



Report on 1st European Argo Delayed-Mode QC Workshop

17 and 18 April 2018, Brest (France)



Romain Cancouët, Sylvie Pouliquen, Claire Gourcuff (Euro-Argo ERIC Office)

Guillaume Maze, Cécile Cabanes, Christine Coatanoan (Ifremer)

Justin Buck (BODC)

Birgit Klein (BSH)

Giulio Notarstefano (OGS)

Breck Owens (WHOI)

euroargo@ifremer.fr

Meeting webpage:

<http://www.euro-argo.eu/News-Meetings/Meetings/Others/1st-European-Argo-Delayed-Mode-QC-Workshop>

Introduction

DMQC processing is presently carried on by a limited number of teams and there is a willingness from some countries to develop the DMQC understanding, and perhaps DMQC capabilities for their own floats.

The main objectives of the workshop were therefore:

- To make sure everybody understands the data system,
- To start bringing EU countries towards the same level of knowledge,
- To start sharing DMQC procedures/tools/methods within EU.

The workshop was mainly dedicated to people who have never been to any DMQC workshops.

The meeting was jointly organised by the Euro-Argo ERIC and its partners within the **MOCCA** (EASME/[EMFF/2015/1.2.1.1](#)) project: Ifremer in Brest, BODC in Liverpool, OGS in Trieste and BSH in Hamburg. It was also a great honour to have with us Breck Owens, Argo Director, from WHOI.

The workshop has been designed to be practical with lectures, examples and exercises to provide skills, encourage participation and exchange information around DMQC of Argo floats.

The workshop gathered **32 persons from 12 countries** (see list in Annexe), involved in the data management of in situ ocean observations: mainly with Argo data, but also with gliders. The workshop was very well welcomed by the participants and the feedback after the two days was globally positive.

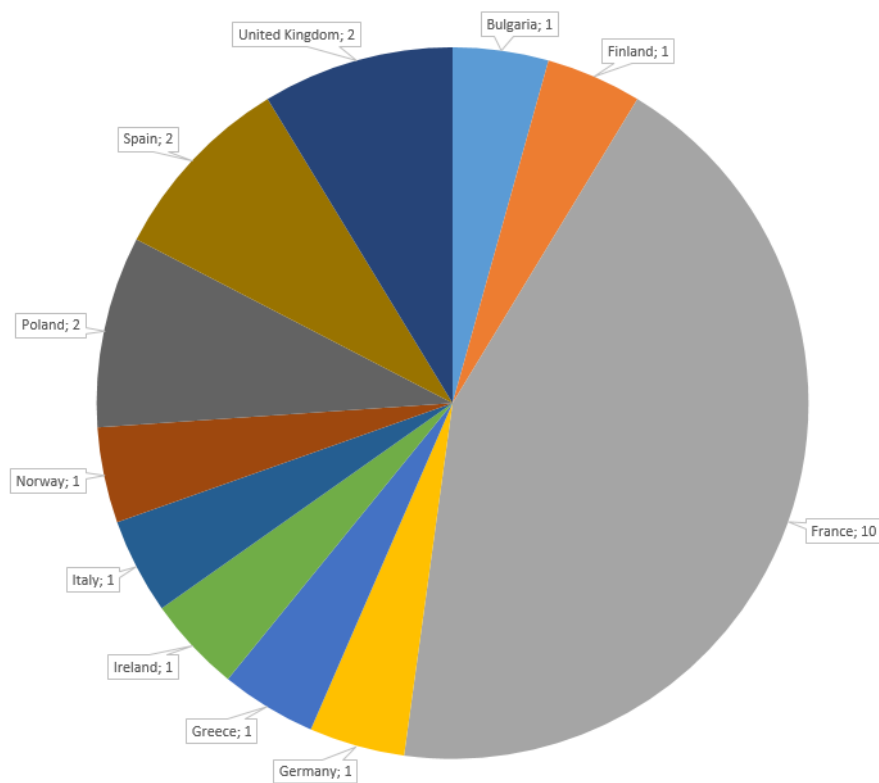


Figure 1: Country of origin of workshop attendees (23 people)

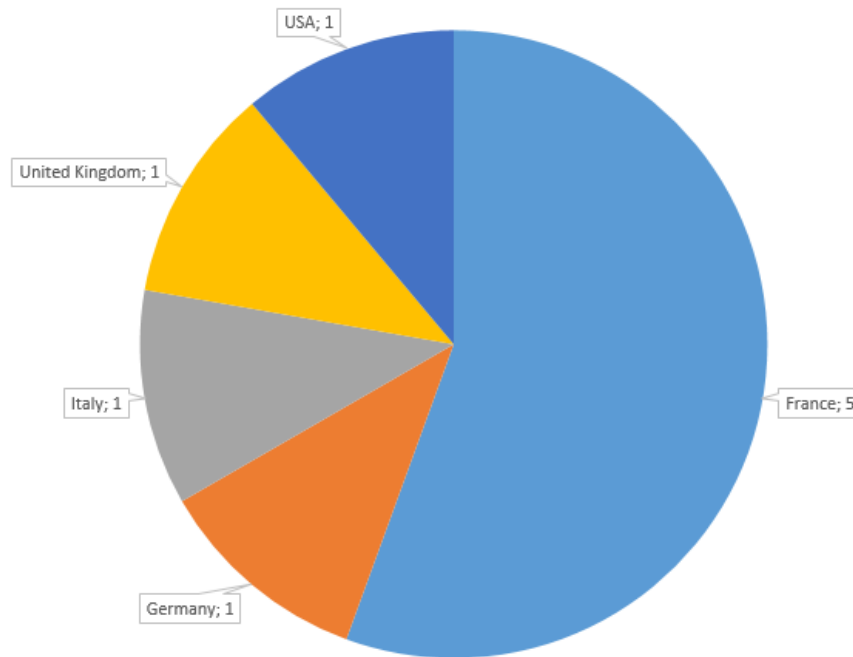


Figure 2: Country of origin of workshop speakers (9 people)

Presentations

The presentations of the first day have been made available on the workshop webpage, hence the content will not be repeated here.

Link to download talks and workshop material: <https://cloud.ifremer.fr/index.php/s/ifgoDyTIDGkr5E>

Instead the items that were discussed and that will probably lead to actions either at European level or at international level with the Argo Data Management Team (ADMT) are summarised hereafter.

Real-Time QC tests

- Density inversion test has been designed based on WOCE experiment recommendations for floats that were transmitting low resolution profiles (70 CTD points) through Argos transmission. With the development of Iridium transmission allowing high resolution profiles (1000 points) transmission the Argo data have changed and density test should be revised, especially to take into account the distance between 2 measurements due to the increase of the number of possible pressure levels. Same with spike gradient. Tests ongoing at ADMT level.
- Real time QC could be more efficient with the introduction of regional and seasonal boundaries in the range test. This would be interesting to implement in the European marginal seas.
- New climatology is available (Gaillard Fabienne (2015). ISAS-13 temperature and salinity gridded fields. SEANOE. <http://doi.org/10.17882/45945>, Min/Max climatology from Gourrion et al.) that would be useful to complement RT tests.

- The difficulty for all DACs to perform the same tests was issued. One solution could be to provide an example dataset with the expected results for a specific test that would be run in all regions.

Calibrations/derivations prior to OW software (pressure corrections)

Birgit suggested sharing the Coriolis Scoop software to any DMQC operator to screen, flag and save the data, especially since now it handles netCDF files.

Guillaume asked how the accuracy of pressure measurements was computed and if it can evolve. It seems the accuracy provided in the netCDF file is the one provided by the manufacturer.

SBE is working on changing the temperature effect correction on the pressure to correct the anomaly detected when working on SBE61 for deep data. From last discussion at AST this anomaly is present for all SBE41 data that have been deployed since the start of Argo. Therefore, a correction on the SBE CTD will induce an inconsistency in the Argo times series where users should be warned that the change is due to change in the sensor and not change in the ocean. How such issue will be handled is an activity at AST level with SBE and that will impact the data system.

Presentation of DMQC manual section “Common instrument errors and failure modes”

The Argo QC manual has identified a series of potential issues that may or have happened to Argo floats. Birgit found difficult to retrieve examples for some of the mentioned problems. She suggested that at next international DMQC workshop, this list is reviewed, that for the problems that have happened examples are provided, and for those which never happened they are removed. For the examples DMQC operators could also record the problem they have discovered in the file (e.g. tags).

It has been shown that no examples for incorrect pressure sensor coefficient could be found. An action should be considered for the next ADMT meeting in December 2018.

OW presentation

It was demonstrated that the operators need to adapt the parameters and configuration to the area of observations.

Breck mentioned the fact that the method underestimates the uncertainties in the mapping procedure.

Comparison with CTD made at deployment

The importance of the deployment CTD was stressed. Sometimes it is the major aspect in the DMQC decision-making process by the operator, to correct or not the float.

North Atlantic ARC feedback on results

It appears that in the tropical North Atlantic (between 10°N and 20°N) the OW method often suggests that a salinity offset is present in the float data while the PI or the DM operator have chosen not to correct the salinity data. In this region, the OW method does not always reproduce the Pi's decision, probably because the reference databases (Argo and CTD) do not well sample the variability in this region, especially during the most recent years. To be looked at!

How to fill in calibration and history sections of D-file

Guillaume would like to have a more standardised history section to better identify when human operators have either modified the quality flags or adjusted the data for an offset or a drift. Action see with Thierry Carval if we can make a proposal for next ADMT.

Practical work with OW

The mapping stage is the longest step that must be only performed again if the configuration parameters or the reference dataset are changed.

The operator can edit the `set_calseries.m` program to choose to fit an offset (`max_breaks=-1`), a linear fit with no breakpoints (`max_breaks=0`) or a piece-wise linear fit (`max_breaks>=1`). It is also possible here to split the time series, ignore some profiles and refine the theta or the pressure range used in the calibration.

Before running OW the operator must screen the data and flag bad data (to 4) that OW will not use. One can put a flag 3 if think the data is correctable.

Breck and Justin recommended using CTD and Argo reference dataset separately when using OW. Anyway, if the reference dataset is scarce in some regions, a combination of the two datasets could be necessary.

Practical work with Scoop

Coriolis has developed a beta version to be used outside Coriolis database, with netCDF files directly. Bathymetry and climatology files are available.

<http://www.seanoe.org/data/00374/48531/>

Ifremer needs to produce a small document for a new operator to know how to use the software. Some improvements will need to be implemented if the software is widely distributed.

Feedback discussion (off-the-cut)

- Attendees would like to see the float data screening. People were interested by SCOOP software on netCDF but we need to improve it to allow better sharing as it has not been designed as an open-source software.
- It was found that the content of the first day was a bit too dense and it was difficult to absorb all information provided. It could have been a good idea to share the presentations with people beforehand. For this first workshop the presentations were not ready in advance; for the next ones this might be feasible.
- The practical exercises on the second day helped to get a better idea of the differences steps of the DMQC process. But although the audience all had access to the virtual machine (which was deemed very well) it was for some persons difficult to follow what was demonstrated on the screen.
- People would like to have some floats, already DMQced that they could play with and check what they did against what experts recommend. It will be possible when the material prepared for the workshop is available.
- The audience definitely needs that the DMQC operators and DACS share some tools to read, check and write the D-Files. *Action set out infrastructure such as a GitHub space.*
- Newcomers need a document that details all steps from getting a file from the GDAC to sending the D-File back. *Action ADMT or Euro-Argo?*
- Sharing best practices to process a float in such or such region was also suggested. *Action based on the material assembled for this workshop. Initiate a best practice document and share it at next International DMQC workshop.*
- In the context of DMQC training it was encouraged to set up a group of experts that could help others (a sort of on-line forum). The idea to associate trainees with a “mentor” was also evocated.
- Guillaume raised the question about the current programming language of the tools: is MATLAB a constraint and should we move to free software such as Python? To be discussed at international level. Breck mentioned that other teams are thinking of switching to Python.
- At last, Breck mentioned that it was important to provide feedback on this workshop to the international DMQC workshop next December. This report will be circulated and a presentation proposed to the DMQC international workshop organiser.

Questionnaire Feedback

An evaluation form was sent to the attendees after the workshop. 25 forms were collected which results are synthesized hereafter.

The overall assessment of the event was deemed very good to excellent by the participants. People declared to be well informed about the objectives of the workshop and reported that it fully achieved its objectives.

In terms of knowledge and information gained from participation at this event, participants stated that it predominantly met their expectations. 50 % found that it will definitely be useful and applicable in their work, 25% mostly and 25 % somehow.

The difficulty level of the workshop was mostly judged appropriate although some people found it intense.

Participants were very satisfied by the organisation aspects and logistics of the workshop.

Conclusion and perspectives

The organisation of this first European DMQC workshop was very positive. It gathered about 30 participants from many countries. The speakers were the current DMQC operators in Europe. The audience comprised people interested to learn more about the DMQC processes and tools, among some of them wanted to start DMQC activities themselves.

In that frame the workshop was organised in 2 days, the first day with lectures on the general concepts and philosophy of DMQC, a review of problems to look at etc. People found this overview was very useful. The second day was designed as a practical work on the OW method and example of DMQC of some floats. This part was harder to follow by the audience since most of them discovered the OW method and the MATLAB code for the first time.

Participants recognised that such workshops are very useful, allow people to meet and discuss on issues that they usually don't discuss with other teams.

There was an agreement that future workshops should be organised with this community as a follow-up of DMQC issues but also on other subjects such as Biogeochemical data processing but not restricted to that topic.

For a follow-up of this workshop we could imagine something like half a day, where the unexperienced DMQC operators show some difficult floats to the guides and get some feedback how to proceed. It could be organized as a group work for 2 or maybe 3 persons. Possibly afterwards some outcomes could be presented to all participants and recommendations would be developed together. Of course, such organisation will require that the attendees (the unexperienced DMQC operators) have been working on their own with the OW-method and have created the whole workflow before the meeting.

The feedback from the participants encourage the organisation of future events on DMQC, but after this first introductory workshop, it is suggested to design the next ones with:

- More time, perhaps 3 days
- More practical work, split into small groups of 3/4 persons + 1 expert

For a productive future workshop, it is highly desirable that first:

- Documentation around DMQC is significantly revised and consolidated at international level, perhaps in the form of a cookbook
- Tools and codes are made available to the new comers into DMQC (e.g. this workshop community)
- Participants start using the tools and methods presented during the first workshop on their floats. This will bring interesting use cases and questions to be discussed from now on between the “experts” and this new European community.

Agenda

1st day – 09:00

Introduction and objectives of the workshop. *S. Pouliquen, R. Cancouët*

Presentation of the data system as a whole. *(0h50)*

- Argo data system (DAC, GDAC, QC operators, ARCs). *S. Pouliquen*
- Argo netCDF variables. *G. Notarstefano*
 - Data modes and quality indicators
 - Recording of calibrations and derivations
 - Delayed-Mode target data accuracy for each variable

Presentation of the Argo delayed-mode QC process for PRES, TEMP and PSAL.

- External QC feedback from DACs. *C. Coatanoan (0h40)*
 - Real time QC, data screening and modification to RT flags
 - Objective analysis
 - Altimetry QC *(CLS slides)*
- Calibrations/derivations prior to OW software. *J. Buck (0h30)*
 - Pressure corrections (the history of pressure issues and correction/flagging policies)
 - Cell thermal mass correction

Break 11:00-11:20

- More pathologies to check. *B. Klein (0h30)*
 - Presentation of DMQC manual section “Common instrument errors and failure modes”, <http://archimer.ifremer.fr/doc/00228/33951/32470.pdf> (page 53)
 - Link to some items of the last AST meeting, http://www.argo.ucsd.edu/AcAST-19_agenda.html
- OW. *B. Owens (01h00)*
 - Presentation of the concept and the method
 - Configuration of OW, review of output i.e. what the plots show

Lunch 13:00-14:00

- OW follow-up.
 - Correction thresholds. *B. Owens (0h30)*

- Reference data (CTD and Argo databases). *C. Coatanoan (0h20)*
- Comparison with CTD made at deployment, *C. Cabanes (0h10)*
- North Atlantic ARC feedback on results (= checking DMQC results at North-Atlantic scale). *C. Cabanes (0h30)*
- Final decisions (*C. Cabanes (0h30)*)
 - Documenting decision
 - How to fill in calibration and history sections of D-file

Break 15:50-16:10

- Can Machine Learning help for Argo DMQC? (*G. Maze (0h30)*)
- Setting-Up virtual machines for the Wednesday practice session (*G. Maze*)

Evening: social dinner for people who want to (Brest city centre, close to the tramway line)

2nd Day – 09:00-16:30

- **Practical work (trained)**
 - Demonstrations by DMQC experts for different sea areas (example OW configuration, example output, oceanographic phenomena and hydrography to be aware of).
 - Attendees to follow on their computers the use cases (virtual machine).
 - Trainers to pick floats from different regions and by problems.
 - North Atlantic (Cécile)
 - South Atlantic (Birgit)
 - Southern Ocean (Justin)
 - Mediterranean (Giulio)
 - Nordic Seas (Birgit)
- Introduce **team exercise on a review of results**

Lunch 13:00-14:00

- **Practical work follow-up (free)**
 - Split into groups with examples of OW output and data to review and make decisions and error estimates, identify pathologies, determine if agree with OW output
 - Propose corrections/error bars/modifications to OW settings to try again
 - Use of the Scoop data screening software
- **Feedbacks/questions from attendees**