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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OCEAN SCIENCE PROGRAMS

Ventilation, Interactions and Transports Across the Labrador Sea (VITALS)

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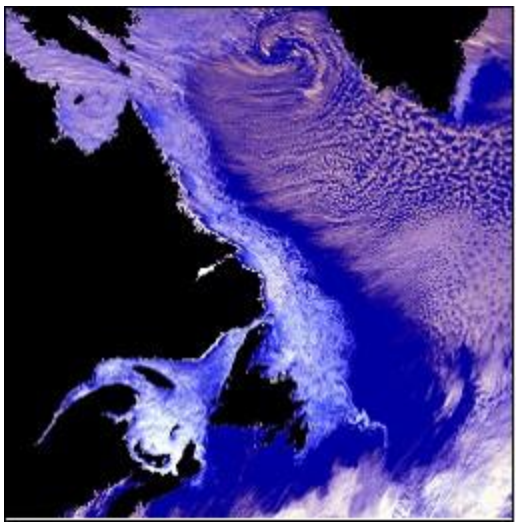
The Labrador Sea and surrounding shelves are critical for the ecological, economic, and societal health of North America and Europe. Canada has a national investment in offshore fisheries and transportation within this basin, and a growing presence as resource exploration and exploitation moves northward and farther offshore. Eastern Canada's weather and climate are also strongly influenced by the Labrador Sea. The Labrador Sea is important strategically as the Canadian gateway to the Arctic. It is therefore critical that Canada, as the only G8 nation that borders this important basin, has a strong voice on the world stage about events occurring in this basin. Canada also has a long tradition of scientific firsts in this globally important region in climate studies, including the earliest recognition of the variability of Labrador Sea Water formation, and the first process-oriented and tracer studies of deep convection and ocean acidification. Scientific studies, as well as intensive programs (such as the Labrador Sea Convection Experiment) have been carried out intermittently in the basin by Canadian, German, U.S. and U.K. groups, among others. On top of this is the long-term monitoring program of Fisheries and Oceans Canada (DFO), which has components both on (Atlantic Zonal Monitoring Program) and off the shelf (Atlantic Zonal Offshore Monitoring Program).



As well, the Labrador Sea is one of the few oceanic regions where the deep ocean exchanges gases such as oxygen and carbon dioxide (CO_2) directly with the atmosphere. This gas exchange, driven by wintertime deep convection is the ocean's "deep breathing" and the Labrador Sea can be viewed as a “lung” in the Earth System. Localized deep convection releases large amounts of

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The Canadian National Committee of the Scientific Committee for Oceanic Research (CNC-SCOR) fosters and facilitates international cooperation. It is a non-governmental body that reflects the multi-disciplinary nature of ocean science and marine technology.

Le Comité national canadien du Comite scientifique de la recherche océanographique (SCOR) favorise et facilite la coopération internationale. Il reflète la nature multidisciplinaire de la science océanique et de la technologie marine.

heat to the atmosphere and the resulting Labrador Sea Water contributes to the global ocean thermohaline circulation that redistributes heat from low latitudes to the poles. Deep water formation in the Labrador Sea is one of several tipping points in the Earth's climate system. Convection also drives a large flux of oxygen and anthropogenic CO_2 into the North Atlantic, oxygenating subsurface layers and slowing the accumulation of CO_2 in the atmosphere, but exacerbating ocean acidification along Canada's sensitive eastern continental margin. The combined action of convection and horizontal circulation redistributes nutrients and contaminants (e.g. from future deepwater oil production along the deep Labrador slope) potentially affecting ocean productivity and marine ecosystem health. These globally significant processes of direct importance to Canada are regionally localized, temporally variable, and sensitive to the effects of ongoing climate changes.

Gas uptake and redistribution processes ("breathing and circulation") are expected to respond to and feedback on climate change, as the high latitude warming surrounding the Labrador Sea increases stratification. Stratification changes may come from direct surface warming as well as the enhanced freshwater input from the melting of snow, multi-year sea ice and glaciers in Greenland and Canada. In either case, enhanced stratification will likely lead to a decline in deep water oxygen and anthropogenic CO_2 sequestration. With the accelerating rate of warming in the high North, multiple sources of freshwater now converge on the Labrador Sea, with the potential to disrupt deep convection, meridional ocean heat transport, climate, and ocean biogeochemistry at regional and global scales. A present concern, which still requires evaluation, is that a slowdown in deep water formation will cut off the source of oxygen and "suffocate" the deep ocean, and reduce a critical sink of anthropogenic CO_2. Thus, it is essential that "breathing and circulation" processes be represented properly in coupled ocean-ice-atmosphere climate models. Currents bringing low-oxygen and high biological CO_2 water from the Arctic and subtropics are analogous to the "veins" of the system. Regional mixing and biogeochemical processes within the Labrador Sea transform the source waters within the basin. Advective-diffusive export pathways ("arteries") connect the oxygenated and transformed water masses to the Atlantic Ocean interior.

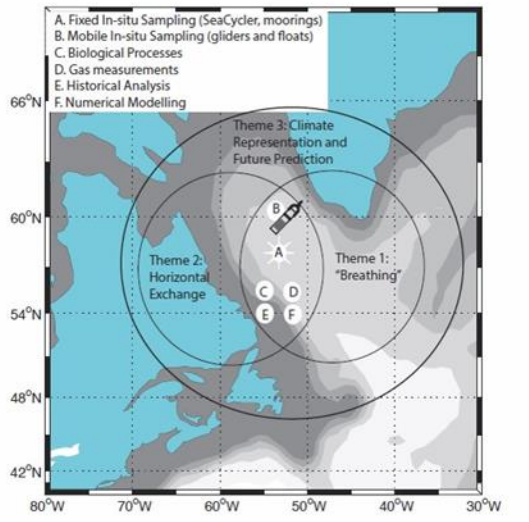
Given these issues, the Ventilation, Interactions and Transports Across the Labrador Sea, or VITALS, project, a recently funded NSERC Climate Change and Atmospheric Research (CCAR) project will spend the next 5 years addressing these questions. VITALs is a pan-Canadian initiative involving scientists from 11 Canadian universities as well as multiple federal government laboratories (Fisheries and Oceans Canada, as well as Environment Canada), industrial and foreign partners.

Its main research goal is to understand and model the functioning and vulnerability of the Labrador Sea as a key component of the earth's climate system including its uptake of oxygen, anthropogenic carbon, and exchange of heat with the atmosphere. It will measure oxygen, carbon dioxide and other climate-relevant gases over several seasonal cycles, characterize their temporal and spatial variability in the Labrador Sea, and determine the factors controlling their uptake, storage and circulation. It will parameterize the fluxes in terms of the forcing factors so that models have the appropriate physics and flexibility to simulate their evolution in a changing climate. It will tie the understanding developed to models of global climate change through the study of one of the few areas in the world, and the only one near Canada, that directly links three important reservoirs within the carbon cycle - the atmosphere, the upper ocean and the deep ocean. Within this high-profile internationally-linked study we will highlight the strengths of the Canadian marine technology industry, by showcasing the latest advanced developments of several Canadian companies in our field program. The working hypothesis is that deep convection in the Labrador Sea, which allows for exchange of oxygen and natural and

anthropogenic carbon to the deep ocean, is sensitive to the warming that is taking place at high latitudes. Validating and quantifying this sensitivity is central to the research network and also the broader community of climate change researchers and policy makers interested in characterizing, and possibly minimizing, the effects of global climate change.

The VITALS strategy revolves around three specific research themes that will be addressed by six implementation teams. These three themes are tightly linked. The central core of VITALS is the Breathing Theme that focuses on the key question how physical, chemical and biological processes control gas exchange between the deep ocean and the atmosphere. The Labrador Sea does not function as an isolated basin with quasi-vertical exchanges; instead processes occurring in the central basin are sensitive to horizontal exchanges and dynamics at small scales, including those operating within the basin, as well as at the boundaries. Consideration of all aspects of the horizontal exchange and associated scales is beyond VITALS in scope. However, it will leverage our work through collaboration with other international programs like OSNAP in the United States, and our Horizontal Exchange Theme will address the key lateral processes influencing the water column in the central basin. Finally, the Climate Representation and Future Evolution Theme will integrate the observational work with the use of numerical models. A significant component of the work that will be carried out within this theme is the use of the models to place the present day in a context that can be compared with the past, as well as examine questions related to future evolution and climate predictability.

The implementation teams will apply different sets of instrumentation and approaches that are appropriate for studying the Labrador Sea and its functionality with respect to the "breathing" process and its climatic vulnerability. Given the need to measure key physical and biogeochemical processes over the full annual cycle within the Labrador Sea, our observational program will be centered around a Fixed in-situ Sampling Team that will deploy a central mooring array incorporating innovative Canadian technology including the SeaCycler (click here for information on Seacycle). To provide spatial structure for our measurements, as well as address questions of horizontal exchange, a Mobile in-situ Sampling Team will carry out innovative experiments using robotic gliders and floats. Given the key role that biological and biogeochemical processes have in controlling the "breathing" process, a Biological Processes Team will characterize these processes and address questions about their climate sensitivity. Our investigation also requires accurate measurements of the gases involved in the "breathing process"; therefore we will also include a Gases Team to provide accurate and innovative measurements of this key aspect of our program. To help place the present measurements in context and take advantage of the extensive data collected via DFO's monitoring programs, a Historical Analysis Team will use the existing observational databases and annually- to decadally-resolved geological archives to document the natural variability of carbon fluxes and ocean water properties on interannual to centennial time scales. Finally, to ensure that our modern and historical observations are understood at a mechanistic level and fully exploited to improve climate representation and



future evolution, we will carry out extensive numerical simulations with both physical and biogeochemical models in our Numerical Modelling Team.

More detail, including the project proposal with references, can be found at the project webpage Assyria.eas.ualberta.ca/~myers/VITALS/index.htm.

IAHS Launches a New Decade of Research

The International Association of Hydrological Sciences (IAHS) previously sponsored an international initiative known as the "PUB Decade," which ran from 2003 to 2012 and focused international attention on the challenges of Prediction in Ungauged Basins. An overview of the PUB decade has recently been published in the Hydrological Sciences Journal (Hrachowitz et al., 2013), and a more detailed statement has been published as an edited book (Bloeschl et al., 2013).

Canada played a major role in the PUB initiative. For example, John Pomeroy of University of Saskatchewan served as Chair of PUB for 2009-2011. In 2011, Canada hosted an international workshop on "Putting Prediction into Practice in Ungauged Basins," held in Canmore, Alberta. Publications arising from that workshop include Pomeroy et al. (in press) and Moore et al. (2013).

Now that the PUB Decade has come to a close, IAHS is embarking on a new initiative: Panta Rhei (Everything Flows).

Panta Rhei aims to bring the hydrological community together under a common umbrella to undertake pioneering research for addressing the challenges of change, by enhancing the knowledge of hydrological systems as fundamental connections between humans and the environment. Panta Rhei is a global initiative. It will bring together scientists from all parts of the world, and it will also provide a global perspective, with the recognition that water problems are highly inter-connected at all scales and levels: local, river basin, regional, and global. Panta Rhei is a grass-roots initiative: it is inclusive of the interests and experiences of a wide range of scientists, and has the ambition to empower people everywhere to contribute to and benefit from the ideas, work and experiences of everyone, and hopefully it will eventually influence the way in which hydrology is taught (hydrological education). Panta Rhei is an inter-disciplinary initiative: it will involve collaborations and interactions across the natural sciences (hydrology, geomorphology, ecology), across the divide between natural and social sciences (economics, politics, policy sciences), and between science and practice (between hydrologists and water managers and practitioners).

The science questions of Panta Rhei are both rooted in the fundamental concepts of hydrology and focused on society and environmental management. They propose a compelling synthesis between basic and applied research. The Panta Rhei Science Plan is available through the IAHS website at: www.iahs.info

Please click here for more for more details on Panta Rhei. You can also access the paper presenting Panta Rhei on the Hydrological Sciences Journal (click here).

All members of the Canadian hydrology community are encouraged to get engaged with Panta Rhei. There will be a session at the upcoming AGU Fall Meeting in San Francisco, 9-13 December 2013: "*H21N Hydrological Change and Water Systems: Feedbacks, Prediction, and Experimental Management*". The oral presentations will take place on, 10 December and posters will be presented in the morning of 11 December 11.

There will also be an "open house" session at the upcoming CGU meeting that will be held 4-8 May 2014, in Banff, to provide a forum for discussion about Canadian participation in Panta Rhei.

The Canadian Representatives on IAHS are Dan Moore and Bill Quinton.

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MEETINGS

IMBER Open Science Conference, 23-27 June 2014, Bergen, Norway

The Integrated Biogeochemistry and Ecosystem Research (IMBER) Project will convene an **Open Science Conference** from 23-27 June 2014 in Bergen, Norway, with the goals of:

- highlighting research results from the IMBER project and activities,
- promoting integrated syntheses of IMBER research, and
- developing a new global research agenda for marine biogeochemistry and ecosystems in the Anthropocene.

You can review the list of sessions and workshops here.

The **Call for Abstracts** is open and the deadline for abstract submission is 15 January 2014. Abstracts for oral and poster presentations are solicited from all areas of marine and coastal research, including observational,

modelling and conceptual studies, from the physical and natural sciences to social sciences and humanities. Click here to submit your abstract.

World Weather Open Science Conference, Montréal, 16-21 August 2014

The ocean sciences community is invited to participate in the 1st World Weather Open Science Conference (WWOSC 2014 - The weather: what's the outlook?) which will take place at the Palais des congrès de Montréal, in Montréal, Québec, 16-21 August 2014. All details, including proposed topics, are available at http://wwosc2014.org/

The organizers are pleased to announce the **Call for Abstracts**. The deadline for the submission of abstracts is **24 February 2014**.

This ground-breaking conference will bring together the entire weather science and user communities for the first time to review the state-of-the-art and map out the scientific frontiers for the next decade and more. We are particularly excited about bringing together the international community – those starting out in science and those with longer experience – to review progress and set the long-term agenda. There has never been a more important time for weather science, which is poised for great breakthroughs.

The overarching theme of WWOSC-2014 is 'Seamless Prediction of the Earth System: from minutes to months'. The Conference is structured around two programs:

- The Science Program which will cover basic weather research that extends our knowledge of processes and systems as well as the applied research needed to put prediction systems together and assess the impacts of weather and climate events.
- The User, Application & Social Science Program which will consider the goods and services economy, the role of government in disaster risk reduction and management, and the communication of weather information.

The list of confirmed plenary speakers can be found here (click).

Conférence scientifique publique mondiale sur la météorologie, Montréal, 16-21 août 2014

La communauté des sciences océaniques est invitée à participer à la 1ère Conférence scientifique publique mondiale sur la météorologie (**WWOSC-2014 - «La météo : quel avenir? »**) qui aura lieu Palais des congrès de Montréal, à Montréal, Québec, du 16 au 21 août 2014. Tous les détails, y compris les sujets proposés, apparaissent sur le site à http://wwosc2014.org/.

Les organisateurs sont heureux d'annoncer leur **Appel de résumés**. La date limite pour la soumission des résumés est le **24 février 2014**.

Cette conférence novatrice rassemblera pour la première fois les spécialistes en météorologie et la collectivité d'utilisateurs pour faire une revue des développements scientifiques de pointe et repousser les frontières de la science pour les prochaines décennies. Nous sommes particulièrement fiers de réunir la communauté internationale - ceux qui s'initient à la science et les plus chevronnés – pour faire le point sur les progrès récents et établir le programme à long terme. Étant sur le seuil de percées décisives, la météorologie est à l'apogée de son importance.

Le thème principal de la conférence WWOSC-2014 est 'La prévision sans discontinuité du système Terre: de quelques minutes à plusieurs mois'. La conférence est organisée autour de deux programmes

- Le programme scientifique qui couvrira la recherche météorologique de fond permettant d'élargir nos connaissances sur les processus et les systèmes ainsi que la recherche appliquée nécessaire à l'assemblage des systèmes de prévision et à l'évaluation des impacts des évènements météorologiques et climatiques.
- Le programme pour la collectivité des utilisateurs, des applications et des sciences socio-économiques qui traitera de l'économie des biens et des services, du rôle des gouvernements dans la réduction des risques et la gestion des catastrophes naturelles, et de la communication de l'information météorologique.

Vous trouverez la liste des conférenciers confirmés pour les plénières ici (clickez).

CANADIAN JOBS and TRAINING

2-year Postdoctoral Fellowships in Coastal Ocean Dynamics

Applications are invited for two 2-year Postdoctoral Fellowships in coastal ocean dynamics related to tidal hydroelectricity development using in-stream tidal energy converters in the Bay of Fundy, Canada, home to the world's highest tides. The positions are part of collaboration among three Canadian universities (Acadia University, Dalhousie University and the University of New Brunswick) and three private sector companies involved in tidal energy development and turbine design and manufacture. For more details click here.

IMBER ClimEco4 Summer School

The Integrated Biogeochemistry and Ecosystem Research (IMBER) is very pleased to announce that the fourth summer school in its ClimEco (Climate and Marine Ecosystems) series will be held at the East China Normal University in Shanghai, China from 4-9 August 2014.

ClimEco4 will focus on Delineating the issues of climate change and impacts to marine ecosystems: Bridging the gap between research, assessment, policy and management.

For more information about the summer school and how to apply, please click here. You can download the summer school flyer here (click).

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GENERAL

Fifth Assessment Report of the IPCC

The *Fifth Assessment Report* (AR5) of the Intergovernmental Panel on Climate Change is being released in four parts between September 2013 and November 2014. In September 2013, the IPCC released the *"Summary for Policymakers,"* (SPM) and released all chapters of *Climate Change 2013: The Physical Science Basis*, including Chapter 3, *"Observations: The Oceans*.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. One of the main IPCC activities is the preparation of comprehensive Assessment Reports about the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies. The IPCC also produces Special Reports, which are an assessment on a specific issue and Methodology Reports, which provide practical guidelines for the preparation of greenhouse gas inventories. Since its inception, the IPCC has prepared four multivolume assessment reports and as noted above is in the process of finalizing the Fifth Assessment Report. The reports can be viewed under Publications and Data.

Access the final draft of the full report from the Fifth Assessment Report web site (click here). For Chapter 3 – "Observations: Ocean", click here.

Expert Panel Report on Ocean Science in Canada

Recognizing the importance of ocean science, the Canadian Consortium of Ocean Research Universities (CCORU) – a group of nine Canadian universities involved in ocean science research – asked the Council of Canadian Academies, an independent not-for-profit organization that began operation in 2005, to undertake an expert assessment of the state of ocean science in Canada, focusing on future opportunities and challenges for Canada and its coasts

On 6 November 2013, the Council of Canadian Academies released the expert panel report on ocean science capacity in Canada. The expert panel report, ***Ocean Science in Canada: Meeting the Challenge, Seizing the Opportunity***, is an evidence-based assessment of the current state of ocean science in Canada and addresses issues such as human capacity, infrastructure, funding, and scientific collaboration. The Panel found that:

- With no single organization responsible for managing ocean research in Canada, scientists face challenges in coordinating activities and pooling resources
- Canada ranks among the top countries in output and impact of ocean science papers, but this position is at risk.
- Canada has several world-class systems for ocean observation and monitoring; however, challenges exist in achieving geographical coverage and integration of data management.
- Canada has a substantial but aging research fleet, leading to higher costs and research days lost due to maintenance.
- Although funding for ocean science in Canadian universities is increasing, direct funding for individual research projects has declined since 2008.
- The state of human capacity in ocean science could not be determined due to data limitations.

The report also notes that Canada has a history of strength in ocean science and there are opportunities to re-affirm leadership and further Canada's role as a steward of the global ocean.

Click here for more information or to download copies of the Panel's report and related products including the executive summary.

For more information on the Council of Canadian Academies, visit the website at **www.scienceadvice.ca**.

Rapport d'un comité d'experts sur la capacité du Canada en sciences de la mer

Reconnaissant l'importance des sciences de la mer, le Consortium canadien des universités de la recherche océanographique (CCURO) – un groupe de neuf universités canadiennes participant à la recherche en sciences de la mer – a demandé au Conseil des académies canadiennes, un organisme à but non lucratif indépendant dont les activités ont débuté en 2005, de réaliser une évaluation sur l'état des sciences de la mer au Canada, en mettant l'accent sur les possibilités et les défis futurs pour le Canada et ses régions côtières.

Le 6 novembre 2013, le Conseil des académies canadiennes a publié le rapport du comité d'experts sur la capacité du Canada en sciences de la mer. Le rapport du comité d'experts, intitulé ***Les sciences de la mer au Canada : Relever le défi, saisir l'opportunité***, est le fruit d'une évaluation fondée sur des données probantes de l'état actuel des sciences de la mer au Canada et aborde des questions telles que la capacité humaine, l'infrastructure, le financement et la collaboration scientifique. Le comité d'experts a constaté que:

- En l'absence d'une organisation unique responsable de la gestion de la recherche océanique au Canada, les scientifiques font face à des défis au niveau de la coordination des activités et de la mise en commun des ressources
- Le Canada se classe dans le groupe de tête des pays pour le nombre et l'impact des articles publiés en sciences de la mer, mais cette position est à risque.
- Le Canada possède plusieurs systèmes d'observation et de surveillance océaniques de calibre mondial; cependant, l'extension de la couverture géographique et l'intégration de la gestion des données posent des défis.
- Le Canada dispose d'une flotte de navires de recherche importante mais vieillissante, ce qui se traduit par des coûts plus élevés et un plus grand nombre de jours de recherche perdus pour cause d'entretien.
- Même si le financement alloué aux sciences de la mer dans les universités canadiennes va en augmentant, le financement direct de projets de recherche individuels est en déclin depuis 2008.
- L'état de la capacité humaine en sciences de la mer n'a pu être déterminé en raison de contraintes de données.

Le comité d'experts note de plus que le Canada a historiquement possédé des atouts en sciences de la mer et de nombreuses possibilités s'offrent pour réaffirmer le leadership du Canada et renforcer son rôle de gardien de l'océan mondial.

Clickez ici pour plus de détails ou pour télécharger une copie du rapport ou des produits connexes.

Pour plus de renseignements sur le Conseil des académies canadiennes consultez le site Web, à **www.sciencepourlepublic.ca**.

Canada and US Institutions Coordinate Ocean Glider Operations

Researchers from U.S. and Canadian institutions are teaming up for a coordinated launch of up to 14 autonomous ocean-monitoring gliders. The gliders will collect a unique and extensive set of oceanographic and animal-tracking data along the North American Eastern Seaboard. The mission represents the largest international use of coordinated autonomous sampling vehicles attempted to date. To read more click here.

Data from the missions are available at the OTN glider page (gliders.oceantrack.org) and the IOOS Glider Asset Map (http://www.ioos.noaa.gov/observing/observing_assets/glider_asset_map.html). More information is also available from the Mid-Atlantic Regional Association for Coastal Ocean Observing Systems blog (http://maracoos.org/blogs/main/).

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Le Bulletin #74 sera distribué le 17 janvier 2014. Veuillez faire parvenir vos contributions à michel.mitchell@dfo-mpo.gc.ca

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