

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

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Project Argo - Recent Developments

Report by Howard Freeland and Bob Keeley, FreelandHj@pac.dfo-mpo.gc.ca and keeley@meds-sdmm.dfo-mpo.gc.ca

Project Argo is a multi-national endeavour aimed at instrumenting the oceans of the world to monitor the changing ocean climate. Ultimately we aim to deploy 3000 robotic devices, evenly distributed throughout the global oceans, to report the temperature and salinity structure from a depth of 2000 metres to the surface every 10 days. The data are intended to be reported in near real-time, which we define to mean, “the data are available to any user within 24 hours”.

Recently Argo crossed one milestone with over 1000 floats reporting, one third of the way to our global target. As I write there are 1024 floats presently reporting and these were deployed by scientists from 18 nations. More importantly, there are now enough floats in the ocean that it is possible to map climate properties of substantial regions of the ocean. Argo now supplies more profiles per month that does the global XBT system. Here are a few examples that will serve to show how Argo will quickly dominate our view of the climatic state of the ocean:-

- 1) In September 2003 2259 XBT profiles were reported. These observe temperature to $\pm 0.1^{\circ}\text{C}$ and compute depth (most to 760m) from the expected fall rate of the instrument. In the same month Argo reported 2868 profiles. These included both temperature (to better than $\pm 0.01^{\circ}\text{C}$) and salinity (to better than ± 0.01 psu) from SeaBird CTDs and include directly observed pressure (most from 0-2000m). A few floats use FSI sensors.
- 2) By 2006 we anticipate that Argo will be supplying almost 10,000 profiles per month.
- 3) It has been estimated that when Argo is fully implemented it will gather more climate data in the southern ocean in one year than has been gathered by all previous research missions to that ocean.

The deployment of floats is continuing rapidly and the majority of data really are available in near real-time, we estimate that about 75% meet the 24-hour criterion and the trend is towards higher percentages meeting the 24 hour target.

In November 2003 the Argo Data Management Committee met in Monterey, California. To this point Bob Keeley from MEDS (Ottawa) has been a co-chairman of the international committee and he took this opportunity (he has Argo working now) to retire as co-chairman and hand over to Mark Ignasiewicz of the US Naval PostGraduate School. Bob continues to work in support of Canada's contributions to Argo. Howard would like to take this opportunity to thank Bob for his contributions to Argo.

Following the Data Management meeting the First Argo Science Workshop took place in Tokyo and was attended by scientists from 22 nations. Many papers were presented and we can only touch on a few here. Highlights were discussions of progress towards integrating Argo into a new generation of Ocean Data Assimilation Models. Prominent among these are the FOAM model (FOAM = Forecasting Ocean Assimilation Model) run from the UK Met Office, and a model being developed at JAMSTEC. The JAMSTEC model is a full 4D-Var model aimed at describing the Pacific Ocean, whereas FOAM involves a series of nested models, 1° global, to

1/3° Atlantic model, to 1/9° North Atlantic models. In a separate discussion Yves Le Traon reported that GODAE is now totally focussed on the assimilation of Argo data.

The assimilation experience not only absorbs and uses Argo data, it also points out problems in the design of the Argo array. Several papers supplied comments resulting from assimilation that were critical of various aspects of the Argo array design. For example, sensitivity tests suggest that the sampling in the Indian Ocean needs to be finer than the Argo design. There were also several papers critical of the so-called PnP sampling scheme used by a few Argo float deployers.

A review of the impact of Argo on climate research was presented by Dr Kimio Hanawa. A paper by Dean Roemmich showed how in isolated regions of the ocean we can now compute the surface heat fluxes (from ECMRWF re-analyses), heat storage (from Argo profiles) and heat transport (from Argo profiles and velocity estimates). Further, any two of those variables can be used to estimate the third so allowing accurate error control. Several papers focussed on our novel ability to monitor mixed-layer evolution and variability frequently and anywhere in the non-ice-covered oceans.

The PowerPoint displays from the Argo Science Workshop are all available at the web site: <http://www.argo.ucsd.edu/> The current distribution of floats around the world, colour coded by the country that supplied each float is available at: <http://argo.jcommops.org/> Experience with mapping properties observed by the Argo array varies around the world, but one attempt to use Argo to describe the monthly evolution of the Gulf of Alaska can be seen at: http://www.pac.dfo-mpo.gc.ca/sci/osap/projects/argo/Gak_e.htm Those wishing for a novel display of the current distribution of Argo floats can download an icosahedral net that can be cut out, folded and assembled into a pseudo-globe. http://www.pac.dfo-mpo.gc.ca/sci/osap/projects/argo/documents/Argo_icos.pdf Finally, a moving gif image gives another view of the current distribution of floats. <http://www.pac.dfo-mpo.gc.ca/sci/osap/projects/argo/graphics.htm> Canada's contributions to Argo can be seen at http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/argo/ArgoHome_e.html Should you wish to use Argo, please do so. Argo maintains a complete "open data policy". The data are yours, use them. If you want help accessing Argo data then feel free to contact Howard Freeland.

The Canadian RADARSAT-1 Program

Report by Howard Edel, howard.edel@rogers.com

The RADARSAT-1 is the first satellite Canada launched in December 1994 which continues to operate in 2004. It was specifically designed for monitoring the Canadian oceans areas in all weather and day/night conditions with the Synthetic Aperture Radar (SAR) sensor. The polar orbit of RADARSAT-1 and modern WEB based electronic communications has enabled Radarsat International Inc. to provide commercial global ocean and coastal monitoring and information services to a growing international user community benefiting from satellite acquired marine environmental information. Based on the success and experience of the RADARSAT-1 Program Canadian industry and the Canadian Space Agency are implementing the RADARSAT-2 system to be launched in 2005 to provide continuity of SAR data for monitoring the marine environment.

The Canadian Space Agency and the Atlantic Canada Remote Sensing Organization are preparing a special issue of the "Backscatter" magazine focused on the Canadian RADARSAT-1 Program to be published in early 2004. This special issue of Backscatter contains several articles outlining the background, development, implementation and user applications of the RADARSAT-1 satellite. The RADARSAT-1 satellite system has demonstrated the unique capability of the SAR sensor for monitoring the marine environmental conditions of ice, waves, winds and human activities including spills, fishing activity and coastal infrastructure development. The Canadian Space Agency is committed to continuing supporting the development of satellite systems for monitoring the oceans and coastal zones of the world through collaboration with the ESA (Europe), NASA (USA) and NASDA (Japan) in planning the Global Ocean Observing System.

The Quest magazine published by the University of Wisconsin will also contain an article on the Canadian RADARSAT-1 Program authored by Howard Edel formerly Senior Marine Remote Sensing Officer at the Department of Fisheries and Oceans and William Jefferies Operations Manager at the Radarsat International Inc.. The article in Quest addresses the development of commercial RADARSAT-1 marine information services.

Monitoring and modelling the oceanographic fluxes passing through the Canadian Arctic Archipelago

Report by Simon Prinsenbergs, prinsenbergs@dfp-mpo.gc.ca

As part of the Arctic, Sub-Arctic Ocean Flux (ASOF) and the Study of Environmental Arctic Change (SEARCH) programs, a research project consisting of instrumentation development, modelling and mooring work has since 1998 monitored the oceanographic fluxes passing through Lancaster Sound. It is one of the three main pathways through the Canadian Arctic Archipelago (CAA). To contribute to these international programs, the project's aim is to better understand the variability of the oceanographic and pack ice heat and freshwater fluxes passing through the CAA. And furthermore to better understand their importance to the heat and freshwater budgets of the Arctic Ocean itself, to the circulation and vertical ventilation of the North Atlantic, and to the global meridional overturning circulation (MOC). The project known as CATS-BIO, Canadian Archipelago Through-flow Study at Bedford Inst. of Oceanography has contributing international partners, UW, Peter Rhines with sea surface slope measurements and NPS, Wieslaw Masloski with large scale numerical simulations.

Finite numerical models have successfully simulated the tides within the CAA and the yearly mean fluxes through the entire CAA as a function of Sea surface slopes. Instrumentation have been developed to measure current direction of ADCPs moored in the low horizontal magnetic field strength and have been implemented in Lancaster Sound moorings. Developments are continuing on the ocean surface layer profiler for deployment in regions where a mobile ice cover exists such as exists in the CAA. A prototype successfully returned daily profiles back from a year-long deployment although the sampling depth range was small due to a software glitch; this was corrected in the field and the prototype re-deployed for another year.

The first three years of time series data from August 1998 to August 2001 of the salinity, temperature and velocity fields have been processed and used to derive estimates of the volume, freshwater and heat fluxes passing through the Lancaster Sound. The fluxes exhibit large seasonal and inter-annual variabilities, they are small in fall/winter and reach their maximum in late summer. The seasonal volume flux estimate ranges from a fall low of -0.01Sv in 1998 to a summer max of 1.3Sv in 2000. It has a 3-year mean of 0.75Sv and varies inter-annually by ± 0.25 Sv. Freshwater flux estimates vary similarly with minimum values in winter and maximum values in late summer. They are generally 1/15 of the volume flux; but may be underestimated as their surface freshwater content is based on data from CTD sensors at 25-30m depth. The pack ice contribution to the freshwater flux is small as most of the year the pack ice has been land-fast; it accounts for less than 5% of the freshwater flux when spread over the entire year. Model simulations with finite element model and with other Arctic models indicate that fluxes through Lancaster Sound make up 40-50% of the fluxes through the Canadian Archipelago. This indicates that the volume flux through the Archipelago would be of the order of 1.5 to 2.05Sv similar to present literature values and could vary in summer by ± 0.25 Sv due to the seasonal variability seen in Lancaster Sound.

Further information on the Archipelago project's instrumentation, modelling, mooring data analysis work and publications can be found on the DFO's web-site: <http://www.mar.dfo-mpo.gc.ca/science/ocean/seaice/public.html>

Oceanography at CMOS Congress

Report by Paul Myers, myers@wessex.eas.ualberta.ca

The 38th Congress of the Canadian Meteorological and Oceanographic Society is to be held in Edmonton, 31 May 2004 to 03 June 2004. Despite Edmonton's inland prairie location, the congress Science Program Committee would like to ensure there is a good turnout from the Canadian oceanographic community, with a number of special sessions planned that should be of broad interest. The Fluid Mechanics/Oceanography group here at the University of Alberta (Andy Bush, Paul Myers, Bruce Sutherland and Gordon Swaters) echo this sentiment and call on the Canadian oceanographic and fluids research communities to attend CMOS 2004 and make this a good "wet" conference.

The theme of this year's congress is "The Human Dimensions of Weather and Climate", with a goal to integrate research done on all aspects of the climate system (including the ocean) and relate that to the people impacted. A number of overarching sub-themes have also been identified, several with an oceanographic focus. The "Northern Oceans (Arctic, Atlantic and Pacific) and Their Linkages" theme will examine, through contributed papers, each of these three important oceans that bound Canada, and the linkages between them. Talks on sea ice, air-sea and air-sea-ice interactions are also encouraged. The second congress sub-theme that has a strong oceanographic connection is one on "New Technologies". Within this sub-theme, special sections will be held on Towards Ocean Nowcasting/Forecasting and Unstructured Grid Modelling.

The congress SPC is proud to announce that we have two excellent plenary speakers confirmed for the congress to support the two above themes. From the Institute of Ocean Sciences, Eddy Carmack will speak on the Arctic Ocean and its linkages to other basins. From Rutgers University in the US, Dale Haidvogel will speak on recent developments in ocean models and modelling.

Additional sessions on the climate carbon connection (measurement and modelling of the past and present), data assimilation, operational oceanography, air-sea interactions and waves, the cryosphere and climate and geophysical fluid dynamics are also going forward.

So I conclude again with a call to the Canadian Oceanographic community to attend CMOS 2004 in Edmonton and make this one of the best CMOS congresses yet!

Defining the first Canadian Antarctic Research Program (CARP)

Report by Émilien Pelletier, emilien_pelletier@uqar.qc.ca

The Canadian Committee for Antarctic Research (CCAR) held a two-day workshop in last September at the University of Alberta with the objective to initiate the development of a Canadian Antarctic Research Program (CARP). The workshop brought together 56 enthusiastic scientists from 7 countries including 45 Canadian polar experts and graduate students.

The following research themes were identified as areas where Canadians have outstanding expertise and that could form the basis of the CARP:

1. Presence, effects and remediation of contaminants in high latitudes.
2. Life cycling in extreme environments using biotechnology and genomic tools.
3. Global changes and paleoclimatic research in icy oceans.
4. Subglacial lakes exploration, including search for lifeforms.
5. Cold ocean dynamics, ecology and biogeochemical processes.
6. Atmospheric chemistry and upper atmospheric physics.

The workshop also included a special session discussing the upcoming International Polar Year (IPY) and suggesting the deployment of a Canadian icebreaker in the Antarctic field season of 2007-08.

A final report of the workshop will be available in a near future on the web site of the Canadian Polar Commission (<http://www.polarcom.gc.ca/>). The CCAR aims to formulate its first Canadian Antarctic Research Program and proposes it to the Canadian authorities before the end of 2004.

Définir le premier Programme canadien des recherches antarctiques (PCRA)

Rapport par Émilien Pelletier, emilien_pelletier@uqar.qc.ca

Le Comité canadien de recherches antarctiques (CCRA) a tenu un atelier de deux jours en septembre dernier à l'Université d'Alberta dans le but d'initier le développement du Programme

canadien des recherches antarctiques (PCRA). L'atelier a réuni 56 scientifiques enthousiastes provenant de 7 pays dont environ 45 experts polaires et étudiants canadiens.

Les thèmes de recherche suivants furent identifiés comme les secteurs où les canadiens ont une expertise exceptionnelle et qui peuvent constituer la base du PCRA :

- Présence, effets et remediation des contaminants en hautes latitudes.
- Cycles vitaux dans les environnements extrêmes utilisant des outils biotechnologiques.
- Changements globaux et recherche paléoclimatique dans les océans glacés.
- Exploration des lacs glaciaux, incluant la recherche de formes de vie.
- Dynamique des océans froids, processus écologique et biogéochimique.
- Chimie atmosphérique et physique du haut atmosphère.

L'atelier a inclus une session spéciale pour discuter l'année internationale polaire (AIP) et suggérer le déploiement d'un brise-glace canadien en zone antarctique pendant la saison 2007-08.

Un rapport final de cet atelier sera bientôt disponible sur le site Internet de la commission polaire canadienne (<http://www.polarcom.gc.ca/>). Le CCRA entend formuler son premier Programme canadien de recherches antarctiques et le proposer aux autorités canadiennes avant la fin de l'année 2004.

CMOS Awards

It is time to think about nominations for oceanographers for selected; the deadline is February 13, 2004. See <http://www.cmos.ca/prizese.html> for details on the various awards and the "call" for nominations for this year. In some years CMOS awards, for eligible ocean scientists, have not had any nominations; e.g. the Tully Medal, and the Prize in Applied Oceanography. A list of past winners is also listed on the aforementioned web site. Oceanographic nominations are also encouraged for The President's Prize. The ocean science community should consider appropriate nominations for this year. Peer recognition is very much appreciated, and a little competition for such awards is very healthy. Any such submissions should be made by the nominator, directly to CMOS; e.g. not via CNC/SCOR.

New Offshore Oil & Gas Research Web Site

Report by Rosalie Allen Jarvis, AllenJarvisR@mar.dfo-mpo.gc.ca

Fisheries and Oceans Canada (DFO) is pleased to announce the creation of a new web site dedicated to Canadian offshore oil and gas environmental research. The Centre for Offshore Oil and Gas Environmental Research (COOGER) was established by DFO in November 2002 to coordinate the department's nation-wide research into environmental and oceanographic impacts of offshore petroleum exploration, production and transportation. The new web sites provides terms of reference and more than 20 related scientific project descriptions. Please visit the COOGER web site at: www.dfo-mpo.gc.ca/science/cooger-crepge/

Canada Ratifies Protocol on Environmental Protection to the Antarctic Treaty

Report by Olav Loken, oloken@sympatico.ca

Bill C-42, the *Antarctic Environmental Protection Act* (AEPA) and related regulations entered into force on December 01, 2003. It provides the Government with the legislation necessary to implement the requirements of the Environmental Protocol (also known as the Madrid Protocol) i.e. to oversee the activities of Canadian nationals in the Antarctic. This allowed the Government of Canada to ratify the Environmental Protocol, which applies to areas south of 60°S. Said Foreign Affairs Minister Bill Graham, who joined Environment Minister David Anderson in announcing the ratification: "The Government of Canada is living up to its international commitment to protect the Antarctic environment..."

Effective December 01, 2003, participants in Canadian expeditions and tours, and those operating Canadian aircraft and vessels are required to apply for, and receive, a permit to be in the Antarctic, except where another party to the Environmental Protocol has approved the activity or in the case of an emergency. Regulations include requirements for environmental assessment of all plans, compliance with rules to prevent marine pollution, proper waste management procedures, requirement to obtain permits to collect samples and to enter an Antarctic Specially Protected Area. According to AEPA a tour operator or a scientific expedition leader can apply for permits on behalf of others in the group.

Environment Canada administers the AEPA. Visit their web-site for an overview of the act and how it protects the Antarctic environment.

http://www.ec.gc.ca/international/regorgs/antarctic/1antarctic_e.htm

Meteorological and Oceanographic Private Sector Directory

The meteorological and oceanographic private sector is expanding and diversifying. In an effort to assist consumers with the selection of suppliers, the Canadian Meteorological and Oceanographic Society (CMOS) has developed a directory of businesses and consultants that specialize in the provision of meteorological and oceanographic services in Canada.

The directory provides potential customers with background information about an extensive list of companies and consultants. They have expertise in a vast number of specialties and services in meteorology, hydrology, hydrometry, oceanography and limnology. Areas of specialization are listed on the directory web pages. The directory is located at

<http://www.cmos.ca/PrivateSector/indexe.html>

This searchable database is used as a referral list by Environment Canada's Meteorological Service of Canada and by Fisheries and Oceans Canada. For further information please contact Susan Woodbury, Chair of the CMOS Private Sector Committee at psc@cmos.ca or (902) 468-3007 ext. 232. Ottawa Contact: Lise Harvey (613) 825-6992, lise.harvey@sympatico.ca

International News

The Canadian Ocean Science Newsletter has focused on (i) Canadian news, and (ii) international news with a direct Canadian involvement. However other international ocean science news comes across our email routes that may also be of interest to Canadian readers – these are posted on our web site at www.cncscor.ca under “International News”. Please let us know of any items of this nature and we will post them at that location for the benefit of others. Items posted in January 2004 include:

- Colin P Summerhayes Appointed SCAR Executive Director
- The Ocean in a High CO₂ World
- Ocean Sciences at the European Geosciences Union (EGU)
- GEOHAB Open Science Meeting on Harmful Algal Blooms in Fjords and Coastal Embayments

Atlantic Coastal Zone Information Steering Committee (ACZISC)

The January 2004 issue of the ACZISC COASTAL UPDATE, as well as previous issues, may be found at: <http://www.dal.ca/aczisc/new>. The ACZISC was formed in 1992 to help establish a coastal zone information infrastructure in Atlantic Canada as a precursor to integrated coastal management. The January 2004 issue contains information on: upcoming ACZISC meetings; best management practices for seafood processing plants; geoscience for ocean management workshop; CHS nautical charts and the copyright act; call for papers - Coastal Zone Canada 2004; proceedings of the 2003 Canadian Coastal Conference; property rights resolution vital to aquaculture; global assessment of organic contaminants in farmed salmon; at a crossroads: will aquaculture fulfill the promise of the blue revolution?; invasive species in North America; a new analysis of marine-related activities in the UK economy; coastal defence and the historic environment; Europe's recovery plan for cod and hake; WHO guidelines for safe recreational water environments; conference and workshop proceedings; deadlines; and, upcoming conferences and other events.

The Sangster Award

CNC/CODATA Student Award, Deadline for Applications: March 31st, 2004

The Canadian National Committee for CODATA (CNC/CODATA) will award a maximum of CAN \$3000 to cover costs associated with the oral presentation or poster presentation of the award winner's work and their attendance at the biannual International CODATA.

The intended recipients of the award are graduate students enrolled in a recognized Canadian University graduate program (either MSc or PhD) in a field of study that supports the goals and activities of CODATA:

- to improve the quality and accessibility of data, as well as the methods by which data are acquired
- to facilitate international cooperation among those collecting, organizing, and using data

- to promote an increased awareness in the scientific and technical communities of the importance of these activities
- to consider data access and intellectual property issues.

Additional information may be found at:

http://www.codata.org/canada/sangster/sangster_e.shtml

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

Newsletter #6 will be distributed on March 2, 2004. Please send contributions to dick.stoddart@sympatico.ca
Bulletin #6 sera distribué le 2 mars 2004. Veuillez faire parvenir vos contributions à dick.stoddart@sympatico.ca

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