Argo Bio-profilers for the validation of satellite observation of ocean colour

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Description of impact study carried out (overview, objectives, role of Argo): The availability of bio-profilers measurements is used to make the connection between the 2D-horizontal picture derived from Ocean Colour and the 1D-vertical information provided by floats. However, several issues appear to perform this connection i) the "common" products that are derived from these two techniques are principally the Chlorophyll-a concentration and the diffuse attenuation coefficient (Kd). Both of them are indirect measurements from Ocean Colour (i.e. making use of semi-empirical model from direct measurements of backscattered light at the sea surface) and the measurement from the float is also an indirect measurement of the Chlorophyll (through fluorescence). The direct comparison between the two sources of "indirect" observation therefore allows pointing toward weakness (or strength) on measurements from both origins as well as on their transformations.
Support to satellite ocean colour validation by bio-floats is to be understood as a reciprocal exercise. Both means of observations have to be seen as complementary. The level of use for a mutual benefit is strongly depending on the characterization of uncertainties and error of the bio-floats observations. If we know this uncertainty we can compare to satellite and even go towards a reciprocal validation. Without this knowledge the bio-profilers could support the ocean colour from space to be used for verification and quality control.

Results:
We propose to take advantage of the statistical independence of both observations (ocean colour and bioprofilers) to make use of classical statistical analysis to combine all the information; values of the Chlorophyll-a from different sources with associated accuracies and precision (this technique is similar to the ensemble-like approach used to derive the SST from several sensors). The main assumption is that the possible bias component has been removed prior to this combination – this should be the result of the QC DM operations.
The main result of the impact study is a methodology to estimate the uncertainties of the bio-profilers observations.

Conclusion:
The impact study is concluded by a set of recommendations for cross-validation between EO and bio-floats:

- Optimise the matchup strategy (ie. program the bio-floats to raise the ocean surface at the time of an OLCI path);
- Focus on the validation of IOP instead of AOP; e.g. the validation is preferably to be done on reflectances and Kd and, in a second step to Chlorophyll in order to be less dependent of fluorescence efficiency;
- Program high frequency cycle of profiling for each float when it is located in a biological stable area;
- Make use of Proval to perform parallel sampling during the launch of each bio-float;
- Pursue research works and validate the characterization of bio-floats uncertainties.

The figure below shows the results obtained for all the bio-profiler missions deployed by LOV (http://www.oao.obs-vlfr.fr/) compared to the GlobColour (http://www.globcolour.info/) dataset for Chlorophyll. Uncertainties on bio-floats measurements (error bars along x-axis) should complement the picture thanks to the methodology derived in the impact study.

Figure: