part of the integrated global observation strategy

19th ARGO DATA MANAGEMENT MEETING

San Diego

6th December – 7th December 2018

Version 1.0

14th January 2019

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1 Objectives of the meeting

The 19th ADMT meeting was hosted by UCSD in San Diego, USA. It started at 8am on the 6th December and finished at 16h00 on the 7th December. 75 people from 14 countries and 35 institutes participated in the meeting.

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

- *Review the actions decided at the 18th 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 7th Bio-Argo Workshop*

2 Feedback from 19th AST meeting

Susan Wijffels reported on the 19th Argo Steering Team meeting, which was held in Victoria, BC, Canada. The focus of the meeting was discussions on the sustainability of Argo, finalizing and implementing design changes and the vision for Argo's future.

Progress on Argo enhancements is generally positive:

- deep pilots are expanding, there has been progress on sensor testing and development is promising (SIO/SBE NOPP proposal)
- for equatorial enhancements, a clear recommendation of doubling (+/- 10°) from TPOS2020 - implementation stalled. Possible progress soon
- Western Boundary Current density specification still needs work
- Sea-ice zones – coverage in the Antarctic continues to grow, some Arctic pilot deployments are underway
- BioGeoChemical regional pilots are expanding.
- Marginal Seas have spotty progress –largely due to EEZ and capacity issues.

Based on the advice from the 2017 Technical workshop, AST also decided to proceed with a global RBRArgo CTD pilot, to be coordinated by Breck Owens. This has proceeded, but at too low a level of deployments. National programs are urged to purchase and deploy some RBR-equipped floats in order to allow a global performance assessment. Ongoing ship-based tests are still valuable. The degradation of the stability SBE41 conductivity cells was revealed and discussed by the community. See below for further actions on this item. A Manufacturers Day was held after the AST, led by Greg Johnson from RBR.

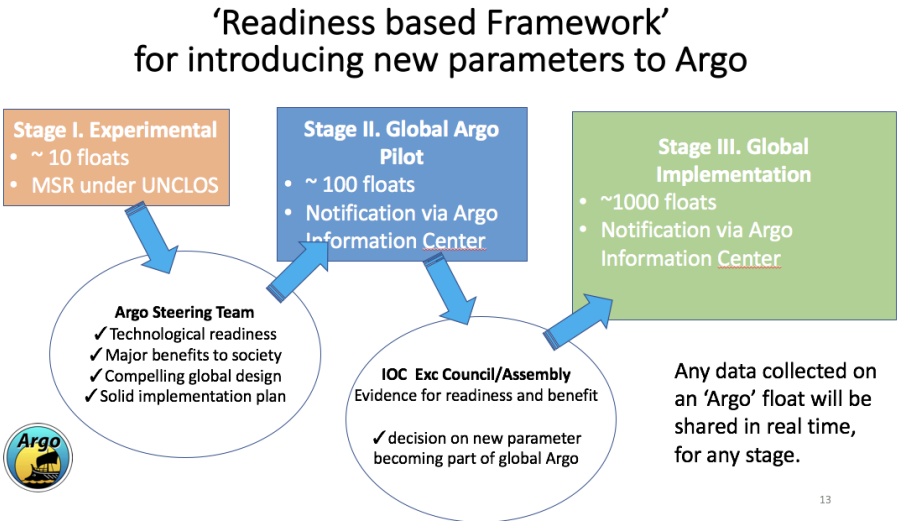
At this meeting, Dean Roemmich, the foundation chair of the Argo Steering Team, stepped down and Professor Toshio Suga stepped into the role. We thank Dean for his tremendously valuable leadership for Argo.

2.1 New parameters in Argo and measuring in EEZs:

Also discussed at AST were preparations to present propositions to the International Oceans Commission member states regarding new parameters to be measured by Argo. Following the AST, this activity was very fruitful. With Argo Core and BGC leadership and GOOS Project office developed a document for IOC General Assembly about the evolving capability of the Argo network, particularly for BGC measurements. Breck Owens presented to the IOC Executive Committee in July

in Paris, and our proposals were very well received, due to support by many member states for Argo. This resulted in:

1. Approval by IOC member states for the proposed 6 BGC Argo parameters to be measured in EEZs by Argo using the provisions made under previous IOC resolutions.
2. Approval of a new framework for new parameters to be included in Argo and measurements in EEZs, where Argo is able to experiment and perform global pilots under the governance of the AST, and only go to the IOC General Assembly when global implementation will start. This framework is illustrated below.



2.2 Developments on Argo's future:

OceanObs'19 White Papers:_ Several Argo abstracts were developed in response to the call for the OceanObs'19 meeting and planned special issue of Frontiers in Marine Science. The abstracts developed were for Core, Deep, BGC Argo and the Argo data systems. Subsequently, the OceanObs19 program committee directed that these papers be combined, along with another abstract on mixing measurements on Argo floats. Dean Roemmich took on the task of acting as coordinating lead author of this combined White Paper. In this paper, a concept of a combined Argo2020 design was put forward. Argo2020 is a global design of around 4700 floats, with 1250 on the deep mission and 1000 carrying BGC sensors. The lynchpin of the Argo2020 concept is that the deep and BGC floats also function as a core floats – that is – they deliver a 0-2000db profile every 10 days.

The 6th Argo Science Workshop was held in Tokyo in October, 2018. Hosted by Argo Japan, around 70 attendees met to hear about Argo design changes, science and applications. Panel and discussion sessions also focused on the Argo2020 vision – strengths and weaknesses, and possible future use and uptake. Discussion of the resourcing challenges (3 x current Argo), logistical coordination, and sensor and platform developments occurred. The Argo2020 vision will be further developed and discussed at the AST-20.

3 Feedback from DMQC Workshop

Annie Wong presented a summary of the DMQC Workshop that was held on 2-3 December. This was the first multi-day DMQC workshop in 10 years. About 50 people attended this workshop, including representative from SeaBird. It was decided that in the future, we would look for opportunities to hold half-day DMQC interactive sessions in conjunction with the annual ADMT meetings.

Annie will produce a workshop report, and update the QC Manual as a result of workshop discussions. Megan put all workshop presentations on the meeting webpage (ftp://kakapo.ucsd.edu/pub/argo/ADMT19/DMQC6_talks1.zip and ftp://kakapo.ucsd.edu/pub/argo/ADMT19/DMQC6_talks2.zip).

4 Feedback on 7th BGC-Argo Workshop

H Claustre reported about the 7th BGC-Argo data management meeting that was held on December 4 and 5 with 65 attendees, both from the Core- and BGC-Argo communities. Besides the various national reports with respect to BGC-Argo data management, the presentations and discussions were organized along several main topics dealing with:

4.1 Data format

During this year a sub-group (Henry Bittig, Thierry Carval, Annie Wong and Josh Plant) worked on the definition of a format easier to use (key for end-users). This format is a balance between complex /large B profile files that represent the reality of the sampling/measurement and the requirements of the end-users. This so called « S-file » (S for synthetic) was tested during the year by several users and meets the requirement. It is proposed to add into the Sfile (ncdf4) the core high resolution CTD and check that we can replace the large merge M-file with the synthetic S-file and the benefit of the ncdf4 compression. It will be tested at the French GDAC and the S-file will be synchronized on the US-GDAC.

4.2 Reprocessing issues.

In 2017, two peer-reviewed papers have pointed out some inconsistencies in the calibrations for both bbp and Chla sensors, which lead to significant inaccuracies in the variable estimations (systematic overestimation by a factor of 2 for all Chla fluorometers, sensor-dependent issue in the gain for bbp).

All the new corrected bbp calibration were gathered in a file available (here) and the whole BGC-Argo dataset has been reprocessed during the year (some DACS are still reprocessing their data, but this will be soon done). Antoine Poteau presents the improvement on the data consistency at depth on the whole fleet.

Regarding the factor of 2, the DACs filling the CHLA_ADJUSTED field have reprocessed their dataset to remove the overestimation.

4.3 New procedure implementation

Clarification was needed on how to implement a new procedure. It was noted that before implementing a new procedure and reprocessing the dataset, the new procedure :

- should be tested on the whole fleet (or at least on a set of floats that fully represent the variability of the ocean
- should be fully documented
- should be presented and agreed at the ADMT

4.4 R, A, D mode.

A fruitful discussion occurred on what should be considered a « D mode » compare to a « A mode » in terms data quality, delay before operator scrutinization, etc.... It has been concluded that BGC-Argo should explain in a document its own definition of R, A and D DATA_MODE to warn the end-users.

The presentations of these two days will be made available through the BGC-Argo web site (here).

5 Status of Argo Program and link with Users

5.1 Review of the Action from last ADMT (M. Scanderbeg)

M Scanderbeg reviewed the status of the action items from ADMT18. The status of the actions is:

- High: the only action was completed
- Routine: Among the 44 actions 15 were done, 14 were partially done, 13 were not done, but will be carried over to next ADMT and 3 canceled
- Low: no low priority actions were identified

See the complete status in Annex 3.

Action 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, P. Velez-Belchi***

Action 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

5.2 Argo Status + Real-time Monitoring (Mathieu Belbéoch)

M. Belbéoch provided a brief status on the Argo program and some feedback on the challenges to design and prepare the Argo2020 multidisciplinary and truly integrated array. He highlighted the good cooperation with Argo teams for registration and notification of deployments. However he noted that the sharing of data in real time was very important to meeting our transparency standards. 150 floats deployed in the last three years are not sharing their data yet which is problematic; JCOMMOPS can't inform coastal states as appropriate if such a float were to drift into their waters.

Initial discussions on developing a procedure for data sequestration in case a costal state request it have begun. After a formal exchange between the Member State and IOC/UNESCO for confirmation, JCOMMOPS would notify as appropriate DACs and GDACs to stop data distribution on the GTS, and move the profile into a quarantine directory at GDACs until new notification allows data distribution to begin again.

The Technical Coordinator mentioned that with a median delay of 7 hours, between observation and availability to users, Argo could adjust its timeliness standard to 6h with minimum efforts. He highlighted a few difficulties for some DACs to submit data directly to the US GDAC. It was pointed out that the delay of (deeper) data levels were not considered as the profile time was tagged at surface.

The team agreed to label research contributions to Argo as "Argo" and other equivalent contributions (such as US navy) as "non Argo".

Finally the TC presented a number of recent and future developments on the JCOMMOPS Information System and websites, including, in particular, some APIs (WIGOS compliant), to share metadata, and

allocate WMO ids. The deployment planning tools will soon integrate work done by the Scripps/SOCCOM team on projected float displacement (1 year). He mentioned that A. Lizé (JCOMMOPS software architect) will visit BODC mid 2019 to fuse reference tables and plug into the BODC vocabulary API. He invited the Argo Data team to consult the background report he provided prior the meeting for more detailed information.

TC provided an overview on the delayed mode processing status and showed that with a 76% quantitative performance indicator, the Argo DM operators made substantial progress in the inter sessional period. A round table indentified volunteers to DM some orphan floats. JCOMMOPS will develop appropriate tools to help DM operators to monitor and prioritize their work. The management of DM operator per float and parameter was considered essential for future activities.

Action 3. M. Belbéoch to study why delay is different between GDACs and GTS

Action 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.

Action 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.

6 Real Time Data Management

6.1 GTS status (Anh Tran)

For the period between November 1, 2017 and November 22, 2018, there was an average of 13648 BURF data subsets (profiles) per month transmitted on the GTS, and 91% of the BUFR profiles were reported within 24 hours of the Argo floats reaching the surface. Most Argo data centers stopped transmitting TESAC on the GTS on July 2018. Only the Japan data center still sends TESAC on the GTS.

The meteorology office expressed the needs of getting Argo data faster than 24 hours, so that they can incorporate the data into the ocean-atmospheric couple model. An analysis was run on the current data sample to determine the percentage of Argo data on the GTS within different time intervals after the float reaching the surface. With the current system, on average 20%, 45%, 68%, 81% and 87% will be available on the GTS within 3, 6, 9, 12 and 18 hours after Argo floats reaching the surface, respectively. Argo will aim to distribute Iridium Argo data within 6 to 12 hours of Argo floats reaching the surface.

6.2 Status of anomalies at GDAC (Christine Coatanoan)

Christine Coatanoan reported on the anomalies detected on the GDAC. On a daily basis, an objective analysis is passed over all in-situ temperature and salinity observations aggregated by Coriolis. A series of alerts are raised on atypical observations. Each profile on alert is scrutinized by a Coriolis operator with Scoop (a visual quality control tool). If the operator changes the flags on a profile, an alert record is created. For each DAC, the list of alerts is sent by email to the DAC contact point. New updates on the message are requested to take into account the N_PROF and level_immersion. Those updates will be taken into account in the coming weeks.

DAC's contact points are invited to check whether their email address is correct. If the DAC contact agrees with the flag changes, he should change these flags on the data files and then resubmit the files. If the DAC does not agree with the changes, he should send an email to codac@ifremer.fr.

In 2018, on average monthly, less than 350 profiles are reported as bad to DACs. In months May, June and July 2018, 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 MinMax method implemented in the Coriolis quality procedure.

Some bad data are not correctly detected with the real-time QC tests. As it is now, there is no obvious solution to improve the real-time QC: an automatic test cannot detect some atypical errors.

All that information can be found in the report sent monthly to mailing lists: argo-dm & argo-dm-dm. This report is also available on the Coriolis GDAC ftp site.
ftp://ftp.ifremer.fr/ifremer/argo/etc/ObjectiveAnalysisWarning/ and
ftp://ftp.ifremer.fr/ifremer/argo/etc/Report_ObjectiveAnalysisWarning/

6.3 Status on Anomalies detected with Altimetry (Nathalie Verbrugge)

Every three months, Argo profile Dynamic Height Anomalies (DHA) are compared with the Sea Level Anomalies (SLA) from altimetry in order to identify some biases, spikes or drift in the in situ Argo dataset and raise alerts which are then distributed to the DACs and DM-operators (later for D-mode only). 118 floats have been detected in the latest analysis done in November 2018. Some of them are on the list for a very long time and really need to be corrected.

Once a year, the general quality of the Argo dataset is also assessed: monitoring of the number of alerts and feedbacks received since June 2008, analysis of the global statistics computed between DHA and SLA, monitoring of the value of the adjustments applied (PSAL, PRES, DHA) on the profiles according to the age of the floats. In 2018, the differences observed with SLA are relatively stable compared to previous year, and this after two years of degradation. This is probably partially due to an update this year of the version of the SLA delayed-mode product that improves the DHA/SLA agreement. Note furthermore, that this new SLA DT version has now been used for the quarterly analysis since September 2018. The analysis of the adjustments done gives similar and stable results compared to the previous year.

Finally, a specific analysis has been done on the 1136 Argo floats that used Seabird CTD cells (serial numbers ranging between 6000 and 7100) and for which a high risk of bias/drift in salinity in real-time has been identified. The DHA/SLA comparisons done on these specific floats are strongly degraded with respect to the analysis done on the entire database. The percentage of RMS of the DHA-SLA in differences for real-time mode reaches 49.4% against 36.62%. But the results should be moderated by the fact that the number of profiles used for the analysis is 10 times smaller than the sample of the entire database and that a more detailed analysis of the spatial distribution of these floats should also be done to understand better this statistic. The latest quarterly analysis has raised for these specific profiles 97 alerts by automatic tests and 12 floats have been confirmed and put on the list.

6.4 Feedback on improving spike test (C. Coatanoan)

The actual RTQC spike test is to evaluate spikiness of one point by considering the values of the point above and the point below. Drawbacks show that shallowest and deepest points are not tested, good points can be detected as spiky and the actual method cannot deal with spikes occurring on several points. Two methods have been developed to design a new spike detection test.

The first method (Med/Std) is based on a vertical sliding median computed with its sliding window expressed and depending on vertical layers. Standard deviation is computed on different vertical

layers, bounded by a given domain. The second method (AIC) is based on a 2 steps estimation of the modified Akaïke information criterion (UEDA, 2009). A vertical sliding window of 5 data centered on 1 potential outlier constrained by distance between 2 samples. A first step calculates Ut_1 without the outlier and second step calculates Ut_2 with the outlier. The measure X is an outlier if dU>dUcrit. dUcrit is estimated depending on parameter on vertical region. Those both methods can be applied on parameters temperature, salinity and oxygen.

The first results are promising. The method (Med/std) works well for true single point spikes, spikes on several points in middle and deep layers, first and last point while method (AIC) works well for true and small point spikes and in thermo-haloclines. The negative points are the limitations to prevent false detection in the upper water column area for method Med/std and to prevent false detection on very small variation, no detection on several points and zigzag for method AIC. Some improvements are already ongoing to improve parametrizations, adjustment of the criteria used for both methods. Robustness will be checked with larger representative datasets and a combination of both methods is also in progress.

UEDA, T. 2009. A simple method for the detection of outliers. Electronic Journal of Applied Statistical Analysis, 67-76

Action 6. Assess and test improvements on proposed spike tests using D-mode flags as the truth. Report back at ADMT20

6.5 Feedback on using MinMax climatology in Real Time (S Pouliquen)

In the last years, delayed-time quality control (QC) procedures of temperature and salinity measurements at the French CORIOLIS facility have improved significantly thanks to the implementation and use of new methods with reduced statistical assumptions. This success led us to introduce the same concept into real-time processing. With such an approach, observations are compared to the known local variability through validity intervals built from historical estimates of minimum and maximum values of the parameter of interest. No a priori assumption on the local parameter distribution shape is required, and natural skewness and kurtosis can be accounted for during the detection process.

J Gourrion (jerome.gourrion@ocean-scope.com) computed such Min-Max climatology from Argo delayed mode on which he performed an additional visual QC (paper to be submitted before the end of the year 2018).

Within the European Copernicus In Situ Service, in a delayed-time context for the elaboration of the CORA product for reanalysis purposes, this QC procedure is used to raise alarms that a scientific operator visualizes and, potentially, confirms. An improved automatic detection procedure essentially saves operator time by reducing the number of false alarms.

In a real-time or near-real-time context, the available operator time is significantly smaller. In order to implement such a procedure in an operational chain, it is fundamental to have good control of the total number of alerts generated. The method shall be adjusted to raise a manageable number of alarms, allowing small anomalies to pass through the filter while ensuring that the largest ones are systematically caught, being more likely associated to gross observation errors. Such tuning has been performed on the period 1st July-30 September 2018 and the method was implemented operationally in early October for Argo data, preventing obviously bad data to be provided to Copernicus modelers.

The anomalies detected using the MinMAX method and confirmed by an operator at Coriolis will be provided back to DACs via Christine. Such a method should allow earlier drift detection than DMQC .

Action 7. When flagging pressure during the RTQC test, put a flag of of '2' for pressure between -2.4 db to -5db Update QC Manual

Action 8. Report back on MinMAx implementation in RT at next ADMT

6.6 Build a gradiant climatology from Argo to help QC (Breck Owens)

Building on the methodology of Min/Max tests to identify erroneous data, we have begun to construct an expanded climatology based on Argo Delayed-Mode data. This climatology will be constructed on a uniform latitude/longitude grid and use a search radius to identify nearby profiles, where the radius will incorporate the CSIRO (Jeff Dunn) algorithm to take into account topography and land masses. From our preliminary tests, it appears that a search radius of 500 km will provide (2000) profiles for each grid point. Means, variances, skewness, kurtosis and cumulative probability density functions (cpdf's) will be computed for:

1. Temperature, salinity and Brunt-Vaisala (N^2) for vertical pressure bins
2. Temperature, salinity and pressure for σ_1 potential density bins
3. Salinity and pressure for potential temperature, θ, bins

Examples of mean and cpdf's were shown. Once this climatology has been constructed, the cpdf's can be used similarly to the Min/Max procedure to refine the detection algorithm and to better take into account the non-Gaussian distribution of Argo data. In addition, we expect to use the climatology of the mean and variance of salinity as a function of θ to more efficiently chose the appropriate θ levels for the OWC salinity calibration procedure.

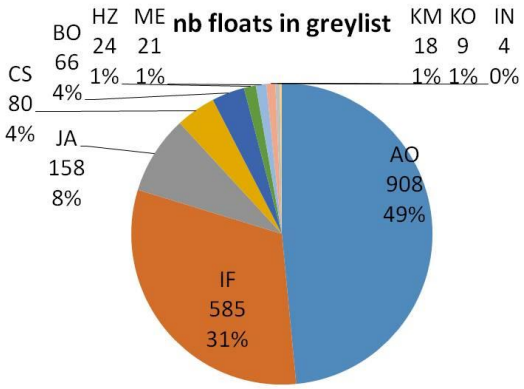
6.7 Grey List Management and Revisiting flagging deep Argo data

This test is implemented to stop the real-time distribution on the GTS of measurements from a sensor that is not working correctly. The decision to insert a float parameter in the grey list comes from the PI or the delayed-mode operator. A float parameter should be put in the grey list when sensor drift is too big to be corrected adequately in real-time, or when the sensor is judged to be not working correctly.

The grey list only concerns real-time files (R-files). When an anomalous float is dead and has been adjusted in delayed-mode, it should be removed from the grey list. When an anomalous float is active and has been partially adjusted in delayed-mode, it should remain in the grey list only if real-time adjustment is not adequate.

The greylist on GDACs lists the floats sensors that are flagged by real-time QC. The greylist has 1873 entries (November 29th 2018), compared to 887 entries a year ago. The 111% increase is noticeable and it can be attributed to BGC sensors in greylist. The greylist does not contain entries for Dmoded floats except for Coriolis and BODC BGC floats. Coriolis reports 441 BGC greylist entries for 63 floats.

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**



Greylist flag restriction
Only flag 3 and 4 (probably bad, bad data) are allowed on the greylist. After discussion, the flag 2 (probably good) may be used in the grey list to flag data from a sensor among the series of salinity sensor that have a significant risk of salinity drift. The priority is to check these float's salinity and flag them 3 if the sensor did drift. The greylist flag 2 for these sensors should be limited to the DACs with no manpower to check these floats. The quality control manual will be updated to allow flag 2 in this unusual situation.

Greylisted data distribution on GTS-BUFR
The quality control manual greylist chapter will be updated: GTS-BUFR data distribution should not be blocked by the greylist. The greylist real-time QC test set quality flags on data, these data and their quality flags are to be distributed on GTS in BUFR messages.

The grey list (RT Test 15) definition has been revised to reflect the evolution of how RT DACs use the grey list, and to reflect the use of BUFR in GTS, which allows the inclusion of QC flags. Discussions were held to revisit RT Test 23 on how to flag Argo data deeper than 2000 dbar.

Action 9. ***Reach out to operational users to communicate that the 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.***

Action 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.***

Action 11. ***DACs to send all data onto the GTS in BUFR format, even greylisted sensor data, with appropriate QC flags.***

Action 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.***

6.8 New Real Time management system at CSIRO (Jenny Lovell)

The existing real time processing system was built up from core Argo, and then had add-ons to handle new parameters, float types and Iridium communication. It is coded in Matlab and data is stored in intermediate mat files, thus a license is required to run the system. Metadata is stored in several Excel

spreadsheets and hand-entered with duplication of metadata through the spreadsheets. This is prone to errors and difficult to maintain with integrity.

The new system is coded in Python with PostgreSQL database and shell scripts to control timing of processing and file movement. Thus it is all open source and is object-oriented to allow for easy code development and reuse as well as flexibility in decoding different float types. The system is currently in the testing phase with four NKE floats. Other floats will be progressively migrated to the system with concurrent processing in the old system. The final system is expected to be complete within 12 months and the source code will be made available.

Data (profile and metadata) is stored in a relational database giving a single source for all data. There is a web front end to the database that allows inspection, interrogation and editing of information. Metadata is extracted from float files where possible, reducing human error and duplication. This system will eventually incorporate all Argo operations including deployment planning, purchasing, engineering, DMQC, data mining capability.

7 GDAC Services

7.1 Feedback on the actions

#15 - Thierry and Mathieu to further investigate difference in GDAC delays
Last month, there was a 9 minute delay between US GADC and Coriolis GDAC (median delay, files available earlier on US GDAC). The 9 minutes delay is reasonable, the GDAC delay difference problem is fixed.

An issue is CSIO files that arrive on US GDAC with a 12 hour delay. Coriolis GDAC has to setup a fast delivery directory for US GDAC.

The UK floats managed by Coriolis on behalf of BODC should be collected by US-GDAC in the specific fast delivery directory (instead of synchronization which adds 24 hours for these few floats).

#16 - Reduce number of significant digits in US GDAC GEO directory
Done in 2018

#17 - Set up the aux directory at US-GDAC
Done in 2018

#18 - Thierry to go with proposal #2 for adding a new directory for index file. Inform users
Done in 2018
http://www.argodatamgt.org/Access-to-data/Argo-GDAC-synchronization-service

The rsync server "vdmzrs.ifremer.fr" provides a synchronization service with the "dac" directory of the GDAC with a user mirror.
The "dac" index files are available from "argo-index".
Synchronization of a particular float, based on the data centre in charge of data processing:

- rsync -avzh --delete vdmzrs.ifremer.fr::argo/coriolis/69001 /home/mydirectory/...
- rsync -avzh --delete vdmzrs.ifremer.fr::argo/aoml/1900050 /home/mydirectory/...
- rsync -avzh --delete vdmzrs.ifremer.fr::argo-index/ /home/mydirectory/...

#19 - Keep the action item to automatically resubmit all files if metafile is fixed within 7 days.
Done on US side in 2017
Done on Coriolis side on November 26th 2018

#20 - Continue investigating ways to allow both GDACs to receive files from all DACs

CSIO cannot push its data files on US-GDAC
CSIO pushes data files on Coriolis GDAC
US-GDAC grabs CSIO data files trough synchronization -> 12 hours delay

Coriolis has to open a directory updated every with new CSIO DAC data US-GDAC will collect these data.

#21 - Stop allowing Config Mission Number of 0 by AST
Done but…
Some files are rejected : Apex prelude observations are sent with a "fill value" for config_mission_number. Can "fill value" config_mission_number be allowed?
Decision : config_mission_number "0" is allowed for the float prelude phase : after deployment and before the first cycle.

#26 - M-File : French GDAC to move them to NetCDF4 and USGDAC to get them by mirroring the French GDAC.
Interim solution until a new M-File format is specified by the group set up at BGC-Argo meeting.
Not done, the M-files will be replaced by the BGC.

M-Files in NetCDF4 are distributed in Coriolis GDAC in "etc" directory:
ftp://ftp.ifremer.fr/ifremer/argo/etc/netcdf4/dac/coriolis

They will be replaced by the S-Files : combination of "M-V2 Core" and "BGC synthetic".
Henry Bittig will update the S-Files generation: the Core-only levels will appear in the S-files (they are currently ignored).

#37 - M-File : Add deepest profile level sampled to index file to facilitate monitoring activities
Done in 2009 (Coriolis) and 2018 (US GDAC)

New need: DOI data file
DOI data file is growing too big (*Argo float data and metadata from Argo GDAC https://doi.org/10.17882/42182*)
The DOI data file is uploaded in one click. In the zipped file (*.tar.gz), there is one compressed file per DAC, the index files and the Argo documentation.

The BGC files contribute to the significant file size increase.

Action 13. NMDIS and Coriolis GDAC to solve the issue of D file submission
Action 14. Improve synchronization between US GDAC and French GDAC to make CSIO data available more rapidly
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.
Action 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.
Action 17. Remove zipped GDAC files from Coriolis. Only serve them on DOI page.
Action 18. Add PARAM into b-traj index file.

7.2 File checker at GDAC

The outstanding FileChecker issues were discussed. The results of several new tests introduced in May 2018 were discussed. Failures of these tests are currently WARNINGS to allow DACs time to correct their files. It was decided that the tests will be converted to ERRORS in time for the AST.

It was also decided that CONFIG_MISSION_NUMBER will be allowed to be zero and this test will be eliminated (and the appropriate documents updated).

The status of the full checking of trajectory files was also discussed. The results are looking very good for all but a few DACs. The US GDAC will engage the individual DACs directly to help them improve their file performance. It was decided that full trajectory checking will be made operational just prior to the AST.

Other decisions for the coming year: D-mode files < v3.1 will be rejected; all existing v3.1 will be re-processed through FileChecker to assess status; greylist checking will be added.

Action 19. Allow MISSION_CONFIG_NUMBER of 0. Change User Manual to add that N can be 0. Filechecker can also accept fill value.
Action 20. Move from warnings to rejections by AST-20 meeting for all GDAC File checker tests.
Action 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.
Action 22. Stop accepting D-mode files < v3.1.
Action 23. Put all existing v3.1 files through current FileChecker and report results to ADMT.
Action 24. Trajectory File Checker live by AST 20

7.3 Reference Table maintenance

Violetta Paba presented on behalf of Matt Donelly the BODC plans to develop an Argo vocabulary for the Argo reference tables within the EU ENVRI-FAIR project starting in early 2019. This vocabulary will be incorporated into the NERC Vocabulary Server (NVS), which BODC already manage and enhance. Through collaboration with JCOMMOPS and interested parties, BODC will carry out the bulk upload of the Argo tables into the NVS. To ensure compliance with SKOS standards, BODC will also fill in blanks, clarify definitions, create mappings, organise Argo terms into collections, and make proposals to constrain fields that are currently free text. BODC plans to collaborate with manufacturers to host sensor-related terms and map them to the Argo vocabulary system. Through the NVS Vocab Editor web application, external editors from the Argo Data Management Team will be able to expand and update existing vocabs. BODC is looking for collaboration and feedback from the Argo community, to reach agreements on content governance arrangements, and to review existing content.

8 Delayed Mode Data Management (1h00)

8.1 Progress on Argo Reference DataBase : summary of the actions since ADMT-18

Christine Coatanoan reported on the CTD reference database for Argo DMQC. Since the last ADMT (ADMT18), a new version CTD_for_DMQC_2018V01.tar.gz has been provided on March 2018, This

version takes into account a set of CTD from the OCL updates (focused on recent data 2002 to 2016) as well as a few CTD from Giulio Notarstefano (OGS) for the Med Sea and data for the North Atlantic Ocean (cruise MSM53 – University of Bremen). Corrections on boxes for the North Atlantic Ocean have also been taken into account from the feedback of Cécile Cabanes (Ifremer).

In the action 41, Christine had to provide the CTD reference database for Argo in index file to CCHDO. Those files have been sent in January 2018. In the zip file, 3 log files were provided =>

- in the reference database : log_read_red_db_mat_files.txt
- in the api provided by cchdo : log_read_cchdo_api_files_netcdf.txt
- in the database, the cchdo data that we have loaded (the others were already in the database): log_read_cchdo_api_index_database_coriolis.txt

A new version 2018_V02 will be delivered for the end of this year with 12 cruises from the program GO-SHIP downloaded from the CCHDO website. Few anomalies have been detected on data and feedbacks will be sent to CCHDO. Few CTD from float deployments will also be added. A work has also started on Hydrobase dataset.

Action 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 data.

Action 26. Add DM operator for each BGC variable into AIC database

Action 27. Check with operational centers that they are using GDAC data for reanalysis products

Action 28. C. Coatanoan to document how she deals with duplicate CTD in ref DB

8.2 CCHDO/US-NODC-progress (Andrew Barna)

Andrew Barna presented on behalf of CCHDO and started with leadership changes over the past year and then gave a brief overview of CCHDO's mandate. The leadership changes include the retirement of Jim Swift, with Karen Stocks taking over as Director of CCHDO and Sarah Purkey is the Scientific Advisor.

CCHDO is a data assembly and dissemination center for sustained observations of trans-oceanic reference quality CTD, ocean carbon, and tracer measurements. Current sources of data include all US GO-SHIP and, to the degree that funds allow, international GO-SHIP and "GO-SHIP associated" cruises (repeat hydrography cruises adopting similar methods as GO-SHIP). CCHDO receives data from the chief/responsible scientist from a cruise, merges data from a cruise/cast, standardizes the data, creates documentation, and serves the data (cchdo.ucsd.edu). CCHDO currently holds data from ~2300 cruises, and has added 34 cruises since ADMT-18 in December 2017. CCHDO data are contributed to the NOAA World Ocean Database for long-term archive.

CCHDO makes all of its public holdings, as well as certain data that have been provided solely for Argo use, to Argo for its reference database via a custom API. *It is important to note that CCHDO does not carry out any quality assessment or quality control: feedback on data quality issues are conveyed to the responsible scientist, who is asked to review the issue and revise and resubmit the data if appropriate*. Variations in data quality, as well as data format, in data from CCHDO are of concern for Argo. Data format and parameter name variability will be improved when CCHDO moves to NetCDF-CF compliant data files in late 2019. CCHDO will also map heterogeneous flags to a common flag set. As discussed in a small group side meeting, carrying out data QC is outside CCHDO's mission and scope, but if Argo develops a list of "good" CCHDO cruises to include in the Argo reference database, CCHDO will revise the API to serve only data from those cruises.

Argo agrees to inform CCHDO of known quality problems with data and CCHDO will inform the responsible scientist and ingest revisions as provided.

During discussion, it was noted that it is not easy to tell if the CTD data has been calibrated to bottle salts. This information can sometimes be found in the exchange file format in the free text at the beginning, but is not necessarily there.

8.3 Orphan float management (M. Belbéoch)

Mathieu presented the list of programs that didn't have a DM-OPERATOR assigned (3380 floats) and the following groups endorsed those floats :

- Finland: Birgit Klein
- China SOA: Mingmei Dong
- Hawaii: US Argo Consortium will think about how to handle this
- WHOI-SODA: P. Robbins
- UMaine: Birgi Klein for T/S floats
- AtlantOS: Cecile Cabanes for Deep ones. G. Notarstefano for T/S on BGC ones. BGC: Christine and LOV
- Bulgaria: G. Notarstefano
- Turkey: G. Notarstefano
- MOCCA-Netherlands: Birgit Klein
- NAOS-Canada:
- Indonesians floats: Christine Coatanoan
- Ecuador:
- US Navy: Gulf of Mexico and Atlantic to P. Robbins. Birgit Klein: Nordic Seas G. Notarstefano: Med Sea Jenny Lovell/CSIRO: Coral Sea Red Sea: difficult because shallow and no ref db

It was agreed that for floats that performed bounce temperature-only profiles, only the primary profile will be dmoded.

8.4 Post-correction to conductivity measurements on RBR CTD (J-M LeConte)

RBR Ltd. presented a new model for the correction of the pressure dependence of its RBR*argo* 2000dBar CT cell. A field bulletin notice has been distributed to the Argo community about this correction (http://oem.rbr-global.com/floats). A web service is available to retrieve calibration information and post-processing requirements for every RBR*argo*. Current investigations on thermal effects were also presented, RBR Ltd. will distribute document about thermal post-processing in early 2019.

Action 29. Breck Owens to apply pressure correction to RBR sensors and analyze the dataset. Asked to present results to AST-20

8.5 Kim Martini and cell thermal mass correction

Through experiments conducted at the WHOI stratified tank, Sea-Bird has determined that salinity spiking observed in Argo profiles may be caused by alignment errors rather than conductivity cell thermal mass errors. The CTD sampling sequence leads to a mismatch between temperature and conductivity, causing spiking similar to those caused by cell thermal mass. Example profiles from Solo floats returning data at 1 Hz verify the behavior. Sea-Bird, in collaboration with the Argo team, is currently working to determine the appropriate corrections for affected data and refine the sampling to minimize these errors in the future.

8.6 How to capture dmode operator in d-files. Store this at DACs for now

For the purpose of monitoring the Argo delayed-mode dataset, which involves subjective decisions, it is desirable to know who the dmode operators are. This is especially important for BGC data, which can involve multiple dmode operators, each responsible for a particular BGC parameter. It was therefore decided that a small group of people should look into how to record this information in the profile files, going forward in time. However, the agreement is that populating this information in the profile files going backward in time is not necessary. That information is available at the DACs and PI groups.

Action 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.

8.7 How to come up with new metric to monitor percentage of suspicious floats that have been dmoded

During the DMQC workshop, it was noted that by providing a metric only on the percentage of dmode files available, Argo is incentivizing dmode throughput. Usually this means that easy floats are put through first to inflate this statistic, but really it would be great to incentivize dmoders to spend time on floats with potentially bad data that need to be addressed quickly but which might take time. It was suggested that a working group could study how to set up a new metric on this.

In the meantime, it was suggested that Argo begin by making a list of floats that need to be looked at quickly like those from the semi-automated tests done in near real time and the CTD serial numbers likely to drift salty. Then, based on those lists, M. Belbéoch can track the progress of delayed mode done on the floats.

Action 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 this as well.

9 Format issues

9.1 Upgrade to V3.1 Real-Time and historical T&S floats at GDAC (J. Gilson, C. Coatonoan, all)

Status on format version upgrade has been presented for profile files and meta-traj-tech files. Some DACs still have 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 being converted 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 still needs to be done for the inactive floats.

Status per DAC

- BODC: Working on this and it will get done in time.
- Coriolis: Has been re-decoding everything to migrate to v3.1, but for some older versions it is very complicated to re-decode as some information is missing. Therefore, for very old floats, Coriolis decided to convert V2 files into v3.1 using fill value for the missing information.
- JMA: Will do BGC floats first and then trajectory files.

- INCOIS: Expect to be done by the end of the year.
- KMA: Expect to be done soon.

Action 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.

9.2 CTD serial number, CTD model audit (J. Gilson) (10 mn)

J. Gilson performed a CTD serial number audit earlier in 2018 to try and identify possible sensors with a high likelihood of drifting salty based on their date of manufacture. Identifying these CTDs will help both Argo and SeaBird study and diagnose the problem. He thanked everyone who helped put the CTD serial numbers in the meta files as it was largely very successful. However, there are some serial numbers that are in conflict (shared between two or more floats) and some that are missing. There are some conflicts, but mostly in older floats. 1483 meta netCDF do not report a CTD SN and the majority of these floats are older.

In doing this audit, he wanted to point out that the placement of the CTD SN in the netCDF file format should be in 'SENSOR_SERIAL' for index shared by SENSOR = 'CTD_TEMP' or 'CTD_PSAL'. John plans on working with DACs after the ADMT meeting to try and resolve conflicts and find missing serial numbers.

John also performed an audit on SENSOR_MODEL in the metafiles. When searching in SENSOR for CTD_<PARAM> and <PARAM> for TEMP and PSAL, he found some files with a pressure sensor model SEASCAN_SSTC in the CTD.

Action 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.

Action 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.

Action 35. Ask File Checker to update to check against allowed sensors by parameter. Consider other cross reference checks.

9.3 Under-ice positions (C. Schmid, E. Van Wijk, Birgit Kein, M Scandebeg, A. Wong)

C. Schmid reported on the working groups suggestions for how to modify the profile and trajectory files to accommodate estimated and RAFOS positions. These suggestions have been finalized after several AST and ADMT meetings and aim to minimize the burden on the overall data system while giving users additional information about estimated positions.

For **profile files**, the solution is to have ***two optional variables*** that can be used if needed:

POSITION_ERROR and POSITION_COMMENT

Both can be filled in real time or delayed mode. POSITION_ERROR will contain the uncertainty of the estimated position in meters. POSITION_COMMENT will contain a description of the estimation method used to derive the position and can be either free text or a specified list of comments.

When a position is estimated by a method other than linear interpolation in real time, DACS are strongly encouraged to fill POSITION_COMMENT. Likewise, when position is estimated by a

method other than linear interpolation in delayed mode, DM groups are strongly encouraged to fill POSITION_ERROR and POSITION_COMMENT.

The final issue for the profile files is how to fill POSITIONING_SYSTEM when POSITION_QC = '8' (estimated). Two cases are considered:

1) When only one positioning system is used to estimate a position, POSITIONING_SYSTEM will record the primary positioning system.

2) When two or more positioning systems are used to estimate a position, or when an estimated position is based on a method that does not rely on positioning systems, POSITIONING_SYSTEM will record 'NONE'. The optional variable POSITION_COMMENT can be used to record additional information of the estimation method.

For **trajectory files**, the ADMT agreed to a change in methodology and to allow lower accuracy positions including estimated ones and Iridium ones in limited cases into the trajectory file. In the past, they had been excluded given that their accuracy was much less than Argos and GPS fixes. Additionally, RAFOS positions should be included. This change was made because it allows for more consistency between profile and trajectory files and it allows more position information to be stored in the trajectory file with the understanding that users will have to understand how the POSITION_QC, POSITION_ACCURACY and POSITIONING_SYSTEM variables can be used to describe the accuracy and source of the positions. In other words, it will be up to users to decide if they want to use estimated or Iridium or any lower accuracy positions in their work, but they are all included in one file so that users do not need to go to the profile files to find them.

Even with this change in what positions go into the trajectory files, POSITIONING_SYSTEM will not be expanded into an N_MEASUREMENT array due to the large burden it would put on the DACs. For the trajectory file, when multiple positioning systems are used, POSITIONING_SYSTEM will record the primary positioning system of the float. Other variables with the N_MEASUREMENT dimension, such as POSITION_ACCURACY and POSITION_QC, will be used to record multiple system information.

POSITION_ACCURACY will be used to indicate information about the accuracy for a particular position. This means an update to Reference Table 5 which is the location classes table which was initially based on Argos accuracy classes. The idea is to provide a meter accuracy for all of the different classes except the estimated one. The exact meter accuracy for GPS, Iridium, RAFOS and Beidou will be finalized by the working group in the coming year. Here is an initial update with additional classes or information shown in green:

Reference Table 5: location classes	
CODE	**ESTIMATED ACCURACY**
0	Argos accuracy estimation over 1500m radius
1	Argos accuracy estimation better than 1500m radius
2	Argos accuracy estimation better than 500 m radius
3	Argos accuracy estimation better than 250 m radius
A	Argos no accuracy estimation (3 messages received)
B	Argos no accuracy estimation (1 or 2 messages received)
Z	Argos invalid location
G	GPS (better than **10** m)
I	Iridium accuracy (better than **XXXXXX** m)

R	RAFOS accuracy (better than **XXXXXX** m)
D	Beidou accuracy (better than **10** m)
E	GLONASS accuracy (better than **XXXXXX** m)
F	GALILEO accuracy (better than **XXXXXX** m)
H	GNSS accuracy (better than **XXXXXX** m)
U	Estimated position. Accuracy not sent back by the float. An estimated accuracy might be shown in AXES_ERROR_ELLIPSE_

Reference Table 9 will also need to be updated:

Code	Description
ARGOS	ARGOS positioning system
GPS	GPS positioning system
RAFOS	RAFOS positioning system
IRIDIUM	Iridium positioning system
BEIDOU	Beidou navigation satellite system
GLONASS	GLONASS positioning system
GALILEO	Galileo positioning system
GNSS	Global Navigation Satellite System
NONE	**For profile file only:** If an estimated position is based on two or more positioning systems, or if the estimation method does not rely on information from positioning systems.

The updates to these tables allow for Iridium or estimated positions to be added to the trajectory files when a GPS or Argos fix is not available.

If no GPS fix is available, but Iridium fixes are, a combination of Iridium fixes should be used to determine a position following a method like the one described in the DAC Profile Cookbook (https://doi.org/10.13155/41151). In that case, the POSITION_ACCURACY will be 'I' and the AXES_ERROR_ELLIPSE variables can be filled with the estimated error. POSITIONING_SYSTEM will record 'GPS'. POSITION_QC would be '1' or '2'.

If no positions are available, but the DAC or DM operator chooses to put in an estimated position, POSITION_ACCURACY would be 'U' and the AXES_ERROR_ELLIPSE variables can be filled with an estimated error. POSITIONING_SYSTEM will record 'GPS' or 'Argos'. POSITION_QC would be '8'.

If all three cases occur in one trajectory files, ie GPS fix, Iridium position and estimated position, POSITIONING_SYSTEM will still record 'GPS'.

There was a brief discussion on RAFOS positions with it being pointed out that the measurement code for them should change from the 290 currently being used in the traj_aux files. A small group has agreed to work on this and make a proposal at the next ADMT along with suggestions on possible

standards for how information used to calculate the RAFOS positions should be stored in the traj_aux files.

These changes are fairly important and will need to be well documented in the User Manual, in the Argo data guide and should be advertised on data portals and web pages.

Action 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. 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.

9.4 Feedback from AST on meta and tech parameters and current status of highly desirable CONFIG_PARAMs (J. Gilson, E. Van Wijk, B. Klein) Actions 32,33 (20 mn)

The presentation was given on behalf of R. Cowley by B. Klein. It informed ADMT on work done since AST-19 to improve meta and tech parameters in the Argo files in order to be able to do more in-depth analysis on technical issues, monitor the health of the array and help increase float lifetimes. It was suggested to ADMT to control the entry for CONTROLLER_BOARD_TYPE_* by adding a managed table, reducing the entries to those listed below.

Apex floats:	**Navis and SOLO:**	**Others:**
APF	N1	CTF
APF9	N2	CTS
APF9E	GG32	DORSON-BATHYSYSTEMS
APF11	HC12	HM2000
APF3		I535
APF6		MetOcean
APF7		PID7008
APF8		015880-100
APF8B		1535
APF8C		41722
APF8R		A9SSU

The controlled list should be used as the first portion of the CONTROLLER_BOARD_TYPE_* field, and the remainder of the field would be free text, to allow addition of revision numbers or anything else a PI would like to add. EG: CONTROLLER_BOARD_TYPE_PRIMARY = "APF9 iridium version xyz". In order to distinguish between the first part of the field and the free text it was suggested by ADMT to add a delimiter as '['.

The FIRMWARE_VERSION definition in the Argo User's manual presently reads "The firmware version. This is specified as per the format on the manufacturer's manual. Example: 072804 ". This should be updated since the manufacturers have been asked to supply that information directly from the float. It was therefore suggested to update the ARGO USER's manual as follows "Firmware version, as returned from the float log files (iridium) or in the test and launch logs (Argos). Example: '072804' or '03/06/17 21:21:20 APF11-2MB-v2.5.2' ".

The current field length of FIRMWARE_VERSION in the metadata file is char32 and that is not sufficient for the new APF11 floats. It was therefore recommended to increase field length to string 64 and still accept field lengths of 32.

It was proposed to introduce controlled values for the battery-related variables to make them more parsable. To do this a controlled table on BATTERY_TYPE was shown of the following form

Manufacturer Alkaline xV
Manufacturer Lithium xV
Manufacturer Lithium xV + *Manufacturer* Alkaline xV
Manufacturer Lithium xV + *Manufacturer* Hybrid xV

And with a controlled list on Manufacturer

Electrochem
Tadiran

And finally it was proposed to introduce a controlled list on BATTERY_PACKS.

xDD y (x = number, y = Li or Alk)
xC y (x = number, y = Li or Alk)
xD y (x = number, y = Li or Alk)
Any combination of above with + to join (eg 4DD Li + 1C Alk)
U (unknown)

The review of the CONFIG_ parameters in the meta files done by John Gilson had suggested to split these into two groups. A smaller subset of mission-critical parameters will be curated and the others will be left in on a non-curated list. An annual audit is proposed to increase consistency across DACs and float types, only mandatory configs will be audited for presence in metafiles and value will not be checked. In terms of the used vocabulary and to increase machine-to-machine readability it is suggested to explore using the NERC Vocabulary Server (NVS).

Action 37. Update User's manual with instructions on how to fill FIRMWARE_VERSION and change field length to 64, but still accept 32.

Action 38. Accept suggested changes to Battery variables. Update manuals and FileChecker accordingly.

9.5 • Update on Trajectory File Status and DAC Trajectory Cookbook (Megan Scanderbeg) (15 mn)

M. Scanderbeg presented on the status of the trajectory files and noted that while there was not a large change in the number of trajectory files in v3.1, several DACs had to learn how to create v3.1 files for the new APF11 float. She noted how successful the DAC Trajectory Workshop had been following the previous ADMT-18 meeting as it allowed DACs to work together to figure out how to correctly match data from floats to MCs. It was helpful to find out what data are delivered to DACs and it what format. For example, some DACs do not have access to all files sent back by a float which complicates the trajectory file creation process. The DAC Trajectory Cookbook was updated after the workshop to include new tables for the HM2000, APF11 Argos and Iridium floats and updated tables for the ARVOR and PROVOR. Some additional recommendations were made on how to fill surface timing information for RUDICS Iridium floats.

Some attempts at code sharing and collaboration were discussed including the offer from J-P Rannou to share excel tables showing where all data from APF11, Provor and Arvor floats go at Coriolis. This was agreed that it would be helpful to do and can be added to a GitHub or ADMT page.

To improve the quality of real time trajectory files, it was agreed that the FileChecker for trajectory files will go live by AST-20. It has been operating in test mode for several months and most DACs have been able to address the failures. A couple DACs still need some time to fix some issues, but agreed to do it by AST-20.

There were a brief couple of statements on how the process for delayed mode trajectory work might develop. M. Scanderbeg has agreed to work with a small group of people to develop methods and tools to create dmode trajectory files.

She ended with stating that the b-trajectory file format should be finalized and had a few issues on this contributed by H. Bittig. In the discussion afterward, there was the suggestion that maybe there does not need to be a split of trajectory files into core and b-files. Therefore, a small working group will form to further investigate this matter.

Action 39. Working group to study whether core and bgc trajectory files can be combined into one file

Action 40. Complete updated version of DAC Trajectory Cookbook

Action 41. Find a way to share excel tables from J-P Rannou on how Coriolis processes data from APF11, Arvor and Provor floats

10 • GADR Status of the Archiving centre (T Boyer) Action item 31-32

M. Scanderbeg reported on behalf of Tim Boyer the status of the GADR. Charles Sun who set up the GADR for Argo is retiring after 28 years at NOAA. Charles had many great contributions at NOAA and it will be hard to fill his shoes, but Tim Boyer will take over responsibility for GADR at NCEI.

The GADR product that is in the same format that other NCEI products is downloaded more frequently than the GDAC archive (97% vs 3%). There were more than 10,000 distinct users of GDAC or GADR Argo data. A single DOI will be issued in a similar manner as is being done at the GDACs currently. This single DOI has been accepted by NOAA but not yet implemented. Tim would like Argo's approval of the title and abstract.

In the past, Argo data were only used at NCEI to be incorporated into the Extended Record of Sea Surface Temperature monthly updates (ERSST, paper by Huang et al. 2017). Now NCEI will extend to daily Optimally Interpolated Sea Surface Temperature (OISST). Argo data contributes to lessening the cool bias in the OISST process in data sparse areas.

Mirroring of the Argo GDAC (IFREMER or GODAE) is performed twice daily at NCEI. It takes ~ 8 hours to complete mirroring that make it difficult for use in the daily OISST at NCEI. A simple fix is to have an rsync manifest updated whenever files are added/changed with files listed chronologically. This would allow NCEI to check against the current mirror and download only the differences.

NCEI contributed to the Argo CTD Reference Database with 2772 CTD casts to depths > 2000 m for years 2000 to 2018 uploaded to the World Ocean Database between November 2017 and November 2018.

Tim noted that it would be very helpful to have a simpler pressure axis for BGC Argo data which should be achieved using the new synthetic profiles.

He noted that despite ample warning, GTSPP was not prepared for Argo's switch to BUFR format and as a result, from June 2018 to present only remaining TESAC messages have made it into GTSPP. BUFR will be incorporated into the main GTSPP stream in May 2019. In the interim, Argo from the GDACs or an interim BUFR conversion should be loaded into GTSPP by January 1, 2019.

Finally, JCOMM Marine Climate Data System was brought up and he noted that an invitation to Argo to be a GDAC has been held up by different definitions of GDAC between JCOMM organizations. He suggested that the MCDS is a good idea and Argo should try and sort out the issues so that it can become a GDAC in this system.

Action 42. Improve synchronization between NCEI and GDAC to reduce mirroring time.

Tim highlighted the difficulty to use the BGC-Argo M-Files because not aligned . Moving to the S-Files should solve the issue

GTSPP didn't switched from TESAC to BUFR and the issue should be solved next year

Action 43. Investigate problem with Argo GDAC as MCDS and try to resolve it.

11 Update on Argo Regional Centers progress

Action 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

11.1 North Atlantic

11.1.1 DM consistency checks in the NA-ARC region

In the Argo data snapshot of June 2018, 1903 floats have been processed in DM in the NAARC region (North of 20°S). Among them, we found 350 floats for which the PI applied a salinity correction and 1553 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 1903 floats, we ran a modified OW method using four sets of configuration parameters. Compared to the OW original method (Owens and Wong, 2009), our modified method better takes into account the interannual variability and provides more realistic error bars (see Cabanes et al., 2016). We further checked the DM salinity correction of a float only if the results 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 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

Action 45. Ask DACs and DMQC operators to look at NAARC website and try to resolve issues with PSAL corrections.

11.1.2 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 synthesizes 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 at monitoring 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).

11.1.3 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 7632 floats. Visual quality control is used to qualify the data (representation parking pressure, grounded flags). Last year, we were able to add the data from 1000 floats. We update, as a priority, the data from the Coriolis DAC. Next year we plan to add the data from another 1000 floats (from AOML/CSIRO DACs).

11.2 Mediterranean Sea

Since 2001 more than 440 floats, from different countries and projects, were deployed in the Mediterranean and in Black Sea. 55000 CTD profiles have been acquired. In 2018, about 500 CTD Argo profiles per month were acquired and 25% of this amount are also BGC profiles. In total, 49 new float were deployed in the framework of national programs and projects; more than 4200 profiles were collected

Statistics have been computed to show the floats' performance. The mean half-life of floats is about 140 cycles and the mean vertical distance travelled is about 110 km; a mean of 0,9 km per cycle is performed. The death rate is about 43% (50% in 2017).

Additional reference data have been added: CTD data available from the European service of Copernicus, personal contacts, and CTD taken at deployments. A visual QC is performed, data are assembled and checked for duplicates.

DMQC activities in the Black Sea are going on and it is planned to work on all the eligible floats next year. Floats with large positive conductivity sensor drift are found. Particular attention will be given to floats whose SBE CTD S/N is in within the ranges considered as critical.

11.3 Pacific Ocean Fumihiko Akazawa

Pacific ARC (PARC) is providing float monitoring information in the Pacific on its web sites since 2006, operating in collaboration with IPRC (USA) and CSIRO (Australia). The PARC is operating well, producing many kinds of information and dataset to Pacific PIs. In this year we will try to improve PARC web site to be more useful. Our plan is to produce useful QC information to PIs based on the process of making AQC v2.0 dataset. Over 10000 profiles in R, A and D mode have been checked with 9 QC test, R-mode files with insufficient QC are mostly corrected. Thus there is the possibility that information of QC flags on AQC dataset will be useful to monitor performance of

Pacific Argo array. Statistical information based on error check process of AQC will be shown monthly from PARC website.

11.4 Indian Ocean

As part of the ARC activities of the Indian Ocean, INCOIS has undertaken the following activities during the period Dec, 2017 - Nov 2018:

1. Continue with co-ordination of float deployments by India and other countries. Helping wit data processing for National Institute of Oceanography (NIO, Goa) floats deployed as a part of Indo-Australian collaboration. Using the float density map to identify regions of low floats density and suggest deployment in those regions.

2. Implementing the recommendations of a working group that was formed for dealing with the data from BGC Argo float data deployed by India. Many ship based measurements are being taken along with the BGC floats during deployment and these are being used for validation of profiles from BGC floats. Also profiles are being taken during all possible cruises when BGC floats pop-up.

3. India celebrated 15 years of the Indian Argo program and held a one day workshop inviting all the users of Argo data to make presentation of their work. Students utilizing the data were also asked to present their work. The best papers out of this workshop are now being compiled to make it to special issue in Current Science Journal.

4. Data search and archeology of high quality CTD for updating the Argo reference data base and also for use in DMQC of Argo data. All the non-EEZ CTD data archived at INCOIS is shared with CCHDO.

5. Working on development of additional QC methods like convex hulls and Artificial Neural Networks (ANN) for detection of outliers and sensor degradations.

6. 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 "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 to maximize the benefit.

7. 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.

11.5 Southern Ocean

A report was given to ADMT19 about the status and future plans of the Southern Ocean Arc (SOARC) on behalf of Matt Donnelly by Birgit Klein. The SOARC partnership consist of four main contact points

- Matt Donnelly, BODC, UK: matdon@bodc.ac.uk
- Esmee van Wijk, CSIRO, Australia: Esmee.Vanwijk@csiro.au
- Birgit Klein, BSH, Germany: Birgit.Klein@bsh.de
- Tanya Maurer, MBARI/SOCCOM, USA: tmaurer@mbari.org

The webpage for SOARC is maintained by BODC at www.soarc.aq.

SOCCOM has joined SOARC at ADMT18 and is contributing largely to the fleet in the Southern Ocean. SOARC partners have limited resources in terms of funding, but improvements in the ARCs activities result from funding from EU projects (MOCCA, Euro-Argo RISE) some specific activities such as regional data quality analysis.

No work in improving the reference data base could be performed last year, but is expected during 2019/20. The SOARC will work with CCHDO and SOOS to improve the Argo reference database in the Southern Ocean and will identify and reduce any gaps in general data availability. It is planned to develop list of co-located CTDs-on-deployment to help the DMQC operators. BODC is also developing collaborations with the University of Liverpool & the University of Bristol to characterize CTD profiles in the Southern Ocean by Frontal position, zone and mixing. This will help the DMQC operators to track ocean front locations and select the appropriate reference data points in the mapping procedures.

SOARC has started to develop guidance on Southern Ocean deployments in compliance with the Antarctic Treaty. Sarah Chapman at BODC and Matt Donnelly have compiled 'Argo and the Antarctic Treaty' document on environmental obligations, of which a draft version is available for feedback.

Observation density in the Southern Ocean still needs improvement. The ACC is reasonably well covered and density in the Ross Sea has significantly improved since the start of SOCCOM. The Weddell Sea coverage decreased in recent years. This could result from a shortage of deployment opportunities in the Weddell Sea, or a shortage of programmes wishing to deploy, or both. The German contribution in the Weddell Sea was stalled during the last year due to the procurement problems. Deployment plans for 2019 and 2020 will cover the area.

It was also suggested to improve deployment opportunities by coordination of existing research vessel deployments and to engage resupply vessels supporting Antarctic bases on Weddell Sea coast. SOARC will try to engage International Association of Antarctic Tour Operators (IAATO) for core deployments from cruise ships (albeit mostly restricted to Antarctic Peninsula).

In terms of delayed-mode quality control SO array under populated, so improving DMQC status particularly at high latitudes important. CSIRO will be providing DMQC support for 20 Italian orphan floats and BODC has restored DMQC capability last year, with dedicated DMQC operator joining the team in January. Opportunities for orphan float are also supported through BODC (EU MOCCA project).

12 All other business

12.1 Summary of the 19th ADMT actions

Sylvie and Megan have collated an action list from the ADMT19 discussions and the list was reviewed, actions assigned to DACs/operators, deadlines identified and priorities set.

12.2 Location of next meeting

The location of ADMT20 will be hosted by Laboratory of Villefranche in South of France.

13 Annex 1 – Agenda

Agenda of the 19th Argo Data Management Meeting

6th – 7th December 2018

V3

Objectives of the meeting

- *Review the actions decided at the 18th 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 7th Bio-Argo Workshop*

Schedule: *Meeting will start at 8h00 and finish around 18h00 on Thursday and 17h00 on Friday*

Thursday 6th December

Welcome address (*15mn)*

- **Feedback from 18th AST meeting** : *S. Wijffels, T. Suga (30mn)*
- **Feedback on 6th DMQC Workshop** *(J. Gilson, A. Wong) (30mn)*
- **Feedback on 7th BGC-Argo Workshop:** *(H. Claustre) (30mn)*

Coffee break

- **Status of Argo Program and link with Users (1h00)**

Status on the actions 1,2,8,9

- ***Review of the Action from last ADMT*** *(M. Scanderbeg) 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 8,9 (20mn)*

- **Real Time Data Management (1h30)**

Status on the actions 3,4,5,6,7,10,11,12,13,14

- **GTS status** *(Anh Tran) (15mn)*
- **Status of anomalies at GDAC** *(Christine Coatanoan) Action7 (15mn)*
- **Status on Anomalies detected with Altimetry** *(Nathalie Verbrugge) (15mn)*
- **Feedback on improving spike and density tests** *(C. Coatanoan) Action 10 (15mn)*

12h30 Lunch break

- **Feedback on using MinMax climatology in RT test** *(S. Pouliquen, J. Gourrion, C Coatanoan) Action 11 (15mn)*
- **Build a gradient climatology from Argo to help QC** *(B. Owens, S. Wijffels) Action 11 (15 mn)*
- **Grey list management** *(T. Carval) Action 12,13,14 (15 mn)*
- **New real time management system at CSIRO** *(J. Lovell) (15mn)*
- **Revisit flagging of Deep Argo data** *(Annie Wong)*

- **GDAC Services (1h30)**

Status on the actions: 15 to 26,28,37

- **Operation status at US-GDAC and Coriolis-GDAC** *(Thierry Carval, Mike Frost) Actions 15,16,17,18,19,20,21,26,37 (30mn)*
- **Status of Format Checker and process to update Format Checker** *(Mark Ignaszewski) Action 22,28 (20mn)*
    - **For profile files (emphasis on existing D-files)**
    - **For metadata, tech and trajectory files**
- **Maintenance of tables centrally – who looks after additions and changes operationally? (***V. Paba, Thierry Carval, Mathieu Belbéoch, Catherine Schmectig) Actions 24,25 (10 mn)*
- **Size of GDAC monthly DOI zipped file** *(Annie Wong, Brian King)*

Coffee break

- **Delayed Mode Data Management (1h30)**
  Status on actions 36, 38 to 45
    - **Progress on Argo Reference data base (0h30)**
        - **Summary of the actions since ADMT-18 (***C Coatanoan*) *Action 41*
        - **CCHDO/US-NODC-progress** *(K. Stocks, T Boyer) Action 41*
    - **Orphan float management** *(M. Belbéoch) Action 42,43,44 (15mn)*

Friday 7th December

- **Delayed Mode Data Management (continued)**
  Status on actions 36, 38 to 45
    - **Post-correction to conductivity measurements on RBR CTD** *(J-M LeConte) (10mn)*
    - **How to capture dmode operator in d-files. Store this at DACs for now**
    - **How to come up with new metric to monitor percentage of suspicious floats that have been dmoded**

- **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 : 27, 29 to 35

- **Upgrade to V3.1 Real-Time and historical T&S floats at GDAC** *(J. Gilson, C. Coatonoan, all) Action 27 (15mn)*
- **Interaction with manufacturers and metadata** *(Mathieu Belbéoch)*
- **What information is stored for CONFIG_MISSION_NUMBER = 0** *(M. Scanderbeg)*
- **CTD serial number, CTD model audit** (*J. Gilson) (10 mn)*
- **Under-ice positions** *(C. Schmid, E. Van Wijk) (15 mn)*

Coffee break

- **Feedback from AST on meta and tech parameters and current status of highly desirable CONFIG_PARAMs** *(J. Gilson, E. Van Wijk, B. Klein) Actions 32,33 (20 mn)*
- **Update on Trajectory File Status and DAC Trajectory Cookbook** *(Megan Scanderbeg) (15 mn)*

- **GADR Status of the Archiving centre** *(T Boyer) Action item 31-32* **(15mn)**

12h30 lunch

- **ARCs: provide an information on what done and what is planned (1h30)**
    - **Update on ARC progress** (ARCs leaders) 15mn each
        - **North Atlantic** Cecile Cabanes
        - **Mediterranean Sea** Gulio Nortastefano
        - **Pacific Ocean** Fumihiko Akazawa
        - **Indian Ocean** Uday Bhaskar
        - **Southern Ocean** Birgit Klein/Matt Donnelly

Coffee break

- **Summary of the 19th ADMT actions** *(S Pouliquen, M Scanderbeg)* **30mn**
- **Location of 20th ADMT**

14 Annex 2 - Attendant List

First name	Last name	Institution	Country
Fumihiko	Akazawa	JAMSTEC	Japan
Andrew	Barna	Scripps Institution of Oceanography / UCSD	USA
Mathieu	Belbéoch	JCOMMOPS	France
Clare	Bellingham	British Oceanographic Data Centre	UK
Vincent	Bernard	IFREMER	France
Carolina	Berys-Gonzalez	Scripps Institution of Oceanography / UCSD	USA
Henry	Bittig	Baltic Sea Research Institute Warnemünde (IOW)	Germany
Emmanuel	Boss	University of Maine	USA
cecile	cabanes	IFREMER	France
Thierry	Carval	IFREMER	France
herve	claustre	CNRS	France
Christine	COATANOAN	IFREMER	France
Giorgio	Dall'Olmo	PLYMOUTH MARINE LABORATORY	UK
Stephen	Diggs	Scripps Institution of Oceanography / UCSD	USA
MINGMEI	DONG	NMDIS	China
Sharon	Escher	Scripps Institution of Oceanography / UCSD	USA
Isabelle	Gaboury	Fisheries and Oceans Canada	Canada
John	Gilson	Scripps Institution of Oceanography / UCSD	USA
Gaëlle	Herbert	IFREMER	France
Shigeki	Hosoda	JAMSTEC	Japan
Mark	Ignazewski	US GODAE	USA
Hyeogjun	Jo	KMA/NIMS	Korea
Kenneth	Johnson	Monterey Bay Aquarium Research Institute	USA
KiRyong	Kang	KMA/NIMS	Korea
Sung-Dae	Kim	KIOST	Korea
Brian	KING	National Oceanography Centre	UK
birgit	Klein	BSH	Germany
Kensaku	Kobayashi	JMA	Japan
Jean-Michel	LECONTE	RBR Ltd.	Canada
Joon-Soo	Lee	NIFS/KODC	Korea
Lisa	Lehmann	Scripps Institution of Oceanography / UCSD	USA
Zenghong	Liu	Second Institute of Oceanography, SOA	China
Jenny	Lovell	CSIRO	Australia
John	Lyman	NOAA/PMEL/JIMAR	USA
Amaru	Marquez	CICIMAR	Mexico
Kim	Martini	Sea-Bird Scientific	USA
Tanya	Maurer	MBARI	USA
Kristy	McTaggart	NOAA PMEL	USA
Dave	Murphy	Sea-Bird Scientific	USA
Giulio	Notarstefano	OGS	Italy
Peter	Oke	CSIRO	Australia

Violetta	Paba	British Oceanographic Data Centre	UK
Massimo	Pacciaroni	OGS	Italy
Hyukmin	Park	KIOST	Korea
JONGJIN	PARK	KYUNGPOOK NATIONAL UNIVERSITY	Korea
josh	Plant	MBARI	USA
Antoine	Poteau	LOV, Villefranche sur mer	France
Sylvie	Pouliquen	Ifremer and Euro-Argo ERIC	France
Sarah	Purkey	Scripps Institution of Oceanography / UCSD	USA
Pelle	Robbins	Woods Hole Oceanographic Institution	USA
Dean	Roemmich	Scripps Institution of Oceanography / UCSD	USA
Tatiana	Rykova	CSIRO	Australia
Raphaelle	Sauzede	CNRS	France
Megan	Scanderbeg	Scripps Institution of Oceanography / UCSD	USA
Catherine	Schmechtig	CNRS	France
Claudia	Schmid	AOML	USA
Karen	Stocks	Scripps Institution of Oceanography / UCSD	USA
Jim	Swift	Scripps Institution of Oceanography / UCSD	USA
Lynne	Talley	Scripps Institution of Oceanography / UCSD	USA
Leonardo	Tenorio-Feranandez	CICIMAR	Mexico
Anh	Tran	Department of Fisheries and Oceans	Canada
Tom	Trull	CSIRO	Australia
TVS	Udaya Bhaskar	INCOIS	India
Pedro	Velez-Belchi	Spanish Institute of Oceanography	Spain
Nathalie	Verbrugge	CLS	France
Ian	Walsh	Sea-Bird Scientific	USA
HAILI	WANG	XIAMEN UNIVERSITY	China
Deb	West-Mack	Woods Hole Oceanographic Institution	USA
Susan	Wijffels	Woods Hole Oceanographic Institution	USA
Nancy	Williams	NOAA	USA
Annie	Wong	CSIRO	Australia
Xiaofen	Wu	Second Institute of Oceanography, SOA	China
Xiaogang	Xing	Second Institute of Oceanography, SOA	China
JINKUN	YANG	NMDIS	China
Nathalie	Zilberman	Scripps Institution of Oceanography / UCSD	USA

15 Annex 3 - ADMT18 Action List

On 44 actions: 15 were done, 14 were partially done, 13 were not done

	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 19	E. van Wijk A. Wong S. Pouliquen M. Belbéoch A. Tran U. Bhaskar R. Cowley M. Scanderbeg P. Velez-Belchi	R	Not done. Carried over
2	Thierry to move ahead with adding list of co-authors to DOI. Ask National Programs to provide Thierry, ADMT co-chairs, AST co-chairs a list of people who have contributed to Argo, along with possible ORCID to begin the list of	ADMT 19	Thierry, National Programs	R	Start with list from meta files and list from AIC. Ask AST, ADMT, DMQC group for a list of names and emails. Start with a Google Doc with names listed by country, orcid In progress

	authors.				
3	INCOIS to investigate why the number of BUFR message is very low compared to TESAC	AST19	Uday	H	Resolved. Some BUFR codes were missing, but now A. Tran has them and numbers should increase. See A. Tran's report at ADMT-19
4	Inform WMO users of the official end of Argo Tesac messages on 1st July 2018. Post message on Argo websites.	January 2018	M. Belbéoch J. Turton M. Scanderbeg T. Carval	R	Done
5	All DACs to stop sending Tesac messages on 1st July 2018.	July 2018	DACs	R	Done except for JMA. JMA has not stopped yet, due to our internal circumstances. JMA will stop sending Tesac as soon as possible.
6	MetOffice to provide the python BUFR converter to Thierry to be made available in the Tools section of the ADMT website and possibly on AIC website	ADMT19	MetOffice	R	Done
7	Kordi to provide feedback contact name for anomaly corrections by Christine	AST19	Kordi	R	Done
8	Mathieu to monitor the Monthly check anomalies in	ADMT19	Mathieu, Christine	R	ftp://ftp.ifremer.fr/ifremer/argo/etc/ObjectiveAnalysisWarning/

	the JCOMMOPS system. Feed ADMT/AST co-chairs if profiles on list repeatedly				to be done late 2018. inprogress
9	Mathieu to modify the AIC warning system to separate out floats that need to be checked and floats that may need to be greylisted from S. Guinehut's comparison with altimetry and send them to appropriate person. Real time files to DAC. D files to DAC and dmode operator.	ADMT19	Mathieu, Stephanie	R	Done. See JCOMMOPS report for details.
10	Study how to improve the Spike and density test : use threshold per meter:	ADMT19	Christine	R	In progress. Will present at mtg.
11	Can we build a gradient climatology from Argo with good un-corrected data as done for the min max range by J Gourrion at Ifremer : Breck/Susan/Jerome to study	ADMT19	J. Gourrion, B. Owens, S. Wijffels	R	In progress. Will present at mtg
12	Annie and Thierry will update the definition of the greylist to take into account BUFR. Annie will update the QC Manual.	AST19	A. Wong, T. Carval	R	Done in January 2018
13	Mathieu and Breck will contact RBR to obtain information from the	ADMT19	M. Belbéoch, B. Owens	R	Contacted a couple of times.

	manufacturer to fill the Argo meta- and technical- tables. Immediate needs are a new WMO_INST_TYPE, and information to fill SENSOR_MODEL for CTD_PRES, CTD_TEMP, and CTD_CNDC				inprogress
14	Breck to check on whether FSI floats have been removed from greylist	ADMT19	B. Owens	R	20% still on greylist Not done
15	Thierry and Mathieu to further investigate difference in GDAC delays	ADMT19	T. Carval, M. Belbéoch	R	In progress
16	Reduce number of significant digits in US GDAC GEO directory	AST-19	M. Ignaszewski	R	done
17	Set up the aux directory at US-GDAC	AST19	Mike	R	DONE (2018-01-02)
18	Thierry to go with proposal #2 for adding a new directory for index file. Inform users on ADMT rsync page	ADMT19	T. Carval	R	done
19	Keep the action item to automatically resubmit all files if metafile is fixed within 7 days.	ADMT19	T. Carval, M. Frost, M. Ignaszewski	R	Done at US GDAC
20	Continue investigating ways to allow both GDACs to receive	ADMT19	GDACs	R	Not Done

	files from all DACs				
21	Stop allowing Config Mission Number of 0 by AST	AST19	DACs	R	Warnings generated. Files still being received (from AOML). MEDS stopped using CONFIG MISSION NUMBER of 0 Study if useful information stored in META_CONFIG cancelled
22	Recheck all files on GDACs with a priority on Dmode files. To be performed early 2018 so that anomalies can be fixed by ADMT	ADMT19	M. Ignaszewski, DACs	R	Not done.
23	Put links to Google Ref tables on the ADMT documentation page	AST19	T. Carval	R	Done
24	Mathieu to work with GDACs to develop API for Argo ref tables . End of February	AST19	M. Belbéoch, GDACs	R	In JCOMMOPS workplan for achievement mid 2019. Meeting JCOMMOPS/BODC to be set up around June 2019. Issue being addressed for all platforms at JCOMMOPS, beyond Argo. In progress
25	Mathieu to look into NERC vocabulary and see how much work we need to do to use such vocabulary for ref table.	ADMT19	M. Belbéoch	R	See above.

					In progress
26	M-File : French GDAC to move them to NetCDF4 and USGDAC to get them by mirroring the French GDAC . Interim solution until a new M-File format is specified by the group set up at BGC-Argo meeting	ADMT19	GDACs	R	Part (1) of Action Item 26: M-File: French GDAC to move them to NetCDF4; US GDAC to get them by mirroring the French GDAC. -> The results of Part (1) are the merge files M"R/D"wmoID_cycle.nc (single-cycle) and wmoID_Mprof.nc (multi-cycle). Part (2) of Action Item 26: Treat Part (1) as the interim solution until a new M-File format is specified by the group set up at the BGC-Argo meeting. -> The results of Part (2) are the synthetic files S"R/D"wmoID_cycle.nc (single-cycle) and wmoID_Sprof.nc (multi-cycle). Manual explains how synthetic merged files made and distributed at Coriolis: https://doi.org/10.13155/55638

					Examples The merged profile of float 6901585 cycle 1 with its Core and BGC parameters • MR6901585_001.nc The merged profiles of float 6901585 aggregated in one NetCDF4 file • 6901585_Mprof.nc The synthetic profile of float 6901585 cycle 1 with its Core and BGC parameters • SR6901585_001.nc The synthetic profiles of float 6901585 aggregated in one NetCDF4 file • 6901585_Sprof.nc
27	Christine and John to send DACs the list of active floats that are still in version 3.0 or lower and DACs to reprocess them in V3.1	ADMT19	Christine, J. Gilson, DACs	R	Lists sent to DACs in Jan 2018. Some DACs asked for an updated list part way through the year. A new lists will be prepared for each DAC in time for the ADMT19 meeting.

					In progress
28	Filechecker to stop accepting files D-Files in version 3.0 or lower 1st July 2018. If dmode operators are having trouble with this, alert ADMT co-chairs. Alert dmode operators of this change.	July 2018	M. Ignaszewski, Dmode operators	R	Not done (Mark will review current deliveries to see impact.)
29	Work with Manufacturer to get firmware_version in data sent back at some point in its life	ADMT19	PIs, B. King, R. Cowley	R	No progress – Navis and Apex seem to do this already in the test messages. Arvor do not send this information. Something to follow up with NKE. In progress
30	Work with manufacturers to define the Battery technical information to be recorded and other trajectory cycle timing data	ADMT19	B. King, R. Cowley, M. Scanderbeg, H. Bittig	R	Some work done via email with Teledyne to define trajectory information for APF11 floats (included in the traj tables and updated traj cookbok). Also, CSIRO have done some emailing to NKE to better refine traj information, but we haven't reviewed the NKE table yet. Bec has contacted manufacturers to get the full detail on the battery types used currently and historically. This information needs to be documented somewhere for everyone. Battery type metadata recommendations will be presented at ADMT. In progress
31	Collect documentation of curated configs such as ice-detection algorithm documentation. Keep this with	ADMT19	PIs, M. Belbéoch	R	Not done. Need discussions with ADMT experts.

	meta and tech tables (AIC or ADMT website?)				
32	John to release draft CONFIG table by March. Feedback needed from DACs and re-run audit before ADMT-19.	AST19	J. Gilson	R	Not done
33	John to propose at next ADMT a process to move CONFIG parameters from non-curated to curated tale	ADMT19	J. Gilson	R	Not done
34	For floats that perform Ascending and Descending profiles in the same cycle, if both are Primary Sampling profiles, then each primary sampling profile in N_PROF=1 in two separate netCDF files. Allow small fragment cycles that are not Primary Sampling profiles in N_PROF > 1 even if direction of profile is different than the Primary Sampling profile	ADMT19	DACs with ascending and descending profiles where one profile is not mandatory	R	Proposal rejected after ADMT meeting. Keeping ascending and descending profiles separate. Put non-core, fragment profiles in N_PROF>1 and leave N_PROF = 1 with fillvalue if there is no core file. cancelled
35	Clarify definition of primary sampling and put updated definition in user manuals. John to circulate this proposal	AST19	J. Gilson	R	Not done
36	The first DMQC should be done after one year. Then the revisit could be after 2 years for the teams that struggle with DMQC backlog	ADMT19	Dmode operators	R	Likely changing this recommendation. Want to keep one year revisit if possible. Rejected in 2018

					cancelled
37	Add deepest profile level sampled to index file to facilitate monitoring activities	ADMT19	GDACs	R	Done
38	Review the list of software reported in the HISTORY_SOFTWARE variable to identify human made actions and non-actions and actions driven by human expertise	ADMT19	G. Maze, others??	R	In progress. New hire who will work on this in next year.
39	Propose an update to the user Manual section 5 to add more explanation about "group" of HISTORY_STEPS/ACTIONS, rather than isolated actions	ADMT19	G. Maze, others??	R	Not done. Carried over
40	Propose profile file format checking tests to ensure the HISTORY variables are compliant to reference tables and coherent with each other	ADMT19	G. Maze, others??	R	Not done. Carried over
41	Christine to provide the CTD ref db for Argo in index file. Steve to provide all CCHDO CTD files that are not recorded in the index file.	ADMT19	Christine, Steve Diggs	R	Zip file with 3 logs sent to CCHDO in January. In October 2018, 12 Go-SHIP cruises were downloaded from CCHDO for the period of 2016 – 2018 which will be in next version of Argo refDB delivered before end of December done
42	Mathieu to provide the list of orphan floats which have no	ADMT19	M. Belbéoch	R	See JCOMMOPS Report and ADMT discussions.

	assigned DMQC operator and ask for volunteers to process them for this year				done
43	Mathieu to specify a way to manage Dm-Operator at Float and parameter level to be able to manage programs that do not have a program DM-operator and BGC-Argo where different operators may be responsible for different parameters	ADMT19	M. Belbéoch	R	Need developments at JCOMMOPS and further specifications. To be added to 2019 workplan. Not done. Carried over
44	Study how to better capture the DM-Operator and Institution for each parameter in the profile file. Consider adding a global attribute. If this is accepted, consider using ORCid and EDMO-code to avoid spelling issues. This can help with audits done on the Argo dataset.	ADMT19	??	R	Not done. Carried over
45	AIC, OGS and AOML to define what to do in term of DMQC for GTS only floats	ADMT19	AIC, OGS and AOML	R	In progress. OGS is willing to do DMQC for these floats, but it cannot be a high priority right now. The floats are difficult due to the truncation of the parameters' values to the second decimal.

16 Annex 4 - ADMT19 Action List

	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 A. Wong S. Pouliquen M. Belbéoch A. Tran U. Bhaskar R. Cowley M. Scanderbeg P. Velez-Belchi	R	
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	
3	M. Belbéoch to study why delay is different between GDACs and GTS	ADMT 20	M. Belbéoch	R	
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	
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	

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	
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		
8	Report back on MinMax implementation in real time at next ADMT meeting.	ADMT 20	S. Pouliquen, B. Owens	R	
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	
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	
11	DACs to send all data onto the GTS in BUFR format, even greylisted sensor data, with appropriate QC flags.	AST 20	DACs	R	
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	
13	NMDIS and Coriolis GDAC to solve the issue of D file submission	AST 20	Mingmei Dong, T. Carval	R	
14	Improve synchronization between US GDAC and French GDAC to make CSIO data available more rapidly	ADMT 20	M. Ignazewski, t. Carval	R	
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	AST 20	T. Carval	R	

	conventions inside. Include all documentation for all User Manuals.				
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	
17	Remove zipped GDAC files from Coriolis. Only serve them on DOI page.	ADMT 20	T. Carval	R	
18	Add PARAM into b-traj index file	AST 20	GDACs	R	
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	
20	Move from warnings to rejections by AST-20 meeting for all GDAC File Checker tests.	AST 20	M. Ignaszewski	R	
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	
22	Stop accepting D-mode files < v3.1.	AST 20	GDACs	R	
23	Put all existing v3.1 files through current FileChecker and report results to ADMT.	AST 20	M. Ignaszewski	R	
24	Trajectory File Checker live by AST 20	AST 20	M. Ignazewski	R	
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	
26	Add DM operator for each BGC variable into AIC database	ADMT 20	M. Belbéoch	R	

27	Check with operational centers that they are using GDAC data for reanalysis products	ADMT 20	P. Oke through GODAE OV	R	
28	C. Coatanoan to document how she deals with duplicate CTD in ref DB	ADMT 20	C. Coatanoan	R	
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	
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	
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	
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	
36	Under-ice working group to update Table 9 to add NONE and a method to include more than one positioning system in	AST 20	E. VanWijk, C. Schmid, B.	R	

	string 8. Update table 5. 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.		Klein, M. Scanderbeg, A. 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	
38	Accept suggested changes to Battery variables. Update manuals and FileChecker accordingly.	AST 20	R. Cowley, B. Klein, T. Carval, M. Ignazewski	R	
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	
40	Complete updated version of DAC Trajectory Cookbook	AST 20	M. Scanderbeg	R	
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	
42	Improve synchronization between NCEI and GDAC to reduce mirroring time.	AST 20	T. Boyer, T. Carval	R	
43	Investigate problem with Argo GDAC as MCDS and try to resolve it.	ADMT 20	M. Belbéoch, T. Boyer	R	
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	
45	Ask DACs and DMQC operators to look 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	ADMT 20	DACs, DMQC operators	R	
46	Get RBR CTD serial number when they changed to new onboard pressure calibration				Done: https://oem.rbr-global.com/floats/0007457

17 Annex 6 National Reports

Australian Argo National Data Management Report

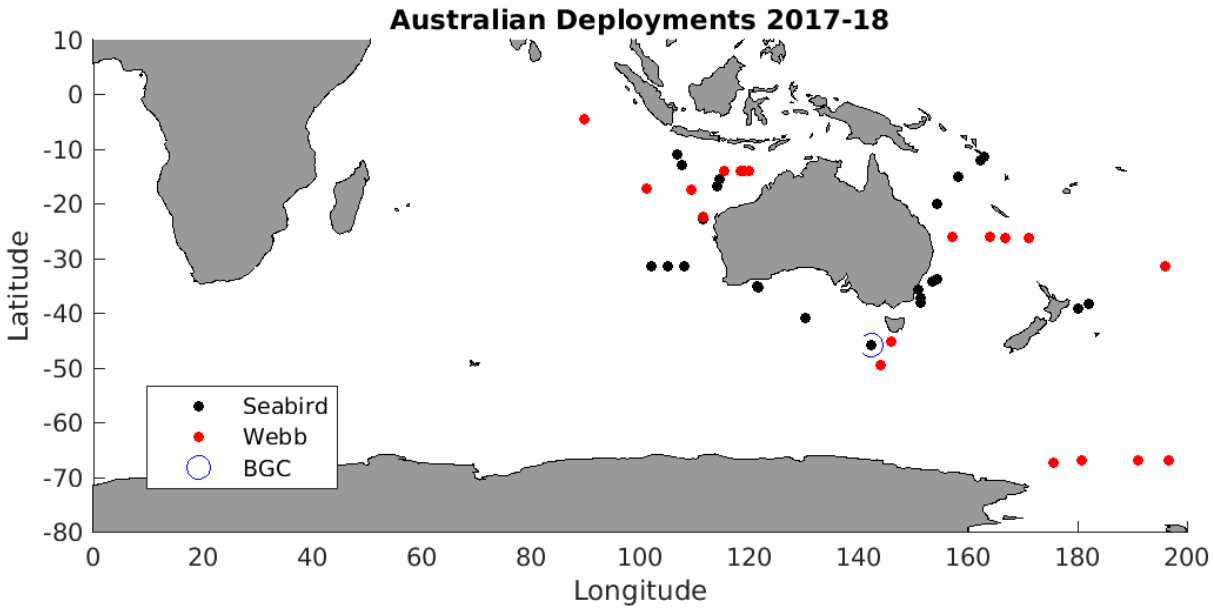
ADMT19

Scripps, San Diego, USA, 6-7 December, 2018

Rebecca Cowley, Lisa Krummel, Jenny Lovell and Catriona Johnson for the Argo Australia Team

Status of Array

Australian deployments in 2017-18



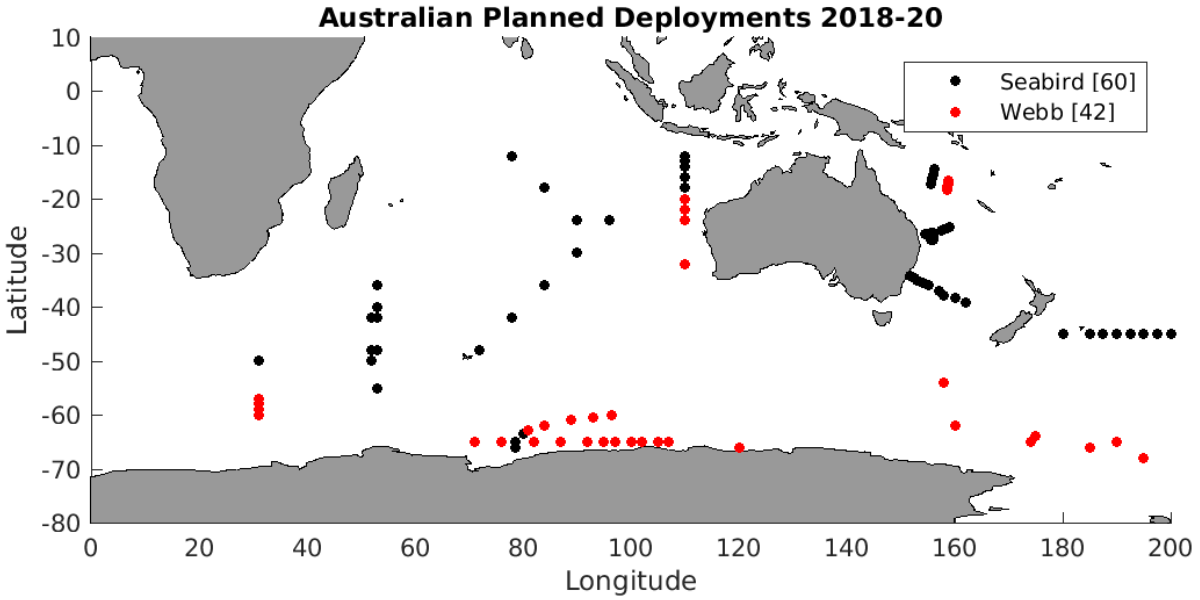
Australian Argo deployments between November 2017 and November 2018.

Australia has deployed 46 floats since the last meeting, including 3 Seabird Bio-Argo models.

We currently have 402 floats listed as 'live' though this includes some that are under ice or have been missing for over a year, from a total of 859 deployments since 1999. Contributors to the Australian Argo program include the Australian Bureau of Meteorology (BoM), Australian Defence, the Integrated Marine Observing System (IMOS) and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE-CRC).

Australian Deployment plans 2018-20:

CSIRO has extra funding through the Science and Industry Endowment Fund (SIEF) that has allowed us to purchase additional floats for the 2018-2020 years. As a result, we have planned deployments for 102 floats through to 2020 (including existing floats in the lab). Approximate deployment locations for Australian floats currently in the lab and being purchased are shown below. Our focus for the coming years is on the Southern Ocean, Coral Sea and the EAC zone. Gaps in the array in the Indian Ocean will be targeted given the number of research voyages planned for 2019/20 into that region.

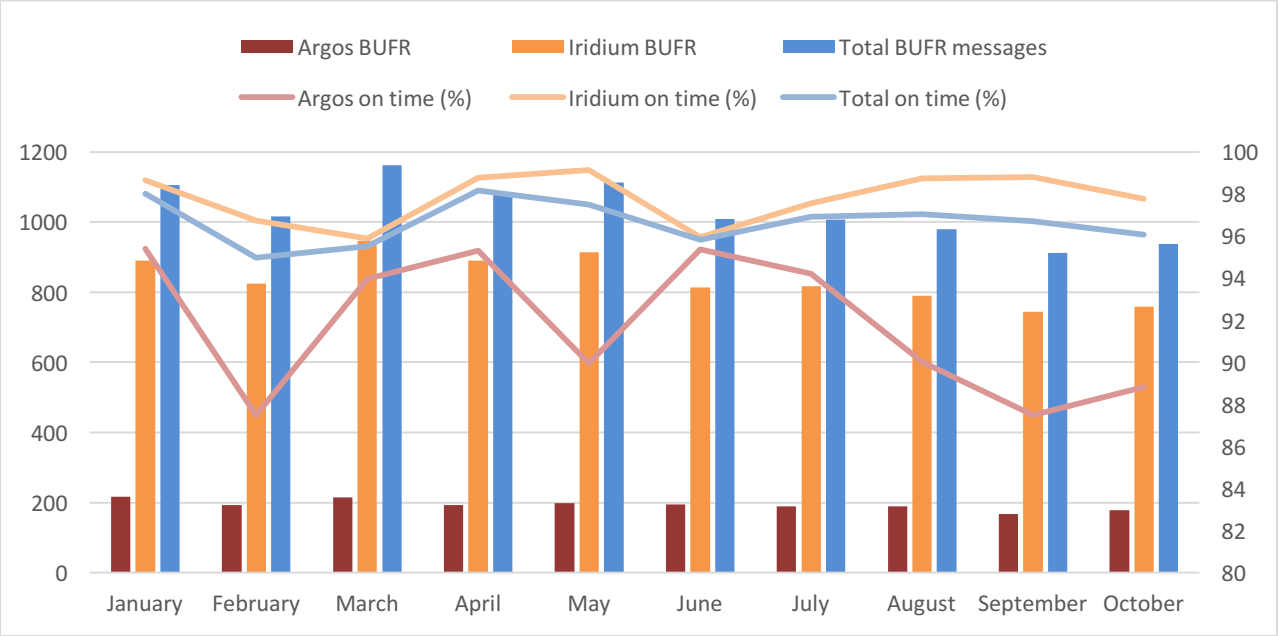


Locations identified for new float deployments. Floats will be deployed from December 2018 to January 2020.

Issues impacting data delivery in 2017-8:
Jenny Lovell has joined the CSIRO Argo RT team and is learning the system. The BoM has recently finalized the upgrade of their new virtual machine to process the RT data in paraellel with CSIRO. Some code changes have been made to fix bugs that have impacted on timely delivery of the data to the GTS. During the year, the delivery times have been consistent for Iridium floats and variable for Argos. Mostly delivery times have been >90% within 24hrs.

Software development:
CSIRO has built a new RT system and is currently bug testing and fixing missing/incorrect metadata for the float fleet. The system is built using PostgreSQL for the metadata and profile data handling, with object-oriented code in python interacting with the database. We expect full testing and commissioning prior to the next ADMT meeting. The code will be made available to the community. Four floats (NKE Arvor) are being handled through the new RT system and delivery of data from them to the GTS has just begun mid-November.

Data Acquisition and delivery to the GDACs and GTS:
Our aim is that raw data is processed within a maximum of 24 hours of delivery from either Argos or Iridium. We are achieving this for most of our floats. The data is issued to the GTS in BUFR bulletins only since July, 2018, via the Bureau of Meteorology (AMMC). These messages are generated 8 times daily.



Summary of the timeliness of the Argo Australia GTS delivery for 2018.

Web Pages:
The Australian Argo Real Time web pages are updated with the most recent data during the processing of the reports from the floats. They are therefore up to date as soon as float data is received.

Home page for Argo Australia (IMOS)
http://imos.aodn.org.au/webportal/
http://imos.org.au/argo.html

Information on individual floats can be found at:
http://www.marine.csiro.au/~gronell/ArgoRT/ ;

Statistics of Argo data usage:
Argo data for the global dataset is downloaded from the GDACs to a local mirror daily using the rsync capability.

Argo usage is a difficult list to compile, as Argo data are now being used routinely by many researchers nationally and globally. In addition to the information below, there are numerous publications from Australian researchers which have used Argo data and have appeared in the last year.

Argo data uploaded to the GTS is accessed and exploited by many operational forecast centres, including:

- Australian Bureau of Meteorology (BoM);
- UK MetOffice;

- Mercator Ocean (French operational ocean organisation);
- Naval Research Laboratory and NAVOCEANO (US Defence);
- Japan Meteorological Agency (JMA);
- Nansen Environmental and Remote Sensing Center (NERSC; Norway's operational ocean forecasting organisation);
- and others.

Most operational ocean forecast centres – a sub-set of which is listed above – use Argo data, together with other publically 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 – BoM's operational Ocean Modelling, Analysis and prediction System (www.bom.gov.au/oceanography/forecasts/index.shtml) – producing daily, 7-day, publically-available, global ocean forecasts;
- POAMA – BoM's operational Predictive Ocean Atmosphere Model for Australia (www.bom.gov.au/oceanography/analysis.shtml) – producing weekly, 9-month, publically-available 14-member ensemble forecasts of the climate;
- eReefs – CSIRO's 4-km resolution forecast/hindcast model for the Great Barrier Reef – producing daily, 4-day forecasts for project partners;
- SAROMS – South Australian Research and Development Institute (SARDI) 1-4 km resolution forecast/hindcast model for waters off Southern Australia – producing regular forecasts and scenarios for project partners;
- ROAM – Royal Australian Navy (RAN) Relocatable Ocean Atmosphere Model – producing multiple (typically 5-10, depending on need) regional, high-resolution (2-5 km) forecasts in regions of interest;
- BRAN – CSIRO's Bluelink ReANalysis system – producing annually-updated 5-25 year, global ocean reanalyses, using Argo R- and D-files;
- BRAN-NRT – CSIRO's Near-Real-Time version of BRAN – producing monthly updates of BRAN, using Argo R- and D-files;
- CARS – CSIRO Atlas of Regional Seas (www.marine.csiro.au/~dunn/cars2009/) – a publically-available, global ocean climatology (an updated version of CARS is in production).

Argo data also underpins other activities in real-time monitoring of the ocean, including:

- CARS, and other climatologies, are heavily used for quality-control systems, including Argo and SOOP XBT;
- OceanCurrent (oceancurrent.imos.org.au/profiles/) – primarily delivering ocean products based on satellite observations (SST and altimetry), but also displaying Argo profiles through an interactive web portal;

We report usage to our funders IMOS – the Argo report can be found at:
imos.org.au/imospublications.html

Delayed Mode QC (DMQC) Report:

We have made good progress towards our DMQC targets this year (Table 1). Currently, the DMQC percentage stands at 90% of eligible core Argo profiles. Core Argo is defined here as floats

with the standard P, T and S sensors including floats in the seasonal ice zone. Our software is now at a stable stage of development also allows us to DMQC the floats with dissolved oxygen sensors using a calibration approach based on Takeshita *et al.* (2013). We are currently revisting all our Oxygen floats to ensure they have all been processed with the latest version of the DMQC software and RT processing.

Australian Delayed Mode Statistics (to 20 Nov 2018)

	Core Argo	**BGC Argo (Oxygen) ****
D files at GDAC	151966	18242
R files at GDAC	22758	2818
eligible R files	16188	1954
Total eligible files *	168154	20196
Total files at GDAC	174724	20820
DMQC % eligible	90	90

* eligible files have a 12 mth lag
** All Oxygen floats are being re-DMQCed to ensure consistency with the latest version of our processing.

We aim to assess each float once per year and profiles are considered eligible when they are 12 months old to ensure there is an adequate time series to assess for sensor drift or offset. If a float is dead, then we process the entire record as long as profiles are more than 6 months old.

A challenge for our program is the significant increase in data volumes not only of the standard P, T and S floats but those with Bio or BGC sensors. Both our RT and DM software only allow for QC of Oxygen and not other BGC parameters and we are currently assessing a way to progess this.

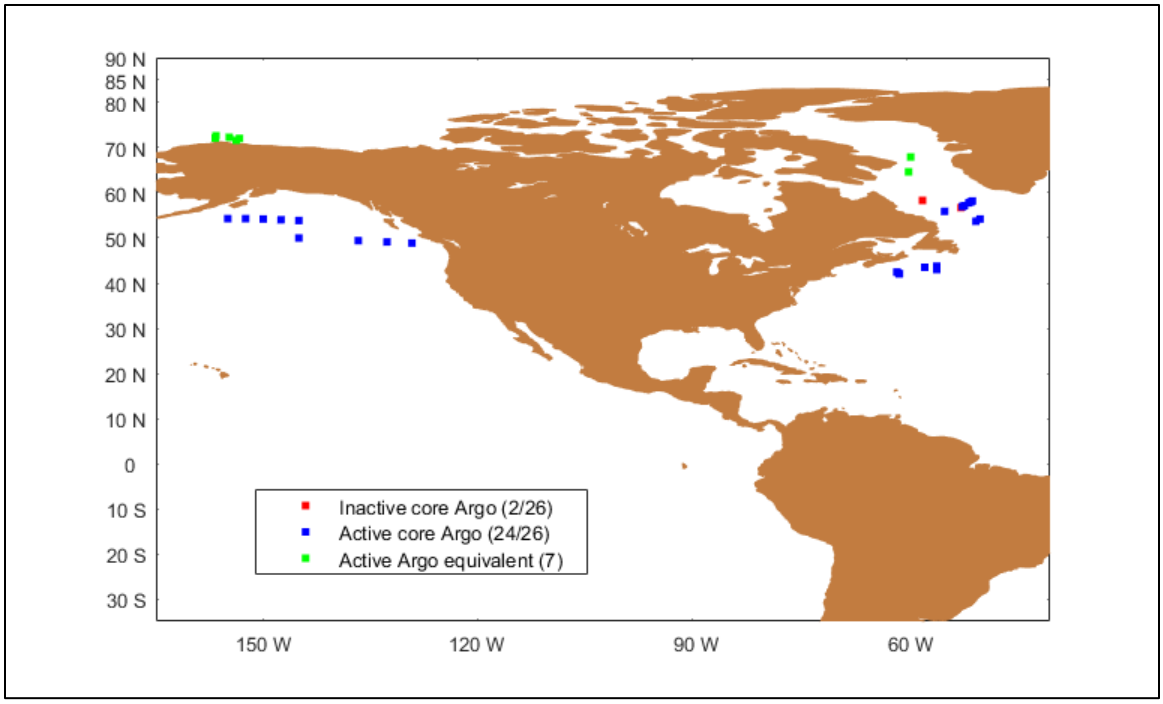
Argo Canada National Data Management Report

ADMT19

San Diego, USA, Dec 2- 7, 2018

1. Status

Canadian deployments from December 2017 to October 2018



Data acquired from floats: We are currently tracking 103 floats of which 7 might have failed to report within the last 2 months. Since December 2017, we deployed a total of 27 core Argo and 7 Argo equivalent floats. Twenty of the new core Argo floats were NOVA floats acquired from MetOcean, and seven were ARVOR-I floats acquired from NKE. All reported on the Iridium satellite system. It was the first time that Argo Canada deployed and managed ARVOR-I profiling floats. The seven Argo equivalent floats, which were NOVA floats, report daily and have maximum profile pressures of 200 to 1500 dBar.

Data issued to GTS: All data are issued to the GTS in TESAC and BUFR formats. As of July 2018, MEDS stopped sending TESAC on the GTS. Since December 2017, on average, 94.1% of data were issued on the GTS within 24 hours in BUFR formats.

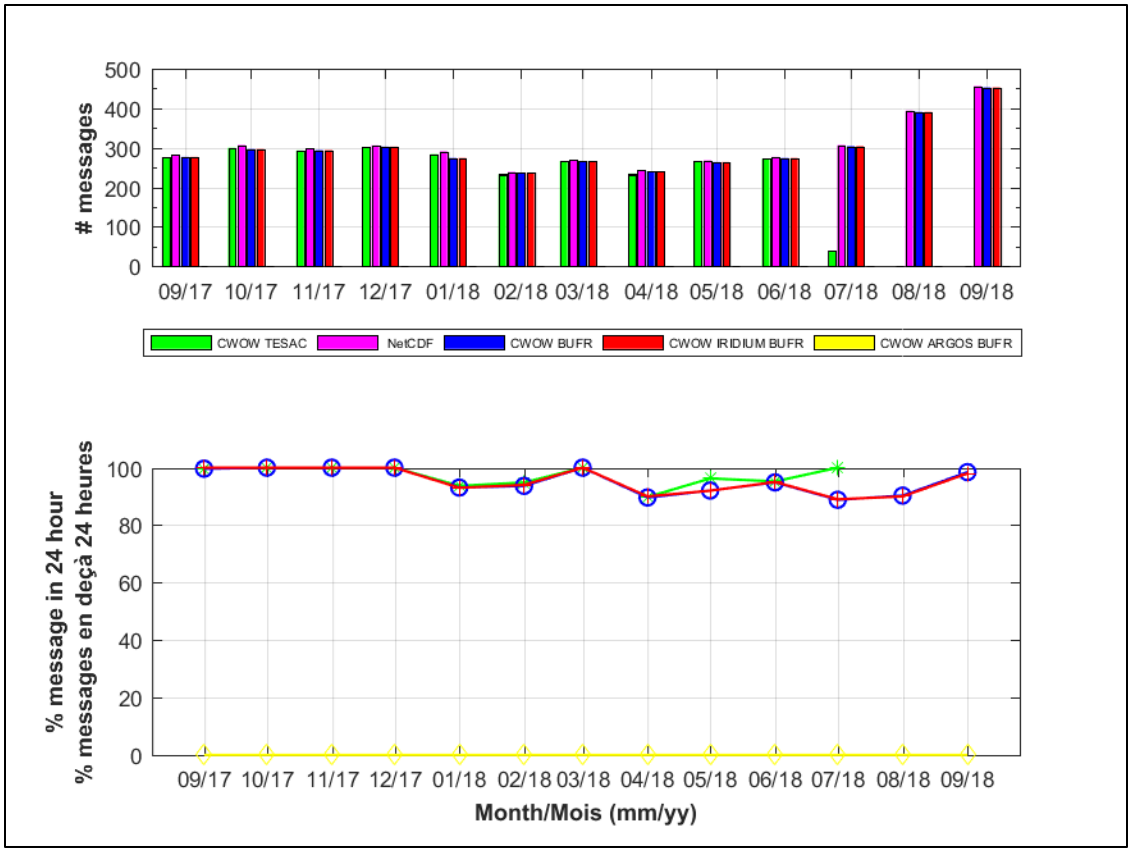


Figure 1: Performance of TESAC and BUFR transmission on the GTS under bulletin CWOW between December 2017 and September 2018

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 mode data sent to GDACs: The DMQC eligible files from 59 floats (~7500 cycles) were quality-controlled or re-quality controlled for salinity or pressure since December 1, 2017.

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.

We also show some information about the global programme including the position of floats over the previous months, the success rate of meeting the 24 hours target for getting data to the GTS at various GTS insertion points, the number of messages transmitted, reports of floats which distributed more than one TESAC within 18 hours and Canadian float performance statistics.
Another website section describes the Line-P products and other uses of Argo to monitor the N.E. Pacific:
http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/canadian-products/index-eng.html
Statistics of Argo data usage: Argo data have been used to generate monthly maps and anomaly maps of temperature and salinity along line P in the Gulf of Alaska. Line P has been sampled for 50 years and has a reliable monthly climatology. For more information on the Line-P products and other uses of Argo to monitor the N.E. Pacific go to:
http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/argo/canadian-products/index-eng.html

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

2. Delayed Mode QC

As of October 23, 2018, 51% 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 73% of eligible cycles. 33% of eligible B-files had been visually QC'd, and 15% 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). For floats that have been DMQC'd at least once and continued transmitting after the most recent DMQC, 14% of new profiles were less than one year old, and 28% of profiles were less than two years old.

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 and TESAC formats.

4. Region Centre Functions

Canada has no regional centre function.

Chinese Argo National Data Management Report
ADMT-19
San Diego, USA, 6-7 December 2018

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 2017- Oct 2018) China acquired 5,433 TS profiles (additionally 140 O2, 233 CHLA, 233 BBP, 156 CDOM, 231 DOWN_IRRADIANCE and 77 NITRATE profiles) from 132 operational floats (Fig.1). The total number of various float models is seen from Table 1. The data service for Chinese iridium floats was moved from CLS America to CLS France this year.

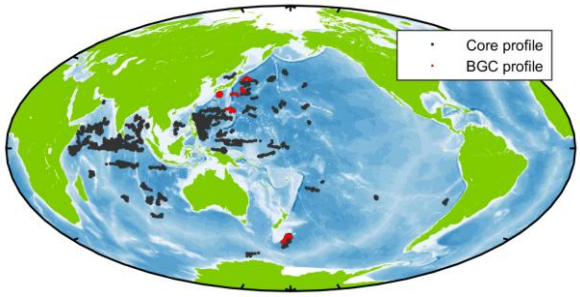


Fig.1 The geographic distributions of Core (black) and BGC (red) profiles

Table 1. The total number of various float models during Dec 2017-Oct 2018

Float model	Number
APEX	43
PROVOR	71
HM2000	13
ARVOR_D	3
NAVIS	2

- Data issued to GTS

  Every day CSIO sends BUFR bulletins to GTS through Beijing node (038) at China Meteorological Administration (CMA). With the perl script developed by JMA, CSIO is able to convert TS & O2 profiles into BUFR.

- 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. This November, CSIO updated the historical old version of monoprofile files to version 3.1. To minimize the back-log of profile submission, the daily frequency of downloading RUDICS messages from the CLS's remote host has been increased to 8 times. Some new decoders were developed and used for decoding message reported by PROVOR-III with DO sensor and PROVOR-IV with DO, ECO3, OCR and SUNA sensors. The RT-QC procedures for DOXY, CHLA and BBP are being applied.

- Data issued for delayed QC
  The situation of the severe backlog for DMQC is still not improved due to the lack of operational funding for DAC to support this work. CSIO is applying an operational funding from the Ministry of Science and Technology.
- Delayed data sent to GDACs
  No D-files were submitted to GDACs this year from CSIO.
- Web pages
  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.
  NMDIS maintains the China Argo Data Centre (Tianjin) website (http://www.argo-cadc.org.cn).Since NMDIS will unify the website style, a new Argo website will be developed and released in the coming year.

- Statistics of Argo data usage (operational models, scientific applications, number of National Pis…)
  Operational uses: NMEFC and NMDIS from SOA, 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 a yearly updated gridded Argo product developed by CSIO (ftp://data.argo.org.cn/pub/ARGO/BOA_Argo/). The product is based on the post-QCed Argo dataset maintained by CSIO.

Post-QCed global ocean Argo dataset: It is a nominally yearly updated Argo dataset after a careful screening (ftp://ftp.argo.org.cn/pub/ARGO/global/). The observational parameter includes PRES, TEMP, PSAL, DOXY, CHLA and NITRATE.

China Argo Data Center has developed distribution maps of global surface currents and mid-depth currents (from Jan. 2000~ Sep.2018) by global Argo trajectory data. At present, the surface current distribution maps are released. The distribution maps and corresponding data of the surface currents and mid-depth currents will be released monthly.

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.)

Now OW tool is used to conduct DMQC for Argo salinity observations. Prior to this, a surface pressure adjustment and thermal mass correction will be conducted. The main difficulty encountered is the lack of stable funding and fixed DMQC operators.

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 2018

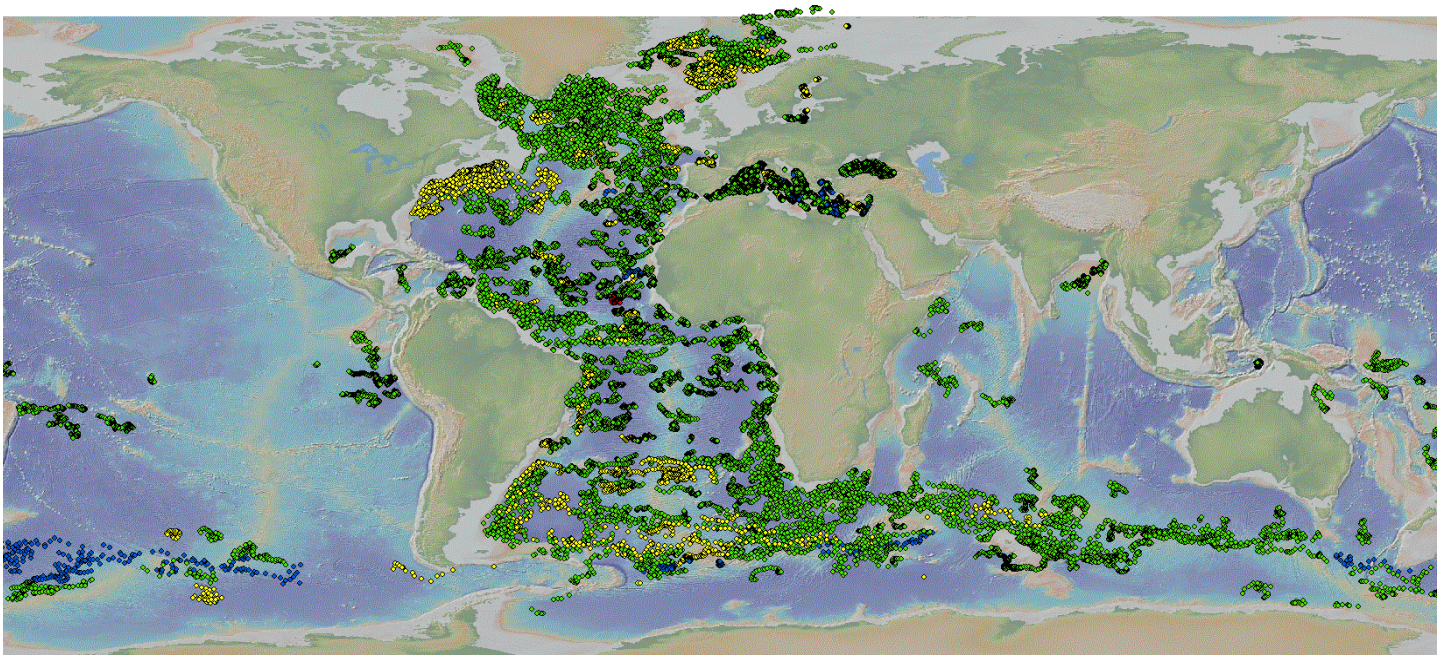
Coriolis DAC & GDAC

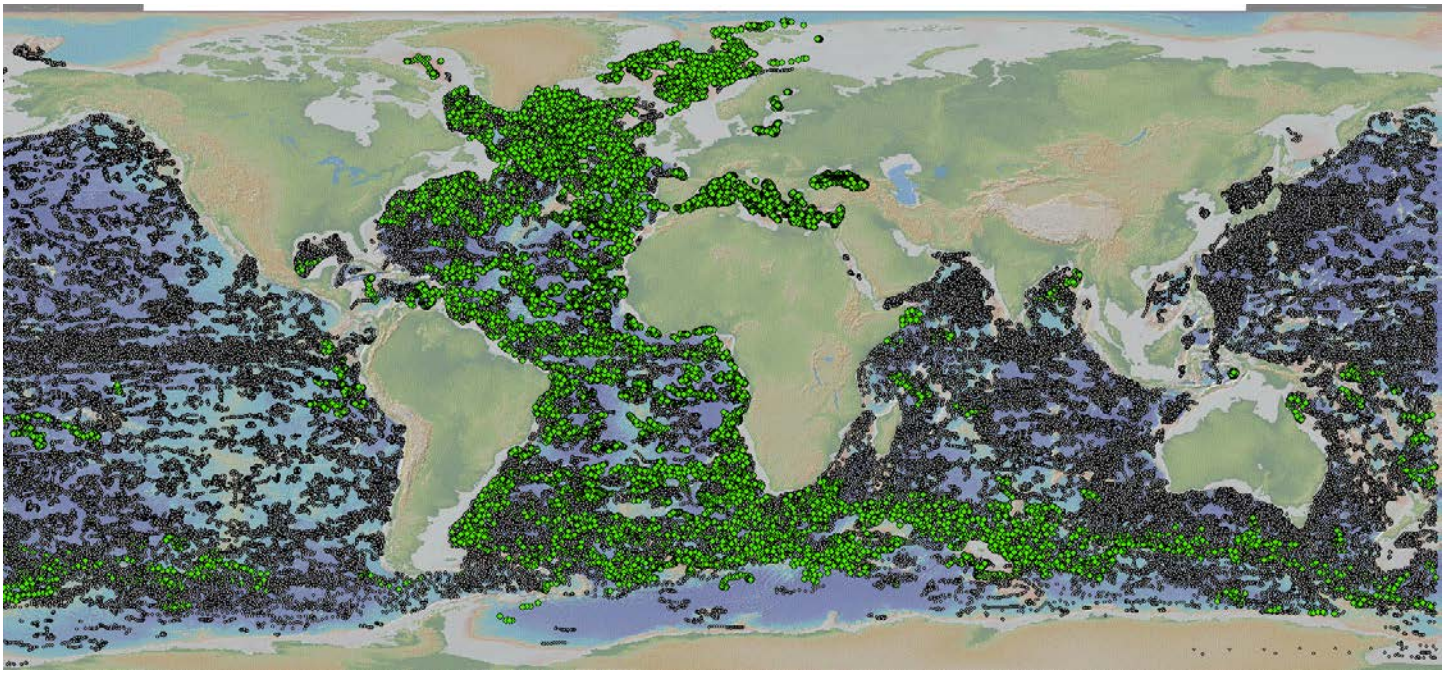
Data Assembly Centre and Global Data Assembly Centre

Annual report November 2018

Version 1.1, November 22nd, 2018

https://doi.org/10.13155/58109





1 DAC status

This report covers the activity of Coriolis data centre for a one-year period from November 1st 2017 to October 30th 2018.

1.1 Data acquired from floats

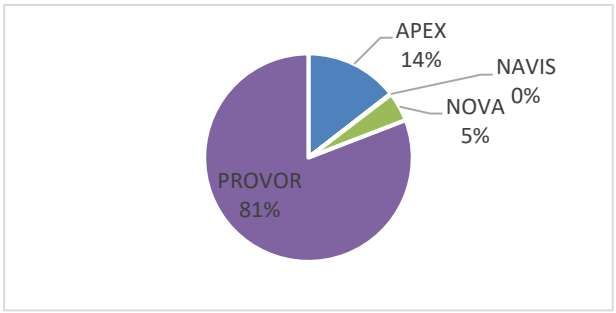
1.1.1 Active floats for the last 12 months

These last 12 months, **30 434 profiles from 794 active floats** were collected, controlled and distributed.

Compared to 2017, **the number of profiles is stable (+0.2%), the number of floats increased by 1%.**
These figures show a fair stability in Coriolis DAC activity.

The 794 floats managed during that period had 57 versions of data formats.

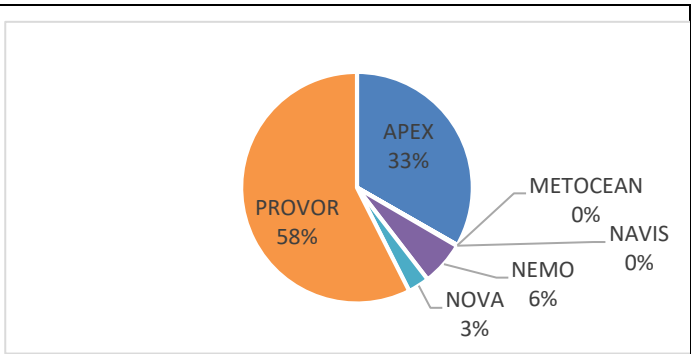
Coriolis DAC, active floats in 2018			
Float family	nb versions	nb floats	nb core profile files
APEX	23	115	3 630
NAVIS	1	1	35
NOVA	3	36	996
PROVOR	30	642	25 773
Total	**57**	**794**	**30 434**

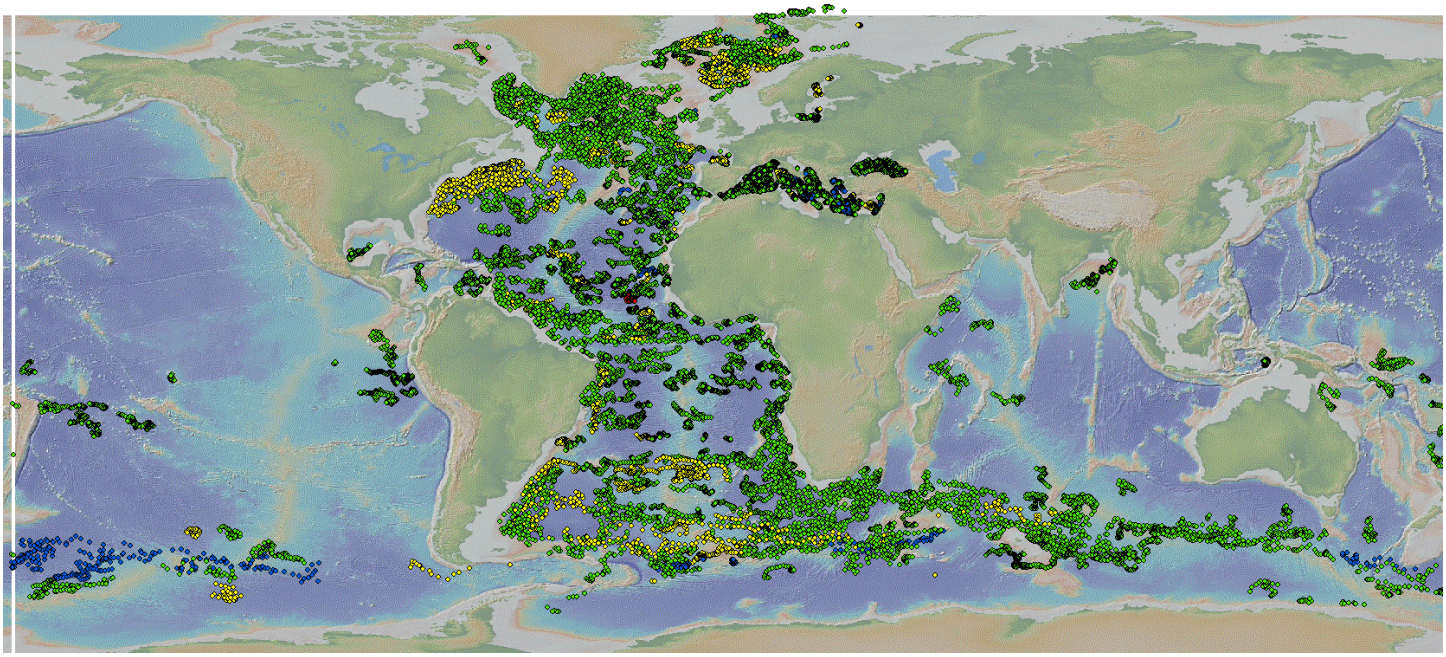


1.1.2 All floats managed by Coriolis DAC

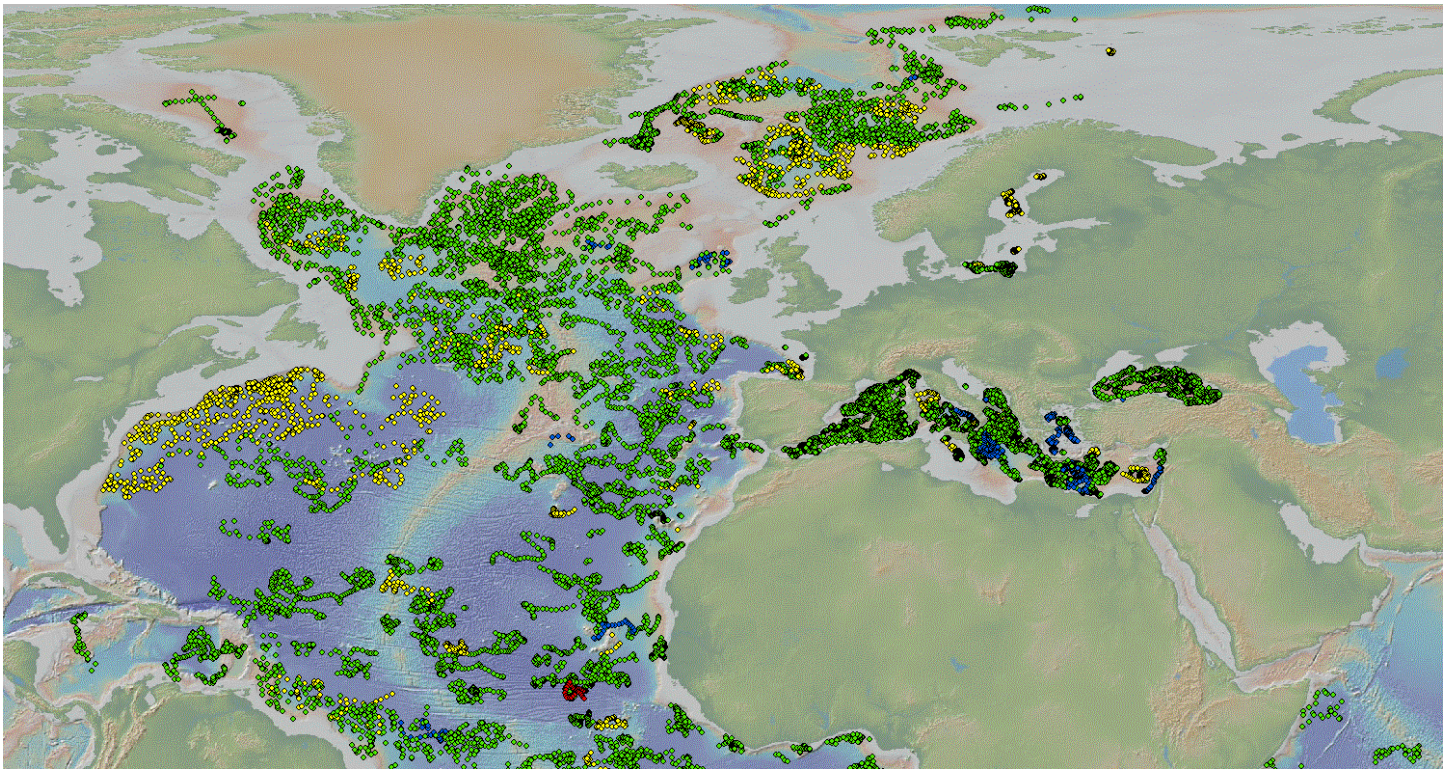
Coriolis DAC manages a total of 2 637 floats with 140 versions, from 6 families.
These floats reported 295 351 core Argo vertical profiles.

Coriolis DAC, all floats			
Float family	nb versions	nb floats	nb core profile files
APEX	67	877	101 062
METOCEAN	1	1	52
NAVIS	1	3	644
NEMO	8	162	8 902
NOVA	3	79	5 583
PROVOR	60	1 515	179 108
Total	**140**	**2 637**	**295 351**

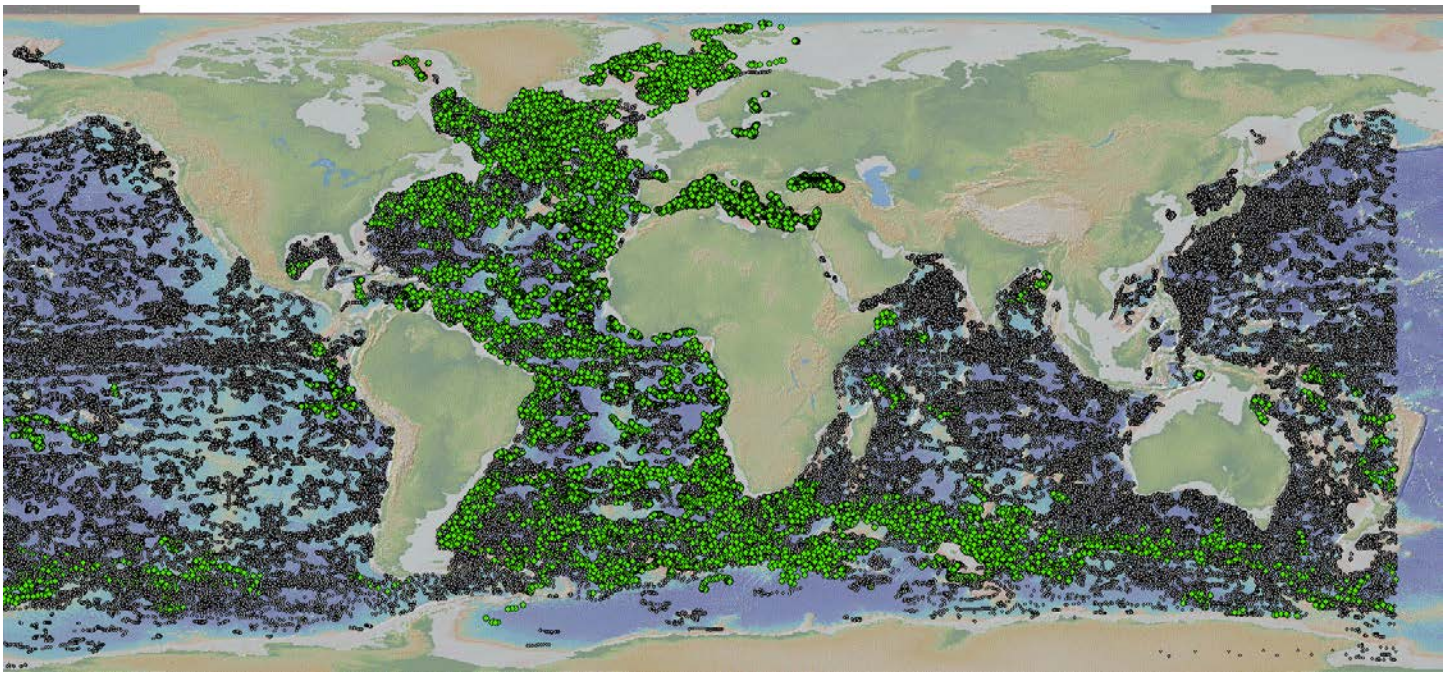




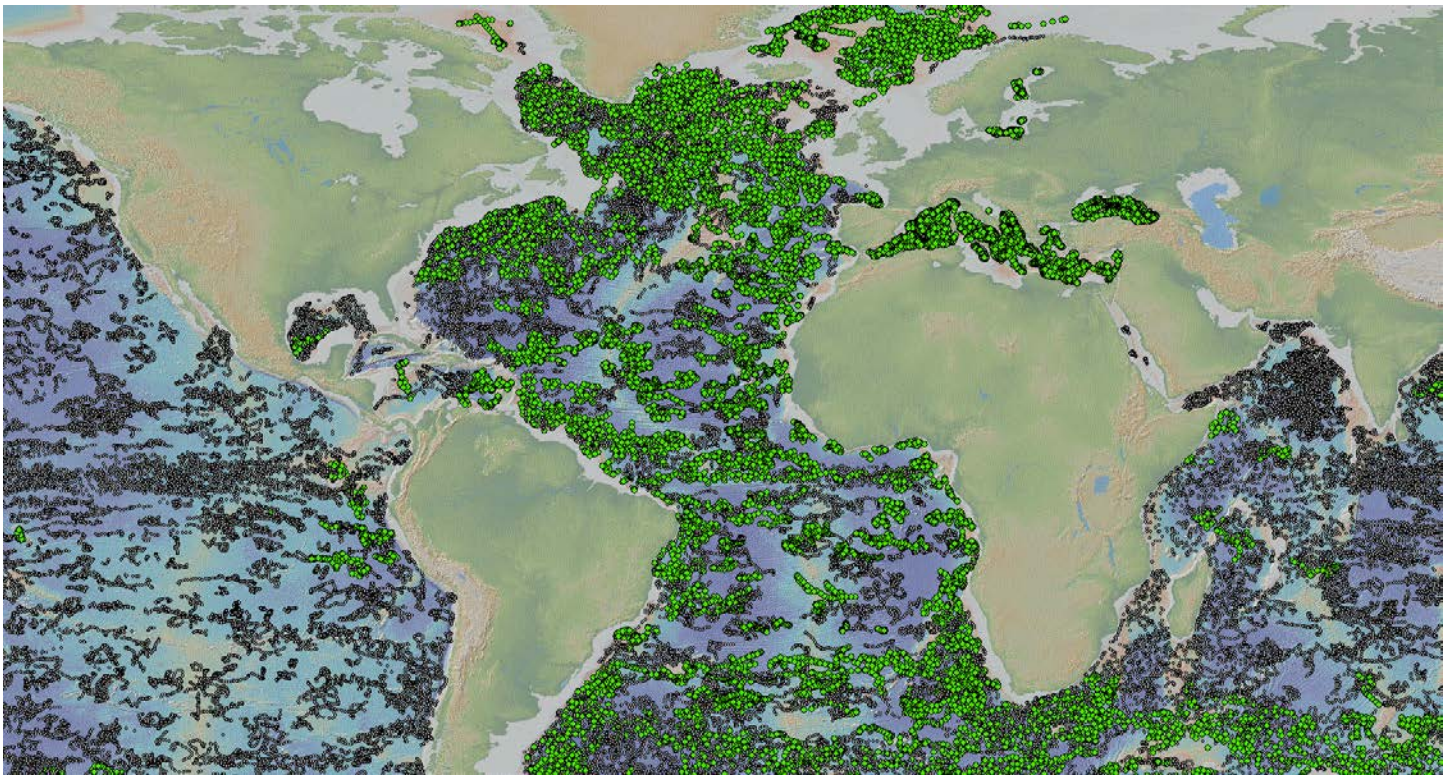
Map of the 30.434 profiles from 794 active floats decoded by Coriolis DAC this current year
Apex Navis Nova Provor



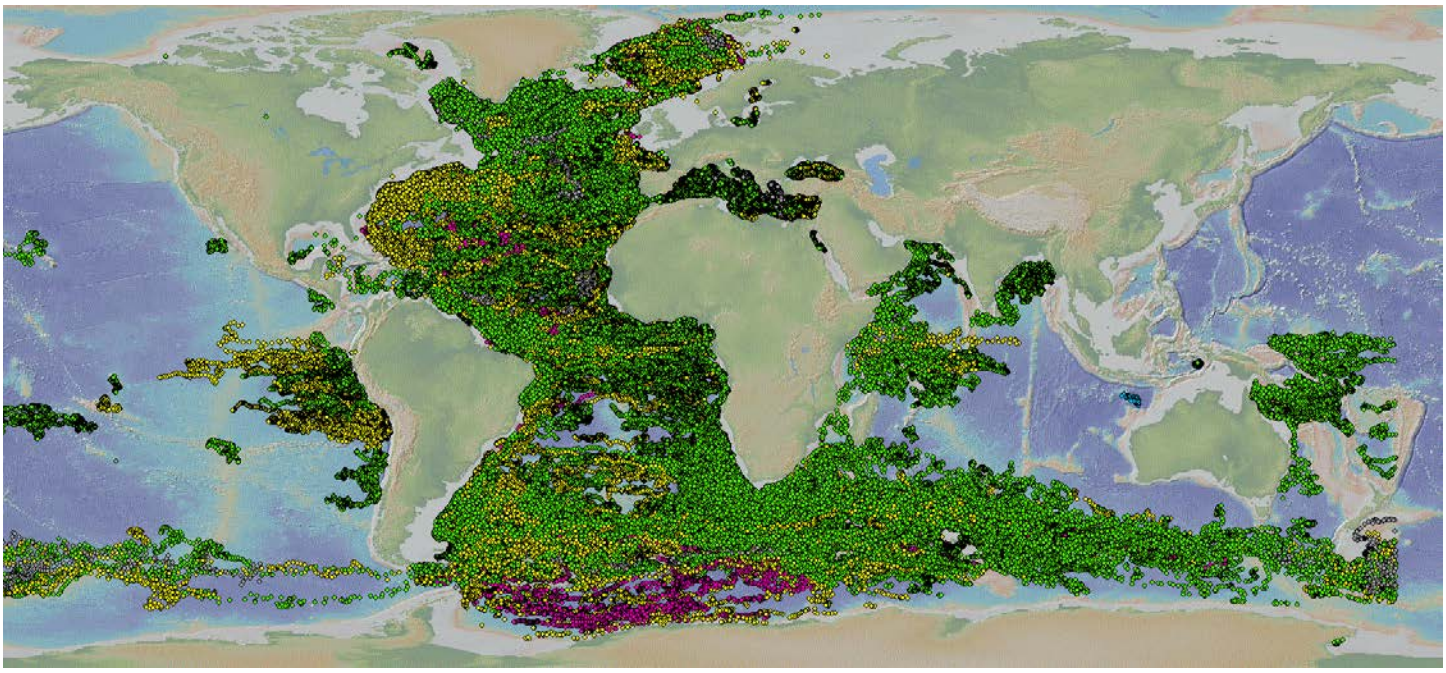
Map of active floats managed by Coriolis this current year, zoom on north Atlantic area



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 409 BGC-Argo floats from 5 families and 57 instrument versions. They performed 53.509 cycles.

The data processing chain is freely available:

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

BBP data reprocessing

In 2018, the BBP manual was updated: “BGC-Argo processing particle backscattering at the DAC level” http://dx.doi.org/10.13155/39459

To implement the updates, all BBP profiles were reprocessed during summer 2018. More than 28 000 files containing BBP data were resubmitted on the GDAC ftp server.

Chlorophyll data reprocessing

In 2018, the Quality control Chlorophyll-A manual was updated: “BGC-Argo quality control manual for Chlorophyll-A concentration” http://dx.doi.org/10.13155/35385

To implement the updates, all chlorophyll profiles were reprocessed during summer 2018. More than 28000 files containing chlorophyll data were resubmitted on the GDAC ftp server.

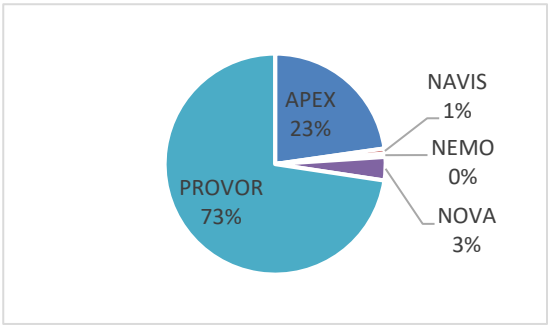
Oxygen data reprocessing

In 2018, 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 summer 2018. More than 42000 files containing chlorophyll data were resubmitted on the GDAC ftp server.

Three PROVOR CTS5 floats deployed in 2017 in the framework of the greenedge project (http://www.greenedgeproject.info/) equipped with BGC sensors reappeared in july 2018 and transferred their data to the Coriolis DAC. They sent the first chlorophyll-A profiles acquired under ice for this type of floats (one per month under ice). All the data are available on the Coriolis DAC.

Bio-Argo floats processed by Coriolis DAC				
Familly	nb versions	nb floats	nb profiles	nb cycles
APEX	23	93	12 391	12 110
NAVIS	1	3	551	551
NEMO	1	2	297	297
NOVA	1	14	942	918
PROVOR	31	297	119 499	39 633
Total	**57**	**409**	**133 680**	**53 509**



General characteristics

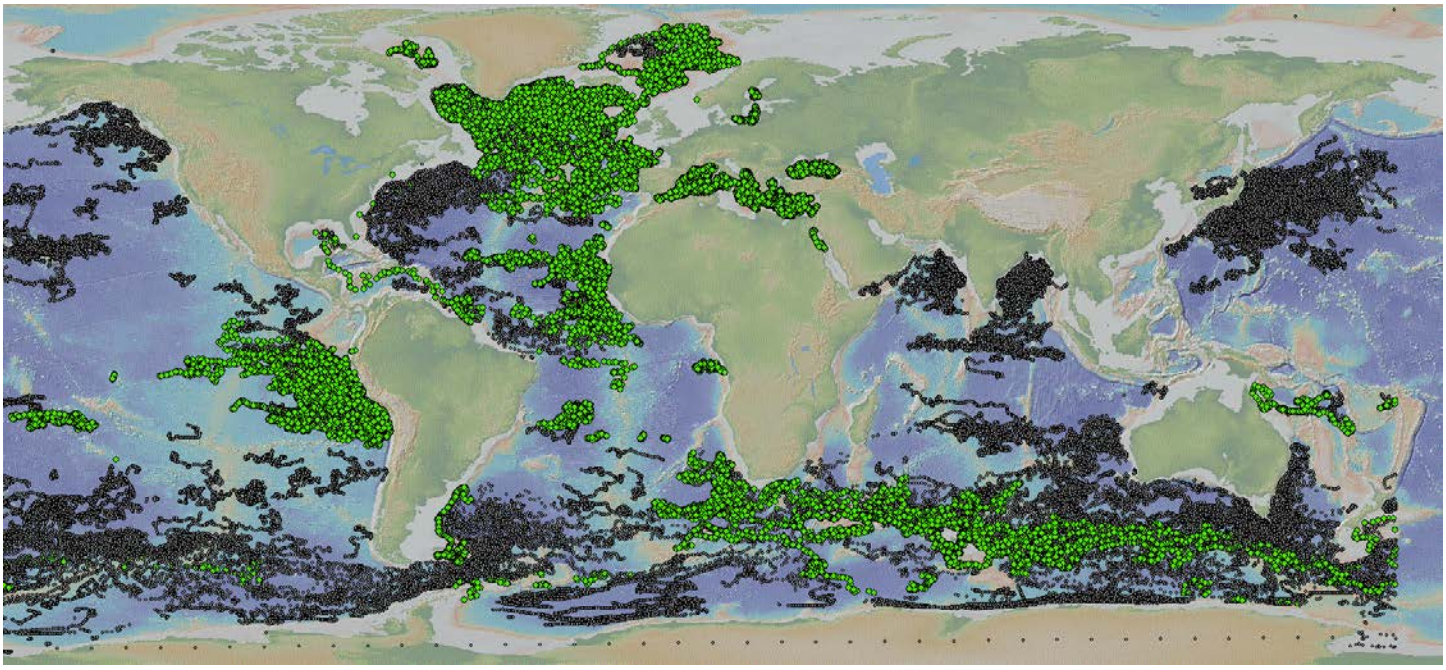
- Iridium sbd or rudics bi-directional communication or Argos
- Fourteen sensors are fitted on the floats
- Eleven BGC parameters reported

Coriolis BGC-Argo floats sensor	nb floats	nb profiles
AANDERAA_OPTODE_4330	265	34194
SATLANTIC_OCR504_ICSW	144	101752
ECO_FLBBCD	141	75852
DRUCK_2900PSIA	102	12349
SUNA_V2	59	8456
AANDERAA_OPTODE_3830	45	6081
SBE63_OPTODE	19	1775
C_ROVER	15	4356
SBE43F_IDO	10	1273
ECO_FLBB_AP2	8	1078
ECO_FLBB2	4	2016
ECO_FLNTU	4	1808
SEAFET	4	164
FLBB	2	616

The 14 types of sensors mounted on Coriolis BGC-Argo floats

parameter	nb profiles
DOXY	42606
CHLA	28278
BBP700	27374
DOWN_IRRADIANCE380	24446
CDOM	24029
NITRATE	7973
CP660	4330
TURBIDITY	904
BBP532	672
BISULFIDE	255
PH_IN_SITU_FREE	162

The 11 BGC parameters reported by Coriolis BGC-Argo floats



Map of the 409 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.

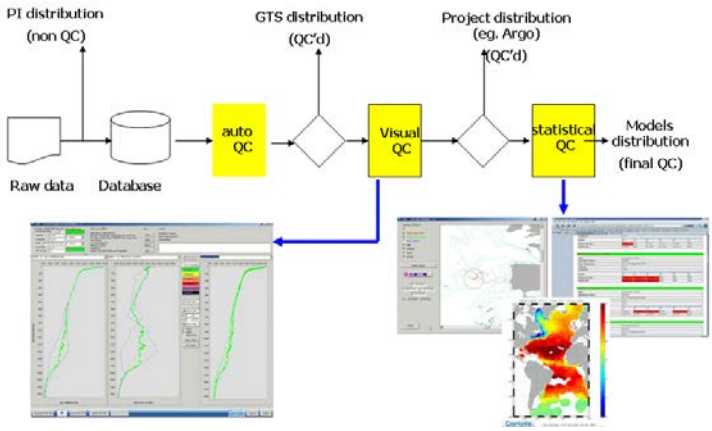
© Antoine Poteau, Observatoire Océanologique de Villefranche (CNRS/UPMC)
Deployments of a bio-argo Provor in Ligurian sea

1.2 Data issued to GTS

All profiles processed by Coriolis are distributed on the GTS by way of Meteo-France. This operation is automatically performed. After applying the automatic Argo QC procedure, the Argo profiles are inserted on the GTS every 2 hours. Argo profiles are inserted on the GTS 365 days per year, 24 hours a day.

The profile files are sent as TESAC and BUFR messages by way of Meteo-France. Meteo-France accepts Coriolis as valid BUFR messages and circulate them on neighbouring nodes.

Once a day, floats data that are less than 21 days old are checked in an objective analysis (ISAS) that triggers alert and visual inspection for suspicious observations.

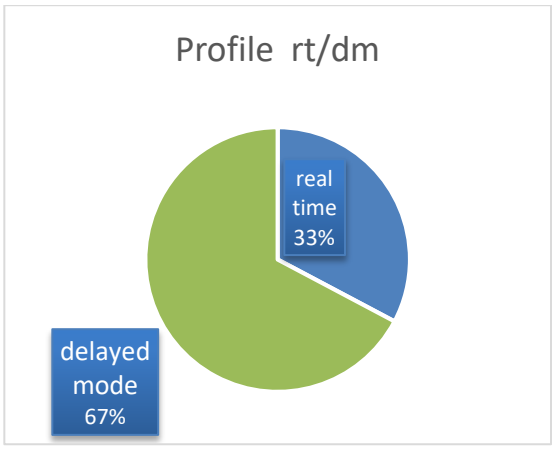


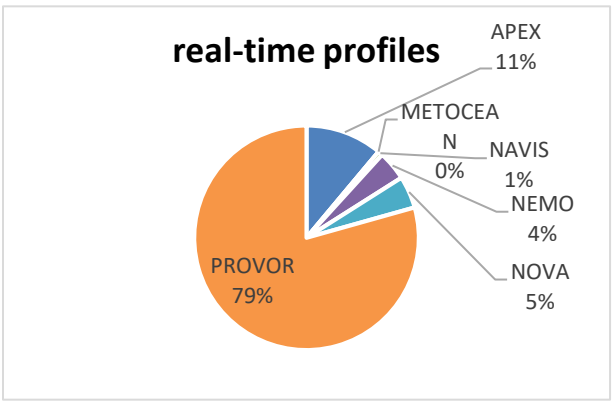
CORIOLIS DAC: Argo data flow

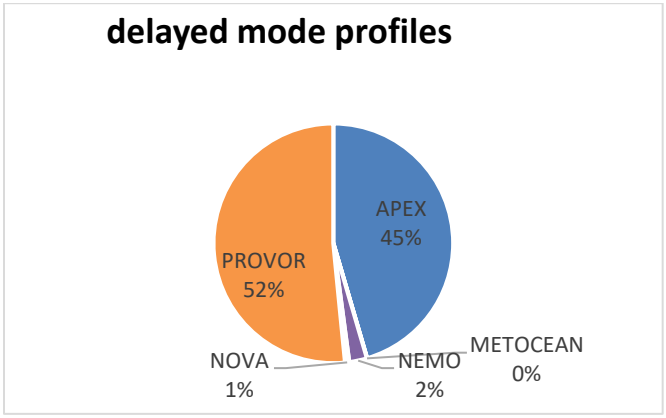
1.3 Data issued to GDACs after real-time QC

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

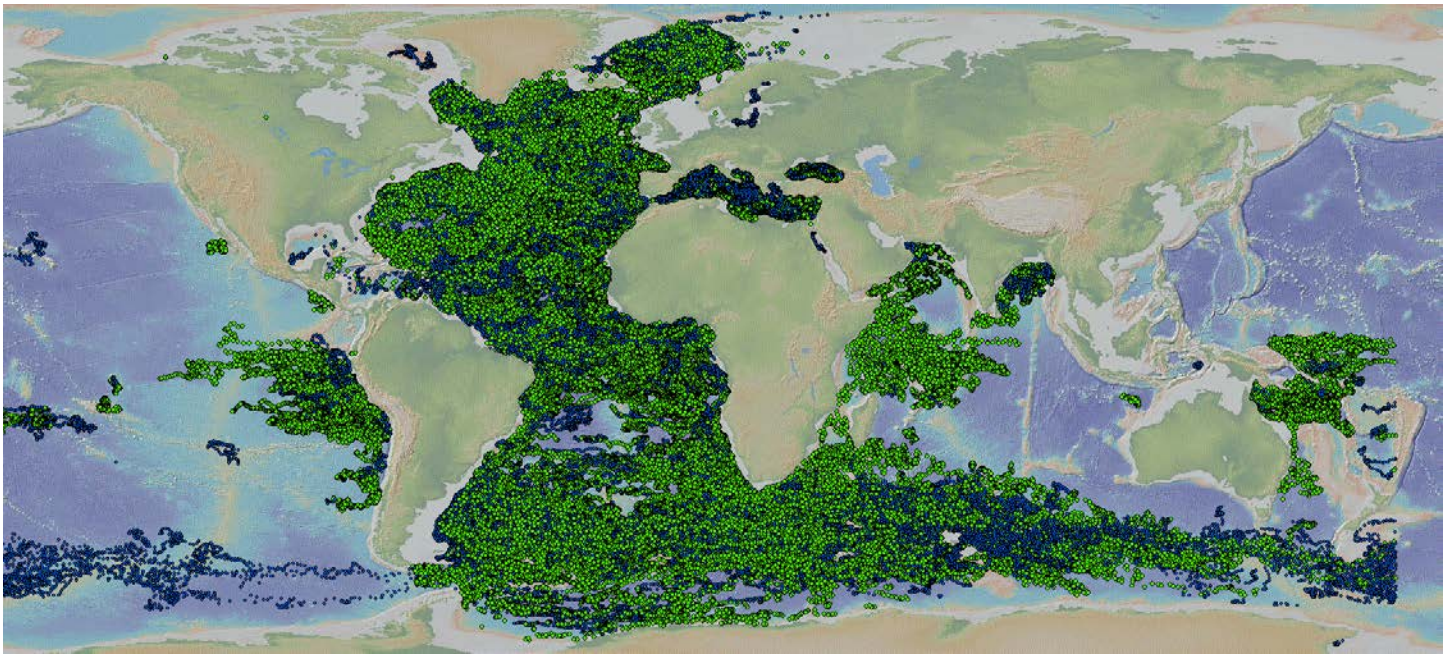
All Coriolis floats, number of profile files on GDAC				
Family	nb floats	nb profiles	RT profiles	DM profiles
APEX	877	101 078	10 735	90 343
METOCEAN	1	52	-	52
NAVIS	3	644	644	
NEMO	162	8 902	4 128	4 774
NOVA	79	5 592	4 477	1 115
PROVOR	1 515	179 303	76 818	102 485
Total	**2 637**	**295 571**	**96 802**	**198 769**







Distribution of Coriolis DAC real-time and delayed mode profiles (96 802 profiles – 198 769 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.

Preparation of Argo delayed mode trajectories

The delayed mode trajectories derived from Andro trajectory product are available from:

- ftp://ftp.ifremer.fr/ifremer/argo/etc/coriolis-custom/argo-andro-data/data/dac/coriolis/

The Andro trajectory TRAJ3 files are available for most of the DACs. Each DAC may decide to use these files to provide delayed mode trajectory on GDAC.

Coriolis DAC will use these files as its delayed mode trajectories for old floats versions.

1.5 Delayed mode data sent to GDACs

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

- A total of **60.598 new or updated delayed mode profiles** was sent to GDACs this year.
- **A total of 198.769 delayed mode profiles** where sent to GDACs since 2005.
  The number of delayed mode profiles increased by 11% this year.

1.6 Web pages

The web site of the French DAC is available at:

- http://www.coriolis.eu.org/Observing-the-Ocean/ARGO

This web page describes all Argo floats:

- http://www.ifremer.fr/co-argoFloats/
    - Individual float description and status (meta-data, geographic map, graphics : section, overlaid, waterfall, t/s charts)
    - Individual float data (profiles, trajectories)
    - FTP access
    - Data selection tool
    - Global geographic maps, GoogleEarth maps
    - Weekly North Atlantic analyses (combines Argo data and other measurements from xbt, ctd, moorings, buoys)

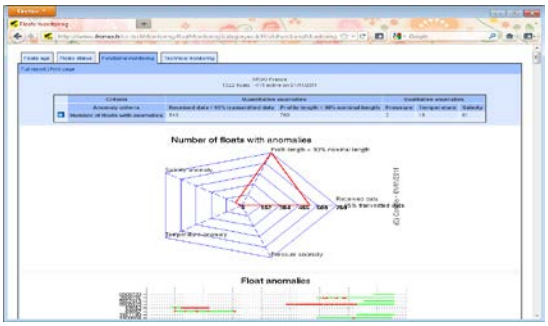
This web page describes all Argo floats interoperability services from Coriolis:

- http://www.coriolis.eu.org/Data-Products/Data-Delivery/Argo-floats-interoperability-services2
    - Display an individual float's data and metadata in HTML or XML format
    - Display all Argo floats, display a group of floats

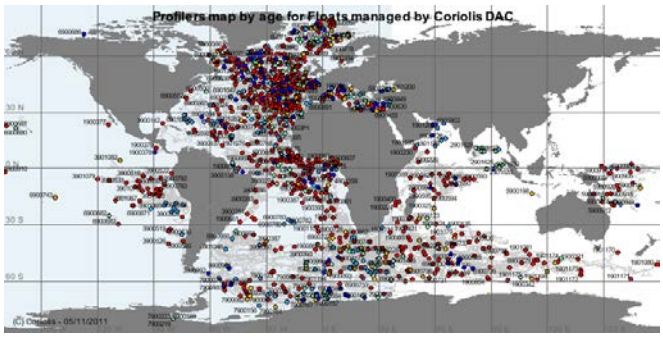
- Argo profiles and trajectories data selection (HTML or XML)
- All individual float's metadata, profile data, trajectory data and technical data
- Argo profiles data on OpenDAP, OGC-WCS and http
- Argo data through RDDAP data server (www.ifremer.fr/erddap)
- Argo data through Oceanotron data server
- Argo profiles data through GCMD-DIF protocol
- Argo data through RDF and OpenSearch protocols
- Display Argo profiles and trajectories with GoogleEarth

Some pages of Coriolis web site are dedicated to technical monitoring:

- http://www.coriolis.eu.org/Data-Products/At-sea-monitoring



Example 1: technical monitoring of Argo-France floats

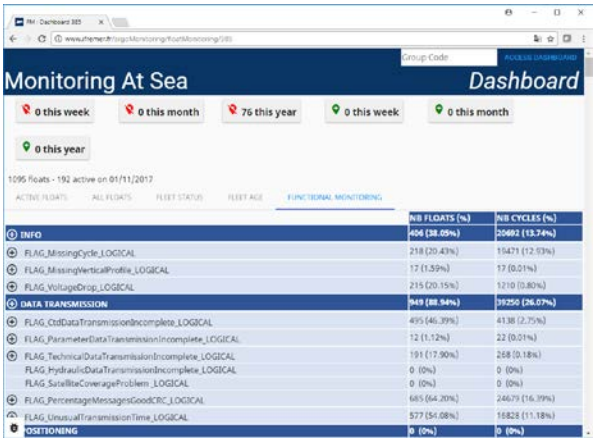


Example 2: age map of floats managed by Coriolis DAC.

Within Euro-Argo ERIC (European Research Infrastructure Consortium), a dashboard with pre-defined alerts on anomalies is operational: http://www.ifremer.fr/argoMonitoring/floatMonitoring/632

For better interactivity, in 2019, the backoffice of the dashboard will be transferred in big data solution : all Argo metadata indexed in Elasticsearch, all data pushed in Cassandra noSQL database.

The front office will adopt and customize the OceanWorks interface developed with NASA-JPL.



Within ENVRIPLUS EU project, an Argo big data demonstration: http://co-discovery-demo.ifremer.fr/euro-argo/
All Argo data is indexed and available through an Elasticsearch API.
More on https://www.youtube.com/watch?v=PKU_JcmSskw

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:

- French model Mercator (global operational model)
- French model MARC (regional operational model)
- French model Soap (navy operational model)
- EU Copernicus models (Foam, Topaz, Moon, Noos)
- EuroGoos projects

Argo projects: this year, Coriolis data centre performed float data management for **47 Argo scientific projects and 50 PIs (Principal Investigators).**

List of Coriolis scientific PIs and project names

project	nb floats
euro-argo	2218
coriolis	1126
bsh	493
goodhope	174
naos	146
argomed	136
argo italy	135
remocean	119
awi	84
gyroscope	84
mocca	70
ovide	70
dap	69
argo_spain	59
pirata	59
mocca-eu	55
argo_awi	40
wen	40
ifm-geomar	38
congas	32
flostral	30

List of projects with more than 30 active floats

List of project with less than 30 active floats: argo norway, gmmc, mfstep, argo_fin, argo greece, cirene, pomme, shom, frontalis, ifm, eto_bb, argo spain, flops, cmgp, rrex asfar, tropat, egypt, argo poland, atlantos, sfb460, bioargo, eaims, ifm2, sagar, gmmc_cnes, mersea, rrex, argo_chile, geovide, mocca-germany, amop, asfar, aspex, gmmc ovide, bwr, narval, prosat, soclim, argo geomar, medargo_it, naos-france, outpace, ticmoc, argo bulgary, brazilian navy argo program, dekosim, ge moose, gmmc argomex, mouton, track, argn, cicio, cienperu, mocca-italy, moose, naos-canada, socib, track2010, argo-finland, cnes, gmmc moana maty, hymex, mafia, mocca-poland, norargo, previmer, sri_lanka, vsf, bioargo-italy, e-aims, euroargo, lefe, perseus, shackelton, upsen, weccon, argo brazil, argo_cr, asa, bide, capricorn, eu fp7 hypox, gmmc perle, heracles, medargo, mgoodhope, mocca-eu, dekosim (metu), mooxy, opportunity (sail), plumrho leg 1, proteusmed, argo_lebanon, argo_mexico, argo_poland, calypso, i-p-study, jerico, lov-atlantos, mocca-ned, mocca-netherlands, peacetime, physindien, protevs swot, sojana - antigua to azores

pi	nb floats
birgit klein	241
christine coatanoan	218
virginie thierry	209
sabrina speich	201
pierre-marie poulain	180
holger giese	136
bernard bourles	113
olaf klatt	90
birgit klein	81

rena czeschel	76
andreas sterl	73
fabrizio d'ortenzio	53
herve claustre	52
gerd rohardt	48
pedro velez belchi	42
klaus-peter koltermann	38
xavier andre	34
christophe maes	33
alain serpette	32
detlef quadfasel	31
rosemary morrow	30

List of Principal Investigators (PI) in charge of more than 30 floats

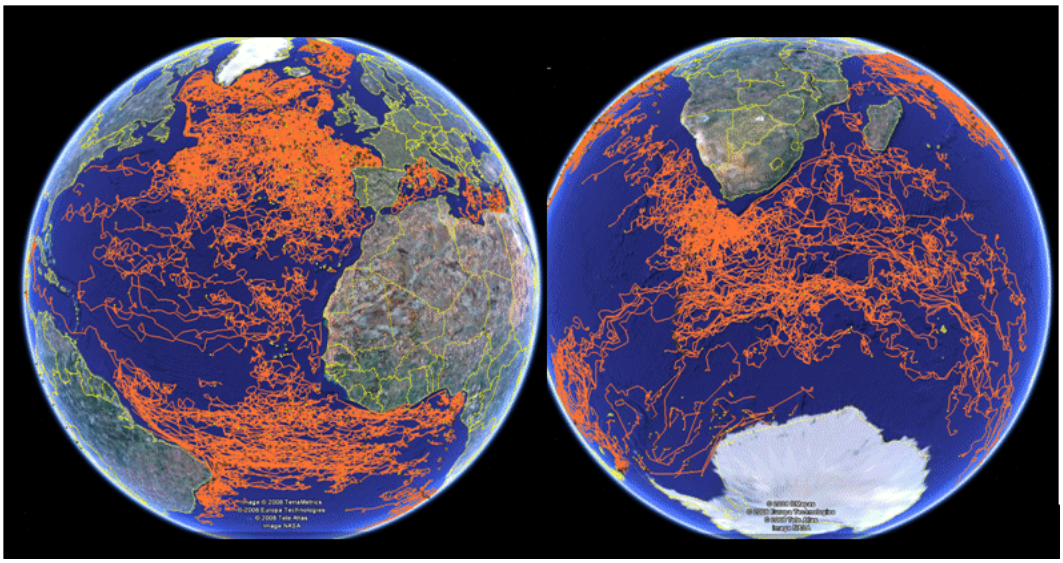
List of Principal Investigators (PI) in charge of less than 30 floats: walter zenk, christine provost, dimitris kassis, laurent coppola, jerome vialard, kjell arne mork, waldemar walczowski, romain cancouët, thierry delcroix, jose lluis pelegri, pedro velez, gerard eldin, fabien durand, antoine poteau, tero purokoski, wilmar van der zwet, isabelle taupier-lepage, franck dumas, jean-baptiste sallee, marcel babin, olaf boebbel, bert rudels, einar svendsen, gregorio parrilla, jens schimanski, osvaldo ulloa, sunke schmidtko, jens meincke, camille daubord, elodie martinez, louis prieur, peter brandt, serge le reste, violeta slabakova, cecile cabanes, fabien roquet, sophie cravatte, alban lazar, bettina fach, luis felipe silva santos, stephane blain, vincent echevin, xavier carton, yves morel, frederic vivier, guillaume maze, marek stawarz / birgit klein, pedro joaquin velez belchi, stephanie louazel, arne kortzinger, gilles reverdin, pascal conan, romain cancouet, sven petersen, thierry moutin, vincent dutreuil et serge le reste, yves gouriou, agus atmadipoera, brian king, christoph kihm, daniel ballestero, hubert loisel, jordi font, josep lluis pelegri, julia uitz, juliet hermes, katrin latarius, louis marie, serguey gladyshev, tobias ramalho dos santos ferreira, anja schneehorst, antje boetius, e. stanev, gerasimos korres, j. haapala, jose luis pelegri, l. tuomi, liu zenghong, louis marié, nathanaele lebreton, ochoa de la torre, sorin balan, velez belchi pedro

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's organized and the difficulties encountered and estimate when you expect to be pre-operational.)

2.1 Delayed mode operations

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 some 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 2017 and following in 2018 to increase the DM files number.

2.1.1 A focus on MOCCA project delayed mode activity

Within the Euro-Argo **MOCCA** project (deployment and processing of 150 floats between 2016 and 2018), RT and DM processing has been organized between the involved partners. Half of the fleet is processed in RT by Coriolis, the other half by BODC using the same processing chain developed by Coriolis.

DMQC is performed by DM operators according to their expertise and the deployment locations. BSH (Birgit Klein, Katrin Latarius), OGS (Giulio Notarstefano), BODC (Matt Donelly) and Ifremer (Gaëlle Herbert, Christine Coatanoan) are highly involved.

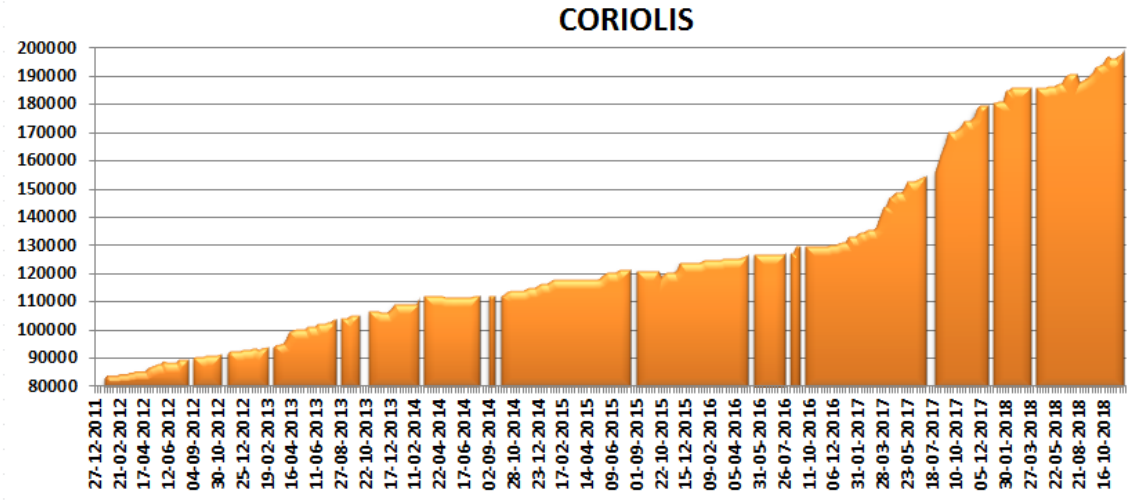
Substantial resources and manpower have been made available through the project to effectively process the floats in both RT and DM, but also to carry on additional activities targeting the improvement of the overall data quality of the Argo dataset, either working on the development of new techniques, improving the reference database or performing pilot/case studies etc. Training of potential new DM operators is also an objective within Euro-Argo and the work has started with the organization of a first European DMQC workshop in April 2018 where 30 people participated.

Here is a non-exhaustive list of Data Management activities performed and financed under the MOCCA umbrella:

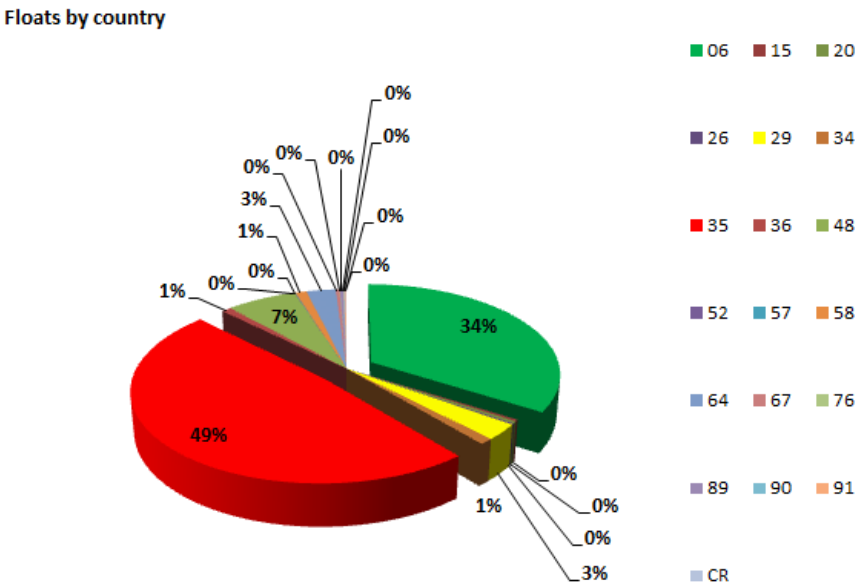
- DMQC of the 150 MOCCA floats
- Update of the reference dataset for the DMQC activity in the Med and Black Sea
- DMQC training for the activity in the Black Sea
- Work on development of some software that can help in the DMQC activity
- Inter-comparison of floats in the Nordic Seas (regional study on data quality)

- Organisation of DMQC in the Baltic sea
- Work on the tuning of ICE-SENSING algorithm for the Nordic Seas
- Work on New RTQC method using MinMax climatology
- Review and development of DMQC training and resources
- Improving under-ice positioning methods in the high-latitude Southern Ocean
- Improving availability of Southern Ocean specific DMQC resources
- Performance assessment of new DMQC method based on machine learning + development of the associated infrastructure

2.1.2 Coriolis delayed mode activity in charts and numbers

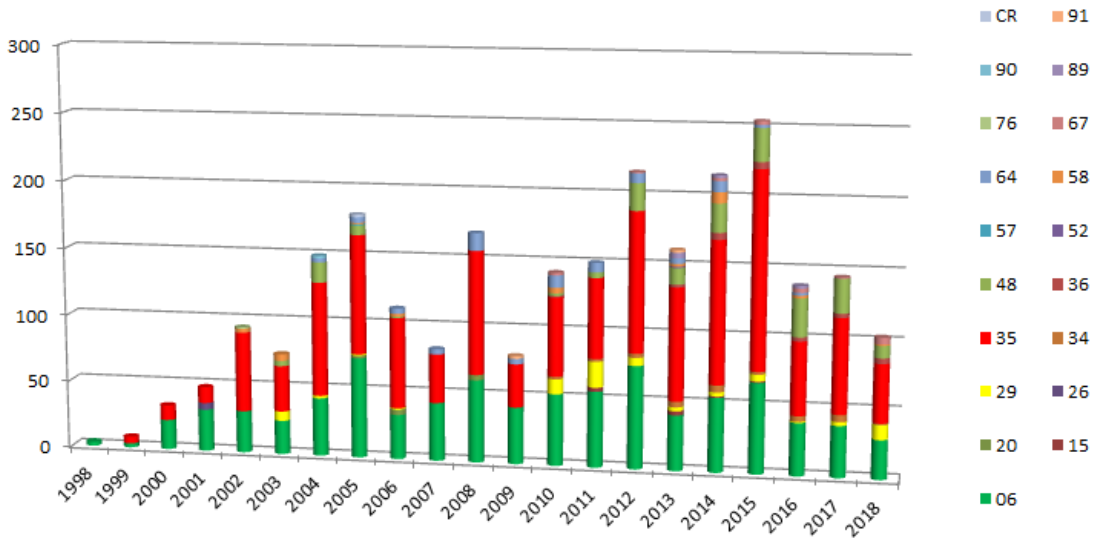


Evolution of the DM profiles' submission versus dates



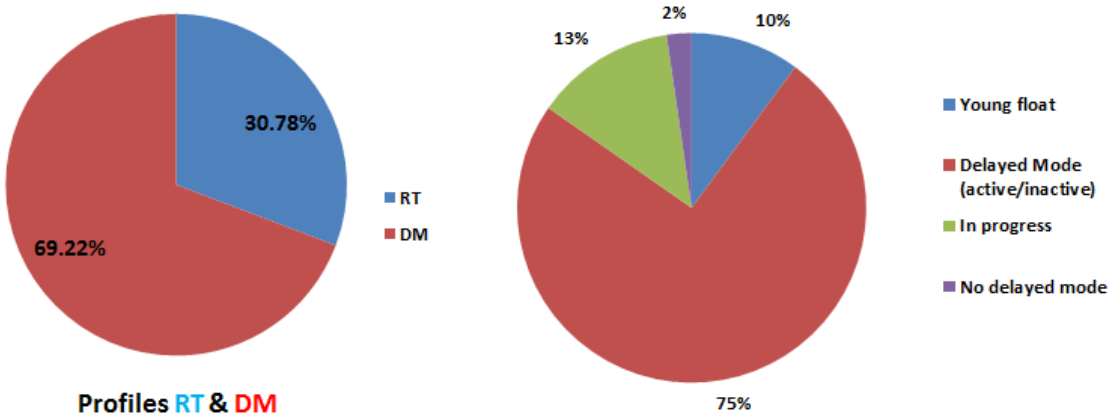
Percentage of floats by country in the Coriolis DAC.

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



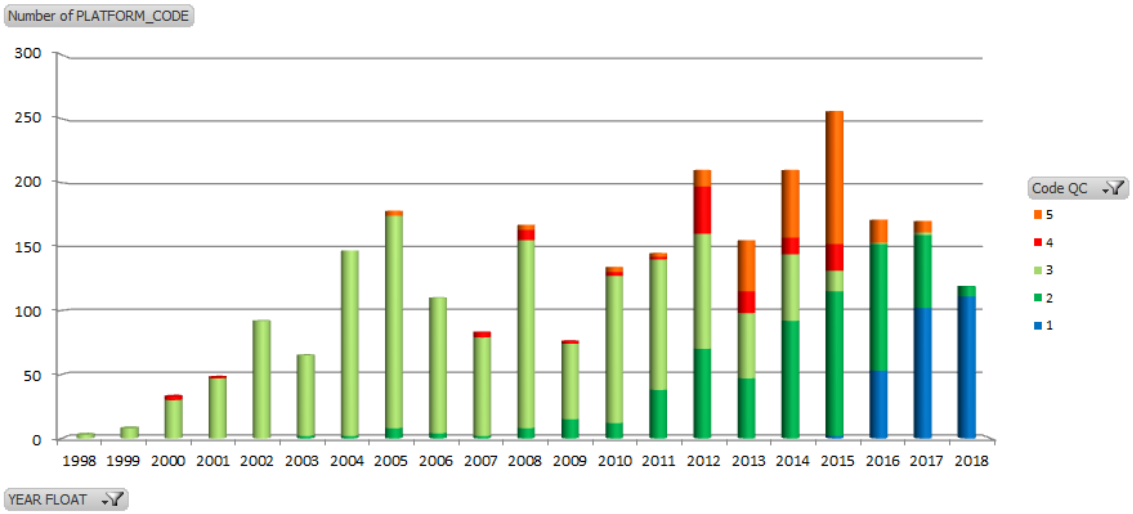
Number of floats by country and by launch's year in the Coriolis DAC

During the last year (from October 2017 to November 2018), 28682 new delayed mode profiles where produced and validated by PIs. A total of 199133 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).

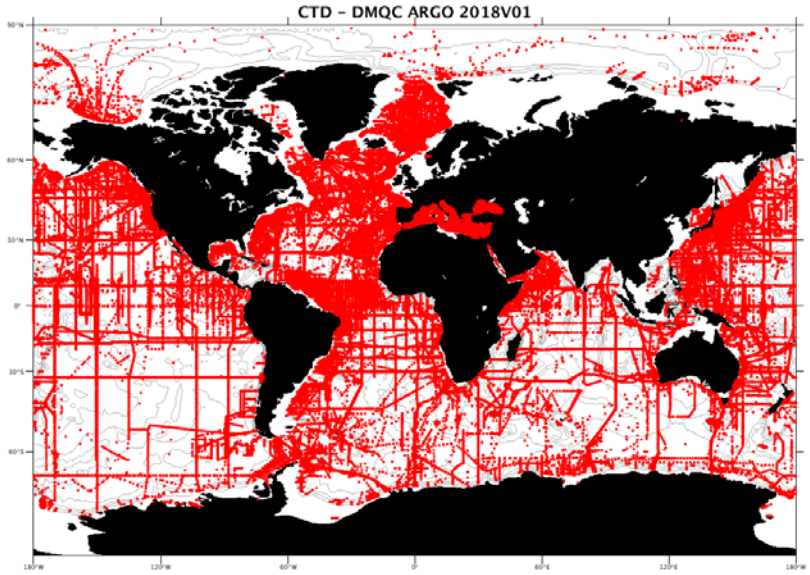
The status of the quality control done on the Coriolis floats is presented in the following plot. For the two last years (2017-2018), most of the floats are still too young (code 1) to be performed in delayed mode. For the years 2012-2013-2014, we are still working on the DMQC of some floats. The codes 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.

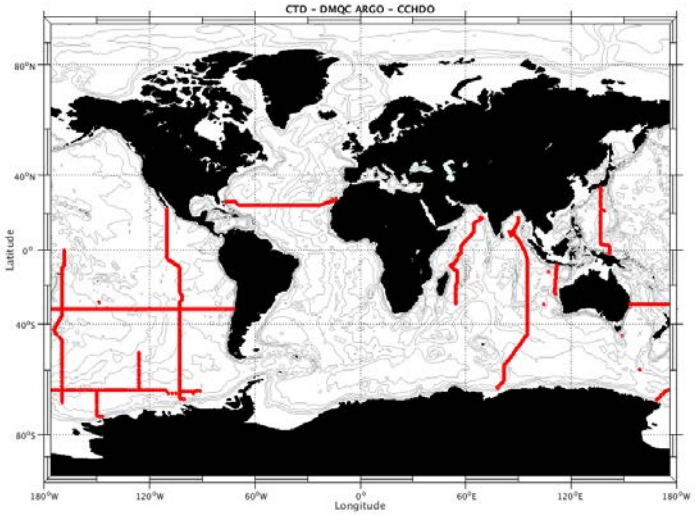
2.2 Reference database

In beginning of 2017, *a* new version 2017V01 has been provided with some updates on a few boxes, following the feedback sent by some scientists. Since March 2018, a new version 2018V01 including OCL updates, CTD from PI, correction from feedbacks is available on the ftp site.



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.

New works are in progress and a new version (2018V02) should be delivered by the end of this year. This version will take into account CTD from the GO-SHIP program (data from 2016 to 2018) and downloaded from the CCHDO Website, as well as a few CTD from scientists.


CTD - DMQC ARGO - CCHDO
80°N
40°N
0°
40°S
80°S
Latitude
180°W
120°W
60°W
0°
60°E
120°E
180°W
Longitude

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

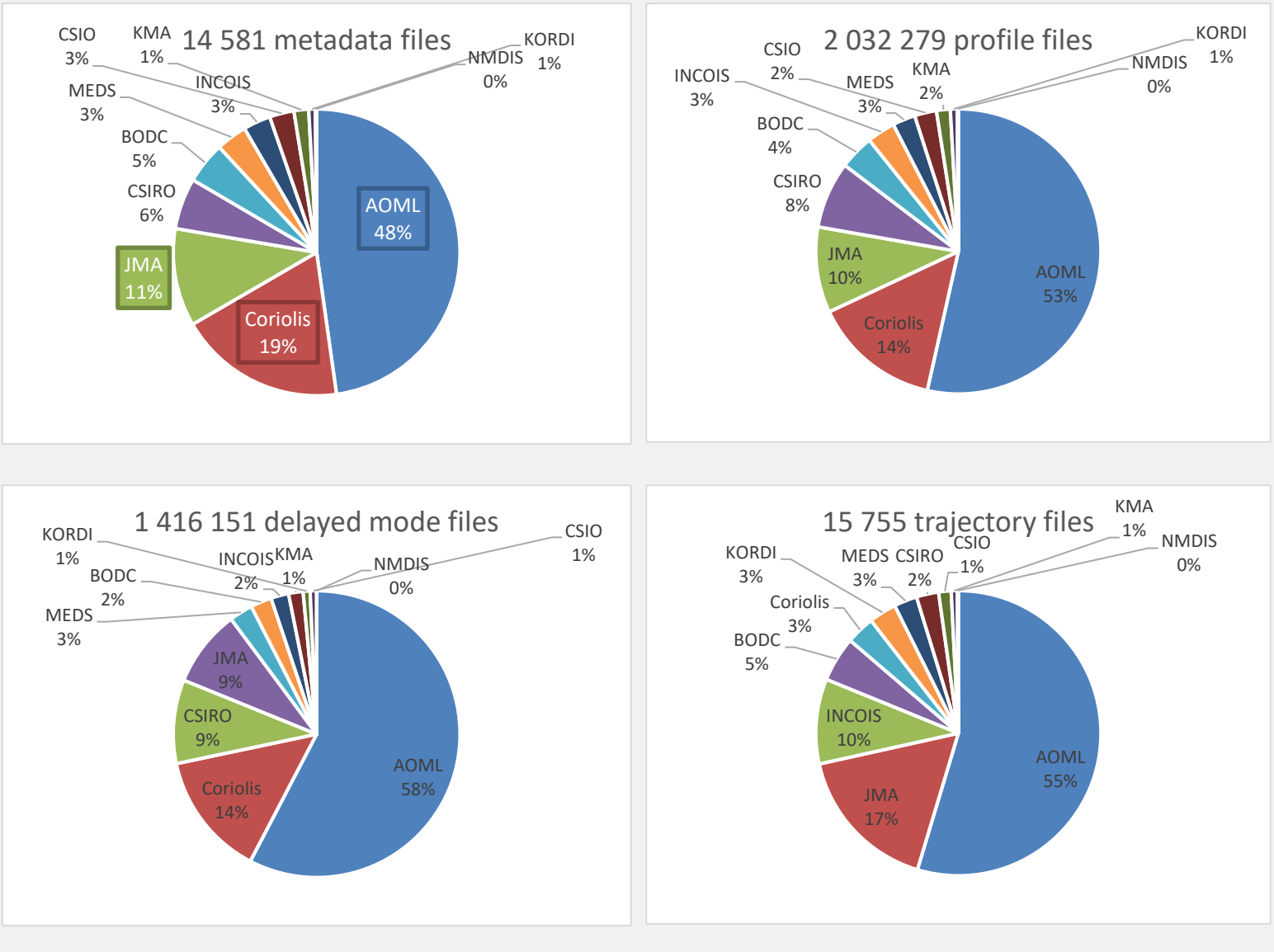
Currently, 11 national DACs submit regularly data to Coriolis GDAC.

The additional GTS DAC contains all the vertical profiles from floats that are not managed by a national DAC. These data come from GTS and GTSPP projects. The GTS profiles are quality controlled by the French DAC (Coriolis).

On November 25th 2018, the following files were available from the GDAC FTP site.

3.1.1 GDAC files distribution

DAC	metadata files 2018	increase	profile files 2018	increase2	delayed mode profile files 2018	increase3	trajectory files 2018	increase4
AOML	6 967	6%	1 087 404	9%	816 536	19%	8 609	7%
BODC	683	7%	79 921	13%	33 680	2%	509	6%
Coriolis	2 748	8%	295 350	12%	198 769	11%	2 661	8%
CSIO	403	9%	50 576	13%	10 221	0%	397	9%
CSIRO	841	4%	153 793	9%	133 816	11%	805	3%
INCOIS	450	7%	65 141	11%	28 418	1%	413	9%
JMA	1 610	4%	197 647	5%	123 006	7%	1 519	2%
KMA	241	6%	31 711	9%	23 094	0%	224	8%
KORDI	110	-8%	15 878	-4%	11 156		107	-10%
MEDS	509	8%	52 398	9%	37 455	18%	492	8%
NMDIS	19	0%	2 460	0%	0		19	0%
Total	14 581	6%	2 032 279	9%	1 416 151	15%	15 755	6%



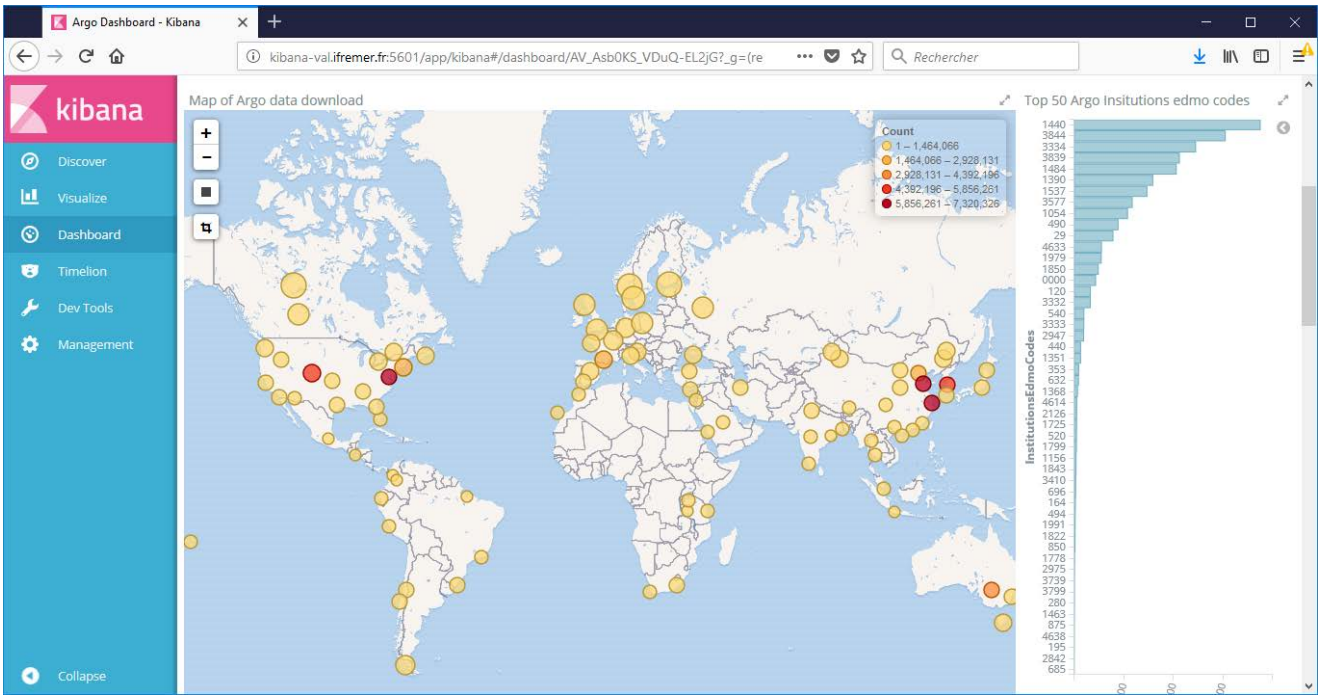
Number of files available on GDAC, November 2018

3.1.2 FTP dashboard: give credit to data providers

Within EU AtlantOS project, Ifremer is setting up a dashboard 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 2017

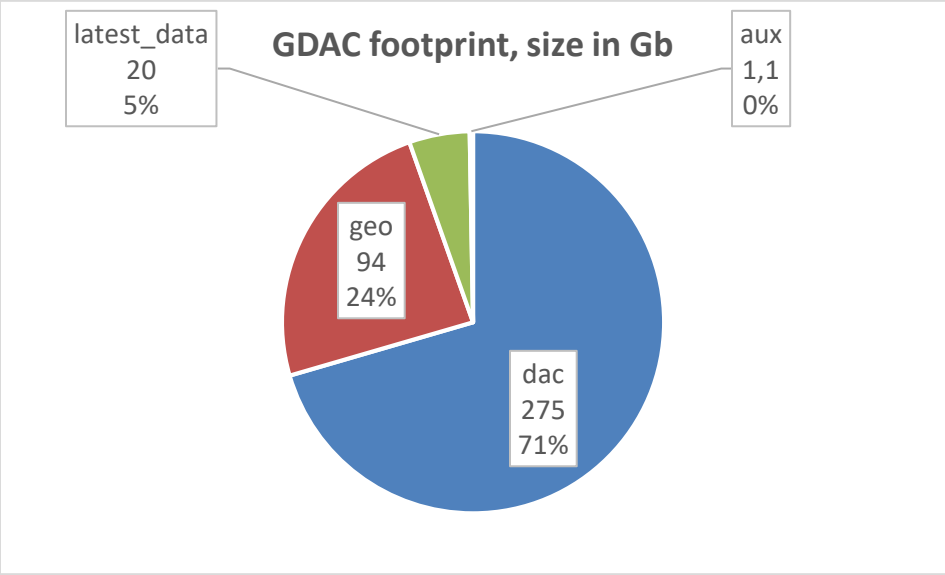
The majority of users (red dots) are located in USA, China, Australia and of course Europe. The right side histogram sorts the floats institution code (1440: PMEL, 3844: WHOI, 3334: INCOIS, 3839: UWA, 1484: CSIRO, …).

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 245 G (+95%)
- The size of the GDAC directory was 553G

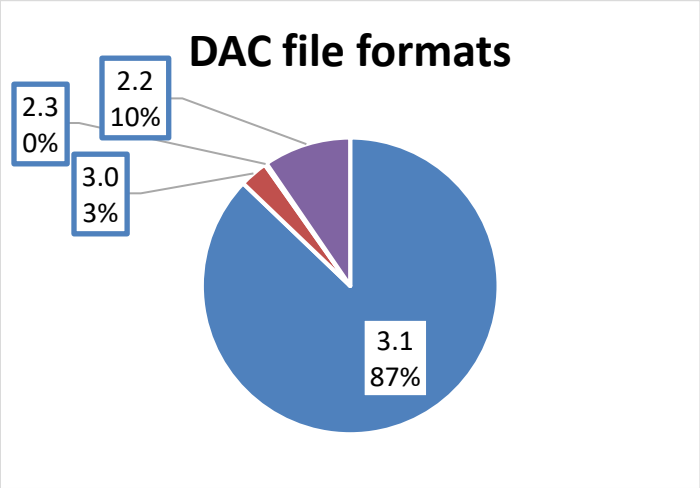
branch	GDAC size in G	since 2016
dac	275	12%
geo	94	11%
latest_data	20	43%
aux	1,1	57%

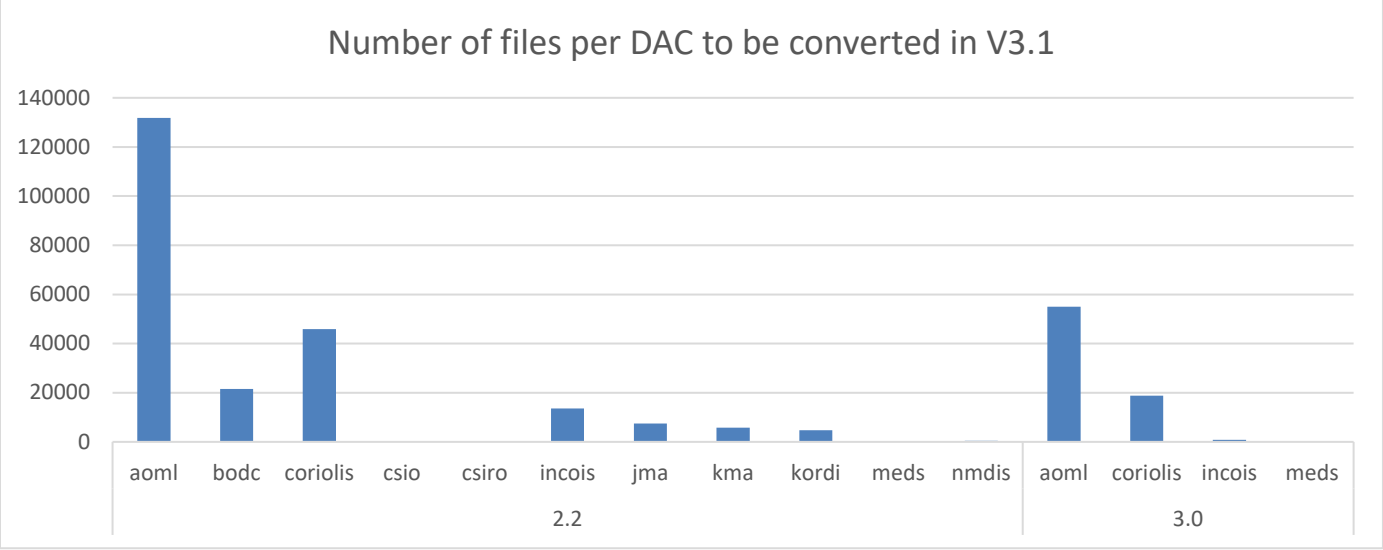


3.1.4 Argo NetCDF transition to format V3.1

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**

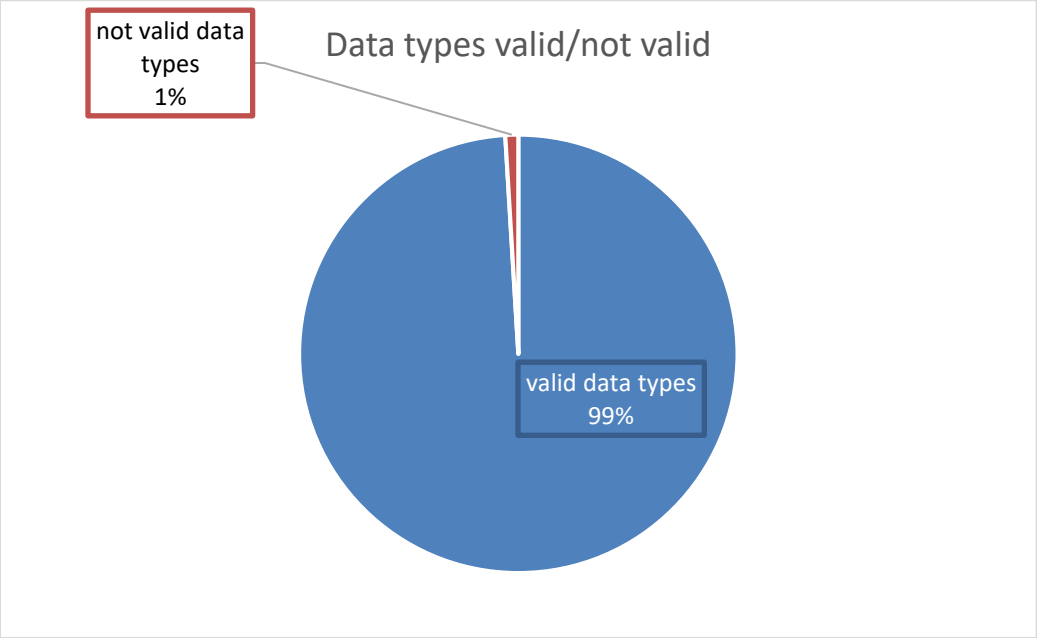
aoml	55061
coriolis	18741
incois	864
meds	4
Total général	**306167**

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.

Example of valid content checked by the format checker on V3.1 files

There are 8 valid DATA_FORMAT variables listed in reference table 1 (there are 26 more tables…).
A survey on GDAC files shows that 24 779 files (1% of the total) do not have a valid DATA_FORMAT.
The V3.1 files are not affected by this kind of problem.

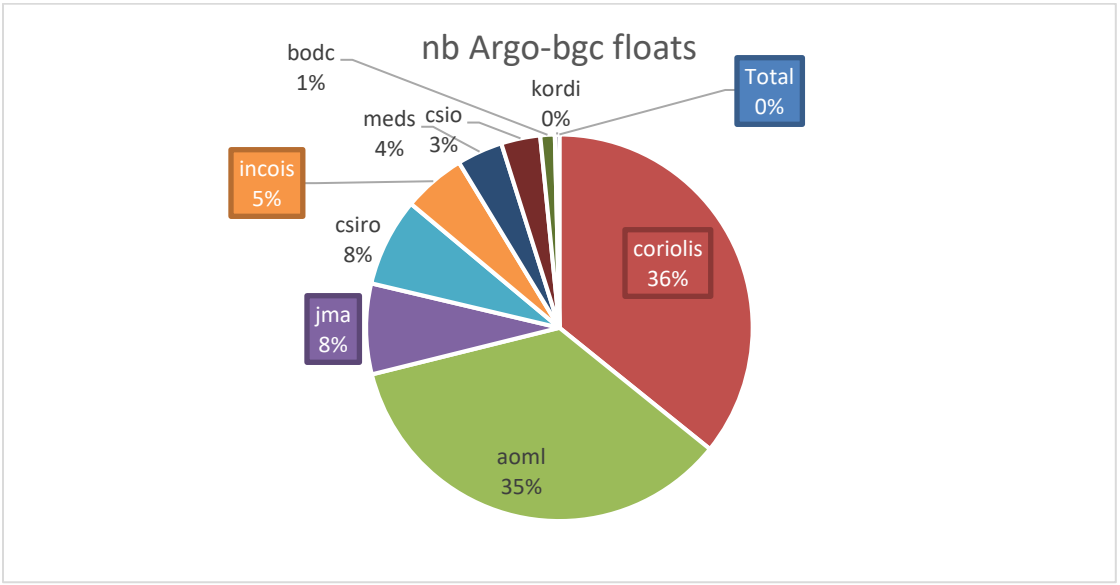
data_type	nb files	valid type
Argo profile	2027964	yes
B-Argo profile	166019	yes
Argo profile merged	165099	yes
ARGO profile	21336	no
Argo meta-data	14581	yes
Argo trajectory	14556	yes
Argo technical data	13639	yes
ARGO trajectory	1093	no
Argo technical	572	no
B-Argo trajectory	445	yes
Argo Trajectory	110	no
ARGO technical data	20	no

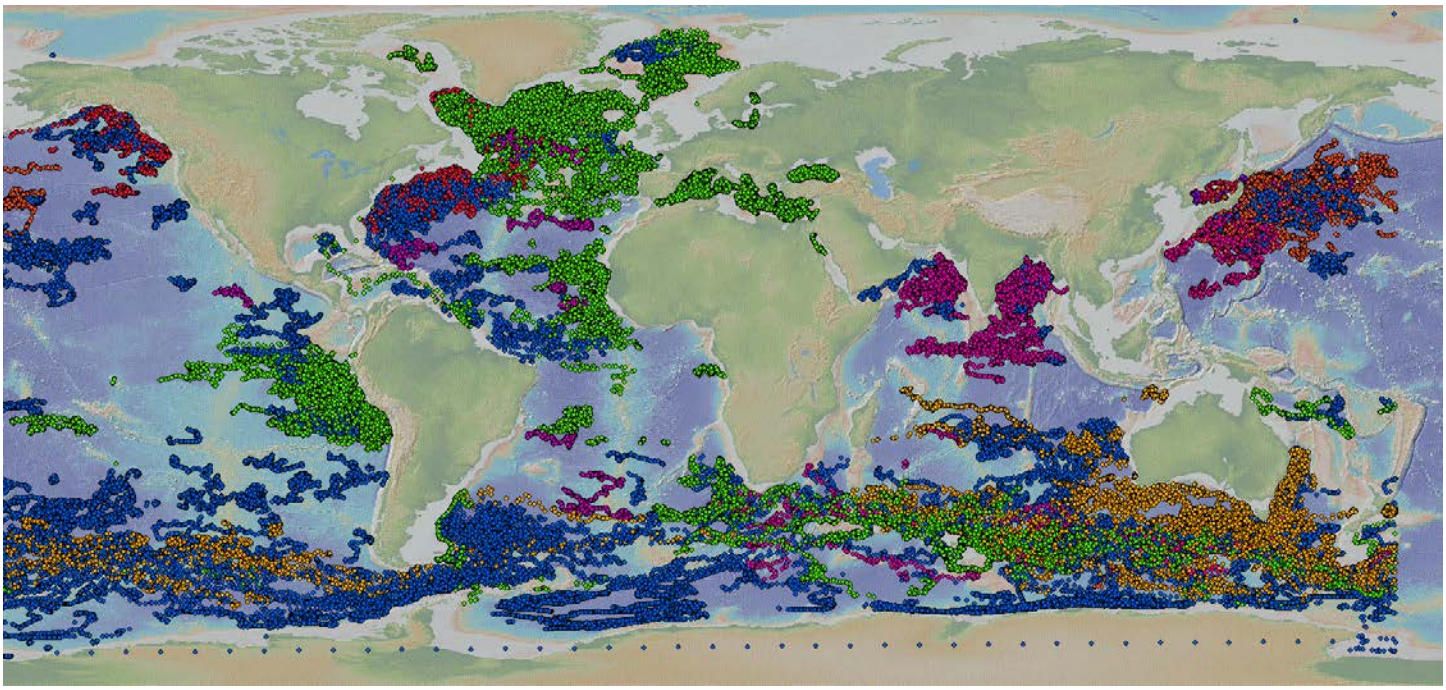

Data types valid/not valid
not valid data types 1%
valid data types 99%

3.1.5 BGC-Argo floats

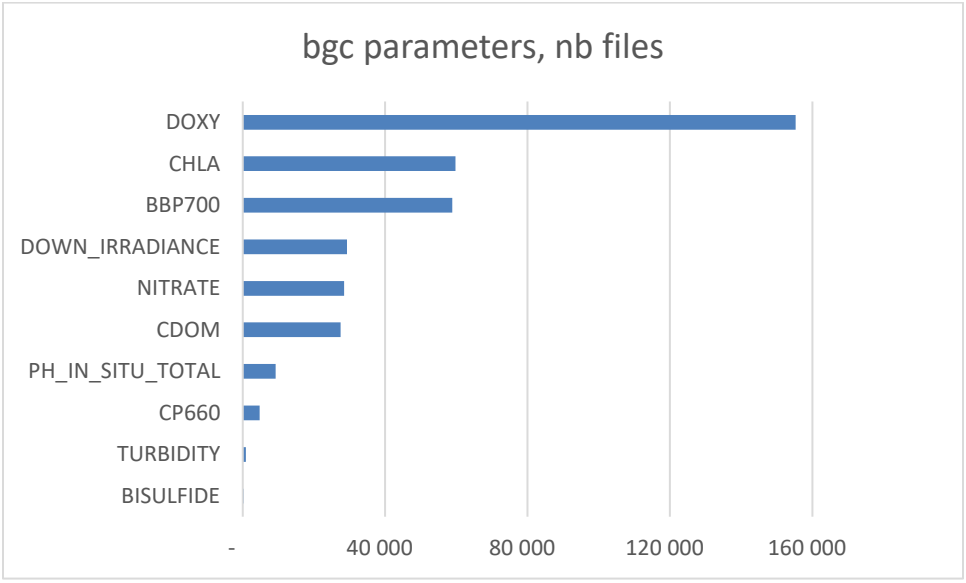
In November 2018, 165 639 BGC-Argo profiles from 1073 floats were available on Argo GDAC. This is a strong increase compared to 2017 : +26% more profiles and +24% more floats.

DAC	nb bio floats	nb bio files
aoml	378	55 176
bodc	13	3 674
coriolis	383	51 981
csio	35	6 784
csiro	79	21 067
incois	56	7 352
jma	81	14 865
kma	3	419
kordi	4	240
meds	41	4 081
Total	**1073**	**165 639**





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 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).

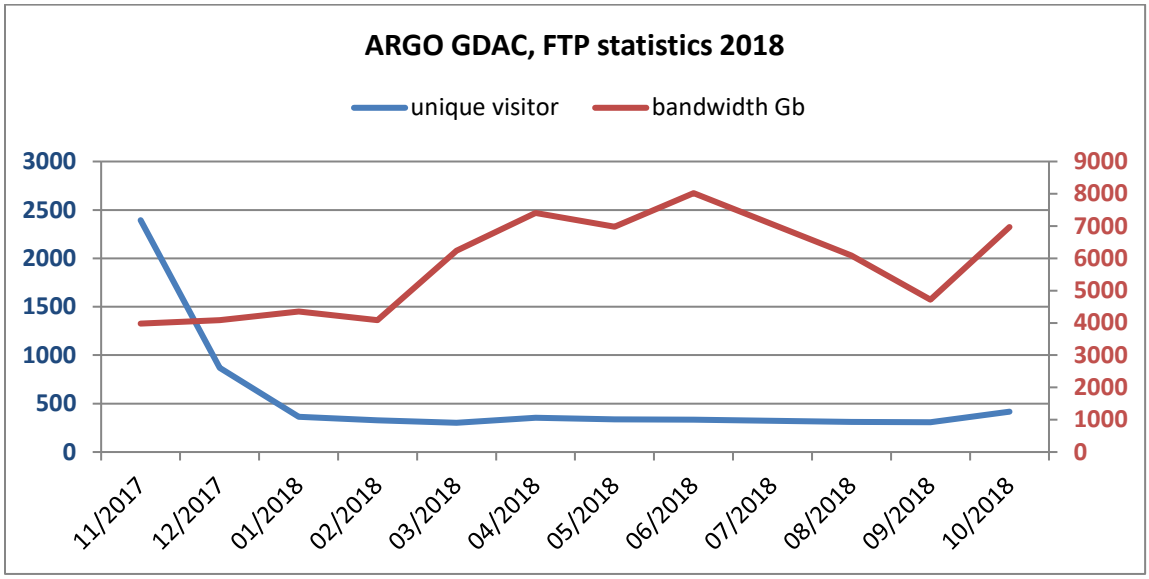
Index files of metadata, profiles, trajectories, technical and auxiliary data are hourly updated.

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.

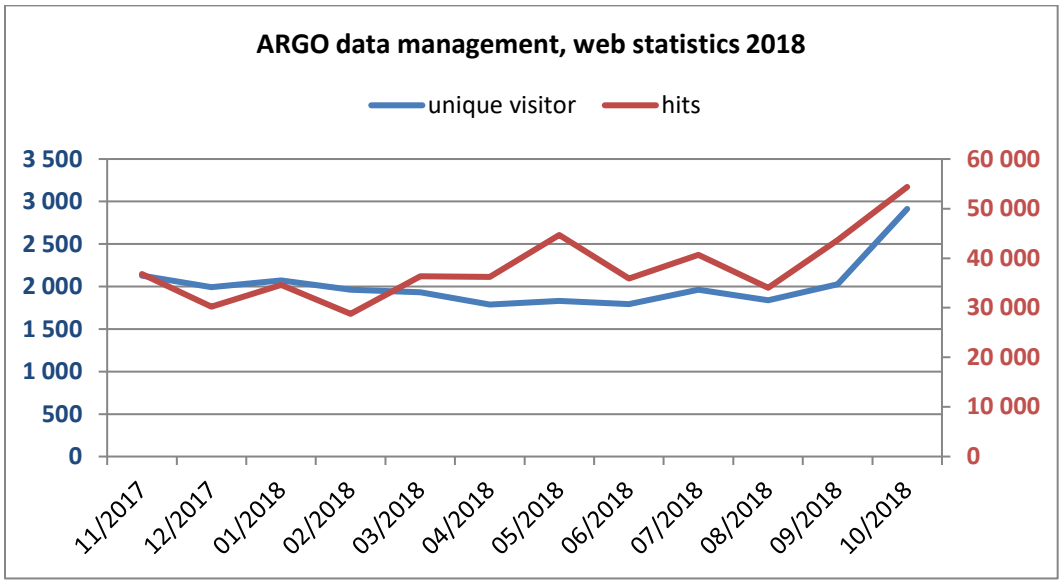
The table below shows an unsusual of visitors in November and December 2017 on GDAC FTP; we do not have a specific explanation.



ARGO GDAC FTP statistics				
month	**unique visitor**	**number of visits**	**hits**	**bandwidth Gb**
11/2017	2394	6 600	2 815 582	3978,83
12/2017	868	5 090	2 933 822	4081,45
01/2018	365	4 246	4 523 428	4352,77
02/2018	328	3 896	2 261 206	4088
03/2018	302	3 551	11 768 691	6238
04/2018	354	4 200	3 943 831	7405
05/2018	339	3 853	4 509 977	6977
06/2018	335	4 281	2 695 216	8020
07/2018	408	4 414	2 932 583	8388
08/2018	312	3 767	3 943 330	6088
09/2018	308	3 519	3 737 580	4718
10/2018	417	4 202	10 758 854	6972
Average	**561**	**4 302**	**4 735 342**	**5 942**

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

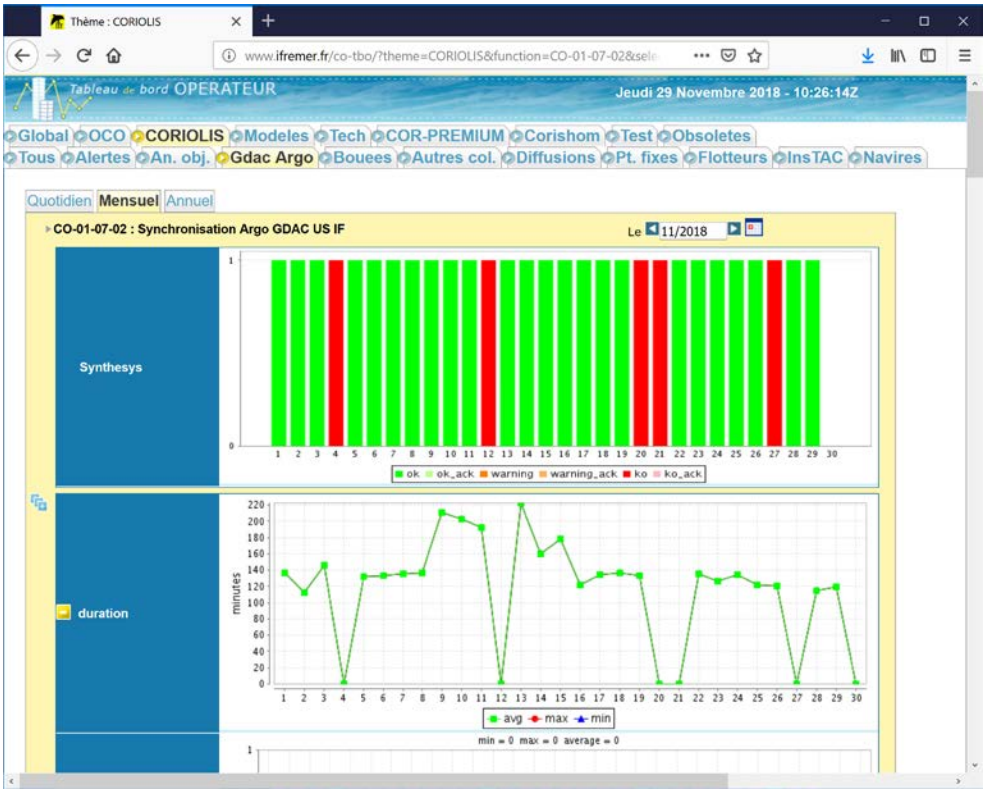
There is a monthly average of 2020 unique visitors, performing 2861 visits and 38029 hits. The graphics shows a slightly increasing number of unique visitors.



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

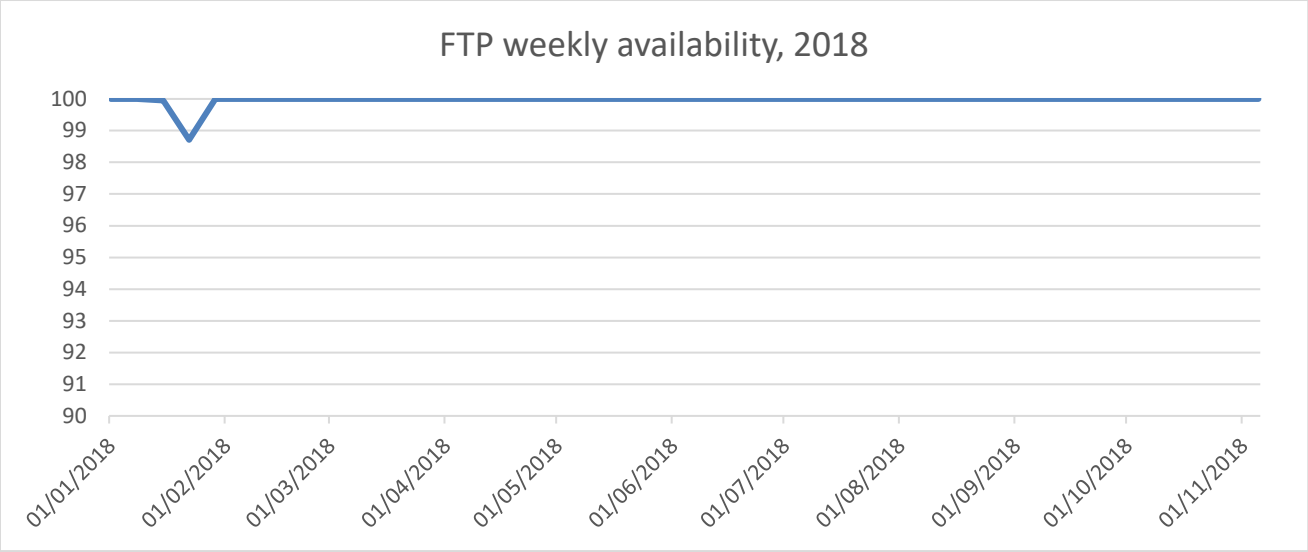
3.4 FTP server monitoring

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

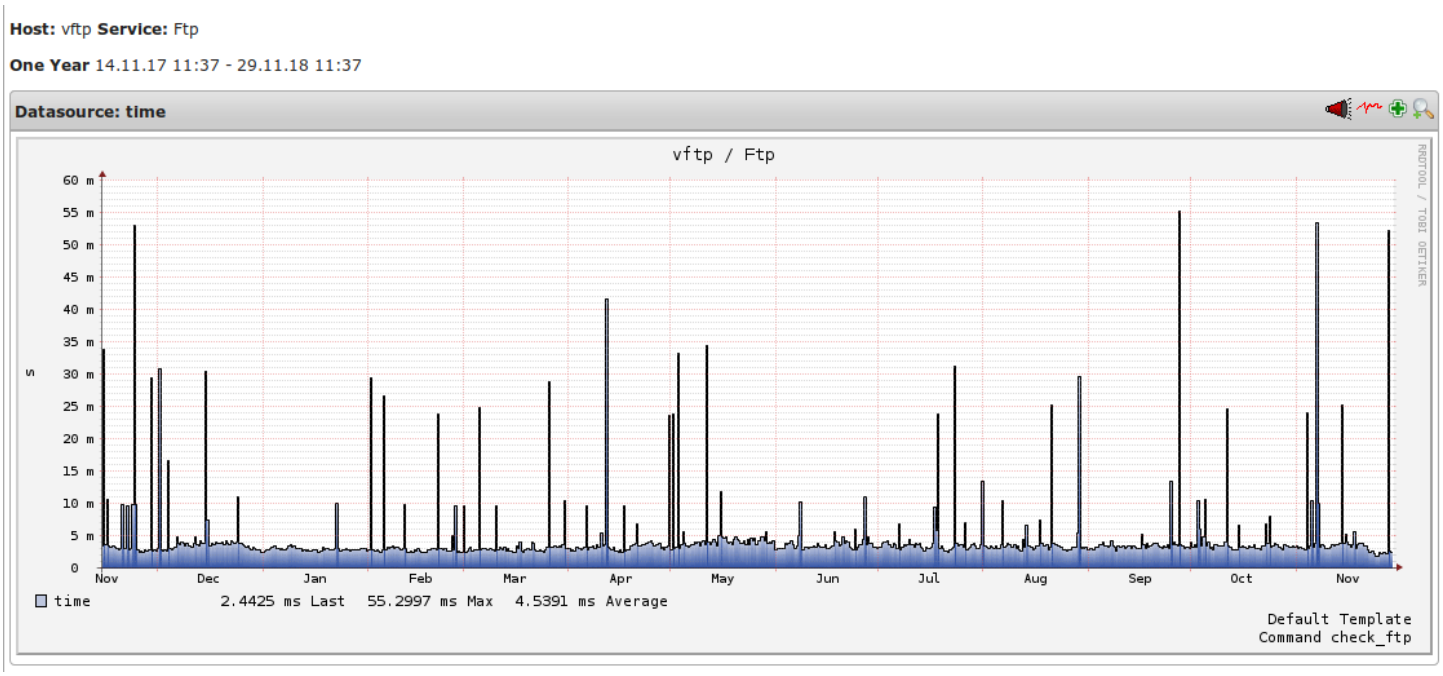
Every 5 minutes, an ftp download test and an Internet Google query are performed. The success/failure of the test and the response time are recorded. The FTP server is a virtual server on a linux cluster.

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

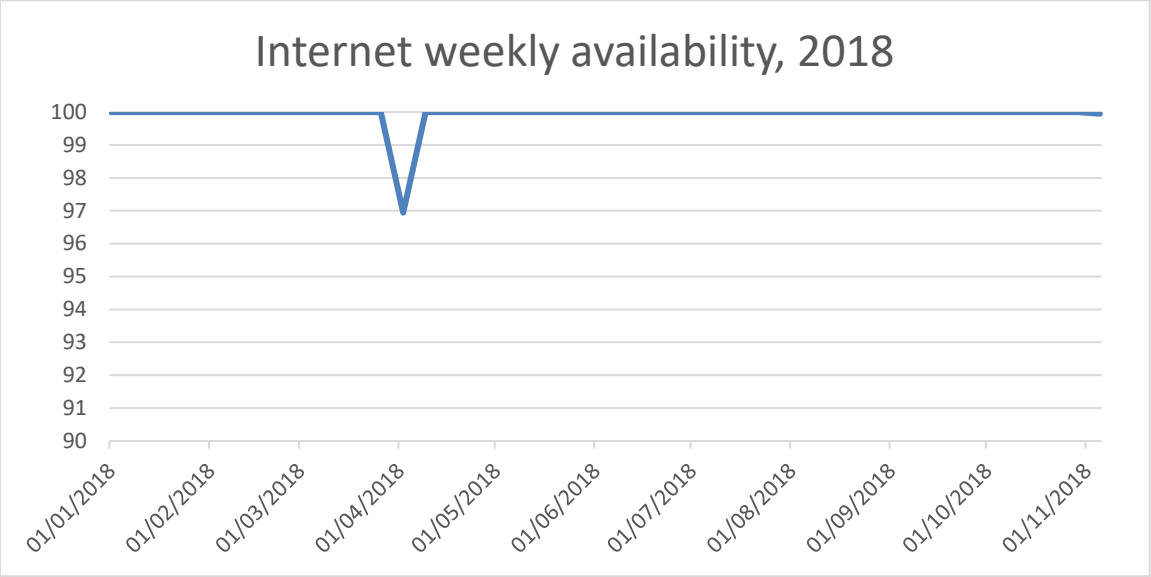


Nagios ftp monitoring: between January and November 2018



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

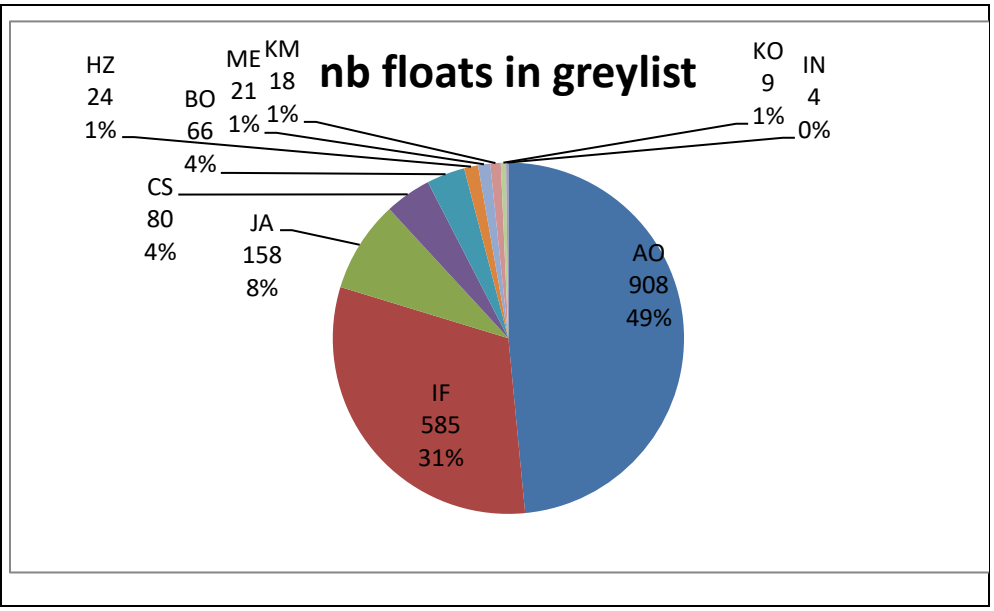


Nagios Internet monitoring: between January and November 2018

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.

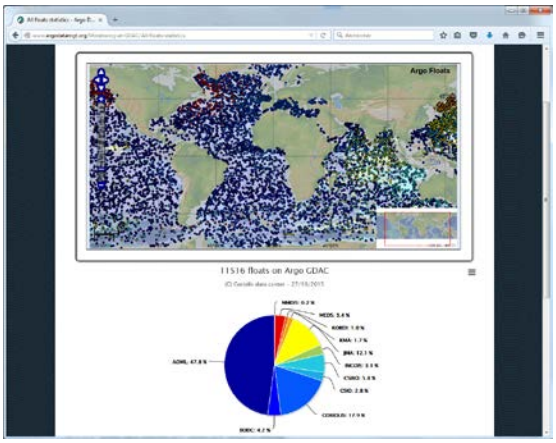
Coriolis reports many BGC greylist entries.

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

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 2018

- 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 154 active/operational German floats which all belong to BSH. 30 floats have been deployed in 2018 to date and 22 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 (25.10.2018) the German Argo fleet comprises 879 floats which have sampled 70778 profiles. 62466 profiles of all eligible files are already available as D-files and 6386 are still pending. The total rate of eligible D-files provided to the GDACs is 88% and has increased from last year's value of 86%.
- 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 is: http://www.german-argo.de/. 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. Argo data are routinely assimilated in the GECCO reanalysis, which is used for the initialisation the decadal prediction system MiKlip. 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 88%. BSH had adopted floats from all German universities (except for the AWI) and had performed the DMQC on these. In this year we have also offered to do DMQC also for the yet unprocessed AWI floats. The AWI had issues with their decoders and had re-decoded all their files in 2017 in close communication with Coriolis to improve the technical information, meta data and solve some problems with the timing information of under-ice profiles. The decoding at Coriolis has nearly been finished and it is expected to have new files ready by beginning of November. At the moment7388 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 (692 floats) the DMQC quota has remained at 93%. Additionally some time was spend to update file formats to V3.1, particular for old floats from the universities with BGC sensors with format inconsistencies in the older formats.

BSH has also adopted floats from Finland (28 floats), the Netherlands (87 floats), Norway (31 floats) and Poland(23 floats) for DMQC and is performing DMQC on parts of floats from the MOCCA fleet (42 floats) from the European Union. The progress in these programs providing D-files is good for MOCCA, the Netherlands and Poland with only small numbers of pending D-files. The number of D-files for floats from Norway could be increased considerably from last year when files had been reformatted by Coriolis in the process of moving to file-format 3.1. The DMQC has been repeated after the new files became available and the remaining pending 1387 profiles should be finished this year.
There is a remaining issue with floats from Finland and Poland, which are operating in the Baltic and will receive their DMQC decisions from regular laboratory calibrations performed when floats are recovered annually. The system for the DMQC is set-up within the EuroArgo ERIC and will cover these floats.

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.

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.

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)

5. References

Argo National Data Management Report (2018) – India

1. Status

- **Data acquired from floats**
  India has deployed 19 new floats (including 2 Provor-BioArgo, 2 Arovor-Ice Argo floats and 15 Arovor-L floats) between December 2017 and November 2018 in the Indian Ocean taking its tally to 454 floats so far. Out of these 139 floats are active. All the active floats data are processed and sent to GDAC.

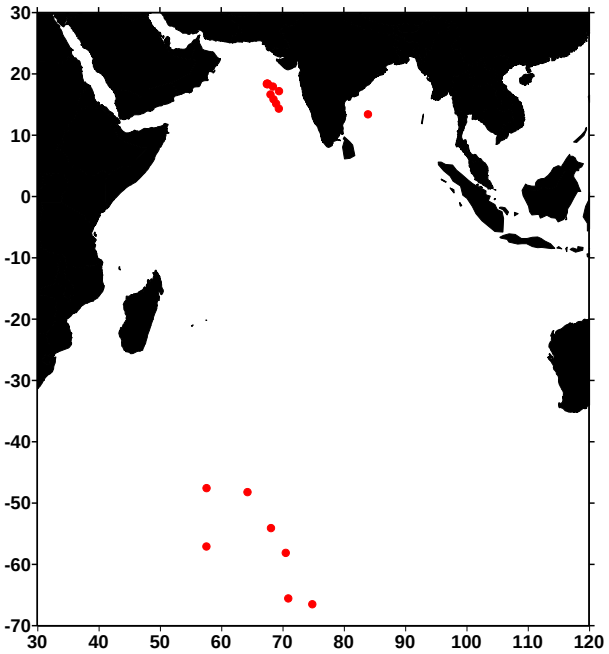


Fig. Location of Argo floats deployed by India

- **Data issued to GTS**
  All the active floats data is being distributed via RTH New Delhi. The problem related to reception of BUFR messages is resolved. This is communicated to Anh Tran and now the count had increased.

- **Data issued to GDACs after real-time QC**
  All the active floats (139) data are subject to real time quality control and are being successfully uploaded to GDAC. Also the some of the old floats whose life had ended are also converted to Ver 3.1 and uploaded to GDAC.

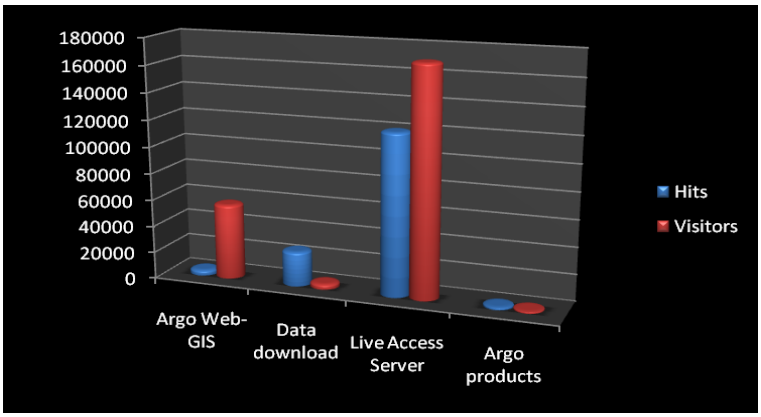
- **Data issued for delayed QC**
  In total ~50% of the eligible profiles for DMQC are generated and uploaded to GDAC. Old DMQCed floats with old version 2.3 are converted to V 3.1 and uploaded to GDAC.

- **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	4287	65017
Data download	29692	4001
Live Access Server	121923	172817
Argo products	2078	1619

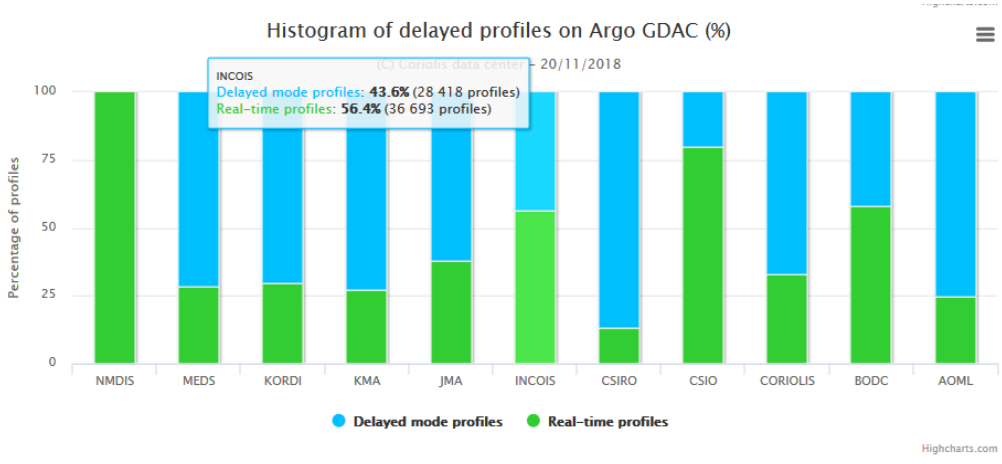
- **Products generated from Argo data**
  1. Value added products obtained from Argo data are continued. Continued to variational analysis method while generating value added

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 April 2018 updated. This DVD consists of ~ 3,30,000 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.

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. Using this s/w all the eligible floats are reprocessed to tackle pressure sensor offset problems, salinity hooks, thermal lag corrections, salinity drifts.
- 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

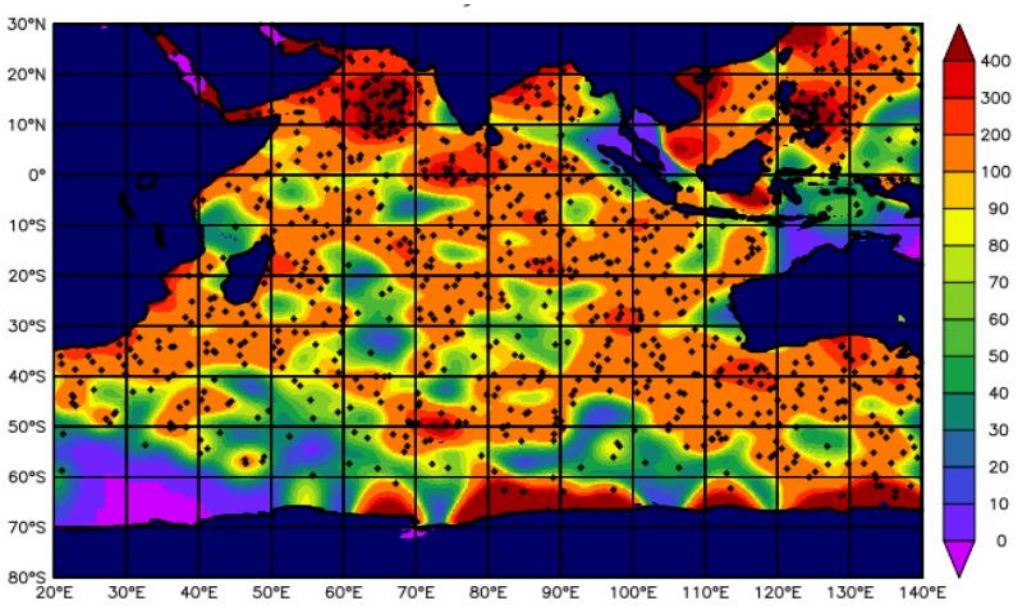
INCOIS is not operating as a GDAC.

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. V. V. S. S. Sarma, T. V. S. Udaya Bhaskar, Ventilation of Oxygen to Oxygen Minimum Zone Due to Anticyclonic Eddies in the Bay of Bengal, Journal of Geophysical Research, https://doi.org/10.1029/2018JG004447.
2. Kakatkar, R., C. Gnanaseelan, J. S. Chowdary, A. Parekh, and J. S. Deepa, 2018: Indian summer monsoon rainfall variability during 2014 and 2015 and associated Indo-Pacific upper ocean temperature patterns. Theoretical and Applied Climatology, 131, 1235-1247, https://doi.org/10.1007/s00704-017-2046-4.
3. Karmakar, A., A. Parekh, J. S. Chowdary, and C. Gnanaseelan, 2018: Inter comparison of Tropical Indian Ocean features in different ocean reanalysis products. Climate Dynamics, 51, 119-141, https://doi.org/10.1007/s00382-017-3910-8.
4. Lotliker, A. A., S. K. Baliarsingh, V. L. Trainer, M. L. Wells, C. Wilson, T. V. S. Udaya Bhaskar, A. Samanta, and S. R. Shahimol, 2018: Characterization of oceanic Noctiluca blooms not associated with hypoxia in the Northeastern Arabian Sea. Harmful Algae, 74, 46-57, https://doi.org/10.1016/j.hal.2018.03.008.
5. Misra, T., R. Sharma, R. Kumar, and P. K. Pal, 2018: Ocean Remote Sensing: Concept to Realization for Physical Oceanographic Studies. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 165-202, https://doi.org/10.1007/978-3-319-66493-4_9.
6. Pattabhi Rama Rao, E., T. V. S. Bhaskar, R. V. Seshu, N. S. Rao, K. Suprit, and G. Geetha, 2018: Marine Data Services at National Oceanographic Data Centre-India. Data Science Journal, 17, 11, http://doi.org/10.5334/dsj-2018-011.
7. Ravichandran, M. and M. S. Girishkumar, 2018: Applications of Ocean In-situ Observations and Its Societal Relevance. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 303-313, https://doi.org/10.1007/978-3-319-66493-4_15.
8. Santhanam, H. and T. Natarajan, 2018: Short-term desalination of Pulicat lagoon (Southeast India) due to the 2015 extreme flood event: insights from Land-Ocean Interactions in Coastal Zone (LOICZ) models. Ecological Processes, 7, 10, https://doi.org/10.1186/s13717-018-0119-7.
9. Sarangi, R. K., S. K. Shrinidhi, P. Chauhan, and B. R. Raghavan, 2018: Remote sensing and in situ platform based study on impact of Bay of Bengal cyclones (Phailin, Helen, Lehar, and Madi) on ocean chlorophyll and associated physical parameters. Natural Hazards, 93, 413-451, https://doi.org/10.1007/s11069-018-3307-y
10. Seelanki, V., P. Sreenivas, and K. V. S. R. Prasad, 2018: Impact of Aquarius Sea-Surface Salinity Assimilation in Improving the Ocean Analysis Over Indian Ocean. Marine Geodesy, 41, 144-158, https://doi.org/10.1080/01490419.2017.1422817.
11. Sherin, V. R., F. Durand, V. V. Gopalkrishna, S. Anuvinda, A. V. S. Chaitanya, R. Bourdallé-Badie, and F. Papa, 2018: Signature of Indian Ocean Dipole on the western boundary current of the Bay of Bengal. Deep Sea Research Part I: Oceanographic Research Papers, 136, 91-106, https://doi.org/10.1016/j.dsr.2018.04.002.
12. Tyagi, G., K. N. Babu, A. K. Mathur, and H. A. Solanki, 2018: INSAT-3D and MODIS retrieved sea surface temperature validation and assessment over waters

surrounding the Indian subcontinent. International Journal of Remote Sensing, 39, 1575-1592, https://doi.org/10.1080/01431161.2017.1407051.
13. Valsala, V., S. Singh, and S. Balasubramanian, 2018: A Modeling Study of Interannual Variability of Bay of Bengal Mixing and Barrier Layer Formation. Journal of Geophysical Research: Oceans, 123, 3962-3981, https://doi.org/10.1029/2017JC013637.
14. Venkatesan, R., A. Tandon, D. Sengupta, and K. N. Navaneeth, 2018: Recent Trends in Ocean Observations. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 3-13, https://doi.org/10.1007/978-3-319-66493-4_1.
15. Vidya, P. J. and S. Kurian, 2018: Impact of 2015–2016 ENSO on the winter bloom and associated phytoplankton community shift in the northeastern Arabian Sea. Journal of Marine Systems, 186, 96-104, https://doi.org/10.1016/j.jmarsys.2018.06.005.

1. Status

- **<u>Data acquired from floats</u>:** 445 floats were deployed in the Mediterranean and in Black Seas between 2001 and 2018 and more than 55500 CTD profiles were acquired. The temporal and spatial distribution of these profiles is depicted in Figure 1, sorted by the two main float models currently used (Bio-Argo and Core-Argo floats); the monthly and yearly distribution is shown in Figure 2. Note that here Bio-Argo includes the floats with any biogeochemical sensor on board. About 70 floats per months have been operated simultaneously in the basins in 2018 and more than 4000 CTD profiles have been acquired (up to September 2018) by different float models (Figure 3).

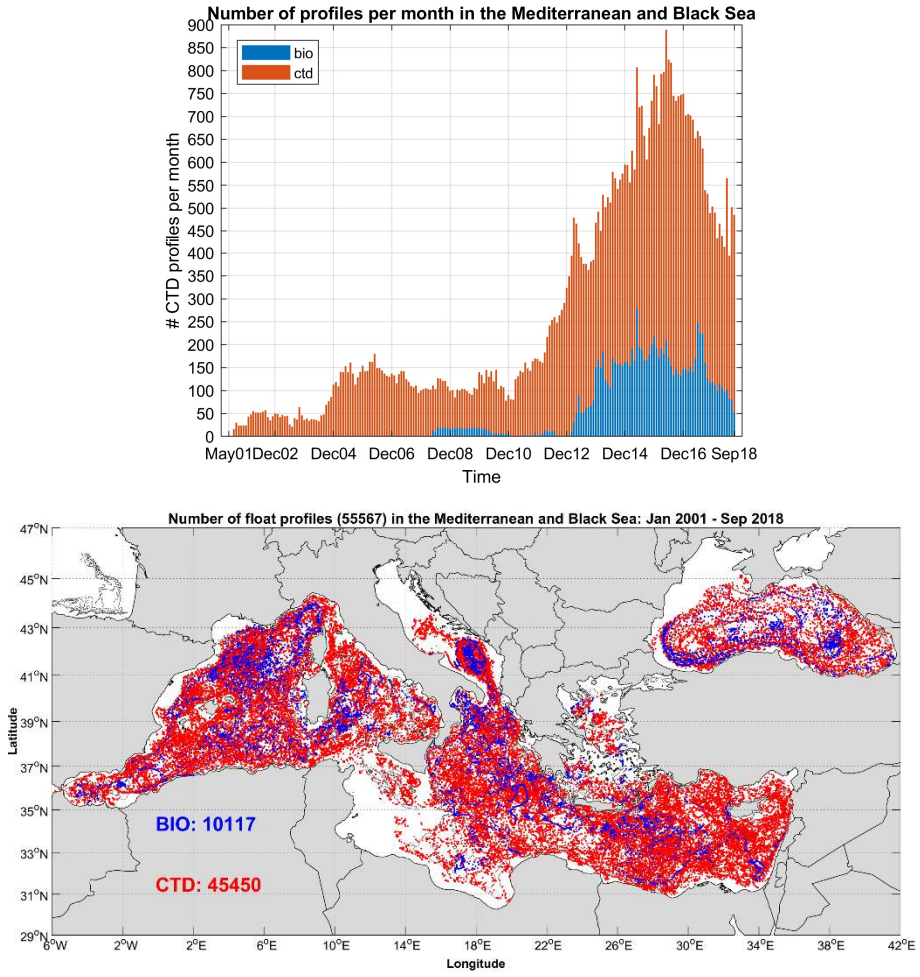


Figure 1. Temporal (upper panel) and spatial (bottom panel) distribution of float profiles in the Mediterranean and Black Sea between 2001 and 2018.

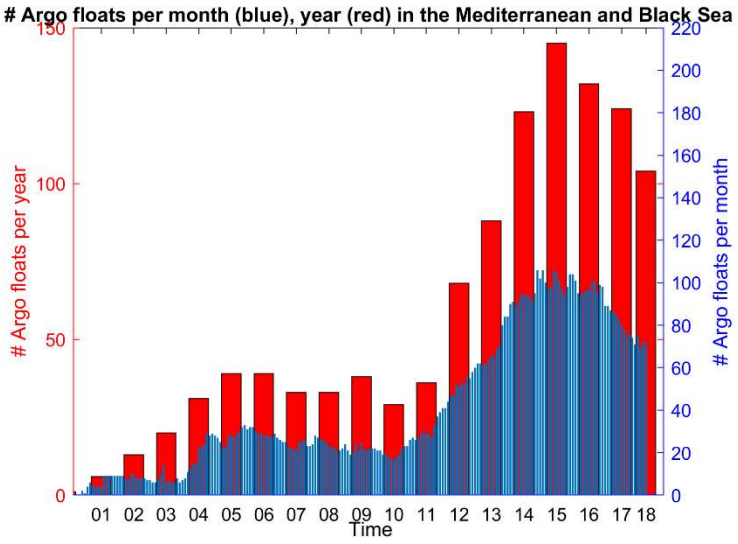


Figure 2. Monthly (blue bars) and yearly (red bars) distribution of Argo floats in the Mediterranean and Black Sea between 2001 and 2018.

The number of CTD profiles acquired by Bio-Argo floats in 2018 (up to September) is about 850 (main contributors: France, Italy and Greece) whilst the ones collected by the core Argo floats are about 3400 (up to September). Euro-Argo and Spain, Greece, France and Italy contributed to maintain/increase the Argo population in 2018: a total of 30 new floats have been deployed both in the Mediterranean and in the Black Seas (Figure 3); 9 out of 30 platforms are equipped with biogeochemical sensors and the deployment strategy was chosen in order to replace dead floats or under-sampled areas.

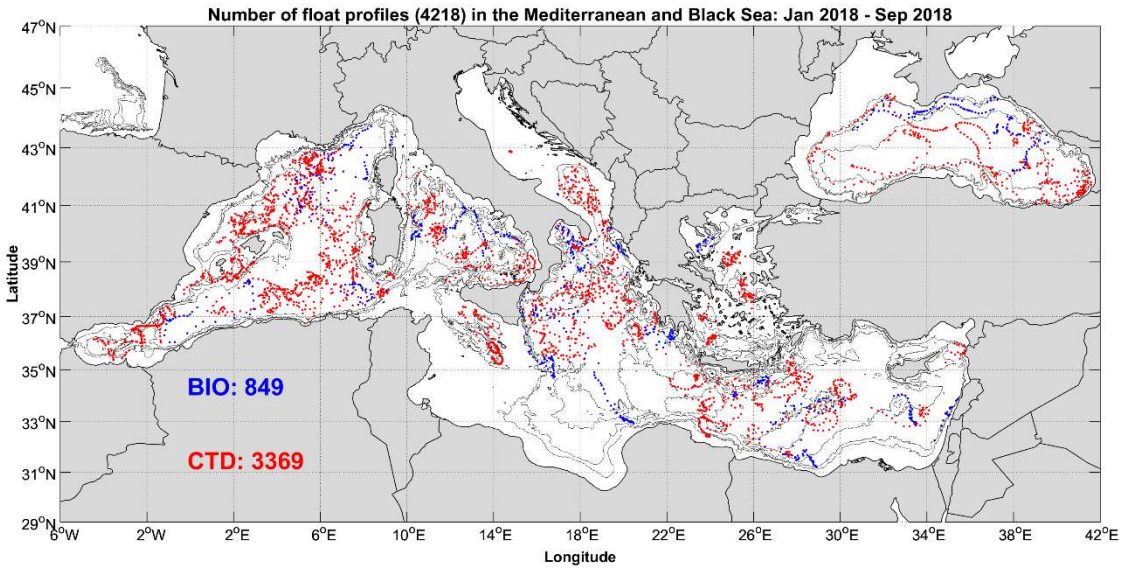


Figure 3. Spatial distribution of profiles collected by Argo floats in 2018 (January-September) in the Mediterranean and Black Sea: Bio-Argo floats (blue dots) and standard Argo floats (red dots).

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 140 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 420 km, whilst the mean distance travelled is about 120 km.

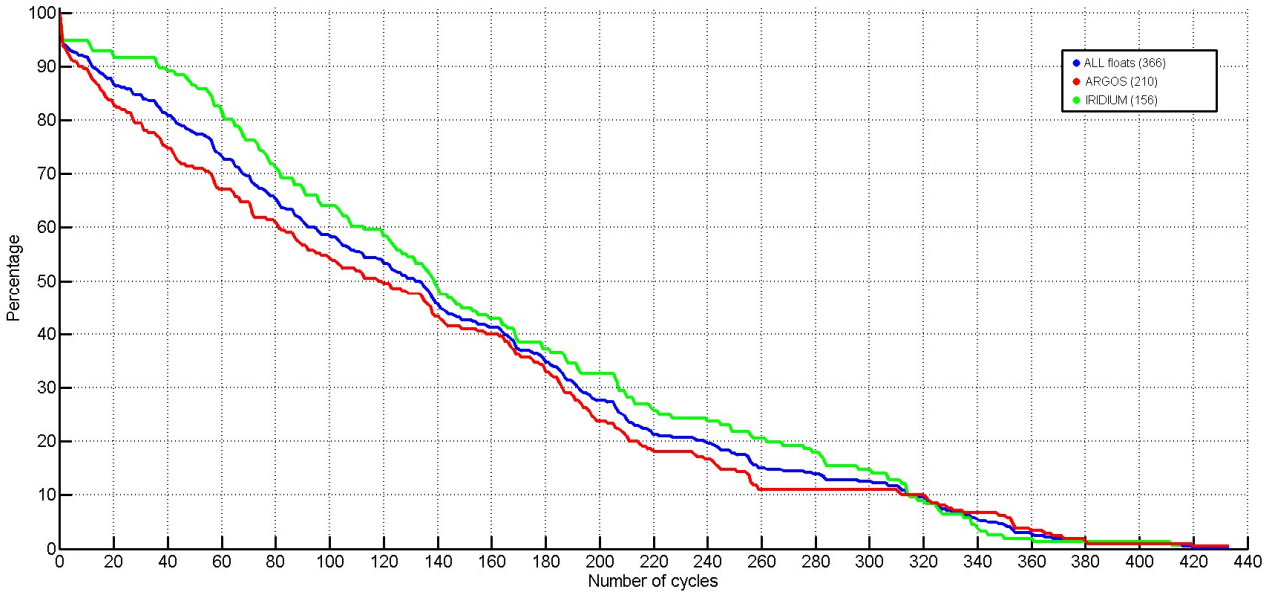


Figure 4a. Survival rate diagrams separated by telemetry system.

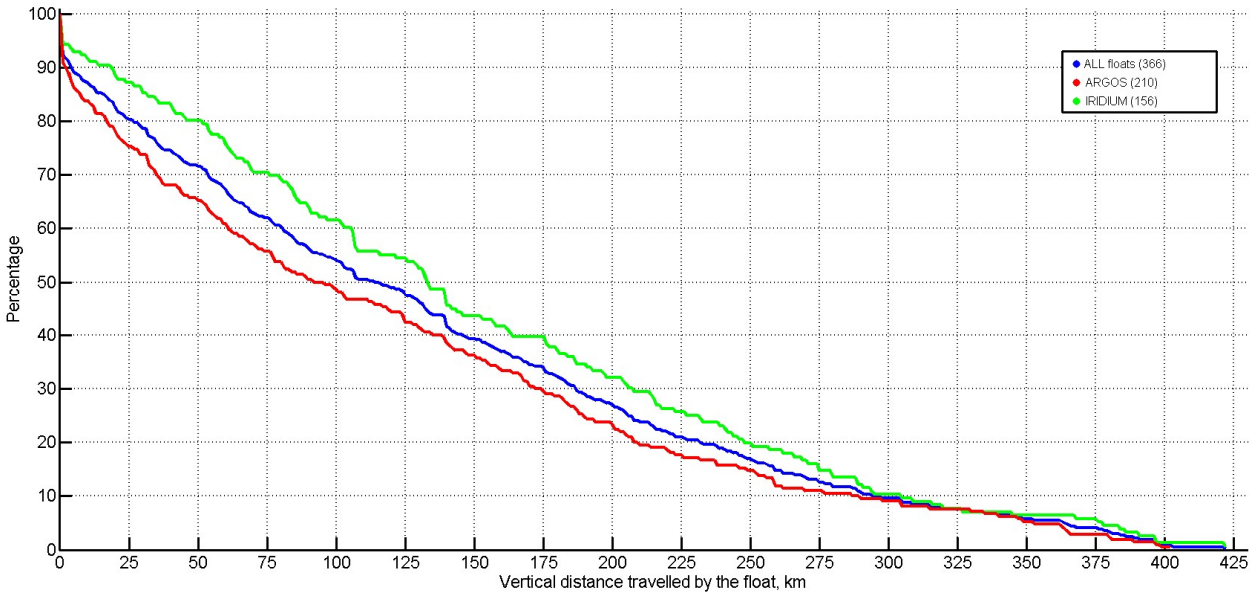


Figure 4b. Diagram of the vertical distance travelled floats, separated by telemetry system.

- **Web pages:**

A completely new web site interface has been designed and developed (http://maos.inogs.it). There are sections dedicated to marine platforms, projects and data visualization; Argo floats detailed information can now be achieved by using a searching tool (Figure 5).

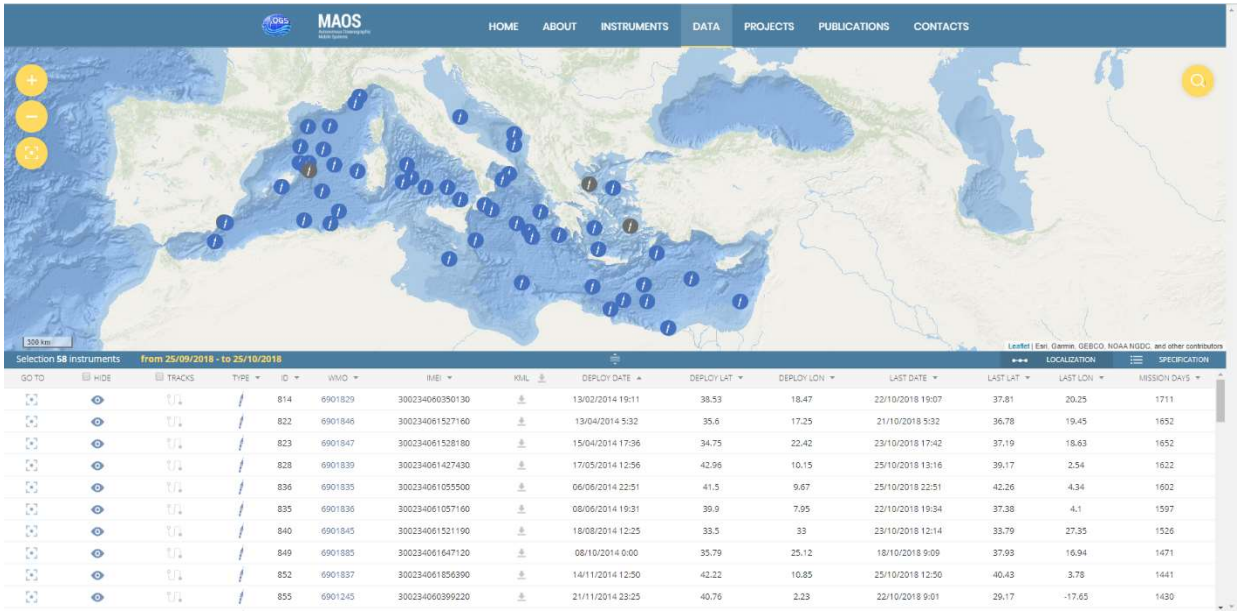


Figure 5. Argo float selection page in the new web site

The old MedArgo web page (http://nettuno.ogs.trieste.it/sire/medargo/active/index.php) is still used and tables and graphics are updated in near real time. The floats deployed during 2018 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.

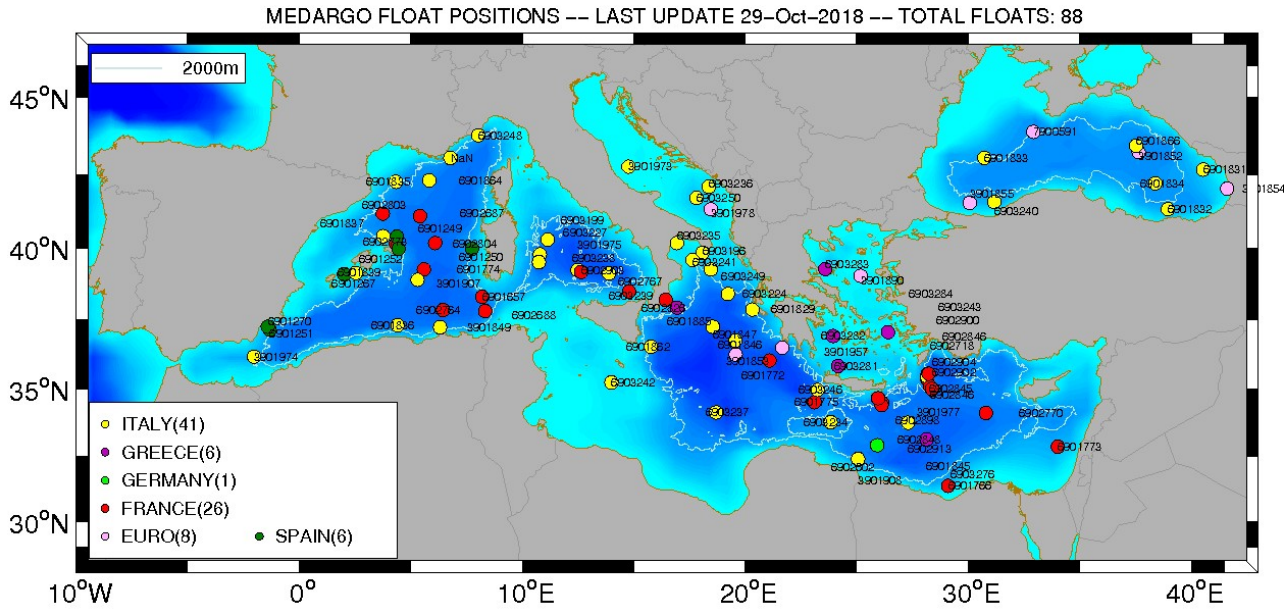


Figure 6. MedArgo float positions as of 29 October 2018 (updated daily).

- **<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).

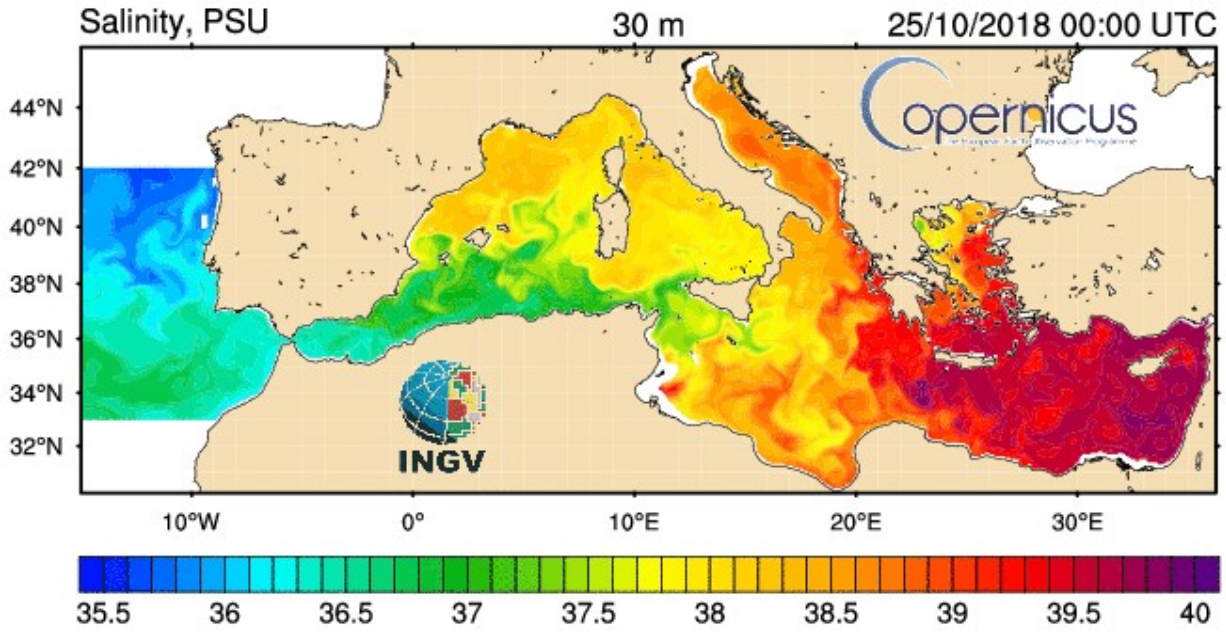


Figure 7. Forecasting model of salinity at 30 meters.

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.
- Since a manufacturing problem linked to the SeaBird Scientific CTD has been highlighted, we perform a preliminary investigation 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. It seems that 8 floats in the Mediterranean Sea, deployed since 2016, are equipped with this kind of SBE CTD. Three of these floats belong to the France (6901772, 6901774 and 6901775); four floats belong to Italy (6903196, 6903198, 6903199 and 6903202); one float belongs to Greece (6903275). Further analysis will be performed to investigate on any potential salinity drift caused by this manufacturing problem.
- The DMQC method has been applied to about 70% (as of September 2018) of the eligible floats deployed between 2001 and 2017 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 30 new floats have been deployed in the Mediterranean and Black Sea during 2018, through a coordinated activity of deployment opportunities.

The third Arvor Deep was deployed in the Rhodes trench in October 2018. It was set to cycle every 5 days and the parking depth equal to the maximal profiling depth (4000 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 50 dbar after grounding and wait there before starting its ascent.

There are 78 active Argo floats in the Mediterranean Sea and 10 in the Black Sea as of 29 October 2018.

Argo National Data Management Report of Japan, 2018

1. Status

The Japan DAC, the Japan Meteorological Agency (JMA), has processed data from 1589 Japanese Argo and Argo-equivalent floats including 150 active floats as of November 21th, 2018. 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 FTP 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 9,287 profiles observed by Japanese floats from November 8th 2017 to November 21th 2018 are in progress. JAMSTEC decoded 6,457 profiles of these, which were acquired as ARGOS messages and Iridium messages from November 8th 2017 to November 21th 2018. JAMSTEC sent 9,026 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 115,054 profiles to GDACs as of November 7th, 2017.

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
     - 244 profiles acquired from 5 floats in 2018
   - Data issued to GTS
     - None
   - Data issued to GDACs after real-time QC
     - 244 profiles in 2018
   - Data issued for delayed QC
     - 2,040 profiles
   - Delayed data sent to GDACs
     - 2,040 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
   - DMQC was accomplished using upgraded program and updated Reference DB.
   - Visual checking program was upgraded and can check profiles more precisely and correct QC flags.
   - New program was developed to fix wrong formatted data.
   - It was found that some R profile data were marked as bad even it is good. They were fixed and sent to GDAC
   - Many profile files which have no data, were removed from GDAC.
   - 11 floats have no data were removed from GDAC.
   - Some profiles need more correction to fix thermal lag effect.

Korea Argo National Data Management Report

ADMT-19

San diego, USA, Dec 2 – Dec 7, 2018

by NIMS/KMA

1. Status

1.1. Data acquired from floats

In 2018, the National Institute of Meteorological Sciences of Korea Meteorological Administration (NIMS/KMA) deployed 11 floats in total around Korea: 7 for the East Sea, 4 for the Yellow Sea (Fig. 1, 2). The NIMS/KMA has deployed 241 Argo floats in the North Pacific Ocean and East Sea since 2001, and 45 floats are in active as of November 9, 2018. 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.

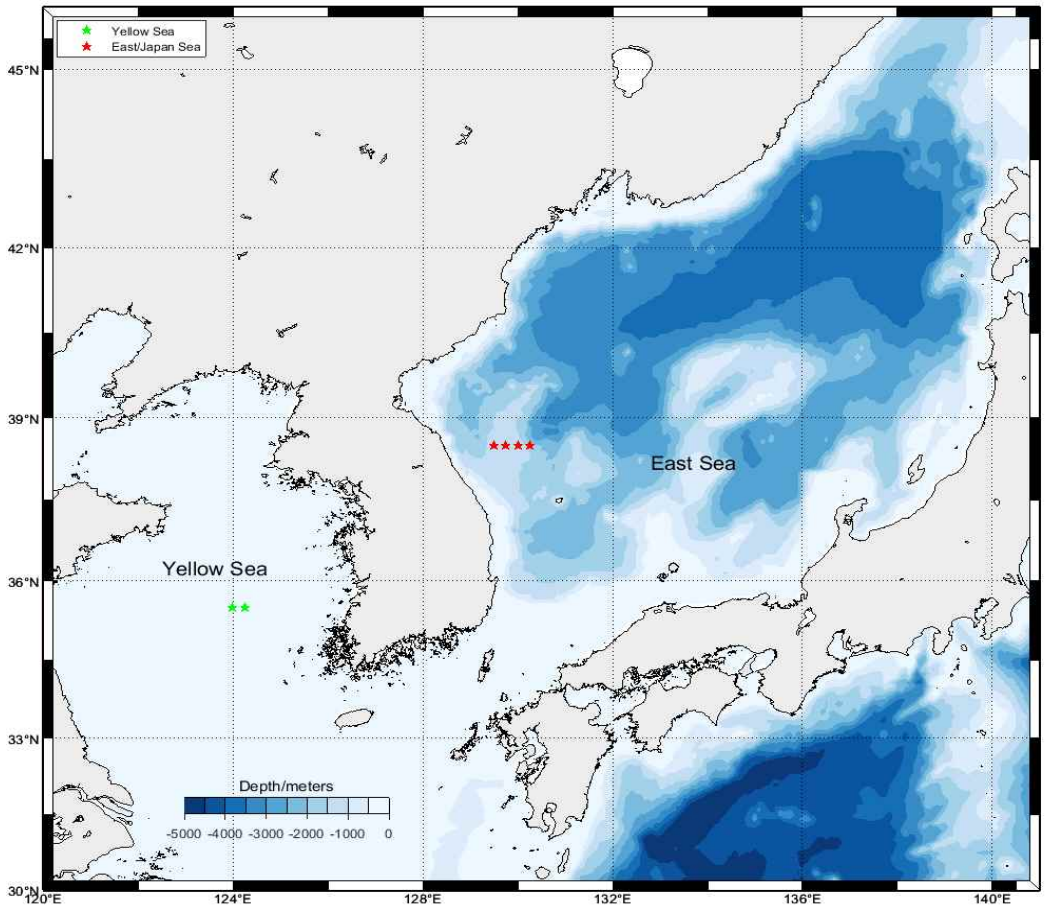


Fig. 1. Location map of deployment of Argo floats around Korea in 2018

Fig.2. Snap shot of the NIMS/KMA's Argo float deployment in the Yellow Sea and East Sea in 2018

1.2. Data issued to GDAC

Total 1,961 profiles were acquired during January thru November in 2018 and sent to the GDAC by real-time after the QC.

- NetCDF meta, technical and trajectory file conversion to v.3.1.
- transmission of converted NetCDF data to GDAC (France/USA)
  - In December 2017, We resumed sending NetCDF data to US-GDAC.
- Implementing the Argo data format check program.
- TESAC data Transmission has been stoped since August 2018.

1.3. Web pages

We 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 25,200 hits by visitors in monthly average. The web page has been updated so far and it is possible to view by the firefox, explorer and chrome browser.

1.4 Shallow Argo Experiment

An experimental observations for the shallow Argo were conducted on July and November 2018 in Yellow Sea, Korea. In July 27, 2018, two floats were successfully deployed and have been working since the starting day, showing that daily variation of temperature and salinity (see Fig. 4). On November, 10-12, two more floats were deployed by using the Gisang1, the KMA's research vessel, at the same location as July experiment at the Yellow Sea, and this kind of observation will be kept in this area in 2019.

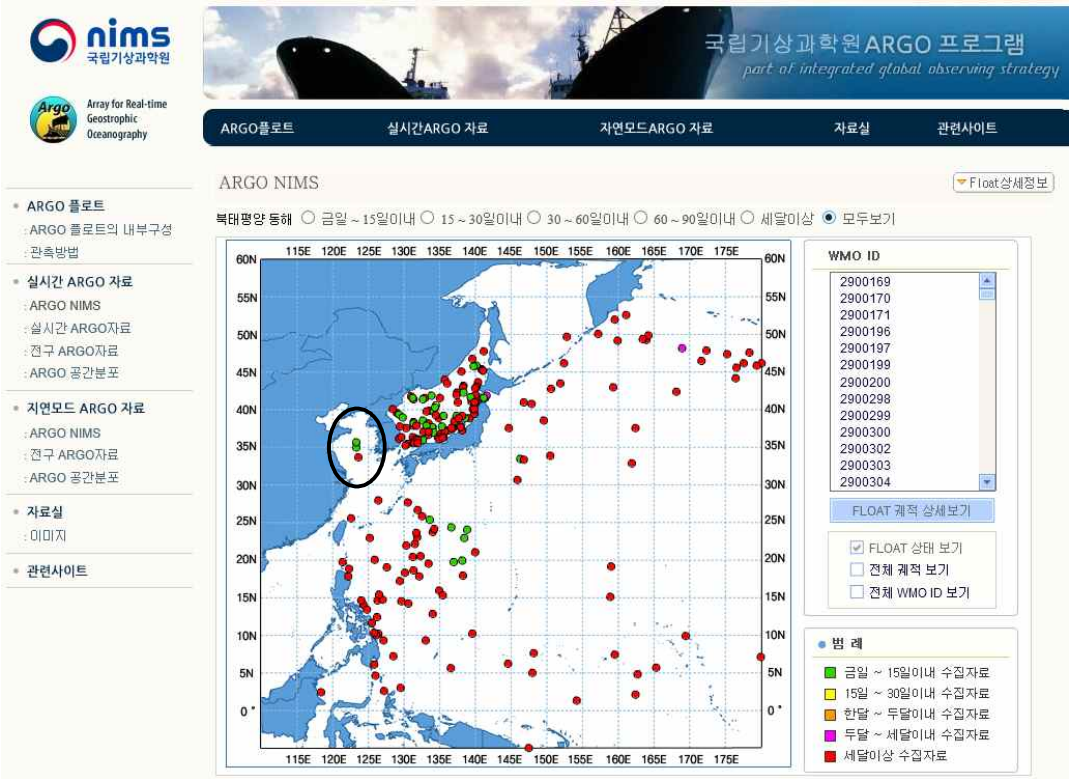


Fig. 3. Argo homepage of NIMS/KMA (http://argo.nims.go.kr)

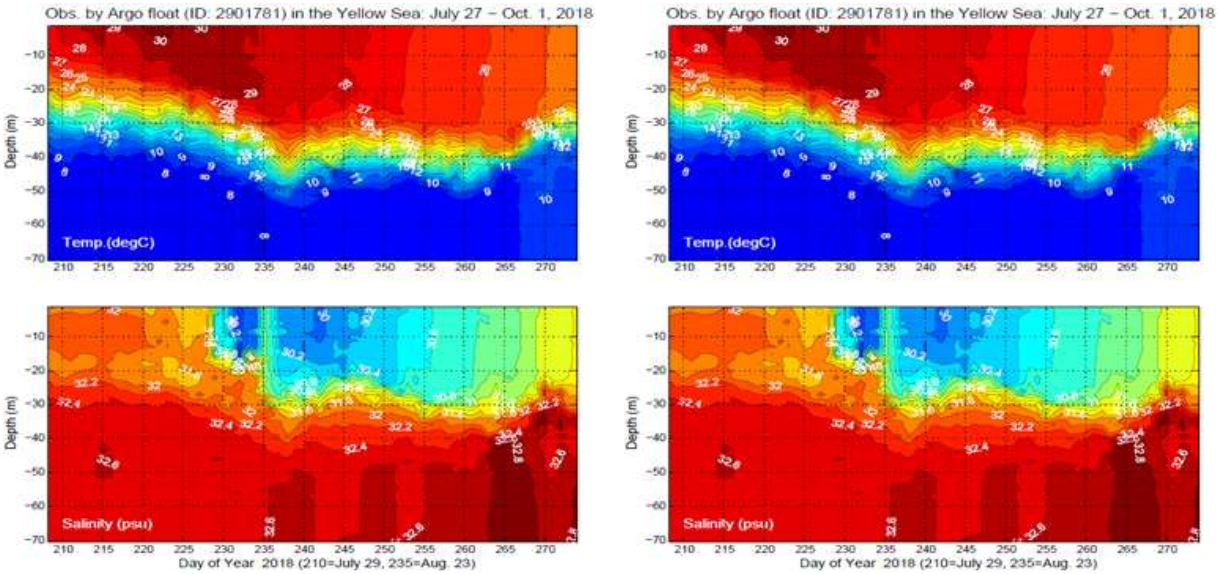


Fig. 4. Daily variation of temperature and salinity profiles from July 27 to Oct. 1, 2018, in the Yellow Sea, Korea.

1.5. Deployment plan for 2019

The NIMS/KMA will continue to deploy the 6 Argo floats around Korea such as Yellow Sea and East Sea (see Fig. 4). The red box shows a potential area for the floats to be deploy in 2019 aiming at covering the regional seas of Korea.

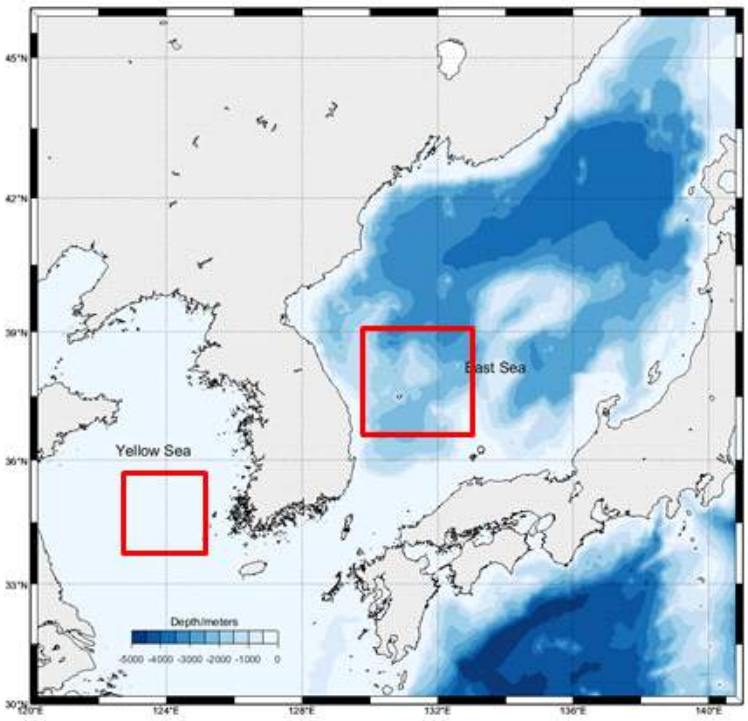


Fig. 5. NIMS/KMA's deployment area in 2019.

2. Delayed Mode QC

We thoroughly reprocessed all the previous D-files in the East Sea and will send 19,007 of the revised D-files with NetCDF format (ver. 3.1) to the GDACs by the end of this November. A precise quality control process is also being taken for the reference database in the East Sea at this moment. The new database will be applied for the DMQC in the next year, and total 1,791 of the new D-files for the floats in the western North Pacific will be uploaded, too.

Argo National Data Management Report – Norway 2018

Institute of Marine Research (IMR), Norway

1. Status

- **Data acquired from floats**

Presently there are 10 operational/active Norwegian floats. 5 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**

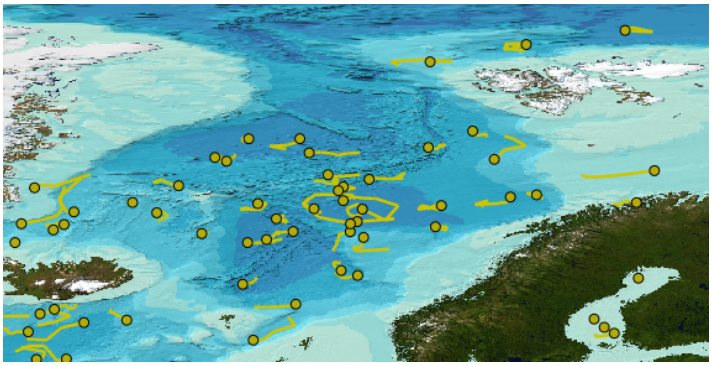
At present (30.11.2018) the Norwegian Argo fleet comprises 31 floats. According to Argo Information Center the floats have so far sampled 4054 profiles, where 2232 profiles are Delayed Mode and 1419 profiles are DM-pending.

- **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 content of the Norwegian Sea are regularly updated.

2. Delayed Mode QC

BSH has adopted all the 31 floats from Norway for DMQC (see report for Germany).

3. GDAC Functions

4. Regional Centre Functions

5. References

UK Argo National Data Management Report 2018

Report to the Argo Data Management Team – ADMT-19

Author list

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

Contributing authors: Robin McCandliss, Matt Donnelly, Clare Bellingham, Violetta Paba

Other team members: Katie Gowers, Paul McGarrigle, Elizabeth Bradshaw, Justin Buck, Sarah Chapman, Roseanna Wright

With contributions from the wider UK Argo team by:

Jon Turton and Fiona Carse (UK Met Office)

Brian King (National Oceanography Centre)

Giorgio Dall'Olmo (Plymouth Marine Laboratory)

Status

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).

General Status

BODC Argo Team

The team currently has two members who work full time on Argo (Matt Donnelly and Clare Bellingham). Katie Gowers and Violetta Paba both work part-time on Argo (0.4 FTE and 0.3 FTE, respectively). Liz Bradshaw and Paul McGarrigle provide support to DAC operations by covering daily processing now and again, as required.

Early in 2018, Matt Donnelly took on responsibility for leading the BODC Argo team and used the opportunity to assign responsibility for defined areas across the team. Responsibility for the DAC workstream has been assigned to Clare Bellingham for the core floats and Violetta Paba for the BGC floats. Katie Gowers is leading the software development workstream, with Clare Bellingham as part of her development team. Justin Buck remains involved on a reduced basis, supporting the regeneration of delayed-mode QC and as a source of expertise and advice. Additional short-term support has been provided to the team by Sarah Chapman working on developing a Southern Ocean deployment guide, and Roseanna Wright who has supported data screening.

The Argo Lead role comes with a significant management overhead, requiring time for project management, attending meetings, preparing reports, reviewing finances, responding to new funding initiatives, managing the team and prioritising their work.

It is worth noting that over the past year there was substantial training time required for Clare and Violetta, to develop their capability in Argo processes. Clare and Violetta have been learning how to do DMQC, and Clare has been learning the software development protocols required for development of the system. In addition to Argo specific development work, the BODC Argo team has completed a system-wide Matlab upgrade during early 2018. None of these activities were trivial.

BODC is currently recruiting an addition to the Argo team in order to address DMQC requirements for MOCCA and UK Argo, and free up the existing team members to focus on NRT operations and development of the system to handle new float types.

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 will continue providing additional sources of data management funding, such as from the ORCHESTRA, ACSIS, BoBBLE and RoSES projects. BODC receives funding from the Euro-Argo ERIC MOCCA project for the European Union floats that are managed by BODC, as well as some funding from the EU H2020 AtlantOS project to support delayed-mode QC of Argo extensions.

During 2018, UK Argo was involved in a successful EU bid culminating in Euro-Argo Research Infrastructure Sustainability and Enhancement (Euro-Argo RISE), where BODC's involvement will encompass DMQC coordination, knowledge sharing of DMQC processes, evaluation and development of DMQC tools and to introduce Southern Ocean regional data quality assessments. BODC was also part of the successful ENVRI-FAIR bid, with the intention of using the NVS vocabulary server to support Argo vocabulary management. BODC continues to seek additional sources of funding to support SOARC functions, some of which will be provided by the EU MOCCA and Euro-Argo RISE projects, but a long-term solution is yet to be identified.

DAC Functions

Data acquired from floats

BODC retrieves data for all UK, Irish, Mauritius and EU MOCCA floats from a number of sources and archives these for further processing. Where possible, processing of arriving data is normally setup within one week of float deployment, and during the past year this has typically been achieved much more quickly for those floats where capability exists. Please refer to table 1 for the types of communications used for different floats.

Progress in the past year:

During the past year, BODC has improved management of incoming data for floats that we are not currently distributing data for to enable float position monitoring as both part of the full delivery of data and as an interim monitoring check.

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 kindly providing the processing for a dozen PROVOR BGC floats and delivering the core data to the GTS on BODC's behalf until BODC can take on the management of these floats. The results of improvements to system performance, a proactive approach to loading floats to the BODC Argo System, and increased frequency of data processing and delivery can be seen in figure 1.

Progress in the past year – general processing:

BODC is currently distributing data to the GTS for c. 221 floats at the time of writing, which is an increase from 151 in November 2016 prior to the start of processing floats for the EU MOCCA project. During 2018, BODC has sustained automated data processing four times a day, rather than twice a day as was the case prior to 2017. Generation of BUFR files was transferred from BODC to the Met Office during 2018 following the successful development of the BUFR converter (see below). BODC ceased issuing TESAC messages to the GTS on 1st July 2018, as agreed by ADMT and AST in 2017. Delivery of core data for floats not currently processed has been a major focus during the past year, particularly for all APF9I/N1/N2 floats, but also work on APF11, and remains our highest priority for completion.

Progress in the past year – BUFR converter:

In support of a new Python netCDF-to-BUFR converter, BODC makes all netCDF files available directly to the Met Office via SFTP and this is now occurring on a routine basis four times a day. Testing was completed during early 2018, and the Met Office took over responsibility for the BUFR generation and distribution on the GTS on 5th June 2018. The BUFR messages from the UK Met Office have the header "IOPXII EGRR". During October 2018, the Met Office sent the Python conversion code to Megan Scanderbeg and Rebecca Cowley, to be made freely available on the ADMT software tools web page. The code has been designed to be extensible, where capability for secondary temperature/temperature and salinity, and oxygen profiles can be added plus other BGC variables when required. The Met Office plans to extend the software to include secondary T/S profiles and oxygen profiles during 2019.

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 finish the work ensuring all floats with an APF9I/N1/N2 controller board are effectively managed within the BODC Argo System, and the main attention will then turn to floats with other controller boards such as the APF11. BODC is seeking to collaborate with other DACs in the development of APF11 decoders.

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 not yet completed the conversion to v3.1 for all file types. With the exception of a small number of legacy files, all metadata files are delivered in V3.1. Significant portions of the core profile files are delivered in v3.1, with the remainder currently being addressed. Please refer to table 1 for the types of float and whether they are being fully processed.

Progress in the past year:

BODC has progressed the delivery of core profile files in v3.1 netCDF files, with now ~ 80 % in v3.1 compared to ~ 60 % at the last ADMT as per the last Report on Anomalies. Progress on the conversion has been slowed by other priorities but work to complete the remainder of the profile files is currently underway, with a submission of ~9300 further profiles in late November 2018. Additional progress has been made on delivering tech files in v3.1, now on 30% with additional batches planned for early 2019. A significant backlog on quality control feedback from Objective Analysis and Altimetry QC reports has been mostly cleared at the time of writing and will be completed in the near future.

Current activity and future plans:

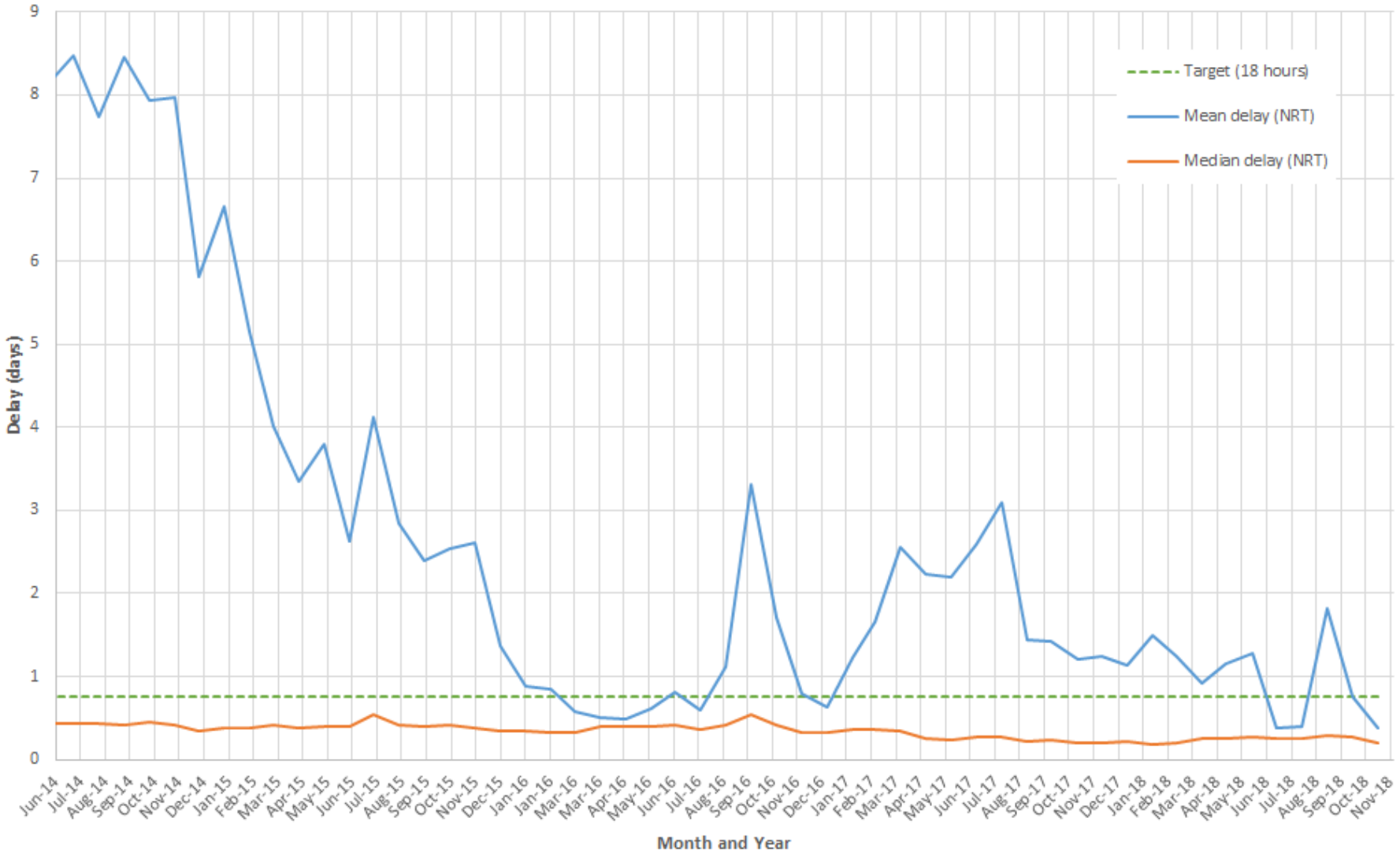
There remains substantial further work to complete the delivery of the remaining core profile, tech and trajectory files, in that order of priority. We are not currently issuing any BGC-Argo files for UK floats due to the current focus on core profile data. The exception to this is the dozen PROVOR floats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

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	1	-	1	-	-	-	-	1
NKE Provor *	Iridium SBD	13	10	-	-	-	-	-	10	10
NKE Arvor	Iridium SBD	76	74	-	-	74	-	-	-	74
NKE Deep Arvor	Iridium SBD	2	-	-	-	-	-	-	-	-
SBE Navis N1	Iridium Rudics	14	7	7	7	-	-	-	-	6
SBE Navis N1 with BGC	Iridium Rudics	4	1	-	-	-	-	-	1	0
SBE Navis N1 with oxygen	Iridium Rudics	8	8	-	-	-	-	8	-	0
SBE Navis N1 with radiometer	Iridium Rudics	3	3	-	-	-	-	-	3	0
TWR Apex APF7	Argos	8	-	-	-	-	-	-	-	-
TWR Apex APF8	Argos	252	1	1	1	-	-	-	-	1
TWR Apex APF9A (7 types)	Argos	266	139	19	28	111	-	-	-	139
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	-	-	-	0
TWR Apex APF11	Argos	7	7	-	7	-	-	-	-	0
TWR Apex APF11	Iridium Rudics	12	9	n/k	-	-	2	-	7	0
TWR Deep Apex APF11	Iridium Rudics	10	2	n/k	-	-	-	2	-	0
TOTAL		666	260	29	46	188	2	10	21	233

* = processing courtesy of Coriolis

Figure 1: Summary of all BODC internal processing times from time of profile to processing completion, indicative of GTS delays



Data issued for delayed-mode QC

All delayed-mode QC on BODC hosted floats is performed within BODC, with the exception of ~35 floats funded under the Euro-Argo MOCCA project. Currently BODC is only capable of providing data for delayed-mode QC for core data, with work required to finish the delivery of biogeochemical parameters in v3.1. Again, the exception to this are a dozen PROVOR floats that Coriolis is kindly hosting on BODC's behalf. See section 2 of this report for the status of delayed-mode QC.

For any given float, if the R-mode or A-mode file is available following real-time QC, then any profiles that have been through delayed-mode QC will be available as D-mode files. This applies to float profile files that are in either v2.2 and v3.1 format.

Progress in the past year:

Progress on v3.1 profile files has made more delayed-mode files available in v3.1. BODC has also begun liaising with relevant Euro-Argo partners to manage the delayed-mode files for MOCCA floats as they become eligible for delayed-mode QC.

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. See section 2 of this report for the status of delayed-mode QC.

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)

Elaine McDonagh is also engaged in using Argo data, bidding for float funds, planning strategies, leading analyses and mapped products

The applications of Argo data at NOC include:

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

UK Met Office

Argo 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;
- and to better understand the nitrogen cycle in oxygen minim zones.

Data Products

National Oceanography Centre

Elaine McDonagh is engaged with 4-D global fields of mapped Argo T and S (Desbruyères et al. 2017), but they are not currently publicly available, however Elaine can be contacted by any interested parties.

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/);
- HadIOD 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, HadIOD obtains sub-surface profile data from EN4. Public release of the data are expected during 2017. HadIOD is expected to supersede the HadGOA data product, which has not been updated for approximately 7 years (http://www.metoffice.gov.uk/hadobs/hadgoa/).

The datasets are used for climate and global change studies, including ocean heat content analysis.

Delayed-Mode QC

Following the regeneration of delayed-mode QC capability though a software and procedural review last year, efforts this year have focused on training additional DMQC operators. This has included BODC (Justin Buck, Matt Donnelly, Clare Bellingham and Violetta Paba) and NOC (Brian King) contributing to the preparation for or attending the 1st European DMQC Workshop, as well as in-house training for Clare Bellingham. BODC use OW software for delayed-mode quality control with the latest reference data available from Coriolis (CTD climatology and Argo profile climatology for guidance).

Following advice from the wider UK Argo team, and particularly from Brian King, we are currently working with the following considerations in-mind:

- To facilitate increasing knowledge/experience of regional oceanography we are addressing DMQC on an ocean basin-by-ocean basin basis. DMQC started with the Indian Ocean last year, with focus moving onto the South Atlantic during 2018, followed by the Southern Ocean and North Atlantic.
- To facilitate increasing knowledge/experience of the use of the OW software and to avoid applying excessive corrections, we are tackling floats with simple pathologies first, then moving onto floats with increasingly complex pathologies as DMQC skills improve within BODC;
- Pursuing delivery of DMQC for the EU MOCCA project floats to meet project deliverables irrespective of basin or complexity.

During Autumn 2018 BODC started the first significant batch of South Atlantic DMQC since 2013 and these are due for submission to the GDACs soon, alongside work on the initial batch of DMQC on EU MOCCA floats. In addition, BODC has started handling DMQC submissions from Coriolis, BSH and OGS as part of the EU MOCCA project.

Violetta Paba at BODC has begun using the SOCCOM/MBARI tool SAGE-O2 to generate the capability at BODC to perform A-mode and eventually D-mode QC on oxygen data.

Current activities and future plans:

BODC has recruited a new member of staff who will have a primary focus as a DMQC operator. This person will start in January and as such BODC expects to achieve a significant improvement in the DMQC situation during 2019.

As part of the EU Euro-Argo RISE project, BODC plans to compile a report on globally available Argo DMQC tools to provide an understanding of the current state of development. The aim is to cover matters such as the 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 improving the sustainability of DMQC tool development within the global Argo data system and at the European level. All organisations with DMQC tools are invited to contribute information to this report. Additionally, BODC will be contributing to the further development of oxygen and pH QC procedures.

GDAC Functions

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."

BODC seeks to receive input from the Argo Data Management Team about the perceived issues with existing vocabularies (Argo reference tables) and additional services that could be developed on-top of the NVS to serve Argo and wider applications. Whilst BODC has the infrastructure to provide technical governance, a content governance structure will need to be discussed, agreed and clearly established.

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.

BODC was present at the BGC Float Workshop in Seattle where it highlighted the need to ensure that the legacy of the SOCCOM project is sustained into the future by international coordination in the region through SOARC. Please refer to the workshop report (when available) for further details.

As a result of increased funding for DMQC-related activities and SOARC, BODC aims in the coming 18 months to 4 years to:

- Provide support to other national programmes with DMQC, with a focus on the Southern Ocean (e.g. orphan floats);
- Improve high latitude Southern Ocean deployment opportunities by, for instance, compiling a guide to deployments in the Antarctic Treaty System area, a draft of which is available;
- 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).

As part of achieving the above, in addition to collaboration with SOARC partners, BODC is in the process of establishing collaborations with the University of Liverpool and University of Bristol.

References

Desbruyères, D., E.L. McDonagh, B.A. King, and V. Thierry, 2017: Global and Full-Depth Ocean Temperature Trends during the Early Twenty-First Century from Argo and Repeat Hydrography. *J. Climate,* **30**, 1985–1997, https://doi.org/10.1175/JCLI-D-16-0396.1

US NATIONAL DATA MANAGEMENT REPORT

December 1st 2017 – November 16th 2018

19th ADMT Meeting

at Scripps Institution of Oceanography

STATUS

US Argo Data Assembly Center at AOML, summary

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 data originated from 2,600 floats and processed more than 92,00 profiles in real time.

The US Argo DAC added 326 floats to the processing system, for 65 of them the deployment was done in a collaboration between AOML and WHOI . Recent maps showing their positions with link to graphics of the data collected by the floats can be found at:

ww.aoml.noaa.gov/phod/argo/opr/php_forms/deployment_maps.php.

The distribution of data to GTS in TESAC format was discontinued on July 2018. During that period of time were submitted approximately 46,400 profiles and 95% of those profiles were transferred within less than 24 hours of transmission. The US Argo DAC also has distributed over 79,000 Argo profiles to GTS in the BUFR format (excluded from this are NAVO floats), where 95 % of them reached the system within the 24 hours .

The distribution of real-time profiles to both GDACs was improved with about 96% of them available within 24 hours. 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 US Argo DAC is also receiving the delayed-mode data from US floats and passes them on to the GDACs. The US Argo DAC maintains an ftp server for file exchanges between the DAC and Delay Mode operators (both for providing reprocessed R-mode files and for receiving D-mode files) as well as for real-time submission of data from Iridium floats and the submission of deployment information.

The US Argo DAC has continued its involvement in deployment planning by finding ships of opportunity and providing ship riders for selected cruises.

The US Argo DAC is maintaining a website that provides documentation and information about the operations as well as some information on Argo-based scientific research:

http://www.aoml.noaa.gov/phod/argo/index.php

Developments at the US Argo DAC

The software for processing data from a modified format originally only used for RUDICS data (msg format) was adapted to process a new instrument type NAVISIR_TSOPJ2 deployed by University Maine. In addition to this, the software was improved to handle files with corrupted drift measurements, missing sampling schemes in meta files and a mix of data from two floats within a submitted msg file.

Tracking Bufr files being sent to GTS was implemented by looking for the submitted data in downloads from GTS. To accomplish this robustly, the program to read the content of bufr files (argobufrdump) was improved (to avoid segmentation fault caused by problems related to memory allocation).

The process to receive and distribute netcdf files (D, BR) was modified to add proper handling of BD and AUX files. The DAC also adapted the code used to check phy files decoded by data providers for inconsistencies and formatting problems (.e.g, problems with measurement codes, or the direction of a profile).This software was also implemented on our remote mirror system.

Because AOML has to have the capability to create BR-files for some floats while not replacing BR-files provided by the float owner, a new system was set up that checks if the US DAC generated file should be sent to the GDAC or not. A similar process was also necessary for meta.nc files, because the float owner may provide a D-moded meta.nc file that should not be replaced in cases where US DAC creates a new real-time meta.nc file.

The US DAC is downloading the error ellipse data from CLS in real-time and stores them in position files. A system to add these to the traj files is being developed.

The US DAC is providing access to its real-time netcdf files to the US Argo partners, the software that does this has been improved to increase its speed and reliability.

The US DAC migrated the whole operational system from a Unix computer to a much more powerful Linux computer and was thus able to increase the frequency of processing the Iridium data from 3 times a day to 14 times a day (implemented 11/15/2018) . This new computer is mirrored daily to a second computer at AOML. In addition to that, the mirror server at a remote location (far from Miami) was replaced with a computer that previously ran the processing at AOML to replace an older computer.

Our qc and netcdf file generating software was adapted to process data from ALTO Iridium floats. In addition to that, the software for the traj.nc file generation was updated to improve the quality of these files. The software for writing meta.nc file was updated as well to fix issues causing GDAC rejections and to include information from new sensors in these files. With respect to profile files, to handle cycles without a primary profile and create correct nc files in

these cases (NPROF=1 empty). Updates were implemented to accommodate new parameters in the meta.nc and tech.nc files as well as measurement codes in the traj.nc files.

An updated version of the Bufr generation program was implemented to encode BR files along with data from R files. This was done in close collaboration with Anh Tran from MEDS who developed the code. Our feedback lead to improvements of the encoder.

Processing system was updated to process data files from deep Argo floats deployed by PMEL.

The program to update flags based on the objective analysis test performed at Ifremer was redesigned and implemented to include additional checks and thus improve its performance and reliability. AOML also made suggestions on how to improve the provided reports.

A quite significant update was the adaptation of our profile nc generator to make BR and R files in format version 3.1 files to replace the version 3.0 files of the majority of those oxygen-only bio-Argo floats the US DAC is responsible for. This required ensuring that all required parameters are included in the BR v3.1 file, along with the quality control flags. BR files of Bio-Argo floats deployed by UW with bio-sensors in addition to oxygen are handled by MBARI. The floats impacted by this upgrade were reprocessed to replace the version 3.0 files at the GDACs. The only remaining 3.0 files from AOML are now from a few specialty floats: (1) floats for which each even cycle contains on the order of 7 short bounce profiles (103 floats; their standard cycles are in format 3.1). The other specialty floats are prototypes with two or three oxygen sensors (8 floats).

With respect to core Argo profile files, the software was modified to allow the processing of floats that record additional profiles (for example an extra profile for bio-data and two extra profiles for near-surface temperature and salinity). This required the capability to make profile files with N_PROF set to 3 or 4. Many other changes in 2018 involved adapting the quality control and file production software to run on a Linux computer, which required changes due to differences in compilers and libraries (e.g., format statements,, variable and array declarations and initialization of variables). Improvements were implemented to facilitate operational monitoring and more quickly and reliably identify problems as well as recognize floats that need to be grey listed due to failures of the frozen profile test. Another requirement that was implemented is the application for quality control flags from PSAL to CNDC. As required by ADMT, in cases where TEMP and/or PSAL is interpolated in secondary profile, these interpolated values are no longer being retained in the R files. Another thing that was improved was the determination of the resolution of data measured and reported by floats.

A float can have profiles for which and interpolated positions has to be derived. Typically, this is needed for floats under ice – but this is not always the reason. The processing system now attempts to distinguish under ice profiles from other cases, and to notify the operator about interpolated cases that are not identified as under ice for further analysis.

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 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. Last year, on 13 November 2017, PMEL had 113,795 D-files at the GDAC that were more than one year old, comprising 72% of the total of 158,072 PMEL profiles that were older than one year at that time. So, John Lyman's and Kristy McTaggart's DMQC efforts resulted in a net increase of 44,775 DMQC profiles for profiles older than one year, well over twice the 20,793 profiles that became older than one year during that time. Over the past two years, they have made excellent progress towards clearing the PMEL DMQC backlog.

That DMQC backlog arose mostly from delays owing to difficulties encountered during major maintenance and upgrading efforts on PMEL DMQC software in response to Argo format changes and internal IT requirements, as explained in previous reports. It took considerable time and effort to make these changes, and debug them.

John Lyman and Kristene McTaggart are continuing their DMQC work. John Lyman is also continuing work on streamlining our DMQC GUIs and processing. 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 (2014V01) and Argo (2014V04) 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

During the past year, Scripps Institution of Oceanography (SIO) has evaluated, as part of delayed-mode quality control (DMQC), a total of 231,512 Argo stations (profiles). This is an increase of 21,407 stations (586 nominal float years) since the previous Argo Data Management Team (ADMT) Report (November 06, 2017). At present, 98.8% of the SIO DMQC-eligible

stations have had their quality assessed. Here we define a station as being elibible for DMQC if the transmitted data is 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 be able to continue 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 2017.

During the year, the trajectory data from 52 end-of-life SIO Argos SOLO floats were delayed-mode quality controlled 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 956 DMQC trajectory netCDF ('Dtraj') data files available at the GDAC from SIO Argos floats (96% 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 is completed as part of the standard 7-9 month DMQC revisit 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 (97.8% total, 100% Iridium, 96.0% Argos).

Scripps has actively participated in moving forward Argo Program priorities during the year, most notably by Megan Scanderbeg's continued work with the Version 3.1 trajectory file. SIO continues to semi-annually update the Argo Climatological Dataset for OW salinity calibration. John Gilson has worked with Susan Wijffels (WHOI) and Annie Wong (UW/CSIRO) to assess and document the change in behavior of the SBE41 and SBE41CP CTD sensor stability within Serial Number ranges. Nathalie Zilbermann and Dean Roemmich have worked with Seabird to improve the calibration of the SBE61 used within the Deep Argo Program.

Scripps continues to work with float developers (IDG[1], MRV) to add capabilities to the SOLOII/S2A/Deep SOLO float types. The battery passivation evident in earlier SOLOII/S2A Iridium floats has been overcome with the transition to a new battery manufacturer: Tadiran hybrid lithium batteries. The first Tadiran battery pack float has been active for 3 years (completing 157 cycles), with no evidence of battery passivation nor other float reliability issues related to the introduction of the new battery type. All deployments since 25 Aug 2017 have been equipped with Tadiran batteries (215 to date). Several firmware upgrades have been added to the

SOLOII and Deep SOLO, including the diagnostic measurement of CPU temperature and relative humidity and the ability to profile on both ascent and descent (Deep SOLO only).

At present, Scripps has 47 active Deep SOLO floats spread over 4 Deep Argo pilot arrays. During the year, Scripps deployed 11 Deep SOLO floats to renew and expand the Southwest Pacific Deep Argo array. In addition, during the latest Deep SOLO deployment cruise on the R/V Kaharoa to the SW Pacfic array, two Deep SOLO were recovered in order to replace their failed SBE61 CTDs. After successful replacement, the floats were redeployed. During the year, a new Southern Ocean pilot array was initiated south of Australia with the deployment of 5 SIO Deep SOLO and a mix of other Deep Argo float models. All Deep SOLO data is reaching the GDAC/GTS within 24 hours of being received.

University of Washington

D-mode profile files for 304 floats were received.

MBARI (Monterey Bay Aquarium Research Institute) by Tanya Maurer.

Biogeochemical data from SOCCOM and pre-SOCCOM-equivalent floats are currently being processed and subjected to real-time and delayed mode quality control by MBARI (a total of 181 BGC floats). BR- files are being generated and transferred to the Argo GDACs at a frequency of twice per day. "Delayed mode" assessment of oxygen, pH and nitrate data is performed on a bi-annual basis. BD-designated files generated at MBARI signify that at least a preliminary DM assessment has been performed, although BD* files are subject to updates periodically throughout a float's life. MBARI-developed MATLAB software used to perform BGC DM assessment is now publically available through the SOCCOM github at https://github.com/SOCCOM-BGCArgo/ARGO_PROCESSING and is starting to be utilized by the international community. On July 15-19, 2018 a training workshop focused on real-time and delayed mode BGC processing and quality control procedures was held at the Second Institute of Oceanography in Hangzhou, China, led in part by MBARI personnel.

During the period of October 1, 2017 – October 30, 2018, 32 BGC floats were deployed as part of the SOCCOM array. During this same period, 9,712 BR* files and 8,779 BD* files were submitted to the GDAC. In addition, documentation outlining pH processing at the DAC level (including real-time and delayed mode procedures) was produced and published on the Argo Data Management Team web site.

Wood Hole Oceanographic Institute

During the period Oct 1st 2017 to Oct 30 2018, WHOI deployed 69 Argo floats and reported 14084 profiles to the GDAC. The total number of WHOI profiles at the GDAC is now 188980 profiles (138476 D-files, 50504 R-files). Of the profiles eligible for DMQC, 80.4% have been completed (138094 D-files, 33717 R-files).

In 2018, WHOI began limited deployments of a new platform, the MRV ALTO, an instrument with similar size of a SOLO-2 but with a potentially more efficient hydraulic system. The majority of the WHOI fleet remains composed of MRV S2A instruments (334 floats) and there are still a few older SOLO-WHOI floats active (23 floats).

WHOI also added a new employee, Deb West-Mack, to assist in data management and operations. She has been learning the OW analysis for DMQC as well as developing a protocol for addressing the backlog of R-trajectory files from the early SOLO-WHOI floats. The telemetry from this hardware provided very few time stamps. Using the known mission files, we are filling in timing information and MC codes to the best of our ability. Other improvements to software include additions to the WHOI decoder so that trajectory MC codes are now reported correctly in the real-time data stream. Sachiko Yoshida at WHOI continues to work on DMQC of NAVO floats, so far completing DMQC on 71 floats in the Arabian Sea.

Wijffels worked with Gilson, Robbins and Wong to do a global analysis of salinity drift against CTD serial numbers. This analysis confirmed the DMQC results seen in the UW and SIO fleet of a particular SN cohort developing a salty bias faster than normal and with larger frequency. This analysis has been shared with SBE and will be updated for the ADMT meeting.

In collaboration with float CTD manufacturer SBE and RBR, WHOI is also testing both RBR and SBE CTDs against a ship board CTD system on the RV Armstrong in November. Both dynamic and static errors will be analyzed. Three RBRArgo’s will be tested, and two SBE41CPs, one with a Kistler and one with a Druck pressure sensor. If the comparison is successful the results might be available for the AST-20 meeting.

World Meteorological Organization &

Intergovernmental Oceanographic Commission (of UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR

OCEANOGRAPHY AND MARINE METEOROLOGY

19th Session of the Argo Data Management Team meeting

December 2018, San Diego, USA

JCOMMOPS Report

Authors:

M. Belbéoch

Summary and Purpose of Document

This document provides a review of Argo data flow issues for year 2018, including notification process, real-time and delayed-mode data flow, metadata and latest developments realized by JCOMMOPS in support of Argo.
The ADMT is invited to comment on this document and take note of recommendations.

1. Argo status

Argo has reached 4000 operational floats in the last couple of months, and the reality should be lightly higher as several floats do not share their data yet.

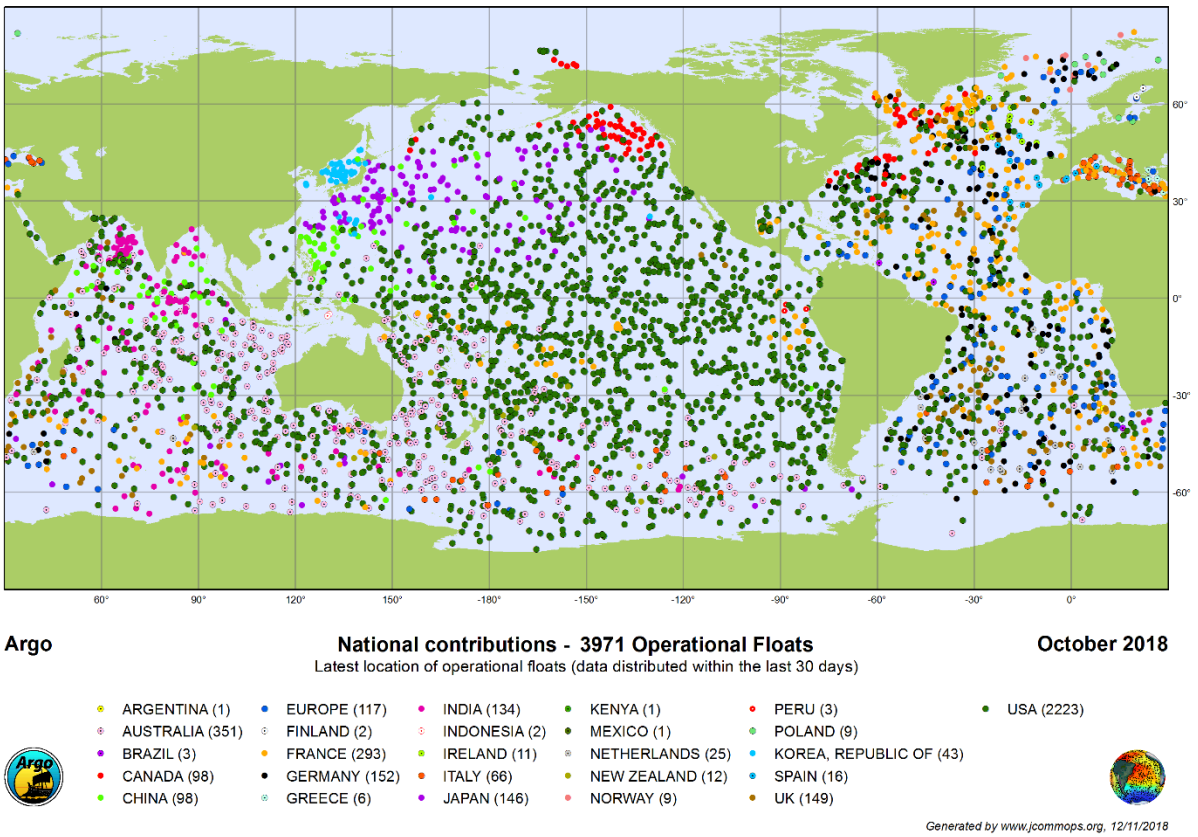


Fig. 1: Argo status by country, as of October 2018

Performance indicators on Argo implementation, based on the 3700 floats array target show an appropriate activity globally, and an intensity a little too short (84%) to meet the target based on 150 cycle lifetime floats. The increase of floats lifetime up to 250 cycles is critical to avoid an anticipated decay of the array.

Activity is slightly too high in North Atlantic and South West Pacific, and inadequate in the Southern Ocean seasonal ice zone (40%) and Marginal Seas (70%) (see Fig. 2).

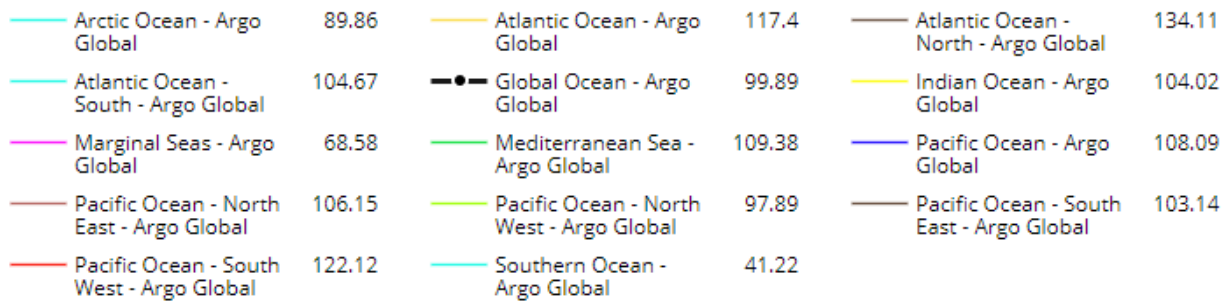


Fig.2: Argo activity by basin (%)

The intensity of yearly deployments is too low in the Southern Ocean (50%), in the Arctic ocean (30%), in the Indian Ocean (60%), in the Marginal Seas (65%), and too high in the North Atlantic and Mediterranean Sea (135%), and adequate elsewhere.

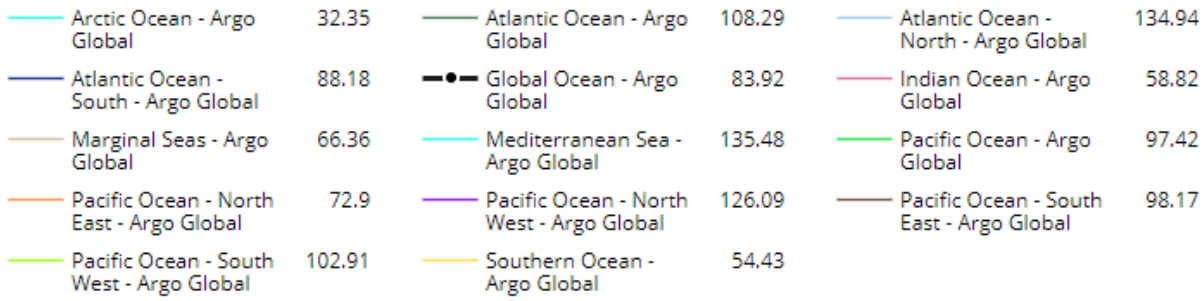


Fig.3: Argo intensity by basin (%)

The spatial distribution is good everywhere except in the Southern Ocean, with an even worse situation in the winter with 50% of iced over floats not transmitting data in real-time.

Reliability (010) Argo Global	80.79% 10/2018 ↘
Reliability (025) Argo Global	83.15% 10/2018 ↘
Reliability (050) Argo Global	89.21% 10/2018 ↗
Reliability (075) Argo Global	81.15% 10/2018 ↗
Reliability (100) Argo Global	74.73% 10/2018 ↘
Reliability (125) Argo Global	71.39% 10/2018 ↗
Reliability (150) Argo Global	59.77% 10/2018 ↗
Reliability (200) Argo Global	36.27% 10/2018 ↘
Reliability (250) Argo Global	18.98% 10/2018 ↗
Reliability (300) Argo Global	6.73% 10/2018 ↘
Reliability (350) Argo Global	4.7% 10/2018 ↗
Reliability (400) Argo Global	2.17% 10/2018 ↘

Fig.4: Float reliability vs targets

There is still room for improvement with float performance. 20% of floats fail in the first 100 days at sea and only 60% reach 150 cycles. The new ideal target of 250 cycles is achieved by 20 % of the fleet.

More details will be provided in the following sections of this report with regard to the data flow.
In short, the real time data delivery is good with 95% but can progress; the proportion of grey-listed floats was doubled in October 2018 to reach 10%; 90% of the floats send their data within 24h of observation date and the DM processing has gained recently 5% to be at its best level ever (75%).

The BGC Argo array (355 operating floats) is slowly progressing (37% activity, 65% intensity), see Fig. 5. Almost all BGC floats have oxygen, more than 200 have chlorophyll and backscatter and more than 100 have nitrate and pH.

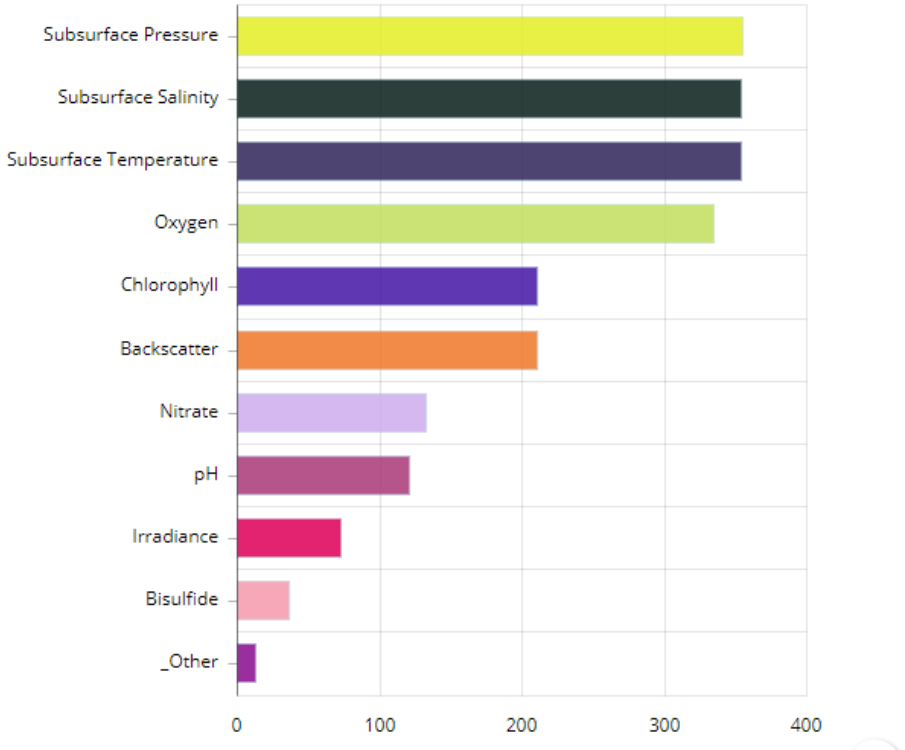


Fig.5: BGC Operational floats by variable.

Finally, while the US contribution remains stable, several national partners had a clear decreasing trend in the last years.

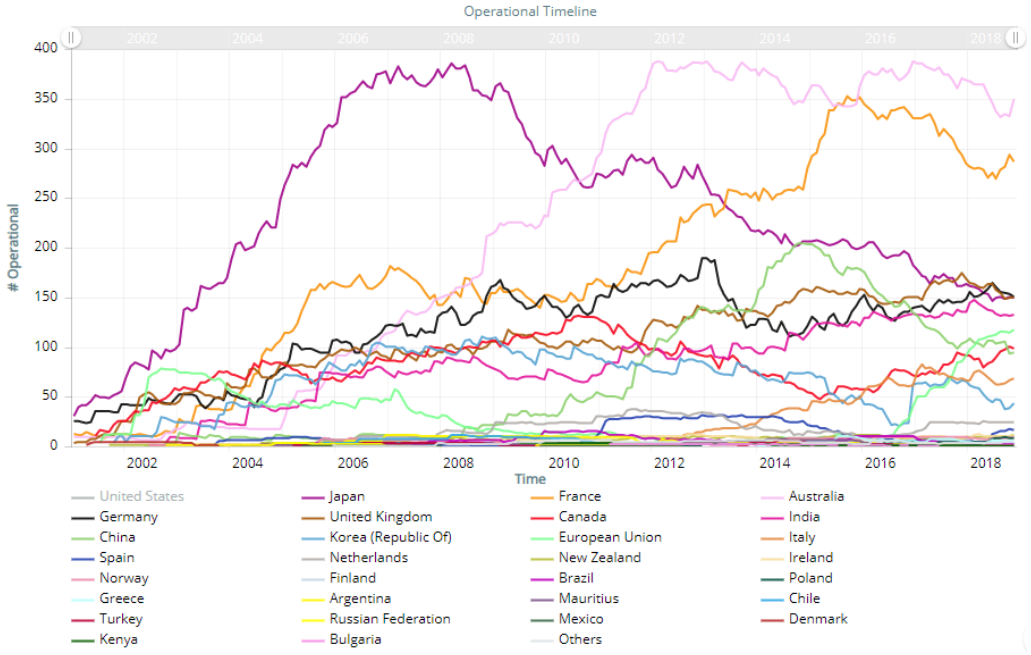


Fig.6: Evolution of operational floats by country (USA hidden for clarity).

A new vision and design for the future Argo array “Argo 2020” was discussed recently to reach a consensus on a truly integrated, global and multi-disciplinary array (Fig. 7). Several elements should be further discussed such as the equatorial enhancement in the Atlantic and Indian oceans or the priorities for the BGC array. Is it more important to have regional BGC pilot arrays with 6 variables, or a global one with less variables? Demand for a higher density of oxygen floats (BGC plans for ¼ of core floats) was also raised, including on deep floats.

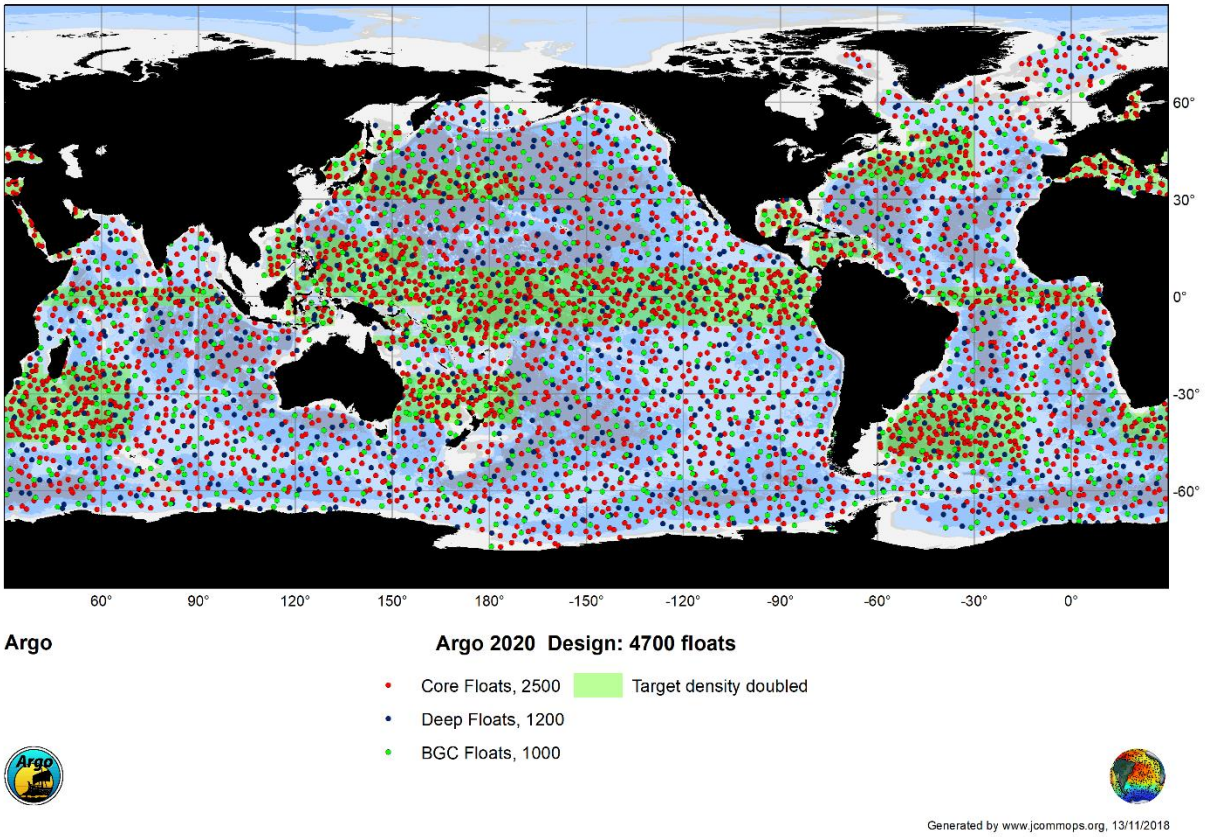


Fig.7: Argo 2020 sketch design

The Argo community will need to prepare an unprecedented communication strategy, with proper means and partners, to succeed in getting agencies and government supports for this future array, requesting roughly to triple national budgets.

Some other questions for the future should be discussed such as the “operationalization” of our data flow. Using Iridium and BGC floats, our national data management practices seem to have been further decentralized, beyond the ten established DACs. How this can be sustained and strengthened in the future.

Are our data services good enough for our community? Do we know well our data users?
We should perform a new users survey to gather their requirements and prepare the future of our data services.

2. Registration and Notification

The registration and notification of all float deployments, “reasonably in advance” is a mandatory activity to comply with international guidelines on float deployments and potential drift into Member States EEZs.
It is also critical to share deployment planning information across the Argo teams, anticipate the data processing, and enable a good tracking at JCOMMOPS.

All Argo programmes should have designated a responsible contact point to make sure the information if well captured in the JCOMMOPS system (http://argo.jcommops.org).
This activity can be made manually on line, by filling a form, either for individual records or by batch. The system currently reads most of netCDF formats, any CSV format, and some national text-based metadata files. The Argo Technical Coordinator assists with this activity but overall, 80% of the community is autonomous with registrations, which is a remarkable achievement.
There is rare negative feedback for this interface which means that it is rather operational, but JCOMMOPS will continue improve this system.

- ⇨ **Recommendation 1:** It is recalled that all float deployments should be registered at JCOMMOPS from draft plans, to formal registration with key metadata, before any data distribution is enabled.

A warning system is operated to inform a dozen of coastal states when floats approach their EEZs. This service is set by JCOMMOPS on implementer’s demand, but it is recommended to make it automatic, so all implementers can be recalled their duties.

- ⇨ **Recommendation 2:** Generalize the float warning system to all implementers.

Recently, one coastal state has requested to sequestrate data in its EEZ. GDACS and GTS data distribution should be interrupted while the float operate in these EEZs, and potentially never be made publicly available.
The ADMT should discuss with JCOMMOPS on how to set up a procedure to trigger some reactive steps to meet coastal states requests.
Member States requests could have varied specificities in time, space (EEZ, territorial sea, etc), or sensors.
Given the operational system in place at JCOMMOPS we could set a notification system from JCOMMOPS to GDACs to put floats in quarantine as long as necessary, without requesting the DACs to do a particular processing beyond switching off the GTS distribution.
Here is a first draft of what could be done:

Ideally only the first profile in the sensitive zone should be temporarily published.
At the first profile in the sensitive zone, JCOMMOPS raises the start flag and notifies the GDACs to put

the profiles in quarantine (a password protected area of the GDAC ftp e.g.) and the DACs to stop GTS distribution.

JCOMMOPS would run the geographical and other filters to notify GDACs and DACs, with a message including WMO_ID, PROFIL_NB_START, PROFILE_NB_END, and QUARANTINE_ENABLE/DISABLED.
GDACs would then move incoming profiles in the quarantine directory.
GDACs would have to set a special index files for such profiles so the tracking can continue at JCOMMOPS (reserved for administrators), and the end of quarantine would be notified when float moves out of the sensitive area, and GDACs could move back profiles in the right directory, and DACs enable GTS distribution.
Maybe we could let those references in the global index files.

Using the standard email subject, the procedure could be fully automated.

We could use and upgrade the current notification system set up for the QC feedback.

- ⇨ **Recommendation 3:** Discuss the procedure between JCOMMOPS, DACs and GDACs, to put floats in quarantine, minimizing the issues for data producers.

Finally, several floats and progammes are tagged as “Argo equivalent” (5%). Based on recent requests for clarification from coastal states it would be better to name these floats as “non Argo” to relieve further our control and responsibilities.

- ⇨ **Recommendation 4:** Rename “Argo equivalent” in “non-Argo”

3. Real-time data flow

a. Delivery

At the time of this report, about 150 floats are operating, and were deployed in the last 3 years, but data processing is not enabled. This metric is usually between 3 and 5 % of the operational fleet and shows the running window of floats to be processed. But 10% of floats deployed in 2018 do not yet share data. What is a reasonable delay to enable the data processing for a float? Ideally, everything should be ready before the deployment.

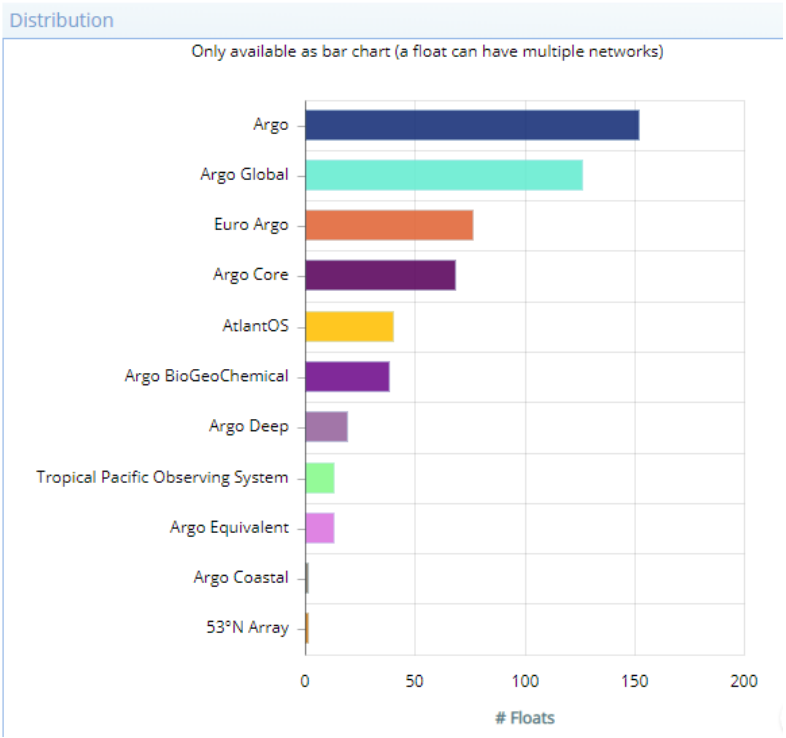


Fig.8: Floats pending data distribution (status='REGISTERED' and deployment date < today, as of 2018-11-26), by network

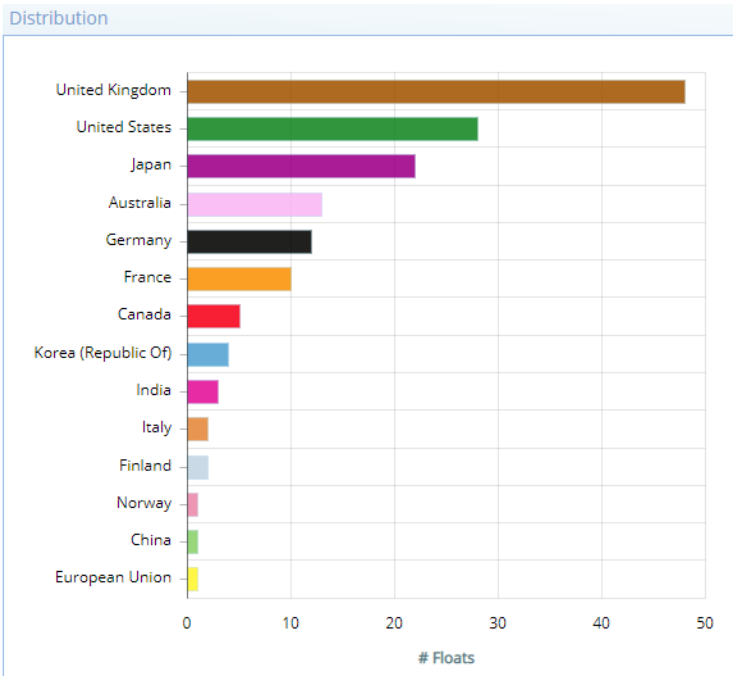


Fig.9: Floats pending data distribution, by country

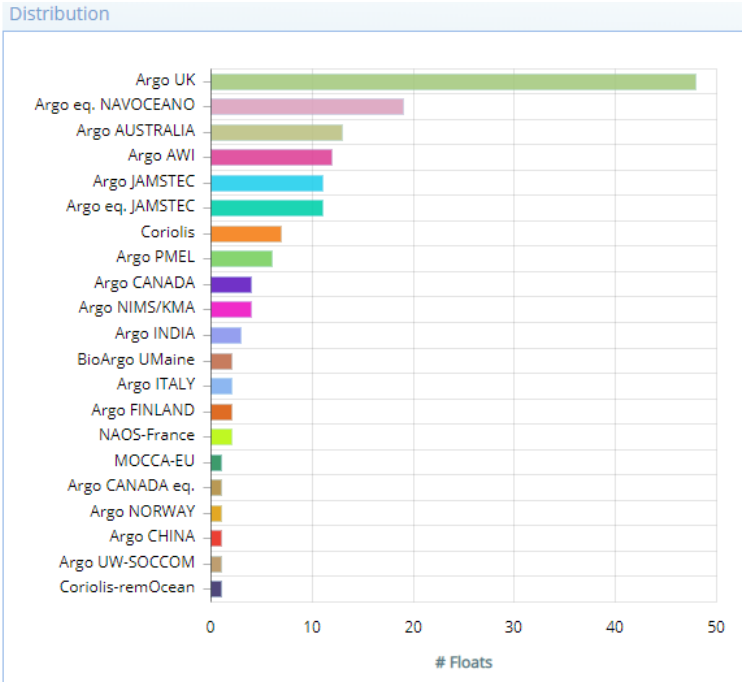


Fig.10: Floats pending data distribution, by program

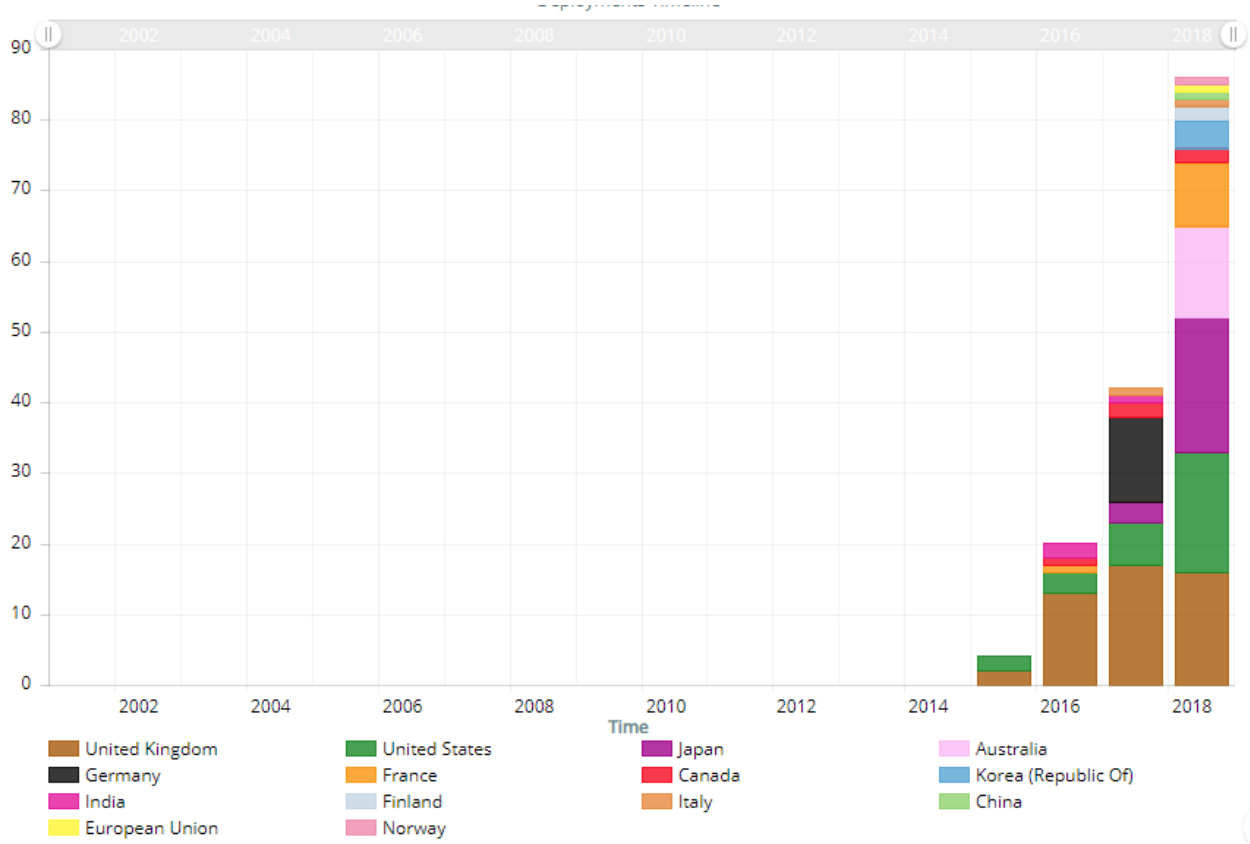
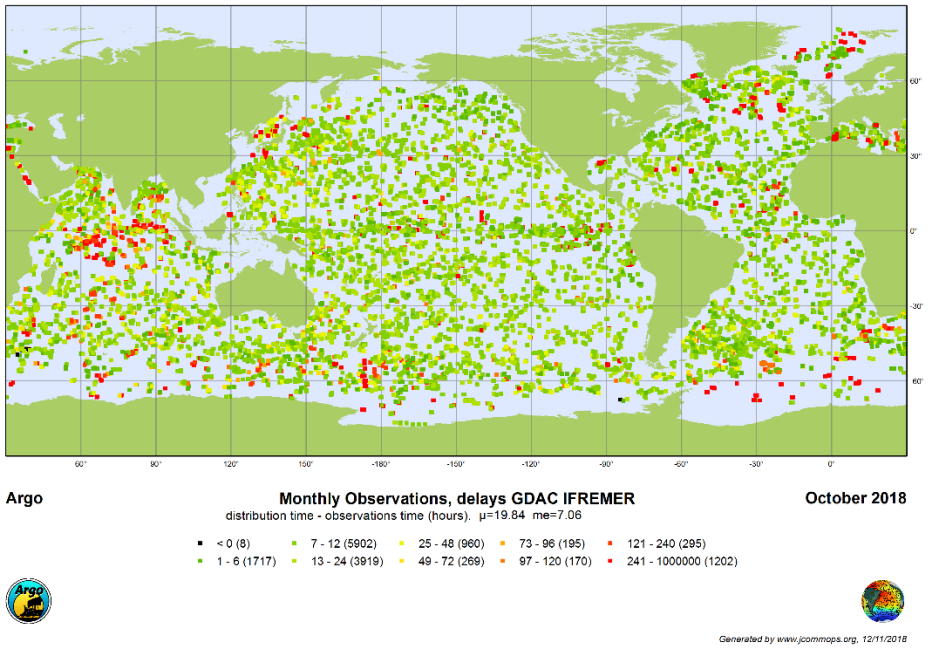


Fig.11: Floats pending data distribution, deployment timeline, by country

⇨ **Recommendation 4:** Sharing the data of deployed floats in real-time is an obligation to comply with international regulations. It should be the first of DAC priorities. Such duty is even more important when floats do not operate in high seas or in national waters of the implementer.

b. Delays

It is to be noted first that JCOMMOPS recovered the capacity to track GTS data distribution (from Meteo-France node). For a while many floats were missing from our GTS feed. The switch to BUFR permitted to review and improve the process.



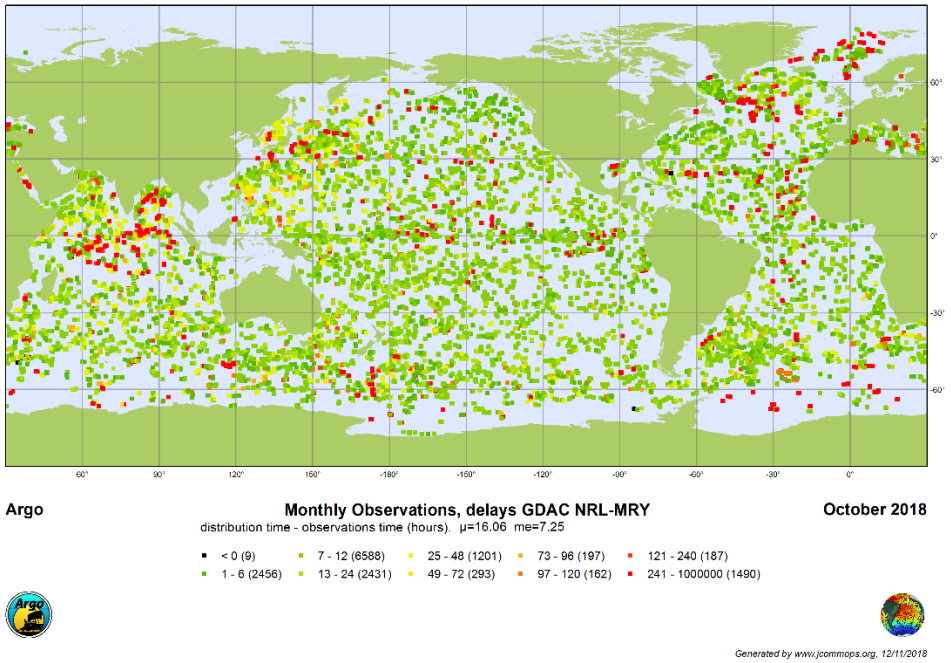


Fig.12,13: GDACs delays

The overall delays at GDACs shows a median of 7 hours. For some reasons the US GDACs has a better mean (16h vs 20h for Coriolis). Some float data might reach the French GDAC through synchronization only.

On November 11th we checked the median delays at GDACs for the 10 first days of observations of the month.

BODC	4.83	KMA	20.5	KORDI	24.73	JMA	9.2	INCOIS	6
CSIRO	4.95	SOA/SIO-2	4.65	ISDM	7.15	NOAA/AOML	7.83	CORIOLIS	3.36

Fig.14: Median Delays by DAC

BODC	3.08	INCOIS	2.91	JMA	4.69	CSIRO	4.16	SOA/SIO-2	4.14
ISDM	7.15	NOAA/AOML	8.32	CORIOLIS	2.68				

Fig.15: Median Delays by DAC, Iridium floats only

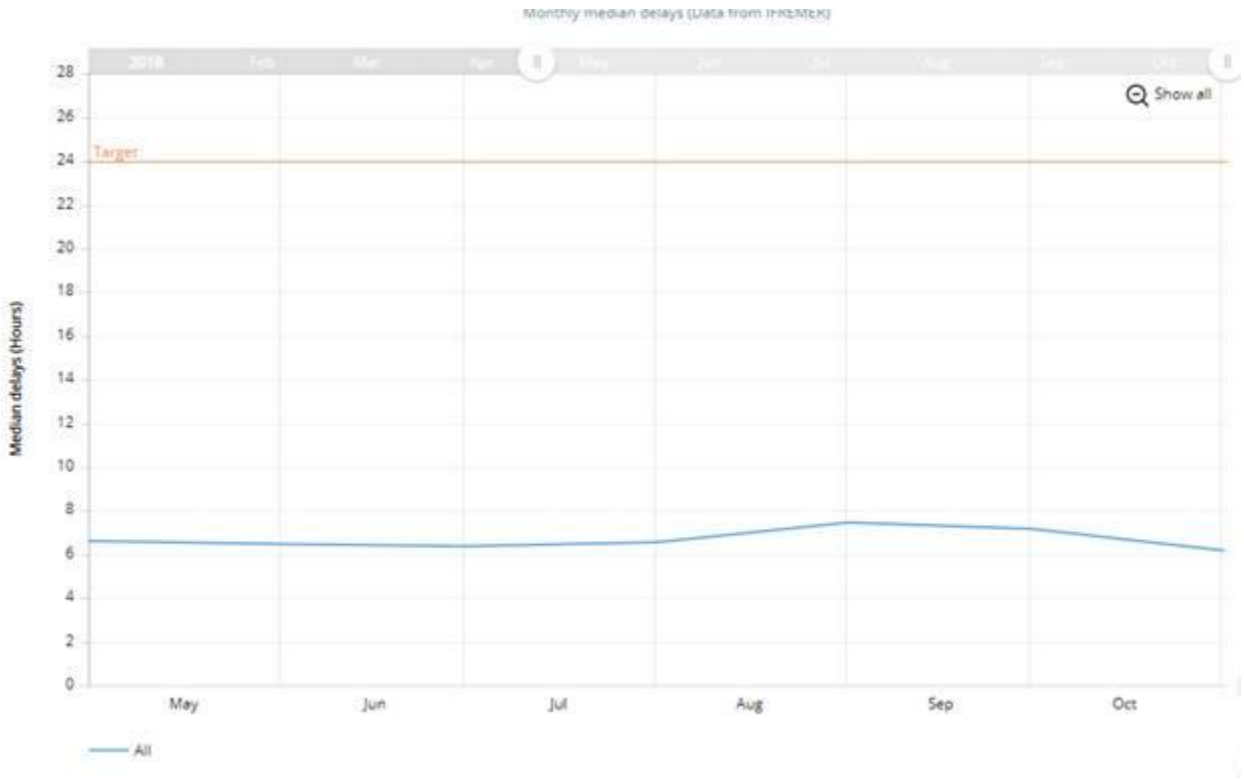


Fig.16: Median Delays 2018.

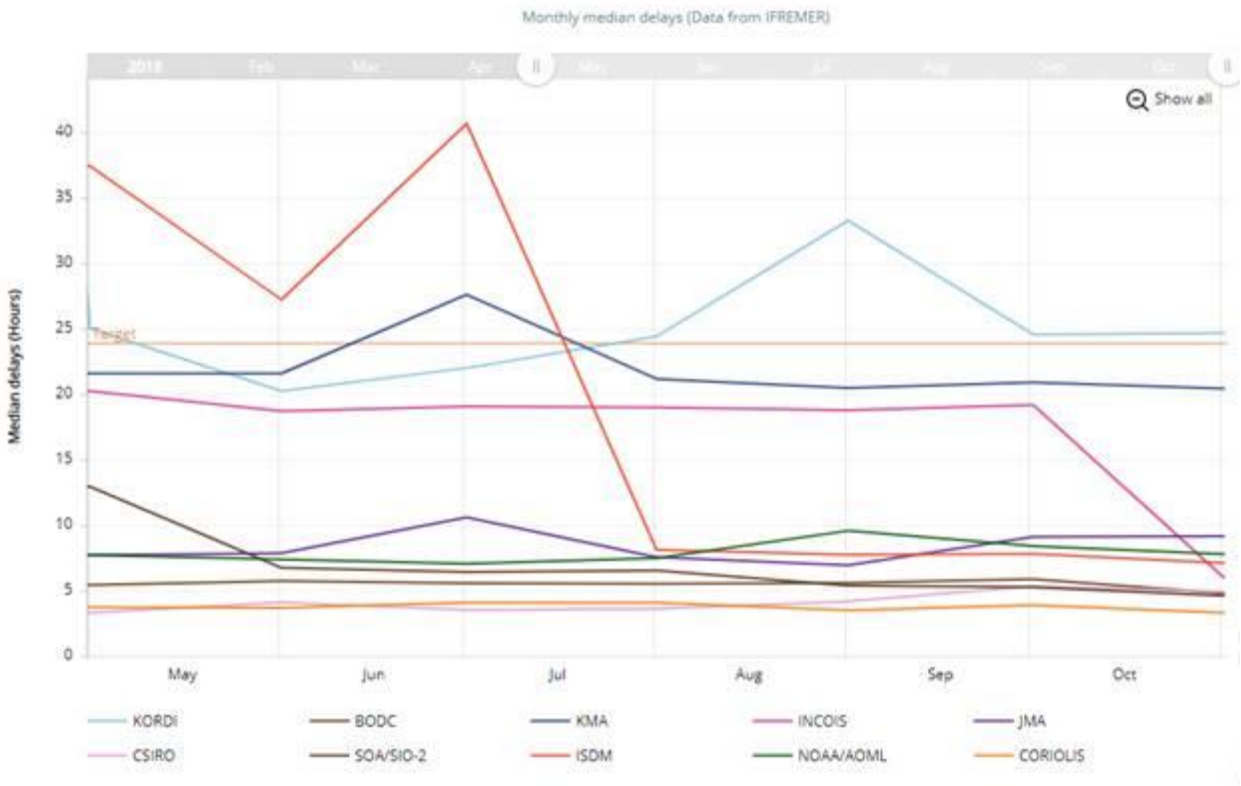
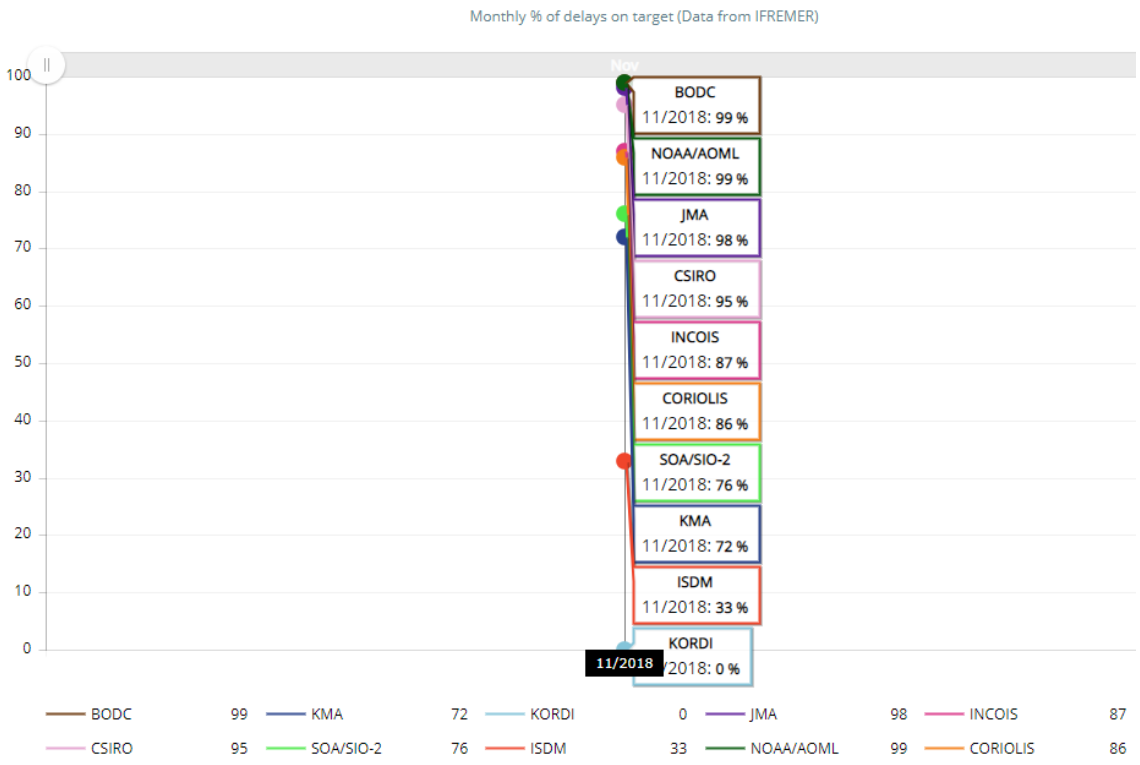


Fig.17: Median Delays 2018, by DAC

Several DACs have improved their delays recently and there is still margin for progress for some others. On Nov 27th, a new check was performed for observation made between 15-25 Nov.



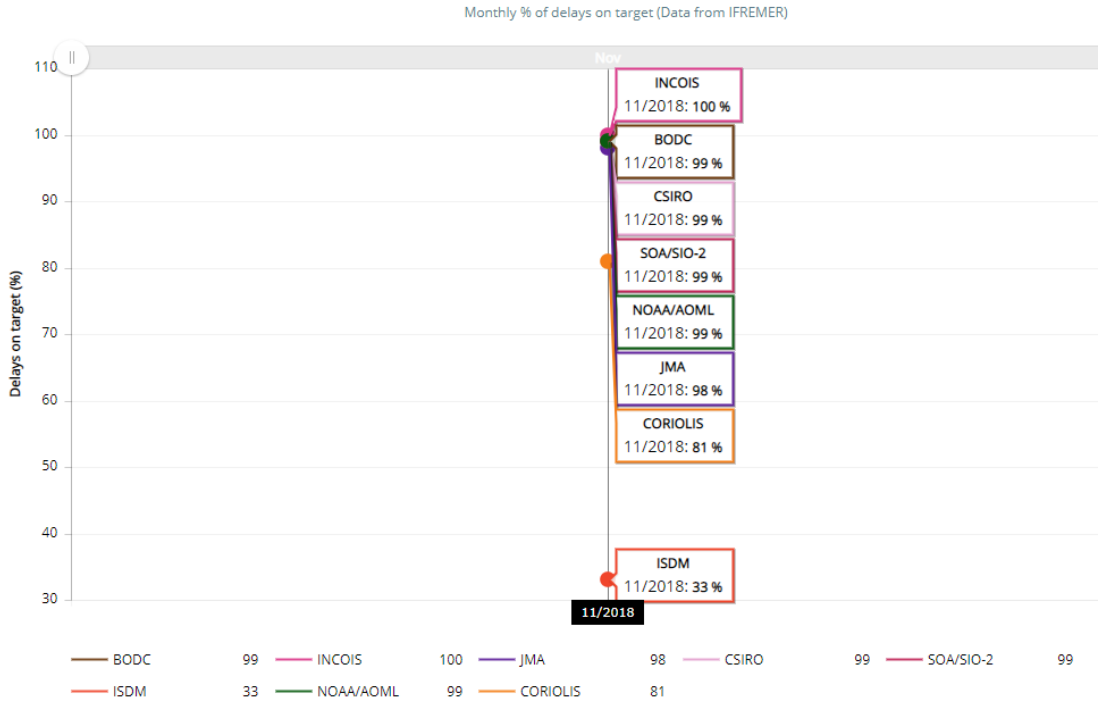


Fig.18-19: % delays on target (24h): All, and Iridium only

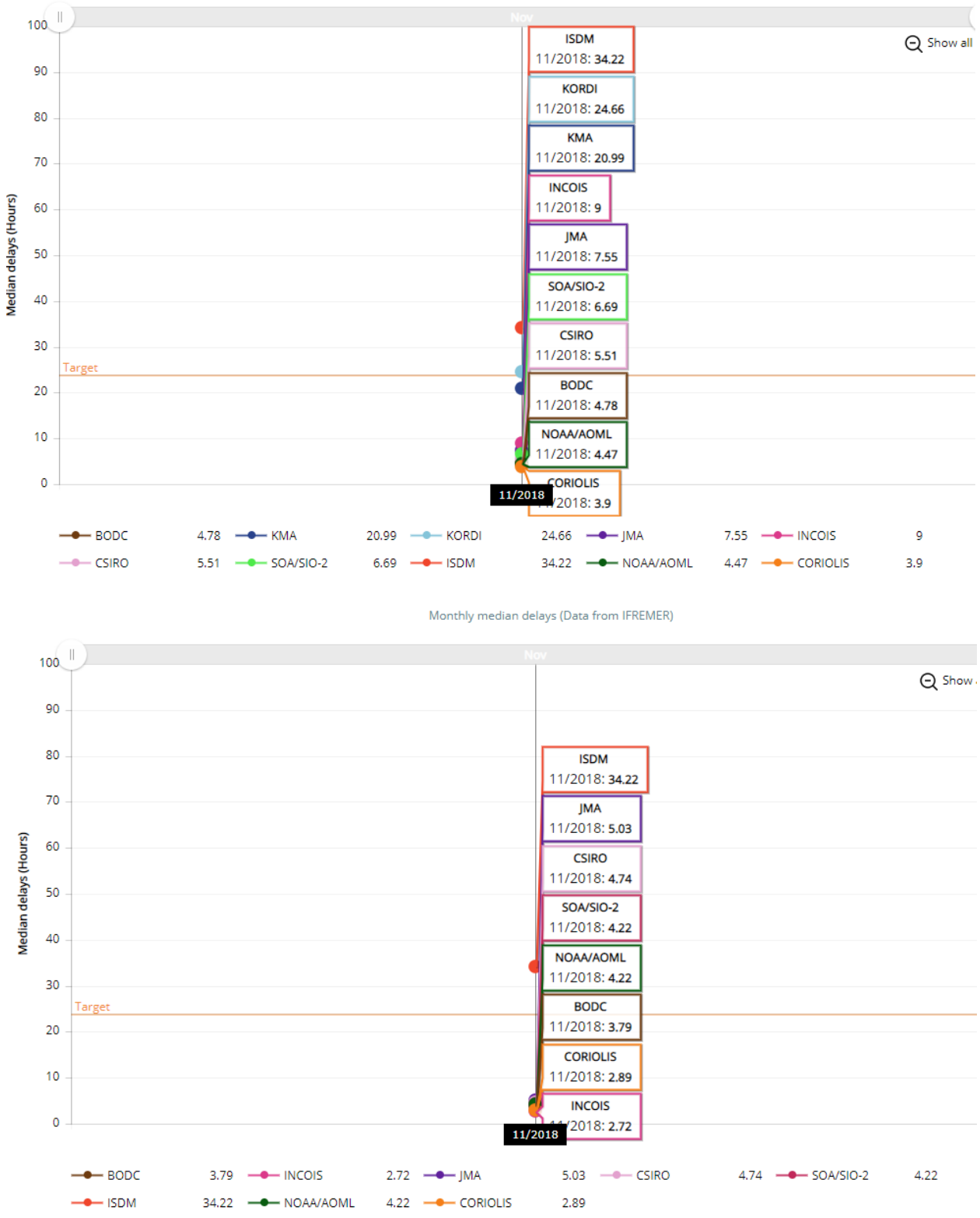


Fig.20,21: Median delays: All, and Iridium only

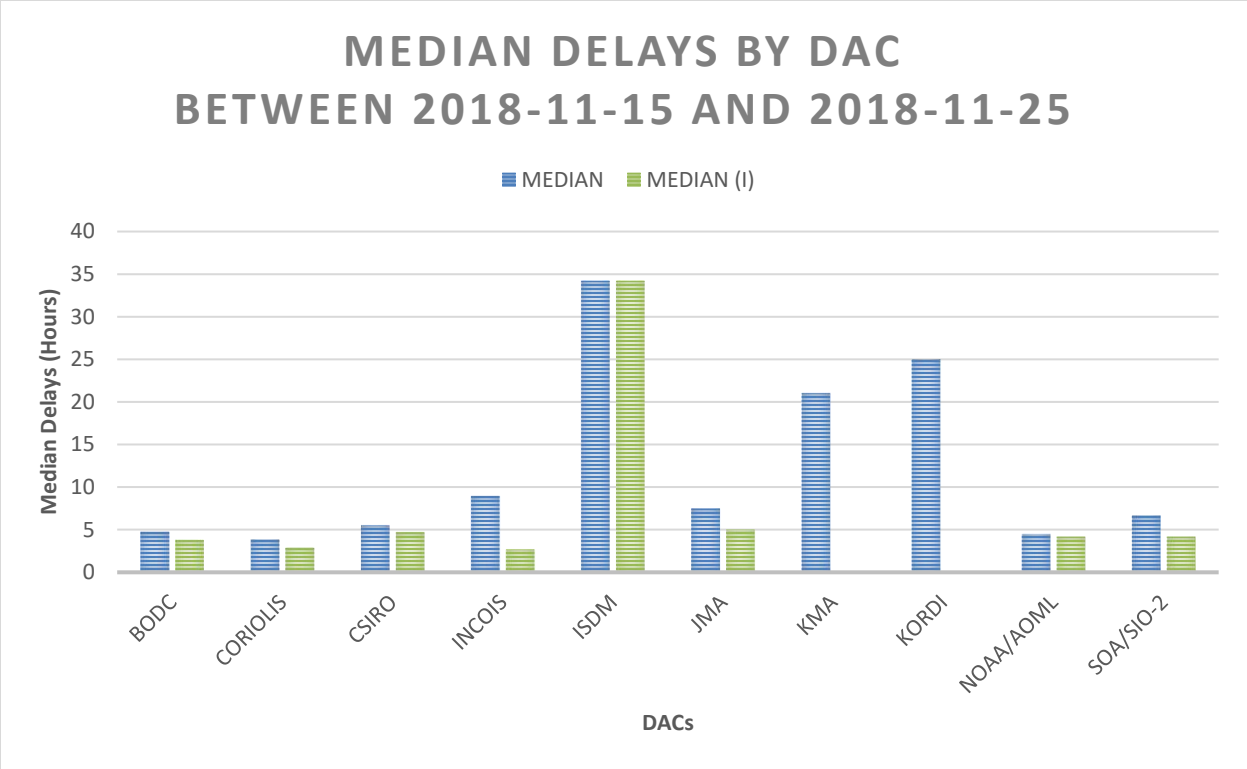


Fig.22: Delays summary table

The same statistics filtered on iridium only floats show no much difference which means that Argos and Iridium floats have no distinct processing, hence we can't get benefit of the substantial reduced surface time with iridium. Some DACs however seem to perform better.

- ⇨ **Recommendation 5:** DACs to review the data processing to make sure that Iridium floats are not slow down by Argos ones and thus optimize the timeliness. Float data should be processed "on the flow" and not at regular batches or at higher frequency (1 hour e.g.).
  A new target of 6 hours might be then easily achieved on the short run.

The delays for BGC floats look very good on the studied time frame, with a median of 3.72hours which means that once processing started, it is flowing properly. A check a year before, shows a median of 6.3h which is very good as well.

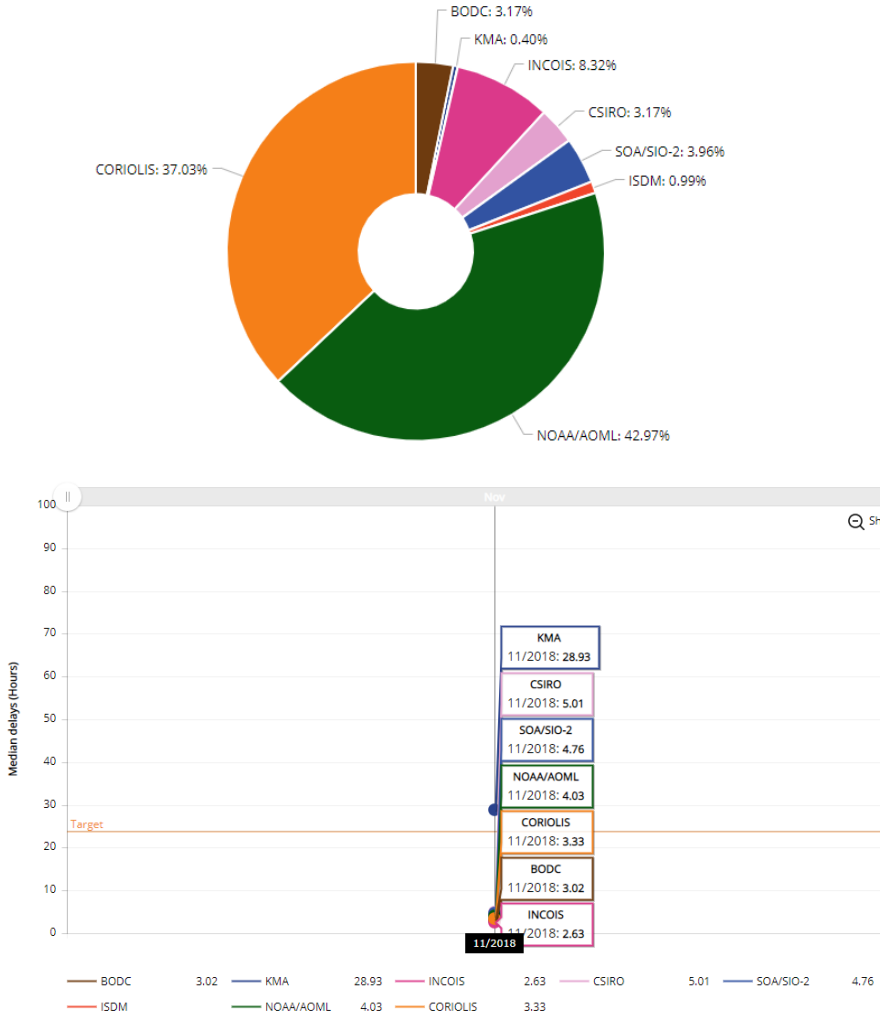


Fig.23, 24: DACs producing BGC data (2018-11-15, 2018-11-25) and delays

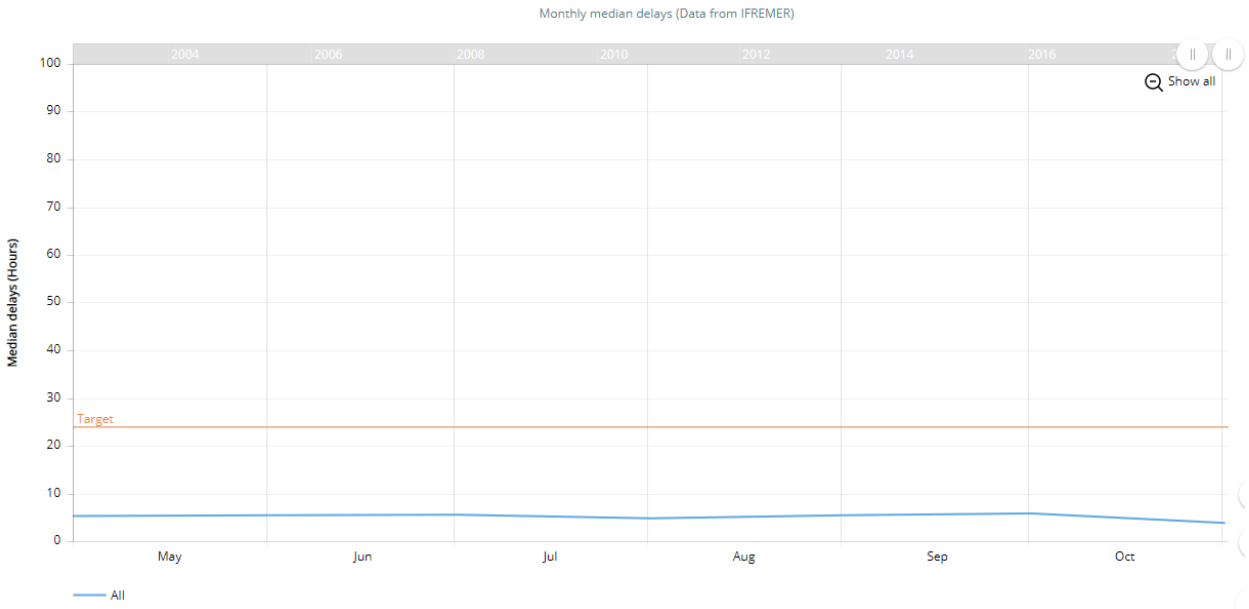


Fig.25: median delays for BGC floats (full time series)

4. Delayed-mode data flow

The quantitative indicator on DM processing (vs DM eligible profiles, i.e. older than 1 year) shows a progress of 5% (vs last year), with 75% of the work achieved by DM operators.
Over the 2 million profiles produced by Argo, 1.4 million were checked by operators.

One DAC doesn't show up any DM profile and I heard it was related to the lack of renaming of profile from 'R' to 'D' so this should be simple to resolve.

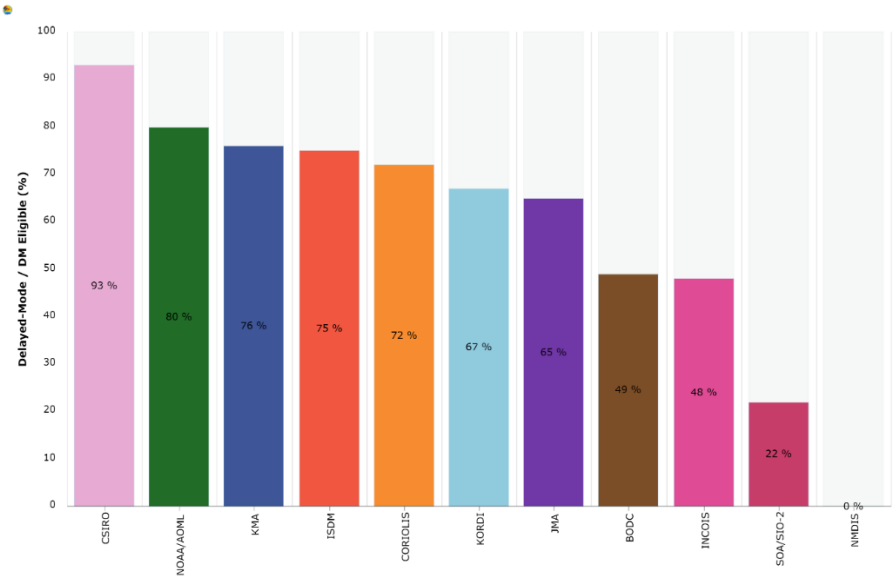
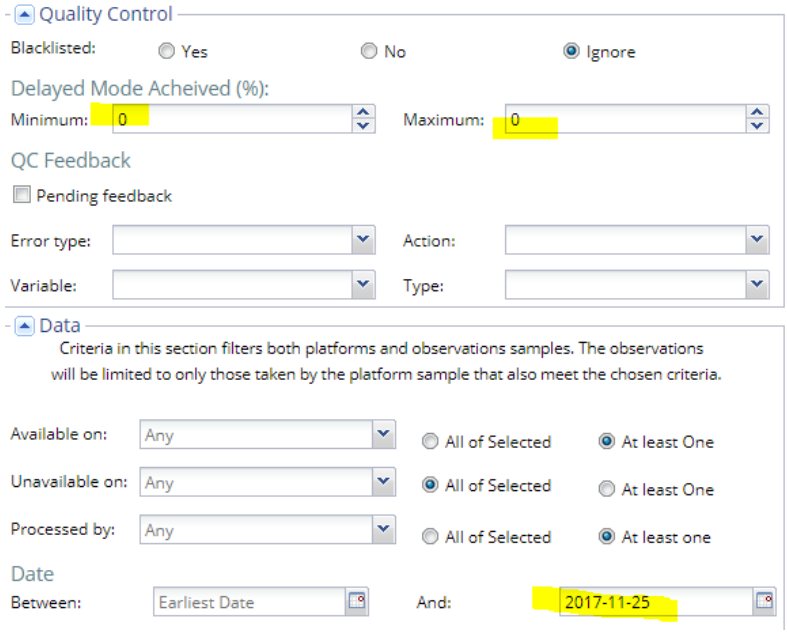


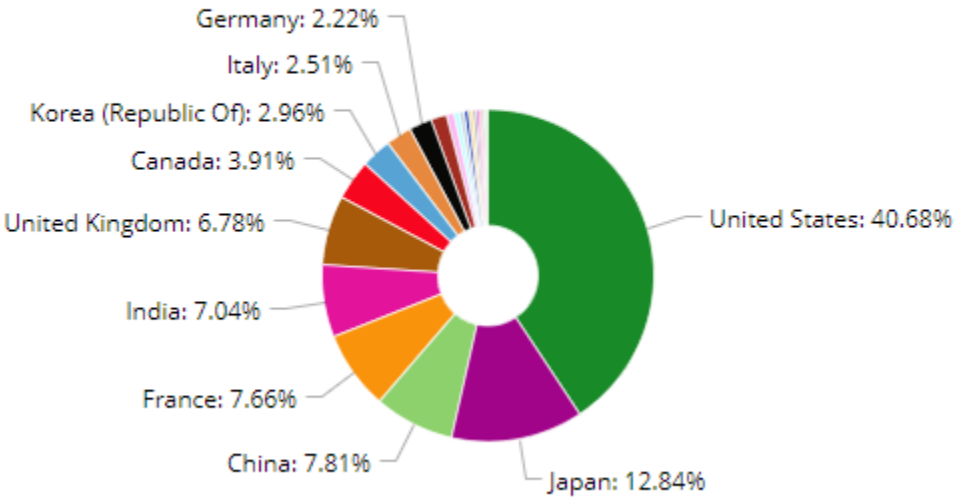
Fig.22: DM processing status by DAC

Orphan floats status

We can check the profiles eligible to DMQC (< 365 days) that have no single DM file available, through the following query:



3380 floats have no DM processing started which represents about 380 000 pending profiles.



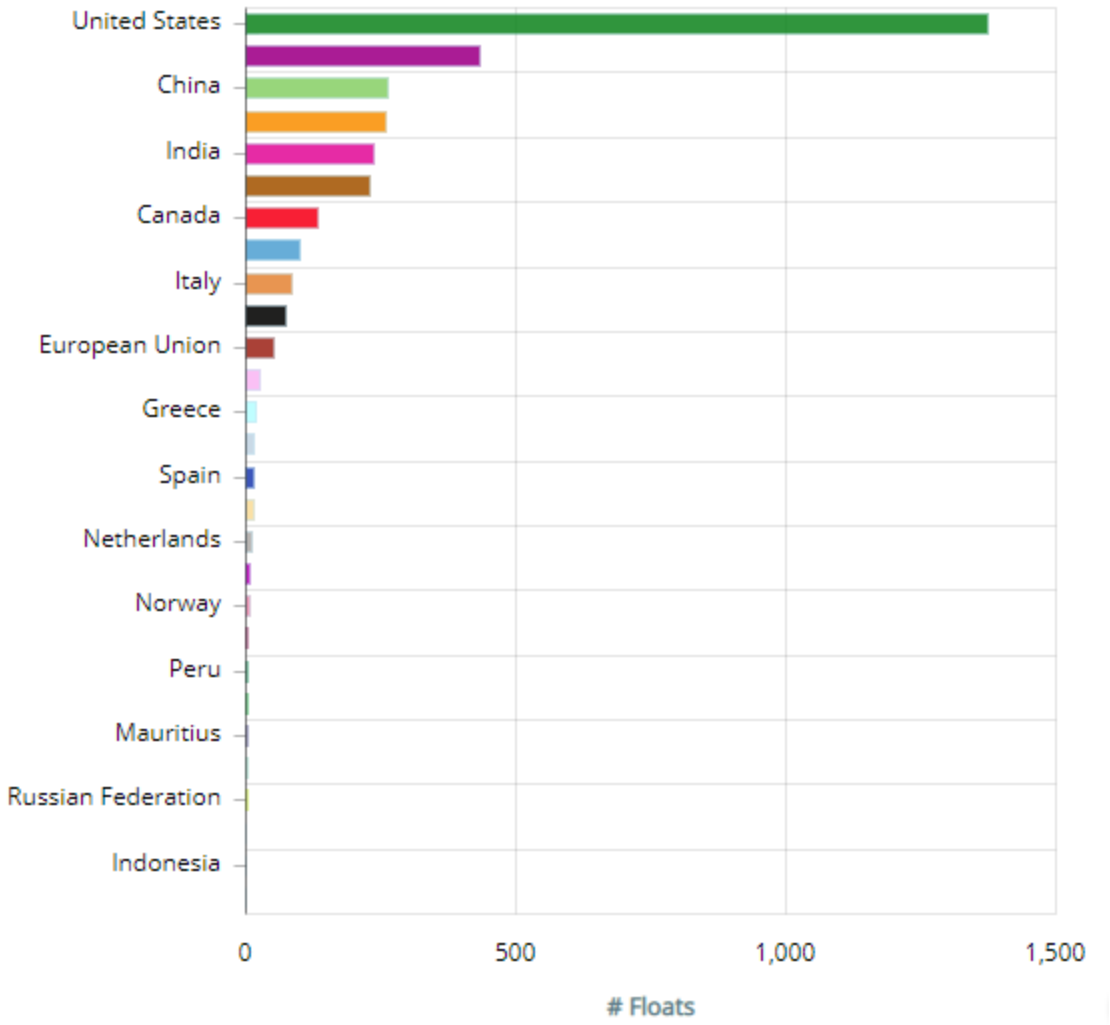


Fig.23,24: Pending floats (no DM QC started), by country (%, and Nb)

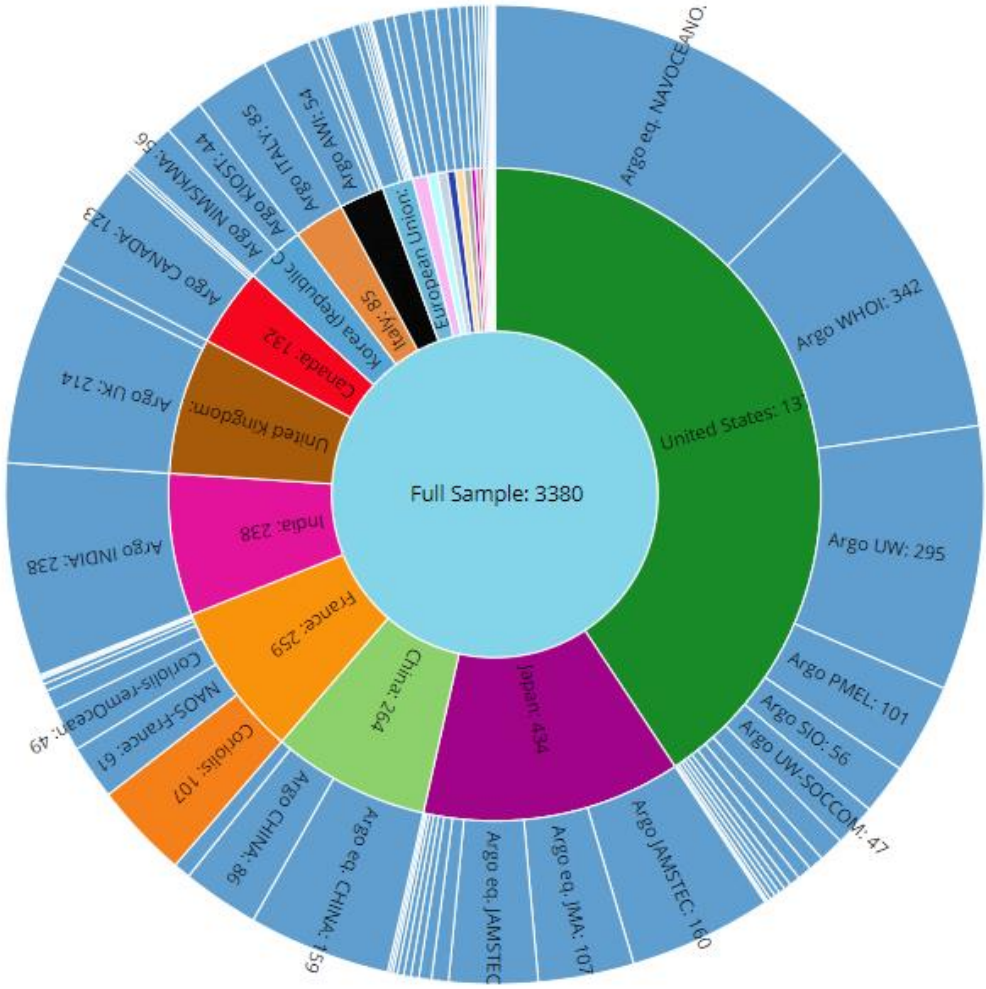


Fig.23: Pending floats (no DM QC started), by country/program

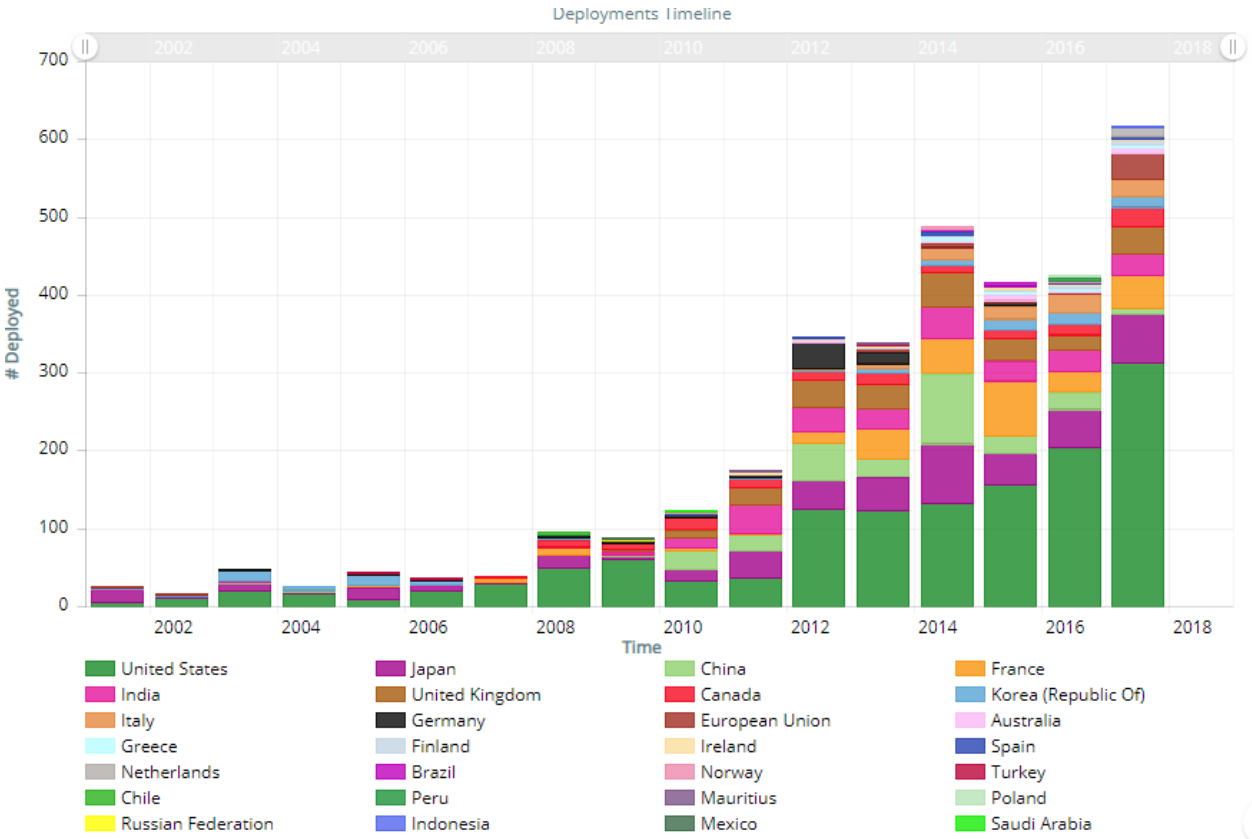


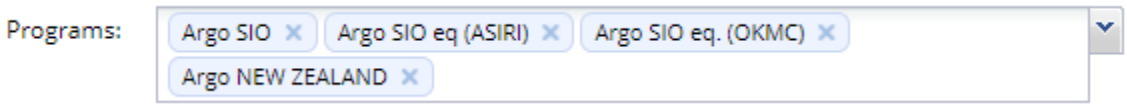
Fig.24: Pending floats (no DM QC started), by country, deployments timeline

How to check pending DM profiles/floats

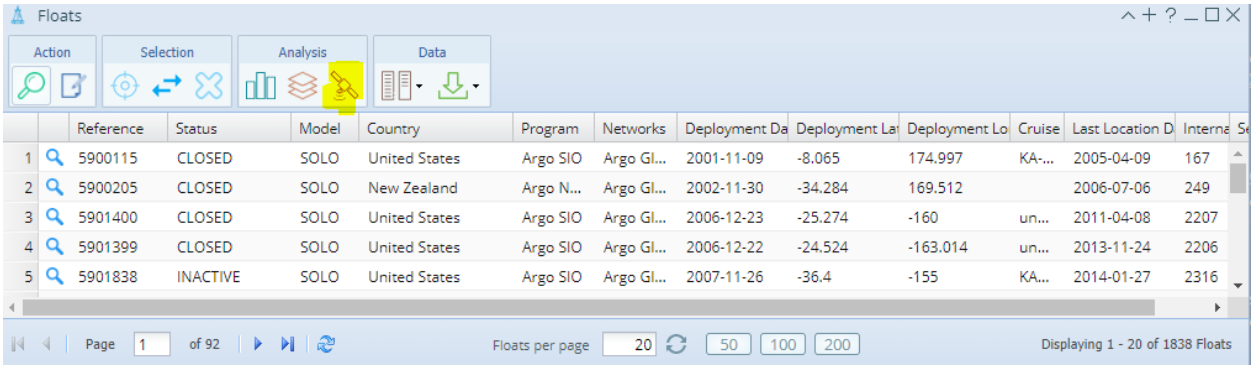
To check pending floats in JCOMMOPS system DM operators can just type their name in the quick search box (bottom left) and check first which programmes are concerned.
Then a search on platforms using the programmes, the data status (real-time profiles e.g.), the observation date, quality control tags (greylist, feedback from Altimetry checks e.g.), PSAL adjustment value, or the ocean basins, can build the list of floats concerned and their profiles (filtered on the criterion as well). The list can be exported in CSV format, including path to data.

Depending on the float/obs sample, the system can be rather overloaded using 2 million records.
We are currently optimizing this part.

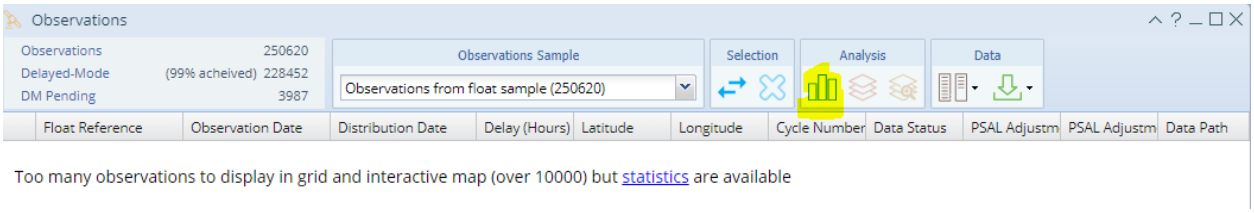
Example: All floats from USA/SIO and New Zealand under the responsibility of one DM operator.



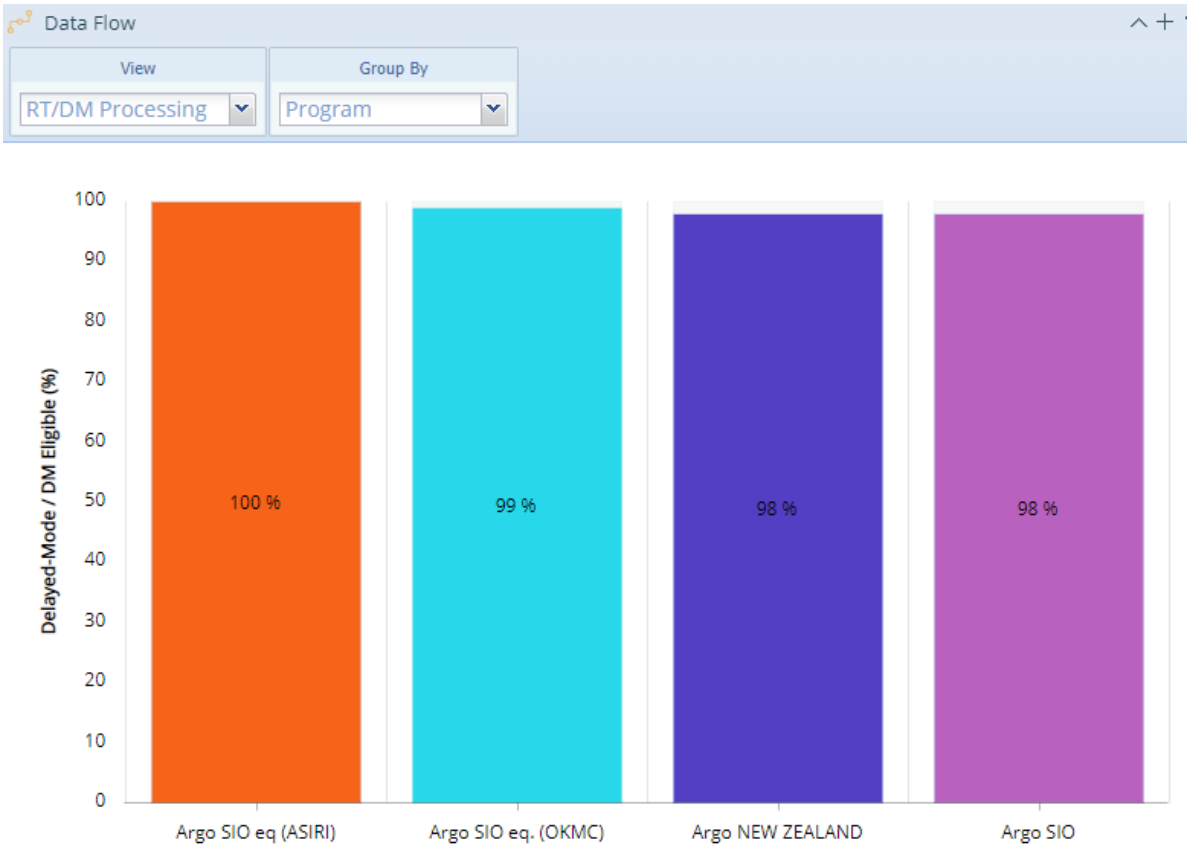
A list of 1838 floats is generated.



A click on “observations icon” highlighted above will open the list of profiles concerned with status of DMQC processing.



A statistics tool highlighted above allows to generate various plots for DM processing, delays, ior PSAL adjustments.



5. QC Feedback

JCOMMOPS maintains a QC feedback relay tool (for all observing systems under its monitoring) which can handle individual feedbacks from users or routine feedbacks such as the Altimetric checks performed by CLS/Coriolis.

The process triggers a standard email to the data producers (DACs and DM operators) with the email subject formatted such as:

`[JCOMMOPS QC] CHK WMO_ID MESSAGE_ISO_DATE`

or

`[JCOMMOPS QC] BLK WMO_ID MESSAGE_ISO_DATE`

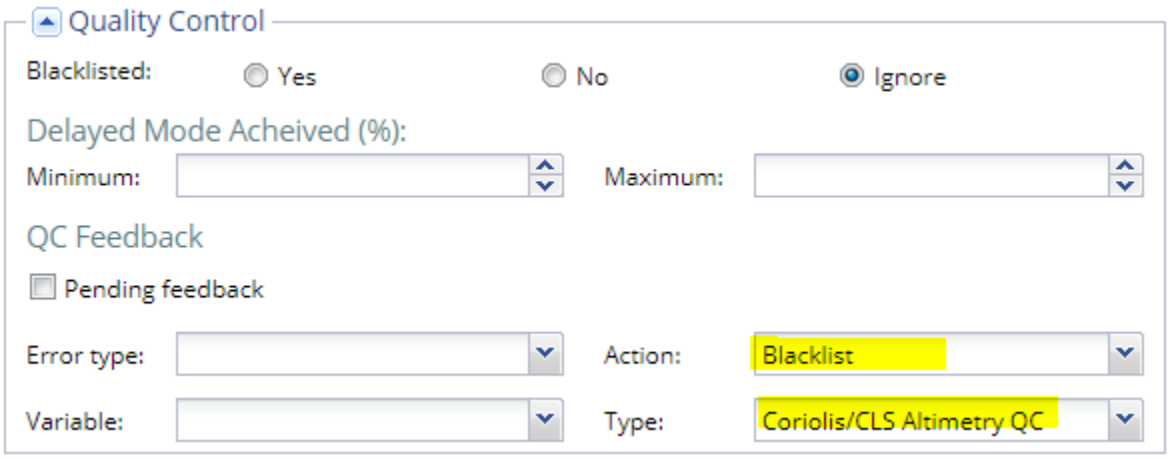
The BLK means that the float targeted by this message needs to be greylisted. This standard email subject could be used routinely by DACs (**action item #9**).

The CHK means that dm operators and DACs should check this float data, potentially feedback through

the link provided to archive the information, and take appropriate steps with DM QC e.g.
If nothing is changed with the data, the next iteration of the Altimetric QC will flag again such float.

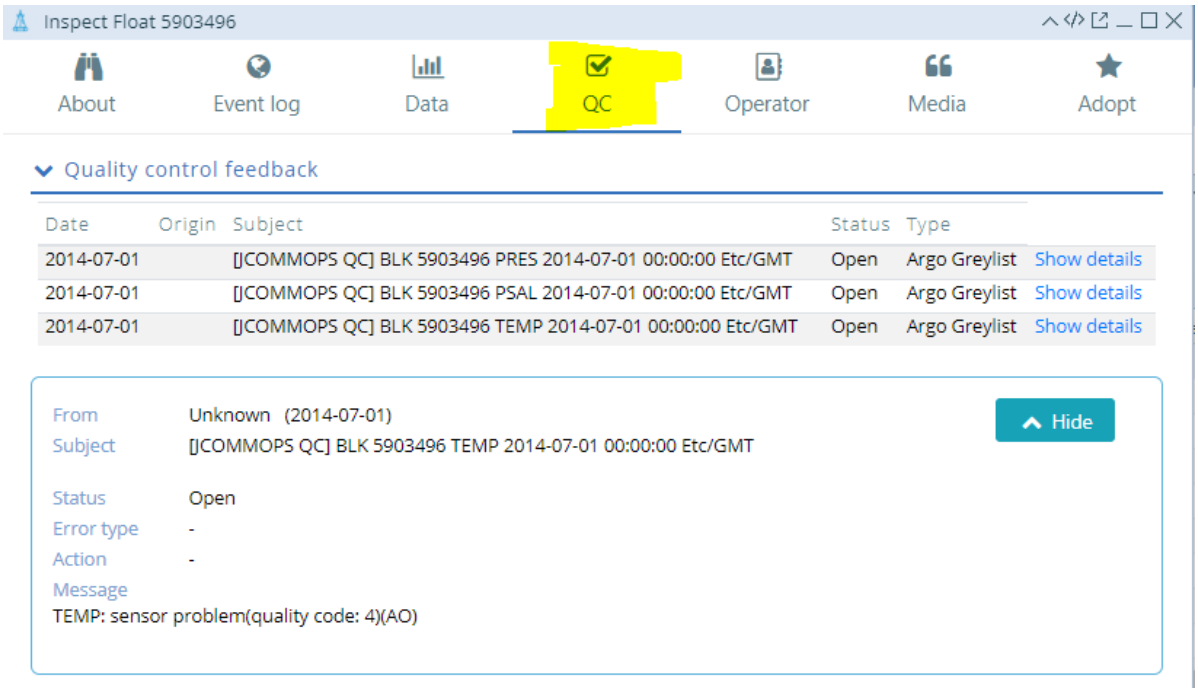
Example:

The search interface allows to generate an appropriate list to check the pending floats.
If we add criterion below to our previous SIO sample, we find 3 floats tagged by the Altimetric QC that have been properly greylisted.



	Reference	Status	Model	Country	Program	Networks	Deployment Da	Deployment Lat	Deployment Lo	Cruise Nam	Last Location D	Internal ID	Serial No.	Blacklisted
	5902364	OPERATIONAL	SOLO_II	United States	Argo SIO	Argo Global, ...	2014-10-01	-41.2	96.5	KAHAR...	2018-11-20	5570	8285	Yes
	3901216	OPERATIONAL	SOLO_II	United States	Argo SIO	Argo Global, ...	2015-05-06	-50.5	-86	NBP15-...	2018-11-18	6265	8378	Yes
	5902398	OPERATIONAL	SOLO_II	United States	Argo SIO	Argo Global, ...	2015-09-21	-36.999	-151.243		2018-11-19		8383	Yes

A search using the “pending feedback” checkbox provides directly the list of floats to be checked.
Details for the QC feedback messages is available in the Float Inspect page:



6. Metadata

Some float operators have suggested JCOMMOPS to develop a netCDF metafile writer/updater.
This is something that could be done.
Overall a better synchronization of JCOMMOPS metadata and Argo meta files is wished.
JCOMMOPS Information System should be migrated soon into the Ifremer network and closer to Coriolis GDAC. This will offer opportunities for machine to machine synchronizations to improve metadata on both hands.

JCOMMOPS is finalizing the development of its API that is based on 5 components:

- GIS API (ESRI engine & API) – operational
- Network specifics (CSV, JSON) for operators and users (push/pull)
- WIGOS compliant XML (to fuel WMO system)
- WMO/WIGOS Id management
- Reference Tables management

Most of the elements of this API will be available and documented by May 2019.
JCOMMOPS will meet with BODC around June 2019 to work on the convergence of the code tables (Networks, seadatanet, WMO, etc).

It is recalled that id the ship name is not a mandatory and standard metadata in the Argo metadata flow, it is in JCOMMOPS. Floats can't be registered and notified without the name of the ship (and ships are unique in JCOMMOPS system with an ICES code).

To conclude this report, we should note that the metadata registration at JCOMMOPS from all Argo programmes (about 50 active) is performed autonomously by "Operations Managers" for 80% of the fleet, rest being done by the Technical Coordinator "on behalf". This is a remarkable cooperation and it also demonstrates some stability of the web interface, which is not yet bug free, but feedback and request for assistance were very rare in 2018.
Argo metadata management is a "golden standard" that all networks wish to achieve.
Thank you all.

On a more general perspective JCOMMOPS is progressing with the metadata quality with all observing networks under its monitoring (Argo, DBCP, OceanSITES, GOSHIP, SOT, OceanGliders, Marine Mammals, HF Radars, SOCONET). All VOS ships have now sensors metadata and unique identifiers, all GOSHIP cruises including WOCE and CLIVAR were registered, all Tropical Moored Buoys and their historical maintenance is registered, and substantial work has started on OceanSITES.

2019 might enable for the first time some cross programme and EOV/ECV based perspective on the observing system. Synergies between the systems will also be captured such as floats deployed along GO-SHIP lines or through VOS ships, or mobile platforms drifting within OceanSITES areas are examples of what an integrated monitoring can provide.