



Biogeochemical-Argo ADMT 17 |  
Meeting Report  
Tianjin, 26 - 27 September 2016

### Hervé Claustre. Introduction/ general objectives of this meeting

A meeting took place in January in Villefranche-sur-mer to discuss and review the science and implementation plan for the Biogeochemical-Argo program. Six core (essential) Biogeochemical-Argo variables were identified: CHLA, NITRATE, BBP, DOXY, pH, IRRADIANCE. Some scientific questions were also highlighted as key questions: carbon uptake, OMZs, acidification, carbon pump, phytoplankton communities. The objectives of the present ADMT meeting is in line with this global implementation through continuing the effort in organizing the data management for these variables.

### Udaya Bhaskar. DAC: Biogeochemical-Argo data management-India

17 floats with only DOXY, 48 with others sensors (CHLA, BBP) (APEX, NKE) were deployed since 2006 in the Indian Ocean. 5 BGC floats in collaboration with NIO/GOA(APEX) will be deployed in the North Indian Ocean. These data are used to study the role of MJO on CHLA, MLD and DCM studies, Tuna fish studies, modelling.

### Justin Buck. DAC: Biogeochemical-Argo data management-UK

The UK fleet represents 26 Floats with different configurations and pending floats (~15 floats : deep apex with optodes, 2 provors, 8 navis with DOXY, 3 navis BGCi). Resources (human and financial) are an issue for the data processing. Since last ADMT, metadata and 40% of the core profiles data are in V3.1. Further work for Biogeochemical data management will begin as soon as core V3.1 and DM-QC are well established.

### Kensaku Kobayashi. DAC: Biogeochemical-Argo data management-Japan

Japan has deployed 77 Biogeochemical-Argo floats since 2005. About 61 floats of them are equipped with only oxygen sensor, and the other are equipped with Chl-a and/or BBP sensor in addition to oxygen sensor. The oxygen data have been submitted to GDAC in format version 3.1 BR files but not put through RTQC. The Chl-a and BBP data have not yet submitted but will be submitted in 2017. We will introduce RTQC according to BGC QC manual. We will also send oxygen data on the GTS in BUFR format.

### Ann Thresher. DAC: Biogeochemical-Argo data management-Australia

CSIRO has now deployed a significant number of BGC floats as well as DOXY only floats. There is a significant cost to processing this data, particularly initially. The DM costs will be even higher. We currently derive all final parameters from these floats and deliver them to the GDACs in RT in version 3.1. RTQC is done on DOXY and TEMP\_DOXY only but we are working in implementing Chl-a RTQC. We have written nice tools to assist with DMQC of DOXY and

many of these BD files have already been delivered to the GDACs as well. Other variables will come in time. Plot tools are available on the web at:

<http://wa-shiny.imos.csiro.au:3838/bioargo/>

and

<https://research.csiro.au/iobioargo/>

Initially, qc'd data will only be available through these visual tools. We still have some issues to address but are making good progress.

#### Annie Wong / Ken Johnson. DAC: Biogeochemical-Argo data management-US

Efforts to transfer biogeochemical data to V3.1 B-files have been focused on 3 projects: SOCCOM (Southern Ocean Carbon & Climate Observations & Modeling), Pre-SOCCOM UW-MBARI equivalents, Historical UW oxygen floats. SOCCOM profile data until June 2016 are available under AOML DAC in V3.1 D- and BR- files. Automate transfer of bgc data of active floats to v3.1 netcdf is still to do as well as Btraj files. Some real time adjustments on BGC data are done at MBARI but not yet automatically transferred to Argo DAC. Regarding historical UW oxygen floats, profile data of 117 UW floats are in V3.1 D- and BR- files, the collaboration with AOML continues to transfer the data of the 63 remaining floats.

#### Anh Tran / Catherine Schmechtig. DAC: Biogeochemical-Argo data management-Canada

Anh Tran reports that the BGC floats (DOXY) data are sent to GDAC in NetCDF format version 3.1 and quality checked in RT. In the next six months, the remaining DOXY NETCDF files will be converted from 2.2 to 3.1 and the DOXY profiles will be visually checked. The Delayed mode will be performed on 23 floats equipped with optodes.

Catherine Schmechtig reports that three CTS5 (provor) bought with canadian funds were deployed during the GreenEdge Cruise. The profile data will be soon available on the GDAC, while the decoding is ongoing work at Coriolis.

#### Thierry Carval . DAC: Biogeochemical-Argo data management-France

Coriolis DAC manages a matlab data processing chain for Argo floats, including Biogeochemical-Argo data. Whenever new or improved specifications are issued, the data processing is updated. Since 2015, Provor floats Biogeochemical-Argo data are distributed on Argo GDAC. They feature version 3.1 core and bio profiles, trajectories, metadata and technical data. Since 2016, Biogeochemical-Argo data from Apex and Nova floats are managed in V3.1 format. The other Biogeochemical-Argo floats (Navis and Nemo) are distributed in V3.0 data files (from a separate data processing chain). The transition to V3.1 is underway.

At Coriolis, for Biogeochemical-Argo more than 80 parameters are managed: core-argo, b-argo, i-argo parameters. These parameters include oxygen, chlorophyll, turbidity, CDOM, back-scattering, nitrate, bisulfide, radiance, PAR. Real time QC is applied on oxygen (DOXY) and chlorophyll (CHLA).

ALL: Discussion on coordination (test case, sharing codes)

A list will be created for those who are interested in the development of the common procedures to perform quality control tests in RT and in DM.

Actions: #4, #7, #11, #12

Catherine Schmechtig. Documentation principles (Cookbook, QC Manual)

During the ADMT16, it has been decided to split the Argo quality control manual in two manuals: the Argo quality control manual for CTD and trajectory data (JULD, LATITUDE, LONGITUDE, PRES, TEMP, PSAL, TEMP, CNDC) and, the Argo quality control manual for biogeochemical data. As there are many different groups of experts in charge of the assessment of different biogeochemical data set, the Argo quality control manual for biogeochemical data should be considered as the cover document (presenting generic tests) of all biogeochemical data quality control manuals (both generic and specific tests).

The outlines of each quality control documents is presented:

- 1- Real Time quality control (R)
  - a. Real time quality control for vertical profiles
  - b. Real time quality control for trajectories
  - c. Real time quality control for Near surface data
  - d. Real time quality control for Deep data
- 2- Real Time quality control for data adjusted in Real Time (A)
- 3- Delayed mode quality control (D)

Virginie Thierry, Henry Bittig, Ken Johnson, Kanako Sato : DOXY session

V. Thierry presented the DOXY cookbooks: processing cookbook at the DAC level and ARGO QC manual for dissolved oxygen concentration, as well as the updates to their contents. John Gilson suggests investigating additional DOXY BRtraj tests (so far only global range) to better qualify the data and to be able to assign meaningful QC flags. Henry Bittig presented recent O2 optode findings. Time response correction is possible for SBE63 and Aanderaa optodes (Bittig and Körtzinger 2016, in review), but it requires the measurement time to be available in the profile files (Discussed at the 17th ADMT). Optode in-air measurements are biased during mid-day, i.e., a fraction of all surfacings should be evening/ night/ morning surfacings to get a good in-air calibration. Detailed O2-correction procedures are investigated by a SOCCOM O2 ad-hoc working group. A real-time adjustment method can yield probably 1-2 % accuracy, while delayed-mode adjustment can be on the order of a few tenths of a percent, compared with

>10 % accuracy for standard / factory calibrations. For anomalously low O<sub>2</sub> values at the base of the profile, a 'hook' test needs to be established.

Henry Bittig also presented a review of the meta data for all DOXY floats. Fields are quite inconsistently filled (mainly pre-V3.1 files, but also some V3.1 files), so that DOXY floats and their sensors/parameters are not adequately identifiable. This holds true for other B-parameters, too, and needs to be addressed by DACs/Pis to enable their floats to be identified appropriately. Format transition for DOXY floats to V3.1 is well underway (CSIRO and JMA transitioned completely). However, some legacy floats with DOXY in old formats (V2.2) will probably need special attention, both to convert to V3.1 and to DMQC the data, as their original PI might be unavailable. The first delayed-mode QCed DOXY data are now available at the GDAC.

Actions: #3, #13, #14, #15, #16

#### Kanako Sato. report on JAMSTEC's oxygen activities

The oxygen activities of JAMSTEC were reported briefly. JAMSTEC will deploy a BGC-APEX float and a Deep APEX with optode4830 by March 2017. We are developing Deep NINJA float equipped with RINKO which can measure oxygen to 4,000 dbar. JAMSTEC examined the time drift of ARO-FT, manufactured by JFE Advantech Co. Ltd. The oxygen data of ARO-FT has no remarkable time drift, because ARO-FT data matches in-situ data well in the layers deeper than 26.8 kg/m<sup>3</sup> after about a year and the time series of oxygen on the isothermal layer 2.2 degC has no remarkable drift.

#### Virginie Thierry DM tools: LOCODOX

Virginie Thierry presented a matlab toolbox called LOCODOX developed at LOPS/Ifremer by E. Brion (Altran ouest company). The tool is designed to correct oxygen data in using either reference in situ profiles (climatological atlas or ship-based O<sub>2</sub> profiles) (Takeshita et al., 2013) or in-air measurements (Bittig et al, 2015). LOCODOX works with Argo profiles in format 3.1 and produces delayed mode NetCDF files complying with Argo 3.1 format and following the BGC/DOXY QC manuals. Once finalized, the tool will be available to the scientific community.

#### Catherine Schmechtig: Open question

-The PREDEPLOYMENT\_CALIB\_EQUATION, PREDEPLOYMENT\_CALIB\_COEFFICIENT, PREDEPLOYMENT\_CALIB\_COMMENT string lengths are by default set to STRING1024. When necessary (such as for Nitrate sensor), the string length is set to 4096.

-The value of QC=8 is used to fill the QC values changed because of the non photochemical quenching correction. That should be changed in the next version of the CHLA documentation of the quality control with QC=5 (values changed).

-It is now possible to append a 2 to a « SENSOR », to keep the link with SENSOR\_PARAMETER (for which it was already possible)

-The size of the merge file for one float (it can exceed 2gb) could be an issue for users. A test with the netcdf4 format will be performed to check that it decreases the size of the file.

Actions: #2, #6, #8, #9, #10

#### Henry Bittig: Time of Surfacing

At present, the ensemble of all Biogeochemical-Argo floats surface at any time of the day. The majority of floats are on a full day cycle interval, so their surface time (UTC) is on average constant. However, a significant portion has a cycle interval with a fractional day contribution, so their surface time (UTC) successively progresses with each float cycle.

This way, diel cycles, e.g., in sea surface temperature, oxygen, POC or chlorophyll fluorescence (due to non-photochemical quenching during the day), can be aliased to higher frequencies (~float cycles). In addition, some sensor measurements are strongly dependent or influenced by the local daytime (O2 optode in air calibration, radiometry, chlorophyll fluorescence).

It is recognized that Biogeochemical-Argo floats, depending on the scientific mission, may be programmed to surface at specific local times (e.g., noon, dawn, night) or to keep a fixed cycle time. Attention needs to be paid that such an approach does not introduce a bias to the array, e.g., if all floats of a certain type or in a certain region sampled a particular part of the diel cycle.

Floats that target a specific surface time (UTC) can be identified by a set value for "CONFIG\_SurfaceTime\_HH" in the "CONFIG\_PARAMETER" of the floats' meta.nc file. To make users aware, an entry to the Data-FAQ at the Argo website will be added. Moreover, LOV will test a draft recommendation for core-Biogeochemical-Argo floats' surface timings and report back at 18th ADMT.

Actions: #5

#### Catherine Schmechtig. NO3: NO3 at Coriolis

Last year, the results of several SUNA sensors providing NITRATE concentration around -50 mg/m<sup>3</sup> were presented. To avoid those bad results due to a misinterpretation of the calibration file, the document « Processing Nitrate at the DAC Level (draft) » : <http://doi.org/10.13155/46121> » is presented. This version explains how to take into account the lag between the CTD and the SUNA sensor as well as the so called « pressure effect » which is still under study at MBARI. As a conclusion, we show that now at the Coriolis DAC, the parameter NITRATE is in the correct range.

#### Ken Johnson. NO3, pH

The pH sensor calibration and drift are largely corrected. The so-called « pressure effect » is still under study at MBARI, but as soon as it is published the documentation « processing Nitrate » should be updated.

Actions: #17, #18, #19, #20, #21, #22

#### Hervé Claustre. NO3/pH : Neural Network approach

Hervé Claustre is presenting the potential use of empirical algorithms for Qcing some Biogeochemical-Argo variables. DOXY is at the cross road of production and remineralization processes for C and N. So with a good measurement of DOXY and training a neural network with the Glodap V2 dataset (Olsen et al., 2016), it is possible to retrieve, for example, the “best” estimate of deep nitrate value to reference QC. Several publications are submitted or in preparation (Sauzède et al., submitted, Pasqueron de Fommervault et al., in prep; Bittig et al., in prep). The application for several parameters (pH, TA, pCO<sub>2</sub>, DIC) are illustrated, as well as validation and calibration for sensors (NO<sub>3</sub> and pH).

#### Hervé Claustre / Catherine Schmechtig. Chlorophyll-A: real-time QC, delayed mode QC

The overestimation of a factor 2 of the factory calibration (identified by the community) will be explicitly addressed in the metadata file, as soon as the paper is published. Beside this overestimation factor, there is a consistent regional (natural) bias in the relationship (float vs HPLC Chla) or (float vs radiometric Chla) that is of more concern for producing DM-Chla. This variability is linked to natural (regional, largely driven by the composition of the phytoplankton community) variability between Chla and its fluorescence proxy.

A revision of the QC manual for the chlorophyll-A for the deep/dark signal will be undertaken for RT while a DM procedure when CDOM is present will be tested.

If FChla gradient < 0.01 mg m<sup>-3</sup> km<sup>-1</sup>, present deep-offset correction is valid.

If Chla gradient > 0.01 mg m<sup>-3</sup> km<sup>-1</sup>

If CDOM is measured:

$$FChla_{cor} = FChla_{meas} - FChla_{dark} - Slope_{FDOM} * (F_{DOMmeas} - F_{DOMdark})$$

Slope<sub>FDOM</sub> is in units of mg m<sup>-3</sup> ppb<sup>-1</sup>

If CDOM is not measured

FChla minimum is used as the Offset value and FChla is assumed to be zero below the minimum of Fchla.

**Actions: #23, #24, #25, #26, #28, #29, #30**

#### Emmanuel Boss / Antoine Poteau / Catherine Schmechtig. BBP: real-time QC, delayed mode QC

The updates of the documentation for the backscattering (BBP) processing are presented by Catherine Schmechtig. The sensor name should be changed into BACKSCATTERINGMETER instead of SCATTEROMETER (which is confusing with remote sensing).

**Actions: #32, #33**

Anomalies in deep signal were presented and remain to be investigated at the different DAC levels. (Antoine Poteau)

Actions: #31, #34

Emmanuel Boss. Backscattering measurements on profiling floats

In this talk E. Boss reviewed the state of the art of backscattering measurements on profiling floats, their applications (what can be inferred from such measurements) and methodology to quality control these measurements in both near real-time and delayed mode. There are currently three different sensors, all from WETLabs, used to infer the backscattering coefficient.

Actions: #27, #35

Emmanuel Boss. Radiometric measurements on profiling floats

In this talk E. Boss reviewed the state of the art of passive radiometric measurements on profiling floats, their applications (what can be inferred from such measurements) and methodology to quality control these measurements in both near real-time and delayed mode. There are currently single PAR sensors and spectral irradiance and radiance sensors, all from Satlantic, deployed on floats.

Actions: #36, #37

Antoine Poteau. Radiometry : Pressure and Temperature dependence

The temperature dependence of the Dark counts in the calibration equation is highlighted, as well as a sensor drift. Some recommendations should be addressed :

- At least 1 midnight profile per year per float with OCR radiometers. (The best timing : at end of summer, when T dynamic range is near maximum).
- Use midnight profiles to correct for T-dependence and deep drift data to correct for sensor drift.

Actions: #38

Catherine Schmechtig. Actions list, Visio in 6 months

The actions list will be restored and a Visio conference will be organized in 6 months.

Actions: #1