

2018 Argo Canada report of activities

(submitted by Blair Greenan, Fisheries and Oceans Canada)



20th meeting of the Argo Steering Team (AST-20)
Hangzhou, China
11-15 March 2019

1. Status of implementation (major achievements and problems in 2018)

- floats deployed and their performance

From January 2018 to December 2018, Argo Canada deployed 25 MetOcean NOVA floats and 7 NKE Arvor floats (9 in the northeast Pacific, and 23 in the northwest Atlantic). Of these 32 floats, 7 died prematurely. The 25 remaining floats are still operational and functioning properly. Of the 32 floats, 3 were replacements. Of the 7 that died prematurely, 4 are being replaced under warranty and one was a replacement. The Government of Canada Standing Offer with MetOcean requires that if a float fails to complete 18 profiles the manufacturer must provide a replacement float.

In addition, 7 Argo-equivalent floats were deployed by Argo Canada eq. in the Beaufort Sea, Labrador Sea, and Baffin Bay. As of 23 January 2019, Canada has 84 operational floats in the Argo Canada program and 7 operational floats in the Argo Canada eq. program.

As of 10 January 2018, the Government of Canada signed a new standing offer with NKE Instrumentation for a 3-year period (10 January 2021) for supplying core Argo float. This contract has the option of two additional years.

- technical problems encountered and solved

Of the 7 floats that failed, two did not transmit any profiles and another stayed at the surface, transmitting every 8 hours.

- Status of contributions to Argo data management (including status of conversion to V3 file formats, pressure corrections, etc)

MEDS, part of DFO Ocean Sciences Branch, continues to acquire data from 84 Argo floats. Data are issued to the GTS and GDACs hourly in BUFR TM315003 and netCDF formats. On July 2018, MEDS stopped the transmission of TESAC on the GTS. The data of all Canadian floats together with some graphics are posted on a website and updated daily: <http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html>.

From January 2018 to October 2018, 93 % of the data were issued to the GTS in BUFR format within 24 hours of the float reporting. This rate decreased to 75% between November 26 and December 13 2018 when one of the servers used for Argo processing broke; ad-hoc procedures were put in place during this period to mitigate the problems. Since AST-19, we have worked on the following:

- All of the profiles netCDF in version 2.2 were converted to version 3.1.
- Developing new decoder software, and modifying the existing netCDF software in order to handle data reported by NKE Arvor-I float.
- Providing ADMT with quarterly reports on the performance of Argo data on the GTS in TESAC and BUFR formats and assist DACs that have difficulty with BUFR transmission
- Developing new procedures to migrate the system to a solution supported by the corporate IT service of Fisheries and Oceans Canada

- Status of delayed mode quality control process

As of January 2019, 51% of all eligible floats, active and inactive, had their profiles QC'd visually and adjusted for pressure according to the latest delayed-mode procedures at least once. The salinity component of DMQC had been performed at least once on 70% of eligible cycles. 31% of B-files had been visually QC'd, and 15% were fully DMQC'd. In addition to DMQC of new profiles, 22 previously-processed floats received either updates to the visual QC or new adjustments in 2018 in response to feedbacks (e.g., reports of density inversions) or to address known issues (e.g., higher likelihood of salinity drift for salinity sensors in the serial number range 6100-7000).

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Financial resources

Argo Canada has ongoing funding for the O&M expenditures related to the International Argo program. Shared Services Canada (SSC) is responsible for the costs related to Iridium telecommunications as part of an initiative to centralize these services with the Federal government and will cover the costs for up to 85 core Argo floats. If Argo Canada has more than 85 active Argo floats, DFO is responsible for the additional telemetry charges. Ongoing capital for float purchases has not been identified and, therefore, it remains necessary to request capital resources on an annual basis to obtain the funding required to purchase new floats. Fisheries and Oceans Canada (DFO) committed \$432k for purchases of core NKE Arvor-I Argo floats in the Fiscal Year 1 April 2018 to 31 March 2019. Department of National Defence (Canada) purchased of 15 NKE Arvor-I floats core Argo. The combined DFO and DND funding resulted in acquisition of 33 Argo floats in this fiscal year. The development of close links between the Argo Canada program and both the operational meteorology and operational oceanography R&D activities at the Canadian Meteorological Centre (Dorval, Québec) has been beneficial. An inter-departmental (Environment and Climate Change Canada,

Department of National Defence, Fisheries and Oceans) Memorandum of Understanding entitled CONCEPTS (Canadian Operation Network of Coupled Environmental Prediction Systems) has provided strong advocacy for the Argo program.

At the G7 meeting in Halifax in October 2018, the Government of Canada announced new funding for the International Argo Program (up to \$5.6M over the next 4 years). The primary intention of this investment is to support the implementation of the BGC-Argo array with a strong emphasis on having ocean observations benefit Small Island Developing States.

<https://g7.gc.ca/en/environment-oceans-energy-ministers-ready-take-action-oceans-seas-conclude-g7-joint-meeting-healthy-oceans-seas-resilient-coastal-communities/>

Human resources

Since 1 April 2015, Blair Greenan of the Bedford Institute of Oceanography (BIO) has acted as national leader of the Argo Canada program. The logistics related to float deployments and satellite data transmission has been handled by Ingrid Peterson, also at BIO. On the west coast, Tetjana Ross (DFO, Institute of Ocean Sciences) is responsible for Pacific deployments for Argo Canada.

The following DFO staff contribute to the logistics and data management for Argo Canada:

Anh Tran (MEDS, Ottawa)
Mathieu Ouellet (MEDS, Ottawa)
Isabelle Gaboury (MEDS, Ottawa)
Blair Greenan (BIO, Halifax)
Ingrid Peterson (BIO, Halifax)
Igor Yashayaev (BIO, Halifax)
Adam Hartling (BIO, Halifax)
Tetjana Ross (IOS, Sidney)
Denis Gilbert (IML, Mont-Joli)

Denis Gilbert (DFO) and Roberta Hamme (University of Victoria) are assisting Argo Canada with issues related to dissolved oxygen. In particular, they have been providing expert advice and support on quality control and data processing of DO data from the MetOcean DOVA floats deployed in the Labrador Sea.

In addition to the above persons, we benefit from the technical support of sea-going staff that follow pre-deployment protocols and perform the float deployments.

National Coordination

With increasing participation in the Argo program within Canada, both in core Argo and BGC-Argo, it was decided to establish a new governance structure in 2018. The Canadian Argo Steering Team (CAST) provides scientific leadership and oversee the

development and implementation of the Canadian contribution to the International Argo Program. The CAST consist of:

- a. Canadian Argo Program Director (CAST Chair – Blair Greenan).
- b. Scientists and technical experts contributing to the Canadian Argo Program.
- c. Manager of the DFO Marine Environmental Data Section (MEDS) or designate.
- d. Chair of the DFO Ocean Science Observation and Monitoring (OSOM) National Sub-Committee.
- e. Chair of the Canadian Biogeochemical Argo Sub-Committee.
- f. Representative of Environment and Climate Change Canada (ECCC).
- g. Representative of the Department of National Defence (DND).

The Canadian Biogeochemical-Argo Committee (henceforth the Committee) facilitates the implementation of the Canadian contribution to the Biogeochemical-Argo program by coordinating and advising national efforts, and acting as liaison to the International Biogeochemical-Argo Steering Committee. The Committee consists of:

- a. Canadian representative on the International Biogeochemical-Argo Steering Committee (Chair – Katja Fennel).
- b. Scientists and technical experts contributing to the Canadian Biogeochemical-Argo Program. Representation from DFO and universities should be approximately equal.
- c. Manager of the DFO Marine Environmental Data Section (MEDS) or designate.
- d. Chair of the DFO Ocean Science Observation and Monitoring (OSOM) National Sub-Committee.
- e. Chair of the Canadian Argo Steering Team (CAST).

Both of these committees held a virtual meeting in 2018.

3. Summary of deployment plans (level of commitment, areas of float Deployment, low or high resolution profiles, Argo extensions) and other commitments to Argo (data management) for the upcoming year and beyond where possible..

In 2019 and early 2020, Argo Canada plans to deploy 38 floats (firm commitment), all of which have already been purchased or are replacements: 20 will be deployed in the North Pacific (18 ARVORs, 2 NOVAs), and 18 ARVORs in the Atlantic. Two of the ARVORs in the Atlantic will have oxygen sensors. In addition, NAOS-Canada plans to deploy 3 BGC floats in Baffin Bay.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

The Government of Canada CONCEPTS initiative (Canadian Operational Network for Coupled Environmental Prediction Systems);

http://science.gc.ca/eic/site/063.nsf/eng/h_97620.html) uses observations from the Argo array for a variety of operational and research applications. These include direct assimilation into operational weather and environmental prediction systems, monitoring of forecast quality (verification), and well as detailed research to improve model physics (e.g. further development and optimization of model parameterizations) and data assimilation (e.g. Observing System Experiments). The CONCEPTS Global Ice Ocean Prediction System (GIOPS) provides daily estimates (analyses) of global ocean and sea ice properties using a multi-variate data assimilation system assimilating Argo observations together with other sources of in situ temperature and salinity, satellite altimetry, and sea surface temperature data. GIOPS analyses are used to initialize the ice-ocean components of the coupled Global Deterministic Prediction System (GDPS), responsible for providing operational medium-range weather forecasts for Canadians. GIOPS analyses are also used to initialize the operational forecasts from the Canadian Seasonal-Interannual Prediction System (CanSIPS). An update to the Regional Ice Ocean Prediction System (RIOPS) was accepted for operational implementation in December 2018 that will now include a regional data assimilation system package (including Argo), as well as extend the domain to include the North Pacific Ocean in addition to the Arctic and North Atlantic Ocean. This system will provide a daily three-dimensional state of the ocean estimate for Canada's three coastlines.

As part of the Year of Polar Prediction (YOPP) running from 2017-2019, CONCEPTS has also been producing experimental 32-day ensemble forecasts of sea ice and ocean conditions initialized from GIOPS analyses. A coupled version of this system is expected to be implemented operationally in 2019 based on the success of this system in predicting sea ice conditions and demonstrated benefits for weather forecasting. An observational effort was initiated by CONCEPTS to look at addressing somewhat the gap in Argo coverage in ice-infested areas. Several Argo floats were deployed to determine if observations taken during the ice-free season could provide a benefit for predictions systems. In total 8 floats were deployed: 5 in the Beaufort/Chukchi Seas, 2 in Baffin Bay and 1 along the Labrador coast. Despite the anticipated loss of the floats following ice formation, the Argo floats nonetheless provided a relatively low-cost method to provide profile observations in poorly observed areas. Work is ongoing to assess the overall benefit of the floats in terms of prediction skill.

The Department of National Defence scientists, operational oceanographers and sonar operators routinely use real time Argo vertical profiles to assess model performance and in some instances use as data to compute acoustic range predictions (both at sea and in the Meteorology and Oceanography Centres (Esquimalt and Halifax)). DND uses the web-based Ocean Navigator tool (<http://navigator.oceansdata.ca/public/>) to assist with these activities.

The Argo Canada web site is maintained by Fisheries and Oceans Canada at <http://www.isdm.gc.ca/isdm-gdsi/argo/index-eng.html>.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

Nothing to report this year.

6. To continue improving the quality and quantity of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include any CTD station data that was taken at the time of float deployments this year. Additionally, please list CTD data (calibrated with bottle data) taken by your country in the past year that may be added to the reference database. These cruises could be ones designated for Argo calibration purposes only or could be cruises that are open to the public. To help CCHDO track down this data, please list the dates of the cruise and the PI to contact about the data.

CTD data collected by DFO researchers are routinely transferred to MEDS and from there to NOAA NCEI on a yearly basis. CCHDO acquires data directly from scientists. In 2018, MEDS contacted CCHDO to resume exchanges for Line-P. CCHDO can acquire Line-P data up to June 2018 directly from the <https://waterproperties.ca/linep> website. Once the Line-P data has been ingested by CCHDO, MEDS will work to complete the AR07W (Labrador Sea) data.

7. Keeping the Argo bibliography (<http://www.argo.ucsd.edu/Bibliography.html>) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.

There is also the thesis citation list (http://www.argo.ucsd.edu/argo_thesis.html). If you know of any doctorate theses published in your country that are missing from the list, please let me know.

Finally, if you haven't already sent me a list of Argo PIs in your country, please do so to help improve the statistics on how many papers are published including an Argo PI vs no Argo PIs.

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