Bio-Argo floats : Data management in progress…

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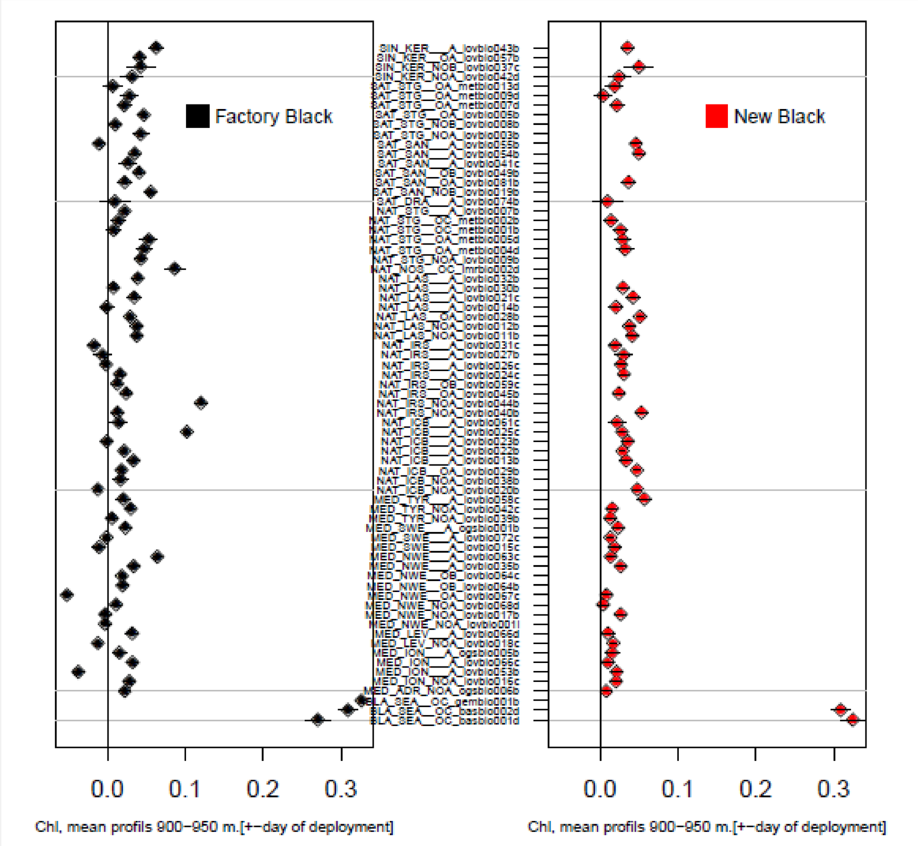
Abstract : In the context of the Bio-Argo program, a significant number of "new" biogeochemical variables are now candidates to be delivered via the Argo data system. These variables are nitrate concentration, dissolved oxygen concentration, Chlorophyll-A concentration, backscattering coefficient, pH and radiometric data. Compared to the core Argo mission (P, T and S), the diversity of new variables is forcing the biogeochemical community to manage the data very carefully. For the last three years the biogeochemical community has actively participated to Argo data management meetings in order to develop procedures for biogeochemical data compliant with Argo requirements regarding distribution policy, format, quality assessment and documentation. We illustrate here the work done for two variables : Chlorophyll-A concentration (CHLA) and particulate backscattering (BBP). From the sensor calibration phase before the mission to the deployment, we present the developed procedures to keep records of the entire preparation of the float until the deployment. Then, we describe the real-time quality controlled procedures that have been performed on about 7000 Chlorophyll-A and BBP profiles. This procedure is still an on-going work but it is already in an implementation phase at the Coriolis data center.

Metadata : From the sensor calibration phase to the deployment

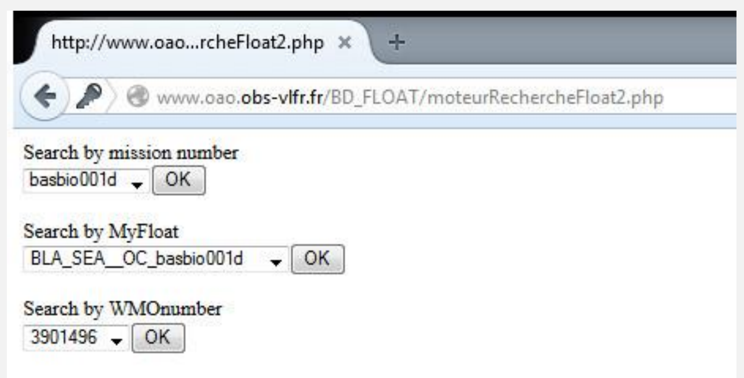
1. Preparation and calibration

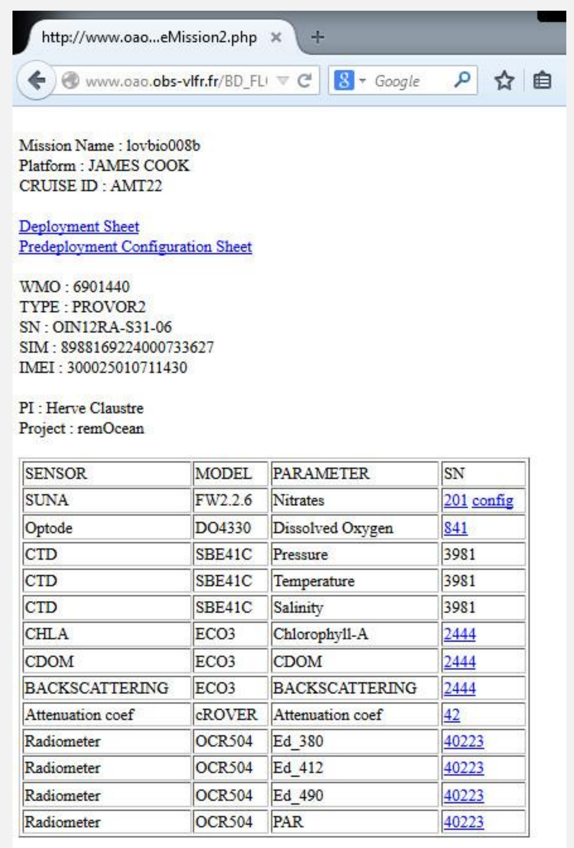


- ✓ Tests conducted in the pool at Ifemer, Brest
- ✓ Ensure the sensor dark value is correct for bio-optical sensors (black tape on sensors) so geophysical values are correctly derived
- ✓ Oxygen sensors are quality controlled

2. Deployment and metadata

We developed a database to store pre-deployment configurations and serial numbers of the float, sensors, modems, antennae, electronic cards, factory calibration sheets. We then make the data available in deployment sheets that were developed by Coriolis.





Storage of all the information is in a database ensuring long term preservation of:

- ✓ Deployment information (sea state, operator, position…) and associated in-situ simultaneous measurements
- ✓ Configuration at the deployment
- ✓ NO3 sensor calibration
- ✓ DO sensor Calibration
- ✓ Results of the tests conducted before the deployment

3. Bio-Argo work at the Argo Data Management (http://www.argodatamgt.org/Documentation)

The Bio-Argo group actively participate and collaborate with ADMT members to produce documentation for Bio-Argo. This makes Bio-Argo compliant with the ARGO project regarding policy, format …

- ✓ Parameter names http://www.argodatamgt.org/content/download/24108/166163/file/argo-parameters-list-core-and-b.xlsx
- ✓ Technical parameter names http://www.argodatamgt.org/content/download/24056/165836/file/ArgoTechnicalParameterNames_v6.2.xlsx
- ✓ Configuration parameter names for metadata files http://www.argodatamgt.org/content/download/23250/160210/file/Bio_Argo_Configuration_Parameter_Names_for_Metafile_17Oct2014.xlsx

Real Time Quality control For Chlorophyll-A

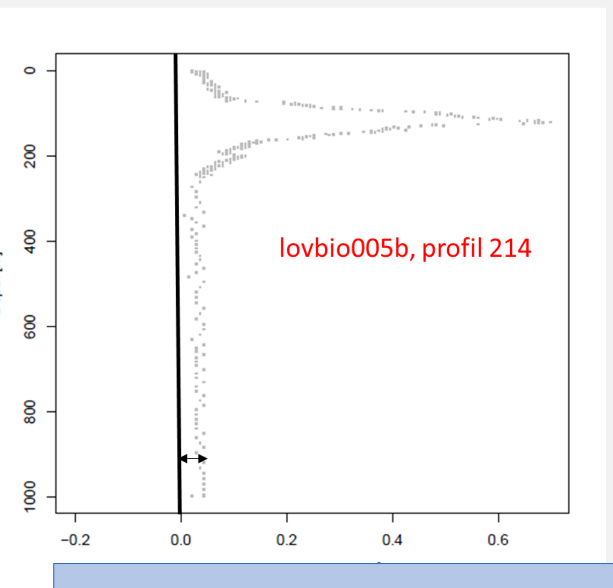
1. Calibration

CHLA=(FLUORESCENCE_CHLA_CHLA-DARK_CHLA) * SCALE_CHLA

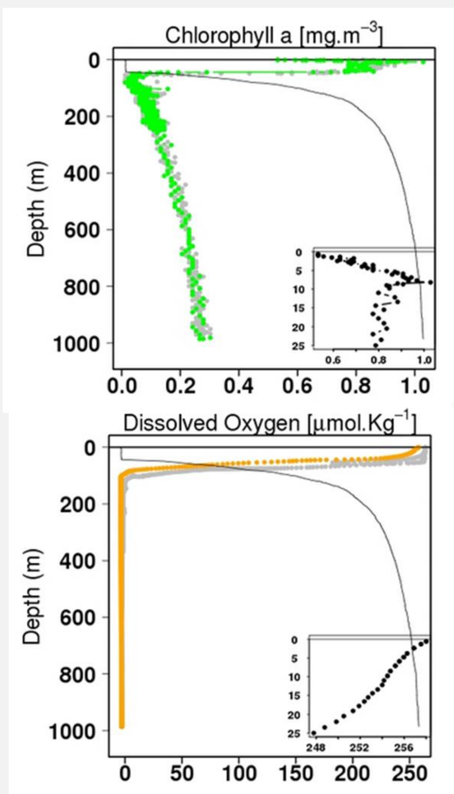
One issue with bio-optical sensors is to define correctly the dark value of the calibration equation. This improves the calibration relative to the with the factory calibration. The dark value measured in pool is stored in the metadata file so it can be use it in the derivation of geophysical values. The CHLA profile is also compared the in-situ measurements performed at deployment.

2. Adjustment at depth and OMZ

CHLA at depth is assumed to be zero. We adjust the profile at depth in order to correct for any factory calibration issues. This offset is then used to derive CHLA_ADJUSTED for all depths.



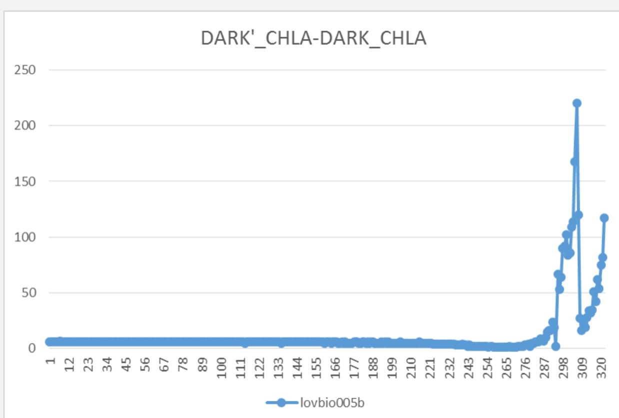
In most cases, this assumption is true. For some specific regions with an oxygen minimum, the CHLA signal can increase with depth (Black Sea) so defining regional criteria is proposed.



Float 7900591
In the Black Sea

3. Sensor Failure

The adjustment at depth is also used to detect sensor failure : when the adjustment at depth is over 20% from the dark factor of the factory calibration, the sensor is considered as a drifting sensor and the CHLA_QC are flagged 3 (indicating probably bad data).



4. Range and Spike Tests

Range: The acceptable range for CHLA is set to -0.1mg/m3 – 50mg/m3, each point out of this range the QC is flagged 4 (indicating bad data).

Spikes: The difference between sequential measurements, where one measurement is significantly different than adjacent values, is considered as a spike. With respect to biogeochemistry, most of the time, spikes contain information, mainly in case of positive spikes. Thus, we defined a test to discriminate negative spikes and flag the negative spikes as 4. For the non photochemical quenching correction (next section) positive spikes also need to be identified and excluded from the subsequent interpolation. Spikes are identified using a median filter.

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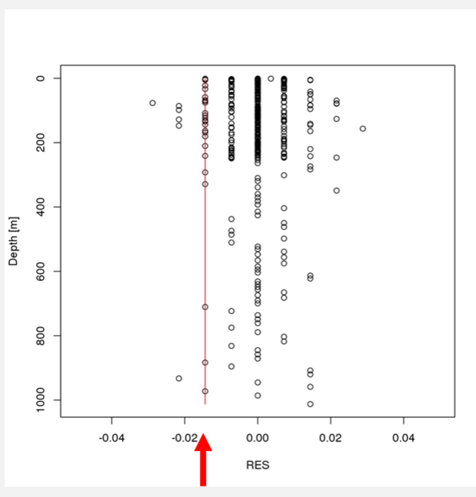

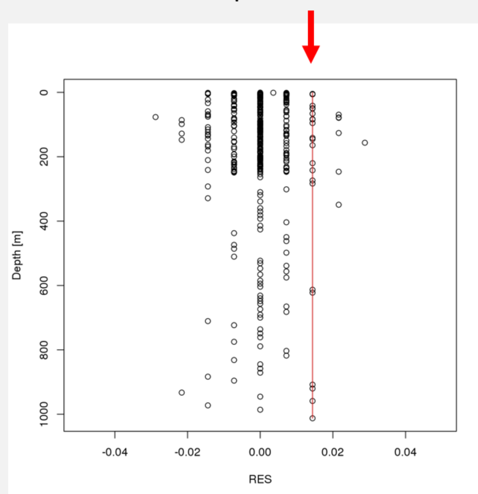

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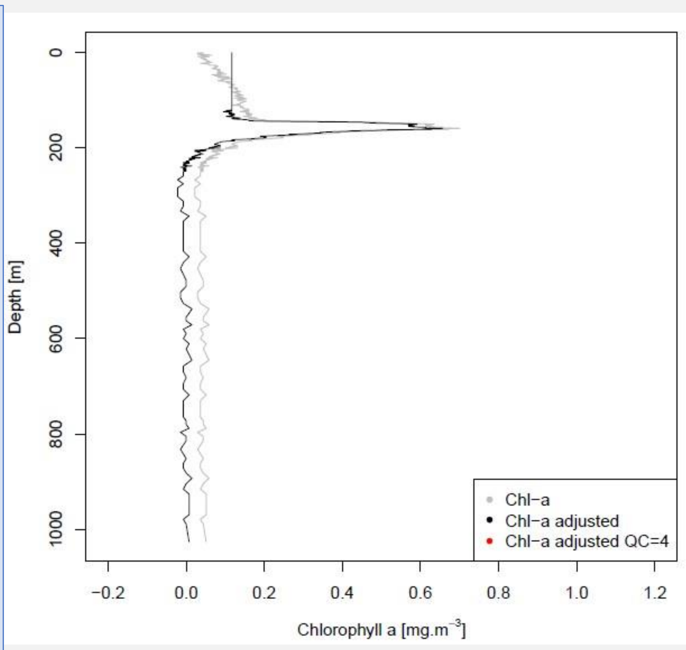
5. Non Photochemical quenching

Non-Photochemical Quenching (NPQ) is a mechanism employed by plants and algae to protect themselves from the adverse effects of high light intensity. In case of Non-Photochemical Quenching, the Chlorophyll fluorescence is no longer proportional to the chlorophyll-A concentration. Non Photochemical Quenching occurs in stratified conditions. It appears that the daytime fluorescence maximum (MaxFluo) and its depth ZMaxFluo within MLD, is a good proxy to identify the depth of NPQ (depthNPQ), the thickness of the layer potentially affected by the quenching. From the surface to depthNPQ, CHLA is flagged 3 and CHLA_ADJUSTED flagged 8.



The documentation describing the quality control tests for CHLA are available at the ADMT website:
Bio-Argo quality control manual for Chlorophyll-A concentration, version 1.0, December 2014: http://dx.doi.org/10.13155/35385

Real Time Quality control for BBP

The basic equation allowing the retrieval of particle backscattering from raw transmitted measurements is:

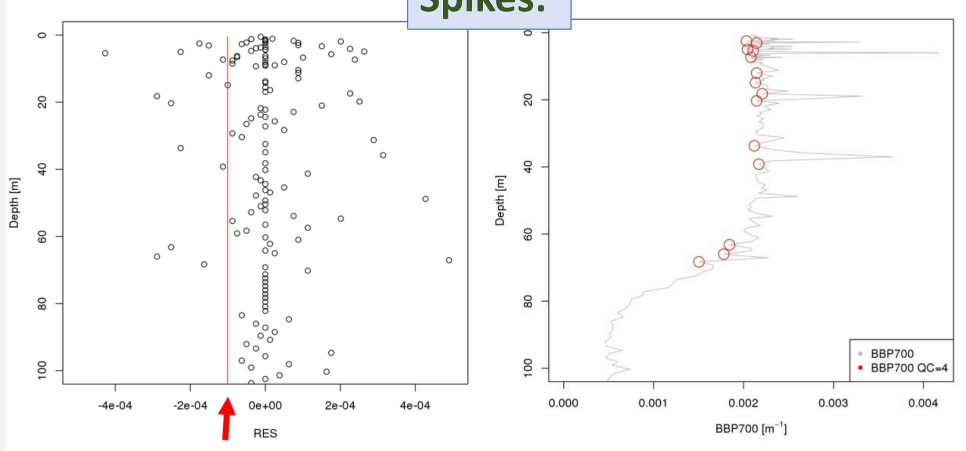
BBP700 =2*π*χ[(BETA_BACKSCATTERING700 – DARK_BACKSCATTERING700)* SCALE_BACKSCATTERING700-BETASW700]

Real Time quality control for particle backscattering is an on-going development activity. Currently a range test and a negative spike test are defined.

- **BBP range test criteria (dependent on optical wavelength)**
- **BBP700 (700nm)**
  Min= -0.000025 m^{-1}
  Max = 0.1 m^{-1}

BBP532 (532nm)
Min = -0.00005 m^{-1}
Max = 0.1 m^{-1}

Spikes:



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