

Australian Argo National Data Management Report prepared for ADMT20, October 2019

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Deployments in 2018/19

Australia has deployed 50 floats between 1 October 2018 and 30 September 2019, including 19 manufactured by Webb, 24 by Seabird, 4 by NKE, and 3 by MRV. The MRV floats are Deep floats, equipped with SBE61 CTDs; the rest are core floats, with SBE41 CP CTDs. Figure 1 shows a map of deployment locations.

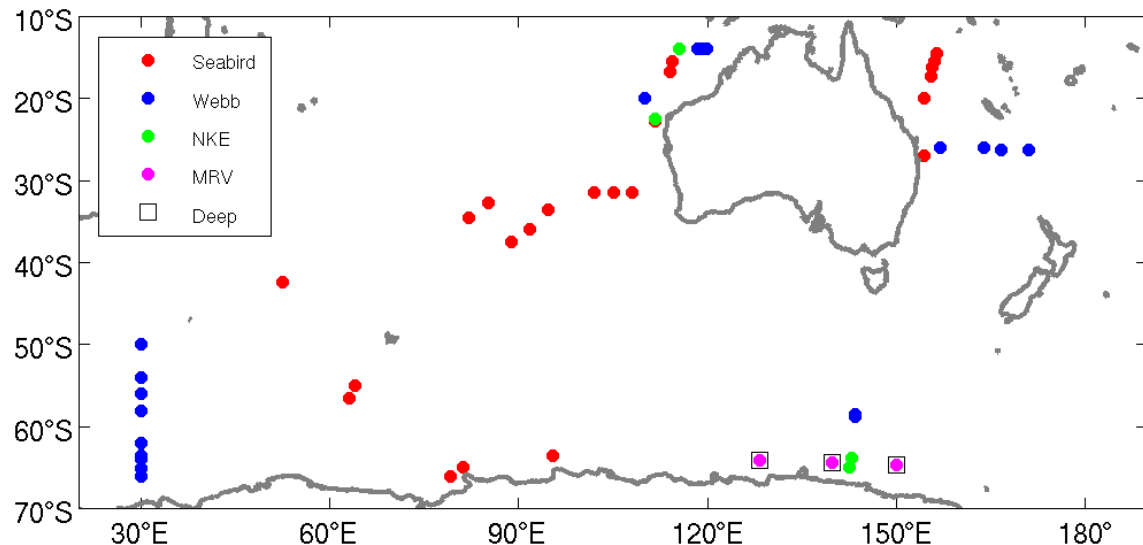


Figure 1: Map of Argo Australia deployments between 1 October 2018 and 30 September 2019, showing the float manufacturer and float type (noting three are Deep floats and the rest are core).

Planned Deployments in 2019/20

At the time of writing (11 September 2019), Argo Australia holds 94 core floats in the lab that are ready for deployment. The locations of planned deployments are indicated in Figure 2 and 3. Most should be deployed by early 2020. Two of these floats use RBR salinity sensors. These will be deployed alongside another float with a SBE41 CP CTD, as a buddy, to facilitate an assessment of the quality of the salinity data over the first few profiles.

Argo Australia also plan to deploy two BGC Webb floats, prepared by UW, in late 2019 off Brisbane from the RV Investigator. Both floats will be deployed at the same location, at a CTD station to provide in-water calibration for the BGC sensors that include: unpumped Aanderaa oxygen optodes, ISUS nitrate spectrometers, SBE pH field effect transistors, and Wetlabs FIBb combined chlorophyll fluorometers and particulate 700nm optical backscatter sensors. Thus providing 5 of the 6 BGC Variables (omitting solar radiation).

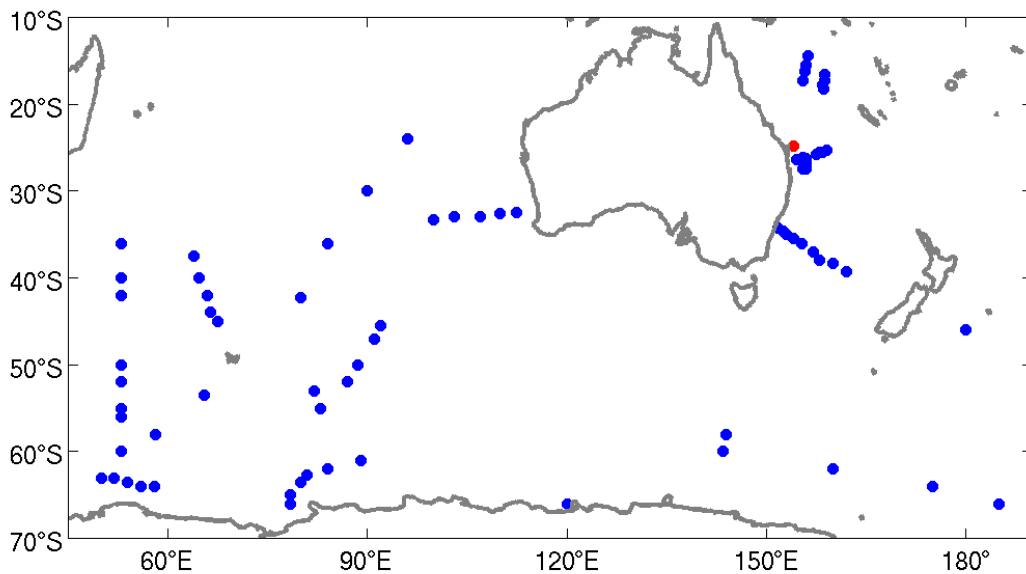


Figure 2: Map of the planned deployment locations for the floats currently held by Argo Australia. The blue dots show the planned locations of the 94 core float deployments, and the red dot shows the planned location of two BGC floats.

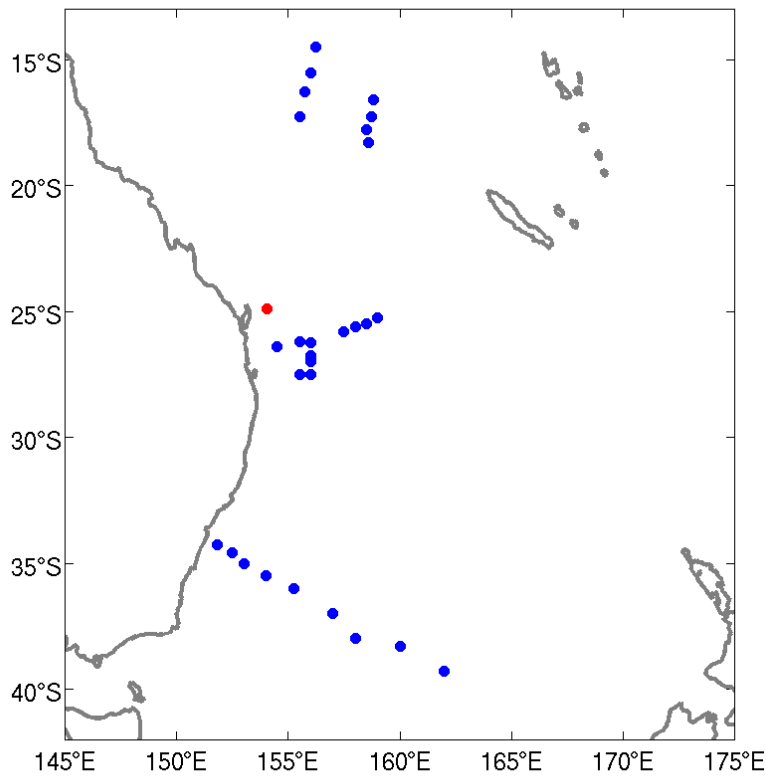


Figure 3: Zoom into the Coral and Tasman Sea, showing the planned deployment locations for the floats currently held by Argo Australia. The blue dots show the planned locations of core float deployments, and the red dot shows the planned location of two BGC floats.

Organization and resourcing

Australian Argo partners include CSIRO, BoM, the Australian Integrated Marine Observing System (IMOS), the Antarctic Climate and Ecosystem Cooperative Research Centre (ACE-CRC), and the Australian Department of Defence (DoD). Argo Australia is organized as a Facility, under IMOS, with the Facility led by Peter Oke (CSIRO), and two sub-Facilities: Deep Argo, led by Steve Rintoul (CSIRO); and BGC Argo, led by Tom Trull (CSIRO) and Peter Strutton (UTAS). The Facility shares resources for real-time data processing, float testing, float deployment, and software support for real-time operations. The DMQC efforts are so far separate, but we're considering how to coordinate our efforts.

All Australian partners are committed to ongoing investment into Argo, with expected procurements of 40-50 core floats, 1-2 BGC floats, and 2-3 Deep floats each year. The only change to the partnership comes as a result of the ACE-CRC, at UTAS, reaching end of life. However, the Australian Antarctic Program Partnership (AAPP), funded by the Antarctic Science Collaboration Initiative (ASCI), will effectively be its replacement. AAPP has a strong commitment to Argo, with plans to acquire and deploy about 50 core Argo floats and 10 BGC floats over the next 10 years; and about 15 deep Argo floats over the next 5 years. Deployments will all be in the Southern Ocean at high latitudes. The CSIRO lead for AAPP is Steve Rintoul.

For many years, Argo Australia's real-time operations have been supported by one full-time person (at CSIRO), and two or three people with fractional allocations (at BoM). This role has included everything from procurement, telecommunications, deployment planning, and decoding; as well as monitoring and trouble-shooting the real-time data streams. Argo Australia have just appointed a new real-time operator and have adopted a different model to support real-time operations – with tasks shared by others in the team. Under the new arrangements, the distribution of the main real-time tasks follow:

- Management and trouble-shooting of real-time data stream at CSIRO: Gabrielo Pilo (with support from Rebecca Cowley);
- Management of real-time data stream at the BoM: Lisa Krummel and Mike Funnell;
- Float procurement and logistics: Pat McMahon;
- Technical deployment planning: Craig Hanstein;
- Science-based deployment planning: Beatriz Pena-Molino;
- Telecommunications management and mission change: Craig Hanstein and Pat McMahon;
- Float pre-deployment testing and preparation: Craig Hanstein and Pat McMahon;
- Database management: Catriona Johnson; and
- Code support: Roger Scott.

One of the motivations for the change is to reduce the pressure and dependency on any single individual.

Argo Australia has a team of seven people with fractional allocations to DMQC operations. This includes three DM operators for core data, one DM operator for BGC data, one DMQC consultant, and two programmers. In total, we have 1 FTE dedicated to DMQC throughput of core data; about 0.5 FTE dedicated to development of DMQC for BGC; 0.1 FTE for a DM consultant for Deep Argo; and 0.5 FTE for programming support. Those individuals involved are:

- Core DM Operators: Catriona Johnson, Jenny Lovell, Tatiana Rykova;
- BGC DM Operator/Developer: Christina Schallenberg;
- DM Consultant: Esmee Van Wijk; and
- Software support: Dirk Slawinski and Roger Scott

Status of RT Operations

The Australian RT Argo operations have operated on reduced staffing for the last year, with one staff member long service leave for several months and with a failed appointment of a new support position. As noted above, a new RT operator was in early October 2019.

CSIRO operates a RUDICS server for reception of Argo Iridium data as well as a secondary modem. Data reception was disrupted for 2-3 days in May 2019 due to a denial of service attack on the RUDICS server. This was identified quickly and circumvented with a block on a particular IP address range. During the outage, 23

floats were unsuccessful in connecting to deliver data. These floats have all subsequently connected and delivered the missing cycles. We have plans to install an off-site backup RUDICS server at CSIRO offices in Western Australia.

Float data are decoded, processed, and disseminated at CSIRO and BoM every 6 hours – staggered, so that data from the Australian array are processed every 3 hours. At the time of writing (11 September 2019), 96.5% of data are uploaded to the GDACs within 24 hours of measurement. The data is issued to the GTS in BUFR bulletins via the Bureau of Meteorology (AMMC). These messages are generated on an hourly basis, as data becomes available. RT performance is summarised in Figure 4.

We have 424 floats on our database that are considered to be alive, from a total of 888 deployments since 1999. This includes floats that are under ice, floats that haven't reported for some time, and 6 floats that are suspected dead. On 11 September, 2019, 363 floats have reported profiles within the last 90 days. Figure 5 shows a map of the current location of operational floats.

The primary RT system used by Argo Australia is still the Matlab-based system that has been used for many years. But a new Python-based system has been developed and is being tested for our most recently-deployed floats. The Python-based system currently processes data from 65 floats.

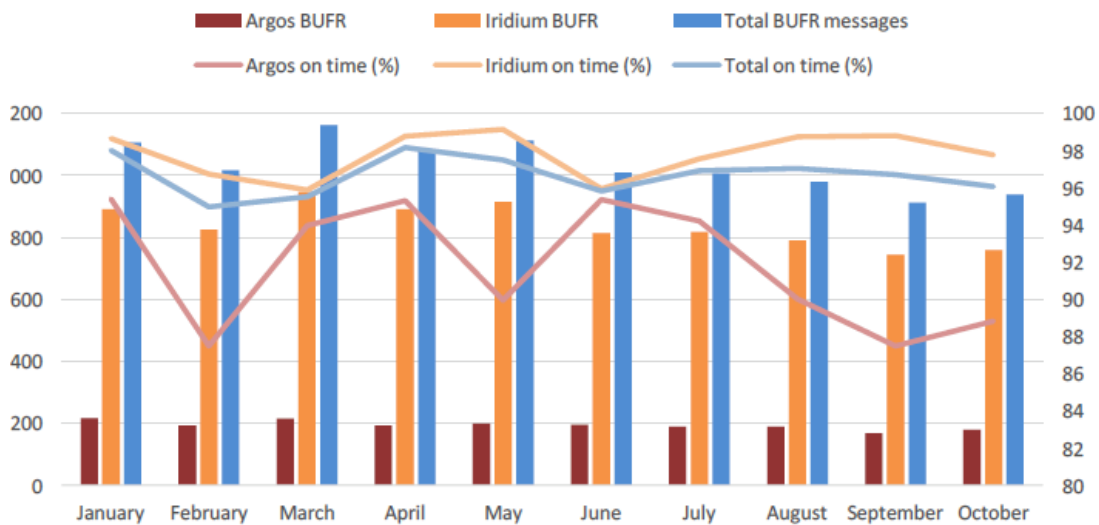


Figure 4: Summary of RT metrics for the Argo Australia operation.

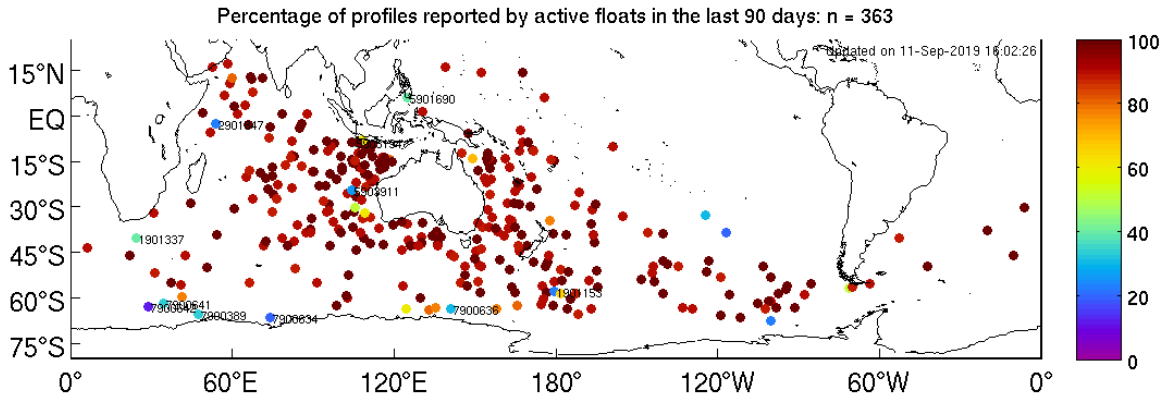


Figure 5: Map of the current locations of operational floats managed by Argo Australia. The color of each dot indicates the percentage of data return over the last 90 days; with 100 indicating that 9 out of 9 profiles have been returned. Floats that have reported profiles fewer than 5 times in the last 90 days are labelled with their WMO ID (used by the Argo Australia team to identify floats that may be dead and that need to be checked and monitored).

Status of DMQC Operations

The Australian DMQC operations have worked with reduced staffing levels for the last year, owing to staff absences due to maternity leave, staff being required to fill in for others, and a failed appointment of a new support position. Despite this, at the time of writing (11 September 2019), 93.5% of eligible core profiles have been DMQC-ed, with D-files uploaded to the GDACs.

CSIRO also hosted a DMQC Operator from China (Xiaofen Wu), who is spending three months at CSIRO, Hobart, to learn how to use the CSIRO DMQC system.

Data Usage and Websites

Some Australian websites that disseminate Argo data and Argo information include:

- <http://imos.aodn.org.au/webportal/>
In addition to the GDACs, Argo Australia also disseminates data in real-time and delayed-mode through the IMOS AODN Portal.
- <http://imos.org.au/argo.html>
IMOS also hosts a website with information about the Argo Australia facility.
- <http://www.marine.csiro.au/~gronell/ArgoRT/>
Technical information on individual floats from Argo Australia.
- <http://www.marine.csiro.au/~oke060/Argo/>
A very basic website, used for in-house monitoring to summarise some key performance indicators for the Argo Australia operation is at:
- oceancurrent.imos.org.au/profiles/

OceanCurrent is an Australia initiative that primarily delivers ocean products based on satellite observations (SST and altimetry), but also displays Argo profiles through an interactive web portal.

Most operational ocean forecast centres, including the BoM in Australia, use Argo data, together with other publicly available data (e.g., satellite sea surface temperature, satellite altimetry, XBT, TAO) to initialize ocean forecasts. Within Australia, Argo data is used to initialise multiple ocean and ocean-atmosphere forecast systems, including:

- OceanMAPS: www.bom.gov.au/oceanography/forecasts/index.shtml
BoM's operational Ocean Modelling, Analysis and prediction System producing daily, 7-day, publicly available, global ocean forecasts;
- POAMA: www.bom.gov.au/oceanography/analysis.shtml
BoM's operational Predictive Ocean Atmosphere Model for Australia, producing weekly and 9-monthly, publicly-available 14-member ensemble forecasts of the climate;
- BRAN – CSIRO's Bluelink ReANalysis system – producing annually-updated 5-25 year, global ocean reanalyses, using Argo R- and D-files;
- CARS: www.marine.csiro.au/~dunn/cars2009/
CSIRO's Atlas of Regional Seas is a publicly-available, global ocean climatology.