Quality control/assurance (QA/QC) of BOUSSOLE data

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ABSTRACT

The BOUSSOLE bio-optical mooring has been deployed for a decade in the oligo- to eu-trophic Case 1 waters of the NW Mediterranean Sea. This autonomous platform measures multi- and hyper-spectral AOPs and IOPs at 4 and 9 m and above the surface, and at high frequency (1 minute record every 15 minutes), populating day after day a huge data set available to the scientific community. The main vocation of this data set is to provide a robust in situ reference for satellite ocean color calibration and validation (cal/val) and, in parallel, to study the observed optical properties at different timescales. **Though a very significant effort is dedicated to the maintenance of the BOUSSOLE buoy and instrumentation, uncertainties due to bio-fouling, inter-calibration of instruments, instruments drifts, ships or animals shadows etc. may still arise on such long-term records.** Consequently, strict criteria have to be enforced when selecting a reference subset that meets the required accuracy for cal/val, thus significantly reducing the amount of available data. Given that such strict criteria have to be maintained for calibration purposes (i.e. vicarious calibration), somewhat relaxed criteria can be used for other uses, such as analysis of time series, validation, data assimilation. With the objective of improving the reliability of our data set, **the entire BOUSSOLE database is being reprocessed** to identify data affected by the above mentioned sources of errors, and either to correct for them when possible or to eliminate the corresponding data. This is **an essential step to update future versions of the BOUSSOLE database with flags** that will help users to extract data adapted to their specific needs.
Here we show some examples of the QA/QC that are currently applied on the BOUSSOLE dataset and instruments (transmissometers, backscattering meter, and radiometers).

1. CONTEXT

Long-term observations of optical properties on oceanic moorings is a complex task demanding a huge effort in the maintenance of instrumentation, quality assurance of measurements and quality control of collected data.

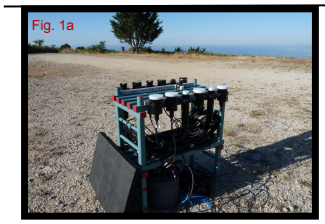
The basic QA strategy for the BOUSSOLE bio-optical mooring is to:

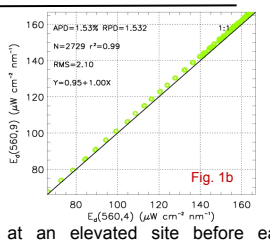
- Rotate factory-calibrated instruments about every 6 months;
- Use copper plates/tape/rings to minimize biofouling contamination;
- Visit the mooring every 2 to 4 weeks for sensors cleanup.

The QC strategy is being built up and systematically applied to data processing of historical and new data.

Here we show some of the procedures adopted or being adopted at BOUSSOLE.

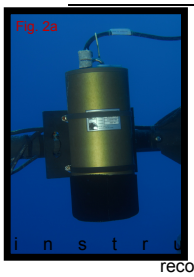
2. INTERCALIBRATION

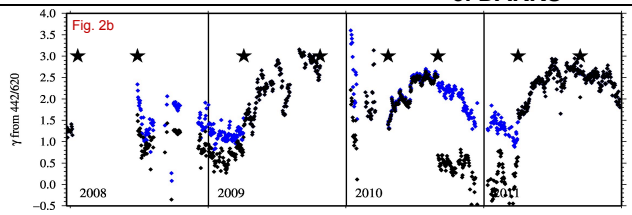




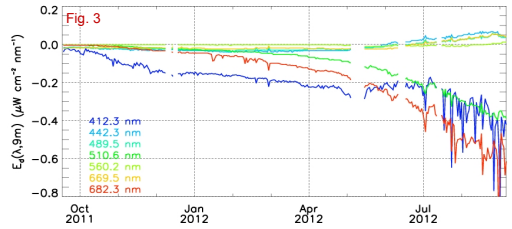
Radiometric measurements are recorded at an elevated site before each deployment (Fig. 1a). Radiometers not performing well are sent back to manufacturers. Fig. 1b: comparison between irradiances at 560 nm. Other intercalibrations are made between buoy and ship-deployed instruments.

3. DARKS



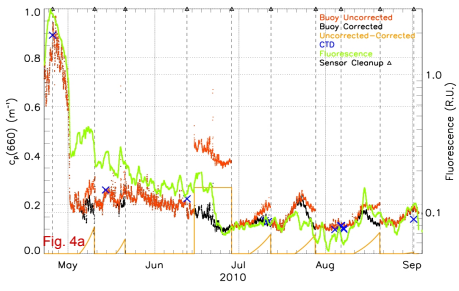


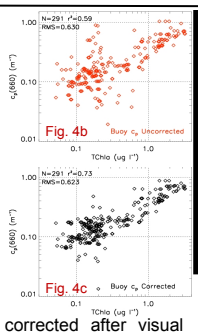
Divers regularly put black covers on IOPs instruments to collect dark records (Fig 2a, neoprene cover on a Hydroscat-4). A mean dark value is then subtractred over each deployment (stars in Fig. 2b). Fig. 2b shows a time series of the spectral slope, γ, calculated from b_{bp} before (black) and after (blue) dark subtraction.



Mean dark (night) values are subtracted from radiometric measures and used as a rapid check of channels integrity. Fig. 3 shows the dark $E_d(\lambda, 9m)$ time series of an entire deployment.

4. BIOFOULING





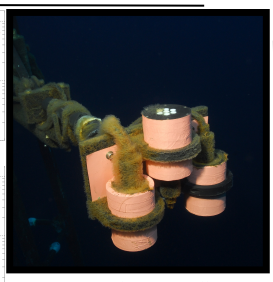
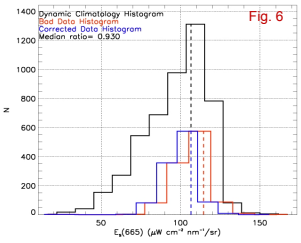


Fig. 5: biofouling affecting radiometers. The mitigation effect of copper is evident.

Measurements affected by biofouling are eliminated or corrected after visual inspection. Fig. 4 shows the corrections applied to a c_p time series and their effect on the Tchla vs c_p relationship (Figs 4b and 4c).

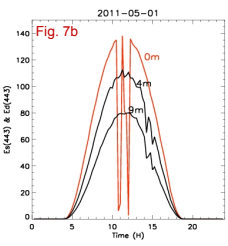
5. SELF CONSISTENCY

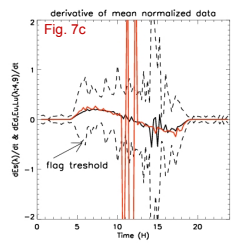


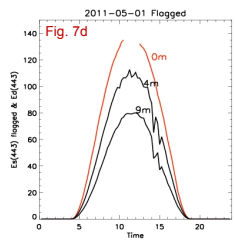
The establishment of a large time-series allows the creation of a climatology for each variable measured at BOUSSOLE. The comparison of a single (or partial) deployment with the climatology (Fig. 6) allows the detection (and maybe correction) of data affected by significant calibration or instrumental drift issues.

6. ANIMAL & SHIP SHADOWING

As all moorings, BOUSSOLE represents occasionally a rest for birds (Fig. 7a) which may shadow the irradiance sensors at surface (Fig. 7b). A procedure has been developed to identify (Fig. 7c) and eliminate (Fig. 7d) data affected by such perturbations.
A similar procedure for identifying shadow from unwanted ship stationing or passing along the mooring (poster head) is being developed too.







7. REFERENCES

Antoine, D. *et al.* 2006 BOUSSOLE: a joint CNRS-INSU, ESA, CNES and NASA Ocean Color Calibration And Validation Activity. ***NASA Technical memorandum N° 2006–214147***, NASA/GSFC, Greenbelt, MD, 61pp.

Antoine, D. *et al.* 2008. The « BOUSSOLE » buoy – A new transparent-to-swell taut mooring dedicated to marine optics : design, tests and performance at sea, ***Journal of Atmospheric and Oceanic Technology***, 25, 968-989.

8. ACKNOWLEDGEMENTS

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