part of the integrated global observation strategy

# 20th ARGO DATA MANAGEMENT MEETING

Villefranche-sur-mer

16th October – 18th October 2019

Version 3

6th January 2020

## TABLE OF CONTENTS

# 1 Objectives of the meeting

The 20th ADMT meeting was hosted by IMEV in Villefranche-sur-Mer, France. It started at 8h30 on the 16th October and finished at 13h00 on the 18th October. 90 people from 12 countries and 30 institutes participated in the meeting.

The objectives that had been fixed for the meeting were the following:

- *Review the actions decided at the 19th ADMT meeting and progress made since last year*
- *Feedback from monitoring the quality of Argo float data processing in Real time and Delayed mode*
- *Discuss ways to improve real time and delayed mode data quality and identification and notification of sensor problems*
- *Review Regional Argo Data Centre progress*
- *Report from 8th Bio-Argo Workshop*

**Welcome address:** *Rodolphe Lemée, LOV Director*

R Lemée, Director of the LOV opened the 20th ADMT meeting. He presented the marine stations of Sorbonne University, the IMEV (Marine Institute of Villefranche-sur-mer) institute and the LOV laboratory missions. He pointed out the specificity of the Villefranche-sur-mer site with no continental shelf and a long history of experience in ocean observing system development, observation processing for biology and biogeochemistry scientific applications. He then focussed on the OMTAM (Marine Optique, Remote Sensing and Biogeochemical applications) laboratory which plays a lead role in the development of BGC-Argo network at French, European and international levels from BGC-float technological development to network design and data management.

# 2 Feedback from 20th AST meeting : B. King, B. Owens, T. Suga, S. Wijffels (30mn )

Argo has undergone several major advances over the last two years: IOC approval of the 6 BGC parameters; ongoing successful pilot arrays for BGC and Deep; a new design: “Argo beyond 2020”.

Argo beyond 2020 envisages a single full-depth, global, multidisciplinary array. This array will serve the needs of the Core, BGC and Deep Missions. This design was discussed at the 6th Argo Science Workshop in Japan in Oct 2018, in the OceanObs19 CWP, and was approved by AST-20 in China. The design of the Core mission in the single Argo array will be augmented by extensions to higher latitude and with enhanced measurement density proposed in the tropics and in western boundary regions. In order to be most cost effective, the BGC and Deep missions will each need to contribute about 25% of the total Argo array (around 1000 floats each), with the total array expanding to 4000 floats to include the Core extensions. BGC and Deep floats will need to deliver Core mission measurements as well as the measurements for the BGC and Deep missions.

The BGC and Deep missions, and the Core enhancements, are not yet fully funded, and there are still technical challenges for each mission to overcome. In order to see these implemented, we must continue to make a compelling case, pursue efficient implementation and entrain new partners. There will be a joint workshop with OceanPredict at AST-21.

To clarify the leadership and governance of Argo beyond 2020, A Deep Argo Mission Team is being established, alongside the already-existing BGC Argo Team, with terms of reference to advance the design and implementation of Deep Argo. The AST retains responsibility for the implementation of the Core mission.

**New parameters or sensors**: Argo has continued to refine the framework for new parameters to enter the Argo missions and data system. The framework envisages a progression between stages: (1) a few floats which are Marine

Scientific Research and are outside Argo (2) Pilot arrays of between a few floats to a few hundred floats. To be included in Argo at this stage, there should be a compelling global design and a solid implementation plan. All such floats must be notified via the AIC, and all data must be published. New variables or sensors not recognised by the Argo data system should be published in the aux directories, until the AST and ADMT agree that the data system should be expanded to include the new measurements. (3) global implementation, with the Argo data system enhanced to accept new measurements.

**Sensor issues**: There is evidence of cohorts of SBE41s showing drifts to higher salinity, see J Gilson's analysis. This highlights the need to continue to be vigilant in DMQC. Analysis of Deep SBE61 data has exposed a correctable bias in deep salinity data attributed to Cpcor which may also be present in 4000m SBE41 data. There is task team working to discover whether there could be any implication for the 2000m dataset. Much has been learned about the RBR CTD from ship- and some float-based deployments. Stronger participation from national programs is needed to develop larger pilot deployments of this sensor.

**Data format**: The transition to data format v3.1, and checking of format compliance at the GDACs, has been a tough exercise, but has resulted in a major improvement in data utility and consistency for users. The findability, accessibility and usability of Argo data are essential for Argo's success. Argo was used as an example of "best practice" many times at OceanObs19, and this depends utterly on the hard work of everyone involved in the data system: ADMT, GDACs, RT and DM experts. Well done to everyone.

## 3 Feedback on Argo Visualization Workshop and do-a-thon *(S. Diggs, M. Belbéoch, M. Scanderbeg) (20mn)*

About 30 people attended the Argo Visualization Workshop and do-a-thon. The first part of the meeting was a review of existing Argo visualization websites and it was good to see a variety of target audiences and approaches. During the afternoon session, there was some general discussion about how to move these visualizations forward in a more collaborative framework. Three working groups were formed for the do-a-thon portion of the meeting: technical solutions, continuing infrastructure and communications, and creating a data and app guide. At the end of the workshop, the three groups reported back with results and feedback. Some initial feedback is data services at the GDACs need improvement and the Coriolis team is working on this. Additionally, there is a strong need for an overall guide for data access, data display on websites and APIs. A data users survey would be helpful to provide guidance on needs and to help establish priorities on what to develop first. There was an identified need to serve gridded datasets and to adopt social media best practices. Finally, the workshop attendees identified four layers of digital engagement: social media, scientific outreach media, Argo viewing services, and technical dashboards.

Action items from the meeting include forming a proposal for a new working group that reports to the AST and the ADMT with the focus on data visualization, technical exchange and outreach. There will be a mailing list set up for API developers and users to share information, feedback and questions. There will be a teleconference prior to AST to check in with the group and get feedback on progress to present at the AST-21 meeting. As stated previously, a data guide and access web page will be improved/added to the AST website. In terms of IT development, two action items were made: one to develop a catalogue of APIs and their functionalities and to construct and maintain a GitHub repository.

## 4 Feedback on 8th BGC-Argo Workshop

The BGC data management task team has been created in 2019 with its terms of reference. A first visio conference took place in September 2019. There are new BGC data managers at CSIRO, WHOI, UW and AOML and a DM operator position is open at the LOV.

The definition of the "R","A" and "D" for BGC has been presented and accepted, some paragraphs describing the differences between "core" and "BGC" definitions are written and will be added in the Argo user manual and in the BGC quality control documentation.

There is an urgent need to increase the number of profiles that have been quality controlled and adjusted in the data system and to flag all the bad profiles. All the PIs that have published data should consider sending their DM data to

the DACs. Hopefully several DACS have started to push ADJUSTED data into the DACS mainly for (NITRATE, pH and DOXY).

Parameters processing:

- The metadata should be consistent across DACs and filled properly according to the documentation.
- The processing of the NITRATE concentration has been changed to take into account the temperature effect. The NITRATE concentration will be reprocessed when needed and the documentation updated
- We should collect the sensor revisions for the pH and expand ref table 27 to track the different versions as there are strong differences between each revision.

QC and adjustment:

- The QC documentation has been published for radiometry and the implementation is ongoing work. A DM test is being investigated for the temperature effect.
- The NITRATE quality control documentation is almost done and should be applied by all DACs.
- A RTQC test is proposed and accepted for CHLA on the solar angle to remove the quenching correction for night profiles.
- A RTQC test is proposed and accepted for DOXY to detect the biofouled profiles based on the saturation. An automated gain adjustment is proposed for DOXY, based on the O2% saturation at surface. MBARI proposes to calculate the gain factor, provide the others DACs with this estimation and identify in a quarterly report the dubious profiles.
- Decision trees explaining the interdependence between parameters and their QC and errors will be finalized and added to the documentation to help DACS and DM operators.
- A DMQC group to investigate the slope of the CHLA has been created
- A DMQC group to estimate the BBP uncertainty has been created
- All the QC documentations will be updated and profiles reprocessed when needed according to the previous recommendations.

A more detailed 8th BGC-ARGO meeting report will be made available at http://www.argodatamgt.org/Data-Mgt-Team/Meetings-and-reports

Action item: Add definition of R/A/D for BGC data into the User Manual and on Argo websites

# 5 Status of Argo Program and link with Users (1h15)

*Status on the actions 1, 2, 3, 5, 27*

## 5.1 Review of the Action from last ADMT (M. Scanderbeg) Action 1, 2 (20 mn)

Of the 46 Action Items from ADMT-19, 24 were completed, 17 remain in progress and 3 were not done. The ones in progress have been updated and carried onto the Action Items from ADMT-20. Of the three that were not done, there are plans to modify one of them and to keep the other two on the list for this year. The one to be modified is the one pertaining to a best practices paper. Instead of aiming for a peer-reviewed publication, the ADMT has chosen to draw upon current best practice documents like the various Cookbooks and to create new ones as needed related to things like float deployment, sensor storage and preparation, etc. The idea is that these documents will be kept on a webpage accessible to all. One of the two action items kept open until next year is the one asking Tim Boyer and Mathieu Belbeoch to work together to try and see if the Argo GDACs can be issued invitations to join the Marine Climate Data System. The second delayed action item is the one asking Mathieu Belbeoch to track DM operators by parameter in the AIC. Finally, one Action Item that remains in progress is related to adding the WIGOS-ID into the Argo metafile and BUFR template. It was agreed that this was important, but more specification was needed prior to asking DACs to re-write the metafiles.

Action item: Work on collecting Best Practices information for core Argo on float deployment, float storage, data practices, etc. and first step make it available on WWW page

Action item: Ask T. Boyer and M. Belbeoch to work together on finding a way to include Argo GDACs as part of the Marine Climate Data System.

Action item: Ask Mathieu to specify what is needed to add the WIGOS-ID in the Argo metafile and BUFR template

## *5.2 Argo Status* + Real-time Monitoring

Mathieu Belbéoch recalled the Argo vision for a new integrated array, global full depth and multidisciplinary which needed refining (Arctic area e.g.), promotion and a substantial funding increase to be completed and sustained.

However, the Argo reality is challenging. The global array shows the first signs of decrease. In this time of stretched resources, flat funding, and environmental concerns, Argo teams should maximize the value of each single float. Float reliability is improving but the 250+ cycles target should be the norm.

He presented the status of the array using the usual performance indicators on activity, intensity of deployments, and spatial coverage. A decreasing trend is anticipated as the number of floats deployed in the last 12 months (intensity) is too low to sustain the array. The Atlantic Ocean still shows a misbalance between the North (excess of 120 units) and South (deficit of 35 units) but has improved. The Indian Ocean, and Southwest Pacific Oceans have a low intensity. The Southern Ocean status is improving but is still only half implemented. Its spatial coverage is decreasing despite a reasonable intensity, showing potentially a lack of proper deployment opportunities.

Float reliability has improved in the last year in particular for the early cycle failures. But only 60% of the floats reach 150 cycles (and 45% for 200). A closer look to recent float models shows some positive trends with survival rates.

M. Belbeoch recalled that for the last two years, NKE was the top float manufacturer in terms of number of units deployed every year and invited the community to join the technical workshop to be held in Brest in January 2020 to keep improving the technology and practices. He remarked that for the first time ever, the US contribution was decreasing, while some other AST members were increasing (e.g. Japan).

The Argo real-time data flow has progressed but still show 80 pending floats (vs 150 last year) not distributing any data. The overall data volume distributed every month is decreasing.

Delays are rather good with a median below 4 hours. 96% of data reached GDACs in 24h and 75% before 6 hours. However, a few DACs still have some room for progress in India and Rep. of Korea.

He concluded by recalling that the real-time data production was a top priority and needed to be secured and grown via a strengthening of the national DACs.

Action item: Suggest ARCs interact with AST on the network implementation aspects and review their Terms of Reference

Action item: Encourage deployment planning coordination at AST, especially in areas that seem over-sampled in the AIC report, or are targeted as pilot areas for DEEP or BGC

### 5.3 Interactions with modelling community

The Argo Steering Team recognises the importance of engaging more closely with the modelling communities and is planning a joint Argo / OceanPredict workshop alongside the AST-21 meeting in 2020. The modelling community use Argo data to initialize forecasts and to constrain reanalyses; and they are an important end-user who provide a window to a broad user group (both researchers and industry). Peter Oke initiated a survey of the GODAE OceanView community, asking questions about data access, data use, and data requirements. Fourteen groups responded, providing reasonable representation of the GODAE OceanView and CLIVAR GSOP communities. All respondents perform forecasts, most perform reanalyses, and most regularly perform observing system experiments. Most forecast groups access data at least once a day. Possibly the most interesting finding from the survey is that forecasting groups tend to access data from the GTS and from community databases (e.g., Copernicus, EN4) – and only two groups access data directly from the GDACs. Forecast groups tend to assume data have much larger error than the instrument error - between 10 and 100 times larger than the target error established by Argo. Additionally, forecast groups don't rigorously use QC flags, and don't always update D-files before performing new reanalyses. There is some work to do to help the modelling community use Argo data appropriately.

Action item: Next year an Ocean-Predict and Argo side to the AST meeting in Southampton. Important to have data people to attend

Action item: Communicate that it isn't necessary for operational centers to use greylist since QC flag information is available in BUFR msgs.

### 5.4 Euro-Argo-RISE and ENVRI-FAIR EU projects how they will contribute to the ADMT activities

S Pouliquen presented the data management activities that will be carried on within two European projects that started in January 2019 and will last 4 years. Some of the activities continue ones started within the MOCCA EU project that will last until June 2020

The activities are first related to the improvement of RTQC and DMQC methods for the core mission, high latitudes, marginal seas where floats operate in shallower waters and BGC Argo. A second axis of development is related to setting up a collaborative environment for tools used in core/Deep/BGC components in order to help new Euro-Argo partners to develop their expertise. The third axis is related to enhancing the FAIRness of the Argo data system by implementing FAIR Services like the Argo vocabulary Service using BODC NVS and the robust API from the French GDAC that will enhance machine to machine access and foster interoperability within other GOOS network systems.

She also highlighted that ADMT meetings are key milestones for these projects:

- proposed enhancements will be presented to ADMT
- adjustments will be made to take into account feedback from ADMT
- methodologies will be shared with Argo community

Already at ADMT-20 the following progress and proposals result from these 3 projects:

- Prototype of new Coriolis GDAC viewing and subsetting service + API, Euro-Argo Dashboard for float monitoring (do-a-thon workshop)
- DMQC for Oxygen (BGC DM meeting)
- BODC Vocab progress (ADMT)
- SO-ARC plan + NA-ARC and MED-BS ARC activities (ADMT)
- Using MinMAx climatology in RT tests (ADMT)
- How to propagate QC in param_adjusted in case of offset (ADMT)

The ADMT team showed interest in the proposed activities and are keen to interact with Euro-Argo to progress on the proposed activities.

## 6 Real Time Data Management (2h15)

*Status on the actions 4, 6, 8 - 12*

### 6.1 GTS status (Anh Tran) (15mn)

Argo Canada Data Acquisition Center continues monitoring the performance of Argo data on the Global Telecommunication System (GTS). The GTS data sources were obtained from Environment and Climate Change Canada, and Japan Meteorological Agency. Between September 2018 to September 2019, on average, 13614 temperature and salinity profiles were transmitted on the GTS in Binary Universal Form for the Representation of meteorological data (BUFR), and 91% of the data were on the GTS within 24 hours of the float's surfacing. As of July 2019, Argo is no longer transmitting any data in the TESAC format.

If Argo changes timeliness target from 24 to 6 hours, 72% of Argo data will meet the 6 hours target. However, only 41% of Argos float profiles will meet the 6 hour target. At the ADMT-20 meeting, the team has agreed to reduce the timeliness target from 24 to 12 hours for floats transmitting data using the Iridium satellite. Hence, the team asked data acquisition centers to increase its frequency of data processing. BODC and JMA are working on reducing their delay. INCOIS stated that for Argos floats, they wait 18 hours before starting the processing to allow time for all Argos messages to be received. It was noted that this time period could be reduced to 12 hours which would help improve delays.

Action item : Change our data delivery target to 12 hours. Ask A. Tran to monitor delivery on GTS in 6 and 12 hours for both Iridium/Beidou and Argos and to monitor O2 data delivery by DAC. Send message to operational users through websites, Argo-OceanPredict Workshop, etc.

### 6.2 Status of anomalies at GDAC (Christine Coatanoan) Action7 (15mn)

Christine Coatanoan reported on the anomalies detected on the GDACs. First, she described the changes in the procedure to detect anomalies since the last ADMT. The MinMax climatology method is now used instead of the objective analysis which needs more adjustments and the MinMax method has proven it can identify floats with suspicious early salinity drift. For the past several months, the report has been upgraded with a focus in first pages on a table with drift observed on floats and statistics on files and format. Message concatenation has been removed since they can be loaded from the ftp site. New updates on the message have been applied to take into account the N_PROF and level_immersion. Those updates have been applied since the July messages.

For each DAC, statistics have been displayed and specific problems for some DACs have been presented. In 2019, on average each month, less than 500 profiles are reported as bad to the DACs. In months May, June and July 2019, a large increase of anomalies has been observed and it is due to the feedback from CORA (the Coriolis ReAnalysis product). In September, some increases can also be observed due to the new spike test implemented in the Coriolis quality control procedure.

Finally, statistics on the missing NeCDF files for each DAC have been presented. For some, trajectory files are missing. Technical files are also missing. The DACs have to recover these files when possible.

All this information can be found in the report sent monthly to the mailing lists: argo-dm & argo-dm-dm. This report is also available on the Coriolis GDAC ftp site.

Action item: Ask DACs to review the list of missing netCDF files from Coriolis monthly anomaly report. Please provide feedback to Christine Coatanoan if there is a reason for the file not appearing so that it will be removed from future reports.

### *6.3* Status on Anomalies detected with Altimetry *(Nathalie Verbrugge) (15mn)*

The Dynamic height anomalies (DHA) from the Argo T/S profiles are compared each quarter to the co-localized sea level anomalies (SLA) from altimetry in order to identify anomalies in the floats' measurements. Several examples of floats in alert since January 2019 with a greylist tag are shown and it is reminded that these floats need to be treated in priority. It is decided that they have to be 1) put on the greylist as soon as possible; 2) analyzed by DMQC-operators in a second step if it is not possible to do it quickly. The greylist tag identifies possible T/S drifts. Feedback from operators when analysis/corrections are done is also required.

Global statistics on the entire floats database are also computed each year. In September 2019, these statistics (rms of the differences between SLA and DHA) are improved in comparison with the analyses done from 2015 to 2018 due to more dmoded floats this year. The analysis of the amplitude of the adjustments done on the salinity and pressure doesn't indicate any change in comparison with the previous years and so remains satisfactory.

Action item: Ask DACs to review floats on satellite altimetry comparison list and provide feedback to Nathalie Verbrugge through the JCOMMOPS website. If suggestion is to add to greylist, please review this quickly as these are large errors that are detected and should be removed from the data system rapidly. It can detect when floats begin to show high salinity drift.

### *6.4* Feedback on improving spike tests *(D. Dobler) Action 6 (15mn)*

Two new spike test designs were presented during the previous ADMT : AIC5 based upon a modified Akaïke criterion and MedStd based upon a sliding median and a sliding standard deviation. They were very promising but unfortunately, they did not pass robustness tests successfully for the purpose of running them automatically in real time.

A new test design has been built called the MEDD test, MED standing for MEDian and D standing for Distance. This new test is based upon three main steps. The first step is the computation of a sliding median but with some improvements. The median sliding windows are expressed in terms of pressure range and some points are discarded from the median computation if they crossover the maximum allowed for the gradient value. The second step is to compute thresholds located at a « relative 2D distance » to the median. This is a two-dimension (2D) distance because the computed thresholds are at least at distance d from every points of the median curve (in the sense of a distance in the x,z plane). This is a relative distance because axes are non-dimensionalized. For the x axis, it is non-dimensionalized by the range of values taken by the parameter and for the z axis, by a fixed value of 700 dbar. Doing so, the units of d can be thought as a percentage of the « observed » window. The third step is to apply this method not

only to the parameter itself (temperature or salinity) but also on the density. The reason for that is because some features can look like a spike but in fact they are real geophysical processes that are simply undersampled. And in this particular case, the density will not be affected by a spike. This is the reason why, for the purpose of automatic procedure, it has been chosen to consider that there is spike on a parameter (salinity or temperature) if the thresholds are exceeded both for the parameter itself and for the density.

This new design has been undergoing robustness tests. The method has been run on all the Delayed Mode primary profiles available on the GDAC with at least 5 measurement points and with a global QC in {A,B,C,D}. E and F profiles (which means more than 75% bad measurements) have been discarded as they are beyond the scope of a spike test. This leaves us with an amount of 1.4 million of salinity profiles and 1.45 million of temperature profiles. A spike detection is considered as good if the QC for the raw value is 3 or 4 or if the QC for the adjusted value is 4 or if the QC of the pressure is 4. This choice was made to take into account all kind of habits seen in QC settings in delayed mode process.

The results of the robustness tests have shown that MEDD raises twice as many alerts (75000) as the actual spike and gradient test together (36500) with a configuration that allows a 98% rate of robustness (number of good alerts compared to total number of alert). The remaining bad alerts are due mainly to two features: a too high number of bad points leading the median to follow these bad points and the first good points to be wrongly detected or a temperature reversal at high latitudes with a missing density. Noteworthy, 85 % of spikes that are detected by the actual RTQC spike test are still detected by the MEDD method. The 15 % that are not detected concerns mainly hedgehog profiles with spiky pressure values that have not been tackled here or spikes in the halo or thermoclines that are inside the relative 2D distance and that cannot be detected by construction of the MEDD method. Interestingly, the results have also shown that the actual RTQC spike test reached 98% of robustness which was not expected, and that the gradient test was far less robust with a 70% rate of good alerts. This might be caused by the fact that gradient test supposes that the spike test has removed all big spikes which is not true.

This method has also been run on real-time profiles (1.11 million profiles temperature and salinity together). The results tendency is kept. Alerts raised by the method have been visualised and qualified in the Coriolis database. Messages have been sent automatically via .csv files broadcast. This represents some 784 alerts for delayed mode and 6890 alerts for real-time. As always, some improvements can still be done to reduce bad detections and to increase performances (which may be evaluated in a future version) but this first version is ready to use. The MEDD method can also serve other specific delayed-mode needs with a finer parameterization (less robust, more detections).

Following this presentation, some decisions have been made :

- It was agreed that this first version is ready to enter the set of automatic QC tests (with a new number).
- It was also agreed to remove the gradient test which is not robust enough for automatic testing.
- The actual spike test is kept as it still captures features that are missed and is robust anyway.

The specification will be included in the QC manual and the matlab code will be made available.

Action item: Replace RTQC gradient test T&S with the new MEDD test

Action item: Make RTQC grad test for T&S obsolete. Add MEDD test. Can replace grad test with MEDD test in the order.

### 6.5 Feedback on using MinMax climatology in RT test (D. Dobler, J. Gourrion, C Coatanoan) Action 8 (15mn)

The MinMax climatology has been run for over a year at Coriolis data center. It was run with the release 3.3 that includes :

- thresholds built with data until 2015,
- enlarged by 40 % to decrease the amount of false alerts but keeping (or loosing few) good alerts (this follows results from a study made by Jérôme Gourrion)
- and that are updated operationally (whenever bad alerts are raised and it is found relevant to correct the corresponding thresholds),
- an ARIVO climatology (with a standard mean +/- 10 * standard deviation) is used for areas where bathymetry is less than 1800m.

This method is run every hour for profiles that are within 120 days and that have not been under MinMax yet. Alerts are checked once or twice a week. Argo profiles that are in alert are not broadcast until a visual inspection (and qualification) frees them.

The thresholds enlargement and operational updates have proved their robustness as with this configuration and procedure, we have reached 85 % of good alerts. The amount of alerts is 20-25 per day which is now a reasonable number of profiles to look at for the operator. Mainly the seen alerts are either drifts (50 % of the good alerts), spikes (35-40%) or transient biofouling (10-15 %). The operational method used to visualize and treat alerts depending on their kind has also been presented for information purpose.

Whenever a new float is suspected to drift using these alerts, it is logged with some meta information (such as serial number, last OWC, cycles RT/DM status, etc). This list is used for feedback purposes:

- in real-time, the analyses are not redone if the next cycles of the float are showing the same tendency and the QC 3 or 4 (depending on the severeness of the drift) is applied to the whole profile
- for monthly reports: to warn other DACs that some floats are to be treated in delayed-mode in priority and grey-listed meanwhile if they agree with the drift suspicion
- For delayed-mode prioritization

It is also interesting to have in mind that 30 % of the seen alerts had already been treated previously. This is due to new submissions of the float (re-decoding or completeness or whatever) which does not yet take into account the QC that was made in Coriolis database and broadcast via csv files.

Operationally, Coriolis will keep on the actual process, and will raise the age threshold progressively to reach the point where all Argo data are treated.

It was agreed that it is quite efficient in raising early alert of floats suspected to drift, at least in areas well covered by the method.

There is a new version of thresholds (and set of analyses) in preparation by Jérôme Gourrions. This new version will probably (analyses are still in progress) include the following features :

- the MinMax thresholds will not mix anymore the ARIVO climatology for areas where bathymetry is lower than 1800 m. This is because it is quite puzzling and inefficient to get these thresholds when you are expecting MinMax shapes. And of particular interest for Coriolis, it degrades Mediterranean and Nordic seas coverage when there are plenty of data there.
- The enlargement distribution to get an idealized robustness in function of depth, and threshold is also under evaluation. We aim at improving the performance (increasing good alerts).
- Data until end of 2018.

Coriolis will put in the operational logbook file a special indication to warn the operator that careful analysis is needed for floats having the serial number indicated in John's presentation as showing early drift (the already known 6000-7100 range and the more recent 8100-9200 range presented by John Gilson).

It was agreed that DACs can take the responsibility of making entries in the grey list for such drifting floats without waiting for an agreement from the PI (but he/she should be warned that his/her float has been greylisted). Run hourly on all profiles before sending them the European Copernicus Marine service for operational use.

Action item: Ask DACs to put floats that fail MinMax test for drift on the greylist. Information for this is found in monthly report from Coriolis in first chart. Start cycle and QC flag suggestion is included in the report. DACs should do this automatically without contacting the PI.

### 6.6 Greylist updates (T. Carval, A. Wong) Actions 9, 10

The proposal to remove the aggregated greylist from the GDAC was not accepted. Various users such as NCEI (World Ocean Database) or modelling centers use the greylist. Argo data managers use the greylist to flag suspicious sensors in real time quality controls. They consider that the greylist is internal information, however, as it having external users, it will remain available at the root of the GDAC FTP server. In September 2019, the greylist had 2271 entries, a 21% increase on 2018, attributed to extensive use by the BGC-Argo community.

Action item: Keep grey list on GDACs. Make sure that it contains only active floats. When floats/profiles are dmoded they should be removed.

Action item: Update wording on grey list to record: when floats/profiles are dmoded, they should be removed from greylist. Make it clear how/where this information can be recovered.

### 6.7 RTQC Test on Pressure T Carval

RTQC test 6: "global range test" improvement proposal

Pressure of less than 5 decibars are flagged as bad (flag 4) by RTQC test 6. The proposed and approved improvement is:

> Pressure in the range –5 to –2.4 dbar should be considered 'probably bad' (flag 3). The limit of 2.4 dbar is determined based on feedback from operational users.

This improvement will be added in the next release of "Core Argo quality control".

John Gilson mentioned that such value often reveals a problem in pressure adjustment and DACs should check their adjustment procedures. Action item: Global range test to be updated

RTQC Test 19 « deepest pressure test» improvement proposal

Coriolis DAC proposes to improve the test 19 that is not suitable for shallow profiles. In the "QC manual", it is specified that PRESSURE_THRESHOLD should be "CONFIG_ProfilePressure_dbar plus 10%". However, since floats usually have difficulties to precisely stabilize at shallow profile pressure depths, this threshold is not suitable for shallow profiles (valid data is flagged bad).

Coriolis proposes to use the specified fixed coefficient of 10% only when CONFIG_ProfilePressure_dbar is greater than 1000 dbar and to use a variable coefficient for shallow CONFIG_ProfilePressure_dbar values. This coefficient is linearly determined so that its value is 10% when CONFIG_ProfilePressure_dbar = 1000 dbar and 150% when CONFIG_ProfilePressure_dbar = 10 dbar. The improved RTQC test 19 is documented in: Implementation of Argo real time quality controls by Coriolis data centre. https://doi.org/10.13155/49438.

If there is no negative feedback by end of November 2019, the improved test will be documented in RTC test and applied by all DACs.

Action item: Ask two DACs with shallow profiles to volunteer to test the refined deepest pressure test for shallow profiles and provide feedback at ADMT-21. This is documented in Argo RT QC Coriolis Implementation Manual (https://doi.org/10.13155/49438). Coriolis is already implementing it.

Action item: Consider how to refine deepest pressure test (RT test 19) or decide not to apply this test

### 6.8 Flagging of Deep Argo data (N. Zilberman, B. King, S. Purkey, V. Thierry) Action 12 (15 mn)

Suggested rules were presented for flagging Deep Argo data below 2000-m depth. These include to

i. Change Real-time QC flag to '1' for Sea-Bird pressure, temperature, and salinity, if data pass the real-time QC
ii. Provide adjusted value of Sea-Bird salinity with attached error in mode "A" 1 year after float deployment. Salinity adjustment would correct for pressure-independent salinity offset, pressure-dependent salinity offset, and time-dependent salinity drift
iii. Distribute Sea-Bird CTD data on the GTS
iv. Keep Real-time interim QC flag of '3' for RBR pressure, temperature, and salinity (under development)

N. Zilberman will present this updated set of suggestions to the AST for approval at AST-21 in March 2020. A Deep Argo quality control manual for CTD and oxygen data will be available by the end of 2020.

Action item : Ask Deep Argo to present to AST their requests about changing RT flags under 2000 dbar if new Cpcoef is used.

Action item : Develop Deep Argo cookbook

### *6.9* Garmin GPS problem on APEX and NAVIS floats *(B. King) (15mn)*

There is a problem that Garmin GPS receivers do not properly update the GPS almanac that is stored in the receiver. The almanac allows the receiver to know the approximate location of satellites, and speeds up the Time To First Fix

(TTFF) when a float surfaces. The absence of an almanac file is expected to delay TTFF by around 20 seconds. The receivers fail to update the almanac file because of the GPS Week Number RollOver (WNRO) problem. The GPS system measures time by week number and seconds of week. Week number is stored in 10 bits, range 0-1023, and reset to zero on 21 August 1999 and 6 April 2019. After 6 April 2019, almanacs are labelled with week number 0,1,2….. and are rejected as being 'older' than a stored almanac labelled with week number eg 1023. The receivers have a fix to recognise the WNRO when calculating date and time, but not when deciding to reject almanac updates.

The problem affects Garmin GPS boards, and we believe this therefore affects ALL APEX and NAVIS floats with GPS that were active in the water on 6 April 2019. Other float types are not affected. Float controllers download a new almanac every 90 days, and both float types will report that they have downloaded a new almanac successfully. The fact that the GPS board has rejected the almanac will not be visible, but it will have been rejected.

The absence of a recent almanac should not reduce position fix accuracy. The satellite orbital details used in position calculation (the satellite ephemeris data) are included in each satellite message with a valid time of 2 hours, so this is not connected to the failure to update the almanac every 90 days. Positions may take longer to compute, but should not have greater error.

Further explanation can be found here: (https://www.novatel.com/support/known-solutions/gnss-ephemerides-and-almanacs/)

The problem was notified by TWR to APEX customers on 14 August 2019. Since the problem was identified, SBE and UW have been testing GPS boards with very old almanac files loaded (eg 6 years old), and have not reported any problems with position accuracy, but SBE have reported longer TTFF. Floats deployed just before the problem was identified will have to function with a frozen almanac file for the entire lifetime at sea of the float. Floats that were not yet deployed can be forced to accept a new, low-week-number almanac file, which will then be updated normally every 90 days. This requires connection to the float, and cannot be done for floats in the water. Float controllers at sea do not have the required commands to force the update.

ACTION required: (1) Any NAVIS or APEX float with a GPS that has not yet been deployed needs to have the almanac problem fixed (once only), following manufacturer's instructions.

(2) DACs need to identify WMO numbers for floats that will have this problem. Floats deployed before 6 April 2019 ALL have this problem and can be identified automatically. Some investigation is required within national programs to identify floats deployed after 6 April 2019 in which the problem was not fixed. This list needs to be compiled once only, since it should be fixed going forward in all floats deployed after a certain date, depending on when a national program became aware of it and was able to fix floats before deployment.

The list of affected floats can be used to audit position performance over the lifetime of the floats.

Action item: Ask J. Gilson to compile list of WMO number for APEX and NAVIS floats with Garmin GPS and the cycle number as of 6 April 2019. This will be a way to note which floats have been affected by the Garmin GPS problem. Store simple ASCII file at the GDACs.

Action item: Ask DACs to make list of APEX and NAVIS floats deployed between April and September 2019 to monitor possible Garmin GPS problem.

# 7 GDAC Services

## 7.1 Status on the actions: 13 to 24, 35.

Action 13: *NMDIS and Coriolis GDAC to solve the issue of D file submission.*.NMDIS delayed mode data is now available on GDAC. The action is closed

Action 14: *improve synchronization between US GDAC and French GDAC to make CSIO data available more rapidly*: Since December 2018, Coriolis GDAC pushes NMDIS and CSIO files on US GDAC every 30 minutes. Before December, NMDIS and CSIO files were pulled by US-GDAC through the synchronization process, only once a day. The action is closed.

Action 15: *Keep DOI monthly download available with one click and one DOI. Inside the download, split the GDAC holdings into two compressed files per DAC: one for core and one for BGC files. Include README file with naming conventions inside.* Include all documentation for all User Manuals. Communication is available on: http://www.argodatamgt.org/Data-Mgt-Team/News/Argo-DOI-monthly-snapshot-core-Argo-and-BGC-Argo-zipped-

files. It is documented on Argo User's manual §6.4, San Diego working release. Each « dac » directory is splitted in to distinct files, one for Core-Argo, one for BGC-Argo.

xxx_core.tar.gz xxx dac core Argo files

xxx_bgc.tar.gz xxx dac bgc-Argo files

This action is closed.

Action 16: *BGC-Argo synthetic profiles: S-prof files will replace M-prof files and will be compressed into NetCDF4. GDACs to decide whether to both produce S-prof files or to mirror them. Inform users through ADMT website, emails.* The BGC-Argo synthetic profiles (S-prof) are now generated on Coriolis GDAC. For a given cycle-direction, the S-prof contains all core and BGC-Argo values aligned on a vertical reference. An index of S-prof files is available at the top level of the GDAC. The US-GDAC is working on a synchronisation of Coriolis S-prof files. When S-prof files are available on both GDACs, the M-prof files generation will stop after 30 days. The M-prof files will be removed from GDAC. More details on http://www.argodatamgt.org/Data-Mgt-Team/News/BGC-Argo-synthetic-profiles-distributed-on-GDAC. See also: Bittig Henry, Wong Annie, Plant Josh (2019). BGC-Argo synthetic profile file processing and format on Coriolis GDAC. https://doi.org/10.13155/55637. This action is ongoing.

Action 17: *Remove zipped GDAC files from Coriolis. Only serve them on DOI page.* The zipped GDAC files were removed in June 2019 from Coriolis GDAC. The US-GDAC did not produced zipped files. The documentation of zipped GDAC files was removed from Argo User's manual §6.3, San Diego working release. This action is closed.

Action 18*: Add PARAM into b-traj index file* The BGC-Argo trajectory file now contains the parameters available in the trajectory file. The new BGC-Argo trajectory file is documented on Argo User's manual §2.7.3, San Diego working release. The index file is available on ftp://ftp.ifremer.fr/ifremer/argo/argo_bio-traj_index.txt The US-GDAC is working on the addition of parameters in the trajectory file. This action is ongoing.

Action 19: *Allow MISSION_CONFIG_NUMBER of 0. Change User Manual to add that N can be 0. File Checker can also accept fill value*. Documented on Argo User's manual "§2.2.4 General information for each profile", San Diego working release. This action is closed.

Action item: Ask GDACs to keep Mprof files available for one month after SProfs are available at both GDACs. Then the MProf files can be removed.

Action item: Release updated User Manual within 1-2 months of ADMT meeting with agreed upon changes. If additional changes are agreed upon later in the year, prior to ADMT, another version can be released.

### *7.2 Status of Format Checker and process to update Format Checker (Mark Ignaszewski) Action 20-24, 35 (20mn)*

M. Ignazewski presented the status of the File Checker at the GDACs. He stated that current warnings for cross-reference checks for:

- PLATFORM_TYPE/PLATFORM_MAKER
- PLATFORM_TYPE/WMO_INST_TYPE
- SENSOR_MODEL/SENSOR
- SENSOR_MODEL/SENSOR_MAKER

will become an error. He also noted that improved VERTICAL_SAMPLING_SCHEME warnings will become errors. The plan is to stop accepting D-mode files in less than v3.1 in November 2019. The full trajectory file checks will begin in January 2020. Additional checks on config and tech parameters will begin in February 2020. It was noted that these should start as warnings and not errors to give DACs time to adjust. Finally, all existing v3.1 files will be put through the current FileChecker and results will be reported back to the ADMT in February 2020.

Action item: Stop accepting D-mode files in less than v3.1 in November 2019

Action item: Make full trajectory file checks live in January 2020

Action item: Begin additional checks on config and tech parameters in February 2020

Action item: Run all existing v3.1 files through the current FileChecker and report results to ADMT in February 2020

### *7.3* Maintenance of tables centrally – what progress has been made and proposition for the governance of vocabularies

In April 2019, the Horizon 2020 ENVRI-FAIR project funding kicked off and BODC started to work towards hosting all Argo metadata tables (included in the Argo User's manual and various spreadsheets) in the NERC Vocabulary Server (NVS). By upgrading our tables to standardised lists of terms, data and metadata will become more FAIR (i.e. Findable, Accessible, Interoperable and Re-usable), while the internal management of the tables and GDAC's handling of the metadata stored in the NetCDF files will also be improved. Each Argo table will be stored in a unique NVS 'collection' labelled R##, where '##' is the table number as defined in the Argo User Manual. These will be available on the NVS portal as soon as they are created: https://www.bodc.ac.uk/resources/vocabularies/vocabulary_search/ ('Simple search within a vocabulary', click on 'Collection ID'), or http://vocab.nerc.ac.uk/collection/. So far, Argo User's Manual tables 03 (PARAMETER), 25 (SENSOR), 26 (SENSOR_MAKER) and 27 (SENSOR_MODEL) have been partially uploaded, and appear under collections R03, R25, R26 and R27. BODC will continue this process until a collection (complete with newly assigned labels and definitions) has been created for every existing table. At this point, ADMT-approved editors will be able to add new terms or modify existing ones with the assistance of BODC. Editors have been confirmed (though more volunteers welcome!), and they will be assigned to the governance of one the five table groupings, listed in collection C88 (http://vocab.nerc.ac.uk/collection/C88/) with IDs BODCSR170, BODCSR171, BODCSR172, BODCSR173 and BODCSR174.

M Belbeoch mentioned that JCOMMOPS wanted to work with BODC as JCOMMOPS want to do similar work for other networks and cross network coherency will be an asset.

Action item: Clearly identify which sensors are accepted and which are pilot in ref table 27. This needs to be in User Manual and NVS tables

# 8 Delayed Mode Data Management

## 8.1 FROM MANUFACTURER

### 8.1.1 Cell Thermal Lag in SBE CTDs and field conductivity drift

Kim Murphy, Sea-Bird Scientific

Data from laboratory tank experiments and high-resolution 1-Hz data from deployed Argo Solo II floats show the main source of dynamic errors in the SBE 41cp are temperature and conductivity alignment and cell thermal mass. Sea-Bird Scientific is in the process of determining the optimal hardware and software corrections to minimize these errors in the Sea-Bird Argo CTD fleet.

Correcting for CTD sensor drift in the field is a well-developed process, however the bounds of what is correctable are unknown due to the lack of laboratory calibration data for Sea-Bird SBE41cp CTDs. As a point of reference for the Argo program, we presented field deployment accuracy and stability specifications from moored Sea-Bird CTDs. These instruments have functionally identical hardware, but represent the upper bounds of drift expected in Argo CTDs due to their deployment in extreme conditions. This data set will also be used to determine the magnitude of correctable drift in SBE 41cps, and preliminary analysis shows a slope correction can be safely used for many salty drifters.

### 8.1.2 Estimating Temperature and Conductivity Drift for Deep Argo CTD from Calibration History

David Murphy, Sea-Bird Scientific

The Deep Argo program requirements for CTD accuracy are more demanding than the core Argo program and will require careful attention to sensor drift. As the base for accurate measurements, manufacturers must maintain primary standards for calibration at the highest levels. For example, Sea-Bird has demonstrated triple point of water transfer standard measurements within +/-0.0001 C for more than the last 20 years. To put this in context, at 6000 decibars pressure 1.0 C, and 3 Siemens/meter conductivity, a 0.001 C error in temperature will result in a -0.0011 error in salinity. This is the level of accuracy required for the success of the Deep Argo program.

An example of typical temperature sensor drift for the SBE 61 Deep Argo CTD is 0.00039 C / year measured as an offset across the oceanographic temperature range. Temperature drift immediately after manufacture is higher and the

sensor requires calibrations spanning more than 100 days before the drift rate settles to levels that meet program requirements.

Drift estimates for the SBE 61 are within the noise levels of the calibration system and can be improved by using a linear fit of error versus time.

Estimates for SBE 61 fleet that have at least 180 days of calibration history are predominately warm with a mode of 0.0005 C / year.

Conductivity drift is typically observed as a slope error rather than the offset discussed above for temperature. Evaluation of drift for 10 sensors with up to 200 days of history show that more than 100 days is required for stability and all are shown to meet the program requirements of +/-0.0001 S/m.

Conclusions are that temperature drift should be considered in evaluation of CTD salinity accuracy and that work needs to be done to improve calibration system noise and drift evaluation of both temperature and conductivity.

A DM operator asked for guidance from the manufacturers on how to correct the high salinity drift and what limits are for applying corrections. SeaBird said they are working on this, but do not have any clear recommendations yet. In other discussion, it was noted that the extended depth SBE41s are less screened than the SBE61s, so they may experience more drift than the 61. Finally, SeaBird recommended referring to best practices on how to ship and store CTD cells including keeping them cold to avoid damaging the cell.

### 8.1.3 Post-processing of RBRargo CTD data *(M. Halverson) (25mn) with input from Breck* RBR pressure correction analysis *(B. Owens)*

*Action 29*

The use of RBR CTDs on Argo floats was approved as a global pilot project at the AST19 meeting in March 2018, in Sidney, BC, Canada. RBR CTDs must meet a series of requirements in order to be approved as a CTD supplier to the Argo program. A number of criteria must be met to win approval: 1) Static accuracy, 2) dynamic performance, and 3) stability. In this talk we summarized the progress made to satisfy these topics. Static accuracy is an issue of how conductivity is compensated for hydrostatic pressure. Breck Owens was originally supposed to discuss this, but because he was unable to attend, RBR presented on his behalf. The most important result is that RBR has updated the white paper discussing this issue with additional in situ data (oem.rbr-global.com). With respect to dynamic performance, RBR has arrived at a series of correction algorithms to improve dynamic performance. The corrections are described in detail in a report that will be distributed to the Argo community when we get permission from the data owner from which the corrections were derived. Finally, a summary of the salinity stability relative to various climatological products using each of the six operational floats with RBR CTDs was presented. The stability estimates are very good, but definitive statement of the stability requires a comparison to the standard datasets used by DMQC operators.

## 8.2 Monitor DMQC progress

### 8.2.1 Update on high salinity drift in SBE CTDs

*Action 18 from AST-20 and Action 5 from DMQC-6 (15mn)*

SIO Argo DMQC and a WHOI Argo/CARS climatology comparison reveal an increasing prevalence of PSAL salty drift in Argo floats within specific SBE CTD SN bands. The previously identified CTD SN band 6000-7100, continues to be flagged as ‘2’ in real-time. A more recent CTD SN band 8100-9200 is emerging as another affected band. The CORIOLIS MinMax test has proved itself as an accurate and early notification of salty drift.

Action item: Ask DMQC operators to use table at beginning of Coriolis monthly report which contains MinMax test results to prioritize floats to DMQC.

The detailed PSAL drift characteristics remain unknown. This information is critical to assess the appropriateness of the standard DMQC OWC piece-wise linear correction. Examples of moderate/strong PSAL drift from the SBE41/61 were shown to explore at what stage the PSAL data becomes uncorrectable with current practice.

Action item: Form DMQC working group to create document with best practices for DMQC of high salinity drift CTDs. Present work at AST to get scientific feedback.

### *8.2.2* Monitor percentage of suspicious floats that have been dmoded *(DMQC operators, M. Belbéoch) Action 31, 45 and* How to capture dmode operator for each BGC variable in AIC database and Core variables at the level of float and not only at program level *(M. Belbéoch) Action 26)*

DMQC processing is still improving quantitatively speaking and increased from 70 to 78% in the last 3 years. M. Belbéoch made some proposals to improve the monitoring of DMQC at JCOMMOPS and to move from a quantitative to a qualitative monitoring. The DMQC practices are varied across Argo teams and complexity is rising (programs, models, geography, sensors). The aim of a new set of monitoring tools would be to ease DM operator work, help them to prioritize floats, and to better identify orphan floats.

The ADMT agreed on the need to add the DM Operator at the JCOMMOPS registration/notification level for each parameter, using ORCID numbers to facilitate interoperability. This information could also go into the netCDF metadata and profile files.

JCOMMOPS will propose in the next months a monitoring dashboard for each DM operator and for fleet monitoring based on these new requirements.

Action item: Ask Mathieu to set up system to capture DMQC operator by parameter with the ability to change operator over a float's lifetime and the possibility of params being grouped in the future. Then, when dmode files come in, Mathieu can pull in dmode operators from the profile files to keep up to date.

Action item: Ask all DMQC operators to make an account at argo.jcommops.org

Action item: Ask DMQC operators to obtain an ORCID for recording in D and BD prof files. Add this ORCID to AIC system

### *8.3* How to capture dmode operator in D- and BD-files

*Action 30*

Annie Wong presented a proposal to record delayed-mode operators in the D- and BD- files by adding a comment line to the //global_attributes section of these profile files. This proposal was initiated by Annie Wong, Henry Bittig and Thierry Carval, in response to Action #30 from ADMT19. It was sent to argo-dm-dm and argo-bio in August 2019 for comments. Further discussions took place during the ADMT meeting and the following was agreed.

For D- and BD- files where one person is in charge of the whole file, add

:comment_dmqc_operator = "PRIMARY | https://orcid.org/16-digit-number| operator name, institution"

For BD- files where some B-PARAMs have dmqc operators who are different from that in PRIMARY and who want to be listed explicitly, add

:comment_dmqc_operator1 = "PRIMARY | https://orcid.org/16-digit-number 1 | operator name 1, institution 1"

:comment_dmqc_operatorN = "B-PARAM | https://orcid.org/16-digit-number N | operator name N, institution N"

where N > 1.

For example,

:comment_dmqc_operator1 = "PRIMARY | https://orcid.org/16-digit-number 1 | Jane Smith, University A"

:comment_dmqc_operator2 = "DOXY | https://orcid.org/16-digit-number 2 | Joe Doe, University B"

:comment_dmqc_operator3 = "NITRATE | https://orcid.org/16-digit-number 3 | Jack Apple, University C"

The first line must list the PRIMARY operator. The core D- files should not list separate DMQC operators, because the delayed-mode process for the core parameters P/T/S should be overseen by one primary person.

It is noted that this is an optional step, because delayed-mode groups will not be required to backfill existing D- and BD- files. Moreover, this is not required for real-time R- and BR- files.

Action item: Ask DMQC operators to add global attribute with DMQC operator name. :comment_dmqc_operator agreed syntax: "PRIMARY| https://orcid.org/16-digit-number | operator name, institution". if BD files need more info, syntax should be: PRIMARY line first, then: "B-PARAM | https://orcid.org/16-digit-number | operator name, institution"

Action item: Annie and Catherine to document how to add global attribute for DMQC operator in D and BD files.

### 8.4 Summary of action items from DMQC-6 *(A. Wong, B. King, J. Gilson) (15mn)*

Annie Wong presented a summary of action items from DMQC-6, which was held in December 2018 and co-convened by John Gilson, Brian King, and Annie Wong. The DMQC-6 Workshop produced 13 action items and recommendations. 5 of these had been done and 8 of these were ongoing recommendations. Highlights included the release of OWC Version 2.1.0 by Cecile Cabanes, and the setting up of a delayed-mode mentor list at http://www.argodatamgt.org/DMQC/Mentors-for-Argo-CTD. The Argo DMQC repository on Github (https://github.com/ArgoDMQC ) included the PMEL GUI and the OWC toolbox. It was proposed that a half-day delayed-mode interactive session be organised at the ADMT meeting week in 2020, if time and resources allowed.

#### 8.4.1 Propagation of flags assigned in D files to R files *(C. Cabanes, R. Cancouet A. Wong) (15mn)*

An analysis of DM/RT flags of floats from the EU-funded MOCCA project has raised a few issues explained below:

***First issue:*** The DM Operator downloads the float profiles at T0 and sends back the corrected D-files at T0 + n. Inevitably between T0 and T0 + n, some R files have been processed. After being analysed by the DM operator, floats might be adjusted in real time with a correction, but the correction is propagated onward only. As a consequence, some "in between" R cycles may be left uncorrected, sometimes with flag 1, while the DM operator knows there is a salinity correction to apply.

Action item: Ask C. Cabanes to write clear instructions on how to apply real time adjustments and to which files they have to be applied.

Action item: DACs to apply real time adjustment to all R files when a D mode adjustment becomes available. This means going back and re-processing R files after last D mode file and current R files coming in.

***Second issue:*** We have noticed some cases where the DM operator decided to flag salinity ‘2’ in the last few D_files. The floats were not placed on the greylist. Hence the DACs are producing R files but with flag 1.
The grey list is the appropriate tool for PI/DM operators to propagate DM flags ('2','3' or '4') into the following RT cycles, but guidelines should be added in the DMQC manual.

It was decided to clearly specify in the QC manual the use of the grey list (flag, starting date). If a flag 2 is applied in delayed mode, the salinity should be greylisted with at least a flag 3 and a starting date corresponding to the beginning of the problem.

Action item: Ask C. Cabanes to update guidance on use of grey list in the DM procedures for salinity. This includes start date of problem so that DACs can reprocess files accordingly.

## 8.5 Progress on DMQC reference databases

### 8.5.1 Summary of the actions since ADMT-19

*Action 28 from ADMT-19, Action 6-7 from DMQC-6*

Christine Coatanoan reported on the progress of actions defined from the DMQC-6 workshop and ADMT-19 meeting. The duplicates procedure has been presented following two cases. First one concerns the data updates coming from OCL and ICES and going through the Coriolis database. The criteria of 15 minutes in time and space is chosen to determine the duplicates, then a comparison is done to discard the false duplicates with the other formats before visualizing for the quality control. Second case concerns data going through directly in the reference database such as data downloaded from the CCHDO website, data coming from scientific cruises, and the export from the Coriolis database. An exact duplicate test is performed regarding latitude, longitude and time. Stations are rejected following hierarchy of the resolution and quality of the data. When the qc level is the same, manual control is performed to identify the station to remove. With the experience of the work done with Ingrid for the Nordic Seas, a content duplicate test (Gronell & Wijffels, 2008) will be performed for the next versions from next year.

> *A Semiautomated Approach for Quality Controlling Large Historical Ocean Temperature Archives. Gronell & Wijffels, 2008, https://doi.org/10.1175/JTECHO539.1*

Regarding the feedbacks about the quality control of the box files, experience has been shown for the NA-ARC and Nordic Seas. Christine really encourages DM operators and people in charge of ARCs to continue improving the reference database (new data, quality, …).

Results of action 7 from the DMQC workshop have been presented. First step was to identify the boxes with the largest size. Preliminary results have shown that a large part of this list concerned the Mediterranean Sea even if other boxes like in the Northeast Pacific Ocean also appeared. For the Med Sea boxes, the data distribution also shows shallow profiles. When the data shallower than 900 dbar are removed from those boxes, many CTD data are lost. Due to the bathymetry of the Mediterranean Sea that in some regions is not very deep (shallow regions in the Med Sea are: Adriatic Sea, Aegean Sea, Sicily Channel, Northern Tyrrhenian Sea, part of the Alboran and Catalan sub-basins), removing the CTD profiles shallower than 900 dbar is not good for the Med Sea. In this way, any action to thin out will not be done presently. Shallow profiles will be added to other marginal seas. Retroactivity will start progressively.

After ADMT-19, the version 2018_V02 has been delivered with 12 cruises from the program GO-SHIP downloaded from the CCHDO website. A new version (2019V01) is in preparation and should be delivered by the end of October. Data from OCL and ICES updates have been added as well as new CTD from the CCHDO website for the GO-SHIP program. A scientific cruise has also been taken into account. From the work done with Ingrid Angel (BSH), updated box files for the Nordic Seas will be upgraded in this version.

### *8.5.2 CCHDO/US-NODC-progress (S. Diggs, T Boyer)*

S. Diggs presented the status of current CCHDO data sources as follows in order of priority: US GO-SHIP, International GO-SHIP, and GO-SHIP Associated. Since March 2018, 59 cruises with 3545 profiles have been added to CCHDO. CCHDO received a request for CTD data in the Caribbean Sea to help with Argo delayed mode quality control which they are working on discovering and adding to their holdings for Argo. In the coming year, CCHDO will be implementing NetCDF-CF compliance in their files, using schema.org markup for improved discovery and offering data by profile rather than just cruise along with data DOIs. In addition, CCHDO plans on providing Argo ref CTD data via an API to help improve format variability problems and to better manage data quality via additional flags, or a list of ‘gold standard’ cruises for filtering.

Since the last ADMT meeting, NOAA’s National Centers for Environmental Information (NCEI) has added 1090 CTD casts taken in or after 2000 which go to depths deeper than 2000 m to the World Ocean Database (WOD). These parameters make the casts eligible for the Argo CTD reference database. C. Coatoanoan accesses the WOD to download eligible CTD casts and uploads those deemed to meet Argo standards for quality and calibration. In addition to the 1090 casts listed above there were 755 casts added to the WOD from CCHDO which match the reference database criteria. However, the CCHDO casts are downloaded by C. Coatoanoan directly from CCHDO. Of the 1090 non-CCHDO casts which meet reference database initial criteria, all are from either the International Council for Exploration of the Seas (ICES) or the Global Temperature and Salinity Profile Program (GTSPP). ICES aggregates data from member states mainly in the North Atlantic. GTSPP aggregates CTD data which are posted to the Global Telecommunications System (GTS). Data posted to the GTS are in near-real time (posted within 48 hours of measurement) and have mainly automated quality control and do not have post-cruise calibration. From this year’s ADMT, it appears that C. Coatoanoan downloads ICES data directly from ICES. So the contribution this year from

WOD is limited. A concerted effort will be made in the coming year to aggregate and make available more reference database eligible CTD casts from both international partners and from within the U. S. A particular effort will be made to provide delayed-mode versions of the data now provided in near-real time through GTSPP. A note: from S. Diggs report to the last AST, there was a large drop in CTD casts eligible for the reference database compared to previous reports. The present report (to ADMT) shows a return to counts found in previous years. The reason for the dip reported to the AST is still not accounted for, but is quite probably due to a lag time in the upload of data from all sources (including CCHDO) to the WOD earlier in 2019.

### 8.5.3 Deep Argo reference data (N. Zilberman, S. Purkey, Katsumata) Action 25 (15mn)

Katsumata, Purkey, Swift and Sloyan are proposing a new data product be developed to assist in delayed mode quality control of Argo data, especially Deep Argo data. The requirements for CTD data to be included in this product are:

- High quality salinity data (>0.002)
    - Salinity data calibrated to bottle salinity samples calibrated to IAPSO Standard Sea Water
    - Pre and post-cruise CTD calibration recommended
- Documentation about salinity calibration and conductivity sensors
- Continuous full-depth CTD measurement
- Delayed-mode QC available

This data product will include all available GO-SHIP and GO-SHIP quality data and both CTD and bottle salinity data. The standard sea water batch numbers from each cruise will be recorded and batch-to-batch differences in salinity will be applied along with additional QC of all data to eliminate any bad data. The data set will be publicly available and updated on a yearly basis. A beta version of the data will be sent to GO-SHIP exec members for feedback in November 2019. The goal is to finalize the dataset and publish a paper on it in July 2020 and serve it from the international GO-SHIP website.

Action item: Ask Christine Coatanoan to incorporate high QC GO-SHIP product profiles selected for DEEP-ref-DB to Core ref db. This will be released yearly. Suggest that if the GO-SHIP profile from CCHDO exists in the ref DB, it should be replaced with higher QC'd version.

### 8.5.4 Gilson Rules updates

*Action 8 from DMQC-6*

At the DMQC-6 workshop (2018) modifications were requested to the Argo profile filters used to build the Argo_for_DMQC climatology. These modifications have been applied to a proposed new Argo_for_DMQC climatology.

- Reject DM profiles measured within 2 months of deployment (previous 6 months)
- Reject DM profiles measured within 12 months of last profile (previous 6 months)
- Reject DM profiles measured within 12 months of onset of salinity drift (previous 6 months)
- Shallow profiles (400-800dbar) are newly accepted if followed by profiles deeper than 800dbar (previous files rejected)
- Reduced the size of the dataset by accepting every 3rd profile from a float's time series.

The ADMT-20 accepted the above changes with the exception of the reduction of the dataset size. A new climatology (named Argo_for_DMQC_2019V01) will be produced applying the accepted filtering changes and submitted to the community.

Action item: Ask John Gilson to apply suggested filters minus thinning out ones and release that version of Argo ref db. Afterwards, ask John to explore thinning data by region

### *8.6* Development & Implementation of DMQC methods as part of EA Rise *(K. Walicka) (15 mn)*

Kamila Walicka (BODC, UK) showed the results from the survey about the development and implementation of DMQC methods, as part of the EU H2020 project Euro-Argo RISE work package 2. The survey results were compiled from the questionnaire responses from the global Argo DMQC operators. The aspiration of this project is to improve the sustainability of DMQC tool development within the global Argo community.

The key findings from this survey show: a wide range of MATLAB versions are in use; multiple in-house GUIs with various modifications to the DMQC process; non-uniform MATLAB codes for the entire DMQC process; the use of independent databases and additional checks by DMQC operators to improve the confidence in salinity drift verification; the lack of uniform software to generate DMQC reports. DMQC operators reported issues associated with expensive MATLAB licences and its toolboxes and suggested the use of alternative free programing language e.g. Python. They also reported long duration of OWC core execution, reflected a need of the reference data for the shallow marginal seas, more flexibility in using the currently available reference data and highlighted a need for more information about the metadata of CTD historical data. Moreover, DMQC operators suggested the introduction of a uniform DMQC GUI or common tools for the entire Argo community, reported a need for a sharing repository for case studies of problematic floats, frequent workshops for DMQC operators and suggested two additional improvements of DMQC methods (Chunling Z et al. 2012, Bhaskar T.V.S. Udaja, peer review).

The final output of this task will be the written report finalised for Euro-Argo RISE WP2 meeting in November that will be shared with the Argo community when approved.

***OWC Python Conversion***

Some DMQC operators have asked for a version of the OWC tool in a free language, specifically python. Ed Small (BODC) showed that not only it is possible, but it will be helpful for the wider community in regards to accessibility, version control, and education. It is also an opportunity to do a deeper dive into the algorithms to see if we can find ways to speed this process up for users.

Ed Small proposed a test driven development that will be a way to build something like this effectively, and he asked the whole of the Argo community to try to get involved and to offer their guidance with this project. Whether it is to offer support, or raise concerns, BODC is completely open to everything. BODC also suggest delivering workshops for DMQC operators on using the OWC tool and (if they desire) how to use python for basic data analysis, manipulation, and visualisation

Full report in a separate document.

Ed was advised to work with Cecile Cabanes and Annie Wong to be sure that the oceanography is kept in the translation. DM Operators also mentioned the importance of keeping the flexibility that exists in the present software

### 8.7 Delayed mode trajectory files (M. Scanderbeg, J. Gilson, D. West-Mack) Action 9 from DMQC-6 (10mn)

M. Scanderbeg reported on progress the working group for on delayed mode trajectory files has made since the DMQC-6 workshop. A document has started to describe the steps needed to create a D-mode trajectory file and an inventory has been done on code available to perform different steps of the process. The working group has split steps into float dependent (timing estimations, applying clock drift) and float independent (checking cycle number, QC of surface positions and params, applying known param offsets, etc). After doing an inventory of floats that will need quite a bit of independent work, three main groups emerged: SOLO floats, APEX Argos floats, and older NKE floats. The SOLO floats have dmode tools developed and will be dmoded by the US Argo Program over time. The APEX Argos floats have some Matlab code available in the DAC Trajectory Cookbook to estimate the necessary times, but this code would need to be incorporated into a tool to make it more widely available. The NKE floats need to recover timing information from technical files.

The working group decided it would be best to focus on developing float independent tools for delayed mode quality control work since these are applicable to all floats types and should be close to all that is needed for newer Iridium floats that report back much more timing information. Deb West has some Matlab functions available to do QC flagging of params, to calculate the representative park pressure and to determine grounded flags. In addition, N. Kolodziejczyk and C. Cabanes are working with an engineer to develop automatic and manually checked tools for similar checks as Deb's tools as well as velocity checks. There is the possibility to further develop these tools to draw upon visualization tools developed by J-P Rannou for ANDRO and to perform additional consistency checks between trajectory and profile files (cycle number, position, time, etc).

The issue of how to record what is done in DMQC of trajectory files was raised. The working group had an initial proposal of creating a table to show what DMQC steps were performed that could be recorded in the history section. Feedback from the group suggested this not be a new table, but an addition the QC test ref table 10.

The working group plans to continue working to develop tools and documentation to describe the DMQC process for trajectory files. Additional feedback is welcome as it will be important that these tools be shared.

# 9 Format issues

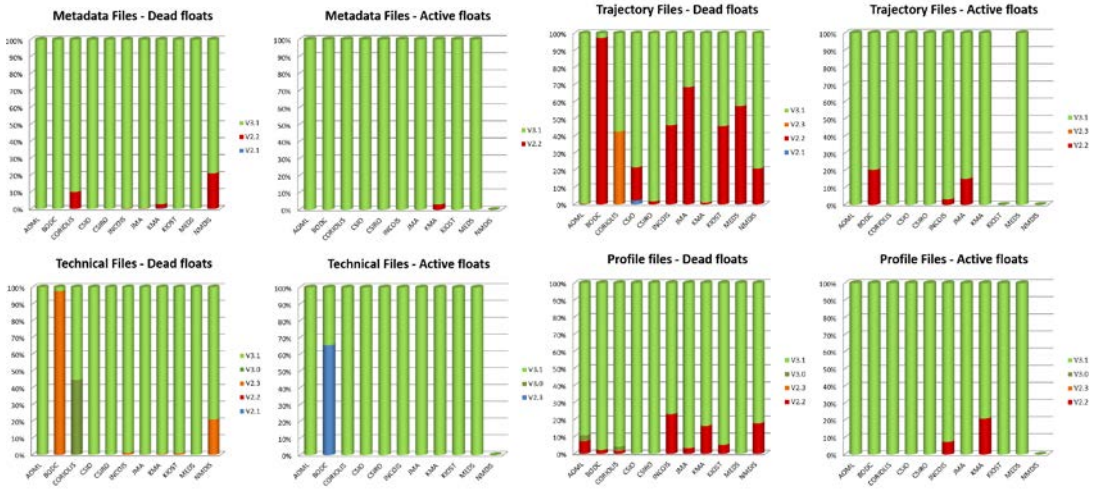
*The new formats mean a challenge for the DACs – how well are we implementing V3.1? What issues remain?*

*Status on the actions* : 32 - 34, 36, 39 - 41

## 9.1 Upgrade to V3.1 Real-Time and historical T&S floats at GDAC

*Action 32*

The status on the format version upgrade was presented for profile files and meta-traj-tech files. Some DACs have still V2.2 or V2.3 and need to update those versions. A large improvement has been observed since the last ADMT for the profiles files to convert to v3.1. On the plots distinguishing the inactive and active floats, the conversion to v3.1 has been improved for the active floats even if there are still a few DACs that need to update their files but some work is still needed for the inactive floats, especially for the trajectory files. Some DACs said that the files were rejected by the file checker and need to investigate the errors. The goal is to upgrade the version for next year.




The statistic plots presented were generated on 1st October. Log file (log_check_versions_files_GDAC_<DAC_name>_<date_update>_notv3-1.txt) indicating the files for which the version is lower than 3.1 has been created between on 10th and 11th October and can be loaded from : ftp://ftp.ifremer.fr/ifremer/argo/etc/format_notyet_3.1/

## 9.2 Under-ice positions (B. Klein, M. Scanderbeg, C. Schmid, A. Wong, E. Van Wijk)

*Action 36*

A presentation was given by the under-ice position working group with feedback from AST on how to include estimated positions in profile files and trajectory files. The request originally has been discussed in connection with under-ice profiles to be able to store information on position accuracy and information on how positions have been estimated for these interpolated positions. For under-ice floats which have a position qc ='8', ADMT-19 had proposed to add two optional variables in the profile files namely POSITION_ERROR and POSITION_COMMENT. This was approved at AST-20 with strong encouragement to fill POSITION_COMMENT with appropriate description of the method if the estimated position was derived by something other than linear interpolation. Following a long discussion prior to ADMT this proposal was modified to open the optional variables to all POSITION_QCs. In order to distinguish properly between position errors reported by the float and those estimated it was proposed to split the POSITION_ERROR variable into two and have error information either be stored in POSITION_ERROR_REPORTED or POSITION_ERROR_ESTIMATED. This was approved by ADMT-20.

Changes in the trajectory files required updates in reference tables 5 and 9. Proposed new entries to both reference tables were presented. POSITION_ACCURACY in table 5 for new entries was discussed and concern was voiced not to give users a wrong impression on the quality of positioning system i.e. IRIDIUM and it was agreed to rephrase comments in the Table accordingly.

| Name | Definition | Comment |
|---|---|---|
| POSITION_ERROR_REPORTED | float POSITION_ERROR_REPORTED(N_PROF);<br>POSITION_ERROR_REPORTED:long_name = "Position error reported by the positioning system";<br>POSITION_ERROR_REPORTED:units = "meters";<br>POSITION_ERROR_REPORTED:_FillValue = "99999."; | **This is an optional variable.** Position error reported by the positioning system. |
| POSITION_ERROR_ESTIMATED | float POSITION_ERROR_ESTIMATED(N_PROF);<br>POSITION_ERROR_ESTIMATED:long_name = "Position error determined by real-time or delayed-mode process";<br>POSITION_ERROR_ESTIMATED:units = "meters";<br>POSITION_ERROR_ESTIMATED:_FillValue = "99999."; | **This is an optional variable.** POSITION_ERROR_ESTIMATED contains the position error as determined by either the real-time or delayed-mode process. Applicable to all POSITION_QC. |
| POSITION_ERROR_ESTIMATED_COMMENT | char POSITION_ERROR_ESTIMATED_COMMENT(N_PROF, STRING1024);<br>POSITION_ERROR_ESTIMATED_COMMENT:long_name = "Comment on the method used to determine POSITION_ERROR_ESTIMATED";<br>POSITION_ERROR_ESTIMATED_COMMENT:_FillValue = " "; | **This is an optional variable.** Comment on the method used to determine POSITION_ERROR_ESTIMATED. |

Action item: Accept proposal for three optional variables related to position error: POSITION_ERROR_REPORTED, POSITION_ERROR_ESTIMATED, POSITION_ERROR_ESTIMATED_COMMENT. User manual and filechecker need to be updated.

## 9.3 Combining c- and b-trajectory files (H. Bittig T. Maurer, J. Nair, M. Scanderbeg, C. Schmid, A. Wong) (15 mn)

The working group presented a proposal to combine the c- and b- trajectory files. The reasoning behind this is:

- File size is not a reason to split into c- and b- trajectory files due to the N_MEASUREMENT array structure.
- Parameter stability is not a big factor for the R trajectory files since processing of raw <BGC PARAM> should remain fairly stable going forward.
- C- and B- file connection: DACs need to understand what MCs to include in the trajectory file even if kept as c- and b-files.
- Allows users to look at one combined trajectory file to find all information
- Less files to keep track of, host and store at GDACs

The suggestion is to call this combined trajectory file V3.2. It would need a few changes, including:

- Change TRAJECTORY_PARAMETERS (N_PARAM,~~STRING16~~STRING64) as in b-traj
- Add TRAJECTORY_PARAMETER_DATA_MODE (N_MEASUREMENT, N_PARAM)
- Add TRAJECTORY_PARAMETER_CALIB_COMMENT (N_PARAM, N_CALIB, STRING256)
- If this proposal is approved, there is an opportunity to add other desirable variables to the trajectory file.

If the proposal is endorsed, the finalized trajectory file format V3.2 needs to be presented to the AST for approval at AST-21. The User Manual will need to updated as well as the GDAC FileChecker. Users will also need to be educated on the changes. There will be a transition period for BGC floats when both v3.1 and v3.2 files can exist. Floats without BGC parameters can stay in v3.1.

Independent of whether this proposal is accepted, DACs with BGC floats are asked to begin producing trajectory files that include all measurement codes for all BGC events.

Additionally, all DACs and delayed mode groups are requested to think about this proposed combined trajectory file format v3.2 and respond with support or refusal by 01 February 2020 so that a proposal can be finalized and presented to the AST in March.

Action item: Ask that all DACs with BGC floats make sure they produce traj files that include all MCs for all BGC events.

Action item: Ask all DACs and dmode groups (Core and Bgc) to reply to email from M. Scanderbeg with YES or NO about proposed combined traj file format v3.2 by 01 Feb 2020.

Action item: Ask Coriolis to produce combined trajectory file format v3.2 examples for testing prior to AST-21

### *9.4 Update on Trajectory File Status and DAC Trajectory Cookbook (M. Scanderbeg) Actions 39, 40, 41 (15 mn)*

M. Scanderbeg gave a more in-depth report on the status of the trajectory file versions, including the information that only ~40 active floats are not in v3.1 and less than 3000 files total are in v2. The majority of Iridium floats are in v3.1 and the far majority of floats in v2 are Apex Argos floats. She suggested that if DACs do not have the ability to go back and re-decode the raw hex messages for these floats, they should consider just transferring what is in v2 to v3.1 and letting dmode operators try to add additional information where possible, including using data from ANDRO.

A new version of the Argo DAC Trajectory Cookbook was released with new/updated float tables for HM2000, APF11 Argos & Iridium, Arvor, Provor and ProvorCT3 floats. A few changes were made to MC codes, a new MC was added for RAFOS positions and times, and the relative MC for surface measurement sequences to accommodate near surface and in-air oxygen samples was added. In addition, instructions were added on how to put Iridium and estimated positions in trajectory files.

Action item 41 called for sharing excel tables created by J-P Rannou for the Coriolis processing chain for APF11, Arvor and Provor floats.

http://www.coriolis.eu.org/Data-Products/Tools/Web-page-dedicated-to-Coriolis-Argo-decoder

The relevant trajectory information in these tables pertains to cycle timing calculation instructions for APEX and Navis Iridium floats and APEX Argos floats. In addition, all MC codes for float types at Coriolis are included. These are more extensive than the ones in the DAC Trajectory Cookbook since Coriolis includes all optional information.

Finally, she brought up two action items from DAC Trajectory Workshop in 2017 in Hamburg that have not been completed yet. The first is asking DACs to ensure information from the greylist is being applied to trajectory parameters as well. This is a bit complicated because would need to convert the time range on the greylist to cycle numbers in the trajectory file and then change the param QC flags accordingly. The other action item stated that offsets to pressure and salinity being applied in real time to profiles should also be applied to trajectory files. In the following discussion, it was agreed that these are not a high priority, but that they should still be added to the list of things DACs should be working on.

Action item: Ask Annie Wong to update QC Manual to include the greylist test on trajectory file.

Action item: Ask DACs to apply the greylist test to trajectory files.

### *9.5* How to accommodate tech data in a time series from APF11 floats

Floats such as APEX APF11 report some technical data with a timestamp (Example: battery voltage). The existing technical data format does not have a time axis (data are reported by cycle). This crucial technical information cannot be reported in the existing tech files for Apex APF11. The Coriolis DAC proposes to add an optional section in the technical file format. When needed, DACs can add a timeseries section in the technical files format, similar to trajectory:

- double JULD(N_TECH_MEASUREMENT)
- int CYCLE_NUMBER_MEAS(N_TECH_MEASUREMENT)
- int MEASUREMENT_CODE(N_TECH_MEASUREMENT) not mandatory
- float <TECH_PARAM>(N_TECH_MEASUREMENT)

Coriolis produce such file and is available for APF11 float 6903554 in the "aux" directory

- ftp://ftp.ifremer.fr/ifremer/argo/aux/coriolis/6903554/6903554_tech_aux.nc

There is a consensus not to have any QC on technical parameters as we don't have QC procedure defined. Therefore, these proposed entries were rejected: <TECH_PARAM>_QC and JULD_QC JULD_ADJUSTED JULD_ADJUSTED_QC JULD_STATUS after each DAC look at the proposed examples. Additionally, it was noted that the SOLO-II provides similar series data, but without a direct timestamp. It was suggested that if no JULD is available, that MEASUREMENT_CODE be used to help define where in the cycle the measurement took place.

Action item: Provide feedback to Thierry on proposal for adding time series to the tech file by AST-21 so finalized proposal can be put forward to AST for approval

### 9.6 Salinity : Argo PSAL CF standard name

The core-Argo PSAL parameter has the CF standard name: sea_water_salinity. The CF definition for sea_water_salinity says "The more precise standard names should be used where appropriate for both modelled and observed salinities. In particular, the use of sea_water_salinity to describe salinity observations made from 1978 onwards is now deprecated in favor of the term sea_water_practical_salinity which is the salinity quantity stored by national data centers for post-1978 observations."

The consensus is to replace sea_water_salinity with sea_water_practical_salinity. An action is opened to organize this change that affects more than 2 million files.

For BGC-Argo, UP_RADIANCE CF standard name is actually not listed in CF list: upwelling_radiance_in_sea_water, Catherine Schmechtig and Andrew Barna are working on fixing this anomaly (register the term in CF standard names).

Action item: Study how to replace "sea_water_salinity" by "sea_water_practical_salinity" and come to ADMT-21 with a proposal. Maybe GDACs can help with this replacement.

Action : Study how to replace "sea_water_salinity" by "sea_water_practical_salinity" and come to with ADMT-21 with a propsoal. Maybe GDACs can help with this replacement.

## *Friday 18th October*

### *10* Discussion on how to better track Action Items in-between ADMT meetings *(M. Scanderbeg, S. Pouliquen, all) (30 mn)*

Action items from ADMT-19 were moved forward with varying degrees of success and many actions were not looked at until right before the ADMT-20 meeting. Additionally, some changes in format occurred prior to updated documentation and a new version of the User Manual. In terms of the User Manual, the ADMT co-chairs proposed that a new User Manual and QC Manual should be released soon after the ADMT meeting with the agreed upon changes included. This allows DACs to begin implementing changes and prepares users for what is coming. The goal is to release the new documents 1-2 months after the meeting. If changes from the meeting cannot be agreed upon in

that time period, the documents should move forward without them as they can always be added in the next version when consensus has been reached. The ADMT agreed to this proposal.

As to the Action Items, M. Scanderbeg suggested improving them by:

- Splitting the list into sections that make it easier for DACs, GDACs, dmode operators, etc to identify pertinent Action Items
- Making the Action Items more detailed so that it is clear what needs to be done
- Making the Action Item list a Google Spreadsheet so anyone can provide feedback easily on the status of the items

Finally, the ADMT co-chairs suggested two progress reports per year instead of one. The first one will be in Jan/Feb prior to the AST meeting to help provide feedback to the AST and to remind everyone of their assigned items. The second will be in Sept/Oct prior to the ADMT meeting. These progress reports may be telecons. This proposal was accepted by the ADMT.

Action item: Put ADMT-20 action items on a Google Spreadsheet and share with ADMT community to help coordinate action status throughout the year. China will be sent separate doc so they can contribute too

## 11 GADR Status of the Archiving centre *(T Boyer) Action item 42,43* (15mn)

Action item: Explore setting up an rsync service at US GDAC to improve archiving at NCEI

Action item: Ask US GDAC to explore ftp connection and see if it is possible to have more than one connection at one time. Study why US GDAC and NCEI ftp synchronization takes 21+ hours

## 12 ARCs: provide an information on what done and what is planned

### 12.1 North Atlantic Cecile Cabanes

**DM consistency checks in the NA-ARC region**

In the Argo data snapshot of June 2019, 2531 floats have been processed in DM in the NAARC region. This year the southern limit of the region has been extended from 20°S to 35°S. Among the 2531 floats, we found 418 floats for which the PI applied a salinity correction and 2084 floats for which no salinity correction was necessary (i.e. the adjusted salinity profile is equal to the raw salinity profile). For each of the 2084 floats, we run the OWC method using four sets of configuration parameters. We further checked the DM salinity correction of a float only if the results gotten for all of the four configurations differ significantly from the result obtained by the PI of the float. We were then able to isolate a small number of floats for which salinity profiles were further checked: sections along the float trajectory, comparison of some profiles with the closest reference data or with the closest real-time Argo data available, if needed. Finally, when we thought it was necessary, we suggested to the PI or DM operator of the float to modify the salinity corrections. A web page has been set up to help track the floats for which the PI or the DM operator has been warned:

http://www.umr-lops.fr/en/SNO-Argo/Activities/NAARC/Consistency-checks-of-DM-salinity-corrections.

**ISAS15 product : a delayed mode in situ temperature and salinity analyses**

ISAS is a data based re-analysis of temperature and salinity fields over the global ocean. It is based on optimal interpolation method and synthesises the temperature and salinity profiles collected by the Argo program as well as different types of profiles and time series (Marine mammals, TAO-TRITON-PIRATA-RAMA moorings and Ice tethered profilers). A configuration using only Argo data is available. The system aims to monitor the time evolution of ocean properties for climatological studies. The data is freely available (http://www.umr-lops.fr/SNO-Argo/Products/ISAS-T-S-fields/Data-access).

**ANDRO product : An Argo-based deep displacement dataset**

The world deep displacement dataset, named ANDRO, has been updated last year. The last release contains data from 8362 floats. Visual quality control is used to qualify the data (representative park pressure, grounded flags). Last year, we were able to add data from 1000 floats. We update, as a priority, the data from the Coriolis DAC.

**Participation to a DMQC cookbook**

It has been decided to write a DMQC cookbook at the end of the Euro-Argo DMQC workshop held in Brest in April 2018 to gather materials that have been prepared. Therefore, this document was first initiated and shared among the workshop's contributors.

The main purposes of this cookbook are to:

- Document the end-to-end processing chain, provide guidelines on existing manuals and explain best practices through use cases.
- Help new DMQC operators and share expertise

Any other contributions will be welcome (other use cases, other regions, ...).

Action item : Rename NA-ARC to Atlantic ARC

### 12.2 Mediterranean Sea

Since 2001, more than 64000 CTD profiles have been acquired. In the last year, about 500 Argo profiles per month were acquired and 36% of these are also BGC profiles (about 11% more than in the past years). In total, 43 new floats were deployed by France, Spain, Italy and Greece and more than 5500 profiles were collected in the last year. The mean half-life of the float population is about 130 cycles which is about half with respect to the global ocean. The mean vertical distance travelled by floats is 105 km; that means about 0.8 km per cycle, a good result if compared to the complex bathymetry of the Mediterranean Sea. DMQC was applied to 67% of the eligible floats. The CTD reference data collection activity is summarized in a MOCCA report (Deliverable D4.4.1). In the framework of a MOCCA activity, a new potential Black Sea operator from the IO-BAS Bulgarian Institute is currently being trained by OGS. Since a manufacturing problem linked to the SeaBird Scientific CTD has been highlighted, a list of the floats, that could be potentially affected by a salinity drift caused by the cells with the serial number in the range of 6000-7100, was created. The salinity of such floats will be analyzed following a defined priority. Two Examples of DMQC for floats in such list with anomalous conductivity sensor behaviour has been presented.

### 12.3 Pacific Ocean Shigeki Hosoda

Since 2006, Pacific ARC is operated by JAMSTEC and IPRC in collaboration with several coastal states of the Pacific region. Main items of the PARC's activity are to monitor the performance of float data and to assess their international consistency, as well as to feedback to PIs and DMQC operators through a website. The PARC website was operated by JAMSTEC and IPRC so far. However, IPRC finds it difficult to continue maintaining the website which IPRC is in change of in part due to limited funding and human resources. Therefore we decided to maintain the website mainly by JAMSTEC, with IPRC supporting through producing useful scientific products. Now JAMSTEC gradually constructs a new PARC website to show the following items:

(1) monitoring results of floats as a Pacific mentor (JAMSTEC)

(2) providing DMQC tools, information of deployment opportunities and related documents (JAMSTEC)

(3) introducing scientific products from Argo float data (JAMSTEC, IPRC).

From the website, we will provide information for float PIs and DMQC operators and interactively exchange them to improve Argo data and the status of array in the Pacific Ocean.

### 12.4 Indian Ocean Uday Bhaskar

As part of the ARC activities in the Indian Ocean, INCOIS has undertaken the following activities during the period Dec, 2018 - Oct 2019:

1. Continue with coordination of float deployments by India and other countries. Continue to render help in processing of Argo floats deployed by NIO, Goa. Using the float density map to identify regions of low float density and suggested deployment in those regions which is extensively used by our deployment team.

2. Continue to implement the recommendations of Bio-Argo working group by obtaining ship based measurements at the time of BGC floats deployment and near pop up locations of active BGC floats.

3. Develop additional wrappers to the SAGEO2 tools for generating the BD files using the gain factor given by the software. This will be made available from the Github for other DACs to use the same.

4. Continue archiving of temperature and salinity profile data from floats deployed by India and other countries in the Indian Ocean and making them available through Web-GIS. Supply of "Argo data and product for Indian Ocean" to students and other researchers with low bandwidth capabilities. A dedicated FTP is setup and the product is being made available. The same page is made available through UCSD website for maximizing the benefit.

5. Continue generation of value added products based on gridded products obtained from Objective and Variational Analysis methods. These value added products are made available on the web and also on the Live Access Server and ERDDAP web sites.

6. Encourage the use of Argo data for assimilation and compared the results of free run with the assimilated runs. Also BGC data assimilation is being processed and test cases were run. Once the results are analyzed the same would be assimilated on day to day basis.

Action item: Ask CSIRO and INCOIS to stop adjusting real time data against CARS climatology. Instead flag it as bad in real time and use it to help identify which floats to DMQC first.

### 12.5 Southern Ocean Matt Donnelly

SOARC has moved from being inactive to being in a healthier state than at any point in corporate memory in the past couple of years, and is working across multiple strands of work.

The SOARC partnership of BODC, CSIRO, BSH and SOCCOM/MBARI is now in the process of working in most areas of ARC responsibilities. Recent discussions have prompted consideration of a holistic approach by SOARC to all the Argo missions in the Southern Ocean, and to that end welcomes discussion with potential additional partners.

Matt Donnelly now represents SOARC on the Southern Ocean Observing System (SOOS) Data Management Sub-Committee (DMSC). This provides a link with the wider community and should minimise duplication of effort in engaging other Antarctic organisations.

SOCCOM has secured an additional round of funding to deploy 30 BGC floats a year up to 2024, whilst BODC/NOC and BSH have secured funding for some SOARC activities from the EU EASME MOCCA project and H2020 Euro-Argo RISE project.

**Essential activities**

- Regional data quality analysis - to be established through work by BODC/NOC and BSH under the EU H2020 Euro-Argo RISE project, work package 5, first in the Weddell Gyre and later on the Antarctic Circumpolar Current.
- Feedback to PIs - will start as part of work on regional data quality analysis work
- Facilitate reference database improvements - CTD in deployment initial assessment planned by end of 2019, followed by start of assessment of reference database gaps in 2020
- Prepare and distribute Argo data products - collaboration currently ongoing between BODC and the University of Bristol to implement profile characterisation by ACC zone

**Optional activities**

- Coordinate Argo float deployments - released 'Argo and the Antarctic Treaty' guide to deploying in the Antarctic Treaty Zone area. Beginning to work with SOOS DMSC and Jcommops to tackle this issue collectively through partnerships with other Antarctic bodies. Beginning to consider other potential alternatives such as Antarctic base resupply vessels.
- Develop new quality control tests - work continuing on near-real time and delayed-mode under-ice positioning options, with the intention to build on the work of Chamberlain et al. (2019) and engage AWI over long-term 'RAFOS roadmap', and continue with development of on-shelf under-ice positioning methods;
- DMQC support to national programmes - CSIRO supporting Italy with 20 Orphan floats, BSH supporting AWI, and BODC now able to support other Argo programmes if required.
- Compare Argo data to models - not a current area of SOARC activity
- Document procedures - new developments and resources being added to website (www.soarc.aq) and SOARC GitHub (https://github.com/argosoarc/).
  Action item: Link to Antarctic Treaty float deployment document from SO-ARC on JCOMMOPS and AST website

Action item: Gather information how it has been done in the past to comply to the Antartic Treaty float deployment

## 13 Summary of the 20th ADMT actions

S Pouliquen and M Scanderbeg assembled the ADMT-20 list of action that were reviewed with the participant. The list is available at:

https://docs.google.com/spreadsheets/d/1X6tMkazwA2YBsj1m1U9Ps039Ese5WAKIS94DeuT0agE/edit?ts=5da6d26e#gid=0

We plan to maintain the status monitoring through a GoogleSheet to facilitate visibility and ease monitoring by the different actors.

## 14 Location of 21st ADMT

Claudia Schmid and Molly Baringer proposed to host next ADMT meeting at AOML Miami in late November 2021.

# 15 Annex1 ADMT20 Agenda

**Wednesday 16th October**

1. **Welcome address: Rodolphe Lemée, LOV Director (15mn)**
2. **Feedback from 20th AST meeting : B. King, B. Owens, T. Suga, S. Wijffels (30mn )**
3. **Feedback on Argo Visualization Workshop and do-a-thon (S. Diggs, M. Belbéoch, M. Scanderbeg) (20mn)**
4. **Feedback on 8th BGC-Argo Workshop: (C. Schmectig) (30mn)**

5. **Status of Argo Program and link with Users (1h15)** *Status on the actions 1, 2, 3, 5, 27*
   - Review of the Action from last ADMT (M. Scanderbeg) Action 1, 2 (20 mn)
   - Argo Status + Real-time Monitoring : including monitoring delays to deliver data to GDACS, monitoring of major anomalies detected each month, requested actions from DACs, trying to identify why some anomalies are not corrected (Mathieu Belbéoch) Action 3,5 (20mn)
   - Interactions with modeling community (P. Oke, B. King) Action item 27 from ADMT-19, Action item 13 from AST-20 (10mn)
   - Euro-Argo-RISE and ENVRI-FAIR EU projects how they will contribute to the ADMT activities (S Pouliquen) 15mn

6. **Real Time Data Management (2h15)** *Status on the actions 4, 6, 8 - 12*
   - GTS status (Anh Tran) (15mn)
   - Processing time of Iridium data at DACs and estimation of 6 hourly delivery target (All DACs) Action 4 (20mn)
   - Status of anomalies at GDAC (Christine Coatanoan) Action7 (15mn)
   - Status on Anomalies detected with Altimetry (Nathalie Verbrugge) (15mn)
   - Feedback on improving spike tests (D. Dobler) Action 6 (15mn)
   - Feedback on using MinMax climatology in RT test (D. Dobler, J. Gourrion, C Coatanoan) Action 8 (15mn)
   - Greylist updates (T. Carval, A. Wong) Actions 9, 10 (10 mn)
   - Gradient climatology from Argo to help QC (B. Owens, S. Wijffels) (15 mn)
   - Flagging of Deep Argo data (N. Zilberman, B. King, S. Purkey, V. Thierry) Action 12 (15 mn)
   - Garmin GPS problem on APEX and NAVIS floats (B. King) (15mn)

7. **GDAC Services (1h30)***Status on the actions: 13 to 24, 35*
   - Operation status at US-GDAC and Coriolis-GDAC (Thierry Carval, Mike Frost) Actions 13,14,15,16,17,18,19 (30mn)
   - Status of Format Checker and process to update Format Checker (Mark Ignaszewski) Action 20-24, 35 (20mn)
     - For profile files (emphasis on existing D-files)
     - For metadata, tech and trajectory files
   - Maintenance of tables centrally – what progress has been made and proposition for the governance of vocabularies (V. Paba, Thierry Carval, Mathieu Belbéoch, Catherine Schmectig) (20 mn)

**Thursday 17th October**

8. **Delayed Mode Data Management (4h00)** *Status on actions 25,26,28 - 31 from ADMT-19, Status on Actions from DMQC-6*
   - Cell Thermal Lag in SBE CTDs and field conductivity drift (K. Martini) (20mn)
   - Calibration of Argo CTDs (D. Murphy) (20mn)
   - Post-processing of RBRargo CTD data (M. Halverson) (15mn)
   - RBR pressure correction analysis (B. Owens) Action 29 (15mn)
   - Update on high salinity drift in SBE CTDs (J. Gilson, N. Zilberman) Action 18 from AST-20 and Action 5 from DMQC-6 (15mn)
   - Monitor percentage of suspicious floats that have been dmoded (DMQC operators, M. Belbéoch) Action 31, 45 (30mn)
   - Summary of action items from DMQC-6 (A. Wong, B. King, J. Gilson) (15mn)

- Propagation of flags assigned in D files to R files (C. Cabanes, R. Cancouet A. Wong) (15mn)
- Progress on DMQC reference databases (1h00)
  a. Summary of the actions since ADMT-19 (C Coatanoan) Action 28 from ADMT-19, Action 6-7 from DMQC-6 (15mn)
  b. CCHDO/US-NODC-progress (S. Diggs, T Boyer)
  c. Deep Argo reference data (N. Zilberman, S. Purkey, Katsumata) Action 25 (15mn)
  d. Gilson Rules updates (J. Gilson) Action 8 from DMQC-6 (15mn)

- How to capture dmode operator in D- and BD-files (A. Wong, H. Bittig) Action 30 (10mn)
- How to capture dmode operator for each BGC variable in AIC database and Core variables at the level of float and not only at program level (M. Belbéoch) Action 26 (10mn)
- Orphan float management (M. Belbéoch) (10mn)
- Development & Implementation of DMQC methods as part of EA Rise (K. Walicka) (15 mn)
- Delayed mode trajectory files (M. Scanderbeg, J. Gilson, D. West-Mack) Action 9 from DMQC-6 (10mn)

9. **Format issues (2h00)** *The new formats mean a challenge for the DACs – how well are we implementing V3.1? What issues remain? Status on the actions : 32 - 34, 36, 39 - 41*

- Upgrade to V3.1 Real-Time and historical T&S floats at GDAC (C. Coatonoan, all) Action 32 (15mn)
- Interaction with NAVIS and ARVOR manufacturers and metadata (M. Belbéoch) Action 20 from AST-20 (10mn)
- Under-ice positions (B. Klein, M. Scanderbeg, C. Schmid, A. Wong, E. Van Wijk) Action 36 (15 mn)
- Combining c- and b-trajectory files (H. Bittig T. Maurer, J. Nair, M. Scanderbeg, C. Schmid, A. Wong) (15 mn)
- Update on Trajectory File Status and DAC Trajectory Cookbook (M. Scanderbeg) Actions 39, 40, 41 (15 mn)
- How to accommodate tech data in a time series from APF11 floats (T. Carval) (10mn)
- Discussion on how to better track Action Items in-between ADMT meetings (M. Scanderbeg, S. Pouliquen, all) (30 mn)

10. **GADR Status of the Archiving centre (T Boyer)** *Action item 42,43 (15mn)*

**Friday 18th October**

**11. ARCs: provide an information on what done and what is planned (1h30)**

- Update on ARC progress (ARCs leaders) Action 44 (15mn each)
- North Atlantic Cecile Cabanes
- Mediterranean Sea Gulio Nortastefano
- Pacific Ocean Shigeki Hosoda
- Indian Ocean Uday Bhaskar
- Southern Ocean Matt Donnelly

**12. Summary of the 20th ADMT actions ( S Pouliquen, M Scanderbeg) 30mn**
**13. Location of 21st ADMT**

## 16 ADMT20 attendance list

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## 17 ADMT19 Action list status

| | Action | Target Date | Responsibility | Priority | Status |
|---|---|---|---|---|---|
| 1 | People who want to contribute to the Best Practice Data Paper to contact ADMT co-chairs. Esmee van Wijk and Annie Wong want to help with the DMODE section. S. Pouliquen with the data system as a whole. M. Belbéoch for Monitoring, T. Carval for Real time GDAC operations, A. Tran for GTS, U. Bhaskar, R. Cowley, M. Scanderbeg | ADMT 20 | E. van Wijk<br>A. Wong<br>S. Pouliquen<br>M. Belbéoch<br>A. Tran<br>U. Bhaskar<br>R. Cowley<br>M. Scanderbeg<br>P. Velez-Belchi | R | Maybe not do a paper, but still would be helpful to put this information out there. Could be information between general Argo descriptions and Argo cookbooks. Refer back to AST to identify lead author. |
| 2 | Ask National Programs to add names of people who have contributed to the Argo Data system along with possible ORCID to Google Doc. This list will comprise the list of authors associated with GDAC DOI. https://docs.google.com/spreadsheets/d/1ZRJxzIqbPpJnBCFIW1dvCi_zi3gG1VHYaU9dB09-_8Y/edit#gid=1975012295 | AST 20 | Thierry, National Programs | R | done<br>On August 23 2019, the contributors list contained 259 entries |
| 3 | M. Belbéoch to study why delay is different between GDACs and GTS | ADMT 20 | M. Belbéoch | R | Improved |
| 4 | DACs to explore speeding up processing of Iridium data to make it available between 6 to 12 hours. Come back with estimate of hourly target they can meet. Communicate with PIs and DAC to synchronize data delivery. | ADMT 20 | DACs | R | Decided to move up to 12 hour delivery target |
| 5 | J. Turton and M. Belbéoch working on a solution to create and capture WIGOS-ID in the Argo data system. They are asked to consider adding this information only to the meta file to minimize reprocessing. | ADMT 20 | M. Belbéoch, J. Turton | R | Done. May need reprocessing for some files.<br>Need to change BUFR template.<br>Need to add meta var with WIGOS-ID |
| 6 | Assess and test improvements on proposed spike tests using D-mode flags as the truth. Report back at ADMT20 | ADMT 20 | C. Coatanoan | R | Report at ADMT-20 |

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| 7 | When flagging pressure during the RTQC test, put a flag of '2' for pressures between -2.4db and -5db. Update QC Manual accordingly. | ADMT 20 | DACs, A. Wong, T. Carval | | The latest version of Argo QC manual for CTD needs an update to implement ADMT-19 action 7.<br>On page 10, the global range test should be modified :<br>• Pressure values within ] -5, -2.4 ] decibars are flagged '2' (probably good data)<br>• Pressure values < -5 decibars are flagged '4' (bad data)<br><br>A new version of the QC manual will come out after ADMT-20 with these changes. |
| 8 | Report back on MinMax implementation in real time at next ADMT meeting. | ADMT 20 | S. Pouliquen, B. Owens | R | Report at ADMT-20 |
| 9 | Reach out to operational users to communicate that greylist is no longer necessary for them to use. Instead, please use QC flags to decide what data to use whether it comes from GTS or GDACs. | ADMT 20 | ADMT co-chairs, AST co-chairs, ADMT, P. Oke | R | In progress. Spoken to some operational users. Have the opportunity at upcoming workshop prior to AST-21. |
| 10 | Update QC manual to allow greylisted parameters to be distributed on the GTS and to allow a QC flag of '2' to help Argo keep track of floats with malfunctioning sensors. | ADMT 20 | A. Wong, T. Carval | R | Done<br>16/01/2019<br>http://dx.doi.org/10.13155/33951<br>Test 15, greylist definition revised and allow qc='2'. |
| 11 | DACs to send all data onto the GTS in BUFR format, even greylisted sensor data, with appropriate QC flags. | AST 20 | DACs | R | done at Coriolis DAC |
| 12 | Group of experts to study the Deep Argo data to see if data is good enough to move QC flags up from '3' or '2'. Task is to put an error bound on the raw data. Report to AST. | AST 20 | N. Zilberman, G. Maze, S. Hosoda, B. King, S. Purkey | R | In progress.<br>Reporting at ADMT-20 |
| 13 | NMDIS and Coriolis GDAC to solve the issue of D file submission | AST 20 | Mingmei Dong, T. Carval | R | done |
| 14 | Improve synchronization between US GDAC and French GDAC to make CSIO data available more rapidly | ADMT 20 | M. Ignazewski, t. Carval | R | implemented in December 2018 for nmdis and csio |
| 15 | Keep DOI monthly download available | AST 20 | T. Carval | R | since July 2019, the DOI |

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| | with one click and one DOI. Inside the download, split the GDAC holdings into two compressed files per DAC: one for core and one for BGC files. Include README file with naming conventions inside. Include all documentation for all User Manuals. | | | | contains distinct core-argo and bgc compressed files. Valid version of documents are in "doc" directory, obsolete versions are i "doc/obsolete" directory. A readme.tx file was added in the "doc" directory. |
| 16 | S-prof files will replace M-prof files and will be compressed into NetCDF4. GDACs to decide whether to both produce S-prof files or to mirror them. Inform users through ADMT website, emails. | AST 20 | T. Carval, M. Ignazewski | R | Done at Coriolis. US GDAC working on synchronization of S-prof files. M-prof files to be replaced by S-prof files. M-prof file distribution will stop in Dec 2019. |
| 17 | Remove zipped GDAC files from Coriolis. Only serve them on DOI page. | ADMT 20 | T. Carval | R | Zipped files are no more available from GDAC ftp "etc" directory. |
| 18 | Add PARAM into b-traj index file | AST 20 | GDACs | R | done |
| 19 | Allow MISSION_CONFIG_NUMBER of 0. Change User Manual to add that N can be 0. File Checker can also accept fill value. | ADMT 20 | A. Wong, T. Carval, M. Ignazewski | R | Update in manual version 3.3<br>§2.2.4 allow CONFIG_MISSION_NUMBER = 0 |
| 20 | Move from warnings to rejections by AST-20 meeting for all GDAC File Checker tests. | AST 20 | M. Ignaszewski | R | Will be done by January 2020 |
| 21 | For changes to be made intersessionally to the File Checker, send requests to the ADMT exec team. ADMT exec team will evaluate the suggestion and send out decision for approval from ADMT. | ADMT 20 | ADMT exec team, DACs | R | Not needed yet. |
| 22 | Stop accepting D-mode files < v3.1. | AST 20 | GDACs | R | Mark will confirm that the format checker rejects D-mode files format < 3.1 |
| 23 | Put all existing v3.1 files through current FileChecker and report results to ADMT. | AST 20 | M. Ignaszewski | R | Will be done in November 2019 |
| 24 | Trajectory File Checker live by AST 20 | AST 20 | M. Ignazewski | R | Will be done in January 2020 |
| 25 | Ask Deep Argo to work on creating a subset of CCHDO/ref DB CTD data that can have a flag assigned to it to indicate it is high quality. | ADMT 20 | Deep Argo, S. Purkey, Katsumata | R | In progress.<br>Reporting on at ADMT-20. High quality CTDs being identified. |
| 26 | Add DM operator for each BGC | ADMT | M. Belbéoch | R | Not done yet. |

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| | variable into AIC database | 20 | | | |
| 27 | Check with operational centers that they are using GDAC data for reanalysis products | ADMT 20 | P. Oke through GODAE OV | R | In progress |
| 28 | C. Coatanoan to document how she deals with duplicate CTD in ref DB | ADMT 20 | C. Coatanoan | R | Report at ADMT20 |
| 29 | Breck Owens to apply pressure correction to RBR sensors and analyze the dataset. Asked to present results to AST-20 | AST 20 | B. Owens | R | Report at ADMT20 |
| 30 | Set up a group to look at how to record DM operator in profile file, by N_PROF, parameter and data mode. Suggest to make it machine readable using a code rather than a name. People will not be asked to go backwards in time, but will be helpful going forward. | ADMT 20 | Henry, Annie, Sylvie, Mathieu | R | Draft proposal sent to argo-dm-dm. Will be finalized during ADMT20. |
| 31 | Make a list of floats that need to be looked at quickly based on semi-automated tests and CTD serial numbers likely to drift salty. DMQC operator to report in ADMT meeting report how they did. M. Belbéoch to monitor as well. | ADMT 20 | M. Belbéoch, DMQC operators | R | In progress. Hasn't done this for high salinity CTDs or MinMax test yet. |
| 32 | DACs to consider converting very old files into v3.1 rather than trying to re-decode. This would help get floats into v3.1 and it is understood that it can be very difficult to find decoders. | ADMT 20 | DACs | R | |
| 33 | J. Gilson to provide a list of CTD serial numbers and D. Murphy to send PRES serial number back. J. Gilson to share with community. | ADMT 20 | J. Gilson, D. Murphy | R | Done. ftp://kakapo.ucsd.edu/pub/gilson/CTDSN_Census_Jan19/ |
| 34 | J. Gilson to do another CTD serial number and CTD model assessment. He will individually email the DACs with the largest issues. Ask DACs to try and correct these issues. High priority on CTD serial number and pressure sensor. | AST 20 | J. Gilson, DACs | R | Done by John. ftp://kakapo.ucsd.edu/pub/gilson/CTDSN_Census_Jan19/ |
| 35 | Ask File Checker to update to check against allowed sensors by parameter. Consider other cross reference checks. | ADMT 20 | M. Ignazewski | R | Will be done in February 2020 |
| 36 | Under-ice working group to update Table 9 to add NONE and a method to include more than one positioning system in string 8. Update table 5. | AST 20 | E. VanWijk, C. Schmid, B. Klein, M. Scanderbeg, A. | R | Done |

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| | Include Beidou and European satellite system that is coming online as well. Add error of magnitude to G, I, R accuracy. Suggest an MC between 250 and 299 to use for RAFOS positions. | | Wong | | |
| 37 | Update User's manual with instructions on how to fill FIRMWARE_VERSION and change field length to 64, but still accept 32. | AST 20 | Thierry Carval | R | done in manual version 3,3 §2.2.4 §2.3.4 §2.4.4 Is the statement in §2.4.9 sufficient: *if exists then not empty otherwise default value = "n/a"* |
| 38 | Accept suggested changes to Battery variables. Update manuals and FileChecker accordingly. | AST 20 | R. Cowley, B. Klein, T. Carval, M. Ignazewski | R | In progress |
| 39 | Working group to study whether core and BGC trajectory files can be combined into one file. | ADMT 20 | H. Bittig, M. Scanderbeg, T. Maurer, J. Gilson | R | In progress. |
| 40 | Complete updated version of DAC Trajectory Cookbook | AST 20 | M. Scanderbeg | R | Done |
| 41 | Find a way to share excel tables from J-P Rannou on how Coriolis processes data from APF11, Arvor and Provor floats | ADMT 20 | J-P Rannou, M. Scanderbeg, T. Carval | R | Done on : http://www.coriolis.eu.org/Data-Products/Tools/Web-page-dedicated-to-Coriolis-Argo-decoder This page is listed on: http://www.argodatamgt.org/Documentation/Tools And on: Coriolis Argo floats data processing chain https://doi.org/10.17882/45589 |
| 42 | Improve synchronization between NCEI and GDAC to reduce mirroring time. | AST 20 | T. Boyer, T. Carval | R | A manifest sample file was sent to Tim, waiting for feedback. The manisfest will improve the rsync process. Tim likes the simple manifest. |
| 43 | Investigate problem with Argo GDAC as MCDS and try to resolve it. Marine Climate Data Center | ADMT 20 | M. Belbéoch, T. Boyer | R | Postponed |
| 44 | Ask all ARCs to check ARC web URLs on Argo Data Management web site (http://www.argodatamgt.org/) and provide updated URL if needed | AST 20 | ARCs | R | done |
| 45 | Ask DACs and DMQC operators to look | ADMT | DACs, DMQC | R | In progress |

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| | at NAARC website and try to resolve issues with PSAL corrections. http://www.umr-lops.fr/en/SNO-Argo/Activities/NAARC/Consistency-checks-of-DM-salinity-corrections | 20 | operators | | |
| 46 | Get RBR CTD serial number when they changed to new onboard pressure calibration | | | | Done: https://oem.rbr-global.com/floats/0007457 |

## 18 ADM20 Action list

There is a Google Spreadhseet with the Action items:

https://docs.google.com/spreadsheets/d/1X6tMkazwA2YBsj1m1U9Ps039Ese5WAKIS94DeuT0agE/edit?usp=sharing

# 19 National reports

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

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## Deployments in 2018/19

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

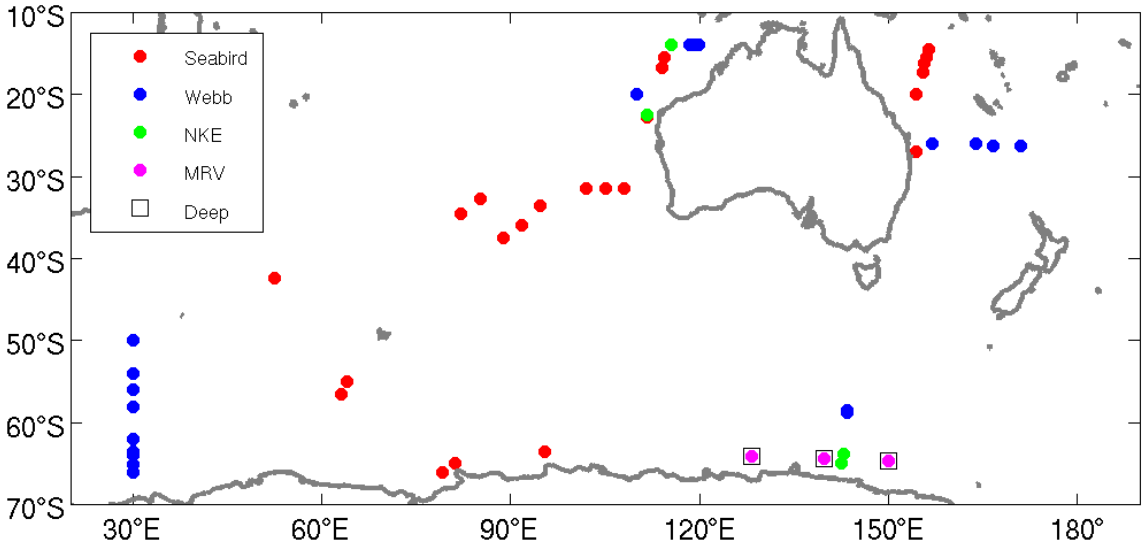



**Figure 1: Map of Argo Australia deployments between 1 October 2018 and 30 September 2019, showing the float manufacturer and float type (noting three are Deep floats and the rest are core).**

## Planned Deployments in 2019/20

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

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

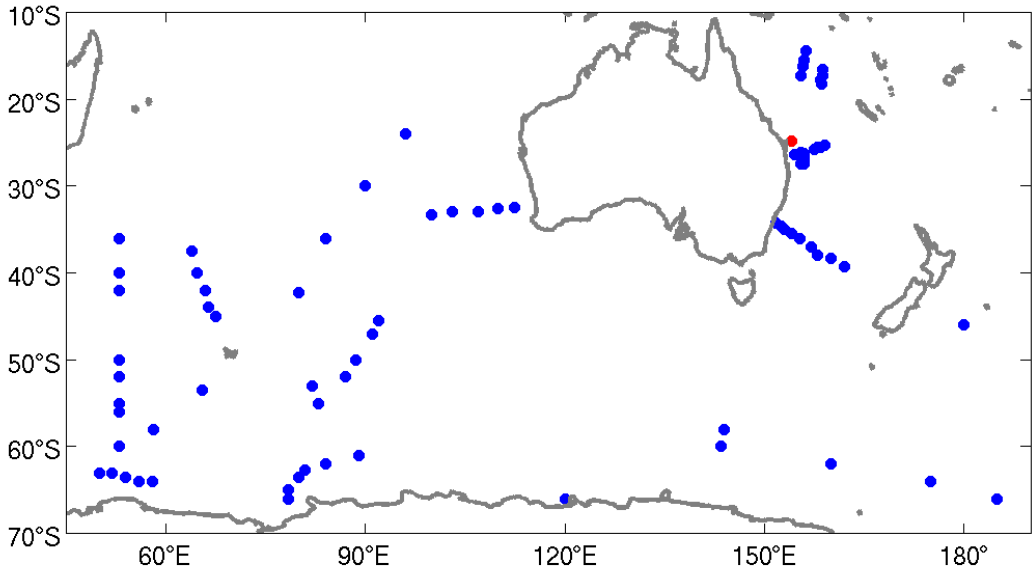



**Figure 2: Map of the planned deployment locations for the floats currently held by Argo Australia. The blue dots show the planned locations of the 94 core float deployments, and the red dot shows the planned location of two BGC floats.**

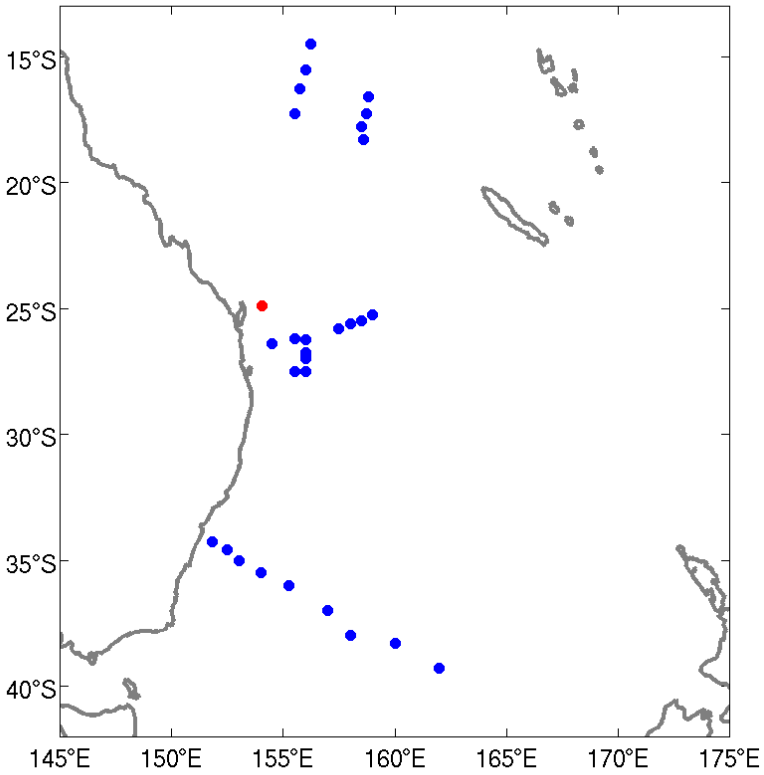



**Figure 3: Zoom into the Coral and Tasman Sea, showing the planned deployment locations for the floats currently held by Argo Australia. The blue dots show the planned locations of core float deployments, and the red dot shows the planned location of two BGC floats.**

## Organization and resourcing

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

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

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

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

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

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

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

## Status of RT Operations

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

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

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

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

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

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

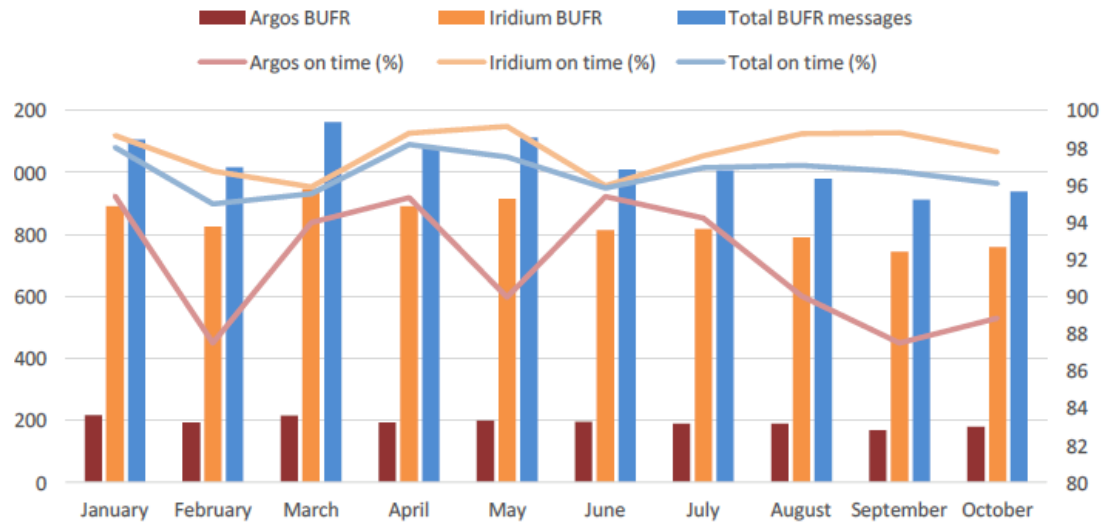



**Figure 4: Summary of RT metrics for the Argo Australia operation.**

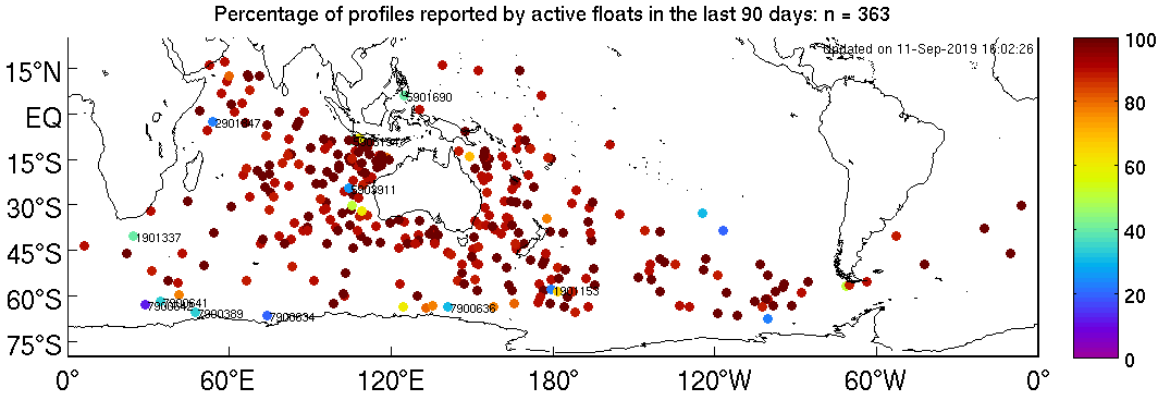



**Figure 5: Map of the current locations of operational floats managed by Argo Australia. The color of each dot indicates the percentage of data return over the last 90 days; with 100 indicating that 9 out of 9 profiles have been returned. Floats that have reported profiles fewer than 5 times in the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

## Status of DMQC Operations

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

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

## Data Usage and Websites

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

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

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

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

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

**Argo Canada National Data Management Report**

**ADMT20**

Villefranche-sur-mer, France, Oct 13-18, 2019

## 1. Status

- *Data acquired from floats:*

  We are currently tracking 110 floats of which 13 floats might have failed to report within the last two months. Since December 2018, we deployed a total of 32 Argo-core, and 2 Argo-Core equipped with dissolved oxygen sensors. Thirty-two of the new floats were ARVOR-I floats acquired from NKE and two were NOVA floats acquired from MetOcean. In addition, NAOS-Canada deployed one biogeochemical Argo floats acquired from NKE. All reported on the Iridium satellite system.

  Furthermore, there has been increasing interest from the university community in participating in BGC-Argo through research projects(e.g. C-PROOF at University of Victoria). This is placing additional pressure on the DAC in terms of planning for data management.

- *Data issued to GTS*

  All data are issued to the GTS in BUFR formats. Since December 2018, on average, 82% of data were issued on the GTS within 24 hours in BUFR formats. In March 2019, one of the servers was downed due to hardware failures, and the percentage of data issued on the GTS within 24 hours was less than 50%.

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

  The profile, technical, trajectory and meta files are transmitted to the GDACs in NetCDF format version 3.1 on an operational basis with some additional delay compared to the data sent on the GTS, because the two processes run on different servers. There are still a number of trajectory NetCDF files of dead floats that are not in format version 3.1 at the GDACs.

- *Data issued for delayed QC*

Data are available for delayed mode QC as soon as they are sent to the GDACs, but only for floats deployed for at least 6 months.

- *Delayed data sent to GDACs*

  The DMQC eligible files from 38 floats (~2781 cycles) were quality-controlled or re-quality controlled for salinity or pressure since October 1, 2018.

- *Web pages*

  http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/index-eng.html

  We maintain web pages that show float tracks and all data collected by Canadian floats. Links to both real-time and delayed mode data are also available for download directly from GDAC. The pages are updated daily.

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

  a. 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.

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

**2. Delayed Mode QC**

As of October 2, 2019, 50% of all eligible floats, active and inactive, had their profiles QCed visually and adjusted for pressure according to the latest delayed-mode procedures at least once. The salinity component of DMQC had been performed at least once on 68% of eligible cycles. 38% of eligible B-files had been visually QC'd, and 12% were fully DMQC'd. In addition to DMQC of new profiles, 17 previously-processed floats received either updates to the visual QC or new adjustments in response to feedbacks (e.g., reports of density inversions).

Currently, Canada is looking into implementation of SAGEO2-Argo software developed by Monterey Bay Aquarium Research Institute to evaluate Oxygen collected by NOVA floats which didn't collect any in-air oxygen measurements.

For oxygen data collected by floats which performed in-air measurements, we are planning to use the method described in "Oxygen Optode Sensors: Principle, Characterization, Calibration, and application in the Ocean" by Henry Bittig et al. (2018), ORCID 0000-0002-8621-3095

**3. GDAC Functions**

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.

**4. Regional Centre Functions**

Canada has no regional centre function.

# Chinese Argo National Data Management Report

# ADMT-20

**Sorbonne Univeristy, France, 13-18 October 2019**

Zenghong Liu[1], Xiaogang Xing[1], Mingmei Dong[2]

1) Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou
2) National Marine Data & Information Services, Ministry of Natural Resources, Tianjin

## 1. Status

(Please report the progress made towards completing the following tasks and if not yet complete, estimate when you expect them to be complete)

- Data acquired from floats

From the last ADMT (Dec 2018- Sep 2019) China acquired 4,259 TS profiles (additionally 472 O2, 675 CHLA, 675 BBP, 558 CDOM, 384 DOWN_IRRADIANCE, 384 NITRATE and 206 pH profiles) from 105 (including 9 BGC floats) operational floats (Fig.1).

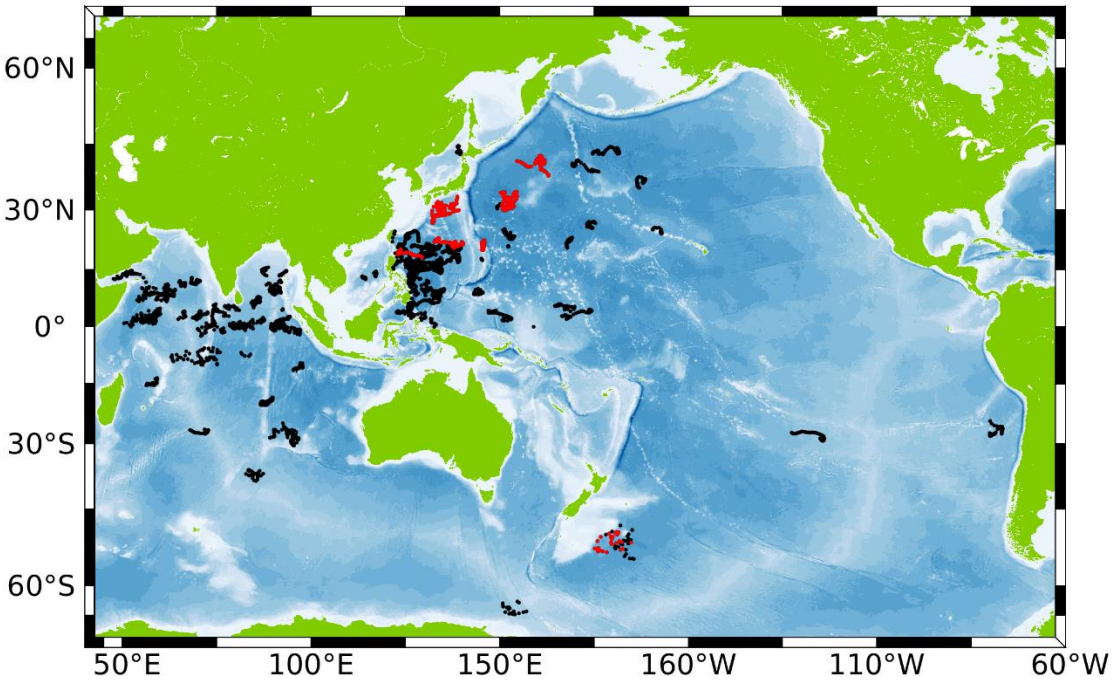



Fig.1 The geographic distributions of Core (black) and BGC (red) profiles

- Data issued to GTS

Every day CSIO sends BUFR bulletins to GTS through Beijing node (038) from China Meteorological Administration (CMA). With the perl script developed by JMA, CSIO is able to convert TS & O2 profiles into BUFR. An interruption happened during May-July 2019 due to a problem of the FTP server from Meteorological Bureau of Zhejiang Province.

- Data issued to GDACs after real-time QC

The meta, technical, trajectory and profile files are submitted to GDAC in netCDF format version 3.1 on an operational basis. A new decoder for two full-equipped (six BGC parameters) PROVOR-IV BGC floats was developed this year. The RT-QC procedures for DOXY, CHLA, BBP and pH are being applied.

- Data issued for delayed QC

This August CSIO sent a technician to CSIRO for receiving a DMQC training under the support from the Ministry of Science and Technology (MOST). Presently she can use OWC tool and is accelerating the pace of eliminating the backlog at CSIRO. We thank CSIRO for their sincere help to China Argo.

- Delayed data sent to GDACs

11,689 D-files (6,018 D-files and 5,671 BD-files) were submitted to GDACs this year from CSIO. The backlog is still there, about 3,7000 profiles are DM pending.

- Web pages

**HomePage :**

Currently the China Argo Real-time Data Centre (Hangzhou) maintains a website (http://www.argo.org.cn) from which the latest progress on China Argo, the real-time observations from Chinese floats including data file and related plots are provided. Some Argo products and a Web-GIS based global Argo data inquiry system are also provided and updated to users.

**Data Service :**

A web-GIS based webpage has been developed and maintained by CSIO, from which users are able to inquire and download the global Argo observations (http://platform.argo.org.cn:8090/flexArgo/out/index.html).

A similar webpage for global BGC floats is being developed by Zhejiang University.

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

  Operational uses: NMEFC and NMDIS from MNR, IAP/Chinese Academy of Sciences have applied Argo data into their operational models.

  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.

  Until now, about 11 PIs from 7 institutions have deployed profiling floats and share data with Argo community.

- Products generated from Argo data

  **BOA_Argo**: It is now 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.

  **Post-QC'd global ocean Argo dataset**: The dataset is based on a FAST post-QC toolbox developed by CSIO, with which users are able to conduct a quick QC for all the T/S profiles downloaded from GDAC. It is a quarterly updated Argo dataset after a careful screening (ftp://ftp.argo.org.cn/pub/ARGO/global/core/).

  **Global ocean BGC-Argo dataset**: The dataset is derived from the B-files on the GDAC, and is separated into various txt files according to BGC parameters. The dataset is also expected to be quarterly updated depending on the CSIO resources (ftp://ftp.argo.org.cn/pub/ARGO/global/bgc/).

## 2. Delayed Mode QC

(Please report on the progress made towards providing delayed mode Argo data, how it's organized and the difficulties encountered and estimate when you expect to be pre-operational.)

The OWC tool developed by CSIRO currently cannot handle DMQC for multiple profiles files. We hope CSIRO update the software, which will enable us to deal with many profiles with N_PROF=2 from APEX Iridium floats. The lack of historical shipboard CTD data in the South China Sea will make it difficult for us to correct salinity drift found in several HM2000 floats.

Dr. Xiaogang Xing from CSIO is leading the DMQC for observations from BGC floats.

Oxygen data observed by 17 Provor floats deployed in the northwestern Pacific in 2014, have been quality-controlled, by comparison to the climatology WOA13 as in Takeshita et al. (2013). The obvious drift appeared after about three months after deployed for all 17 Provor, probably due to the biofouling. The “drift date” for each sensor was identified and the slope factor m was obtained for correcting all the profiles before the “drift date”. The corrected Oxygen data were uploaded in the DB files, where all profiles after the “drift date” were not processed.

Nitrate data observed by Float 2902753 and 2902756 (two 6-variable Provor floats deployed in March of 2019 in the northwestern Pacific gyre), had the abnormal positive bias at sea surface due to the high temperature (> 20°C), which cannot be well solved by tuning the reference wavelength. Ken Johnson provided a new temperature-salinity correction algorithm, which worked well as long as the reference wavelength was tuned as 208.5 nm and 209 nm for two floats, respectively. The new algorithm was, therefore, suggested to be published as soon as possible.

FDOM (CDOM) data observed by Float 2902753 and 2902756 appeared the “detection-limit” issue which was never seen before. The detection limit was found as 49 raw counts for 2902753 and 50 for 2902756, from ~70 m to sea surface at the local noon (No such an issue at local night). The detected minimum counts

are consistent to our on-float-measured dark count values (50 and 50). We guess it is related to the extremely low FDOM in the northwestern Pacific gyre, even much lower than 1 count at daytime due to the strong photo-bleaching, but FDOM could be supplied by vertical diffusion or produced by upper-layer ecosystem itself (phytoplankton, zooplankton, bacteria) during the night.

**3. GDAC Functions**

(If your centre operates a GDAC, report the progress made on the following tasks and if not yet complete, estimate when you expect them to be complete)

None

**4. Regional Centre Functions**

(If your centre operates a regional centre, report the functions performed, and in planning)

None

# Argo data management report 2019

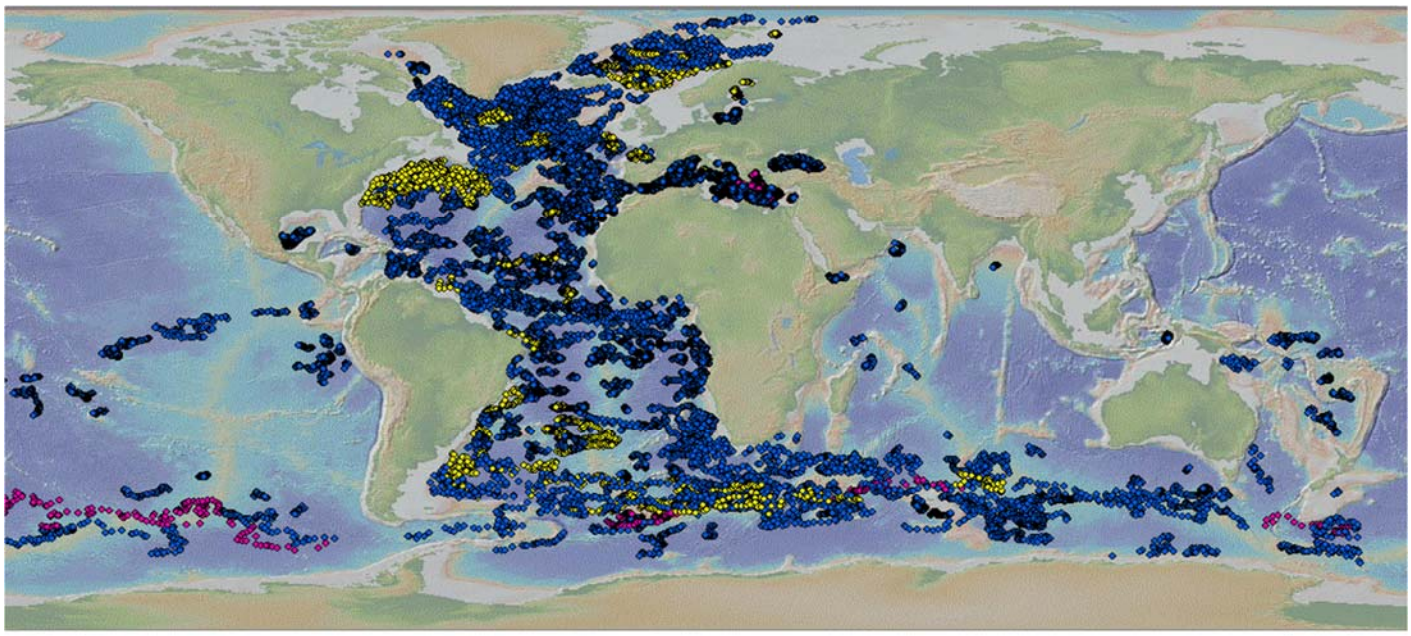
## Coriolis DAC & GDAC

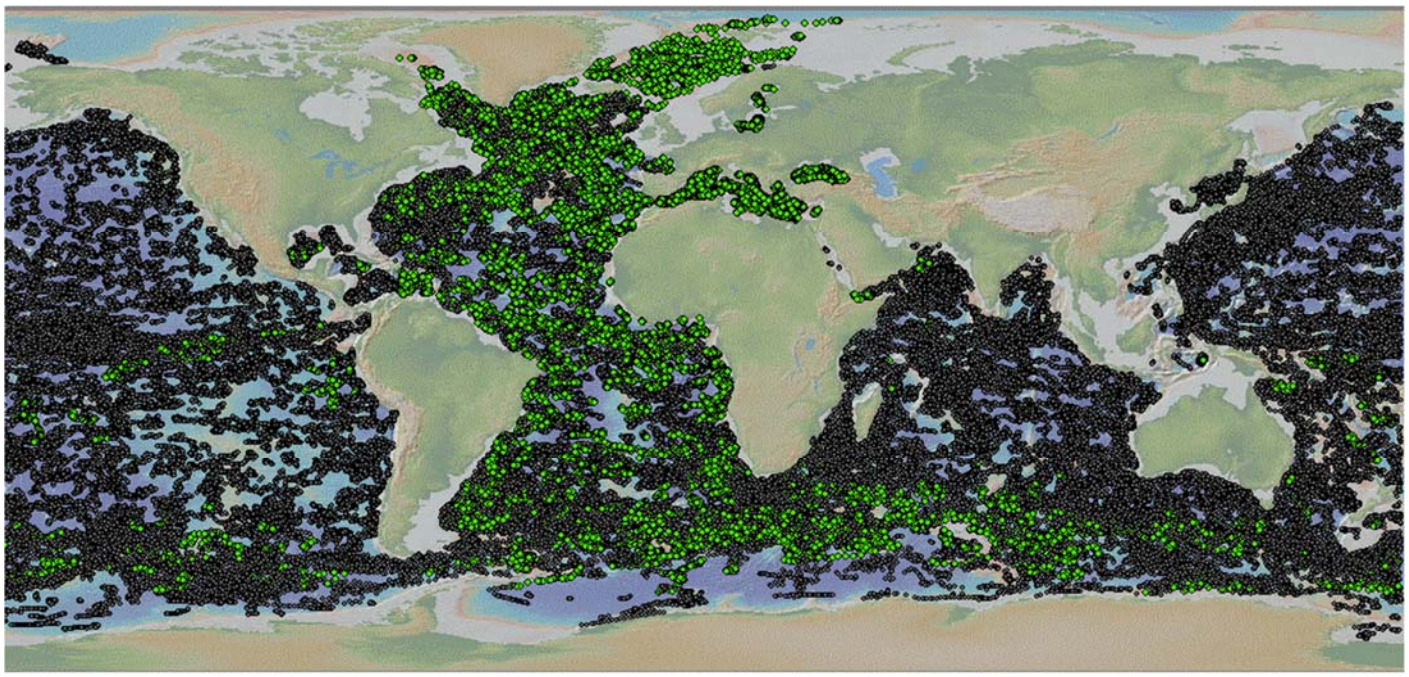
Data Assembly Centre and Global Data Assembly Centre

Annual report September 2019

Version 1.0

https://doi.org/10.13155/xxx





# 1 DAC status

This report covers the activity of Coriolis data centre for a one-year period from July 1st 2018 to August 31tt 2019.

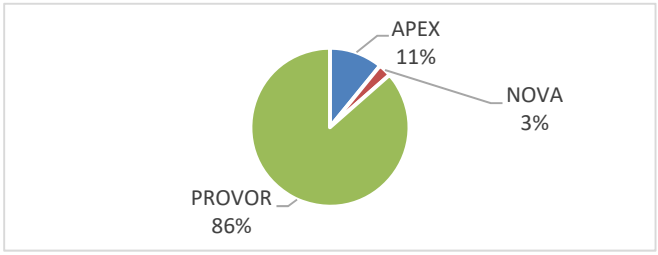
## 1.1 Data acquired from floats

### 1.1.1 Active floats for the last 12 months

These last 12 months, **34.921 profiles from 827 active floats** were collected, controlled and distributed.
Compared to 2018, **the number of profiles is significantly increasing (+15%), the number of floats increased by 4%.**
These figures illustrate a good momentum in Coriolis DAC activity.

The 827 floats managed during that period had 51 versions of data formats.

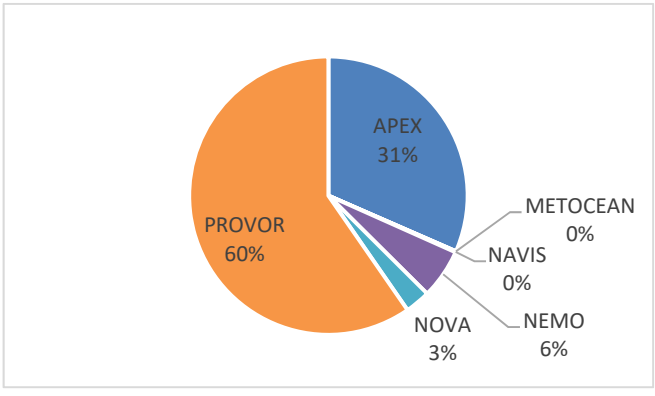
| Coriolis DAC, active floats in 2019 | | | |
|---|---|---|---|
| Float family | nb versions | nb floats | nb core profile files |
| APEX | 19 | 90 | 3 069 |
| NOVA | 2 | 22 | 696 |
| PROVOR | 30 | 715 | 31 158 |
| **Total** | **51** | **827** | **34 923** |

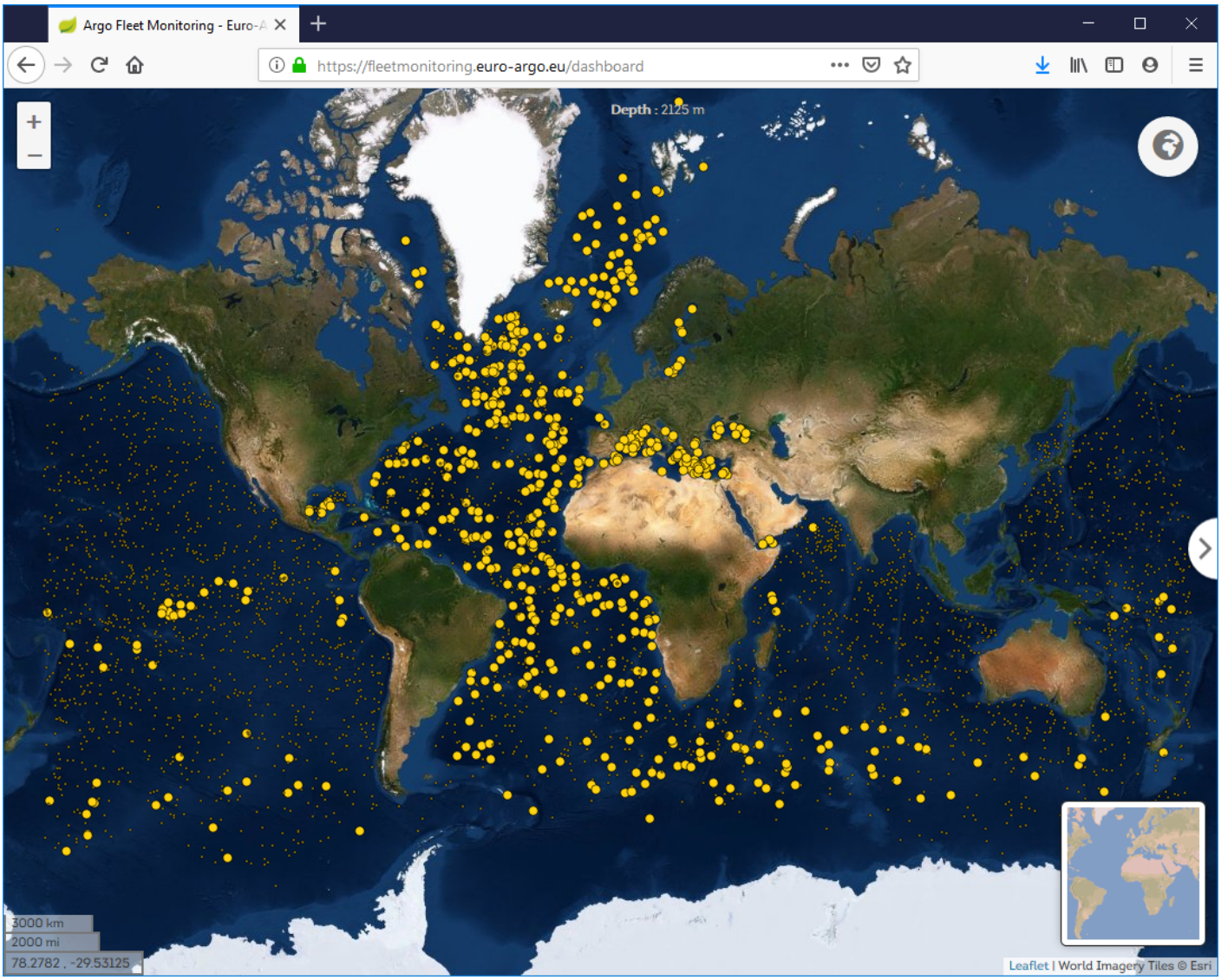



### 1.1.2 All floats managed by Coriolis DAC

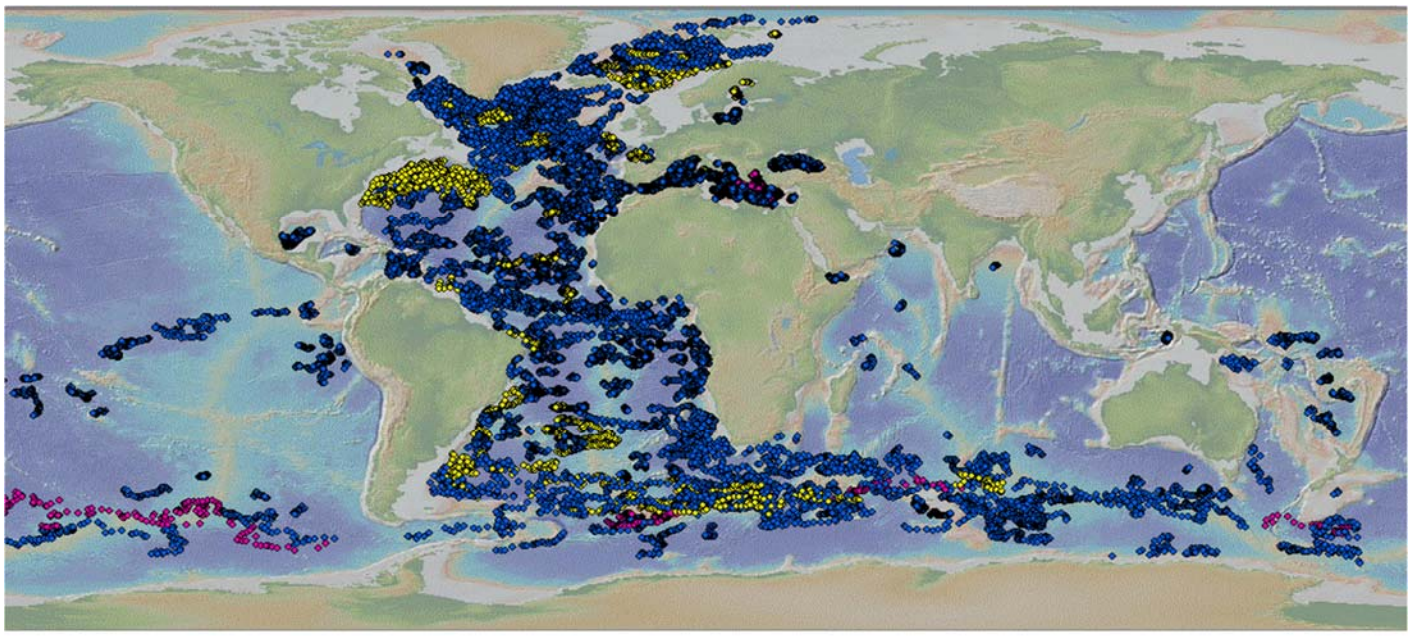
Coriolis DAC manages a total of 2.809 floats with 146 versions, from 6 families.
These floats reported 324.351 core Argo vertical profiles.

| Coriolis DAC, all floats, 2019 | | | |
|---|---|---|---|
| Float family | nb versions | nb floats | nb core profile files |
| APEX | 69 | 886 | 103 867 |
| METOCEAN | 1 | 1 | 52 |
| NAVIS | 1 | 3 | 644 |
| NEMO | 8 | 162 | 8 902 |
| NOVA | 3 | 82 | 6 100 |
| PROVOR | 64 | 1 675 | 204 786 |
| **Total** | **146** | **2 809** | **324 351** |

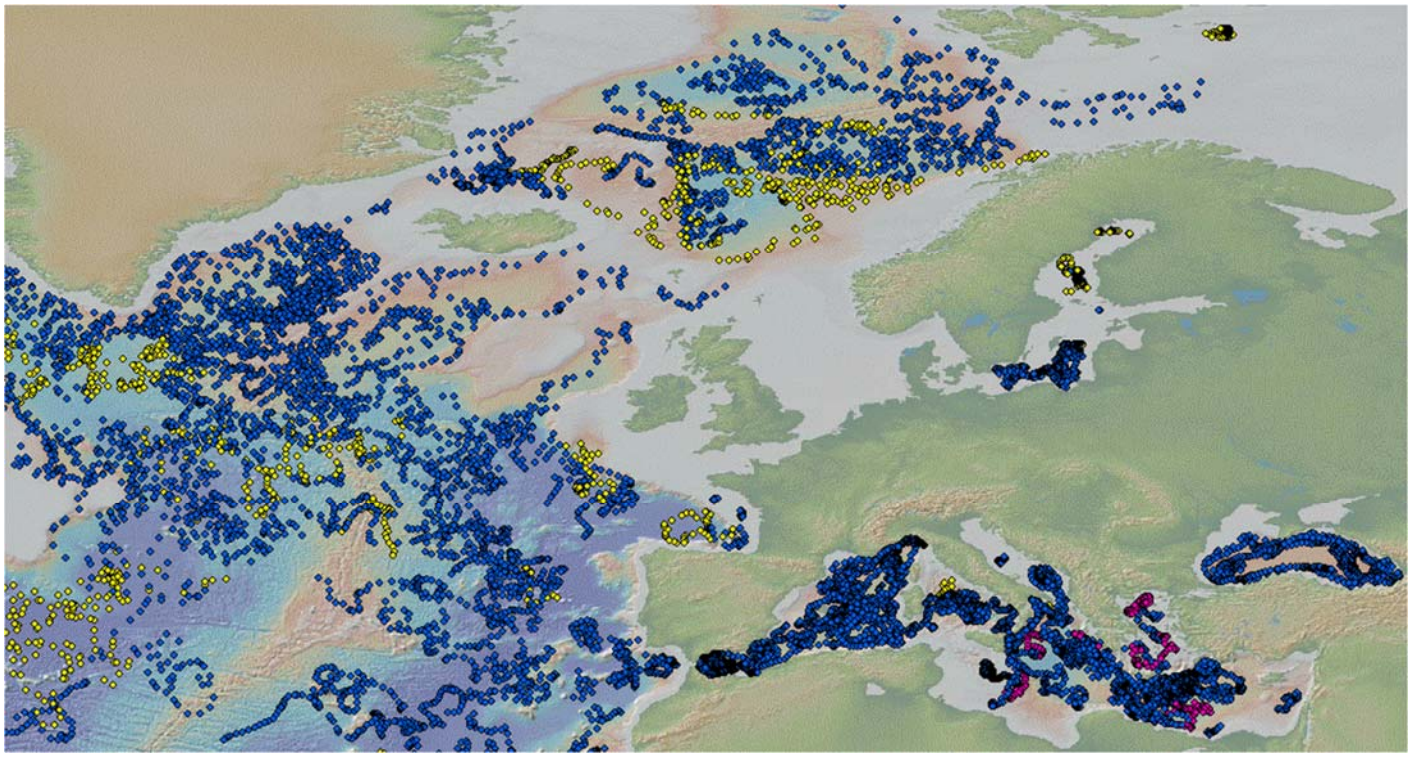




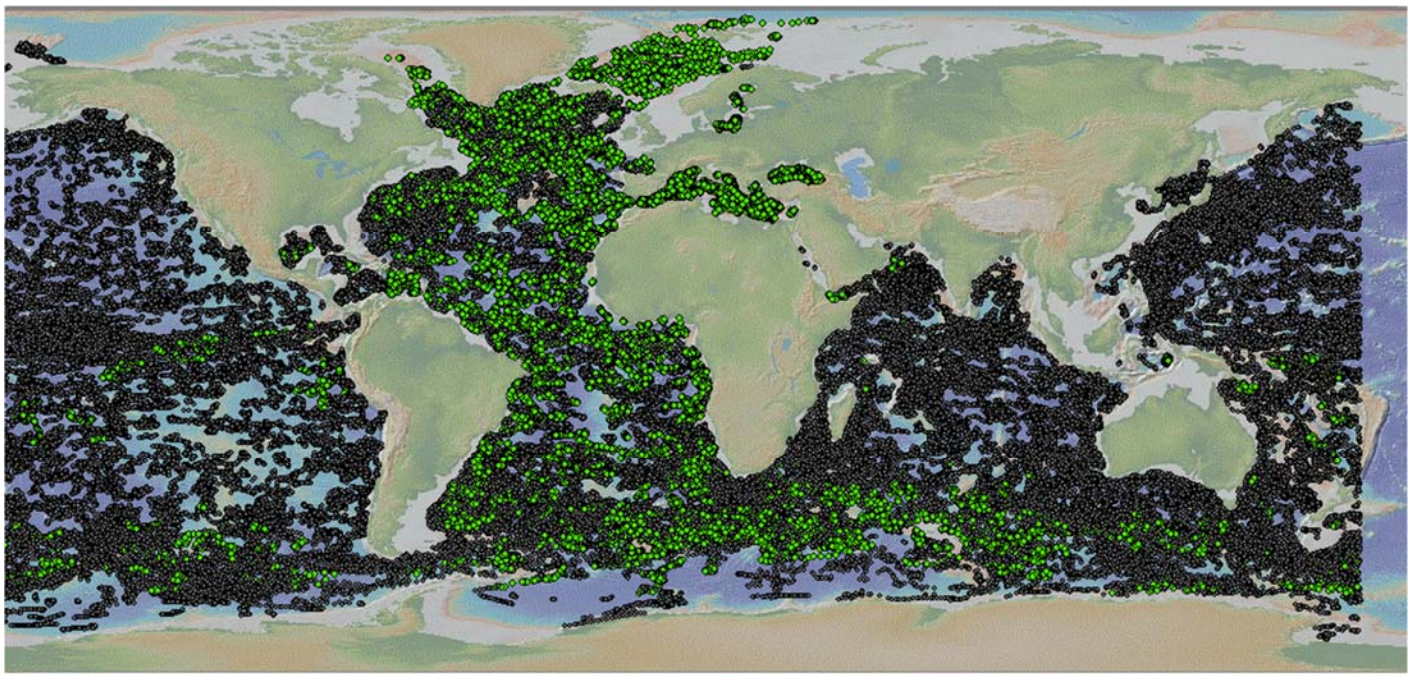

Map of the 827 active floats decoded by Coriolis DAC this current year, among others DACs (small dots)



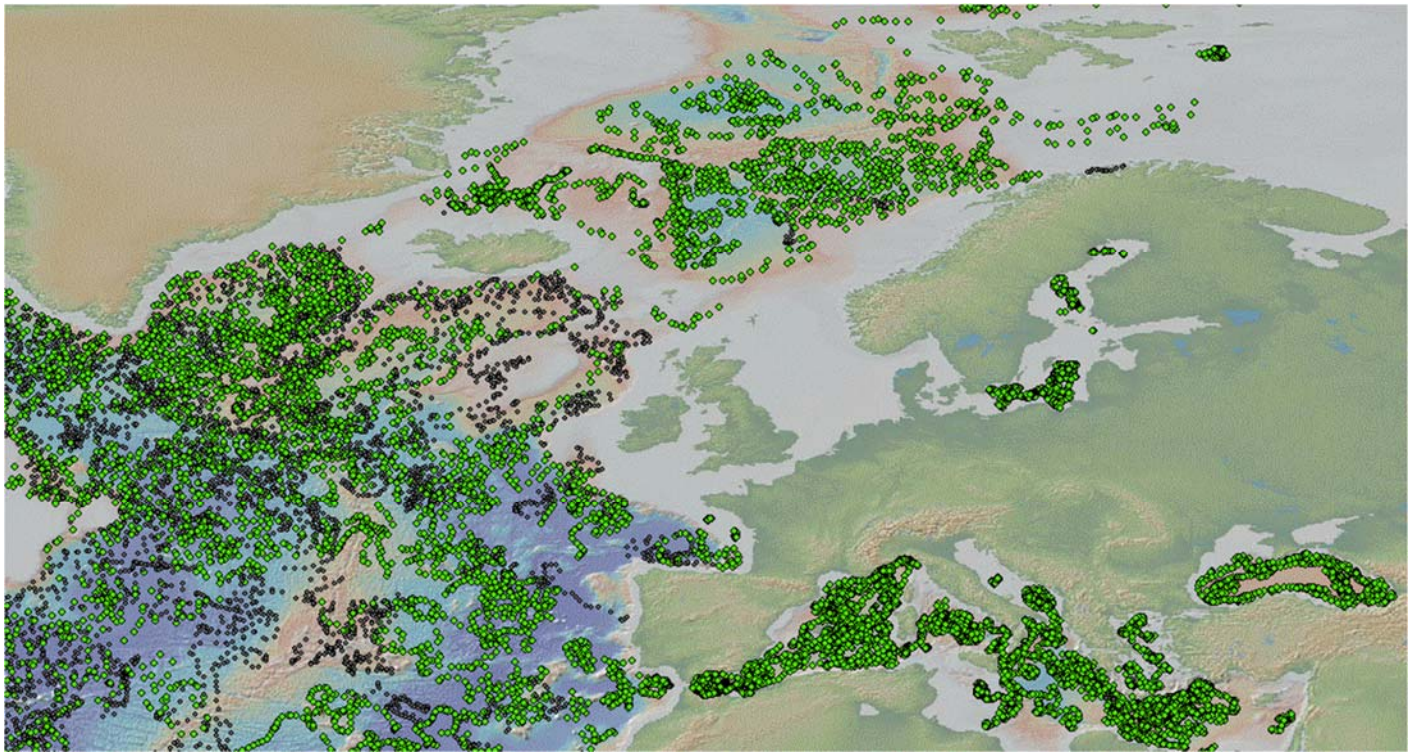
Map of the 34 923 profiles from 827 active floats decoded by Coriolis DAC this current year
Apex Nova Provor



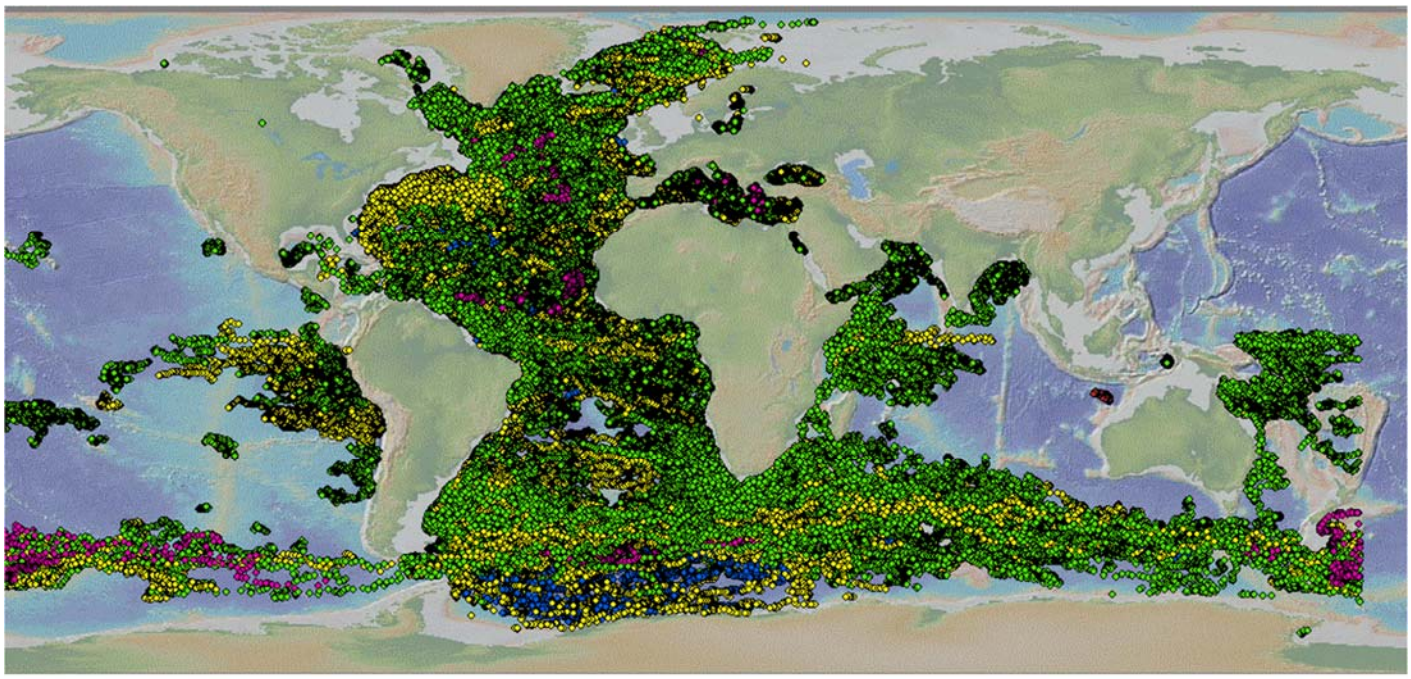
Map of active floats managed by Coriolis this current year, zoom on north Atlantic area



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)



Atlantic map active floats profiles from Coriolis DAC this current year, among the other DAC's profiles (Coriolis: green, other DACs: grey)



Map of the 295.351 profiles from 2.637 floats managed by Coriolis DAC
Apex Metocean Navis Nemo Nova Provor

### 1.1.3 BGC-Argo sensors on Coriolis floats

The data processing chain based on Matlab to manage data and metadata from Coriolis BGC-floats is continuously improved. These are advanced types of floats performing bio-geo-chemical (BGC) measurements.

Coriolis DAC manages 453 BGC-Argo floats from 4 families. They performed 63 634 cycles.

The data processing chain is freely available:

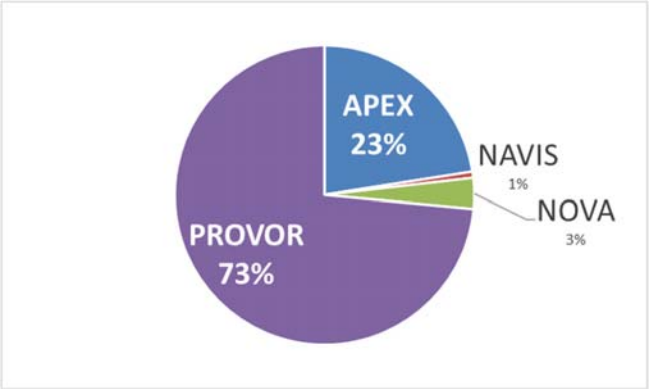
- Coriolis Argo floats data processing chain, http://doi.org/10.17882/45589

## Oxygen data reprocessing

In 2019, the Oxygen manual was updated: “Processing Argo oxygen data at the DAC level cookbook” http://doi.org/10.13155/39795

To implement the updates, all oxygen profiles were reprocessed during spring 2019. More than 42000 files containing oxygen data were resubmitted on the GDAC ftp server.

| BGC-Argo floats processed by Coriolis DAC | | |
|---|---|---|
| Coriolis float family | nb floats | nb profiles |
| APEX | 102 | 12 917 |
| NAVIS | 3 | 644 |
| NOVA | 15 | 1 055 |
| PROVOR | 333 | 49 018 |
| **Total** | **453** | **63 634** |




## General characteristics

- Iridium sbd or rudics bi-directional communication or Argos
- Fourteen sensors are fitted on the floats
- Eleven BGC parameters reported

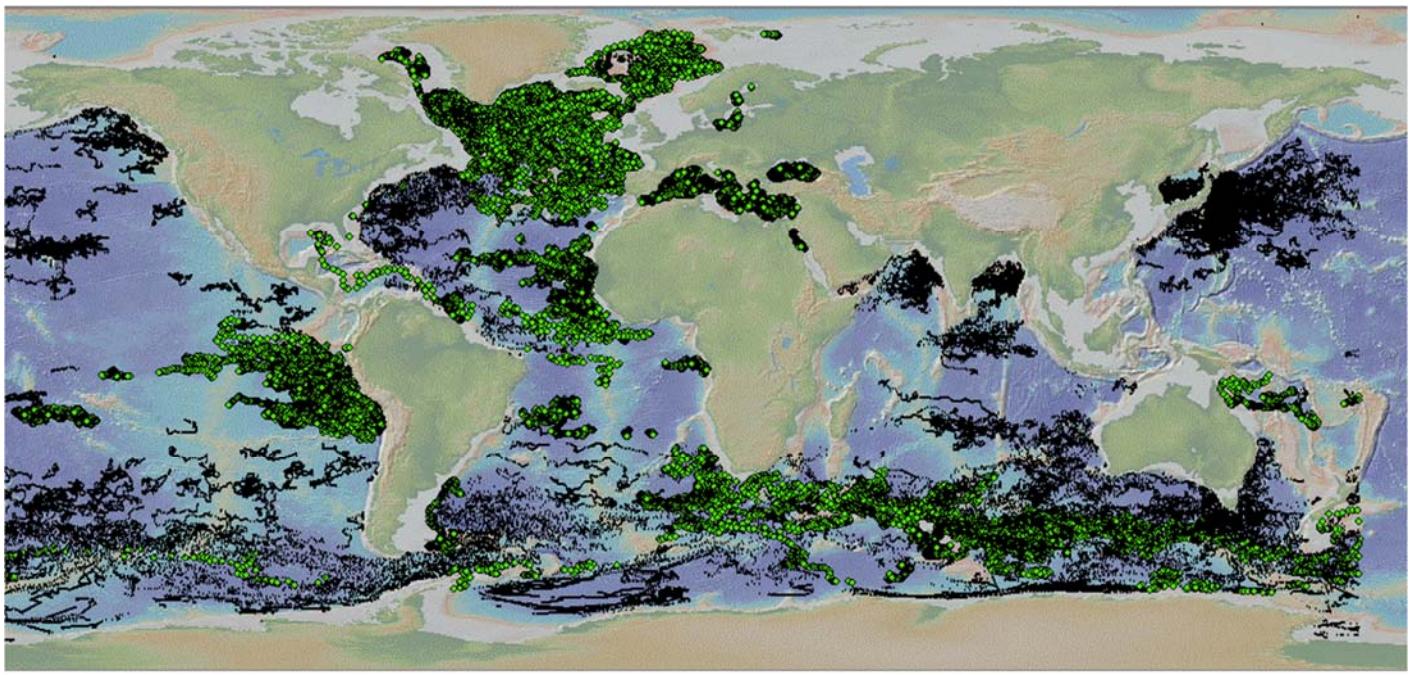
| Coriolis BGC-Argo floats sensor | nb floats | nb profiles |
|---|---|---|
| AANDERAA_OPTODE_3830 | 66 | 9164 |
| AANDERAA_OPTODE_4330 | 308 | 41613 |
| AANDERAA_OPTODE_4330 | 1 | 21 |
| C_ROVER | 15 | 4449 |
| ECO_FLBB_AP2 | 19 | 4982 |
| ECO_FLBBCD | 163 | 89820 |
| ECO_FLBB2 | 4 | 2112 |
| ECO_FLNTU | 10 | 5366 |
| FLBB | 2 | 616 |
| SATLANTIC_OCR504_ICSW | 166 | 120504 |
| SBE41CP | 246 | 77855 |
| SBE43F_IDO | 13 | 1596 |
| SBE63_OPTODE | 20 | 1885 |
| SEAFET | 8 | 409 |
| SUNA_V2 | 73 | 10933 |
| UVP6-LP | 1 | 30 |

The 16 types of sensors mounted on Coriolis BGC-Argo floats

| PARAMETER_CODE | NB_FILE |
|---|---|
| DOXY | 53 538 |
| CHLA | 33 309 |
| BBP700 | 31 200 |
| DOWN_IRRADIANCE380 | 28 264 |
| DOWNWELLING_PAR | 28 264 |
| CDOM | 27 697 |

| | |
|---|---|
| NITRATE | 10 003 |
| CP660 | 4 423 |
| TURBIDITY | 2 109 |
| BISULFIDE | 543 |
| PH_IN_SITU_TOTAL | 389 |

The 11 BGC parameters reported by Coriolis BGC-Argo floats



Map of the 453 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.

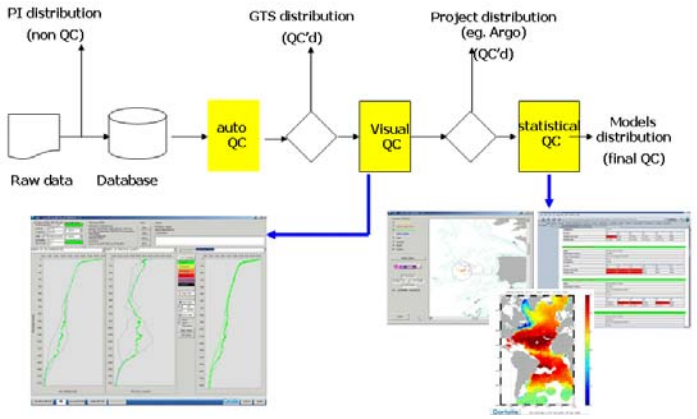
© Antoine Poteau, Observatoire Océanologique de Villefranche (CNRS/UPMC)
Deployments of a bio-argo Provor in Ligurian sea

## 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 ISAS objective analysis 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.

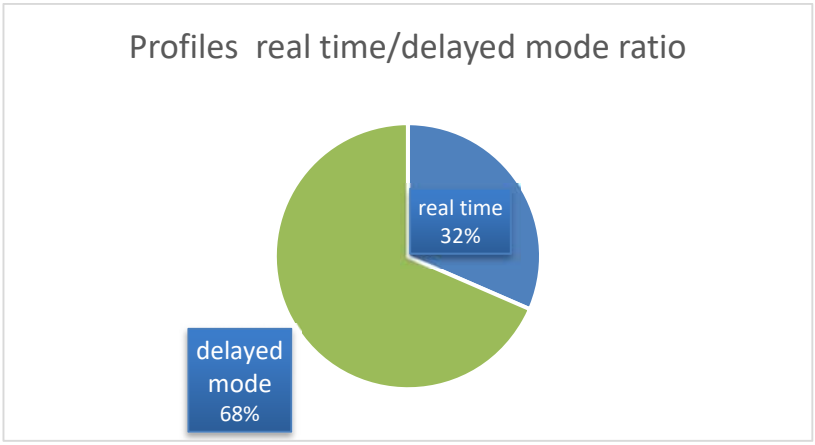


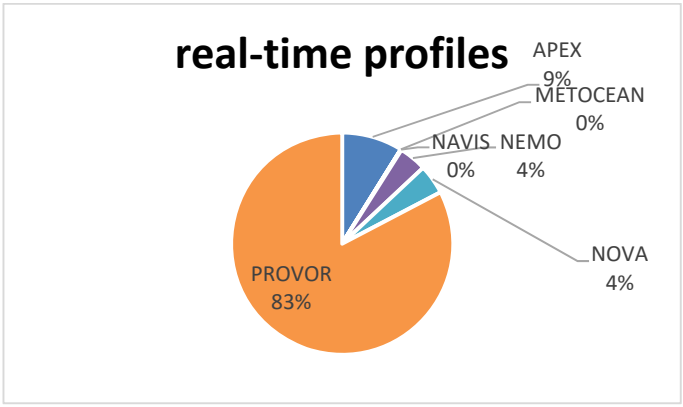

Coriolis DAC Argo data flow

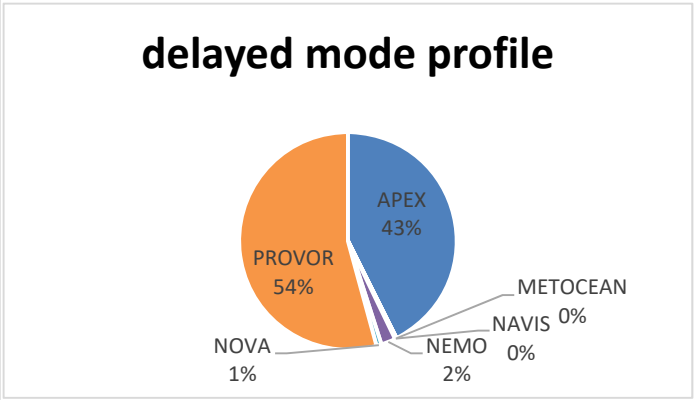
## 1.3 Data issued to GDACs after real-time QC

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

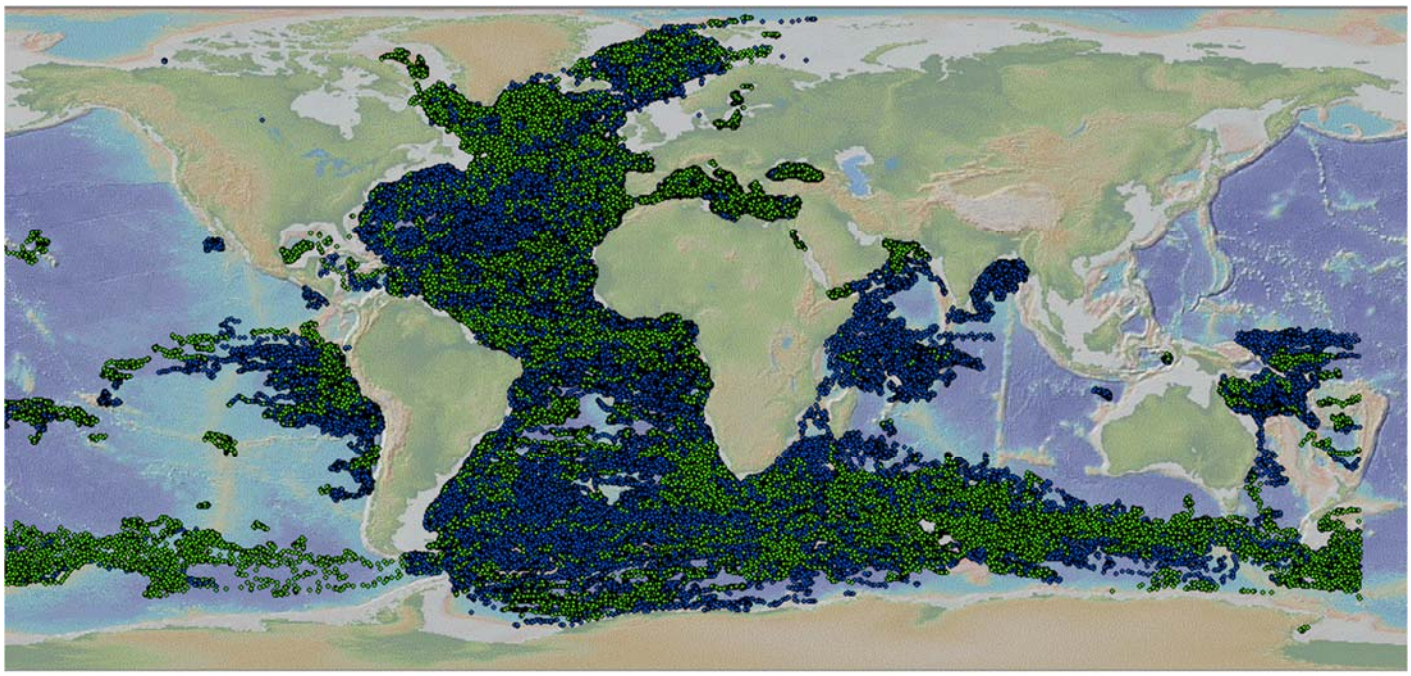
| All Coriolis floats, number of profile files on GDAC | | | | |
|---|---|---|---|---|
| Family | nb floats | nb profiles | RT profiles | DM profiles |
| APEX | 887 | 103964 | 9085 | 94879 |
| METOCEAN | 1 | 52 | 0 | 52 |
| NAVIS | 3 | 644 | 123 | 521 |
| NEMO | 162 | 8902 | 4128 | 4774 |
| NOVA | 82 | 6115 | 4421 | 1694 |
| PROVOR | 1677 | 205455 | 84734 | 120721 |
| **Total** | **2 812** | **325 132** | **102 491** | **222 641** |




Distribution of Coriolis DAC real-time and delayed mode profiles (102.491 profiles – 222.641 profiles)



Map of real-time profiles and delayed mode profiles
Real time: green dots, delayed mode: blue dots

## 1.4 Data issued for delayed mode QC

### Delayed mode profiles

All profile files are sent to PIs for delayed QC. Most of the Atlantic data handled by Coriolis are checked by the European project Euro-Argo.

## 1.5 Delayed mode data sent to GDACs

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

- A total of **115.892 new or updated delayed mode profiles** was sent to GDACs this year.
- **A total of 222.641 delayed mode profiles** where sent to GDACs since 2005.

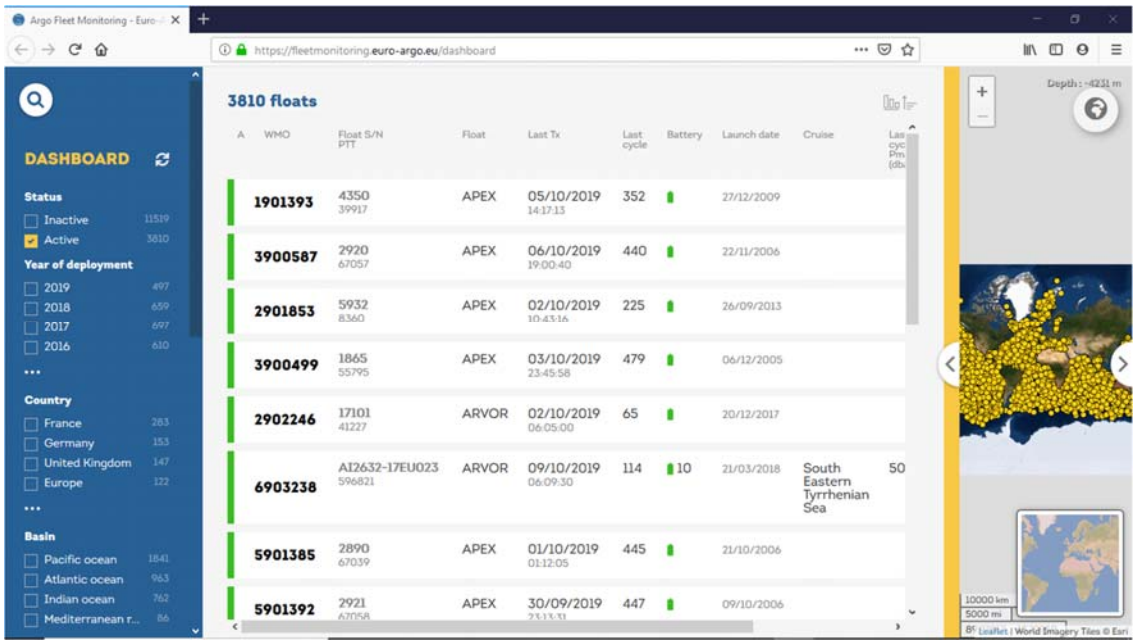
  The number of delayed mode profiles increased by 11% this year.

## 1.6 Web pages

### 1.6.1 Argo dashboard

The Argo floats dashboard developed in 2019 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.

### 1.6.2 Argo data on EU BlueCloud

A collaboration is underway with NASA-JPL and the European Blue Cloud to use the CMC (Common Mapping Client) client as the front office of Argo dashboard to provide in situ – satellite – model integration.

- http://bluecloud.ifremer.fr

### 1.6.3 Interoperability services (ERDDAP API,…)

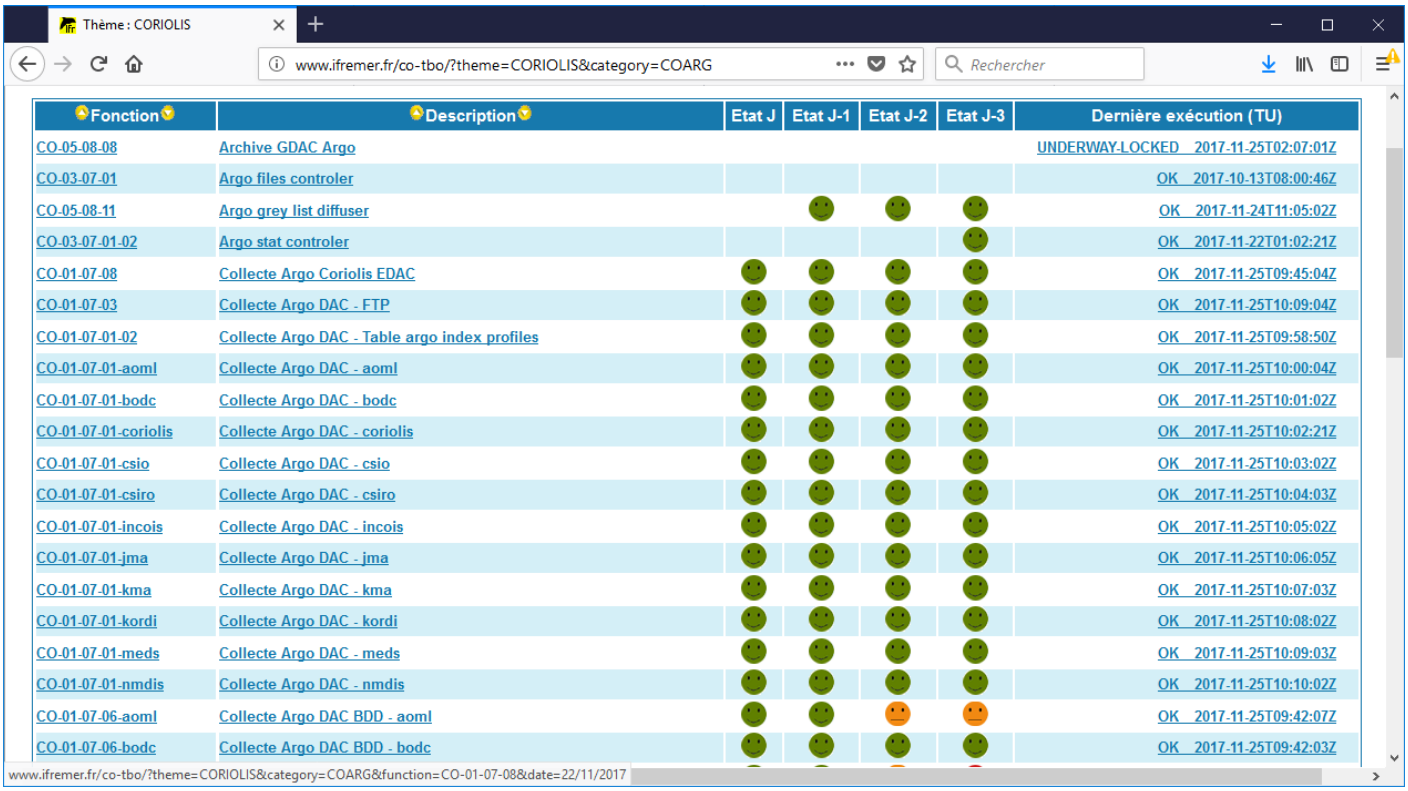
This web page describes all Argo floats interoperability services from Coriolis:

- 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
- Display Argo profiles and trajectories with GoogleEarth

### 1.6.4 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 | Archive GDAC Argo | | | | | UNDERWAY-LOCKED 2017-11-25T02:07:01Z |
| CO-03-07-01 | Argo files controler | | | | | OK 2017-10-13T08:00:46Z |
| CO-05-08-11 | Argo grey list diffuser | | | | | OK 2017-11-24T11:05:02Z |
| CO-03-07-01-02 | Argo stat controler | | | | | OK 2017-11-22T01:02:21Z |
| CO-01-07-08 | Collecte Argo Coriolis EDAC | | | | | OK 2017-11-25T09:45:04Z |
| CO-01-07-03 | Collecte Argo DAC - FTP | | | | | OK 2017-11-25T10:09:04Z |
| CO-01-07-01-02 | Collecte Argo DAC - Table argo index profiles | | | | | OK 2017-11-25T09:58:50Z |
| CO-01-07-01-aoml | Collecte Argo DAC - aoml | | | | | OK 2017-11-25T10:00:04Z |
| CO-01-07-01-bodc | Collecte Argo DAC - bodc | | | | | OK 2017-11-25T10:01:02Z |
| CO-01-07-01-coriolis | Collecte Argo DAC - coriolis | | | | | OK 2017-11-25T10:02:21Z |
| CO-01-07-01-csio | Collecte Argo DAC - csio | | | | | OK 2017-11-25T10:03:02Z |
| CO-01-07-01-csiro | Collecte Argo DAC - csiro | | | | | OK 2017-11-25T10:04:03Z |
| CO-01-07-01-incois | Collecte Argo DAC - incois | | | | | OK 2017-11-25T10:05:02Z |
| CO-01-07-01-jma | Collecte Argo DAC - jma | | | | | OK 2017-11-25T10:06:05Z |
| CO-01-07-01-kma | Collecte Argo DAC - kma | | | | | OK 2017-11-25T10:07:03Z |
| CO-01-07-01-kordi | Collecte Argo DAC - kordi | | | | | OK 2017-11-25T10:08:02Z |
| CO-01-07-01-meds | Collecte Argo DAC - meds | | | | | OK 2017-11-25T10:09:03Z |
| CO-01-07-01-nmdis | Collecte Argo DAC - nmdis | | | | | OK 2017-11-25T10:10:02Z |
| CO-01-07-06-aoml | Collecte Argo DAC BDD - aoml | | | | | OK 2017-11-25T09:42:07Z |
| CO-01-07-06-bodc | Collecte Argo DAC BDD - bodc | | | | | OK 2017-11-25T09:42:03Z |

www.ifremer.fr/co-tbo/?theme=CORIOLIS&category=COARG&function=CO-01-07-08&date=22/11/2017

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 **79 Argo scientific projects and 51 PIs (Principal Investigators).**

### List of Coriolis scientific PIs and project names

| project | nb floats |
|---|---|
| euro-argo | 296 |
| coriolis | 277 |
| argo-bsh | 181 |
| naos | 136 |
| mocca | 120 |

| | |
|---|---|
| argo italy | 43 |
| pirata | 32 |
| remocean | 31 |
| argo-italy | 28 |
| argo spain | 26 |

Top 10 of Coriolis DAC projects having active floats

Other projects having active floats:

| pi | nb active floats |
|---|---|
| birgit klein | 182 |
| pierre-marie poulain | 94 |
| christine coatanoan | 87 |
| virginie thierry | 59 |
| sabrina speich | 49 |
| bernard bourles | 35 |
| pedro velez | 29 |
| romain cancouët | 26 |
| herve claustre | 22 |
| fabrizio d'ortenzio | 19 |

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

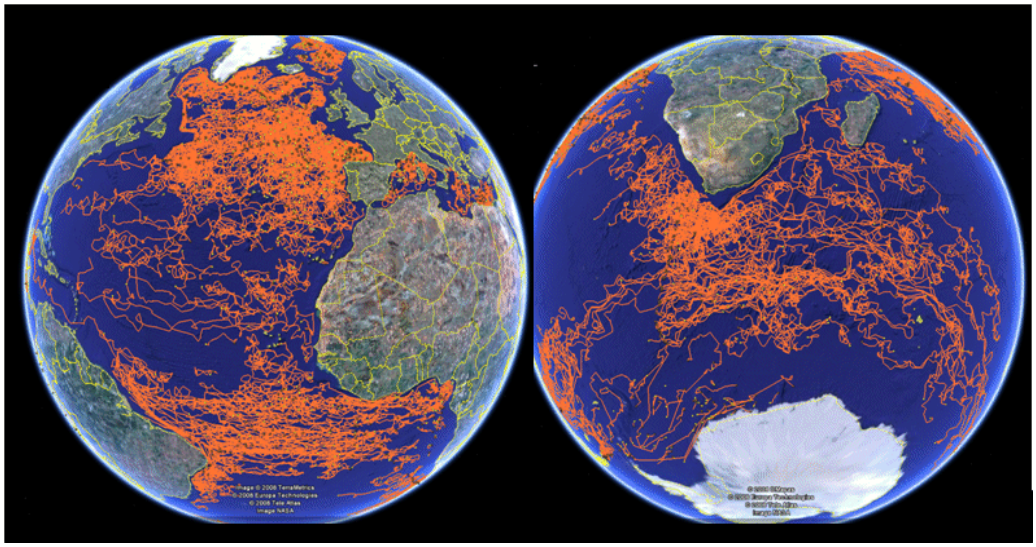
List of Principal Investigators (PI) in charge of active floats:
goodhope, asfar, rrex asfar, atlantos, gmmc_cnes, gmmc ovide, norargo, argo greece, argo poland, bwr, gmmc, narval, dap, mocca-germany, outpace, argo-finland, geovide, gmmc argomex, gmmc moana maty, gmmc perle, moose, rrex, argo italy , morsea, cienperu, gmmc oblady, soclim, amop, argo norway, aspex, mafia, mocca-italy, mocca-poland, naos-france, ticmoc, vsf, argo bsh, argo_fin, brazilian navy argo program, mocca-ger, norway-bgc-argo, argo italy,calypso 2019, argomed, bide, capricorn, mocca-eu, dekosim (metu), naos-canada, norargo2, argo bulgary, argo finland, argo italy , adri19_01, argo italy , moma, argo italy , perle2, argo italy, calypso 2019, argo_finland, argo_spain, argo-norway, bioargo italy, bioargo-italy, calypso, eaims, euroargo, greek argo, lov-atlantos, mocca-ned, mocca-netherlands, naos,pirata, ovide 2018, perseus, sagar

## 1.8 Products generated from Argo data

**Sub-surface currents ANDRO Atlas**

Based on Argo trajectory data, Michel Ollitrault and the Ifremer 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 (2013). **ANDRO: An Argo-based deep displacement dataset**. SEANOE. http://doi.org/10.17882/47077



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

# 2 Delayed Mode QC

(Please report on the progress made towards providing delayed mode Argo data, how it is organized and the difficulties encountered and estimate when you expect to be pre-operational.)

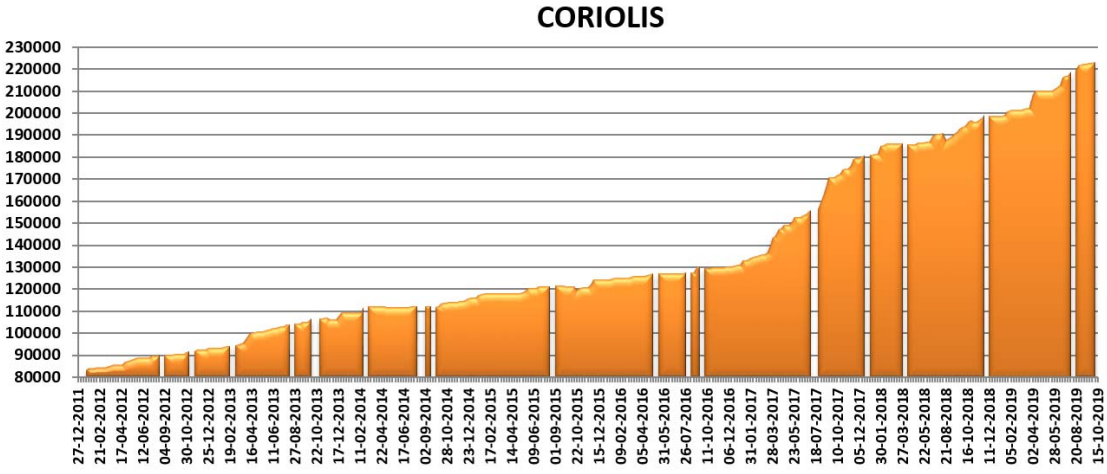
At the Coriolis data centre, we process the delayed mode quality control following four steps. Before running the OW method, we check carefully the metadata files, the pressure offset, the quality control done in real time and we compare with neighbor profiles to check if a drift or offset could be easily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

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.

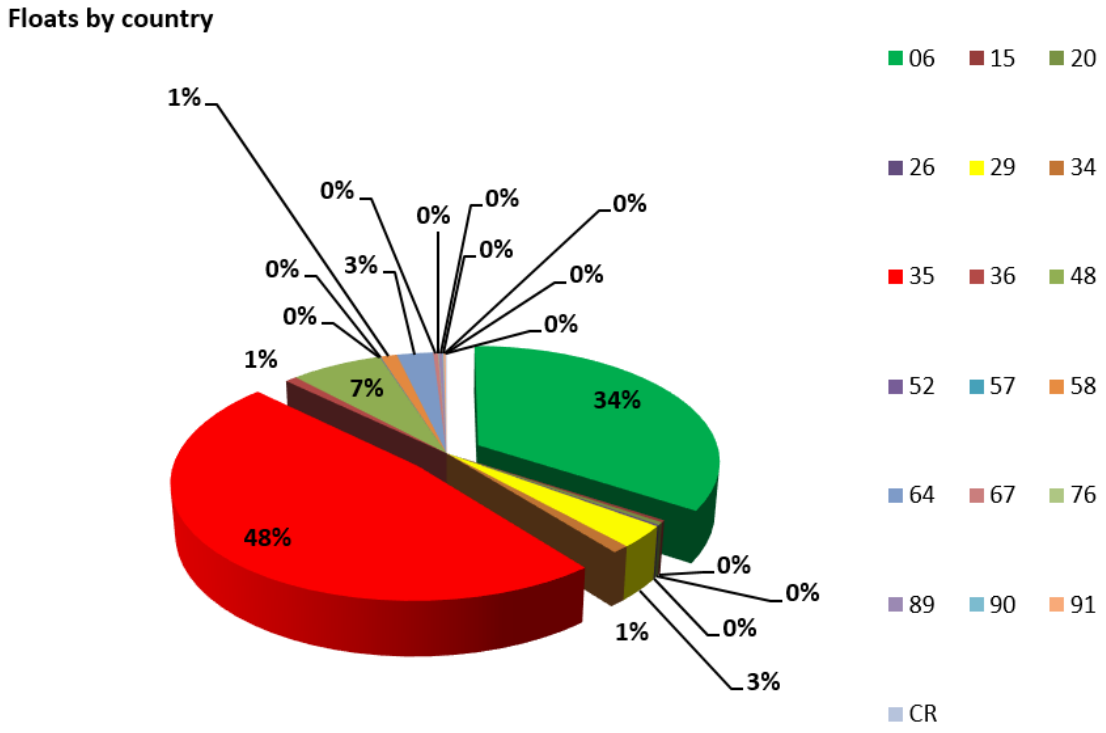
For a few projects, there are still no identified operators to do DMQC, for instance the first run has been done by students which have now left institutes or are not available to carry on with this work. We have made a lot of progress with BSH (Birgit Klein) taking into account also floats from other German institutes and OGS (Giulio Notarstefano) for the MedSea.

Some DM files have been updated to format version 3.1 taking into account a new decoder (matlab) developed at Coriolis. This work has been done for Provor and Apex, few files need to be manually updated.

Regular DM files submission is performed each year but an effort has been done since the year 2018 and following in 2019 to increase the DM files number.

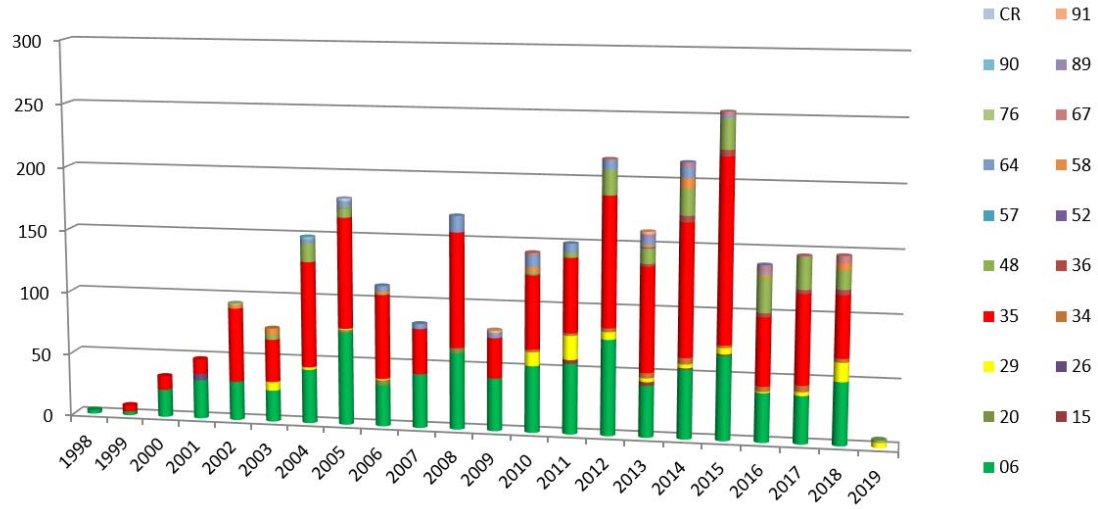


*Evolution of the DM profiles' submission versus dates*

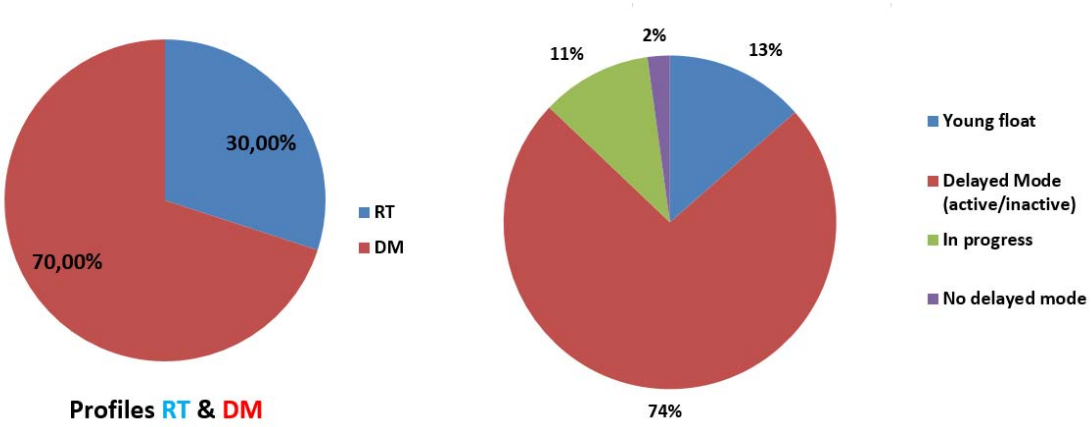



*Percentage of floats by country in the Coriolis DAC.*

*Codes for the countries: 06 : Germany - 15 : Bulgaria - 20 : Chili – 26 : Denmark – 29 : Spain – 34 : Finland - 35 : France – 36 : Greece - 48 : Italy – 52 : Lebanon - 57 : Mexico - 58 : Norway – 64 : Netherlands – 67 : Poland – 76 : China – 89: Turkey - 90 : Russia – 91 : - South Africa - CR : Costa Rica*

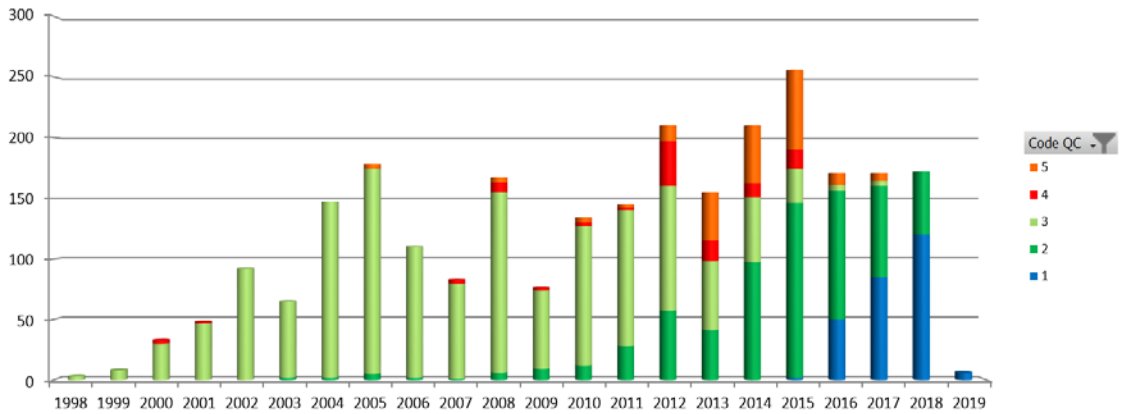


During the last year (from October 2018 to October 2019), 29180 new delayed mode profiles where produced and validated by PIs. A total of 222773 delayed mode profiles where produced and validated since 2005.




*Status of the floats processed by Coriolis DAC.*
*Left: in terms of profile percent and right: in terms of float percent (DM : delayed mode – RT : real time).*

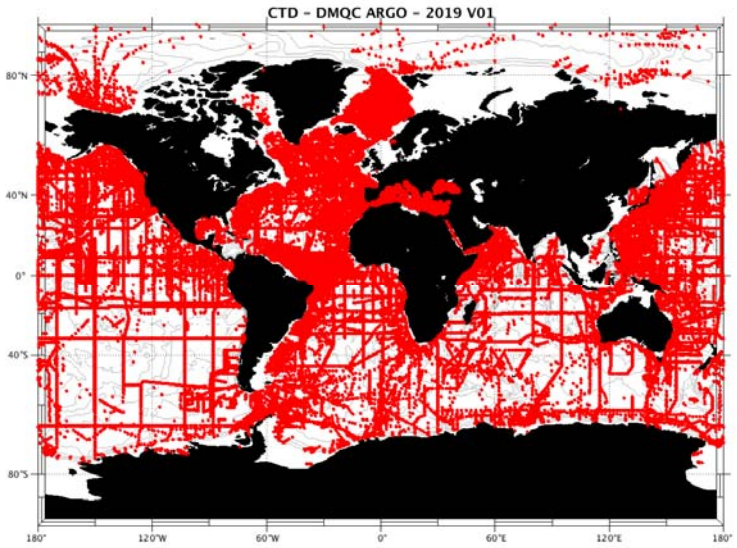
The status of the quality control done on the Coriolis floats is presented in the following plot. For the two last years (2018-2019), most of the floats are still too young (code 1) to be performed in delayed mode. For the years 2012-2013-2014, we are still working on the DMQC of some floats. The codes 2 and 3 show the delayed mode profiles for respectively active and dead floats.



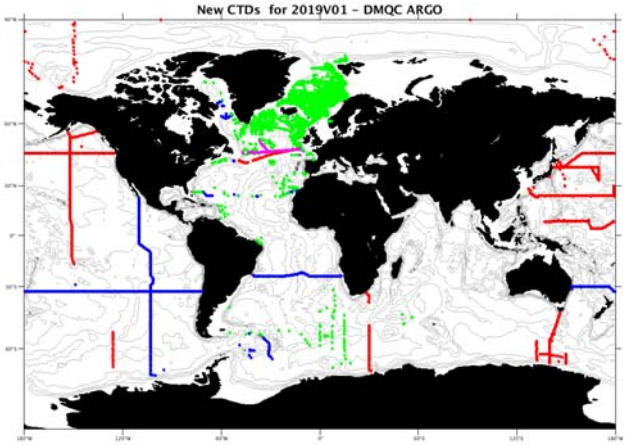

*Status of the quality control done on profiles sorted by launch's year, code 1: young float, code 2: active float, DM done, code 3 : dead float, DM done; code 4 : DM in progress, code 5 : waiting for DM, code 6 : problems with float.*

## 2.1 Reference database

At the end of 2018, an updated version 2018V02 has been provided with some updates on a few boxes and including 12 cruises from the program GO-SHIP. This year 2019, a new version 2019V01 including CCHDO, OCL and ICES updates, CTD from PI, correction from feedbacks will be available on the ftp site in the middle of October.




This new version includes 12 new cruises from the GO-SHIP program (downloaded from the CCHDO website), updates from OCL, ICES and MSM cruise provided by a scientist. A work has also been done for the boxes in the North Sea, with Ingrid Angel from BSH. Expertise on data has been realized to improve the quality and new data has been added (from UDASH and ICES).



GO-SHIP – OCL- ICES-MSM

This version is divided in smaller tar balls, one by wmo box area (1-3-5-7): for instance, CTD_for_DMQC_2018V01_1.tar.gz for all boxes starting with wmo 1, then we will have 4 tar files.

# 3 GDAC Functions

(If your centre operates a GDAC, report the progress made on the following tasks and if not yet complete, estimate when you expect them to be complete)

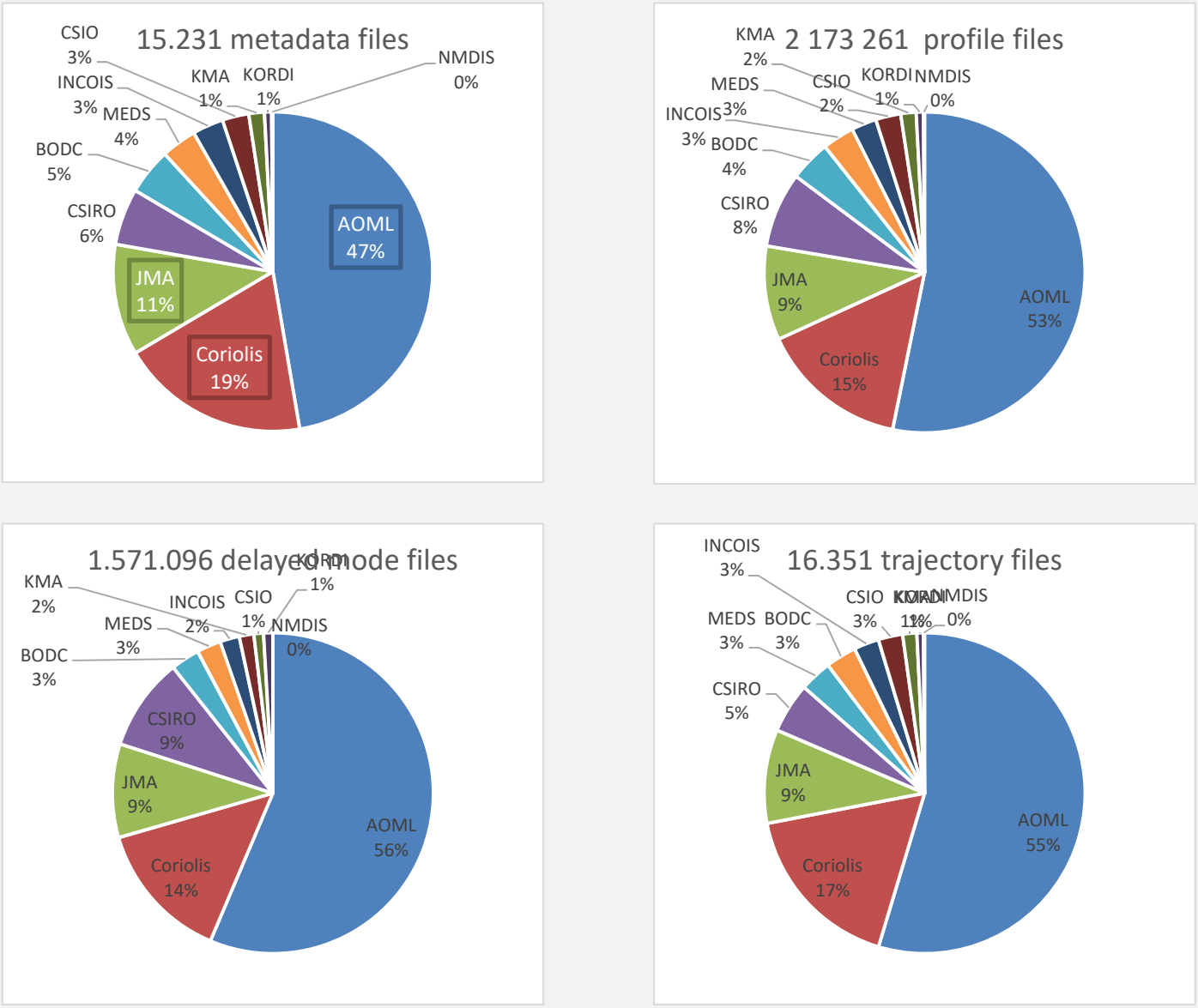
- National centres reporting to you
- Operations of the ftp server
- Operations of the www server
- Data synchronization
- Statistics of Argo data usage : Ftp and WWW access, characterization of users ( countries, field of interest : operational models, scientific applications) …

## 3.1 National centres reporting to you

Currently, 11 national DACs submit regularly data to Coriolis GDAC. On September 2019, the following files were available from the GDAC FTP site.

### 3.1.1 GDAC files distribution

| DAC | metadata files 2019 | Increase | profile files 2019 | increase2 | delayed mode profile files 2019 | increase3 | trajectory files 2019 | increase4 |
|---|---|---|---|---|---|---|---|---|
| AOML | 7 205 | 3% | 1 156 291 | 6% | 885 520 | 8% | 8 934 | 4% |
| BODC | 715 | 5% | 89 781 | 12% | 45 686 | 36% | 509 | 0% |
| Coriolis | 2 922 | 6% | 325 133 | 10% | 222 641 | 12% | 2 835 | 7% |
| CSIO | 408 | 1% | 54 914 | 9% | 15 260 | 49% | 402 | 1% |
| CSIRO | 873 | 4% | 164 482 | 7% | 147 208 | 10% | 826 | 3% |
| INCOIS | 478 | 6% | 69 633 | 7% | 30 651 | 8% | 413 | 0% |
| JMA | 1 715 | 7% | 206 144 | 4% | 148 198 | 20% | 1 545 | 2% |
| KMA | 241 | 0% | 33 685 | 6% | 23 094 | 0% | 232 | 4% |
| KORDI | 109 | -1% | 15 736 | -1% | 14 505 | | 107 | 0% |
| MEDS | 546 | 7% | 55 002 | 5% | 38 333 | 2% | 529 | 8% |
| NMDIS | 19 | 0% | 2 460 | 0% | 0 | | 19 | 0% |
| **Total** | **15 231** | **4%** | **2 173 261** | **7%** | **1 571 096** | **11%** | **16 351** | **4%** |



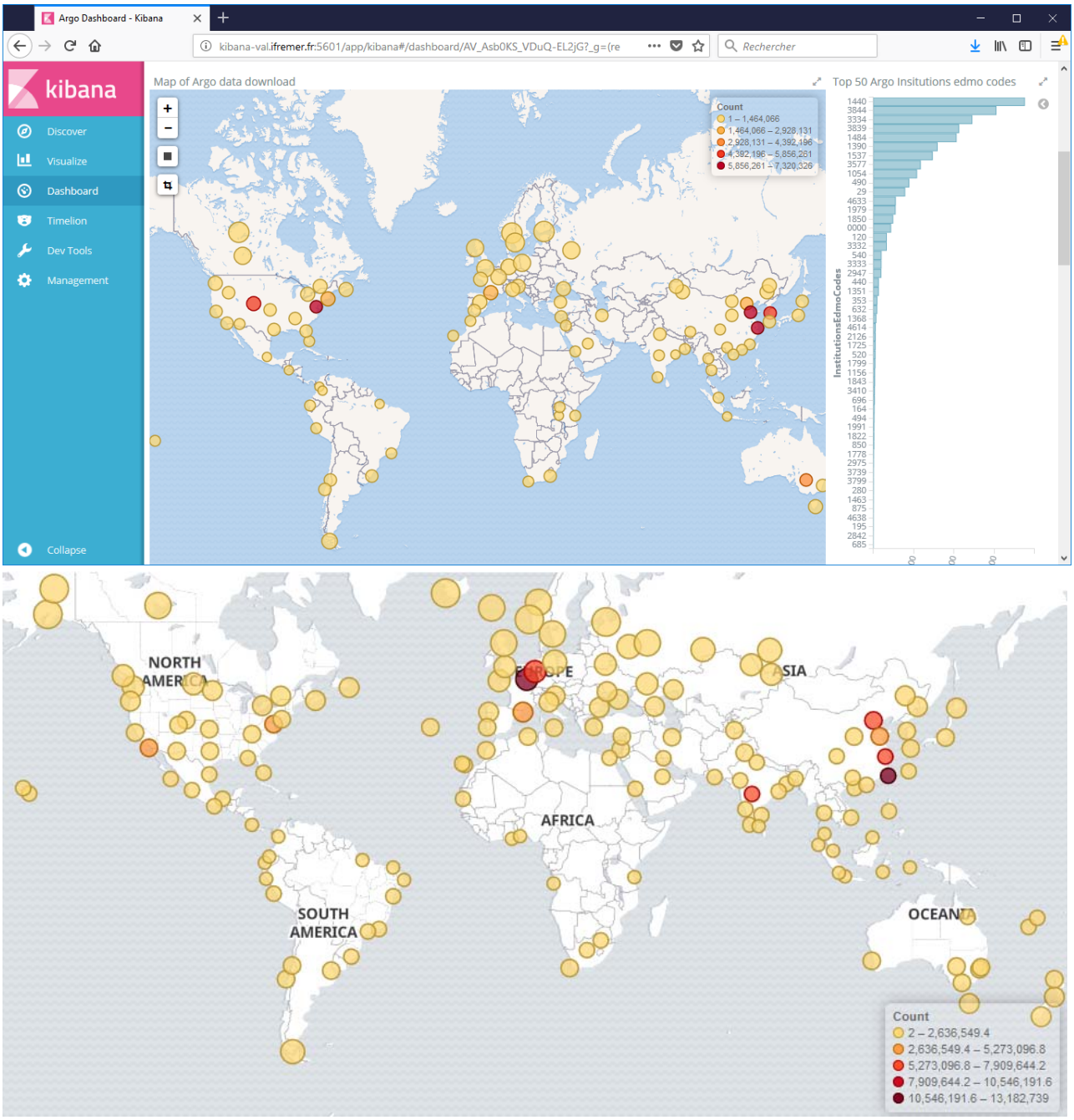

Number of files available on GDAC, November 2018

### 3.1.2 Argo Semaphore dashboard: give credit to data providers

Within EU AtlantOS project, Ifremer is setting up a dashboard (Semaphore) to monitor data distribution and give credit to data providers such as Argo floats.

FTP downloads log files are ingested in an Elsaticsearch 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 will offer the possibility to give credit to Floats owner institutions such as how many data from one particular institution was downloaded, by whose data users.




## Geographical distribution of GDAC ftp downloads in 2018 - 2019

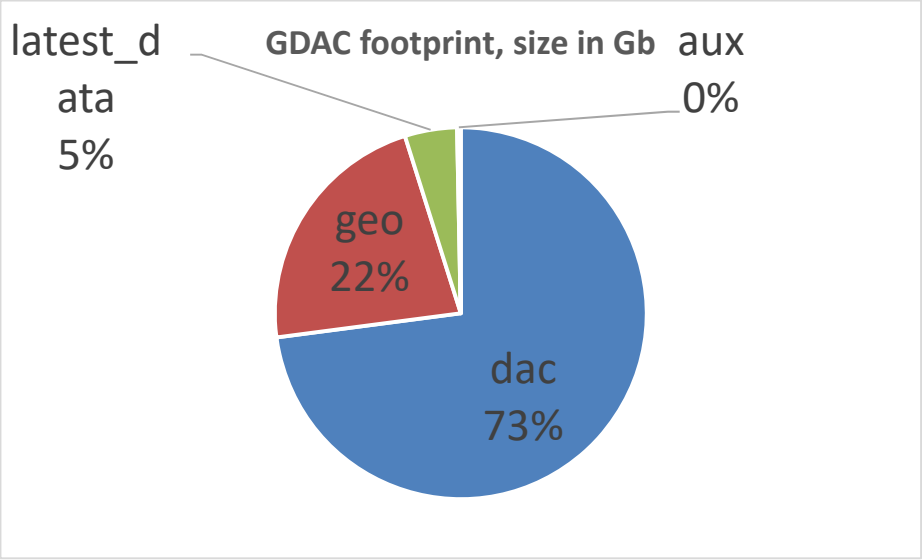
The majority of users (red dots) are located in USA, China, Australia and of course Europe. The right side histogram sorts the floats institution code (1440: PMEL, 3844: WHOI, 3334: INCOIS, 3839: UWA, 1484: CSIRO, …).


The top 50 of floats institutions downloads and the top 50 of data user's

### 3.1.3 GDAC files size

- The total number of NetCDF files on the GDAC/dac directory was 2 420 372
- The size of GDAC/dac directory was 275Gb (+12%)
- The size of the GDAC directory was 593Gb (+7%)

| branch | 2019 Gb | yearly increase |
|---|---|---|
| dac | 338 | 28% |
| geo | 103 | 17% |
| latest_data | 21 | 33% |
| aux | 2 | 53% |
| gdac total | 593 | 42% |

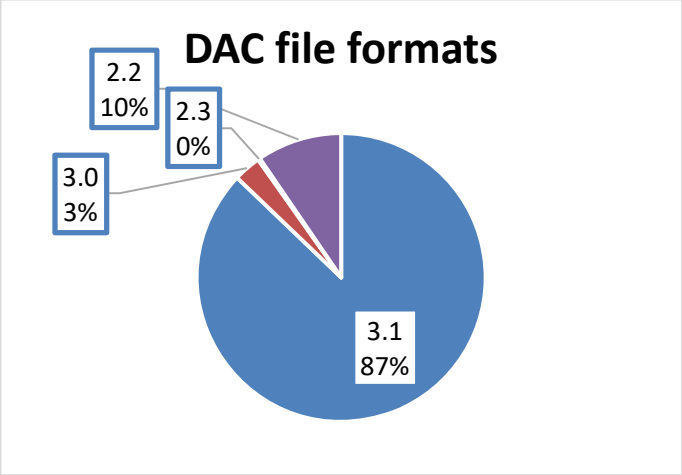


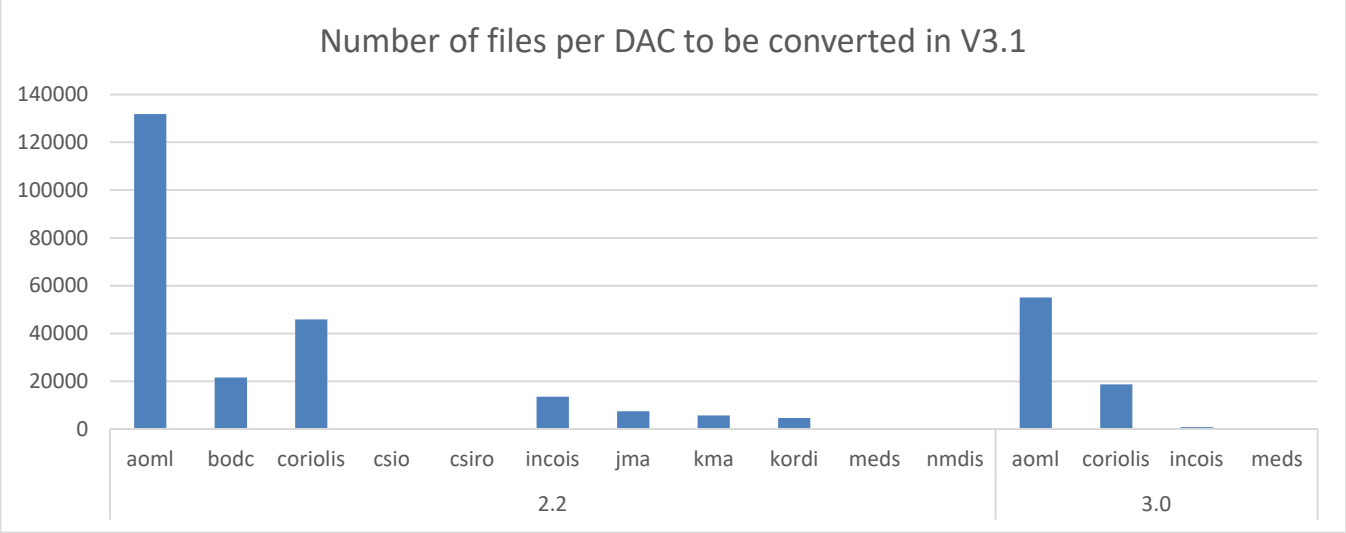

### 3.1.4 Argo NetCDF transition to format V3.1

*The transition from Argo format 2.* and 3.0 toward Argo NetCDF format 3.1 is underway. In 2018, the number of files in format version 3.1 is heading toward 90%.*

| format version | nb files | percentage |
|---|---|---|
| 3.1 | 2 113 833 | 87% |
| 3.0 | 74 670 | 3% |

| | | |
|---|---|---|
| *2.3* | *5 422* | *0%* |
| *2.2* | *231 497* | *10%* |
| *2.1* | *12* | *0%* |
| ***Total*** | ***2 425 434*** | ***100%*** |




| *File format* | *number of files* |
|---|---|
| ***2.2*** | ***231497*** |
| *aoml* | *131785* |
| *bodc* | *21554* |
| *coriolis* | *45916* |
| *csio* | *63* |
| *csiro* | *10* |
| *incois* | *13562* |

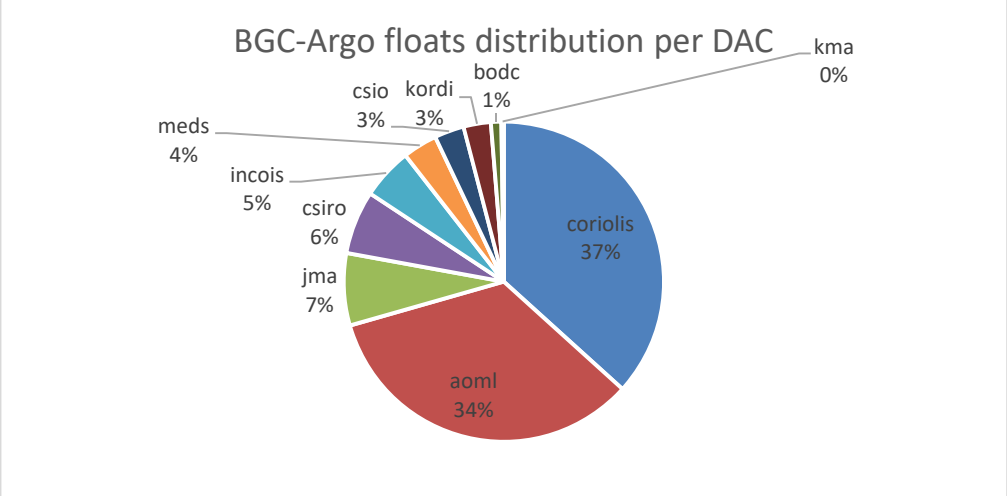
| | |
|---|---|
| *jma* | *7452* |
| *kma* | *5747* |
| *kordi* | *4674* |
| *meds* | *286* |
| *nmdis* | *448* |
| ***3.0*** | ***74670*** |
| *aoml* | *55061* |
| *coriolis* | *18741* |
| *incois* | *864* |
| *meds* | *4* |
| ***Total général*** | ***306167*** |

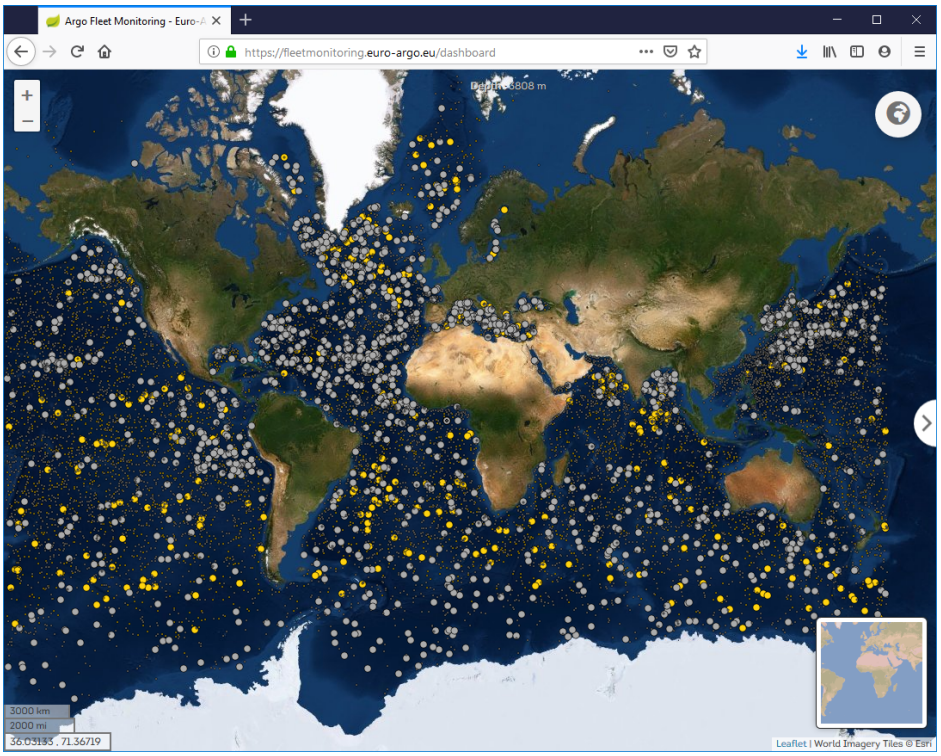
*The files in format version V3.1 are much more homogeneous than their previous versions. The controls applied by the format checker on V3.1 is much more exhaustive. The controlled vocabulary listed in the 27 reference tables is used for V3.1 format checks. A non-valid content is automatically rejected. Only valid V3.1 content appears on GDAC.*

### 3.1.5 BGC-Argo floats

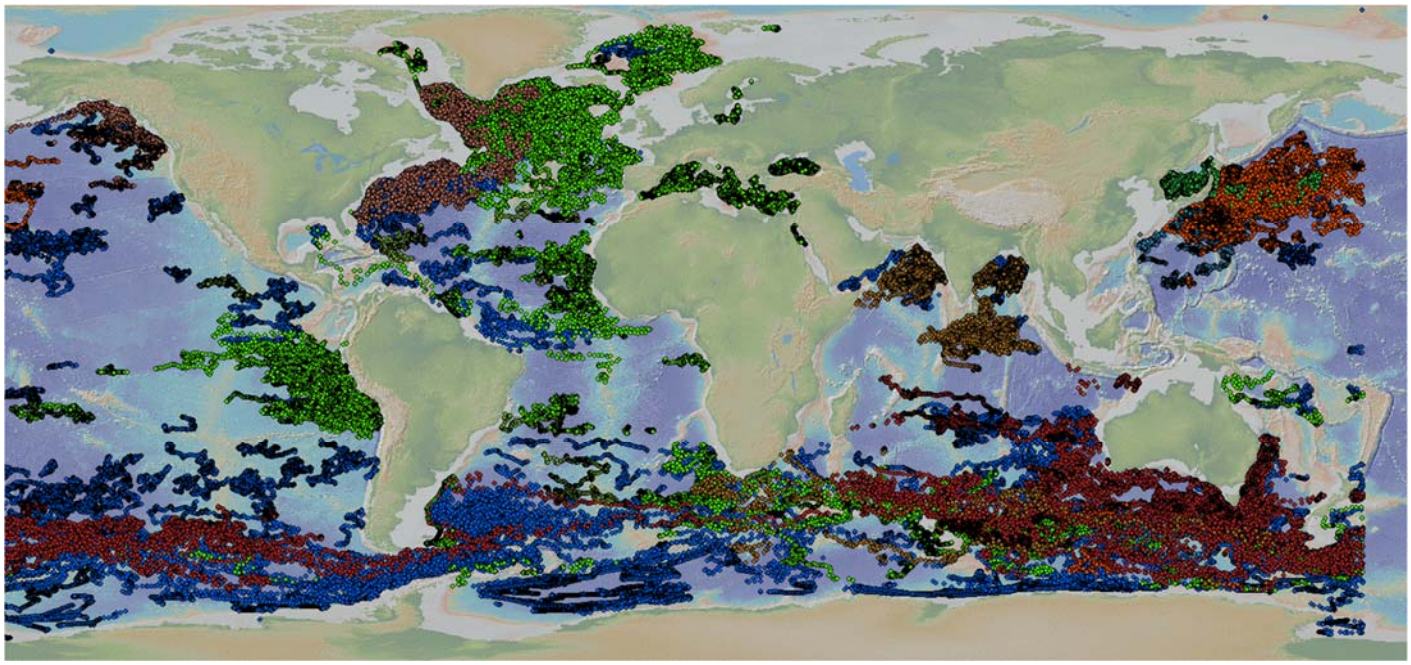
In October 2019, 189.142 BGC-Argo profiles from 1234 floats were available on Argo GDAC. This is a strong increase compared to 2018: +15% more float and +14% more profiles.

| DAC | nb bgc floats | nb bgc files |
|---|---|---|
| Coriolis | 453 | 63 634 |
| Aoml | 418 | 59 762 |
| Jma | 90 | 15 629 |
| Csiro | 79 | 21 498 |
| Incois | 64 | 8 667 |
| Meds | 43 | 4 263 |
| Csio | 37 | 7 562 |
| Kordi | 34 | 3 555 |
| Bodc | 13 | 4 110 |
| Kma | 3 | 462 |
| **Total** | **1234** | **189 142** |

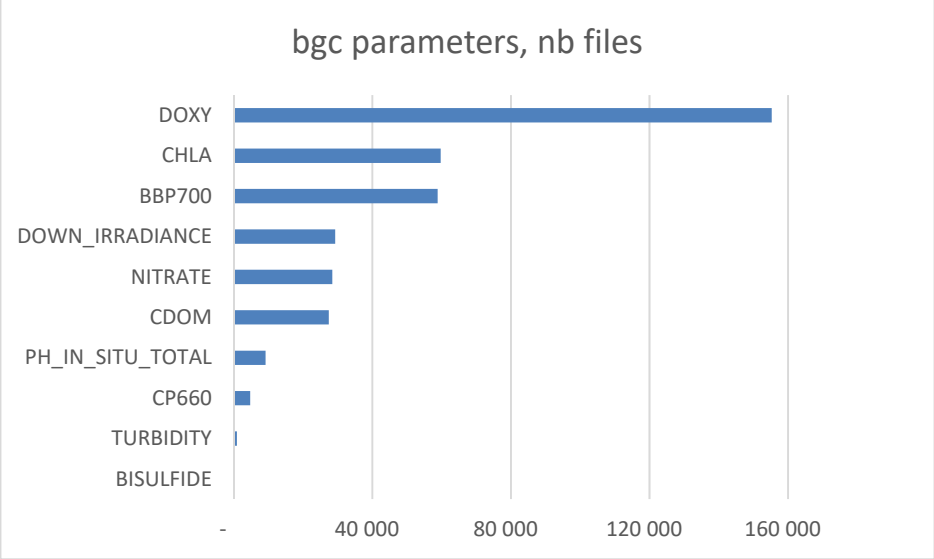





Map of 209 BGC-Argo floats (active: yellow, other: grey) from https://fleetmonitoring.euro-argo.eu/dashboard



BGC-Argo profiles, colored by DACs




Main BGC-Argo physical parameters, number of profiles

| parameter | nb files |
|---|---|
| BISULFIDE | 255 |
| TURBIDITY | 904 |
| CP660 | 4 722 |
| PH_IN_SITU_TOTAL | 9 209 |
| CDOM | 27 455 |
| NITRATE | 28 475 |
| DOWN_IRRADIANCE | 29 259 |
| BBP700 | 58 852 |
| CHLA | 59 756 |
| DOXY | 155 309 |

## 3.2 Operations of the ftp and web server

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).

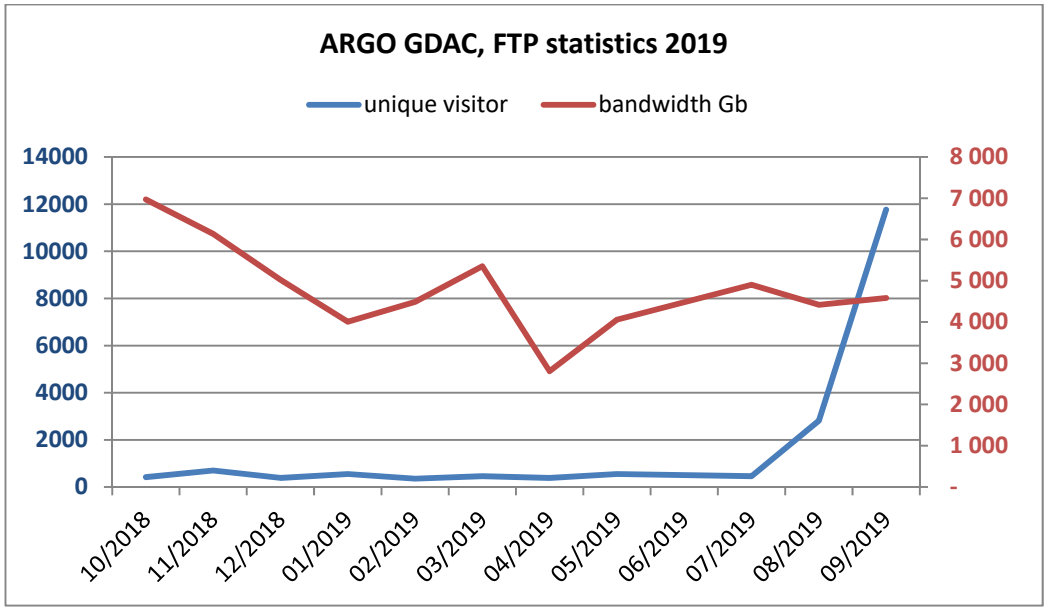
Index files of metadata, profiles, trajectories, technical and auxiliary data are hourly updated.

GDAC ftp address: ftp://ftp.ifremer.fr/ifremer/argo

**Statistics on the Argo GDAC FTP server: ftp://ftp.ifremer.fr/ifremer/argo**

There is a monthly average of 561 unique visitors, performing 4302 sessions and downloading 5.9 terabytes of data files.

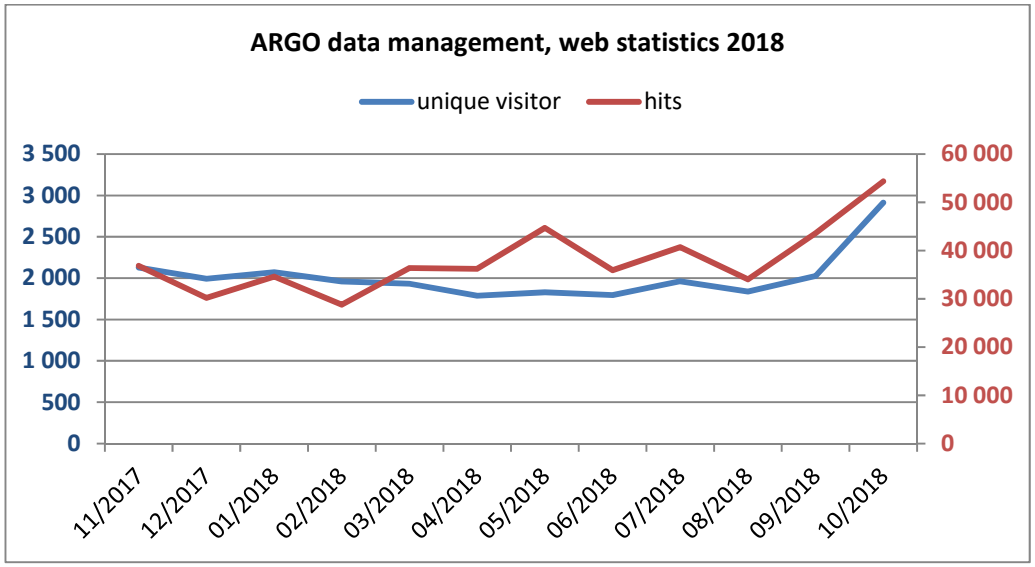
The table below shows an unsusual increase of visitors in August and September on GDAC FTP; we do not have a specific explanation.




| ARGO GDAC FTP statistics | | | | |
|---|---|---|---|---|
| month | unique visitor | number of visits | hits | bandwidth Gb |
| 10/2018 | 417 | 4 202 | 10 758 854 | 6 972 |
| 11/2018 | 701 | 5 727 | 8 648 964 | 6 137 |
| 12/2018 | 385 | 4 519 | 8 576 991 | 5 023 |
| 01/2019 | 548 | 4 931 | 5 683 220 | 4 007 |
| 02/2019 | 356 | 4 717 | 4 234 694 | 4 490 |
| 03/2019 | 459 | 5 946 | 5 490 499 | 5 351 |
| 04/2019 | 385 | 4 851 | 4 219 564 | 2 808 |
| 05/2019 | 551 | 7 111 | 6 978 746 | 4 059 |
| 06/2019 | 499 | 5 316 | 6 847 654 | 5 316 |
| 07/2019 | 460 | 5 978 | 5 055 490 | 4 903 |
| 08/2019 | 2 816 | 8 291 | 4 889 725 | 4 417 |
| 09/2019 | 11 769 | 19 205 | 5 212 730 | 4 584 |
| **Average** | **1 612** | **6 733** | **6 383 094** | **4 839** |

**Statistics on the Argo data management web site: http://www.argodatamgt.org**

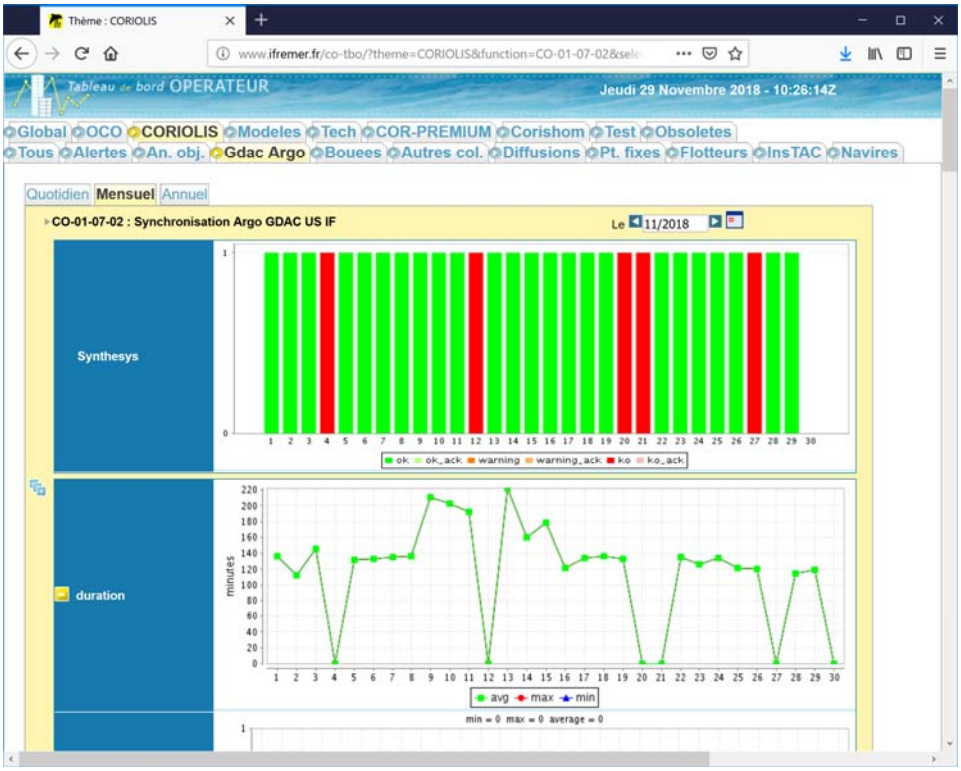
There is a monthly average of 2020 unique visitors, performing 2861 visits and 38029 hits. The graphics shows a slightly increasing number of unique visitors.




| ARGO GDAC web statistics | | | | | |
|---|---|---|---|---|---|
| month | unique visitor | visits | pages | hits | bandwidth Go |
| 11/2017 | 2 128 | 3 012 | 5 380 | 36 832 | 1,06 |
| 12/2017 | 1 992 | 2 693 | 4 511 | 30 195 | 1,12 |
| 01/2018 | 2 072 | 2 906 | 5 296 | 34 603 | 944,41 |
| 02/2018 | 1 961 | 2 459 | 4 006 | 28 775 | 1,71 |
| 03/2018 | 1 933 | 2 718 | 4 963 | 36 372 | 2,88 |
| 04/2018 | 1 788 | 2 563 | 4 768 | 36 218 | 1,49 |
| 05/2018 | 1 829 | 2 666 | 5 733 | 44 710 | 2,56 |
| 06/2018 | 1 795 | 2 585 | 4 847 | 35 920 | 1,52 |
| 07/2018 | 1 963 | 2 889 | 5 764 | 40 707 | 3,59 |
| 08/2018 | 1 839 | 2 618 | 5 278 | 34 029 | 1,47 |
| 09/2018 | 2 026 | 2 921 | 6 029 | 43 625 | 1,57 |
| 10/2018 | 2 913 | 4 303 | 7 947 | 54 367 | 1,50 |
| **Average** | **2 020** | **2 861** | **5 377** | **38 029** | **80,41** |

## 3.3 GDAC files synchronization

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




The synchronization dashboard in November 2018: the daily synchronization time takes on average 2 hours.

You may notice on the dashboard that the synchronization process reported 5 errors in November (red bars):

- "Can't create the ftp connection to usgodae.org"
  There was an ftp connection problem between Coriolis and US GDACs

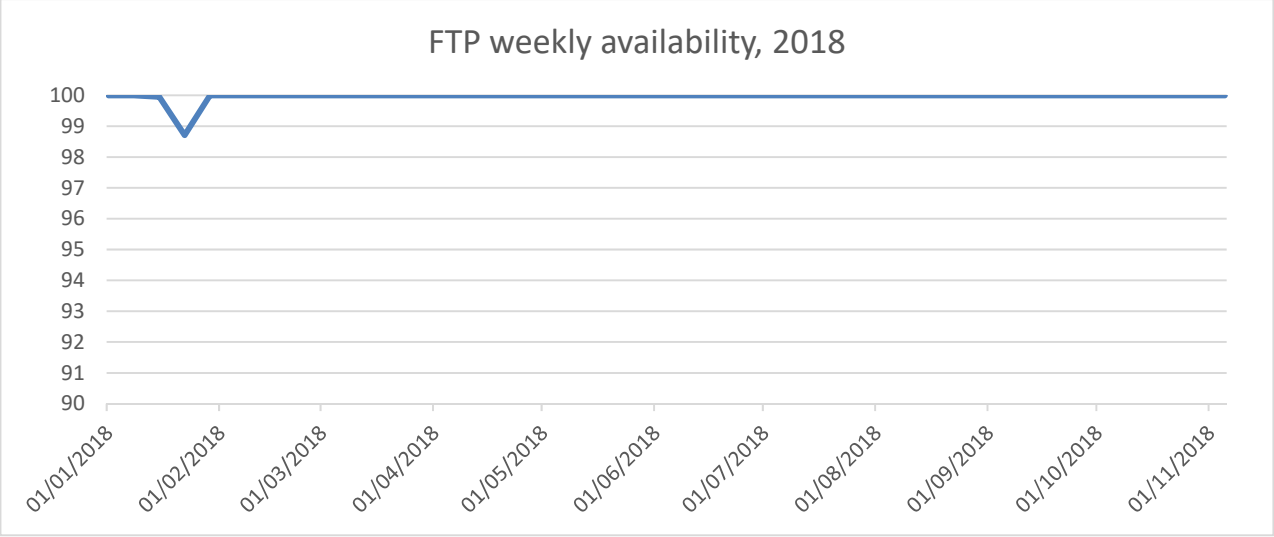
## 3.4 FTP server monitoring

The Argo GDAC ftp server is actively monitored by a Nagios agent (http://en.wikipedia.org/wiki/Nagios).

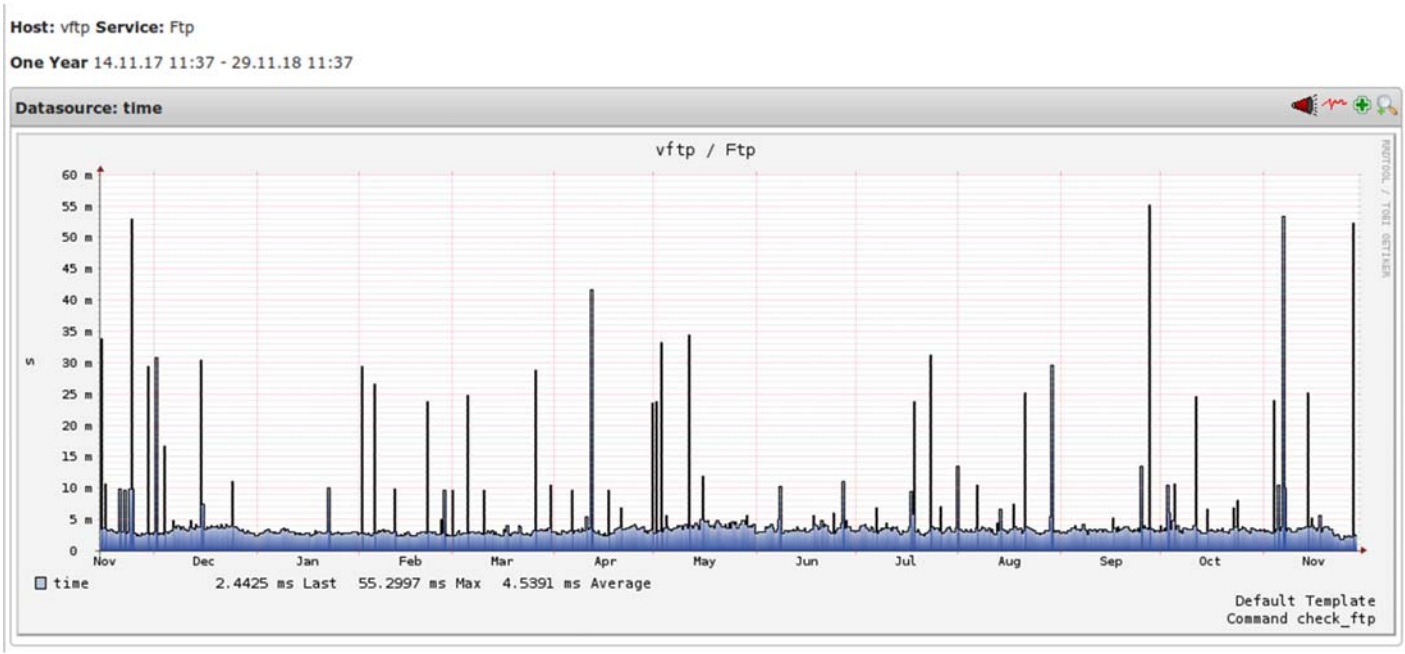
Every 5 minutes, an ftp download test and an Internet Google query are performed. The success/failure of the test and the response time are recorded. The FTP server is a virtual server on a linux cluster.

On the last 11 months, the FTP server was operational on 99.970% of time, non-operational during 14 minutes (0.003%).

| FTP server monitoring 01/01/2018 - 29/11/2018 | | | |
|---|---|---|---|
| Status | percentage | duration | comment |
| OK | 99,970% | 332d 9h 57s | operational |
| Warning | 0,027% | 0d 2h 10m 10s | poor performance |
| Unknown | 0,000% | 0d 0h 0m 0s | |
| Critical | 0,003% | 0d 0h 14m 50s | non operational |

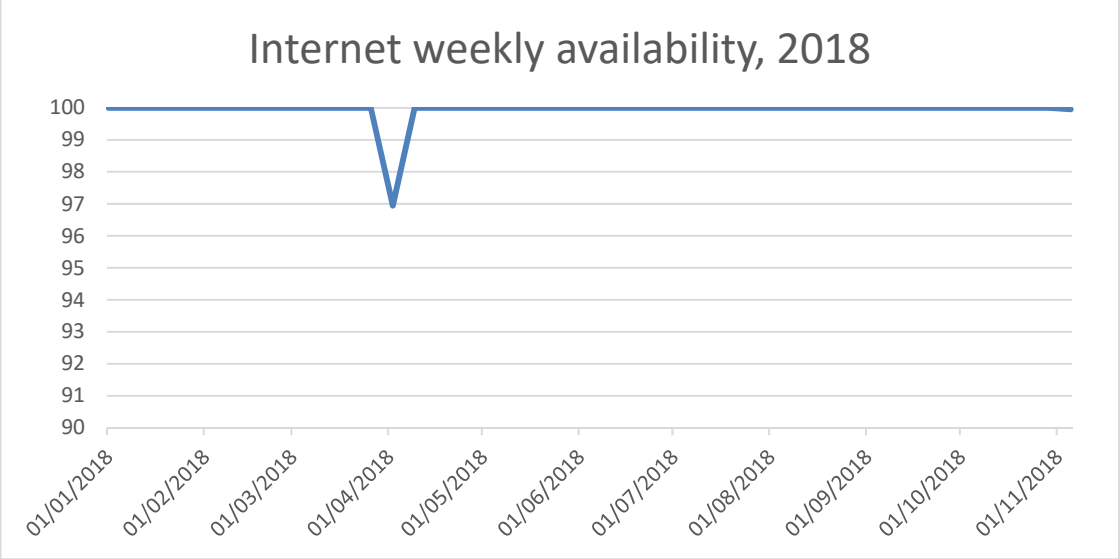



Nagios ftp monitoring: between January and November 2018




FTP server response time monitoring

| Internet access monitoring 01/01/2018 - 29/11/2018 | | | |
|---|---|---|---|
| **Status** | **percentage** | **duration** | **comment** |
| OK | 99,934% | 332d 6h 36s | operational |
| Warning | 0,000% | 0d 0h 0m 0s | poor performance |
| Unknown | 0,000% | 0d 0h 0m 0s | |
| Critical | 0,066% | 0d 5h 18m 1s | non operational |

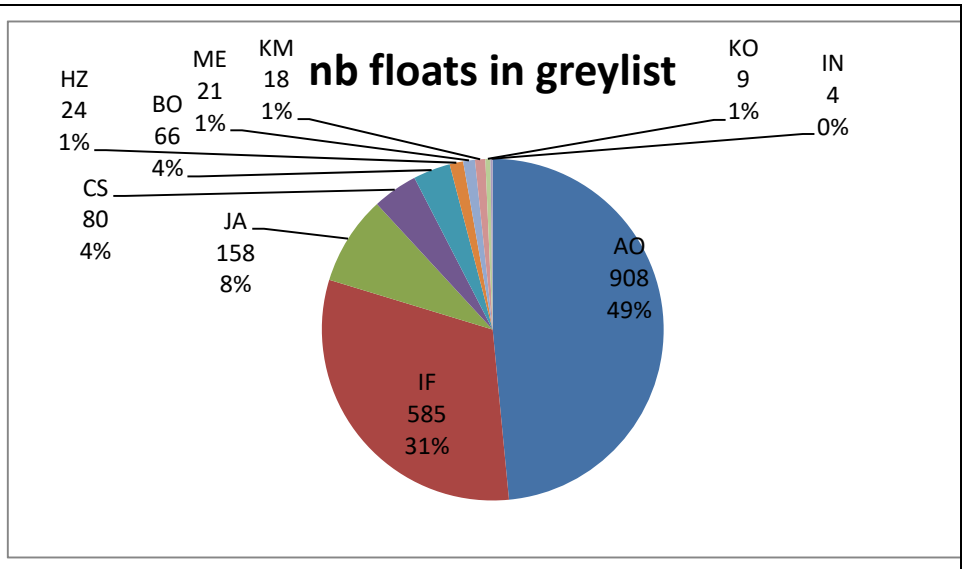



Nagios Internet monitoring: between January and November 2018

## 3.5 Grey list

According to the project requirements Coriolis GDAC hosts a grey list of the floats which are automatically flagged before any automatic or visual quality control. **The greylist has 1873 entries** (November 29th 2018), compared to 887 entries one year ago. **The 111% increase is noticeable; it can partly be attributed to BGC sensors in greylist.**

| DAC | nb floats in greylist |
|---|---|
| AOML | 908 |
| Coriolis | 585 |
| JMA | 158 |
| CSIRO | 80 |
| BODC | 66 |
| NMDIS | 24 |
| MEDS | 21 |
| KMA | 18 |
| KIOST | 9 |
| INCOIS | 4 |
| **Total** | **1873** |




### Distribution of greylist entries per DAC and per parameter

AOML reports a high percentage of pressure and temperature in the greylist, compared to other DACs.

Coriolis reports many BGC greylist entries.

| Greylist record | Nb floats |
|---|---|
| **AOML** | **908** |
| PRES | 155 |
| PSAL | 618 |
| TEMP | 135 |
| **BODC** | **66** |
| PRES | 15 |
| PSAL | 34 |
| TEMP | 17 |
| **CSIRO** | **80** |
| PRES | 12 |
| PSAL | 52 |
| PSAL | 1 |
| TEMP | 15 |
| **NMDIS** | **24** |
| PRES | 3 |
| PSAL | 18 |
| TEMP | 3 |
| **Coriolis** | **585** |
| DOXY | 12 |
| PRES | 5 |
| PSAL | 121 |
| TEMP | 18 |
| BBP700 | 119 |
| CDOM | 170 |
| CP660 | 41 |
| CHLA | 84 |
| DOWNWELLING_PAR | 3 |
| DOWN_IRRADIANCE380 | 3 |
| DOWN_IRRADIANCE412 | 3 |
| DOWN_IRRADIANCE490 | 3 |
| NITRATE | 2 |
| BBP532 | 1 |
| **INCOIS** | **4** |
| PRES | 1 |
| PSAL | 2 |
| TEMP | 1 |
| **JMA** | **158** |
| DOXY | 1 |
| PRES | 24 |
| PSAL | 101 |
| TEMP | 32 |
| **KMA** | **18** |
| PRES | 6 |
| PSAL | 6 |
| TEMP | 6 |

| | |
|---|---|
| **KIOST** | **9** |
| PRES | 3 |
| PSAL | 3 |
| TEMP | 3 |
| **MEDS** | **21** |
| PRES | 2 |
| PSAL | 16 |
| TEMP | 3 |
| **Total général** | **1873** |

## 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

**Argo GDAC monthly snapshots DOIs**

- Snapshot of 2018 November 8th http://doi.org/10.17882/42182#59903
- Snapshot of 2014 October 8th http://doi.org/10.17882/42182#42280
- Snapshot of 2012 December 1st http://doi.org/10.17882/42182#42250

Argo National Data Management Report 2019

- BSH (Federal Maritime and Hydrographic Agency), Germany

1. Status

(Please report the progress made towards completing the following tasks and if not yet complete, estimate when you expect them to be complete)

- Data acquired from floats
  Presently there are 149 active/operational German floats which all belong to BSH. 26 floats have been deployed in 2019 to date and 21 more will follow until the end of the year. Data from all presently active floats are available from the GDACS.
- 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.
- Data issued for delayed QC
  At present (23.09.2019) the German Argo fleet comprises 928 floats which have sampled 75695 profiles. 69012 profiles of all eligible files are already available as D-files and 4999 are still pending. The total rate of eligible D-files provided to the GDACs is 92% and has continued to increase from last year's value of 88%.
- Delayed 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.
- Web pages
  BSH is maintaining the Argo Germany Web site. The URL for the Argo Germany has moved from http://www.german-argo.de/ to 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 Argo data usage
  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 (22.08.2019) 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 projects such as KLIWAS, RACE,

MiKlip, ICDC and Expertennetzwerk BMVI. Data are also used in various research groups at universities.

- Products generated from Argo data
  A quality screened subset of float data in the Atlantic has been created on the yearly basis and has been exchanged with the universities.

2. Delayed Mode QC

(Please report on the progress made towards providing delayed mode Argo data, how it's organized and the difficulties encountered and estimate when you expect to be pre-operational).

The overall percentage of D-files from all German programs is increasing again and has reached a quota of 92%. BSH had adopted floats from all German universities and agreed last year to perform similar services for the AWI floats. The DMQC for the yet unprocessed AWI floats is still pending, since the reprocessing of the float data at Coriolis has been delayed due to formatting issues. There has been ongoing communication between AWI and Coriolis how to re-decode float files and provide all files in V3.1. A last exchange of information has been submitted in August 2019. The decoding at Coriolis should start soon and hopefully been finished until the end of the year. At the moment 7240 profiles are available from the 187 AWI floats and only 49% are available as D-files. We hope to get this up to 100% as soon as Coriolis releases the new files. For all other floats (741 floats) the DMQC quota has increased to 97%. Additional time was spend to check files updated to format V3.1 and repeat DMQCs (if necessary), particular for old floats from the universities with BGC sensors with format inconsistencies in the older formats. Occasionally new R-files would be created during reprocessing which were not created before.

| German Floats/ Program Name | Number of profiles | Number of D-files | D-files pending | Comments |
|---|---|---|---|---|
| Argo BSH | 51635 | 48813 | 1138 | Overall 97% |
| Argo AWI | 7240 | 3548 | 3692 | Are waiting for reprocessing<br>Overall 49% |
| Argo GEOMAR (129 floats) | 13474 | 13393 | 81 | Reprocessing nearly finished<br>Overall 99 % |
| Argo U. HH (187 floats) | 3346 | 3258 | 88 | Reprocessing nearly finished<br>Overall 98 % |
| Argo Denmark (5 floats) | 371 | 360 | 11 | Old floats associated with U. HH, reprocessing nearly finished<br>Overall 97% |

BSH has also adopted floats from Finland (34 floats), the Netherlands (89 floats), Norway (40 floats) and Poland (23 floats) for DMQC and is performing DMQC on parts of the MOCCA fleet (42 floats) from the European Union. The progress in these programs providing D-files is generally good, but redecoding of older file-

formats and pending DMQCs for floats in the Baltic are resulting in lower numbers in some programs. Since Argo-Norway has received fundings from the national research council to increase the number of Norwegian floats deployed per year, the program will get more involved in the dmqc activities. Floats deployed from 2019 onward will be covered by Norwegian DMQC operators.

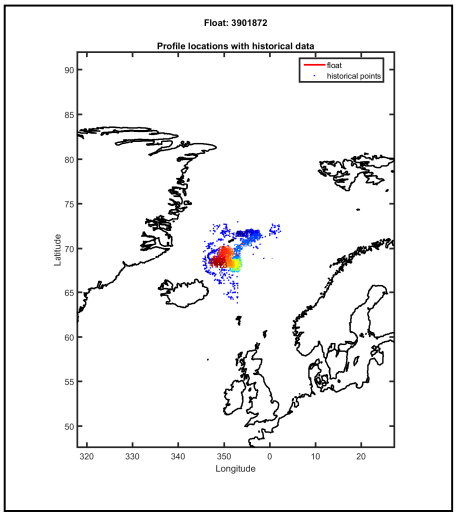
There are remaining issue with floats from Finland, Poland and MOCCA which are operating in the Baltic and will receive their DMQC decisions from regular laboratory calibrations performed when floats are recovered annually or from nearby calibration stations. The system for the DMQC is set-up within the EuroArgo ERIC in research projects as MOCCA and EArise.

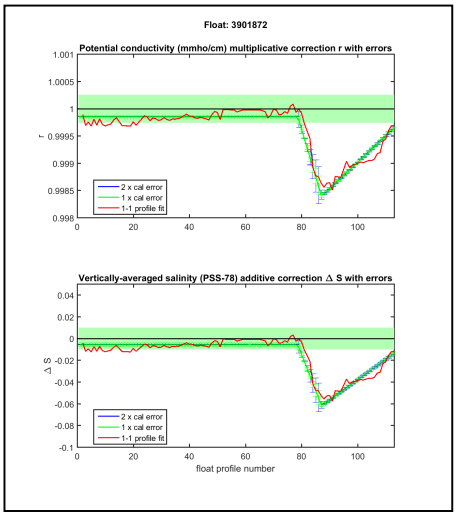
| Adopted floats/ Program Name | Number of profiles | Number of D-files | D-files pending | Comments |
|---|---|---|---|---|
| Argo Poland (23 floats) | 2466 | 887 | 662 | Baltic floats pending Overall 54% |
| Argo Finland (34 floats) | 3038 | 795 | 1800 | Baltic floats pending Overall 30% |
| Argo Netherlands (89 floats) | 10648 | 9998 | 184 | Overall 98% |
| Argo Norway (40 floats) | 4502 | 3625 | 569 | Due to reprocessing Overall 85% |
| MOCCA (42 floats) | 5347 | 2766 | 499 | Baltic floats pending Overall 80% |
| US Navy (10 floats) | 1990 | 1843 | 147 | Overall 93% Overlooked new cycles from one float |
| NAAMES/US (E. Boss) (13 floats) | 2854 | 2736 | 118 | Overall 96% Have to check why files have not been uploaded |

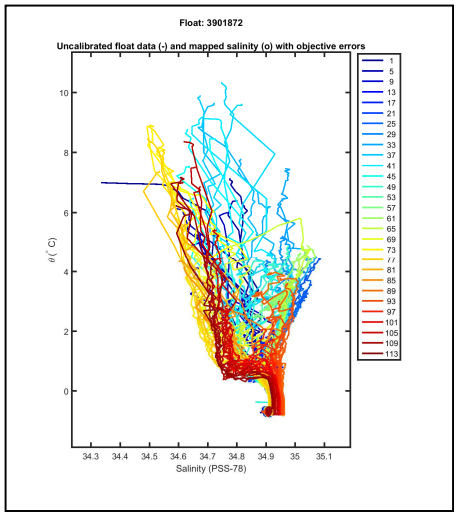
Some data archeology has been performed to retrieve missing CTD-serial numbers for older floats in the German fleet. The updated information has been exchanged with Coriolis and will be included in the meta-files. AWI has just submitted CTD serial numbers for its NEMO floats which will be included in meta-files.

Checks have been performed on the CTDs with serial numbers between 6000-7100 which were suspicious of showing large salinity drifts. The sample of floats from BSH covers 165 floats with deployments ranging from 2013-2016. All floats within the list have been in run through dmqc and are either finished or have their next half-yearly dmqc scheduled within a few months. For 18 floats out of this set the dmqc had showed large positive salinity drift and therefore negative

corrections, two other have received positive corrections and 9 had malfunctioning salinity sensors too bad to be repaired sometimes during their life. Additional floats with fast salty drift have been detected with serial numbers ranging from 8000-10000 with a major cluster around 8100-8300.
All diagnostic plots for fast salty drifters have been shared with SBE (Kim Martini) for their assessment. Drifts are not only differing in rate, some show reversal of drift. Since it remains unclear how the cells are behaving and which corrections could be applied under these non-monotonic behaviour, all cycles affected by non-monotonic drift have been flagged as bad until more information is given by SBE. This float behavior has been included in SBE analysis, but no explanation could be given so far.




Example of float 3901872 showing drift behavior with increasing and decreasing values of ‘fast-salty-drift’.

3. GDAC Functions
(If your centre operates a GDAC, report the progress made on the following tasks and if not yet complete, estimate when you expect them to be complete)

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

4. Regional Centre Functions

(If your centre operates a regional centre, report the functions performed, and in planning)

As work performed in the European projects MOCCA and EArise we are presently working on RDAC functions for the Nordic Seas and Arctic proper. The reference data base for these areas is updated/established and once done the dmqc results for all floats in this area will be checked to test for data set homogeneity.

5. References

# Argo National Data Management Report (2019) – India

## 1. Status

- **Data acquired from floats**
  India has deployed 28 new floats (including 8 Apex-BioArgo [1 with Nitrate Sensor), 20 Arovor-L floats) between January 2019 and September 2019 in the Indian Ocean taking its tally to 482 floats so far. Out of these 149 floats are active. All the active floats data are processed and sent to GDAC.

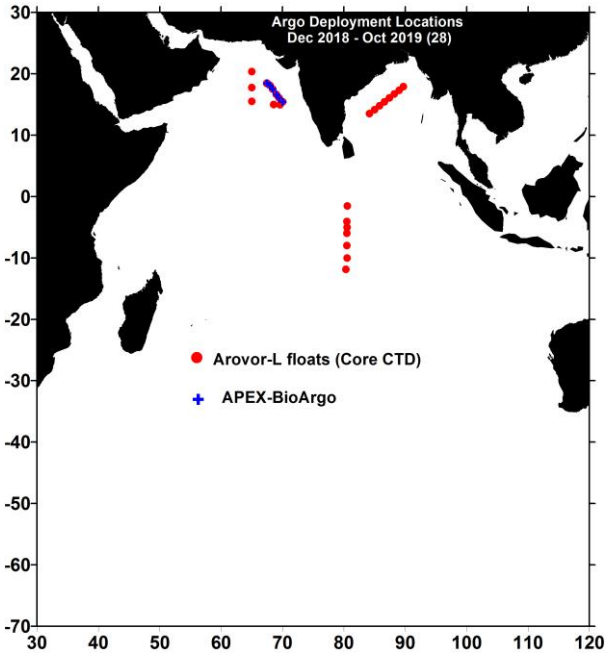



Fig. Location of Argo floats deployed by India

- **Data issued to GTS**
  All the active floats data is being distributed via RTH New Delhi. Previously identified problems are rectified and data are pushed regularly.

- **Data issued to GDACs after real-time QC**
  All the active floats (149) data are subject to real time quality control and are being successfully uploaded to GDAC. Few old floats with old version (Ver 2.3) are being converted to Ver 3.1 and uploaded to GDAC.

- **Data issued for delayed QC**
  In total ~50% of the eligible profiles for DMQC are generated and uploaded to GDAC. Old DMQCed floats with old version 2.3 are converted to V 3.1 and uploaded to GDAC.

- **Web pages**
  - INCOIS is maintaining Web-GIS based site for Indian Argo Program. It contains entire Indian Ocean floats data along with trajectories. 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.

- 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.

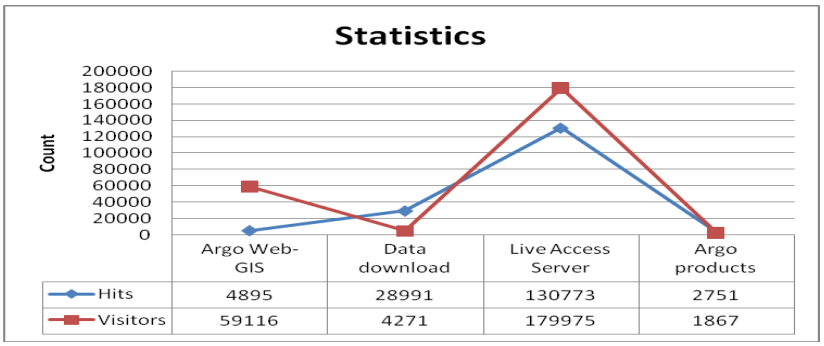
- **Trajectory**

  INCOIS started generating Ver 3.1 trajectory files for all APEX Argo and Iridium floats and uploading them to GDAC. Provor, Arvor floats data will be uploaded shortly.

- **Statistics of Argo data usage**

  Argo data is widely put to use by various Organisations/ Universities/ Departments. Indian Meteorological Department (IMD) is using Argo data for their operational purpose. 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.

  - The demand for Bio-Argo data is increasing and the same is being supplied for research interest by various research institutes and universities. More and more BioArgo floats are being deployed in the Indian Ocean. Simultaneous cruises are also being planned.
  - This data is continued to be used for validation of Biogeochemical model outputs like ROMS with Fennel module.




INCOIS Argo web page statistics (for the past one year) are as shown below

| Page | Hits | Visitors |
|---|---|---|
| Argo Web-GIS | 4895 | 59116 |
| Data download | 28991 | 4271 |
| Live Access Server | 130773 | 179975 |
| Argo products | 2751 | 1867 |

- **Products generated from Argo data**

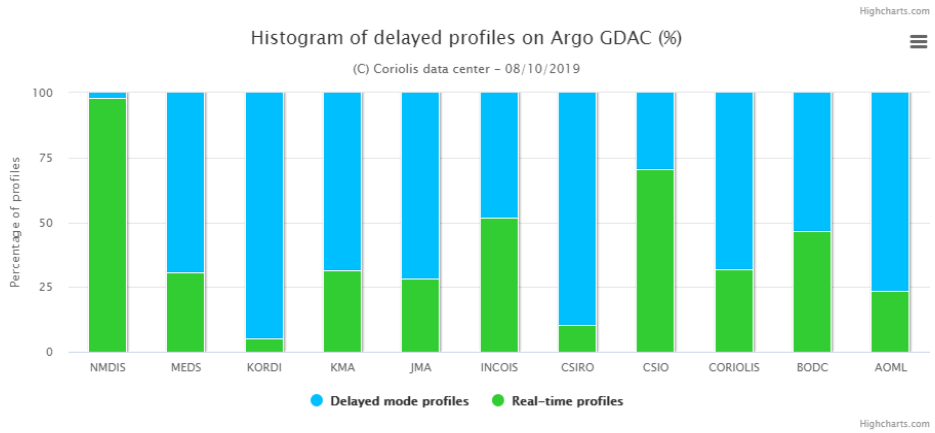
  1. Value added products obtained from Argo data are continued. Continued to variational analysis method while generating value added products. Many products are generated using Argo temperature and salinity data. The Argo T/S data are first objectively analysed and this

gridded output is used in deriving value added products. More on this can be see in the RDAC functions.

2. Version 2.2 of DVD on "Argo data and products for the Indian Ocean" is released to public for use with data corresponding to Dec 2018 updated. This DVD consists of ~ 3,50,000 profiles and products based on the Argo T/S. A GUI is provided for user to have easy access to the data. DVD product is discontinued and it is being made available via INCOIS and UCSD web sites.
3. To cater to many users of INCOIS LAS, it is enhanced in term of capacity. New Server is procured and new products viz., model outputs, new wind products (OSCAT), fluxes are made available. New products as per the request received from the users in future are being made available. For further details visit http://las.incois.gov.in.
4. The Argo and value added products derived from Argo data are also alternatively made available through ERDDAP. Here the provision for individual data and the derived products is also enabled for users.

## 2. 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.
- Advanced Delayed Mode Quality Control s/w developed by CSIRO is being put to use successfully. Also the 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. COW S/w is mainly used for performing DMQC of Provor/Arovor floats.
- Under the data search and archeology data from our own sister concerns is being obtained and put to use in the delayed mode processing.
- About 51% of the eligible profiles are subjected to DMQC and the delayed mode profiles are uploaded on to GDAC. Majority of the old dead float which are passed through DMQC are converted to Ver 3.1 and uploaded to GDAC.



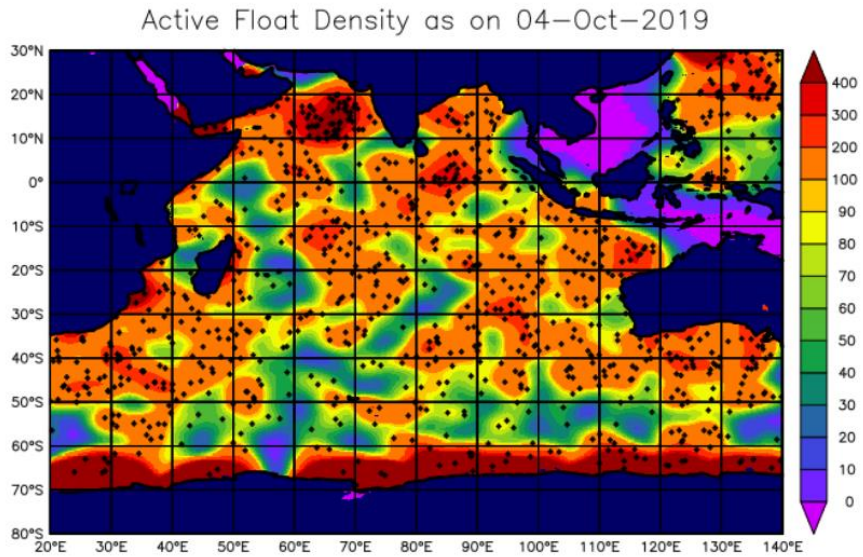

## 3. GDAC Functions

INCOIS is not operating as a GDAC.

## 4. Regional Centre Functions

- Acquisition of Argo data from GDAC corresponding to floats other than deployed by India and made them available on INCOIS web site.
- All these data sets are made available to the user through a s/w developed with all GUI facilities. This s/w is made available through FTP at INCOIS and UCSC web sites.
- 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. These gridded data sets are made available through INCOIS Live Access Server (ILAS). Users can view and download data/images in their desired format.
- ERDDAP site was set up for the data and data products derived from Argo floats.
- Additionally SST from TMI, AMSRE and Wind from ASCAT, Chla from MODIS and OCM-2 are also made available on daily and monthly basis.
- Global wind products from OSCAT is also generated and made available on LAS along with TROP flux data sets.
- Data Sets (CTD, XBT, Subsurface Moorings) are being acquired from many principle investigators. These data are being utilized for quality control of Argo profiles.
- Value added products:
  Two types of products are currently being made available to various user from INCOIS web site. They are:
  (i) Time series plots corresponding to each float (only for Indian floats).
  (ii) Spatial plots using the objectively analysed 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

- Regional Co-ordination for Argo floats deployment plan for Indian Ocean. The float density in Indian Ocean as on 21 Nov, 2018 is shown below.



**Publications:**

INCOIS is actively involved in utilization of Argo data in various studies pertaining to Indian Ocean. Also INCOIS is encouraging utilization of Argo data by various universities by funding them. Some of the publications resulted from Argo data which includes scientists from INCOIS are given below:


1. Bhowmick, S. A., N. Agarwal, M. M. Ali, C. M. Kishtawal, and R. Sharma, 2019: Role of ocean heat content in boosting post-monsoon tropical storms over Bay of Bengal during La-Niña events. *Climate Dynamics*, 52, 7225-7234, https://doi.org/10.1007/s00382-016-3428-5.
2. Chakraborty, K., N. Kumar, M. S. Girishkumar, G. V. M. Gupta, J. Ghosh, T. V. S. Udaya Bhaskar, and V. P. Thangaprakash, 2019: Assessment of the impact of spatial resolution on ROMS simulated upper-ocean biogeochemistry of the Arabian Sea from an operational perspective. Journal of Operational Oceanography, 1-27, https://doi.org/10.1080/1755876X.2019.1588697.
3. Chakraborty, K., A. A. Lotliker, S. Majumder, A. Samanta, S. K. Baliarsingh, J. Ghosh, P. P. Madhuri, A. Saravanakumar, N. S. Sarma, B. S. Rao, and P. Shanmugam, 2019: Assessment of model-simulated upper ocean biogeochemical dynamics of the Bay of Bengal. Journal of Sea Research, 146, 63-76, https://doi.org/10.1016/j.seares.2019.01.001.
4. Chatterjee, A., B. P. Kumar, S. Prakash, and P. Singh, 2019: Annihilation of the Somali upwelling system during summer monsoon. Scientific Reports, 9, 7598, https://doi.org/10.1038/s41598-019-44099-1.
5. Chaudhuri, D., D. Sengupta, E. D'Asaro, R. Venkatesan, and M. Ravichandran, 2019: Response of the Salinity-Stratified Bay of Bengal to Cyclone Phailin. Journal of Physical Oceanography, 49, 1121-1140, https://doi.org/10.1175/JPO-D-18-0051.1.
6. Girishkumar, M. S., V. P. Thangaprakash, T. V. S. Udaya Bhaskar, K. Suprit, N. Sureshkumar, S. K. Baliarsingh, J. Jofia, V. Pant, S. Vishnu, G. George, K. R. Abhilash, and S. Shivaprasad, 2019: Quantifying Tropical Cyclone's Effect on the Biogeochemical Processes Using Profiling Float Observations in the Bay of Bengal. Journal of Geophysical Research: Oceans, 124, 1945-1963, https://doi.org/10.1029/2017JC013629.
7. Goni, G. J., J. Sprintall, F. Bringas, L. Cheng, M. Cirano, S. Dong, R. Domingues, M. Goes, H. Lopez, R. Morrow, U. Rivero, T. Rossby, R. E. Todd, J. Trinanes, N. Zilberman, M. Baringer, T. Boyer, R. Cowley, C. M. Domingues, K. Hutchinson, M. Kramp, M. M. Mata, F. Reseghetti, C. Sun, U. Bhaskar TVS, and D. Volkov, 2019: More Than 50 Years of Successful Continuous Temperature Section Measurements by the Global Expendable Bathythermograph Network, Its Integrability, Societal Benefits, and Future. Frontiers in Marine Science, 6, https://doi.org/10.3389/fmars.2019.00452.
8. Hermes, J. C., Y. Masumoto, L. M. Beal, M. K. Roxy, J. Vialard, M. Andres, H. Annamalai, S. Behera, N. D'Adamo, T. Doi, M. Feng, W. Han, N. Hardman-Mountford, H. Hendon, R. Hood, S. Kido, C. Lee, T. Lee, M. Lengaigne, J. Li, R. Lumpkin, K. N. Navaneeth, B. Milligan, M. J. McPhaden, M. Ravichandran, T. Shinoda, A. Singh, B. Sloyan, P. G. Strutton, A. C. Subramanian, S. Thurston, T. Tozuka, C. C. Ummenhofer, A. S. Unnikrishnan, R. Venkatesan, D. Wang, J. Wiggert, L. Yu, and W. Yu, 2019: A Sustained Ocean Observing System in the Indian Ocean

for Climate Related Scientific Knowledge and Societal Needs. Frontiers in Marine Science, 6, https://doi.org/10.3389/fmars.2019.00355.
9. Jena, B., M. Ravichandran, and J. Turner, 2019: Recent Reoccurrence of Large Open-Ocean Polynya on the Maud Rise Seamount. Geophysical Research Letters, 46, 4320-4329, https://doi.org/10.1029/2018GL081482.
10. Jyoti, J., P. Swapna, R. Krishnan, and C. V. Naidu, 2019: Pacific modulation of accelerated south Indian Ocean sea level rise during the early 21st Century. Climate Dynamics, https://doi.org/10.1007/s00382-019-04795-0.
11. Kakatkar, R., C. Gnanaseelan, J. S. Chowdary, J. S. Deepa, and A. Parekh, 2019: Biases in the Tropical Indian Ocean subsurface temperature variability in a coupled model. Climate Dynamics, 52, 5325-5344, https://doi.org/10.1007/s00382-018-4455-1.
12. Prasad C, A. and P. Kumar, 2019: On the Possible Mechanisms for Saltening of the Bay of Bengal. Defence Science Journal, 69, 93-103, https://doi.org/10.14429/dsj.69.12220.
13. Gulakaram, V. S., N. K. Vissa, and P. K. Bhaskaran, 2018: Role of mesoscale eddies on atmospheric convection during summer monsoon season over the Bay of Bengal: A case study. Journal of Ocean Engineering and Science, 3, 343-354, https://doi.org/10.1016/j.joes.2018.11.002.

**Argo National Data Management Report – Italy (2019) - MedArgo**

## 1. Status

- **<u>Data acquired from floats</u>:** more than 64000 CTD Argo profiles were acquired in the Mediterranean and in Black Seas between 2001 and September 2019. The temporal and spatial distribution of these profiles is depicted in Figure 1, sorted by the two main float models currently used (BGC-Argo and Core-Argo floats); the monthly and yearly distribution is shown in Figure 2. Note that here BGC-Argo includes the floats with any biogeochemical sensor on board. About 80 floats per months have been operated simultaneously in the basins in 2019 and more than 8500 CTD profiles have been acquired (from September 2018 to September 2019) by different float models (Figure 3).

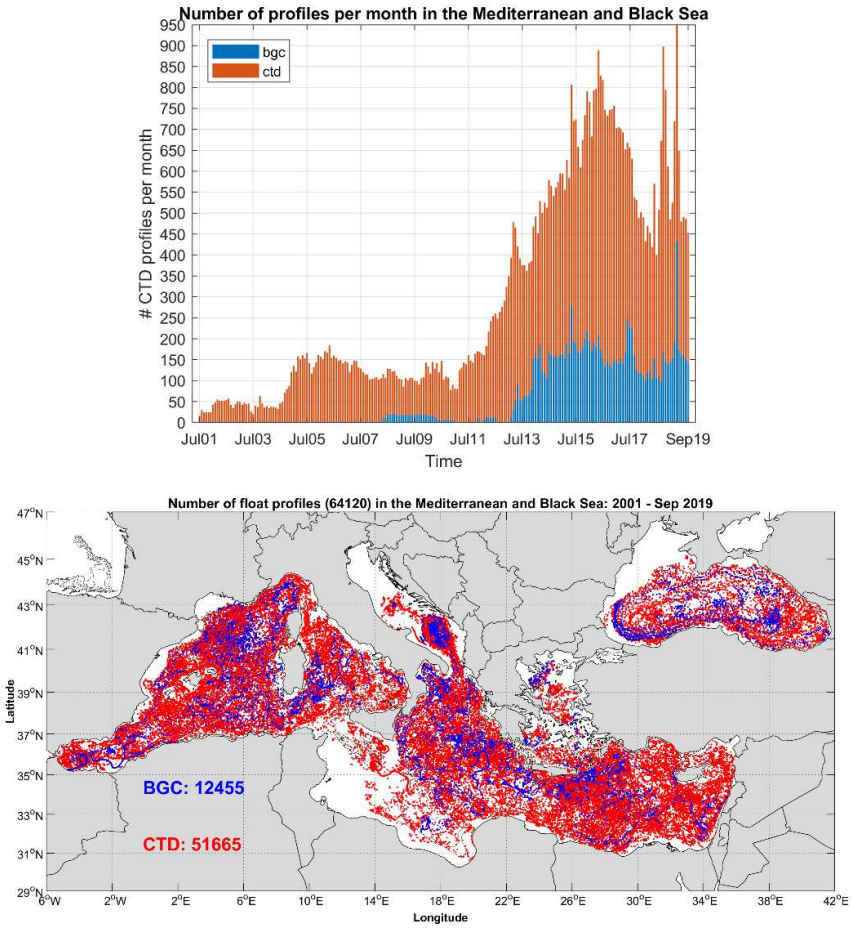



Figure 1. Temporal (upper panel) and spatial (bottom panel) distribution of float profiles in the Mediterranean and Black Sea between 2001 and 2019.

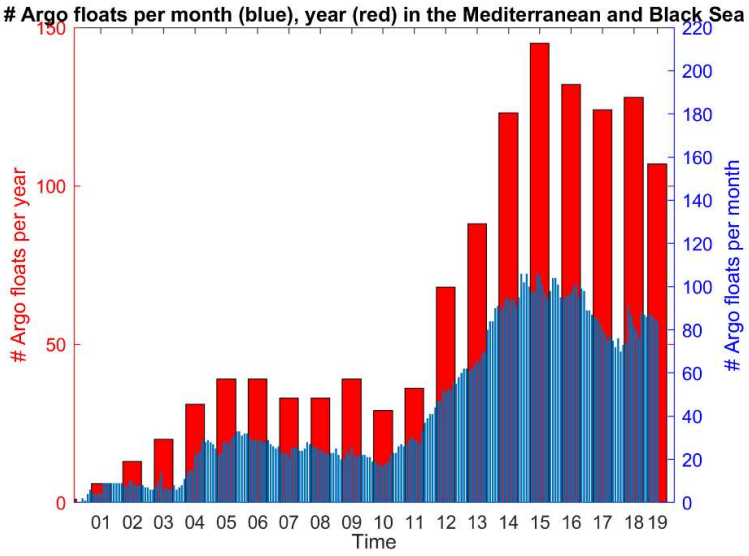



Figure 2. Monthly (blue bars) and yearly (red bars) distribution of Argo floats in the Mediterranean and Black Sea between 2001 and 2019.

The number of CTD profiles acquired by BGC-Argo floats in the last year (September 2018-September 2019) is about 2200 (main contributors: France, Italy and Greece) whilst the ones collected by the core Argo floats are about 6300. Spain, Greece, France and Italy contributed to maintain/increase the Argo population in 2019: a total of 43 new floats have been deployed both in the Mediterranean and in the Black Seas (Figure 3); 20 out of 43 platforms are equipped with biogeochemical sensors and the deployment strategy was chosen according to project's targets and to replace dead floats or under-sampled areas.

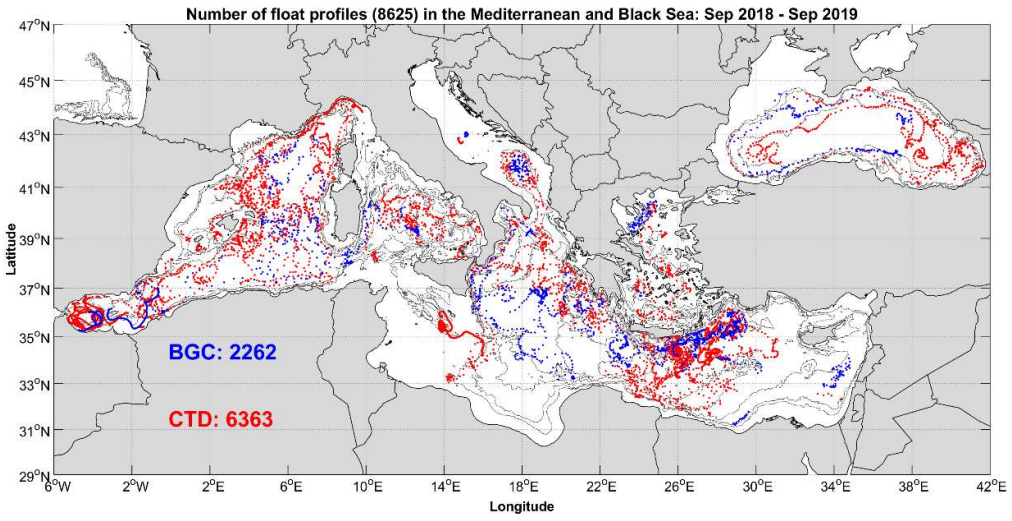



Figure 3. Spatial distribution of profiles collected by Argo floats in the last year (September 2018-September 2019) in the Mediterranean and Black Sea: BGC-Argo floats (blue dots) and standard Argo floats (red dots).

Statistics of the float survival rate in the Mediterranean Sea were computed, using the entire dataset. The survival rate diagram produced are separated by transmission mode (figure 4). The maximum operating life is more than 430 cycles, whilst the mean half life is about 130 cycles (figure 4a). The vertical distance travelled by floats is computed and used as an indicator of the profiler performance (figure 4b). The maximal distance observed is about 430 km, whilst the mean distance travelled is about 105 km.

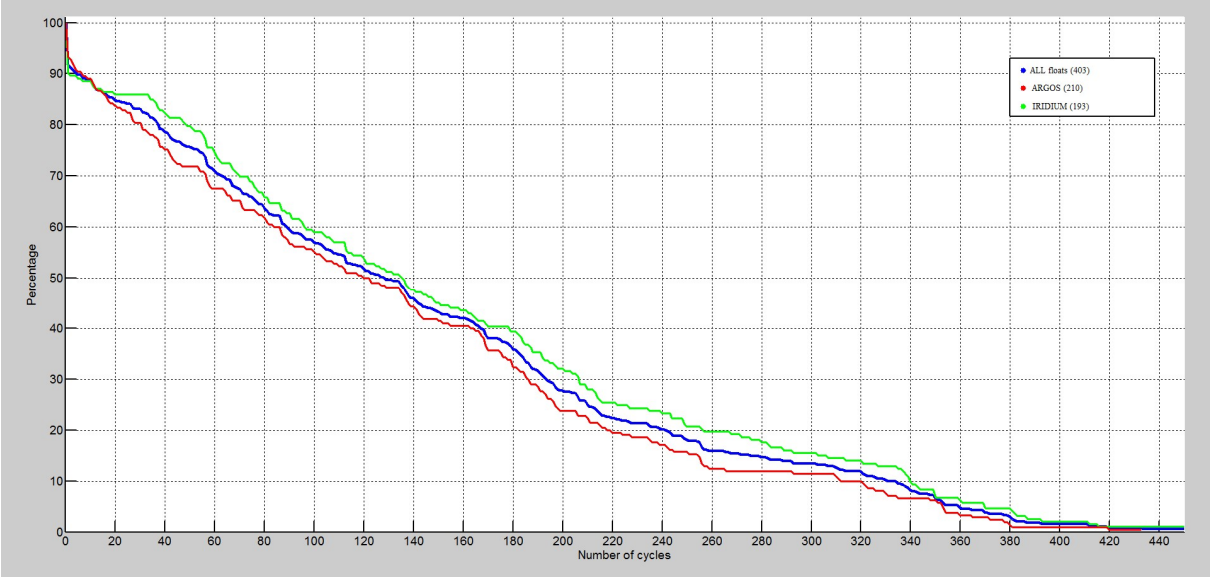



Figure 4a. Survival rate diagrams separated by telemetry system.

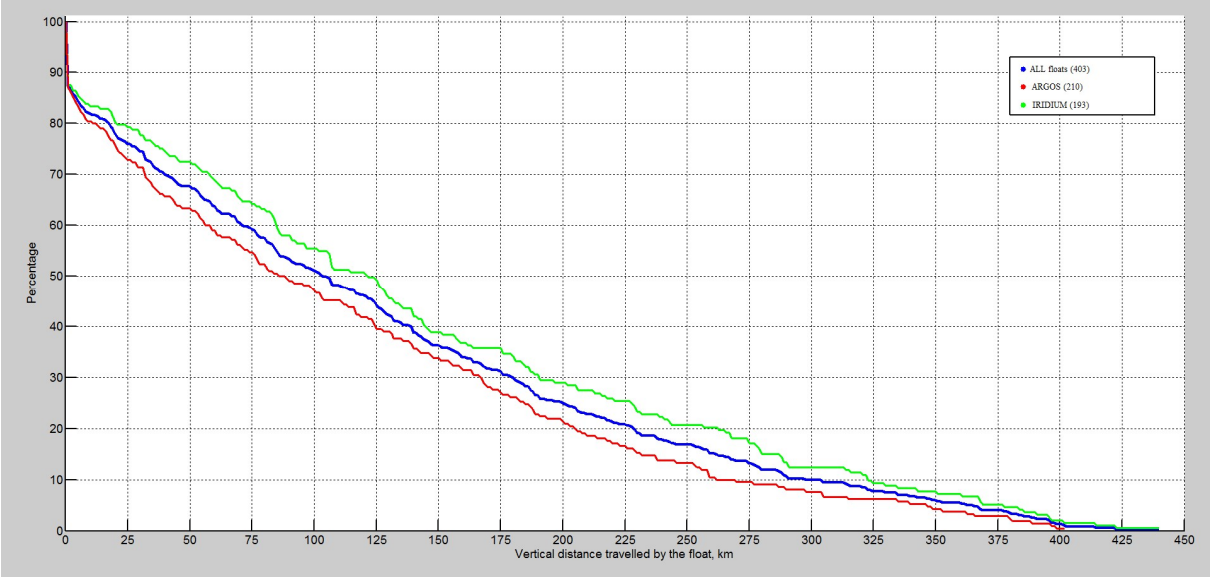



Figure 4b. Diagram of the vertical distance travelled floats, separated by telemetry system.

- **Web pages:**

The OGS MAOS group web site http://maos.inogs.it provides detailed information of the Argo-Italy floats (Figure 5).

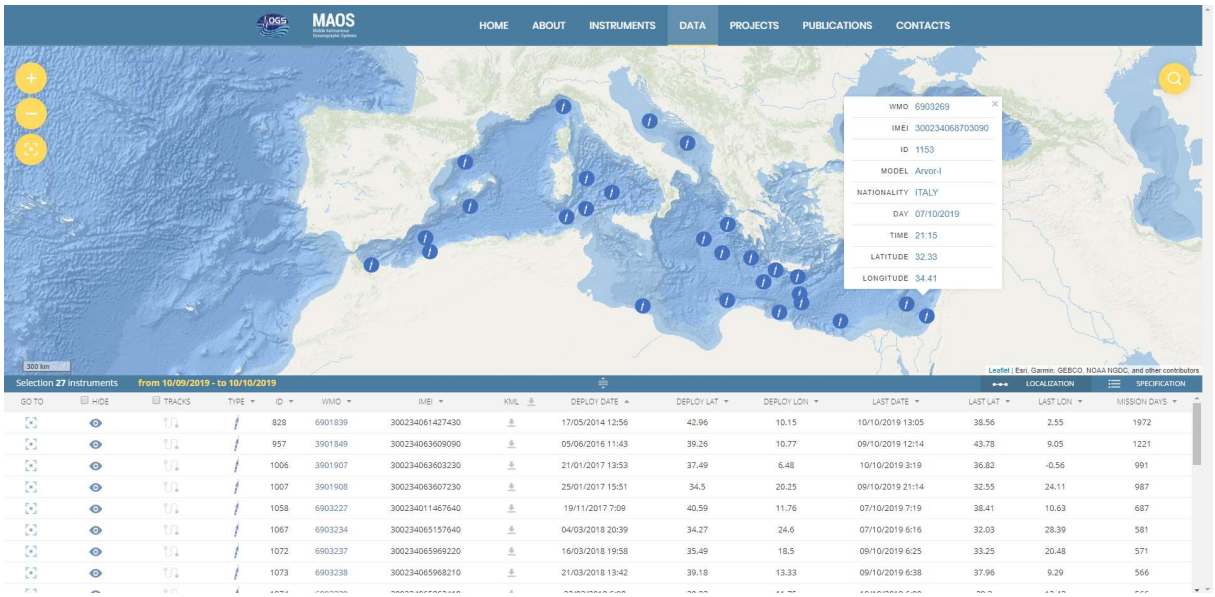



Figure 5. Mediterranean Argo-Italy floats web page

In the MedArgo web page (http://nettuno.ogs.trieste.it/sire/medargo/active/index.php) tables and graphics are updated in near real time. The floats deployed during 2019 have been added to the web page as soon as the technical information are available. The float positions are plotted daily (Figure 6); the monthly and the whole trajectories are also provided. Links with the GDAC center (Coriolis) are also available for downloading both the real-time and delayed-mode float profiles. A link with the Laboratoire d'Oceanographie de Villefranche (OAO - Oceanographic Autonomous Observations) can provide detailed information about Argo floats equipped with biogeochemical sensors.

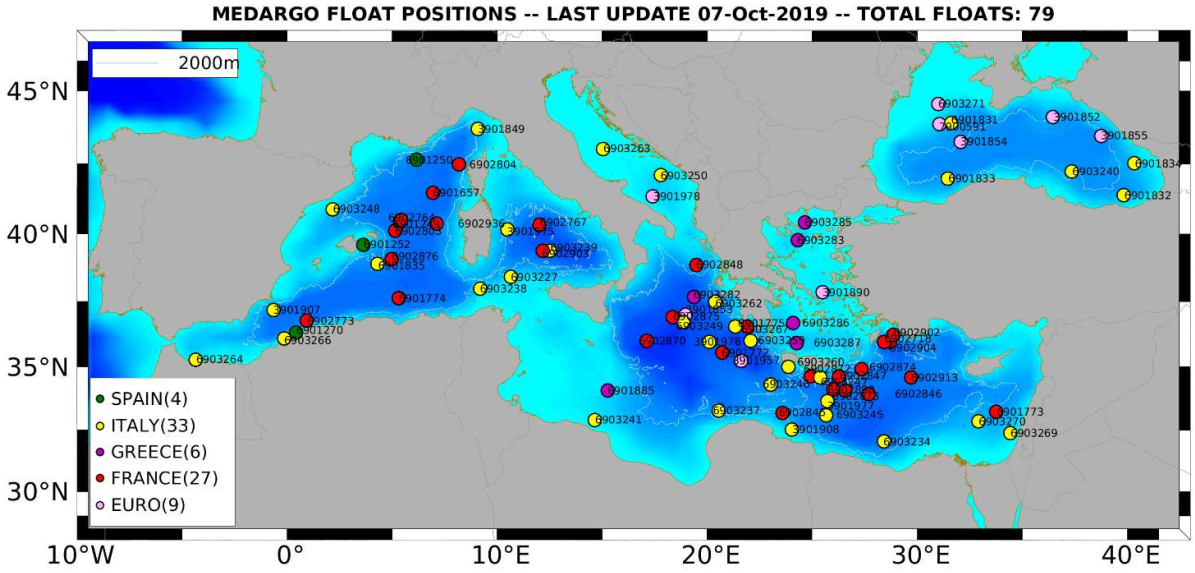



Figure 6. MedArgo float positions as of 7 October 2019 (updated daily).

- **<u>Statistics of Argo data usage</u>:** ( operational models, scientific applications, number of National Pis… ):
- **<u>Products generated from Argo data</u>:**
  a. Daily maps of float positions (Figure 6)
  b. Monthly maps of float positions and track
  c. Float data are assimilated in numerical forecasting models by INGV (MFS); daily and weekly maps of Mediterranean ocean forecasting system are produced (Figure 7).

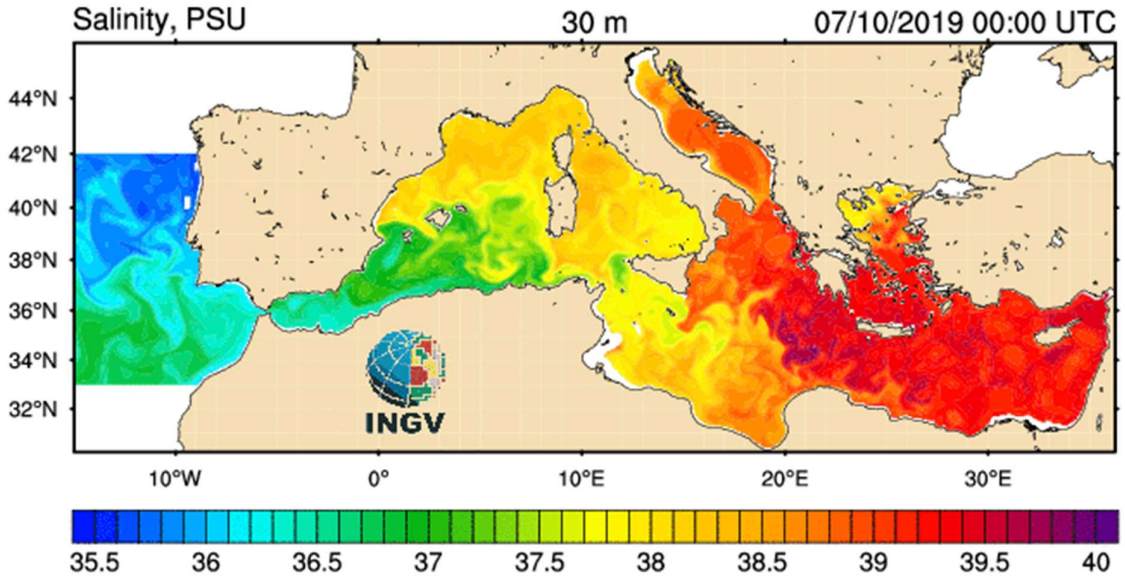



Figure 7. Forecasting model of salinity at 30 meters.

## 2. Delayed Mode QC

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.

- Additional and most recent Argo and CTD reference datasets for the Mediterranean and the Black Seas have been added to the current reference dataset. The CTD reference dataset consists of data collected from personal contacts, the CMEMS portal and data provided by Coriolis. The activity is summarized in a report written under the European MOCCA project: *Notarstefano G. (2019). Report on the reference dataset for the delayed-mode quality control activity in the Mediterranean and Black Sea. Deliverables D4.4.1. MOCCA project. European Maritime and Fisheries Fund (EMFF). Agreement number: EASME/EMFF/2015/1.2.1.1/SI2.709624*.
- Since a manufacturing problem linked to the SeaBird Scientific CTD has been highlighted, a list of the floats, that could be potentially affected by a salinity drift caused by the CTDs with the serial number in the range of 6000-7100, was created (Action 31, a doc file was provided separately).
- The DMQC method has been applied to about 67% (as of October 2019) of the eligible floats deployed between 2001 and mid 2018 in the Mediterranean and Black Seas: they were quality controlled in delayed-mode for salinity, temperature and surface pressure and the respective D-files are gradually sent to GDAC. The DMQC report/info of each float can be downloaded by the MedArgo web page (http://nettuno.ogs.trieste.it/sire/medargo/all/table_out_all.php).

## 3. 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 43 new floats have been deployed in the Mediterranean and

Black Sea during 2019, through a coordinated activity of deployment opportunities and thanks to scientific projects.

- The fourth Arvor Deep was deployed in the Hellenic trench on 19th July 2019. It was set to cycle every 2 days and the parking depth equal to the maximal profiling depth (3000 dbar). The vertical resolution was set at 2 dbar in the upper layer (0-100 dbar), 10 dbar in the intermediate layer (100-700 dbar) and 25 dbar in the deep one. The grounding mode is set to "0" that means the float goes up 100 dbar after grounding and wait there before starting its ascent. As soon as the float received a new mission configuration (5 days cycle and 3500 m as the maximal profiling and drifting depth) it stopped transmitting at cycle 6. This issue is still under investigation by the NKE experts.
- There are 69 active Argo floats in the Mediterranean Sea and 10 in the Black Sea as of 7 October 2019.
- A DMQC training activity started in 2019 as an activity planned under the European MOCCA project. A potential new Black Sea DM operator from the IO-BAS Bulgarian Institute is currently trained by OGS.

# Argo National Data Management Report of Japan, 2019

## 1. Status

The Japan DAC, the Japan Meteorological Agency (JMA), has processed data from 1705 Japanese Argo and Argo-equivalent floats including 217 active floats as of October 1st, 2019. There are ten 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.

The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has done the Delayed Mode QC for all Japanese floats. The delayed mode QC for the 8,880 profiles observed by Japanese floats from Novenber 22th 2018 to October 1st 2019 are in progress. JAMSTEC decoded 6,559 profiles of these, which were acquired as ARGOS messages and Iridium messages from November 22th 2018 to October 1st 2019. JAMSTEC sent 25,095 delayed profile files (D-files) to GDACs through the Japan DAC, JMA, during the period.

JMA and JAMSTEC have been converting 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 the almost all of Japanese meta-files, except a few Iridium floats, 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 30% 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.

### Web pages:

**Japan Argo**

http://www.jamstec.go.jp/J-ARGO/index_e.html

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.

**Real-time Database (JMA)**

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

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

**Delayed mode Database (Argo JAMSTEC)**

http://www.jamstec.go.jp/ARGO/argo_web/argo/?lang=en

JAMSTEC's website shows mainly Japanese float list, trajectory map, profile chart, and QCed float data. Moreover, the position and trajectory maps of all floats of the world as well as Japanese floats by using Google Map. Brief profile figures of the selected floats are also shown. This site also shows global maps based on objective analysis (temperature, salinity, potential density, dynamic height, geostrophic current, mixed layer depth, etc.).

## Statistics of Argo data usage:

**Operational models of JMA**

MOVE/MRI.COM-G2 (Multivariate Ocean Variation Estimation System/ Meteorological Research Institute Community Ocean Model – Global 2)

JMA operates the MOVE/MRI.COM-G2, which replaced the previous version (MOVE/MRI.COM) in June 2015, for the monitoring of El Niño and the Southern Oscillation (ENSO) and for initialization of the seasonal prediction model (JMA/MRI-CGCM2). The MOVE/MRI.COM-G2 consists of an ocean general circulation model (OGCM) and an objective analysis scheme.

For details please visit:

http://ds.data.jma.go.jp/tcc/tcc/products/elnino/move_mricom-g2_doc.html

JMA/MRI-CGCM2 (JMA/MRI - Coupled ocean-atmosphere General Circulation Model 2)

JMA operates JMA/MRI-CGCM2, which replaced the previous version (JMA/MRI-CGCM) in June 2015, as a seasonal prediction model and an ENSO prediction model. The oceanic part of this model is identical to the OGCM used for the MOVE/MRI.COM-G2.

For details please visit:

http://ds.data.jma.go.jp/tcc/tcc/products/model/outline/cps2_description.html

MOVE/MRI.COM-WNP (Multivariate Ocean Variation Estimation System/ Meteorological Research Institute Community Ocean Model - Western North Pacific)

MOVE/MRI.COM-WNP provides daily, 10day-mean and monthly products of subsurface temperatures and currents for the seas around Japan and northwestern Pacific Ocean.

**Other operational models**

JCOPE2 (Japan Coastal Ocean Predictability Experiment)

JCOPE2 is the model for prediction of the oceanic variation around Japan which is operated by Research Institute for Global Change of JAMSTEC. JCOPE2 is the second version of JCOPE, developed with enhanced model and data assimilation schemes. The Argo data are used by way of GTSPP. The hindcast data 6 months back and the forecast data 3 months ahead are disclosed on the following web site: http://www.jamstec.go.jp/frcgc/jcope/.

More information is shown in
http://www.jamstec.go.jp/frcgc/jcope/htdocs/e/home.html

FRA-JCOPE2

FRA-JCOPE2 is the reanalysis data created by assimilating most of available observation data into the JCOPE2 ocean forecast system. The high horizontal resolution of 1/12 deg. is used in order to describe the oceanic variability associated with the Kuroshio-Kuroshio Extension, the Oyashio, and the mesoscale eddies from January 1993 to December 2009. Collaboration with Japanese Fishery Research Agency (FRA) has allowed us to assimilated huge amount of in-situ data around Japan. FRA-JCOPE2 reanalysis data are openly available. The website, http://www.jamstec.go.jp/frcgc/jcope/vwp/, provides information about downloading and interactively visualizing the reanalysis data for users.

FRA-ROMS

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 started the operation in May 2012. The forecast oceanographic fields are provided every week on the website http://fm.dc.affrc.go.jp/fra-roms/index.html/.

## Products generated from Argo data:

### Products of JMA

El Niño Monitoring and Outlook

JMA issues the current diagnosis and the outlook for six months of ENSO on the following web site. The outputs of the MOVE/MRI.COM-G2 and the JMA/MRI-CGCM2 can be found here.
http://ds.data.jma.go.jp/tcc/tcc/products/elnino/index.html

Subsurface Temperatures and Surface Currents in the seas around Japan

The following parameter outputs of the MOVE/MRI.COM-WNP can be found on https://www.data.jma.go.jp/gmd/goos/data/database.html.

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

### Products of JAMSTEC

MOAA (Monthly Objective Analysis using the Argo data)

MOAA is the global GPV data set which was made by monthly OI objective analysis using Argo and TRITON mooring data. Various maps have been made using MOAA, and opened to the public on the Argo

JAMSTEC web site,
http://www.jamstec.go.jp/ARGO/argo_web/argo/?page_id=83&lang=en

### Objectively mapped velocity data at 1000 dbar derived from trajectories of Argo floats

The gridded velocity data at 1000 dbar is made by optimal interpolation analysis using YoMaHa'07. This dataset has been disclosed since October 2009. This dataset are updated every 6 months. This data is opened to the public on the Argo JAMSTEC web site,
http://www.jamstec.go.jp/ARGO/argo_web/argo/?page_id=86&lang=en

### MILA GPV (Mixed layer data set from Argo floats in the global ocean)

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. The updated data set is released on the Argo JAMSTEC web site,
http://www.jamstec.go.jp/ARGO/argo_web/argo/?page_id=223&lang=en.

### Scientifically quality-controlled profile data of Deep NINJA observations

We have 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 conducted at float deployments. Its detailed information has been provided on the Argo JAMSTEC web site:
http://www.jamstec.go.jp/ARGO/deepninja/

### ESTOC (Estimated state of global ocean for climate research)

This product is an integrated dataset of ocean observations including Argo data by using a four dimensional variational (4D-VAR) data assimilation approach. ESTOC is the open data that consists of not only physical but also biogeochemical parameters for 55 years during 1957-2011 (See the web site in JAMSTEC, http://www.godac.jamstec.go.jp/estoc/e/).

### AQC Argo Data (Advanced automatic QC 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. JAMSTEC improved this data set and has released it as AQC version 1.2. This data set has been provided in the ascii format as well as netcdf format, because it is useful for analyses using various software (see the web site in JAMSTEC,
http://www.jamstec.go.jp/ARGO/argo_web/argo/?page_id=100&lang=en)

**Products of JAMSTEC/JMA·MRI**

FORA-WNP30 (Four-dimensional Variational Ocean ReAnalysis for the Western North Pacific)

FORA-WNP30 is the first-ever dataset covering the western North Pacific over the last three decades (1982-2014) at eddy-resolving resolution. This is the cooperative work of Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Meteorological Research Institude, Japan Meteorological Agency (JMA/MRI) using the Earth Simulator. (see the web site http://synthesis.jamstec.go.jp/FORA/e/index.html)

## 2. Delayed Mode QC

JAMSTEC has done the DMQC for all Japanese floats.JAMSTEC has submitted the delayed mode files of 148,209 profiles to GDACs as of October 1st, 2019.

The procedure of DMQC in JAMSTEC is as follows.

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

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

**(Argo-equivalent floats that had ceased by 2007)**

JMA executes real-time processing again by using the latest procedure. The procedure after real-time processing is executed by JAMSTEC according to the procedure describe above.

The OW software is mainly operated instead of WJO. The calculation result of OW has been used at the definitive judgment. The result OW has been used just for reference.

## 3. GDAC Functions

The JAMSTEC ftp server has been providing the mirror site of GDACs since 2003.

ftp://ftp2.jamstec.go.jp/pub/argo/ifremer/

ftp://ftp2.jmastec.go.jp/pub/argo/fnmoc/

## 4. Regional Centre Functions

JAMSTEC operates PARC in cooperation with IPRC and CSIRO and has extended the responsible region into the whole Pacific including the Southern Ocean by request of AST-9 (Action item 9) since April 2008.

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 on the following web pages (http://www.jamstec.go.jp/ARGORC/). JAMSTEC had changed PARC web site system in association with the release of v3.1 netcdf files from GDAC. We will plan to upgrade the contents of PARC web site.

# Argo National Data Management Report
# - KIOST(KORDI), Korea Rep of. -

1. Status
   - Data acquired from floats
     - 82 profiles acquired from 4 floats in 2019
   - Data issued to GTS
     - None
   - Data issued to GDACs after real-time QC
     - 82 profiles in 2019
   - Data issued for delayed QC
     - 3,505 profiles
   - Delayed data sent to GDACs
     - 3,505 profiles
   - Web pages
     - None
   - Statistics of Argo data usage (operational models, scientific applications, number of National Pis… )
     - No information
   - Products generated from Argo data …
     - No information

2. Delayed Mode QC
   - Total 3,538 BR profiles (only DO) of 35 floats were extracted from ver2.1 data files, checked by real-time QC programs, and sent to GDAC.
   - 109 Metadata files were updated and uploaded to GDAC.
   - 53 Trajectory files were converted to ver3.1 and uploaded to GDAC.
   - It was found that some D profile data had wrong QC flags. They were fixed and sent to GDAC
   - Some profiles need more correction to fix thermal lag effect.

# KOREA Argo National Data Management Report
# ADMT-20
# Nice, France, Oct 14 - Oct 18, 2019

## 1. Status

### 1.1. Data acquired from floats

In 2019, the National Institute of Meteorological Sciences of Korea Meteorological Administration (NIMS/KMA) will deploy 6 floats around Korea: 4 for the East Sea, 2 for the Yellow Sea (Fig. 1). The NIMS/KMA has deployed 241 Argo floats in the North Pacific Ocean and East Sea since 2001, and 31 floats are in active as of October 1, 2019. As one of regional DACs, the NIMS/KMA is acquiring ARGOS messages and Iridium messages via web service from CLS in real-time, and all profiles obtained from the floats are transmitted to GDAC in the NetCDF format using BUFR data after the real-time quality-control process on operational system.

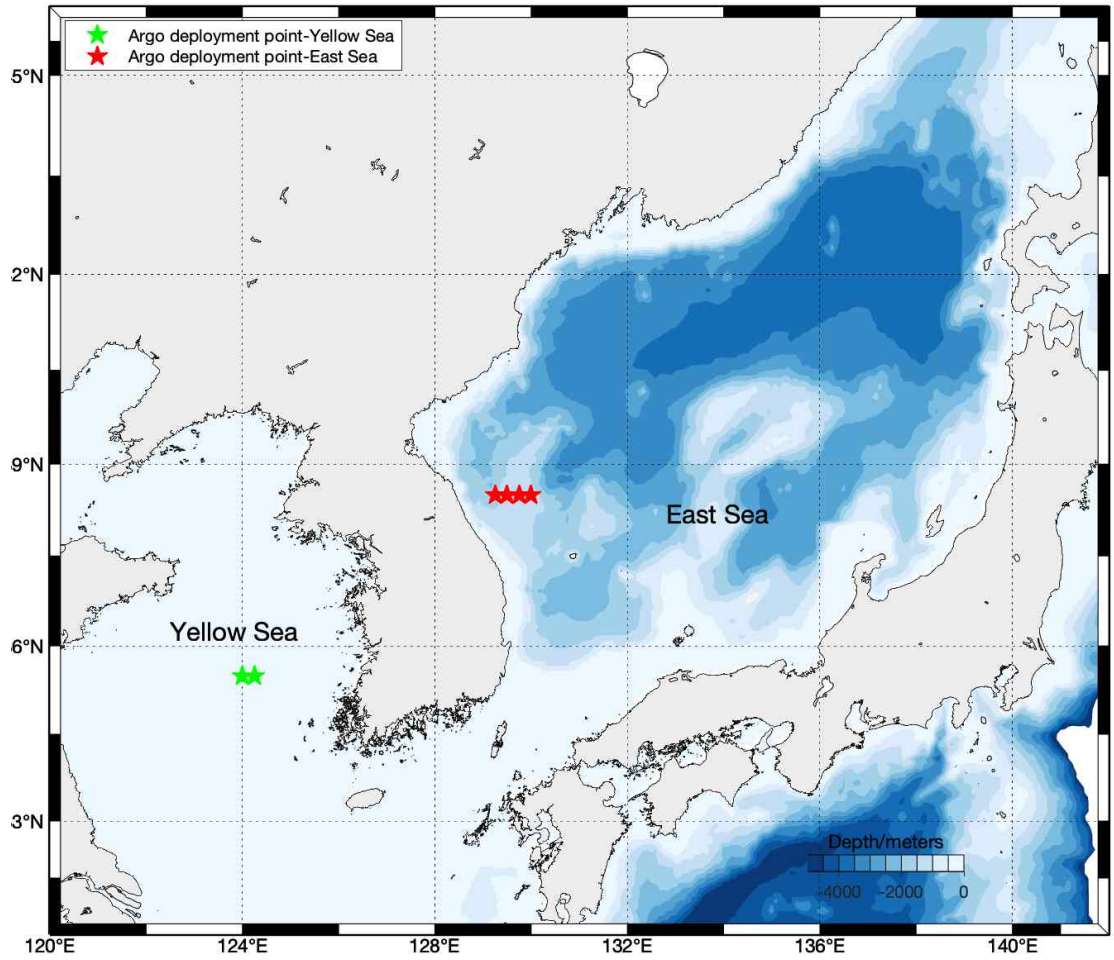



Fig. 1. Deployment point of Argo floats around Korea in 2019

### 1.2. Data issued to GDAC

Total **1,470 profiles** were acquired during January through September in 2019 and sent to the GDAC by real-time after the QC.

・Data reproduction and resubmission to GDAC by applying Warning Objective Analysis report.

・Implementing the Argo data format check program(New version).

The RTQC procedure has been updated for KMA floats in the East Sea by applying the new regional range test, spike test, gradient test, and density inversion test. The East Sea has much stronger stratification than the open ocean, so that the Argo samples in the thermocline were often flagged as bad data(QC flag = 4). In addition, data collected at parking depths for ARVOR and PROVOR floats will be separated from the data collected during descent/ascent for the convenience of data processing. The new regional RTQC will be introduced by the end of /November after a few test runs.

### 1.3 Shallow Argo

Experimental observations for the shallow Argo were conducted on July and November 2018 in Yellow Sea, Korea. In November 13, 2018, two floats were successfully deployed and have been working since the starting day, showing that trajectory of Argo float and daily variation of temperature and salinity (see Fig. 2). In particular, 2901786 float achieved more than 300 cycles observation from November 13, 2018 to September 9, 2019. It is surprising result from a daily cycle of shallow observation. NIMS/KMA will try to keep this kind of shallow Argo observation network in around Korean peninsular area.

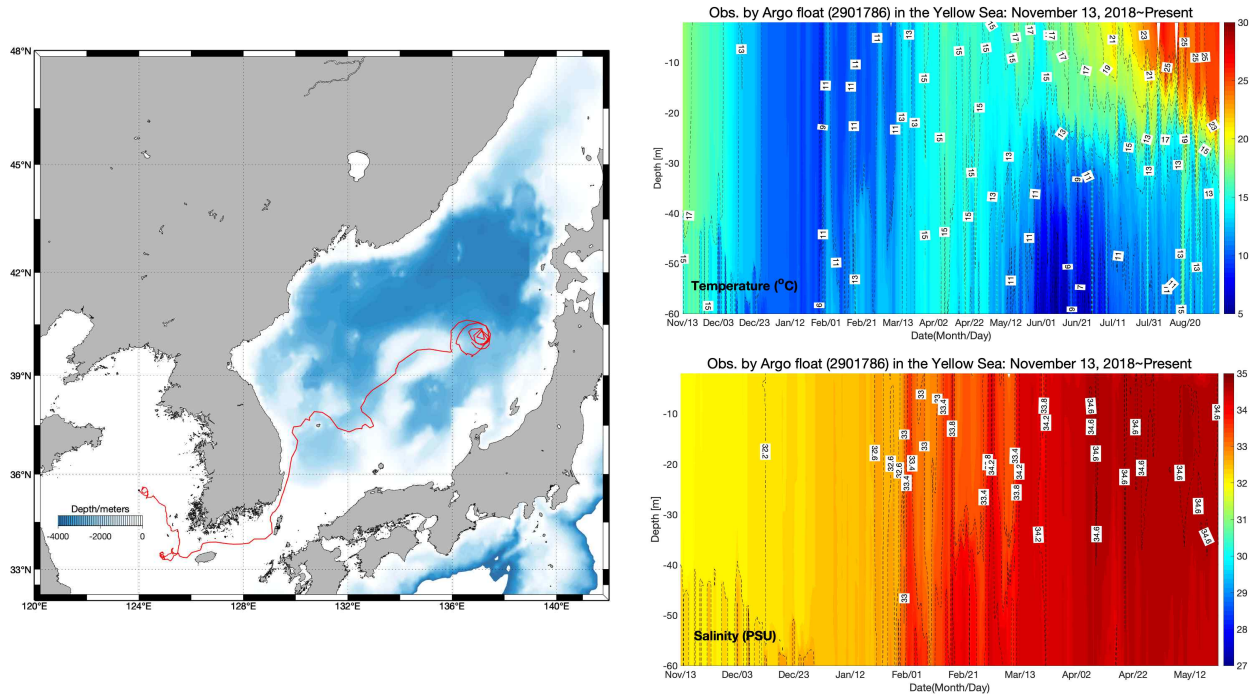



Fig 2. Trajectory and time-series of Shallow Argo float (2901786/300 cycles)

## 1.4. Web pages

NIMS/KMA operates the Korea Argo web page (http://argo.nims.go.kr), and provides profile data and status of Argo floats to the public and has shown **39,903 hits** by visitors in monthly average. also, It provides figures of vertical profile, spatial distribution and T-S diagram.

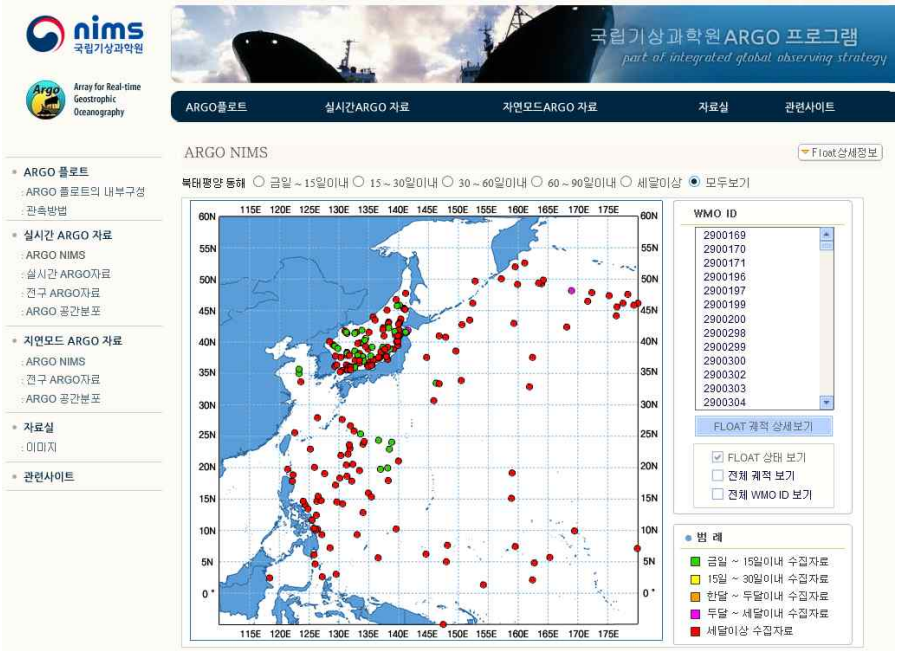



Fig. 3. Argo homepage of NIMS/KMA (http://argo.nims.go.kr)

## 1.5. Deployment plan for 2020

NIMS/KMA will continue to deploy the 6 Argo floats around Korea such as Yellow Sea and East Sea (see Fig. 4). The red square shows a possible area for the floats to be deploy in 2020 aiming at covering the regional seas of Korea.

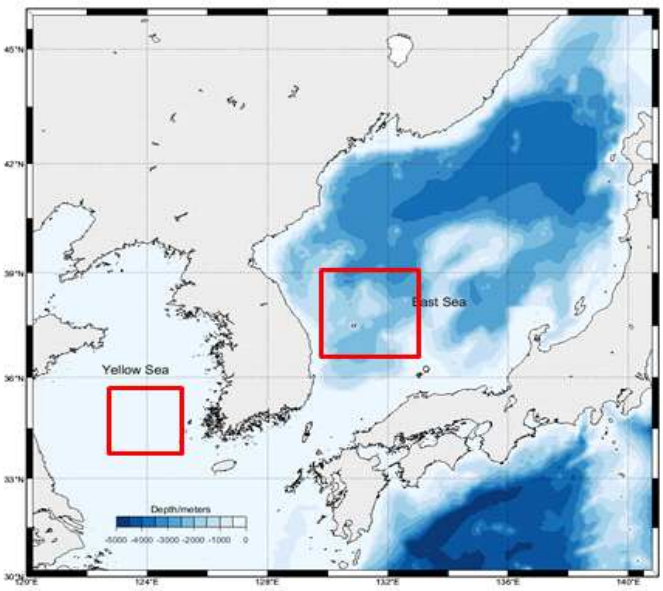



Fig. 4. NIMS/KMA's deployment area in 2020

## 2. Delayed Mode QC

We are currently processing new R-files that have been collected since 2013 in the East Sea and Western North Pacific. Those **10,125 files**(8,816 files from the East Sea and 1,309 files from the Western North Pacific) will be revised to D-files with NetCDF format(ver. 3.1) and will be sent to the GDACs by the end of this October, or at the earliest when the surface pressure issue is resolved. It has been identified that the surface pressure values in tech.nc files are missing, and we are trouble shooting the cause of these missing values for accurate DMQC process.

# Argo National Data Management Report – Norway 2019

Institute of Marine Research (IMR), Norway

## 1. Status

- **Data acquired from floats**

Presently there are 22 operational/active Norwegian floats. 13 floats have been deployed in 2018. Data from all operational floats are available from the GDACs.

- **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.

- **Data issued for delayed QC**

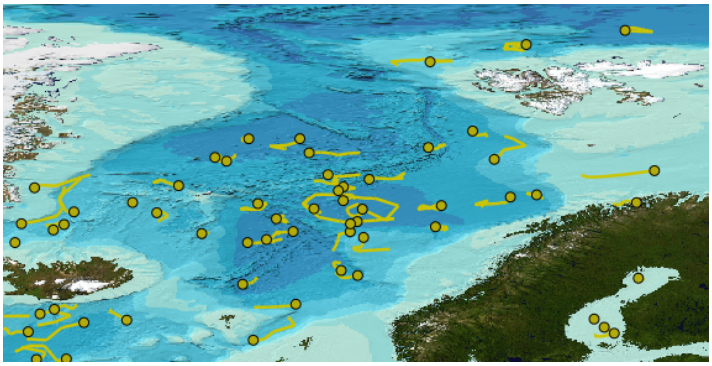
At present (07.10.2019) the Norwegian Argo fleet comprises 44 floats. According to Argo Information Center the floats have so far sampled 4599 profiles, where 3632 profiles are Delayed Mode and 569 profiles are DM-pending.

- **Delayed data sent to GDACs**

BSH (Germany) has done the Quality Control of all Norwegian floats, and the D-files are submitted to Coriolis with a short summary and diagnosis figures.

- **Web pages**

A new web page for NorArgo (norargo.no) has been developed that IMR updates. The web page has a link to daily updates of all operational Argo floats in the Nordic Seas and Arctic Ocean (see figure) and where profiles can be viewed.



- **Statistics of Argo data**

We have no statistics of Argo data usage. 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. 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.

## 2. Delayed Mode QC

BSH has adopted all the 44 floats from Norway for DMQC (see report for Germany).

## 3. GDAC Functions

## 4. Regional Centre Functions

## 5. References

# UK Argo National Data Management Report 2019

Report to the Argo Data Management Team – ADMT-20

## Author list

The UK Argo data team (British Oceanographic Data Centre, National Oceanography Centre)

Contributing authors: Matt Donnelly, Clare Bellingham, Violetta Paba, Kamila Walicka

Other team members: Katie Gowers, Ed Small, Paul McGarrigle, Justin Buck, Sarah Chapman, Roseanna Wright

With contributions from the wider UK Argo team by:

Jon Turton (UK Met Office)

Brian King (National Oceanography Centre)

Giorgio Dall'Olmo (Plymouth Marine Laboratory)

## General Status

### Data management team

The British Oceanographic Data Centre (BODC) is the data assembly centre for UK Argo funded primarily by the UK Natural Environment Research Council (NERC) and responsible for data management of UK, Irish and Mauritian floats. In addition, UK Argo is a member of Euro-Argo and is managing some European Union floats as part of the MOCCA project. BODC is also the lead for the Southern Ocean Argo Regional Centre (SOARC).

The composition of the team at BODC has changed further in the past year, with an overall increase in staffing levels. Liz Bradshaw has stepped away from providing temporary support for DAC operations, whilst Sarah Chapman who undertook some SAORC related work has left BODC. Kamila Walicka and Ed Small have joined the team with a focus on DMQC. Additionally we have temporary support from Matt Cazaly for a short project on BGC derivation equations. The team currently consists of:

| **BODC Argo Team Member** | **Role** | **Estimated contribution this FY as Full time Equivalent (FTE)** |
|---|---|---|
| Matt Donnelly | BODC Argo Lead<br>DAC contributor<br>DMQC operator<br>SOARC coordinating partner | 1.00 FTE |
| Clare Bellingham | DAC Lead<br>DMQC operator | 1.00 FTE |
| Ed Small | DMQC tools developer | 0.80 FTE |
| Kamila Walicka | DMQC Lead | 0.70 FTE |
| Violetta Paba | BGC Lead<br>Lead for Argo Vocabs<br>DAC contributor<br>DMQC operator | 0.70 FTE |
| Katie Gowers | Senior Argo Developer<br>DAC contributor | 0.60 FTE |
| Paul McGarrigle | Systems support | 0.10 FTE |
| Justin Buck | ENVRI-FAIR project manager | 0.05 FTE |
| Roseanna Wright | DAC and SOARC support | 0.05 FTE |
| | **TOTAL** | **5.00 FTE** |

## Funding outlook

National Capability funding from NERC is currently maintained for BODC at the same rate as previous years. In addition, NERC-funded research projects deploying Argo floats continue provide additional sources of data management funding, such as from the ORCHESTRA, ACSIS, BoBBLE and RoSES projects. Funding for system upgrades has also been secured as part of capital purchases of a type of float in the UK inventory.

BODC funding from the EU H2020 project AtlantOS ceased in early 2019 with the end of that project. BODC continues to receive funding from the Euro-Argo ERIC MOCCA project for the European Union floats that are managed by BODC along with related DMQC activities. The Euro-Argo Research Infrastructure Sustainability and Enhancement (Euro-Argo RISE) project provides funding for developing core and deep DMQC, management of BGC extensions and regional data quality assessments in the Southern Ocean. Additionally, BODC is funded under the EU H2020 project ENVRI-FAIR to introduce the NVS vocabulary server to support Argo vocabulary management.

BODC continues to seek additional sources of funding to support SOARC functions, but a long-term solution for sustained funding is yet to be identified.

# DAC Functions

## Data acquired from floats

BODC retrieves data for all UK, Irish, Mauritius and assigned EU MOCCA floats from a number of sources and archives these for further processing. Processing of incoming data is normally setup within one week of float deployment. Please refer to table 1 for the types of communications used for different floats.

## Data issued to GTS

BODC delivers core data 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. Coriolis is providing the processing for 12 PROVOR BGC floats and delivering the core data to the GTS on BODC's behalf. Delivery times to the GTS can be seen in figure 1.

### *Progress in the past year – general processing:*

BODC is currently distributing data to the GTS for c. 256 floats at the time of writing, which is an increase from 221 in November 2018. During 2019, BODC has sustained automated data processing four times a day. Delivery of core data for floats previously unprocessed has been a major focus during the past year, for all APF9I/N1/N2 and APF11 Argos floats. Work on APF11 iridium floats remains a priority for completion.

### *Current activity and future plans:*

Distribution of all core data to the GTS from all BODC managed floats is a priority, including core data from floats with any type of Argo extension (deep, BGC or auxiliary data). BODC's current focus is to ensure all floats with APF11 iridium controller boards are effectively managed within the BODC Argo System. Delivering on this objective is the highest priority for UK Argo. BODC is seeking to collaborate with other DACs in the development of BGC parameters especially regarding QC techniques.

## Data issued to GDACs after real-time QC

All core data received for currently processed floats are distributed to the GDACs within one hour of the data arriving at BODC, with the real-time quality control tests applied. Any file that fails to be transferred is queued for the next transfer attempt. BODC has completed the conversion to v3.1 for meta and core data with the exception of a small number of legacy fil. Please refer to table 1 for the types of float and whether they are being fully processed.

*Progress in the past year:*

BODC Argo has developed capability for the delivery of data from floats that house the APF9 Iridium and N1/N2 controller boards, enabling data delivery of core data for 23 additional floats. We have also developed our system to deliver APF11 Argos floats, enabling data delivery of core data for another 6 floats. Work has also progressed on managing BGC profile data providing the infrastructure for its delivery after all core data is available. Work is underway to deliver data from all of our APF11 Iridium floats.

*Current activity and future plans:*

There remains substantial further work to complete the delivery of the remaining core profile, tech and trajectory files, in that order of priority. We are not currently issuing any BGC-Argo files for UK floats due to the current focus on core profile data. The exception to this is the dozen PROVOR floats kindly hosted for BODC by Coriolis until such time as BODC can take over the real-time processing.

## Data issued for delayed-mode QC

Delayed-mode QC on BODC hosted floats is performed within BODC and as well as through external operators on some floats in the MOCCA project. Currently BODC is only capable of providing data for delayed-mode QC for core data. Investigative work has progressed to enable the delivery of biogeochemical parameters in v3.1. The exception to this is 13 PROVOR floats that Coriolis is hosting on BODC's behalf. See section 2 of this report for the status of delayed-mode QC.

*Progress in the past year:*

Progress on v3.1 profile files has made more delayed-mode files available in v3.1. BODC Argo has made significant progress this year on the number of profiles with delayed mode QC of core data on the GDAC. BODC Argo is now also able to visually QC core data from floats which use the Coriolis processing stream i.e. MOCCA floats as they become eligible for delayed-mode QC using the SCOOP software (but some issues remain with this software).

*Current activity and future plans:*

Progress on DMQC will continue in the coming year, and BODC expects to reach > 90% of core profiles in D-mode by ADMT-21

## Delayed-mode data sent to GDACs

All delayed-mode QC on BODC hosted floats is 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. See section 2 of this report for the status of delayed-mode QC.

Table 1: Summary of all BODC managed Argo floats, with a focus on those that are currently active

| | | | | | Mission of active floats | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Float type/controller** | **Comms** | **Total no. of deployed floats** | **Total no. of active floats** | **No. of active floats with ice detection** | **Core only** | **Core + NST** | **Core with RBR CTD** | **Core + oxygen only** | **Core + other BGC** | **Total no. of active floats being fully processed** |
| Martec Provor | Argos | 26 | - | - | - | - | - | - | - | - |
| MetOcean NOVA | Iridium | 1 | - | - | - | - | - | - | - | - |
| NKE Arvor | Argos | 5 | - | - | - | - | - | - | - | - |
| NKE Provor * | Iridium SBD | 13 | 8 | - | - | - | - | - | 8 | 8 |
| NKE Arvor | Iridium SBD | 77 | 72 | - | - | 72 | - | - | - | 72 |
| NKE Deep Arvor | Iridium SBD | 2 | - | - | - | - | - | - | - | - |
| SBE Navis N1 | Iridium Rudics | 12 | 5 | 5 | 5 | - | - | - | - | 5 |
| SBE Navis N1 with BGC | Iridium Rudics | 4 | - | - | - | - | - | - | - | - |
| SBE Navis N1 with oxygen | Iridium Rudics | 8 | 8 | - | - | - | - | 8 | - | 8 |
| SBE Navis N1 with radiometer | Iridium Rudics | 3 | 3 | - | - | - | - | - | 3 | 3 |
| TWR Apex APF7 | Argos | 8 | - | - | - | - | - | - | - | - |
| TWR Apex APF8 | Argos | 252 | - | - | - | - | - | - | - | - |
| TWR Apex APF9A (7 types) | Argos | 269 | 124 | 6 | 24 | 100 | - | - | - | 124 |
| TWR Apex APF9I | Iridium Rudics | 20 | 2 | 2 | 2 | - | - | - | - | 2 |
| TWR Apex APF9I with BGC | Iridium Rudics | 4 | - | - | - | - | - | - | - | - |
| TWR Apex APF9I with STS | Iridium Rudics | 4 | 3 | - | - | 3 | - | - | - | 3 |
| TWR Apex APF11 | Argos | 6 | 6 | - | 6 | - | - | - | - | 6 |
| TWR Apex APF11 | Iridium Rudics | 14 | 10 | n/k | - | - | 2 | 2 | 6 | 0 |
| TWR Deep Apex APF11 | Iridium Rudics | 14 | 3 | n/k | 2 | - | - | 1 | - | 0 |
| TOTAL | | 742 | 244 | 13 | 39 | 175 | 2 | 11 | 17 | 231 |

* = processing courtesy of Coriolis

## Web pages

BODC continues to maintain the UK Argo website (www.ukargo.net) along with a Facebook page (www.facebook.com/UKArgofloats/) and a Twitter account (twitter.com/ukargo). BODC/NOC also maintains the SOARC website (www.soarc.aq).

## Data use and data products

### Statistics of Argo Data Usage

#### *National Oceanography Centre*

Argo data are used widely within NOC science with the following regional leads for float deployment and science:

- Alex Sanchez Franks (Indian Ocean)
- Yvonne Firing (Southern Ocean)
- Penny Holiday (Sub-polar N Atlantic)
- Brian King (everywhere else)

The applications of Argo data at NOC include:

- Measurement of evolution and drivers of mixed layer processes in the (Indian Ocean);
- Inventory, transports and evolution of heat and freshwater establishing controls on budgets (both regional and global);
- Deep heat content (N Atlantic).

#### *UK Met Office*

All Argo data together with other ocean data, received over the WMO GTS, are routinely assimilated into the Met Office's FOAM (Forecasting Ocean Assimilation Model) which is run daily. The FOAM suite runs daily in an early morning slot and produces 2 analysis days and a 7-day forecast. The 3-D temperature, salinity and current fields from the global model run are used as boundary conditions for the regional models. There are 4 different configurations: ¼ degree global, 1/12 degree North Atlantic, 1/12 degree Mediterranean, 1/12 degree Indian Ocean and ~6km European North West Shelf. More details are at: http://www.ocean-sci.net/12/217/2016/os-12-217-2016.pdf and http://www.geosci-model-dev.net/7/2613/2014/gmd-7-2613-2014.html . The global FOAM system is used to initialise the ocean component of coupled monthly-to-seasonal forecasts, and so the requirements for Argo for that application are the same as for FOAM.

A coupled ocean/atmosphere prediction system has been developed for weather forecasting timescales, including assimilating Argo data in a coupled data assimilation framework (Lea et al., 2015), and is now being run operationally, delivering ocean forecast information to the Copernicus Marine Environment Monitoring Service (CMEMS). The timeliness constraints on Argo for this application are more stringent (data need to be available within 24 hours of measurement, and preferably within 6 hours). The impact of Argo on this system was assessed as part of the E-AIMS EU project (King et al., 2015). It is likely that future versions of coupled data assimilation schemes will require Argo data with timeliness of 3 hours (Chris Harris, Met Office Coupled Data Assimilation Manager, pers. comm., October 2018).

Near-surface Argo data are used to validate the output from the Met Office's OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis) – the OSTIA fields are in turn used as a lower boundary condition in numerical weather prediction models run by both the Met Office and ECMWF.
Argo data are also used in the initialization of ocean conditions in models run to make decadal predictions, see: http://www.metoffice.gov.uk/research/modelling-systems/unified-model/climate-models .

### *Plymouth Marine Laboratory*

Giorgio Dall'Olmo is the lead PI for BGC data in the UK. Bio-Argo data from 13 Provor floats are now available from the GDACs, thanks to processing courtesy of Coriolis.
Core-Argo data are used at PML for:

- providing a description of the physical environment in the framework of biological (e.g. mapping eel migration routes) and biogeochemical studies;
- developing techniques to generate 3D fields of biogeochemical variables by merging ocean-colour and in-situ data;
- investigating mesoscale structures by combining altimetry and in-situ profiles with a special focus on Agulhas rings.

BGC-Argo data focuses on investigating new methods to:

- efficiently monitor the ocean biological carbon pump;
- quantify particle flux attenuation;
- vertically-resolve seasonal remineralisation rates;
- to better understand the nitrogen cycle in oxygen minimum zones.

## Data Products

### *UK Met Office*

The Hadley Centre maintains two data products that incorporate Argo observations:

- EN4 contain in-situ ocean temperature and salinity profiles and objective analyses. It is updated monthly using real-time Argo profiles, and annually using delayed-mode Argo profiles. EN4 is freely available for scientific research use (see ***http://www.metoffice.gov.uk/hadobs/en4/***);
- HadGOA is an integrated database of surface and sub-surface temperature and salinity observations for the period 1850 to present. It includes quality flags, bias corrections and uncertainty information (Atkinson et al., 2014). At present, HadGOA obtains sub-surface profile data from EN4. The data is publicly available at: https://www.metoffice.gov.uk/hadobs/hadgoa/data/download.html.
- The datasets are used for climate and global change studies, including ocean heat content analysis.

# Delayed-Mode QC

BODC has improved delayed mode QC capability through a number of activities:

## 2.1 Workflow improvement

Shortly after the previous ADMT-19 meeting, BODC installed and implemented the new DMQC software OWC 2.0.1, released in December 2018 by Coriolis. The update of software was accompanied by an installation of the newly updated CTD and Argo reference dataset (CTD_for_DMQC_2018v1 and Argo_for_DMQC_2018v2). This activity required an update of in-house DMQC procedural documents.

In the early January BODC employed a new staff member, Kamila Walicka who received in-house training, mostly from Matt Donnelly with the support of Justin Bulk. Kamila has obtained extensive training about the structure and procedures of OWC software and has learnt about the DMQC methodology developed since the beginning of the Argo observing network. From February, Kamila started to submit a vast major of BODC's floats to GDAC. In March, Kamila visited our external European partners (Ifremer and BSH) in order to obtain more experience in using OWC software and benefit from wider knowledge and experience.

Another workflow improvement was the creation of a new DMQC report generator by Clare and Kamila, using the open-source LaTex (https://www.latex-project.org/) typesetting system. The newest improved DMQC report generator includes the detailed description of the OWC configurations for the specific regions, sequence of the checking procedures of data quality and scientific justification of the decisions made to provide the a high quality report for long-term reference.

## 2.2 Current activities

### 2.2.1 DMQC core progress

From December 2018 until the time of writing, BODC has submitted 101 floats, including 15 213 profiles:

- 31 EU MOCCA project floats, including 2028 profiles
- 13 UK MetBio Provor floats, including 3868 profiles
- 57 UK Argo floats, including 9317 profiles

By the end of September 2019, 55 % of BODC hosted floats profiles eligible for delayed mode QC have been processed and submitted to the GDACs. BODC expects to continue improving the number of submitted floats in the coming year, involving Kamila, Matt and Clare.

### 2.2.2 Argo DMQC Community Tools Survey

As a part of the Euro-Argo RISE project, Task 2.4: "Development & Implementation of DMQC methods" BODC is committed to undertaking a review of DMQC tools used within the Argo community. The aim of this report is to cover matters such as the report assessments of tool capabilities, interoperability between organisations, state of development, minimum system requirements, availability of access to the tool and number of current users. The final output from the report will be one or more recommended pathways to improve the sustainability of DMQC tools development within the global Argo data system. The aspiration is to improve collaboration to allow the DMQC process to be more sustainable, transparent, and easier to implement for groups managing a modest fleet of Argo floats or simply freshly involved in the complex task of DMQC.

This work was originally started under regeneration of our DMQC procedures for MOCCA in late 2017 but has been put on hold due to other demands. This task was undertaken by Kamila Walicka under Euro-Argo RISE WP2that will be completed before the Euro-Argo RISE WP2 meeting in November 2019. The main effort is to

produce a report on DMQC tools detailing their capability and operating requirements. Initial findings of the survey will be shared at ADMT20 for consideration by the community.

### 2.2.3 Argo OWC Conversion from Matlab to Python

The currently available OWC software has been developed in Matlab over the course of the past 10+ years. The computational efficiency of this process is not clear, but it is a time-consuming process. However, we know that various Argo partners do not have Matlab licenses, or have old versions of Matlab, or do not have access to Matlab toolboxes, such as the Optimisation Toolbox used by OWC. The licensing issue restricts the pool of potential DMQC operators, exacerbating a human resource shortage. Transferring the Maltab version of OWC to open-source software has the potential to enable more groups to use the most up-to-date version of OWC, and to enable DMQC operators from newly contributing institutions.

In order to address the issues mentioned above, BODC aims to deliver a translatedversion of OWC in the Python language.,To address this task, in September, BODC employed software engineer Edward Small, who is responsible for transferring the OWC software from Matlab to Python. This project is undertaken within the MOCCA project that runs up until June 2020. However, the aim is for this work to be completed well in advance of this close-down date. The main objectives of this project are to retain all existing functionality, achieve the same outputs as the Matlab version, enhance the computational efficiency, and ensure the Python version of the code is suitable for integration into a GUI interface.

### 2.2.4 Quality Control of BGC data

BODC has downloaded and implemented the newest version of software SAGE-O2 that is used for verification of the O2 and pH data quality and applying proposed corrections. Currently, these works are focused on understanding the SAGE software and provide the training for the UK Argo team, with an aspiration to begin applying corrections to the netCDFs in the coming months. This task is led by Violetta Paba. Additionally, BODC will be contributing to the further development of oxygen and pH QC procedures.

## 2.3 Future Plans

BODC is considering the implementation of Jupyter Notebooks to manage workflow and efficiency improvements under MOCCA. The Jupyter Notebooks (https://jupyter.org/) is a tool that could potentially be used to streamline the DMQC process, integrating Python OWC version with LaTeX report generation to move to an increasingly seamless approach.

# GDAC Functions

## NERC Vocaulary Server

As part of a wider environmental sciences infrastructure application, BODC has secured funding from the EU's H2020 funding programme to undertake significant work on adding the Argo vocabulary to the NERC Vocabulary Server (NVS). The outline for this package of work submitted for the proposal was:

> "The provenance of data in the Argo Data System is underpinned by rich metadata which is standardised across the data system using vocabularies currently held in manuals and associated spreadsheets. The accuracy, controlled evolution and semantic value of this metadata can be further enhanced by migrating these existing vocabularies to a controlled vocabulary management environment and server such as the NVS vocabulary server. The NVS manages controlled vocabularies according to internationally agreed W3C-compliant standards. Its existing infrastructure and associated tools underpin various environmental data systems in Europe, Australia and the USA. As part of the European SeaDataCloud project the NVS is being further enhanced to improve the transparency of the governance model and provide editorial access to external users. High quality management of Argo's vocabularies (including list of codes, terms and their definitions) will involve reviewing and potentially enhancing/refining existing definitions to create a set of well managed catalogues, introducing new catalogues where required, and performing detailed concept mapping within and between catalogues. Such mappings will facilitate and enhance the accessibility of the Argo netCDF repositories and interoperability with other research infrastructures through inter and intra domain mappings, as well as facilitate future efficiencies at Data Assembly Centres (DACs) by introducing new catalogues of manufacturer metadata concepts mapped to Argo data system terms. This work will prioritise vocabularies and mappings that would have the highest impact. This activity will be undertaken through close cooperation with the global Argo Data Management Team to ensure that appropriate governance is maintained for migrated vocabularies."

Since last year, in consultation with other members of ADMT, BODC has developed plans for this project and begun implementing the use of the NVS for Argo Vocabularies. This includes developing an understanding of how this work will improve the 'FAIRness' of the Argo system:

- Findable
  - Fully described on a vocabulary server
  - Mappings within and beyond the Argo data system
  - the NVS will make Argo metadata readable by machines
- Accessible
  - All metadata definitions in one place
  - Potential for e.g. GDAC checks automation
  - the NVS can be accessed through several APIs, including ReSTful, SOAP and SPARQL.
- Interoperable
  - NVS collections easily exported to machine-readable formats, e.g. JSON, CSV etc.
  - Holding the Argo vocabularies in the NVS will make Argo NetCDFs fully self-descriptive (to humans as well as machines).
- Re-usable
  - Facilitate aggregation with other data

In addition to the development of 'FAIRness', there are additional benefits for the Argo Data System. Firstly it should decrease the overall workload and decrease the risk of error by having a single version-controlled

definitive source of information which is fully described, machine and human readable. Secondly, it will facilitate connections with other data infrastructure through clear an unambiguous mappings, and in doing so will set the standard for other ocean observing networks as they develop their data systems. The NVS provides a single source of information for a wide variety of vocabularies, whilst supporting different governing authorities. Governance policies have been put in place for the different vocab editors within Argo, overseen by BODC technical governance, see:

- C30 Active vocabulary content governance authorities
- C88 BODC asset access right roles

As part of the upload of Argo reference tales to the NVS their content will be reviewed to ensure each term has an appropriate ID, name and definition. Argo reference tables on the NVS will carry the 'R' prefix, such as R03, R25, R26, R27 – named to match existing reference table names were possible. These four vocabularies have been partially uploaded as demonstrators.

BODC aims to provide training to vocab editors and other contributors regarding the NVS to support them in adopting the service. BODC will consult with the Argo community regarding further development of the services provided by the NVS.

## Regional Centre Functions

BODC continues to provide the coordinating role between the SOARC partners and hosts the SOARC website (www.soarc.aq). Feedback on the website is welcome and can be submitted either via the website contact form or direct to argo@bodc.ac.uk. Matt Donnelly is the SOARC lead at BODC.

Following discussions at the BGC Workshop in Seattle, Tanya Maurer and Josh Plant now represent the SOCCOM project in SOARC. As of September 2019, Matt Donnelly represents SOARC on the Southern Ocean Observing System (SOOS) Data Management Sub-Committee (DMSC).

BODC activities progressed in the past year include:

- Completion of the 'Argo and the Antarctic Treaty' guidance document, now available on the SOARC website;
- Beginning a project on Argo profile characterisation in the Southern Ocean in collaboration with the University of Bristol;
- Restored full DMQC capability and able to support other national programmes in the Southern Ocean;
- Developed a better understanding of other work on under-ice float position research ready to pursue operationalising that knowledge;
- Various website updates and creation of a SOARC GitHub organisational repository;
- Research on potential approaches to Southern Ocean regional data quality assessments. The initial focus is on using the work of Reeve et al. (2016a), Reeve et al. (2016b) and Reeve et al. (2019) to establish routine Weddell Gyre data quality assessments.

Future work for BODC on SOARC includes:

- Developing more deployment opportunities in collaboration with Jcommops and SOOS, e.g. through other organisations such as IAATO and CCAMLR;
- Improving under-ice positioning methods;
- Improve the availability of Southern Ocean DMQC resources;
- Develop regional data quality assessments for the Antarctic Circumpolar Current (ACC) and Weddell Gyre, in collaboration with NOC (UK) and BSH (Germany), with the latter intended to be based upon Reeve et al (2016a), Reeve et al. (2016b) and Reeve et al. (2019).

A more comprehensive summary about BODC's activities, and those of other partners, will be available in the SOARC presentation and written report.

# References

Reeve, Krissy A; Boebel, Olaf; Kanzow, Torsten; Strass, Volker H; Rohardt, Gerd; Fahrbach, Eberhard (2016a): Objective Mapping of Argo data in the Weddell Gyre: a gridded dataset of upper ocean water properties, link to data files in NetCDF format. *PANGAEA*, https://doi.org/10.1594/PANGAEA.842876

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Krissy Anne Reeve, Olaf Boebel, Volker Strass, Torsten Kanzow, Rüdiger Gerdes (2019) Horizontal circulation and volume transports in the Weddell Gyre derived from Argo float data, Progress in Oceanography, Volume 175, Pages 263-283, https://doi.org/10.1016/j.pocean.2019.04.006

# US NATIONAL DATA MANAGEMENT REPORT

## 20th ADMT

## September 1st 2018 – September 1st 2019

## STATUS

## US Argo Data Assembly Center at AOML

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 2,541 floats and sent more than 85,00 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 75,000 Argo profiles to GTS in the BUFR format (excluded from this are NAVOCEANO floats, which are sent to GTS by NAVOCEANO), where 95 % of them reached the system within the 24 hours.

The distribution of real-time profiles to both GDACs was improved with, on average, about 95% of them available within 24 hours (see Figure 1).

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.

The US Argo DAC added 307 new floats to the processing system, 40 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

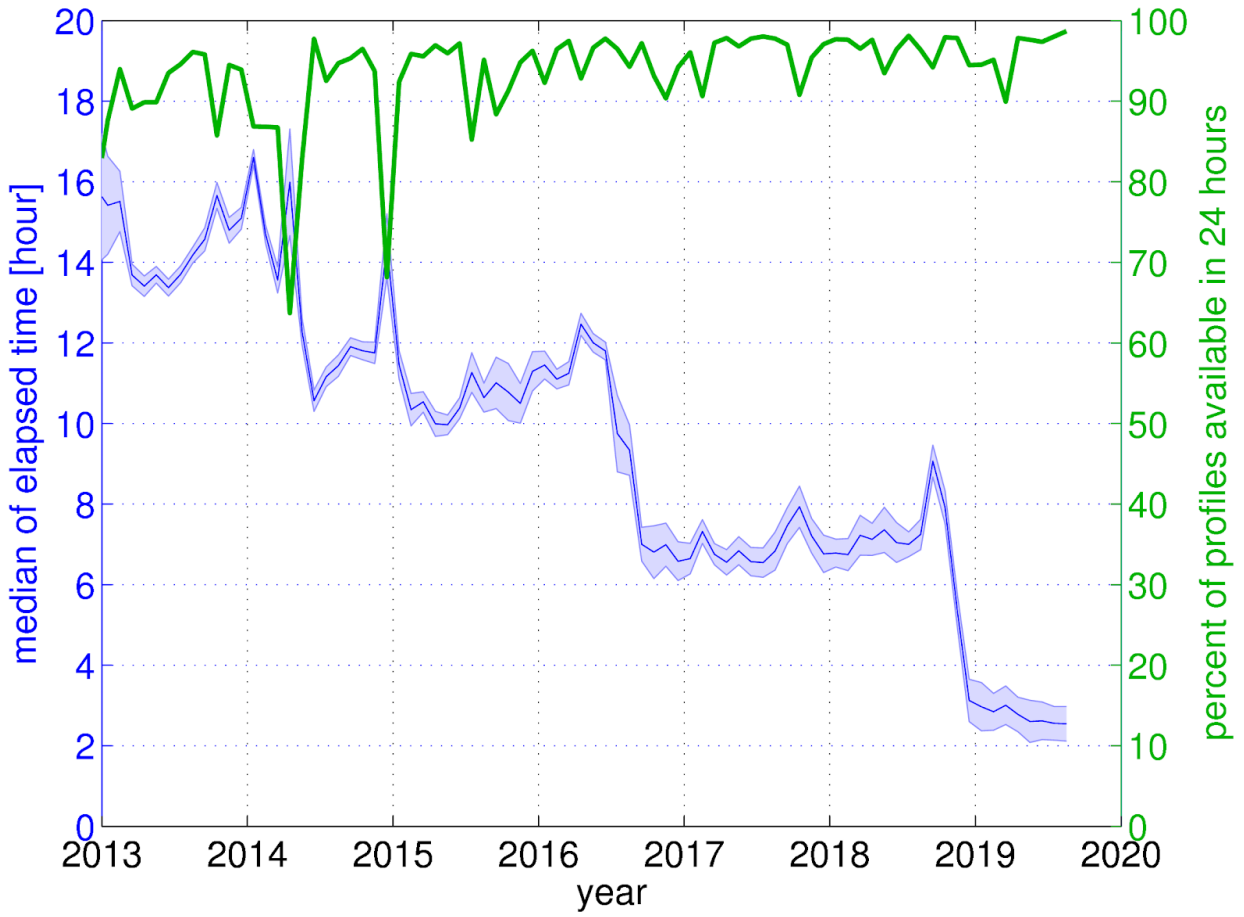


Figure 1: median of the difference between the time of the profile and the time of submission to the Argo GDACs (elapsed time, blue). The shading represents the standard error. The percentage of profiles available to users in 24 hours is also shown (green).

## Developments at the US Argo DAC

The software use d for decoding data from Iridium floats that come in as msg files was updated to adapt to changes of these files with respect to detection of under ice profiles (which lack a GPS fix) and for re-processing of cycles without a GPS fix that are not related to a float being under ice (e.g., the more recent cycle with position is not provided at the same time as the cycle that does not have a position). Problems with the initial approach started because of more recently deployed that do not always indicate whether ice was detected or not.

The decoder and quality control software was updated to handle the issue of erroneous dates due to the GPS rollover problem, Essentially, two distinct cases occurred when the GPS reached 1024 weeks: (1) the year jumped to 2038; (2) the year jumped to 2099 and went from there to 2000. For the files with year 2038 or 2099, the fix was straightforward because the internal clock provided the date. Once the GPS year became 2000 in case (2) the float date was reset to match the GPS date. This will not be detected by any of the standard QC tests for profile files. To handle these cases correctly, it became necessary to use

the launch time of the affected float as a baseline. Once a case has been identified as a GPS rollover problem, the date is corrected (the time of day is not affected by the rollover; the date is adjusted by adding 1024 weeks). The correct date for case (1) can be determined using the other dates/times recorded by the float (e.g., ascend end time).

Various smaller changes to the quality control and software were implemented as well: (1) improvement of the regional test to better handle floats in the Red Sea and Mediterranean Sea; (2) ensure that the interpolated positions are never added to the trajectory files; (3) improvement of the algorithm determining which position is most suitable for the profile file. (4) ensure that profile files without a primary profile comply with the GDAC requirements. (5) change the handling of JULD_LOCAITON and POSITION_QC for profiles with a GPS fix that comes without a date/time (still waiting for acceptance of the best option in the absence of a variable JULD_LOCAITON_QC: POSITION_QC='1' and JULD_LOCATION=FillValue).

Suggested improvements of the information in the csv generated on the basis of objective analysis to improve flagging of the pprofile data. These improvements are the added entries START_IMMLEVEL, STOP_IMMLEVEL, PROFILE NUMBER. The software was changed to take advantage if these to take advantage of the robust matching of flags with the appropriate pressure levels (crucial for high resolution near surface profiles from STS sensors, for example). The only remaining problem has to do with cases where some levels are all fill value (and thus excluded from the objective analysis; which can lead to values in START_IMMLEVEL, STOP_IMMLEVEL that do not match the levels in the profile NetCDF file.

Sensor related information in the meta files controlling the processing system has been updated, mainly for some BGC sensors and new meta NetCDF files were created.

Multiple software changes were done to improve the availability of timing information, mainly for the trajectory files. In addition to this, new software was developed to process data from Argos SOLO floats when the hex data are insufficient to decode the profile and engineering data. Once completed, the missing cycles can be added to the trajectory files. In addition to that a software packages was developed to add error ellipses info into the trajectory files. After some final testing we will implement that software.

## DELAYED MODE QC:

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/PMEL

As of 25 September 2019, PMEL had 186,159 D-files at the GDAC that were more than one year old, comprising 94% of the total of 197,302 PMEL profiles that were older than one year at that time. Last year, on 4 November 2018, PMEL had 161,550 D-files at the GDAC that were more than one year old, comprising 90% of the total of 178,865 PMEL profiles that were older than one year at that time. So, John Lyman's and Kristene McTaggart's DMQC efforts resulted in a net increase of 24,609 DMQC profiles for profiles older than one year, (one-third more than) the 18,437 profiles that became older than one year during that time. They have made good progress towards clearing the last 10% of the PMEL DMQC backlog.

John Lyman and Kristene McTaggart are continuing their DMQC work. John Lyman is also continuing work on streamlining our DMQC GUIs and processing. As an alternative to the SIO GUI1 routine, John has developed an alternative flagging routine that displays more windows with more plotting options, including plotting just the profiles that have bad flags verses all profiles that have been autocorrected. There is an option to QC all or some profiles, an option to save data in order to come back to it later without losing your work, and an option to view previously QC'd profiles. A very useful option displays buoyancy frequency to identify density inversions. This GUI allows us to evaluate profiles faster and with greater accuracy.

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). We do visual inspection and modification of quality control flags for adjusted pressure, temperature, and salinity using the SIO GUI. We overwrite the raw Param_QC flags during this step as required. We use OW Version1.1, currently with CTD (2018V02) and Argo (2018V01) reference databases, and adjust run parameters to get appropriate recommended salinity adjustments. Errors in OW are computed directly from the least squares fit. We accept or reject the OW recommendations on the basis of comparison with nearly historical profiles using a new PMEL GUI recently written for this step.

## Scripps Institution of Oceanography

Scripps Institution of Oceanography (SIO) has evaluated, as part of delayed-mode quality control (DMQC), a total of 248,998 Argo stations (profiles). This is an increase of 17,486 stations (479 nominal float years) since the previous Argo Data Management Team (ADMT) Report (November 13, 2018). This count represents 98.5% of the SIO DMQC-eligible stations (older than 12 months). The above numbers include SIO Core and Deep Argo floats, all Argo New Zealand floats, 7 NAVOCEANO floats deployed from the Peruvian vessel Zimic, and 2 floats donated to Argo Mexico.

SIO expects to maintain a high DMQC completion percentage during the coming year and will continue to revisit the profile data of floats every 7-9 months. The consensus standard DMQC procedures for SOLO/SOLOII/Deep profile data were continued in 2019.

During the year, the trajectory data from 16 end-of-life SIO Argos SOLO floats were finalized through DMQC after which a Dtraj netCDF was created and passed to the GDAC. This process most notably included the estimation of float cycle timing, including float arrival and departure from the surface, and

the full quality control of all Argos position data. There are now 972 DMQC trajectory netCDF ('Dtraj') data files available at the GDAC from SIO Argos floats (98% complete). DMQC on the few remaining Argos SOLO trajectory data will be ongoing as the floats cease transmitting data. The DMQC of trajectory files from SOLOII/Deep floats with Iridium data transmission are completed as part of the standard 7-9 month DMQC revisiting pattern. The 'Dtraj' netCDF files from SIO Iridium floats include those cycles which have been DMQC'd as well as all subsequent transmitted realtime data, resulting in only a single necessary trajectory netCDF.

Although not often considered a DM file, the V3.1 meta file contains information shared between both the profile and trajectory netCDF, thus consistency across all three are required. Because of this fact, SIO has transmited DMQC meta files to the GDAC at the same rate as the trajectory files (98.9% total, 100% Iridium, 98.0% Argos).

Processing of incoming SBD email messages, and submission to AOML via ‘phy’ flat file, has been increased to every hour. This has been done to reduce the latency time before the data is posted to the GDAC. Due to delays in receiving SBD emails, SIO is transitioning to adding directIP delivery of the SBD data through the Iridium system. By using both pathways, the reliability of the SIO data within 24 hours will be improved.

SIO has actively participated in moving forward the priorities of the Argo Program during the year, most notably by Megan Scanderbeg's continued work with the BGC trajectory file. SIO continues to update the Argo Climatological Dataset for OW salinity calibration. John Gilson has worked with Susan Wijffels (WHOI), updating the change in behavior over time (serial number ranges) of the SBE41 and SBE41CP CTD sensor stability. Nathalie Zilbermann and Dean Roemmich have worked with Seabird to improve the calibration of the SBE61 CTD (0-6000dbar capability).

The SIO IDG built and designed SOLOII/Deep SOLO float firmware has been unchanged over the course of the year, except for minor internal bug fixes.

## University of Washington

In 2019, delayed-mode activities at the University of Washington (UW) were focused on processing the CTD data from the Iridium floats because these were suspicious of the recent salty drift problem identified in SBE CTDs. These Iridium floats included those from the SOCCOM project. Between January and June 2019, CTD data from 487 UW Iridium floats were processed in delayed-mode. 13% of these had been adjusted for sensor drifts.

At UW, the salinity adjustment tool was upgraded to the OWC tool in 2019, used with the most recent CTD_for_DMQC and Argo_for_DMQC reference databases distributed by Coriolis.

## MBARI (Monterey Bay Aquarium Research Institute)

File count shows that the US DAC has 23707 BD files (all less than 1 year old & at the GDAC) as well as 39830 BR files that were processed by MBARI.

## Wood Hole Oceanographic Institution

During the period Sep 1st 2018 to Sep 30 2019, WHOI deployed 61 Argo floats and reported 16785 profiles to the GDAC from 432 unique platforms. The total number of WHOI profiles at the GDAC is now 202,133 profiles (142772 D-files, 59361 R-files). Of the profiles eligible for DMQC, 76.3% have been completed.

The majority of the WHOI fleet are MRV S2A instruments (342 floats) and there are still a few older SOLO-WHOI floats active (3 floats). WHOI has continued testing and limited deployments of the new platform, the MRV ALTO. There currently are 23 ALTOs operating, with the oldest having delivered 92 profiles. Work has continued to improve reliability, the surface behavior and ice avoidance algorithm to enable more Arctic deployments in the future. Three were recently deployed into the Arctic in deep water and we await to see if they survive the winter. One float deployed on the shelf and profiling frequently, did survive and has delivered winter data. WHOI will also deploy a test RBR-oxygen equipped ALTO this upcoming year.

Deb West-Mack has ongoing work to address the backlog of R-trajectory files from the early SOLO-WHOI floats. Sachiko Yoshida at WHOI continues to work on DMQC of NAVO floats and core WHOI floats. Sachiko is testing the new OWC drift assessment tool to compare its performance with the previous OW method. Tuning horizontal and time scales can be one way to minimize OW errors and misjudgment on false drifting where the historical data coverage is relatively sparse and not sufficient enough to represent the stable water mass in the area. DMQC of the near surface profiles reported by S2As is underway. Large spikes in the 1$^{st}$ and 2$^{nd}$ cycles are commonly seen in salinity profiles from recent deployed S2A in the secondary high resolution profiles (upper 50 meter). The cause of this remains unknown. Wijffels worked with John Gilson to update the global analysis of salinity drift against CTD serial numbers, revealing that a new serial number range in the 8000's are also prone to faster than normal drift. Wijffels has also updated and made plots of N2 and salinity anomalies available to the Argo community.

In collaboration with float CTD manufacturer SBE and RBR, WHOI acquired both RBR and SBE CTDs against a ship board CTD system on the RV Armstrong in November, 2018. Analysis is underway and will be presented at the AST-20. Intercomparison data for the RBR Argo CTD will be also collected of the RV Investigator in October 2019 and the RV Armstrong in November 2019.

## Germany/BSH

NAVOCEANO: 10 floats with 1990 profiles; 1843 D-files; 93%

NAAMES/US (E. Boss): 13 floats with 2854 profiles; 2736 D-files; 96%