part of the integrated global observation strategy

24th Argo Data Management Team meeting

23-27 October 2023, Hobart, Australia

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1. Introduction

This document summaries the 24th ADMT meeting that was organised on 23-27 October 2023 and hosted by CSIRO in Hobart, Australia. The first two days were dedicated to BGC issues (section 2, 3 and 4 of this report) and the three last days were dedicated to core, Deep and general subjects (sections 5 to 20 of this report).

The presentations and other material from this meeting are available on the following Google Drive: https://drive.google.com/drive/folders/1gUALjIhy_75RLF7iOfbtkcbFQZfGR4ci

and the Action items are managed on the following github repository: https://github.com/OneArgo/ADMT

2. BGC session: RT status updates (DAY1)

2.1 Introductory talk

The BGC-Argo array is still progressing, but the challenge stays in the fact that BGC-Argo continues to be funded as a series of research projects without sustained funding.

The data quality still improves but we should continue to focus on this point. The QC documents for the six variables are available on line (https://biogeochemical-argo.org/data-management.php).

We still have some challenges to face such as multiple sensors for the same variable, but we should take it as an opportunity. There is a recommendation from AST to set up a framework for the inclusion of this new sensors to address :

- Assessment of the “initial” sensor performance
- Assessment of the impact on DACs : new sensors means new decoders, more documentation for processing and QC and could be more sensor- than parameter-driven
- If accepted: assessment / monitoring of sensor performance over time

There is also a recommendation from AST to set up a Technological Task Team, all information regarding this task team is here (https://biogeochemical-argo.org/technological-task-team.php)

2.2 DAC BGC Status Updates

2.2.1 Australia

Argo Australia has 13 active BGC floats, and 7 BGC floats to be deployed in the next 6 months (all in the Southern Ocean, 5 are DOXY only, 2 are 4 sensors - no pH or nitrate). We’ve picked up two floats that were at the end of life, and they are now being refurbished for de-redloyment. BGC floats are surfacing at different times of the day at each cycle; we ordered our first RAMSES hyperspectral sensors. RT flags are in place; adjustment coefficients in R files are updated every 6 months; DMQC is happening.

2.2.2 Canada

Since December 2022, Argo Canada deployed 4 NKE Provor IIII equipped with Aanderaa Optode 4330, ECO_FLBB2K, 1 NKE Provor III equipped with Aanderaa Optode 4330, ECO_FLBB2K and SBE PH, and 6 Arvor-I equipped with Aanderaa Optode 4430. Ocean Network Canada contributed 5 Arvor-I Deep equipped with Aanderaa Optode 4330 to the Argo Canada program for the first time. Currently, Argo Canada has a total of 47 active floats. Over the last 10 months, we developed the software to process data reported from Deep Arvor. We also updated the flagging of CHLA and PH following the last ADMT23 as well as 16% of the eligible DOXY profiles were scientific quality control.

The python package bgcArgoDMQC provides code to load in BGC-Argo oxygen data, calculate gain via comparison to WOA climatology data in the water column or NCEP data using in-air measurements, update QC flags and DOXY_ADJUSTED values, and export them to a D-mode netCDF file. The software is under active development, but a stable release is available that has been shown to closely agree with the analogous MATLAB software, SAGE-O2. This release can be installed via Anaconda or pip, and code can be found on the ArgoCanada github page. This package also provides a simple framework to update flags in netCDF files, for example to update historical raw DOXY flags from 1 to 3.

2.2.3 China

1) In 2023, China deployed 6 BGC-Argo floats in the Northwest Pacific, with two of them equipped with rechargeable batteries. However, these two floats faced ballasting issues, preventing them from descending beyond 400 meters. CSIO is actively exploring opportunities to retrieve and re-ballast these floats for redeployment.

2) To date, 20 China-deployed BGC-Argo floats are working, with 1 in the North Indian Ocean, 9 in the Northwest Pacific, and 10 in the South Atlantic. In the next year, China plans to deploy 6 more BGC-Argo floats in the Northwest Pacific.

3) In 2023, scientists from China contributed 10 BGC-Argo-related publications.

2.2.4 Europe

Key accomplishments in the past year include:

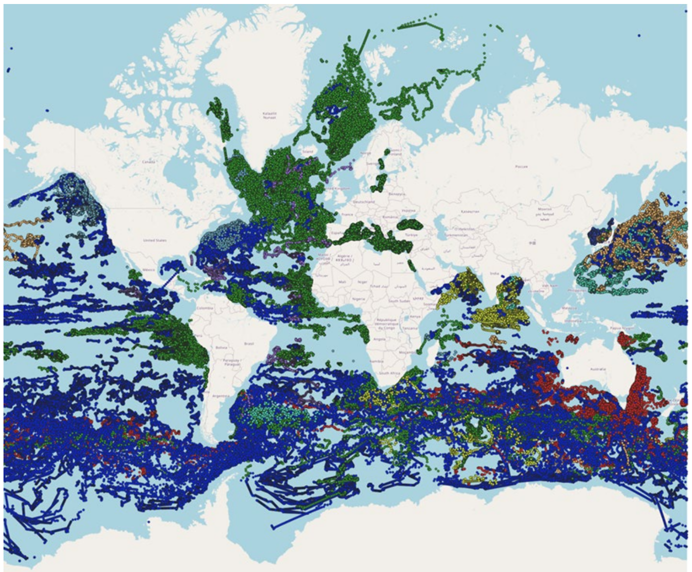
- The management of Provor CTS5 jumbo floats, which are substantial floats equipped with a range of BGC sensors, such as the UVP (a camera for identifying and counting zooplankton), the Ramses hyperspectral sensor, pH, chlorophyll, BBP, and Suna nitrate (refer to §1.1.3).
- The Ramses sensor conducts measurements of downward illuminance, upward luminescence, and reflectance. The reflectance data serves as a direct reference for satellite water color data.
- Comprehensive reprocessing of particulate backscattering (BBP) was carried out to implement the new quality control procedure available at https://doi.org/10.13155/60262
- Chlorophyll A (CHLA) also underwent a general reprocessing to adhere to the new quality control procedure, accessible at https://dx.doi.org/10.13155/35385
- The reprocessing of trajectories with format 3.2 was completed. Trajectories 3.2 contain both Core and BGC-Argo data.
- Deployment sheets for Coriolis floats, including metadata and calibrations, are shared on a cloud workspace located at cloud.ifremer.fr.

The data processing chain for data and metadata from Coriolis BGC-Argo floats is continuously improved. These are advanced types of floats performing bio-geo-chemical (BGC) measurements. Coriolis DAC manages 733 BGC-Argo floats from 4 families. They performed 108 444 cycles. The data processing chain is freely available

- Coriolis Argo floats data processing chain, http://doi.org/10.17882/45589

BGC-Argo floats on GDAC

In October 2023, 294 950 BGC-Argo profiles from 2 084 floats were available on Argo GDAC. This is a fair increase compared to 2022: +12% more floats and +9% more profiles.



BGC-Argo profiles, colored by DACs

BGC parameter	nb files
DOXY	281 767
CHLA	122 800
BBP700	120 284
NITRATE	69 287
CDOM	56 737
DOWN_IRRADIANCE490	53 371
DOWNWELLING_PAR	51 984
PH_IN_SITU_TOTAL	48 049
TURBIDITY	2 514
BISULFIDE	1 383

BGC-Argo files, distribution per parameter

2.2.5 India

The Indian Biogeochemical Argo Program currently has 14 active floats (67 total have been deployed, historically). RTQC is currently being performed for the DOXY parameter, and in the testing phase for BBP700 and NITRATE. DOXY_ADJUSTED fields are being populated, with adjustment gains derived from the DOXY-audit produced by Josh Plant (MBARI). Work is currently ongoing comparing results of SageO2 corrections with WOA-based gains from the DOXY-audit. Additionally, CHLA_ADJUSTED has been populated for select floats following Jayaram and Bhaskar (2021). However, consistency between this method and the SOCA-light method for CHLA DMQC has not been fully addressed and will require further assessment/action.

2.2.6 Japan

The Japan DAC, JMA, decodes all the variables of active BGC-Argo floats of Japan. JMA has been developing RTQC for each parameter and implemented RTQC for DOXY with adjustments based on WOA in August 2022. JMA plan to introduce the adjustment for DOXY based on previous delayed-mode adjustment by next summer and proceed with the implementation of RTQC for other BGC parameters.

Japan has 5 active BGC floats all deployed by JAMSTEC, which have measured DOXY, Nitrate, Chla, BBP and CDOM. This year, JAMSTEC deployed two BGC-Navis floats equipped with DOXY, Nitrate, Chla, BBP, and CDOM sensors. Initially, JAMSTEC planned to deploy 2 floats equipped with SEAFET, but they postponed the deployment after receiving the notification about elevated risk of early-life failure of pH sensors from SEA-BIRD in May 2023. JAMSTEC are going to deploy 3 BGC Navis floats in the next year.

JAMSTEC are now preparing to processing programs for DOXY-DMQC and will start submiting BD files with DOXY-adjusted value by the end of 2023. JAMSTEC are also testing whether Nitrate and pH observed by our BGC floats in the North Pacific are corrected well by SAGE.

2.2.7 United Kingdom

Since ADMT23 BODC have developed the capability to deliver BGC data from NKE Provor floats using a version of the Coriolis processing chain based at BODC. These 6 parameter BGC floats are part of the Atlantic Sector BGC Argo Network (ASBAN UK) project. Floats have been deployed in collaboration with various projects such as AMT, where they pioneer as the first UK full BGC floats in the South Atlantic, and C-Streams which is looking at the question of whether ocean circulation plays a central role in determining the carbon sink. Here the floats were part of multi-platform deployments and have provided initial intelligence for piloting the gliders within the Gulf Stream.

Brian King made adjustments to the time of UK Argo float profiles to ensure that we are not always profiling at the same time each day.

Following the BGC RTQC workshop and training from Catherine Schmechtig BODC have enabled and calculated real time adjustments to DOXY, initially now applied to 10 DOXY nocbio (ASBAN UK) floats. Adjusted data has also been submitted for BBP and CHLA for 13 metbio floats and delayed mode data submitted for radiometry and DOXY for 13 metbio floats.

BODC plans to install some updates within the processing chain in 2024 to enable further RTQC tests initially implemented at Coriolis. In 2024 capability will be added to deliver CTS5 float data using the remaining ASBAN UK funding.

UK Argo have purchased 11 CTS5 floats to complete the ASBAN UK project. These complement the 2 CTS5 floats already in UK Argo's fleet from the PICCOLO project which have a unique grounding spike to help prevent drifting far while under ice. The first PICCOLO float was deployed last February, it reported and disappeared under ice. The second failed comms prior to deployment but has been fixed and is set to be deployed in February 2024 near its partner on the eastern side of the Antarctic Peninsula.

2.2.8 United States

US biogeochemical (BGC) float data management is a collaboration among multiple US institutions (UW, SIO, MBARI, WHOI, AOML, PMEL). A total of 764 BGC floats have been deployed to date, 81 of which have been deployed in the past year. Float deployment contributions in 2023 include 35 SOCCOM and 46 GO-BGC, ~60% of which were APEX (the rest Navis). The US is starting to deploy more 6-sensor floats with OCR (3 deployed in the last year), as well as more floats with GDF, SBS83, and FL2BB. Numerous cruises are currently being organized for 2024, and include deployments in the Inidan Ocean (along I08 and I09), as well as deployments in the South & SouthEast Pacific and Atlantic (GO-BGC & SOCCOM), Gulf of Mexico (NOAA AOML), and California Current (NOAA PMEL). Data management activities have been a collaborative effort in monitoring sensor and platform performance (including continued investigation of TW APEX bladder issues) and bringing new sensors online. Note that pH performance has improved (SBS failure rate of >60% in 2022 to <20% in 2023). Additional DAC activities noted include continuation of the global DOXY audit (MBARI), implementation of the new nitrate temperature correction in SOCCOM & GO-BGC floats (Plant et al 2023) and analysis of float data through the passage of Hurricane Idalia (AOML).

2.3 New sensors and Sensors updates

2.3.1 Tridente Sensors (G. Dall'Olmo)

Results from the new RBR Tridente sensor that measures BBP, CHLA and CDOM were presented. In laboratory tests, the sensor appears to be considerably more sensitive than those currently available on the market. Test deployments in the Southern Ocean down to ~4800 dbar demonstrated that the sensors performs well when compared to other optical scattering sensors (transmissometer and turbidity meter). In addition, the Tridente consumes a fraction of the energy needed by other existing commercial sensors.

2.3.2 CDOM calibration announcement (SBS)

Some CDOM fluorometers have been reported to measure biased values. This bias has been traced back to three distinct root causes: 1. Incorrect primary CDOM standard, 2. In situ bias, and 3. Out-of-tolerance UV LED. Regarding #1, SBS has updated its primary CDOM standard. CDOM fluorometers calibration date of 13 January 2023 or later have the correct scale factor to retrieve CDOM fluorescence in QSDE ppb units. A correction for prior data sets will be provided to the Argo community before Q12024. If you have any of the affected sensors that are not deployed, please contact SBS (support@seabird.com) for recalibration of the sensor. Regarding #2, the hypothesis is that small changes in CDOM dark counts is causing the random bias from “true values”. SBS is currently working with the ocean optics community to provide corrections based on reference climatologies of deep CDOM. Regarding #3, SBS Sea-Bird will provide SN of ECOs that are safe from the UV LED issue before Q12024. For those with undeployed sensors with SNs that predate the safe range, our recommendation is to send those back to us for evaluation and repair if needed. For those with imminent deployments, please reach out to Eric Rehm (erehm@seabird.com) for assistance with determining if the LED is out-of-tolerance.

2.3.3 Hyperspectral radiometry (data format, differences between APEX and PROVOR floats)

The Ramses is a hyperspectral radiometric sensor with enhanced sensitivity compared with the OCR504. The sensor is certified 2000 dbars and is available in 3 versions: Irradiance UV/VIS (280..720nm), Irradiance VIS (320..950nm) and Radiance VIS (320..950nm). The simultaneous use of irradiance and radiance sensors on the same float (possible on the Provor CTS5) makes it possible to estimate Remote-Sensing Reflectance (Rrs), which can then be used for the Cal/Val of Ocean Color satellite missions such as PACE. To date, 17 floats (Provor CTS5 and Apex) were deployed with 1 or 2 Ramses for around 1000 Irradiance profiles. The data measured by a Ramses consists of 255 raw pixel counts, an integration time, two tilt measurements and two pressure measurements (before and after the radiometric acquisition).

While the sensor is identical, the differences in integration on Apex and Provor generate different data at the DAC level. Indeed, the APEX transmits all the data generated by the Ramses. The Provor, on the other hand, allows us to reduce the volume of data per spectrum, so that we can increase vertical resolution and use two sensors. The provor allows you to limit the spectrum to be transmitted by specifying the acquisition parameters: Pixel_Start and Pixel_stop. It also allows pixels to be binned by 1 (no modification), 2 or 4. Finally, we transmit the average of the dark pixels, not each individual value.

The next step is to write the raw data processing document to enable distribution of the calibrated physical data. A presentation of the Ramses data with an intercomparison with the historical sensor would also be of interest.

2.3.4 UVP

35 floats are presently equipped with a Underwater Vision Profiler (UVP) sensor. This sensor is able to estimate a size distribution from 100 micrometers to 2.5 millimeters and a taxonomy identification of 20 classes is embedded. All the data are stored in the aux directory and documentation is available (on request).

2.3.5 Double Chloro sensor

The study aims to compare the vertical distribution of Fchl at 470 nm and Fchl at 435 nm in a water column, with a focus on nighttime profiles to avoid photochemical quenching and assuming that both types of Fchl respond in the same way at the surface.

The study focuses on six different oceanic areas and examines variations in Fchl (470/435) ratios with depth in these areas. Fchl (470/435) ratios vary in different oceanic zones, with ratios greater than 1 in some areas, notably in the North Atlantic, and less than 1 in others, notably in the North Pacific.

It is noted that in some instances, sensors may react strangely or exhibit unusual behavior. Further investigations are necessary, taking into account potential issues with certain sensors. Additionally, HPLC samples were collected during cruises to establish a connection between Fchl ratios and the phytoplankton community.

2.3.6 RINKO ARO-FT update

Two update information of ARO-FT and AROD-FT, which are optical DOXY sensors developed by JFE Advantech with JAMSTEC, were reported. Their features are high accuracy and fast response time. First is the result of evaluating the temporal drift of ARO-FT accuracy by extending the data period. I reported at last ADMT that ARO-FT's temporal drift is small, by using DOXY profiles for one year and a half. I examined it again, because all floats with ARO-FT were inactive. I got the same results that ARO-FTs are stable and their temporal drifts are small. And the carry-over coefficients are relatively large. Because it is possible cause that water drops may remain on the membrane when the sensor is in air, JFE Advantech improved the film stopper. It makes sensor window become a flat surface. It is hoped that the sensor can measure DOXY in air better. Second is the initial evaluation of AROD-FT accuracy. The storage drift is not small, like as ARO-FT. But, it can be corrected within the initial accuracy range at the deep layers and near sea surface by using linear relationship between bottle data and the difference between bottle data and AROD-FT's DOXY. The temporal drift of AROD-FT increases with pressure and oxygen concentration at deep layers. The amount of drift is large in the first 10~20 days and then gradually decreases. Optode4330 mounted on an APEX Deep float as well as AROD-FT has temporal drift with these features. In order to investigate temporal drift of AROD-FT, more data is needed. JAMSTEC continues to examine the causes of slightly large storage drift of ARO-FT and AROD-FT, to monitor their temporal drift, and to explore the relationship between temporal drift of AROD-FT and pressure and doxy at deep layers.

2.3.7 SBE83 response time lab experiments

SBE83 is an oxygen optode that has a fast response time because it is in the outflow of the pumped CTD flowstream, but also can be air-calibrated. The SBE83 uses all of the same sensing elements and electronics as the proven SBS63, thus, this is a mechanical repackaging thus a low-risk development. We have deployed 11 SBE83's on floats in the Pacific, and all sensors are working well. There are 3 tripleO2 floats where Aanderaa 4330, SBS63, and SBS83 are equipped on a Navis float. Results from these floats suggest that: 1) SBS83 have better air calibration precision than the Aanderaa; 2) SBS83 air-calibrations are consistent to Aanderaa 4330 to 0.5%, and 3) SBS83 have comparable response time as SBS63. We characterized the response time of SBS83 in the laboratory, and can achieve consistent [O2] with the SBS63 to ~2 umol/kg after response time corrections in the oxycline. The GO-BGC program is planning to equip ~50% of their floats next year with the SBS83, amounting to ~80 floats that will be procured with SBS83 in 2024.

2.3.8 pH sensor development, performance

Seabird pH sensors experienced a high failure rate in 2021 within the first couple of months of deployment, stemming from issues in the reference electrode. In spring 2022, MBARI worked with Seabird to identify 2 issues. One issue (o-ring durometer) was fixed and cross-calibration efforts were conducted between MBARI and Seabird, and failures were not observed in the lab. These updated pH sensors were deployed on GO-BGC floats starting ~September 2022, but unfortunately early failures in the reference electrode were again observed. Therefore in Spring 2023, the second issue (pre-treatment of the reference electrode) was fixed, and cross-calibration efforts were conducted again. The reference electrode design are now nearly identical between MBARI and Seabird, thus, we are hopeful that we have fully addressed this issue. The first pH sensor with this update will be deployed by the end of 2023.

Two pH sensor alternatives are being explored. First is a pH-optode by Pyroscience (Pico-pH), and we have successfully deployed these on underwater gliders, but response time was an issue. A faster response time version was developed at Pyroscience, and glider results were greatly improved. One pico-float is scheduled to be deployed by end of 2023. The second is a pH sensor utilizing an ISFET from LioniX International. Preliminary results suggest that these sensors have excellent Nernstian response, and a linear temperature and pressure coefficient. Parallel development is being conducted at MBARI and Seabird. Mechanical refinement is currently underway at MBARI, aiming to deploy these sensors on floats in 2024.

2.4 Introduction of new Technological task team - terms of ref, objectives

The Technological Task Team (T3) was recently formed in response to the growing need to track BGC-sensor performance across the Argo array, and a growing number of new BGC-sensors in the pipeline for BGC-Argo. The team consists of 12 international scientists with expertise that encompasses the 6 BGC-Argo parameters. We will work closely with the BGC-ADMT to ensure synergy between the two groups.

2.5 Documentation

2.5.1 BGC QC document : Status of WMO BGC BUFR, PSAL recovering, HISTORY QC

The Argo QC Manual for Biogeochemical Data had never been updated since its initial release in 2016. In 2023, it was revised to become the BGC QC cover document to contain information common to all BGC parameters. A new section was added on what BGC data to send on the GTS with the new WMO BGC BUFR sequences. Another new section was added on how to recover BGC data in delayed-mode when salinity from the accompanying CTD had gone bad. Parameter-specific information was moved to the 6 BGC parameter-specific QC manuals, which would be cleaned up in the coming year to make sure there was no duplicate information. Lastly, discussions continued on how to record BGC RTQC tests performed and/or failed in the HISTORY section of the B-files.

2.5.2 CHLA

The last official version of the CHLA QC document was from 2018. We present here, what has changed from this version:

- The dark is estimated now as the minimum of the first 5 profiles that are deeper than 950dbars (estimated below 5dbar and for median filtered values)
- The quality of the dark is assessed again the factory calibration
- No negative spikes are flagged with a QC=4
- The quenching correction is triggered only for Sun Angle > 0

The documentation will be soon released and is already operational at the Coriolis DAC.

2.5.3 BBP

The paper describing the real time quality control for the BBP was release in May 2023. The flowcharts describing the 5 tests are available in the paper (https://doi.org/10.12688/openreseurope.15047.2 and in the documentation https://doi.org/10.13155/60262). There is also a jupyter notebook available on the euroargodev github : https://github.com/euroargodev/BBP_RTQC

An indication of the tests passed and the test failed could be recorded in the SCIENTIFIC_CALIB_COMMENT of the Bfile, in order to help the delayed mode operator.

Next steps for BBP :

- For all DACs, apply the procedures for BBP700
- Work on estimating the BBP700_ADJUSTED_ERROR
- Work on delayed Mode procedure

2.5.4 pH and NITRATE

V1.2 Nitrate Processing (https://doi.org/10.13155/46121) and V1.1 pH Processing (https://doi.org/10.13155/57195) documents are now available online. Major updates include the incorporation of the new nitrate temperature correction (Plant et al, 2023; https://doi.org/10.1002/lom3.10566), as well as specification for the recently approved Gasket DuraFET (GDF) pH sensor, and pressure-dependent temperature response for select pH sensors. Nitrate and pH quality control documentation is also currently being updated and should be published sometime during Q1_2024 (new and in-progress items will be highlighted in green and yellow, respectively, once published).

2.6 Status of WMO BUFR format for BGC parameters

On May 2023, John Turton and Fiona Carse from UK Metoffice proposed the following new sequences for dissolved oxygen (3 06 044), chlorophyll-A (3 06 045), dissolved nitrate (3 06 046) , sea water PH (3 06 047) and BBP700 (3 06 048). These sequences were validated with the help of Anh during summer 2023 and published in ‘AMENDMENTS TO MANUAL ON CODES (WMO-NO. 306), VOL I.2 BY FAST-TRACK PROCEDURE (FT2023-2)’ on 28th August. If no objections are raised by WMO national focal points by 30 October 2023, then they will become operational as from 30 November 2023.

The profile sequences for dissolved oxygen, chlorophyll-A and nitrate include a change in reference value (offset) to allow negative values that are consistent with the Argo netCDF. The profile sequence for dissolved oxygen also specifies a change in oxygen data width from 19 to 20 bits. The new profile sequences only have pressure as the vertical coordinate. For Chlorophyll-A, sea water PH and BBP700, new descriptors were defined while descriptors for nitrate (0 41 003) and dissolved oxygen (0 22 188) are already available.

The Argo community has agreed that only PARAM_ADJUSTED data will be released onto the GTS in BUFR, raw unadjusted data should not be released on the GTS.

In the UK, we plan to write Python code to convert from netCDF R and BR files to BUFR for all of the new sequences. When this is working, we will be happy to share it with the community (hopefully during 2024)

3. BGC session: QC TOPICS (Day2)

3.1 Feedback from the DMQC workshop (same ppt presented at AST24)

This year, the BGC-Argo community held the first BGC-Argo delayed-mode quality control (DMQC) workshop in Villefranche, France (January 23-27), hosted by the Laboratoire d'Océanographie de Villefranche (LOV). Over fifty participants attended (24 in-person). The main objectives of this hybrid workshop included training participants on DMQC methods currently in use for BGC parameters, facilitating international use of available QC software tools, and promoting collaboration and communication among Argo data centers. These objectives support the broader community goal of maintaining a unified, standardized global Argo dataset. The workshop incorporated a mix of presentations on BGC sensor operation and quality control, as well as a practical component where DMQC was reviewed collectively by the group for select case studies. Different software tools were also compared and discussed. Throughout the week, key processes and areas of the DMQC approach that require further refinement for various parameters were also identified. For example, these included discrepancies seen in DMQC results using the LOCODOX software for DOXY, how to handle large animal spikes in select BBP signals, and new methods proposed for improving the fluorescence-to-Chla slope factor. Some of these issues were brought to AST for further discussion and planning, and will be further discussed here during ADMT24. There was lots of positive feedback from participants at the workshop, and the community plans to continue with this framework into the future (with perhaps a second organized workshop in 2025).

3.2 DOXY: intercomparison of the O2-correction tools - Argo oxygen bias

We compare DOXY_ADJUSTED fields of 11 core and deep-arvor floats provided by 3 DMQC tools: SAGE-O2, LOCODOX and Henry's software (« BITTIG »). All floats were in the North-Atlantic Ocean. Tools are used as they are. The Main Gain and the Time drift Gain are calculated from the same method, that is in air measurements using NCEP reanalysis. Results of the test done with ERA5 are also presented. LOCODOX was run with the same configuration as SAGEO2 (no carryover, raw P,T and S data as input). We verified with LOCODOX that this does not impact the results. LOCODOX and SAGEO2 were run without or with a Time drift Gain.

The intercomparison reveals that SAGE-O2 and LOCODOX agree +/- 1 mumol/kg with no time drift gain. No systematic bias detected between the two methods. Differences increase (about 3-4 mumol/kg) when considering the time drift gain. Similar conclusions are drawn when considering BITTIG sofware.

The difference between the time drift corrections is unsatisfactory but it was impossible to determine which solution is « best » as a comparison with reference data did not help. It needs to be investigated.

There is a « method uncertainty » that should be considered when estimating the DOXY_ADJUSTED uncertainty. It needs to be estimated in considering a larger dataset and reduced if possible.

Whatever the software, the corrected DOXY field is biased 2% low compared to WOA18 surface PSAT. Similar bias is observed when comparing to ship-based cast (LOPS or GLODAPv2). Or when using ERA5 (but comparison done on 1 float). Such systematic bias need to be evaluated in considering a larger dataset (covering all oceans).

Deep float data suggest that there is a pressure dependent bias compared to ship-based cast (even after in air correction).

3.3 When to end acceptance of v3.1 b-trajectory files for BGC floats

The GDAC file checker began accepting the new V3.2 traj files in March 2023. As of September 2023, some BGC DACs were still transitioning to the new V3.2 traj files, with a few yet to implement the new V3.2 traj files. It was obvious that BGC DACs needed more time to implement the new V3.2 traj files. It was therefore agreed that the topic of when to end acceptance of the old V3.1 B-traj files would be revisited in 2024.

3.4 Code sharing and tools for the community

This presents the update of the argopy python library for taking into account BGC parameters. Some examples are presented. This new version of argopy was released in September 2023. https://github.com/euroargodev/argopy

3.5 pH pump offset correction dev (RT/DM)

Ken Johnson presented on the pH "pump offset" sensor issue and potential pathway moving forward for addressing affected data within the Argo system. The problem amounts to a small (-0.004 fleetwide mean bias for sensors on APEX) discontinuity in the pH profile at the pressure level that the CTD pump turns on. The magnitude of the discontinuity can vary across floats, as well as through time (different for each profile). Additionally, the root cause is not fully understood. Therefore, identifying a robust correction method that can be applied routinely to all floats has been difficult. An automated method for estimating (and subsequently correcting) each profile's offset was presented, based on linear extrapolation of points above and below the discontinuity. This method has been tested across the array, and MBARI plans to implement, beginning with inactive floats. pH_IN_SITU_TOTAL_ADJUSTED_ERROR will be inflated for affected floats, based on the estimated uncertainty in the correction approach, and under DM-operator discretion.

3.6 CHLA DM : available library of synthetic profiles Ed490 and PAR for every floats with satellite matchups + Renosh's routines

This is a follow-up of the first BGC DM QC workshop in january 2023 in Villefranche. During the workshop, the importance of light to assess a good CHLA (PAR for quenching correction, Ed490 for slope determination) was highlighted.

For the whole archive of floats equipped with fluorometers, PAR and Ed490 synthetic profiles were computed, using the the work described in https://doi.org/10.3390/rs15245663

And the routines stored https://github.com/renoshpr/SOCA-LIGHT-MODELS

These are available on request (catherine.schmechtig@imev-mer.fr) as text files ranging every 5m form surface to 250m.

3.7 CHLA (RT) Slope map

This presentation suggests the use of a look-up table of slope to be used in REal-Time. It will (1) improve the accuracy of the CHLA_ADJUSTED dataset and (2) allow to push CHLA_ADJUSTED in delayed-mode without having too important jumps between data adjusted in real time and in delayed mode that fill the same CHLA_ADJUSTED fields. The main issue is that users are far from always checking the data mode of the variable but use all the CHLA_ADJUSTED data. By using the SOCA climatologies of CHLA_ADJUSTED and ED490, we applied the Xing et al. 2011 method to determine a slope for each grid cell of 1°x1°. This slope appears to be in agreement with the slope proposed to be applied in Delayed mode from the procedure proposed last year by C. Schmechtig.

3.8 Calculating chl-slopes based on satellite/flt crossovers, monthly climatology

A gridded, 5x5 lat/lon monthly climatology of chlorophyll correction slopes were presented based on satellite/float crossovers. These results were compared with the SOCA method presented in the previous presentation, proposed to be implemented for real-time adjustments of float chlorophyll data. The satellitecrossover climatology could be used for verification/validation of the SOCA method, as it is a quasi-independent estimate of surface chlorophyll. A systematic bias of ~30% between the two methods were observed globally, where SOCA overestimates surface chlorophyll relative to satellites. Furthermore, the correction slopes are sensitive to small implementation details, thus, deliberate choices should be made for these details. These results should be incorporated for the uncertainties reported for the real-time adjusted chlorophyll, and efforts should be made by the community to resolve the source of the bias between the two methods.

3.9 About CHLA QC: Workflow to determine the best BGC-Argo CHLA_ADJUSTED dataset

This presentation is a reminder of the machine learning-based workflow that was presented last year to determine the quality of the BGC-Argo CHLA_ADJUSTED dataset against HPLC reference data. Using the machine learning method SOCA that is trained using the global BGC-Argo dataset, it becomes possible to estimate synthetic profiles of CHLA_ADJUSTED representative of the BGC-Argo dataset used for the training. This method can be used in some way as an extrapolator of the BGC-Argo dataset to the location and time of HPLC reference data and allows a new validation against reference data at a global scale. Thanks to this methodology, it becomes possible by training different models to compare different BGC-Argo CHLA_ADJUSTED datasets, adjusted by different methods (e.g. different slope factors). The model with the best agreement against the HPLC dataset will tell which dataset is the more representative of Chlorophyll-a concentration. This workflow can be used to evaluate other datasets, the only requirement is to have a global dataset for the training of the machine learning method.

3.10 Status update and feedback on parameter audits

3.10.1 DOXY

The global DOXY audit continues to be run annually at MBARI by Josh Plant, with the goal of identifying anomalous profiles (both raw and adjusted) within the global data system via use of available Sprof files. The approach, description, output, and visualization plots for the latest audit (run Oct, 2023) are available on the MBARI ftp at https://ftp.mbari.org/pub/BGC_argo_audits/DOXY. There continues to be an improvement globally in terms of the efficacy of the audit for cleaning up the dataset; however, numerous anomalous profiles have remained on the audit list for multiple years. Additionally, a number of false positives also exist that would benefit from future refinement of the audit. This work is in progress. The audit run in 2023 resulted in 1910 DOXY floats inspected, with 1,780 anomalous profiles detected (which amounts to 0.8% of all DOXY profiles). 94% of the DOXY dataset now contains ADJUSTED data fields, and this is up 4% from the previous year. An action was voiced to continue to address anomalous profiles throughout the next year that have persisted on the audit list, with the recommendation to DAC managers to add such profiles to the grey-list if the float’s PI is not responsive.

3.10.2 BBP

This presentation shows the status update of the BBP700 audit that is based on the same philosophy as the DOXY audit and can be found through the same ftp access (audits repo). The repositories are structured in the same way as the DOXY audit (documentation and repositories available for each dac). The audit is proposed thanks to the comparison of BBP700 measurements with reference data that corresponds to the SOCA weekly climatological fields of BBP700 (more details available in the documentation available from the Copernicus Marine Service where the product is released). The update of the audit: ~85 000 on ~110 000 profiles of good BBP700 profiles have been inspected from the audit release of September 2023. There are 10 000 more profiles compared to 2022. From the inspected profiles, 875 profiles were flagged as anomalous (~1% of the data). Since three years, less and less data have been flagged, so it is good news. As it was done for DOXY, I added a plot repository in the audit repo that releases plots where you can visualize the BBP700 profile that is flagged anomalous, its geographical localization and its comparison with the BBP700 climatology from the SOCA reference. It is needed that DACs send their exclusion lists to improve the number of false positives and to improve this audit. Any feedback is welcome. Next year, the same type of audit will be released for radiometric profiles.

3.11 Summary status of flagging and QC across DACs and BGC array

Maintaining standardization of the BGC-Argo flagging structure across all DACs (and all floats) is essential. Doing so better serves product development, usability and utility of the dataset, which, in turn, inevitably promotes success of the program. Key messaging to BGC-Argo users is to (1) always use ADJUSTED fields, and (2) always look for QC=1. Therefore, DACs should prioritize producing adjusted fields for BGC data, and assuring that quality flags of '1' are adequately represented by good, usable data only. A summary of flagging status for three selected parameter examples was presented, including BBP700, DOXY, and PH_IN_SITU_TOTAL. It was highlighted that there is still work to be done in populating adjusted fields (although percentages of adjusted parameters continue to increase each year), and modifying raw qc fields from '1' (which is in error), to '3'. This should continue to be a focus for DACs in the coming year. Some recent activities among the community were then highlighted that further underpin the need for continuous attention to improving the flagging across DACs. These include (1) recent acceptance of the SCOR working group proposal for BGC-Argo product development; (2) preliminary development of a single-file csv file including all QC=1 adjusted BGC parameter data interpolated to a common z-axis; and (3) OCADS database development (recent publication), which has been identified as a potential future access point for serving BGC profile data. Furthermore, in addition to providing good, adjusted data fields, action could be taken by the DACs to better specify the methods applied in producing adjusted data fields. Specific, controlled vocabularies can better serve users interested in finding this information. A first set of such keywords were recommended for DOXY (within SCIENTIFIC_CALIB_COMMENT), to be agreed upon and inserted into the QC manual at a future date.

3.12 Feedback from modelers in the Mediterranean Sea

BGC-Argo float profiles provide suitable information to be used in ocean biogeochemistry forecasting. As part of the European Copernicus Marine Service (https://marine.copernicus.eu), OGS has developed an operational model system (MedBFM) to forecast the biogeochemical state of the Mediterranean Sea in the past (20-year reanalysis) and in the future (10-day forecast, provided daily).

The MedBFM uses BGC-Argo data for several tasks: model initialization, data assimilation (DA), reconstruction of nitrate profiles (using Neural Network, NN) and product validation (https://medeaf.ogs.it/).

Before integrating chlorophyll, nitrate, oxygen profiles and MedBFM, we implemented internal quality control procedures (pre-assimilation and model-observation checks).

Before the oxygen assimilation, two additional quality controls are performed: a trend and a climatological analysis. Trend analysis aims to assess and correct possible oxygen sensor drift using non-parametric statistical methods (RANSAC? and Theil Sen) and applying them at different depths (600 and 800 m) in cases of floats time series longer than 1 year. Climatological checks aim to assess the goodness of a profile before the eventual assimilation comparing the data with a reference value retrieved from the EMODnet dataset.

An Observing System Experiment (OSE) is performed and consists of three numerical simulations with different assimilation setups: one without assimilation; one with assimilation of BGC-Argo chlorophyll, nitrate and oxygen; and one with assimilation of BGC-Argo and profiles reconstructed with a NN method . The results demonstrated the positive and increased impact obtained by maximizing the information content of BGC-Argo through the use of the NN reconstructed profiles.

4. Identified BGC actions

Number	PARAMETERS	ACTION
1	UVP	Place all prelim files in the aux (even simple) to identify which wmo currently have this sensor
2	CDOM	Continue communication with SBS on this topic; (1) need wmo list of affected (by end of yr); (2) need timelines for resolution (fix); (3) for LED issue, DACs get in touch with SBS, as needed
3	NEW params	Work closely with TTT to establish workflow on definitions for bringing new sensors on
4	NEW params	Megan to share the discussions on the use of the SPECIAL_FEATURE variable to record experimental sensors. Thierry and Annie to record the agreement on how to record experimental sensors in the Users Manual.
5	GTS params	By 30th Nov: check BUFR template status/acceptance. If your DAC is ready, send files to Anh first for testing. DACs without capability to do encoding – please wait for python code to be available
6	CHLA	Explore RT test for partial profiles (may be able to extend some code from BBP)
7	CHLA	Prepare an report/plan to submit to AST regarding RT slope correction via lookup table(first check with DACs on feasability==upcoming task team meeting)
8	DOXY	Working group established to further explore discrepancies in DMQC softwares, as well as any deep oxygen bias in dataset (Virginie Thierry, Chris Gordon, Kanako Sato, Roo Nicholson, Tanya Maurer, Annie Wong, Catherine Schmechtig)
9	DOXY	Finalize selection of 'keywords' to represent DMQC method applied (for insertion into SCIENTIFIC_CALIB_COMMENT); add to the manual as recommendation
10	DOXY & BBP	For profiles flagged in audit -- clean these up in the next year. Official recommendation for DAC managers to put on greylist if PI does not respond within one year.
11	NITRATE	All DACs to implement updated NITRATE Temp-corr, as resources permit
12	PH	MBARI to phase in the pump-offset correction; evaluate & add to manual
13	DOCUMENTATION	Revisit the BGC QC manual to remove all the redundancies between documents; establish a template for all the BGC document to increase the readability of all the manuals
14	DOCUMENTATION	Verify consistency regarding flagging descriptors (for how we are flagging raw variables)
15	ALL	Finalize a scheme on how to report RT test pass/fail for BGC (ie renumbering tests, HISTORY section)
16	ALL	Further communication with RT users/modellers (keep in the loop with Annie & core discussions, as well as new BGC SCOR WG on product dev)

17	ALL	Generate a template of stoplight chart for tracking priorities by next ADMT (work with DACs to fill in during TT meeting)

5. Plenary session: Introduction

5.1 Welcome

Megan Scanderbeg welcomed everyone to the 24th ADMT meeting in Hobart and hoped it would be a productive three days.

5.2 Feedback from AST-24 (Susan, Brian)

Brian King delivered feedback from the AST-24 meeting in Halifax, Canada. He opened by saying that he has taken on the AST co-chair role after Toshio Suga served a five year term. He noted that we are making uneven progress on the implementation of OneArgo and that overall, the Argo program is in decline. The average coverage remains solid due to longer float lifetimes, but deployments are decreasing. In addition, since more BGC and Deep floats are being deployed, which have on average shorter lifetimes, the average float lifetimes will be decreasing. Given that, it is becoming critical to both deploy floats effectively and to better estimate float lifetimes for BGC and Deep floats. He stated that the ADMT can help in this effort by maintaining reliable and clean platform metadata to facilitate failure mode analysis.

OneArgo's largest issue is the resource challenge which comes from expanding the budget to roughly three times the current one. The AST has been reaching out to the global user community, but there is more to be done in all communities. We need to try and convert the enthusiasm for OneArgo into resources for its implementation. To work on this, Argo will be showcased at the G7 Future of Seas and Oceans Initiative in Japan in November 2023 and at COP28 in December 2023.

Turning to data quality, Brian noted that the Argo dataset often sets the benchmark against which other networks are measured. He urged the ADMT to continue its efforts to get bad data identified and flagged in the system **before** the data are distributed. In addition, near real time (NRT) actions should be implemented as quickly as possible to improve the quality of the NRT dataset. Thankfully, the ASD issue has been addressed, but the ADMT must remain vigilant when looking for any new floats showing ASD or other anomalous behavior and to promptly flag it. He urged DM operators to consider producing more D-trajectory files as the use of trajectory files grows.

He noted that despite these efforts by the ADMT, biases in Argo's real time data stream have contaminated ocean data archives and products. In order to combat this, the AST has begun engaging directly with these groups to educate them on Argo data and how to effectively use it and refresh it. This has been successful and will continue.

In terms of diversifying sensors, the AST is ready to help guide this process from experimental to pilot to operational sensor. He noted that while diversification has many benefits, it can take time and resources to test them and incorporate them into Argo.

He concluded with many thanks for the work done by the ADMT to deliver data in a timely and quality controlled manner.

5.3 Status of Action items from ADMT-23 (Claire, Megan)

After the ADMT23 meeting, we ended up with 57 actions: 11 DAC actions (see dedicated presentation) and 46 non-DAC actions. Among the 46 non-DAC actions, 10 were carried over from ADMT22 and 36 were created at ADMT23. The status of the actions at the start of ADMT24 meeting was as follow:

- 23 done
- 16 ongoing
- 1 not done
- 4 unknown
- 2 canceled

Open actions were then listed by Claire, by topic. Most of them were closed during the course of the week, and the remaining will be listed in the ADMT24 action list.

6. GDAC data management and archiving Argo data

6.1 Operational status of Argo GDACs (Thierry Carval, Mike Frost)

Thierry Carval presented the operational status of the GDAC which contains 18,355 floats and 2.9 million profiles as of October 2023. There was an increase in 4% in the number of floats and a 5% increase in the number of profiles on the GDAC as compared to the previous year. The total number of netCDF files on the GDAC is 3,535,214 (+6%). The size of the GDAC/dac directory is 423 Gb (+11%) and the size of the entire GDAC directory is 931 Gb (+26%), largely due to an increase in the aux directory. There was a 12% increase in the number of BGC floats and a 9% increase in the number of BGC profiles, with many DACs contributing BGC data. There was an increase in the number of Deep floats and profiles, but with fewer DACs contributing data. The grey list had about the same number of entries as last year.

In terms of operations at the Coriolis GDAC, DAC files are collected in parallel every 30 minutes and the index files are updated hourly. There are GDAC download services via ftp, https, erddap and s3. There were six million sessions for Argo downloads which was a 200% increase and one billion files were downloaded (+53%). Notably, 55% of downloads were ftp and 45% were https compared to 80% and 20% last year. An average of 14 terabytes were downloaded daily. The majority of downloads come from North America, China, Russia and Europe. There were no periods of poor performance in the past year and a prototype GDAC has been set up on the cloud in an S3 bucket.

6.2 Argo archive & serving Argo data from the cloud (Tim Boyer, Thierry Carval)

Tim Boyer presented work done within NCEI to maintain the Argo archive and to explore new ways of archiving Argo data by profile to allow for better reproducibility of the Argo dataset. He also mentioned that he received permission to explore how DACs might upload data to a GDAC in the NCEI cloud. He is exploring the best format to serve Argo data from the cloud, including the PARQUET format that Coriolis is using to serve data.

6.3 Discussion on moving GDACs to the cloud & the need for one or two GDACs

The discussion focused on how best to serve Argo data from the cloud and included thoughts on what format the data should be stored in, what type of cloud services should be used, how secure they are and what steps Argo can take to move this forward. It was agreed that two GDACs are needed for now in order to maintain robustness and it was noted that some academic clouds are being set up that could host the Argo GDACs which may alleviate some concerns associated with commercial cloud service vendors. A first step is to ask people to test out accessing Argo data from the prototype Amazon Web Services portal that Coriolis has set up (https://registry.opendata.aws/argo-gdac-marinedata/). It was also noted that serving data in the cloud is a hot topic for many countries right now and that it could be incorporated into upcoming proposals.

6.4 GDAC file checker status and update (Mark Ignazsewski, Thierry Carval)

Thierry Carval presented on Mark Ignaszewski's behalf on the status of the File Checker. Mark reported that the File Checker was successfully updated to accept v3.2 trajectory files in April 2023. He was unable to convert the File Checker to reading NVS versions of the Argo reference tables. Some work was done to accept time series data in the technical files, but this was not finished. He ended by saying that he would be stepping down from maintenance of the File Checker.

Thierry then went on to present work done by Coriolis to investigate the File Checker and see the feasibility of continuing with the current version. Unfortunately, after investigation by software developers, it was suggested that the current File Checker would need to be refactored to be effective moving forward. Therefore, Thierry proposed moving towards the Coriolis file checker which is widely used by Copernicus Marine Service and other programs and actively updated (https://registry.opendata.aws/argo-gdac-marinedata/). It contains the following:

- A netCDF file format checker: a stable java engine and XML rule files
- A netCDF file content checker: a python code to check the contents of the variables

Before adopting it, Thierry proposed validating it by running it on the current GDAC files and compare the results to what the current File Checker gives. He also noted that the file checker should begin using the NVS tables to generate file checker rules, but that it should not be dependent on the NVS availability. Instead, the NVS tables will be downloaded with each update and the file checker will access them automatically. The goal is to finish this adaptation by 2024 Q1.

It was pointed out that the current file checker does not manage core, intermediate and bgc parameters, but the Coriolis file content checker could implement the check which would look for *_ADJUSTED, *_ADJUSTED_QC and *_ADJUSTED_ERROR for core and bgc parameters only and not for intermediate ones.

After some discussion where it was agreed that others could help with software development of the Coriolis file checkers and that the code could be downloaded and run by DACs, the proposal was accepted.

7. Real Time Data Management (core)

7.1 Timeliness of real time data delivery for all parameters on GTS and GDACs (Anh Tran)

Marine Environmental Data Section (MEDS) monitors the performance of Argo data transmission on the Global Telecommunication System (GTS). The sources of Argo GTS data are from the Department of Environmental and Climate Change Canada and Japan Meteorology Agency (JMA). MEDS regularly decodes the data BUFR sequence 3 15 003 and 3 06 037 and makes data available to the Global Temperature and Salinity Profile program as well. MEDS also generates the BUFR message index file and make it available to the community at ftp://ftp.isdm.gc.ca/pub/staff/tran/gts_bufr_stat/bufr_msg_index.txt

Between December 2022 and September 2023, on average 13545 BUFR messages were transmitted monthly on the GTS, of which 88% of the messages achieved the Argo target. 93% of the messages were from floats using Iridium satellite and 88% of these messages met the 12-hour target. For floats which used Argos satellite, 97% of these messages met the 24-hour target. If Argo considers revising its timeliness target from 12 down to 6 hours, approximately 82% of the existing Argo data would still meet this target.

Most DACs with DOXY floats relay data on the GTS using sequence 3 06 037 except INCOIS and JMA DAC. There is an error in encoding DOXY quality control flag in BUFR format for CSIRO, CSIO and Coriolis DAC. During the meeting, we decided to stop sending non-adjusted DOXY data. From now on, we'll only send DOXY adjusted data on the GTS using sequence 3 06 044 which allows negative values. DACs are asked to wait on sending DOXY adjusted data using sequence 3 06 044 until code can be shared to implement this properly.

7.2 Results of external monitoring of what data goes onto the GTS (V. Turpin)

The primary aim of this initiative is to evaluate the accuracy and reliability of the statistical data on GTS data flow, including timeliness, as provided by OceanOPS. The objective is to contribute valuable insights that can enhance the overall monitoring process. Additionally, our goal was to pinpoint areas where the Argo program could optimize its performance in terms of timeliness.

To achieve this, we conducted a comprehensive comparison between the computations performed by Anh Tran and the OceanOPS standard computations. The analysis revealed a noteworthy correlation between the two sets of results, affirming the robustness of OceanOPS' online monitoring of the GTS data flow. However, a consistent 5% offset was observed, suggesting potential areas for improvement.

Further investigation into the source of data, specifically examining GTS headers, uncovered an anomaly – the absence of the 'IOPJO5' header in the OceanOPS monitoring, while 'IOSX02' was erroneously included. This finding underscores the need for refining the data sources to enhance accuracy.

The secondary objective of our survey focused on identifying strategies to improve timeliness. The results indicate that implementing a standardized procedure to transmit data to the GTS every 3 hours across all DACs could significantly contribute to achieving the target of making 90% of Argo data available on the GTS within a 12-hour timeframe. This key insight offers a clear pathway for enhancing the efficiency of the Argo program in delivering timely and accurate data.

7.3 Transition from GTS to WIS2.0 (Megan Scanderbeg)

Megan Scanderbeg briefly mentioned that the GTS will be transitioning to WIS2.0 by 2030. So far, it appears that this will have little impact on the DACs as the same BUFR format is still accepted and National Weather Services, who mainly push Argo data onto the GTS, will develop the capability to send data onto WIS2.0.

The ADMT co-chairs, Jon Turton, Fiona Carse, and OceanOPS will continue to monitor the situation to see if it would be advantageous to make any changes in the future that would make Argo data available in a faster manner or in an easier to digest format. More information can be found here: WMO Information System (WIS) | World Meteorological Organization

8. Real time and near real time QC tests (core)

8.1 Update on Coriolis min/max test (Christine Coatanoan)

The different steps of the min/max procedure at the GDAC level were presented and an update of message delivery now allows DACs to get the messages with the correction twice a day (noon and midnight Paris time). The types of anomalies that continue to run through the Argo data stream were presented through a number of examples: interpolated bad position, obvious slight drift in RT and DM profiles, ASD drift, bad DM profile adjustment, and bad data on temperature and salinity. Two actions were proposed for DACs and Delayed Mode Operators : 1) DACs : to implement the results from the min/max test automatically as the messages are received (AOML is doing it and could maybe share its code with other DACs) and 2) PIs/DMOs : to check the index file with questionable floats detected by the min/max test and put the floats on greylist if needed (send request to DAC). Finally, the link to access the python codes of the Min/Max method was provided (Reference files and python code to run Min/Max QC test (seanoe.org)).

8.2 How to make min/max test results available to operational users (Annie Wong)

Feedback from communication with operational users suggested that there was some value in making the list of questionable floats identified by the min/max test available to external users, because they may be able to act on these results faster than the Argo PIs/DACs. Christine Coatanoan can provide this list in a csv file, available via ftp. This list will contain questionable floats identified by the min/max test that have not been greylisted. As soon as a questionable float is greylisted, it will be removed from this list. This supplemental list can then be used by external users together with all the other QC test results that can be found in the Argo data files.

8.3 Anomaly detection from altimetry (Christine Boone)

8.4 Improvement to real time quality control test 8 (Henry Bittig, Annie Wong)

Most of the real-time QC tests that are currently used in Argo came from the 1980s with application to XBT data. While they can effectively pick out bad data in simple vertical profiles, they can also penalize potentially good data in profiles with complex behaviors. As a reminder, the real-time QC flags are used for insertion of data on the GTS via BUFR. During DMQC, the RTQC flags in Argo data files are revised if the raw data have been flagged erroneously in real-time.

Test 8 is a test on PRES data sanity based on expected float behavior. With higher resolution data, the expected behavior needs refinement. Henry Bittig suggested improvements to RTQC Test 8. The suggested improved Test 8 is:

On ascent, a measurement fails the test if the pressure value V_1 is the same or larger than any previous value V_{pre} plus a plausible pressure reversal threshold, PRES_reversal, i.e.,

if $V_1 >= \min(V_{pre})$ + PRES_reversal is true, then V_1 fails the test.

On descent, a measurement fails the test if the pressure value V_1 is the same or smaller than any previous value V_{pre} minus a plausible pressure reversal threshold, PRES_reversal, i.e.,

if $V_1 <= \max(V_{pre})$ – PRES_reversal is true, then V_1 fails the test.

If a pressure value fails this test with PRES_reversal = 20 dbar, that pressure value should be flagged as bad with PRES_QC ‘4’.

For near-surface profiles, this test should be run from the deepest pressure to the shallowest pressure.

For all other profiles, this test should be run from the middle of the profile to the shallowest pressure, and from the middle of the profile to the deepest pressure. The middle of the profile is length(profile)/2.

When evaluating the updated test on the entire GDAC snapshot, the number of bad QC flags fell to about 1% as compared to 10% with the previous test, indicating real, but complex behavior.

The proposal was accepted. The improved RTQC Test 8 will be recorded in the next update of the QC Manual.

9. DAC Status

9.1 Discussion on DAC Actions

Megan Scanderbeg presented the status of DAC actions from ADMT-23 and was happy to report that three actions were completed by all DACs. Several others had partial completion and the high priority one was close to finished. However, several DACs did not have some of the actions assigned to them because they applied to RBR CTD floats, Deep floats or BGC floats which not all DACs have yet. In addition, only a small number of DACs are able to complete ADMT actions in a timely manner. Therefore, Megan presented the idea of an overhaul of the DAC processing chain.

She noted that the DACs developed 20 years ago with much simpler data formats, fewer float types and sensors and without the ease of collaborative code development and sharing. Much has changed since then and with the multitude of sensors, much more data per float and the advancement of tools like GitHub and containers, it is time to start thinking about improving the efficiency of the real time processing chain.

The overall vision presented was to develop a single real time processing chain that could be wrapped up into a container which any DAC could download and deploy either in the cloud or on a local machine. The code (in a modern, free language) would be maintained by various Argo people, as currently happens, but would only need to be implemented once and then DACs could immediately begin producing the updating files. This would make the processing chain more scalable, reliable and robust. However, it will be a large task to develop and implement which needs a task team to fully flesh out the vision.

There was a discussion afterwards with general feedback and ideas on some first steps to get the process started. Several actions were developed including:

- Forming a Task Team to oversee the scaling up of the Argo data system. This will include coordinating different aspects of the modernization process such as:
    - How best to serve Argo data in the could (ie storage format, cloud service, update frequency, etc)
    - Consider developing an internal storage format for decoded data and work with manufacturers to implement this
    - Work with software engineers to map out an implementation plan for upgrading the processing chain
    - Consider using containers for the real time processing chain that could be deployed locally or in the cloud
- Organize a DAC and super decoder workshop where processing chains are shared to find places where collaboration would be the most successful. Include discussions of a possible internal storage format and the development of a common dataset of several float types that could be used for testing purposes moving forward.
- Ask Thierry Carval to create a prototype container with the Coriolis real time processing chain and share this via GitHub for DACs to test out. The container could be run locally or on the cloud. DACs are asked to share feedback at AST and ADMT meetings.

10. Local Talks

10.1 Using Argo data to understand mesoscale eddies (Tatjana Rykova)

Tatiana gave a presentation on how Argo data can be used to understand mesoscale ocean eddies, including the details of processes within eddies. Results from three papers that use Argo data to understand eddies in the Tasman Sea were presented, including:

- A description of a new method, called feature Mapping, that uses Argo profiles that directly sample eddies to update the properties within the sampled feature. Feature Mapping is a post-processing method that is intended to be applied to ocean analyses or reanalyses to better align gridded products with observations. The details of Feature Mapping are described in a paper in Scientific Reports (Rykova 2023).
- An analysis of a case study when two warm-core eddies merge. Details of the merging event are evident in Argo, including the spiraling and subduction of water from the smaller, denser eddy around the larger, lighter eddy. Details of the case study are published in an article in Geophysical Research Letters (Rykova and Oke 2022).
- An analysis of the variability of properties in Tasman Sea eddies from Argo that showed a decadal cycle in the properties of eddies. Changes in the properties of Tasman Sea eddies appear to be determined by anomalies in surface fluxes in the Coral Sea.

11. Pilot data management

11.1 Deep Argo data: cpcor correction & DMQC status (Cecile Cabanes)

An update was provided on the status of real time and delayed mode corrections applied on deep Argo floats. As of October 2023, 373 deep floats have been processed by 6 DACs. Salinity profiles should be corrected with new Cpcor values (Cpcor corrects for cell compressibility). 81% of the salinity profiles were corrected with a new Cpcor value in either A or D mode, and 69% of the profiles in real time were corrected with a new Cpcor value. This is a significant improvement compared to last year for both A and D mode.

The majority of A-mode profiles were corrected using the new recommended Cpcor values (-12.5e-8 for the SBE61 and -13.5e-8 for the SBE41CP). Only a few A-mode profiles have been corrected using the optimized Cpcor provided by the PI. Instead, optimized Cpcor values are often used in D mode to correct salinity profiles, following the ADMT23 recommendation.

A few deep floats (17) in D mode don't have Cpcor correction information in the SCIENTIFIC_CALIB section and/or Cpcor is not corrected. DMQC operators should check the list of 17 floats that can be found here, and either correct the SCIENTIFIC_CALIB section or apply the Cpcor correction if necessary.

DMQC operators should continue to populate the spreadsheet with the optimum CPcor values obtained for each deep float. This spreadsheet can be found here: https://docs.google.com/spreadsheets/d/1ai1I0gzyHHRv_n6t2M3BMWVBp1F9XO4L2XB1YhBni9U/edit?usp=sharing

In the discussion, the need for individual values of cpcor provided by the manufacturers was mentioned. RBR is heading this way, SBS is also considering it. An update on this possibility will be asked at the next ADMT meeting.

11.2 Summary of Deep Argo QC workshop (Cecile Cabanes, Annie Wong)

A summary of the Deep Argo QC workshop held on 5-6 June 2023 was presented. Two important aspects of DMQC for Deep-Argo salinity data were discussed during this workshop:

- The estimation of a CPcor correction for salinity from SBE CTDs.
- The evaluation of sensor drift to the expected Deep-Argo salinity accuracy of 0.004.

About 24 participants attended and there was a mix of invited presentations and open discussions.

The main outcomes of this workshop were that the Argo delayed-mode groups are still at an experimental stage where various methods are being trialled, compared and evaluated, which are dependent on availability of reference data and concurrent shipboard CTD casts. As such, it is still too early for there to be a single recommended method. Instead, a github repo has been set up to facilitate interactive discussions with examples: https://github.com/euroargodev/dmqc_deep_examples

The two repos, DM_Cpcor and Deep_CTD_selection, have been consolidated under one repo: https://github.com/ArgoDMQC/Deep_Argo_DMTools

The lack of reference CTD data continues to be a limiting factor in Deep-Argo DMQC work. Therefore, the availability of high quality CTD data that are calibrated with bottle samples, taken at or close to deployment, would greatly improve the ability of Deep-Argo delayed-mode processing.

11.3 Proposal on how to indicate deep Argo profiles in the index lists (Megan Scanderbeg)

Megan Scanderbeg shared with the ADMT the AST's request to easily identify Deep Argo profiles in the data stream. While developing a proposal on how to do this, conversations with the Deep Argo Mission team identified two separate needs:

- Ability to identify Deep Argo floats for monitoring purposes
- Ability to identify Deep Argo profiles that are deeper than Core Argo profiles for scientific purposes

To fulfill these needs, the idea of a Deep Argo float profile index list was presented. Due to some Deep floats carrying oxygen, the general format could follow the synthetic profile index list. However, to make it easier to identify deeper profiles, it was suggested to add the deepest pressure measured during the profile. This will allow people to have both a list of Deep Argo floats (identified by their WMO_INST_TYPE) and the ability to select profiles deeper than their own desired pressure level. The proposal was accepted.

She also raised the possibility of adding DATA_MODE to the profile index list as tools have been developed based on the synthetic index list where PARAMETER_DATA_MODE is used to choose which profiles to select. While the name of the profile does at least indicate delayed mode data, the 'R' name could mean real time or adjusted data is present. It also means that users must parse the name of the file rather than read in a letter. In the discussion that followed, there was general agreement that the profile index list needs to be updated, but a format could not yet be agreed upon. Therefore, an action was taken to develop a proposal for an improved profile index list for presentation at ADMT-25.

Action: Add a Deep Argo index list that choses Deep Argo floats based on WMO_INST_TYPE. The list should mimic the synthetic profile list and include the deepest pressure level reached during the profile.

Action: Create homogeneous index lists that serve the entire Argo datastream with the understanding that this will replace the current index list.

11.4 RBR CTD update (Mat Dever)

An update on the status of the data from RBR sensors was provided. It included:

1. A review of the progress made on "argo monitoring", an internal tool to RBR to assist the ADMT in keeping metadata consistent, and to keep an eye on the health of the RBRargo fleet.

2. Results from the first Argo float equipped with onboard dynamic corrections were shown, with very encouraging results. All float manufacturers now support this option to transmit a corrected salinity, alongside the usual variables.
3. In response to the efforts made by Brian King to homogenize metadata format across manufacturers, RBR now distributes all metadata in a JSON file following the agreed upon format, directly on its website (oem-lookup.rbr-global.com)
4. The progress made on the dynamic corrections for the RBRargo|deep6k (Deep Argo RBR CTD), demonstrating its performance on field data, and emphasizing the fact that the data flow is identical to RBargo|2k data, only with different coefficients.
5. A review of the RBRcoda3 T.ODO oxygen optode was provided, demonstrating the performance across all key characteristics (accuracy, compressibility, time response, dynamic errors, stability, air calibration, and field validation).

The presentation was followed by a discussion on how to record data from floats sending two PSAL channels. It was agreed to add information in SPECIAL_FEATURES and to form a small working group to propose how to record salinity data coming from RBR floats reporting both onboard corrected salinity and raw, uncorrected salinity channels and report proposal at AST-25.

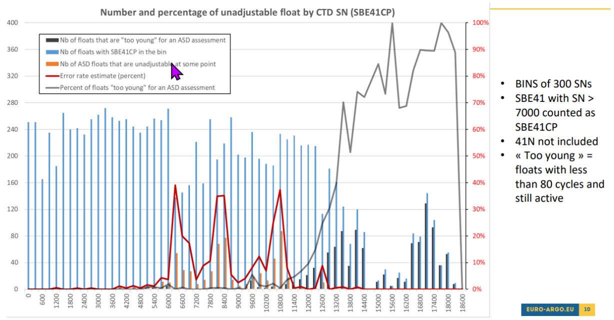
12. Delayed mode quality control (core)

12.1 SBE CTDs

12.1.1 Salty drifter spreadsheet update (Delphine Dobler on the behalf of the ASD WG - Birgit Klein, Claire Gourcuff, Matthew Alkire, Uday Bhaskar, Cecile Cabanes, John Gilson, Kanako Sato, Kamila Walicka, Susan Wijffels and Annie Wong)

The ASD analyses were updated with one more year of data:

- The global comparison to climatology still shows the three batches of CTD SNs affected with ASD, with no particular additional batches
- The ASD international spreadsheet has had 89 more entries since the last ADMT meeting.
  - These newly declared ASD floats mostly concern the SBE41CP warranty range with CTDs within [10482 - 11252] (+ 41 floats) and the launch year 2019 (from 4.2% in 2022 audit to 9.2% in 2023 audit; percentage with respect to the total number of cycles for floats deployed this year). Increase in lost cycles/additional floats since the last ADMT were highlighted. It was noted that an increase in lost cycles is due to both additional cycles from already declared ASD floats that are still active and to cycles from newly declared ASD floats.
  - There are 10 more floats after SN 11252 (for a total of 24 floats)
- While preparing meetings with SBS in early 2023, it occurred to the ASD working group that not all SNs in batches of 1000 SNs were mounted on Argo floats. So it was decided to compute the error rate relative to the number of effectively used SNs in the fleet. The new error rate assesses the relative percentage of ASD that have reached an unadjustable state with respect to the number of effectively used SNs in the fleet, by bins of 300 SNs. It shows that the three batches of affected floats locally reach an error rate of 35 to 40%. A small peak almost reaching 10% appears in the [12600 - 12900] range. The graphics also shows the number and percentage of “too young” floats for an assessment, ‘too young’ being defined by active floats with less than 80 cycles.



- Finally, the percentage of profiles with PROFILE_PSAL_QC equal to F (meaning the whole profile is QC 3 or 4) with respect to the profile year was presented. In 2022, it reached 16.4%, 2023 now shows a slight decrease, showing that the situation is improving.

The warranty process over the year was presented, in particular, the final warranty agreement, with details of cut-off cycle confirmed after AST-24, was recalled:

Floats with CTD SNs in the warranty range, that have reached unadjustable state before cycle 220, with a pro-rating depending on C2 (100% if C2 <100; 75% if < 130 and 50% if< 220).

Lists of affected floats were sent to SBS by Europe, SIO/UW/WHOI and JAMSTEC in January and March. CTDs effectively entering the warranty criteria were confirmed by Jochen shortly before ADMT. We are now waiting for the reception of certificates from SBS.

It has also been agreed that the list of floats will be updated in summer 2024 to account for floats that were too young at the time of the first assessment.

12.1.2 Warranty update from SBE (Jochen Klinke)

Jochen presented an update on the ASD sensors including a timeline showing the start of issue (manufacturing change in 2018) through to June 2024 when another fleet performance review will be done. He noted that the ASD recall is 85%, but that a few are still missing and he asks for those owners to get in touch with him ASAP to get the warranties issued. He reminded everyone of the ASD credit criteria which is based on cycles rather than pure age as some floats performed faster cycling. The warranty scale is sliding and starts at 100% for 100 or fewer good cycles performed and goes down to zero credit for a float performing more than 220 cycles or approximately 6 years of life. The far majority of warrantied CTDs got 100% credit as they failed prior to 100 cycles or about 2.5 years. 180 CTDs with ASD within the serial number recall range have been submitted to date with the majority being SBE 41cps. The US, Japan and France constitute 87% of the ASD warrants so far. Certificates will be provided by the end of November 2023 and the issue will be revisited in June 2024 to see if more certificates need to be issued. Countries with ASD sensors who have not submitted their list to SBS yet are encouraged to contact Jochen.

12.2 Other DMQC items

12.2.1 Initial asymptomatic adjustment of salinity (Birgit Klein, Cecile Cabanes)

A preliminary analysis was shown dealing with the magnitude and time scales of initial asymptotic salinity adjustments seen in SBS CTDs. The initial drift from too fresh readings towards higher salinities is associated with TBTO being flushed through the conductivity cell. A total of 207 floats from the Weddell Gyre were examined out of which 119 showed such behavior. The low levels of natural variability make the detection of small signals in the order of 0.003 possible.

As a simple diagnostic for the magnitude of the adjustment the salinity difference between the first cycle and a cycle approximately 100 days later is used. The resulting histograms show skewed distributions with high occurrences of values in the bins up to 0.005 adjustment. The percentage of floats with initial asymptotic adjustment seems to become more frequent in recent years. While prior to 2017 about 50% showed initial adjustment, numbers increased to 67% after 2017. Time series from deep floats deployed in the NE Atlantic showed similar behavior. Additionally the time series of salinity at park depth can be used to evaluate how the signal is flushed through the cell when the pump is activated.

More analysis from other quiet parts of the world ocean is welcome to support the findings from the Weddell Gyre. A Spreadsheet to share information is available at TBTO.xlsx.

Plots and other information can also be shared on github:

https://github.com/euroargodev/publicQCforum/issues/23.

12.2.2 DMQC status and statistics tool (Delphine Dobler, Romain Cancouët)

This tool aims at following-up the DMQC advancement of **a chosen set of floats** with specific information including data quality. Outputs are provided as both graphics and log textual files. The tool is developed in Matlab and is accessible on the euroargodev github repository:

https://github.com/euroargodev/DMQC_status_and_statistics

This script was originally created by Andrea Garcia Juan and Romain Cancouët, updated by Luca Arduini Plaisant and Delphine Dobler. It uses as inputs a list of WMOs, the index files (both the core and the synthetic one), and the grey list, and allows to check the DMQC status of the chosen set of floats for all parameters. It outputs 11 types of graphics and 4 types of textual logs. The various outputs were presented.

12.2.3 Update on status of D trajectory files (Megan Scanderbeg)

Megan Scanderbeg presented the number of D-trajectory files at the GDAC and their growth over time which has been slow. Most of the dmode files come from a couple of PIs, but other PIs were waiting for the v3.2 trajectory file format to be available. Now that the format has been implemented by many DACs, it is expected that more dmode trajectory files will begin appearing on the GDAC. It was suggested to revisit a dmode trajectory workshop at ADMT-25 when more DM operators have had a chance to try producing dmode trajectory files.

12.2.4 Definition of D trajectory file (Annie Wong, Jean-Philippe Rannou)

A definition of what constituted a Dtraj file was presented. This definition will be added to the QC Manual for CTD and Trajectory data.

12.3 DMQC reference database

12.3.1 CTD reference database updates (Christine Coatanoan)

Since ADMT-22, the version 2021_V02 was made available on the ftp site at the end of 2021. This version is getting old and it is time to move on to a new version with additional recent CTDs. Following the action #58 decided at the last ADMT (ADMT endorses the request to add CTD and Argo reference data with depth >700m in shallower regions), some studies showed the importance of new CTD profiles selected from the criteria of shallower than 700 dbar in some areas, like the Gulf of Mexico and Arctic Ocean. The boxes selected to take into account this new criteria were presented and are focused on polar areas and the Gulf of Mexico as well as the Labrador Sea. Christine was encouraged to get feedback from the Polar team to decide on the depth cutoff in the high latitudes boxes. Some feedback from users will also allow Christine to correct bad profiles still observed in some boxes. New CTD coming from OCL, CCHDO, and the EasyOcean product will be integrated in the next version which should be available by the end of this year.

13. Data access and communication

13.1 Regular updates on status of Argo data (Megan, Claire)

Megan Scanderbeg presented on behalf of the working group that has been considering how best to regularly update the Argo user community of the status of the Argo data system. She presented the general topics they are considering including in the yearly update:

- Data delivery
- Data quality
- Technology updates
- Format updates
- Data access updates
- How to stay up to date with Argo

She also mentioned that there should be flexibility in these to allow for additional important topics that come up. She presented the groups' thoughts on the format to deliver this update: either an emailed newsletter or a slide deck with annotations that could be downloaded and even recorded for people to watch. The plan is to produce this update soon after each ADMT meeting and to email it out and make it available on the Argo websites.

In the discussion that followed, there was not strong feedback either way on the format, but the general idea was strongly endorsed.

13.2 Update on interactions with modeling community to improve Argo data use (Peter Oke, Annie Wong, Breck Owens)

Peter Oke described ongoing efforts to better engage with the modeling community. The goal of these efforts is to promote best-practice use of Argo data and to solicit the modeling community to advocate for the Argo Program, especially the promotion of OneArgo. Peter described how Argo leaders are approaching this engagement, which includes presentations at various workshops and conferences (including OceanPredict, CLIVAR, and OOPC meetings), as well as smaller meetings with specific groups (e.g., UKMet, ECMWF). The smaller meetings have been most effective, with the opportunity to explain the relevant details to our data users. These efforts will continue. Some upcoming opportunities to promote best-practice use of Argo data and to promote the importance of Argo for forecasting include a special issue of Frontiers in Marine Science on "Demonstrating Observation Impacts for the Ocean and Coupled Prediction", and the "8th WMO Workshop on the impact of Various Observing Systems on Numerical Weather Prediction and Earth System Prediction".

The presentation was followed by a discussion on how CORA and EN4 producers actually update their products. We still need to check if they replace the data or simply append newly available data. The same question can also be asked for other types of data than Argo, and it could be interesting to include IQUAD in the loop.

13.3 Website updates (Thierry Carval, Megan scanderbeg, Orens de Fommervault)

Megan Scanderbeg presented on the data products and tools that were included in the National Reports submitted for ADMT. She suggested a reorganization of tools between the various Argo websites. Namely, she suggested removing all expert tools from the AST website and adding the appropriate ones to the DMQC ADMT website page and creating a new RTQC ADMT website page where such real time tools could be added. This should prevent most duplication and lessen confusion for new users looking for data access tools on the AST website. She left it up to BGC Argo to determine which tools would be included on the BGC Argo website.

She presented a draft of the float deployment best practices website and plans to publish it shortly after the meeting with the publication of the Argo Best Practices paper.

14. Monitoring by OceanOPS

14.1 Monitoring of BGC sensor behavior at OceanOPS (Orens de Fommervault)

This presentation is provided in response to action item #39 from ADMT-23. Since last year, relatively little progress has been made due to the absence of a dedicated working group and a shortage of internal resources within the OceanOPS team. However, it is acknowledged that this topic is classified as a priority and considered essential in the context of OneArgo for the BGC-Argo mission. OceanOPS would benefit from the support of an additional IT resource and the newly formed Technological Task Team for this matter. It is agreed that diagnostics developed by MBARI will be adapted and applied to the entire fleet. Initially, the general case will be implemented. A first version is scheduled to be presented at the AST meeting. It was mentioned that the data team should also be kept in the discussions.

14.2 Orphan floats (Orens de Fommervault)

This presentation first addresses the work performed by OceanOPS to monitor orphan floats. A consensus definition was recalled and approved (Orphan float = Floats that have no registered DM operator). From a situation of 100 orphaned floats a year ago, we have now reached zero, thanks to the update of the DMO list, the creation of DMCP, and community involvement in handling the identified "orphaned" floats. This situation should no longer be observed as this information has become mandatory for program registration.

Subsequently, the issue of "standby/forgotten profiles" was addressed. A definition was proposed, although there is no consensus on the generic term (Standby/Forgotten Profiles: = Floats whose DMCP is registered but has not produced D-files for a number of years). Standby/Forgotten profiles can now be tracked through the OceanOPS interface, thanks to the development of a dedicated tool, which was presented in detail. Graphs have also been created, and new developments can be considered based on the needs of the community. The creation of alerts is also a possibility. We would like to remind you that a CSV with all standby profiles after 3 years (October 2023) is available:

https://drive.google.com/file/d/1HJwW_wtYPJjvqpgOJNpA6TD77M0OV8nr/view?usp=sharing

In the discussion it was mentioned that some floats may still be in R mode because of early sensor failures, but it was reminded that these should be flagged as bad and put in Dmode. It was agreed that OceanOPS would develop a system to identify standby profiles and find a way to create list of profiles/floats to be picked up by DM operators at ADMT-25.

14.3 Monitoring of floats through DMQC with highest priority on floats on notification lists. Could these notifications be improved? & DM alert contacts (Victor Turpin)

The objective of this initiative was to conduct a comprehensive review of the intricate notification systems developed by OceanOPS over the years, with a specific focus on enhancing real-time information delivery to Argo operators and data managers. The table below succinctly outlines the diverse alerts, warnings, and notifications that OceanOPS provides to operators, program managers, and data managers.

It's crucial to emphasize that this notification system extends beyond data management, encompassing legal notifications related to deployment and drift in Exclusive Economic Zones (EEZ), as well as planning considerations. For the purpose of this discussion, our focus is solely on the last row of the table, addressing DMQC, deployment plans, and metadata notifications.

Notification , alerts, warnings	When / frequency	Who
Deployment Notification	At float notify at OceanOPS (save and notify)	Argo NFP
Aproaching EEZ	Once a week for float drifting 100nm of the EEZ of a identified country	Program managers
DMQC Atlimetry alerts	Twice a year, from cls, one message by floats	Program manager, delayed mode operators
DMQC Min/Max alerts	Monthly, from Coriolis, one message by floats	Program manager, delayed mode operators
Deployment plan reminder	2 months after deployment plan if not notified	Program manager, Operation manager
Metadata notification	On ad hoc basis to correct particular metadata	… Not sure… DMO probably

During the assessment, three key issues emerged:

1. Program managers and Delayed Mode Operators (DMO) received a high volume of messages, making it challenging to manage and keep track of them.
2. False alerts occurred, particularly when DMO received DMQC alerts for floats they did not manage.
3. There was a lack of an efficient mechanism for tracking feedback from DMO personnel.

In response to these challenges, OceanOPS proposes adapting the notification system with the following recommendations:

- **Suggestion 1:** Implement a system where Delayed Mode Contact Point (DMCP Core and DMCP Bio) receives a consolidated DMQC alert by program, rather than individual alerts for each float.
- **Suggestion 2:** Develop a publish-and-subscribe protocol to allow users to receive notifications based on their specific interests.

The implementation timeline involves adopting Suggestion 1 in 2024, with Suggestion 2 slated for integration in the coming years. This refined approach not only addresses the current issues but also streamlines the development of future notifications, such as technical alerts, environmental alerts, recovery notifications, BGC DMQC, and data assimilation feedback.

It's noteworthy that while these suggestions enhance the overall notification system, the specific issue of tracking DMO feedback is not directly addressed by these proposals, warranting further consideration in the ongoing refinement of the notification system.

14.4 OceanOPS investigation on why a small number of registered floats never send any data and update on aic@jcommops.org email address (Victor Turpin)

The primary objective of this initiative is to exert control over the OceanOPS database, comprehensively understanding and rectifying the status of floats that have been registered by operators but are not actively transmitting data. In the Argo monitoring dashboard on the OceanOPS website, this is denoted by the float status "REGISTERED."

Our investigation identified 29 floats, all deployed before September 1, 2023, registered at OceanOPS but currently not transmitting any data. This cutoff date was chosen during the survey to mitigate the risk of flagging floats with no apparent issues.

Each float was meticulously examined to unravel the underlying reasons for this inactive status. Out of the 29, 3 were found to be in ice, 6 featured experimental pressure sensors stored in the Aux file, 1 was erroneously reverted to operational status due to decoding errors, 3 faced deployment challenges and were subsequently returned to the planning phase (“CONFIRMED” status), 1 was closed with an unknown cause of failure, 4 had processing systems not yet implemented at the DAC, and 2 awaited DAC declaration as "CLOSED" after deployment. Additionally, 4 floats were switched to "INACTIVE" status. Only 5 floats (IDs: 4903675, 5906992, 6990535, 7901029, 1902609) remained problematic.

The exercise revealed the efficacy of the monitoring system implemented by Argo, as only a small fraction (29 out of 20,000) of floats fell into this category. However, the second noteworthy conclusion is that to proactively address such situations, an automated alert system should be established. For instance, triggering an alert for every registered float not transmitting data for more than two months could prompt an investigation to identify the underlying reasons for this situation. This proactive approach ensures the continuous maintenance of the Argo dataset at a consistently reliable status.

14.5 Sensor metadata review (Victor Turpin)

We have identified disparities in metadata between the GDAC and OceanOPS, particularly in crucial metadata such as float Serial Numbers, sensor and parameter metadata, and to a lesser extent, deployment location and date. While the discrepancies are not numerous, they are significant enough to warrant corrective actions.

These differences arise from variations in the registration procedures, where the meta.nc file serves as a live document, while registration at OceanOPS occurs only once. This investigation pertains to approximately 1200 floats within the historical fleet, constituting around 6% of all historical Argo floats. Notably, these floats exhibit inconsistencies in "essential" metadata, necessitating curation efforts at OceanOPS.

The importance of this endeavor cannot be overstated, as it directly impacts the quality and reliability of the Argo monitoring conducted at OceanOPS and the information disseminated to the broader Argo community and beyond.

Addressing this challenge is made possible through a collaborative effort involving OceanOPS, EuroArgo, and Coriolis teams. This ongoing collaboration exemplifies effective teamwork in ensuring the accuracy and coherence of Argo metadata. Furthermore, to maintain the integrity of our metadata, we have established a commitment to conduct this curation process before each Argo Data Management Team (ADMT) session.

By proactively addressing and rectifying these metadata discrepancies, we strive to uphold the highest standards of data quality, reinforcing the trustworthiness of the Argo monitoring system and enhancing the information provided to the global Argo community.

Check 1: “No sensor floats”

~900 floats registered at OceanOPS had no sensor model registered

- 614 floats have been updated with sensor_model from Coriolis data base
- 316 floats registered at OceanOPS have not sensor model neither at Coriolis
- 230 of them only exist at OceanOPS (WMO does not exist at Coriolis)

Action: Understand what are those floats and the history of the registration

11 of them exist at OceanOPS and Coriolis without any parameter's information (declared or effective)

Action: contact PI to get sensor information.

Check 2: Duplicate Sensor/SN

This is a regular error due to meta.nc uploading procedure. The following duplicate have been deleted from OceanOPS database:

- Same float, same sensor_model, same S/N

- Same float, same sensor_model, only one S/N
- Same float, similar sensors (SBE41 and SBE41CP)

Check 3: Comparison between observed and declared variable

Check that every float registered at OceanOPS has a corresponding sensor model declared attached to observed variables.

Action: to be done

Action: set up an internal warning when the declared variable does not match with observed variables.

Check 4: Deployment date, deployment location and float S/N comparison between Coriolis and OceanOPS

- Automatic monthly check
- comparison between Coriolis float S/N and OceanOPS float S/N
- comparison between deployment dates (threshold = 1 day)
- comparison between deployment location (threshold = 1 degree)

Duplicates in SN: be careful of re-deployed floats. This has to be considered by OceanOPS (it is not at the moment).

15. Format and Vocabulary issues

15.1 Update from machine readable metadata working group: provide feedback on draft format (Brian King)

Brian King reported on the work done with both SeaBird and RBR to develop a common JSON schema to make platform and sensor data available in a machine readable format to populate Argo meta fields. The idea is that sensor manufacturers would create a sensor JSON schema file which would be passed onto the platform manufacturers who could incorporate it into the platform JSON schema file. Both SBS and RBR are excited to participate in this path forward and the option will be shared with other manufacturers to see if they are willing to incorporate it into their business model. It would greatly benefit Argo as it would prevent typos and time consuming copying and pasting of information from numerous documents. It could also potentially check the entries in each controlled field with the corresponding Argo NVS reference table, making it able to pass the Argo File Checker.

He then pointed out several inconsistencies and issues discovered in the development process including a lack of consistency in the units associated with parameters in the Argo NVS tables, and issues in the SENSOR_* and PARAMETER* fields. Annie Wong and Catherine Schmectig agreed to investigate the units inconsistencies and improve the entries in the NVS table so that they accurately reflect what Argo wants. He also noted that a more rigorous audit of SENSOR and PARAMETER_SENSOR is needed to make sure there is a unique entry for each situation.

The current plan is for the platform and sensor metadata JSON schema to be finalized and then for manufacturers to start implementing it right away. SeaBird is ready and RBR is nearly ready to do so. Brian King will reach out to other manufacturers as well to gauge their interest and ability to produce Argo sensor or platform metadata JSON files.

In the discussion, the question of other networks practices was asked. It was agreed that the subject would be passed to OCG.

15.2 European metadata audit and curation (Delphine Dobler, Romain Cancouët, Vincent Bernard, Kamila Walicka and Magali Krieger)

An audit was performed on some metadata fields. The starting purposes were the ASD analyses and the identification of recovered floats. In both contexts, we found a few issues in CTD model and/or SNs (inhomogeneous naming conventions or sometimes errors), leading to more complex and more time spent for analyses.

The following checks were performed:

- Consistency between the sensor model and SN content in the Argo GDAC and in the OceanOPS database
- Consistency between CTD_PSAL and CTD_TEMP SNs
- CTD SN range consistency
- Duplicated CTD and PRES SNs (duplicates assessed with respect to the whole fleet)
- Non-numerical CTD and PRES SNs (i.e. prefixed by 41-, 41_, 41CP- or 41CP_)
- Missing CTD / PRES SNs
- Accounting for SBS correspondence file and associated John Gilson 2019's audit
    - Consistency between Pressure sensor model / SNs range with launch date
    - Correspondence pres model /sn with CTD SN according to the SBS file
    - Consistency between CTD calibration date and float launch date
- Checks for float SN = CTD SN (mis-matched on some APEX when both numbering were close)
- Missing PI names
- Greater than 5° difference in deployment longitude/latitude between OceanOPS and GDAC (use of profile location information and Cruise Summary Report to curate) (1-digit error, sign error, other).

This work necessitated a large collaboration (390 email exchanges, 40 people, various organizations). The curations were performed both in the GDAC (and Coriolis database) and in the OceanOPS database. The number of curations almost reached 800 for the GDAC. These curations were mainly related to the pressure sensor information (480), but also some were related to CTDs (102), some to the float SN (naming conventions; 138), and a small number to deployment positions (59), PI_names (6), etc.. The number of curations reached 1360 for OceanOPS.

15.3 GitHub workflow overview (Claire, Megan and Thierry)

After reminding the ADMT of the role of the Argo Vocabulary Task Team (AVTT) and the progress made so far in constraining the Argo vocabulary using the Nersc Vocabulary Server (NVS), Claire presented the workflow in place to continue this work. She recalled that it was agreed at last ADMT-23 to negotiate changes to Argo vocabularies using the https://github.com/nvs-vocabs/ArgoVocabs/ space ("dashboard view" of the same space available here: ttps://github.com/orgs/nvs-vocabs/projects/2) and that the former GoogleDoc has become obsolete. She then showed how to use GitHub to submit vocabulary changes to Argo through "issues", and how to follow and participate in the discussions. For minor change requests the approval is made by the AVTT, while major changes should gather consensus through discussions within the ADMT either via emails or directly on the GitHub repository (preferred). Once a vocabulary change is approved, the Argo User Manual is updated and the change is made in the NVS by the editors. The individual GitHub repositories dedicated to each Argo Reference Table will be merged into the main repository (ArgoVocabs/) for easier management. A documentation page on how to use AVTT dashboard has been created on the ADMT website: http://www.argodatamgt.org/Documentation/Argo-vocabulary-server, where the Reference Tables editors as well as the slides showed by Claire will be also be added after ADMT24.

Once all Argo Reference Tables will be published on the NVS, the file checker will be updated to manage NVS vocabularies, using a regular export (to avoid blocking argo files in case the NVS is down for any reason). At the time of the ADMT24 meeting there were 33 open issues (12 “Todo”, 12 “In progress”, 7 “AVTT approval”). It was also agreed to move forward with setting up a separate GitHub to capture non AVTT ADMT tickets as suggested. It was noted that the GitHub repository should be restricted to authorized persons (consult with Dirk).

Thierry then presented the NVS dashboard and reviewed the tickets that were requesting ADMT approval (5 tickets):

- PREDEPLOYMENT_CALIB_DATE (Brian, Thierry)

The proposal was approved. The date has to be the most recent one in case of re-cal (previous dates will be stored in the .json file)

DACs can implement it (it will pass the file checker because file checker ignore new fields).

- SENSOR_MODEL / SENSOR_FIRMWARE_VERSION

(see below, presentation from Megan)

- SENSOR_STATUS

There was a discussion about advertising experimental sensors. It is not recommended, but OCeanOPS needs controlled vocabulary for their monitoring. The decision was to reject experimental sensors in R25, to use SPECIAL_FEATURES and use L22 to control the vocabulary.

- DEPLOYMENT_PLATFORM (Thierry Carval)

The proposal was accepted: use the ship name, followed by the uri (universal resource identifier) of the ship. If there is no code for the ship one can leave the field blank.

- PI Name field (Thierry Carval)

A table was created in the NVS with unique PI names. Some concerns were raised regarding possible privacy issues. It was agreed that the ADMT co-chairs would send an email to the AST mailing list to inform about this and request feedback. If no one reacts it will be accepted and we will continue this way.

It was clarified that in the github repository, the tickets can be moved from the “In progress” column to “ADMT approval requested” by the ticket owner, or anyone from the AVTT once some discussions occurred and it is considered as mature enough.

15.4 Project Name proposal (Victor Turpin)

The status of the discussion is available here: https://github.com/nvs-vocabs/ArgoVocabs/issues/5

The population of PROJECT_NAME is currently unconstrained and seemingly used for 2 different concepts

- Time-limited ‘projects’ e.g. EU “MERSEA”, French “SOCLIM”
- Ongoing ‘Argo programmes’, e.g. British “Argo UK”, American “Argo UW”

This results in difficulty to use this metadata for monitoring and filtering applications. This result also resulted in errors in the OceanOPS float registrations.

We propose the following change to the Argo format.

- (1.) Add an entry for "PROGRAM NAME" in the table of sections 2.2.4 ; 2.3.4 ; 2.4.4 of the (Argo user manual)
- (2.) Update the definition of "PROJECT_NAME" in the table of sections 2.2.4 ; 2.3.4 ; 2.4.4 of the (Argo user manual)

(1.)
PROGRAM_NAME | char PROGRAM_NAME(N_PROF, STRING64);
PROGRAM_NAME:long_name = "Name of the program";
PROGRAM_NAME:_FillValue = " "; | The overarching program(s) of which the dataset is a part. A program consists of a set of related and possibly interdependent projects (PROJECT_NAME) that meet an overarching objective.
A program defines a group of floats managed by the same lead agency. It materializes the implementing, operating, and responsible team.
PROGRAM_NAME are managed by OceanOPS, the list of acceptable PROGRAM_NAME types is in the reference table: "ref table". Detailed definition of PROGRAM_NAME is available here. Example : “Argo India” or "Argo GO-BGC, UW" |

(2.)
PROJECT_NAME | char PROJECT_NAME(N_PROF, STRING64);
PROJECT_NAME:long_name = "Name of the project";
PROJECT_NAME:_FillValue = " "; |
Name of the projects which operates the profiling float that performed the profile. Multiple projects can be separated by commas. Example : “GYROSCOPE, GMMC”; |

15.5 Updated definition for SENSOR_MODEL & separation of sensor firmware version (Megan, Claire)

Megan Scanderbeg presented the plan moving forward for SENSOR_MODEL. As many have noted, this meta field has grown over time with each new sensor firmware version for some sensors making it difficult to effectively monitor sensor performance. The issue has been discussed on GitHub with people from within the ADMT as well as manufacturers and consensus has been reached on how to move forward. She presented the GitHub issue’s proposal to separate SENSOR_MODEL and SENSOR_FIRMWARE_VERSION which would mean improving the definition of SENSOR_MODEL and fully defining SENSOR_FIRMWARE_VERSION.

The NVS table for SENSOR_MODEL (R27) will need to be updated to reflect the actual sensor models after discussion with the manufacturers. The other entries will be deprecated. SENSOR_FIRMWARE_VERSION will not be constrained.

When this work has been completed, DACs can begin implementing the changes. When DACs are ready, the file checker will be updated to use R27 rather than the current spreadsheet version and DACs can begin going back to reprocess older files to become compliant.

The proposal was accepted.

15.6 Status of NVS version of Argo ref tables (Violetta Paba)

Presented by: Violetta Paba, BODC-NOC (UK). vpaba@noc.ac.uk

Action item 32: *NVS task team to clearly identify Editors* – DONE. Editors’ list available in the landing page of the ArgoVocabs GitHub repo: https://github.com/nvs-vocabs/ArgoVocabs

Action item 33: *NVS Argo team to finalise transition of last tables to allow GDAC FileChecker upgrade* – DONE. R14 and R18 now on the NVS. R28 and R40 were also created. BATTERY_TYPE, BATTER_MAKER, ENDING_CAUSE and ENDING_CAUSE_CATEGORY are work in progress.

Action item 35: *NVS/AVTT team to show how to best access the NVS Argo reference tables via the API* – DONE (human), WIP (machines). Users: https://vocab.nerc.ac.uk/search_nvs/ . Editors: https://vocab.nerc.ac.uk/editor/. Machines: https://vocab.nerc.ac.uk/sparql/; example Jupyter Notebook file 'm2m_NVS_sparql.ipynb' was uploaded to https://github.com/nvs-vocabs/ArgoVocabs. M2M users: please share your requirements here: https://github.com/nvs-vocabs/ArgoVocabs_Meetings/issues/9

Action item 36: *Ask NVS team for M2M solution to find identical sensors, even if the name has been changed* – WIP. 'SYN' mappings can be created between identical concepts. Requirements needed: https://github.com/**nvs-vocabs**/ArgoVocabs_Meetings/**issues**/10. For M2M solutions, SPARQL queries can be built and shared by BODC.

BODC plans for upcoming year: in summary, BODC will be providing support through the wider internal Vocabulary Management Group to ADMT users and AVTT editors. Support includes: providing M2M solutions; collect feedback; review and implement Editors' NVS edits; and maintain Argo NVS GitHub space. BODC seeks to strengthen collaborations and secure new funding to keep enhancing the Discoverability, Accessibility and Interoperability of the Argo programme through new and improved semantics solutions.

16. Special Interests

16.1 Background on float sampling report (Steve Riser)

Steve Riser reported on the work done by the Argo Sampling Committee over the past year whose job was to investigate:

1. The effects of nonstandard timing of Argo profiles
2. The effects of high-frequency sampling for BGC purposes on the lifetime of the Argo array
3. The vertical resolution of profile sampling associated with BGC variables, especially in the context of radiometers
4. The possibility of park-depth sampling of variables beyond temperature and pressure

He stated that many floats deployed in the past two years have not carried out random sampling at all times of the day. Instead, there is a preference for standard profiling times, sometimes around noon, but at other times as well (*TOD sampling*). He showed an example of a UW float that has been programmed to sample every 10 days plus 1.92 hours which means it takes 13 months for the floats to cycle through one day of surface arrival times. He noted that it is possible to systematically examine phenomena that occur on time scales faster than the nominal Argo period of 10 days when using space-time averaging, but this only works if the timing of the profiles are uniformly distributed throughout all times of the day. This was demonstrated by Johnson and Bif (2021), but they could only use about 30% of the profiles due to non-randomness of profile times. This non-uniform sampling throughout the day could also lead to bias in estimating ocean temperatures.

The group's recommendations:

1) All Argo floats should be set to sample at approximately 10 days (ie 10.08 days, but not a divisor of 24 hours), drift at 1000m and profile to 2000m, whenever possible. The goal should be to obtain an even distribution of surfacing time. In general, floats should not use TOD sampling.
2) This approximate 10 day sampling should be implemented on all floats in the future. For some float types, this may mean a change in the manufacturer's default settings prior to deployment.
3) Present floats using some other protocol yielding non-uniform sampling should be changed to the approximate 10-day protocol as soon as it is feasible, using two-way communication (if possible).

4) Float users and manufacturers should work together to ensure that these changes are implemented in the proper manner.

BGC variables were then examined for preferred sampling time and some (NO3, pH) had no preference, while O2 and FLBB somewhat prefer the dark and the radiometer has a strong desire for noon sampling. This was the strongest preference and the group came up with the following recommendations to accommodate this preference:

5) Add one full 0-2000m noon profile per month. This would be additional profile and all surrounding profiles would stay with regular sampling strategy.

6) Flag these profiles in the database so that they can be easily removed if not wanted for certain studies.

7) Set the radiometer to sample at the maximum practical rate near the surface during ascent.

The final topic considered was park-level sampling and here are the group's recommendations:

1) All BGC-Argo floats should sample temperature, pressure and FLBB (or equivalent) hourly during the park-phase.

2) Salinity and nitrate would be useful, but they consume too much energy for this to be practical.

3) The radiometer could also provide useful sampling during park depth, but more discussion is needed.

During the ensuing discussion, there were questions about how or if some float types can technically be adjusted to add an additional noon profile per month. The AST asked for more exploration into this topic. It also recommended that the working group continue to study how often the radiometer needs to sample during drift. Overall, the AST agreed to endorse the recommendations about cycling frequency and the noon profile every 1 -2 months.

The default sampling should not be 10 days, and it was agreed that AST and ADMT chairs will bring that to the manufacturers.

16.2 How to flag Time of Day profiles in the data system (John Gilson, Megan Scanderbeg)

John presented on follow up work he did based on Steve Riser's sampling report to audit the Time of Day information contained in the Ago netCDF files. First he reported on the separate audit he just performed to look at Time of Day profiles based on surfacing time of the profile and found results broadly similar to Steve Riser's results. He was mostly unable to confirm in the meta file that these floats were programed to perform time of day sampling. He found that many core floats show Time of Day sampling behavior and that the issue is not limited to BGC floats. He reiterated the request that DACs/float owners follow the sampling committee's recommendation of sampling at a 10.2 or some other fraction of days to prevent floats from always surfacing at the same time of day.

Next he looked in the meta files to see how time of day missions could be recorded and recommended the following DAC action:

Please add the TOD CONFIG settings to the meta netCDF (values at deployment as well as modifications via 2-way comms). Include indication if the TOD CONFIG is off/disabled (Define as = -1). This requires no change to the netCDF structure nor asks DACs to do a task beyond what was already expected.

However, just filling in the meta config variables related to time of day sampling is not enough to determine if a profile is truly trying to repeatedly target a specific time of day since some float models use those same configs to nudge the float into sampling at different times of the day. Therefore an additional action is requested:

Add a general alert string to the CONFIG_MISSION_COMMENT of 'TOD_SAMPLING_ALERT', for any mission that results in unbalanced diurnal sampling (e.g. TOD firmware on and actively targeting a single local surfacing time, OCR extra noon-time surfacing, etc.).

John will do another audit prior to ADMT-25 to check on progress.

16.3 Tool for Provor floats to comply with sampling recommendations (Chris Gordon)

The code for automatically updating NKE PROVOR surfacing times is available on github: ArgoCanada/provor-auto-param-update: Python code to automatically update the target surface timing of NKE PROVOR floats after they report a profile (github.com)

Argo Canada has made a significant effort to ensure good time-of-day coverage from its floats in the last 2 years (read more: Diversifying Argo Surfacing Times). As part of that effort, a protocol using python and github actions was developed to update the surfacing time of NKE PROVOR floats after each cycle.

PROVOR floats use a time of day parameter along with cycle time to determine their surfacing time. With other floats, setting the cycle time to say, 10 days plus 5 hours, would result in a different surfacing time with each cycle. With PROVOR floats however, because the time of day parameter controls the surfacing time, it must be updated after each cycle in order to achieve good time of day coverage throughout the lifetime of the float. This parameter can be reprogrammed remotely, but doing so manually quickly becomes impossible to manage for even a few different PROVOR floats.

For floats that have radiometry sensors, it is best to sample at local noon. To both comply with varying time of day and operate the float to more frequently profile at local noon time, the user can define for example a list of times for the float to cycle through that includes extra noon time profiles.

16.4 Storing ice evasion reporting (Esmee, John Gilson)

AST-24 asked the ADMT to consider how to add information to the Argo dataset to indicate if a float has "*detected ice*".

Polar Argo arrays comprise 252 active floats in the Southern hemisphere and 96 floats in the Northern hemisphere. Twelve countries deploy 12 different float types in the Southern hemisphere and 10 countries deploy 8 different float types in the northern hemisphere leading to a diverse array of under-ice information returned by floats. There are now a variety of software-based methods of ice avoidance plus hardware approaches (ice guards) to improving float longevity in ice. Polar floats return useful under-ice data, however this ice-related information is often missing in the netCDF files and/or not consistent across float models/DACs. The Ice Working Group aims to improve the ice-related information available to users.

The Ice Working Group came up with several recommendations:

1) Important Ice Algorithm CONFIG should be fully implemented in the meta netCDF (launch and mission changes; apply to all floats with the Ice-Algorithm firmware)

Ice Algorithm status transmitted by floats should be fully implemented in the tech netCDF:

- Inconsistently placed in the tech netCDF, sometimes placed in aux directory
- Working Group will confirm the correct CONFIG/TECH names/values
- Standard CONFIG meta and Tech netCDF handling, no new requirements for DACs.
- Audit on progress next year
- For several float types, important information is not as easily accessed as it could be

Requested Action Item:

- Ask manufacturers if ice-algorithm information can be transmitted in a more standard, more accessible way (e.g. enabled/disabled via simple value versus IceMonths hex; APEX/NAVIS info only in log file)

2) Ice Working Group plans to ask for ADMT acceptance of a new variable with details to be released within the year.

One new variable (BASIC and EXTENDED scheme, based on 1-1 mapping of tech/config)

Ø BASIC:

- Does the float have an ice-algorithm firmware?

- Is the ISA enabled/disabled?

- Did the ISA get tripped in a cycle?

Ø EXTENDED: What 'fork'/'test' of the ISA caused the float not to surface?

o Naming of categories (generic? based on existing names? How to future-proof?)

o Are the different float models 'mapped' to shared values? How?

o APEX/Navis: status value returned in the log files.

- Do DACs have access to the log files? - Have they developed code to use these files?

Appropriate netCDF file: trajectory, profile or tech file?

• Non-unanimous preference for the trajectory based upon the traj files use case and flexibility in representing the data.

• Polar Argo Mission Team feedback is a preference for the profile netCDF based upon ease of use and likely wider uptake by the user community.

• A solution suggested at ADMT was to put the new variable in the trajectory file and also have a summary index file (i.e. a super index file) which contains information on whether a profile was under ice.

3) Floats with Ice Hardware*:*

- There is not an optimized location within the present netCDF to communicate specialized hardware (SPECIAL_FEATURES variable catchall is possible but not preferred).
- Would need to store information like: Hardware Type (e.g. IceGuard_Pole, IceGuard_Loop, IceGuard_Eggbeater), Manufacturer, etc.
- Prefer to Add to the meta netCDF name, i.e. "CONFIG_IceGuardHeightOffsetFromPressureSensor_cm" (to record offset of pressure sensor from top of ice guard) "CONFIG_IceGuardType_int"
- New configuration parameter names will be added to the current list.

16.5 Discussion on how to handle user group requests

Megan Scanderbeg began the short discussion by noting that as more people start using the data, more requests are coming in for additions to the Argo dataset. She proposed that these requests should be as specific as possible, backed up with scientific reasoning, and go through the AST who can then evaluate whether it would be useful to ask the ADMT to investigate the feasibility. After investigation by the AST and the ADMT a decision will be made as to how to respond to the requests, with the understanding that they may not be granted or may be granted in a different manner than originally requested.

In the discussion, it was noted that communication should be open between the AST, ADMT and user group making the request to help determine how best to implement it.

17. Argo Regional Centres

17.1 Atlantic (Cecile Cabanes)

An update on Atlantic ARC activities was provided. This year, the quality of the CTD reference database in the A-ARC region has been checked, focusing on the deepest layers. A simple Matlab tool was developed to visualize and select suspicious profiles in 10° x 1° boxes. So far 761 suspicious profiles have been detected in the North Atlantic and it is planned to check the South Atlantic soon. The list of all suspicious profiles will be sent to Christine Coatanoan and will be removed from the new release of the reference CTD database.

The ISAS20 product (T,S monthly field and new DOXY climatology) https://www.seanoe.org/data/00412/52367/) has been released as well as an update of the ANDRO velocity atlas (https://www.seanoe.org/data/00360/47077/).

17.2 Pacific Ocean (Kanako Sato)

JAMSTEC operates the PARC website. There are two things that have progressed in this year. One is the addition of two new products from China to the PARC website as well as the AST website. One is a global ocean gridded data set of temperature from IAP, using Argo profile and other profile data. The other is the trajectory data set of CSIO. The other is to share information about the Pacific Deployment Coordination Group for Argo floats and its activities. Its aim, its meeting reports and its members are on PARC website. You can also see figures to help with planning of Argo float deployments by JAMSTEC. These figures are the results of particle tracking from the location of active floats to estimate the location of about 1, 2, and 3 years after now, using G-YoMaHa which is objectively mapped velocity at 1000 dbar derived from trajectories of Argo floats. These will be updated several times a year. Because the particle tracking is run under some assumptions, it is a rough estimate as the first step. But, it will help determine where to deploy floats. The documentation of the particle tracking is on PARC website.

17.3 Indian Ocean (Uday)

Uday reported on work done at the Indian Ocean Argo Regional Center including:

- Deployment and coordination of Indian Argo program.
- BGC-Argo floats
    - Worked with gain and offset to correct Chla.
    - Gridded product of BGC-Argo profile data.
- Performing DMQC of ASD floats.
- Data Search and archeology (CTD for DMQC)
- Mirroring Float data pertaining to India and other countries.
- Continued generation of gridded and value added products.
- Monitoring data use in terms of papers and PhDs.
- Conducting Data Awareness campaigns and user interaction workshop.
- Data outreach through LAS and ERDDAP.

17.4 MedArgo (Antonella Gallo)

MedArgo is the Argo Regional Centre for the Mediterranean and the Black Sea and OGS coordinates its activities. More than 92000 profiles were acquired in Mediterranean and Black seas from 2000 to October 2022, about 4600 profiles are collected up to September 2023. 16 new floats were deployed: 5 core-Argo, 4 core-Argo with DO, 1 BGC-six sensor float and 6 BGC floats with less than 6 sensors. Regarding the performance of the fleet, the mean half-life is about 150 cycles for all floats. In detail, floats with Iridium telemetry systems have a mean life much larger than floats with Argos telemetry systems. This confirms that less time spent at the surface to transmit data reduces the risk of losing the float. Looking at the vertical distance (only upward profiles) traveled by floats, 50% of floats reach 900 m depth. This is important for DMQC purposes since CTD and Argo reference profiles have to be shallower than this depth. The rate of population change related to the number of yearly deployments and dead floats, is constant in the last years due also to the decreasing of the dead rate. OGS performed the DMQC activity for the Argo physical data. The DMQC analysis is applied to 86% of the eligible floats deployed between 2003 and 2022 in the Mediterranean and Black Seas. 12% out of this percentage were quality controlled but the D-files were not sent to GDAC yet. This percentage includes analysis that has to be repeated due to limitations related to the reference dataset or floats that are too shallow. The DMQC report/info of each float can be downloaded by the MedArgo web page. OGS continues to improve and implement the DMQC procedure for Core and Deep Argo floats, in particular it has started to implement the PCM (Profile Classification Model) method in the Mediterranean sea. In the framework of the European H2020 Euro-Argo Rise project, the DMQC qualitative analysis was also conducted on the shallow-coastal floats deployed in the Mediterranean Sea. The high-quality ship-based CTD reference data from the near-surface to depths more than 2000 m, for QC purposes of Core and Deep-Argo float data in the Mediterranean and Black seas, was reviewed and improved.

There are 68 active Argo floats in the Mediterranean Sea and 10 in the Black Sea as of 11 October 2023. The aim is to maintain at least 60 active floats, with ~20-25% BGC and Bio and 2 deep floats in deep Ionian & Rhodes Gyre area for Mediterranean Sea and 10 active floats, with ~20% Bio & TS DO for Black sea.

17.5 Southern Ocean (Kamila Walicka)

Currently, the SOARC Argo group still has not found a replacement of the group lead to carry on and coordinate the activities within the group. Despite that, SOARC group members continue to carry on the ARC activities independently focusing on developing tools and interaction with scientific users. However, SOARC activities are constrained by very limited funding from the national projects. The progress made by the particular SOARC group members include:

UK Argo in 2023 deployed 14 floats <45S and expected to deploy another 23 floats later in 2023 and early in 2024. Moreover, **BODC** attended the 10th EuroGOOS conference (October 2023, Galway, Ireland), supported OGS in implementation of the DMQC-PCM software, and contributed to the DMQC discussion meetings led by CSIRO.

SOCCOM in 2023 deployed 35 floats in the SO. They published The Southern Ocean carbon and climate observations and modeling (SOCCOM) project: A review (Sarmiento et al., 2023) which highlights the history & observing system design, as well as key scientific research findings that have come out of it. They have made 12-month Southern Ocean pH mapped product prepared based on the BGC Argo floats data from 2014. This product has been compared with the ship-based measurements showing a decrease in pH of up to 0.02 per year. pH changes are widespread with varying magnitudes reflecting the pattern of the meridional overturning circulation. Thus comparison of this new BGC-Argo mapped pH estimate to historic observations allows quantifying the structure of Southern Ocean acidification.

AWI, In the Weddell Sea there is an array of moored RAFOS sound sources so you can acoustically track under ice floats. The AWI team developed new A*rtoa4Argo* software allowing creating trajectories for RAFOS floats. In 2024 they plan to shift the RAFOS sources to the continental shelf break to map AABW (Antarctic Bottom Water) pathways. As well as 18 new floats are planned to be deployed.

BSH, their activities were focused on the deployments and interaction with the scientific users. They join the project with the Norwegian Polar Institute to deploy 3 BGC floats in early 2024. Deployments are planned on a supply cruise for the Norwegian Antarctic station at Jutulsessen from Troll transect. Additionally, float 7900517 from Argo Germany drifted shortly before winter into the area of Cosmonaut Bay when a huge persistent polynya was observed. The float was reprogrammed to do short shallow cycles and park at 200 dbar to help collect data on 'supercooling' and instabilities.

CSIRO, in 2023/2023 deployed in the SO 21 floats below 40S. Their key challenges are the increase in float process which may reduce the number of purchased floats in the following year. Moreover, they identified technical issues with the floats bladder causing some loss of data in floats not able to surface high enough to telemeter. CSIRO, (Tatiana Rykova has been leading regular DMQC discussion group meetings for DMQC operators of core Argo floats.)

18. Review of action items (Plenary session)

The action items proposed during the 3 days of the plenary ADMT were reviewed and agreed. As agreed during the meeting, the actions status will be tracked on github: https://github.com/OneArgo

19. Other ADMT business

A general discussion was held to get ADMT thoughts about scaling up the Argo data system as introduced earlier in the week.

The need to include the AST in the discussion was raised. Two aspects were discussed: the way to collaborate for sharing pieces of code, and the possibility for DACs to process codes from other DACs using “containers”. On the first aspect, possible ways to progress practically were discussed, starting with concrete collaborations already existing (e.g. within the US for Solo floats, between Coriolis and BODC, between CSIRO, CSIO and INCOIS, etc.). Github can be a powerful tool for collaborative coding, and the need for one big OneArgo github to gather the various independent existing repositories was mentioned.

Thierry shared a “mind map” to help identify the various aspects to be considered: https://www.mindmeister.com/app/map/2950722831?t=5GeDmUlmmN

Another example of code sharing is BUFR encoder: key component was agreed upon file format input.

The idea of having an internal sharing format other than NetCDF was proposed.

It was agreed that Coriolis would make its processing chain available on a container so that other DACs could test it. Thierry explained the concept of “container”: a container is made to be activated on a virtual machine. You need a configuration file that lists all resources to run your software. The container is a package that wraps your software, librairies, in/out pathways etc. up and is activated on an infrastructure.

20. Upcoming Meetings

20.1 AST-25

The AST25 meeting will be hosted by NOC in Southampton, on the week 18-22 March 2025.

20.2 ADMT meeting in 2024

It was agreed during the meeting that the ADMT25 meeting would be held in Europe, with options in Trieste (Italy) and Brest (France). It was confirmed in November that it will be held in Trieste, Italy, hosted by OGC, on the week 20-25 October 2024.

20.3 Workshops

An Argo Technician’s Community of Practice meeting will be hosted by the University of Washington on 9 – 13 September 2024. (more information here).

21. Annex 1 Agenda

Link to google drive for ADMT-24 with presentations and reports

Start time		duration	Presentation	Speaker	Link
CET time	AEDT time				
MONDAY					
			Introductory session		
23/10/2023 00:00	23/10/2023 09:00	00:10	Welcome	Ken Johnson, Herve Claustre	
			DAC BGC Status Updates		
23/10/2023 00:10	9:10 AM	00:10	Australia	Gabriela Pilo	
23/10/2023 00:20	9:20 AM	00:10	Canada	Anh Tran, Chris Gordon	
23/10/2023 00:30	9:30 AM	00:10	China	Xiaogang Xing	
23/10/2023 00:40	9:40 AM	00:10	Europe	Thierry Carval	
23/10/2023 00:50	9:50 AM	00:10	India	Uday	
23/10/2023 01:00	10:00 AM	00:10	Japan	Chihiro	
23/10/2023 01:10	10:10 AM	00:10	UK	Clare Bellingham	
23/10/2023 01:20	10:20 AM	00:10	US	Tanya Maurer, Claudia Schmid	
23/10/2023 01:30	10:30 AM	00:30	**Discussion**		
23/10/2023 02:00	11:00 AM	00:30	BREAK		
			New sensors and Sensors updates		
23/10/2023 02:30	11:30 AM	00:15	Trident Sensors	Giorgio Dall'Olmo / Edouard leymarie	
23/10/2023 02:45	11:45 AM	00:20	CDOM calibration announcement (SBS) - tentative	Eric Rehm	
23/10/2023 03:05	12:05 PM	00:15	hyperspectral radiometry (data quality, differences between APEX and PROVOR floats)	Edouard Leymarie	
23/10/2023 03:20	12:20 PM	00:10	UVP	Catherine Schmechtig	
23/10/2023 03:30	12:30 PM	01:00	LUNCH BREAK		
23/10/2023 04:30	1:30 PM	00:20	Double Chloro sensor	Antoine Poteau	
23/10/2023 04:50	1:50 PM	00:10	RINKO ARO-FT update	Kanako Sato	
23/10/2023 05:00	2:00 PM	00:20	SBE83 response time lab experiments	Yui Takeshita	
23/10/2023 05:20	2:20 PM	00:20	pH sensor development, performance	Johnson / Takeshita	
23/10/2023 05:40	2:40 PM	00:20	Introduction of new technical task team - terms of ref, objectives	Yui Takeshita / Edouard Leymarie	
23/10/2023 06:00	3:00 PM	00:30	BREAK		
			Documentation		
23/10/2023 06:30	3:30 PM	00:20	CHLA and BBP	Catherine Schmechtig	
23/10/2023 06:50	3:50 PM	00:20	pH and NITRATE	Tanya Maurer	
23/10/2023 07:10	4:10 PM	00:30	BGC QC document : Status of WMO BUFR, PSAL recovering, HISTORY QC	Wong, Schmechtig, Bittig	
			BGC BUFR templates for GTS		
23/10/2023 07:40	4:40 PM	00:20	Status of WMO BUFR format for BGC parameters	Jon Turton, Fiona Carse	
23/10/2023 08:00	5:00 PM		**END OF MEETING**		
TUESDAY					
24/10/2023 00:00	24/10/2023 09:00	00:30	Feedback from the DMQC workshop	Maurer, Schmechtig	
24/10/2023 00:30	9:30 AM	00:30	DOXY: intercomparison of the O2-correction tools (LOCODOX, Sage-O2 and Henry's one) and pressure effect	Virginie Thierry	
24/10/2023 01:00	10:00 AM	00:10	When to end acceptance of v3.1 b-trajectory files for BGC floats	Annie, Thierry, Megan	54
24/10/2023 01:10	10:10 AM	00:20	Code sharing and tools for the community (argopy , update the DOXY DM tools to the new trajectory file ...)	Guillaume, Henry, Virginie, Tanya... (TBC)	
24/10/2023 01:30	10:30 AM	00:30	pH pump offset correction dev (RT/DM)	Plant / Maurer	
24/10/2023 02:00	11:00 AM	00:30	BREAK		
			QC		
24/10/2023 02:30	11:30 AM	00:10	CHLA DM : available library of synthetic profiles Ed490 and PAR for every floats with satellite matchups + Renosh's routines	Catherine Schmechtig	
24/10/2023 02:40	11:40 AM	00:20	CHLA (RT) Slope map	Raphaelle Sauzede	
24/10/2023 03:00	12:00 PM	00:20	Calculating chl-slopes based on satellite/flt crossovers, monthly climatology	Jacki Long, Yui Takeshita	
24/10/2023 03:20	12:20 PM	00:10	Workflow to determine the best BGC-Argo CHLA_ADJUSTED dataset	Raphaelle Sauzede	
24/10/2023 03:30	12:30 PM	01:00	LUNCH BREAK		
24/10/2023 04:30	1:30 PM	00:20	Status update and feedback on parameter audits	Plant, Sauzede	
24/10/2023 04:50	1:50 PM	00:20	Summary status of flagging and QC across DACs and BGC array		
24/10/2023 05:10	2:10 PM	00:20	Suggested actions (TBD)	Tanya, Annie, Josh, Raphaelle, Catherine	
24/10/2023 05:30	2:30 PM	00:30	Interaction with BGC scientific users	Carolina Amadio	
24/10/2023 06:00	3:00 PM	00:30	BREAK		
24/10/2023 06:30	3:30 PM	01:00:00	Final Discussion and planning	All	
24/10/2023 07:30	4:30 PM		**END OF MEETING**		
WEDNESDAY					
24/10/2023 00:00	24/10/2023 09:00	00:10	Welcome & Objectives of the meeting	ADMT co-chairs	
24/10/2023 00:10	9:10 AM	00:20	Feedback from AST-23	S. Wijffels, B. King	
24/10/2023 00:30	9:30 AM	00:20	Status of Action Items from ADMT-23	M. Scanderbeg	
			GDAC Data Management & Archiving Argo data		
24/10/2023 00:50	9:50 AM	00:15	Operational status of Argo GDACs	Thierry Carval, Mike Frost	
24/10/2023 01:05	10:05 AM	00:20	Argo archive & serving Argo data from the cloud	Tim Boyer, Thierry Carval	
24/10/2023 01:25	10:25 AM	00:30	Discussion on moving GDACs to the cloud & need for one or two GDACs		
24/10/2023 01:55	10:55 AM	00:15	GDAC File Checker status and update	Mark Ignaszewski, Thierry Carval	1, 2, 3, 21, 33
24/10/2023 02:10	11:10 AM	00:30	BREAK		
			Real Time Data Management		
			GTS		
24/10/2023 02:40	11:40 AM	00:25	Timeliness of Real Time Data Delivery for all parameters on GTS and GDACs	Anh Tran, V. Turpin	
24/10/2023 03:05	12:05 PM	00:20	Results of external monitoring of what data goes onto the GTS	V. Turpin, BGC ADMT co-chairs, Thierry Carval, Anh Tran, Molly	38
24/10/2023 03:25	12:25 PM	00:15	Transition from GTS to WIS2.0	?	

24/10/2023 03:40	12:40 PM	01:00	LUNCH BREAK		
			Real time and Near real time QC tests		
24/10/2023 04:40	1:40 PM	00:20	Update on Coriolis min/max test	Christine Coatanoan	
24/10/2023 05:00	2:00 PM	00:20	How to make min/max test results available to operational users	Annie, Christine Coatanoan	
24/10/2023 05:20	2:20 PM	00:20	Anomaly detection from Altimetry	Christine Boone	
24/10/2023 05:40	2:40 PM	00:20	Improvement to real time test 8	Henry, Annie	
24/10/2023 06:00	3:00 PM	00:30	BREAK		
			DAC Status		
24/10/2023 06:30	3:30 PM	00:30	Discussion on DAC Actions and needs	ADMT co-chairs to introduce discussion	4 - 18, 25
			Local Talks		
24/10/2023 07:00	4:00 PM	00:20	Using Argo data to understand mesoscale eddies	Tatjana Rykova	
24/10/2023 07:20	4:20 PM	00:20	Development of a low cost, bladderless, shallow buoyancy engine	Pat McMahon	
24/10/2023 07:40	4:40 PM		**END OF MEETING**		

THURSDAY					
25/10/2023 00:00	25/10/2023 09:00	00:15	Deep Argo data: cpcor correction & DMQC status	Cecile Cabanes	29, 30
25/10/2023 00:15	9:15 AM	00:15	Summary of Deep Argo QC workshop	Annie, Cecile	
25/10/2023 00:30	9:30 AM	00:15	Proposal on how to indicate deep Argo profiles in the index lists	Megan Scanderbeg	AST action item
25/10/2023 00:45	9:45 AM	00:15	RBR CTD update	Mat Dever, Annie Wong	25
			Delayed mode quality control		
			SBE CTDs		
25/10/2023 01:00	10:00 AM	00:15	Salty drifter spreadsheet update	D. Dobler, B. Klein	
25/10/2023 01:15	10:15 AM	00:15	Warranty update from SBE	Jochen Klinke	
			Other DMQC items		
25/10/2023 01:30	10:30 AM	00:15	Initial asymptotic adjustment of salinity	Cécile Cabanes	
25/10/2023 01:45	10:45 AM	00:10	DMQC status tool	Delphine Dobler	
25/10/2023 01:55	10:55 AM	00:10	Update on status of d traj files (groups that produce them)	Megan	27
25/10/2023 02:05	11:05 AM	00:10	Definition of D-trajectory v3.2 file	Annie, Tanya	
25/10/2023 02:15	11:15 AM	00:30	BREAK		
			DMQC reference databases		
25/10/2023 02:45	11:45 AM	00:15	CTD reference database updates	C. Coatanoan, CCHDO	58
			Data access and communication		
25/10/2023 03:00	12:00 PM	00:15	Regular updates on status of Argo data	ADMT co-chairs	47, 48
25/10/2023 03:15	12:15 PM	00:15	Update on interactions with modeling community to improve Argo data use	Peter Oke, B. Owens, A. Wong	45, 47, 48
25/10/2023 03:30	12:30 PM	00:15	Website updates	Thierry Carval, Megan Scanderbeg	20, 46, 49, 50
25/10/2023 03:45	12:45 PM	01:00	LUNCH BREAK		
			Monitoring by OceanOPS		
25/10/2023 04:45	1:45 PM	00:15	Monitoring of BGC Sensor behavior at OceanOPS	O. de Fommervault	39
25/10/2023 05:00	2:00 PM	00:10	Monitoring of floats through DMQC with highest priority on floats on notification lists. Could these notifications be improved? & DM alert contacts	V. Turpin, Christine, Birgit, Claire	40
25/10/2023 05:10	2:10 PM	00:15	Orphan floats: which are they and who will DMQC them?	O. de Fommervault	31, 41, 43
25/10/2023 05:25	2:25 PM	00:10	OceanOPS investion on why a small number of registered floats never send any data and update on aic@jcommops.org email address	V. Turpin	44, 37
25/10/2023 05:35	2:35 PM	00:10	Sensor metadata review	V. Turpin	
			Format and Vocabulary issues		
25/10/2023 05:45	2:45 PM	00:30	Update from machine readable metadata working group: provide feedback on draft format	Brian King	59
25/10/2023 06:15	3:15 PM	00:10	European metada audit and curation	Delphine Dobler	
25/10/2023 06:25	3:25 PM	00:30	BREAK		
			GitHub AVTT dashboard items for discussion		19
25/10/2023 06:55	3:55 PM	00:10	Github workflow overview	ADMT co-chairs, Thierry	
25/10/2023 07:05	4:05 PM	00:15	Floats ending cause vocabulary #26 (github.com)	Thierry Carval	
25/10/2023 07:20	4:20 PM	00:15	DEPLOYMENT_PLATFORM : unambiguous ship name and codes (github.com)		
25/10/2023 07:35	4:35 PM	00:15	The PI_NAME field is current free-text and unconstrained (github.com)	Thierry Carval	
25/10/2023 07:50	4:50 PM	00:15	PROJECT_NAME proposal	Victor Turpin	
25/10/2023 08:05	5:05 PM	00:15	Updated defition for SENSOR_MODEL & separation of sensor firmware version	Megan Scanderbeg, Claire, Annie	
25/10/2023 08:20	5:20 PM	00:15	Status of NVS version of Argo Reference Tables & plan for upcoming year	Violetta Paba	32, 33, 35, 36
25/10/2023 08:35	5:35 PM	00:05	**END OF DAY**		

FRIDAY					
26/10/2023 00:00	26/10/2023 09:00	00:15	Storing ice evasion reporting	Esmee, John	AST action
26/10/2023 00:15	9:15 AM	00:10	Background on float sampling report	Steve Riser	
26/10/2023 00:25	9:25 AM	00:20	How to flag time of day profiles in the data system for those who want to remove them from their analyses.	John Gilson, Megan Scanderbeg	AST action
26/10/2023 00:45	9:45 AM	00:10	Tool for Provor floats to comply with sampling recommendations	Chris Gordon	
26/10/2023 00:55	9:55 AM	00:30	Discussion on how to handle user group requests		
26/10/2023 01:25	10:25 AM	00:30	BREAK		
			Argo Regional Centres		
26/10/2023 01:55	10:55 AM	00:15	Atlantic	Cecile Cabanes	
26/10/2023 02:10	11:10 AM	00:15	Mediterranean Sea	Antonella Gallo	
26/10/2023 02:25	11:25 AM	00:15	Pacific Ocean	Kanako Sato	
26/10/2023 02:40	11:40 AM	00:15	Indian Ocean	Uday Bhaskar	
26/10/2023 02:55	11:55 AM	00:15	Southern Ocean	?	
26/10/2023 03:10	12:10 PM	01:00	LUNCH BREAK		

26/10/2023 04:10	1:10 PM	00:30	**Review Action Items**		
26/10/2023 04:40	1:40 PM	00:20	Other ADMT business		
			Upcoming Meetings		
26/10/2023 05:00	2:00 PM	00:05	AST-25	Brian King	
26/10/2023 05:05	2:05 PM	00:10	ADMT meetings in 2023		
26/10/2023 05:15	2:15 PM	00:15	Workshops in 2023-2024		
26/10/2023 05:30	2:30 PM		**END OF MEETING**		

BGC-ADMT Meeting

octobre 24

	Link to google drive for ADMT-24 with presentations and reports			
	admt-24-meeting-bgc Slack channel			
Start time	duration			
Time is EST		**QC**		
9:00 AM	00:30	Feedback from the DMQC workshop	Maurer, Schmechtig	
9:30 AM	00:30	DOXY: intercomparison of the O2-correction tools (LOCODOX, Sage-O2 and Henry's one) and pressure effect	Virginie Thierry	
10:00 AM	00:10	When to end acceptance of v3.1 b-trajectory files for BGC floats	Annie, Thierry, Megan	54
10:10 AM	00:20	Code sharing and tools for the community (argopy , update the DOXY DM tools to the new trajectory file ...)	Guillaume, Henry, Virginie, Tanya... (TBC)	
10:30 AM	00:30	pH pump offset correction dev (RT/DM)	Plant / Maurer	
11:00 AM	00:30	BREAK		
		QC		
11:30 AM	00:10	CHLA DM : available library of synthetic profiles Ed490 and PAR for every floats with satellite matchups + Renosh's routines	Catherine Schmechtig	
11:40 AM	00:20	CHLA (RT) Slope map	Raphaelle Sauzede	
12:00 PM	00:20	Calculating chl-slopes based on satellite/flt crossovers, monthly climatology	Jacki Long, Yui Takeshita	
12:20 PM	00:10	Workflow to determine the best BGC-Argo CHLA_ADJUSTED dataset	Raphaelle Sauzede	
12:30 PM	01:00	LUNCH BREAK		
1:30 PM	00:20	Status update and feedback on parameter audits	Plant, Sauzede	
1:50 PM	00:20	Summary status of flagging and QC across DACs and BGC array		
2:10 PM	00:20	Suggested actions (TBD)	Tanya, Annie, Josh, Raphaelle, Catherine	
2:30 PM	00:30	Interaction with BGC scientific users	Carolina Amadio	
3:00 PM	00:30	BREAK		
3:30 PM	1:00:00 AM	Final Discussion and planning	All	
4:30 PM		**END OF MEETING**		

ADMT-24 EXECUTIVE MEETING

octobre 24

zoom

Start time	duration	Presentation	Speaker
Time is AEDT/UTC+11			
5:00 PM	02:00	ADMT-24 executive meeting	
7:00 PM		END OF MEETING	

ADMT-24 DAY 1 SCHEDULE

octobre 25

Link to google doc with ADMT-24 Agenda and Notes **admt-24-meeting Slack Channel**

Link to google drive for ADMT-24 with presentations and reports

Start time	duration	Presentation	Speaker	ACTIONS
Time is AEDT/UTC+11		**Introductory session**		
9:00 AM	00:10	Welcome & Objectives of the meeting	ADMT co-chairs	
9:10 AM	00:20	Feedback from AST-23	S. Wijffels, B. King	
9:30 AM	00:20	Status of Action Items from ADMT-23	M. Scanderbeg	
		GDAC Data Management & Archiving Argo data		
9:50 AM	00:15	Operational status of Argo GDACs	Thierry Carval, Mike Frost	
10:05 AM	00:20	Argo archive & serving Argo data from the cloud	Tim Boyer, Thierry Carval	
10:25 AM	00:30	Discussion on moving GDACs to the cloud & need for one or two GDACs		
10:55 AM	00:15	GDAC File Checker status and update	Mark Ignaszewski, Thierry Carval	1, 2, 3, 21, 33
11:10 AM	00:30	BREAK		
		Real Time Data Management		
		GTS		
11:40 AM	00:25	Timeliness of Real Time Data Delivery for all parameters on GTS and GDACs	Anh Tran, V. Turpin	
12:05 PM	00:20	Results of external monitoring of what data goes onto the GTS	V. Turpin, BGC ADMT co-chairs, Thierry Carval, Anh Tran, Molly	38
12:25 PM	00:15	Transition from GTS to WIS2.0	?	
12:40 PM	01:00	LUNCH BREAK		
		Real time and Near real time QC tests		
1:40 PM	00:20	Update on Coriolis min/max test	Christine Coatanoan	
2:00 PM	00:20	How to make min/max test results available to operational users	Annie, Christine Coatanoan	
2:20 PM	00:20	Anomaly detection from Altimetry	Christine Boone	
2:40 PM	00:20	Improvement to real time test 8	Henry, Annie	
3:00 PM	00:30	BREAK		
		DAC Status		
3:30 PM	00:30	Discussion on DAC Actions and needs	ADMT co-chairs to introduce discussion	4 - 18, 25
		Local Talks		
4:00 PM	00:20	Using Argo data to understand mesoscale eddies	Tatjana Rykova	
4:20 PM	00:20	Development of a low cost, bladderless, shallow buoyancy engine	Pat McMahon	
4:40 PM		**END OF MEETING**		

ADMT24 DAY 2 SCHEDULE

octobre 26

Link to google doc with ADMT-23 Agenda and Notes
Link to google drive for ADMT-24 with presentations and reports

admt-24-meeting Slack Channel
Link to ADMT-23 draft meeting report

Start time	duration	Presentation	Speaker	ACTIONS
Time is AEDT/UTC+11		**Pilot data management**		
9:00 AM	00:15	Deep Argo data: cpcor correction & DMQC status	Cecile Cabanes	29, 30
9:15 AM	00:15	Summary of Deep Argo QC workshop	Annie, Cecile	
9:30 AM	00:15	Proposal on how to indicate deep Argo profiles in the index lists	Megan Scanderbeg	AST action item
9:45 AM	00:15	RBR CTD update	Mat Dever, Annie Wong	25
		Delayed mode quality control		
		SBE CTDs		
10:00 AM	00:15	Salty drifter spreadsheet update	D. Dobler, B. Klein	
10:15 AM	00:15	Warranty update from SBE	Jochen Klinke	
		Other DMQC items		
10:30 AM	00:15	Initial asymptotic adjustment of salinity	Cécile Cabanes	
10:45 AM	00:10	DMQC status tool	Delphine Dobler	
10:55 AM	00:10	Update on status of d traj files (groups that produce the	Megan	27
11:05 AM	00:10	Definition of D-trajectory v3.2 file	Annie, Tanya	
11:15 AM	00:30	BREAK		
		DMQC reference databases		
11:45 AM	00:15	CTD reference database updates	C. Coatanoan, CCHDO	58
		Data access and communication		
12:00 PM	00:15	Regular updates on status of Argo data	ADMT co-chairs	47, 48
12:15 PM	00:15	Update on interactions with modeling community to improve Argo data use	Peter Oke, B. Owens, A. Wong	45, 47, 48
12:30 PM	00:15	Website updates	Thierry Carval, Megan Scanderbeg	20, 46, 49, 50
12:45 PM	01:00	LUNCH BREAK		
		Monitoring by OceanOPS		
1:45 PM	00:15	Monitoring of BGC Sensor behavior at OceanOPS	O. de Fommervault	39
2:00 PM	00:10	Monitoring of floats through DMQC with highest priority on floats on notification lists. Could these notifications be improved? & DM alert contacts	V. Turpin, Christine, Birgit, Claire	40
2:10 PM	00:15	Orphan floats: which are they and who will DMQC them?	O. de Fommervault	31, 41, 43
2:25 PM	00:10	OceanOPS investion on why a small number of registered floats never send any data and update on aic@jcommops.org email address	V. Turpin	44, 37
2:35 PM	00:10	Sensor metadata review	V. Turpin	
		Format and Vocabulary issues		
2:45 PM	00:30	Update from machine readable metadata working group: provide feedback on draft format	Brian King	59
3:15 PM	00:10	European metada audit and curation	Delphine Dobler	
3:25 PM	00:30	BREAK		
		GitHub AVTT dashboard items for discussion		19
3:55 PM	00:10	Github workflow overview	ADMT co-chairs, Thierry	
4:05 PM	00:15	Floats ending cause vocabulary #26 (github.com)	Thierry Carval	
4:20 PM	00:15	DEPLOYMENT_PLATFORM : unambiguous ship name and codes (github.com)		
4:35 PM	00:15	The PI_NAME field is current free-text and unconstrain	Thierry Carval	
4:50 PM	00:15	PROJECT_NAME proposal	Victor Turpin	
5:05 PM	00:15	Updated defition for SENSOR_MODEL & separation of sensor firmware version	Megan Scanderbeg, Claire, Annie	
5:20 PM	00:15	Status of NVS version of Argo Reference Tables & plan for upcoming year	Violetta Paba	32, 33, 35, 36

ADMT-24 DAY 3 SCHEDULE

octobre 27

Link to google doc with ADMT-23 Agenda and Notes **Link to ADMT-23 draft meeting report**
Link to google drive for ADMT-24 with presentations and reports
admt-24-meeting Slack Channel

Start time	duration	Presentation	Speaker	ACTIONS
Time is AEDT/UTC+11				
		Special interests		
9:00 AM	00:15	Storing ice evasion reporting	Esmee, John	AST action
9:15 AM	00:10	Background on float sampling report	Steve Riser	
9:25 AM	00:20	How to flag time of day profiles in the data system for those who want to remove them from their analyses.	John Gilson, Megan Scanderbeg	AST action
9:45 AM	00:10	Tool for Provor floats to comply with sampling recommendations	Chris Gordon	
9:55 AM	00:30	Discussion on how to handle user group requests		
10:25 AM	00:30	BREAK		
		Argo Regional Centres		
10:55 AM	00:15	Atlantic	Cecile Cabanes	
11:10 AM	00:15	Mediterranean Sea	Antonella Gallo	
11:25 AM	00:15	Pacific Ocean	Kanako Sato	
11:40 AM	00:15	Indian Ocean	Uday Bhaskar	
11:55 AM	00:15	Southern Ocean	?	
12:10 PM	01:00	LUNCH BREAK		
1:10 PM	00:30	**Review Action Items**		
1:40 PM	00:20	Other ADMT business		
		Upcoming Meetings		
2:00 PM	00:05	AST-25	Brian King	
2:05 PM	00:10	ADMT meetings in 2023		
2:15 PM	00:15	Workshops in 2023-2024		
2:30 PM		END OF MEETING		

22. Annex II - ADMT24 Action List

The action items are managed on the following github repository: https://github.com/OneArgo/ADMT

23. Annex IV - National Reports

Argo National Data Management Report – Australia, October 2023

Peter Oke[1], Joel Cabrie[2], Annie Foppert[3], Lisa Krummel[2], Jenny Lovell[1], Pat McMahon[1], Gabriela Pilo[1], Tatiana Rykova[1], Christina Schallenberg[1], Peter Strutton[3], Roger Scott[1], Dirk Slawinski[1], Esmee Van Wijk[1]
[1]CSIRO, [2]BoM, [3]UTAS

1. Real Time Status

Deployments

Between September 2022 and September 2023, we deployed 47 floats. Of these floats, 4 were BGC floats with six BGC sensors, and 43 were core floats. We deployed 2 buddy pairs (Altos with RBR sensors, buddied up with floats with SBE41 sensors), and the other 6 Altos with RBR sensors deployed did not have buddy pairs. A map of deployment locations, showing float types, is presented in Figure 1. We have deployed more Arvors (NKE) this year than in the previous years. All recently deployed BGC-Argo floats are Provor floats.

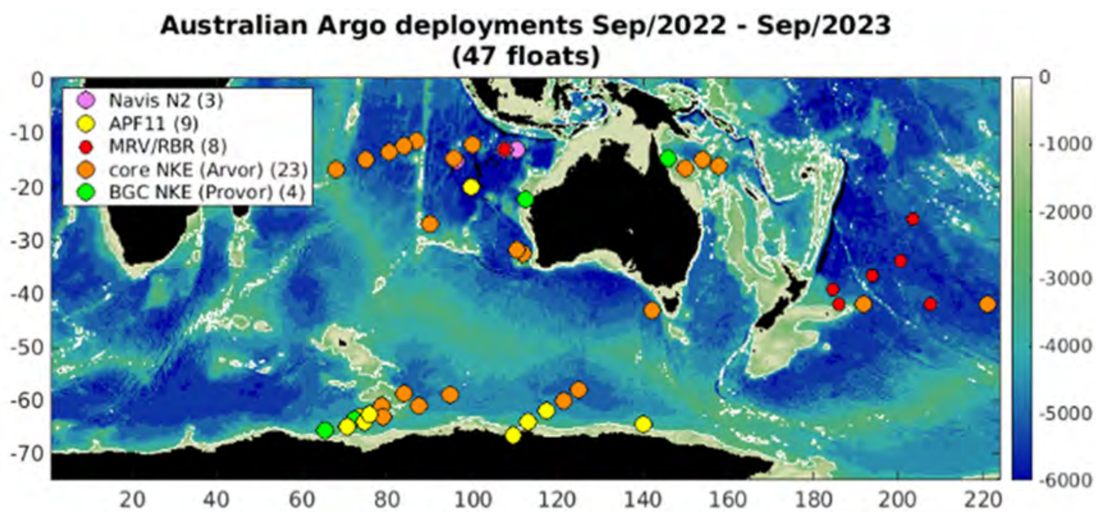


Figure 1: Map showing deployments between October 2022 and October 2023.

We have recovered two end-of-life BGC floats east of Tasmania; they're being refurbished and we plan to redeploy them within the next 12 months in the East Australian Current.

Overall, the biggest impediment to growing the Australian BGC-Argo fleet is cost. The nitrate sensor has become prohibitively expensive – to the point that we're refraining from purchasing any more of these sensors for our floats for the time being. We're also not buying any more pH sensors for the moment because we have seen such high failure rates (7 out of 12 on our live floats).

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 to process data received from the RUDICS server and it requires regular manual intervention. Our Python-based system has more stability, is more portable, and does not require a paid user license. The Python-based system can process data from floats communicating through either the RUDICS server or via SBD. Both systems are run at CSIRO, and the Matlab system is also 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, to maintain consistency through the life of a float, we continue to process some floats through the Matlab-based RT system. Currently, data from almost 50% of our operational floats are being exported to the GDACs from the Python-based RT system and this fraction will increase as the older floats end.

Both Matlab and Python RT systems perform real-time adjustment of salinity. We now routinely apply the PSAL offset value saved by the DMQC operator to data in the RT systems.

In total, we manage 332 operational floats, including 317 core floats, 3 deep floats, and 12 BGC floats. Our effort to support the BGC floats is disproportional to the float numbers. The complexity of BGC floats means that about half the time supporting our RT system (i.e., code support) is dedicated to BGC.

Data issued to the GTS

Currently, the Australian Fleet has 332 operational floats, including 317 Core, 12 BGC, and 3 Deep floats. Of the 12 operational BGC floats, all have six BGC sensors – however the pH sensor failed on 7 of our BGC floats. Parameters pushed to the GTS are P, T, S and DOXY.

We run our Matlab-based system every 3 hours, four times a day at CSIRO and four times a day at the BoM – with execution at the two locations offset by 3 hours; and we run our Python-based system every 3 hours at CSIRO. Real-time data delivery, after real-time QC is applied, is summarised in Figure 2 and 3. Of all Iridium BUFR bulletins reported during October 2022-October 2023, 99.43% were submitted within 12 hours of observation time; and 97.40% were submitted within 6 hours. We no longer have any operational floats that communicate using Argos.

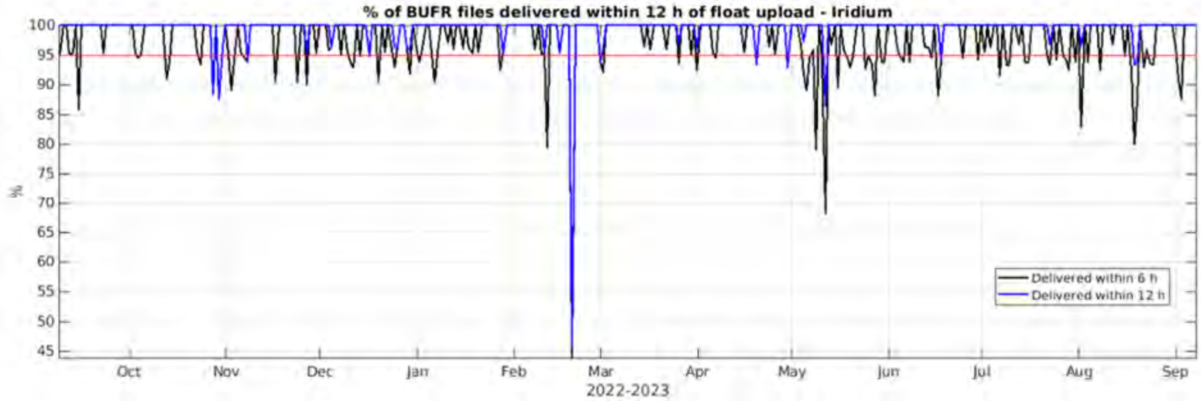


Figure 2: Percentage of BUFR files delivered within 12 (blue) and 6 (black) hours after data being received by the float, for floats with RUDICS communications between September 2022 and September 2023. Floats with SBD comms are not included in this measurement, but BUFR files from floats with SBD are also transmitted.

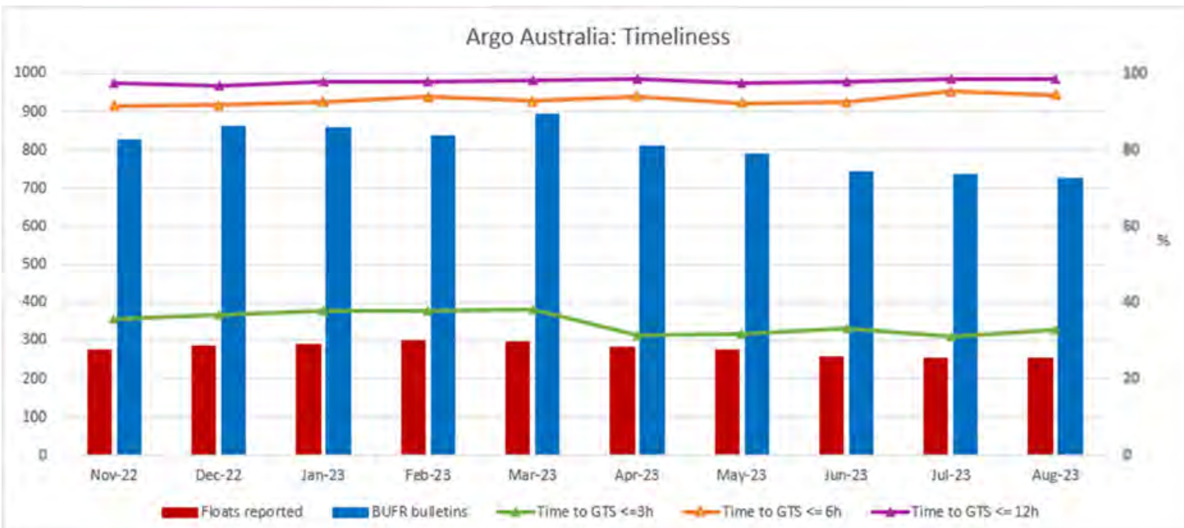


Figure 3: Timeliness of Argo Australia BUFR files reaching the GTS

Real Time QC status

For core floats, real-time QC is applied (P, T, S) and real-time adjustment is made to S based on DMQC offset values. For BGC floats, real-time QC and adjustments are performed on DOXY, NITRATE, PH and CHLA. We hope to soon apply real-time QC to BBP data. We are also working on improved nitrate calculations (from the UV spectra) with the recently updated calibration coefficients. Our DOXY adjustments are still calculated using % surface saturation (with SAGE, using WOA 2018) but we hope to have traj files operational soon so that we can switch to in-air oxygen calibrations.

We have recently accomplished QC of CHLA on most of our “legacy” floats (processed 24 floats out of 27), following the most recent RTQC recommendations. Almost all our raw DOXY, NITRATE, PH and CHLA data now has QC set to 3 (as per recommendations). We will continue to work our way through the backlog over the next 12 months.

2. Delayed Mode QC status

Delayed Mode data sent to the GDACs

As of 8 September 2023, in the preceding year, the number of R-files (NR) submitted to the GDACs is 13,604; the number of R-files older than 365 days (NN) is 4,021; and the number of D-files (ND) is 201,000. The raw percentage of D-files processed (100*ND/[NR+ND]) is 93.66%. Considering only data from the eligible floats, we calculate that the percentage of D-files (100-100*NN/[NN+ND]) is 98.04%. Over the last year, the number of D-files submitted to the GDACs is 44974, from a total of 363 different floats.

We have submitted D-files for 18 floats with RBR CTD sensors. These include both pre-April 2021 (batch calibration) sensors with post-deployment compressibility coefficients determined by RBR and post-April 2021 (individually calibrated) sensors.

We have implemented a significant update to our DMQC matlab code to accommodate QC of core parameters on multi-profile (N_PROF>1) floats. This was previously limited to N_PROF=2, but is now more flexible and has been used successfully with both APF-11 and Provor floats with N_PROF=6.

The DMQC group has been active in participation in the bi-monthly working group lead by Tatiana Rykova. In particular, we have contributed to the recent discussion of TBTO effects.

We are up to date with feedback on Objective Analysis and Altimetry alerts and have regularly updated the ASD spreadsheet. We have submitted our response to the 2023 Audit and updated profile files on the GDACs.

Delayed Mode BGC data sent to the GDACs

We are currently not producing any new D-mode BGC data. A lot of our A-mode data is technically D-mode (only lacking spike detection/visual inspection of individual profiles) but is not currently reported as such. We hope to change this in the next 6 months and start producing D-mode data for NITRATE, PH and DOXY. This will be done for both active and legacy floats.

Support for Argo, India

We performed core (P, T, S) DMQC on 40 Argo-India floats with CTD sensors in the SBR recall serial number range. The R-files were obtained from the GDAC and we delivered the D-files and DMQC documentation to Uday Bhaskar at INCOIS. The Dfiles were then submitted to the GDAC by INCOIS. Of the 40 floats, 10 had severe PSAL drift with some uncorrectable cycles. The documentation provided to INCOIS will enable them to approach SBR with evidence to discuss warranty claims on some of these sensors. Some updates to our matlab DMQC software were required to accommodate the Argo-India Arvor floats (which deliver profile data on cycle 0). We have offered to provide the updated matlab code to INCOIS so that they can continue to assess their floats when they have the capacity.

3. Value Added items

Argo Technician Community of Practice

The Argo Technical Community of Practice, initiated in 2021 and endorsed by AST in 2022, has continued. The forum aims to promote collaboration, knowledge sharing and coordinated action to establish, review and refine best practice procedures for pre-deployment testing of floats to eliminate premature loss of function.

This group meet quarterly over Zoom, and rotate the chair and responsibility for each meeting. The group has not been open to vendors, and is targeted at technical staff working directly with floats. The group welcome topics for investigation from PI's and will capture and report 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***, initiated in 2022, has continued. 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 build a greater sense of community, and to promote consistent DMQC practices. The meeting is open to anyone interested. Discussions have been held every two months, with 6 discussions held this calendar year. Topics covered include:

- TBTO Issues (identifying characteristics of TBTO contamination);
- OWC best practice (how to);
- Demonstrations of DMQC systems; and
- Many discussions on Difficult floats.

Discussions have been led by 9 different members of the Argo DMQC community, and have been attended by 9-20 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 Pilo leads our deployment planning and has joined the international community in meetings focused on the Indian Ocean and on the Pacific Ocean deployments. Esmee Van Wijk plans the deployments of floats in the Southern Ocean, Esmee, Steve Rintoul and Annie Foppert plan Deep float deployments and Christina Schallenberg and Peter Strutton plan the deployments of BGC floats.

We are making an effort to populate the Indian Ocean – this year we have deployed 13 floats in the central and western part of the Indian Ocean, and 3 floats off Australia's west coast that are likely to be advected towards the Indian Ocean's inner gyre. We have 4 more deployments planned between Australia and Réunion for early 2024.

For the upcoming year, we have deployments planned in the tropical western Pacific (in the new Kaharoa delivery voyage), in the East Australian Current (western boundary current of the South Pacific), in the Indian sector of the Southern Ocean, and on the Antarctic Shelf.

This Austral summer, we will deploy 10-12 deep floats in the Indian Sector of the Southern Ocean, off the RV Investigator. We are very grateful to our German colleagues from AWI who have offered to deploy 10 floats (5 with oxygen optodes) for us from RV Polarstern this summer in the East Australian Antarctic sector, in an area that we would otherwise not be able to access.

We are continuously looking for opportunities to deploy near the Kerguelen Plateau and in the central part of the Indian Ocean. A limitation for us is the departure port of the vessels. We give preference to voyages in which we can load the floats in Australian or New Zealand ports – to reduce shipping costs.

Over the past years, our deployments were supported by the RV Investigator, the Kaharoa, the vessels from the Australian Antarctic Division during their resupply voyages, the L'Astrolabe, the RV Sonne, Laura Bassi, Japanese research vessels, NZ Navy vessels, and a vessel from the Minderoo Foundation.

A tourism vessel, from Heritage Expeditions, has recently agreed to support Argo float deployments. Their vessel is large and has recurrent voyages that leave Auckland (NZ) towards the Ross Sea, the Antarctic Islands, the South Pacific Islands, and Japan.

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.

IMOS-OceanCurrent (https://oceancurrent.aodn.org.au/product.php) shows the location of Argo floats within oceanographic context, by overlaying them into maps of Sea Surface Temperature and satellite-derived surface geostrophic velocity. The maps cover regions around Australia, NZ, and the South Pacific Islands. The user can then click on the float to look at the cycle's profile sampled on the date of the surface map (e.g., https://oceancurrent.aodn.org.au/profiles/cycle.php?wmoid=5905515&cycle=124&depth=0)

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 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

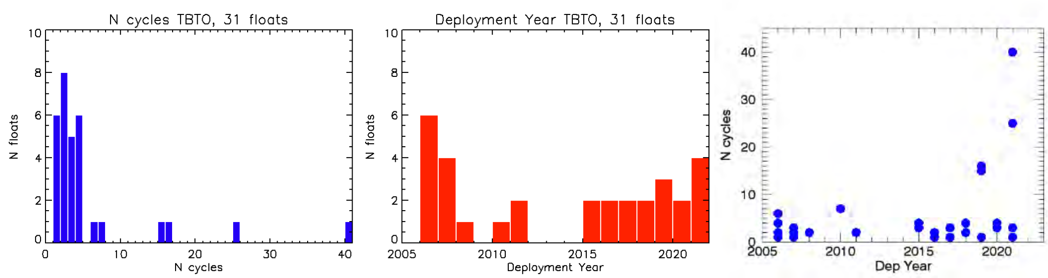
N/A

6. Other Issues

As part of the DMQC Discussion series, an emerging issue with TBTO contamination been identified which was illustrated by an extensive study of floats in the Weddell Gyre (Birgit Klein). Following this discussion, we made a preliminary study of the prevalence of TBTO contamination in Australian Argo floats. We note that our current deployment practice does not include any flushing of the CTD. The criteria for inclusion in this study were:

1. Floats deployed after 2000
2. Floats with Seabird CTD
3. PSAL fresh offset initially and later returning to climatologically consistent values (consistent over all depths)

Of 1017 floats fitting the first 2 criteria, we found 31 floats that fit the third. Most of these floats exhibit fresh offset for a small number of cycles (< 8 cycles), but in four floats the offset persisted for more than 15 cycles.



These four floats (5905432, 5905441, 5906654, 5906655) were deployed in 2019 and 2021, two are Seabird Navis hulls and two are TWR APEX hulls. One (5905441) was initially profiling with a daily mission, reverting to a 10-day mission after 14 cycles. The other three were on a 10-day cycle throughout. One float (5905441) has since been recovered and is undergoing refurbishment of the BGC sensors. This may provide an opportunity for examination of the CTD and the TBTO tablets. We are following this up with Seabird.

Argo Canada Data Management Report
ADMT 24
Hobart, Australia, Oct 23-28, 2023

1. Real Time Status

- <u>Deployments:</u>

Between December 2022 to September 2023, Argo Canada deployed a total of 20 floats manufactured by NKE. Ocean Network Canada contributed Arvor -I Deep floats to the Argo Canada program for the first time. The table below summarizes the floats deployed since December 2022.

Float Type	# of Float
Arvor -I	4
Arvor – I with Aanderaa Optode sensor	5
Arvor – I with RBR sensor	2
Arvor – I Deep	5
Provor III (CTD, DOXY, Chlorophyll- A, Backscattering)	3
Provor III (CTD, DOXY, Chlorophyll- A, Backscattering and SBE PH)	1

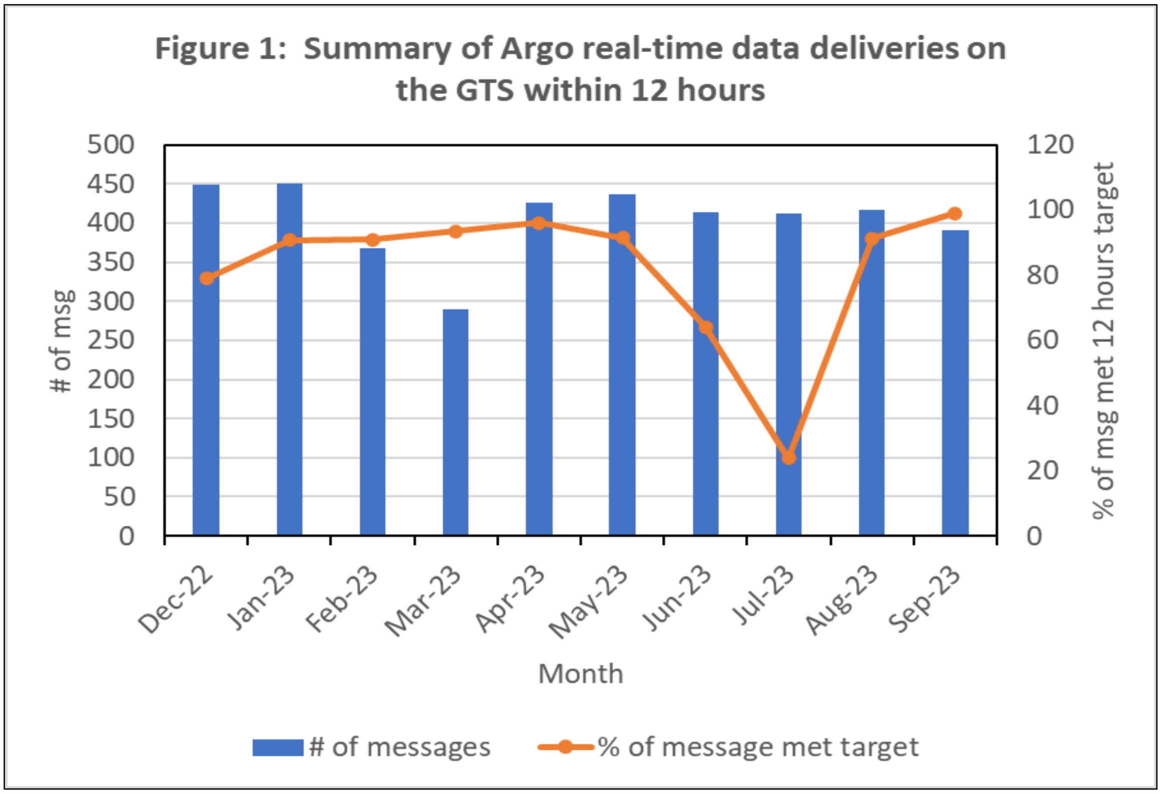
- <u>Data acquired from floats</u>

As of September 2023, Argo Canada has 165 active floats, including 7 NOVA, 136 Arvor – I, 7 Arvor with RBR sensor, 5 Arvor Deep and 10 PROVOR III floats.

The process to acquire data for Arvor and NOVA floats runs every 3 hours while the process to acquire data from PROVOR III runs every 6 hours. The data processing was developed in Fortran, Java and Python.

- <u>Data issues to GTS</u>

All data are issued to the GTS in BUFR format. From December 2022 to September 2023, an average of 407 BUFR messages were issued on the GTS monthly, of which 80% of the messages met the 12-hour target. During the year, we experienced some significant drops in timeliness due to the deployment of new float types and software to handle new float data format. Figure 1 shows the performance of Argo real-time data delivery on the GTS.



- <u>Data issued to GDACs after real-time QC</u>

The profile, technical, trajectory and meta files are transmitted to the GDACs in NetCDF format version 3.1 on an operational basis for all floats except BGC and Arvor Deep floats.

For BGC and Arvor Deep floats, the profile, technical and meta files are available at the GDAC in NetCDF format version 3.1 every 6 hours after the float surfaces. We are currently working on incorporate the cycle data into the trajectory NETCDF file for these floats. We anticipate to complete the transition of Argo Trajectory NETCDF format from version 3.1 to 3.2 by AST 2024.

- <u>BGC RT Flags</u>

Following ADMT23, chlorophyll and pH RTQC updated to comply with proper flagging schemes. Prior to this update, there was an error in the chlorophyll mixed layer depth calculation causing data to be incorrectly flagged as 2 instead of 1, and pH was being flagged with no QC, 0.

Updated BBP RTQC is in the process of being implemented following Dall'Olmo et al. 2023. Tests are written, now working on tests to ensure agreement with publication.

2. Delayed Mode QC status

- Core Argo DMQC

Delayed mode QC has resumed at MEDS, with 1,105 profiles processed since last year. Approximately 71% of eligible profiles have been DMQC'd at least once, and 72% of eligible floats have been DMQC'd at least once for salinity, while 53% of floats have been DMQC'd at least once with both salinity and pressure.

- BGC-Argo DMQC

Other tasks took priority over DMQC for much of the year, however roughly 400 new D-mode profiles were submitted to the GDAC. For 2 other floats (4901140, 4901141), D-mode files were re-submitted after removing some bad data identified by the DOXY audit.

Near-future priority on fixing data that appears in the DOXY audit. Currently 6 Argo Canada floats have points identified in the audit. Of those 6, 2 are ready for submission to the GDAC and 1 has been deemed ok based on visual inspection.

Delayed mode quality control of DOXY profiles has resulted in 16% of eligible profiles, from 5% of eligible DOXY floats being DMQC'd at least once.

3. Value Added items

- List of current national Argo web pages, especially data specific ones

  We are working on upgrading the Argo Canada web pages, http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html, that show float track and all data collected by Canadian core floats to handle the new variables collected by PROVOR III floats. Links to both real-time and delayed mode data are also available for download directly from GDAC. The pages are updated daily.
  Argo Canada data is discoverable from the Government of Canada Open Government Portal, https://open.canada.ca/en.
  It provides links to download data in NETCDF and web services to access float positions.

- Statistics of National Argo data usage (operational models, scientific applications, number of National PIs…)

Argo data have been used to generate monthly maps and anomaly maps of temperature and salinity along line P in the Gulf of Alaska. Line-P has been sampled for 50 years and has a reliable monthly climatology. For more information on the Line-P products and other uses of Argo to monitor the N.E. Pacific go to: http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/canadian-products/index-eng.html.

The Canadian Meteorological Centre (Dorval, Québec) of Environment Canada is assimilating real-time Argo data in operational mode.

- Publicly available software tools to access or qc Argo data

  The python package bgcArgoDMQC provides code to load in BGC-Argo oxygen data, calculate gain via comparison to WOA climatology data in the water column or NCEP data using in-air measurements, update QC flags and DOXY_ADJUSTED values, and export them to a D-mode netCDF file. The software is under active development, but a stable release is available that has been shown to closely agree with the analogous MATLAB software, SAGE-O2. This release can be installed via Anaconda or pip, and to code can be found on the ArgoCanada github page. This package also provides a simple framework to update flags in netCDF files, for example to update historical raw DOXY flags from 1 to 3.

  Python software for performing RTQC on CHLA and BBP (medsrtqc) continues to be developed. Radiometry RTQC will be added shortly, as will updated BBP processing following Dall'Olmo et al. 2023 as described above. While the package is currently specific to the MEDS DAC, the code was written in a modular way, and there is strong interest in contributing to a "system-agnostic" python package for RTQC. This code is also publicly available on the ArgoCanada github page.

4. GDAC Functions

Canada has no Argo GDAC function. However, Canada forwards TESAC data to the GDACs in Ifremer (France) and USGODAE (USA) three times a week. Canada also monitors the timeliness of Argo data on the GTS in BUFR format.

5. Regional Centre Functions

Canada has no regional centre function

6. Other Issues

There was no issue reported during the compilation of this report.

Chinese Argo National Data Management Report

23-27 October, 2022 (ADMT-24)

Zenghong Liu[1], Xiaogang Xing[1], Xiaofen Wu[1], Mingmei Dong[2], Fengying Ji[2]

1) Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, China

2) National Marine Data and Information Service, Ministry of Natural Resources, Tianjin, China

1. Real Time Status

1.1 Data acquired from floats

From last November, China acquired 2,581 temperature and salinity (additionally 820 O2, 483 CHLA, 748 BBP, 218 CDOM, 570 DOWN _IRRADIANCE, 323 NITRATE and 244 pH) profiles from 67 operational floats including 2 APEX, 55 PROVOR, 4 HM2000, 2 ARVOR_D, 2 NAVIS and 2 XUANWU floats (Fig.1).

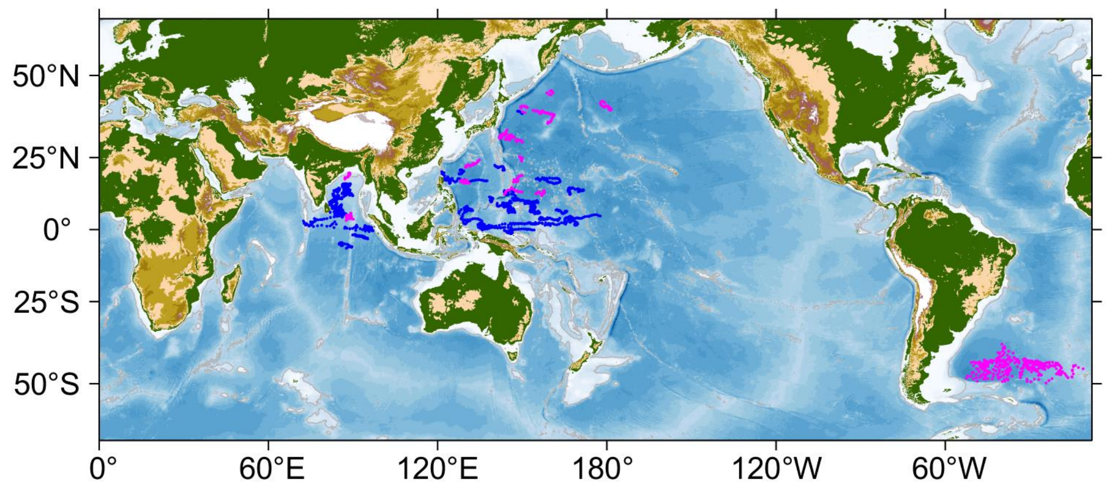


Fig.1 The geographic distributions of Core (blue) and BGC (pink) profiles

1.2 Data issued to GTS

The JMA script is being applied to generate BUFR bulletin for each TS and DO profile. BUFR bulletins are transferred to China Meteorological Administration (CMA) and then to the GTS.

1.3 Data issued to GDACs after real-time QC

Meta, technical, trajectory and profile files are submitted to GDAC in netCDF format on an operational basis. CSIO also routinely checks feedbacks from Coriolis data center and reflags the doubtful data.

CSIO began to submit version 3.2 core trajectory files from this October. The historical trajectory files will be converted to the new format soon.

1.4 Delayed mode data sent to GDACs

- At CSIO, the number of the profiles submitted to GDACs is limited, totally about 6,185 D-files were sent to GDACs. About 78% of the core profiles have been DMQC'd.
- At NMDIS, Dr. Ji Fengying conducted DMQC for all the floats by adopting newest tool package and background data, and 2,391 D-files were sent to GDAC.

2. Delayed Mode QC status

During the upcoming ADMT-24 meeting, we will seek to update the existing DMQC system with the help of the Australian Argo DMQC team so that it could process profiling data from RBR floats.

3. Value Added items

3.1 List of current national Argo web pages

- China Argo Real-time Data Center (CSIO) http://www.argo.org.cn
- https://www.argo-cndc.org which maintained by NMDIS provides global Argo data query and download services. The data format includes three types: NC, CSV and ASCII. Among them, NC is the original data of GDAC, CSV is converted directly from NC, and ASCII data is quality controlled and reformatted by NMDIS.

3.2 Statistics of National Argo data usage

- **Operational uses**: Argo data have been used into most ocean data assimilation systems operated by department or institutions such as NMEFC, NMDIS, IAP, QNLM, etc.

- **Scientific applications**: The Argo data are mainly used in from seasonal to decadal ocean variations in global and regional scales, air-sea interactions, ocean's role in global climate change.
- About 21 PIs from 10 agencies have deployed profiling floats and share data with Argo community.

3.3 Products generated from Argo data that can be shared

- **BOA_Argo**: It is a biannually updated gridded Argo product developed by CSIO (ftp://data.argo.org.cn/pub/ARGO/BOA_Argo/). The product is based on the post-QC'd Argo dataset maintained by CSIO.
- **GDCSM_Argo**: It is a gridded Argo product jointly developed by SHOU (Shanhai Ocean University) and CSIO based on the Gradiente-dependent Correlation Scale Method (ftp://data.argo.org.cn/pub/ARGO/GDCSM/).
- **IAP data set**: The IAP data set is a global ocean gridded data set developed by Lijing Cheng from IAP. Besides Argo TS profiles, other available profiles from various instruments (e.g. XBT, MBT and shipboard CTD, etc.) are also used while producing the data set. It includes 1°×1° monthly temperature fields since 1940 from the sea surface to 2000 m (http://www.ocean.iap.ac.cn/).
- **CSIO Argo trajectory data set**: This Argo trajectory data set provides the QC'd satellite fixes and underwater velocities for all floats and annual mean mid-depth velocity field at 1000m is also calculated. The extrapolated fixes for the floats using Argos satellite system are calculated with the Park method. The trajectory files with old format are excluded before we process the data (ftp://data.argo.org.cn/pub/ARGO/float_trajectory/).
- **Real-time Analysis Dataset**: The products in the Northwest Pacific Ocean covers a range of 99°E~ 150°E,10°S~52°N, with a horizontal resolution of 0.125°and a vertical standard layer. The product elements

include three-dimensional temperature, salinity, density, velocity of sound and geotropic flow, https://www.cmoc-china.cn/pages/productService.html.

- **Reanalysis products (CORA v1.0) of northwest Pacific Ocean areas**: The product elements include the sea surface temperature, salinity and ocean current; the sea areas cover 99°E ~ 150°E and 10°S ~ 52°N. The resolution of spatial horizontal grid is 0.5°×0.5° and there are 35 layers vertically; the timeframe is from January 1958 to December 2015, 57 years in total. The time resolution is monthly mean over the years. More information could be found via https://www.cmoc-china.cn/pages/productService.html.

3.4 Publicly available software tools to access or qc Argo data

None.

4. GDAC Functions

None.

5. Regional Centre Functions

None.

6. Other Issues

None.

Argo data management report 2023

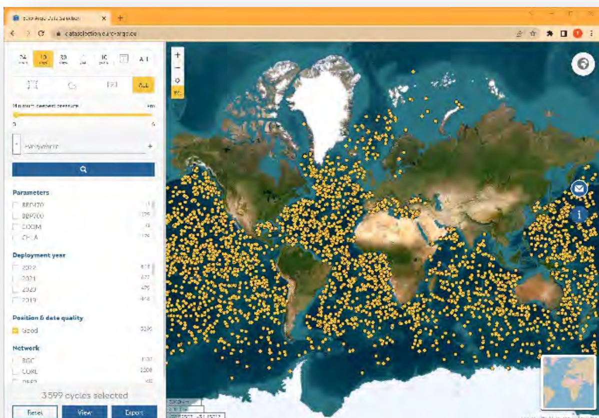
Coriolis DAC & GDAC

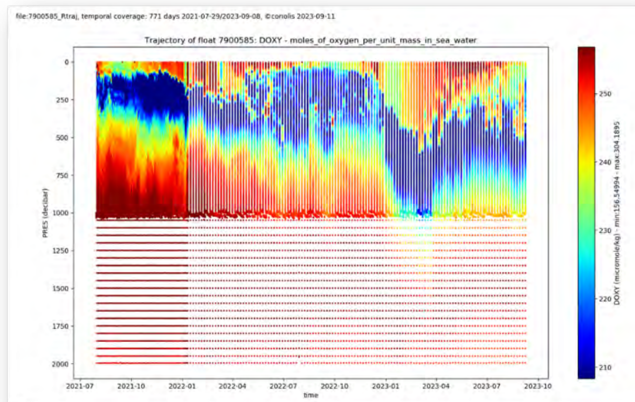
Data Assembly Centre and Global Data Assembly Centre

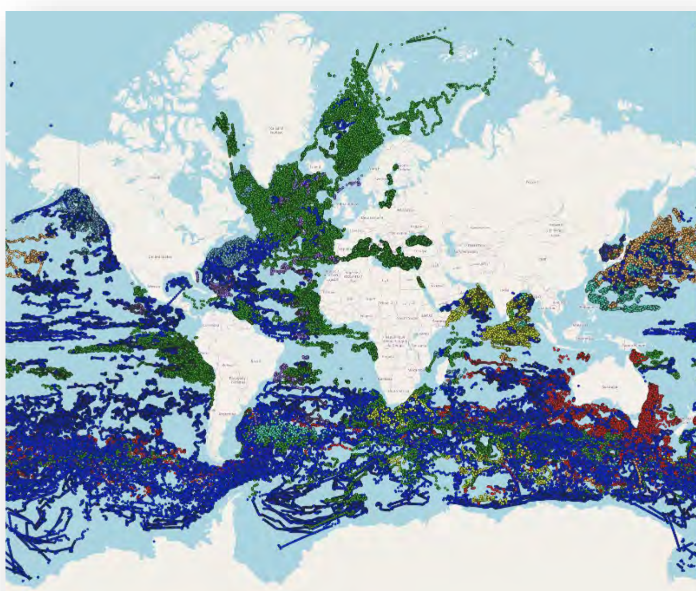
Annual report October 2023

Version 1.1.2

https://doi.org/10.13155/96772







1 DAC status

This report covers the activity of Coriolis DAC (Data Assembly Centre) for the one-year period from September 1st 2022 to September 30th 2023.

Key accomplishments in the past year include:

- The management of Provor CTS5 jumbo floats, which are substantial floats equipped with a range of BGC sensors, such as the UVP (a camera for identifying and counting zooplankton), the Ramses hyperspectral sensor, pH, chlorophyll, BBP, and Suna nitrate (refer to §1.1.3).
- The Ramses sensor conducts measurements of downward illuminance, upward luminescence, and reflectance. The reflectance data serves as a direct reference for satellite water color data.
- Comprehensive reprocessing of particulate backscattering (BBP) was carried out to implement the new quality control procedure available at https://doi.org/10.13155/60262
- Chlorophyll A (CHLA) also underwent a general reprocessing to adhere to the new quality control procedure, accessible at https://dx.doi.org/10.13155/35385
- The reprocessing of trajectories with format 3.2 was completed.
- An enhanced Argo real-time trajectory product that incorporates 20 additional RTQC procedures was developed. Additionally, a daily Argo deep currents product is now available for distribution.
- Deployment sheets for Coriolis floats, including metadata and calibrations, are shared on a cloud workspace located at cloud.ifremer.fr.

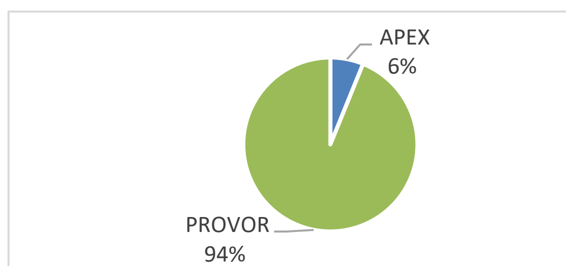
1.1 Data acquired from floats

1.1.1 Active floats for the last 12 months

These last 12 months, **62 155 profiles from 923 active floats** were collected, controlled and distributed. Compared to 2022, **the number of profiles slightly decreasing (-4%), the number of floats increased by 4%.**
These figures illustrate a good momentum in Coriolis DAC activity.

The 923 floats managed during that period had 48 versions of data formats.

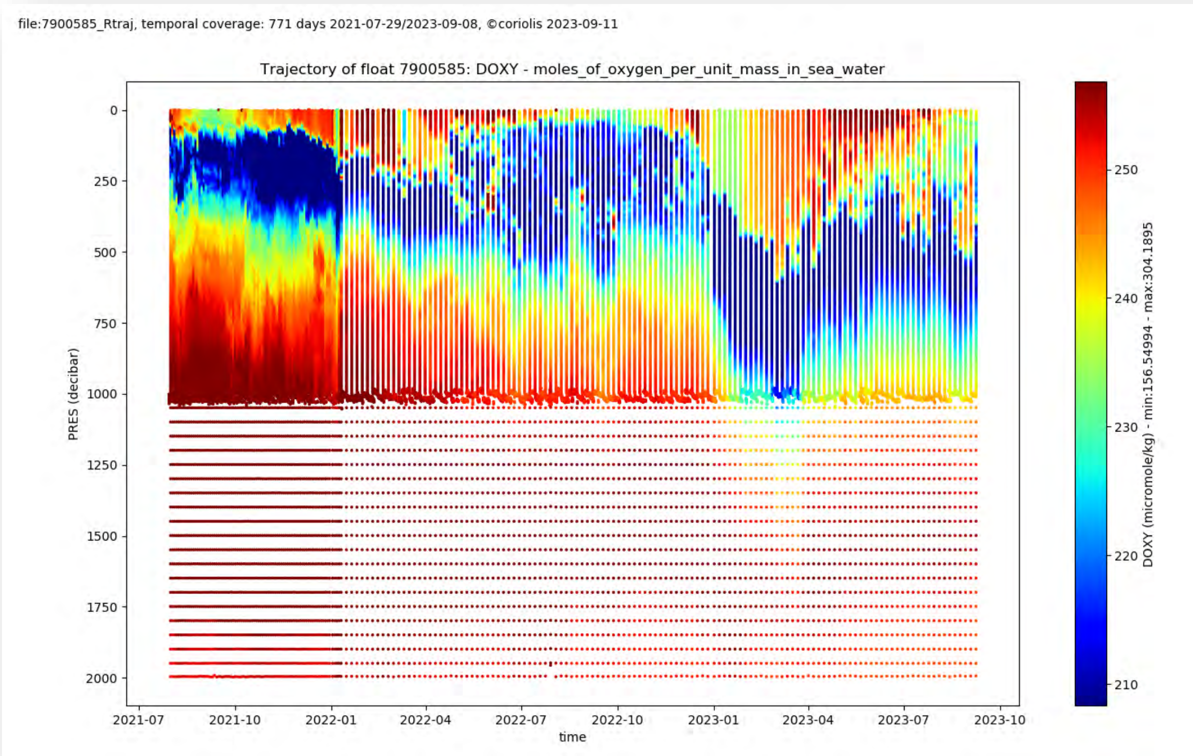
Coriolis DAC, active floats in 2023			
Float family	nb versions	nb floats	nb cc
APEX	15	57	2
NOVA	2	5	
PROVOR	31	861	59
Total	48	923	62



1.1.2 All floats managed by Coriolis DAC

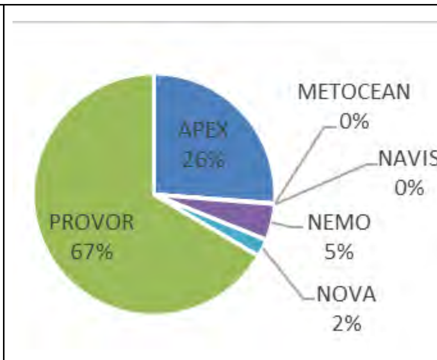
Coriolis DAC manages a total of 3 601 floats with 177 versions, from 6 families.
These floats reported 700 586 core Argo vertical profiles.

In 2023, most of Coriolis trajectory files were converted into format 3.2; in recent floats such as Provor CTS5 or Apex APF11, every observation has a timestamp and is available in the trajectory file.

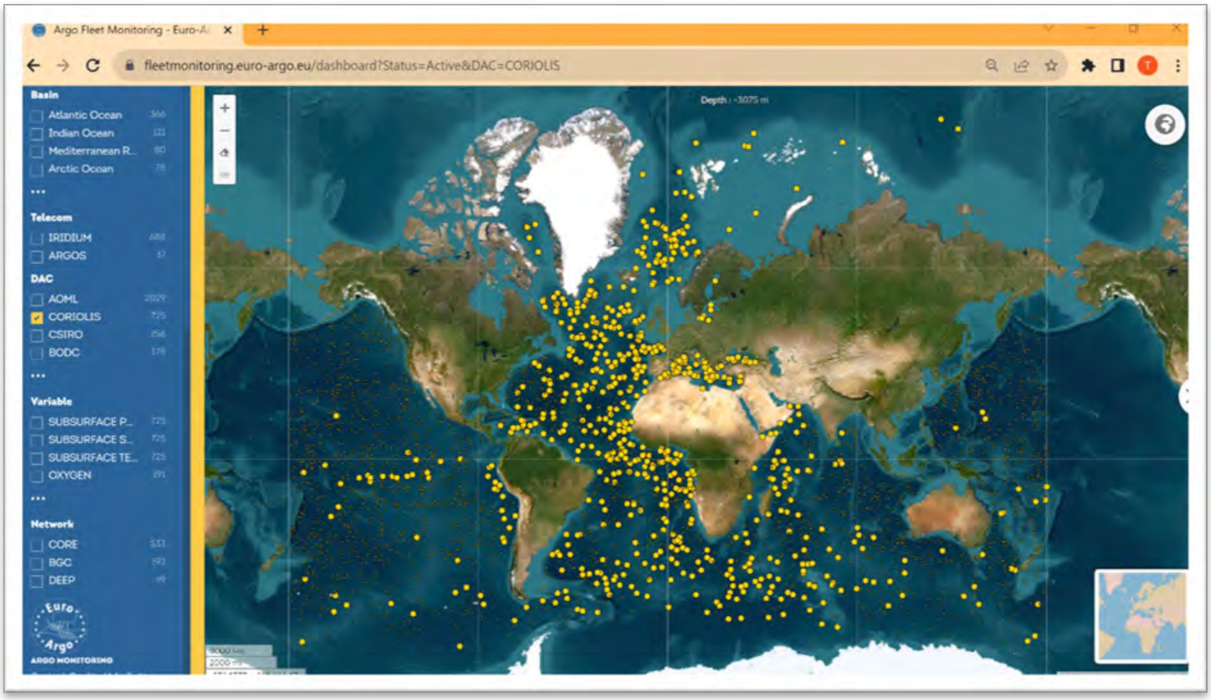


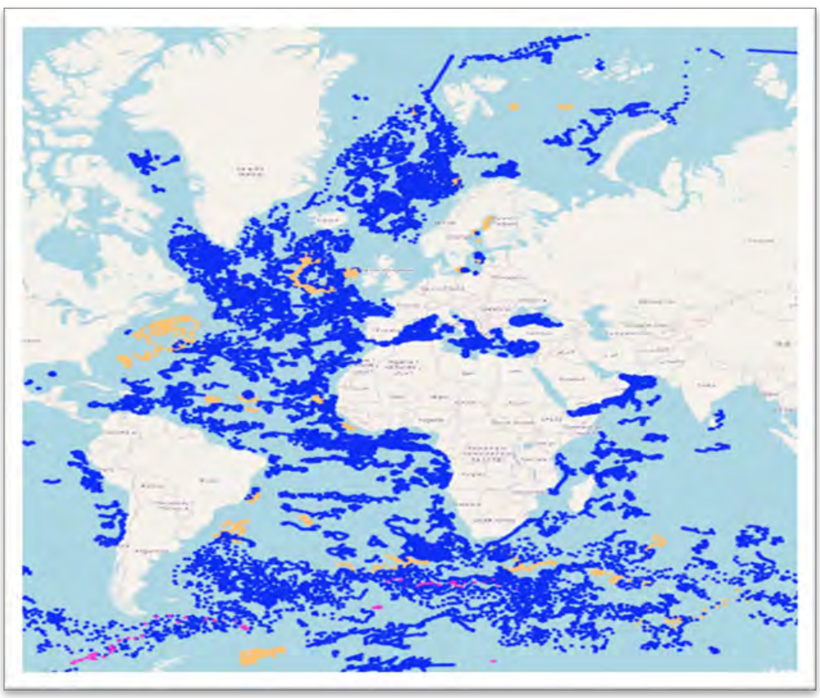
Oxygen observations from float 7900585 trajectory file

Coriolis DAC, all floats			
Float family	nb versions	nb floats	nb core p
APEX	80	942	148 540
METOCEAN	1	1	52
NAVIS	1	3	1 932
NEMO	8	174	10 185
NOVA	3	85	9 715
PROVOR	84	2 396	530 162
Total	177	3 601	700 586



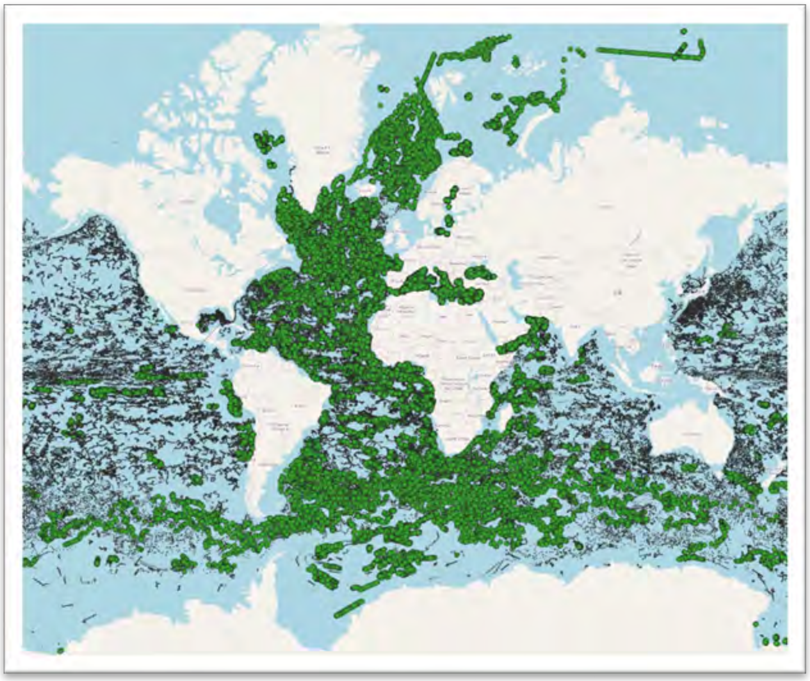
Map of the active floats on October 10th 2023 decoded by Coriolis DAC, among others DACs (small dots) as displayed on Euro-Argo floats dashboard https://fleetmonitoring.euro-argo.eu/dashboard



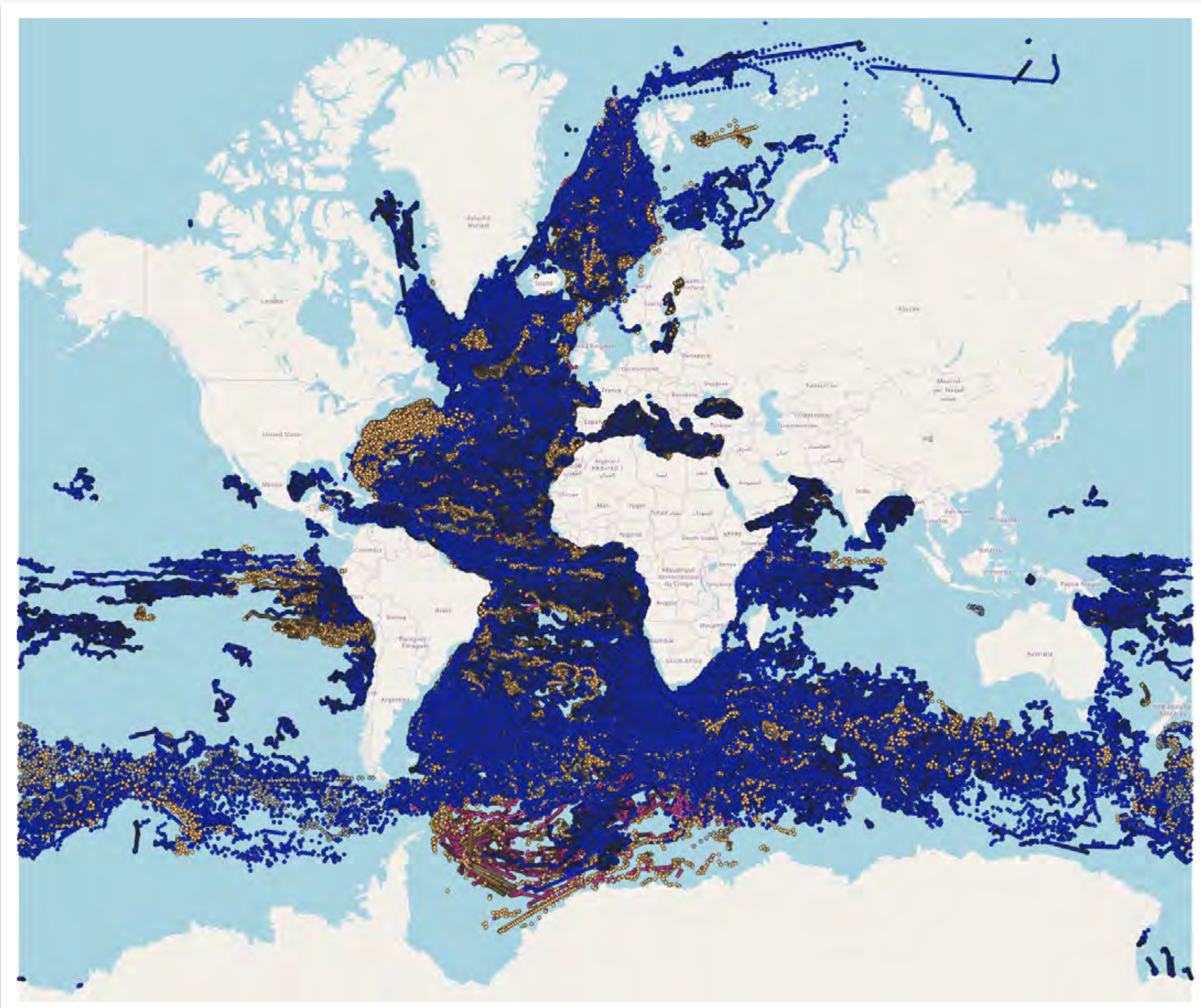


Map of the 62 155 profiles from 923 active floats active floats decoded by Coriolis DAC this current year

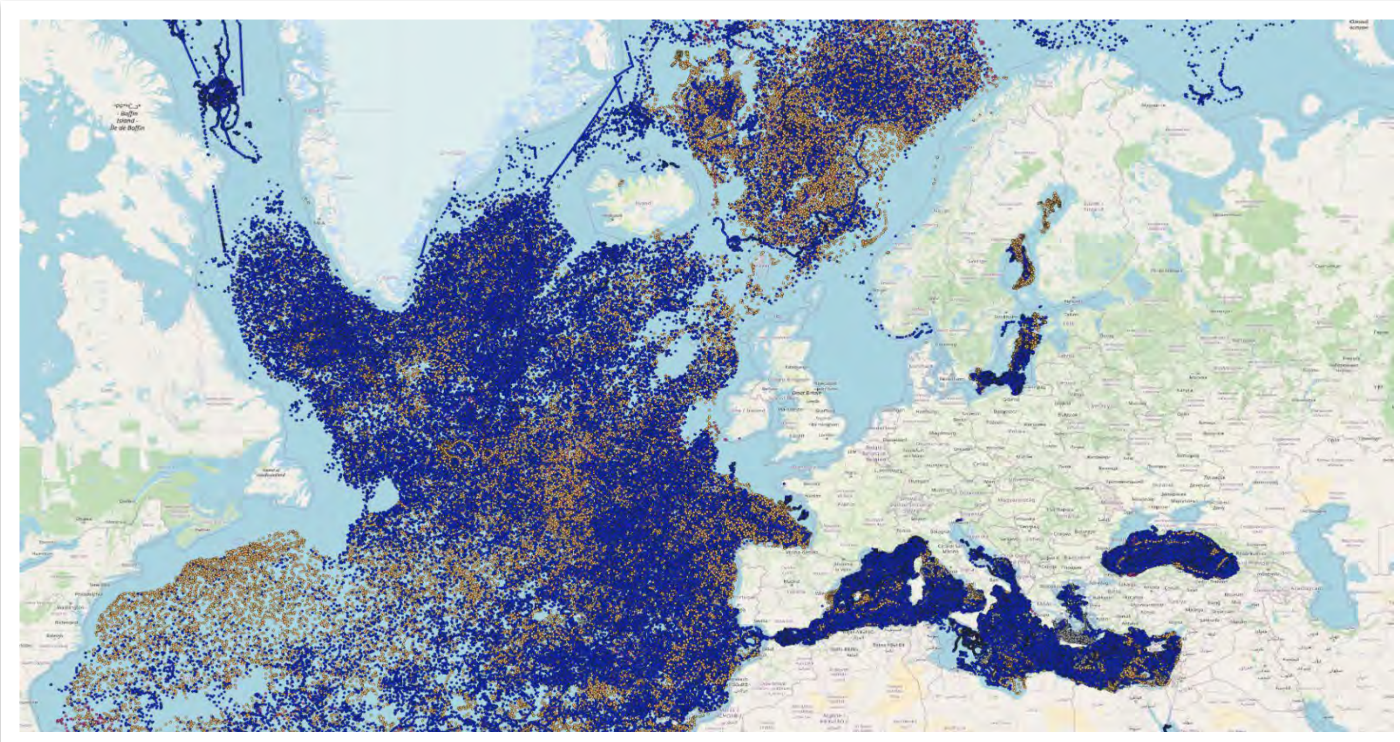
Apex Nova Provor



Map of the profiles from active floats decoded by Coriolis DAC this current year, among the other DAC's profiles (Coriolis: green, other DACs: grey)



Map of the 700 000 profiles from 3 600 floats managed by Coriolis DAC
Apex **Metocean** **Navis** **Nemo** **Nova** **Provor**



Map of the profiles floats managed by Coriolis DAC , focus on North Atlantic
Apex **Metocean** **Navis** **Nemo** **Nova** **Provor**

1.1.3 BGC-Argo sensors on Coriolis floats

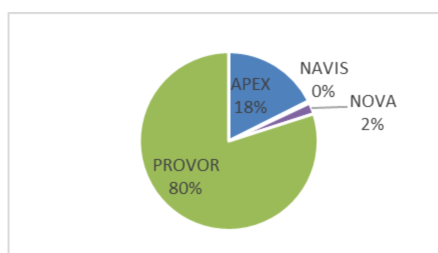
The data processing chain for data and metadata from Coriolis BGC-Argo floats is continuously improved. These are advanced types of floats performing bio-geo-chemical (BGC) measurements.

Coriolis DAC manages 733 BGC-Argo floats from 4 families. They performed 108 444 cycles.

The data processing chain is freely available:

- Coriolis Argo floats data processing chain, http://doi.org/10.17882/45589

Float familly	nb versions	nb floats	nb cycles
APEX	34	129	16 960
NAVIS	1	3	644
NOVA	1	15	1 241
PROVOR	48	586	89 599
Total	**84**	**733**	**108 444**



General characteristics

- Iridium sbd or rudics bi-directional communication or Argos
- There are 18 types of sensors fitted on the floats

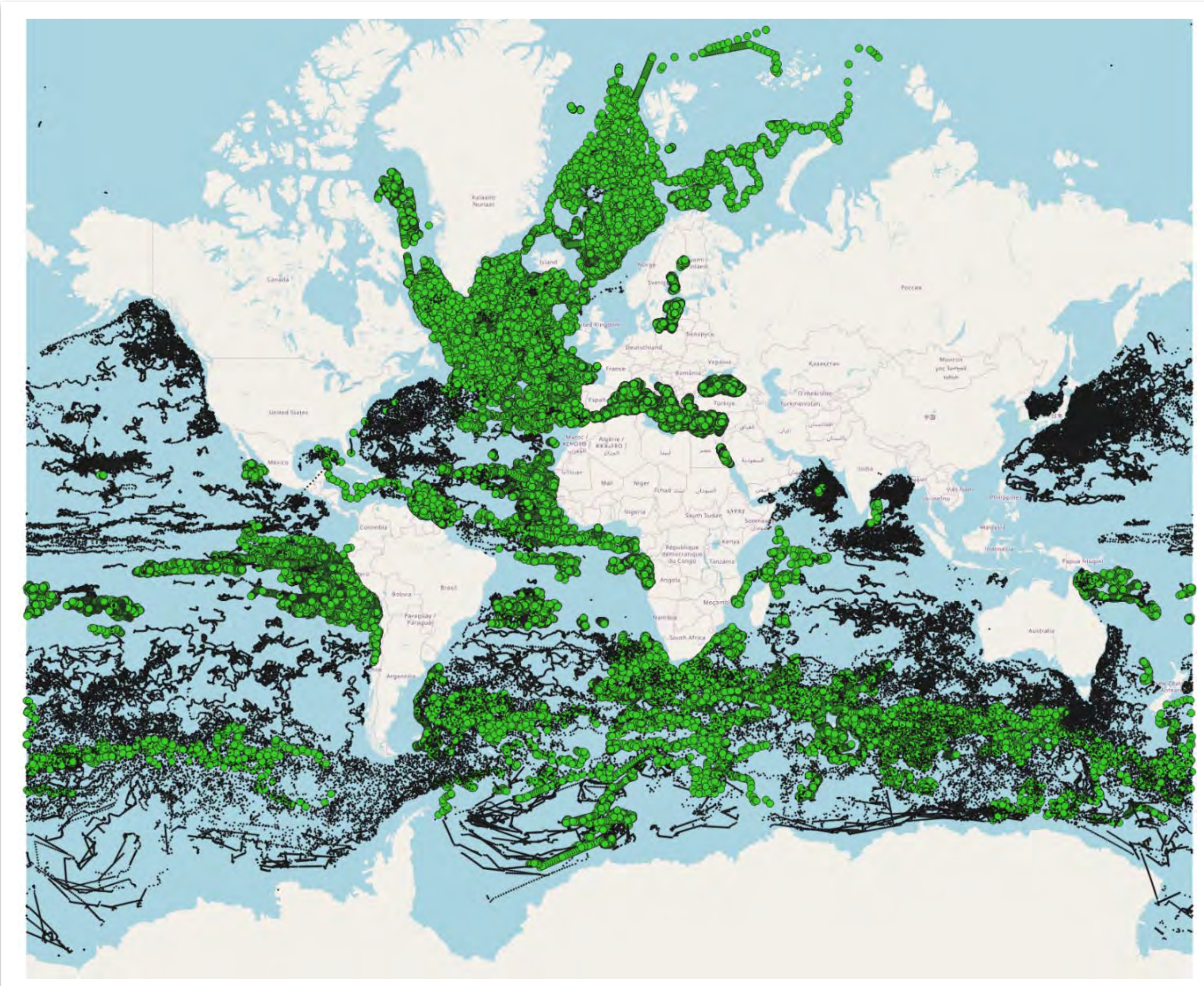
Coriolis BGC-Argo floats sensor	nb floats	nb profiles
AANDERAA_OPTODE	655	94 631
ECO_FLBB	312	163 019
SATLANTIC_OCR504_ICSW	261	199 680
SUNA_V2	110	19 929
SEAFET	60	6 593
C_ROVER	43	5 724
UVP6-LP	32	1 556
SBE63_OPTODE	20	2 071
RAMSES_ACC	19	1 225
ECO_FLNTU	14	6 176
SBE43F_IDO	13	1 596
9AXIS_IMU	12	317
RAMSES_ARC	12	317
MPE	6	1 004
OPUS_DS	2	792
HYDROC	2	154
CYCLOPS-7_FLUOROMETER	2	106
SEAPOINT_TURBIDITY_METER	2	106

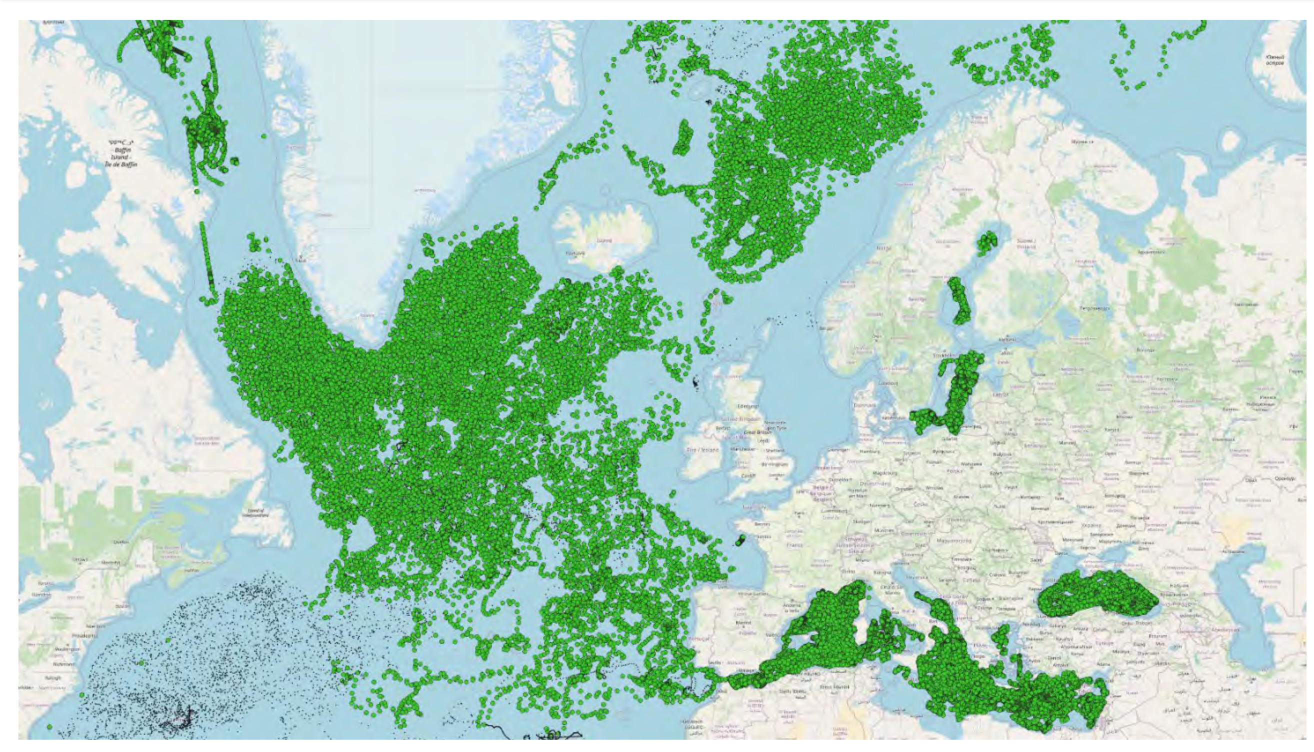
The 18 types of sensors mounted on Coriolis BGC-Argo floats

PARAMETER_CODE	NB_FILE
DOXY	97 201
CHLA	50 512
BBP700	47 998
CDOM	43 094
DOWNWELLING_PAR	42 339
NITRATE	16 509
PH_IN_SITU_TOTAL	5 614
TURBIDITY	2 514
BISULFIDE	1 383

The 9 main BGC parameters reported by Coriolis BGC-Argo floats

Map of the 733 BGC-Argo floats managed by Coriolis DAC (grey dots: the others DACs bio-Argo floats). They measure parameters such as oxygen, chlorophyll, turbidity, CDOM, back-scattering, UV, nitrate, bisulfide, pH, radiance, irradiance, PAR.





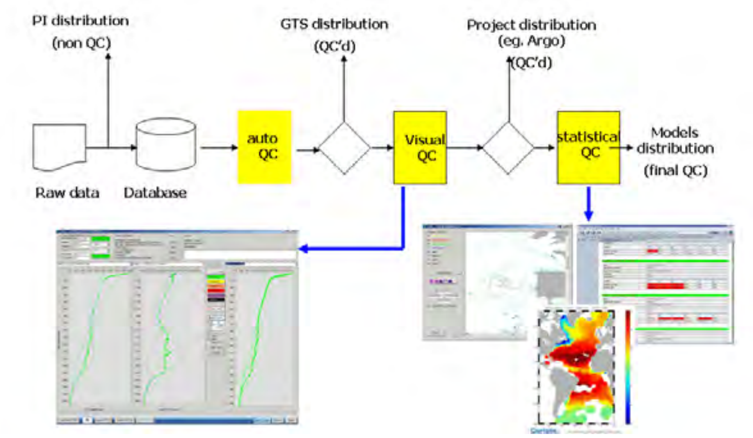
A zoom on North Atlantic of the BGC-Argo floats managed by Coriolis DAC (grey dots: the others DACs bio-Argo floats).

1.2 Data issued to GTS

Vertical profiles processed by Coriolis are distributed on the GTS by way of Meteo-France. This operation is fully automated. After applying the automatic Argo QC procedure, the Argo profiles are inserted on the GTS every hour. The profile files are sent as BUFR messages.

Vertical profiles are distributed on GTS if they are less than 30 days old. Once a day, floats data are checked with Min-Max climatology that triggers alerts and visual inspection for suspicious observations. The corrected data are not redistributed on GTS.

In July 2019, Coriolis stopped the TESAC messages distribution; only BUFR messages are now distributed.

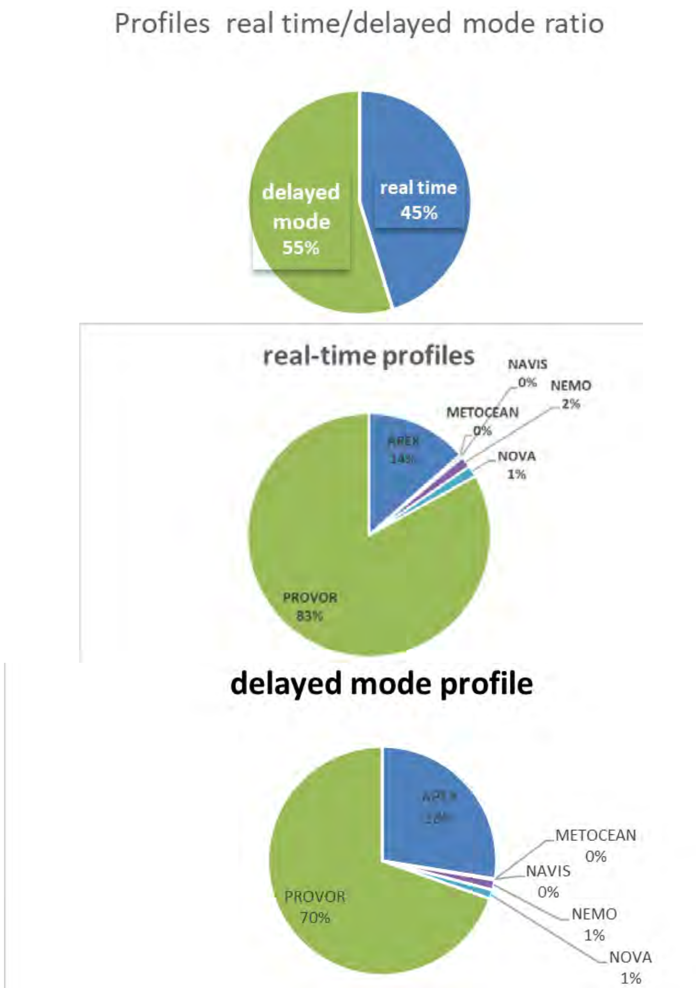


Coriolis DAC Argo data flow

1.3 Data issued to GDACs after real-time QC

All meta-data, profiles, trajectory and technical data files are sent to Coriolis and US-GODAE GDACs. This distribution is automated.

All Coriolis floats, number of profile files on GDAC				
Family	nb floats	nb profile	RT profile	DM profiles
APEX	862	148 540	42 858	105 682
METOCEAN	1	52	-	52
NAVIS	3	1 932	1 288	644
NEMO	110	10 185	4 786	5 399
NOVA	61	9 715	4 776	4 939
PROVOR	1864	530 552	263 360	267 192
Total	**2 901**	**700 976**	**317 068**	**383 908**



Distribution of Coriolis DAC real-time and delayed mode profiles

1.4 Data issued for delayed mode QC

Delayed mode profiles

All profile files are sent to PIs for delayed QC.

1.5 Delayed mode data sent to GDACs

An Argo delayed mode profile contains a calibrated salinity profile (psal_adjusted parameter).

- A total of **108 689 new or updated delayed mode profiles** was sent to GDACs this year.
- **A total of 383 908 delayed mode profiles** were sent to GDACs since 2005.

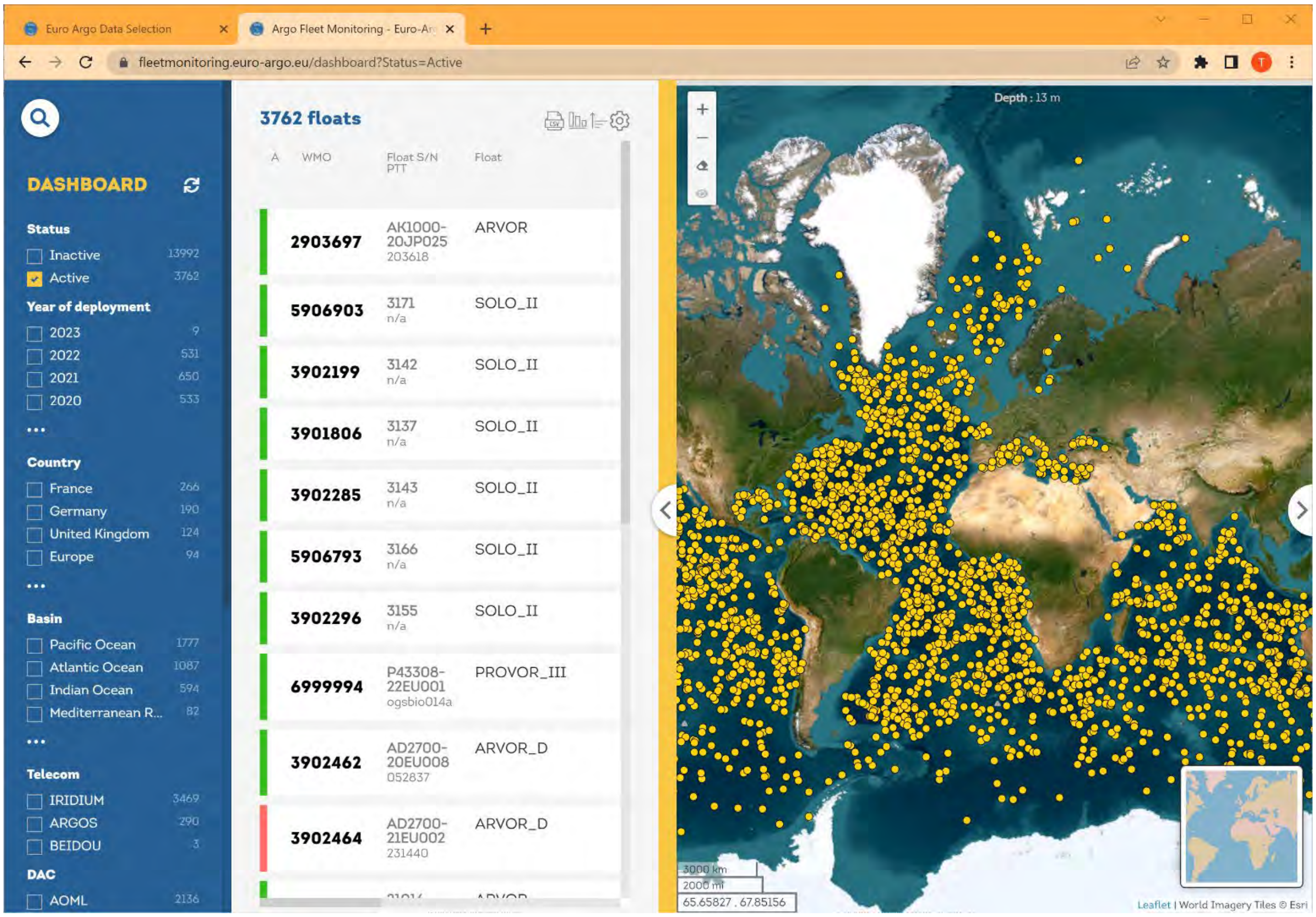
  The number of delayed mode profiles increased by 1% this year compared to 2022.

1.6 Web pages

1.6.1 Argo dashboard

The Argo floats dashboard developed in 2019 and regularly improved by Coriolis team is available at:

- https://fleetmonitoring.euro-argo.eu/dashboard

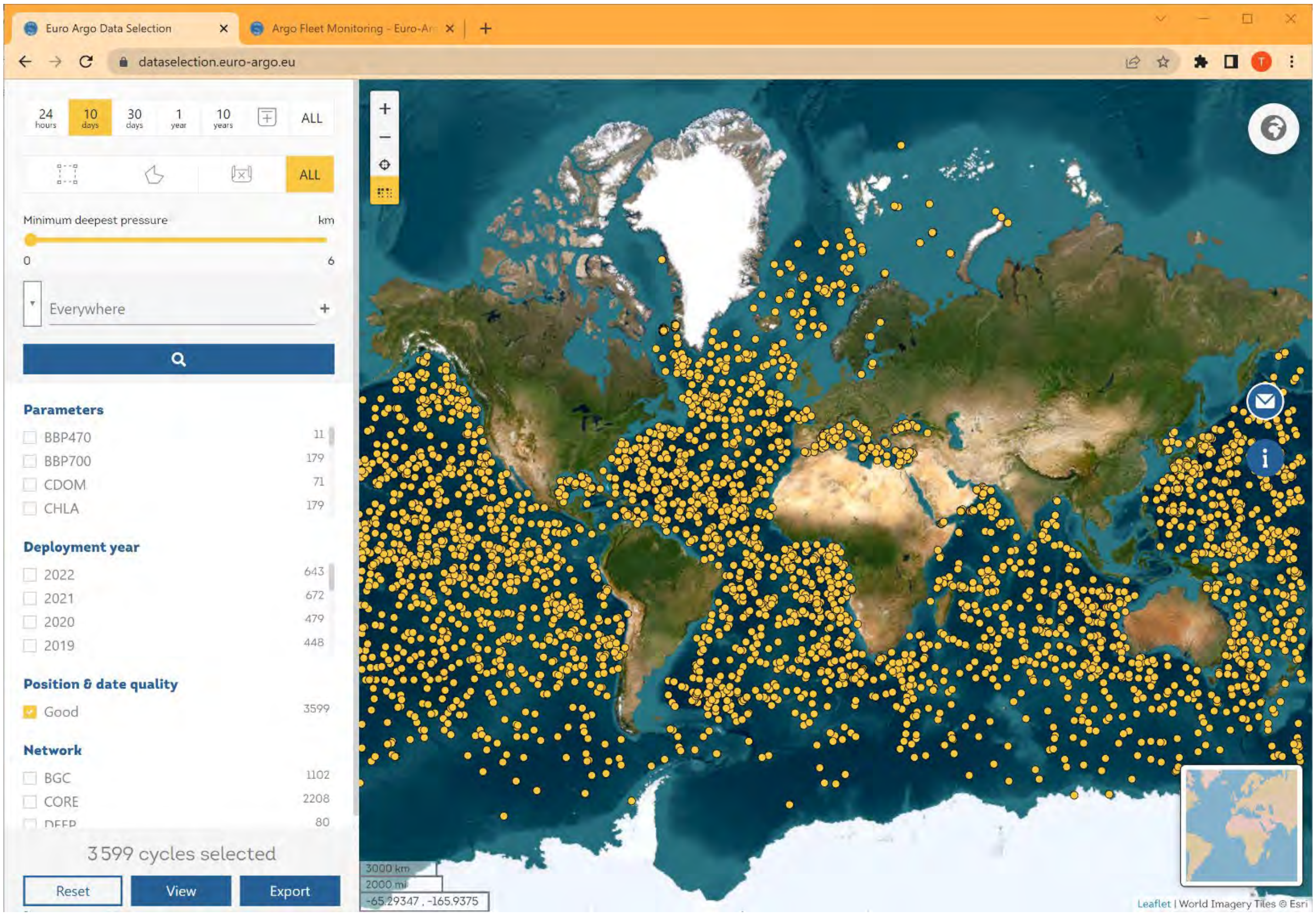


It displays all Argo floats, with facetted interrogations and instantaneous answers. The dashboard is developed on cloud and big-data techniques.

- Cloud techniques: a metadata and a data APIs, opened to internet machine to machine queries
- Big-data techniques: Argo metadata are hourly indexed in an Elasticsearch index, Argo data are hourly indexed in a Cassandra data base. Elasticsearch and Cassandra allows instant answers on dataset having billions of observations.

The Argo data selection was developed in 2020. The initial version is online at https://dataselection.euro-argo.eu/

It proposes data discovery with facetted search on temporal and spatial coverage, parameters, deployment years or quality codes. The selected data are downloadable in NetCDF and CSV formats.



Argo data selection https://dataselection.euro-argo.eu

1.6.2 Interoperability services (ERDDAP API,…)

The APIs used by Argo dashboard and Argo data selection web portals are open and publicly available to interested users at the following endpoints OpenAPI (swagger):

- https://fleetmonitoring.euro-argo.eu/swagger-ui.html
- https://dataselection.euro-argo.eu/swagger-ui.html

More information available on https://www.euro-argo.eu/Argo-Data-access

This web page describes all Argo floats interoperability services from Coriolis:

- http://www.coriolis.eu.org/Data-Products/Data-Delivery/Argo-floats-interoperability-services2
  - Argo data through ERDDAP data server (www.ifremer.fr/erddap)
  - Display an individual float's data and metadata in HTML or XML format
  - Display all Argo floats, display a group of floats
  - Argo profiles and trajectories data selection (HTML or XML)
  - All individual float's metadata, profile data, trajectory data and technical data
  - Argo profiles data on OpenDAP, OGC-WCS and http

- Argo data through Oceanotron data server
- Argo profiles data through GCMD-DIF protocol
- Argo data through RDF and OpenSearch protocols

1.6.3 Data centre activity monitoring

Coriolis operators perform an activity monitoring with an online control board.

Fonction	Description	Etat J	Etat J-1	Etat J-2	Etat J-3	Dernière exécution (TU)
CO-05-08-08	Archivage du GDAC Argo pour DOI (mensuelle)					OK 2023-09-09T03:44:14Z
CO-01-01-13	Argo - Synchronisation des QC de la base et du DAC Coriolis					OK 2023-10-07T16:42:29Z
CO-01-07-08	Collecte Argo Coriolis EDAC					OK 2023-10-07T16:55:11Z
CO-01-07-08-02	Collecte Argo Coriolis EDAC - table index					OK 2023-10-07T16:54:26Z
CO-01-07-01-aoml	Collecte Argo DAC - aoml					OK 2023-10-07T17:01:03Z
CO-01-07-01-bodc	Collecte Argo DAC - bodc					OK 2023-10-07T17:02:02Z
CO-01-07-01-coriolis	Collecte Argo DAC - coriolis					OK 2023-10-07T17:03:02Z
CO-01-07-01-csio	Collecte Argo DAC - csio					OK 2023-10-07T17:04:02Z
CO-01-07-01-csiro	Collecte Argo DAC - csiro					OK 2023-10-07T17:05:42Z
CO-01-07-01-incois	Collecte Argo DAC - incois					OK 2023-10-07T17:06:02Z
CO-01-07-01-jma	Collecte Argo DAC - jma					OK 2023-10-07T17:07:06Z
CO-01-07-01-kma	Collecte Argo DAC - kma					OK 2023-10-07T17:08:12Z
CO-01-07-01-kordi	Collecte Argo DAC - kordi					OK 2023-10-07T17:09:02Z
CO-01-07-01-meds	Collecte Argo DAC - meds					OK 2023-10-07T17:10:02Z
CO-01-07-01-nmdis	Collecte Argo DAC - nmdis					OK 2023-10-07T17:11:02Z
CO-01-07-01-03	Collecte Argo DAC - resubmit files cause meta missing					OK 2023-10-07T14:51:01Z
CO-01-07-01-02	Collecte Argo DAC - table index					OK 2023-10-07T17:22:58Z

Argo GDAC operations monitoring: every working day, an operator performs diagnostics and take actions on anomalies (red or orange smileys)

1.7 Statistics of Argo data usage (operational models, scientific applications, number of National Pis…)

Operational oceanography models; all floats data are distributed to:

- EU Copernicus Marine service models (Mercator, Foam, Topaz, Moon, Noos, Boos)
- French model Soap (navy operational model)

Argo projects: this year, Coriolis data centre performed float data management for **89 Argo scientific projects and 56 PIs (Principal Investigators).**

List of Coriolis scientific PIs and project names

project	nb floats
argo-bsh	108
coriolis	100
argo italy	86
argo germany	63
norargo2	38
argo-france	36
argo bsh	34
ovide	33
mocca	32
mocca-eu	28

Top 10 of Coriolis DAC projects having active floats

pi name	nb active flo
birgit klein	196
pierre-marie poulain	69
christine coatanoan	65
kjell arne mork	55
damien desbruyeres	42
elena mauri	34
andreas sterl	34
herve claustre	26
romain cancouet	25

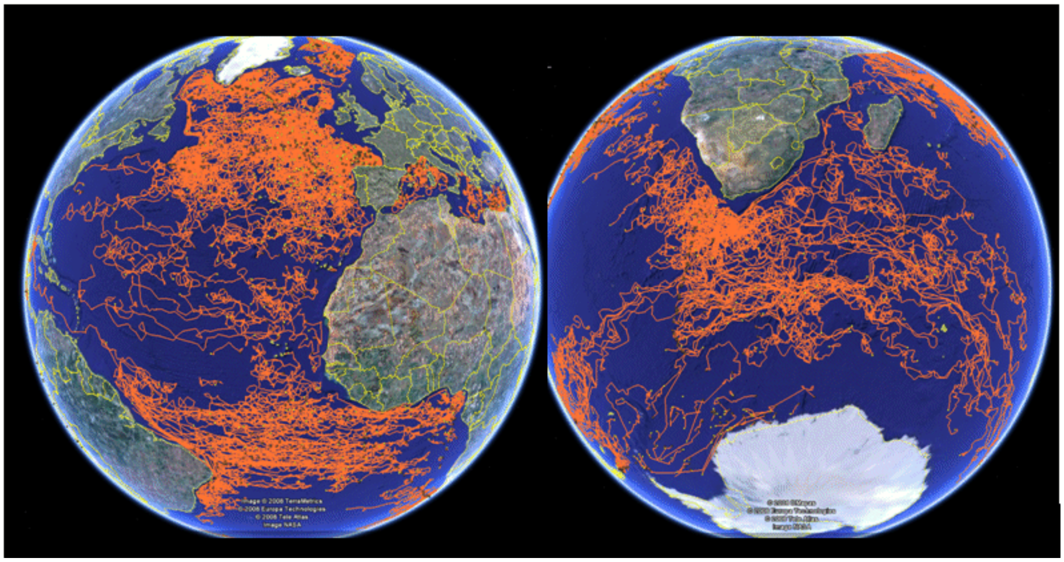
Top 10 of Principal Investigators (PI) in charge of active floats

1.8 Products generated from Argo data

Sub-surface currents ANDRO Atlas

Based on Argo trajectory data, Ifremer and CNRS team are regularly improving the "Andro" atlas of deep ocean currents. The ANDRO project provides a world sub-surface displacement data set based on Argo floats data. The description of each processing step applied on float data can be found in:

- Ollitrault Michel, Rannou Philippe, Brion Emilie, Cabanes Cecile, Piron Anne, Reverdin Gilles, Kolodziejczyk Nicolas (2022). **ANDRO: An Argo-based deep displacement dataset**. SEANOE. https://doi.org/10.17882/47077



Argo trajectories from Coriolis DAC are carefully scrutinized to produce the "Andro" atlas of deep ocean currents.

Sub-surface currents real time data

The Argo current product produced by Copernicus marine in situ is derived from the original trajectory data from Argo GDAC (Global Data Assembly Center). The Argo currents are calculated from Argo trajectories format version 3.1 or higher; the previous formats are ignored (2.*, 3.0).

It is daily updated and available from https://doi.org/10.48670/moi-00041

In November 2023 release, two significant improvements are implemented:

- A series of 20 quality control tests is applied on each Argo trajectory file documented in *Herbert Gaelle (2020). Qualification temps réel des données trajectoire des flotteurs Argo. https://doi.org/10.13155/95169*
- The currents are calculated with the Ollitrault-Rannou method documented in *Ollitrault Michel, Rannou Jean-Philippe (2013). ANDRO Dataset contents and format. https://archimer.ifremer.fr/doc/00360/47126*

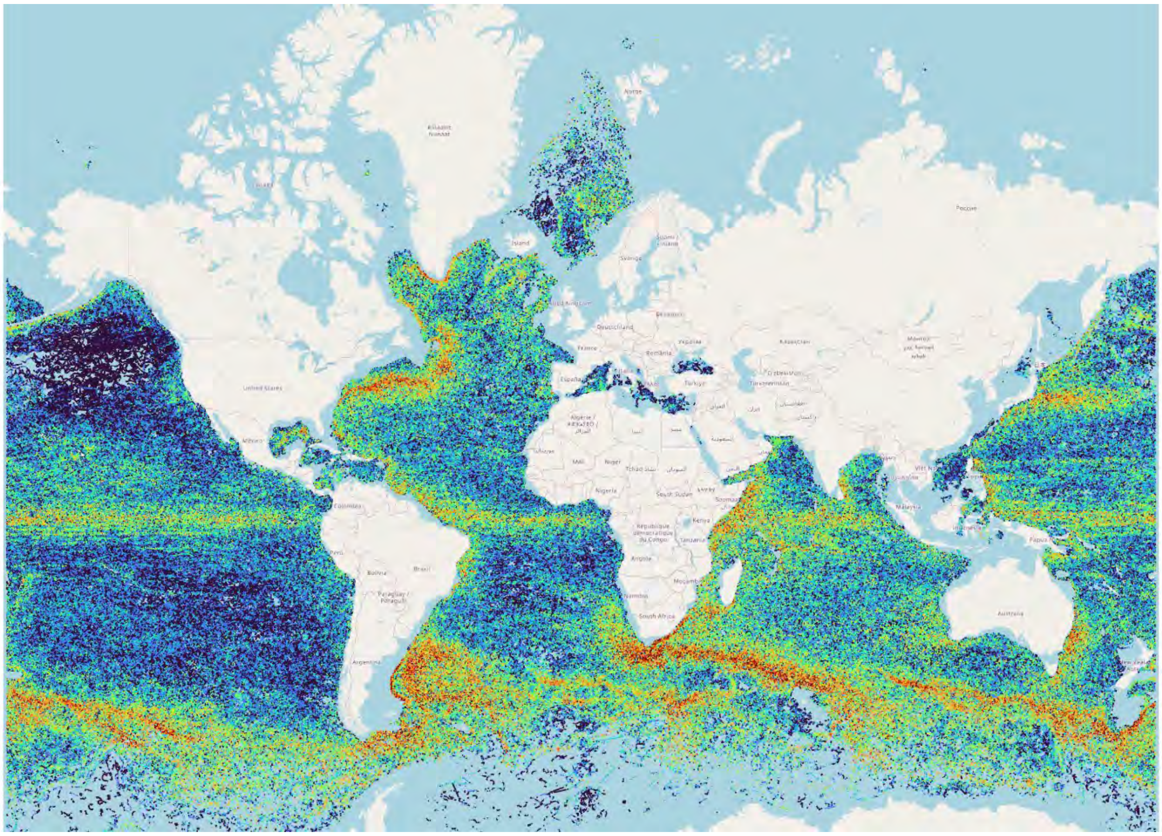


Figure 20: Map of Argo deep ocean currents, each dot represents the deep ocean current from one cycle (typically 10 days) from one float
From dark blue dot: 0 meter/second, to red dot: 2 meter/second

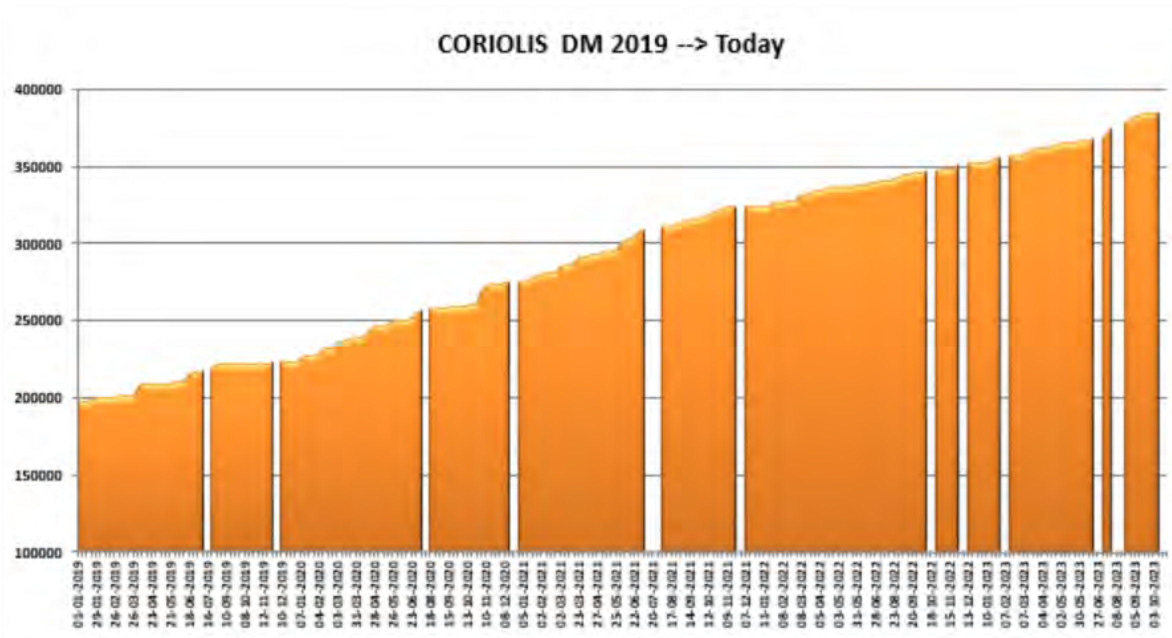
2 Delayed Mode QC

At the Coriolis data centre, we process the delayed mode quality control following four steps. Before running the OW method, we check carefully the metadata files, the pressure offset, the quality control done in real time and we compare with neighbor profiles to check if a drift or offset could be easily detected. By working on this way with PIs, the delayed mode quality control is strengthen.

Some floats have been deployed from some projects, meaning a lot of PIs and a lot of time for explaining the DM procedure to all of them. A few PIs are totally able to work on DMQC following the four steps but this is not the case for most of them. Since the unavailability of the PIs leads to work by intermittence and then extend the period of work on the floats, we did the work with a private organism (Glazeo) to improve the realization of the DMQC, exchanging only with the PIs to validate results and discuss about physical oceanography in studied area. Working in this way, we largely improve the amount of delayed mode profiles

A lot of work is always done from BSH (Birgit Klein) taking into account also floats from other German institutes and OGS (Antonella Gallo/Massimo Pacciaroni/Giulio Notarstefano) for the MedSea as well as Alberto Gonzalez Santana for IEO.

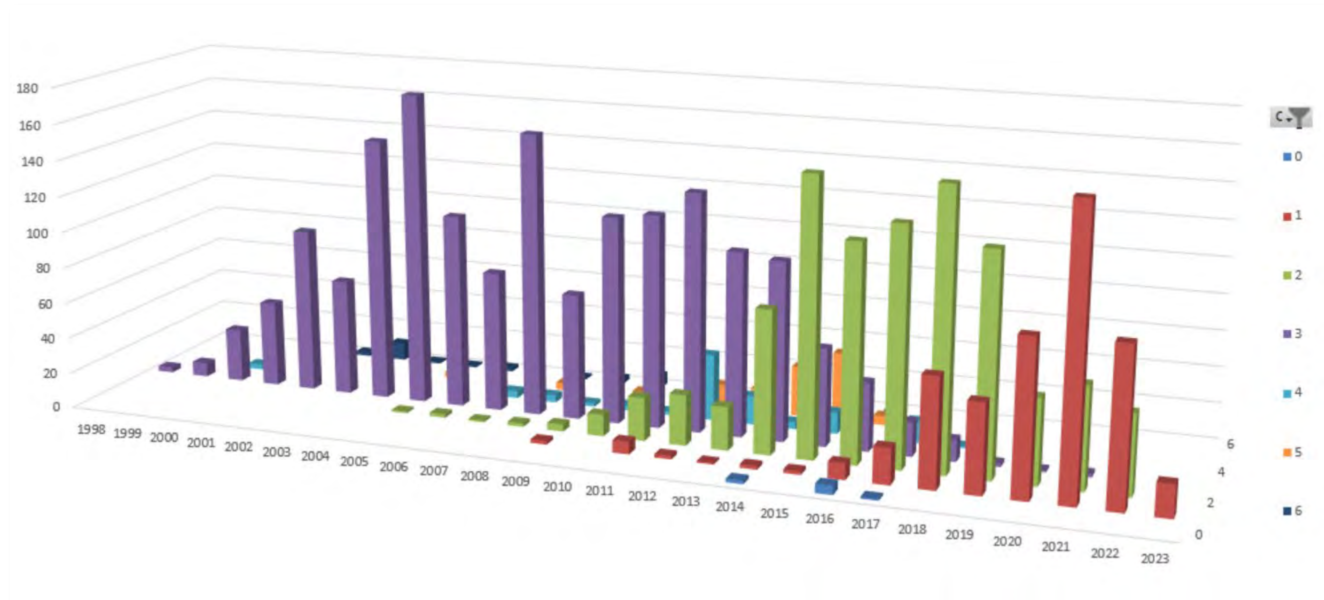
Over the past 5 years, a major effort has been made to steadily improve the quality control status of the delayed mode.



Evolution of the DM profiles' submission versus dates in last 5 years

During the last year (from October 2022 to October 2023), 37524 new delayed mode profiles where produced and validated by PIs. A total of 383908 delayed mode profiles were produced and validated since 2005.

The next figure shows the distribution of float by year and by quality level.

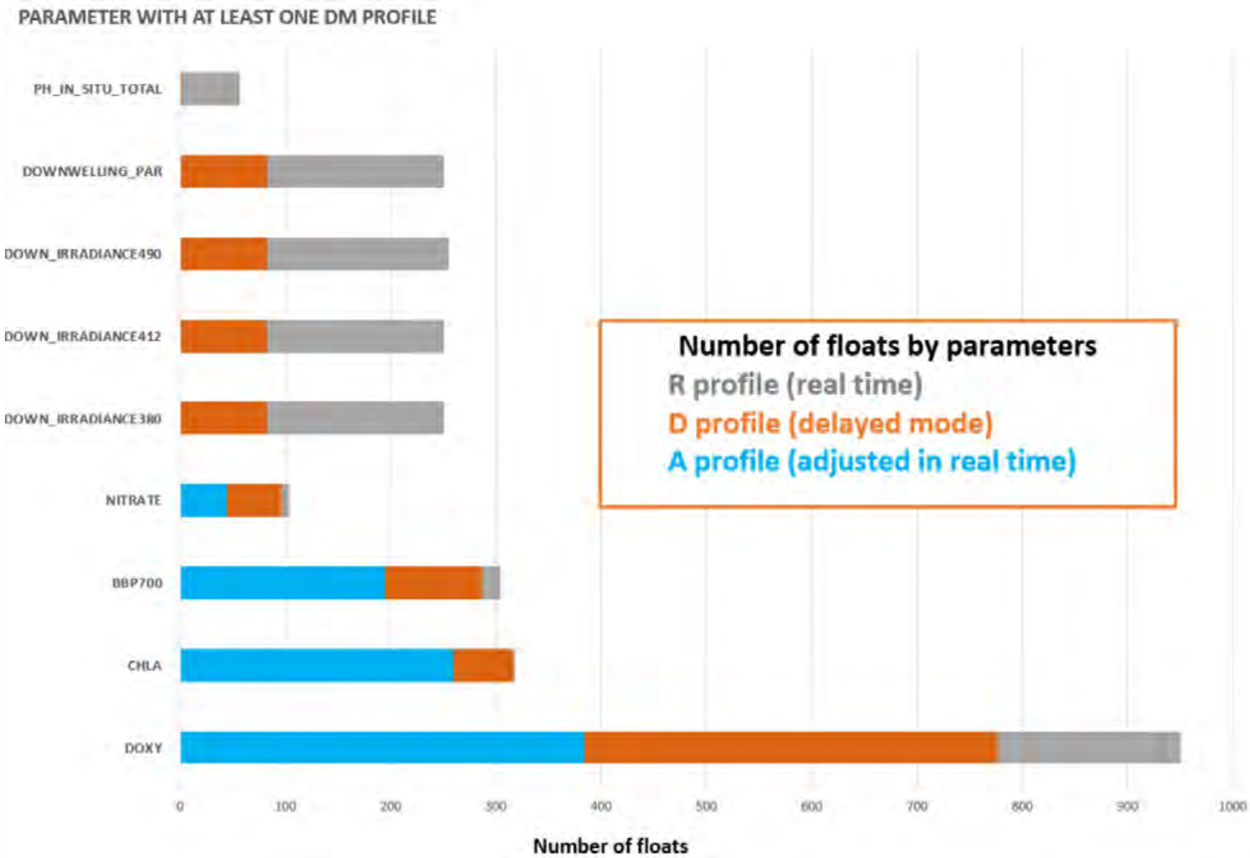


Status of the quality control done on profiles sorted by launch's year, code 1: young float, code 2: active float, DM done, code 3 : dead float, DM done; code 4 : DM in progress, code 5 : waiting for DM, code 6 : problems with float

In the following float, the status of quality control on floats is presented. For the BGC floats, the BD percent means that at least one parameter has been processed in delayed mode.

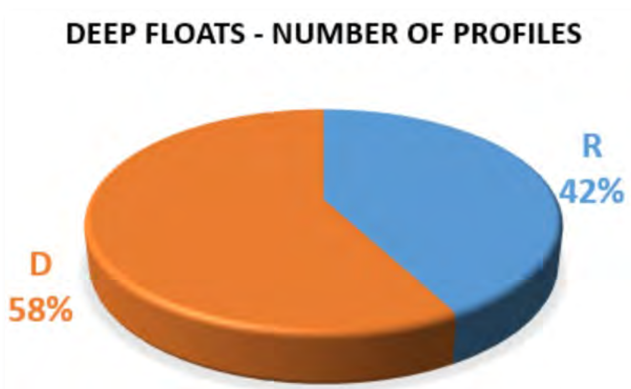
Status of the floats processed by Coriolis DAC.
Left: CORE profiles percent and right: BGC profiles percent (D/BD : delayed mode – R/BR : real time).

The status of the quality control done on the Coriolis BGC floats is presented in the following plot for some BGC parameters. Some parameters are regularly updated in DM mode (Doxy, ChlA, BBP).

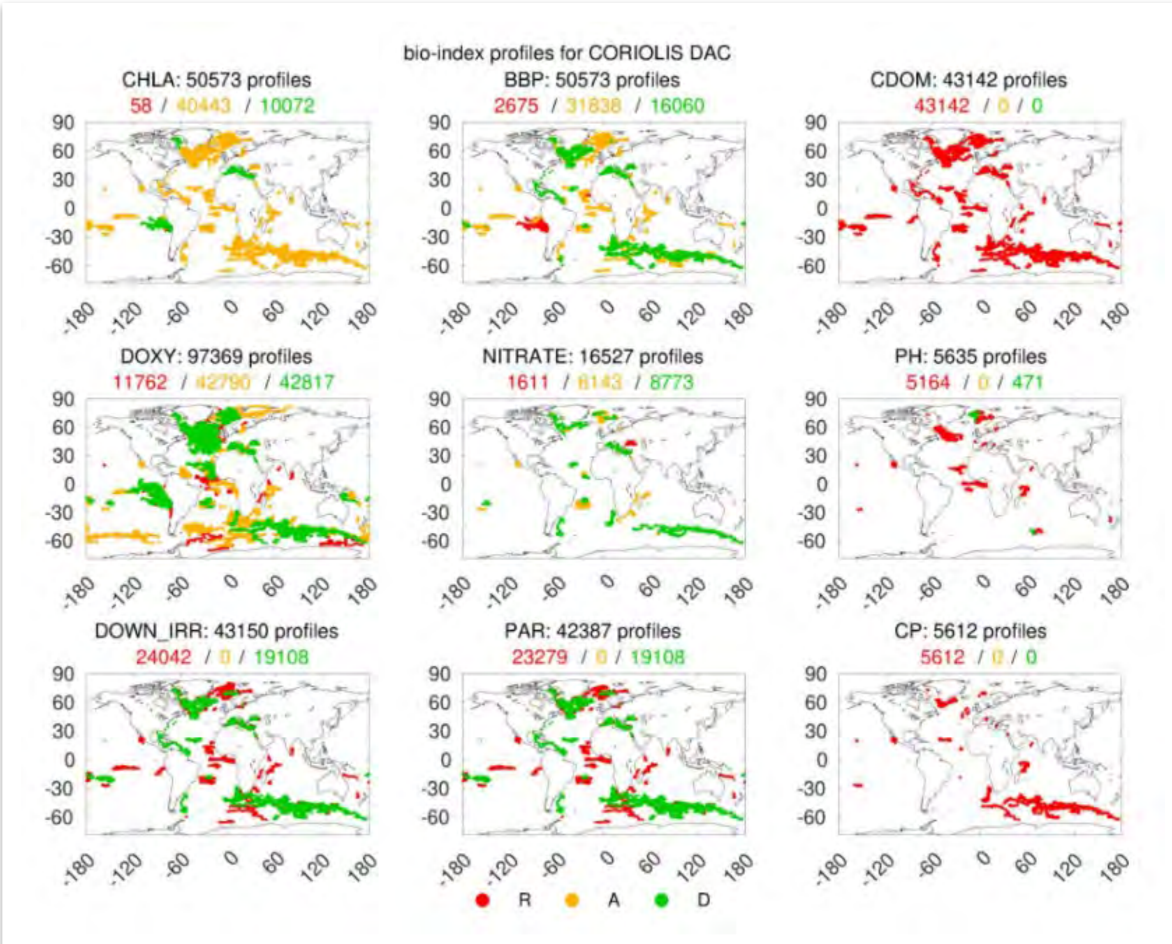


Status of the quality control done on BGC floats.
Float for which at least one profile has been performed in delayed mode for the parameter.

Looking in more detail to focus Deep Argo data, a great effort has also been made to increase the count of delayed mode profiles: 58% of Deep Argo profiles have been processed in delayed mode.



Regarding the BGC data, some information can be found on the document provided by the audit of Henry Bittig *(https://biogeochemical-argo.org/cloud/document/implementation-status/BGC_summary_coriolis.pdf)*.

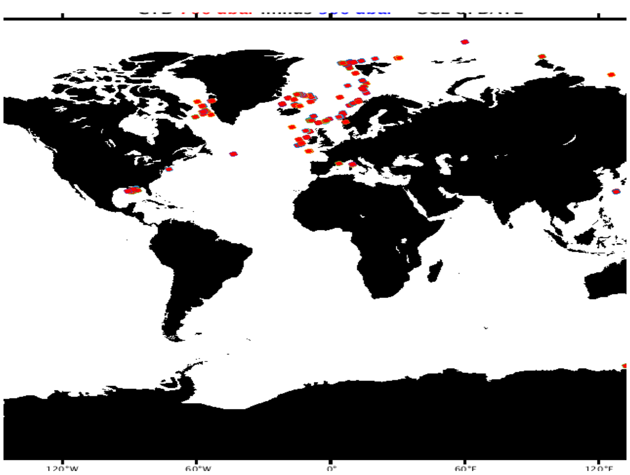


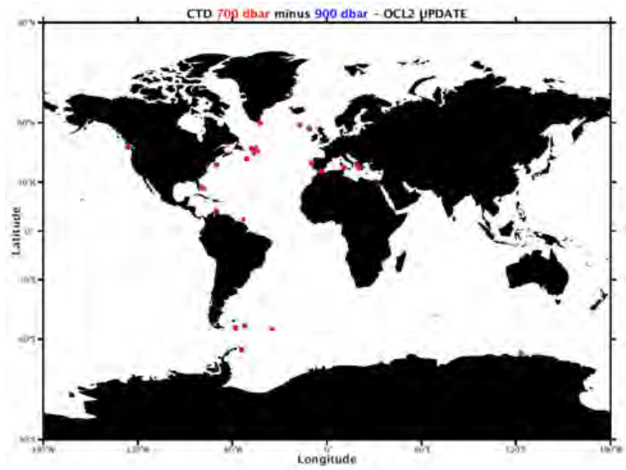
Location and number of R,A,D profiles per parameters.

CTD Reference database

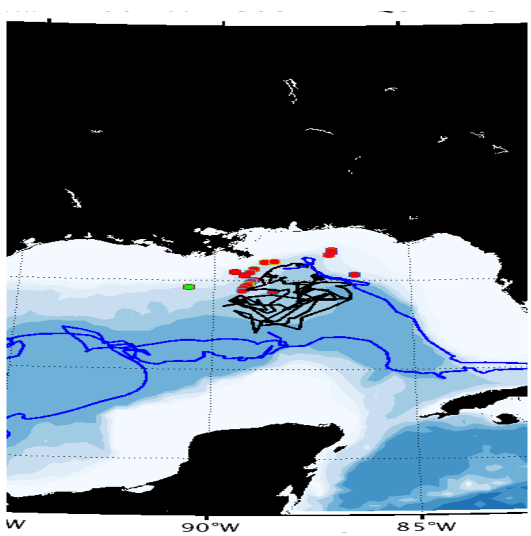
A work is in progress to take into account the criteria 700 dbar in shallower regions, as decided at the last ADMT. A new version 2023V01 is currently being prepared and will include updates from OCL, data provided by CCHDO (confidential, and GO-SHIP data from Website), as well as some corrections of anomalies detected by users.

Some tests have been made to study differences between criteria 700 dbar or 900 dbar for selecting profiles, which be included in the CTD reference database. Starting with the two OCL updates datasets, boxes have been created using the both criteria and differences have been studied to vizualise on which part of the ocean, new stations can increase the CTD dataset for the calibration.

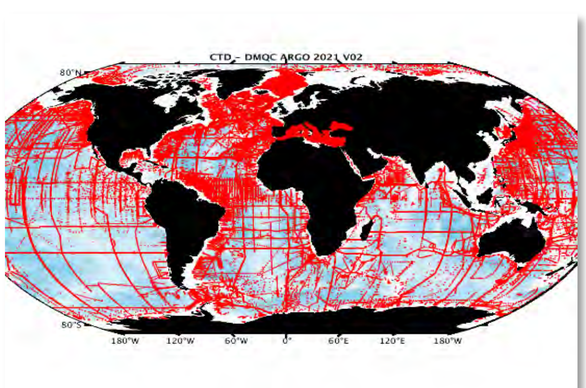


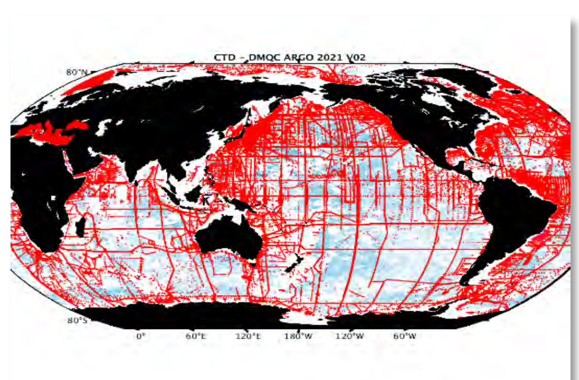


In the Gulf of Mexico, it seems that using 700 dbar as criteria will improve the number of CTD to perform the calibration method.



The last version is available on the Ifremer ftp site (ask login/password at codac@ifremer.fr) and is divided in smaller tar balls, one by wmo box area (1-3-5-7): for instance, CTD_for_DMQC_2021V02_1.tar.gz for all boxes starting with wmo 1, then we will have 4 tar files.





3 GDAC Functions

A significant achievement for the last 12 months is the daily distribution of Argo data on Amazon cloud infrastructure, see §3.9 .

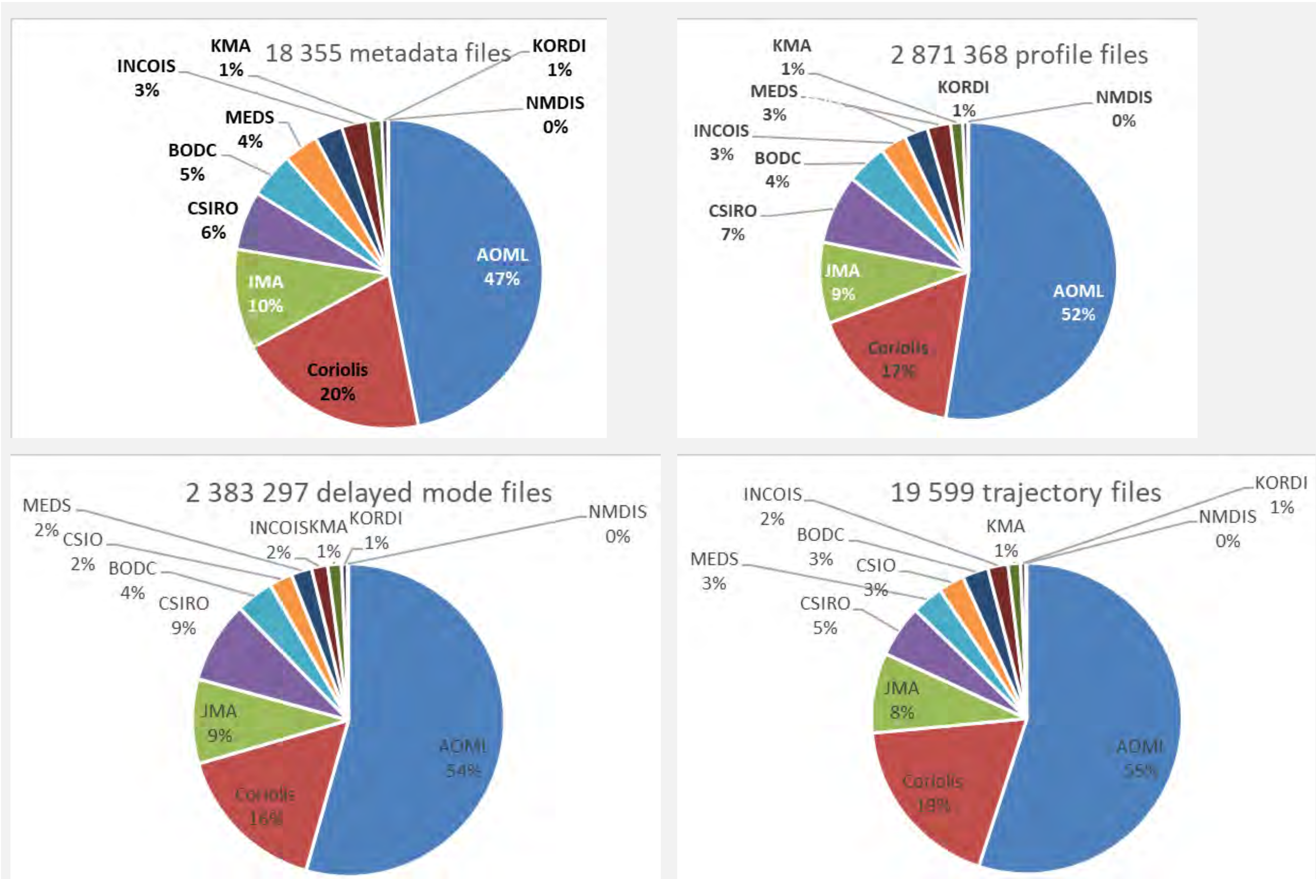
3.1 National centres reporting to you

Currently, 11 national DACs submit regularly data to Coriolis GDAC. On October 2023, the following files were available from the GDAC FTP site.

Compared to 2022, the number of floats (metadata) increased by 4%, the number of profile files increased by 5%.

3.1.1 GDAC files distribution in October 2023

DAC	metadata files	increase	profile files	increase2	delayed mode profile files	increase3	trajectory files
AOML	8 612	4%	1 507 278	5%	1 296 336	6%	10 782
BODC	871	6%	127 722	7%	93 122	2%	530
Coriolis	3 710	5%	483 866	8%	383 908	10%	3 624
CSIO	534	2%	73 594	4%	57 822	4%	533
CSIRO	1 130	3%	215 407	5%	201 710	6%	1 062
INCOIS	505	3%	81 813	2%	39 996	10%	412
JMA	1 921	2%	252 772	4%	208 454	4%	1 635
KMA	264	2%	38 064	2%	34 052	1%	255
KORDI	117	2%	15 624	1%	14 504	0%	107
MEDS	672	3%	72 768	7%	51 012	2%	640
NMDIS	19	0%	2 460	0%	2 381	-	19
Total	**18 355**	**4%**	**2 871 368**	**5%**	**2 383 297**	**6%**	**19 599**



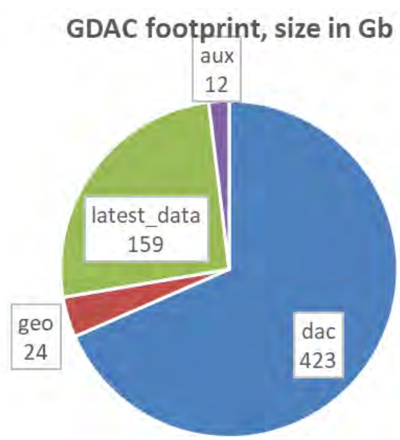
Number of files available on GDAC, October 2023

3.1.2 GDAC files size

- The total number of NetCDF files on the GDAC/dac directory was 3 535 214 (+6% in one year)
- The size of GDAC/dac directory was 423 Go (+11%)
- The size of the GDAC directory was 931 Go (+26%)

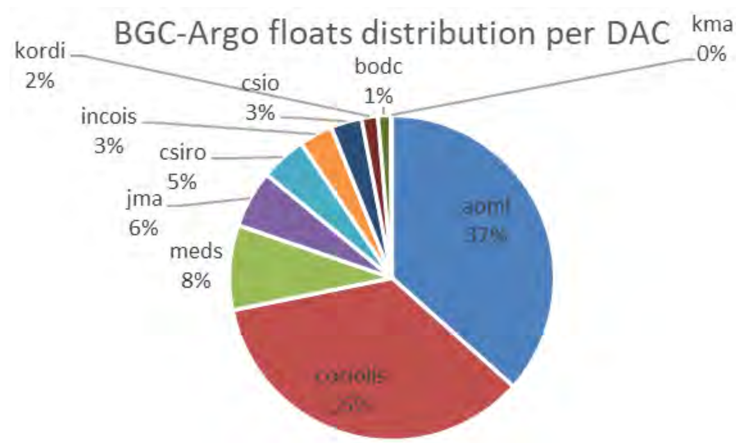
More on: http://www.argodatamgt.org/Data-Mgt-Team/News/BGC-Argo-M-prof-files-no-more-distributed-on-GDAC

branch	GDAC size in Gb	yearly increase	N-1
dac	423	11%	382
geo	24	33%	18
latest_data	159	7%	149
aux	12	179%	4,3
gdac total	931	26%	740

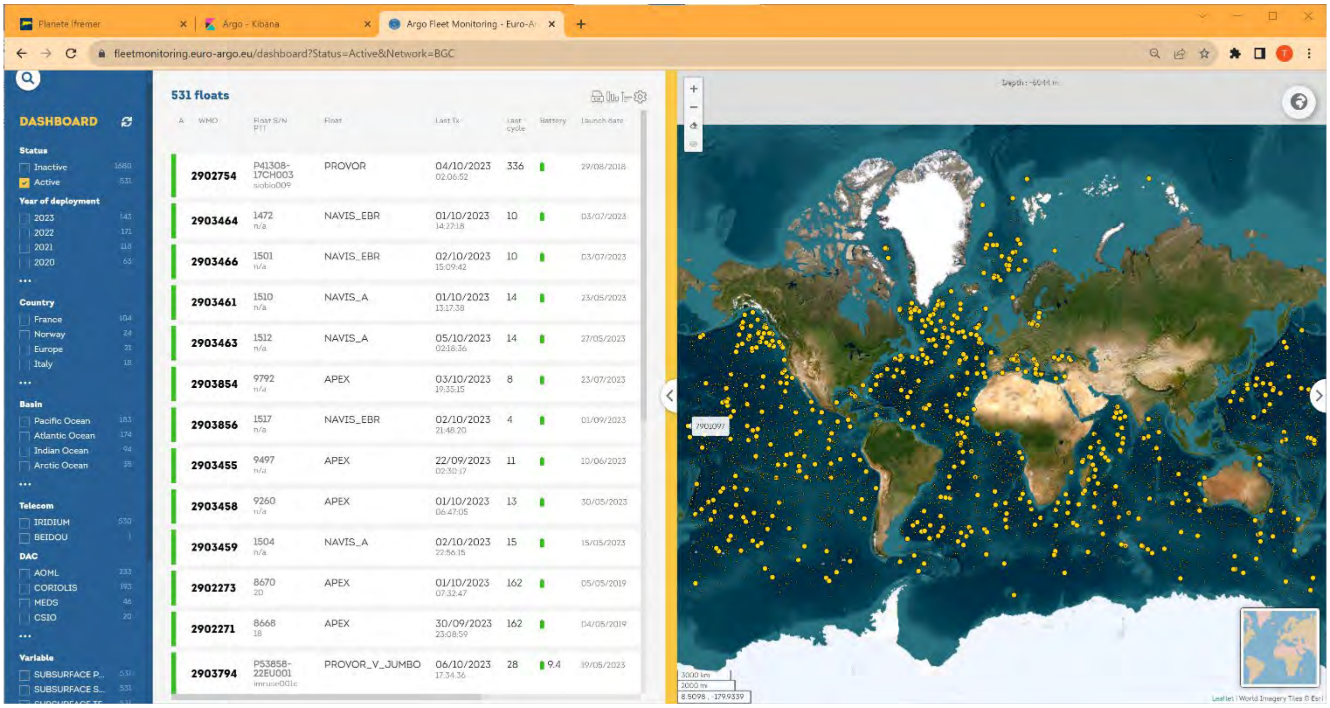


3.1.3 BGC-Argo floats

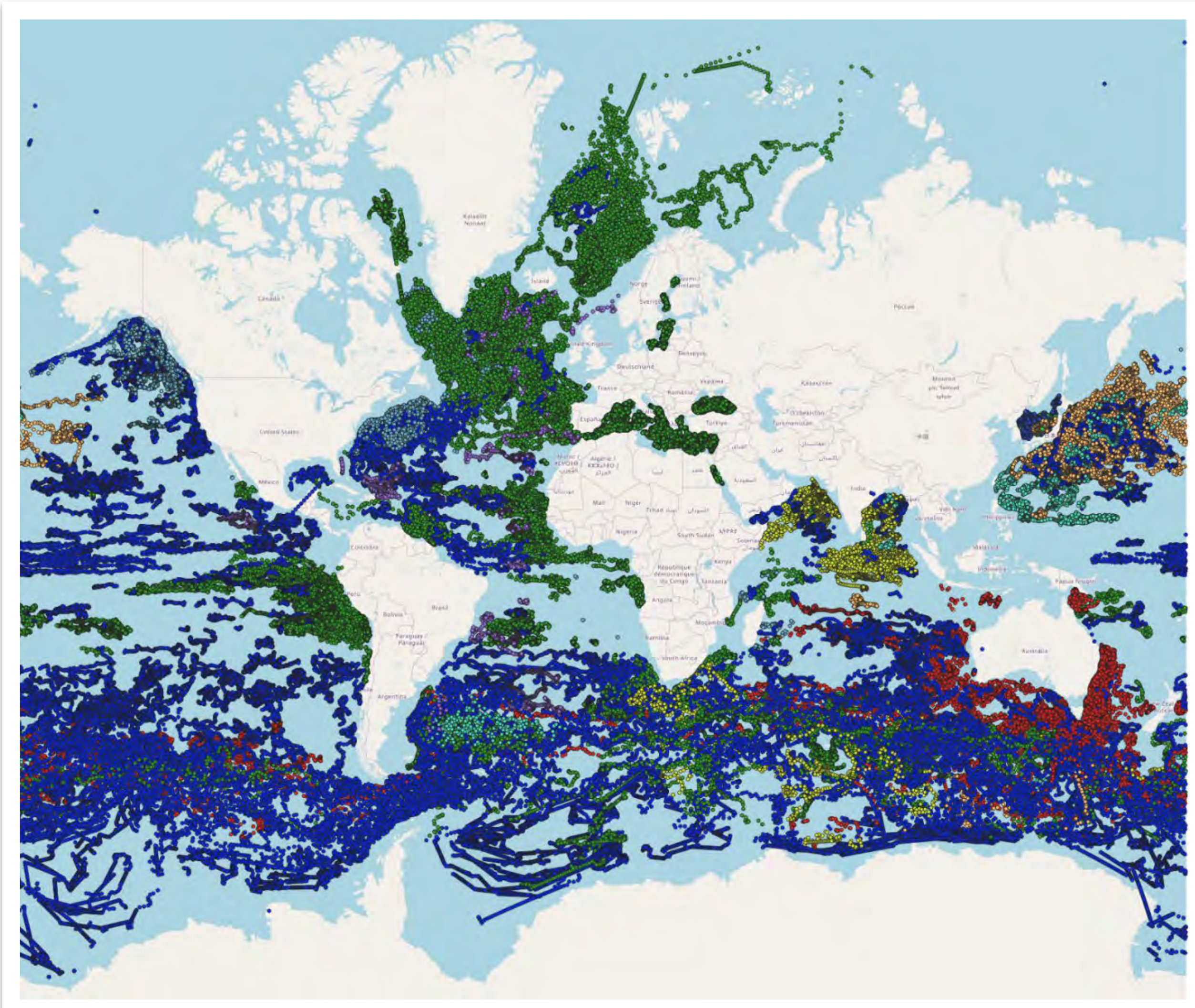
In October 2023, 294 950 BGC-Argo profiles from 2 084 floats were available on Argo GDAC. This is a fair increase compared to 2022: +12% more floats and +9% more profiles.



DAC	nb bgc float	nb bgc file
aoml	763	102 177
coriolis	734	108 574
meds	176	6 969
jma	119	20 470
csiro	95	23 271
incois	70	12 736
csio	64	11 285
kordi	34	3 426
bodc	26	5 574
kma	3	468
Total	**2084**	**294 950**

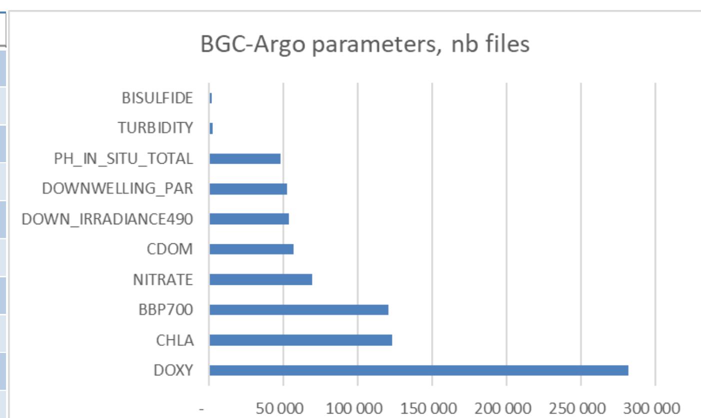


Map of 531 BGC-Argo active floats (yellow) among 2084 BGC-Argo floats (other: grey dots) from https://fleetmonitoring.euro-argo.eu/dashboard



BGC-Argo profiles, colored by DACs

BGC parameter	nb files
DOXY	281 767
CHLA	122 800
BBP700	120 284
NITRATE	69 287
CDOM	56 737
DOWN_IRRADIANCE490	53 371
DOWNWELLING_PAR	51 984
PH_IN_SITU_TOTAL	48 049
TURBIDITY	2 514
BISULFIDE	1 383

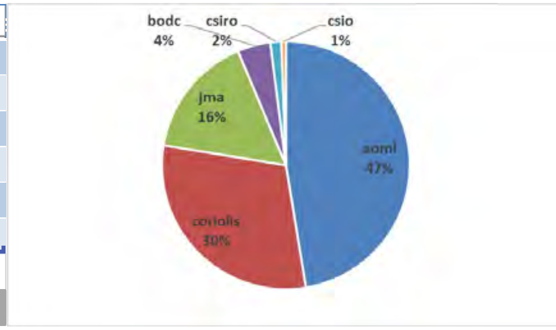


Main BGC-Argo physical parameters, number of s-profiles

3.1.4 Deep-Argo floats

The deep-Argo component of the One-Argo program is under development. A deep Argo float performs high precision observations from ocean surface to bottom, at up to 6000 meters deep.

dac	nb float	nb deep pro
aoml	165	20 318
coriolis	105	6 516
jma	56	3 870
bodc	15	850
csiro	5	478
csio	2	174
Total	**348**	**32 206**



3.2 Operations of the ftp, https and erddap servers

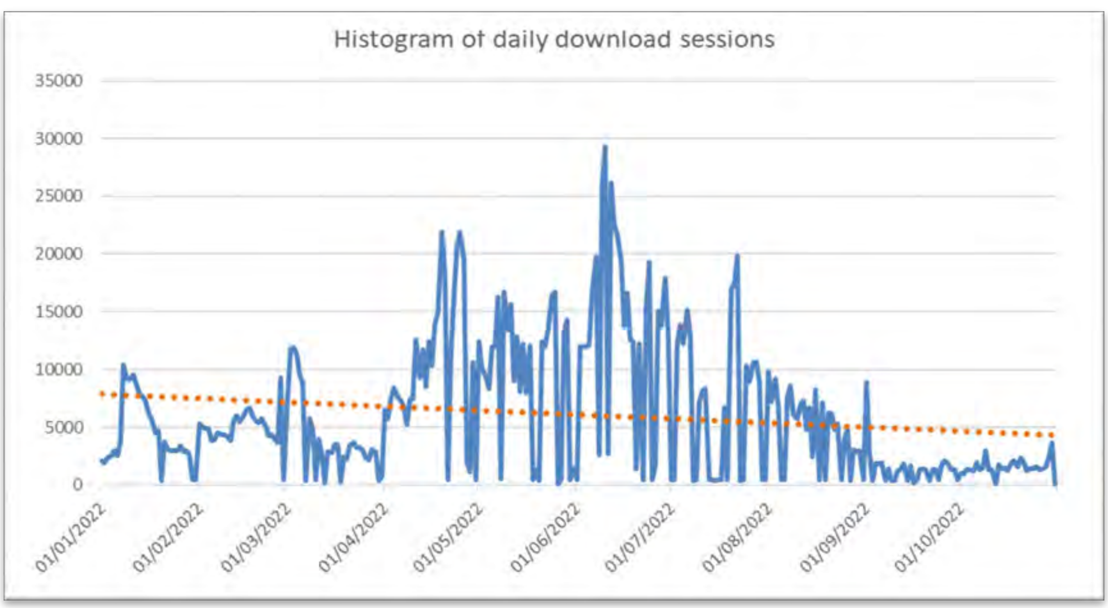
For each individual DAC, every 30 minutes, meta-data, profile, trajectory and technical data files are automatically collected from the national DACs. The 11 DACs are processed in parallel (one process launched every 3 minutes).

Index files of metadata, profiles, trajectories, technical and auxiliary data are hourly updated.

GDAC download services

- ftp ftp://ftp.ifremer.fr/ifremer/argo
- https https://data-argo.ifremer.fr
- erddap https://erddap.ifremer.fr

There is a daily average of 6000 sessions and downloading 20 terabytes of data files. There was a huge variability in number of sessions between May and August 2022.



3.3 GDAC files synchronization

The synchronization with US-GODAE server is performed once a day at 03:55Z

Synchronization dashboard in September 2023: the daily sync. time takes on average 80 minutes, with a failure on September 12th

3.4 Download services monitoring

Ifremer manage a dashboard (Semaphore) to monitor data distribution and give credit to data providers such as Argo floats.

- https://audience-argo.ifremer.fr

FTP, HTTPS and ERDDAP downloads log files are ingested in an Elasticsearch index. A link between downloaded files, download originators, floats included in the downloaded files and institution owners of the floats is performed. These links are displayed in a Kibana dashboard.

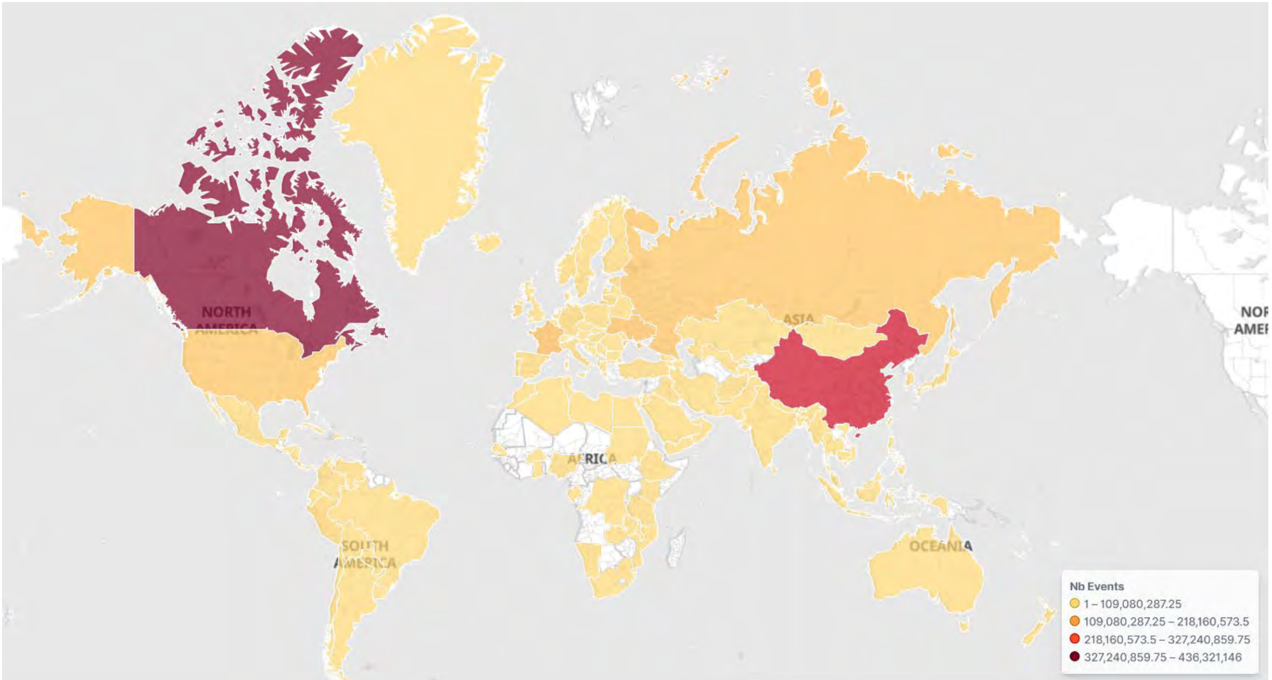
This dashboard offers the possibility to give credit to Floats owner institutions such as how many data from one particular institution was downloaded, by whose data users.

Semaphore key figures for 2023 and yearly increase:

- **6 million sessions for Argo data downloads (+200%)**
- **1 billion files downloaded (+53%)**
- **55% of ftp downloads, 45% of https downloads (80% and 20% a year ago)**
- **14 terabytes daily downloads, median value (+27%)**

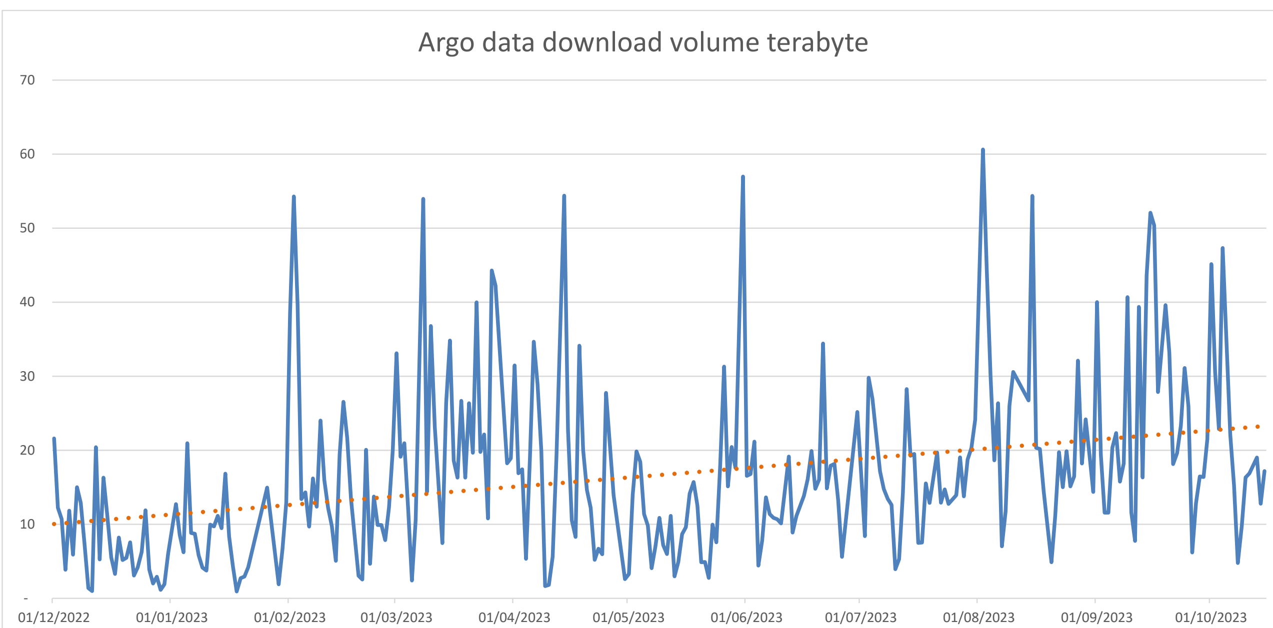
Download service	Nb hits	percent
ftp	584 121 875	55,26%
http	472 617 398	44,71%
thredds	174 582	0,02%
cms-ezpublish	36 327	0,00%
seanoe	15 179	0,00%
Total	1 056 965 362	

The majority of downloads is with ftp (55%), followed by https (45%) and a tiny fraction from Thredds , Argo CMS, Seanoe and ERDDAP data services.



Distribution by countries of GDAC ftp, https erddap downloads in 2023

The majority of downloads are from North America, China, Russia, Europe



Argo FTP, HTTPS and ERDDAP downloads in 2023, an average of 14 terabytes per day with spikes up to 60 terabytes a day

Semaphore is also used to monitor the data distribution activity.

In 2023, according to the daily data download volume statistics, there were no period of poor performances (compared to 6 days in 2022). A poor performance is an abnormally low volume of data downloaded by Argo users (less than 0,1 terabyte of data for a day).

- The lower traffic was on 2023-01-18 with 1 terabyte of data download.
- The peak traffic was on 2023-08-02 with 61 terabytes of data download

3.5 Grey list

The GDAC hosts a grey list of the floats that are automatically flagged as part of the automatic Real-Time quality controls (Test #15 from Argo Quality Control Manual for CTD and Trajectory Data. https://doi.org/10.13155/33951).

The grey list has 1 561 core-Argo entries (October 2023, 879 inactive entries), compared to 1519 entries one year ago.

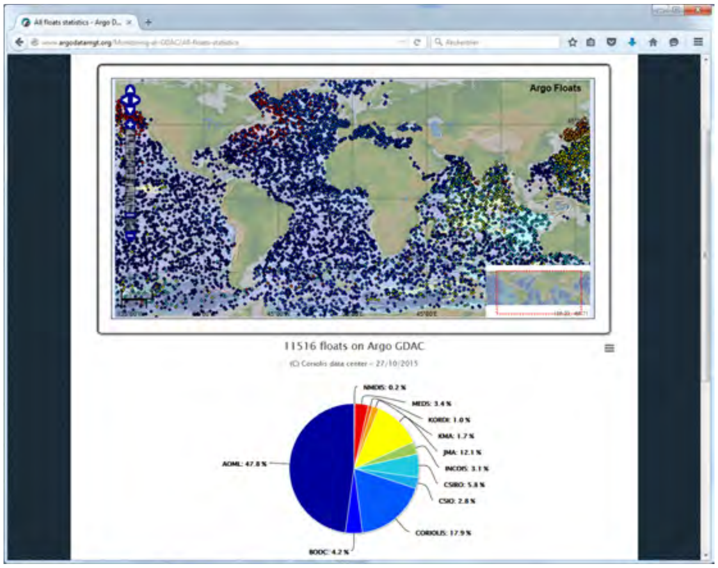
All floats core-Argo		
DAC	nb float	nb inactive floa
aoml	964	502
coriolis	192	99
jma	127	88
bodc	124	77
csiro	62	29
csio	28	27
meds	24	19
incois	24	23
kma	13	12
kordi	3	3
Total	**1561**	**879**

Parameter	nb entries
PSAL	1560
TEMP	160
PRES	121
DOXY	71
BBP700	51
CHLA	37
CDOM	24
BBP532	11
NITRATE	9
DOWN_IRRADIANCE380	4
DOWNWELLING_PAR	4
DOWN_IRRADIANCE490	4
DOWN_IRRADIANCE412	4
PH_IN_SITU_TOTAL	3
CP660	3
PH_IN_SITU_FREE	1
TURBIDITY	1

Distribution of grey list entries per DAC and per parameter

3.6 Statistics on GDAC content

The following graphics display the distribution of data available from GDAC, per float or DACs. These statistics are daily updated on: http://www.argodatamgt.org/Monitoring-at-GDAC



3.7 Mirroring data from GDAC: rsync service

In July 2014, we installed a dedicated rsync server called vdmzrs.ifremer.fr described on:

- http://www.argodatamgt.org/Access-to-data/Argo-GDAC-synchronization-service

This server provides a synchronization service between the "dac" directory of the GDAC with a user mirror. From the user side, the rysnc service:

- Downloads the new files
- Downloads the updated files
- Removes the files that have been removed from the GDAC
- Compresses/uncompresses the files during the transfer
- Preserves the files creation/update dates
- Lists all the files that have been transferred (easy to use for a user side post-processing)

Examples

Synchronization of a particular float

- rsync -avzh --delete vdmzrs.ifremer.fr::argo/coriolis/69001 /home/mydirectory/...

Synchronization of the whole dac directory of Argo GDAC

- rsync -avzh --delete vdmzrs.ifremer.fr::argo/ /home/mydirectory/...

3.8 Argo DOI, Digital Object Identifier on monthly snapshots

A digital object identifier (DOI) is a unique identifier for an electronic document or a dataset. Argo data-management assigns DOIs to its documents and datasets for two main objectives:

- Citation: in a publication the DOI is efficiently tracked by bibliographic surveys
- Traceability: the DOI is a direct and permanent link to the document or data set used in a publication
- More on: http://www.argodatamgt.org/Access-to-data/Argo-DOI-Digital-Object-Identifier

Since July 2019, the DOI monthly snapshot of Argo data is a compressed archive (.gz) that contains distinct core-Argo tar files and BGC-Argo tar files. A core-Argo user can now ignore the voluminous BGC-Argo files.

Argo documents DOIs

- Argo User's manual: http://dx.doi.org/10.13155/29825

Argo GDAC DOI

- Argo floats data and metadata from Global Data Assembly Centre (Argo GDAC) http://doi.org/10.17882/42182

3.9 Argo GDAC available from Amazon S3 cloud service

As part of "action 48 - admt-21 Argo data on the cloud" we contacted Amazon and its ASDI program (Amazon Sustainability Data Initiative). There is now a prototype of GDAC on the cloud, updated daily in an S3 bucket.

- https://registry.opendata.aws/argo-gdac-marinedata/

Argo GDAC data is directly available, it is no more necessary to download files before using them. Anyone from anywhere can run something like a python script with direct access to an Argo cloud prototype hosted on Amazon.

German Data Management Report 2023 (Period 1.11.2022 to 30.10.2023)
Submitted to ADMT 24, October 2023

By BSH (Federal Maritime and Hydrographic Agency), Germany

1. Real Time Status

Please report the progress made towards completing the following tasks and if not yet complete, estimate when you expect them to be complete. Please remember to include information on all Argo missions (including BGC, Deep and core) as well as pilot data from the RBR CTD.

- Data acquired from floats
  In 2023, there are/were 246 active/operational German floats which belong to BSH except for 15 associated to AWI, and 6 to ICBM, 1 to GEOMAR and 1 to IOW.
  Of all the active floats, 14 floats are equipped with biogeochemical sensors, 6 floats belong to BSH, 6 to ICBM, 1 to IOW and 1 to GEOMAR. 2 more floats were deployed by IOW and ICBM in the Baltic sea, unfortunately, one was dead on deployment, the other one died after 17 cycles.
  Data from all presently active floats are available from the GDACs.
- Due to logistical delays with deployment cruises only 29 BSH and 2 ICBM floats have been deployed in the reporting period 1.11.2022 to 30.10.2023. 16 more are either on their way to deployments already or will be shipped soon, and 5 floats are stored in South Africa with the Weather Service and now at SAEON (South African Environmental Observation Network) to be used on the SANAE/Goodhope/Crossroads cruises by South African colleagues in the coming months.
- From the 16 floats still to be deployed in 2023, 3 Provor BGC floats with an oxygen and a pH sensor were purchased and will be deployed in December of 2023 in the Labrador Sea.
- Data issued to GTS
  All German floats are processed in real-time by Coriolis and immediately inserted into the GTS
- Data issued to GDACs after real-time QC
  All profiles from German floats are processed by Coriolis following the regular quality checks and are routinely exchanged with the GDACs.
- Delayed mode data sent to GDACs
  The D-files are submitted by email to Coriolis together with the diagnostic figures and a short summary of the DMQC decision taken and are inserted into the GDAC after format testing.

2. Delayed Mode QC status

Please report on the progress made towards providing delayed mode Argo data, difficulties encountered and, if possible, solved. Please remember to include information on all Argo missions (including BGC, Deep and core) as well as pilot data from the RBR CTD.

For the core mission the overall percentage of D-files from all German programs is remaining at a quota of above 90%. BSH had adopted floats from all German universities and research institutions.

German Floats/ Program Name	Number of profiles	Number of D-files	D-files pending
Argo BSH	81413	74171	3724
Argo AWI	8721	3926	4781
Argo GEOMAR	13474	13407	67
Argo U. HH	3347	3258	89
Argo Denmark with U.HH	371	360	11

The most important remaining issue still is the dmqc of the AWI floats. The analysis of the salinity time series of AWI floats in the Weddell gyre showed initial asymptotic adjustments from fresh start cycles in the order of <0.005 psu (Fig. 1). These consistent but small adjustments seem to be abundant in the quiet environment of the Weddell gyre.

The asymptotic adjustment is not only a feature of floats deployed by AWI but common to floats from the area deployed by other national programs. The analysis of 207 floats within the center of the Weddell gyre from all participating national programs has been presented during the international Argo dmqc operator meetings. The analyis showed an asymptotic behavior in 119 cases and no such signal in 88 floats.

Because of the pending decision on the initial adjustment and how to flag the concerned cycles at the moment 9419 profiles are available from the 216 AWI floats and but only 45% are available as D-files. For all other floats in the German program (949 floats) the DMQC quota is at 96%. Cycles from some older floats appeared in the audit requests during the year and corrected d-files have mostly been submitted. For a few legacy floats with cycles still in file format V2.2 need updates from Coriolis which are presently discussed.

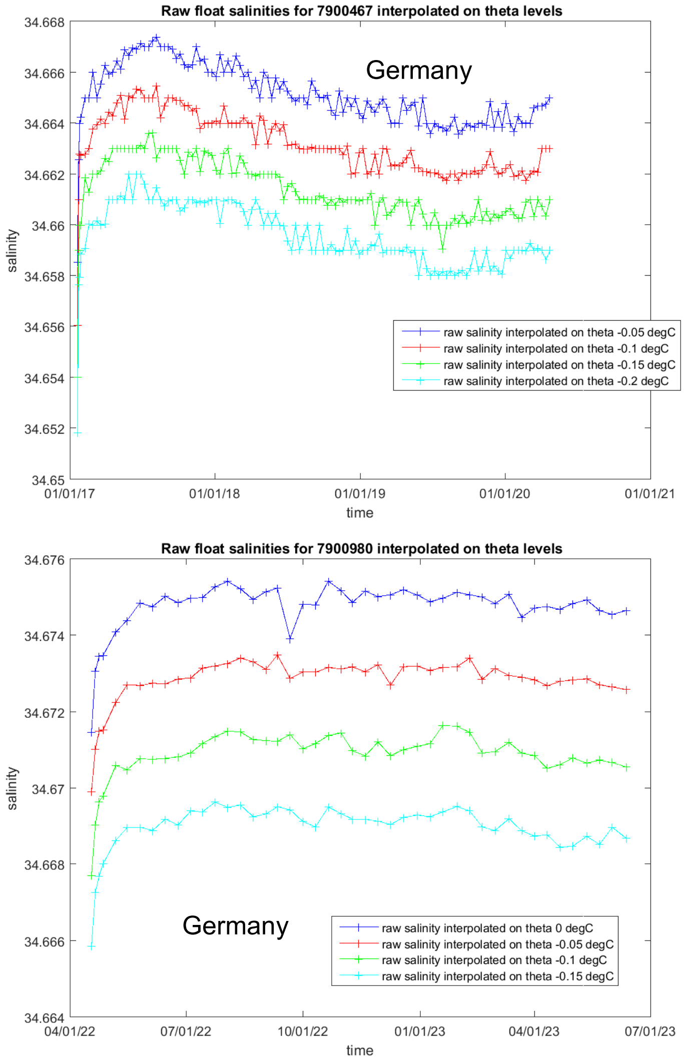


Fig.1: Examples of initial asymptotic adjustment from AWI floats.

The data from 5 RBR floats which were part of the pilot swarm experiment of 10 floats in 2021 are due to be d-moded with priority, now that all floats have left the eddy in which they have been deployed. RBR pilot data is being received from 5 floats deployed in October 2023, the deployments were made pairwise at 5 locations in the South Atlantic together with a float equipped with a SBE CTD. The next 5 Arvor floats with RBR sensors (reporting high frequency data) will be deployed in the North-East Atlantic, near to the Azores in the end of 2023 or beginning of 2024.

BSH has also adopted some floats from Finland (10 non Baltic floats), the Netherlands (100 floats), Norway (30 floats) and Poland (13 floats) for DMQC and is performing DMQC on parts of the MOCCA fleet (44 floats) from the European Union. The progress in these programs providing D-files is generally good. Since Argo-Norway has received fundings from the national research council to increase the number of Norwegian floats deployed per year, the program has gotten more involved in the dmqc activities. Floats deployed from 2019 onward have been covered by Norwegian DMQC operators. The same is true for Argo-Poland which also has performed DMQC on their own floats from 2019 onward.

Adopted floats/ Program Name	Number of profiles (selection)	Number of D-files (selection)	D-files pending (selection)	Comments
Argo Poland (13 floats out of 35)	1503	1467	2	Arctic and Baltic floats handed over
Argo Finland (10 floats out of 49)	798	795	3	Mostly Baltic and Barent Sea floats handed over
Argo Netherlands (100 out of 112 floats)	12511	11593	282	RBR floats still pending
Argo Norway (30 floats out of 92)	5011	4817	117	Cut in 2019
MOCCA (45 floats out of 119)	11635	8452	2995	Baltic floats pending
US Navy (10 floats)	1908	1901	7	Overlooked new cycles from one float
NAAMES/US (E. Boss) (13 floats)	2724	2622	102	One float missing

Investigations of fast salty drifters were continued and consolidated with the entire European fleet. Information is now available in a shared in a spreadsheet. Efforts have been made since last year to make sanity checks on the manually entered entries into the table and afterwards to perform statistical analysis from the data holdings at the GDACs. Delphine Dobler from Ifremer has undertaken this work. DMQC operators have been asked to update their entries into the table prior to ADMT24.

https://docs.google.com/spreadsheets/d/1TA7SAnTiUvCK7AyGtSTUq3gu9QFbVdONj9M9zAq8CJU/edit#gid=974650348

Seabird has agreed to issue certificates for 5.25 CTDs for the identified fast salty drifter in the recall range from the German program, which have not yet arrived

Starting in 2023 a full term position for dmqc of BGC parameters has been filled at BSH and has started to establish the structure for dmqc procedures for German BGC floats and collaboration with the institutes on their floats. This should be integrated well in the European structures. The dmqc for BGC parameters is supported by the research institutes: GEOMAR will collaborate on pH, IOW will provide background for nitrate and O2 and ICBM will oversee the bio-optical sensors from the radiometers. Software structure and programs are being set up, due to internal organization the DMQC of BGC is starting slowly. The focus is on oxygen, other parameters will follow.

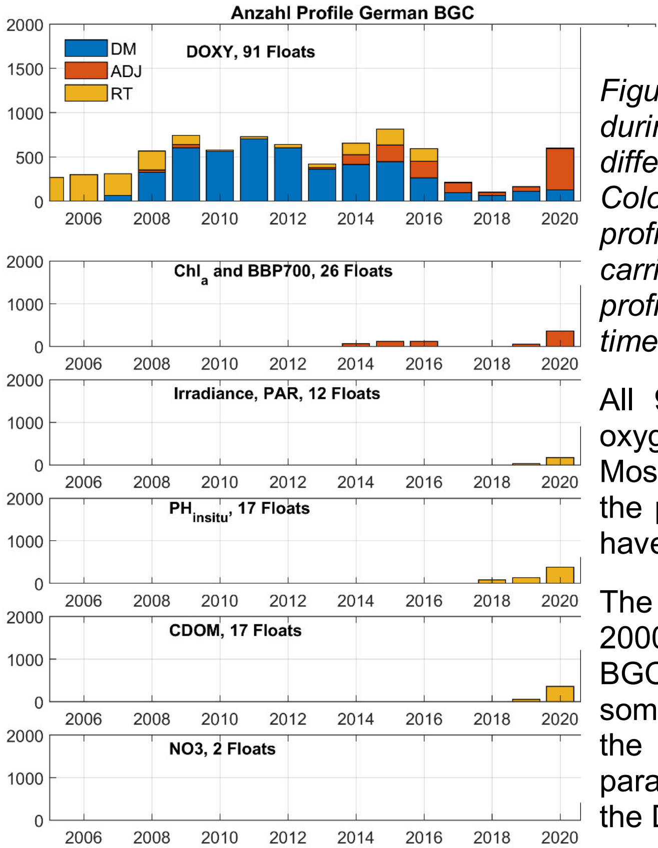


Figure 3: Number of Profiles gathered during the last 17 years for the different biogeochemical parameters. Color shading shows the status of the profiles in blue (DM): full DMQC carried out, red (ADJ): adjusted profiles, yellow (RT): profiles in real time mode.

All 91 floats gathered about 12000 oxygen Profiles in the last 2 decades. Most profiles were dmqc-ed (blue), the profiles from the last 2 to 3 years have to be done.

The German BGC floats gathered 2000 to 4000 profiles. Most of these BGC data profiles are not dmqc-ed, some are adjusted (red), others are in the real time status (yellow). Each parameter has its own reasons why the DMQC is late.

3. Value Added items

- List of current national Argo web pages, especially data specific ones
  BSH is maintaining the new Argo Germany Web site at https://www.bsh.de/DE/THEMEN/Beobachtungssysteme/ARGO/.
  It provides information about the international Argo Program, the German contribution to Argo, Argo array status, data access and deployment plans. It also provides links to the original sources of information.

- Statistics of National Argo data usage (operational models, scientific applications, number of National PIs…)
  Currently no statistics of Argo data usage are available. The German Navy uses Argo data on a regular basis for the operational support of the fleet and uses their liaison officer at BSH to communicate their needs. The SeaDataNet portal uses German Argo data operationally for the Northwest European Shelf. Based on the feedback from the national user workshop

(in June 2023) Argo data are routinely assimilated in the GECCO reanalysis, which is used for the initialisation the decadal prediction system MiKlip. They are also routinely assimilated into the Earth-System-model of the Max-Planck Society in various applications reaching from short term to decadal predictions and are used for model validation. At BSH the data are used within several applications such as EArise and Expertennetzwerk BMDV. Data are also used in various research groups at universities.

- Products generated from Argo data that can be shared
- Publicly available software tools to access or qc Argo data

4. GDAC Functions

If your centre operates a GDAC, report the progress made on the following tasks:

- Operations of the ftp server
- Operations of the www server
- Operations of a user friendly interface to access data
- Data synchronization
- Statistics of Argo data usage : Ftp and WWW access, characterization of users (countries, field of interest : operational models, scientific applications) …

5. Regional Centre Functions

If your centre operates a regional centre, report the functions performed and any future plans.

BSH is part of the SOARC consortium and is working continuously on updating the CTD reference data base for the Weddell gyre.

In continuation of work performed in the European projects MOCCA and EArise we are presently working on reference data for the Baltic Sea, Nordic Seas and Arctic proper and revising dmqc methods. A workshop was held in Sopot (Poland) in April 2024 and will be followed by a workshop in Bergen (Norway) in October 2024.

6. Other Issues

Please include any specific comments on issues you wish to be considered by the Argo Data Management Team. These might include tasks performed by OceanOPS, the coordination of activities at an international level and the performance of the Argo data system.

Argo National Data Management Report (2023) – India

1. Status

- **Data acquired from floats**
  India has not deployed any new floats between December 2022 and mid September 2023. However a cruise is currently underway in the northern Indian Ocean and it is planned to deploy 30 floats (17 in BoB and Arabian Sea). With these deployments, the overall the contribution from India stands at is 524 from the year 2002. Out of these 51 floats are active. Data from all these active floats are processed and sent to GDAC.

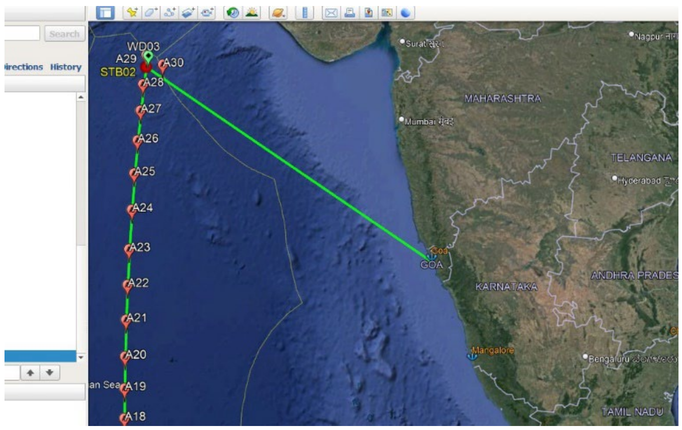


Fig: Tentative deployment plan of the Argo floats in the northern Indian Ocean. Actual deployment (location/date) might vary depending on the prevailing conditions at sea.

- **Data issued to GTS**
  All the 51 active floats data is being distributed via RTH New Delhi. Data in BUFR format is distributed to IMD, New Delhi and the same are distributed to GTS by assigning a time stamp.

- **Data issued to GDACs after real-time QC**
  All the active floats (51) data are subject to Real Time Quality Control (RTQC) and are being successfully uploaded to both GDACs.

- **Data issued for delayed QC**
  In total ~49% of the eligible profiles for DMQC are generated and uploaded to GDAC. Floats identified and notified through the ocean-ops are passed through DMQC and submitted to GDAC. Some more floats are grey listed and the list is updated on GDAC.

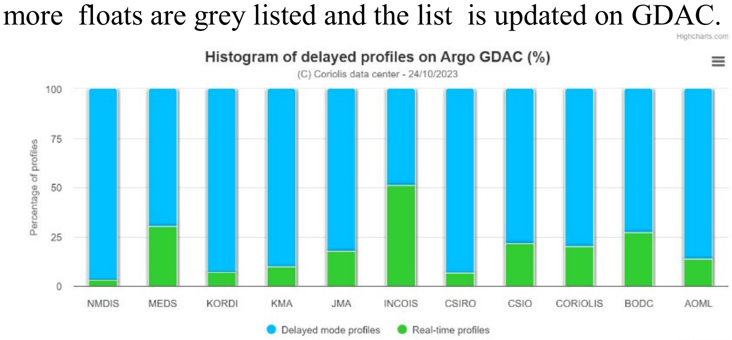


Fig: Histogram of DMQC profiles of all DACs

- **Web pages**
- INCOIS continued maintaining Web-GIS based site for Indian Argo Program. It contains entire Indian Ocean floats data along with profile position. Further details can be obtained by following the link

  http://www.incois.gov.in/Incois/argo/argo_home.jsp.

  Apart from the floats deployed by India, data from floats deployed by other nations in the Indian Ocean are received from the Argo Mirror and made available in the INCOIS website. User can download the data based on his requirement.

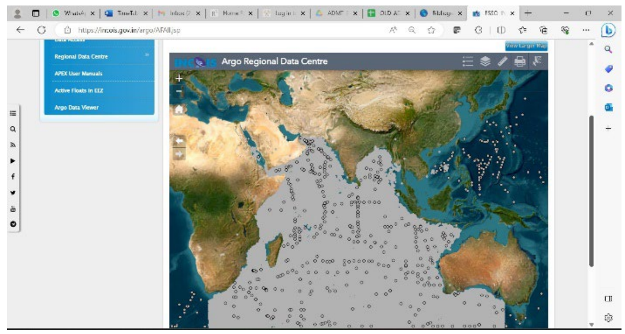


Fig: Snapshot of all the profiles being served by INCOIS website.

- Statistics of Indian and Indian Ocean floats are generated and maintained in INCOIS web site. The density maps for aiding people for new deployments are made available on a monthly basis. For full details visit : http://www.incois.gov.in/Incois/argo/argostats_index.jsp.

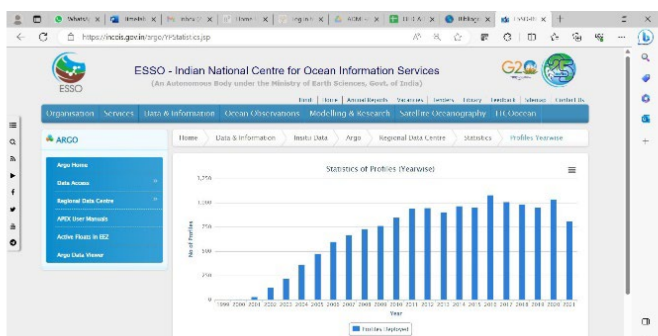


Fig: Statistics of all the profiles available/archived at INCOIS.

- **Trajectory**

  INCOIS continued generating Ver 3.1 trajectory files and uploaded them to GDAC.

- **Statistics of Argo data usage**

  INCOIS continued Argo data outreach program specifically targeting students, researchers and research scholars. Argo data is popularized and being widely put to use by various Organisations/ Universities/ Departments. Scientists, Students and Researchers from INCOIS, NIO, SAC, C-MMACS, NRSA, IITM, NCMRWF, IISc etc are using Argo data in various analysis. Many paper based on Argo data were also published in reputed journals. See the references below. Bio-Argo data is continued to be supplied to researchers interested in using it. Data from BGC-Argo is continued to be used for validation of Biogeochemical model outputs like ROMS with Fennel module.

- **Products generated from Argo data**
  1. INCOIS continued to generate value added products using all Argo data (both national and international). Continued to use variational analysis method (DIVA) while generating value added products. Many products are generated using Argo temperature and salinity data. The Argo T/S data are first objectively analysed and this gridded output is used in deriving value added products.
  2. DVD on "Argo data and products for the Indian Ocean" is discontinued which is being made available via INCOIS and UCSD web sites. However the older version of the same is still available for download.

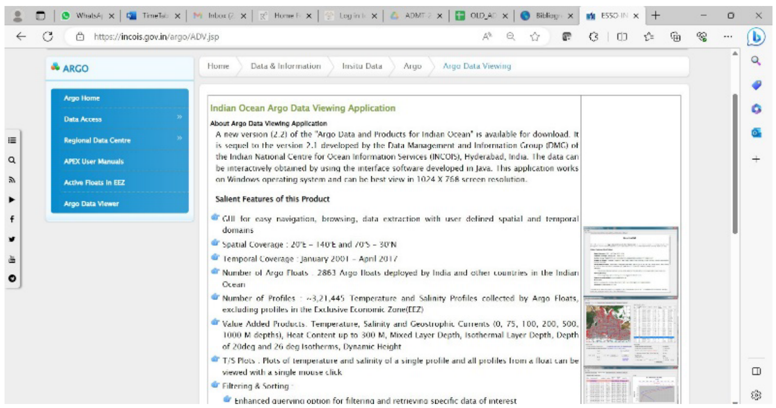


Fig: Web page of the Argo data viewer.

  3. Argo valued products are continued to be made available through INCOIS LAS. For further details visit http://las.incois.gov.in.

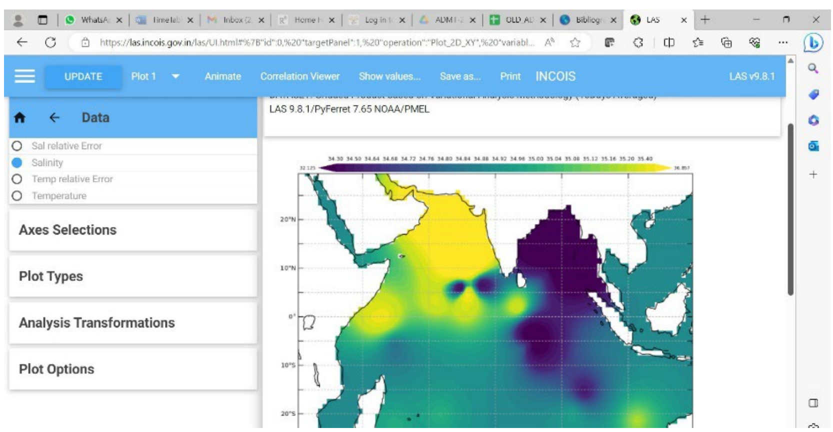
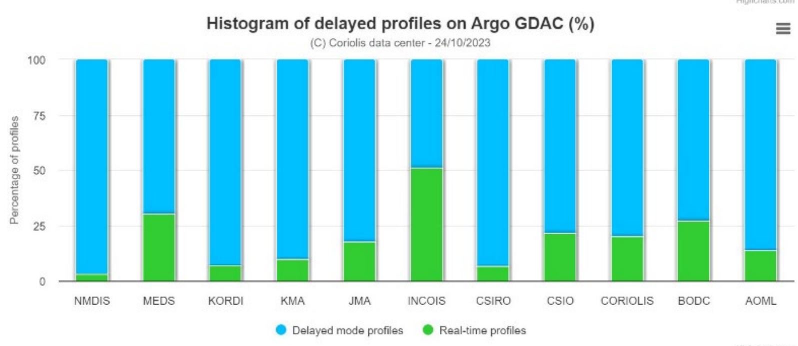


Fig: Screeshot of the LAS page for Argo value added products.

  4. Continued to provide the Argo and value added products derived from Argo data through ERDDAP.
  5. Argo data and products are made available through Digital Ocean. For more details users are requested to visit: http://do.incois.gov.in

3. Delayed Mode QC

- INCOIS started generating and uploading D files to GDAC form July 2006, and as of today, profiles belonging to all eligible floats have been subjected to DMQC.
- Modified DMQC S/W obtained from Cecil, IFREMER is also being used. Using this s/w all the eligible floats are reprocessed to tackle pressure sensor offset problems, salinity hooks, thermal lag corrections, salinity drifts.
- Floats specifically falling in serial numbers above 10,000 are specifically subjected to DMQC in collaboration with CSIRO. Those identified as having ASD were grey listed and Dmoded files were uploaded to GDAC.
- Data obtained from sister concerns and archived is continued to be used in the delayed mode processing.
- About 49% of the eligible profiles are subjected to DMQC and the delayed mode profiles are uploaded on to GDAC.



4. GDAC Functions

INCOIS is not operating as a GDAC.

5. Regional Centre Functions

- INCOIS continued acquisition of Argo data from GDAC corresponding to floats other than deployed by India and made them available on INCOIS web site.
- Delayed Mode Quality Control (Refer 2.0 above).
- Data from the Indian Ocean regions are gridded into 1x1 box for monthly and 10 days and monthly intervals using Variational Analysis (DIVA) and Objective Analysis. These gridded data sets are made available through INCOIS Live Access Server (ILAS).
- ERDDAP site was set up for the data and data products derived from Argo floats.
- INCOIS continued acquisition of data Sets (CTD, XBT, Subsurface Moorings) from principle investigators. The CTD data are being utilized for quality control of Argo profiles.
- Value added products:
  Products are currently being made available to various user from INCOIS web site. They are:
  - (i) Spatial plots using the objectively analysed from all the Argo floats data deployed in the Indian Ocean.
  - (ii) Spatial plots using the DIVA method from all the Argo floats data deployed in the Indian Ocean

These valued added products can be obtained from the following link http://www.incois.gov.in/Incois/argo/products/argo_frames.html and also through Live Access Server (LAS).

- Regional Co-ordination for Argo floats deployment plan for Indian Ocean. Coordinating the deployment of floats based on the density maps. These maps are generated before cruise beginning and possible regions with low density are targeted for deployment provided they are with in the regions of planned cruises.

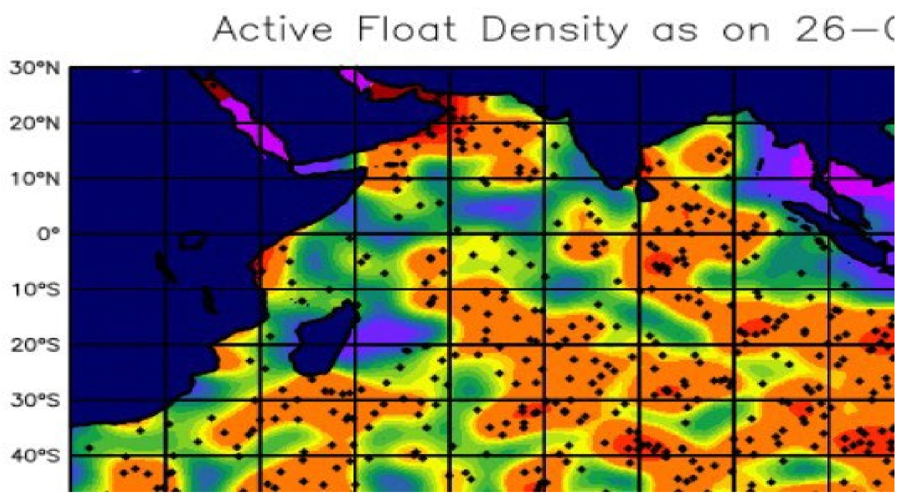


Fig : Argo density map of all available floats as on 26 Oct 2023.

- **Publications:**

INCOIS continued to actively utilize Argo data in various studies pertaining to Indian Ocean. Also INCOIS is encouraging utilization of Argo data by various universities by bringing awareness about the data. Some of the publications resulted from Argo data which includes scientists from INCOIS are given below:

1. Akhil, V. P., M. Lengaigne, K. S. Krishnamohan, M. G. Keerthi, and J. Vialard (2023), Southeastern Arabian Sea Salinity variability: mechanisms and influence on surface temperature, Climate Dynamics, doi: https://doi.org/10.1007/s00382-023- 06765-z.
2. Anjaneyan, P., J. Kuttippurath, P. V. Hareesh Kumar, S. M. Ali, and M. Raman (2023), Spatio-temporal changes of winter and spring phytoplankton blooms in Arabian sea during the period 1997–2020, Journal of Environmental Management, 332, 117435, doi: https://www.sciencedirect.com/science/article/pii/S0301479723002232.
3. Bhattacharya, T., K. Chakraborty, P. K. Ghoshal, J. Ghosh, and B. Baduru (2023), Response of Surface Ocean pCO2 to Tropical Cyclones in Two Contrasting Basins of the Northern Indian Ocean, Journal of Geophysical Research: Oceans, 128(4), e2022JC019058, doi: https://doi.org/10.1029/2022JC019058.
4. Chacko, N. (2023), On the rapid weakening of super-cyclone Amphan over the Bay of Bengal, Ocean Dyn., 73(6), 359-372, doi: https://doi.org/10.1007/s10236-023-01555- x.

5. Jha, R. K., and T. V. S. U. Bhaskar (2023), Generation and Assessment of ARGO Sea Surface Temperature Climatology for the Indian Ocean Region, Oceanologia, 65(2), 343-357, doi: https://doi.org/10.1016/j.oceano.2022.08.001.
6. Konda, G., V. S. Gulakaram, and N. K. Vissa (2023), Intraseasonal variability of subsurface ocean temperature anomalies in the Indian Ocean during the summer monsoon season, Ocean Dyn., 73, 165-179, doi: https://doi.org/10.1007/s10236-023- 01547-x.
7. Maneesha, K., S. Ratheesh, and T. V. S. U. Bhaskar (2023), Impact of the Upper Ocean Processes on Intensification of Cyclone Amphan, Journal of the Indian Society of Remote Sensing, 51(2), 289-298, doi: https://doi.org/10.1007/s12524-022-01592-x.
8. Mohanty, S., V. S. Bhadoriya, and P. Chauhan (2023), Upper Ocean Response to The Passage of Cyclone Tauktae in The Eastern Arabian Sea Using In Situ and Multi- Platform Satellite Data, Journal of the Indian Society of Remote Sensing, 51(2), 307- 320, doi: https://doi.org/10.1007/s12524-022-01621-9.
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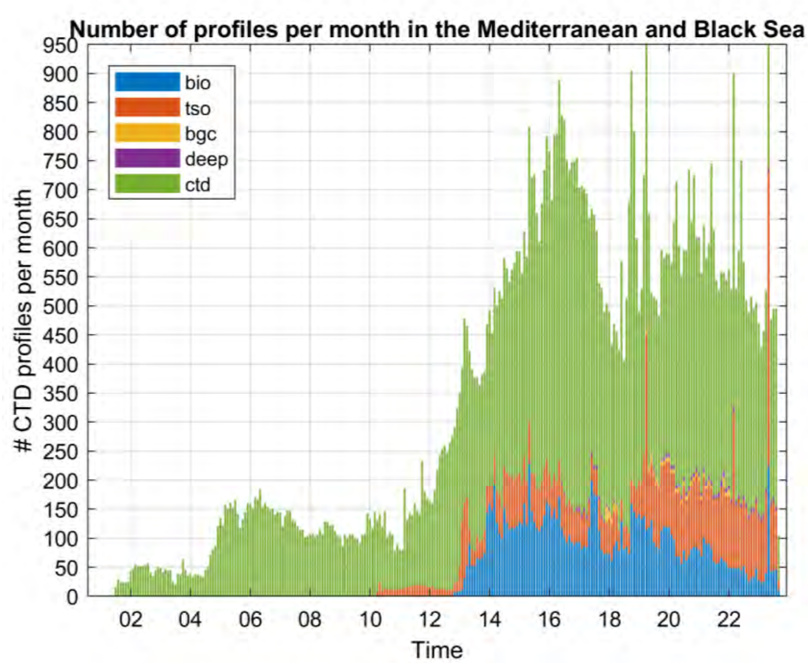
1. Real Time Status

- Data acquired from floats

More than 92500 Argo profiles were acquired in the Mediterranean and in Black Seas between 2000 and September 2023. The temporal and spatial distribution of these profiles is depicted in figure one, sorted by the different float types used (Core-Argo, Core-Argo with DO, Bio-Argo [carrying some of the BGC sensors], Deep-Argo and BGC-Argo [equipped with sensors to measure the 6 EOVs]); the monthly and yearly distribution is shown in Figure 2. About 75-80 floats per month have been operated simultaneously in the basins in 2023 and more than 4600 profiles have been acquired (up to September 2023) by different float models (figure 3).



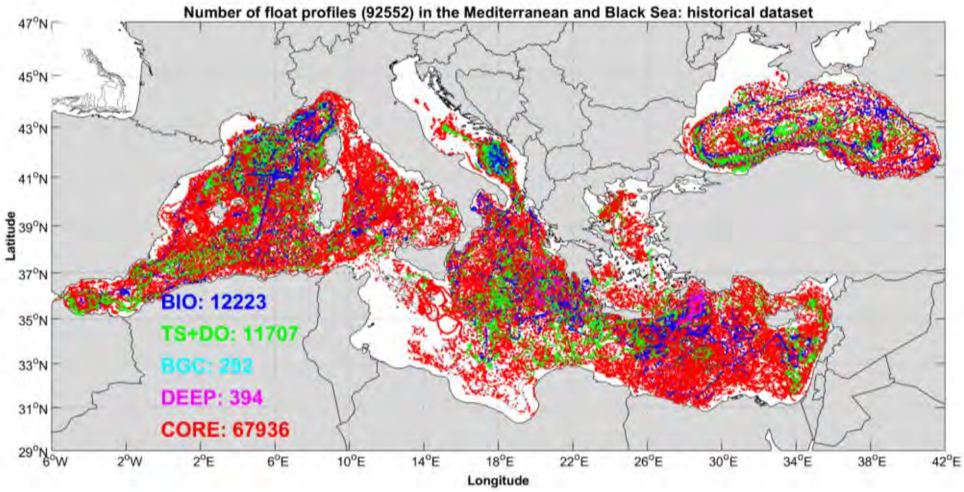


Figure 1. Temporal (upper panel) and spatial (bottom panel) distribution of float profiles in the Mediterranean and Black Sea between 2000 and September 2023.

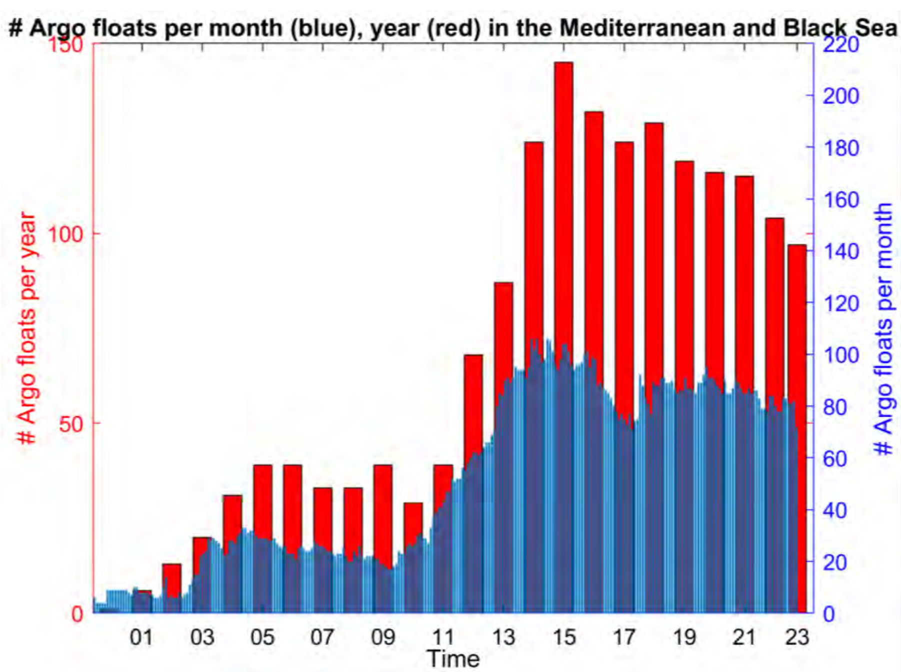


Figure 2. Monthly (blue bars) and yearly (red bars) distribution of Argo floats in the Mediterranean and Black Sea between 2000 and September 2023.

The number of profiles acquired by Argo-extension floats in 2023 is about 1850 whilst the ones collected by the core-Argo floats are about 2800 (figure 3). EU, Spain, Greece, France, Bulgaria (see their national reports at https://argo.ucsd.edu/organization/argo-meetings/argo-data-management-team-meetings/argo-data-management-team-meeting-24-admt-24/) and Italy (national report available at https://argo.ogs.it/pub/Argoitaly_annual_report_2022_firmato_ricercabile.pdf) contributed to maintain the Argo population in 2023: a total of 16 new floats have been deployed both in the Mediterranean and in the Black Seas; 5 out of 16 platforms are core-Argo, 4 are core-Argo with DO, 1 is BGC and 6 are Bio. Additional deployments are planned by the end of 2023. The deployment strategy was chosen according to the project's targets and to replace dead floats or under-sampled areas.

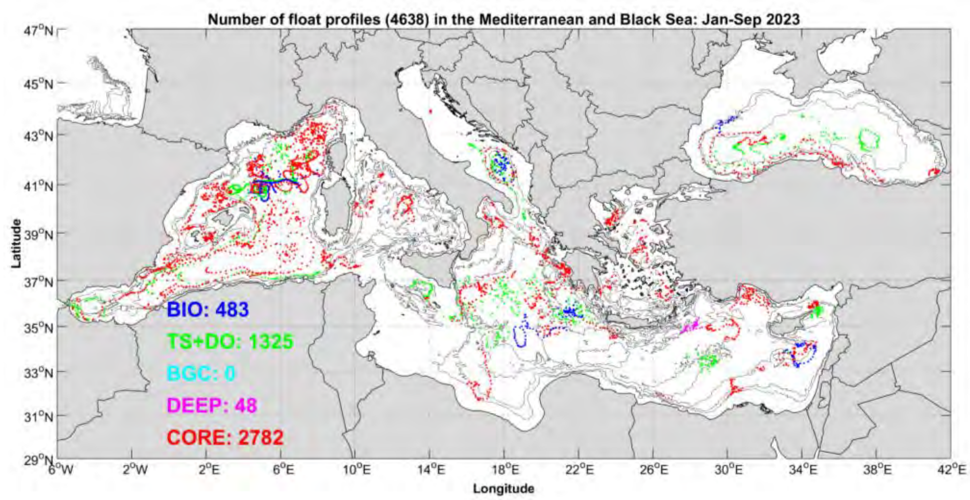


Figure 3. Spatial distribution of profiles collected by Argo floats in 2023 (January-September) in the Mediterranean and Black Sea: locations are color-coded per float type.

Statistics have been computed to assess the fleet performance. The survival rate diagrams produced are separated by transmission mode (figure 4). The maximum operating life is about 580 cycles, whilst the mean half-life is about 150 cycles (figure 4a). In this computation, active floats with life lower than the mean half-life and recovered floats were excluded (about 20). The vertical distance (upward profiles) traveled by floats is computed and used as an indicator of the profiler performance (figure 4b). The maximal distance observed is about 600 km, whilst the mean distance traveled is about 125 km. The balance of the population is in figure 5a and the annual death rate in figure 5b.

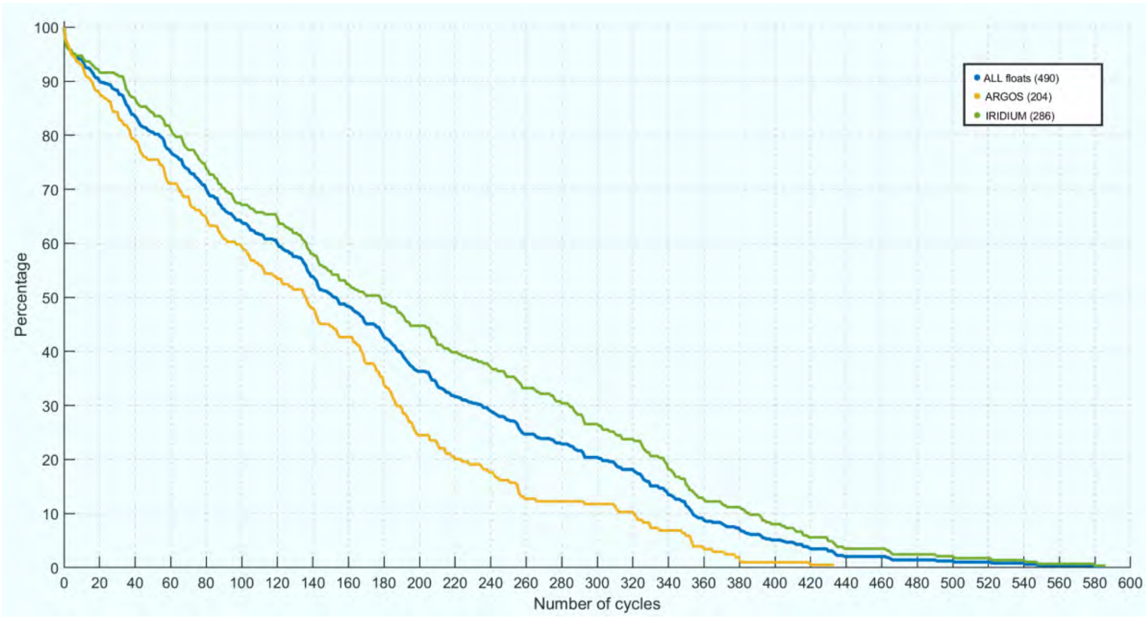


Figure 4a. Survival rate diagrams separated by telemetry system.

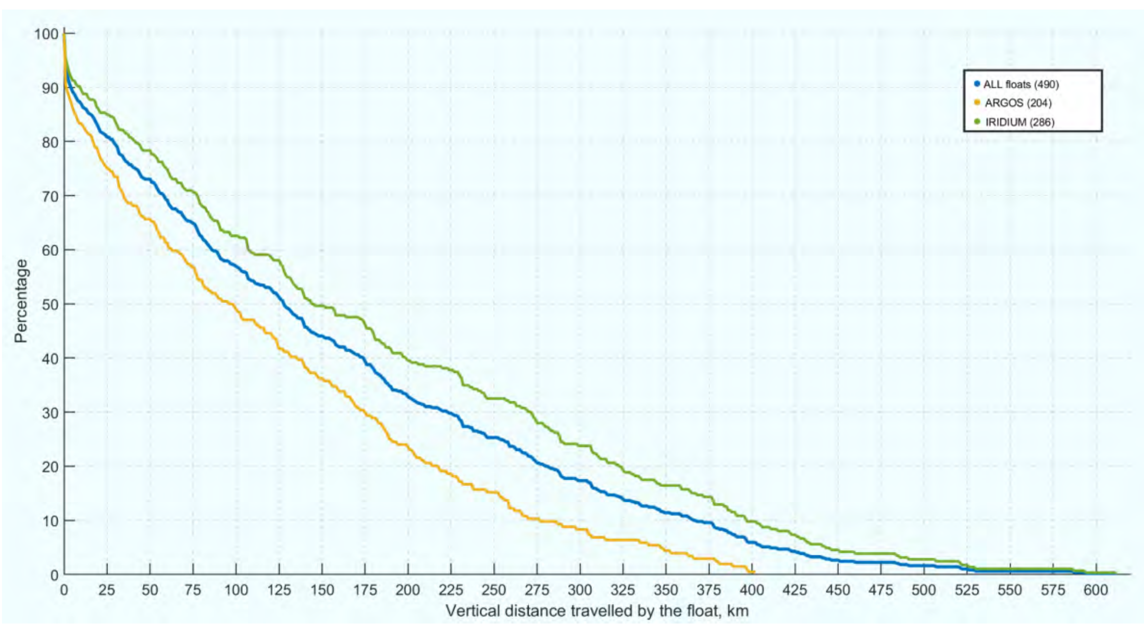


Figure 4b. Diagram of the vertical distance traveled floats, separated by telemetry system.

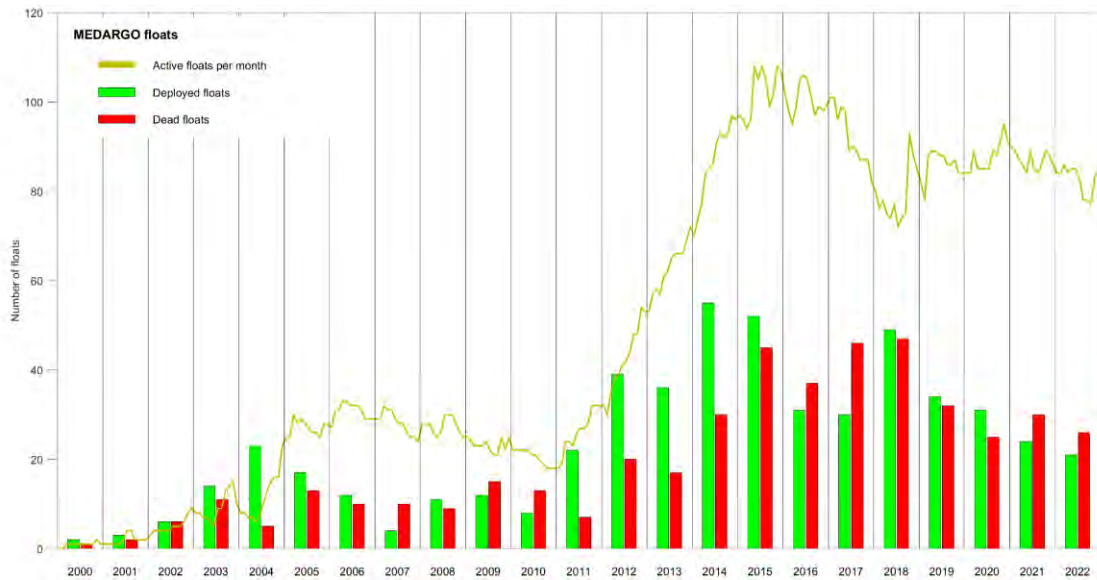


Figure 5a. Balance of the population (rate of population change related to the number of yearly deployments and dead floats).

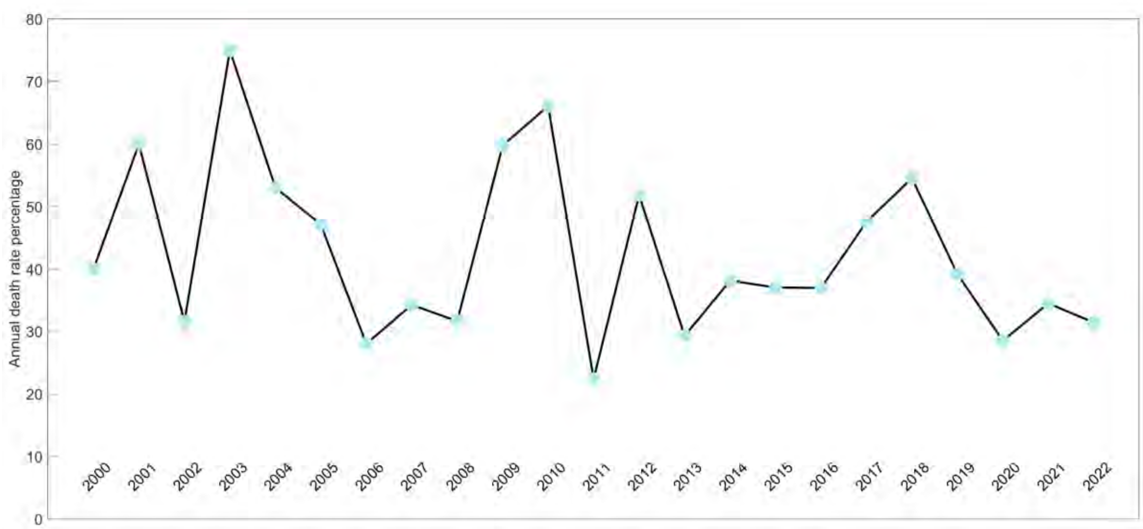


Figure 5b. Annual death rate (ration between yearly failure and yearly average population).

- Delayed mode data sent to GDACs

Most of the eligible floats were quality controlled in delayed-mode for salinity, temperature and surface pressure and the respective D-files were gradually sent to GDAC. The DMQC method was applied to approximately 86% of eligible floats deployed between 2003 and 2022 in the Mediterranean and Black Seas (figures 6 and 7). 12% out of this percentage were quality controlled but the D-files were not sent to GDAC yet. This percentage includes analysis that has to be repeated due to problems related to the reference dataset (scarcity or old data), shallow/coastal floats. The DMQC report/info of each float can be downloaded by the MedArgo web page (http://argo.ogs.it/medargo/table_out.php).

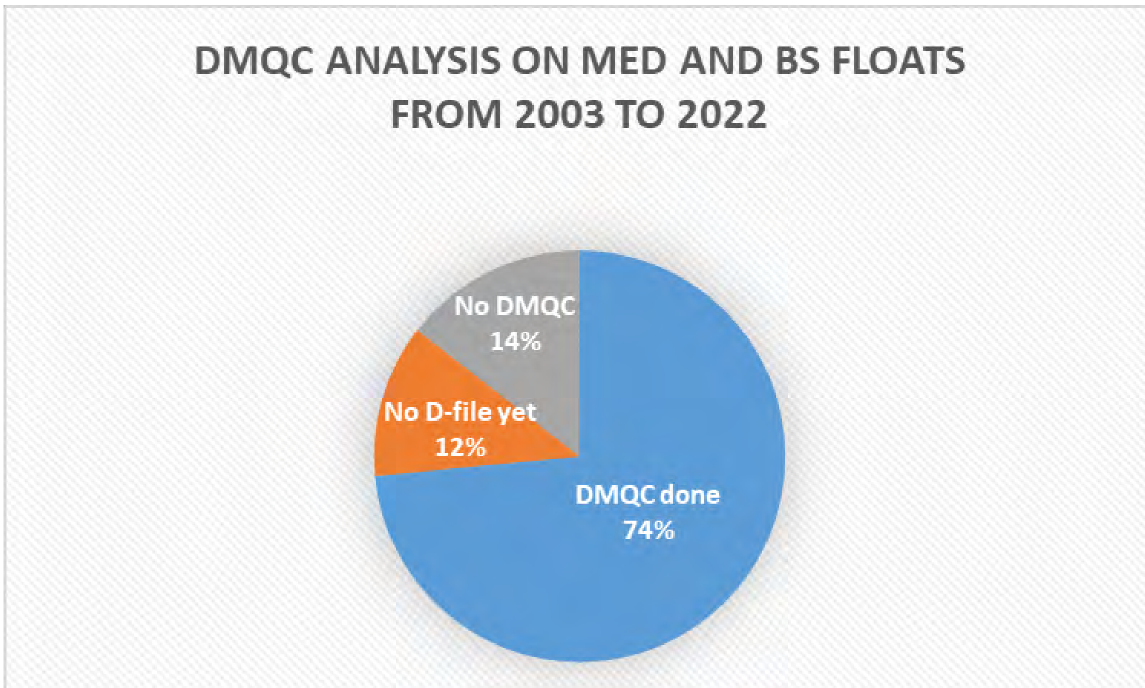


Figure 6. DMQC status.

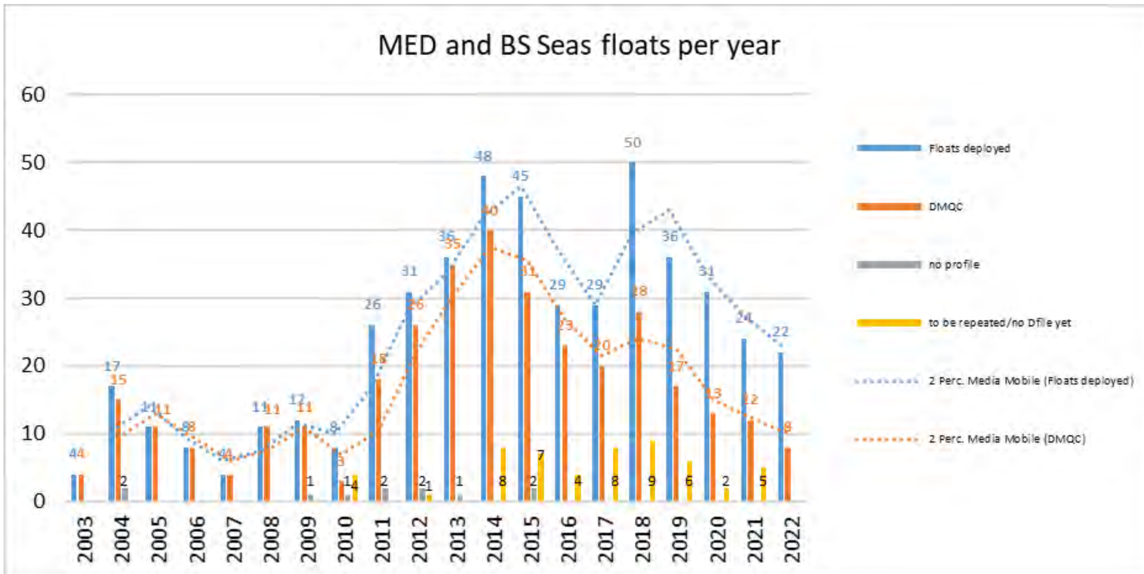


Figure 7. DMQC status per year.

2. Delayed Mode QC status

OGS performed the DMQC activity for the Argo data in the Mediterranean and Black Seas. The OW method in conjunction with other procedures is adopted to conduct the quality control analysis for the salinity data.

● The PCM (Profile Classification Model) method is under implementation in the Mediterranean sea. The selected reference profile based on vertical profile classification could improve the OWC results, especially in basins where the reference dataset is scarce and old (see figure 8 as an example).

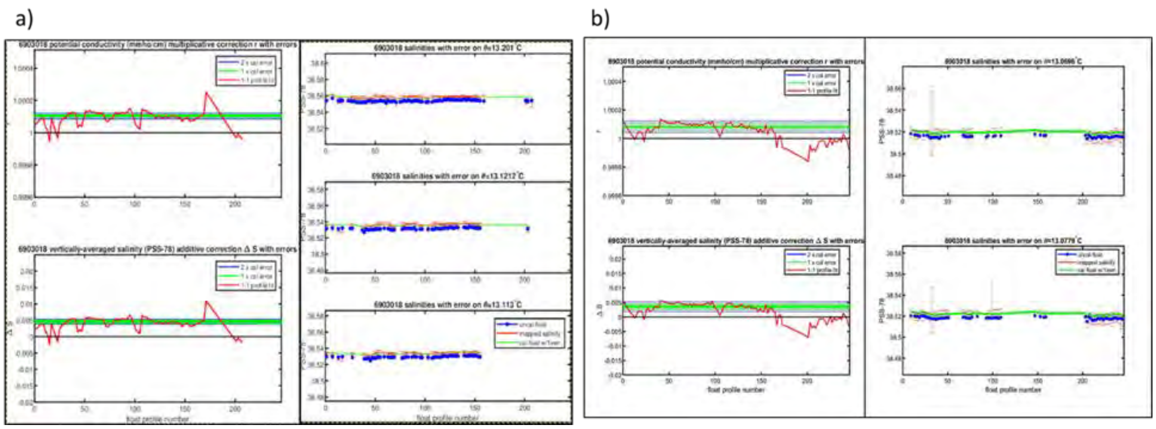


Figure 8. OWC figures obtained using PCM method (a) and not (b).

- The DMQC analysis was also conducted on the shallow-coastal floats deployed in the Mediterranean Sea, in the framework of the European H2020 Euro-Argo Rise project. Several additional qualitative analyses, as qualitative comparisons between floats profiles and CTD at deployment or nearest CTD in space, were computed in order to obtain a more reliable quality control (figure 9). The procedure developed for the Baltic sea (https://www.euro-argo.eu/content/download/162917/file/D2.7_MarginalSeasDMQC_V2.1.pdf) was adapted to the Adriatic sea in order to improve the qualitative analysis.

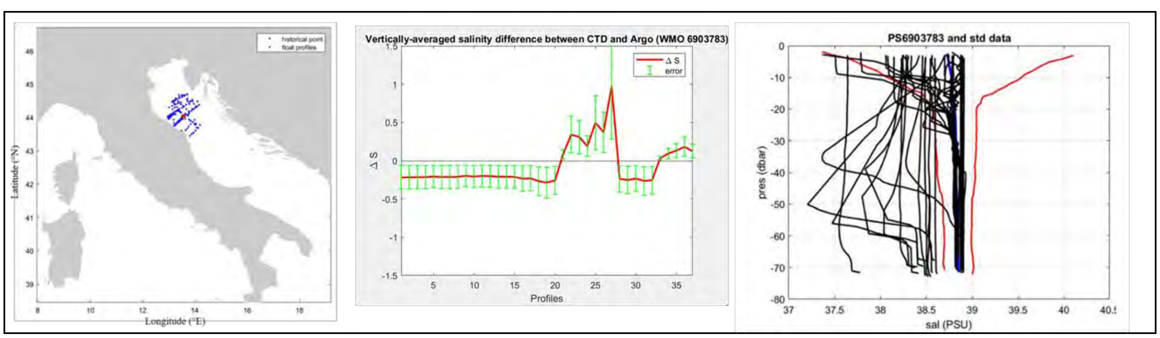


Figure 9. An example of plots obtained for the WMO 6903783 float. On the left, locations of float profiles (red dots) and reference profiles selected for statistical comparison (blue dots). In the middle, the vertically-averaged salinity difference between CTD and Argo. On the right uncalibrated float salinity profiles (black lines), standard deviation calculated with all CTDs (red lines), The mean of the most recent CTD data (blue line).

- The high-quality ship-based CTD reference data from the near-surface to depths more than 2000 m, for QC purposes of Core and Deep-Argo float data in the Mediterranean and Black seas, was improved adding some new CTD data (figures 10 and 11). Data was collected from several research institutes at regional level and the main European Marine Services. Data was converted in mat format to be used in OWC procedure. A quality control was applied such as an additional visual check to avoid spike or duplication. Data was merged and divided in subsets of WMO boxes according to the climatological areas of the Mediterranean Sea. The updated reference dataset consists of about 66800 CTD profiles.

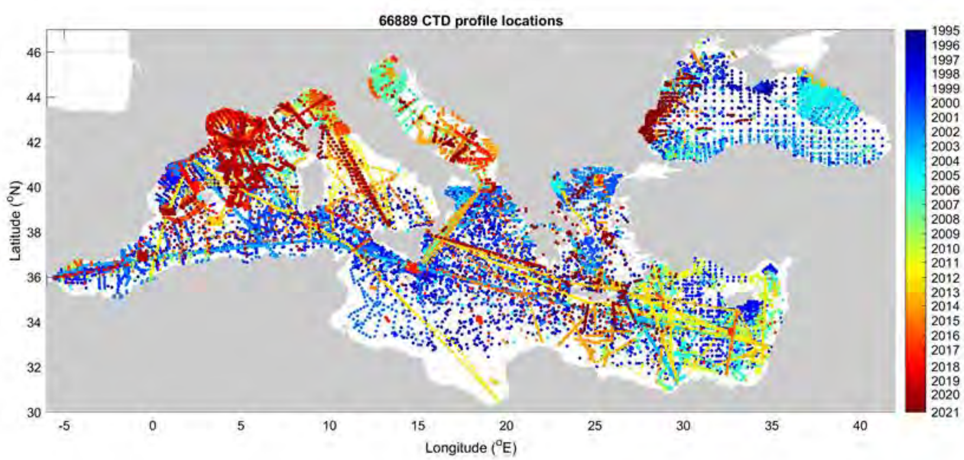


Figure 10. Spatial distribution, color-coded for time, of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas.

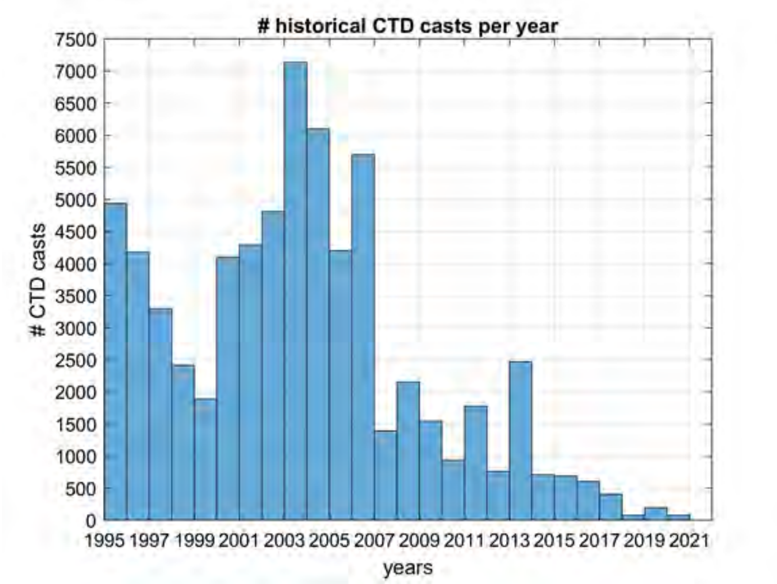


Figure 11. Temporal distribution of the CTD profiles in the final version of the CTD reference dataset of the Mediterranean and Black Seas.

In addition, the method developed by BSH was implemented and tested. Since it was developed for open oceans, it works well for profiles deeper than 600 m in the Mediterranean Sea, so it is only used in certain sub-basins.

3. Value Added items

- List of current national Argo web pages, especially data specific ones

The layout of the MedArgo web page (http://argo.ogs.it/medargo/) has been re-designed according to the OGS web page. Tables and graphics are updated in near real time. The float positions are plotted daily (figure 12); the float deployments are added to the web page as soon as the technical information is available (figure 13); the monthly and the whole trajectories are also provided. Links with the Euro-Argo data selection tools and GDAC center (Coriolis) are also available for downloading both the real-time and delayed-mode float profiles.

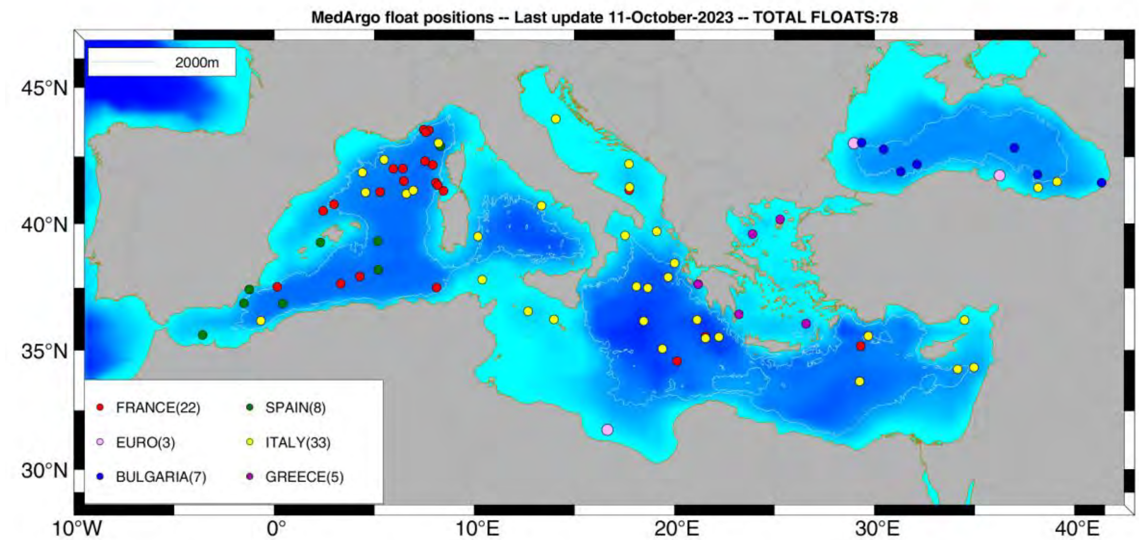


Figure 12. MedArgo float positions as of 11 October 2023 (updated daily).

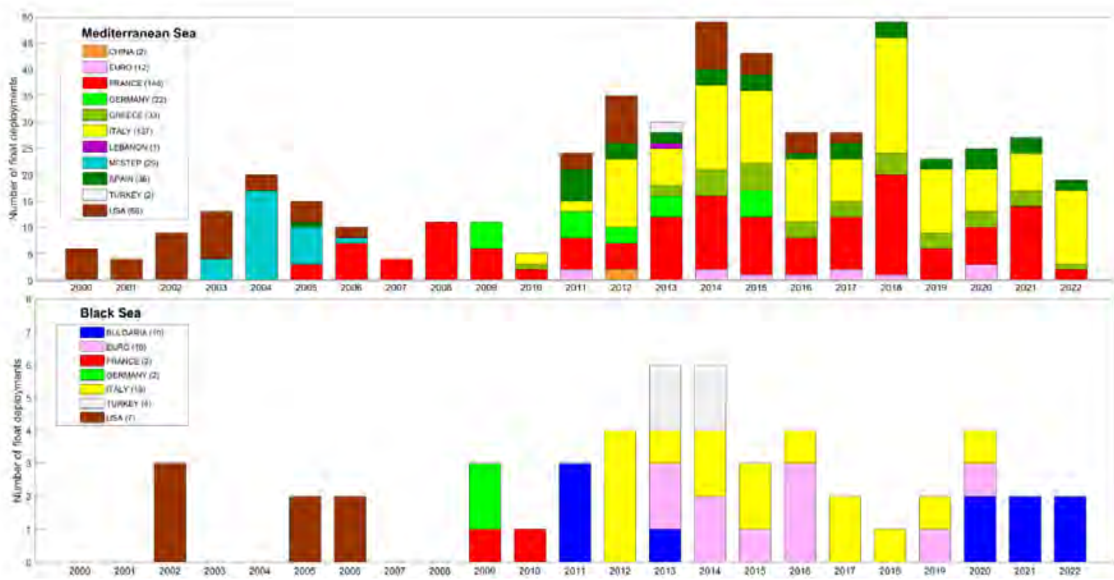


Figure 13. MedArgo number of float deployments until 2022.

- Products generated from Argo data that can be shared

a. Physical and Biogeochemical Argo float data are assimilated in numerical forecasting models by CMCC and OGS; 3D daily maps of Mediterranean ocean forecasting systems are produced and available on CMEMS (figure 14).

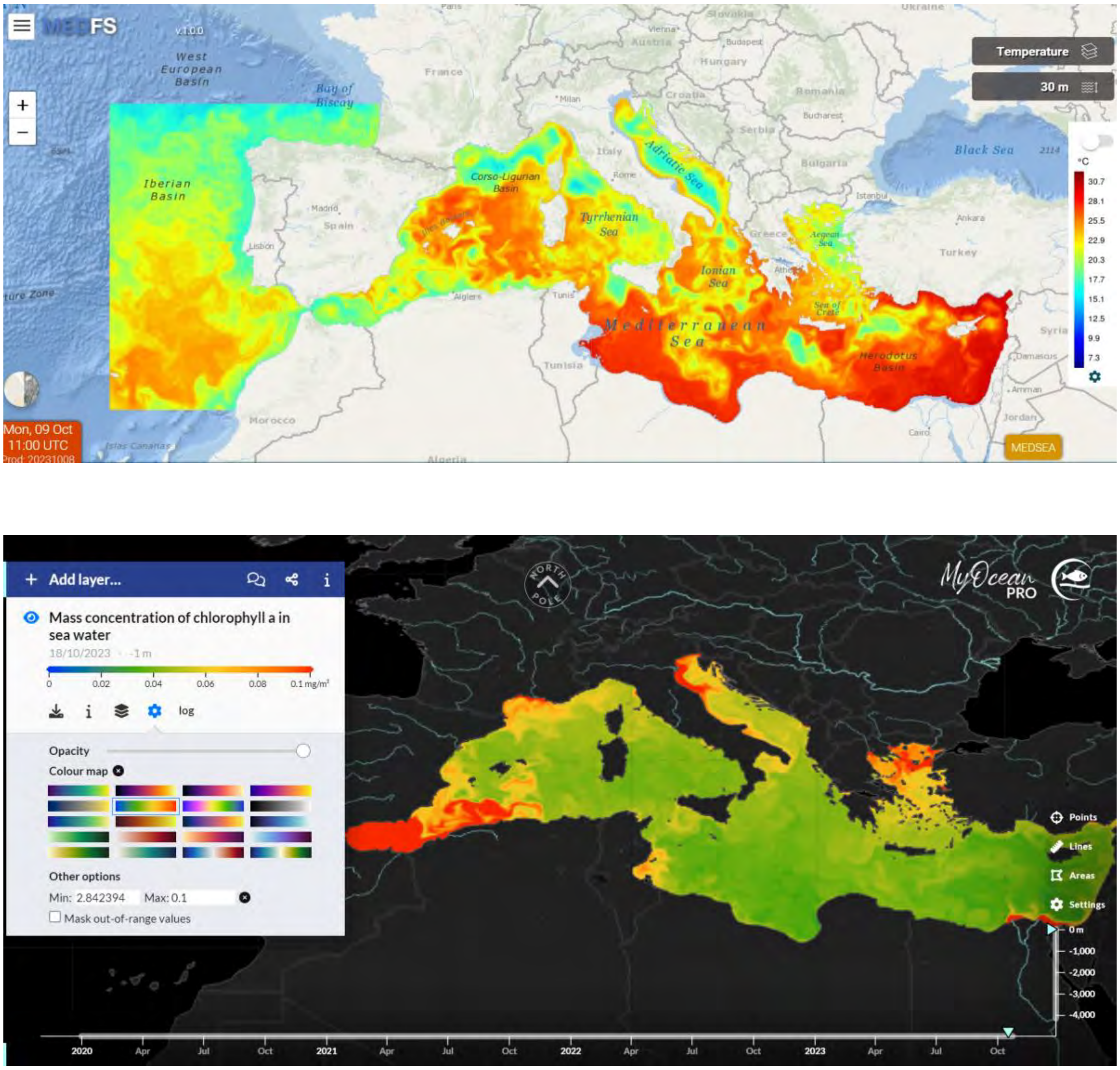


Figure 14. Forecasting models' products available on CMEMS. Physical (top panel https://medfs.cmcc.it/) and biogeochemical (bottom panel https://data.marine.copernicus.eu/product/MEDSEA_ANALYSISFORECAST_BGC_006_014/description?view=-&product_id=-&option=-) products.

4. Regional Centre Functions

✓ MedArgo is the Argo Regional Centre for the Mediterranean and the Black Sea. OGS, who coordinates the MedArgo activities, established several collaborations with European and non-European countries in order to set the planning and the deployment coordination of floats. Hence, a good coverage is maintained throughout the years. As part of these cooperations, the float data are transferred in near real time to MedArgo and 16 new floats have been deployed in the Mediterranean and Black Sea during 2023, through a coordinated activity of deployment opportunities and thanks to scientific projects. Additional floats will be deployed before the end of 2023.

✓ There are 68 active Argo floats in the Mediterranean Sea and 10 in the Black Sea as of 9 October 2023.

✓ The main MedArgo partners (Italy, Greece, Spain, France and Bulgaria) strengthened collaborations with the riparian countries through the H2020 Euro-Argo RISE project, (https://www.euro-argo.eu/EU-Projects/Euro-Argo-RISE-2019-2022) to improve the Argo activities (deployment plans and opportunities, sharing reference datasets for QC, sharing expertise, joint activities, advance in DMQC). Furthermore, in the framework of this project, extension of Argo operations in shallow/coastal was performed.

✓ The high-quality CTD reference dataset for DMQC has been updated.

✓ The D-files of 74% of the eligible profiles (core variables) have been submitted to the GDAC.

Future plans:

➢ Maintain > 60 active floats in the Mediterranean Sea, with ~20-25% BGC and Bio

➢ Maintain 2 deep floats in deep Ionian & Rhodes Gyre area

➢ Maintain > 10 active floats in the Black Sea, with ~20% Bio

Argo National Data Management Report

1. Real Time Status

The Japan DAC, the Japan Meteorological Agency (JMA), has processed data from 1934 Japanese Argo and Argo-equivalent floats including 119 BGC floats, 59 Deep floats and 12 RBR CTD floats, of which 172 are active floats (red dots in Fig. 1) including 4 BGC floats, 8 Deep floats and 12 RBR CTD floats, as of October 6th, 2023. There are 11 Japanese PIs who agreed to provide data to the international Argo data management. The DAC is acquiring ARGOS messages from CLS and getting IRIDIUM messages via e-mail and WebDAV server in real-time, thanks to the understanding and the cooperation of PIs. Almost all profiles from those floats are transmitted to GDACs in the netCDF format and issued to GTS using BUFR codes after real-time QC on an operational basis.

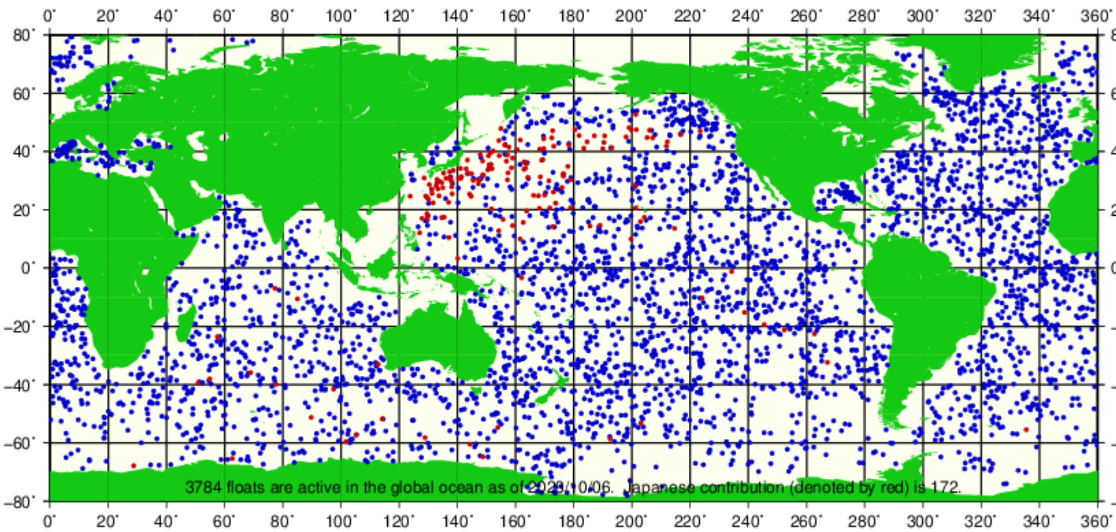


Fig. 1 Active floats (blue and red dots) on October 6th, 2023. Red dots denote floats released by Japanese PIs.

JMA and JAMSTEC have converted the meta-, prof-, tech-, and traj-files of Japanese floats, including APEX, DeepAPEX, PROVOR, ARVOR, NEMO, NOVA, Navis, NINJA, DeepNINJA and S2A. JMA and JAMSTEC have converted most all of Japanese meta-files from v2 to v3.1 and submitted them to GDAC. JMA has converted almost all of Japanese tech-files and submitted them to GDAC. Accordingly, JMA has converted the Rprof-files of Japanese ARGOS floats, except floats with NST sampling scheme and Iridium floats. JAMSTEC has converted all v2 Dprof-files of Japanese floats to v3.1 and submitted them to GDAC. JMA has converted about 68% of Japanese traj-files from v2 to v3.1 and submitted them to GDAC.

JMA has made meta-, tech-, traj-, and Rprof-files v3.1 of the almost all of floats newly deployed since March 2016 and JAMSTEC has made meta-files in v3.1 of JAMSTEC's floats newly deployed since October 2015. JAMSTEC has made Dprof-files in v3.1 since January 2016.

JMA decodes all the variables of active BGC floats of Japan. Now, JMA has been developing RTQC for each BGC parameter and implemented RTQC for DOXY and DOXY adjustments using WOA in August 2022. We plan to introduce RTQC and adjustments for other BGC parameters as well.

2. Delayed Mode QC Status

JAMSTEC has done the DMQC for all Japanese floats. JAMSTEC has submitted the delayed mode files of 208,454 profiles to GDACs as of October 6th, 2023. JAMSTEC has submitted 16,140 core delayed mode files (Core-D files) to GDACs through the Japan DAC, JMA, from November 26th, 2022, to October 6th, 2023. JAMSTEC is also re-checking the contents of the D-files and resubmitting 7,261 Core-D files during the period, based on the results of our check and the results of Dr. Annie Wong's audit of the Core-D files.
The procedure of DMQC in JAMSTEC is as follows. Our data processing system has been updated in 2022. As a result, Core-DMQC processing has become more efficient. The number of D-file submissions shows the effect.

(JAMSTEC floats and the most of Argo-equivalent floats)

5. (within 10days) data re-acquisition from CLS, bit-error repair (for ARGOS floats if possible),
   real-time processing, position QC, visual QC
2. (within 180days) surface pressure offset correction, cell TM correction
3. (after 180days) OW and WJO salinity correction, the definitive judgement by experts, D-netCDF file making

The calculation result of OW has been used at the definitive judgment. The result OW has been used just for reference.

JAMSTEC has adjusted salinity data of Deep floats by using optimal CPcor for each Deep float. When our Deep float is launched, shipboard-CTD observation is often performed. Therefore, for the optimal CPcor for each Deep float is estimated by comparing its first profile with shipboard-CTD data at its deployment. JAMSTEC will start submitting Core-D files of Deep floats whose salinity are adjusted by optimal CPcor for each Deep float by the end of 2023.

And, JAMSTEC has started performing delayed mode QC for our BGC floats. We are now preparing to processing programs for DOXY-DMQC. We are also testing whether Nitrate and pH observed by our BGC floats in the North Pacific are corrected well by SAGE. We will start to release D-mode DOXY Adjusted of our BGC floats to GDAC by the end of 2023.

3. Value Added items

・List of current national Argo web pages:

Japan Argo

https://www.jamstec.go.jp/J-ARGO/?lang=en

This site is the portal of Japan Argo program. The outline of Japanese approach on the Argo program, the list of the publication, and the link to the database site and PIs, etc. are being offered. The website restarted its service in August 2022, although it has been currently unavailable since mid-March 2021 due to a network security incident at JAMSTEC.

Real-time Database (JMA)

https://www.data.jma.go.jp/argo/data/index.html

This site shows global float coverage, global profiles based on GTS BUFR messages, and status of the Japanese floats.

・Statistics of National Argo data usage:

Operational models of JMA

MOVE/MRI.COM-G3 (Multivariate Ocean Variation Estimation System/ Meteorological Research Institute Community Ocean Model – Global version 3)

JMA operates the ocean data assimilation system for monitoring oceanic condition such as El Niño and oceanic initialization of the seasonal prediction model. The latest version (MOVE/MRI.COM-G3) had been parallelly used since February 2022 and completely replaced from the previous version (MOVE/MRI.COM-G2) in May 2023.

For details please visit:
https://www.data.jma.go.jp/tcc/tcc/products/elnino/move_mricom-g3_doc.html

JMA/MRI-CPS3 (JMA/MRI – Coupled Prediction System version 3)

JMA operates the atmosphere and ocean Coupled Prediction System (JMA/MRI-CPS3), which was replaced from the previous version (JMA/MRI-CPS2) in February 2022, as a seasonal prediction model including ENSO prediction. The oceanic model is identical to the one used for the MOVE/MRI.COM-G3.

For details please visit:
https://www.data.jma.go.jp/tcc/tcc/products/model/outline/cps3_description.html

MOVE/MRI.COM-JPN (Multivariate Ocean Variation Estimation System/ Meteorological Research Institute Community Ocean Model - an operational system for monitoring and forecasting coastal and open ocean states around Japan)

JMA operates MOVE/MRI.COM-JPN, which provides daily, 10day-mean and monthly products of subsurface temperatures and currents for the seas around Japan and North Pacific Ocean.

Other operational models

FRA-ROMSII

FRA-ROMS is the nowcast and forecast system for the Western North Pacific Ocean developed by Japan Fisheries Research and Education Agency (FRA) based on the Regional Ocean Modeling System (ROMS). FRA-ROMS was operated from May 2012 to March 2022. From March 2022, FRA began operating FRA-ROMSII, a new system based on FRA-ROMS with improved model performance in the Japan Sea. The outputs of FRA-ROMS/FRA-ROMSII are used primarily for fisheries resource surveys and are provided every week through the website: https://fra-roms.fra.go.jp/fra-roms/index.html.

・Products generated from Argo data:

Products of JMA

El Niño Monitoring and Outlook / Indian Ocean Dipole Monitoring

JMA issues on a monthly basis an ENSO diagnosis and six-month outlook as well as an IOD analysis on the following website. The outputs (ex. Fig. 2) of the MOVE/MRI.COM-G3 and the JMA/MRI-CPS3 can be found here on the Tokyo Climate Center website;.

https://www.data.jma.go.jp/tcc/tcc/products/elnino/index.html

These products serve as an indispensable basis for the operational seasonal prediction disseminated by JMA and inform National Meteorological Hydrological Services for the purpose of helping them produce their own predictions.

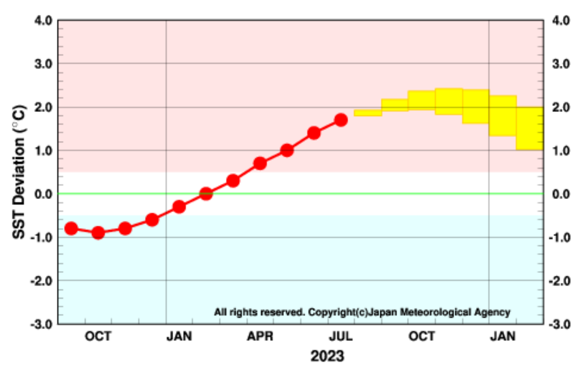


Fig. 2 Five-month running mean of the SST deviation for NINO.3 predicted by JMA's seasonal ensemble prediction system (JMA/MRI-CPS3).
Red dots indicate observed values, and yellow boxes indicate predictions. Each box denotes the range where the value will be included with the probability of 70%.

Subsurface Temperatures and Surface Currents in the seas around Japan

The following parameter outputs of MOVE/MRI.COM-JPN was released in December 2021 and can be found on https://www.data.jma.go.jp/goos/data/database.html.

- Daily, 10day-mean and Monthly mean subsurface temperatures at the depths of 50m, 100m, 200m and 400m analyzed for approximately 0.1 x 0.1 degree grid points (ex. Fig. 3).
- Daily and 10day-mean Surface Currents for approximately 0.1 x 0.1 degree grid points.

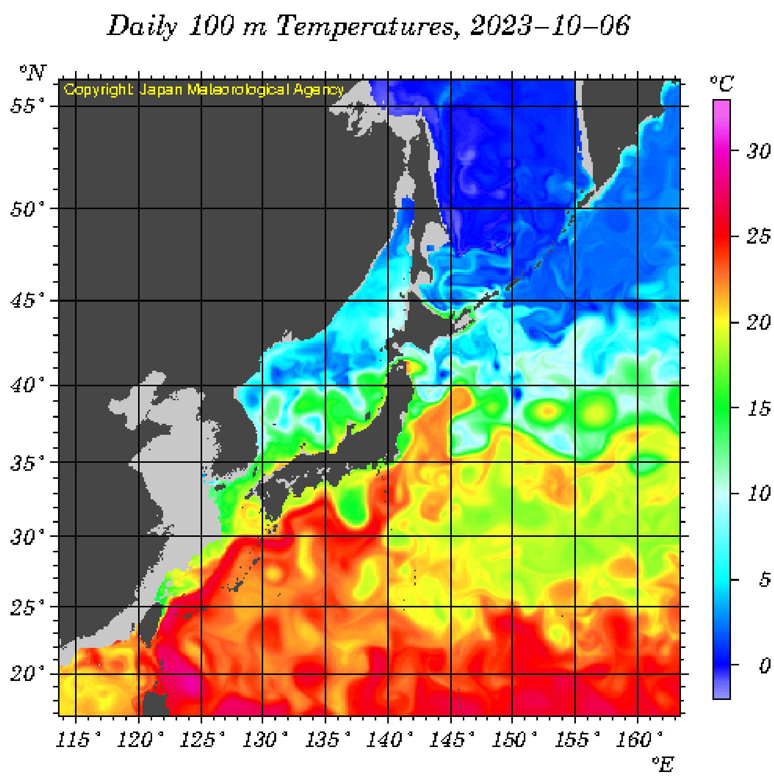


Fig. 3 Daily 100m Sea Temperature around Japan on October 6th, 2023.

Products of JAMSTEC

MOAA GPV (Grid Point Value of the Monthly Objective Analysis using the Argo data)

MOAA GPV is the global GPV data set which was made by monthly OI objective analysis using Argo and TRITON mooring data.

According to abrupt salty drift of CTD sensors on Argo floats that occur more frequently than usual because of a manufacturing problem, JAMSTEC recalculated using the Argo profile data on the latest quality control status at September 17th 2021.

Furthermore, JAMSTEC has released the new dataset mainly delayed mode Argo profile data (hereinafter referred to as Delayed Mode (DM)),

in addition to the MOAA GPV mainly using real time QC Argo profile (this version is hereinafter referred to as Near Real Time (NRT)). DM is updated once a year and JAMSTEC will recalculate the dataset for the entire period, using all Argo profile data in GDAC at that time. Therefore, DM uses more delayed mode Argo profile data than NRT.
These data set are released on the following website:
https://www.jamstec.go.jp/argo_research/dataset/moaagpv/moaa_en.html

G-YoMaHa (Objectively mapped velocity data at 1000 dbar derived from trajectories of Argo floats)

JAMSTEC mapped the drift data from Argo floats, YoMaHa'07, at the depth of 1000 dbar on a 1 degree grid, using optimal interpolation analysis. The mapped velocity field satisfies the geostrophic balance and the horizontal boundary condition of no flow through the boundary. The dataset is released on the following website:
https://www.jamstec.go.jp/argo_research/dataset/gyomaha/gyomaha_en.html

MILA GPV (Mixed Layer data set of Argo, Grid Point Value)

JAMSTEC has produced a data set of gridded mixed layer depth with its related parameters, named MILA GPV. This consists of 10-day and monthly average data and monthly climatology data in the global ocean using Argo temperature and salinity profiles.
According to abrupt salty drift of CTD sensors on Argo floats that occur more frequently than usual because of a manufacturing problem, JAMSTEC recalculated using the Argo profile data on the latest quality control status at September 17th 2021.
Furthermore, JAMSTEC has released the new dataset mainly delayed mode Argo profile data (hereinafter referred to as Delayed Mode (DM)), in addition to the MILA GPV mainly using real time QC Argo profile (this version is hereinafter referred to as Near Real Time (NRT)). DM is updated once a year and JAMSTEC will recalculate the dataset for the entire period, using all Argo profile data in GDAC at that time. Therefore, DM uses more delayed mode Argo profile data than NRT.
These data set are released on the following website:
https://www.jamstec.go.jp/argo_research/dataset/milagpv/mila_en.html

AQC Argo Data version 1.2

JAMSTEC has produced the Argo temperature and salinity profile data put through more advanced automatic checks than real-time quality controls every month. This data set has been provided in the ascii formation as well as the netcdf format, because it is useful for analyses using various software. This dataset are released on the following website:
https://www.jamstec.go.jp/argo_research/dataset/aqc/aqc_en.html

Scientifically quality-controlled profile data of Deep NINJA observations

JAMSTEC has released a product of a quality-controlled data set of Deep NINJA observations for convenient use on scientific/educational purposes. The quality-control was led by JAMSTEC on the basis of mainly comparisons with highly accurate shipboard CTD observations at float deployments. Its detailed information has been provided on the following website:
https://www.jamstec.go.jp/argo_research/dataset/deepninja/dn_en.html

ESTOC

This product is an integrated dataset of ocean observations including Argo data by using a for dimensional variational (4D-VAR) data assimilation approach. ESTOC is the open data that consists of not only physical but also biogeochemical parameters for 60 years during 1957-2016 (See the website in JAMSTEC, https://www.godac.jamstec.go.jp/estoc/e/).

JCOPE (Japan Coastal Ocean Predictability Experiment)

JCOPE is a research project for prediction of the oceanic variation using ocean models with assimilation of remote-sensing and in-situ data, which is managed by JAMSTEC. In 2019, JCOPE2M, which is updated version of JCOPE2/FRA-JCOPE2 reanalysis covering the Northwestern Pacific, was released. The Argo data are used by way of GTSPP. The hindcast data 6 months back and the forecast data 2 months ahead are disclosed on the following website: https://www.jamstec.go.jp/jcope/htdocs/e/home.html.
More information is shown in
https://www.jamstec.go.jp/jcope/htdocs/e/distribution/index.html.
In 2022, JCOPE-FGO, a reanalysis product covering a quasi-global ocean, was released:
https://www.jamstec.go.jp/jcope/htdocs/e/distribution/fgo.html.

4. Regional Centre Functions

Pacific Argo Regional Center (hereafter, PARC) is now operated by JAMSTEC since 2019 when IPRC terminated to co-operate due to their funding and human resource issue. However, IPRC (APDRC) actively provides various products. Users can easily and freely download products from http://apdrc.soest.hawaii.edu/.
JAMSTEC has released the new version of PARC website in November 2022 (https://www.jamstec.go.jp/PARC). JAMSTEC is providing the float monitoring information in the Pacific region (e.g., float activity watch, QC status, anomaly from objective analysis, diagnosis plot for sensor correction, etc.), reference data set for DMQC (SeHyD and IOHB), the link to the CTD data disclosure site of Japanese PIs, some documents, and some QC tools.

JAMSTEC has also released the information of Pacific Deployment Coordination Group and its activities on the PARC website:

https://www.jamstec.go.jp/PARC/float_deployment.

This is due to the fact that the area is too large for the Pacific region to communicate with each other. You can see reports of the group meetings and members.

We also plan to develop a few new functions; to share information of technical problems and quality control of data including Core, BGC, and Deep Argo floats among PIs, and DMQC operators and users in the next year. We plan to release a part of the new functions of PARC in the next spring.

5. Other Issues

・Status of Abrupt Salty Drift for Japanese floats:

Japan has 88 floats, including BGC and Deep floats, suffering from Abrupt Salty Drift (ASD). They were deployed from 2013 to 2021. The most serial numbers of SBE41 and SBE41CP affected by ASD are 10501~11251 (Fig. 4). One of the floats are equipped with SBE41CP whose SN is larger than 11252. After last ADMT meeting, one float with SN between 8001~8500 and three floats with 11001~11251 were suffered from ASD. Six Deep floats equipped with SBE61 suffered from ASD, whose SNs are smaller than 5724.

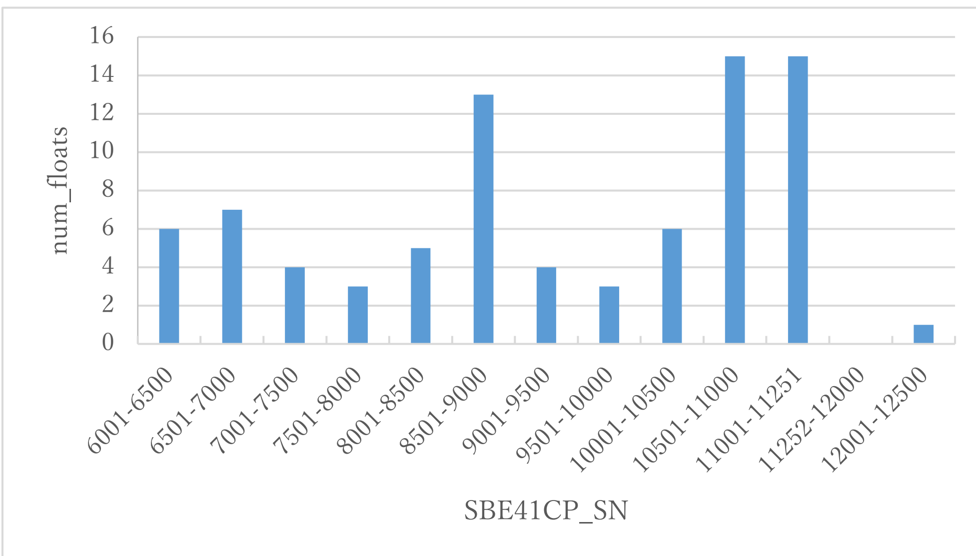


Fig. 4 Number of Japanese floats suffering from ASD by serial number range for SBE41 and SBE41CP.

Japan lost about 4,900 salinity profiles because of ASD from 2015, and they are mainly in the northwestern Pacific (Fig. 5) at a rate of about 800~900 profiles every year (Fig. 6). This number of profiles is equivalent to 5~10% of the number of profiles measured by Japanese floats (Fig. 6).

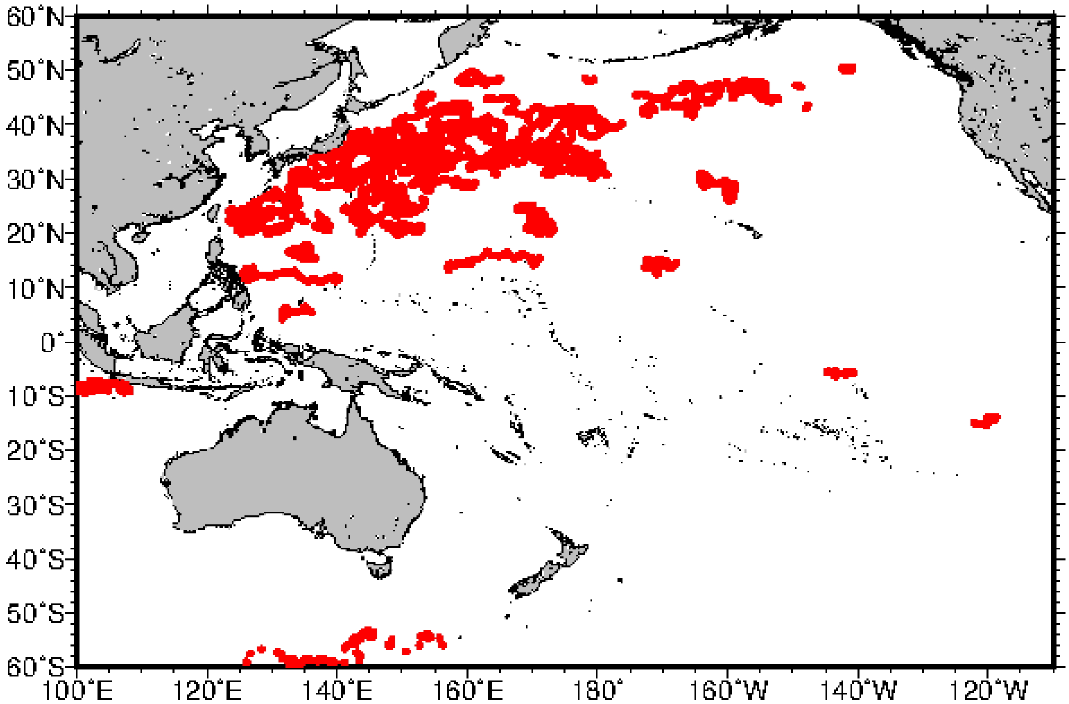


Fig. 5 Distribution of Japanese floats' PSAL profiles with PSAL_QC=4 due to ASD

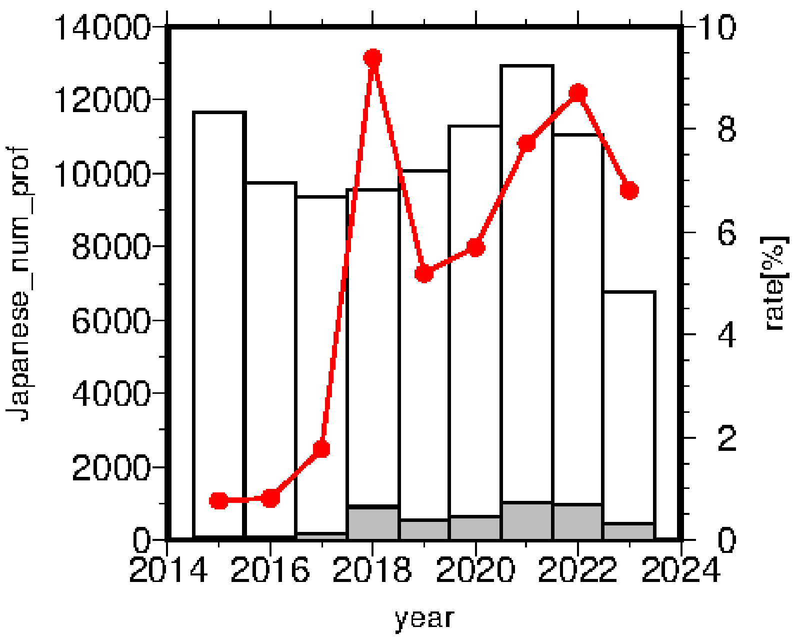


Fig. 6 (Bar) Time series of Japanese PSAL profile: (grey) those with PSAL_QC=4 due to ASD, (white) those with PSAL_QC=1,2,3,or 8. (Red line) Temporal change of the ratio of the number of Japanese PSAL profiles with PSAL_QC=4 due to ASD to the number of all Japanese PSAL profiles.

・**Development Argo real-time QC procedure using path-signature-based neural network:**

Argo profile data undergone the real-time quality control (rQC), which are automatically processed by DACs, could contain some error data, and could sometimes be difficult to use directly for analytical researches. In this study, we propose an automated QC of Argo profiles, based on a path-signature-based neural network (NN) to improve the procedure proposed by Sugiura and Hosoda (2020). The weights of the NN were determined by learning the existing pairs of the signature of raw profile and its delayed-mode QC (dQC) flag across global Argo observation. By using the NN, nonlinear features in discriminant function for error data can be considered. Furthermore, we introduced metric learning methods for more efficient learning the QC flags. We applied the method to the global Argo profile data, and examine the advantages for the current procedures. One of the main results is that the score of precision/recall is approaching to an acceptable level of practical use, clearly improved from the previous version of the signature method. The other implication is that the precision/recall score seems to be dependent on observed area of ocean. The signature-based NN has large advantages to end-users to help providing better rQCed data by just applying a simple processing, and also opening up a possibility in offering a quick and automated QC processing of Argo profiles prior to providing dQC data.

・**Performance evaluation of oxygen sensor (ARO-FT/AROD-FT):**

ARO-FT and AROD-FT are optical DOXY sensors, developed by JFE Advantech in collaboration with JAMSTEC in 2011. Their features are high accuracy (±2μmol/kg or ±2%) and fast response time (< 1sec). JAMSTEC have been evaluating the data quality of ARO-FT and AROD-FT (oxygen sensor for deep floats) since last two years by using the data of about 10 floats equipped with ARO-FT and about 5 floats with AROD-FT deployed after 2017. All of them were performed by multi-point calibration in the laboratory before floats deployment. Storage drift of ARO-FT and AROD-FT is more than -5 μmol/kg compared with bottle DOXY data at each float deployment. But, they can be corrected by using clear linear relationship between bottle DOXY data at each float's deployment and the difference of it and ARO-FT/AROD-FT DOXY. The fast response time of ARO-FT and AROD-FT enable us to correct their DOXY data.
When JAMSTEC calculated carry-over coefficient and slope of each ARO-FT by using equation 21 of Bittig et al. (2018), we found that slopes are small, less than -0.016 μmol/kg/yr, although more than half of the floats had carry-over coefficient more than 0.5. When JAMSTEC compare DOXY profiles of ARO-FT adjusted by using the slopes for each sensor more than 200 days after deployment with the nearest bottle data within 25 days and 35km for them, the difference between the adjusted DOXY profile of ARO-FT and the nearest bottle data are within ±4μmol/kg at the layer deeper than 1200 dbar. Therefore, the time drift of ARO-FT is small and we can correct time drift of DOXY data of ARO-FT using by equation 21 of Bittig et al. (2018).

KOREA Argo National Data Management Report
ADMT-24

Hobart, Australia, Oct 23 – Oct 27, 2023

1. Status

1.1. Data acquired from floats

In 2023, the National Institute of Meteorological Sciences of Korea Meteorological Administration (NIMS/KMA) deployed five floats around Korea: two in the Yellow Sea and three in the East China Sea. Two additional floats will be deployed in November.

Since 2001, NIMS/KMA has deployed 264 Argo floats in various locations around Korea, including the East Sea, Yellow Sea, and the North Pacific Ocean. As of October 10, 2023, eight floats are active(Fig. 1). As one of the regional DACs, NIMS/KMA is acquires ARGOS messages and Iridium messages in real-time via a web service from CLS. All profile data obtained undergo a real-time quality control preocess within the operational system before being transmitted to GDAC in NetCDF format using BUFR data.

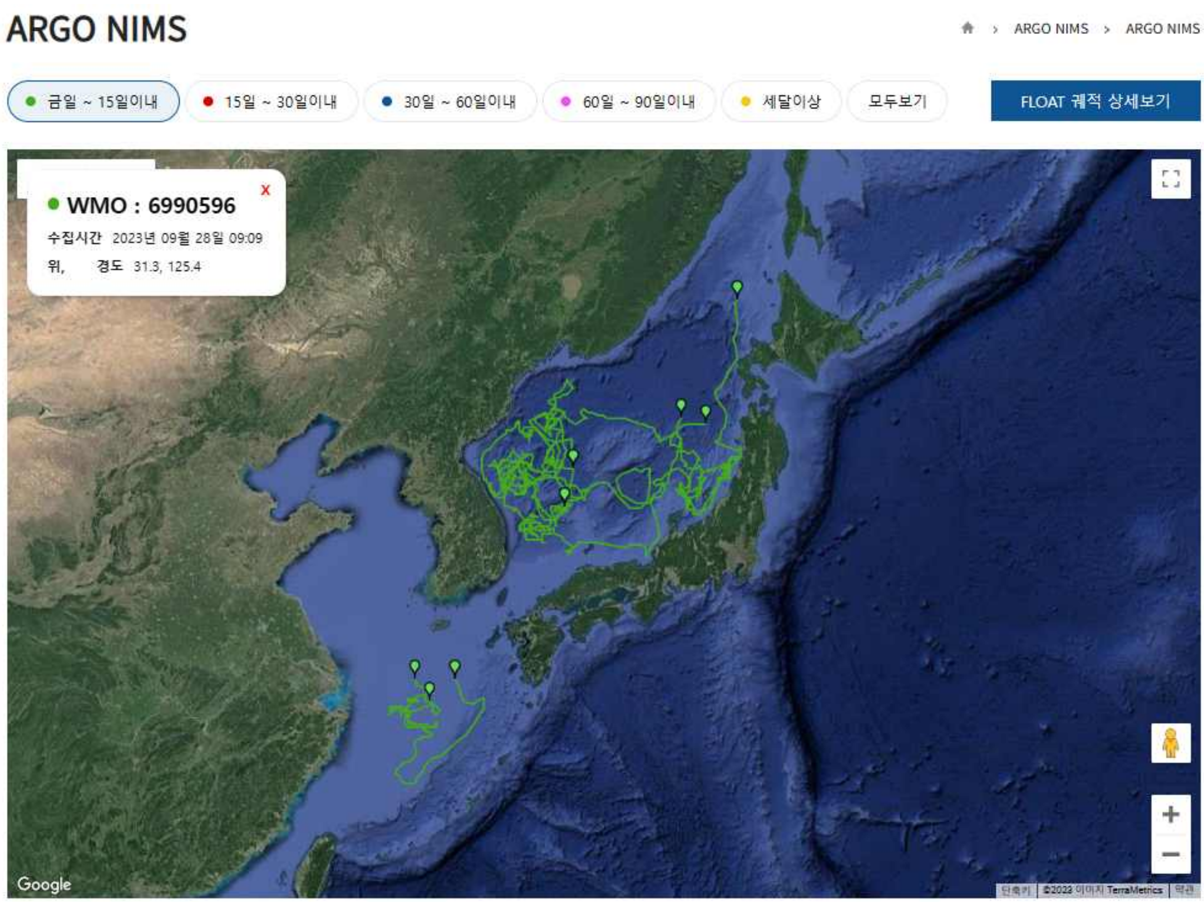


Fig. 1. Location and trajectory active Argo floats deployed by NIMS (October 11)

1.2. Data issued to GDAC

A total of 581 profiles were acquired from January through October in 2023 and sent to the GDAC after undergoing real-time QC processes.

・Data reproduction and resubmission to GDAC was conducted by applying the Warning Objective Analysis Report.

・The RTQC procedure for shallow profiles and greylisted ones has been updated.

・The RTQC procedure has been updated for the global range test for the Pacific and East Sea.

・Some missing files, such as “Tech.nc” and “Meta.nc”, were found on the KMA Data Center server. This issue may be related to an unexpected failure of FTP data transmission to GDAC. A fix is currently in progress and will be implemented soon.

1.3. Shallow Argo

Shallow sea observations with shallow Argo floats were conducted in the Yellow Sea and East China Sea on July 13, 2023. Three floats were successfully deployed and have been opeational since the start, showing that the trajectory of Argo floats and daily (1 day cycle) variations in temperature and salinity(Fig. 2). NIMS/KMA plans to maintain this shallow Argo observation network in the vicinity of the Korean peninsula.

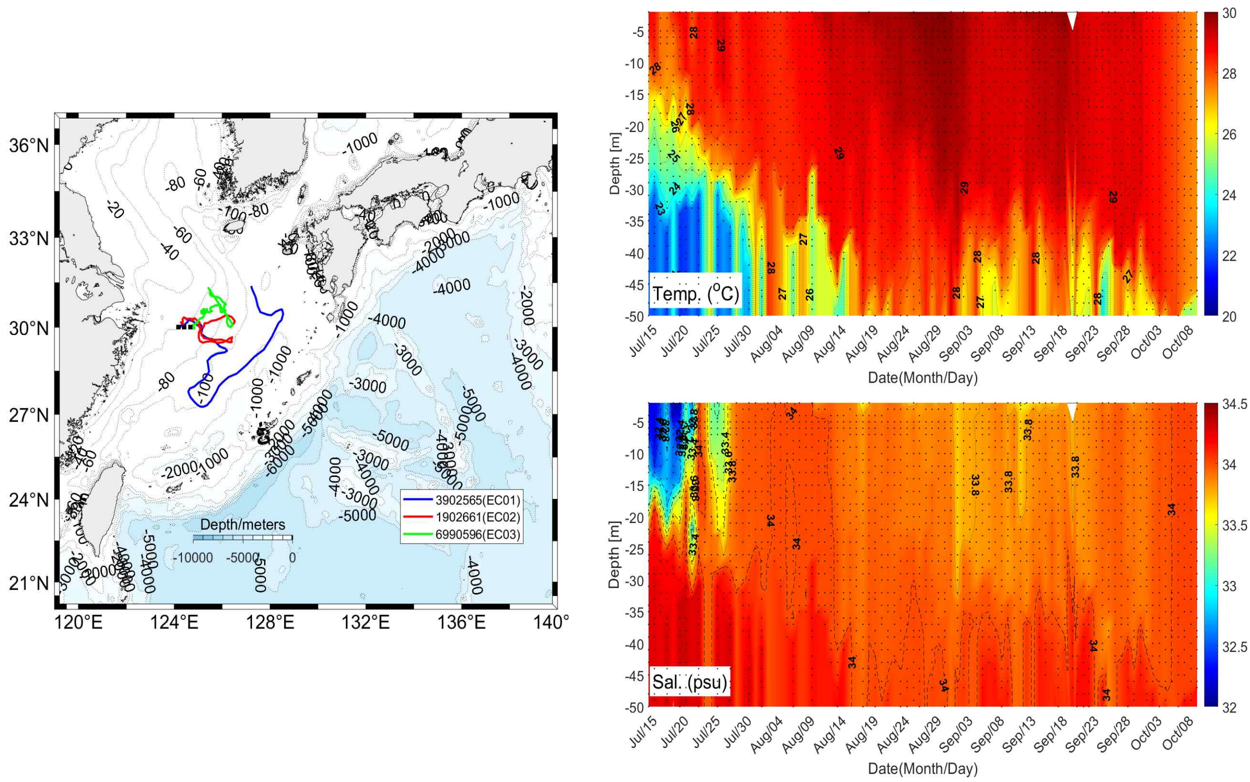


Fig 2. Trajectory (three floats) and time-series of shallow Argo floats (WMO ID: 1902661)

1.4. Web Page

NIMS operates the Argo web page (http://argo.nims.go.kr) as a regional data assembly center, providing profile data, temporal and spatial distributions of T and S, and the status of Argo float activities to the public. On average, it receives 165,025 monthly hits from visitors.

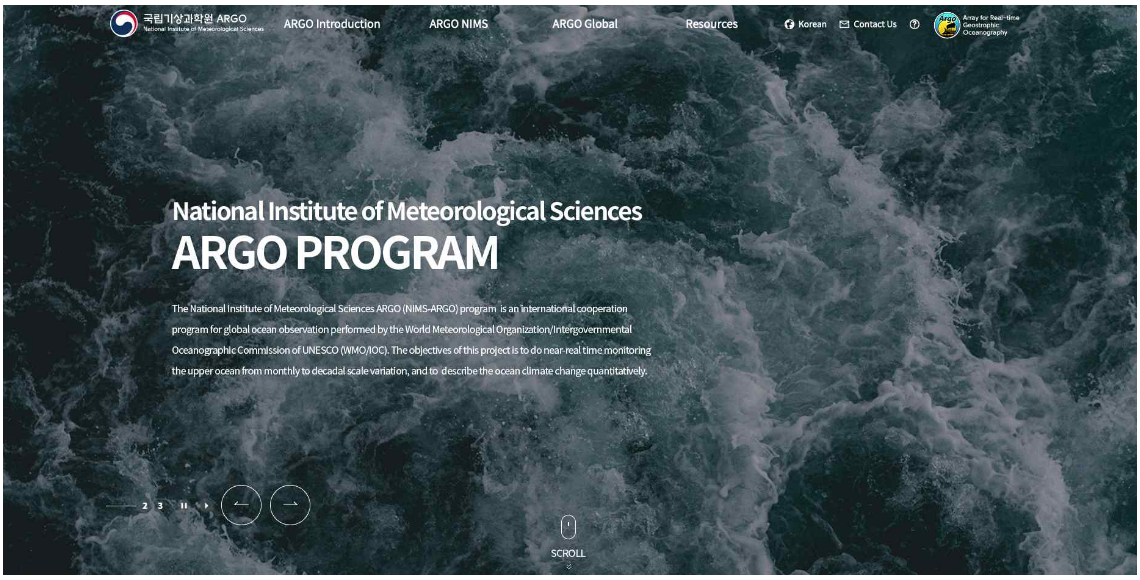


Fig. 3. Argo homepage of NIMS/KMA (http://argo.nims.go.kr)

1.5. Deployment Plan for 2024

In 2024, a total of seven Argo floats will be deployed around the Korea peninsula in July and November (Fig. 4). The red indicate show the potential deployment area for next year, with the aim of covering the regional seas of Korea.

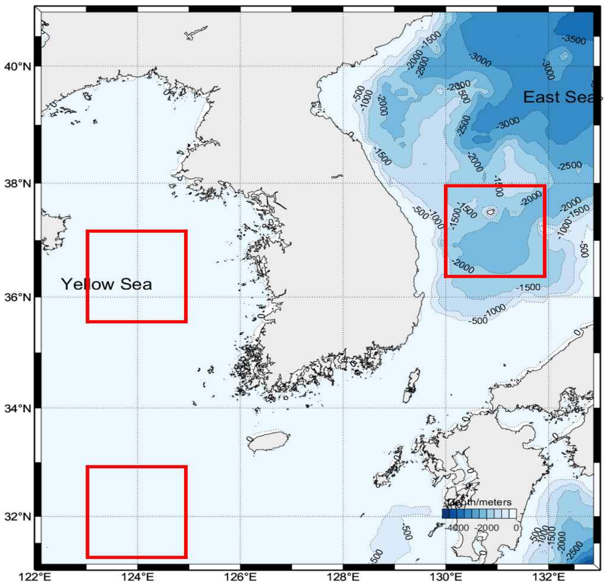


Fig. 4. NIMS/KMA's deployment area for 2024

2. Delayed Mode QC

We have completed the Delayed Mode QC (DMQC) operation on 652 profiles, with 446 profiles from the East Sea, and 206 from the Yellow Sea. These profiles were from early September 2022 to early September 2023. The OWC version 3.0.0 was used for the DMQC in the East Sea with new parameters, including spatio-temporal correlation scales, etc. The D-files were successfully sent to the Ifremer GDAC on June 29 and October 20, 2023, in NetCDF format and their updates in GDAC were checked.

We are in ongoing communication with Euro-Argo to dffectively address the CTD duplicated S/N issue, and it is expected to be resolved by the end of this year. All the data listed in the 2023 Delayed Mode T/S Audit Report are currently under full review and will be updated, including feedback, in early November.

For some of the newly deployed shallow Argo floats in July, due to a lack of shipboard CTD reference data, we have conducted spike checks. The DMQC for those floats will be completed next year, although the other QC procedures, apart from salinity drift correction, will be finished by the end of October.

Constant salinity offsets were identified in several shallow ARGO floats right after their deployment in the Yellow Sea by using shipboard CTD data. Since these floats in the Yellow Sea observed for a relatively short period of time (due to shallow parking depths of less than 100m and short cycle times for about a day), they usually have initial salinity offsets rather than salinity drift. Additionally, given that the Yellow Sea is a wide continental shelf area, its temporal and spatial scale of salinity variability are much smaller than those in the open ocean. Therefore, the only available shipboard CTD data collected at similar times and locations to the Argo floats were utilized as a reference for OW.

The identified offset for PSAL, evaluated based on the shipboard CTD data is adjusted by using “LAUNCH_OFFSET” in the "MAIN_write_dmqc_files"(matlab code). We have plans to further enhance the DMQC process for the shallow Argo floats by collecting more precise CTD data in the future.

Argo National Data Management Report – Norway 2022

(19 October 2023)

Kjell Arne Mork[1], Siv Lauvset[2], and Jan Even Nilsen[1]

[1] Institute of Marine Research (IMR), Norway
[2] NORCE Norwegian Research Centre, Norway

1. Real Time Status

Please report the progress made towards completing the following tasks and if not yet complete, estimate when you expect them to be complete. Please remember to include information on all Argo missions (including BGC, Deep and core) as well as pilot data from the RBR CTD.

- **Data acquired from floats**

Presently there are 47 operative Norwegian floats registered at OceanOPS (Figure 1):

- 6 full BGC (PROVOR) floats (all 6 bgc-variables)
- 7 BGC* (PROVOR) floats (4 bgc-variables: DO, chla, bbp, irradiance)
- 8 Core (ARVOR) + DO
- 6 Deep floats (ARVOR) with DO.
- 20 core floats (ARVOR)

*Two (CTS5+Jumbo) of these include UVP-6 and transmissometer (CROVER) sensors.

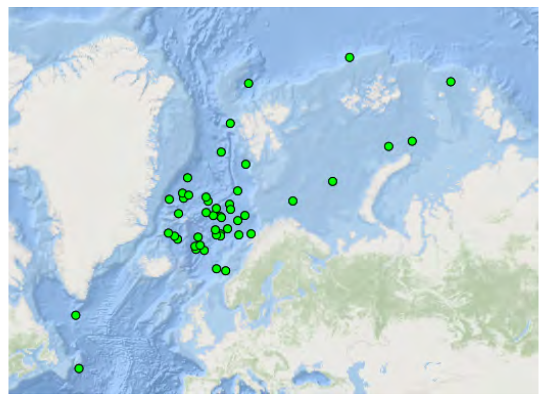


Figure 1. *Last registered position of the active floats in Argo Norway. From OceanOPS.*

Data from all operative floats are available from the GDACs.

8 floats were deployed in 2023, all in the Nordic Seas; 2 full BGC (6 bgc-variables) with UVP6 and transmissometer (CROVER) sensors, 2 BGC with 4 bgc-variables (DO, chla, bbp, irradiance), 2 core + DO, and 2 core floats.

- **Data issued to GTS**

All Norwegian floats are processed in real-time by Coriolis and delivered to GTS.

- **Data issued to GDACs after real-time QC**

All profiles from Norwegian floats are processed in real-time by Coriolis and exchanged with GDACs.

- **Delayed mode data sent to GDACs**

Norway do DMQC of floats deployed in 2019 and later, both core and BGC-floats. The D-files of core variables are submitted to Coriolis together with the diagnostic figures and a short summary of the DMQC decision taken. For bgc-variables drift and offset are provided with short summary. BSH (Germany) did the Quality Control of core data from Norwegian floats deployed in 2018 and earlier.

2. Delayed Mode QC status

Please report on the progress made towards providing delayed mode Argo data, difficulties encountered and, if possible, solved. Please remember to include information on all Argo missions (including BGC, Deep and core) as well as pilot data from the RBR CTD.

Norway do now DMQC of 67 floats (2019-2023). There exist 8568 profiles (2019-2023) with 6375 DM and 284 DM-pending.

BGC-variables:

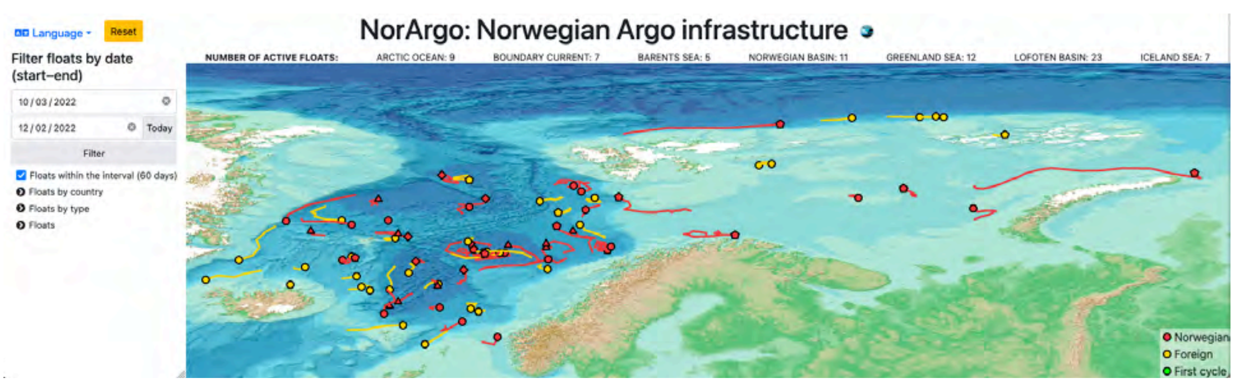
Several pH sensors have failed (provided wrong/crazy values). DMQC of nitrate needed to be redone with the new temperature correction of the sensor. We plan to do DMQC on the other BGC-variables (IMR) in near future; CHLA at the end of this year, and then BBP and Irradiance.

DMQC has been performed on the oxygen (NORCE) for 37 of 37 floats, on the pH (NORCE) for 4 of 9 floats (125 profile) and on nitrate (IMR) for 6 of 9 BGC-floats.

3. Value Added items

- List of current national Argo web pages, especially data specific ones

A web page for NorArgo (https://norargo.hi.no) has been developed that IMR updates. A web page for the operational Argo floats in the Nordic Seas have been developed: https://norargo-map.hi.no/ (see below).



- Statistics of National Argo data usage

▪ Norway uses the data in research, operational services and monitoring.

▪ IMR uses the data as part of the monitoring program for the marine environment in Norwegian waters.

▪ The NERSC routinely assimilates the data into their TOPAZ4 model and assimilation system for operational monitoring and forecast of the ocean climate.

▪ MET.NO also assimilates the Argo data into their operational models.

▪ The data are used in many research projects and in master and Dr. thesis.

- **Products generated from Argo data …**

The ocean heat and fresh water contents of the Norwegian Sea are regularly updated using Argo data and used for monitoring (see figure below).

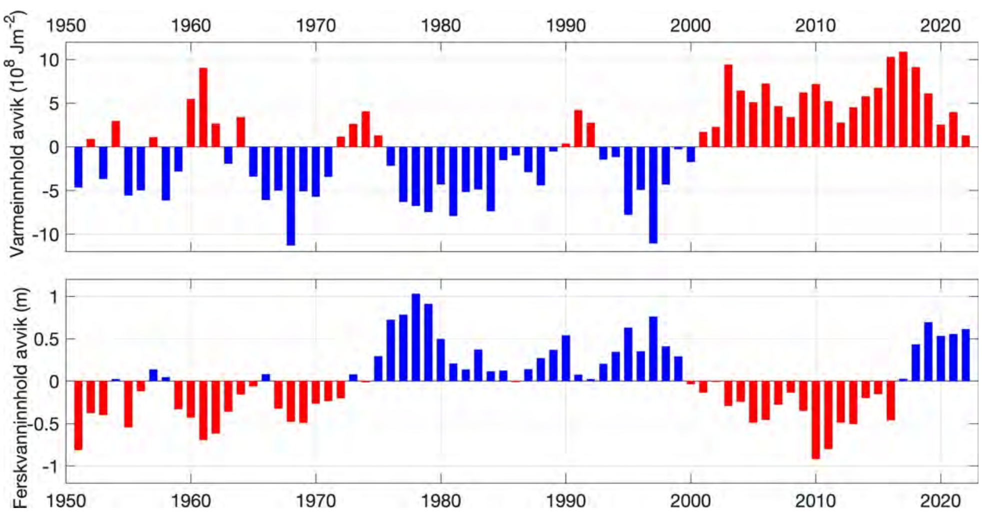


Figure 2. Yearly relative ocean heat (upper) and fresh water (lower) content in the Norwegian Sea. Updated from Mork et al., 2014, GRL.

4. GDAC Functions

5. Regional Centre Functions

6. Other Issues

UK Argo National Data Management Report for the 24th Argo Data Management Team meeting

Authors

UK Argo data team at the British Oceanographic Data Centre, part of the National Oceanography Centre:

- Contributing authors: Kamila Walicka, Clare Bellingham, Violetta Paba, Emma Gardner, Helen Snaith, Justin Buck

- Other team members: Roseanna Wright, Charlotte Dempster, Katy Baldwin

With contributions from the wider UK Argo team by:

- Jon Turton and Fiona Carse (Met Office)

- Brian King, Nathan Briggs, Darren Rayner (National Oceanography Centre)

Data Management Team

The British Oceanographic Data Centre (BODC), part of the National Oceanography Centre (NOC), is the data assembly centre for UK Argo. It is funded primarily by the UK Natural Environment Research Council (NERC) of UK Research and Innovation (UKRI) and is responsible for data management of UK and Irish floats. In addition, UK Argo is a member of Euro-Argo. BODC hosts the NERC Vocabulary Server (NVS) which now hosts the Argo reference tables. BODC is also a member of the Southern Ocean Argo Regional Centre (SOARC).

Emma Gardner has been recently appointed to the role of Autonomous Platform Lead within BODC. She is providing a leadership and co-ordination role for Argo, Gliders and AUV (Autosub) platforms, with the aim of bringing together the existing teams in support of a more sustainable and unified approach. Currently, she oversees the BODC Argo team in this role. Clare Bellingham manages the BODC Argo DAC, loading and enabling the processing of new UK Argo floats and managing the day to day running of the DAC. This includes applying real time quality control corrections and working with BODC software developers on system requirements. Two new BODC data managers (Katy Baldwin and Charlotte Dempster) are currently being trained in the real-time data management of Argo data. Kamila Walika is a lead of the Argo DMQC Centre, DMQC operator -Expert in the UK Argo DMQC of core, BGC and Deep Argo floats, Argo DAC operator and is the BODC representative for SOARC.

Roseanna Wright provides a support to works on reviewing and applying suggested corrections to core Argo floats in the objective analysis reports and altimetry QC feedback from Ifremer.

Violetta Paba focuses on supporting the Argo Vocabulary Task Team, with the newest contribution of two members of the BODC Vocabulary Management Group, Danielle Wright and Jordan Atherton.

BODC’s role management of the NVS tasks pertaining Argo metadata lists and vocabularies and provide guidance on wider efforts to enhance the interoperability of the Argo (meta) data system.

Funding Outlook

UK based floats draw down data management funding available from NERC for projects utilising Argo float data, when the PI has completed a data management plan (DMP). Core BODC Argo national capability funding from NERC remained static for 2022-23 and is therefore still decreasing in real terms. There is additional funding from NERC associated with research projects and the floats they have procured, such as PICCOLO.

NOC/BODC secured funding to develop data infrastructure for NKE BGC floats (the ASBAN UK project) purchased by NOC through NERC Capital funding. Efforts have continued to establish a clear plan for a more sustainable model of UK funding for Argo data management to support the UK contribution to the full-depth multi-disciplinary Argo array, but the funding situation remains challenging.

BODC has been funded under the EU H2020 project ENVRI-FAIR (ended in mid-2023) to introduce the NVS vocabulary server to support Argo vocabulary management.

BODC has been unable to source sustainable funding to support SOARC functions, so the ARC remains unfunded in the UK to date.

BODC Argo team has been undertaking activities to provide a more secure long-term funding position and are keen to be part of future funding opportunities required to enable the UK's contribution to OneArgo. This would significantly strengthen the UK's contribution to the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS). It would secure the UK a leading role in shaping and optimising OneArgo alongside other key G7 members USA, Canada, France, Germany and Japan.

The UK Argo team are working on a UK briefing document to present to Defra (Department for Environment Food & Rural Affairs) on the UK funding landscape for Argo and the priority topic recommendations to implement OneArgo. These briefing notes will be used to inform key persons who will be present at the G7 Future of the Seas and Oceans Initiative Working Group Meeting in Tokyo, Japan in November.

Real Time Status

Data acquired from floats

BODC retrieves data for all UK, Irish and assigned EU MOCCA floats from a number of sources and archives these for further processing. BODC currently processes data from floats with Argos communications, Iridium Rudics and Iridium Short Burst Data (SBD) from a diverse fleet of floats manufactured by TWR, SeaBird, NKE and SOLO.

To date this year UK Argo have deployed 43 floats with a further 19 expected for 2023. These are a mix of core and BGC where the core floats are Apex, Apex with RBR and NKE Arvor, and the BGC floats are NKE Provor III and 1 Navis N2.

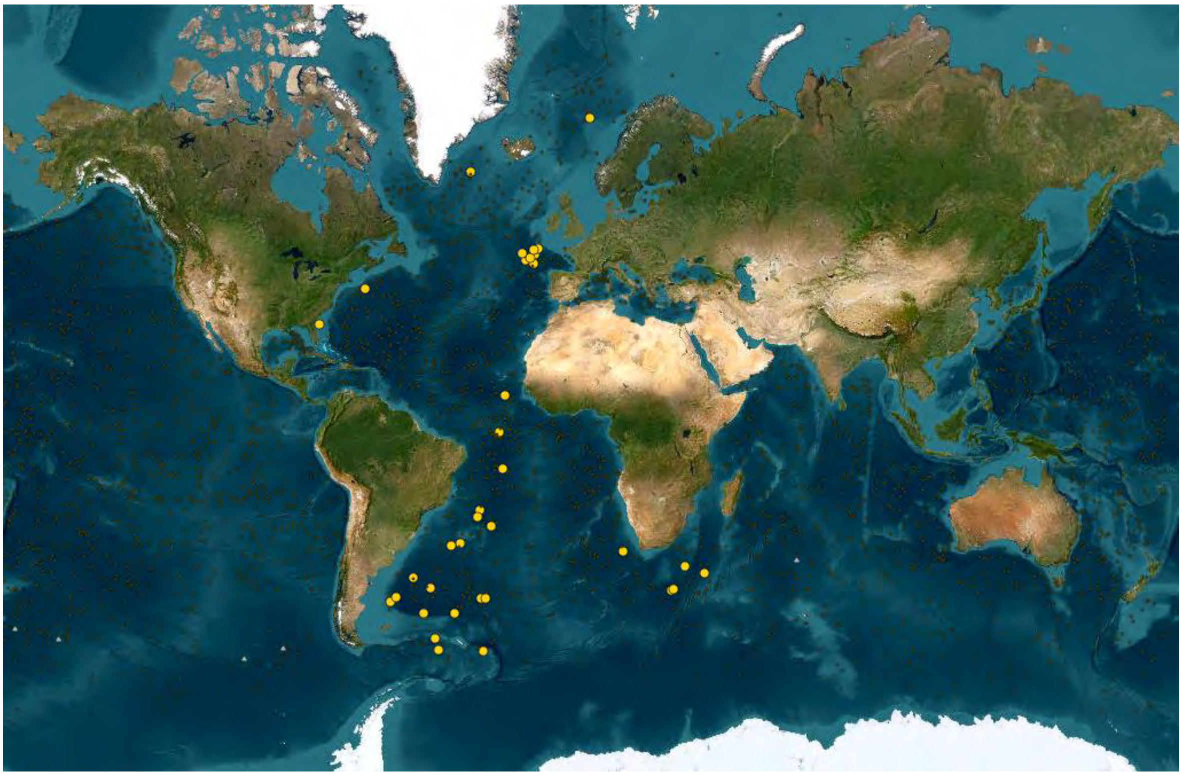


Figure 1: Map showing current locations (16/10/2023) of UK Argo deployments Jan-Oct 2023 (https://fleetmonitoring.euro-argo.eu/dashboard)

BODC is currently processing the temperature and salinity coming from the RBR sensor in real time. BODC has 21 RBR Apex floats in their fleet, where 10 of them are currently active. UK Argo is planning to deploy another 8 RBR Apex floats by spring 2024.

BODC has a capacity to process temperature and salinity of the UK Deep Argo floats using the SBE61 sensor in real-time. BODC has 22 deep Argo floats in their fleet, where all of them are currently inactive. NOC deployed a SOLO deep float in 2022 which is the first float of this type in the UK Argo fleet. BODC has been working with software developers with help from AOML to enable capability to process and deliver the data from this float to the GDAC. This work is nearing completion and files can be seen on the GDAC for float 2903791

Near real-time data delivery

Processing and delivery of incoming data is normally set up within one week of deployment where the capability already exists for a given float type. We have found that development work for new float types can be significant and manufacturer's data decoders and discussions with other DACs have been important.

BODC continue to operate two parallel processing chains. The BODC-developed chain processes and delivers all UK Navis, Apex and SOLO floats. In the beginning of 2023, a version of the Coriolis processing chain has been updated in the BODC software stack enabling processes and delivers UK NKE, the EU MOCCA NKE that BODC have responsibility for and Irish NKE floats.

During 2023 BODC DAC completed the development work required to process NKE BGC floats purchased through the Natural Environment Research Council (NERC) and NOC investment project UK Atlantic Sector Biogeochemical Argo Network (ASBAN-UK) meaning that these floats now deliver real time core and BGC data to the GDAC. Following the BGC workshop earlier in the year DAC operators were able to calculate the DOXY gain for these floats meaning that DOXY adjusted is also regularly delivered in real time to the GDAC. Delivery of real time BGC parameters has enabled NOC scientists to strategically deploy Argo floats alongside gliders and use the Argo BGC data as intelligence to pilot the gliders. This use case scenario was recently utilised in the Gulf Stream as part of the ongoing C-Streams project.

Data issued to GTS

BODC delivers core data, and oxygen from NKE floats, in NetCDF format to the UK Met Office four times a day, where it is subsequently issued to the GTS in BUFR format. Over 95% of the NetCDF files are delivered within 24 hours of the data being available to BODC.

We have identified issue with Apex floats not making a fix with GPS on the first attempt impacting the GTS delivery. Our experience has seen that the fix is made shortly before the float dives again and so cannot be retrieved until 10 days later, so while we have the science data at the DAC we cannot process and deliver the profile due to the lack of GPS fix. This is something that UK Argo have started to discuss with Teledyne, but a resolution has not yet been found and 20 of our floats have found to be affected by this during some cycles.

Data issued to GDACs after real-time QC

BODC delivers updated meta and tech files for all floats it processes alongside new core profile files to the GDACs as part of every processing run. Delivery of BGC profile data for most floats and many trajectory files are hold on due to limited funding resources to continue these developments.

- ### Core

BODC endeavours to address any QC changes needs identified by the Objective Analysis reports and Altimetry QC issued by Ifremer and OceanOps on a regular basis and made updates to the meta files following reports from the GDAC file checker. Additionally, BODC is undertaking visual inspection of the core Argo parameters from core, deep and BGC float types of all profiles which then undergo further DMQC analysis.

The workflow to implement real-time adjusted corrections to RBR Argo floats is still under development. This activity will be strongly dependent on very limited funding and resources in BODC.

- ### BGC

BODC developed their workflow of applying the real-time adjusted corrections to the dissolved oxygen data using the Sage02 software. Currently, the corrections have been applied to 10 recently deployed BGC NOCBio Provor floats.

The workflow to implement the real-time adjusted corrections to Arvor and Apex BGC Argo floats is still under development.

- ### Deep

The workflow to implement the real-time adjusted corrections to Apex and Solo Argo floats is still under development.

Uk Argo metadata update

BODC Argo floats meta data went through the verifying the status regarding the requests for changes on metadata that were issued this year (for OceanOPS, Coriolis and BODC). BODC reviewed the correctness of CTD serial numbers of 77 UK Argo floats. In result 33 changes (26 floats) have been effectively performed and 57 changes (51 floats) are remaining pending. The delay in completing the remaining updates has been caused lack of documentation for these floats confirming the correct serial numbers. These has been reported and requested to be reviewed and delivered by PI's and manufacturers (Teledyne, SeaBird, Martec).

Submitting of real time adjusted and d-mode data from external partners

The BODC Argo DAC function currently interacts with DMQC operators through two different modes of operation. The first is internal BODC DMQC operators who directly submit DMQC decisions to the BODC Argo System, and for which updated D-mode NetCDFs are automatically generated and submitted. In the second approach in which the UK Argo MOCCA floats managed through the Coriolis processing chain at BODC, both internal and DMQC operators from Ifremer, OGS and BSH submit updated NetCDFs which are archived within BODC and submitted to the GDACs.

Additionally, BODC has received support from LOV in processing Irradiance (d-mode), Chlorophyll and Backscatter data of the real-time adjusted mode.

All data received from internal and external DMQC operators are submitted to the GDACs the same day that delayed mode QC is complete for a profile when completed by BODC, or as soon as the data has been accepted following submission by external DMQC partners. Submissions from external partners are issued with accession numbers for tracking purposes within BODC archives.

Delayed Mode QC status

- ### CORE

From January 2023 BDOC Argo submitted to GDAC 15 core Argo floats with ~1600 new core profiles in D-mode. The DMQC analysis has been focused to process the suspected salty drifting floats listed in the Argo graylist.

Additionally, in 2023 some of the BODC Argo floats coming from MOCCA project has been continuously DMQC-ed by external European partners. We have received and submitted to GDAC 8 analysed core Argo floats (with ~380 new D-mode profiles) from BSH.

The key focus for BODC is to implement the workflow of DMQC Deep and RBR Argo in BODC including analysis of these floats and continue DMQC analysis of core Argo floats. These activities will be strongly dependent on very limited funding and resources in BODC.

- ### DEEP

BODC have greatly improved their understanding of the current procedures and guidelines for RT and DMQC of deep Argo data. BODC performed initial DMQC analysis for two Deep Argo floats following the most recent recommendations from the Argo manual. However, these data have not been submitted to the GDACs because the BODC processing chain and BODC database is not yet adapted to new deep Argo procedures.

- BGC

The BODC Argo team has greatly expanded their knowledge of the DMQC analysis of BGC Argo floats. BODC has started implementing the workflow of the DMQC BGC procedures of the DOXY parameter for the BGC Argo floats.

The UK Argo fleet currently has 64 BGC Argo BODC floats requiring DMQC analysis (>1 year old). However, BODC is currently able to process in DMQC only parameters from 17 BGC floats. The remaining 47 legacy BGC Argo floats are still not available in R-time in BODC. These require additional development works in the BODC Argo processing chain.

In early 2023, BODC Argo performed DMQC analysis of Dissolved Oxygen parameters from 13 MetBio NKE float and submitted to GDAC about 4500 profiles in D-mode. Our further ambition is to start the DMQC analysis of other BGC parameters.

Software in DMQC

BODC has regularly adopted the latest reference databases for DMQC analysis of core and deep Argo floats (CTD_for_DMQC_2021V02 and ARGO_for_DMQC_2022V03).

BODC has adopted the procedures and SAGE_O2Argo software for estimates of the Gain of the DOXY parameters of Argo floats. Additionally, we also implemented the procedures from https://github.com/catsch/DM_FILLER allowing applying corrections in D-mode BGC floats, generation and population of the D-mode NetCDF files.

Improvements to the quality of the UK Argo fleet data

The UK core Argo fleet data went through the international DMQC audit run by external partners from the DMQC core Argo group. The audit was motivated by the fact that a higher percentage of SBE CTDs are now experiencing sensor drifts, which may not be easily identifiable by only examining individual time series. All identified BODC profiles with some issues were reviewed. Any additional revisions or corrections have been completed and re-submitted to the GDACs. BODC was not able to resubmit the few remaining floats from the beginning of the Argo project in early 2000s due to technical issues with the float data related to a deprecated NetCDF version (Format 2.2) of Argo profiles which are not acceptable by the GDAC file checker.

Support to national programs

The strategy adopted to deliver the support to national programs focused on ensuring a high-quality approach and the progressive enhancement of expertise. This supports OGS in implementing the DMQC-PCM software, contribution to the working groups. Moreover, BODC also provides support in analysis of the dissolved oxygen parameters of Argo floats to IOPAN.

Working groups

BODC actively contributed to activities related to the Abrupt Salty Drift (ASD) group, focusing on estimating the best practices, guidance and examples on how to treat salinity data that are affected by sensor drift to produce optimal adjustment in d-mode. This involved actively contributing to updating the shared list of floats affected by the salty drift and reviewing best practices and procedures for DMQC operators of core Argo floats.

Furthermore, BODC and NOC contributed to the research article with the collaboration of the international Deep Argo community on "*The implementation plan of the global Deep Argo array to measure the full ocean volume"*. The article is currently under review in Frontiers journal.

Data use and data products

Met Office

At the Met Office Argo data are used operationally:

- They are routinely assimilated into its FOAM (Forecasting Ocean Assimilation Model) workflow which is run daily and produces 2 analysis days and a 7-day forecast.
- A coupled ocean/atmosphere/sea-ice/land global prediction system is now operational for producing the main Met Office weather forecasts. This coupled NWP system assimilates data in all components of the coupled model, including Argo data in the ocean component. These data therefore affect both weather forecasts and short-range ocean forecasts. An assessment of the impact of Argo in a lower atmospheric resolution version of that coupled system was detailed in King et al., 2019.
- Initial conditions for coupled monthly-to-seasonal forecasts are taken from the global coupled NWP system so the Argo data are used to initialize these forecasts and are used in ocean reanalyses.
- Argo data are also used in the initialization of ocean conditions in climate models run to make decadal predictions;
- Near-surface Argo data are used to validate the output from the Met Office's OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis).

Met Office research & development applications (non-operational) which have made significant use of Argo data:

- A new paper describing work to develop an ensemble ocean system, including improvements to the way data (including Argo) are assimilated, has been published (Lea et al., 2022);
- A paper was published on OSSEs to investigate the potential impact of expanding the Argo array (Mao et al., 2020);
- David Ford has done some OSSEs looking at the impact of the planned BGC-Argo array of floats in a global physical-biogeochemical model where he assimilates synthetic versions of the BGC Argo profiles in conjunction with satellite ocean colour data (Ford, 2021);
- A PhD project is currently looking at the impact of real BGC Argo data in a global physical-biogeochemical model. The BGC Argo data are assimilated into the model and the impact on air-sea CO_2 fluxes is being investigated.
- A paper was published jointly with the University of Reading on the application of a simple smoother algorithm to make better use of Argo data in ocean reanalysis (Dong et al., 2021).
- A project where we made good use of Argo data was in the assimilation of satellite sea surface salinity data from SMOS, Aquarius and SMAP. The near-surface salinity data from Argo was used to bias correct the satellite salinity data and was crucial for the performance of the assimilation of SSS data. That work is written up in Martin et al., 2019. Another paper

was published investigating impact in FOAM and the Mercator system of satellite SSS assimilation which used Argo for assessment (Martin et al., 2020).

In the Hadley Centre for Climate Science and Services, Argo data is used in the following products:

- EN4 contains in-situ ocean temperature and salinity profiles and objective analyses. It is updated monthly using real-time Argo profiles and GTSPP data, and annually using delayed-mode Argo profiles (and WOD, GTSPP and ASBO data). EN4 is freely available for scientific research use (see http://www.metoffice.gov.uk/hadobs/en4/). The latest version is EN.4.2.2, which includes a fresh download of all the source data and a substantial update to the XBT/MBT correction schemes. EN.4.2.2 contains four ensemble members where previously there was only two. There is also a new product user guide (based on both the Argo Users' Manual and the HadIOD user guide), including FAQs and example code. EN4 is also forming part of a GEWEX EEI project - comparing Ocean Heat Content calculated from reanalyses, in situ data and satellite products (the project website is https://sites.google.com/magellium.fr/eeiassessment/dissemination/documents?authuser=0).
- HadIOD (Hadley Centre Integrated Ocean Database) is a database of in situ surface and subsurface ocean temperature and salinity observations supplemented with additional metadata including bias corrections, uncertainties and quality flags. The dataset is global from 1850-present with monthly updates. The current version is HadIOD.1.2.0.0, the chief sources of data are ICOADS.2.5.1, EN4 and CMEMS drifting buoy data. This product has been available to the public since mid-2020 via https://www.metoffice.gov.uk/hadobs/.

Met Office science uses of the EN4 product include OHC analysis, seasonal forecasting, decadal forecasting, climate model initialization and evaluation.

National Oceanography Centre (Brian, Nathan)

At NOC we produce a 4-D global map of Argo T and S data at 2 degree lat and long resolution from 60S to 60N. The data are gridded in 10-day windows using objective mapping on sigma-1 or neutral density levels and then interpolated back to 20 dbar vertical resolution. This is generally updated towards the end of each calendar year. A time series of global heat content is calculated and reduced to annual averages and then incorporated into the synthesis of global heat content calculations led by K von Schuckmann. The full 4-D gridded fields can be made available by contacting Brian King at NOC.

A two-year NOC-led project called GLOBESINK started in August 2022 to generate a global dataset of particle size and downward particulate organic carbon flux from BGC Argo measurements of optical backscattering. This dataset contributes to the wider NERC BIO-CARBON programme, which aims to improve our ability to predict changes in biological carbon update by the oceans. One output of the project will be a publicly available particle dataset using BGC Argo data through 2022 (to be delivered in 2024). NOC aims to maintain this product in the future through single centre NERC bid AtlantiS. New BIO-CARBON projects PARTITRICS and IDAPro, led by NOC and University of Southampton, will deploy two UK BGC Argo floats and fund their data delivery and QC, and also deploy three French BGC Argo floats. The float data will be used for estimates of primary production, net community production, and downward POC flux as part of 2024 BIO-CARBON fieldwork.

Currently, three NOC-led PhD projects have a large component utilizing BGC Argo data. One focuses on net community production in the Weddell Gyre, another is exploring methods to optimally interpolate subsurface chlorophyll data, and a third is looking into the drivers of variability in the remineralization depth of sinking organic carbon in the ocean. A fourth NOC-based project led by the University of Southampton will develop methods to QC and correct pH data from BGC Argo.

GDAC Functions: Argo NERC Vocabulary Server (NVS) activities

As the ENVRI-FAIR project came to an end in June 2023, BODC completed the transfer of all the original Argo metadata lists onto NVS collections, and full governance was handed over to the designated NVS Editors from the wider Argo Data Management Team/Argo Vocabulary Task Team.

BODC continues its role of NVS support and guidance to the ADMT community, routinely monitoring AVTT GitHub tickets, answering queries and making suggested edits, and participating in technical meetings with the team and its stakeholders.

To unleash the full potential of a metadata system underpinned by the NVS, tools and templates are being developed by various groups to incorporate the NVS machine-readable technology into current processes and enhance automation; specific efforts include the upgrade of the GDAC file checker, and the standardisation of sensor metadata harvesting and parsing from manufacturers to DACs.

As BODC and Argo hold an ambitious vision in pioneering cross-domain interoperability and FAIR (Findable, Accessible, Interoperable, Reusable) development of this remarkable data system underpinned by the NVS, additional funding is being sought to pursue these objectives and further raise Argo's status in the Oceanographic Observational Networks of the modern world.

Value Added items

Webpages

- NOC continues to maintain the UK Argo website (www.ukargo.net)
- BODC Argo website (https://www.bodc.ac.uk/data/hosted_data_systems/argo_floats/)
- NVS VocPrez website (http://vocab.nerc.ac.uk/)
- Argo Vocabulary Task Team (AVTT) GitHub space: https://github.com/orgs/nvs-vocabs/teams/avtt
- Facebook page (www.facebook.com/UKArgofloats/)
- Twitter account (twitter.com/ukargo)
- NOC maintains the SOARC website (www.soarc.aq)
- NVS Argo collections (new):
    - R14- Argo technical parameters names
    - R18 – Argo configuration parameter names
    - R28 Argo controller board types and generations
    - R40 – Argo Principal Investigator names

Software tools

- A Python implementation of the "OWC" salinity calibration method traditionally available for Matlab used in Argo floats Delayed Mode Quality Control https://github.com/euroargodev/argodmqc_owc
- A software for an infrastructure agnostic set of common BGC parameter derivation equation functions https://github.com/euroargodev/bgc_derivation
- Real time QC automated tests for Argo data. https://github.com/euroargodev/argortqcpy
- The quality assessment method in the Southern Ocean (SO) uses the pre-classified core Argo float and climatological data belonging to similar water mass regimes using the Profile Characterization Model (PCM). https://github.com/euroargodev/DMQC-PCM/tree/SO_assesment
- This repository includes the report template and Matlab codes used to generate plots required in the DMQC report for core Argo parameters. https://github.com/euroargodev/dm-report-template
- BODC has provided the material to update the 'Argo vocabulary server' web page on the Argo data management website: http://www.argodatamgt.org/Documentation/Argo-vocabulary-server

Manufacturer engagement

NOC (Brian King) Since the 2022 ADMT NOC has been engaged with SBS and RBR to develop machine-readable files for exchange of metadata between platform and sensor suppliers and DACs or other users. The present status of this work will be presented for discussion at ADMT. The development so far is shared on GitHub: https://github.com/euroargodev/sensor_metadata_json and a document describing the project and progress has been distributed for comment on the argo-dm mailing list.

Workshops and training

BODC Argo team (Kamila Walicka, Clare Bellingham and Violetta Paba) attended the 1st DMQC workshop of the BioGeoChemical parameters. The meeting was focused on reviewing the available procedures, tools and methods of processing the BGC Argo parameters in delayed mode and upskill the DMQC operators.

The key outcome of this meeting for BODC and NOC were:

- improve the international collaboration with the BGC Argo community and
- BODC Argo team for the first time have started DMQC analysis of Oxygen data in D-mode. As for the time of writing BODC Argo team submitted about 4500 BGC Argo profiles to GDAC. The profiles come from the MetOffice BGC Argo floats.

Kamila Walicka and Brian King attended the Deep Argo workshop. This workshop was intended for delayed-mode operators of Deep-Argo floats to share their experiences regarding two important aspects of DMQC for Deep-Argo data: the application of a CPcor adjustment for salinity from SBE CTDs; and the evaluation of sensor drift to the expected Deep-Argo salinity accuracy of 0.004.

Kamila and Emma participated at the 10th International EuroGoos conference in Galway. Kamila Walicka presented a poster on Implementing a machine learning method based on a profile classification approach in the delayed mode quality control of Argo floats.

Kamila and Brian as the experts in the DMQC analysis of core Argo parameters, participated at the series of the International DMQC discussion meeting led by CSIRO. These virtual discussions helped to promote collaboration between DMQC operators and interested members of the Argo community. This forum gives an opportunity for newer operators to improve their skills and get advice on concerning and difficult floats, promote a sense of community, and contribute to the adoption of more consistent DMQC practices.

Regional Centre Functions

BODC Argo is a member of the SOARC working group. However, due to very limited funding and stuff resources in BODC we were not able to contribute to this group.

Other Issues

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US NATIONAL DATA MANAGEMENT REPORT

24st ADMT

December 1, 2022 - October 15, 2023

1. Real Time Status

US Argo Data Assembly Center at AOML statistics

The US Argo Data Assembly Center (DAC) at AOML is responsible for processing of Argo data obtained from all US floats. During the reporting period the DAC has received real-time data from 2,537 floats and sent more than 84,200 profiles to the GDACs. In addition to this, the US Argo DAC distributed meta, technical and trajectory files in the Argo NetCDF files to the GDACs as part of the real-time processing.

The DAC distributed over 81,500 Argo profiles to GTS in the BUFR format. Both for GDACs and GTS 93% of the profiles reached the system within 24 hours. If floats with large delays are excluded (e.g. new deployments, descending profiles and floats under ice), then 97% of the profiles are available in 12 hours and 99% of the profiles are available in 24 hours.

The DAC also passes the files on to the GDACs that come from delayed-mode processing, BGC float processing and auxiliary files. For this purpose, the DAC maintains an ftp server for file exchanges, both for providing reprocessed R-mode and meta files as well as for receiving D-mode files, real-time submission of data from Iridium floats and the submission of deployment information.

Overall, the US Argo DAC has 1,508,544 core/deep profiles (at the GDACs: 210,557 R-files, 1,297,987 D-files), 102,392 BGC profiles (4,116 BR-files, 98,276 BD-files). The corresponding numbers for non-profile files are 8,614 meta, 8,451 tech, 8,444 Rtraj and 2,339 Dtraj files (total 10,783). Total number of BR files generated by AOML 48,185 (only a subset of these are sent to the GDACs - floats for which MBARI is responsible are run through BGC processing so we can add BGC data to the Rtraj files; the AOML_BR files for these are not distributed but are useful for testing).

The US Argo DAC added 382 new floats to the processing system, 68 of them were deployed in collaboration between AOML and WHOI. As part of this collaboration, the US Argo DAC is finding ships of opportunity and provides ship riders for selected cruises. Recent maps showing their positions with link to graphics of the data collected by the floats can be found at:

https://www.aoml.noaa.gov/phod/argo/opr/php_forms/deployment_maps.php

The US Argo DAC is maintaining a website that provides documentation and information about the operations: http://www.aoml.noaa.gov/phod/argo/index.php

Developments at the US Argo DAC

As in the past, changes in float technology or core Argo floats, sensor configuration on BGC floats as well as decisions by the IADMT, of which AOML is a major contributing partner, are the main reasons for changes to existing software and the development of new software.

Updating the procedure for calculating real time salinity adjustment in Argo profiles to make use of the latest calibration information provided in the scientific calibration fields of the Delayed-mode profile files. These are stored in dedicated files for use during adjustment of the salinity in R-mode profile and trajectory files. For deep Argo floats the calculation adjusted salinity was updated to include CPcor correction. Additional adaptations for salinity adjustments were added that are specific to floats with RBR CTDs. These required adding the quality control test26 for TEMP_CNDC. The main change was the need to apply a Thermal Inertia Correction for RBR floats. This development is currently undergoing testing and will be operational in October 2023.

A decoder was developed in collaboration with JPL for their float deployed near Greenlands These floats are APEX SBD that send their data in the Teledyne format. Teledyne granted permission to revise their source code to facilitate this development. Adaptations to the real time qc/netcdf software were implemented to allow for end-to-end processing of these data.

Floats found new ways to break the procedures for adding interpolated positions when a profile has no position fix. The procedures were updated to handle the unusual cases correctly. This included updates to the speed check.

Metadata improvements were implemented. One of these involved setting up a system for adding the pre-deployment calibration information to the meta.nc files. The other was related to improving how STATION_PARAMETERS and PARAMETER fields were completed for the core & BGC profile files.

The trajectory NetCDF file format version 3.2 has been defined in user manual 3.41 (July 2021). Adaptations for writing trajectory files in format 3.2 (in this format core and BGC data are in the same file) were completed in September 2022 and the updated code was activated in March 2023 (once the GDAC format checker had been updated to accept the files). Doing this required adaptations to our decoders, especially for adding air oxygen data from different oxygen sensors (SBE83 and Aanderaa Optode) to the trajectory files for APEX/NAVIS floats. Depending on the float type, the development was completed in the March-April time frame. Another improvement for these types of floats included decoding the number of CTD samples used during bin-averaging. All these data are already added for new floats. Reprocessing old floats with such data is ongoing.

Real time pressure adjustment and salinity adjustment were added to the code generating the traj.nc file. Revisions to this code were started to apply grey list flag th the data in traj.nc file.

BGC profile related changes include: Adding the QC Range tests for radiance, irradiance, and PAR (January 2023). In February 2023, Solar Angle checking for revised QC procedures for CHLA were written. Most of the Nitrate QC tests were added to the quality control software in the spring of 2023.

In March the DAC also adapted how CHLA_ADJUSTED fields were updated and filled based on the currently approved QC manual. The DAC developed a processing system for a new float type, NAVISIR, that required changes to the meta files that control how data are processed, the decoding system and a qc/netcdf software. A new temperature module called getTRUE_SUNAtemp, unique to SUNA nitrate sensors, was implemented to account for differences in the measurement delay of the SUNA sensor and the CTD sensor. A challenge was that the direction of profiles written to the data files depends on the data set.

Development of a decoder for SOLO BGC processing for CHLA, BBP, CDOM, pH, NO3, irradiance and PAR is close to completion in preparation for floats to be deployed by PMEL (expect first deployment in January 2024). Adaptations to the qc/netcdf software will be done as needed to accommodate the created data files.

The AOML DAC and AOML BGC D-mode operators are working together to develop a system to apply Sage and Sage-O2 determined adjustments in real-time to produce A-mode data. This system will also be used for PMEL floats and can be used for floats from other teams (if necessary with adaptations to the code).

2. Delayed Mode QC status

The US Argo DAC receives the Delay mode Argo profiles from US delayed-mode operators and verifies their contents to ensure soundness of the files if requested.

Each US Argo institution has provided information on their delayed-mode processing which was added to this report.

NOAA/AOML

AOML set up the delayed-mode processing system for core data based on OWC and a GUI from SIO. The reference database was expanded to cover the Gulf of Mexico where our floats are with the help of Christine Coatanoan from France. So far three floats (150 profiles) in the Gulf of

Mexico have been DMQC'd. All these are quite young and had good data that did not need adjustment and no flagging needed to be done during visual QC.

AOML's BGC group has implemented Sage-O2 and Sage for DOXY, nitrate, and pH corrections to their Apex and Navis BGC data. Code has been developed to use alongside Sage-O2 to utilize the in-air data collected by Apex floats to make in-air rather than WOA corrections. AOML continues to develop scripts to translate DMQC data into GDAC accepted bd files. DOXY data for AOML's floats have been submitted and accepted to the GDAC. Work is underway to write DMQC'd nitrate and pH data to these bd files. AOML has not begun deeply exploring the DMQC tools created by EuroArgo for chl-a corrections, but plans to do this over the coming year.

NOAA/PMEL

According to OceanOps, as of 28 September 2023, PMEL had 225,617 D-files at the GDAC and 50,495 profiles pending for DMQC, and so was at ~82% of the Argo target for DMQC. Last year, on 28 November 2022, PMEL had an estimated 214,525 D-files at the GDAC and 46,025 pending for DMQC, and so was also at ~82% of the Argo target for DMQC. The PMEL DMQC team's efforts since last year's report resulted in a net increase of ~11,902 DMQC profiles, which is not quite as many as the ~13,127 PMEL real-time profiles that came in during that time period, but is more than the ~7,975 DMQC profiles added during the previous reporting period. In the past year, Kristy McTaggart has been occupied by GO-SHIP work and John Lyman by a product development project, which diminished the amount of DMQC work that they could do. A focus on difficult cases identified by automated checking also slowed progress. In May 2023 Hristina Hristova was hired to work part-time on PMEL Argo DMQC. Her addition to the PMEL Argo team, in addition to the continued DMQC work by Lyman and McTaggart, should begin to clear this backlog in the next year.

The PMEL float DMQC procedure currently consists of the following steps: We perform an automated correction, with visual check, of reported pressure drifts and correction for the effect of these pressure drifts on salinity, as well as an automated correction of conductivity cell thermal lag errors following Johnson et al. (2007). For deep floats, we also make estimations of the conductivity cell compressibility coefficients, subject to availability of reference data, and use it or (in the absence of sufficient reference data) the agreed upon nominal coefficient for SBE61 CTDs. We do visual inspection and modification of quality control flags for adjusted pressure, temperature, and salinity using the SIO GUI and the Lyman GUI. We overwrite the raw Param_QC flags during this step as required. We use OWC Version1.1, currently with CTD (CTD_2021v2) and Argo (2021v03) reference databases, and adjust run parameters to get appropriate recommended salinity adjustments. Errors in OWC are computed directly from the least squares fit. We accept or reject the OWC recommendations on the basis of comparison with nearly historical profiles using a PMEL GUI written for this step.

Scripps Institution of Oceanography (SIO)

Scripps Institution of Oceanography (SIO) has evaluated, as part of delayed-mode quality control (DMQC), a total of 363,989 Argo stations (profiles). This is an increase of 28,989 stations (794 nominal float years) since the previous Argo Data Management Team (ADMT) Report (November 2022). This count represents 98.6% of the SIO DMQC-eligible stations (older than 12 months). The above numbers include SIO Core, BGC, and Deep Argo floats and all Argo New Zealand floats for which SIO does DMQC.

SIO expects to maintain a high DMQC completion percentage during the coming year and will continue with a 7-9 month revisit schedule. Annie Wong has joined the SIO DM group allowing this goal to be achievable. Over the past year, SIO has nearly returned to our historical DMQC completion level. The DMQC backlog of SIO's Deep SOLO floats is much improved from last year, with only the Southern Ocean pilot array remaining to update. The consensus standard DMQC procedures for SOLO/SOLOII/BGC/Deep profile data were continued in 2021.

Although not a DMQC metric, the timeliness of SIO real time Iridium data arrival at the GDAC is dependent on the initial parsing of the data received by the float done by the SIO PI group. Timeliness this year has been good. SIO profile data collected between 1 Jan 2023 and 02 Oct 2023 reached the GDAC within 24 hours 99.4% of the time, and 94.2% of the time within 6 hours. The month of best performance was in July with on time arrival percentages of 99.9%/97.6%. There were no hardware issues of note for Core data during the year, although a transition to a new computer at SIO has led to some delay in BGC profile netCDF file creation. The above timeliness calculation used the float surfacing time, so the temporal span includes the time of transmission, SIO SBD/directIP processing, and AOML DAC netCDF creation.

The transition to the Dtraj V3.2 netCDF has been completed for the 6-sensor BGC SOLO floats. Utilizing the new V3.2 for SIO's Core Dtraj files will continue to be considered. However, at this point in time it is not a priority.

SIO deployed in 2023 a single RBR equipped SOLOII, with an older RBR sensor (prior to new calibration done by manufacturer). The integration of the updated RBR CTD sensor onto the SOLOII remains a goal for SIO. In the previous 2 years, SIO has ordered 5 RBR sensors each year. However development of the SOLOII with RBR CTD has been slowed due to IDG (Instrument Development Group) personnel changes as well as other SIO priorities which took precedence.

University of Washington

The total number of real-time profiles (R-files) recorded by active UW floats (n = 690) during the 2023 reporting period (January 1 through September 22) was 14,980. The total number of profiles processed in delayed mode (i.e., D-files) from the UW fleet was 27,383, of which, 13,037 were either reprocessed from currently existing D-files (reprocessing is necessary when calibrations are updated or changed) or processed from R-files that were written before 2023 and were missed during previous reporting periods. A total of 14,346 "new" D-files were written in 2023; thus, 96% of R-files written in 2023 have been processed in delayed mode.

Floats associated with the SOCCOM program recorded 2,755 new profiles, of which 2,200 (~80%) have been processed in delayed mode. The total number of D-files written in 2023 was 4,729 (includes new and reprocessed D-files).

Floats associated with the GO-BGC program recorded 2,236 new profiles, of which 2,003 (~90%) have been processed in delayed mode. The total number of D-files written in 2023 was 2,957 (includes new and reprocessed D-files).

In addition, a total of 529 dissolved oxygen profiles were acquired from 16 floats during the reporting period. These profiles were recorded by floats equipped with Aanderaa 4330 optodes and are not processed by the Monterey Bay Aquarium Research Institute. These floats are separate from the SOCCOM and GO-BGC programs. All of these newly-recorded profiles have been processed in delayed mode and an additional 2,653 files were reprocessed after associated calibration coefficients (i.e., gain values) were updated. It is common practice to update all existing, delayed-mode files with newly calculated gain values.

In addition to the UW floats, 2,436 profiles recorded by 24 "orphan" floats that are not officially assigned to any specific institution for processing, were processed in delayed mode.

MBARI (Monterey Bay Aquarium Research Institute)

Biogeochemical data from 303 operational five- or six-sensor BGC-Argo floats are currently being processed and subjected to real-time and delayed-mode quality control by the Monterey Bay Aquarium Research Institute (MBARI). This includes 138 active SOCCOM floats in the Southern Ocean, 125 active floats deployed as part of the Global Ocean Biogeochemistry (GO-BGC) array, and 40 active "SOCCOM-equivalent" partner floats in various locations. The majority of these are five-sensor BGC floats, although six-sensor BGC deployments are increasing, with seven deployed thus far under MBARI management throughout the Pacific and Indian Ocean. The MBARI data management team includes Tanya Maurer, Josh Plant, Emily Clark, and recently hired, Nicola Guisewhite.

A total of 78 BGC-floats managed at MBARI have been deployed throughout 2023. 43 of these were GO-BGC floats deployed across 13 different cruises, and 35 were SOCCOM floats deployed across six cruises. These deployments included 46 APEX and 32 Navis. MBARI has also been involved in the processing and management of data from various test-floats within the past year, including two five-sensor APEX floats with SBS83 oxygen optode (a new SBS design capable of in-air sampling), three six-sensor APEX with OCR504, and two five-sensor APEX with FLBBFL (a three-channel bio-optical unit that includes BBP at 700nm, as well as CHLA at both 435nm and 470nm excitation). Additionally, in collaboration with other US institutions, MBARI has assisted with the monitoring of two recent test-deployments of the SBS Nautilus. Assessment of sensor and data performance on this new BGC- profiling float platform is ongoing.

BR- files are being generated and transferred to the Argo GDACs for all 5- and 6- sensor operational floats managed by MBARI at a frequency of four times per day. Since January, 2023, over 6,000 B-files have been submitted to the GDAC, including over 4,700 BD-files. Delayed-mode (DM) quality control assessment of oxygen, pH and nitrate data is performed multiple times per year. BD-designated files generated at MBARI signify that at least a preliminary DM assessment has been performed, although BD* files are subject to updates periodically throughout a float's life. MBARI-developed MATLAB software used to perform BGC DM assessment is publically available through the SOCCOM Github at https://github.com/SOCCOM-BGCArgo/ARGO_PROCESSING and methods are described in Maurer et al (2021), https://doi.org/10.3389/fmars.2021.683207.

MBARI continues to generate a semi-annual audit on DOXY profiles to assist DACs with furthering the amount of adjusted DOXY data at the GDAC. Work is ongoing and international response to this audit has been positive thus far (information on the audit can be found on the MBARI ftp: https://ftp.mbari.org/pub/BGC_argo_audits/DOXY/).

An updated temperature correction for NITRATE was recently developed at MBARI which improves the accuracy of processed nitrate, particularly in surface waters in regions where temperatures are well beyond the sensor calibration temperature. A manuscript describing this method was recently published in to L&O methods (Plant et al, 2023; https://doi.org/10.1002/lom3.10566) and the method was subsequently added to the Argo processing document for nitrate (https://doi.org/10.13155/46121) as a replacement to the earlier Sakamoto et al (2009) correction. Additionally, documentation outlining processing methods for PH_IN_SITU_TOTAL was enhanced this year by the MBARI team and this document is also now publicly available (https://doi.org/10.13155/57195).

MBARI continually supports the ADMT. Tanya Maurer serves as co-chair of the BGC-ADMT task team and the MBARI data team members remain active in various ADMT working groups focused on various BGC parameter topics. MBARI played a key role in organizing the first BGC DMQC workshop in January, 2023 in Villefranche Sur Mer, France. Along with other international DAC representatives, the MBARI Argo data management team continues to strive toward the common goal of improving the standardization, usability and utility of BGC-Argo data.

Wood Hole Oceanographic Institution (WHOI)

WHOI Argo data management report covering the time period Oct 1, 2022 thru Sep 30, 2023. During this time, the WHOI Argo group deployed 94 floats. Of these there were 71 MRV S2A, 19 Navis-BGC, 3 MRV Deep Solo (for Deep Madagascar Basin Experiment) and 1 MRV-RBR Alto.

The size of the standing fleet averaged about 450 platforms. There are currently 273693 profiles reported to the GDAC, of which 255999 are eligible for DMQC. Of the eligible profiles, 94.5% have completed DMQC. WHOI maintains two instances of our real-time telemetry decoder. The first operates on a server in Woods Hole while the second backup server operates in the cloud.

Both of these servers are configured to submit data to the primary AOML DAC as well as the DAC's backup server. This system provides redundancy which has been exercised several times in the past year with good success as we have managed to maintain data flow despite numerous downtime events of the primary servers at WHOI and AOML.

Deb West-Mack continues significant progress in development of protocols and software for performing DMQC on trajectory files. Other contributions to Argo data management include Global audits of salinity drift of each individual CTD (https//argo.whoi.edu/argo/sbedrift_wmo/) and global maps of fleet coverage (https://argo.whoi.edu/argo/maps/sparse)

3. Value Added items

University of Washington

A manuscript summarizing physical and biogeochemical data recorded from floats deployed in the Argentine Basin was recently published in JGR Oceans:

Alkire, M.B. and S. Riser (2023). Net community production in the Argentine Basin estimated from nitrate drawdown using biogeochemical Argo floats, *J. Geophys. Res. Oceans,* **128**: https://doi.org/10.1029/2023JC019858.

Scripps Institution of Oceanography

SIO continues to maintain the Argo Program website (https://argo.ucsd.edu) as well as the local Scripps float webpage which contains info/engineering/DM status of the Scripps float fleet (https://sio-argo.ucsd.edu).

SIO has actively participated in expanding the scientific application of Argo data. One example of this is the work of Nathalie Zilberman and Megan Scanderbeg who have been exploring the feasibility of adding Argo float bottom hits to the data incorporated into the creation bathymetric maps.

Value added efforts at Scripps have been crucial for incrementally improving the Argo data set. John Gilson updates on a yearly basis the Argo Climatology Dataset (ARGO_IN_OWC) used for OWC salinity calibration. Annie Wong updated and distributed her DMQC salinity audit of the global Argo salinity dataset. Annie Wong has also been very active in updating the Argo QC manuals to the latest best practice.

Float and sensor improvements are critical to the Argo Program. Nathalie Zilberman, Dean Roemmich, and IDG have continued to assess the quality of the Keller pressure sensor for eventual use in Deep Argo. Over this year, Sarah Purkey has assisted the transition of the IDG developed BGC SOLO to commercial release by MRV Systems. This will crucially diversify the available choice of BGC Argo floats.

John Gilson has continued to release monthly updates to the RG Climatology Argo product that is openly available to aid scientists in their research. Nathalie Zilberman and Megan Scanderbeg led the development of an Argo level-of- known-motion research product based on Argo data (Scripps Argo Trajectory-Based Velocity Product). Both of the above are available through the official Argo 'products' website (https://argo.ucsd.edu/data/argo-data-products).

4. GDAC Functions

US GDAC is up and running. Details will presented during ADMT24

5. Regional Centre Functions

Not applicable

6. Other Issues

Nothing to report