Argo National Data Management Report – Australia, November 2022

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1. Real Time Status

Deployments

Between November 2021 and November 2022, we deployed 68 floats. Of these floats, 2 were NIWA (NZ) floats, 2 were deep floats, 4 were BGC floats with six BGC sensors, and 13 core floats were deployed south of 60°S (including the 2 NIWA floats). We deployed 7 buddy pairs (Altos with RBR sensors, buddied up with either an APF11 or Navis with SBE41 sensors). A map of deployment locations, showing float types, is presented in Figure 1.

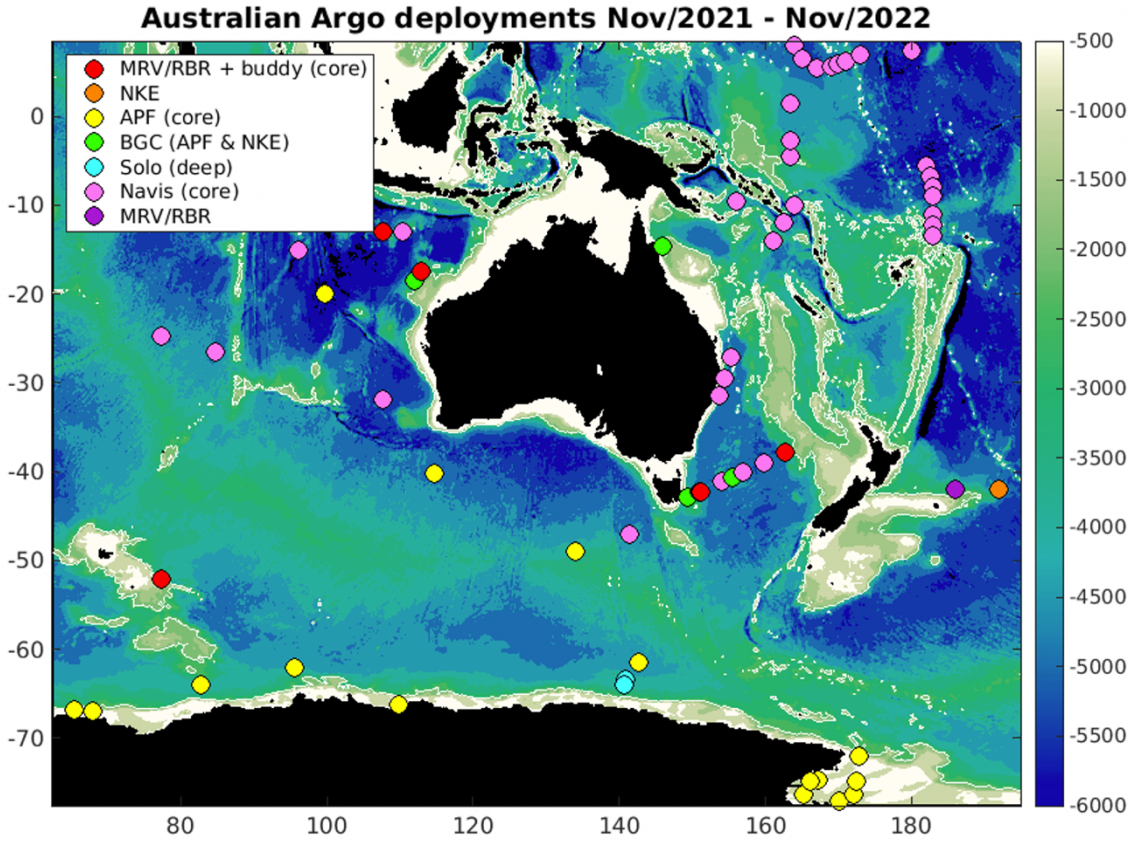

Figure 1: Map of deployment locations for the period November 2021 to November 2022. The colour of each dot denotes the float type.

Real-Time (RT) system developments

We still maintain two RT systems: a Matlab-based RT system and a Python-based RT system. The Matlab-based system has been used for a long time. Our motivation for developing a Python-based system is to deliver a system with more stability, that is more portable, and does not require a paid user license. Both systems are run at CSIRO, and the Matlab system is run at the BoM. In the coming year, we hope to port the Python-based system to BoM, and may be able to retire the Matlab-based system.

All of our operational floats are being processed by the Python-based RT system (including BGC and Deep floats). However, only data from 38% of our operational floats being exported to the GDACs are produced by our Python-based RT system. For the rest, the data uploaded to the GDACs are produced by Matlab-based RT system.

Over the past year, there has been a lot of coordination between the RT and DMQC teams to make sure the new files can be ingested by the DM system. Processing data that reports 2 or more profiles per cycle (i.e., from APF11s and BGC floats) has taken a lot of time and effort.

Data issued to the GTS

Currently, the Australian Fleet has 347 operational floats, including 333 Core, 11 BGC, and 3 Deep floats. Data are processed every 3 hours in the Python system and every 6 hours in the Matlab system. Of the 11 operational BGC floats, all but two have six BGC sensors – however the pH sensor failed on 4 of our BGC floats. We no longer have any operational floats that communicate using Argos.

We run our Matlab-based system every 3 hours, four times a day at CSIRO and four a day at the BoM – with execution staggered by 3 hours; and we run our Python-based system every 3 hours at CSIRO. Real-time data delivery at the BoM, after real-time QC is applied, is summarised in Figure 2**: Summary of the timeliness of real-time data delivery. Not included here are statistics for 31 floats that we think may still be operating (but are under ice), but have not reported in 2022.**. Of all Iridium BUFR bulletins reported during November 2021-October 2022, 97% were submitted within 12 hours of observation time; and 88% were submitted within 6 hours.

Both Matlab and Python RT systems perform real-time adjustment of salinity. After coordination with the DMQC team, we established a workflow were the PSAL drift value is saved by the DMQC operator as they evaluate the float, and then automatically ingested by the RT systems.

Real-time QC and adjustments performed on DOXY, NITRATE, pH and CHLA. We hope to soon apply real-time adjustments for BBP RTQC (waiting for ADMT recommendations).

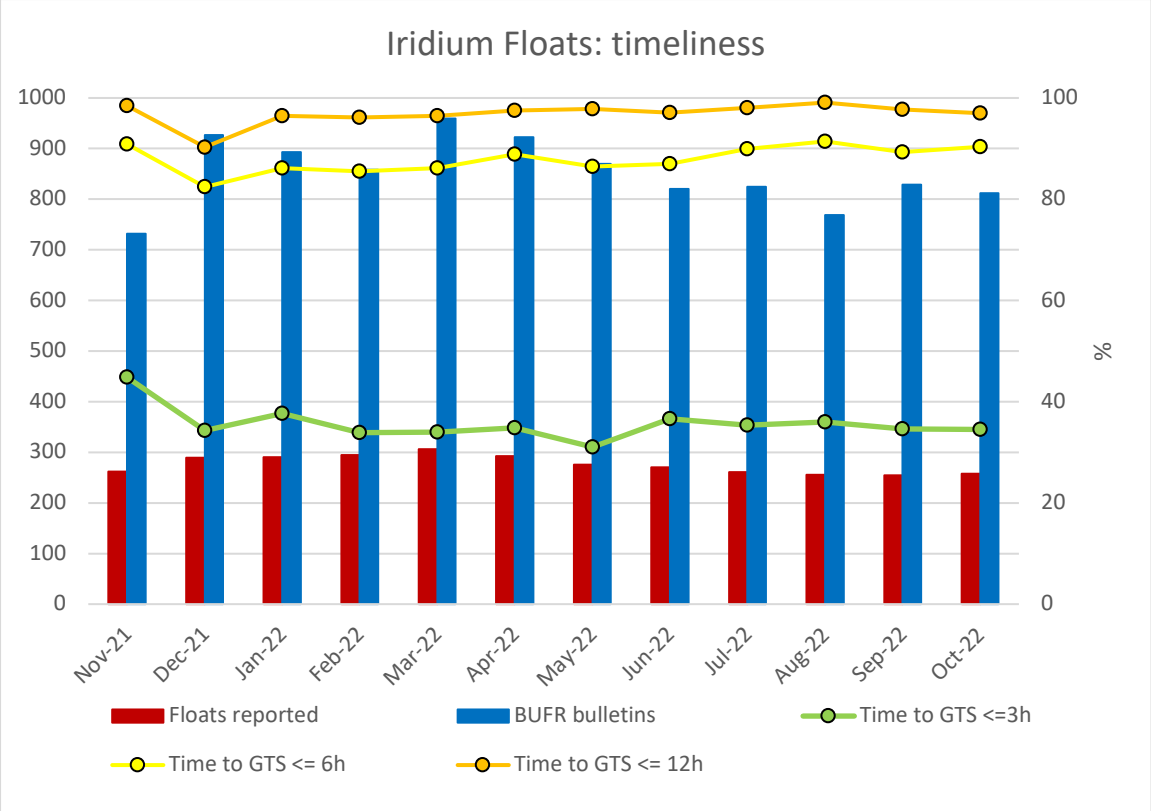

Figure 2: Summary of the timeliness of real-time data delivery. Not included here are statistics for 31 floats that we think may still be operating (but are under ice), but have not reported in 2022.

Delayed Mode data sent to the GDACs

D-files have been submitted to the GDAC for over 97% of eligible files.

As of 14 November 2022 (14:07), in the preceding year, the number of R-files (NR) submitted to the GDACs 13,831; the number of R-files older than 365 days (NN) is 4,637; and the number of D-files (ND) is 190,798. The raw percentage of D-files processed (100*ND/[NR+ND]) is 93.2409%. Considering only data from the eligible floats, we calculate that the percentage of D-files (100-100*NN/[NN+ND]) is 97.6273%. Over the last year, the number of D-files submitted to the GDACs is 54191, from a total of 386 different floats.

No D-mode BGC data are currently being generated for operational floats; our reasoning is that getting to A-mode is 90% of the job done, and that Christina is also still learning and gaining confidence in calculating the adjustment factors (for example for NITRATE and PH). So calling the result A-mode rather than D-mode seems prudent for now. There is also still a backlog of dead floats that haven't received any QC or adjustments at all, so starting DMQC on those is currently considered higher priority by our DAC.

2. Delayed Mode QC status

DMQC-related achievements over the past year include:

- A long-time serving member of our DMQC team, Catriona Johnson, has left CSIRO to pursue other things. Catriona made a fantastic contribution to our Program. We have trained a new DMQC Operator, Lyudmila Koziy, who is now a valued member of our DMQC team.
- Coordination between DMQC and RT systems to pass back DM adjustments to be used in RT – implemented for PSAL drift adjustments.
- Coordinated with the RT system to handle incomplete files from floats experiencing the APF11 bladder issue. RT places a "hold" at the point where R-files are incomplete and DMQC ingests cycles prior to this point. This has been done to avoid spending DM time on incomplete data and having to repeat that work later if more data are received.
- RBR processing code has been completed and can produce correct D-mode files. Including:
    - Applying the re-calculated compressibility coefficient;
    - Thermal lag correction;
    - QC of TEMP_CNDC; and
    - Writing correct SCIENTIFIC_CALIBRATION information in D-files.
- Work is continuing to process data in more complex file structures e.g. N_PROF>2 or where N_PROF=1 is not the deepest profile. This has required some re-writing of routines that compare float data with climatologies and nearby floats and restructuring the local matlab storage of float data (csiromat files).
- The DMQC group has been active in participation in the bi-monthly working group lead by Tatiana Rykova, with presentations from Tatiana, Jenny and Lyuda at recent meetings.
- We have provided prompt feedback to Objective Analysis and Altimetry alerts and updated the ASD spreadsheet. We notified Susan Wijffels of 5/136 sensors with SN>11252 showing signs of ASD.
- Responses have been provided to the DMQC Audit, conducted by Annie Wong and John Gilson. Discussion about one cohort of 3 floats in the Southern Ocean is ongoing, and is waiting on the resolution of a software issue for finalisation. We expect this will be completed by the end of the calendar year.
- Most of our DOXY data on dead floats is in D-mode, and work has begun on doing DMQC for BBP and adjustments for CHLA on dead floats; holding back on DMQC for CHLA on dead floats until consensus has been reached on how the slope factor should be calculated (awaiting ADMT advice on that)
- Overall, the strategy at the moment is to focus on RT adjustments for live floats and DMQC dead floats, with the priorities being 1) FL/BB, 2) DOXY, 3) other BGC sensors, which reflects the frequency of sensors in our fleet of dead floats
- The next step change for BGC QC will be for DOXY – we're currently still using WOA to adjust DOXY even though all our live floats are capable of in-air measurements; we're

working in decoding the in-air measurements so that they can be used for DMQC and RTQC adjustments.
- The next step for DMQC team is to update the climatology and to better understand how to optimally configure OWC.

3. Value Added items

Argo Technician Community of Practice

A series of virtual meetings to maintain the Argo Technical Community of Practice was initiated by Pat McMahon in 2021 as a forum for collaboration, knowledge sharing and coordinated action to establish, review and refine best practice procedures for pre-deployment testing of floats to eliminate premature deaths and performance-debilitating failures for core and BGC Argo. The group aims to create an environment where individuals working directly with Argo floats can discuss technical problems, including checkout testing, hardware design ideas, and deployment logistics. One of the primary goals is to identify issues that occur across programs which will then be presented to manufacturers with 'one voice'. To date, this group has met to discuss new developments, and issues that include:

- Deployment techniques and Remote controlled float release;
- Navis BGC and ballasting;
- Development of “coastal” floats.
- UW APEX APF11 Bladder stiction Issues

This group meet quarterly over Zoom, and rotate the chair and responsibility for each meeting. The group is not be open to vendors, and is targeted at technical staff working directly with floats. The group welcome topics for investigation from PI's and we will capture and report our key findings to AST. For more details, contact Pat McMahon (Pat.McMahon@csiro.au). A website has been maintained to communicate with participants and to provide a record of past meetings and topics covered. The website is at: www.cmar.csiro.au/argo/dmqc/html/ArgoCop.html.

DMQC Discussion Series

A series of virtual meetings on ***Argo DMQC Discussions*** was initiated in February 2022. This discussion series is intended to promote collaboration between Argo DMQC Operators and interested members of the Argo Community. The forum is an opportunity for newer Operators to learn from more experienced Operators, to ask questions, and to seek second opinions. This forum is intended to build a greater sense of community, and to promote consistent DMQC practices. This forum may also have a role in training the next generation of DMQC Operators, to address the emerging issue of succession planning in Argo DMQC. The meeting is open to anyone interested. Discussions have been held every two months, with 6 discussions held this calendar year. Topics covered include:

- Difficult floats;

- Floats with RBR sensors;
- Deep floats; and
- Floats showing abrupt salty drift.

Discussions have been led by 11 different members of the Argo DMQC community, and has been attended by 14-20 people at each gathering. Meetings run for 2 hours, and are scheduled with start times that are offset by 8 hours for each consecutive meeting, to allow people in all different time-zones to attend without necessarily having to endure meetings at night. For more details, contact Tatiana Rykova (tatiana.rykova@csiro.au). A basic website has been maintained to communicate with participants and to provide a record of past meetings and topics covered. The website is at: www.marine.csiro.au/argo/dmqc/html/ArgoDM-Disc.html.

Deployment Planning

Gabriela has participated in the deployment planning meetings for the Indian Ocean, organised by Tammy Morris ; and the Pacific Ocean, organised by Sarah Purkey.

Web pages

We maintain several technical web pages that we use to monitor the status of our fleet, and the performance of each component of our operation. Details can be provided if anyone from the Argo community wishes to examine these, but they are intended for internal use.

Statistics of Argo data usage

Australian operational systems that use Argo data include:

- OceanMAPS: www.bom.gov.au/oceanography/forecasts/;
- POAMA/ACCESS-S: poama.bom.gov.au;
- OceanCurrent: oceancurrent.imos.org.au; and
- BoM's SST Analysis: www.bom.gov.au/marine/sst.shtml.

Scientific applications include:

- BRAN2020: research.csiro.au/bluelink/global/reanalysis/
- Blue Maps: research.csiro.au/bluelink/blue-maps-a-new-ocean-analysis/;
- Argo Trajectories under ice: zenodo.org/record/6571146#.Y3thKS0Rptw.

A record of what data types are used by OceanPredict systems are at for initializing forecasts and reanalyses is at: oceanpredict.org/observations-use/#section-argo-profiling-floats. This is not a product produced, or maintained by Argo Australia, but we include it here in case it interests members of the ADMT.

4. GDAC Functions

N/A

5. Regional Centre Functions

N/A

6. Other Issues

Cycles with multiple profiles has caused us some problems, and has required significant resources to resolve (which we haven't completed yet). We understand that some floats report raw, decimated, averaged, and median samples, and that merging these data is not straightforward. But we wonder whether ADMT might consider establishing a protocol for combining multiple profiles into one – to avoid this issue?