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Canadian Meteorological and Oceanographic Society

La Société canadienne de météorologie et d'océanographie

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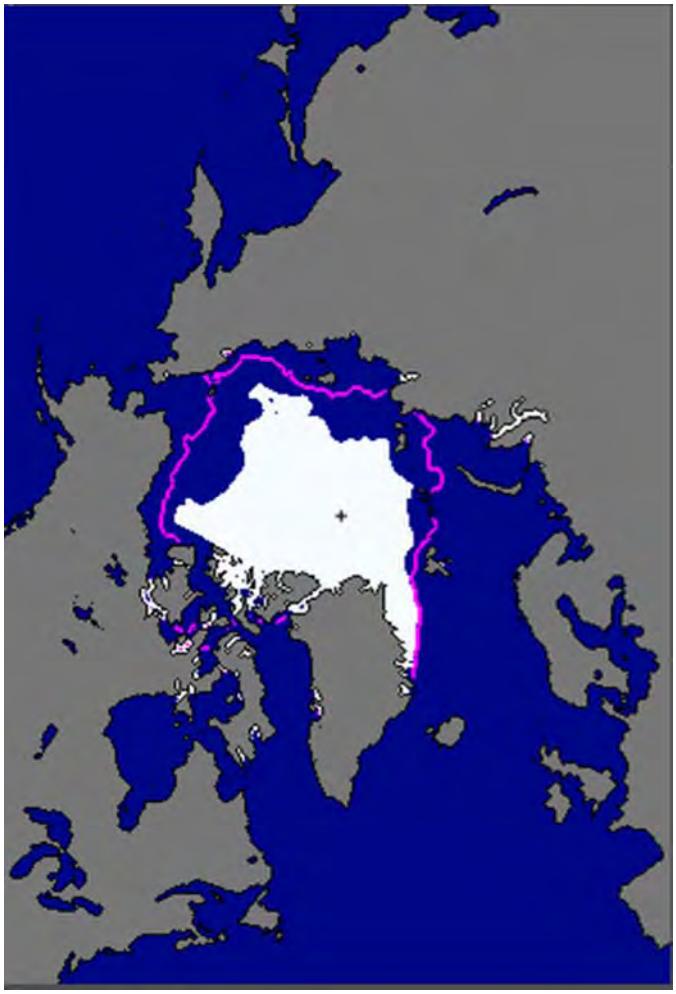

Arctic Sea Ice Extent as of September 2011
La couverture de glace dans l'Arctique en septembre 2011

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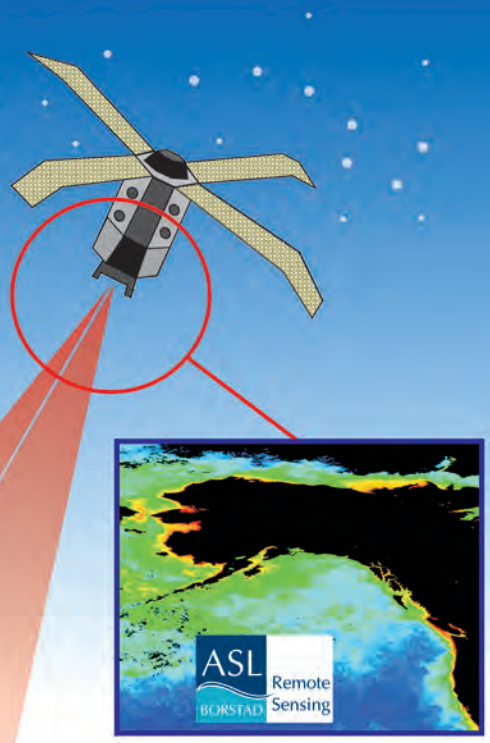

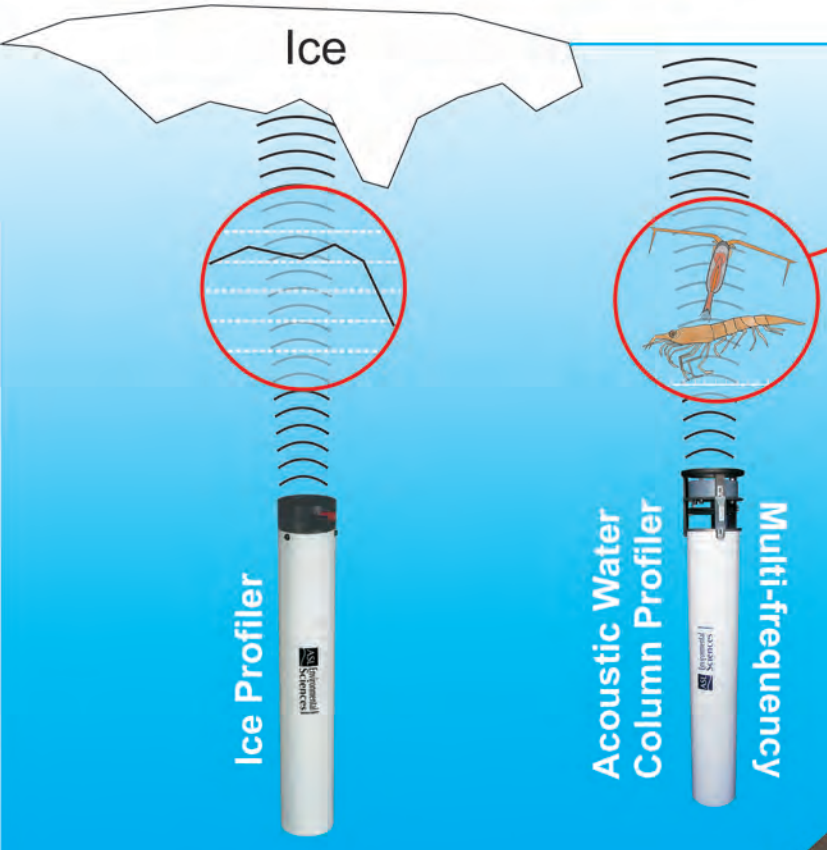

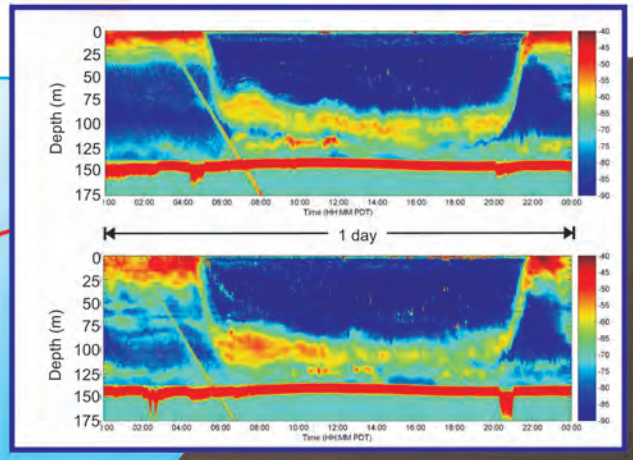

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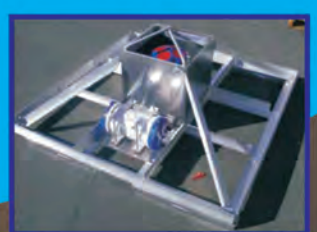

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ASL Environmental Sciences Inc.
1986 Mills Rd, Sidney
BC, Canada V8L 5Y3

toll-free: 1-877-656-0177
email: aslenv@aslenv.com
website: www.aslenv.com

....from the President's Desk

Friends and colleagues:

Norman McFarlane
President CMOS
Président de la SCMO

I am writing this column a few days after returning from the Open Science Conference of the World Climate Research Programme. This was the first WCRP-wide conference to be held in over a decade. It was very large (over 1900 participants) but well organized with a strong focus on science. In contrast to the usual large scientific conferences that may include many sessions or symposia on different topics that in many cases are organized in a largely independent manner, this WCRP OSC was organized so as to bring together diverse research communities from around the world to present a comprehensive overview of climate research, identify overarching research challenges and facilitate strategic input into key scientific assessments. Perhaps more important, this OSC was held in the context of the, now widely accepted, understanding that human activities are now a dominant agent of climate change. The need for understanding and predicting of the evolution of climate system in its complexity and diversity is now critical for reducing vulnerability to high impact weather and climate events, and sustaining life.

The OSC highlighted many accomplishments as well as issues and challenges for the future in weather and climate science and applications. For example, great progress has been made in weather and climate modelling over the last half century. Models have increased in both complexity and accuracy and are now the main tool for predicting changes in the climate system that may result from human activities. However, much remains to be done. Although the dramatic increases in computing power that have occurred in the past half century have been a major factor in the progress of weather and climate modelling, there are remaining major challenges for climate modelling, such as those associated with the trade-off between accuracy (higher resolution and better representation of small scale features and processes in space and time) and complexity (modelling many components of the earth system in a coupled way, including biogeochemical interactions between ecosystems and the physical climate system, with widely different temporal and spatial scales).

(Continued on page 195 / Suite à la page 195)

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Climate Change / Changement climatique

Our regular sections / Nos chroniques régulières

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Editor / Rédacteur: Paul-André Bolduc
Associate Editor / Rédactrice associée: Dorothy Neale
Canadian Meteorological and Oceanographic Society
Société canadienne de météorologie et d'océanographie
P.O. Box 3211, Station D
Ottawa, ON, Canada K1P 6H7
E-Mail: bulletin@cmos.ca; Courriel: bulletin@scmo.ca

Cover page: Shown on the cover page is the extent of Arctic Sea Ice as of September 2011. Observations were collected by the NASA Advanced Microwave Scanning Radiometer. The magenta line shows the 1979 to 2000 median extent. To learn more, please read the short news on **page 230.** Figure credit to the US National Snow and Ice Data Center. Merry Christmas!

Page couverture: L'image en page couverture illustre l'étendue de la glace dans l'Arctique au mois de septembre 2011. Les observations ont été faites par le "Advanced Microwave Scanning Radiometer" de la NASA. La ligne en magenta indique la position médiane de 1979 à 2000. Pour en savoir plus, prière de lire la courte nouvelle en **page 230.** L'image est une courtoisie de la National Snow and Ice Data Center des États-Unis. Joyeux Noël!

CMOS Executive Office / Bureau de la SCMO

P.O. Box 3211, Station D
Ottawa, Ontario, Canada, K1P 6H7
Fax / Fascimilé: 613-990-1617
homepage: http://www.cmos.ca
page d'accueil: http://www.scmo.ca

Dr. Ian Rutherford
Executive Director - Directeur éxécutif
Tel/Tél.: 613-990-0300
E-mail/Courriel: cmos@cmos.ca

Dr. Richard Asselin
Director of / Directeur des Publications
Tel/Tél.: 613-991-0151
E-mail/Courriel: publications@cmos.ca

Ms. Qing Liao
Office Manager - Chef de bureau
Tel/Tél.: 613-991-4494
E-mail/Courriel: accounts@cmos.ca

Canadian Meteorological and Oceanographic Society (CMOS)
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Executive / Exécutif

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

It has become increasingly clear that these modelling challenges can not be considered in isolation from each other and diverse approaches to dealing with them are needed and being explored more extensively than ever. For example, multi-component Earth-system models of intermediate complexity (EMICs), though simplified in their treatment of the component processes, have demonstrated their usefulness for addressing many key issues such as the implications of the nearly irreversible (on human time scales) impact of changes in atmospheric CO_2 on mitigation choices (plenary presentation by Susan Solomon).

The OSC also highlighted the importance and current threats to long-term high quality observations of weather and climate variables as a fundamental requirement for monitoring and understanding changes in climate. The Earth is now observed more completely and extensively than at any other time in human history. However, many of these observations suffer from inadequacies in quality and continuity that limit their usefulness for monitoring long-term changes in climate. Satellite observations have become a major part of the Earth observing system. However, critical gaps may emerge when the current earth observing satellites reach the end of their lifetimes. This concern was noted in talks presented at the OSC and is discussed in a recent informative Nature News report:

http://www.nature.com/news/2011/111028/full/news.2011.616.html

Key long-term quality controlled ground based measurements are also a critical component of the earth observing system that is needed to monitor climate change. These systems not only complement satellite measurements but are also critical for validating satellite measurements. Thus maintaining and enhancing ground-based measurements is of increasing importance in light of the uncertainties associated with future satellite measurements. (see the article on measurement of ozone profiles in this issue of the Bulletin on page 198).

One of the more sobering presentations during the OSC drew attention to the impact of the rapid increase in the population of the Earth in the last half century (presentation by Eugenia Kalnay, session B9). The population of the earth has recently (perhaps sometime during the OSC) surpassed the seven billion level and has more than doubled since 1950. Current reasonable projections of growth suggest that it will exceed nine billion by 2050. Although improvements in sanitation and disease control (the use of antibiotics) has been a major factor in this growth, the increased agricultural production that has been associated with the use of fossil fuels has also been a major factor. However, this rapid increase in human population is rapidly drawing down natural capital (grain production is flattening, urbanization and industrial farming practices are destroying forests and other ecosystems…) and is likely not sustainable. Thus the drivers of population growth are intimately connected with climate change as well. However, population growth has perhaps not hitherto received the attention it deserves in the climate science community.

For readers who are interested, many of the presentations at the WCRP OSC are on line at the conference web site:

http://www.wcrp-climate.org/conference2011/index.html

Finally, but not least, I wish all CMOS members and readers of the Bulletin a joyous holiday season and a happy and healthy new year.

Norman McFarlane
CMOS President
Président de la SCMO

Letters to the Editor / Lettres au rédacteur

From: Ken Denman
University of Victoria

Environment Canada
Canadian Centre for Climate Modelling and Analysis

Date: September 29, 2011

Subject: Ken Denman's Public Lecture during 2011 Congress in Victoria

The August issue of the *CMOS Bulletin SCMO* contained a report (Vol.39, No.4, p. 134) on the 2011 CMOS Congress. In my evening public lecture, I was reported to have stated that "*Once again, global climate warming was confirmed at two degrees C by 2050, but model results are increasingly agreeing that the warming will not increase much in later decades and centuries*". This statement is basically the **opposite** of what I did say. However, as this was not in my talk but was a response to a question from the audience, maybe I was not clear.

I was in fact reporting on the results in our recently published paper [Arora et al., 2011], which to our knowledge is the first publication of results from a full Earth System Model using the new future climate change scenarios, Representative Concentration Pathways (RCPs), which are being used in the next assessment report of climate change (AR5) by the IPCC [Moss et al., 2010]. In our model, the most optimistic scenario 'RCP 2.6' yields a mean global warming over the period 1850-2100 of 2.3°C, above the 2°C maximum that many policymakers refer to as the threshold for dangerous warming. Our result is not good news, because as we say in the last line of our abstract *"The results of this study suggest that limiting warming to roughly*

2°C by the end of this century is unlikely since it requires an immediate ramp down of emissions followed by ongoing carbon sequestration in the second half of this century." To limit the warming to 2.3°C by 2100, the model results actually require removal and sequestration of CO_2 from the atmosphere from 2060 onwards. At present there are no proven technologies capable of removal of large amounts of CO_2 once they are released into the atmosphere.

References

Arora, V. K., J. F. Scinocca, G. J. Boer, J. R. Christian, K. L. Denman, G. M. Flato, V. V. Kharin, W. G. Lee, and W. J. Merryfield, 2011. Carbon emission limits required to satisfy future representative concentration pathways of greenhouse gases, *Geophysical Research Letters*, doi:10.1029/2010GL046270.

Moss, R. H., J. A. Edmonds, K. A. Hibbard, M. R. Manning, S. K. Rose, D. P. van Vuuren, T. R. Carter, S. Emori, M. Kainuma, T. Kram et al., 2010. The next generation of scenarios for climate change research and assessment. *Nature,* 463:747–756.

Note from the Editor: This second letter follows Richard Asselin's book review on "**Merchants of Doubt**" (*CMOS Bulletin SCMO*, Vol. 39, No.5, pages 184-185) and also John Atcheson's comments on the same book http://energybulletin/node/53446.

From: John Stone
Member of Bureau for IPCC 3rd and 4th Assessment Report

Lead Author for the Polar Regions Chapter on the WGII contribution to the 5th Assessment Report

Carleton University
Department of Geography and Environmental Studies

Date: October 19, 2011

Subject: What Drives the Climate Change Nay-Sayers?

Addressing the threat of climate change has become a polarized political divide in North America leaving little room for debate or uncertainty. This has led to a situation where constructive discussion is near to impossible. In particular, there has been a handful of individuals whose contributions to any discussion have been entirely unconstructive and disproportionately influential. I am, of course, referring to the climate change deniers. I use the word "deniers" rather than skeptics intentionally since organized skepticism is an essential element of scientific progress.

Using the language of warfare may not sit well with many of us. In war there are rarely any clear winners and almost always some collateral damage. But make no mistake, for the denier sect this is war (or at least a street fight). It thus may be useful to follow the military advice: know thy enemy. This short article is intended to throw some light on what drives the deniers. It is based on a decade or more of sometimes frustrating experience.

This handful of individuals has been remarkably well organized and successful in that they have managed to hold back action on climate change for over a decade. They have achieved this through a determined and well orchestrated disinformation campaign to sow doubt on the validity of the science. This campaign, at least in the early years, benefitted from the journalistic practice of giving both sides of an issue equal weight. The deniers' argument was simple: that it was irresponsible to invest considerable resources in addressing the issue until the science was certain. Of course, seeking certainty in science is, as we know, a continuing challenge - new questions always arise, especially with a system as complicated as the climate. But the practice of science is sadly not well understood by large sections of the public and this plays to the deniers' advantage.

The tactics of the nay-sayers are now fairly well known – simply asking questions where is there is not as yet full understanding, cherry-picking data that seems to disagree with a given hypothesis; publishing in non-peer-reviewed literature including media outlets looking for a "story"; accessing significant resources contributed by business sectors that see addressing climate change as a threat to their industry; and orchestrating personal attacks on individual scientists. The deniers have also taken advantage of many scientists' discomfort and sometimes inability to respond, being more interested in pursuing their research interests.

These tactics have been well described in several books including *Merchants of Doubt* by Naomi Oreskes, which was reviewed recently in the CMOS Bulletin, and *Climate Cover-up* by two Vancouver-based activists, Jim Hoggan and Richard Littlemore. These books tell of the original small group of deniers*, often physicists with seemingly impressive scientific backgrounds. These individuals have been active in a series of campaigns beginning with the attack on the scientific relationship between smoking and lung cancer, taking on attacks on acid rain, stratospheric ozone depletion and, more recently, attempts to vilify Rachel Carson for causing the deaths of millions from malaria as a result of the banning of DDT. In each case, there is well documented evidence that the lobbying campaigns were generously funded by businesses with clear vested interests but through less-than-clear financial schemes.

*Deniers: There were four scientists that were involved in manufacturing doubt on the science of climate change. Fred Singer first Director of the US National Weather Satellite Service, Bill Nierenberg former Director of the Scripps Institute of Oceanography, Fred Seitz past-President of the US National Academy of Science and Rockefeller University, and Robert Jastrow founding Director of the US NASA Goddard Institute for Space Sciences. Of these four, only Fred Singer is still alive at 77.

The denier sect's approach is, to quote from one of the ClimateGate reviews: "*to take every opportunity for un-moderated comment to stand alongside peer reviewed publications; for presentations or lectures at learned conferences to be challenged without inhibition; and for highly personalized critiques of individuals and their work to be promulgated without hindrance*". This is now sadly a fact of life.

So what are their motives? It would be misleading to lump all deniers together as an indistinguishable tribe. For some, climate change is an inconvenient message and one they would rather deny. There are a few with good scientific credentials who seem genuinely to have a different interpretation of the science. In contrast to most deniers, these few scientists do participate in academic conferences and publish in respectable journals. Most deniers usually have scant backgrounds in climate science.

Financial gain might seem to be an easily identified incentive but it is doubtful that any climate change nay-sayer has ever got very rich through this avenue or was driven solely by such considerations. It is not clear if any had financial interests in the companies whose interests they were serving. Furthermore, it is tempting to suggest that some are driven by the public image of challenging mainstream scientific consensus - a modern-day Copernicus – and when the scientific consensus is not on their side, to complain of being systematically excluded.

Closer to the truth is that addressing climate change conflicts with explicit or unacknowledged ideologies. These include, for example, the role and size of governments, regulatory constraints on business and trade, and moral issues such as responsibility for future generations. For some of the deniers, particularly the original ones, there is an identifiable right-wing preoccupation (including a growing anti-science attitude). Deeply involved in Cold War defence projects, they argued that we fought to protect our freedoms and are now giving them away in the name of tackling an, as yet, unproven threat. This is accompanied by an unsubstantiated allegation, generated by a suspicion of elites, that the real agenda of scientists is to establish and lead a global utopia. It is, of course, futile to try to argue against such ideological principles - we will quickly meet a brick wall. It does after all embrace a distinct set of values; ones with which we may not agree but which cannot be simply dismissed.

While this ideological brick wall may be discouraging enough, we now are up against what can only be described as dogma. We see this today in stark terms in the United States where a "belief" in climate change is being used as a kind of litmus test - no thinking is required. It is a way of choosing sides. It is no easier to go against a tide of political tribalism as it is to argue against deep ideological certainties. But as scientists we must at least try. We must rely on our science as our strongest weapon. If the science is correct some can try to deny it but it won't go away.

Correspondence / Correspondance

From: 1) Professor Theodore Shepherd
Co-Chair SPARC SSG
Department of Physics
University of Toronto
Toronto M5S 1A7 Canada

And from 2) Professor Thomas Peter
Co-Chair SPARC SSG
Swiss Federal Institute of Technology ETH
CH-8092 Zurich Switzerland

Date: September 22, 2011

To: The Honourable Peter Kent
Minister of the Environment
Les Terrasses de la Chaudière
10 Wellington Street, 28th floor Gatineau
Quebec K1A 0H3 Canada

Subject: Closure of Canadian ozone network

N.B. An earlier version of this letter was sent to you on September 15, 2011, signed by the SPARC co-Chairs. The letter was subsequently distributed to the SPARC community and it has now been endorsed by the undersigned, representing scientists from around the world.

Dear Minister Kent:

We are writing in our capacity as the co-Chairs of the Scientific Steering Group of the World Climate Research Programme's SPARC (Stratospheric Processes And their Role in Climate) core project, to express our grave concern about the termination of Environment Canada's long-standing program to monitor changes in atmospheric ozone, as recently announced by *Nature* http://www.nature.com/news/2011/110912/full/477257a.html. This has very serious repercussions for the international scientific community.

Ozone is an important greenhouse gas — indeed the third most important greenhouse gas in terms of its radiative forcing of climate change, after carbon dioxide and methane — and is also critical to life on Earth and human health through its role in filtering ultraviolet (UV) radiation. The cornerstone of our scientific understanding of any environmental issue is the observed record of past changes, which is why developing and maintaining this record through the Global Climate Observing System is a treaty obligation of all signatories to the United Nations Framework Convention on Climate Change. SPARC coordinates international research efforts to understand the role of the stratosphere in the climate system, and the observed record of ozone changes is central to this effort.

Although satellites play a unique role in the Global Climate Observing System through their near-global coverage of the planet, they are anchored by ground-based networks (including balloon launch sites) which provide essential calibration standards — critical for the issue of longterm changes — as well as providing more detailed and typically more accurate information than can be provided by satellites. In the case of ozone, satellite measurements provide only very limited information on tropospheric ozone, while the satellite-derived stratospheric ozone profiles currently come from research rather than operational instruments so their future provision is highly uncertain. For all these reasons, the ground-based ozone network — and, especially, the ozonesonde component of this network, which provides the information on vertical profiles and tropospheric ozone — is critical, as is confirmed by the continual use of this data in scientific research and in international scientific assessments of ozone and climate change.

For reasons of sovereignty, ground-based measurement stations are the responsibility of the host country, and so Canada has a special role to play as the occupant of such a large fraction of the northern high-latitude land mass. Yet because ozone is transported globally, a global network is required in order to understand ozone changes: the Canadian measurements are of value not just to Canadian scientists, but to scientists worldwide. The loss of the Canadian measurements will therefore leave a devastating hole in the global ozone network. In addition, the Environment Canada research group responsible for these measurements, which we understand has now been decimated, has played a key international role for both ozone and UV measurements in maintaining calibration standards, assessing past changes for the World Meteorological Organization/United Nations Environment Programme Scientific Assessments of Ozone Depletion (which are mandated by the Montreal Protocol to occur at least every four years), and hosting the world data centre for these measurements (the World Ozone and UV Data Centre).

The value in long-term measurements lies in the continuity and stability of the record. Once there is a gap, it can never be filled. This is not the sort of activity that can be taken on by universities, which perform more 'project-driven' research. So we are extremely concerned, from an international perspective, about the implications of your Government's decision to eliminate such a critical component of the Global Climate Observing System, and hope that a way can be found to maintain these key measurements.

Note from the Editor: SPARC: Stratospheric Processes and their Role in Climate; a World Climate Research Programme (WCRP) Project.

On ozone monitoring in Canada

by T.G. Shepherd (University of Toronto)

and

N.A. McFarlane (University of Victoria)

On September 15, 2011, Nature News[(1)] published an article drawing attention to a decision by Environment Canada to make major cuts to its ozone monitoring program (not ground-level ozone, which is relevant for air quality, but ozone in the free atmosphere). While the exact details of the cuts are not yet publicly known, statements issued by the Assistant Deputy Minister for the Science and Technology Branch of Environment Canada confirmed the intention of STB to cut back on its ozone monitoring program[(2)] and not maintain the current combination of ozone sondes and measurements of column ozone amounts using the Brewer spectrophotometers. In addition, the Professional Institute of the Public Service of Canada has confirmed that scientists in the ozone research unit of Environment Canada were among the 776 employees who received notice of their positions being affected by the planned workforce adjustment, suggesting that, in addition to elimination of ozone sonde measurements, the activities of the World Ozone and Ultraviolet Radiation Data Centre (WOUDC) will be curtailed. This unit also operates a World Meteorological Organization Global Atmosphere Watch (GAW) Programme Central Calibration Laboratory which hosts the primary standard for the world-wide Brewer spectrophotometer network.

The international scientific community has reacted with shock to this news. The Canadian ozone sonde measurements are regarded as a '**gold standard**' for the monitoring of the vertical structure of ozone. The WOUDC, one of the World Data Centres for the GAW Programme, has been operated by Environment Canada on behalf of the WMO since 1961.

The letter reproduced above, written to Minister Kent by the Co-Chairs of the SPARC (Stratospheric Processes and their Role in Climate) Core Project of the World Climate Research Programme (WCRP) and endorsed by 118 scientists from the international SPARC community, was among the first of several international responses that urged that the Minister of the Environment should take steps to ensure the continuity, quality and integrity of the Canadian ozone measurement programme and the WOUDC. At the time of writing, no response to this letter has yet been received by SPARC.

The aforementioned Nature article noted the coincidence of the Environment Canada decision with the occurrence of the first recorded ozone hole in the Canadian Arctic. This occurrence has been further documented more recently in a scientific article[3] that has been coauthored by an international group of scientists including members of the Environment Canada ozone research unit. This article and associated public statements by several of its authors[4] has attested to the importance and complementarity of all of the measurements that are currently taken within the Canadian ozone monitoring programme.

We provide the above summary as information for CMOS members and readers of the *CMOS Bulletin SCMO*. The international concern that has arisen in connection with the perception that the ozone monitoring network is in jeopardy underlines the critical importance of maintaining high quality measurements of essential climate variables, one of which is ozone, together with the technical knowledge and expertise needed to ensure quality control and long-term reliability and consistency of the observational record. Interrupting ozone sonde measurements over Canada would cause irreparable damage to the observational record. In addition to being a fundamental component of the long-term ozone record, these measurements are critical for validation of satellite measurements and anchoring of future chemical reanalyses.

The critical importance of long-term measurements of key climate variables has once again been highlighted in plenary presentations and discussions at the Open Science Conference of the WCRP, held in Denver, Colorado during October 24-28, 2011 [5,6]. The Canadian contribution to this global effort is the responsibility of all Canadians. We suggest a broader discussion of Canada's contribution to the Global Climate Observing System (GCOS) and a strategic plan to maintain it, which involves scientists both within and outside Environment Canada.

1) Nature 477, 257-258 (2011) | doi:10.1038/477257a Corrected online: 15 September 2011.

2) Environment Canada defends ozone monitoring cuts, The Canadian Press, Posted: Sep 21, 2011 4:05 PM ET

3) Unprecedented Arctic ozone loss in 2011, Gloria L. Manney, et al., 2011, Nature 478, 469–475 (27 October 2011) doi:10.1038/nature10556.

4) Arctic ozone hole blamed for weird weather. Environment Canada cuts could disable future Canadian measurements. By Emily Chung, CBC News ,Posted: Oct 3, 2011 12:52 AM.

5) Climate researchers warn of data crisis. Looming gaps in satellite coverage challenge sustained climate observation. Quirin Schiermeier. Published online 28 October 2011; Nature doi:10.1038/news.2011.616

6) http://www.wcrp-climate.org/conference2011/

La version française suit:

News from CMOS Council and Executive

CMOS Council triples financial support for CMOS Centres

At its meeting on 21 September 2011, the Council voted to immediately triple the annual subvention for CMOS Centres. This was the outcome of a proposal first made at the Annual Meeting of Centre Chairs on 5 June at the Congress in Victoria by the Ottawa Centre. Following discussion at two Executive meetings over the summer, Denis Bourque drafted a Council paper on the issue which showed that the formula, unchanged since at least the early 1980's, should be about tripled in order to account for inflation over all those years. The updated subvention formula is :

S = $270 + $7.50 (# of CMOS members in Centre)

The subvention is normally calculated on membership figures at the end of the previous year and paid in September of the current year at the beginning of the new season of centre activities. This year the cheques were held up pending the Council decision and were actually mailed in early October. The subventions are conditional of course on the receipt of a report, including a financial report, on the activities of the previous year for publication in the Annual Review. A key part of the Council decision was that in future these subventions will be conditional on Centres providing a satisfactory plan for expenditure of the funds for the following year, as a part of their annual report.

The subventions are paid out of the general operating fund and are a line item in the financial reports and budgets. Needless to say the payments this year will exceed the budget for subventions in 2011 set at the AGM in 2010, but other budget items will likely compensate.

Another source of support for Centre activities is the Uri Schwarz Development Fund. This is commonly used for matching support for Centres to support local Science Fairs, but it can also be used for support for any worthwhile development project, simply by making a proposal to Council, which controls the fund. Council has delegated to the Executive routine approval of applications for Science Fair matching funds and for CMOS co-sponsorship of non-CMOS conferences and workshops, within certain limits.

Ian Rutherford
CMOS Executive Director

English version precedes;

Des nouvelles du Conseil de la SCMO et de l'Éxécutif

Le Conseil de la SCMO triple le soutien financier des centres de la Société

À sa réunion du 21 septembre, le Conseil a voté pour tripler immédiatement la subvention annuelle destinée aux centres de la SCMO. Le centre d'Ottawa avait émis cette proposition à la réunion annuelle des présidents des centres, le 5 juin, lors du congrès de Victoria. À la suite de discussions menées au cours de deux réunions de l'exécutif, tenues cet été, Denis Bourque a rédigé un document à ce sujet. Il a montré que la formule, inchangée depuis au moins le début des années 1980, devrait être triplée pour tenir compte de l'inflation accumulée au fil des ans. La formule de subvention actualisée est :

S = 270 $ + 7,50 $ (nombre de membres de la SCMO pour ce centre)

La subvention se calcule habituellement à partir du nombre de membres inscrits à la fin de l'année précédente et elle est payée en septembre de l'année courante, au début de la nouvelle période d'activité des centres. Cette année, les chèques ont été retenus en attendant la décision du Conseil et ont été postés au début d'octobre. Les subventions sont bien sûr conditionnelles à la réception d'un rapport, incluant un rapport financier, sur les activités de l'année précédente, pour publication dans la revue annuelle. La décision du Conseil repose principalement sur le fait que les futures subventions seront conditionnelles à l'élaboration, par les centres, de plans adéquats inclus dans leur rapport annuel et montrant comment les fonds seront dépensés durant l'année qui suit.

Les subventions proviennent du fonds général de fonctionnement et font l'objet d'un poste distinct dans les rapports financiers et les budgets. Il va sans dire que, cette année, les paiements pour les subventions de 2011 dépasseront le budget alloué lors de l'AGA de 2010. Toutefois, d'autres postes budgétaires compenseront vraisemblablement cette augmentation.

Autre source de financement pour les activités des centres, le fonds de développement Uri-Schwarz. Ce fonds sert habituellement de subvention de contrepartie, afin que les centres financent des expo-sciences locales. Il peut aussi servir à soutenir tout projet de développement prometteur, tout simplement en faisant la demande au Conseil, qui administre ce fonds. Le Conseil a délégué à l'exécutif l'approbation courante des subventions de contrepartie destinées aux expo-sciences, et aux congrès et ateliers externes coparrainés par la SCMO, et ce, à l'intérieur de certaines limites.

Ian Rutherford
Directeur exécutif

Next Issue *CMOS Bulletin SCMO*

Next issue of the *CMOS Bulletin SCMO* will be published in **February 2012.** Please send your articles, notes, workshop reports or news items before **January 6, 2012** to the address given on page 194. We have an URGENT need for your written contributions.

Prochain numéro du *CMOS Bulletin SCMO*

Le prochain numéro du *CMOS Bulletin SCMO* paraîtra en **février 2012.** Prière de nous faire parvenir avant le **6 janvier 2012** vos articles, notes, rapports d'atelier ou nouvelles à l'adresse indiquée à la page 194. Nous avons un besoin URGENT de vos contributions écrites.

ARTICLES

The First Radiosonde Flight in Canada

by Kenneth A. Devine[1]

While Pierre Idrac and Robert Bureau of France are given credit for the first radiosonde ascent in 1929, there were other experimenters active during that period. These included: Pazel A. Moltchanoff of Russia, Paul Duckert of Germany, and William Blair of the USA. The results of Moltchanoff and Blair were reported in 1931 and Duckert in 1932 (Dubois et al, 2002). Radio transmission from aircraft had occurred by 1915 but radiosondes required much lighter and more energy efficient designs since they were to be carried by free flight balloons. Upper air flights were being conducted in Canada from 1911 using the Dines meteorograph but these had to be recovered after the flight which took many months, as well many were not recovered and the data was lost (Devine and Strong, 2009).

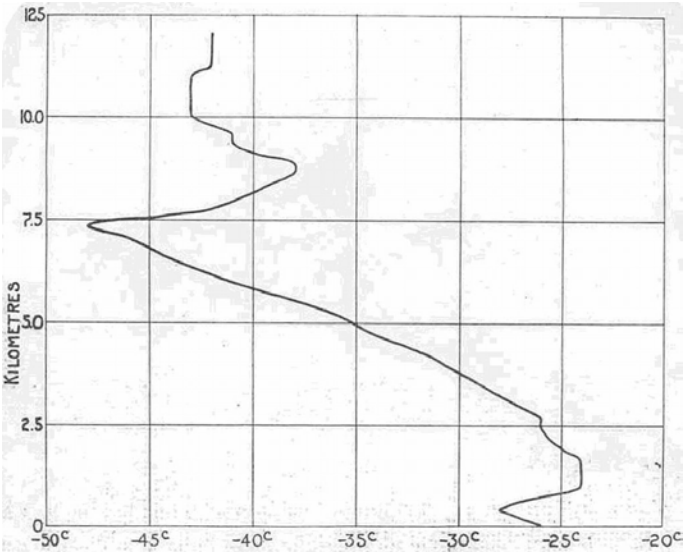

Figure 1: Radiosonde Flight at Coppermine, NWT on 4 March 1933

The Russian radiosonde may have been the first one available for general use since a second version was already being manufactured by Askania in Germany by 1931 and John Patterson only mentioned the Moltchanoff and Duckert radiosondes in his 1931 paper. The Moltchanoff radiosondes were used at Coppermine, NWT, during the Second Polar Year of 1932-33. Twelve (or maybe thirteen) Moltchanoff and three Duckert radiosondes were given to the Meteorological Service of Canada for these expeditions by the International Polar Commission, having been donated by the Rockeffler Foundation (MSC, 1940). The Canadian expeditions included year-long observations at Cape Hope's Advance in Quebec, Chesterfield Inlet in the NWT, Coppermine in the NWT and Meanok in Alberta.

While there may have been an earlier test flight of the Moltchanoff radiosonde in Toronto or elsewhere in Ontario, the first documented radiosonde flight in Canada (Figure 1) was conducted at Coppermine in the North West Territories (NWT) on March 4th 1933. The community of Coppermine (now called Kugluktuk in Nunavut) is located near sea level on the arctic coast at 115 west longitude. This radiosonde was released at 1600 local time. The flight was documented on a lantern slide which is available in the Environment Canada library at Downsview. The wind was light and the temperature at release was -27ºC with a typical polar inversion above the surface. The temperature dropped to -48ºC at the tropopause before passing a second tropopause and reaching a final height of 12 Km in the stratosphere. Since the flight was conducted during the daytime some of the temperature increase for the upper portion of the flight was due to solar heating.

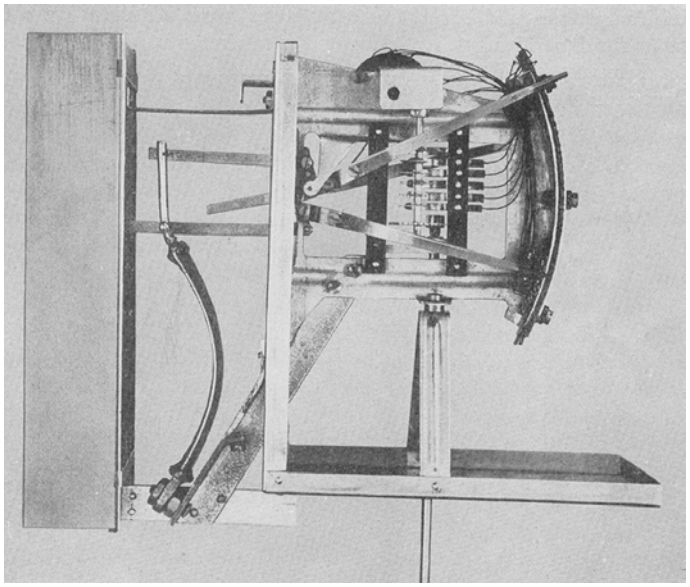

Figure 2: Moltchanoff Radiosonde with the temperature duct on the left

[1] Meteorologist Consultant
Aurora, Ontario, Canada

The Moltchanoff radiosonde (Figure 2) used mechanical sensors: an aneroid (either a curved Bourbon tube or later a Vidie type aneroid cell) for pressure, a bimetal for temperature and a hair bundle for humidity (Middleton, 1969). This mechanical radiosonde was very complex (Lange, 1935). The pointers from each of these sensors moved over their individual commutators called combs. A cupwheel beneath the radiosonde housing turned a vertical and, in turn, a horizontal shaft which each had a set of cams to switch in these commutators thus switching through the different sensors and their values. The one-tube transmitter broadcast these results using Morse code. The sequence: e, i, s, h, was transmitted for rising temperatures of a fixed amount (probably one degree) and the reverse order for falling temperatures. For lowering pressures the sequence: t, n, d, b, was transmitted. The operator had to copy down the transmissions and then decode the results starting with the release temperature and pressure to determine the temperature versus pressure profile.

While all the other observations at Coppermine were documented in the Canadian publication of the polar year results (MSC, 1940), there was no mention of the radiosonde flight data , only the preparations for same. All the surface measurements were published as were the pilot balloon flights for upper winds. Pilot balloon flights were conducted twice daily using both six and three-inch balloons manufactured in Guelph. Even the five flights of John Patterson's meteorograph which only reached about 2 Km at Coppermine were displayed in a graph. The total flight weight of Patterson's inexpensive meteorograph (Patterson, 1932) was 180 gm which was carried by the two nine-inch diameter balloons. The sensor lights which were arranged along the balloon train, were switched on and off by mechanical commutators transversed by each sensor. The pressure lights switched for every 16 millibars and the temperature (a spiraled bimetal) for every 0.6ºC. Of course this meteorograph suffered from the same problems as pilot balloons in that the data was lost when it entered cloud or was too far away. A radiosonde while more expensive, would supply data even when it was long out of sight or in the clouds. Only this one radiosonde flight from Coppermine seems to be available. In 1931, a year before the Polar year began, hydrogen cylinders for the radiosonde and pilot balloons were shipped to Coppermine. The size of the balloons required for the radiosonde flights were not mentioned but they would have been over one metre in diameter at release.

Using a Morse code output, the Moltchanoff radiosonde (Smithsonian, 1969) had the advantage that a general purpose high frequency receiver could be used and no special recorder was necessary. The radiosonde transmitters operated at wavelengths of 30 to 60 metres (10 to 5 MHz). While the coded output simplified the ground equipment, it made the radiosonde heavier for a total flight weight of 1275 gm (Thomson, 1932). There are three Moltchanoff radiosondes in the meteorological collection of the Canadian Science and Technology Museum (CSTM) in Ottawa. In the summer of 1930 a Moltchanoff radiosonde which had fallen in eastern Finland, was given for examination to Vilho Vaisala, a senior lecturer at the University of Helsinki. He found found that it was "too big, too heavy and too complicated" (Michelsen, 2006) and by 1932 had designed his own radiosonde.

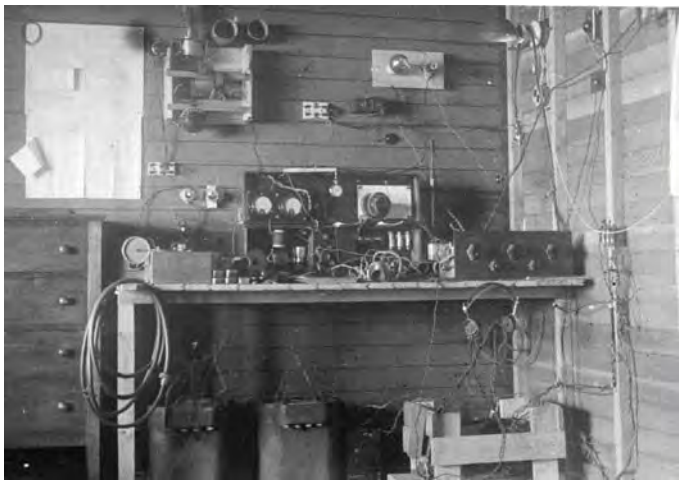

Figure 3: Communication Equipment at Coppermine, NWT(courtesy of the Canadian Science and Technology Museum)

Ratje Charles Jacobsen who was selected to operate this special station at Coppermine (Figure 3), was an honours graduate of the University of Toronto and held both a radio licence and a pilot's licence. In Coppermine he was assisted by the radio operators: D.R. Kinnear and A.V. Potruff. The results were abstracted after his return in 1933. Later in 1936 he was hired as a full time employee and assisted Gerald Gill in aircraft flights to study North American cold air masses with the USA (Thomas, 1996). In 1939 he designed the Canadian chronometric radiosonde which was used at seven stations in Canada until 1963. He became head of the Instrument Section in 1946 after Bill Middleton moved to the National Research Council in Ottawa. The first operational radiosonde stations in Canada used the Canadian radiosonde at Gander in 1941 and the USA audio modulated radiosonde at Argentia and Stephenville in 1942. The latter USA or Bendix-Friez designed radiosondes were used, with numerous modifications, at Canadian aerological stations until entirely replaced by the RS80 radiosonde from Vaisala in 1994.

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CLIMATE CHANGE / CHANGEMENT CLIMATIQUE

La version française suit.

Registration of Expert Reviewers for the WG I Contribution to the IPCC Fifth Assessment Report

Working Group I (WGI) of the Intergovernmental Panel on Climate Change (IPCC) has announced that the First Order Draft of the WGI contribution to the IPCC Fifth Assessment Report, *Climate Change 2013: The Physical Science Basis* will be available for Expert Review from 16 December 2011 to 10 February 2012. **Individuals interested in participating in the expert review of the WGI Report are invited to register themselves as expert reviewers using the form available on the IPCC WGI website.**

This registration process has been established by the WGI Bureau to facilitate an objective, open and transparent expert review. The WGI expert review follows the IPCC Procedures. All individuals with expertise and/or publications in the specific areas covered by the WGI Report are invited to assist in the IPCC assessment process by registering to review the chapter(s) of the WGI First Order Draft for which they are an expert. Prospective reviewers will be asked to indicate the chapter(s) that they are interested in reviewing, provide supporting information on their relevant expertise, and confirm their expertise through a statement of self-declaration. Following completion of the registration process, each expert reviewer will receive an email from the WGI Technical Support Unit on 16 December 2011 with an individual username and password to access the draft report.

BACKGROUND: At its 28th Session in April 2008, the IPCC decided to undertake the preparation of the IPCC Fifth Assessment Report (AR5), consisting of contributions from WGI (the physical science basis), WGII (impacts, adaptation and vulnerability), WGIII (mitigation of climate change) and a Synthesis Report. Complete information on the AR5 is available on the IPCC website.

The WGI contribution to the AR5 will include chapters on:

- Observations: Atmosphere and Surface;
- Observations: Ocean;
- Observations: Cryosphere;
- Information from Paleoclimate Archives;
- Carbon and Other Biogeochemical Cycles;
- Clouds and Aerosols;
- Anthropogenic and Natural Radiative Forcing;
- Evaluation of Climate Models;
- Detection and Attribution of Climate Change: from Global to Regional;
- Near-term Climate Change: Projections and Predictability;
- Long-term Climate Change: Projections, Commitments and Irreversibility;
- Sea Level Change;
- Climate Phenomena and their Relevance for Future Regional Climate Change

Please refer to the approved outline for the WGI contribution for additional detail on the content of the Report.

All IPCC Reports undergo a multi-phase review process. During the first review phase, First Order Drafts are circulated to expert reviewers with expertise and/or publications in particular areas of the report. During the second review phase, Second Order Drafts and a first draft of the Summary for Policymakers are circulated to all expert reviewers and to governments (through government focal points to the IPCC).

Questions about registration as an expert reviewer for the WGI contribution to the AR5 can be directed to the WGI Technical Support Unit at wg1@ipcc.unibe.ch

IPCC Secretariat for Canada
Science & Technology Branch
Environment Canada
200 Sacré Coeur Blvd, 11th Floor
Gatineau QC K1A 0H3
e-mail: ipcc-giec@ec.gc.ca
Telephone 819-953-7625; Facsimile 819-953-0550
Government of Canada Website www.ec.gc.ca/sc-cs

English version precedes.

Inscription des examinateurs experts Groupe de travail I 5e Rapport d'évaluation du GIEC

Le groupe de travail I (WGI) du Groupe d'experts intergouvernemental sur l'évolution du climat (GIEC) a annoncé que le premier projet de texte de la contribution du WGI au Cinquième rapport d'évaluation du GIEC, *Climate Change 2013: The Physical Science Basis* pourra être examiné par les experts du 16 décembre 2011 au 10 février 2012. **Les personnes qui désirent participer à l'examen du rapport du WGI sont invitées à s'inscrire comme examinateurs experts au moyen du formulaire disponible sur le site web du WGI du GIEC.**

Le processus d'inscription a été établi par le bureau du WGI afin d'assurer un examen objectif, ouvert et transparent. L'examen par les experts du WGI doit suivre les procédures du GIEC qui figurent sous IPCC Procedures. Toutes les personnes qui ont une expertise et/ou sont auteurs d'articles dans des domaines spécifiques couverts par le Rapport du WGI sont invitées à contribuer au processus d'évaluation du GIEC et à proposer leur candidature comme examinateurs des chapitres du premier projet de texte du WGI qui correspondent à leur domaine de compétence. Les examinateurs éventuels devront indiquer les chapitres qu'ils souhaitent étudier, fournir l'information relative à leur domaine d'expertise et confirmer leur expertise en signant un formulaire d'autodéclaration. À la fin du processus d'inscription, l'unité de soutien technique du WGI enverra le 16 décembre 2011 un courriel à chaque examinateur expert pour lui communiquer un nom utilisateur et un mot de passe permettant d'accéder au rapport provisoire.

Veuillez communiquer cette information aux personnes concernées.

CONTEXTE : À sa 28e session tenue en avril 2008, le GIEC a décidé d'entreprendre la préparation du Cinquième rapport d'évaluation du GIEC (AR5) qui comprend les contributions du WGI (les fondements physiques), du WGII (les impacts, l'adaptation et la vulnérabilité), et du WGIII (atténuation du changement climatique) ainsi qu'un rapport de synthèse. L'information complète sur l'AR5 se trouve dans le site web du GIEC.

La contribution du WGI à l'AR5 comprend les chapitres sur les sujets suivants :

- Observations : Atmosphère et surface;
- Observations : Océan;
- Observations : Cryosphère;
- Information sur les archives paléoclimatiques;
- Cycle du carbone et autres cycles biogéochimiques;
- Nuages et aérosols;
- Forçage anthropique et forçage radiatif naturel;
- Évaluation des modèles climatiques;
- Détection et attribution du changement climatique : mondial à régional;
- Changement climatique à court terme : Projections et prévisibilité;
- Changement climatique à long terme : Projections, engagements et irréversibilité;
- Changement du niveau de la mer;
- Les phénomènes climatiques et leur pertinence dans les changements climatiques régionaux futurs.

Veuillez consulter le sommaire de la contribution du WGI pour de plus de détails sur le contenu du rapport.

Tous les rapports du GIEC sont soumis à une révision qui comporte plusieurs phases. Au cours de la première phase de révision, les premiers projets de texte sont transmis aux examinateurs qui possèdent l'expertise et/ou ont publié des articles sur les sujets spécifiques contenus dans le rapport. Au cours de la deuxième phase de révision, les seconds projets de texte et un premier projet de texte du Sommaire à l'intention des décideurs sont transmis à tous les examinateurs experts et aux gouvernements (par l'entremise de points de contact des gouvernements au GIEC).

Vous pouvez adresser vos questions sur votre inscription en tant qu'examinateur expert pour la contribution du WGI à l'AR5 à l'unité de soutien technique du WGI à:

wg1@ipcc.unibe.ch

Secrétariat du GIEC pour le Canada
Direction générale des sciences et de la technologie
Environnement Canada
200, boulevard Sacré Coeur, 11e étage
Gatineau QC K1A 0H3
courriel: ipcc-giec@ec.gc.ca
Téléphone 819-953-7625; Télécopieur 819-953-0550
Gouvernement du Canada Site Web www.ec.gc.ca/sc-cs

CMOS BUSINESS / AFFAIRES DE LA SCMO

Prière de noter que les versions françaises suivent.

Summer Meteorology Workshop
Project Atmosphere 2012

Call for Applications by Pre-College Teachers

As in previous years, the Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in PROJECT ATMOSPHERE. This is a summer workshop for pre-college teachers of Atmospheric Science topics sponsored by the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA) of the United States. It will take place from **15 to 27 July 2012** at the National Weather Training Center, Kansas City, Missouri.

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

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

Interested teachers can obtain more information on the workshop and an application form on the CMOS website www.cmos.ca/ProjectAtmosphere.html. An application form can downloaded from the CMOS website or requested by writing to the address below.

Completed application forms can be mailed or faxed to the address below no later than **March 19, 2012**. Applicants are encouraged to submit their forms as soon as possible.

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

Summer Oceanography Workshop
Maury Project 2012

Call for Applications by Pre-College Teachers

The Canadian Meteorological and Oceanographic Society (CMOS) has been invited to select a Canadian teacher to participate in THE MAURY PROJECT. This is a summer workshop for pre-college teachers of Oceanographic topics sponsored by the American Meteorological Society (AMS) and the US Naval Academy. This year's workshop is on **9-20 July 2012** at the US Naval Academy, Annapolis, Maryland.

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

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

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

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

Interested teachers should download the application form (in pdf format) and mail or fax the filled form as soon as possible not later than **March 17, 2012** to the address given below. Applicants are encouraged to submit their forms as soon as possible.

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

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

Please note that the English versions precede.

Atelier d'été en météorologie
Projet Atmosphère 2012

Demande de candidats enseignants de niveau pré-collégial

Comme par les années passées, la Société canadienne de météorologie et d'océanographie (SCMO) a été invitée à choisir un enseignant canadien qui participera au PROJET ATMOSPHÈRE. Il s'agit d'un atelier d'été à l'intention des enseignant(e)s de niveau pré-collégial spécialistes en sciences atmosphériques; cet atelier est parrainé par l'American Meteorological Society (AMS) et la National Oceanic and Atmospheric Administration (NOAA) américaine. Il aura lieu du **15 au 27 juillet 2012** au centre de formation du National Weather Service à Kansas City au Missouri.

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

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

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site de la SCMO sur la toile à www.scmo.ca/ProjectAtmosphre.html où ils peuvent obtenir un formulaire d'application. Ils peuvent également obtenir un formulaire en le téléchargeant du site web de la SCMO ou en le demandant à l'adresse ci-dessous.

Les formulaires dûment remplis doivent être envoyés par courrier ou télécopieur à l'adresse ci-dessous au plus tard le **19 mars 2012.** Les candidat(e)s sont encouragé(e)s à soumettre leur formulaire dès que possible.

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

Atelier d'été en océanographie
Projet Maury 2012

Demande de candidats enseignants de niveau pré-collégial

Comme par les années passées, la Société canadienne de météorologie et d'océanographie (SCMO) a été invitée à choisir un enseignant canadien qui participera au PROJET MAURY. Il s'agit d'un atelier d'été à l'intention des enseignant(e)s de niveau pré-collégial spécialistes en sciences océanographiques; cet atelier est parrainé par l'American Meteorological Society (AMS) et le US Naval Academy. Il aura lieu du **9 au 20 juillet 2012** au US Naval Academy à Annapolis au Maryland.

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

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

Le lauréat devra écrire un court rapport pour la SCMO de son expérience estivale qui pourra être publié dans le Bulletin de la SCMO.

Les enseignant(e)s intéressé(e)s peuvent obtenir plus d'information en visitant le site web http://www.cmos.ca/ProjectMaury.html. Si vous êtes intéressés, vous devez télécharger le formulaire de candidature (en format pdf) et, une fois rempli, le poster ou le télécopier à l'adresse donnée ci-bas avant le **17 mars 2012.** Les candidat(e)s sont encouragé(e)s à soumettre leur formulaire dès que possible.

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

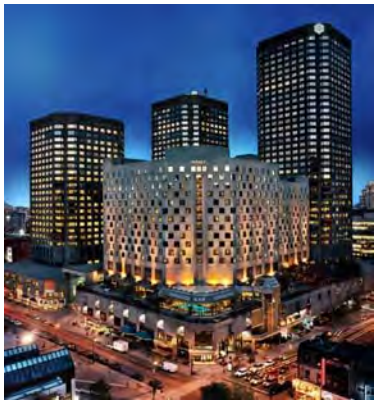
Prière de noter que vous ne pouvez pas enregistrer votre formulaire rempli sur votre ordinateur mais vous pouvez le compléter sur l'écran et imprimer des copies par la suite.

English version follows:

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. Un **appel à contributions** vous sera envoyé par courriel au début de janvier 2012 et sera également affiché sur le site internet du congrès au http://www.cmos.ca/congress2012/. Les soumissions de contributions seront acceptées à partir de ce moment jusqu'au **17 février 2012**. 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. Pour de plus amples informations, communiquez avec le Comité conjoint du programme scientifique (Courriel: spc@cmos.ca) ou le Comité organisateur (Courriel: lac@cmos.ca).

La version française précède:

ANNOUNCEMENT

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


Typical scenery of Montreal

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.

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 interests for our community.

The scientific program for the 2012 Congress will include plenary sessions jointly with our colleagues from the AMS. A **Call for Papers** will be sent by Email in early January 2012 and will be posted on the website of the congress (http://www.cmos.ca/congress2012/). Submissions will be accepted from that moment until **February 17, 2012**. Workshops, business meetings and the icebreaker reception will be scheduled for May 28, and the Congress program will begin May 29. For more information, please contact the Joint Scientific Program Committee (Email: spc@cmos.ca) or the Local Arrangement Committee (Email: lac@cmos.ca).

Atmosphere-Ocean 49-4 Paper Order

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DRI Preface (A-O 49-4)

The Drought Research Initiative: A Comprehensive Examination of Drought over the Canadian Prairies

by Ronald Stewart, John Pomeroy and Rick Lawford

The Canadian Prairies are often subjected to drought, and it is sometimes catastrophic. The most recent event occurred over the period 1999–2005, and it produced some of the driest conditions in the historical record. To address such droughts, the Drought Research Initiative (DRI) network was established. The particular focus of DRI was to understand better the factors that led to, sustained and

ended this recent drought, including its internal structure, and to contribute to the better prediction of such events. To accomplish this objective, the drought was considered from several perspectives involving the atmosphere, the land surface and sub-surface, and the role of vegetation was also considered. This drought was unusual in that its large scale forcing was quite variable over its duration; regions of record high precipitation sometimes occurred simultaneously across the Prairies and cloud fields were common. It nonetheless produced some of the greatest reduction in sub-surface moisture on record and led to major declines in river flows. The DRI research community from across the country, furthermore, worked closely with many partners affected by the drought so that they are better able to cope with such events in the future. This article provides a brief overview of this drought's characteristics as well as DRI's objectives and key scientific issues. It also summarizes key results from each of the articles in this special issue and ends with comments on DRI's overall contributions.

Préface pour le numéro spécial DRI (AO 49-4)

Le réseau de recherche sur la sécheresse

par Ronald Stewart, John Pomeroy and Rick Lawford

[Traduit par la rédaction] Les Prairies canadiennes sont souvent touchées par des sécheresses et celles-ci sont parfois catastrophiques. L'événement le plus récent est survenu durant la période 1999–2005 et a produit certaines des conditions les plus sèches jamais enregistrées. Afin d'étudier ces sécheresses, le Réseau de recherche sur la sécheresse (DRI) a été créé. L'objectif premier du DRI était de mieux comprendre les facteurs qui ont donné naissance à cette sécheresse, qui l'ont entretenu et qui y ont mis fin, y compris sa structure interne, et de contribuer à mieux prévoir ces événements. Pour atteindre cet objectif, la sécheresse a été examinée de différents points de vue prenant en considération l'atmosphère, la surface de la terre et la subsurface tout en tenant compte du rôle de la végétation. Cette sécheresse était inhabituelle en ce que son forçage à grande échelle a été assez variable au cours de sa durée; certaines régions des prairies ont en même temps reçu des précipitations record et les champs de nuages étaient fréquents. Elle a néanmoins produit certaines des plus importantes réductions de l'humidité souterraine jamais enregistrées et a occasionné des diminutions marquées du débit des cours d'eau. Les chercheurs du DRI d'un bout à l'autre du pays ont en outre travaillé étroitement avec plusieurs partenaires touchés par la sécheresse afin que ceux-ci soient mieux en mesure d'affronter de tels événements dans le futur. Le présent article donne un bref aperçu des caractéristiques de cette sécheresse ainsi que des objectifs du DRI et des principales questions scientifiques auxquelles il s'intéresse. Il résume aussi les résultats clés de chacun des articles publiés dans ce numéro spécial et se termine par des commentaires sur les contributions générales du DRI.

A-O Abstracts Preview

Avant Première des résumés de A-O

The following abstracts will soon be published in your next *Atmosphere-Ocean* publication, Special issue on DRI **(49-4)**.

Les résumés qui suivent paraîtront sous peu dans votre prochaine revue *Atmosphere-Ocean*, numéro spécial sur le projet DRI **(49-4).**

Drought Research in Canada: A Review

by Barrie R. Bonsal, Elaine E. Wheaton, Aston C. Chipanshi, Charles Lin, David J. Sauchyn and Lei Wen

Abstract: Since human activities and ecosystem health are dependent on adequate, reliable water supplies, droughts pose a serious threat to society and the environment. Large-area, prolonged droughts are among Canada's costliest natural disasters having major impacts on a wide range of sectors including agriculture, forestry, industry, municipalities, recreation, health and society, and aquatic ecosystems. Although most regions of Canada experience drought, southern regions of the Canadian Prairies are more susceptible mainly because the precipitation they experience is highly variabile in time and space. This paper reviews relevant scientific research and program activities on droughts in Canada with an emphasis on the Canadian Prairies. Investigations into past trends and variability of drought occurrence in the instrumental record and the paleo-record are examined first. This is followed by a description of the existing knowledge of the large-scale atmospheric causes of Canadian drought. Studies into the potential occurrence of future droughts are also summarized. Current monitoring and modelling techniques, prediction capabilities and adaptation strategies related to Canadian droughts are then presented. The paper concludes with the identification of major research gaps and program needs that will aid in our ability to understand and predict Canadian droughts, monitor and model their status, and adapt to their negative effects.

Résumé: Puisque les activités humaines et la santé des écosystèmes dépendent d'approvisionnements en eau adéquats et fiables, les sécheresses constituent une menace sérieuse à la société et à l'environnement. Les sécheresses prolongées touchant de grandes superficies sont parmi les désastres naturels les plus coûteux au Canada et ont un impact important dans de nombreux secteurs, y compris l'agriculture, la foresterie, l'industrie, les municipalités, les activités récréatives, la santé et la société et les écosystèmes aquatique. Bien que la plupart des régions du Canada connaissent des sécheresses, c'est dans les régions du sud des Prairies canadiennes qu'il s'en produit le plus souvent, surtout parce que les précipitations y sont très variables dans le temps et dans l'espace. Le présent article passe en revue

les activités de recherches et de programmes scientifiques portant sur les sécheresses au Canada, en accordant une attention particulière aux Prairies canadiennes. Nous examinons d'abord les études concernant les tendances et la variabilité des sécheresses dans le passé d'après les relevés instrumentaux et les renseignements paléolithiques. Nous faisons ensuite une description des connaissances actuelles sur les causes atmosphériques à grande échelle des sécheresses au Canada. Nous résumons aussi les études sur l'occurrence possible de sécheresses dans le futur. Nous présentons ensuite les techniques de surveillance et de modélisation, les capacités de prévision et les stratégies d'adaptation actuelles se rapportant aux sécheresses au Canada. En guise de conclusion, nous identifions les recherches nécessaires et les besoins des programmes visant à améliorer notre capacité de comprendre et de prévoir les sécheresses au Canada, de surveiller et de modéliser leur état et de nous adapter à leurs effets nuisibles.

Characterizing the Surface Features of the 1999–2005 Canadian Prairie Drought in Relation to Previous Severe Twentieth Century Events

by Barrie R. Bonsal, Elaine E. Wheaton, Alison Meinert and Evan Siemens

Abstract: The Canadian Prairie drought of 1999–2005 negatively affected several activities including agriculture, stream flow, hydro-electric production, and forest fires. However, surface drought conditions and associated impacts were neither spatially nor temporally uniform. Following an assessment of several gridded temperature and precipitation datasets, this study incorporates the Standardized Precipitation Index (SPI) and the Palmer Drought Severity Index (PDSI) to characterize the surface features of the 1999–2005 Prairie drought in terms of its origin, spatial propagation, persistence and termination. This includes the development and application of a newly proposed multi-stage concept to characterize and classify drought. These characteristics are then compared to previous major Prairie droughts in the instrumental record.

Results show that the 1999–2005 drought originated in the Great Plains of the United States and expanded into southwestern Alberta in late 1999 to early 2000. It then intensified to cover much of south-central Alberta and Saskatchewan in 2001. By 2002, it mainly affected the northern agricultural regions of these two provinces. This was followed by a widespread end to drought conditions in 2004 to 2005. Comparisons with other major twentieth-century droughts on the Prairies revealed many similarities, but notable differences, with the 1999–2005 episode. Analyses also showed that these major Prairie droughts originated in a variety of regions, although several can be traced back to the northern United States. Results from this investigation aid in a better understanding of temporal and spatial features associated with major Canadian Prairie droughts and can be used to help improve preparation and adaptation mechanisms for future drought occurrences.

Résumé: La sécheresse qui a sévi dans les Prairies canadiennes de 1999 à 2005 a eu plusieurs conséquences fâcheuses, notamment sur l'agriculture, le débit des cours d'eau, la production d'hydroélectricité et les feux de forêts. Cependant, les conditions de sécheresse de la surface, tout comme leurs conséquences, n'ont été uniformément réparties ni dans le temps ni dans l'espace. Faisant suite à une évaluation de plusieurs ensembles de données de température et de précipitations à des points de grille, nous incorporons dans cette étude l'indice de précipitation normalisé (SPI) et l'indice de gravité de sécheresse de Palmer (PDSI) pour caractériser les particularités de surface lors de la sécheresse de 1999–2005 dans les Prairies en fonction de son origine, de sa propagation spatiale, de sa pertinence et de sa terminaison. Cela inclut la mise au point et l'application d'une nouvelle approche multiétagée proposée pour caractériser et classifier la sécheresse. Nous comparons ensuite ces particularités à celles de sécheresses importantes survenues dans le passé selon les relevés instrumentaux.

Les résultats montrent que la sécheresse de 1999–2005 a pris naissance dans les Grandes Plaines des États-Unis et s'est propagée dans le sud-ouest de l'Alberta à la fin de 1999 et au début de 2000. Elle s'est ensuite intensifiée pour couvrir la majeure partie du centre-sud de l'Alberta et de la Saskatchewan en 2001. En 2002, elle a surtout affecté les régions agricoles du nord de ces deux provinces. Les conditions de sécheresse se sont ensuite généralement terminées de 2004 à 2005. Les comparaisons avec d'autres sécheresses importantes du vingtième siècle dans les Prairies ont révélé plusieurs similitudes, mais des différences notables, avec l'épisode de 1999–2005. Les analyses ont aussi montré que ces grandes sécheresses dans les Prairies ont pris naissance dans des régions variées, quoique l'origine de plusieurs peut être retracée dans le nord des États-Unis. Les résultats de cette étude aident à mieux comprendre les particularités spatiales et temporelles liées aux principales sécheresses dans les Prairies canadiennes et peuvent être utilisés pour aider à améliorer les mécanismes de préparation et d'adaptation aux futurs événements de sécheresse.

Atmospheric and Oceanic Variability Associated with Growing Season Droughts and Pluvials on the Canadian Prairies

by Amir Shabbar, Barrie R. Bonsal and Kit Szeto

Abstract: This study documents and assesses the atmospheric and oceanic variability associated with growing season (May to August) droughts over the Canadian Prairies. For comparison, extreme wet seasons or pluvials are also examined. Using the Palmer Z-Index as a drought indicator, extreme dry and wet seasons are first identified for the period 1950 to 2007. Interrelationships among several atmospheric parameters including large- to synoptic-scale circulation patterns, low-level moisture transport, moisture convergence, precipitable water content and cyclone frequency are then assessed during extreme drought and pluvial periods. In addition, links to the previous winter's global sea surface temperature (SST) patterns are identified using the multivariate technique of singular value decomposition.

Results show that moisture from the Gulf of Mexico is notably decreased during the identified drought seasons. Stronger than normal subsidence associated with anomalously high pressure over northwestern North America also leads to weakened moisture transport from the Pacific Ocean. Conversely, during pluvial seasons, low-level flow aided by the circulation associated with increased cyclone frequency over western North America brings abundant moisture northward into the southern Prairies. These circulation patterns over western North America and their

associated moisture transport anomalies into the Prairies show some linkages to previous winter SST patterns both globally and in the Pacific Ocean where the SSTs are similar to those associated with inter-annual El Niño Southern Oscillation (ENSO) events and ENSO-like inter-decadal North Pacific variability. This is the first study to examine several interconnected atmospheric and oceanic processes at various scales as they relate to the occurrence of growing season extreme climate over the Canadian Prairies. Results provide a better understanding into the physical mechanisms responsible for the initiation and perpetuation of these extremes.

Résumé: Cette étude documente et évalue la variabilité atmosphérique et océanique associée aux sécheresses survenant durant la saison de croissance (mai à août) dans les prairies canadiennes. À titre comparatif, nous examinons aussi les saisons ou les périodes extrêmement pluvieuses. En utilisant l'indice Z de Palmer comme indicateur de sécheresse, nous commençons par identifier les saisons extrêmement sèches et extrêmement pluvieuses durant la période de 1950 à 2007. Nous évaluons ensuite les interrelations entre plusieurs paramètres atmosphériques durant les périodes extrêmement sèches ou extrêmement pluvieuses, notamment les configurations de circulation à grande échelle ou à l'échelle synoptique, le transport d'humidité à basse altitude, la convergence d'humidité, le contenu en eau précipitable et la fréquence des cyclones. De plus, nous déterminons les liens avec les configurations globales de température de la surface de la mer (TSM) durant l'hiver précédent au moyen d'une méthode d'analyse multivariée : la décomposition en valeurs singulières.

Les résultats montrent que l'humidité venant du golfe du Mexique est notablement moindre durant les saisons de sécheresse identifiées. Une subsidence plus forte que la normale associée à des pressions anormalement élevées dans le nord-ouest de l'Amérique du Nord explique aussi un plus faible transport d'humidité depuis l'océan Pacifique. Réciproquement, durant les saisons pluvieuses, l'écoulement à basse altitude, aidé par la circulation associée à une fréquence accrue des perturbations dans l'ouest de l'Amérique du Nord, apporte une humidité abondante vers le nord jusque dans le sud des Prairies. Ces configurations de circulation dans l'ouest de l'Amérique du Nord et les anomalies de transport d'humidité correspondantes dans les Prairies exhibent certains liens avec les configurations de TSM de l'hiver précédent, tant à l'échelle du globe que dans le Pacifique où les TSM sont semblables à celles associées aux épisodes El Niño – oscillation australe (ENSO) interannuels et à la variabilité interdécennale dans le Pacifique Nord similaire à l'ENSO. Il s'agit de la première étude à examiner, à diverses échelles, plusieurs processus atmosphériques et océaniques interreliés du point de vue de leur rapport avec l'occurrence de conditions climatiques extrêmes durant la saison de croissance dans les prairies canadiennes. Les résultats permettent de mieux comprendre les mécanismes physiques responsables de l'établissement et de la perpétuation de ces extrêmes.

Drought and Associated Cloud Fields over the Canadian Prairie Provinces

by Heather Greene, Henry G. Leighton and Ronald E. Stewart

Abstract: Little is known about clouds during drought. From 1999 to 2005 the Canadian Prairies experienced one of the most severe and prolonged droughts in the historical record. This study characterizes clouds during drought in the Canadian Prairie Provinces with a particular focus on this recent drought.

Drought severity was determined using the Standardized Precipitation Index (SPI) based on monthly precipitation on a 1^{o}x1^{o} grid. Cloud fields from the National Aeronautics and Space Administration/Global Energy and Water Experiment's (NASA/GEWEX) Surface Radiation Budget database were used to examine overall cloud amount, optical thickness, and top-of-the-atmosphere albedo. Anomalies in monthly precipitation in the satellite record from 1984 to 2004, with an emphasis on the recent drought from 1999 to 2004, were related to anomalies in cloud fields.

During drought, a decrease in cloud amount was observed. During the spring and summer months of the 1999-2004 drought, for example, the observed cloud cover fraction decreased by approximately 7% between severely wet and severely dry conditions. There was, however, large month-to-month and spatial variability, and the correlation of cloud cover fraction anomaly with precipitation was weak. A higher correlation was found between the top-of-the-atmosphere albedo and precipitation. The occurrence of thick clouds and clouds of medium thickness did decrease with drought severity. These trends also applied to sub-regions within the overall domain. These observations further the understanding of the role of clouds in feedback mechanisms during drought.

Résumé: On sait peu de choses à propos des nuages durant les sécheresses. De 1999 à 2005, les Prairies canadiennes ont connu l'une des périodes de sécheresse les plus longues et les plus intenses depuis que l'on tient des relevés. La présente étude porte sur les nuages durant les périodes de sécheresse dans les Prairies canadiennes, en mettant l'accent sur les sécheresses récentes.

Nous avons déterminé l'intensité des sécheresses au moyen de l'indice de précipitations normalisé (SPI) fondé sur les précipitations mensuelles sur une grille de 1^{o} x 1^{o}. Nous avons étudié les champs de nuages obtenus de la base de données du bilan radiatif de la surface du GEWEX (Expérience mondiale sur les cycles de l'énergie et de l'eau) de la NASA pour examiner l'étendue générale des nuages, l'épaisseur optique et l'albédo du sommet de l'atmosphère. Nous avons mis en relation les anomalies dans les précipitations mensuelles d'après les données satellitaires de 1984 à 2004, en mettant l'accent sur la sécheresse récente de 1999 à 2004, avec les anomalies dans les champs de nuages.

Pendant les sécheresses, nous avons noté une diminution de l'étendue des nuages. Durant les mois de printemps et d'été de la période de sécheresse de 1999 à 2004, par exemple, la fraction de couverture du ciel observée a diminué d'environ 7 % entre les conditions très humides et très sèches. Cependant, la variabilité

intermensuelle et spatiale est grande, et la corrélation de l'anomalie de la fraction de couverture nuageuse avec les précipitations est faible. Nous avons trouvé une meilleure corrélation entre l'albédo du sommet de l'atmosphère et les précipitations. La quantité de nuages épais et de nuages d'épaisseur moyenne diminuait quand l'intensité de la sécheresse augmentait. Ces tendances s'observent aussi dans les sous-régions à l'intérieur domaine général. Ces observations permettent de mieux comprendre le rôle des nuages dans les mécanismes de rétroaction au cours des sécheresses.

On Precipitation and Virga over Three Locations during the 1999–2004 Canadian Prairie Drought

by E. Evans, R.E. Stewart. W. Henson and K. Saunders

Abstract: The recent 1999–2004 drought, and especially the period from 2001 to 2002, had major impacts across Canada and in the western Canadian Prairie region in particular. This study characterizes the recent drought with respect to precipitation on a small scale at three sites: Calgary, Edmonton and Saskatoon. Climatologically, precipitation events of low daily accumulation ($\leq$10 mm) account for the majority of the total accumulation (up to 58%) at all study locations. During the recent drought, these events contributed a higher proportion of the total precipitation (up to 63%) because of a lack of heavy precipitation events. Using radar data at these locations, precipitation events were also classified into three categories: convective, stratiform and virga. There was wide variation in the relative importance of stratiform and convective precipitation at the sites with, for example, some drought periods being dominated by convective and others by stratiform events. Virga was also present with an average cloud base temperature < 0°C which would have led to efficient sublimational loss contributing to the reduction of precipitation at the surface. Any understanding of drought must take into account such precipitation issues.

Résumé: La récente sécheresse de 1999–2004, et plus spécialement la période de 2001 à 2002, a eu des répercussions majeures au Canada en général et dans la région des Prairies canadiennes en particulier. La présente étude caractérise cette sécheresse récente en fonction des précipitation à petite échelle à trois sites : Calgary, Edmonton et Saskatoon. D'un point de vue climatologique, les événements de précipitations de faible accumulation journalière ($\leq$10 mm) comptent pour la majorité de l'accumulation totale (jusqu'à 58 %) à tous les endroits étudiés. Durant la récente sécheresse, ces événements ont constitué une plus grande proportion des précipitations totales (jusqu'à 63 %) à cause du faible nombre d'événements de fortes précipitations. À l'aide des données radar à ces endroits, les événements de précipitation ont aussi été classifiées en trois catégories : convective, stratiforme et virga. Il y a eu une grande variation de l'importance relative des précipitations stratiformes et convectives à ces sites avec, par exemple, certaines périodes de sécheresse dominées par des événements convectifs et d'autres par des événements stratiformes. Il y a eu aussi des virgas avec une température moyenne de la base des nuages < 0 °C, ce qui aurait causé des pertes par sublimation contribuant à la réduction des précipitations à la surface. Pour comprendre toute sécheresse on doit prendre en compte ce genre de facteurs liés aux précipitations.

The Catastrophic June 2002 Prairie Rainstorm

by Kit Szeto, William Henson, Ronald Stewart and Gabrielle Gascon

Abstract: A catastrophic rain event occurred in early June 2002 during a major drought over the Canadian Prairies. The storm brought record-breaking rainfall and major flooding to many locations in the region. Given the importance of this event, this study's overall objectives are to characterize and to understand the physical nature of the rainstorm better. The event was associated with a major extratropical cyclone which acted in concert with the Great Plains low-level jet to transport a tremendous amount of moisture into the eastern Prairies producing intense diurnal mesoscale convective systems over the region. At the same time, moisture was transported to the western Prairies by a strong easterly low-level jet which produced heavy and long-lived orographic precipitation near the foothills. Several working hypotheses were developed to explain the severity and longevity of the rainstorm; it was found that the Rockies played a central role in the organization and development of the system. Atmospheric features that are critical to the development of an important class of extreme rain events in the Canadian Prairies were also identified. The severity of the June 2002 system is partly a result of the rare co-occurrence of these features during the period. Results from a preliminary analysis show that the atmospheric conditions associated with the extreme background drought enhanced the likelihood of the co-occurrence of these features during spring 2002, hence facilitating the development of the extreme rain event. In return, the tremendous precipitation from the storm alleviated the drought conditions in the southern Prairies.

Résumé [Traduit par la rédaction]: Un événement de pluie catastrophique s'est produit au début de juin 2002 pendant une sécheresse importante dans les Prairies canadiennes. La tempête a produit des chutes de pluie records et des inondations importantes à plusieurs endroits dans la région. Étant donné l'importance de cet événement, les objectifs généraux de la présente étude sont de mieux caractériser et de mieux comprendre la nature physique de la tempête de pluie. L'événement a été causé par une importante dépression extratropicale qui s'est associée au courant-jet à basse altitude des Grandes Plaines pour transporter une énorme quantité d'humidité dans l'est des Prairies et produire d'intenses systèmes convectifs de mésoéchelle diurne dans la région. En même temps, de l'humidité transportée dans l'ouest des Prairies par un fort courant-jet à basse altitude soufflant de l'est a produit d'intenses précipitations orographiques persistantes près des contreforts. Nous avons formulé plusieurs hypothèses de travail pour expliquer l'intensité et la persistance de la tempête de pluie; il ressort que les Rocheuses ont joué un rôle central dans l'organisation et le développement du système.

Nous avons aussi identifié les caractéristiques atmosphériques essentielles à la formation d'une catégorie importante d'événements de pluie extrêmes dans les Prairies canadiennes. L'intensité du système de juin 2002 est en partie le résultat de la rare présence simultanée de ces caractéristiques durant la période. Les résultats d'une analyse préliminaire montrent que les conditions atmosphériques liées à la sécheresse extrême qui régnait en toile de fond ont augmenté la probabilité d'une présence simultanée de ces caractéristiques au cours du

printemps 2002, ce qui a favorisé la formation de l'événement de pluie extrême. En revanche, les précipitations diluviennes produites par la tempête ont atténué les conditions de sécheresse dans le sud des Prairies.

Regional Groundwater Storage from GRACE over the Assiniboine Delta Aquifer (ADA) of Manitoba

by S. Z. Yirdaw and K.R. Snelgrove

Abstract: Total water stored in the landscape, which includes groundwater, surface water and snow storage components, plays a major role in the hydrologic water balance. Distributed measurements of high spatial resolution moisture storage could be valuable information sources for model parameterization and validation if they were readily available. However, it is well known that moisture storage is difficult to measure at scales required for hydrological model applications because of representativeness issues. This paper explores the feasibility of using the Gravity Recovery And Climate Experiment (GRACE) gravity information for regional hydrological model studies. The significance of total water storage measured by the GRACE satellite is investigated by downscaling these satellite measurements onto groundwater level data available over the Assiniboine Delta Aquifer (ADA) located in southwestern Manitoba. The goal is to obtain and evaluate local groundwater storage information from coarse resolution GRACE-based total water storage. Results show that downscaled groundwater storage estimates compare favourably with measured groundwater storage over the study area. It was found that correlations (*R*) between the measured and downscaled groundwater storage vary spatially between 0.5 and 0.85. However, it must be cautioned that significant training data were required to construct the downscaling model and that these data are not widely available for other locations. Transferability of these results to other areas remains an open research topic.

Résumé [Traduit par la rédaction]: La quantité totale d'eau stockée dans le paysage terrestre, qui inclut les composantes eau souterraine, eau de surface et eau stockée dans la neige, joue un rôle majeur dans le bilan hydrologique. Des mesures réparties du stockage d'humidité à haute résolution spatiale pourraient être des sources d'information intéressantes pour la paramétrisation et la validation des modèles si elles étaient facilement disponibles. Cependant, il est connu que le stockage de l'eau est difficile à mesurer aux échelles convenant aux applications des modèles hydrologiques à cause de problèmes de représentativité. Dans le présent article, nous examinons la faisabilité d'utiliser l'information sur la gravité du projet GRACE (Gravity Recovery And Climate Experiment) pour les études hydrologiques régionales par modèle. Nous étudions la signification de la quantité totale d'eau stockée mesurée par le satellite GRACE en faisant une réduction d'échelle de ces mesures satellitaires dans une surjection sur les données de niveau phréatique disponibles pour l'aquifère du delta de la rivière Assiniboine situé dans le sud-ouest du Manitoba. Nous cherchons ainsi à obtenir et à évaluer l'information sur le stockage local d'eau souterraine à partir des données de stockage total d'eau fournies par le GRACE à basse résolution. Les résultats montrent que les estimations de stockage d'eau souterraine obtenues par réduction d'échelle se comparent favorablement au stockage d'eau souterraine mesuré dans la région à l'étude. Nous avons trouvé que les corrélations (*R*) entre le stockage d'eau souterraine mesuré et celui obtenu par réduction d'échelle varient dans l'espace entre 0,5 et 0,85. Cependant, il faut savoir qu'il a été nécessaire d'utiliser un nombre important de données d'apprentissage pour construire le modèle de réduction d'échelle et que ces données ne se trouvent pas facilement pour d'autres endroits. La transférabilité de ces résultats à d'autres endroits reste un sujet à étudier.

Evaluation of Land Surface Scheme SABAE-HW in Simulating Snow Depth, Soil Temperature and Soil Moisture within the BOREAS Site, Saskatchewan

by Alireza Hejazi and Allan D. Woodbury

Abstract: The Soil Atmosphere Boundary, Accurate Evaluation of Heat and Water (SABAE-HW) model is a multilayered, one-dimensional, physically based version of the Canadian Land Surface Scheme (CLASS) and uses the same methodologies as CLASS, version 2.6. SABAE provides an improved interface for groundwater modelling to simulate soil moisture, soil temperature, energy fluxes and snow depth for a wide range of soil and vegetation. This paper reports the results of the first field comparison of SABAE-HW using an extensive ten-year dataset from the Boreal Ecosystem Atmosphere Study (BOREAS) and the Boreal Ecosystem Research and Monitoring Sites (BERMS) project, an area in central Saskatchewan, Canada, rich in terms of hydrological and meteorological data. The model is also independently tested and verified with the Simultaneous Heat and Water (SHAW) which is an unsaturated-zone transport model. Two boundary conditions are considered at the bottom of the soil profile: a water table boundary condition and a unit gradient boundary condition. There was substantial agreement between the results of the simulations and observations in terms of snow depth and soil temperature. Snow depth and soil temperature were simulated reasonably well by SABAE, with correlation values of 0.96 and 0.98, respectively. However, there were some discrepancies for simulated soil temperature in winter. General agreement was obtained in terms of unfrozen soil moisture results, especially at greater depths, but there were general similarities in observed and simulated soil moisture trends in winter. An average correlation of 0.55 was found for SABAE while the correlation for SHAW was much smaller (less than 0.30), which indicates a better fit between simulated and field data by SABAE. Although a unit gradient boundary condition does not influence soil moisture, it was found that unit gradient boundary runs resulted in increased bias towards overestimation of the soil temperature. Thus, a safer and more accurate approach, we believe, is to adopt a first type boundary (i.e., water table) condition at the bottom of the domain. This has implications for climate and weather modelling in general. The result of this field testing demonstrated the potential and high accuracy of SABAE-HW as a Canadian model capable of simulating snow depth, soil temperature, soil moisture, energy fluxes, and we believe it is now appropriate to include this land surface scheme with its counterparts.

Résumé: Le modèle *Soil Atmosphere Boundary, Accurate Evaluation of Heat and Water (SABAE-HW)* est une version multicouche, à une dimension, basée sur la physique du schéma CLASS (*Canadian Land Surface Scheme*) qui utilise les mêmes méthodologies que le CLASS version 2.6. Le SABAE offre une interface améliorée pour la modélisation des eaux sous-terraines permettant de simuler l'humidité du sol, la température du sol, les flux d'énergie et l'épaisseur de la neige pour une grande variété de sols et de végétation. Cet article présente les résultats de la première comparaison terrain du SABAE-HW en utilisant une base de données étendue de dix ans de l'Étude de l'atmosphère

et des écosystèmes boréaux (BOREAS) et du projet des Sites de recherche et de surveillance des écosystèmes boréaux (BERMS), une région du centre de la Saskatchewan, au Canada, riche en données hydrologiques et météorologiques. Le modèle est aussi indépendamment testé et vérifié à l'aide du *Simultaneous Heat and Water (SHAW)*, un modèle de transport en zone non saturée. Deux conditions aux limites sont supposées au fond du profil du sol : une condition aux limites de nappe phréatique et une condition aux limites de gradient unitaire. Il y avait une concordance importante entre les résultats des simulations et les observations en ce qui a trait à l'épaisseur de la neige et à la température du sol. L'épaisseur de la neige et la température du sol ont été raisonnablement bien simulées par le modèle SABAE, avec des corrélations de 0,96 et 0,98, respectivement. Cependant, il y avait certaines divergences pour la température simulée du sol en hiver. Pour ce qui est des résultats concernant l'humidité du sol non gelé, ils s'accordaient généralement, surtout pour les plus grandes profondeurs, mais il y avait des similarités générales dans les tendances observées et simulées de l'humidité du sol en hiver. Nous avons trouvé une corrélation moyenne de 0,55 pour le SAGAE alors que la corrélation pour le SHAW était beaucoup plus faible (0,30), ce qui indique un meilleur ajustement des données simulées aux données de terrain pour le SABAE. Même si une condition aux limites de gradient unitaire n'influence pas l'humidité du sol, il ressort que des passes faites avec un gradient unitaire aux limites ont produit un biais accru vers la surestimation de la température du sol. Donc, nous croyons qu'une approche plus sûre et plus précise serait d'adopter une condition aux limites de Dirichlet (c.-à-d. une nappe phréatique) au fond du domaine. Ceci a des répercussions sur la modélisation du climat et du temps en général. Le résultat de cet essai sur le terrain a démontré le potentiel et la grande exactitude du SABAE-HW en tant que modèle canadien capable de simuler l'épaisseur de la neige, la température du sol, l'humidité du sol et les flux d'énergie et nous croyons qu'il est maintenant approprié d'inclure ce schéma de surface avec ses contreparties.

Characterization and Summary of the 1999–2005 Canadian Prairie Drought

J.M. Hanesiak, R.E. Stewart, B.R. Bonsal, P. Harder, R. Lawford, R. Aider, B.D. Amiro, E. Atallah, A.G. Barr, T.A. Black, P. Bullock, J.C. Brimelow, R. Brown, H. Carmichael, C. Derksen, L.B. Flanagan, P. Gachon, H. Greene, J. Gyakum, W. Henson, E.H. Hogg, B. Kochtubajda, H. Leighton, C. Lin, Y. Luo, J.H. McCaughey, A. Meinert, A. Shabbar, K. Snelgrove, K. Szeto, A. Trishchenko, G. van der Kamp, S. Wang, L. Wen, E. Wheaton, C. Wielki, Y. Yang, S. Yirdaw and T. Zha

Abstract: Droughts are among the world's most costly natural disasters and collectively affect more people than any other form of natural disaster. The Canadian Prairies are very susceptible to drought and have experienced this phenomenon many times. However, the recent 1999–2005 Prairie drought was one of the worst meteorological, agricultural and hydrologic droughts over the instrumental record. It also had major socio-economic consequences, adding up to losses in the billions of dollars. This recent drought was the focus of the Drought Research Initiative (DRI), the first integrated network focusing on drought in Canada. This article addresses some of the key objectives of DRI by providing a collective summary, understanding and synthesis of the 1999–2005 drought. Bringing together the many datasets used in this study was in itself a major accomplishment. This drought exhibited many important, and sometimes surprising, features. This includes, for example, (1) a non-steady large-scale atmospheric circulation (and sea surface temperature) pattern that mainly resulted in subsidence over the region but also cold and warm periods in its evolution; such features have typically not occurred in previous droughts; (2) large spatial gradients between wet and dry areas that, in some instances, were linked with major precipitation events; and (3) many impacts at and below the earth's surface that occurred with varying temporal lags from the meteorological conditions and, in response, these impacts would have fed back onto the character of the drought (e.g., the surface-convection feedback). The drought's complexity poses enormous challenges for its simulation and prediction at all temporal scales. High-resolution models coupled with the surface are needed to address these and many other issues identified in this article.

Résumé [Traduit par la rédaction]: Les sécheresses sont parmi les catastrophes naturelles les plus coûteuses et, collectivement, affectent plus de gens que toute autre forme de catastrophe naturelle. Les Prairies canadiennes sont très vulnérables aux sécheresses et ont souvent subi ce phénomène. Toutefois, la récente sécheresse de 1999–2005 dans les Prairies a été l'une des pires sécheresses météorologiques, agricoles et hydrologiques enregistrées depuis que l'on effectue des relevés. Elle a aussi eu d'importantes conséquences socio-économiques, les dommages se chiffrant en milliards de dollars. C'est à cette sécheresse récente que s'est intéressé le Réseau de recherche sur la sécheresse (DRI), le premier réseau intégré consacré à la sécheresse au Canada. Le présent article traite de certains des objectifs clés du DRI en fournissant un résumé général, une compréhension et une synthèse de la sécheresse de 1999–2005. Le seul fait de rassembler les nombreux ensembles de données utilisés dans cette étude était en soi un accomplissement remarquable. Cette sécheresse présentait plusieurs caractéristiques importantes et quelquefois surprenantes. Parmi celles-ci : (1) une configuration de circulation atmosphérique transitoire à grande échelle (et de température de la surface de la mer) qui a généralement causé de la subsidence dans la région mais aussi des périodes de froid et de chaleur au cours de son évolution; ces caractéristiques ne se sont généralement pas produites lors des sécheresses précédentes; (2) de forts gradients spatiaux entre les zones humides et sèches qui, dans certains cas, étaient liés à des événements de précipitations extrêmes; et (3) plusieurs conséquences à la surface et sous la surface de la terre qui se sont produites avec des retards variables par rapport aux conditions météorologiques et qui auraient à leur tour rétroagi sur le caractère de la sécheresse (par exemple, rétroaction de convection de surface). La complexité de la sécheresse pose des défis énormes pour sa simulation et sa prévision à toutes les échelles temporelles. Des modèles à haute résolution couplés avec la surface sont nécessaires pour traiter ces questions et plusieurs autres mentionnées dans cet article.

Atmosphere-Ocean keeps on rolling!

Following the signature of our Publishing agreement with Taylor & Francis (T&F), many changes have been made: a new journal web site (informaworld.com/tato), a new online manuscript submission and review system (mc.manuscriptcentral.com/a-o) and an online Central Article Tracking System. These systems have made life much simpler, easier, and faster for authors, as well as being more responsive and more reliable for all involved. Coupled with the page charge incentive for new Canadian authors, these improvements have spurred a marvellous response. Whereas we had been publishing an average of 23 articles per year over the last ten years, we are publishing 36 articles in our first year, a number attained only once in A-O's history, in 1991. This performance is also reflected in the number of pages published (464 in 2011, compared to an average of 377 in the previous 10 years).

Our co-editors William Hsieh and Guoqi Han have worked hard to encourage the submission of 89 new manuscripts since 1 December 2010, and 21 manuscripts are currently being revised. So, the expectation for 2012 is further growth and rapid progress toward our goal of 100 published articles for 2013-14. In agreement with T&F, next year's "page budget" has been increased from 480 to 544 pages and we plan to publish an additional 5th special issue.

There is more! For several years, prospective authors have been requesting journal templates to facilitate the preparation of their manuscripts. Thanks to T&F's staff, we are now offering templates for both MSWord and LaTex (see Instructions for Authors on the journal site).

Despite all this automation, we continue to pay a personalized attention to each of your manuscripts. Authors can always contact our technical editor Sheila Bourque (ao.tech.ed@rogers.com) if they have questions once their manuscript is in the publication process. We also offer considerable flexibility concerning financial matters.

Thanks to all authors who have submitted this year. If you have not yet submitted to your journal, please think about submitting your best paper soon!

Richard Asselin
CMOS Publications Director

Ça continue de rouler à *Atmosphere-Ocean*!

Suite à la signature de l'entente de publication avec Taylor & Francis (T&F), il y a eu beaucoup de changement : un nouveau site web (informaworld.com/tato), un nouveau système de soumission et de revue des manuscrits (mc.manuscriptcentral.com/a-o) et un système de suivi en ligne des manuscrits en production. Ces systèmes ont rendu la vie plus simple, plus facile et plus rapide pour les auteurs, en plus d'être plus souples et plus fiables pour tous. Survoltés par l'exonération des frais pour les nouveaux auteurs canadiens, ces améliorations ont stimulé une merveilleuse réaction. Alors que nous avions publié une moyenne de 23 articles durant les 10 dernières années, nous en publions 36 en cette première année, ce que nous n'avions réussi qu'une seule fois dans l'histoire de A-O, en 1991. Cette réussite se voit aussi dans le nombre de pages publiées (464 par rapport à une moyenne de 377 dans les dix années précédentes).

Nos co-directeurs William Hsieh et Guoqi Han ont travaillé fort pour encourager la soumission de 89 nouveaux manuscrits depuis le 1er décembre 2010, et il y a encore 21 manuscrits en cours de révision. Pour 2012, nous prévoyons une croissance continue et nous approcher de notre objectif de 100 articles publiés en 2013/14. Avec l'accord de T&F, notre "budget de pages" a été augmenté de 480 à 544 pages pour 2012 et nous prévoyons publier un numéro spécial (5e) en sus.

Il y a plus! Depuis plusieurs années, nos auteurs réclamaient des modèles de mise en page pour faciliter la préparation des manuscrits. Grâce au personnel de T&F, nous offrons maintenant des modèles pour MSWord et LaTex (voir les Informations pour le auteurs sur le site de la revue).

Même avec toute cette automation, nous continuons à porter une attention personnalisée à chacun de vos manuscrits. Les auteurs peuvent toujours contacter notre éditrice technique Sheila Bourque (ao.tech.ed@rogers.com) si des questions surviennent en cours de publication. Nous déployons aussi beaucoup de flexibilité dans le traitement des choses financières.

Grand merci aux auteurs qui ont fait des soumissions cette année. Si vous n'avez pas soumis cette année, planifiez de nous soumettre votre meilleur manuscrit bientôt!

Richard Asselin, Directeur des publications SCMO

BOOK REVIEWS / REVUES de LITTÉRATURE

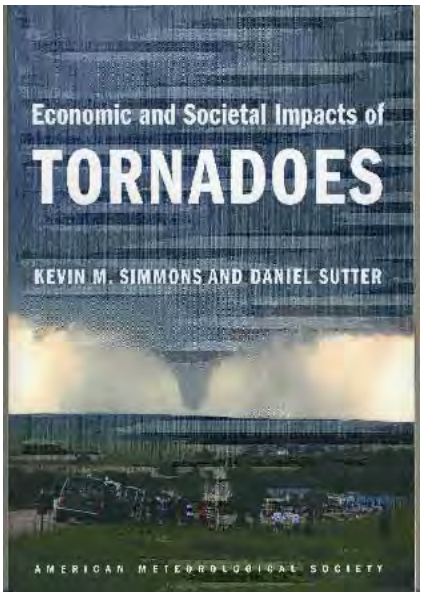
Economic and Societal Impacts of Tornadoes

by Kevin M. Simmons and Daniel Sutter

Published by the American Meteorological Society
Distributed by the University of Chicago Press, 2011
ISBN 978-1-878220-99-8.
Paperback; 296 pages, 13 colour plates
List Price: US$30.00 through the AMS bookstore
(AMS Member Price: US$22.00)

Book reviewed by T. Colleen Farrell[1]

The promotional campaign on the American Meteorological Society website recommends this book "*for meteorologists, social scientists, and emergency managers*". I would add that this book has a broad appeal, for anyone curious about tornadoes or other natural disasters and their societal impacts, but not necessarily interested in physics or meteorology.



About 12,000 tornadoes touch down in the USA each year. In the Foreword, Tyler Cowen, Professor of Economics at George Mason University, writes: "*Disasters, including tornadoes, test the flexibility and resilience of economic and political institutions*". Recovery from tornadoes can involve large steps backward, followed by significant leaps forward. It can show how politics work and sometimes how it fails.

What do I recall from Economics 101? Like most meteorologists, I remember learning the basics of supply and demand. What do a couple of economists know about tornadoes? Their primary focus is on casualties rather than property damage or the impacts for businesses. They analyze the efforts to reduce impacts (benefits versus costs of "safe-rooms" or tornado shelters (Chapter **5**), Doppler Radars, timeliness of weather watches, warnings and false alarms (Chapter **4**). What is the most cost-effective way to reduce impacts? How can scientific knowledge of tornado genesis and storm dynamics lead to a reduction in societal impacts?

With the introduction of Doppler Radar technology, improved warnings would lead to a reduction in fatalities; however, fatalities increased 70% since the introduction of NEXRAD system between 1992 and 1997. The two deadliest years were 1998 and 1999, immediately after the NEXRAD network was completed, at a cost of 1.2 billion USD.

Economic methods can be applied to "crime, the family, politics and (even) morality to try to understand our world by using theoretical models and statistical techniques to find patterns…" *They call study outside the traditional domain of economists "academic disciplinary trespassing*". Their book is an extension of the field of environmental economics (similarly used for studying flood, hurricane or forest fire impacts) and their analysis can be used to answer the broader questions of societal impacts: What are the determinants of tornado casualties? Do false alarms create a "cry wolf" effect? Is tornado-related damage increasing? They also attempt to estimate the value of meteorological research and tornado warning products of the US National Weather Service (NWS). Can impacts direct scientific research? What can reduce tornado impacts? Do people adequately prepare for low-probability, high-impact events ("low-probability event bias")?

Chapter **2** discusses Tornado Climatology in great detail. An estimation of tornado frequency and differences in frequency across the USA is necessary in order to assess the threat to life and property. They discuss the problems when looking for trends in frequency in the archives due to the improved ability to document and record tornadoes in the years since records began (1950). The Fujita Scale (F-scale) of tornado intensity was adopted by the NWS in the early 1970s. Tornadoes archived prior to 1975 were retrospectively assigned F-scale ratings, based on descriptions of the damage. If there was insufficient information to assign a rating, they were assumed to be weak, F0 or F1. Building codes were less stringent 35 years ago, and even less so 60 years ago, so damage reports may have been skewed leading to higher retrospective F-scale ratings. In recent years, when there are many more storm chasers and cell phones, the total number of tornadoes reported annually has risen dramatically since 1989. One assumption made by the researchers is that, while F0 and F1 tornadoes are more likely to be reported in recent history due to the increased availability of video cameras and cell phones, larger and more destructive

[1] Environment Canada, Dartmouth, Nova Scotia, Canada.

tornadoes would likely still have been reported back in the 1950s and 60s. They conclude that tornado frequency does not appear to be increasing in the U.S. Their methodology was very well explained and I, as a non-statistician, found their arguments to tease a credible trend out of the data a very interesting exercise.

Also, it has been speculated that tornado frequency may be increasing over time due to climate change. In fact, the annual number of F2 and stronger tornadoes in the archive has declined from 1950 to 2007, tornadoes have become less deadly over time and, confirming a popular belief, fatality rates for mobile (manufactured) home dwellers is 10 times that for those living in permanent structures (Chapter **3** – An Analysis of Tornado Casualties).

In Chapter **4**, they conclude that warning lead times up to 15 minutes reduced fatalities and injuries, but beyond 15 minutes, there was no additional reduction in casualties. There is a very real "cry wolf" syndrome: when recent local false alarms increase, fatalities and injuries increase.

At the end of each chapter, there is a summarizing paragraph or three.

The El Niño-Southern Oscillation Phenomenon

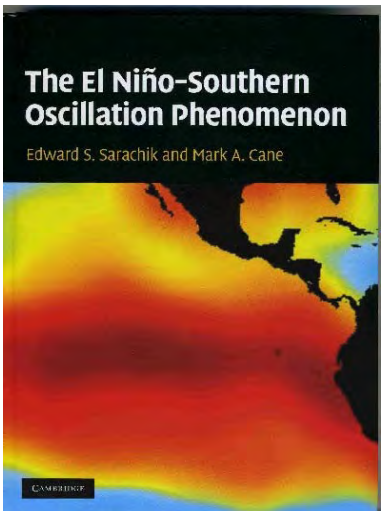
by Edward S Sarachik & Mark A Cane

Cambridge University Press, ISBN:978-0-521-84786-5
Hardback US $75, Published 2010

Book reviewed by Madhav Khandekar*

The ENSO (El Niño-Southern Oscillation) phenomenon, a complex coupled atmosphere-ocean system in the equatorial Pacific Ocean, is a fascinating large-scale feature of the tropical atmosphere which impacts world-wide weather and climate patterns far more than any other single feature in the earth's climate system. The ENSO has been a subject of intense study by a large number of weather and climate scientists, resulting in over several hundred papers, reports, documents and several books over the last 25 years. The ENSO phenomenon still continues to attract a number of scientists today who have used extensive mathematical modeling to provide an improved understanding of ENSO, its mechanism, predictability and world-wide impacts on weather and climate.

Prof (emeritus) Edward Sarachik (University of Washington, Seattle, USA) and Prof Mark Cane (Columbia University, New York, USA) have put together an extensive amount of their research efforts of the last 25 years in this latest book on El Niño and the associated Southern Oscillation phenomenon. The book presents a primarily modeling view of the ENSO phenomenon with selected examples of using ENSO information and forecasts for agriculture, water resources and related areas. Most of the book material has come about from a series of lectures given in Fortaleza, Brazil, and at the International Centre for Theoretical Physics in Trieste, Italy.



The book has eleven chapters, with a comprehensive overview of the ENSO phenomenon in the (first) **Preview** Chapter. This preview chapter provides a very readable account of various ocean-atmosphere processes in the equatorial Pacific, the two (*warm and cold)* distinct phases of the ENSO and their markedly different world-wide weather impacts, predicting ENSO and the present and future of ENSO in the context of present debate on climate change. Chapter **Two** provides the observational basis, the most important 'building block' for subsequent developmental work on ENSO modeling and mechanism. These two chapters provide valuable information for a general reader on ENSO and its role in the earth-atmosphere system.

Chapter **Three** gives a useful summary of the basic equations of motion and their simplification for development of simple layered-models of the ocean and of tropical convection and atmosphere-ocean interaction. Chapter **Four** gives a mathematical description of atmospheric and oceanic boundary layer and includes a good account of various processes like turbulent fluxes, ocean mixed layer, mixed-layer parameterization, etc. The next two chapters (**Five & Six**) are the two most substantive chapters of the book containing a large amount of descriptive and also mathematical account of atmospheric and oceanic processes that govern the ENSO phenomenon. The chapter on atmospheric process provides a comprehensive treatment of the dry and moist thermodynamic processes that lead to cloud heating, precipitation, boundary layer winds forced by SST (Sea Surface Temperature) gradients and many related topics involved in the complex ocean-atmosphere interaction. The chapter on ocean processes deals with various upper ocean processes involved in maintenance of SSTs and their gradients through the response of the tropical thermocline to wind stresses in the form of Kelvin and Rossby waves and their propagation from the equator outward to higher latitudes. This chapter also summarizes some of the important modeling developments reported by the two authors in several research papers published in the 1970s and 1980s. Several

solved exercises given in these chapters provide useful guidance to students as well as to a general reader.

In Chapter **Seven**, a coherent picture of the ENSO mechanisms based on the knowledge accumulated over the last 30 to 40 years is provided. The chapter summarizes pioneering work of Jacob Bjerknes who first put forward the idea of a coupled atmosphere-ocean state over the equatorial Pacific more than forty years ago. Also summarized in this chapter are extensive studies of Klaus Wyrtki and his observations about "*sea level rising in the western Pacific before and during the warm phase of ENSO and declining as the warming phase approaches its peak*". The ideas of Bjerknes and Wyrtki has led to the concept of ENSO Cycles. These ENSO cycles (warm cycle- El Niño; cold cycle-La Niña) have been extensively studied by Cane and his coworker Zebiak leading to the well-known Zebiak-Cane (ZC) model with delayed oscillator mechanism. The ZC model has been used to successfully simulate some of the recent ENSO events and has also been used to simulate the oscillatory behaviour of El Niño (simulating Niño-3 index) over the last one thousand years. The ZC model essentially captures one of the most important physical processes of the ENSO cycles, namely '*the wind-driven surface layer divergence results in strong upwelling of colder thermocline waters along the equator, thus connecting thermocline movements to SST changes'*. Further, the ZC model results suggest that "*El Niño events will NOT develop if the zonally integrated heat content of the equatorial Pacific wave guide is lower than its average value*" in accordance with observational findings of Klaus Wyrtki. The chapter concludes with a brief discussion on simulation of ENSO and annual cycle of earth's climate using a number of coupled atmosphere-ocean models developed by various climate modelling groups.

Chapter **Eight** summarizes ENSO prediction and associated short-term climate prediction in an operational setting. A number of climate models today put out ENSO forecasts for two or more seasons and various details on these forecasts are discussed in monthly issues of *Climate Diagnostics Bulletin* published by NOAA in Washington, US. The utility of ENSO-based forecasts are extensively discussed in many operational documents and news letters. The ENSO-based forecasts on seasonal scale have achieved a usable operational skill at present and this has opened up a new area of intensive further research into longer-term climate prediction.

Chapter **Nine** discusses the past & future of ENSO and in particular the possible impact of climate change on future ENSO and its evolution in response to increasing green-house gas concentrations. A good discussion is presented on "ENSO past" about ENSO from the Pliocene (about 1.8 M to 5.3 M y BP) to Pleistocene (from 2.5 M to 12000 y BP) to Holocene (last 12000 years or so). Most of this discussion summarizes various recent research studies which employ a variety of paleo-climate data using corals, ice cores, oxygen isotopes etc. These studies reveal that ENSO cycle is present in all relevant records going back 130,000 years to the previous interglacial period. During early to mid-Holocene, ENSO cycles appear to be weaker, while the last 1000 years show substantial decadal and longer variations, possibly linked to solar and volcanic forcing. The 20th century ENSO variations and El Niño events in a future warmer world are considered in the final sections of this chapter. At this point in time, there is NO agreement among the scientific community about the ENSO cycle would evolve in a warmer future climate.

Using ENSO information and forecasts can be quite involved as discussed in Chapter **Ten**. Several aspects of using ENSO-related information and their possible world-wide impacts are discussed and the uncertainties associated with many of these impacts are considered. For example, El Niño impacts on Indian Monsoon and on rainfall over east Africa and north-east Brazil are well documented; however, other regional factors (SSTs in the Indian Ocean and in southern Atlantic Ocean) also play an important role in influencing precipitation patterns. From a Canadian perspective, an El Niño/La Niña is generally associated with a warmer/colder winter over the Prairies. However, the degree and the extent of warmer/colder winter may depend upon how an El Niño/La Niña event evolves eventually and also on other regional factors. Every El Niño (and La Niña) event evolves differently and it is important to realize and appreciate this aspect of ENSO cycles.

The book is well produced and appears to be free from minor typographical or other errors. Among the long list of over 300 references provided at the end, there were several notable omissions: there was no mention of the meticulous and painstaking research of William Quinn (and his coworkers) on extending recent El Niño events to about 600 AD and of the extensive historical work on El Niño by David Enfield. Also extensive work on documenting recent El Niños and their impacts by Michael McPhaden and Jerome Namias did not make the reference list. Notwithstanding these (presumably inadvertent) omissions, the book presents the most up-to-date information on the present state of our knowledge on ENSO and related topics. The book is well suited for a graduate level course in meteorology and/or oceanography. With a relatively modest price tag, the book may also interest many ENSO aficionados.

* Madhav Khandekar is a former research scientist from Environment Canada and was an Expert Reviewer for the IPCC (Intergovernmental Panel on Climate Change) 2007 climate change documents. Khandekar has been in the weather & climate science for over 54 years and has analyzed and documented ENSO impacts on Canadian Prairie weather and also on the Indian summer Monsoon. Khandekar continues his research at present on extreme weather, global weather anomalies and monsoon inter-annual variability.

Discoveries of the Census of Marine Life

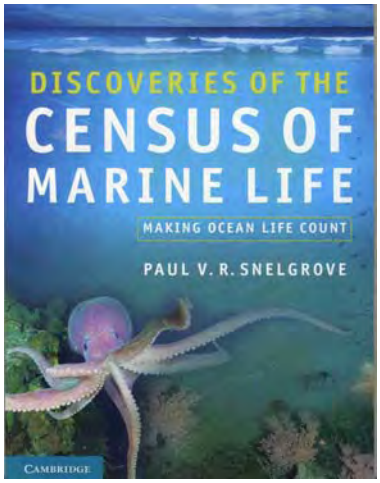
Making Ocean Life Count

by Paul V.R. Snelgrove

Cambridge University Press, Paperback
ISBN 978-0-11129-4270pp, US$45

Book reviewed by Paul LeBlond[2]

How many fish are there in the ocean? Fisheries managers would love to know the answer to that question! But there is more to life in the ocean than just fish, a lot more! As a matter of fact the bulk of marine life is too small to see with the naked eye: the total biomass bacteria and other single cell organisms far exceeds the combined mass of zooplankton and fish. There are on the average a million bacteria per millilitre of sea water (Pomeroy et al., 2007)! The vast empire of ocean life rests on that foundation and it is to understand its diversity at all sizes, and its distribution and abundance, that experts from more than 80 countries collaborated in the Census of Marine Life.



Generously funded initially by the Sloane Foundation and benefitting from the intellectual, logistic or financial support of literally hundreds of agencies, universities, institutions and businesses (the list goes on for pages), the Census was by far the largest study of marine life ever undertaken. Organized in 17 interlinked projects focussing on different habitats, groups of organisms and regions, the First Census of Marine Life (others may follow) has yielded a new level of understanding of ocean life. Over a decade (2000-2010) of intense exploration, several thousand new species were discovered, new technologies developed and exploited to sample marine organisms and their movements, and innovative methods used to synthesize and disseminate the results. The Census' web presence (www.coml.org) offers a lavish description of everything one might wish to know about the program, including publications, one of which is reviewed here.

Snelgrove chaired the Synthesis Group of the Census. He has put together an accessible and informative resume of the Census' discoveries. As befits a synthesis, the book is more than a mere catalogue of new species. The author first introduces the reader to the ocean environment, to the history of the discovery of marine diversity, and to the motivation for a Census of Marine Life to better understand the oceanic ecosystems in the context of global biogeochemistry. Subsequent chapters describe the new ways of looking at the ocean and what they reveal, with specific sections on the coastal oceans, the polar seas, and the largely still poorly explored deep seas.

The Census has fostered the introduction of new sampling techniques: the use of satellite imagery, advanced acoustic methods, and data synthesis and presentation. Of note is the Ocean Biological Information System (OBIS), a web-based archive of all the Census data which already includes more than 22 million data integrated from 700 different databases. The pioneering **Pacific Ocean Shelf Tracking Project** (POST) developed for tracking salmon on Canada's Pacific Coast is featured among innovative acoustic applications. POST in turn has spawned the **Ocean Tracking Network**, based at Dalhousie University, which plans to apply similar techniques more widely.

A concluding chapter discusses the applications of the Census and the future of Planet Ocean, faced with the encroachments of human activities and by-products. The author reminds us that *"every environment on Earth is tied to marine life*" and concludes that *"the age of discovery in the ocean has certainly not passed and more is discovered that demands preservation*".

The book is richly illustrated with high quality colour photographs, maps and graphics. My only criticism is the lack of scales on many photos of marine organisms, which makes it impossible to know their exact size.

This book is an excellent introduction to marine life and its diversity, suitable for a non-technical course. The presence of an extensive list of publications at the end of each chapter offers the reader access to the primary literature and may form the basis for a more avanced course. At $45 the paperback edition is quite affordable and tells a fascinating story to everyone interested in the ocean.

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[2] Galiano Island, British Columbia, Canada.

Planète Coeur – Santé cardiaque et environnement

de François Reeves

Éditions MultiMondes et Édition du CHU Sainte-Justine,
201, 200 pages, Soft cover, $24.95

Book reviewed by Denis A. Bourque[3]

This is a book about environmental influences on specifically heart disease as viewed by a Montréal cardiologist. In this book, the first of its kind according to David Suzuki, Dr. Reeves sets out to describe in layman's terms how cardio-vascular health is dependent on environmental quality.

Dr Reeves is well-suited to present this issue. Not only is he a practising cardiologist at l'Hôpital Notre-Dame in Montréal and at the Centre Hospitalier de l'Université de Montréal (CHUM), he is member of the "Cercle Scientifique David Suzuki", and of the "Institut en environnement et développement durable" of the Université de Montréal and spokesperson for the regional environment council of the Cité de Laval.

Dr Reeves begins with a question: why did heart disease increase so dramatically in the first half of the 20th Century, outranking cancer mortality? He points out that this has been under study since the late 1940s in the world famous Framingham Heart Study, the USA longitudinal health investigation that continues to this day and now spans 5 decades. That study is responsible for defining the concept of *risk factor* and, by the 1980s, had identified the now commonly-accepted five major risk factors for heart disease: genetics, tobacco, high blood pressure, high cholesterol and diabetes. Obesity and sedentary lifestyle were added as risk factors in the 1990s.

But because the Framingham study is entirely carried out in just one community, it cannot hope to explain the striking differences in cardiovascular mortality between countries (e.g., Russia has 1000% higher cardiovascular mortality than France), or even between urban and rural regions. Understanding these differences brings forth three new factors, all associated with where one lives (hence, the title). This is where Dr. Reeves takes over and guides the reader through these newest risk factors: food, environment and urbanization.

Dr. Reeves takes the reader on a journey. In the early chapters, he describes the important advances in medicine and nutrition of the last century, pointing out the major breakthrough in our understanding the positive roles of bacteria, vitamins and minerals to our health.

But at the same time, food production became industrialized and regrettably, as Dr. Reeves puts it, brought food additives and modifications for preservation, taste enhancement, and presentation: fructose-glucose, phosphoric acid, trans fats, animal fats, excessive salt, aspartame, food dyes and GMOs (Genetically Modified Organisms). Several chapters are devoted to describing the disastrous effect these additives have had on cardiovascular health.

Planète Coeur est le monde vu avec les "yeux du coeur". C'est la première fois que l'on expose de façon si extensive et claire que la santé cardio-vasculaire dépend de la qualité environnementale.

David Suzuki

Dr. Reeves devotes the next chapters to the role of environmental pollutants on cardiovascular incidence. He speaks of lead and then introduces climate change and its direct impact on biodiversity. He follows these by chapters on the role of poor air quality and heat waves as further stressors on heart health.

[3] CMOS Ottawa Centre Member with a 30-year history as an enthusiast for understanding, and as an advocate for applying everyday weather to improving our health.

The last chapters discuss the impact of urbanization on heart disease, most notably the existence of localized heat island pockets created by poor urban design, policy and planning. The very last chapter discusses the benefits of urban reforestation.

Dr Reeves does a remarkable job of presenting in layman's terms how cardiovascular health is influenced by the environment to which we subject it. When he writes of food additives, air quality and urbanization, he supports his arguments well by drawing on studies and statistics that clearly demonstrate his points. He uses tables and graphs effectively, keeping them simple so that the average member of the public can understand these complex relationships. His presentation becomes a little tenuous when he discusses the impact of climate change on cardio-vascular health, but that is understandable given that this liaison is still under investigation (as are the impacts of climate change on the other sectors of our society). By the time the reader has finished the book, there is no question that Dr. Reeves has presented a strong case that anthropogenic behaviour, be it with regards to industrial food production or quality of the natural environment in which we live, is responsible for the degradation of cardio-vascular health not explained by the Framingham Heart Study.

If I can fault him at all, it would be for the book's very last chapter devoted to an exposition of the benefits of reforestation of the urban environment. Whereas reforestation deserves mention in the book as positive environmental action for individuals, the length of his discussion is, in my opinion, incongruous with the rest of the book.

My opinion on the last chapter notwithstanding, this is a book well worth recommending. We all know that environmental degradation is neither healthy nor desirable. But, in many ways, over time, that argument has lost its edge in our society. However, Dr. Reeves' focus of the issue on specifically cardio-vascular health, which is both personal and essential to life, is an eye-opener. In other words, this book written in French should be translated into English so that it can reach and influence a greater audience.

Climate Change: Global Risks, Challenges and Decisions

by K. Richardson, W. Steffen and D. Liverman

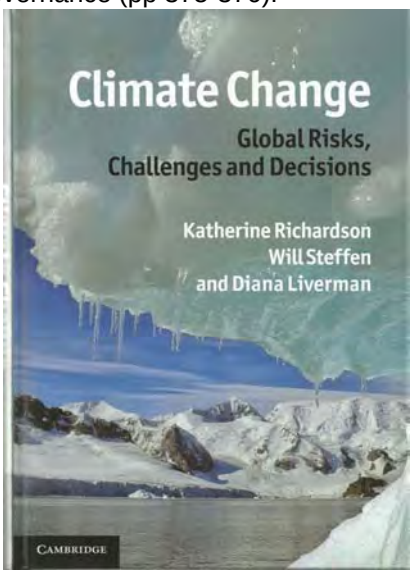
Cambridge University Press, Hardback
ISBN 978-0-521-19836-3: US$99.00

Book reviewed by Ted Munn[4]

This book on climate change is astonishing – for several reasons. Firstly, the book is multi-authored, with emphasis on the word "multi"! There are three lead authors. I know Will Steffen and Diana Liverman personally, and Katherine Richardson by reputation. All three are at the top of their fields. There is a foreword by the Prime Minister of Denmark, Sections by a writing team of 11 listed specialists, and 105 contributors of highlighted boxes. Back in the wings is Cambridge University Press, which has brought the production together extraordinarily well. I am reminded of a stellar performance of Mahler's Eighth Symphony.

I am overwhelmed by the richness of the contents of this book, and I can touch on only a few highlights.

Chapter 13: Geopolitics and Governance, pp 344-387 This contains important information on an emerging field. (I note that the word "governance" is appearing more frequently in the titles of university climate/environmental institutes.) And I draw your attention to three highlighted boxes in the book: Governance (pg 338), Adaptive Governance (pp 370-372) and Global Energy Governance (pp 375-376).



Was the Copenhagen Summit a Failure? In the first part of Chapter 13, a case is made that the Copenhagen Summit was at least a partial success because Heads of State for the first time played a central role in the debate. (In fact six of the world leaders retired to a small room in the Copenhagen Conference Centre, and drafted the Climate-Change Accord.) Climate change had first emerged as an environmental issue, then it became an economic issue, then a security issue, and now it is a political issue. As

[4] CMOS Member, Toronto Centre.

Barack Obama observed in his recent Nobel Peace Prize speech (as quoted on pg. 344): *It is not merely scientists and environmental activists who call for swift and forceful action (on the threat of climate change) – it's military leaders in my own country and others who understand our common security hangs in the balance.*

Other highlights of the book: Other highlights of the book are Chapters 1-4 on climatic trends, Chapters 5-8 on dangerous climate change, Chapters 9-10 on equity (especially Chapter 10 on ethics), Chapter 11 on technology, Chapter 12 on economics, and all of the rest of the book. There! I have included every chapter in my list!

So what is missing from the book? I would like to have seen a chapter on Climategate and more generally on the role of sceptics. There is nothing on palaeoclimate except for one highlighted contribution on sea-level rise (pp 57-58), and GAIA and Lovelock are not mentioned in the index. The recent publication by Molina *et al.* (2011) describing a fast-action response plan to slow down climate change probably appeared too late to be included. But I would have hoped that in the Preface, a brief explanation would be given as to why Climategate was excluded.

In summary, I have read or scanned about 25 books on climate change in the last decade. I would rate this one as the best, the next best being a text by Mike Hulme, 'Why We Disagree About Climate Change." When I started my studies of meteorology in the early 1940s, there were only three books on meteorology available: Dynamic Meteorology by Brunt, Weather Analysis and Forecasting by Petterssen, and Meteorological Instruments by Middleton. What a cornucopia of titles on climate change we have today!

Troubled Waters: Ocean Science and Governance

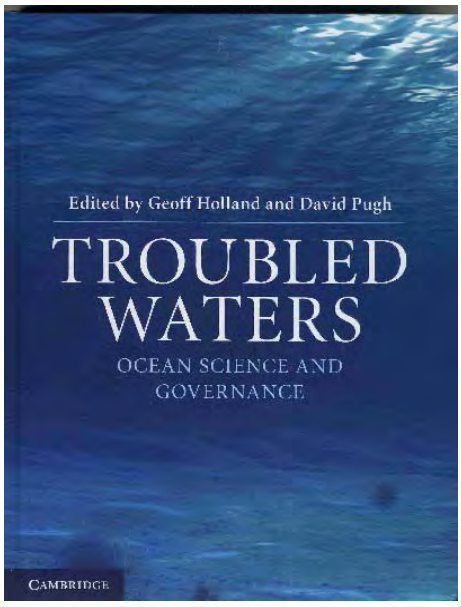
Editors: Geoff Holland and David Pugh,

Cambridge University Press, Hardback
ISBN 978-0-521-76581-7, 2010, US$50, 316pp.

Book reviewed by John Stone[5]

"*Which part of our planet is the most shared, used, exploited and yet least well-known, protected …. and surveyed?*" - Prince Albert of Monaco, 2009.

The oceans cover some 71% of the Earth's surface and contain 97% of the Earth's water and almost 90% of the planet's carbon. We now recognize that they are an important component of the global climate system storing an enormous amount of heat - the heat capacity of the global atmosphere corresponds to that of only the top three metres of the ocean. We have catalogued perhaps less than 3% of the species living in the oceans. In addition, most of the World's population lives within a few kilometres of the oceans' coastline, generally in tumultuous mega cities. And yet our understanding of the oceans is still far from complete.



From the days of the earliest mariners our knowledge of the oceans has come from observations. These mariners accumulated a formidable body of empirical knowledge. Today these observations seem rudimentary compared to the quantity and quality of observations being provided by a flight of satellites and a flotilla of Argo floats. These observations have been the essential basis on which we have advanced our understanding of ocean processes and

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[5] Retired meteorologist and Adjunct Research Professor in the Department of Geography and Environmental Studies, Carleton University, Ottawa, Ontario, Canada.

are slowly enabling us to provide useful services to mariners and managers. Much of this encouraging progress has been due to unprecedented international collaboration in which the efforts of the International Oceanographic Commission (IOC) have been instrumental. To commemorate its 50 year anniversary, several individuals who have played an active part in the IOC's work have collectively produced what is effectively a *festschrift* entitled, "*Troubled Waters: Ocean Science and Governance*".

The book is well produced and contains some illuminating essays expertly edited by our own Geoff Holland and by David Pugh, both being past-President of the IOC. CMOS readers will recognize many of the authors almost all of whom have had "insider" experience of the IOC. However, its title is somewhat misleading: it is more about governance than about science; more about the evolution of the organization than about the exciting advances that we have made in our scientific understanding. It is not, as I would have hoped, a celebration of the last 50 years in ocean science discoveries. Furthermore, being "insiders" one occasionally gets the sense that this book is being used as a platform for pleading for resources.

The history of the IOC is convoluted and it is perhaps not surprising, but unfortunate, given the different backgrounds of the contributors, that it is scattered throughout the book. Some might trace the origins back to the Brussels Maritime Conference of 1853 which led to the first International Meteorological Congress, illustrating the organic links between meteorology and oceanography. Cooperation in marine sciences can also be traced back to the establishment in 1902 of the International Council on the Exploration of the Sea. It was not until October, 1961 that the IOC met for the first time at the UNESCO headquarters in Paris. It is interesting to learn that the environment, as we now understand it, was not highlighted in the initial priorities of the IOC.

Observations continue to be a bottleneck in our understanding of the climate both for the understanding of the processes involved and the development of useful products and services. For a global interconnected system such as the oceans nationally focussed observational programmes, while clearly necessary, are not sufficient. International collaborative programmes such as the World Ocean Circulation Experiment (WOCE) are crucial. We all know that in difficult budgetary times (which we seem never to escape) it is always a challenge to preserve our systematic observing programmes. As this book describes, the IOC has played a valuable role in encouraging continued national contributions. It continues to make the point that wise decision-making requires good science.

Being an intergovernmental organization, it is not surprising that this book focusses on the contributions to the IOC of governments. But this is at the expense of describing the contributions from university scientists under the umbrella of the International Council for Science (ICSU) and particularly its Scientific Committee on Oceanic Research which actually predates the IOC being created in 1957.

There is no doubt the IOC has benefitted by its intergovernmental nature as part of the United Nations system. However, being only a component of a relatively small organization – the United Nations Educational, Scientific and Cultural Organization (UNESCO) – it has limited government attention. In addition, the fact that there is a plethora of ocean-related UN bodies has led to tensions and has not helped to focus governments' attention on the opportunities and challenges of the IOC. Furthermore, although as one author notes: *"the road to global science starts with local priorities*", the lack of uniformity in national responsibility for the oceans has complicated matters within the IOC. The UN Law of the Sea has been a particularly serious challenge although the IOC is officially recognized as the *"competent international body*" dealing with ocean science. The contributors to this book do not share a common perspective on these matters – which is probably healthy. In fact, although all authors are understandably proud of the IOC's achievements, several openly admit to its shortcomings.

To return to the comment of Prince Albert of Monaco, we are only now recognizing the extent to which we humans are capable of changing the ocean environment. A key step was the UN Resolution to undertake a comprehensive assessment of the state of the marine environment. The process was led by the IOC and the United Nations Environment Programme (UNEP). While, like the Intergovernmental Panel on Climate Change (IPCC) the assessment report went through a full peer-review, there was no similar process whereby all governments could "own" the scientific conclusions. This and other issues regarding the IOC's role in global science in support of wise decision-making are realistically explored in this book.

The book has two chapters at the end that look towards the future. The first is by Neville Smith who is now head of research at the Australian Bureau of Meteorology. He notes cautiously that it typically takes four years for the importance of new science to be recognized; at least a decade for the creation or modification of an intergovernmental mechanism and perhaps 50 years to influence the evolution of climate change. His advice is "good science" directed more at assisting developing countries and regions adapt to the now inevitable threats of climate change. The "Afterword" is written by the book's two editors and, although surprising in not mentioning the IOC explicitly, provides an eloquent call to collectively and unambiguously acknowledge the importance of the ocean to our very existence and work tirelessly for the survival of our planet.

Risk: The Science and Politics of Fear

by Dan Gardner

McClelland and Stewart, 2008

Book Reviewed by John Stone[6]

The books reviewed in these pages are usually provided by well-known publishers such as Cambridge University Press. This may mean that occasionally some worthwhile books from non-scientific publishers, that may be of interest to CMOS members, are missed. This is particularly unfortunate when the book is written by a Canadian author on a topic that is central to the application of science to everyday decision-making. Such a book is *Risk: The Science and Politics of Fear* by Dan Gardner, a regular columnist for the Ottawa Citizen.

Dan Gardner starts and ends his book with the thought: **We are the healthiest, wealthiest and longest-lived people in history and yet we are increasingly afraid**. As a journalist, he focusses mainly on the role the media has played in generating this fear. He openly recognizes the failings of some of his scribbler colleagues. Nevertheless, he does admit that "fear sells". This poses a paradox for scientists who wish to constructively engage the public on important public policy issues such as the threat of climate change. Carefully worded warnings with cautious assignments of uncertainty don't seem to work. Should we then step away from the detached manner that we have been taught and begin to use fear to stimulate the action we believe is needed? Is an alarmist approach useful? Many of us would quickly say: no, and rely on the quiet power of evidence and reason. However, as the author demonstrates, this puts us at a disadvantage. To illustrate this he discusses Steve Schneider's "double ethical bind" in which we all have to decide what the right balance is between being scientifically honest and being effective in gaining the public's attention.

The reason the cards are stacked against us is that journalists and marketers take advantage of the irrational way in which people assess risks. Dan Gardner supplies several examples such as the advice that President Bush gave to Americans after 9/11 to avoid flying and instead drive even though air travel is demonstrably much safer than driving. But that is what millions of Americans did – at least for a year, until they got back to normal. Another example which would be appreciated by geophysicists concerns the risk of being hit by an asteroid – what risk experts refer to a low-probability/high-consequence event. The odds may be low but they are not zero; it could kill millions of people just as an asteroid wiped out the dinosaurs 65 million years ago. What those who have to manage such risks have to do is to consider how much should be spent on avoiding one type of risk as opposed to some other. Of course, there is no one answer – it depends on who you ask which often is determined by the values they hold and how they assess specific risks.

In his book, Dan Gardner takes advantage of what must have been an extended seminar with Paul Slovic, a professor of psychology at the University of Oregan on why people react to risk in different ways. There are several observations (rules, is the term the author uses, implying a level of quantification that is probably unjustified). These include the Example Rule where people are strongly influenced by an example that they can readily recall or is provided to them. At the root of these observations is the disconnect between the Head and the Gut – to use Gardner's terms. Typically the Gut reacts much more quickly, something which some scholars argue is a legacy from when we were hunter-gatherers in the dangerous plains of Africa but is equally useful in the dangerous streets of some big cities. As scientists we tend to believe we should be more influenced by evidence and rational thought – that is the Head. It seems most people are not accustomed to the effort required for the Head to intervene and correct the Gut.

So how can we communicate with non-scientists who may not have our scientifically trained backgrounds? What lessons can we derive from those who study risk? According to Slovic, and not surprisingly, more immediate threats loom larger than future ones which we tend to discount. This doesn't help us with the insidious threat of climate change where, as Dan Gardner correctly argues, when we have enough evidence that there is "an identifiable, certain, imminent, dreadful threat" we can no longer deny, it is likely to be too late – change will then be irreversible.

Gardner clearly understands how science operates when he writes that: "*In all forms of inquiry, hard facts and strong explanations are built up slowly and only with great effort*". The language of science is the opposite of the simple statements that the media often want. While journalists may revert to anecdotes to get attention, they can often mislead. Furthermore, anecdotes are no substitute for data. However, statistics, which the author refers to as "people with the tears dried off", don't always help either. And as

[6] Retired meteorologist and Adjunct Research Professor in the Department of Geography and Environmental Studies, Carleton University, Ottawa, Ontario, Canada.

Gardner notes: "science never delivers absolute certainty."

While Dan Gardner is a supporter of science he is not afraid to tilt his lance at some commonly held points of view. As an example, he mentions Rachel Carson who cleverly used the deeply held fear of cancer, rather than the damage to the environment, to promote the abolition of DDT even though the number of deaths from DDT is demonstrably much less than the number of deaths from malaria that could have been avoided by spraying this chemical. [It is interesting that cars kill more people each year than malaria]. Major health agencies today generally agree that traces of synthetic chemicals in the environment are not a large risk factor but this statement depends on what we regard as a safe limit. Defining what is a "safe" limit is akin to defining "dangerous" interference with the climate system: it depends again on what are your values.

This is not a text book but it has many lessons for us as scientists and members of the public. It is a book that, unless we dramatically change the way we seem to be wired to make decisions on risk, will be worth recommending to our students today and tomorrow.

The Fluid Envelope of our Planet

How the Study of Ocean Currents Became a Science

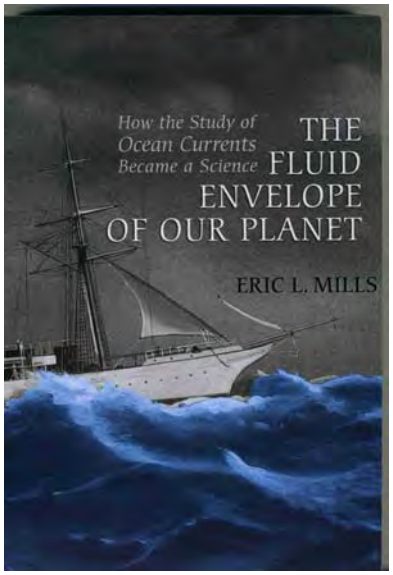
by Eric L. Mills

University of Toronto Press, 2009, 434 p.p.
ISBM 978-0-8020-9697-5 (cloth, $75.00)
ISBM 978-1-4426-1270-9 (paper, $34.95)

Book Reviewed by R. Allyn Clarke[7]

This monograph traces the development of ocean dynamics from Aristotle to the post World War II ascendance of physical oceanography as a science.

The **first** chapter traces the growing knowledge of the winds over the ocean as well as its surface temperature and currents. By the end of the 17th century, map makers were able to sketch the principal wind and surface current systems over much of the ocean with the application of artistic licence where they lacked information. During this period, natural philosophers began thinking about the source of these phenomena. In 1686, Halley attributed the trade winds to a convection cell driven by heating of the air in the equatorial region and in 1735, Hadley argued that the trades blew from east to west as a result of the earth's rotation. It was not until the end of the 19th century that the dynamical consequences of the earth's rotation were fully adopted by meteorologists and then hydrographers.



The **second** chapter deals with the circulation of the deep ocean. W.B. Carpenter's early measurements of deep ocean temperatures led him to propose a large scale ocean circulation driven by convection in the polar regions. This view was opposed by James Croll who argued that the ocean currents were driven by the winds. This controversy absorbed the British scientific community throughout the second half of the 19th century and was a factor in the launching of the Challenger Expedition.

In chapter **three**, Professor Mills moves to Scandinavia where G.O. Sars and Heinrich Mohn begin a series of observations in the Norwegian Sea to study the causes and variability of the fisheries. Mohn was a meteorologist and a physicist at the time when geostrophic methods were being introduced in meteorology. He and Vilhelm Bjerknes applied these ideas to ocean currents and devised methods of estimating the strength of ocean currents from vertical profiles of temperature and salinity.

Canadian fisheries also suffered from variability of the strength of the stocks. Chapter **four** describes how Canada sought expertise from Scandinavia for the analysis of the hydrographic data collected during the 1915 Canadian Fisheries Expedition.

Chapter **five** describes the development of both dynamical and descriptive oceanography in Germany from 1900 to the important Meteor Expedition to the South Atlantic.

In chapter **six**, Professor Mills describes how the French remained isolated from the development of the dynamical method through the first half of the 20th century. This was in spite of the important role that Prince Albert of Monaco played in the internationalization of the other aspects of marine science.

Chapter **seven** traces how the dynamical method moved from Scandinavia to Woods Hole, Scripps and the International Ice Patrol in the United States.

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[7] Scientist Emeritus, Fisheries and Oceans, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada

Chapter **eight**, discusses how oceanography developed in Canada from 1930 to 1950 through the leadership of Harry Hachey on the east coast and Jack Tully on the west. The volume concludes with a chapter on the importance of Sverdrup, Johnson and Fleming's classic text book "*The Oceans*" to the post war flowering of physical oceanography as a science.

This book contains a wealth of references from the early foundations of ocean dynamics. Readers will be interested in the interplay among scientists as they sought to understand ocean circulation from sparse observations and incomplete theory of geophysical fluid dynamics. The interplay between individuals and national communities described in this book brings to mind the observation by Max Plank:

> *"A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."*
>
> *Max Plank*

It is worth mentioning that this book won the Canadian Nautical Research Society's Keith Matthews Award for the best book in 2009.

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

Latest Books received / Derniers livres reçus

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

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, 482pp, US$135.

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, 740pp, US$110.

2011-16) *River Discharge to the Ocean, A Global Synthesis*, Edited by John D. Milliman, Katherine L. Farnsworth, Cambridge University Press, ISBN 978-0-521-87987-3, Hardback, 123pp, US$160.

2011-19) *Atmospheric Dynamics*, by Mankin Mak, Cambridge University Press, Hardback, ISBN 978-0-521-19573-7, 2011, 486pp, US$80.

2011-21) *Fluid Mechanics, A Short Course for Physicists*, by Gregory Falkovich, Cambridge University Press, Hardback, ISBN 978-1-107-00575-4, 2011, US$60, 167pp.

2011-22) *Rising Waters, The Causes and Consequences of Flooding in the United States*, by Samuel D. Brody, Wesley E. Highfield and Jung Eun Kang, Cambridge University Press, Hardback, ISBN 978-0-521-19321-4, 2011, US$99, 195pp.

2011-26) *The European Nitrogen Assessment, Sources, Effects and Policy Perspectives*, Edited by Mark A. Sutton, Clare M. Howard, Jan Willem Erisman, Gilles Billen, Albert Bleeker, Peringe Grennfelt, Hans van Grinsven and Bruna Grizzetti, Cambridge University Press, Hardback, ISBN 978-1-107-00612-6, 2011, US$130, 612pp.

2011-28) *The Garnaut Review 2011, Australia in the Global Response to Climate Change*, Ross Garnaut, Cambridge University Press, ISBN 978-1-107-69168-1, Papeback, US$34.95, 222pp.

2011-29) *Engineering Strategies for Greenhouse Gas Mitigation*, Ian S.F. Jones, Cambridge University Press, ISBN 978-0-521-51602-0, Hardback, US$85.00, 170pp.

2011-30) *Eruptions that Shook the World*, Clive Oppenheimer, Cambridge University Press, ISBN 978-0-521-64112-8, Hardback, US$30, 392pp.

2011-32) *The Theory of Large-Scale Ocean Circulation*, R.M. Samelson, Cambridge University Press, ISBN 978-1-107-00188-6, Hardback, US$85, 193pp.

2011-34) *Modeling Methods for Marine Science*, David M. Glover, William J. Jenkins and Scott C. Doney, Cambridge University Press, Hardback, US$85, 571pp.

2011-36) *Ocean Dynamics and the Carbon Cycle, Principles and Mechanisms*, Richard G. Williams, Michael J. Follows, Cambridge University Press, ISBN 978-0-521-84369-0, Hardbback, US$73, 404pp.

2011-38) *Ocean Surface Waves, Breaking and Dissipation of*, Alexander Babanin, Cambridge University Press, ISBN 978-1-107-00158-9, Hardback, US$130, 463pp.

2011-40) *Climate Change in the Polar Regions,* John Turner and Gareth J. Marshall, Cambridge University Press, ISBN 978-0-521-85010-0, Hardback, US$115, 434pp.

2011-42) *Physics and Chemistry of Clouds*, Dennis Lamb and Johannes Verlinde, Cambridge University Press, ISBN 978-0-521-89910-9, Hardback, US$85, 584pp.

2011-44) *Auroras, Fire in the Sky*, by Dan Bortolotti with photographs by Yuichi Takasaka, Firefly Books, ISBN 978-155407-681-9, Hardback, 143 pp, CDN$29.95.

NASA's Fermi Catches Thunderstorms Hurling Antimatter into Space

Scientists using NASA's Fermi Gamma-ray Space Telescope have detected beams of antimatter produced above thunderstorms on Earth, a phenomenon never seen before.

Scientists think the antimatter particles were formed in a terrestrial gamma-ray flash (TGF), a brief burst produced inside thunderstorms and shown to be associated with lightning. It is estimated that about 500 TGFs occur daily worldwide, but most go undetected.

"*These signals are the first direct evidence that thunderstorms make antimatter particle beams*," said Michael Briggs, a member of Fermi's Gamma-ray Burst Monitor (GBM) team at the University of Alabama in Huntsville (UAH). He presented the findings Monday, during a news briefing at the American Astronomical Society meeting in Seattle.

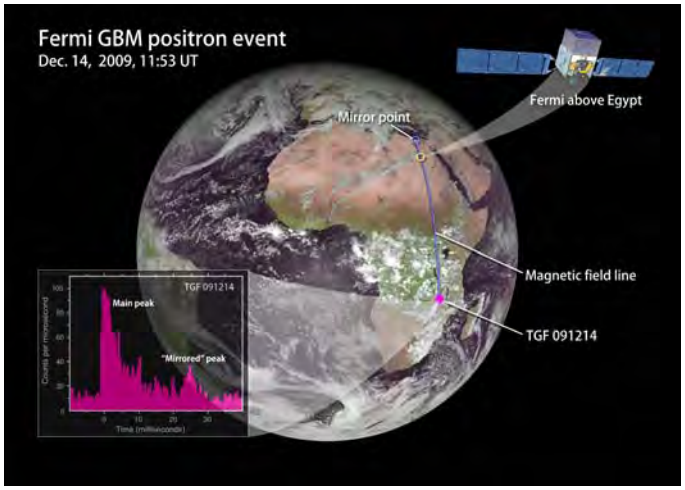
Fermi is designed to monitor gamma rays, the highest energy form of light. When antimatter striking Fermi collides with a particle of normal matter, both particles immediately are annihilated and transformed into gamma rays. The GBM has detected gamma rays with energies of 511,000 electron volts, a signal indicating an electron has met its antimatter counterpart, a positron.

Although Fermi's GBM is designed to observe high-energy events in the universe, it's also providing valuable insights into this strange phenomenon. The GBM constantly monitors the entire celestial sky above and the Earth below. The GBM team has identified 130 TGFs since Fermi's launch in 2008.

"*In orbit for less than three years, the Fermi mission has proven to be an amazing tool to probe the universe. Now we learn that it can discover mysteries much, much closer to home*," said Ilana Harrus, Fermi program scientist at NASA Headquarters in Washington.

The spacecraft was located immediately above a thunderstorm for most of the observed TGFs, but in four cases, storms were far from Fermi. In addition, lightning-generated radio signals detected by a global monitoring network indicated the only lightning at the time was hundreds or more miles away. During one TGF, which occurred on Dec. 14, 2009, Fermi was located over Egypt. But the active storm was in Zambia, some 2,800 miles to the south. The distant storm was below Fermi's horizon, so any gamma rays it produced could not have been detected.

"*Even though Fermi couldn't see the storm, the spacecraft nevertheless was magnetically connected to it*," said Joseph Dwyer at the Florida Institute of Technology in Melbourne, Fla. "*The TGF produced high-speed electrons and positrons, which then rode up Earth's magnetic field to strike the spacecraft*."



On December 14, 2009, while NASA's Fermi flew over Egypt, the spacecraft intercepted a particle beam from a terrestrial gamma-ray flash (TGF) that occurred over its horizon. Fermi's Gamma-ray Burst Monitor detected the signal of positrons annihilating on the spacecraft -- not once, but twice. After passing Fermi, some of the particles reflected off of a magnetic "mirror" point and returned. Image credit: NASA's Goddard Space Flight Center.

The beam continued past Fermi, reached a location, known as a mirror point, where its motion was reversed, and then hit the spacecraft a second time just 23 milliseconds later. Each time, positrons in the beam collided with electrons in the spacecraft. The particles annihilated each other, emitting gamma rays detected by Fermi's GBM.

Scientists have long suspected TGFs arise from the strong electric fields near the tops of thunderstorms. Under the right conditions, they say, the field becomes strong enough that it drives an upward avalanche of electrons. Reaching speeds nearly as fast as light, the high-energy electrons give off gamma rays when they're deflected by air molecules. Normally, these gamma rays are detected as a TGF.

But the cascading electrons produce so many gamma rays that they blast electrons and positrons clear out of the atmosphere. This happens when the gamma-ray energy transforms into a pair of particles: an electron and a positron. It's these particles that reach Fermi's orbit.

The detection of positrons shows many high-energy particles are being ejected from the atmosphere. In fact, scientists now think that all TGFs emit electron/positron beams. A paper on the findings has been accepted for publication in Geophysical Research Letters.

"*The Fermi results put us a step closer to understanding how TGFs work*," said Steven Cummer at Duke University. "*We still have to figure out what is special about these storms and the precise role lightning plays in the process*."

NASA's Fermi Gamma-ray Space Telescope is an astrophysics and particle physics partnership. It is managed by NASA's Goddard Space Flight Center in Greenbelt, Md. It was developed in collaboration with the U.S. Department of Energy, with important contributions from academic institutions and partners in France, Germany, Italy, Japan, Sweden and the United States.

The GBM Instrument Operations Center is located at the National Space Science Technology Center in Huntsville, Ala. The team includes a collaboration of scientists from UAH, NASA's Marshall Space Flight Center in Huntsville, the Max Planck Institute for Extraterrestrial Physics in Germany and other institutions.

Reference: Briggs, M.S. et al., 2011, Electron-positron beams from terrestrial lightning observed with Fermi GBM. *Geophys Res. Lett.*, 38, L02808, DOI: 10.1029/2010GL046259.

Source:
http://www.nasa.gov/mission_pages/GLAST/news/fermi-thunderstorms.html
Website visited on October 4th, 2011.

2011: International Year of Forests

Forests cover one third of the earth's land mass, performing vital functions around the world. In fact, 1.6 billion people depend on forests for their livelihoods. They play a key role in our battle against **climate change**. Forests feed our rivers and are essential to supplying the water for nearly 50% of our largest cities, including New York, Jakarta and Caracas. They also help to regulate the often devastating impact of storms and floods.

Source: UNEP website visited on November 4th, 2011.

Canadians Shine on the International Scene

Canadian expertise in the field of meteorology and oceanography is well respected worldwide. Together, they convey enormous influence in advancing Earth observations, research and services related to the atmosphere, oceans, hydrosphere and cryosphere. These activities reap significant societal benefits to Canadians and the world. Among those playing a major role on the international scene, we find:

Mr. David Grimes	ADM, Meteorological Service of Canada	President, World Meteorological Organization (WMO)
Mr. Brian Day	Campbell Scientific & Member of Private Sector Committee, CMOS	President, HydroMeteorological Equipment Industry Association (HMEI).
Dr. Gordon McBean	Former ADM of MSC & currently Director, Policy Studies for the Institute for Catastrophic Loss Reduction, University of Western Ontario	President-elect of the International Council for Science (ICSU)
Dr. Wendy Watson Wright	Former ADM – Science Department of Fisheries & Oceans	Assistant Director General & Executive Secretary Intergovernmental Oceanographic (IOC) Commission of UNESCO
Dr. Michel Béland	Former Director General of Research, Environment Canada	President of the WMO Commission for Atmospheric Science (CAS) [2nd term]
Dr. Mike Sinclair	Director, Bedford Institute of Oceanography, DFO	President, International Council for the Exploration of the Sea (ICES)
Dr. Gilbert Brunet	Director, Meteorological Research, EC's Science and Technology Branch	Chair, WMO World Weather Research Programme

New UNEP Report Tracks the Changing Global Environment over the Past Two Decades

The United Nations Environment Programme (UNEP) has released early November a report entitled: "***Keeping Track of our Changing Environment: From Rio to Rio+20***". This report highlighted the environmental changes that have swept the planet over the last twenty years. This report is produced as part of UNEP's "Global Environmental Outlook-5" (GEO -5) series, the UN's most authoritative assessment of the state, trends and outlook of the global environment. The full GEO-5 report will be launched next May, one month ahead of the Rio+20 Conference taking place in Brazil.

Shown here are selected highlights reported by UNEP:

On Climate change

- Global $C0_2$ emissions continue to rise due to increasing use of fossil fuels, with 80 per cent of global emissions coming from just 19 countries.
- The amount of CO_2 per US$1 GDP has dropped by 23 per cent since 1992 underlining that some decoupling of economic growth from resource use is occurring.
- Nearly all mountain glaciers around the world are retreating and getting thinner, with severe impacts on the environment and human well-being.
- Diminishing glaciers not only influence current sea-level rise, but also threaten the well-being of approximately one-sixth of the world's population.
- Sea levels have been rising at an average rate of about 2.5 mm per year since 1992.

On Forests

- Despite the net reforestation now seen in Europe, North America and Asia Pacific, ongoing forest loss in Africa and Latin America and the Caribbean means that global forest area has decreased by 300 million hectares since 1990.
- The annual 20 per cent rise in the number of forests receiving certificates for sustainable forestry practices shows that consumers are exerting influence on timber production. However, only around 10 per cent of global forests are under certified sustainable management.
- A growing percentage of the world's forests are one that has been replanted - an area equal to the size of a country like Tanzania.

On Drinking Water

- The world will meet, or even exceed, the Millennium Development Goals target on access to drinking water; indicating that by 2015 nearly 90 per cent of the population in developing regions will have access to improved sources of drinking water, up from 77 per cent in 1990.
- The data compiled also indicates that environmental target-setting works best for well-defined issues such as phasing out leaded gasoline or ozone-depleting substances.
- The Montreal Protocol on Substances that Deplete the Ozone Layer, for example, used mandatory targets to phase-out the pollutants that were damaging the planet's protective shield.
- Over 90 per cent of all ozone-depleting substances under the treaty were phased out between 1992 and 2009. Similarly, only a small number of countries still use leaded gasoline and they are expected to make the switch over the next year or two.

Other facts and figures from the report include:

- 13 per cent of the world's land surface, 7 per cent of its coastal waters and 1.4 percent of its oceans are protected.
- There is a growing concern that the oceans are becoming more acidic. This could have significant consequences on marine organisms which may alter species composition, disrupt marine food webs and potentially damage fishing and tourism activities.
- The ocean's pH declined from 8.11 in 1992 to 8.06 in 2007.
- The number of tanker oil spills recorded has declined in 20 years.
- Biodiversity has declined by 12 per cent at the global level and by 30 per cent in the tropics.
- Eco-tourism is growing at a rate three times faster than traditional mass-tourism.
- Plastics production has climbed by 130 per cent.

The authors of the report point out that the lack of sufficient, solid data and monitoring systems to measure progress remains an obstacle to achieving the environmental goals set by the international community. The report highlights the missing pieces in our knowledge about the state of the environment, calling for global efforts to collect scientifically-credible data for environmental monitoring.

The Eye on Earth Summit, to be held in Abu Dhabi in December, presents one such opportunity, where scientists, policymakers and governments will work together to define the key challenges and solutions related to environmental data access and sharing.

Notes from the Editor:

1) Rio Earth Summit: In 1992 the UN Conference on Sustainable Development, popularly known as the Rio Earth Summit, was convened in Rio de Janeiro, Brazil, to address the state of the environment and sustainable development. The meeting yielded several important agreements, including '**Agenda 21**', a plan of action adopted by over 178 governments to address human impacts on the environment at local, national and global levels, as well as key treaties on climate change, desertification and biodiversity. In June 2012 will be the follow-up meeting or Rio+20 in Brazil.

2) Keeping Track of our changing environment can be found on the GEO-5 website: http://www.unep.org/GEO/pdfs/Keeping_Track.pdf

3) Eye on Earth Summit (Abu Dhabi / 12-15 December 2011): Facilitated by Abu Dhabi Global Environmental Data Initiative (AGEDI) and hosted by Abu Dhabi Environment Agency (EAD) in partnership with the United Nations Environment Programme (UNEP), the Eye on Earth Summit will strengthen existing efforts for unified, global solutions to the issues that preclude access to data and information on the environment. More information can be found at: http://www.eyeonearthsummit.org/

Source: UNEP website visited on November 3rd, 2011 : http://www.unep.org/newscentre/Default.aspx?DocumentID=2656&ArticleID=8922&l=en

Water Organizations and Advocates Ask International Joint Commission to Declare the Great Lakes a Public Trust While Continuing to Assess Persistent Threats

DETROIT, MI, October 11, 2011 – Flow for Water, a coalition of several national and state organizations, Council of Canadians, and On the Commons are excited to announce participation in Great Lakes Week in Detroit from October 12 – 14. Specifically, the Joint Great Lakes Town Hall Meeting on October 12 at the International Joint Commission's (IJC) Biennial Meeting will offer our organizations and other water rights activists the opportunity to speak openly with key administrators and advisors from the United States and Canada on the global water issues facing the Great Lakes and beyond.

Flow for Water Chair, Jim Olson, alongside Emma Lui, Water Campaigner of the Council of Canadians, will present on the overarching principles for integrating water pollution concerns from the Great Lakes Water Quality Agreement with the Boundary Water Treaty's treatment of flows, levels, and quantities. This is one step in the campaign to address the need for providing lasting protection of our waters in the form of a public trust.

A Great Lakes Basin commons would reject the view that the primary function of the Great Lakes is to promote the interests of industry and give them preferential access to the Lakes' boundaries.

"*We need overarching twenty-first century principles to address massive twenty-first century threats that transcend an obsolete twentieth century legal framework*," said Jim Olson, a leading U.S. water law expert and Chair of Flow for Water. "*The International Joint Commission took the lead when it addressed pockets of pollution in its landmark 1972 Water Quality Agreement. It can take the lead again by looking to adopt a broad framework of principles, like commons and the public trust, which will assure rights of shared use and duties of shared respect for the Great Lakes for generations to come*."

As part of the overall effort to save the Great Lakes from the myriad threats from the past and this century, we are asking that the International Joint Commission consider the Great Lakes a commons and public trust and in doing so, acknowledge the threats facing the Great Lakes and its ecosystem and take steps to re-envision the Great Lakes Water Quality Agreement as was done when it was enacted as a landmark step in 1972.

"*The threats facing the Great Lakes and our waters and communities, like climate change, fracking oil and gas, mining tar sands in Canada, are compounded by the global water crisis*," said Maude Barlow, renowned water activist, author, and National Chairperson of the Council of Canadians. "*Our right to water, health, economy, and environment depend on the integrity of the water and Great Lakes ecosystem as a shared living commons*."

The public trust principles are about a broader picture for the health of our waters and citizens and the IJC has an opportunity to acknowledge that.

"*In today's ever more privatized world, the Great Lakes are seen as up for grabs. We see them as a living commons that belongs to all, whose waters must be equitably shared and vigorously protected for the generations to come*," said Alexa Bradley, Program Director of On the Commons.

The organizations say that a comprehensive approach will protect the Great Lakes as a whole from abuse and threats by powerful outside interests, while leaders, scientists and citizens address specific problems, like healing our waters from past harms, invasive species, or climate change.

Arctic Sea Ice Decline

In September 2011, sea ice covering the Arctic Ocean declined to the second-lowest extent on record. Satellite data from NASA and the National Snow and Ice Data Center (NSIDC) (http://nsidc.org) showed that the summertime ice cover narrowly avoided a new record low.

The image acquired early September, was made from observations collected by the Advanced Microwave Scanning Radiometer (AMSR-E) on NASA's Aqua (http://aqua.gov) satellite. The map — which looks down on the North Pole — depicts sea ice extent on September 9, 2011, the date of minimum extent for the year. The animation available on NSIDC website shows the growth and decline of sea ice from September 2010 to September 2011.

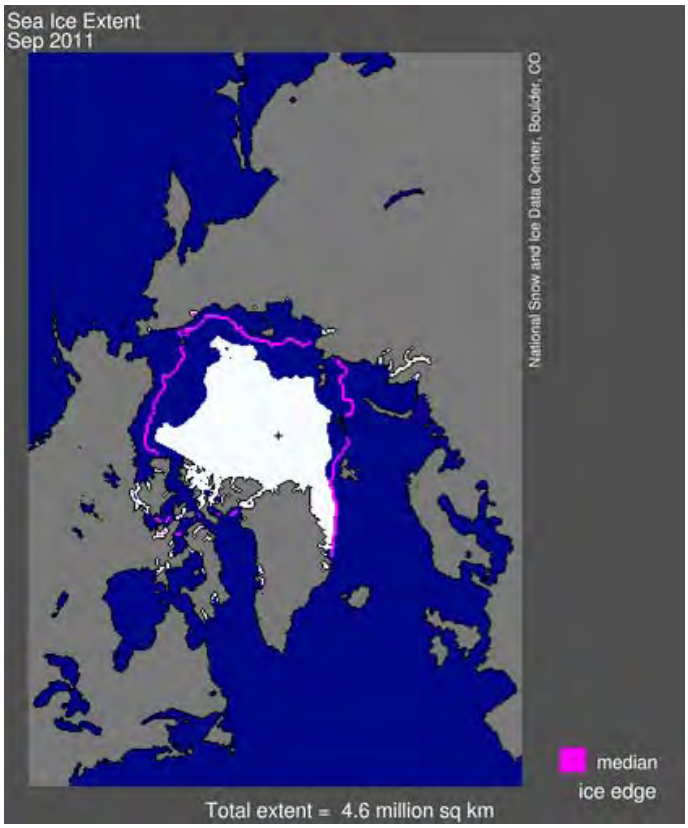


Figure1: Arctic sea ice extent for September 2011 was 7.10 million square kilometers. The magenta line shows the 1979 to 2000 median extent for that month. The black cross indicates the geographic North Pole. Also shown in colour on cover page. Figure credit: National Snow and Ice Data Center.

Melt season in 2011 brought higher-than-average summer temperatures, but not the unusual weather conditions that contributed to the extreme melt of 2007, the record low. "*Atmospheric and oceanic conditions were not as conducive to ice loss this year, but the melt still neared 2007 levels*," said Walt Meier of NSIDC. "*This probably reflects loss of multi-year ice in the Beaufort and Chukchi seas, as well as other factors that are making the ice more vulnerable*."

The low sea ice level in 2011 fits the pattern of decline over the past three decades, said Joey Comiso of NASA's Goddard Space Flight Center. Since 1979, September Arctic sea ice extent has declined by 12 percent per decade.

"*The sea ice is not only declining; the pace of the decline is becoming more drastic*," he noted. "*The older, thicker ice is declining faster than the rest, making for a more vulnerable perennial ice cover*."

While the sea ice extent did not dip below the record, the area did drop slightly lower than 2007 levels for about ten days in early September 2011. Sea ice "area" differs from "extent" in that it equals the actual surface area covered by ice, while extent includes any area where ice covers at least 15 percent of the ocean.

Arctic sea ice extent on September 9, 2011, was 4.33 million square kilometers (1.67 million square miles). Averaged over the month of September, ice extent was 4.61 million square kilometers (1.78 million square miles). This places 2011 as the second lowest ice extent for *both* the daily minimum and the monthly average. Ice extent was 2.43 million square kilometers (938,000 square miles) below the 1979 to 2000 average.

Climate models have suggested that the Arctic could lose almost all of its summer ice cover by 2100, but in recent years, ice extent has declined faster than the models predicted.

Further Reading

1) NASA (2011, October 4) Arctic Sea Ice Continues Decline, Hits 2nd-Lowest Level; accessed October 4, 2011. (http://www.nasa.gov/topics/earth/features/2011-ice-min.html/).

2) NASA Earth Observatory (n.d.) World of Change: Arctic Sea Ice (http://earthobservatory.nasa.gov/Features/WorldOfChange/sea_ice.php).

3) NOAA Climate Watch (2011, October 4) Old Ice Becoming Rare in Arctic; accessed October 4, 2011. (http://www.climatewatch.nasa.gov/video/2011/old-ice-becoming-rare-in-arctic).

NASA Earth Observatory images created by Jesse Allen, using AMSR-E sea ice concentration data provided courtesy of the National Snow and Ice Data Center. Caption based on text from Patrick Lynch (NASA) and Katherine Leitzell (NSIDC), edited by Michael Carlowicz.

Source: NSIDC website visited on November 4th, 2011.

In Memoriam

William (Bill) Silvert

1937-2011

Bill Silvert - eminent scientist, teacher, mentor, father, husband, polymath, epistemologist, gastronome, humorist, colleague and friend — died of cancer at his home in Peral, Portugal on June 28th. Bill is survived by his wife of almost 14 years, Maria Emília de Freitas Mota e Cunha, his daughter Rebecca and son Richard. All who knew or had contact with Bill are better for the experience. His courtesy, kindness, keen intellect and dedication will be sorely missed.


Dr. William Silvert

Bill was born in New York City. He trained as a physicist (Ph.D., Brown University, 1964) and held faculty positions in physics at Case Western Reserve University (Cleveland, Ohio USA), the University of Kansas (Lawrence, Kansas, USA) and Dalhousie University (Halifax, Nova Scotia, Canada).

Physics was not sufficiently complex for Bill; theoretical and applied issues in marine ecology piqued his interest. He joined the Oceanography Department at Dalhousie University in 1975, and then moved to the Bedford Institute of Oceanography (BIO) in 1978. Bill retired from BIO in 1998 but remained as an Emeritus Research Scientist until 2000. Bill moved to Portugal where he became a Senior Research Fellow at the Departamento de Ambiente Aquático (Department of the Aquatic Environment). Bill was a prolific scientist and published more than 150 primary contributions in marine ecology, oceanography, mariculture, mathematical biology and modeling.

If you wish to offer your condolences or share your recollections of Bill you can contact his family through the family mailing list at family@silvert.org

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Robert (Bob) Conover

Dr. Robert J. (Bob) Conover passed away on August 1, 2011 in Cobourg, Ontario. Bob was educated at Oberlin College and Yale University, earning his doctorate from Yale in 1955 in marine biology. His doctoral thesis focussed on a planktonic crustacean (copepod) that is essential to the ocean's food web. He continued his research on copepods at the Woods Hole Oceanographic


Dr. Robert (Bob) Conover

Institute with the late Gordon Riley. In the fall of 1966 he took a position at the Bedford Institute of Oceanography in Dartmouth, NS., where he and his colleagues furthered our understanding of the feeding physiology of various plankters. He received two citation classics for papers published during this period. In the late 1980s, Bob took his interest in plankton physiology to the Arctic, where he continued to be at the forefront of his field. During his career he worked and co-authored many publications with younger scientists who went on to become leaders in the field. Bob loved travel, took sabbaticals in Scotland and France, and gave scientific papers around the world. He retired from the Bedford Institute in 1994, continuing to publish papers on Arctic biology for many years. In retirement, he pursued his passion for organic gardening and every fall would take his pickup truck and head east for salmon fishing in his beloved Nova Scotia.

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American Meteorological Society



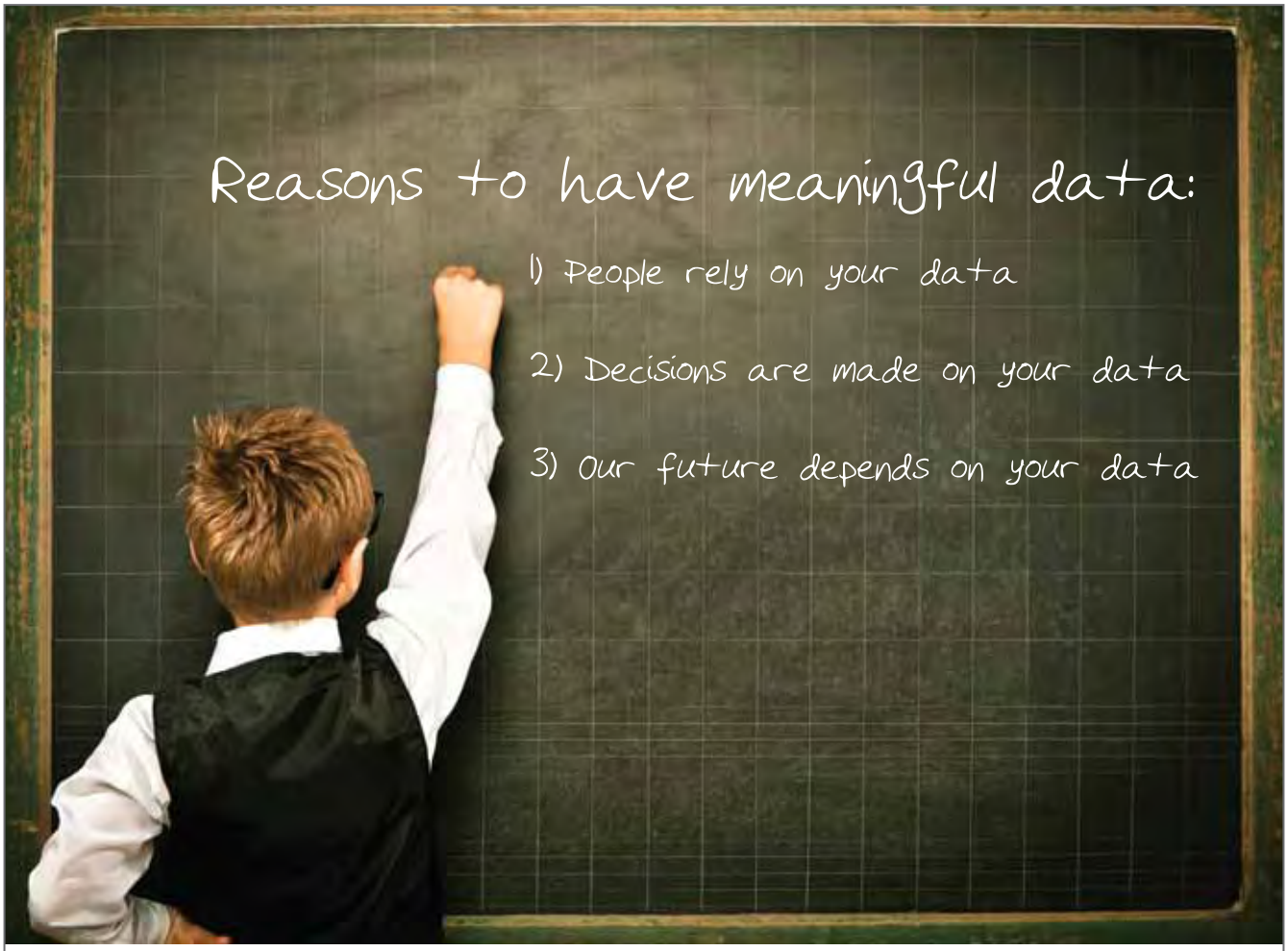


46e congrès SCMO I 46th CMOS Congress
25th Conference on Weather Analysis and Forecasting
21st Conference on Numerical Weather Prediction

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

Montréal 2012
29 mai - 1er juin / May 29 - June 1



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