Canadian National Committee for SCOR
Comité national canadien pour SCOR
Scientific Committee on Oceanic Research

# CANADIAN OCEAN SCIENCE NEWSLETTER
# LE BULLETIN CANADIEN DES SCIENCES DE L'OCÉAN

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Newsletter #4 will be distributed on December 5, 2003. Please send contributions to dick.stoddart@sympatico.ca
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**Rob Macdonald: Musings on Arctic Research – a personal view**

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Over the past decade I have been involved in three arenas of Arctic research; the freshwater cycle, the organic carbon cycle and contaminant pathways in the Arctic Ocean. Here, I'd like to offer a brief perspective on where this research has led me. The 1990s have seen a science community enlivened by rapidly accumulating evidence that the Arctic is undergoing change. It is now clear that, among other things, ice thickness and area have declined, ice-drift pathways have changed, water masses have rearranged themselves with the Atlantic layer warming, and precipitation has increased. There is vigorous debate over the meaning of these changes and whether they should be assigned to the strong positive phase of the Arctic Oscillation/North Atlantic Oscillation in the early 1990s or alternatively to the leading edge of global climate warming. When it comes to moving forward from the observed changes into ones more consequential to the globe – like the thermohaline circulation, the carbon cycle, and polar ecosystems – we become stymied and far more speculative.

The Arctic's freshwater cycle holds surprises, and the key to unlocking these is to understand how the ice cycle (freezing-melting) interacts with the runoff cycle. Both produce buoyancy but in very different ways (Macdonald, 2000). Recent freshening of the Canada Basin surface waters provides an example of change hidden in geochemical space. Although the loss of ice mass and the enhancement of freshwater inventories in the Canada Basin appear to be opposite manifestations of one process – melting ice – the isotopic composition of the water and models both assign much of the change to altered storage of river runoff. Our time-series data from the Canada Basin together with the SHEBA drift section in 1997-98 clearly show this (Macdonald et al., 2002a; 1999). Why would we care? The transfer of runoff from one location to another in the Arctic Ocean sets up a storage-and-release engine that could export pulses of buoyancy into the North Atlantic convection sites. Furthermore, the rearrangement of stratification within the Arctic Ocean alters heat, nutrient and contaminant fluxes with obvious consequences for ice and biology. We have to understand the reasons for freshening before we can develop realistic predictive models.

Organic carbon provides perhaps an even greater challenge to projecting the consequence of changes in Arctic Ocean circulation and sea-ice distribution. A first step to understanding organic carbon cycles in the Arctic is to construct a budget and here there is a parallel with freshwater. We need to understand two components of the system; the terrigenous organic carbon imported at the margins and the organic carbon produced within the ocean (Stein and Macdonald, 2003). Presently the Arctic Ocean appears to be a net burner of organic carbon, imperfectly preserving the terrigenous carbon but not making up for it by preserving enough of the marine organic carbon. Perhaps the most intriguing aspect of the Arctic Ocean's organic carbon cycle is the large mismatch between the size and activities of the two organic carbon sources; the terrigenous carbon component is rather small and sluggishly degraded whereas the marine carbon engine is large but recycles practically all of its products leaving the remaining organic matter in Arctic Ocean sediments to have a strong terrigenous flavour. A crucial research question, then, is whether recent or projected climate change leads to increased vigour in the marine organic carbon engine – a vigour that might show up only indirectly in the

sediment record (Gobeil et al., 2001a). Furthermore, this strong recycling of the marine carbon engine offers powerful means of contaminant amplification (Macdonald et al., 2002b).

Contaminants within the Arctic have provided a focus for the Canadian Northern Contaminants Programme throughout the 1990s, leading to two Canadian assessments (CACAR) plus two international assessments (AMAP). Lateral thinking, according to Edward deBono, is stimulated by throwing a randomly-selected topic into a thought process. And so, having worked on freshwater, the organic carbon cycle and contaminants, I came to realize that trying to fit contaminants into a changing Arctic might be a way to see something new (Macdonald et al., 2003b). It quickly became obvious to me that two large science communities working either on climate change or contaminants were virtually out of communication with one another to the detriment of both. Although a few things have been written earlier about the consequences of global warming for contaminants, conclusions were limited mostly to rather simple cause-and-effects such as "warming will increase volatility and microbial degradation." But, when one considers the other changes that cascade out of temperature change, the Arctic's systems provide rich opportunities for altered pathways and concentrating mechanisms. These changes clearly offer a warning – connecting contaminant time series or proxy records directly with contaminant emission histories rides on a tenuous base because many processes between the point of emission and the sink can alter what actually gets recorded. For example, the sediments of lakes receiving large numbers of returning salmon record not only the atmospheric input, but a second one delivered by the fish which, themselves, are subject to large climate variations (Krümmel et al., 2003). I am hoping in the future that a lively dialogue can be initiated wherein climate change scientists will begin to recognize that new 'contaminant' tools may illuminate changing pathways (Gobeil et al., 2001b; Mysak, 2001) whereas contaminant scientists will begin to incorporate elements of climate change into their pathways and risk assessments (Li et al., 2002; Macdonald et al., 2003a).

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## Gordon Research Conference on Permeable Sediments

Reported by: Bernard P. Boudreau , Oceanography, Dalhousie University,
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During the week of 15-20 June, 2003, an interdisciplinary group of 70 scientists and engineers met at a Gordon Research Conference (GRC) at Bates College, Lewiston, Maine, USA, to discuss the emerging field of permeable sediments. Permeable sediments, as opposed to muddy sediments, are characterized by their ability to allow significant advective flows, caused by pressure gradients associated with waves, tides, bottom roughness (Bernoulli effects), and hydrology.

Permeable sediments are increasingly recognized as major players in controlling the biogeochemistry of coastal, estuarine and riverine systems. These sediments act like fluidized-bed chemical reactors, where advective transport supplies substrates and reactants at accelerated rates and removes potentially inhibitory end products equally rapidly. This serves to maintain biogeochemical reactions at near-optimal rates. Aquatic environments that overlie permeable bottoms are therefore likely to be unusually efficient in cycling carbon and nutrients. Critically, many of the techniques and instruments developed to examine fine-grained sediments provide inaccurate and misleading results in permeable sediments. The study of these sediments thus presents important scientific and technical challenges.

The conference was initiated by SCOR Working Group 114 on Transport and Reaction in Permeable Sediments (co-chairs: Bernard Boudreau, Canada, and Markus Hüttel, Germany) and chaired by Rick Jahnke (USA) and Ian Webster (Australia). The conference was both a great success and quite novel, in that it had both one of the highest participation rates from non-US scientists and from first-time attendees for a GRC. The scope of interests and expertise was also remarkable, extending from benthic biologists, geologists, hydrologists, geochemists, physicists, all the way to chemical and civil engineers. Rules for GRCs prevent a report of the discussions,

but a flavor for their wide-ranging nature can be gleaned from the titles of the plenary presentations: Markus Hüttel (Max Planck Institute for Marine Microbiology), "The Coastal Biocatalytic Sand Filter - Transport and Reaction in Permeable Sediments"; William Burnett (Florida State University), "Terrestrial Groundwater Inputs to the Ocean - An Unquantified Pathway Between Land and Sea"; Ian Webster (CSIRO), "Understanding Flows in Permeable Sediments - It's Really Down to Newton's Second Law"; Aaron Packman (Northwestern University), "Interfacial Fluxes, Flow Paths, and Reactions in Permeable Sediments"; Carolyn Oldham (University of Western Australia), "Life in These Turbulent Times: Interactions Between Bottom Turbulence and Permeable Sediments, and the Implications for Interfacial Fluxes"; Filip Meysman (Netherlands Institute of Ecology), "In the Wake of Charles Darwin: Quantifying and Modeling Bioturbation"; Jim Nelson (Skidaway Institute of Oceanography), "Benthic Primary Production and the Optical and Chemical Microenvironment of Continental Shelf Sands"; John-Francois Gaillard (Northwestern University), "Spectroscopic and Microscopic Investigations of the Chemical and Physical Makeup of Sediments"; Tim Shaw (University of South Carolina), "The Impact of Flow in Permeable Sediments in the Mass Balance and Exchange of Redox Sensitive Metals and Rare Earth Elements"; Frank Sansone (University of Hawaii), "Biogeochemical Implications of Fluid Flow in Permeable Carbonate Sediments"; Henry Bokuniewicz (SUNY Stony Brook), "Circulation and Salt Dispersion in Coastal Aquifers: The Classification of Subterranean Estuaries"; Billy Moore (University of South Carolina), "Use of Radium Isotopes to Infer and Measure Fluid Exchange Between the Seabed and Overlying Ocean"; Allen Burton (Wright State University), "The Critical Role of Permeable Sediments in Risk Assessments of Streams"; Anthony D'Andrea (Oregon State University), "The Role of Tidal Mixing and Bioturbation in Controlling the Efficiency of Permeable Sands as Organic Matter Biofilters: An Intertidal Example"; Wiebke Ziebis (Scripps Institution of Oceanography), "Convective Porewater Transport at Shallow-water Hydrothermal Vents and Effects on Geochemical Gradients, Biogeochemical Processes, and Associated Microbial Communities"; Clare Reimers (Oregon State University), In Situ Measurements of Solute Transport Velocities in Permeable Shelf Sand Ripples"; Makoto Taniguchi (Nara University), "Interactions Between Groundwater and Seawater in Permeable Sediments"; Arzhang Khalili (Max Planck Institute for Marine Microbiology), "Modeling Porewater Exchange in Permeable Sediments"; Gia Destouni (Royal Institute of Technology, Sweden), "Temporal Variability of Submarine Groundwater Discharge: Model Results and Implications"; Peter Berg (University of Virginia), "Oxygen Uptake by Aquatic Sediments Measured with a New Eddy Correlation Technique"; Bernie Boudreau (Dalhousie University), "Where Do We Go from Here?"

## Changes in the Fresh Water Budget of the Ocean From Decades to Centuries

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A special session is being organized at the 2003 AGU Fall meeting on the fresh water and heat budget change in the ocean. (http://www.agu.org/meetings/fm03/index.shtml) At this session we will attempt to cover both regional and large scale aspects of temperature and salinity variability, look in the sources of the dramatic changes seen in oceanographic records (atmospheric, continental, ice melt etc), and explore abilities of the models to reconstruct and predict the changes of heat and fresh water content of the ocean. Special attention will be paid to variability in precipitation, continental and sea ice and river runoff. We also received a number of abstracts

describing and showing first results from new and perspective technologies of measuring the heat and fresh water content of the ocean, (remote sensing, PALACE and ARGO floats, Sea-gliders etc.). The aim of the session is to build an assessment of coordinated changes in fresh water and heat content of the ocean basins, identify the likelihood of environmental consequences of these changes and find new grounds for collaboration between regional studies based on data analyses and models. Our invited speakers include: Peter Rhines (*Observing and Modeling the Arctic-Atlantic Climate Connection*), Ruth Curry (*Recent Changes in Large Scale Ocean Salinity Distributions in the Context of Climate Variability*), Roger Lukas (*Freshwater Flux Variations and Impacts on the North Pacific Ocean*), Gary Lagerloef (*The Aquarius/SAC-D salinity mapping satellite mission: Science and measurement objectives for studying the ocean freshwater budget*) and Dan Seidov (*Inter-basin Versus Meridional Ocean Freshwater Disparity and Global Ocean Conveyor*). We would be glad to see you at the meeting and hope your participation and communication in the special session will help to establishing new and to broaden existing ties in the international oceanography and climate study communities.

## 36th Executive Committee SCOR Meeting

The 36th Executive Committee was held at the Russian Academy of Sciences, Moscow, Russia, September 15-18, 2003. Canada was represented at the meeting by Dr. Bjorn Sundby, Chair of the Canadian National SCOR Committee. Also present from Canada, representing the International Council of Science (ICSU), was Dr. Gordon A. McBean, The University of Western Ontario. The meeting covered progress and recent events for SCOR sponsored large-scale programs, including the Joint Global Ocean Flux Study (JGOFS), Global Ocean Ecosystem Dynamics (GLOBEC), Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) (initially called "OCEANS"), Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB), Surface Ocean - Lower Atmosphere Study (SOLAS), and Land Ocean Interactions in the Coastal Zone (LOICZ).

The meeting also discussed four proposals for new working groups, three of which were approved subject confirmation that financial co-sponsorship will be confirmed. Two of the new working groups, "Analyzing links between present oceanic processes and paleo-records" and "Reconstruction of past ocean circulation", are related to the International Marine Global Change Study (IMAGES) program, which had expressed interest and willingness to co-sponsor these working groups. A third proposal, "Geotraces", is of interest to the Intergovernmental Oceanographic Commission (IOC), which also expressed willingness for co-sponsorship. There were no working group proposals from Canada this year. *It is urged that those who read this report and have ideas for new working group topics contact the Canadian National SCOR Committee for advice on how to prepare a successful proposal. Working groups form the backbone of SCOR, and there is a successful record of Canadian proposals.* Status reports and decisions relative to completion/continuance were made on active working groups, namely WG 108 on Double diffusion, WG 112 on Magnitude of submarine groundwater discharge and its influence on coastal oceanographic, WG 114 on Transport and reaction in permeable marine sediments, WG 115 on Standards for the survey and analysis of plankton, WG 119 on Quantitative ecosystems indicators for fisheries management, and WG 121 on Ocean Mixing.

Other highlights of the SCOR meeting included: work of the SCOR – IOC Advisory Panel on $CO_2$; planning for an international science symposium on "The Oceans in a High-$CO_2$ World" to be held in 2004 (tentatively in Lisbon, Portugal); a favourable review of SCOR by ICSU; planning for the International Polar Year 2007/2008; interactions with the Scientific Committee on Antarctic Research (SCAR); and SCOR finances, budget and election of new officers. Additional details on all the above topics may be found on Canadian SCOR web site, www.cncscor.ca, in Bjorn Sundby's summary report of the Moscow meeting

## Ocean Observation Panel for Climate

Report by Bob Keeley, keeley@meds-sdmm.dfo-mpo.gc.ca

The 8th meeting of the Ocean Observation Panel for Climate was held in Ottawa at the Marine Environmental Data Service from Sep 3-6, 2003. This Panel is the main body advising the GOOS Steering Committee (GSC) on the science requirements for an ocean climate observing system. Members of the Panel are experts in one or more areas but have broad knowledge in a number of areas of concern to the Panel. More information about the OOPC can be found at http://ioc.unesco.org/oopc

As happens at every OOPC meeting, there were invited talks to hear at first hand what are the scientific questions of the day. Val Swail from Environment Canada gave a talk on the wind waves and storm surge program internationally and in Canada. Allyn Clarke from BIO described the meridional overturning circulation, its importance to climate and what kinds of measurements are needed to observe it. James Morison (US-PMEL) talked about Arctic Ocean oceanography and some planned research activities in this basin.

The agenda of the meeting covered a broad range of topics. This ranged over reports on El Nino, SST calculations, progress reports on Argo and GODAE, the VOS program, time series stations, air-sea flux measurements, ocean carbon and tide gauges. The role of satellites in the global observing system was discussed and the future satellite plans evaluated for their complementarity to in-situ observations. The importance of modern and robust data systems to support the global observation system was also part of the discussions. Other reports covered sponsoring agencies activities or actions by members of the Panel. These discussions covered GCOS, The Second Report on the Adequacy of the Global Climate Observing System, GOOS, WCRP and CLIVAR, POGO, IGBP and JCOMM. All of these have activities that relate to observing the global ocean climate and therefore all look to the Panel for advice on both the scientific and data management requirements.

The broad discussion emphasizes once again at least four themes. First, while not all of the observational requirements are settled, the next steps forward were well laid out at the Ocean Observations '99 conference in St. Raphael, and those still apply. Second, that no one observational strategy will answer all questions. We need to combine satellite and in-situ observations in complementary ways to exploit the strengths that each brings. In-situ programs such as Argo complement high density XBT data, but other observation strategies are required to look at questions such as meridional overturning. Third, that Canada has a clear interest in environmental changes taking place in the Arctic and to ensure these interests are considered,

needs to be involved in the research undertaken. Finally, that the global observing system will require the contributions and co-operation of a large number of nations and that the expertise and skills of Canadians has a strong role to play.

## CMOS 38th Annual Congress: Call for papers

The Alberta Centre of the Canadian Meteorological and Oceanographic Society (CMOS) will host the 38th annual CMOS Congress at the Fantasyland Hotel in Edmonton, Alberta, Canada from 31 May – 03 June 2004. The overall theme of the 2004 Congress is Human Dimensions of Weather and Climate. We particularly encourage papers directed towards the Congress theme, while we are also soliciting submissions in key focus areas, including Climate Change, Aviation Meteorology, High Latitude Processes, Severe and Hazardous Weather, The Northern Oceans (Arctic, Atlantic and Pacific) and their Linkages, Drought and Water issues, and Remote Sensing and New Technologies. Several workshops are planned in conjunction with the 38th Congress, possibly including MAGS and CWRP. There will also be traditional CMOS sessions in other aspects of meteorology and oceanography, and we are once again encouraging a special Teachers' Day at Congress. The deadline for submission of abstracts is Friday, February 27, 2004. Abstracts should be no more than 400 words, including title, author(s), affiliation, city, and e-mail address of the lead author, with no figures. Abstracts should be submitted electronically in English or French on the Congress web site at http://www.CMOS.ca. Authors are asked to include 4-6 keywords with their abstract, which will be used to organize the final list of sessions. Authors may request either an oral or a poster presentation. Submissions from graduate students are especially encouraged. Contact the Chair of the Science Program Committee, Geoff Strong, at geoff.strong@shaw.ca for enquiries regarding scientific sessions.

## Québec-Océan (Le groupe interinstitutionnel de recherches océanographiques du Québec)

Les océanographes québécois se sont récemment regroupés au sein de Québec-Océan. Les membres du regroupement incluent des chercheurs de l'Université Laval, de l'Université du Québec à Rimouski, de l'Université McGill, de l'INRS (Institut national de la recherche scientifique), de l'Université de Sherbrooke et de l'Université du Québec à Chicoutimi, de même que de l'Institut Maurice-Lamontagne (Pêches et Océans Canada). Les infrastructures et équipements mis à la disposition des chercheurs du regroupement incluent le navire océanographique CORIOLIS II, opéré par un consortium universitaire; le nouveau brise-glace de recherche NGCC Amundsen; un pool important d'équipements océanographiques de pointe; la Station aquicole de Pointe-au-Père; et un accès privilégié au LARSA, le Laboratoire régional des sciences aquatiques.

Les quatre axes du programme de recherche de Québec-Océan sont: fonctionnement et intégrité des écosystèmes marins; climat des océans; ressources marines; et prévisions et observations. Quatre chaires de recherche étudient respectivement la génétique des espèces d'eau douce; la variabilité du climat et les ecosystems planctoniques; l'écotoxicologie moléculaire dans la zone côtière; et l'acoustique marine appliquée. Deux réseaux de recherche dans lesquels Québec-

Océan est fortement impliqué sont l'Étude internationale du plateau arctique canadien (CASES) et l'Étude de l'Océan superficiel et de la basse atmosphère (SOLAS).

Pour plus de renseignements sur Québec-Océans, consultez le site www.quebec-ocean.ulaval.ca ou écrivez à quebec-ocean@giroq.ulaval.ca

**Québec-Océan** (Le groupe interinstitutionnel de recherches océanographiques du Québec)

A number of Québec oceanographers have recently grouped together under the banner of Québec-Océan. Members of the group include researchers at Université Laval, Université du Québec à Rimouski, McGill University, INRS (Institut national de la recherche scientifique), Université de Sherbrooke and Université du Québec à Chicoutimi, as well as scientists from the Maurice Lamontagne Institute (Fisheries and Oceans Canada). Infrastructure and equipment available to Québec-Océan researchers include the oceanographic ship CORIOLIS II, owned and operated by a university consortium; a research icebreaker, CCGS Amundsen; an extensive array of state-of-the-art oceanographic equipment; an aquaculture laboratory at Pointe-au-Père; and preferential access to LARSA (Laboratoire régional des sciences aquatiques).

The four areas of focus for Québec-Océan research are: the function and integrity of marine ecosystems; ocean climate; marine resources; and forecasting and observations. Four research chairs cover: genetic management of freshwater species; climate variability and planktonic ecosystems; molecular ecotoxicology in coastal areas; and applied marine acoustics. Two research networks having a Québec-Océan focus are the Canadian Arctic Shelf Exchange Study (CASES) and the Surface Ocean Lower Atmosphere Study (SOLAS).

Additional information about Québec-Océan may be found at www.quebec-ocean.ulaval.ca or by emailing quebec-ocean@giroq.ulaval.ca

## Polar Continental Shelf Project (PCSP) 2004 Applications

The Polar Continental Shelf Project (PCSP) coordinates support for, and offers expert advice to Canadian government and university scientists and independent, private sector and non-Canadian researchers working in isolated areas throughout the Canadian Arctic. Support includes: transportation, communications, accommodation, field equipment and related services. Principal investigators planning to conduct fieldwork in the Arctic are invited to apply for logistics support by submitting an application form to the PCSP. The deadline for submitting applications to PCSP is November 10, 2003. Only 2004 forms will be accepted. For more information please see: http://polar.nrcan.gc.ca/

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