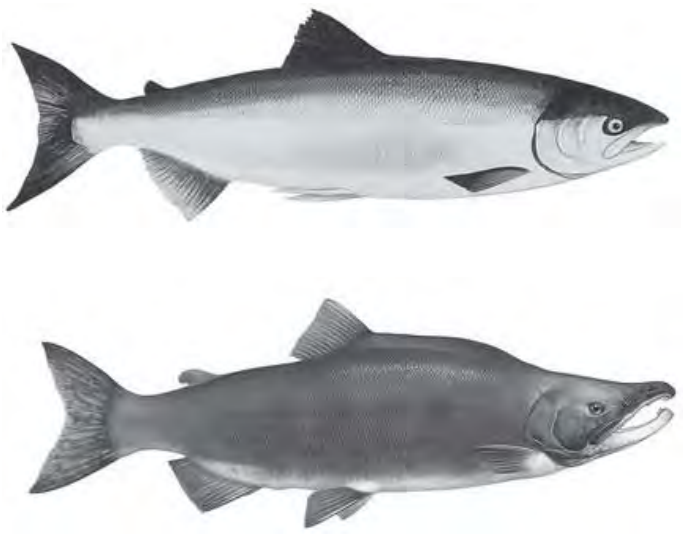


Figure 1. Sockeye salmon *(Oncorhynchus nerka).* Above, silvery adult before entering freshwater. Below, male on the spawning ground, with the hooked (Onco) nose (rhynchus) that gave its name to the genus. About1 m long, 2-3 kg. Named by German naturalist Johan Julius Walbaum in 1792 based on a specimen from the Sea of Okhotsk; *nerka* was the Russian word for the fish.

[2] Galiano Island, British Columbia, Canada

The enquiry, led by Justice Bruce Cohen, is under way and will report in 2012 . The many reasons put forward for the decline have been debated at length in the scientific and mediatic press and are summarized in the enquiry's interim report (see http://www.cohencommission.ca/). They range from managerial failures (such as overfishing), through destructive impacts of human activities (aquaculture, hatcheries, forestry, pollution), and large scale environmental impacts (predation by seals, direct and indirect effects of global warming). Failure to link the decline unambiguously to any specific cause has led many scientists to suspect that the explanation may lie within the complex ecosystem interactions linking physical and chemical conditions of the ocean through many trophic levels (plankton, small crustaceans, small fish, big fish…) to affect sockeye survival. Sampling in 2007 in the Strait of Georgia, where young salmon spend the first part of their marine life and where they are most vulnerable, revealed a failure of production for both salmon and herring, a very unusual situation (R. Beamish, pers. com.).

Given the gloomy prospects aired in the spring at the opening of the Cohen enquiry, the summer 2010 sockeye returns to the Fraser came as a shocking surprise. In contrast to the disappointing returns of 2009, where a little over 1 million fish showed up instead of the 10 million or so expected, more than 30 million fish returned: far, far more than expected and more than in any year since 1913. Ocean and fishery scientists were left puzzled and humbled, not only unable to account for the long decline but completely taken by surprise by the sudden recovery. Was this an accident? a low-probability outburst of a chaotic system? The fortunate consequence of ocean fertilization by an Aleutian volcanic eruption (as suggested by Hamme et al., 2010, *Geophys. Res.Lett.*,**37**, L19604, doi:10.1029/2010GL044629)? Or was it a reversal of the decadal trend associated with a regime shift in ocean conditions? The surprise may have been a pleasant one, but it has exposed an even deeper ignorance and lack of understanding of the ocean ecosystem.

How might one forecast sockeye returns? Currently, returns are estimated from the number of spawners, four years before, (more parents = more offspring) and the help of an empirical relation, Ricker's Curve, which takes into account decreasing spawning efficiency at higher numbers. Some environmental information – e.g. ocean temperature – is sometimes also invoked. Results are presented in a probabilistic fashion, with wide error bars. This method certainly has the advantage of simplicity. It averages out the plethora of incidents that mark the life of a young salmon, first in a lake, then down river to the ocean, where it meets larger predators as well as more abundant but fluctuating food supplies. However, even in the absence of heavy fishing and other human interference, one would expect significant fluctuations in a complex non-linear ecosystem. Occasional collapses of the salmon fishery as documented by 19th century Hudson Bay factors bear witness to the variability of the natural system. For example, in 1826, the young James Douglas, then stationed at Fort St. James, reported that "the salmon fishery had failed that season".

There is some consensus that young salmon are most vulnerable when entering the ocean and that the survival of a cohort is strongly affected by what happens in the first few months of life at sea. Improved forecasting reliability would result from better knowledge and understanding of what happens over that period. Knowledge would result from extensive sampling of the ocean, its properties and of those components of the ecosystem relevant to the sockeye; understanding the interactions between these various components and the physico-chemical environment would then lead to some predictability. What this implies is a major program of observations and modeling of the ecosystem, with the hope of identifying those factors which play the major role in sockeye survival and ultimately of defining crucial measurements and indices with reliable predictive power.

At this point, one may well ask: "*Is this worth the effort?*" Sampling at sea is expensive; modeling requires highly trained personnel and state-of-the-art equipment. Would management of the fishery end up costing more than its commercial value? Might there not be a way of managing catches and allocations in a flexible manner that adapts to uncertainty? The Cohen Enquiry is struggling with these issues, made even more pressing by the great surprise of the 2010 sockeye returns.

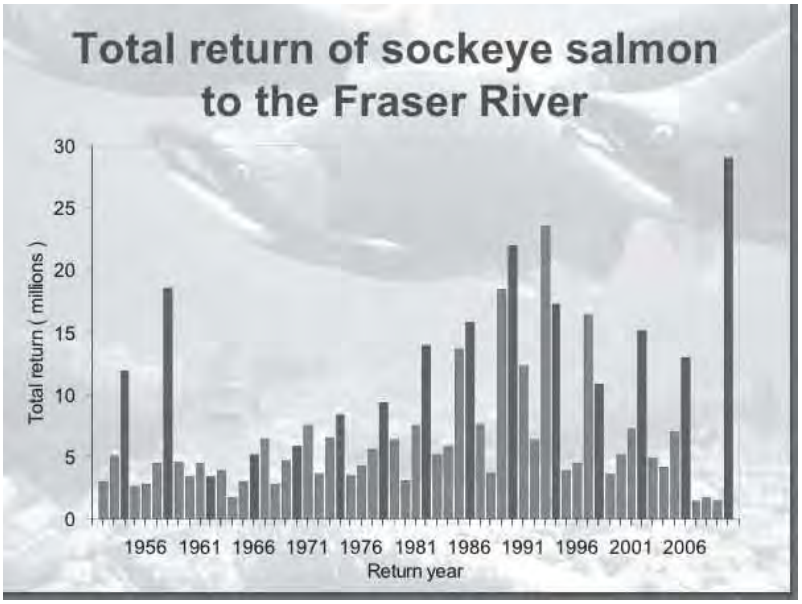


Figure 2. Sockeye returns to the Fraser River. Note the presence of a dominant run every fourth year, steadily declining since the 1990s. The 2010 surprise run follows a steady decline of the dominant run and three very poor years; it exceeds all other runs in this record. (Graph courtesy of R. Beamish).

CLIMATE CHANGE / CHANGEMENT CLIMATIQUE

Runaway Warming Ahead, According to Ancient Climate Records

Fast-action Mitigation Can Provide Critical Insurance Against Repeating Past Warming

Washington, D.C., January 14, 2011 – What insurance can the world afford to prevent repeating the catastrophic temperature increase of the past? A package of fast mitigation measures is recommended by Nobel Laureate Mario Molina and colleagues Durwood Zaelke, K. Madhava Sarma, Stephen O. Andersen, V. Ramanathan, and Donald Kaniaru.

These fast-action mitigation measures can be implemented in two to three years and produce climate benefits in one to two decades. They complement efforts to cut CO_2 under any climate treaty.

As reported in *Science* today, ancient climate records show that the Earth warmed by 16˚C (29˚F) when concentrations of CO_2 were at the levels that will be reached by 2100 under business-as-usual trends.

Current emissions have warmed the Planet about 0.76˚C. There are signs that climate impacts are already wreaking havoc, including torrential rains and floods and uncontrollable fires and droughts. Increased warming of 16˚C would be catastrophic, and push the Planet past tipping points for irreversible changes, including the melting of the polar and glacial ice, which would cause tens of metres of sea level rise.

Yet world leaders have not been able to agree to a strong climate treaty and are not likely to do so before 2012. Nor is the United States able to agree on a strong domestic climate law.

Molina's fast-action strategies recognize that climate change is not one problem but a package of related problems, caused by a variety of factors. CO_2, for example, is causing 50 to 60% of warming, while four other pollutants are causing the other 40 to 50%.

"*The fast-action approach recognizes the need for speed to slow climate change*," said Durwood Zaelke, President of the Institute for Governance & Sustainable Development. "*We can start immediately*," Zaelke continued, "*and cut non-CO_2 pollutants using existing technologies and existing laws and institutions*."

First on Molina's list of fast-action strategies is strengthening the Montreal Protocol, by amending the treaty to phase out the upstream production and use of hydrofluorocarbons, or HFCs, super greenhouse gases. These chemicals are man-made and used for refrigeration and making insulating foams. (Downstream emissions of HFCs are included in the Kyoto Protocol.)

According to Zaelke, "*Phasing out HFCs could produce 100 or more billion tonnes of CO_2-equivalent in climate mitigation, at a cost between $0.10 and $0.20 per tonne*." He added, "*This is the cheapest climate insurance available anywhere in the world, and delivered by an existing treaty that has already phased out nearly 100 similar chemicals*."

Other fast-action mitigation strategies on Molina's list include reducing black carbon soot, tropospheric ozone, known as urban smog, and methane. Technologies exist that can be deployed today to make these cuts. And the cuts create strong collateral benefits for public health, ecosystem protection, and agriculture productivity.

Molina also calls for carbon-negative strategies that can draw down existing excess CO_2 from the atmosphere. Photosynthesis is a key technology for doing this, turning CO_2 into biomass in forests, grasslands, and other plants. This biomass can be turned into a permanent and stable form of carbon called biochar by cooking it with limited oxygen.

Zaelke emphasized that CO_2 is the priority long-term pollutant that must be cut to stabilize the climate system. "*But cutting CO_2 is not enough. We also need to cut the pollutants causing the other 50% of climate change*," he added.

References

Kiehl, Jeffrey. Lessons from Earth's Past. *Science*. 14 Jan 2011. http://www.sciencemag.org/content/331/6014/158.summary

Mario Molina, Durwood Zaelke, K. Madhava Sarma, Stephen O. Andersen, Veerabhadran Ramanathan, and Donald Kaniaru. Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO_2 emissions. *Proceedings of the National Academy of Sciences*, 2009. http://www.pnas.org/content/early/2009/10/09/0902568106.full.pdf+html

Source: Press release from Institute for Governance & Sustainable Government, Washington, D.C., USA.

CMOS BUSINESS / AFFAIRES DE LA SCMO

New CMOS Undergraduate Scholarship in Memory of Dan Wright

Dr. Daniel G Wright

A new CMOS undergraduate scholarship has been created in memory of Dr. Dan Wright, who passed away suddenly in July 2010. Dr. Wright was a senior research scientist at DFO's Bedford Institute of Oceanography, as well as an Adjunct Professor at Dalhousie University, for many years prior to his passing. In his outstanding career as an eminent physical oceanographer, Dr. Wright was highly productive, a generous and respected scientist, and an advisor, colleague and friend to many in the oceanographic and atmospheric research communities. In particular, he cherished the opportunity to interact with students and young scientists, which is the motivation for honouring his memory through an Undergraduate Scholarship. A complete summary of his many accomplishments and honours appeared in the *CMOS Bulletin SCMO* (Vol. 38, No. 4) in August 2010.

The new CMOS Undergraduate Scholarship named in honour of Dan Wright, in the amount of $1,000, will be awarded to a Canadian undergraduate student entering his/her final year of a B.Sc. Honours program in Mathematics and/or Physics, or a related discipline, at a Canadian university. The successful candidate will be selected on the basis of: his/her academic standing; a demonstrated interest in pursuing graduate studies in physical oceanography or a related field of study; and the ability and interest to communicate and share his/her knowledge with others, as indicated in his/her resume and/or letter(s) of reference. CMOS intends to offer this new undergraduate scholarship for at least the next five years, or longer as donations allow. Donations for the new CMOS Undergraduate Scholarship in Dan Wright's memory can be made to the Scholarship Fund of the Canadian Meteorological and Oceanographic Society (CMOS). A donation form can be found on the CMOS website.

Nouvelle bourse d'études de premier cycle de la SCMO à la mémoire de Dan Wright

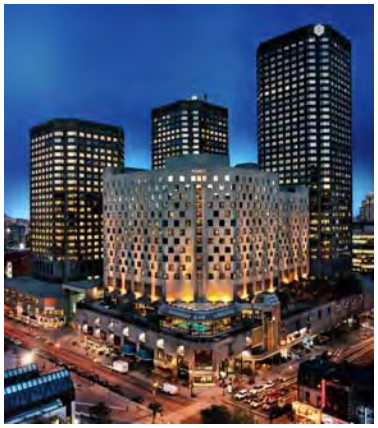
La SCMO a créé une nouvelle bourse d'études de premier cycle en souvenir de Dan Wright, Ph.D., qui est décédé subitement en juillet 2010. Dr. Wright a été chercheur principal à l'Institut océanographique de Bedford (MPO), ainsi que professeur auxiliaire à l'Université Dalhousie durant de nombreuses années, jusqu'à son décès. Au cours de sa carrière exceptionnelle d'éminent océanographe physicien, Dan Wright fut un scientifique très prolifique, généreux et respecté, en plus d'être le conseiller, le collègue et l'ami de plusieurs chercheurs de la communauté des sciences océanographiques et atmosphériques. Il prenait particulièrement plaisir à interagir avec les étudiants et les jeunes scientifiques, ce qui motive la SCMO d'honorer son souvenir par le biais d'une bourse d'études de premier cycle. Un résumé complet de ses multiples réalisations et des honneurs qu'il a reçus a été publié dans le *CMOS Bulletin SCMO* (Vol. 38, N^{o} 4) en août 2010.

Cette nouvelle bourse d'études de premier cycle, offerte par la SCMO et nommée en l'honneur de Dan Wright, s'élève à 1000 $. Elle sera octroyée à une étudiante ou à un étudiant canadien commençant sa dernière année de baccalauréat spécialisé en mathématiques ou en physique, ou dans une discipline connexe, au sein d'une université canadienne. La candidature retenue sera choisie sur la base des résultats scolaires; de l'intérêt démontré pour les études supérieures en océanographie physique ou dans un domaine connexe; de l'aptitude et de l'intérêt pour la communication et le partage des connaissances, comme le démontreront le curriculum vitae et les lettres de recommandation. La SCMO compte offrir cette nouvelle bourse d'études pendant les cinq prochaines années, et aussi longtemps que le permettront les dons, par la suite. Les dons destinés à la nouvelle bourse d'études de premier cycle à la mémoire de Dan Wright peuvent être faits dans le cadre du Fonds pour les bourses d'études de la Société canadienne de météorologie et d'océanographie. Un formulaire de don est accessible sur le site Web de la SCMO.

COMMUNIQUÉ

Congrès conjoint de la SCMO 2012 avec les conférences de l'AMS sur la Prévision numérique du temps et sur la Prévision et l'analyse météorologique

Le 46e congrès annuel de la Société canadienne de météorologie et d'océanographie (SCMO) se tiendra du 29 mai au 1er juin 2012 à l'hôtel Hyatt-Regency de Montréal (Québec) au Complexe Desjardins. Ce congrès est organisé conjointement avec la 21e Conférence de l'«American Meteorological Society» (AMS) sur la Prévision Numérique du Temps (21st Conference on Numerical Weather Prediction) et la 25e Conférence de l'AMS sur la Prévision et l'analyse météorologique (25th Conference on Weather Analysis and Forecasting). Ces deux conférences se tiennent une fois sur deux à l'extérieur de la réunion annuelle de l'AMS et en 2012, elles se tiendront à Montréal et seront organisées en collaboration avec la SCMO. Un Comité conjoint du programme scientifique a déjà été formé pour organiser les sessions portant sur la prévision numérique du temps et la météorologie opérationnelle, des thèmes communs aux deux partenaires. Un effort particulier sera fait pour encourager une participation internationale sur ces thèmes.


Complexe hôtelier la nuit

L'hôtel Hyatt-Regency et son centre des congrès sont situés au Complexe Desjardins en plein centre-ville et à deux pas de la Place des spectacles inaugurée en 2010. La ville de Montréal s'anime durant l'été avec de nombreux festivals. Vous aurez ainsi l'occasion de découvrir une ville très animée lors de votre passage à Montréal. Le Comité organisateur et le Comité du programme scientifique travaillent déjà à préparer le congrès 2012 pour vous accueillir chaleureusement.

Thème du congrès et programme scientifique

Le thème du congrès de 2012 sera ***l'environnement en évolution et son impact sur les services pour le climat, les océans et la météo*** et se veut une réflexion sur les changements dans notre environnement sur plusieurs facettes. L'environnement physique change et plusieurs secteurs d'activités sont affectés par ces changements. Ceci amène un changement dans l'environnement socio-économique qui dépend d'informations fournies par les prévisions météorologiques, les simulations climatiques et océaniques également. Cette connaissance est maintenant critique pour harmoniser notre développement à de tels bouleversements. Ceci conduit à des changements dans notre environnement de travail pour la recherche et les applications des sciences du climat, des sciences atmosphériques et océaniques. Le thème du congrès n'est bien sûr qu'une facette de la rencontre et comme toujours, le congrès sera l'occasion de couvrir les nombreux thèmes qui intéressent notre communauté.

Le programme scientifique pour le congrès 2012 comprendra des conférences plénières et conjointes avec nos collègues de l'AMS. Au début septembre, un **appel de propositions de thèmes de sessions** vous sera envoyé par courriel et sera affiché sur le site internet du congrès au http://www.cmos.ca/congress2012/. Les soumissions de thèmes seront acceptées jusqu'au **30 septembre 2011**. Des ateliers, des réunions d'affaires et une réception de bienvenue auront lieu le 28 mai 2012, alors que le programme du congrès débutera le 29 mai. Les personnes qui veulent discuter du programme ou y apporter des suggestions peuvent communiquer avec le Comité du programme scientifique (contact: Pierre Gauthier, courriel: gauthier.pierre@uqam.ca).

ANNOUNCEMENT

Joint 2012 CMOS congress with the AMS Numerical Weather Prediction and Weather Analysis and Forecasting Conferences

The 46th congress of the Canadian Meteorological and Oceanographic Society (CMOS) will take place from May 29 to June 1st 2012 at the Montréal Hyatt-Regency hotel in Complexe Desjardins in Montréal (Québec). This congress is organized jointly with the 21st American Meteorological Society (AMS) Conference on Numerical Weather prediction (NWP) and the 25th AMS Conference on Weather Analysis and Forecasting (WAF). These two conferences are organized one out of two outside the annual AMS meeting and in 2012, they will be held in Montréal and organized in collaboration with CMOS. A joint scientific committee has already been formed to organize the sessions on NWP and WAF, themes that are common to the two groups. A special effort will be made to seek an international participation on those topics.


Typical scenery of Montreal

The Hyatt-Regency hotel and its conference centre are located in the Complexe Desjardins right downtown and next to the Place des Spectacles inaugurated in 2010. The

city of Montréal becomes very lively during summer with several festivals. You will have the opportunity to discover this during your stay in Montréal. The local organizing committee and the scientific committee are already working on the preparations for the 2012 Congress to welcome you here.

Congress Theme and Scientific Program

The theme for 2012 will be ***The Changing Environment and its impact on climate, ocean and weather services*** and intends to be a reflection on the changes in our environment from different perspectives. The physical environment is changing and several sectors of activity are impacted by these changes. This brings in a change in the socio-economic environment, which increasingly depends on information provided by weather forecasts, and also oceanic and climate simulations. Such knowledge is now critical to harmonize our development with such important changes. This in turn leads to changes in our ways of working both in research and applications of climate, atmospheric and oceanic sciences. The theme of the congress is of course one of the many topics of our meeting and as always, the congress will also be the occasion to cover several other subjects of interest for our community.

The scientific program for the 2012 Congress will include plenary sessions jointly with our colleagues from the AMS. In early September, a **Call for Sessions Proposals** will be circulated by Email and posted on the website of the congress (http://www.cmos.ca/congress2012/). Submissions will be accepted until **September 30, 2011**. Workshops, business meetings and the icebreaker reception will be scheduled for May 28, and the Congress program will begin May 29. Those wishing to discuss or provide input to the program can contact the Joint Scientific Program Committee (contact: Pierre Gauthier, Email: gauthier.pierre@uqam.ca).

Remise du prix Alcide-Ouellet* 2010 de la SCMO à Allan Rahill du SMC

Allan Rahill. Cette remise de prix à eu lieu devant un auditoire nombreux venu entendre le "Conférencier itinérant de la SCMO 2011", Thomas F. Pedersen, PhD, de l'Université de Victoria.

Allan Rahill est météorologue à la Division des opérations nationales de prévisions du Service météorologique du Canada, où il a contribué entre autres au développement du modèle de prévisions météorologiques du SMC GEM-Régional à 15km de résolution. Né en 1956 à Farnham, au sud-est de Montréal, Allan est un excellent communicateur et vulgarisateur enthousiaste de la science météorologique. Il est aussi depuis l'adolescence un passionné d'astronomie, qui construit ses propres instruments d'observation.

M. Rahill est surtout connu par la communauté des astronomes, amateurs et professionnels, pour le développement de cartes de prévisions pour l'astronomie basées sur le modèle GEM. L'originalité de ces prévisions est de tenir compte de la présence des couches minces d'humidité, de la turbulence en air clair, des gradients de température et de la stabilité de l'atmosphère pour évaluer la qualité du ciel pour l'observation astronomique. Ces cartes et des explications détaillées sur ces prévisions sont disponibles sur le site d'Environnement Canada :

http://www.meteo.gc.ca/astro/index_f.html

Ces mêmes produits servent de base pour le site de prévisions pour astronomes amateurs «Clear Sky Chart»

http://cleardarksky.com/csk/

développé et maintenu par M. Attila Danko. MM Rahill et Danko ont déjà reçu une citation spéciale de la SCMO en 2004 pour cette réalisation. On y trouve des météogrammes de la clarté et de la transparence du ciel synthétisant les prévisions développées par Allan, et ce pour plus de 4000 sites d'observation en Amérique du Nord. Pour cette contribution Allan a également reçu le «Amateur Achievement Award» de 2010 de la "Astronomical Society of the Pacific", et a même eu un astéroïde nommé en son honneur :

http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=allanrahill

On peut aussi entendre et voir Allan dans des extraits des émissions de vulgarisation scientifique "Découverte" de la Société Radio-Canada du 4 juillet 2004, ainsi que "Le code Chastenay" de Télé-Québec du 12 octobre 2010, disponible sur ces deux liens :

http://www.radio-canada.ca/actualite/decouverte/reportages/2004/07-2004/7-topos.html#astronomes/

http://lecodechastenay.telequebec.tv/occurrence.aspx?id=292&ep=69

*Le prix Alcide-Ouellet est attribué à chaque année à un météorologiste s'étant illustré dans la communication, la divulgation et le développement de la météorologie au Québec. Alcide Ouellet (1924-89) était un météorologue

québécois qui, comme chroniqueur-météo à la radio de la SRC pendant plus de 25 ans, a contribué de façon notoire à la vulgarisation de la météorologie au Québec. Ce prix honorifique, autrefois décerné par la défunte "Association professionnelle des météorologistes du Québec", est maintenant attribué par le Centre de Montréal de la SCMO.

André Giguère
Centre de Montréal de la SCMO

CMOS "Prix Alcide-Ouellet 2010"* awarded to MSC's Allan Rahill

On February 8th 2011, at the Canadian Meteorological Centre, in Dorval, Québec, Mr. Louis Lefaivre, Chair of the CMOS Montréal Centre, presented the "Prix Alcide-Ouellet 2010"* to Mr. Allan Rahill. This was done in front of the audience present to hear the "2011 CMOS Tour Speaker", Dr. Thomas F. Pedersen from University of Victoria.

Allan Rahill is a meteorologist with the National Predictions Operation Division of the Meteorological Service of Canada, where he contributed among other things to the development of the GEM-Regional meteorological forecast model at 15km resolution. A 1956 native of Farnham, southeast of Montréal, Allan is an excellent communicator and enthusiastic popular science writer of meteorology. He is also a passionate amateur astronomer since his teenage years, who builds his own observation instruments.

M. Rahill is above all well-known to the community of astronomers (amateurs and professionals) for having developed a series of forecast maps designed for astronomy, based on the GEM model. The originality of these forecasts is to integrate the presence of thin moisture layers, clear air turbulence, temperature gradients and atmospheric stability to evaluate the quality of the sky for astronomic observations. These maps and details about the forecast are available online at Environment Canada's website:

http://www.meteo.gc.ca/astro/index_e.html

The same products are the backbone of the «Clear Sky Chart»

http://cleardarksky.com/csk/

website, developed and maintained by Mr. Attila Danko, which provides astronomers (professional and amateur) invaluable information on observing conditions. Both MM Danko and Rahill received a special CMOS citation for this work in 2004. The site shows meteograms of the sky clarity and transparency, synthesizing the forecasts developed by Allan, for more than 4000 different observation sites in North America. For his contribution Allan also received the 2010 "Amateur Achievement Award" of the Astronomical Society of the Pacific, and even had the honour to have his name given to an asteroid:

http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=allanrahill

One can also hear and watch Allan during portions of the scientific vulgarisation television French-language programs "Découverte" aired on July 4 2004 on the Société Radio-Canada, and "Le code Chastenay" aired on Télé-Québec October 12 2010, visible here:

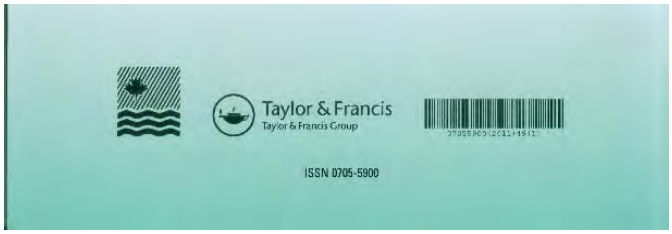
http://www.radio-canada.ca/actualite/decouverte/reportages/2004/07-2004/7-topos.html#astronomes/

http://lecodechastenay.telequebec.tv/occurrence.aspx?id=292&ep=69

* The "Prix Alcide-Ouellet" is awarded annually to a meteorologist having performed in the field of communication, popularization and development of meteorology in Québec. Alcide Ouellet (1924-89) was a Québec meteorologist who, as a radio weatherman at the French-language CBC during more than 25 years, contributed significantly to popularization of meteorology in Québec. This honorary award, once presented by the now disappeared "Association professionnelle des météorologistes du Québec" is now awarded by the CMOS Montréal Centre.

André Giguère
CMOS Montréal Centre

Atmosphere-Ocean is on a roll!



The first issue of *Atmosphere-Ocean* published by Taylor & Francis has been distributed. Volume 49, No.1 March 2011, looks much the same as if had been published by CMOS, but the cover is more glossy and the colours more vivid. The printing inside is also excellent. Clearly, T&F know about high quality. That first issue had six relatively short papers. The next issue will have seven articles of normal length. Several special issues are in preparation.

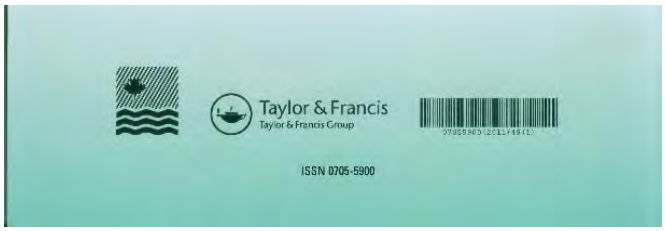
There is clearly a renewed interest for publishing in our own journal, as demonstrated by the large number of manuscripts submitted so far this year through our new online manuscript submission and review system. At the time of writing, 46 manuscripts have been submitted via ScholarOne since 1 January and 38 remain at various stages of review. With ScholarOne, the editorial process is much streamlined, with automatic reminders sent to tardy/forgetful reviewers and editors. As a result, manuscripts are moving through the system much quicker than before.

CMOS Executive members have discussed the growth of Atmosphere-Ocean at three of their meetings this year and adopted a strategy aimed at publishing 100 articles per year within the next 2-3- years. This strategy calls upon Canadian scientists who are leaders in their specialty, who work or study outside of Canada and who present papers at our congresses to consider **A-O** as their journal of choice or to submit more frequently. By publishing in a Canadian journal, they will contribute towards recognition of Canada as a scientific research leader.

Please consider submitting your next paper to **A-O**. And yes, your can attach supplementary material to the electronic version of your article!

Richard Asselin
Director of Publications

Atmosphere-Ocean est en marche!



Le premier numéro de *Atmosphere-Ocean* publié par Taylor & Francis a été distribué. L'apparence du Volume 49, No.1, Mars 2011, est semblable à ce que la SCMO aurait publié, sauf que la couverture est plus brillante et les couleurs plus vives. L'impression du texte est excellente. De toute évidence, Taylor & Francis sait bien faire les choses. Ce premier numéro contenait six articles relativement courts. Le numéro suivant comprendra sept articles de longueur normale. Il y a plusieurs numéros spéciaux en préparation.

Il y a un renouveau d'intérêt à publier dans notre propre revue, comme en fait foi le grand nombre de manuscrits soumis jusqu'à date dans notre système de soumission et de revue en ligne. À date, 46 manuscrits ont été soumis via ScholarOne depuis le 1er janvier et 38 demeurent à divers stades de révision. Grâce à ScholarOne, le processus éditorial est de beaucoup amélioré car des messages de rappel sont envoyés automatiquement aux réviseurs ou éditeurs délinquants. Ainsi, les manuscrits progressent beaucoup plus rapidement qu'auparavant.

Les membres de l'Exécutif de la SCMO ont discuté de la croissance d'*Atmosphere-Ocean* à trois reprises cette année et ils ont adopté une stratégie qui vise à publier 100 articles par année d'ici 2 à 3 ans. Cette stratégie fait appel aux chercheurs canadiens qui sont des chefs de file dans leur spécialité, qui travaillent ou étudient à l'extérieur du Canada ou qui font des présentations à nos congrès, pour qu'ils considèrent **A-O** comme leur revue préférée ou y soumettent plus fréquemment. En publiant dans une revue canadienne, ils contribuent à faire du Canada un chef de file en recherche scientifique.

Pensez à soumettre votre prochain article à *Atmosphere-Ocean*. Et oui, vous pouvez attacher du matériel supplémentaire à la version électronique de votre article!

Richard Asselin
Directeur des publications

A-O Abstracts Preview

Avant Première des résumés de A-O

The following abstracts will soon be published in your next *Atmosphere-Ocean* publication (49-2).

Les résumés qui suivent paraîtront sous peu dans votre prochaine revue *Atmosphere-Ocean* (49-2).

Quantifying Snowfall Rates Using Underwater Sound

by TAHANI ALSARAYREH AND LEN ZEDEL

Abstract
It is well known that rainfall rates can be estimated by analyzing the spectral character and level of the underwater sound that it generates. There have been a few field reports of increased sound levels associated with the occurrence of snow: these reports suggest an increase in sound levels above 20 kHz. It has previously been demonstrated that snowflakes can generate both a small impact sound and a separate high frequency pulse that is consistent with the sound generated by a resonant bubble. One aspect that these earlier studies have not explored is the dependence of this sound generation on the type or intensity of snowfall. We report on observations of sound generated by snow falling into a tank of water, quantifying snowfall rate using an Optical Scientific precipitation gauge. Recorded signals allowed analysis of frequencies between 1 and 50 kHz. Using the classification scheme of the International

Association of Hydrological Sciences for snow, seven distinct snow types, as well as rain and freezing rain, were observed with a range of precipitation rates. Snow types that produced a signal included column, needle, irregular crystal, graupel and ice pellet. Snow types for which no signal was detected were plate, stellar crystal and spatial dendrite. The previously reported rise in high frequency sound could not be unambiguously distinguished in the present data. A small peak at around 12 kHz was seen in spectra of some snow types similar to the characteristic 14 kHz peak seen in some rain-generated sounds. There was a clear correlation between sound level and snowfall rate at frequencies above 10 kHz.

Résumé
Il est bien connu que l'on peut estimer l'intensité des chutes de pluie en analysant le caractère spectral et l'intensité du son qu'elles produisent sous l'eau. Il y a eu quelques observations sur le terrain de niveaux sonores accrus associés à des chutes de neige : selon ces observations, il y aurait une augmentation des niveaux sonores au-dessus de 20 kHz. Il a précédemment été démontré que les flocons de neige peuvent produire un son faible à l'impact ainsi qu'une impulsion distincte de haute fréquence correspondant au son produit par une bulle en résonnance. L'un des aspects auxquels ces études antérieures n'ont pas porté attention est la relation entre cette production de son et le type ou l'intensité de la chute de neige. Nous présentons un rapport sur des observations de son produit par de la neige tombant dans un réservoir d'eau, en quantifiant l'intensité des chutes de neige au moyen d'un capteur de précipitations Optical Scientific. Les signaux enregistrés ont permis d'analyser les fréquences entre 1 et 50 kHz. En nous servant du schéma de classification de l'Association internationale des sciences hydrologiques pour la neige, nous avons observé sept types de neige distincts, de même que la pluie et la pluie verglaçante, avec un intervalle d'intensité de précipitations. Les types de neige ayant produit un signal comprennent les colonnes, les aiguilles, les cristaux irréguliers, la neige roulée et les granules de glace. Les types de neige pour lesquels aucun signal n'a été détecté sont les plaques, les cristaux étoilés et les dendrites spatiales. La hausse précédemment mentionnée dans le son de haute fréquence n'a pas pu être distinguée de façon non ambiguë dans les présentes données. Nous avons observé une faible crête à environ 12 kHz dans les spectres de certains types de neige, semblable à la crête caractéristique à 14 kHz observée dans certains sons produits par la pluie. Il y avait une nette corrélation entre le niveau sonore et l'intensité des chutes de neige aux fréquences supérieures à 10 kHz.

A Ten-Year Record of Arctic Trace Gas Total Column Measurements at Eureka, Canada, from 1997 to 2006

by H. FAST, R.L. MITTERMEIER AND Y. MAKINO

Abstract
This paper presents a long-term set of total column densities of N_2O, CH_4, HF, COF_2, HCl, $ClONO_2$, O_3, NO, NO_2 and HNO_3, measured with an ABB Bomem DA8 Fourier transform infrared (FTIR) spectrometer and a consistent methodology, during fall and spring at Eureka (80°N), Nunavut, Canada. The instrumentation, observations and retrievals of the column densities from infrared atmospheric solar absorption spectra are described in detail, including an estimate of the uncertainties in our retrieved column densities. This description also applies to the column data that we have archived on the Data Host Facility of the Network for the Detection of Atmospheric Composition Change (NDACC). The work presented here serves as an introduction to the entire dataset of atmospheric spectra recorded with the DA8 spectrometer at Eureka from 1993 to 2008. A few highlights from the results of our column retrievals for the years 1997 to 2006 are briefly discussed. One of these is the exceptionally low O_3, HCl and HNO_3 column amounts observed in the spring of 1997 which we ascribe to uptake of gaseous HNO_3 on aerosols of type Ib Polar Stratospheric Clouds (PSCs), resulting in appreciable chlorine activation with subsequent chemical ozone depletion. Another is the anomalously high NO columns measured throughout the month of March 2004, the only time this was observed in our ten-year record presented here. We attribute this to the meso-thermospheric contribution by enhanced solar activity. Some comparisons with Ny Alesund observations at 79°N are also discussed.

Résumé
Cet article présente un ensemble de données à long terme sur les densités totales dans la colonne de N_2O, CH_4, HF, COF_2, HCl, $ClONO_2$, O_3, NO, NO_2 et HNO_3, mesurées à l'aide d'un spectromètre infrarouge à transformée de Fourrier (IRTF) ABB Bomem DA8 et d'une méthodologie compatible, durant l'automne et le printemps à Eureka (80°N), au Nunavut, Canada. L'instrumentation, les observations et les extractions de densités dans la colonne à partir des spectres d'absorption atmosphérique de l'infrarouge solaire y sont décrites en détail, y compris une estimation des incertitudes dans nos extractions de densités dans la colonne. Cette description s'applique aussi aux données de colonnes que nous avons archivées dans le système d'accès aux données du NDACC (*Network for the Detection of Atmospheric Composition Change*). Le travail présenté ici constitue une introduction à l'ensemble de données complet sur les spectres atmosphériques enregistré à l'aide du spectromètre DA8 à Eureka de 1993

à 2008. Nous discutons brièvement de quelques points saillants dans les résultats de nos extractions pour les années 1997 à 2006. L'un de ceux-ci porte sur les quantités exceptionnellement faibles de O_3, HCl et HNO_3 observées dans la colonne au printemps 1997, que nous attribuons à une fixation du HNO_3 gazeux sur des aérosols de type *nuages stratosphériques polaires (NSP) Ib* résultant en une activation appréciable du chlore et un appauvrissement subséquent de l'ozone par voie chimique. Un autre point concerne les colonnes de NO anormalement élevées mesurées tout au long du mois de mars 2004, le seul moment où cela a été observé durant les dix années d'enregistrement présentées ici. Nous attribuons ce fait à la contribution méso-thermosphérique résultant d'une activité solaire accrue. Nous discutons aussi de quelques comparaisons avec les observations de Ny Alesund à 79°N.

Middle Atmospheric Response to ENSO Events in Northern Hemisphere Winter by the Whole Atmosphere Community Climate Model

by CHUNHUI LU, YI LIU AND CHUANXI LIU

Abstract
The influences of El Niño and La Niña sea surface temperature anomalies on the middle atmosphere are analyzed using a chemistry-climate model, the Whole Atmosphere Community Climate Model, version 3 (WACCM3), and the 40-year reanalysis dataset from the European Centre for Medium-range Weather Forecasts (ERA-40). Monthly mean data are used to perform statistical and dynamical analyses. Temperature anomalies are found in the stratosphere during both El Niño and La Niña years. These anomalies exhibit diverse distribution patterns, which we ascribe to the different scales of the planetary waves. During an El Niño winter, planetary waves are most active in December and January, leading to more disturbances of the stratospheric polar vortex and a higher frequency of stratospheric sudden warming (SSW) events. Moreover, on the basis of the three-dimensional Eliassen-Palm (E-P) flux, we find that the main wave action is located in the eastern hemisphere and displaces the polar vortex to the western hemisphere. These vortex displacements are closely connected to the weather and climate in the corresponding areas. In contrast, during a La Niña winter, planetary waves are most active in February and March, and most SSW events occur at the same time. The distribution of the E-P flux indicates that planetary wave fluctuations are located between 90°E and 180°E, resulting in a displacement of the polar vortex with some associated changes in the related atmospheric circulation.

In addition, the mesospheric residual circulation (RC) reverses between February and March in both El Niño and La Niña years. Dynamical analyses using parameterized gravity waves show that the mesospheric meridional RC is closely connected to gravity-wave drag. This, in turn, is directly influenced by temperature and zonal wind patterns in the early and late winter of El Niño and La Niña years. These anomalies in the RC may influence the distribution of atmospheric constituents and should be explored further.

Résumé
Nous analysons l'influence des anomalies de température de surface de la mer de l'El Niño et de La Niña sur l'atmosphère moyenne au moyen d'un modèle chimie–climat, le Whole Atmosphere Community Climate Model, version 3 (SACCM3), et de l'ensemble de données réanalysées de 40 ans du Centre européen pour les prévisions météorologiques à moyen terme (ERA-40). Nous utilisons les données mensuelles moyennes pour effectuer des analyses statistiques et dynamiques. Nous trouvons des anomalies de température dans la stratosphère tant durant les années d'El Niño que de La Niña. Ces anomalies exhibent diverses configurations de distribution, que nous attribuons aux différentes échelles des ondes planétaires. Durant un hiver d'El Niño, les ondes planétaires sont plus actives en décembre et janvier, ce qui engendre davantage de perturbations du tourbillon polaire stratosphérique et une fréquence plus élevée d'événements de réchauffement stratosphérique soudain (RSS). Qui plus est, en nous basant sur le flux tridimensionnel d'Eliassen-Palm (E-P), nous trouvons que l'action principale des ondes se produit dans l'hémisphère oriental et déplace le tourbillon polaire vers l'hémisphère occidental. Ces déplacements de tourbillons sont étroitement liés aux conditions météorologiques et climatiques dans les régions correspondantes. En revanche, durant un hiver de La Niña, les ondes planétaires sont surtout actives en février et mars, et la plupart des événements de RSS se produisent à cette même époque. La distribution du flux d'E-P indique que les fluctuations des ondes planétaires ont lieu entre 90°E et 180°E, ce qui entraine un déplacement du tourbillon polaire avec quelques changements consécutifs dans la circulation atmosphérique associée.

De plus, la circulation résiduelle (CR) mésosphérique s'inverse entre février et mars, tant durant les années d'El Niño que de La Niña. Les analyses dynamiques utilisant des ondes de gravité paramétrisées montrent que la CR mésosphérique méridionale est étroitement liée à la résistance due aux ondes de gravité. Ce facteur, à son tour, est directement influencé par les configurations de température et de vent zonal au début et à la fin de l'hiver lors des années d'El Niño et de La Niña. Ces anomalies dans la CR peuvent influencer la distribution des constituants atmosphériques et devraient être explorées davantage.

Aerosol Model of the Marine and Coastal Atmospheric Surface Layer

by G. A. KALOSHIN AND I. A. GRISHIN

Abstract
We present a microphysical model for the surface layer marine and coastal atmospheric aerosols that is based on long-term observations of size distributions for 0.01–100 μm particles. The fundamental feature of the model is a parameterization of amplitudes and widths for aerosol modes of the aerosol size distribution function (ASDF) as functions of fetch and wind speed. The shape of ASDF and its dependence on meteorological parameters, height above sea level (*H*), fetch (*X*), wind speed (*U*) and relative humidity (*RH*), are investigated. At present, the model covers the ranges $H = 0 – 25$ m, $U = 3 – 18$ km s^{-1}, $X \leq 120$ km and $RH = 40 – 98\%$.

The latest version of the Marine Aerosol Extinction Profiles model (MaexPro) is described and applied for the computation and analysis of the spectral profiles of aerosol extinction coefficients α(λ) in the wavelength band λ = 0.2 - 12 μm. MaexPro is based on the aforementioned aerosol model assuming spherically shaped aerosol particles and the well-known Mie theory.

The spectral profiles of α(λ) calculated by MaexPro are in good agreement with observational data and the numerical results obtained from the Navy Aerosol Model (NAM) and the Advanced Navy Aerosol Model (ANAM). Moreover, MaexPro was found to be an accurate and reliable tool for investigating the optical properties of atmospheric aerosols.

Résumé
Nous présentons un modèle microphysique pour les aérosols atmosphériques marins et côtiers de la couche de surface, basé sur les observations à long terme des distributions granulométriques pour les particules de 0,01–100 μm. La caractéristique fondamentale du modèle est une paramétrisation des amplitudes et des largeurs pour les modes d'aérosols de la fonction de distribution granulométrique des aérosols (ASDF) comme des fonctions du fetch et de la vitesse du vent. Nous étudions la forme de l'ASDF et sa dépendance à l'égard des paramètres météorologiques : hauteur au-dessus du niveau de la mer (H), fetch (X), vitesse du vent (U) et humidité relative (HR). À ce moment-ci, le modèle couvre les intervalles $H = 0 – 25$ m, $U = 3 – 18$ km s^{-1}, $X \leq 120$ km et $HR = 40 – 98$ %.

Nous décrivons la dernière version du modèle Marine Aerosol Extinction Profiles (MaexPro) et l'appliquons pour le calcul et l'analyse des profils spectraux des coefficients d'extinction α(λ) dans la bande de longueurs d'onde λ = 0,2 - 12 μm. MaexPro est basé sur le modèle d'aérosols mentionné ci-dessus pour des particules d'aérosol de forme sphérique et la théorie bien connue de Mie.
Les profils spectraux de α(λ) calculés par MaexPro s'accordent bien avec les données d'observation et avec les résultats numériques obtenus du Navy Aerosol Model (NAM) et du Advanced Navy Aerosol Model (ANAM). Qui plus est, MaexPro s'est avéré un outil précis et fiable pour étudier les propriétés optiques des aérosols atmosphériques.

Validation of Forecast Cloud Parameters from Multispectral AIRS Radiances

by LOUIS GARAND, OVIDIU PANCRATI AND SYLVAIN HEILLIETTE

Résumé [traduit par la rédaction]
Nous adaptons la technique bien connue de la stratification radiative des canaux CO2 (technique "CO2-slicing"), qui fournit des extractions de paramètres nuageux (hauteur et couvert nuageux effectifs), pour la validation de modèles à l'aide de sondeurs infrarouges multispectraux. La technique est appliquée à la fois aux radiances réelles des sondeurs infrarouge de l'atmosphère (AIRS) et aux radiances simulées correspondantes des prévisions globales de 6 h et de 12 h pour les 31 jours de juillet 2008. Le modèle de prévision utilisé est le modèle opérationnel du Centre météorologique canadien. Les radiances sont simulées à l'aide du modèle RTTOV (transfert radiatif pour le sondeur vertical opérationnel du satellite TIROS — satellite d'observation par télévision et en infrarouge). Lorsqu'on les compare aux paramètres de nuages de la sortie du modèle, les extractions simulées nous aident à comprendre les biais systématiques inhérents à la technique d'extraction. Les erreurs systématiques d'intérêt, attribuées aux paramètres de nuages des prévisions, sont alors évaluées plus clairement à partir des extractions réelles. C'est là l'idée maîtresse de cet article. La définition proposée du sommet des nuages du modèle, basée sur la transmittance des nuages, correspond bien à la hauteur dérivée de l'instrument CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation). Ces hauteurs de nuages dérivées du lidar confirment, à leur tour, la nature des biais produits par la technique de la stratification radiative (p. ex., un biais négatif augmentant avec la hauteur jusqu'à environ 2 km — approximativement 50 hPa — pour les nuages les plus hauts à 16 km — approximativement 100 hPa —). Les résultats semblent indiquer que le modèle a tendance à produire un surplus de nuages bas en dessous de 2 km, compensé par un déficit de nuages entre 3 et 6 km. Aucune différence appréciable n'est observée entre les champs mensuels des prévisions de 6 h et de 12 h, ce qui semble indiquer qu'une période de démarrage de quelques heures pour le modèle est suffisante. Nous comparons les champs mensuels globaux des paramètres de nuages extraits à des produits indépendamment dérivés fournis par le

spectromètre imageur à résolution moyenne (MODIS) et le traitement courant de l'AIRS. Nous observons des différences appréciables, liées aux différentes méthodes d'extraction, aux données en entrée et à la résolution. Cela souligne en outre que, pour les besoins de la validation, les définitions des paramètres observés et des paramètres des modèles doivent être cohérentes.

Process Study of Dry-Season Circulation in the Pearl River Estuary and Adjacent Coastal Waters using a Triple-Nested Coastal Circulation Model

by XIAOMEI JI, JINYU SHENG, LIQUN TANG, DABIN LIU AND XUELIAN YANG

Abstract
The Pearl River Estuary (PRE) on the east coast of Guangdong Province in South China is a complicated hydrodynamic system affected by various forcing functions including tides, wind forcing and sea surface heat and freshwater fluxes. The PRE also receives a large amount of freshwater runoff from the Pearl River through eight major river inlets. In this study, the three-dimensional circulation, hydrography, and associated temporal variability in the PRE and adjacent coastal waters during the dry season from December to March are examined using a triple-nested coastal ocean circulation modelling system based on the Princeton Ocean Model. Four numerical experiments are conducted by driving the triple-nested modelling system with different combinations of external forcing functions. Analysis of multi-year model results in the four experiments demonstrates that the estuarine plume in the dry season is close to the western shoreline of the PRE, mainly due to the combination of the low Pearl River discharge and the influence of the southwestward coastal current over the inner shelf of the northern South China Sea. Temperature and salinity inside the estuarine plume in the dry season are weakly stratified in the vertical, with large horizontal salinity gradients near the frontal zone of the plume. Baroclinic dynamics play a very important role in the plume, with the frontal circulation forced by the combination of wind, tides and the Pearl River discharge. Over the offshore deep waters of the PRE in the dry season, vertical stratification in the top 15 m is weak and circulation can be approximated by barotropic dynamics forced by wind forcing and tides.

Résumé
L'estuaire du fleuve Perle (EFP) sur la côte est de la province de Guangdong, dans le sud de la Chine, est un réseau hydrodynamique complexe soumis à diverses fonctions de forçage, y compris les marées, le forçage par le vent et les flux de chaleur de la surface de la mer et d'eau douce. L'EFP reçoit aussi une grande quantité d'eau douce de ruissellement du fleuve Perle par le biais de huit affluents importants. Dans cette étude, nous examinons la circulation tridimensionnelle, l'hydrographie et la variabilité temporelle connexe dans l'EFP et les eaux côtières adjacentes durant la saison sèche de décembre à mars au moyen d'un système de modélisation de la circulation océanique côtière triplement imbriqué basé sur le modèle océanique de Princeton. Nous menons quatre expériences numériques en fournissant au système de modélisation triplement imbriqué différentes combinaisons de fonctions de forçage externe. L'analyse des résultats du modèle sur plusieurs années dans les quatre expériences démontre que le panache estuarien pendant la saison sèche est près du rivage ouest de l'EFP, surtout à cause de la combinaison du faible débit du fleuve Perle et de l'influence du courant côtier vers le sud-ouest sur la plate-forme interne du nord de la mer de Chine méridionale. La température et la salinité à l'intérieur du panache estuarien durant la saison sèche sont faiblement stratifiées dans la verticale, avec de forts gradients horizontaux de salinité près de la zone frontale du panache. La dynamique barocline joue un rôle très important dans le panache, où la circulation frontale est forcée par la combinaison du vent, des marées et du débit du fleuve Perle. Dans les eaux profondes extracôtières de l'EFP en saison sèche, la stratification verticale dans les 15 premiers mètres est faible et la circulation peut être approximée par la dynamique barotrope forcée par le forçage du vent et les marées.

An Overview of the Second Generation Adjusted Daily Precipitation Dataset for Trend Analysis in Canada

by ÉVA MEKIS AND LUCIE A. VINCENT

Abstract
A second generation Adjusted Precipitation daily dataset has been prepared for trend analysis in Canada. Daily rainfall and snowfall amounts have been adjusted for 464 stations for known measurement issues such as wind undercatch, evaporation and wetting losses for each type of rain-gauge, snow water equivalent from ruler measurements, trace observations and accumulated amounts from several days. Observations from nearby stations were sometimes combined to create time series that are longer; hence, making them more useful for trend studies. In this new version, daily adjustments are an improvement over the previous version because they are derived from an extended dataset and enhanced metadata knowledge. Datasets were updated to cover recent years, including 2009. The impact of the adjustments on rainfall and snowfall total amounts and trends was examined in detail. As a result of adjustments, total rainfall amounts have increased by 5 to 10% in southern Canada and by more than 20% in the Canadian Arctic, compared to the original observations, while the effect of the adjustments on snowfall were larger and more variable throughout the

country. The slope of the rain trend lines decreased as a result of the larger correction applied to the older rain-gauges while the slope of the snow trend lines increased, mainly along the west coast and in the Arctic. Finally, annual and seasonal rainfall and snowfall trends based on the adjusted series were computed for 1950–2009 and 1900–2009. Overall, rainfall has increased across the country while a mix of non-significant increasing and decreasing trends was found during the summer in the Canadian Prairies. Snowfall has increased mainly in the north while a significant decrease was observed in the southwestern part of the country.

Résumé
Un ensemble de données quotidiennes de précipitations ajustées de deuxième génération a été préparé pour l'analyse des tendances au Canada. Les hauteurs quotidiennes des chutes de pluie et des chutes de neige ont été ajustées pour 464 stations en fonction de problèmes connus comme la sous-capture due au vent, l'évaporation et les pertes par mouillage pour chaque type de pluviomètre, l'équivalent en eau de la neige selon des mesures avec une règle, les observations de traces et les hauteurs accumulées de plusieurs jours. Les observations de stations situées à proximité ont parfois été combinées pour créer des séries chronologiques plus longues et donc plus utiles pour les études de tendance. Dans cette nouvelle version, les ajustements quotidiens constituent une amélioration par rapport à la version précédente parce qu'ils sont dérivés d'un ensemble de données étendu et d'une meilleure connaissance des métadonnées. Les ensembles de données ont été mis à jour pour inclure les années récentes, y compris 2009. L'effet des ajustements sur les hauteurs totales et les tendances des chutes de pluie et des chutes de neige a été examiné en détail. En raison des ajustements, les hauteurs totales de pluie ont augmenté de 5 à 10 % dans le sud du Canada et de plus de 20 % dans l'Arctique canadien, comparativement aux observations originales, alors que l'effet des ajustements sur les chutes de neige était plus important et plus variable à travers le pays. La pente des lignes de tendance de la pluie a diminué par suite de la plus forte correction appliquée aux pluviomètres plus anciens alors que la pente des lignes de tendance de la neige a augmenté, surtout le long de la côte ouest et dans l'Arctique. Finalement, les tendances annuelles et saisonnières des chutes de pluie et des chutes de neige basées sur les séries ajustées ont été calculées pour 1950–2009 et 1900–2009. Dans l'ensemble, les chutes de pluie ont augmenté dans le pays alors qu'on a trouvé un mélange de tendances non significatives à la hausse et à la baisse durant l'été dans les prairies canadiennes. Les chutes de neige ont augmenté principalement dans le nord alors qu'une diminution marquée a été observée dans la partie sud-ouest du pays.

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Quantifying Snowfall Rates Using Underwater Sound by TAHANI ALSARAYREH AND LEN ZEDEL

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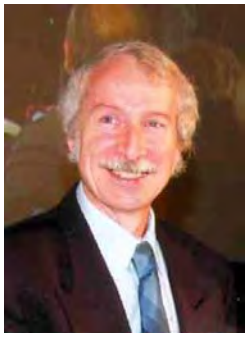
An Overview of the Second Generation Adjusted Daily Precipitation Dataset for Trend Analysis in Canada by ÉVA MEKIS AND LUCIE A. VINCENT

Bob Keeley wins international award



Bob (Robert J.) Keeley was presented with the International Oceanographic Data and Information Exchange (IODE) Achievement Award by Wendy Watson-Wright, Ph.D., Assistant Director General and Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), at the IODE 50th Anniversary International Conference, on March 21 2011.

Bob Keeley retired in 2010 after more than 30 years of service at the Integrated Science Data Management (ISDM) branch of Ocean Sciences - Canadian Hydrographic Service. He was an important contributor on the international data exchange and management forum, fostering international cooperation and standards within the international community, while at the same time making DFO benefit from the fruits of this work.

This award expresses special appreciation for the experts who contributed time and effort to develop and grow the IODE programme to an active global network of data and information centres, ever since its inception as a committee of IOC in 1961.

BOOK REVIEWS / REVUES de LITTÉRATURE

Measuring Global Temperatures Their Analysis and Interpretation

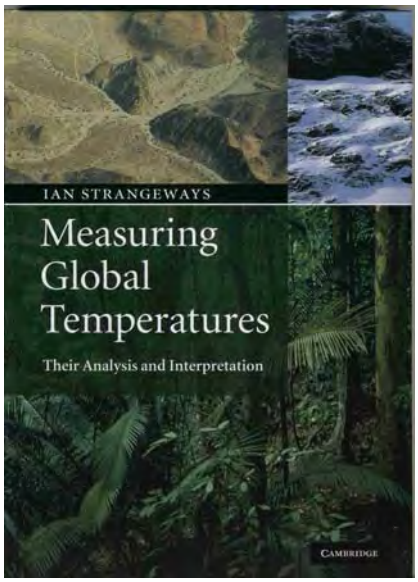
by Ian Strangeways

Cambridge University Press, New York, 2010
pp. 233, 11 chapters, 52 figures, 1 table, index 6 pages
ISBN 978-0-521-89848-5, Hardback, US$115

Book reviewed by Kenneth A. Devine[1]

Dr. Strangeways has again put pen to paper, so to speak, and brought out another parameter specific survey. This time it concerns temperature measurements and how they are brought together to determine global temperatures. His intent was like his previous books, for the more general meteorological scientist than the climate change specialist. The book consists of eleven chapters with six appendices which cover detailed scientific material.

Chapters



1. The Balance of Energy covers the source of radiation from the sun including variations and modification by the atmosphere. After the usual description of radiation balance in the atmosphere, the author expands to cover the latent heat and convection energy transfers. The energy balance within the troposphere results in a retention of 155 W/M^2 due to green-house gases (GHG) that increase the average temperature by 21ºC. There is a short description of the common radiation sensors, namely the sunshine recorder, pyranometer and net radiometer. Finally changes to the solar constant caused by the sun itself are mentioned.

2. Thermometry covers the sensors or sensing systems used to measure surface temperature. A historical description of the development of thermometers is followed by the changes in temperature scales up to the presently used Celsius and Kelvin. Besides the mechanical bimetal, the electrical sensors such as: resistance, capacitance, thermocouple and thermistor are described. The author points out the drift that can occur in all of these sensors could become serious after a decade or two (~0.3Cº) in operational use. Remote sensing is touched upon only slightly.

3. Sensor screens are necessary to allow the measurement of air temperature while being bathed in radiation. The louvred screen presently used to measure temperature evolved from earlier ones which were open on the north side. But fully louvred screens like the Stevenson became the norm until faster response miniature and flat plate screens were developed in the mid 20th century. Aspiration of the sensors greatly reduces heat buildup in the screens and reduces random errors. A fixed height above ground for temperature sensors is recommended but this is not the case in Canada.

4. Measuring air temperature on land covers the operational techniques necessary for accurate temperatures. The difficulties include much more than just sensors and screens. Overall exposure and maintenance are just as important. Screens can become clogged with snow or even be completely overcome with rising snow depth. The author sarcastically commented that "…keeping the screens clean may seem an utterly trivial point hardly worthy of mention in comparison with the clever statistics used to process the data".

5. Measuring marine temperatures discusses the more difficult problems encountered on the oceans. Sea surface temperatures (SST) are more consistent than the air temperatures above the surface since the latter is strongly affected by surrounding environment such as on a ship and by the height above the water such as for buoys. Starting with buckets, SST measurements have included intake, hull and skin temperatures using a radiometer. But buoys, both moored and drifting, offer more consistent measurements over volunteer ships which are gradually disappearing.

6. Both historic and advanced systems have been used to measure ocean temperature profiles. The bathythermograph was used historically to measure water temperature profiles. But even with the expendable versions a ship was required for their deployment and only a single profile was obtained. Drifting profilers have been used since the 1980s to measure temperatures and salinity. One major advantage is that multiple profiles are taken with each drifter; as well, the data is transmitted in near real time when the profiler automatically surfaces for a few hours.

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Aurora, Ontario, Canada

7. International cooperation has fostered global networks for the determination of global temperatures. This rather short chapter starts with individual researchers such as W. Koppen who used relatively few observations to define the climate types for the world in the early 20th century. Now large scale cooperation is necessary to bring together the national services and to set standards for these global systems such as GCOS.

8. Diverse measurements are used to produce global averages. Starting with station averages the text moves quickly onto anomalies which allow extraordinary temperature changes to be revealed. Finally gridding of these averages brings them together to produce the global datasets.

9. Historical measurements show what changes have occurred in temperatures. This, the longest chapter in the book, examines the changes over time such as those for central England over the last three-and-a-half centuries. The correlation between the indices such as the Southern Oscillation Index and natural influences such a volcanoes are described with their effects on the global average temperatures trends. There seems to be more emphasis on indices than on the natural forces which determine the indices.

10. Upper air measurements produced vertical profiles which are used both operationally and for climatological studies. The author returns again to the instrumentation but this time for aerological purposes. Early measurements, radiosondes and profilers are all described. The trends in these upper air measurements show a slight increase over the last fifty years but some researchers have indicated that it is not significant.

11. The author brings his discussion to a conclusion by recommending methods for future climate measurements. For surface temperatures his recommendations include platinum resistance sensors in aspirated screens which are distant from human habitations and older meteorological stations. As he pointed out earlier, only a limited number of stations (350) would be required to determine regional and global temperatures.

As in his former books, Ian Strangeways writes in a very readable style. But the reader has to keep track of his frequent, though possibly necessary, use of acronyms. This book would be worthwhile for anyone using temperature data from the networks such as climate researchers and those professionals responsible for operational networks as well as for those who wish an overall view of how temperatures are used.

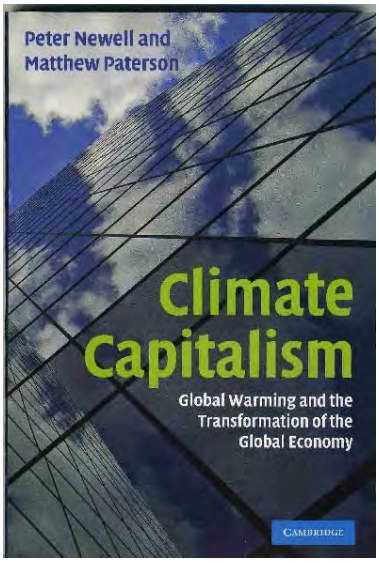
Climate Capitalism: Global Warming and the Transformation of the Global Economy

by Peter Newell and Matthew Paterson

Cambridge University Press, Paperback
ISBN 978-0-521-12728-8, pp. 205, US$30.

Book reviewed by John Stone[2]

As is well known, there are basically two responses to addressing the threat of climate change: reducing emissions and adapting to its impacts. Both responses will be necessary. Because of the physical inertia in the climate system as well as the drivers of anthropogenic climate change, future impacts are now inevitable and adaptation has become an imperative. Nevertheless, to have any chance of avoiding even worse impacts, it is clearly essential that we eliminate the imbalance in the climate system by reducing the emissions of greenhouse gases into the atmosphere as a result of our burning of fossil fuels.



But by how much must we reduce emissions? The national delegations that crafted the UN Framework Convention on Climate Change wrote that we should avoid "dangerous" interference with the climate system which poses the further question of what is dangerous. This is something to which science can provide some guidance but ultimately it depends on what is valued by society, something which itself depends on where you live and how you live. To add some quantitative elaboration, governments are now coalescing around the notion of keeping global temperature increases below 2°C. This, despite all the science that tells us we are running out of time, now seems almost unattainable. Any higher temperature increases will have to be managed by adaptation but adaptation has limits and we will per force have to have contingency plans for worst case possibilities.

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The tools available to achieving emission reductions, effectively decarbonising the economy, are either technological or economic. Technology will be needed to improve energy efficiency and produce less carbon-emitting fuels. There will be no silver bullet; we will need an armoury of technologies most of which are already available. These possibilities are well known to CMOS members. What will be less well known are the economic possibilities. To help the curious enquirer Peter Newell and Ottawa University Professor, Matthew Paterson, have collaborated to write a helpful guide: "*Climate Capitalism*" whose sub-title should be "From Threat to Opportunity".

Contrary to what might be expected from the title, the authors are no unreconstructed merchants of greed, arguing for weak regulation, free markets and small government, but indeed quite the opposite. The authors argue that the origins of climate change are deeply rooted in the global capitalist economy. Capitalism here refers to economic systems driven by the logic of accumulation (as opposed to sharing) of capital or other resources in economic activity. It should not be confused with consumerism which is all about lifestyles. Recalling Nicholas Stern's statement that climate change is the biggest market failure that we have seen, the authors turn this around and explore in their slim volume whether it is possible to use the power of the market to decarbonize our economy. This will require coordinated policy responses by governments around the World in an attempt to align the interests of a multitude of stakeholders. This will be an enormous challenge; we have seen in the United States and elsewhere how tackling climate change has clashed with explicit or unacknowledged political ideologies (for example the role of governments, constraints on business and trade to say nothing of moral issues).

The book challenges the argument of some political leaders that addressing climate change cannot be achieved without damaging economic growth. The current initiative of the National Roundtable on the Environment and the Economy on *Climate Prosperity* similarly seeks to dispel this argument (much to the displeasure of the government). In a recent joint statement by some of the World's best-known enterprises: "tackling climate change is the pro-growth strategy; ignoring it will ultimately undermine economic growth". From my own experience in discussions with senior leaders of some of Canada's largest companies, it is clear that they not only recognize that the issue of climate change will not go away but that with smart actions they can make long-term returns for the shareholders. What they continue to lack is confidence that the government will put in place a consistent and durable enabling environment.

The authors discuss some initial and encouraging examples that are being taken. Most of these examples involve the notion of a carbon market. A necessary condition for such a market is that there be a price on carbon emissions achieved through constraints on emitters by schemes such as "cap and trade". Such a price not only reflects the social costs to the environment as a result of our dumping into the atmosphere the wastes from our burning fossil fuels but also provides economic incentives for businesses to become more energy efficient and so save money. It is aligned with the liberal notions of free trade and globalization and turns climate change into a question of trade and investment; carbon becomes a commodity. Examples that are discussed in the book include the European Union Emission Trading Scheme, which will soon be in its third phase, and the Kyoto Protocol "flexibility mechanisms" such as the Clean Development Mechanism (CDM) and Joint Implementation (JI).

As encouraging as these examples may be, they do raise some troubling issues. They transfer perhaps too much power to the financial sector. As a result they open up the possibility of gaming, the sort of trickery that caused the recent financial collapse, where the products that are traded turn out to be unsupported by real assets. The authors refer to this as "Enron environmentalism": creative accounting where either what appears on the books bears no relation to activities undertaken or where carbon savings that are expected to be made in the future are counted as savings made in the present. The parallel between the climate change problem and the financial sector can be quite instructive for in both we are building up debt for future generations by not addressing fundamental imbalances now.

The use of carbon offsets also raises worrying concerns. In this case emissions in the North are traded for emission reduction actions in the South, for example by forest conservation or regeneration - similar to religious indulgencies of the medieval period. This is seen by some as carbon colonialism, an insidious attempt to regain control of developing country resources. In fact there are several examples that suggest such carbon financing performs ineffectively as a means of improving the lot of poor people; they fall short in their ability to steer investment where it is most needed.

Addressing climate change can be regarded as a "wicked problem" Such problems are difficult to frame, constantly changing, with no one simple solution, where the methods of normal science are inadequate and where the best we can do is to reach "maybe". A useful approach to tackling such problems has been that of "learning by doing" and we indeed seem to have fallen into following this path. There will be mistakes and absent any overall strategy we will continue to muddle along. The authors of this book, while maintaining a healthy scepticism, have provided a valuable text that could help decision-makers avoid stumbling into making an already dangerous threat worse.

Of Seas and Ships and Scientists

The remarkable story of the UK's National Institute of Oceanography 1949-1973 [3]

or in other words

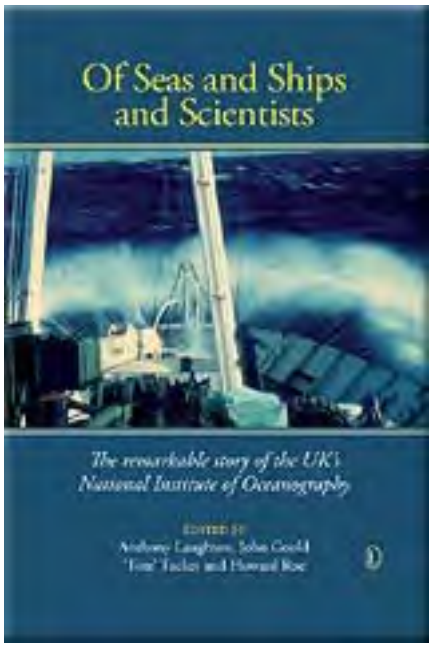
The Pioneers of Wormley

Edited by A.S. Laughton, W.J. Gould, M.J. Tucker and H.S.J. Roe

The Lutterworth Press, 2010, Paperback, 350pp, £25
ISBN 978-0-7188-9230-2

Book Reviewed by John Phillips[4]

When I first studied oceanography in the 1960s the terms 'NIO' and 'Wormley' seemed synonymous, so it may still be useful to distinguish between the Wormley site, which hosted oceanographic research for more than forty years (1953-95), and the Institute (1949-73) that occupied the site for the first twenty of those years and is the subject of this book.



The National Institute of Oceanography was formed by bringing together scientific staff from three existing organisations: the Discovery Investigations, which began in 1923 with the primary objective of conducting research to support the whaling industry in the Antarctic, based at the British Museum (Natural History); Group W (for Waves) of the Admiralty Research Laboratory at Teddington, set up in June 1944 to develop methods for predicting the waves encountered by amphibious landings on hostile shores, and the Oceanographic Branch of the Hydrographic Office at Cricklewood. The new body was placed under the leadership of George Deacon, previously head of Group W. The political and adminstrative background to its formation, and the history of Britain's relative neglect of oceanography during the preceding half century, are well described in Chapter 2 by Deacon's daughter, Margaret, using largely unpublished sources. (Chapter 1 summarises the development of marine science in Europe and North America since the mid-seventeenth century.) Deacon had left the Discovery Investigations on secondment to the Admiralty in 1939 and joined the Royal Naval Scientific Service in 1946. His oceanographic experience already went back to 1928-29, when he sailed as chemist on the *William Scoresby* in the waters around South Georgia. Chapter 3, by Margaret Deacon and Sir Anthony Laughton, is devoted to his career.

The Institute remained an 'invisible college' until its scattered personnel were brought together by the move to Wormley in 1953, making fresh synergies possible. The spacious building acquired for NIO was well suited to its new purpose, although its location in Surrey, about 40 km from the sea, was something of a compromise, proximity to London being a major consideration. Thus UK oceanographers had, for the first time, a worthy focus with a name to match. This happy congruence lasted for twenty years until the reorganisation of 1973, when incorporation of the Institute of Coastal Oceanography and Tides at Bidston, near Liverpool, and the Unit of Coastal Sedimentation at Taunton brought about a change of name to the Institute of Oceanographic Sciences (IOS). There were further changes in 1987, when the Bidston laboratory was separated to become the Proudman Oceanographic Laboratory (POL) and IOS was renamed the Institute of Oceanographic Sciences Deacon Laboratory. (The Taunton laboratory had been closed two years earlier.) Soon afterwards, planning started for a radically different approach to oceanographic education and research in conjunction with the University of Southampton. This eventually led to creation of the Southampton Oceanography Centre (SOC) and closure of the Deacon Laboratory. The move to Southampton took place in 1995 and the buildings vacated at Wormley were subsequently demolished to make way for luxury flats. Sir Anthony Laughton and Howard Roe describe this series of changes in the final chapter – Chapter 20.

Between these 'bookends' lies the heart of the book: sixteen chapters written by a total of fifteen NIO veterans, recounting life and work in Britain's oceanographic community during its formative period and consolidation. They cover the Institute's research activities in all departments of marine science. To mention a few examples: pioneering studies of vertical structure in pelagic ecosystems; invention of the neutrally buoyant (Swallow) float to track deep water movements; precise measurement of relationships between the fundamental properties of sea

[3] Fist published in *Ocean Challenge*, Journal of the Challenger Society for Marine Science, Vol.18, Winter 2011, pp. 49-50.

[4] Milton Keynes, U.K.

water, on which the International Oceanographic Tables were based; combined theoretical and observational investigations of wind waves, which had important applications in the offshore oil industry; and the development of a powerful side-scan sonar mounted in a towed body (GLORIA) for surveys of the ocean floor.

All these achievements were underpinned by close liaison with the Institute's support services, in particular the Engineering and Applied Physics Groups who designed and built the necessary instrumentation and underwater gear – from the once familiar yellow polypropylene water bottles to the six-tonne bulk of GLORIA – and the officers and crew of the research vessels from which the equipment was deployed (RRS *Discovery II* until 1962 and the new RRS *Discovery* thereafter). Their essential contributions, together with those of the Library and Information Service, the Secretary and his administrative staff, are all recorded here.

The level of treatment ranges from the mildly personal to the seriously technical, depending as it must on the style of the individual author. For similar reasons the same episode is sometimes described more than once, although from different viewpoints. Despite these changes of focus several themes emerge. One of these is the leadership given by the Institute's founding director, George Deacon, knighted on his retirement in 1971, and by his worthy successor, Henry Charnock, who had worked at NIO for most of its existence prior to 1966. It seems clear that Deacon's informal approach to recruitment and his encouragement of staff to pursue promising ideas of their own were reflected in the respect they had for him. Charnock took a similar view about the priority of research and saw NIO through the difficult years of transition to IOS and beyond. The value of cooperation is another recurrent feature, whether it was within NIO or between the Institute and outside organisations. The teamwork necessary for successful research at sea consolidated working relationships among all concerned. Productive relations were maintained, often through personal contacts, with the Admiralty, with other government laboratories, the universities (Cambridge in particular) and with industry. On the international scale there was participation in major programmes of research, including the International Geophysical Year (1957/8), the International Indian Ocean Expedition (in 1963-64) and the Deep Sea Drilling Project (from 1969), as well as frequent collaboration with scientists from laboratories overseas, especially the Institute's neighbour across the pond, Woods Hole. During its residence at Wormley, NIO expanded roughly threefold in staff numbers and in expenditure (adjusted for inflation). It seems to have been an unusually happy ship.

Some of these advantages diminished when the Institute was absorbed into NERC in 1965; as bureaucratic control spread, the element of autonomy was lost. After 1972 balanced long-term funding became problematic, following introduction of the policy of commissioned research based on the Rothschild report. A justified air of nostalgia for the earlier years is present in several chapters.

Looking back half a century from these days of bigger science and tighter budgets, it's obvious that much has changed, although some original features remain: the joys and terrors of working at sea, to name but a few. Only one sea-going woman appears in these pages, a small figure in the group photo on p.275 taken aboard RRS *Discovery* in 1963 (Betty Kirtley, where are you now?) – some things have changed for the better. And what of the future? Inevitably uncertain, but if recent history is any guide, the Bidston laboratory can expect to regain its independence around 2025, thereby completing its second cycle of administrative accountability. There's nothing as recurrent as change!

When I heard about this book I feared it might be a dull institutional chronicle, a tale of committees, budgets and memoranda; it is not. The editorial team has assembled these first-hand accounts of oceanographic research and set them within a broader context in order to tell the illustrious story of NIO. The result is a book that is both accessible and historically valuable. Finally, I must mention that it has clear illustrations throughout, a comprehensive index and several useful annexes, including detailed cruise lists for both 'Discoveries'.

Note from the Editor: Thanks to Langley Muir for suggesting to the author to publish this review in the *CMOS Bulletin SCMO*. A very much appreciated initiative!

Ocean Circulation: Wind-driven and Thermohaline Processes

by R. X. Huang

Cambridge University Press, 2010, Hardback, 791 pages
ISBN 978–0 521-85228-9, US$85.

Book reviewed by Rich Pawlowicz[5]

Physical oceanography is at its heart an intensely mathematical field. The pinnacle of this tendency is perhaps the long-established stream of research developing the theory underlying the ocean general circulation. Based largely on a few simple dynamical concepts, centred around the role of the Coriolis "force" and its implications for steady flows on the shell of a spherical earth, these theoretical

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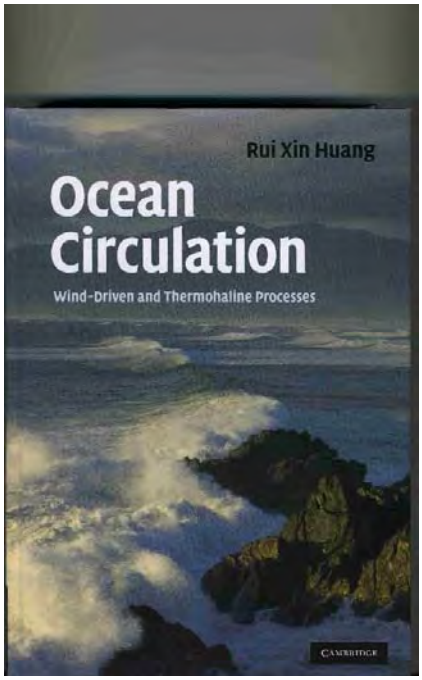
investigations have proved astoundingly useful in shaping our perceptions of the workings of the ocean. Books like Pedlosky's "Geophysical Fluid Dynamics" (2nd edition 1987), and his more advanced "Ocean Circulation Theory" (1996) provide results that seem to replicate many observed features of our oceans. However, these books are now somewhat dated, and there has been much observational, theoretical, and conceptual progress in this area in the past 15 years. Thus the arrival of this advanced reference, written by one of the major exponents of the field, is welcome and timely.



The book is divided into two parts. The first part (Chapters 1 to 3) is mostly concerned with "setting up the problem". First (Chapter 1), we are given a good overview of the temperature and salinity structure of the ocean, with figures based on various global climatologies. Then (Chapter 2), we are led through a development of the basic dynamical equations. A welcome part of this chapter is a long and detailed discussion of thermodynamics. In many ways, our ability to precisely and repeatably measure temperature and conductivity (or "Practical Salinity") in the ocean has outstripped our theoretical understanding of what these measurements really represent and how they should be treated. The recent reformulation of the equation of state using a Gibbs function, now formally adopted under the name TEOS-10 as the recommended method of determining the physical properties of seawater (IOC et al., 2010), lets us take advantage of these precise measurements by carefully considering thermodynamical parameters. This means becoming familiar with concepts such as enthalpy and entropy (as well as energy), which should now become a part of the basic education of every physical oceanographer. Chapter 3 is also new and worthwhile. In this chapter an attempt is made to describe the ocean using energy concepts, which can now be done comprehensively starting with a thermodynamical underpinning. A tentative attempt is made to budget energy for all important mechanisms of the circulation.

The second part of the book is concerned with theories of the wind-driven circulation (Chapter 5) and thermohaline circulation (Chapter 6). The beginning of these chapters follows well-worn paths, but they quickly move on to more current results. The book ends with a discussion of means by which the wind-driven and thermohaline circulations can be combined. One unifying feature is that layer models are used almost exclusively, without the additional restriction to layers of almost constant thickness that leads to QG and streamfunction formulations.

One difference from the earlier texts mentioned above is the tone of the mathematical presentation. The rigour and logical development in the earlier books always gave the (at least initial) impression of a finished product. Selected results were presented as buffed and shiny pearls on a pedestal of logical and mathematical perfection! In contrast, the presentation in this work tends towards briefer, even "sketch-like" descriptions over a more comprehensive range of subjects. It is clear that much work still remains to clarify the implications of dynamical principles in many particular applications. In this sense the book is a useful reference to the current state of the art, although also likely to become obsolete much more rapidly. However, although there are some 21 pages of literature references, as well as a 2 page list of "suggested readings" for the different chapters, the density of citations is low in many parts of the text. This is suitable for a textbook but makes it more difficult to use a reference in order to access the primary literature. On the other hand, no problem sets are provided, making it less useful as a pure textbook.

In general, the presentation is highly readable. I found no typographical or grammatical errors. However, although the sentences themselves are readable, the meaning of the text is sometimes obscure. It is not clear if a crucial "not" is missing in some places, so that the deeper meaning of a paragraph should in fact be the reverse of what is written. Analogies are sometimes suspect. In addition, the overall organization shows clear signs of its ancestry in the notes for a graduate course (or courses). There are a number of occasions when a paragraph, jarringly, contains almost the same information that was presented a few pages back (perhaps in the notes for a previous lecture?). On the other hand, a variable σg , "global pressure corrected density" (apparently different from potential density and neutral density), is used in section 5.2.1 without being defined (perhaps in material that was dropped?).

There is a generous section of colour plates, with gray-scaled versions of these and many other figures integrated with text, improving the flow. One pedantic criticism would be that many of these images are not, strictly speaking, "maps", since they merely present the data over a crude grid of equally-spaced latitudes and longitudes. The result is neither equal-area, nor conformal. Even worse, the longitude grids are broken at 0 degrees , thus splitting the Atlantic between the left and right sides of the images. There is no good reason for doing this in a text that is trying to unify descriptions of all oceans!

Finally, although the mathematical theory is developed in a clear and lucid way, the descriptions of more practical aspects of physical oceanography lack clarity (e.g., the definition of temperature on p. 74), or are just incorrect (viz., "the common expression of salinity is the practical salinity unit, which is defined in parts per thousand", p. 85). It is also unfortunate (but perhaps unavoidable) that the notation in this text does not match with recent recommendations (IOC et al., 2010), which may lead to confusion. In particular, potential temperature is assigned the non-standard symbol Θ, likely to avoid confusion with the use of θ for latitude. However, potential temperature is usually designated with θ, and Conservative Temperature, a new variable defined by TEOS-10 which more accurately reflects the heat content, is denoted by Θ.

In spite of these shortcomings, this book should be required reading for anyone teaching ocean dynamics at the graduate level, will be a useful reference for anyone with research interests in this area, and is an interesting and enjoyable read for anyone else with a mathematical inclination and a curiosity about the ocean general circulation.

References:

IOC, SCOR, and IAPSO, *The international thermodynamic equation of seawater - 2010: Calculation and use of thermodynamic properties*, Intergovernmental Oceanographic Commission, UNESCO (English), Manual and Guides No. 56, Available from http://www.TEOS-10.org, 2010.

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

Latest Books received / Derniers livres reçus

2010-24) *The Climate Connection, Climate Change and Modern Human Evolution*, by Renée Hetherington and Robert G.B. Reid, Cambridge University Press, Paperback, ISBN 978-0-521-19770-0, pp.422, $44.

2010-29) *Contemporary Issues in Estuarine Physics*, Edited by Arnoldo Valle-Levinson, Cambridge University Press, Hardback, ISBN 978-0-521-89967-3, pp. 315, $120.

2010-31) *Introduction to Atmospheric Physics*, by David G. Andrews, 2nd edition, Cambridge University Press, Paperback, ISBN 978-0-521-69318-9, pp. 237, $65.

2011-01) *Discoveries of the Census of Marine Life, Making Ocean Life Count,* Paul V.R. Snelgrove, Cambridge University Press, Paperback, 2010, ISBN 978-1-107-00013-1, pp. 270, US$45.

2011-02) *Internal Gravity Waves*, by Bruce R. Sutherland, 2010, Cambridge University Press, ISBN 978-0-521-83915-0, Hardback, pp.377, US$120.

2011-03) *Groundwater Modelling in Arid and Semi-Arid Areas*, Edited by Howard S. Wheater, Simon A. Mathias and Xin Li, International Hydrology Series, Cambridge University Press, ISBN 978-0-11129-4, Hardback, pp.137, US$99.

2011-05) *Climate Change and Climate Modeling*, by J. David Neelin, Cambridge University Press, ISBN 978-0-521-60243-3, Paperback, pp.282, US$55.

2011-06) *Numerical Weather and Climate Prediction*, by Thomas Tomkins Warner,Cambridge University Press, ISBN 978-0-521-51389-0, Hardback, pp.526, US$75.

2011-07) *The Development of Atmospheric General Circulation Models, Complexity, Synthesis and Computation*, Edited by Leo Donner, Wayne Schubert and Richard Smerville, Cambridge University Press, ISBN 978-0-521-19006-0, Hardback, pp.255, US$85.

2011-09) *Principles of Planetary Climate*, by Raymond T. Pierrehumbert, Cambridge University Press, ISBN 978-0-521-86556-2, Hardback, pp.652, US$80.

2011-11) *Climate Change and Climate Modeling*, by J. David Neelin, Cambridge University Press, ISBN 978-0-521-60243-3, Paperback, pp.282, US$55.00.

2011-12) *Economic and Societal Impacts of Tornadoes*, by Kevin M. Simmons and Daniel Sutter, American Meteorological and Oceanographic Society, ISBN 978-1-878220-99-8, pp.282, 13 color plates.

2011-13) *Radiation in the Atmosphere, A Course in Theoretical Meteorology*, by Wilford Zdunkowski, Thomas Trautmann and Andreas Bott, Cambridge University Press, ISBN 978-0-521-87107-5, Hardback, pp.482, US$135.00.

2011-14) *Tropical Montane Cloud Forests*, edited by L.A. Bruijnzeel, F.N. Scatena and L.S. Hamilton, International Hydrology Series, Cambridge University Press, ISBN 978-0-521-76035-5, Hardback, pp.740, US$110.00.

2011-15) *Generation Us, The Challenge of Global Warming*, by Andrew Weaver, Raven Books (Rapid Reads), ISBN 978-1-55469-804-2, pp.123, CDN$9,95.

SHORT NEWS / NOUVELLES BRÈVES

CFES 2011 Mentorship Medal to Dr. Douw Steyn

The 2011 Canadian Federation of Earth Sciences (CFES) Mentorship Medal has been awarded to Dr. Douw Steyn of the Department of Earth and Ocean Sciences at the University of British Columbia.

Douw Steyn received his undergraduate degrees in Physics and Applied Mathematics from the University of Cape Town (UCT), after which he spent six years working for UCT. Some of that time was spent in the School of Environmental Studies, a foray that sparked a life long interest in atmospheric sciences.

In 1976, Douw came to UBC to pursue a PhD; under the supervision of Prof. Tim Oke in the Department of Geography, he studied atmospheric turbulence over coastal cities. He subsequently joined the Deparment of Earth and Ocean Sciences where he joined a multidisciplinary group working across the entire spectrum of Earth Sciences.

Dr. Steyn's main scientific interest has always been urban air pollution and he has never shied from going public with sometimes unpopular conclusions. In doing so, he inspired colleagues and students alike.

His students have described him as a model supervisor. He understands their diverse talents and how these skills can be useful in a diverse work environment. Douw Steyn describes mentoring as engaging with students on as many levels and within as many spheres as they are prepared for.

These former students now work in all levels of government in Canada, as well as for foreign companies and institutions.

Dr. Steyn is currently on sabbatical leave at the African Institute of Mathematical Sciences (AIMS) in Cape Town, South Africa. He will return to Canada in the late summer. The award ceremony is therefore still being planned and will be announced at a later date.

Record stratospheric ozone loss in the arctic in spring of 2011

Geneva, 5 April 2011, WMO — Depletion of the ozone layer- the shield that protects life on Earth from harmful levels of ultraviolet rays - has reached an unprecedented level over the Arctic this spring because of the continuing presence of ozone-depleting substances in the atmosphere and a very cold winter in the stratosphere. The stratosphere is the second major layer of the Earth's atmosphere, just above the troposphere.

The record loss is despite an international agreement which has been very successful in cutting production and consumption of ozone destroying chemicals. Because of the long atmospheric lifetimes of these compounds it will take several decades before their concentrations are back down to pre-1980 levels, the target agreed in the Montreal Protocol on Substances that Deplete the Ozone Layer.

Observations from the ground and from balloons over the Arctic region as well as from satellites show that the Arctic region has suffered an ozone column loss of about 40% from the beginning of the winter to late March. The highest ozone loss previously recorded was about 30% over the entire winter.

In Antarctica the so-called ozone hole is an annually recurring winter/spring phenomenon due to the existence of extremely low temperatures in the stratosphere. In the Arctic the meteorological conditions vary much more from one year to the next and the temperatures are always warmer than over Antarctica. Hence, some Arctic winters experience almost no ozone loss, whereas cold stratospheric temperatures in the Arctic lasting beyond the polar night can occasionally lead to substantial ozone loss.

Even though this Arctic winter was warmer than average at ground level, it was colder in the stratosphere than for a normal Arctic winter.

Unprecedented but not unexpected

Although the degree of Arctic ozone destruction in 2011 is unprecedented, it is not unexpected. Ozone scientists have foreseen that significant Arctic ozone loss is possible in the case of a cold and stable Arctic stratospheric winter. Stratospheric ozone depletion occurs over the polar regions when temperatures drop below -78°C. At such low temperatures clouds form in the stratosphere. Chemical reactions that convert innocuous reservoir gases (e.g. hydrochloric acid) into active ozone depleting gases take place on the clouds' particles. The result is rapid destruction of ozone if sunlight is present.

Ozone depleting substances such as chlorofluorocarbons (CFCs) and halons, once present in refrigerators, spray cans and fire extinguishers, have been phased out under the Montreal Protocol. Thanks to this international agreement, the ozone layer outside the polar regions is projected to recover to its pre-1980 levels around 2030-2040 according to the WMO/UNEP Scientific Assessment of Ozone Depletion (see link below). In contrast, the springtime ozone layer over the Antarctic is expected to recover around 2045-60, and in the Arctic it will probably recover one or two decades earlier.

Without the Montreal Protocol, this year's ozone destruction would most likely have been worse. The slow recovery of

the ozone layer is due to the fact that ozone-depleting substances stay in the atmosphere for several decades. In the polar regions the drop in ozone depleting gases is 10% of what is required to return to the 1980 benchmark level.

Global Atmosphere Watch

"*The Arctic stratosphere continues to be vulnerable to ozone destruction caused by ozone-depleting substances linked to human activities,*" said WMO Secretary-General Michel Jarraud. "*The degree of ozone loss experienced in any particular winter depends on the meteorological conditions. The 2011 ozone loss shows that we have to remain vigilant and keep a close eye on the situation in the Arctic in the coming years,*" he said.

"*WMO's Global Atmosphere Watch Network has many stations in the Arctic and helps us to obtain an early warning in case of low ozone and intense UV radiation.*"

If the ozone-depleted area moves away from the pole and towards lower latitudes one can expect increased ultraviolet (UV) radiation as compared to the normal for the season. As the solar elevation at noon increases over the next weeks, regions affected by the ozone depletion will experience higher than normal UV radiation. The public is recommended to stay informed through national UV forecasts.

It should be pointed out, however, that the UV radiation will not increase to the same intensity as one suffers in the tropical regions of the globe. The sun is still relatively low in the sky, and this limits the amount of UV radiation that passes through the atmosphere.

UV-B rays have been linked to skin cancer, cataracts and damage to the human immune system. Some crops and forms of marine life can also suffer adverse effects.

Background

The stratosphere is the second major layer of the atmosphere, above the troposphere and below the mesosphere. The stratosphere starts at about 10 km altitude and reaches up to an altitude of about 50 km. About 90% of the ozone in the atmosphere is found in the stratosphere with the remaining 10% in the troposphere. The ozone in the stratosphere is called the ozone layer, which absorbs ultraviolet light and protects life on earth from harmful ultraviolet radiation from the sun. The ozone in the troposphere, and especially close to the ground, is unwanted because it is a corrosive gas that causes damage to vegetation and can harm lung function and irritate the respiratory system in humans and animals.

Increased amounts of greenhouse gases lead to higher temperatures at the surface of the earth, but models show that the stratosphere at the same time will get colder. Therefore, ozone scientists have foreseen that significant ozone loss can happen in the Arctic stratosphere. If the cold temperatures persist into spring, i.e. when the sun comes back after the polar night, ozone destruction speeds up. In Antarctica such conditions prevail every winter/spring season, whereas in the Arctic the variability from one year to the next is much larger. Large ozone loss is therefore not an annually recurring phenomenon in the Arctic stratosphere. While increased amounts of longlived greenhouse gases, such as carbon dioxide and methane, are expected to cause some cooling of the stratosphere in the long term, it cannot explain the large variations in temperature that is observed from one year to the next in the Arctic stratosphere.

Both satellite observations and coordinated launches of ozonesondes carried by weather balloons show us at which altitudes the ozone loss takes place. These measurements show that the ozone loss takes place between 15 and 23 km above the ground with an ozone minimum around 19-20 km. This coincides with the region of low temperatures below –78°C. In this region more than 2/3 of the ozone has been destroyed so far. Measurements from the SCIAMACHY satellite instrument show record high amounts of the molecule OClO, a compound that takes part in ozone destruction. Satellite measurements of total ozone from OMI, GOME-2 and SCIAMACHY show a region of low ozone above the Arctic regions. As of late March the ozone poor region is shifted away from the pole and covers Greenland and Scandinavia.

The Vienna Convention to Protect the Ozone Layer came into force in 1985. Two years later the Montreal Protocol to phase out production and consumption of ozone-depleting products was signed. The Montreal Protocol has been reinforced on several occasions after 1987.

Images of total ozone column and vertical ozone profiles around the pole on March 30, developed by Finnish Meteorological Institute using satellite and ground based data, can be found at

http://www.ava.fmi.fi/~jtammine/gomos_video.gif

The 2010 WMO/UNEP Scientific Assessment on Ozone Depletion is available at

http://www.esrl.noaa.gov/csd/assessments/ozone/

with more details about the current state of the ozone layer and projections for the future.

Source: WMO Press Release # 912.

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

Déperdition record d'ozone stratosphérique au-dessus de l'Arctique au printemps 2011

Genève, le 5 avril 2011, OMM — La destruction de la couche d'ozone, qui protège les organismes vivants des effets nocifs du rayonnement ultraviolet, a atteint des records ce printemps au-dessus de l'Arctique à cause de la persistance dans l'atmosphère de substances nocives pour ce gaz et d'un hiver très froid au niveau de la stratosphère, deuxième grande couche de l'atmosphère terrestre située juste au-dessus de la troposphère.

Cette déperdition record s'est produite en dépit d'un accord international qui a permis de réduire considérablement la production et la consommation de substances destructrices d'ozone. En raison de la longue durée de vie de ces composés dans l'atmosphère, il faudra attendre plusieurs dizaines d'années avant que leurs concentrations ne reviennent aux niveaux d'avant 1980, objectif fixé dans le Protocole de Montréal relatif à des substances qui appauvrissent la couche d'ozone.

Les observations effectuées à partir du sol et par ballonsonde au-dessus de l'Arctique ainsi que par satellite révèlent que la colonne d'ozone a accusé une déperdition d'environ 40 % dans cette région entre le début de l'hiver et la fin du mois de mars. Le précédent record en matière de destruction d'ozone était une perte d'environ 30 % sur tout un hiver.

En Antarctique, le fameux trou dans la couche d'ozone est un phénomène annuel qui survient en hiver et au printemps à cause des températures extrêmement basses qui règnent dans la stratosphère, alors que dans l'Arctique, les conditions météorologiques varient beaucoup plus d'une année sur l'autre et les températures sont toujours plus élevées que dans l'Antarctique. C'est ainsi que certains hivers arctiques se caractérisent par une déperdition d'ozone quasi nulle alors que d'autres années, la persistance de basses températures stratosphériques après la fin de la nuit polaire peut entraîner parfois une destruction importante de ce gaz.

Bien que l'hiver ait été plus clément que la normale cette année dans l'Arctique au niveau du sol, il a été plus froid que d'ordinaire dans la stratosphère.

Sans précédent mais prévisible

Le degré de destruction de la couche d'ozone en 2011 au-dessus de l'Arctique est sans précédent mais l'on pouvait s'y attendre. Les spécialistes de l'ozone ont en effet annoncé qu'une forte déperdition d'ozone au-dessus de l'Arctique était possible dans le cas d'un hiver stratosphérique stable et froid. La destruction de l'ozone stratosphérique survient dans les régions polaires lorsque la température descend audessous de -78°C, ce qui entraîne la formation de nuages dans la stratosphère. Les réactions chimiques qui convertissent des gaz réservoirs inoffensifs tels que l'acide chlorhydrique en gaz nocifs pour l'ozone se produisent sur les particules nuageuses. Il s'ensuit une destruction rapide de l'ozone pour autant que la lumière du soleil soit présente.

Les substances qui appauvrissent la couche d'ozone telles que les chlorofluorocarbones (CFC) et les halons, utilisées naguère dans les réfrigérateurs, les propulseurs d'aérosols et les extincteurs, ont été progressivement éliminées conformément aux dispositions du Protocole de Montréal. Grâce à cet accord international, la couche d'ozone en dehors des régions polaires devrait revenir à son niveau d'avant 1980 aux alentours de 2030-2040 d'après l'évaluation scientifique OMM-PNUE de l'appauvrissement de la couche d'ozone (voir le lien ci-dessous). En revanche, le trou dans la couche d'ozone qui se forme chaque printemps au-dessus de l'Antarctique est un phénomène qui devrait persister jusque vers 2045-2060, tandis qu'au-dessus de l'Arctique, le retour à la normale interviendra probablement 10 à 20 ans plus tôt.

Si le Protocole de Montréal n'avait pas existé, la déperdition d'ozone cette année aurait été très probablement plus importante, et la reconstitution de la couche d'ozone prend beaucoup de temps parce que les substances destructrices de ce gaz persistent dans l'atmosphère pendant plusieurs dizaines d'années. Dans les régions polaires, la baisse de la concentration de ces substances ne représente encore que 10 % de ce qui serait nécessaire pour revenir aux valeurs de 1980.

Veille de l'atmosphère globale

Comme l'a déclaré le Secrétaire général de l'OMM, M. Michel Jarraud, "*la stratosphère arctique demeure exposée à l'action destructrice des agents de raréfaction de l'ozone d'origine anthropique, mais le degré de destruction de l'ozone auquel on assiste au cours d'un hiver donné dépend des conditions météorologiques. La raréfaction de l'ozone constatée cette année montre que nous devons rester vigilants et suivre de près la situation dans l'Arctique ces prochaines années*".

"*Le réseau de la Veille de l'atmosphère globale de l'OMM compte de nombreuses stations dans l'Arctique qui nous aident à anticiper la situation en cas de baisse de la concentration d'ozone et d'intensification du rayonnement ultraviolet*".

Si les masses d'air pauvres en ozone se déplacent vers le sud, on peut s'attendre à ce que le rayonnement ultraviolet accuse des valeurs supérieures à la normale pour la saison. Comme la hauteur du soleil au-dessus de l'horizon va augmenter au fil des semaines, les régions concernées par la raréfaction de l'ozone connaîtront un rayonnement ultraviolet anormalement élevé. Les populations sont donc invitées à se tenir informées en consultant les prévisions nationales établies dans ce domaine.

Il faut toutefois souligner que le rayonnement ultraviolet ne sera pas aussi intense que dans les régions tropicales, vu que le soleil est encore relativement bas au-dessus de l'horizon et que cela limite la quantité de rayons UV qui parvient à traverser l'atmosphère.

L'exposition au rayonnement UV-B peut causer, chez l'homme, des cancers de la peau, des cataractes et une altération du système immunitaire. Certaines cultures et certaines espèces de la faune marine peuvent aussi en pâtir.

Contexte
La stratosphère est la deuxième couche principale de l'atmosphère, située au-dessus de la troposphère et sous la mésosphère, entre 10 et 50 km d'altitude environ. Elle renferme environ 90 % de l'ozone atmosphérique, les 10 % restants se trouvant dans la troposphère. L'ozone stratosphérique constitue ce qu'on appelle la couche d'ozone, qui absorbe le rayonnement ultraviolet émis par le Soleil et protège par conséquent les organismes vivants de ses effets nocifs.

Quant à l'ozone troposphérique, en particulier celui qui se trouve à proximité du sol, c'est un gaz corrosif néfaste à la végétation qui peut provoquer des lésions pulmonaires et irriter les voies respiratoires chez l'homme et l'animal.

L'augmentation des concentrations de gaz à effet de serre se traduit par une hausse des températures à la surface de la Terre tandis que, parallèlement, la stratosphère se refroidit, comme le montrent les modèles. Aussi les spécialistes de l'ozone ont-ils prévu qu'une forte déperdition d'ozone peut se produire dans la stratosphère arctique. Si les basses températures persistent à l'arrivée du printemps, lorsque la lumière du soleil succède à la nuit polaire, la destruction de l'ozone s'accélère. C'est ce scénario qui prévaut chaque année dans l'Antarctique alors que dans l'Arctique, la variabilité interannuelle est beaucoup plus marquée. Ce n'est donc pas chaque année qu'on assiste à une forte déperdition d'ozone dans la stratosphère arctique. S'il semble avéré que les concentrations accrues de gaz à effet de serre persistants tels que le dioxyde de carbone et le méthane entraînent un certain refroidissement de la stratosphère sur le long terme, cela ne saurait expliquer les fortes variations de température constatées d'une année sur l'autre dans la stratosphère arctique.

Tant les observations par satellite que les lâchers de sondes emportées par des ballons météorologiques nous indiquent à quelles altitudes intervient la destruction de l'ozone, soit entre 15 et 23 km au-dessus du sol, les valeurs minimales étant observées aux alentours de 1920 km d'altitude, c'est-à-dire là où les températures sont inférieures à 78°C. Dans cette partie de la stratosphère, plus des deux tiers de l'ozone ont été détruits jusqu'à présent. Les mesures effectuées par l'instrument satellitaire SCIAMACHY révèlent une abondance record de la molécule OClO, composé qui participe à la destruction de l'ozone. Quant aux données sur l'ozone total recueillies par les capteurs satellitaires OMI, GOME-2 et SCIAMACHY, elles mettent en évidence la raréfaction de l'ozone au-dessus de l'Arctique. Fin mars, les masses d'air pauvres en ozone quittaient les régions polaires pour s'installer au-dessus du Groenland et de la Scandinavie.

La Convention de Vienne pour la protection de la couche d'ozone est entrée en vigueur en 1985. Le Protocole de Montréal, destiné à éliminer progressivement la production et l'utilisation de substances nocives pour l'ozone, sera conclu deux ans plus tard. Ses dispositions ont été renforcées à plusieurs occasions après 1987.

Des graphiques sur la colonne d'ozone au 30 mars provenant de l'Institut météorologique finlandais sont accessibles sur le site

http://www.ava.fmi.fi/~jtammine/gomos_video.gif

L'évaluation scientifique OMM-PNUE de l'appauvrissement de la couche d'ozone est disponible sur le site

http://www.esrl.noaa.gov/csd/assessments/ozone/

qui donne des précisions sur l'état actuel de la couche d'ozone et son évolution probable.

Source: Communiqué de presse de l'OMM # 912

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

Weather phenomena most harmful to transport in Europe now identified

Precipitation in its various forms causes the most damage

With climate change, the occurrence of extreme weather phenomena in Europe is expected to increase. The EWENT research project headed by VTT Technical Research Centre of Finland is exploring the harmful impact of weather phenomena on transport in the EU. No previous studies have been conducted on this scale.

Weather is a major factor in traffic flow and safety. Sudden and harmful weather phenomena such as storms and flash floods can, in a worst-case scenario, paralyse an entire transport system and cause serious financial and human losses.

With climate change, the occurrence of extreme weather phenomena in Europe is expected to increase. More information on these phenomena and their impacts is needed in order to minimise or prevent damage caused by them. The international research project Extreme Weather Impacts on European Networks of Transport (EWENT) headed by VTT is exploring the impacts of extreme weather phenomena on various forms of transport: road traffic, non-vehicular traffic, rail, aviation, and shipping at sea and on inland waterways. The aim is to determine which weather phenomena are the most harmful for transport and what the costs of their impacts might be in the EU. The research is focusing on atmospheric phenomena which are more severe than normal and which may pose a danger to traffic and transportation in particular. This is to say that the research excludes tsunamis and earthquakes, for instance, as they are natural disasters rather than weather phenomena.

The impacts of weather phenomena are being explored in five climatic zones: the Mediterranean climatic zone, the Alpine climatic zone, the maritime and temperate climatic zones in central Europe, and the Scandinavian climatic zone, which also includes Finland. This division is based on data from the European Severe Storms Laboratory. The determination of which weather phenomena are the most harmful is being made on the basis of an extensive dataset, analysing phenomena by the harmfulness of their impacts. The principal outcome of the first phase of the EWENT project is the determination and classification of parameters describing the severity of weather types. The researchers analysed more than 150 scientific and professional studies of weather phenomena and damage caused by them, and more than 200 media reports of extreme weather phenomena.

The findings show that it is precipitation in its various forms that causes the most damage to transport. This is true in all parts of Europe and for all forms of transport. For example, a heavy snowfall complicates road traffic, rail transport and airport operations regardless of where in Europe it occurs. The only differences are in how efficiently this problem can be resolved and how well unexpected weather conditions are prepared for with sufficient availability of maintenance equipment, for instance. Heavy rain causes flash flooding, which disrupts transport connections, inhibits inland waterway traffic and damages earth structures such as roads, bridges and rail embankments.

High winds are bad for aviation in particular, but shipping and rail transports are also affected by them. Thunderstorms cause disruption mainly when lightning strikes incapacitate traffic control systems. Rail transports and aviation are particularly susceptible to this, as they require traffic control systems to be fully operational all the time.

VTT and the Finnish Meteorological Institute are currently analysing long-term changes in the probability of extreme weather phenomena, to 2070. These results will be completed in the summer. Also, VTT and the German Aerospace Centre DLR are studying the impacts of the now identified weather phenomena on the annual number of accidents and on time delays in various forms of transport. Both studies are component studies of the EWENT project.

The EWENT project also involves the World Meteorological Organisation (WMO), the Institute of Transport Economics (TØI) in Norway, the European Severe Storms Laboratory in Germany, the inland waterways management and development company 'via donau' in Austria, and Foreca Consulting Oy in Finland. The project began in 2009 and will continue until spring 2012. It is being funded by the European Commission.

Note from the Editor: VTT Technical Research Centre of Finland is a globally networked multitechnological contract organization. VTT provides high-end technology solutions and innovation services. Its goal is to enhance customers' competiveness, thereby creating prerequisites for society's sustainable development, employment and wellbeing. VTT is an applied research organization in Northern Europe which creates new technology and science-based innovations in co-operation with domestic and foreign partners. VTT's turnover is EUR 290 million and its personnel totals 3,100.

Glaciers in Canada's north now major players in sea-level rise

Wednesday, April 20, 2011, Peterborough, Ontario — Dr. J. Graham Cogley of Trent University's Department of Geography is part of an international, multi-author team that has documented a dramatic increase in ice loss from glaciers in Canada's northernmost islands, as reported in the study, "Sharply increased mass loss from glaciers and ice caps in the Canadian Arctic Archipelago", published in the leading scientific journal *Nature* on April 20, 2011.

From 2004 to 2006, the region's glaciers lost an average of 31 billion tonnes per year. That went up threefold to 92 billion tonnes per year from 2007 to 2009. Over all six years, the loss amounted to nearly 368 billion tonnes, the equivalent of three-quarters of the water in Lake Erie and enough to cover the global ocean to a depth of one millimetre.

The team's study, coordinated by Dr. Alex Gardner of the University of Michigan, points directly to warmer temperatures as the drivers of melting. Each one degree

Celsius increase in mean summer air temperature was matched by 64 billion tonnes of additional melting. Iceberg calving was only a minor contributor to the total loss.

Ninety-nine percent of all the world's land ice is in the ice sheets of Antarctica and Greenland, but currently they only account for about half of the contribution to sea-level rise from glaciers, mainly by calving. The other half comes from smaller glaciers such as those in the Queen Elizabeth Islands and Baffin Island. Dr. Gardner said, "*Outside of Antarctica and Greenland, we now know that the Canadian Arctic was the largest regional contributor for the years 2007 through 2009*."

"*A sixth of a millimetre of sea-level rise per year might not sound like much*", said Trent's Professor Cogley, "*but it adds up, year on year, and recent studies have confirmed that the actual rise varies around the world. Some places, including the Maritimes and New England, can expect more sea-level rise than the average in coming decades*."

The six-year study period is too short to establish a trend. "*Year-to-year variation in the mass balance of the glaciers is very large*", added Prof. Cogley. "*Part of Trent's role in this study was to provide long-term context, based on its involvement in field work in the Arctic going back all the way to 1959. We also helped to provide 'ground truth'. Technically, an encouraging aspect of the study was that several independent sources of information - the laser-altimeter and gravimeter observations from orbit, Dr. Gardner's numerical simulations, and the sparse and hard-won field measurements - all lined up beautifully*."

In addition to the University of Michigan and Trent University, the team's workers are with the University of Alberta, Scripps Institution of Oceanography, the University of Oslo, the Royal Netherlands Meteorological Institute, the Alaska Department of Natural Resources, the Geological Survey of Canada, Westfield State University and Campbell Scientific Canada. The study "*Sharply increased mass loss from glaciers and ice caps in the Canadian Arctic Archipelago*", was funded by the Natural Sciences and Engineering Research Council, the Alberta Ingenuity Fund, the Canadian Foundation for Climate and Atmospheric Sciences and the European Union's 7th Framework Programme.

Source: Trent University Press Release

Warm Water Causes Extra-cold Winters in Northeastern North America and Northeastern Asia

Wednesday, March 30, 2011, Pasadena, California — If you're sitting on a bench in New York City's Central Park in winter, you're probably freezing. After all, the average temperature in January is 32 degrees Fahrenheit. But if you were just across the pond in Porto, Portugal, which shares New York's latitude, you'd be much warmer - the average temperature is a balmy 48 degrees Fahrenheit.

Throughout northern Europe, average winter temperatures are at least 10 degrees Fahrenheit warmer than similar latitudes on the northeastern coast of the United States and the eastern coast of Canada. The same phenomenon happens over the Pacific, where winters on the northeastern coast of Asia are colder than in the Pacific Northwest.

Researchers at the California Institute of Technology (Caltech) have now found a mechanism that helps explain these chillier winters - and the culprit is warm water off the eastern coasts of these continents.

"*These warm ocean waters off the eastern coast actually make it cold in winter - it's counterintuitive*," says Tapio Schneider, the Frank J. Gilloon Professor of Environmental Science and Engineering.

Schneider and Yohai Kaspi, a postdoctoral fellow at Caltech, describe their work in a paper published in the March 31 issue of the journal *Nature*.

Using computer simulations of the atmosphere, the researchers found that the warm water off an eastern coast will heat the air above it and lead to the formation of atmospheric waves, drawing cold air from the northern polar region. The cold air forms a plume just to the west of the warm water. In the case of the Atlantic Ocean, this means the frigid air ends up right over the northeastern United States and eastern Canada.

For decades, the conventional explanation for the cross-oceanic temperature difference was that the Gulf Stream delivers warm water from the Gulf of Mexico to northern Europe. But in 2002, research showed that ocean currents aren't capable of transporting that much heat, instead contributing only up to 10 percent of the warming.

Kaspi's and Schneider's work reveals a mechanism that helps create a temperature contrast not by warming Europe, but by cooling the eastern United States. Surprisingly, it's the Gulf Stream that causes this cooling.

In the northern hemisphere, the subtropical ocean currents circulate in a clockwise direction, bringing an influx of warm water from low latitudes into the western part of the ocean. These warm waters heat the air above it.

"*It's not that the warm Gulf Stream waters substantially heat up Europe*," Kaspi says. "*But the existence of the Gulf Stream near the U.S. coast is causing the cooling of the northeastern United States.*"

The researchers' computer model simulates a simplified, ocean-covered Earth with a warm region to mimic the coastal reservoir of warm water in the Gulf Stream. The simulations show that such a warm spot produces so-called Rossby waves.

Generally speaking, Rossby waves are large atmospheric waves - with wavelengths that stretch for more than 1,000 miles. They form when the path of moving air is deflected due to Earth's rotation, a phenomenon known as the Coriolis effect. In a way, similar to how gravity is the force that produces water waves on the surface of a pond, the Coriolis force is responsible for Rossby waves.

In the simulations, the warm water produces stationary Rossby waves, in which the peaks and valleys of the waves don't move, but the waves still transfer energy. In the northern hemisphere, the stationary Rossby waves cause air to circulate in a clockwise direction just to the west of the warm region. To the east of the warm region, the air swirls in the counterclockwise direction. These motions draw in cold air from the north, balancing the heating over the warm ocean waters.

To gain insight into the mechanisms that control the atmospheric dynamics, the researchers speed up Earth's rotation in the simulations. In those cases, the plume of cold air gets bigger - which is consistent with it being a stationary Rossby-wave plume. Most other atmospheric features would get smaller if the planet were to spin faster.

Although it's long been known that a heat source could produce Rossby waves, which can then form plumes, this is the first time anyone has shown how the mechanism causes cooling that extends west of the heat source. According to the researchers, the cooling effect could account for 30 to 50 percent of the temperature difference across oceans.

This process also explains why the cold region is just as big for both North America and Asia, despite the continents being so different in topography and size. The Rossby-wave induced cooling depends on heating air over warm ocean water. Since the warm currents along western ocean boundaries in both the Pacific and Atlantic are similar, the resulting cold region to their west would be similar as well.

The next step, Schneider says, is to build simulations that more realistically reflect what happens on Earth. Future simulations would incorporate more complex features like continents and cloud feedbacks.

The research described in the *Nature* paper, *"Winter cold of eastern continental boundaries induced by warm ocean waters*," was funded by the NOAA Climate and Global Change Postdoctoral Fellowship, administered by the University Corporation for Atmospheric Research; a David and Lucille Packard Fellowship; and the National Science Foundation.

Source: California Institute of Technology Office of Media Relations

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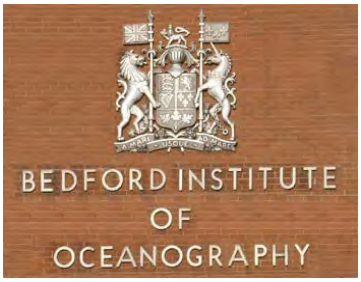
BIO at 50: A Voyage of Discovery

Since 1962, the Bedford Institute of Oceanography (BIO) has been a leader in scientific research and innovation. In 2012, BIO will celebrate **50 years of discovery** and host many events scheduled throughout the year. Among these events will be the ever-popular Open House in September and a Gala celebration in October.



One of the major programs in BIO history was the work done during the Arrow crisis in Chedabucto Bay starting in February 1970 when the tanker struck Cerebrus Rock. On February 24th a task force was formally created and the science support team, centred at BIO, was led by Bill Ford. The task force was dissolved seven months later. For those of us involved in this work it is a lasting memory.

This is one of the events in BIO history which should be remembered and acknowledged in the **50th celebration**. More than 100 scientists and engineers, with supporting staff, worked on a full or part time basis on the problems created by the massive, near shore oil spill. Memories fade, all of those involved in this work have retired and many have passed away. There never was a complete list.

I have assembled a partial list of the actors in this drama, obviously there are too many omissions. I would like to assemble a list of all the science/engineering/admin folks who contributed to the Arrow event, including those involved before the task force was created (in itself a considerable number). If you were involved, you know about it - please send me some information.

Please help create this memory and reply to this message with more information about this major BIO program.

Clive Mason
Bedford Institute of Oceanography
bio.oceans@gmail.com

Sheila Bourque Retires!

Sheila Bourque, our long-time A-O Technical Editor, took her retirement after many years of faithful service with Environment Canada (EC). Having joined EC as a meteorologist in 1973 where her first and only posting was at the London Weather Office, she then joined the Ozone Research Group in Atmospheric Environment Service (AES) in Downsview where she used her meteorologist skills in preparing upper air forecasts to support high altitude balloon launches. One day she was asked by her supervisor to provide training to users of computer systems she was developing. This was her first assignment as a trainer and one for which she developed a passion very quickly. After a few years spent in raising her two children (Kevin and Emily), she was back with the Training Branch in 1992 and eventually joined the Canadian Ice Service (CIS) in Ottawa as the Directorate Training Officer in 1995. Over the years, Sheila has evolved this new position from keeping track of training for all staff and advising them on their learning plans to many more challenging projects:

Dave Jackson, A/Director, Canadian Ice Service and Sheila Bourque on her retirement party, May 12, 2011. Photo courtesy of Denis A. Bourque.

- organizing the development of six computer-based training modules;
- organizing a joint Ice Service Specialist and Ice Analyst course in 2006;
- creating Task Analyses for operations staff;
- organizing specialized courses such as an introduction to oceanography;
- advising Managers with their major training projects;
- being a direct advisor to the Director for all training related issues.
- organizing annual CIS Workshops that brought together staff from all of CIS;
- implementing the Universal Classification System and organizing work descriptions for all jobs;
- managing the Canadian Long Range Ice Forecasting Program for a number of years;
- organizing training and orientation and end-of-term presentations for the co-op students;
- led the way for Applied Science to implement ISO 9000 in CIS' work;
- played a significant role in organizing Teachers' Day at CMOS congresses.

Luckily, at the retirement party, CMOS Executive learned that Sheila is **NOT** retiring from her position as A-O Technical Editor. We wish Sheila and her family a long, healthy and happy retirement!

World Oceans Day — June 8

World Oceans Day, June 8, is a time to remember the life-giving role of oceans. The Government of Canada proposed the concept of World Oceans Day in 1992 at the Earth Summit in Rio de Janeiro and the day had been celebrated internationally ever since. As of 2009, June 8 has been officially declared by the United Nations as "World Oceans Day."

Objectives of World Oceans Day

- Change attitudes — encourage individuals to think about what the oceans mean to each of us, and what oceans have to offer.
- Learn — discover the wealth of diverse and beautiful creatures and habitats found in the oceans, and how our actions affect them.
- Change our ways — encourage each one of us to become caretakers of our oceans, and to conserve them for our future.
- Celebrate — organize or participate in ocean events, whether we live inland or on the coast.

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46e congrès SCMO I 46th CMOS Congress
25th Conference on Weather Analysis and Forecasting
21st Conference on Numerical Weather Prediction

L'Environnement en évolution et son impact sur les services pour le climat, les océans et la météo

The Changing Environment and its Impact on Climate, Ocean and Weather Services

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