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OCEAN SCIENCE PROGRAMS

2007-2010 IAPSO report: Four years of Physical Oceanography in Canada

Submitted by Blair Greenan¹ and Jody Klymak²

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Physical oceanography research in Canada has been extremely productive for the period of 2007-2010, with over 750 peer-reviewed journal articles by over 600 individual researchers from 111 institutions, departments, or companies from across the country. These accomplishments are recorded in the 2011 report to the International Association for the Physical Sciences of the Oceans (IAPSO) compiled by Blair Greenan and Jody Klymak with assistance from Tineke van der Baaren. This report is provided in three components (bibliography with full abstracts, alphabetical listing of the bibliography and a list of Canadian researchers and organizations). The documents are available on the CNC-SCOR web site ([click](#)). The bibliography is also available on the Mendeley website ([click](#)).

The following criteria were used in the compilation of this report:

- Canadian publications are those published by researchers in Canadian institutions such as universities or government labs. It does not include publications by Canadian researchers working at institutions outside Canada.
- This survey only includes peer-reviewed journal articles (no tech reports, data reports, white papers, etc.).
- The time frame of the survey is 1 Jan 2007 to 31 Dec 2010.

The report consists of a categorized bibliography summarizing abstracts from Canadian scientists conducting physical oceanography research. Topics span the breadth of the global oceans, with Canadian contributions, including observations of the oceans on all scales, laboratory studies, numerical studies, and theoretical work. The list of papers makes clear that Canadians are sought after for many international collaborations, as well as working on problems of national significance. In addition, the impact of student training on the papers is clear, with many of the 600 Canadian researchers mentioned above being students when the cited work was written.

The report is deliberately broad in its interpretation of "physical science of the oceans", and includes a number of climate papers, papers on atmospheric flows, and a significant number of papers on the chemistry of the oceans. We hope no one is offended if their

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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 Comité 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.

work ended up on one side of the line or the other and it is certainly possible that we have omitted some publications in error. Hence, we would encourage the community to provide feedback to us.

The numbers above are an impressive body of research for a four year period, and it is worth noting where the support for these programs came from:

- First, and most noteworthy, this was the period when the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) was being actively funded. This allowed support for graduate students, post-docs, and technicians that made many of these papers possible.
- This period also encompassed the first batch of papers from the International Polar Year (2007-2008). Physical oceanographers participated in the C3O project, the Circumpolar Flaw Lead System Study, along with significant effort put into Arctic climate and ice changes during these years. This effort was reflected in a recent special issue of Atmosphere-Oceans.
- NSERC Discovery Grants still remained an important source of funding of the University system, funding diverse programs across the discipline.
- Research in the federal government lab system was supported through departmental core A-base funding as well as targeted funding through programs such as CSA-GRIP and PERD.

Arguably, the backbone of observational physical oceanography in Canada remains the government laboratories operated by Fisheries and Oceans Canada (DFO). These labs have a mission that attempts to balance efforts in environmental monitoring with directed research. The Bedford Institute of Oceanography (BIO), St. Andrews Biological Station, Maurice Lamontagne Institute and the Northwest Atlantic Fisheries Centre have well-established long-term monitoring programs both on and off the continental shelves of the Northwest Atlantic. The Institute of Ocean Sciences (IOS) maintains the Station Papa time series, monitoring of the Strait of Georgia, and the west coast of Vancouver Island. Work regularly takes place by Arctic groups from BIO, IOS, and the Freshwater Institute Science Laboratory on the Coast Guard icebreakers. These efforts are complemented through academia with platforms such as the CCGS Amundsen, which focuses on Arctic research.

The successes of previous years point towards challenges for the future. Firstly, CFCAS is no longer being funded by the federal government. This is a major loss for physical oceanographers, as our efforts do not always fit in well with multidisciplinary programs and networks, and CFCAS was a good way to keep small independent efforts funded. Secondly, federal spending is restrained and this has and will continue to have impact on federal laboratories. Third, shiptime for government and academia will continue to be constrained by the availability of platforms.

Academia can possibly take up some of this slack, and perhaps universities are an appropriate place for basic research to be carried out. However, it is quite difficult to get adequate funding from NSERC for field-going programs without assembling something on the scale of a Network Centre of Excellence. We would argue more medium-scale funding needs to be made available, and the unique nature of seagoing research needs to be argued for vigorously if Canada is to remain internationally relevant in oceanography.

These challenges are mitigated by many advances that are being made in physical oceanography that Canadian scientists can take advantage of. Autonomous instruments are becoming cheaper and much more flexible. Canada already plays an important role in the Argo profiling float program. We are

starting to gain expertise in gliders and other floats. Improvements in battery technology and data telemetry via Iridium satellites makes collecting comprehensive data sets with these instruments possible for a fraction of the cost of using a ship. Of course, in the meantime improved numerical models and laboratory experiments will continue to guide our understanding of physical oceanography.

In summary, the document we assembled is perhaps idiosyncratic in scope, but it highlights the comprehensive work being done by Canadian oceanographers. Assembling these reports is a significant effort, and we would be interested in ideas as to how to improve it in the future. In particular, as we argue for our science to our funding agencies, it would really help to indicate what investments pay off in terms of impact on the scientific community. Future efforts will be directed towards assembling those metrics, but based on this effort we suspect Canada is getting a phenomenal return for its investment in our research, and further renewal and investment is necessary to keep the discipline alive and healthy.

Rapport 2007-2010 de l'IAPSO : Quatre années d'océanographie physique au Canada

Soumis par Blair Greenan¹ et Jody Klymak²

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Au cours des années 2007 à 2010, le domaine de l'océanographie physique s'est révélé extrêmement productif, comme le démontre la publication de 750 articles révisés par les pairs, rédigés par plus de 600 chercheurs différents provenant de 111 organisations, départements ou entreprises de partout au pays. Ces réalisations figurent dans le rapport de 2011 de l'Association internationale des sciences physiques appliquées à l'océan (IAPSO). Blair Greenan et Jody Klymak les ont compilées avec l'aide de Tineke van der Baaren. Trois éléments constituent ce rapport : une bibliographie comprenant les résumés complets, une liste alphabétique de la bibliographie et une liste des organisations et des chercheurs canadiens. Ces documents sont accessibles sur le site Web du Comité national canadien pour le Comité scientifique de la recherche océanique (CNC/CSRO) à l'adresse <http://www.cmos.ca/scor/scorindexf.html>. La bibliographie est aussi accessible sur le site de Mendeley à l'adresse <http://www.mendeley.com/groups/1305293/canadian-iapso-2007-2010/>.

Les critères suivants ont guidé à la compilation du rapport :

- Les publications canadiennes sont celles publiées par les chercheurs d'organisations canadiennes, comme les universités et les laboratoires gouvernementaux. Elles n'incluent pas les articles rédigés par des chercheurs canadiens qui travaillent pour des organismes à l'extérieur du Canada.
- Ce sondage ne porte que sur les articles évalués par les pairs (et exclut les rapports techniques, la communication de données, les livres blancs, etc.).
- La période du sondage s'étend du 1er janvier 2007 au 31 décembre 2010.

Le rapport contient une bibliographie divisée en catégories, où figurent des résumés provenant de scientifiques canadiens menant des recherches en océanographie physique. Les sujets, qui font l'objet d'une contribution canadienne, couvrent tous les océans de la planète et comprennent l'observation des

océans à toutes les échelles, les études en laboratoire, les études numériques et les travaux théoriques. La liste des articles démontre sans équivoque qu'on fait appel aux Canadiens pour de nombreuses collaborations internationales et pour traiter de problèmes d'importance nationale. De plus, l'incidence de la formation universitaire sur les articles est évidente. Plusieurs des 600 chercheurs mentionnés ci-dessous étaient des étudiants quand ils ont écrit les articles cités.

Le rapport emploie une définition intentionnellement large de « science physique des océans » et inclut des articles sur le climat et sur la circulation atmosphérique, ainsi qu'un nombre considérable d'articles sur la chimie des océans. Nous espérons n'offusquer personne, que leurs travaux soient inclus ou non. Il est bien sûr possible que nous ayons omis par erreur quelques publications. En ce sens, nous encourageons les parties intéressées à nous transmettre leurs commentaires.

Les données présentées ci-dessus représentent un corpus de recherche remarquable pour une période de seulement quatre ans. Il convient donc de souligner la provenance du financement de ces programmes :

- Premièrement, et des plus notables, il s'agit de la période au cours de laquelle la Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA) a obtenu un financement stable. Ce qui a permis de financer des étudiants postdoctoraux, et de 2e et 3e cycles, ainsi que des techniciens, qui ont rendu possibles plusieurs de ces articles.
- Cette période englobe aussi la première série d'articles relatifs à l'Année polaire internationale (2007-2008). Au cours de ces années, les spécialistes en océanographie physique ont participé au projet C3O (mission de recherche sur les trois océans du Canada), à l'Étude sur le chenal de séparation circumpolaire, ainsi qu'aux activités liées aux modifications du climat et de la glace. Ces activités ont fait l'objet d'une édition spéciale d'*Atmosphere-Ocean*.
- Le Programme de subventions à la découverte du CRSNG est demeuré une source importante de financement pour les universités et a appuyé différents programmes dans divers domaines.
- Le financement de la recherche dans les laboratoires du gouvernement fédéral est assuré par les services votés et les affectations ciblées issues de programmes comme le Programme d'initiatives gouvernementales en observation de la Terre (IGOT) de l'Agence spatiale canadienne (ASC), et le Programme de recherche et de développement énergétiques (PRDE).

De toute évidence, les laboratoires gouvernementaux exploités par Pêches et Océans Canada demeurent le pivot de l'observation en océanographie physique au Canada. Ces laboratoires s'efforcent de par leur mandat à trouver un équilibre entre la surveillance environnementale et la recherche dirigée. L'Institut océanographique de Bedford (IOB), la station biologique de St. Andrews, l'Institut Maurice-Lamontagne et le Centre des pêches de l'Atlantique nord-ouest gèrent des programmes bien établis de surveillance à longue échéance, sur les plateaux continentaux de l'Atlantique Nord-Ouest et au-delà. L'Institut des sciences de la mer (ISM) est responsable de la série temporelle de la station Papa, ainsi que de la surveillance du détroit de Géorgie et de la côte ouest de l'île de Vancouver. Les groupes d'étude de l'Arctique provenant de l'IOB, de l'ISM et du laboratoire scientifique de l'Institut des eaux douces entreprennent régulièrement des travaux à partir des brise-glaces de la Garde côtière

canadienne. Le milieu universitaire complète ces activités à l'aide de plateformes comme le NGCC *Amundsen*, qui participe à la recherche sur l'Arctique.

Les réussites des années passées pointent vers les défis des années à venir. Premièrement, le gouvernement fédéral ne finance plus la FCSCA. Ce qui représente une perte majeure pour les spécialistes en océanographie physique, puisque nos activités ne s'insèrent pas toujours très bien dans les programmes et les réseaux pluridisciplinaires. La FCSCA s'avérait une bonne façon de financer les petits projets indépendants. Deuxièmement, le gouvernement fédéral limite ses dépenses. Ce qui a déjà, et aura dans l'avenir, une incidence sur les laboratoires fédéraux. Troisièmement, la disponibilité des plateformes continue de restreindre le temps-navire mis à la disposition des chercheurs gouvernementaux et universitaires.

Le milieu universitaire pourrait combler partiellement le vide et peut-être que les universités représentent l'endroit adéquat pour mener la recherche de base. Toutefois, il est très difficile de recevoir un financement adéquat du CRSNG pour les programmes sur le terrain, à moins de mettre sur pied des projets de l'ordre de ceux des Réseaux de centres d'excellence. Nous sommes d'avis que du financement à moyenne échelle devrait être offert. La nature unique de la recherche en mer doit être défendue vigoureusement si le Canada souhaite maintenir sa pertinence internationale en océanographie.

Les progrès continus qu'on accomplit en océanographie physique, et dont les scientifiques canadiens peuvent tirer profit, atténuent ces problèmes. Les instruments autonomes sont maintenant polyvalents et leurs coûts baissent de plus en plus. Le Canada joue déjà un rôle important dans le programme de flotteurs profilants Argo. Notre expertise en matière de planeurs océaniques et d'autres flotteurs augmente de plus en plus. L'amélioration de la technologie relative aux accumulateurs et la télémétrie à l'aide des satellites d'Iridium permettent une collecte de données exhaustive, à une fraction des coûts d'utilisation d'un navire. Bien entendu, les modèles numériques améliorés et les expériences en laboratoires continueront de guider notre compréhension de l'océanographie physique.

En résumé, le document que nous avons assemblé peut sembler de portée particulière, mais il met en lumière les travaux exhaustifs qu'effectuent les océanographes canadiens. L'assemblage de ces rapports a demandé un effort considérable et nous souhaitons recevoir vos commentaires sur la manière de l'améliorer dans le futur. Notamment, en ce qui a trait à la justification des fonds destinés à notre science et offerts par les organismes de financement. Il serait utile de savoir quels investissements s'avèrent les plus profitables, en ce qui concerne leurs impacts sur la communauté scientifique. Les tâches à venir porteront sur le regroupement de ces données, mais nous soupçonnons que le Canada retire un profit phénoménal de ses investissements dans notre recherche. La reconduction de subventions et l'affectation de nouveaux fonds apparaissent nécessaires à la survie et à la santé de notre discipline.

Call for New Working Group Proposals

A reminder that SCOR is seeking proposals for new working groups ([click](#)). SCOR encourages proposals from groups of scientists who desire an international approach to advance their area of ocean science. Proposals are due by **15 April 2012** and proposals received by this date will be posted on the SCOR Web site for review. National SCOR Committees rank the proposals according to criteria given in the call for proposals and decisions

will be made at the General Meeting regarding which proposals will be funded. SCOR also welcomes review comments from anyone in the worldwide ocean science community.

Sufficient funding should be available to support two new working groups to start in 2013. SCOR working groups are an important mechanism for the ocean science community to identify and advance important ocean science issues. SCOR does not fund the associated research but does fund expenses such as travel connected with coordination. Canadian scientists are asked kindly to consult with the Chair of CNC-SCOR if considering participation.

Update on SCOR/InterRidge WG 135

WG 135 on Hydrothermal Energy Transfer and its Impact on the Ocean Carbon Cycles met in Hangzhou, China on 10-11 October 2012. Meeting participants worked on two modeling and synthesis papers that will present conceptual models for carbon cycling at the ocean-crust interface and in hydrothermal plumes. The group plans to hold a final meeting and workshop later this year. There is no Canadian member on this WG.

Update on SCOR WG 139

WG 139 on Organic Ligands – A Key Control on Trace Metal Biogeochemistry in the Ocean met for the first time in Salt Lake City, Utah, USA on 25 February 2012. Bioactive metals are important at all levels of oceanic food chain, in terms of availability of trace metals for organismal growth (e.g., iron) or sequestration of toxic trace metals (e.g., copper). In this way, ligands play an important—yet poorly quantified—role in the global carbon cycle and climate. A better understanding of the role of ligands in the global carbon cycle is necessary for specifying model parameters correctly. On a more basic level, ligands control the global cycles of trace elements by their effects on solubility and residence time of the metals in seawater. The working group discussed actions needed to develop a database of the experimental results from ligand titrations and measurements in the ocean (including on GEOTRACES sections), the need for additional intercalibrations and development of more-standardized methods, how to create an online resource of best practices, and how to extend the study of ligands to developing countries. The group will submit a report from its first meeting to *EOS*. Jay Cullen (UVic; [click](#)) is the Canadian member of this WG.

MEETINGS

GEOHAB Open Science Meeting, 29-31 May, Victoria BC

Registration is open for the second Open Science Meeting of the Core Research Project on HABs in Fjords and Coastal Embayments. The meeting will focus on four themes: (1) Life history of HAB species; (2) Allelochemical interactions; (3) Genetic diversity and (4) Transport and mixing of blooms in small-scale, mesoscale and semi-confined systems ([click](#)).

The aim of the meeting is to highlight recent progress in evaluating the processes and mechanisms involved in HAB dynamics, notably with respect to genetic diversity, life history of key harmful species, allelochemical and toxic interactions affecting HAB populations, and the importance of coastal morphology, hydrodynamics and associated physical retention or dispersion of cells within the coastal zone. Special attention will be devoted to

the comparative approach among sites where HABs occur, since this is a focus of the international GEOHAB program.

GEOHAB is also sponsoring a workshop on “Advances and Challenges for understanding physical-biological interactions in HABs in stratified environments” in Monterey, California, on 21-23 August, 2012.

PERSONNEL

Bernie Boudreau



In a ceremony on 26 November in Ottawa, Bernie Boudreau (Dalhousie University) was welcomed a fellow of the Royal Society of Canada. Bernie is well recognized for his outstanding contributions to the modeling of chemical, biological and physical processes in sediments and in the bottom boundary layer. A large number of his papers are widely cited and his book *Diagenetic Models* is considered a classic on the topic. Bernie has contributed extensively to the understanding of the pH of marine waters, the mixing of sediments by organisms, the formation and movement

of free gas in near-surface sediments and the effects of the boundary layer on chemical exchange between sediments and the overlying waters.

Bernie is currently the Dean of Graduate Studies at Dalhousie University and holds a Faculty of Science Killam Professorship. He received a BSc (Honors) in Geology from UNB, a Master’s degree in Oceanography from Texas A&M, and a PhD in Geology and Geophysics from Yale University. He was our CNC/SCOR speaker (west bound) in 2009.

Dick Peltier



University of Toronto professor Dick Peltier has been awarded NSERC’s highest honour, the Gerhard Herzberg Medal for 2011. The medal, which comes with \$1 million in funding over five years, is named for Canadian Nobel Laureate Gerhard Herzberg and awarded annually for outstanding and sustained contributions to Canadian research in natural sciences and engineering. It is widely considered the most prestigious award a natural scientist or engineer can win.

Early in his research career, Peltier recognised the strong interrelationship between land-surface processes, continental ice sheets, sea ice, and the circulations of the oceans and atmosphere. Using sophisticated mathematical concepts, he builds models that depict how climate has evolved over the past 750 million years and project how it will change in the future. His research on ice-age climate variability is considered the gold standard for scholarship on past climate change. The Herzberg Medal is the latest in a long line of honours for Peltier, which includes the 2002 Vetlesen Prize (often called the Nobel of earth sciences) and the 2010 Bower Award.

JOBS & TRAINING

No Canadian vacancies have been offered or located. International oceanographic opportunities are posted on the CMOS site ([click](#)).

Looking for work? Try the CMOS site ([click](#))

GENERAL

Towards a More Comprehensive Database for Biodiversity

With the end of the Census of Marine Life program in 2010, the International Ocean Biogeographic Information System (OBIS) joined the International Oceanographic Data and Information Exchange programme (IODE). Historically the IODE focused on delayed mode physical oceanographic data but its scope has broadened over the years and, in 2001, a group of experts (GE-BICH) was formed to address issues related to biological and chemical data management and exchange practices. The inclusion of OBIS within the IODE is helping to facilitate marine biodiversity research within member countries. It will also facilitate access to a standardized view of the marine biogeographical content stored in the various national oceanographic data centres and mobilize other sources of information within the international community.

Canadians are participating in the Global Biodiversity Information Facility (GBIF) through national and international networks and initiatives, each with its own purpose, governance and funding. Although the Canadian Biodiversity Information Facility (CBIF; [click](#)) has a formal representative role in GBIF, a centralized top down approach does not work well in the Canadian context. A mechanism to keep in touch and regularly discuss strategic, technical and logistic issues related to the Canadian participation in GBIF is required to coordinate efforts and minimize overlap where possible.

Since November 2011, a group of interested individuals gather informally once a month for a one-hour conference call. The group currently includes participants from CBIF, Canadensys, NatureServe Canada, OBIS Canada, Birds Studies Canada, and the international Barcode of Life (iBOL) project and is open to additional participation. There is a similar larger group taking shape at the North American scale – this will be comprised of interested individuals from several of the GBIF Participants organizations headquartered in Canada and United States (including OBIS Canada). The next gathering will be a joint conference phone call with US participants. Further information can be obtained from Guy Baillargeon ([click](#)). A short report from OBIS Canada was included in the December, 2010 newsletter, COSN/BCSO # 54 ([click](#)).

Nouveau livre sur les pigments

Suzanne Roy, professeure à l'UQAR-ISMER et membre titulaire de Québec-Océan, est coéditrice du nouveau livre « Phytoplankton Pigments – Characterization, Chemotaxonomy and Applications in Oceanography » ([cliquer](#)). Ce recueil de textes scientifiques écrits par les plus grands spécialistes

New Book on Phytoplankton Pigments

Suzanne Roy a professor at UQAR-ISMER and a member of Québec-Océan, has co-edited the new book *Phytoplankton Pigment -- Characterization, Chemotaxonomy and Applications in Oceanography* ([click](#)). This expert compilation includes up-to-date knowledge of algal pigments, the biosynthesis of

de la pigmentation algale présente les connaissances les plus récentes sur les nouveaux pigments, les nouveaux groupes d'algues, la biosynthèse des chlorophylles et des caroténoïdes, les phycobiliprotéines, les plus récentes méthodes analytiques et les méthodes de traitement des données (chémotaxonomie). Les applications de ces nouvelles connaissances sont également détaillées : photoprotection, marquage radioactif des pigments, télédétection et monitoring côtier, notamment pour le suivi des algues nuisibles. Ce livre est publié grâce à la contribution du Comité Scientifique pour les recherches océaniques (SCOR).

chlorophyll and carotenoids, phycobiliproteins, and the most recent methods for analysis and the application of data to chemotaxonomy. The book also includes a detailed treatment of photoprotection, radioactive markers, and the use of remote sensing to track harmful algal blooms in the coastal zone. The book will be a valuable reference for students, researchers and professionals in aquatic science, biogeochemistry and remote sensing. Its publication was supported by SCOR.

CANADIAN OCEAN SCIENCE NEWSLETTER

LE BULLETIN CANADIEN DES SCIENCES DE L'OcéAN

Previous newsletters may be found on the CNC/SCOR web site.
Les bulletins antérieurs se retrouvent sur le site web du CNC/SCOR.

Newsletter #64 will be distributed on April 27, 2012. Please send contributions to Bob Wilson, wilson@telus.net
Bulletin #64 sera distribué le 27 avril 2012. Veuillez faire parvenir vos contributions à Bob Wilson, wilson@telus.net

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