5\textsuperscript{nd} Bio-Argo Workshop
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Chla : RT and DM-QC
Chla QC

Challenges and issues

- Overestimation by Wetlabs Eco-Puck fluorescence sensors
- Non Photochemical-Quenching
- Issue of Chla fluorescence increase with depth (with CDOM)

- Some general considerations with respect to DM
Chla Overestimation by Wetlabs Ecopuck fluorescence sensors

SOCCOM: Chla overestimation by a factor of 7

From soccom group
Labrador deployments along AR07E
Figure 1. Validation of factory calibrated in vivo chlorophyll fluorescence observations from WETLabs ECO sensors with paired HPLC total Chl samples for the regions described in Table 1 on A. linear and B. log scales. Lines indicate slope factors of 0.5 (dash), 1 (solid) and 2 (dotted).
Analysis of a global HPLC vs Wetlabs ECO serie database
Analysis of a BGC-Argo database

Results from 8000 profiles
Analysis of a ~ 9 mooring time serie

Figure 7. Time series of daily observations of in situ Chl fluorescence calibrated by the factory (grey) or in the lab with cultures of *Thalassiosira pseudonana* (green). MODIS Aqua 8-day Chl observations for the 0.1°x01° box around NERACOOS mooring A off Cape Ann, Massachusetts (data from Roesler 2014).
Conclusions/recommandations

Given field and laboratory results, we suggest that the oceanographic community take into account the bias in the calibration slope at the data processing step to correct their data. We recommend against an industry correction of the bias because such corrections lead to uncertainty on the user end of which calibration applies to which data set, etc. By placing the responsibility on to the user, each data set can be evaluated for the statement in the metadata and in publications “The community-established calibration bias of 2.xx for the WETLabs ECO-series fluorometer was applied to these fluorometric chlorophyll values.”

Beside the 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.
Issue of Chla fluorescence increase with depth (in specific situations)

Increase in fluorescence with depth: e.g. South Pacific Gyre
Increase in fluorescence with depth: e.g. black Sea
Increase in fluorescence with depth: e.g. black Sea

\[ \text{FChla}_{\text{cor}} = \text{FChla}_{\text{meas}} - \text{FChla}_{\text{dark}} - \text{Slope}_{\text{FDOM}} \times (\text{FDOM}_{\text{meas}} - \text{FDOM}_{\text{dark}}) \]

\text{Slope}_{\text{FDOM}} \text{ is in units of mg m}^{-3}\text{ ppb}^{-1}
Conclusions

• Deep fluorescence signal is associated to O2 minimum areas (Arabian Sea, Black Sea, subtropical gyres)

Recommendation

• If FChla gradient <0.01 mg m\(^{-3}\) km\(^{-1}\)
  – present deep-offset correction is valid.

• If Chla gradient > 0.01 mg m\(^{-3}\) km\(^{-1}\)
  – If CDOM is measured:
    • use the method presented here
  – 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.
Quenching correction
Chla non-photochemical quenching of fluorescence

Labrador Sea

North Atlantic Sub-tropical gyre

Austral Ocean Kerguelen area
SOCLIM deployments during OISO
Recommended Chl F Quenching Correction

Current Correction:
• Step 1: Smooth profile (what interval?)
• Step 2: Find max within ML
• Step 3: Extrapolate ML max to surface.

Contribution by Nathan Briggs, LOV

\[ \text{PAR(planar)} = 20 \, \mu\text{mol m}^{-2}\text{s}^{-1} \]

MLD
Recommended Chl F Quenching Correction

Current Correction:
• Step 1: Smooth profile (what interval?)
• Step 2: Find max within ML
• Step 3: Extrapolate ML max to surface.

Recommended changes:
• Step 1: *Increase smoothing interval* (15-point running median followed by 15-point running mean)
• Step 2: Find maximum within the ML and where PAR>20
• Step 3: Extrapolate high-PAR ML max to surface.
• Step 4: *Restore high-frequency variability* by multiplying raw profile by the ratio of corrected to smoothed uncorrected Chl
• Step 5: Three QC flags:
  • 3: MLD < \( z_{\text{PAR}=20} \) : POINTS where PAR>20, quenching correction probably bad
  • 2: MLD > \( z_{\text{PAR}=20} \) : POINTS where PAR>20, quenching correction probably good
  • 1: PAR<20. No correction needed

Contribution by Nathan Briggs, LOV
Alternative Chl F Quenching Correction

Contribution by Xing
DM-Chla Comparison with databases of reference

• Making historical (and heterogeneous) Chla fluorescence databases interoperable is an ongoing work.

• The amount Chla fluorescence profiles in these database nevertheless remains a limitation to develop reference climatologies (e.g. 3° x 3°).

• Presently it seems that climatologies can only be developed at a regional scale (e.g. biogeochemical provinces) to envisage possible use in DM-QC.
  – They will be restricted to perform /refine control on the range (regional test) and on the (seasonal) shape of the vertical profile.
DM-Chla: comparison with satellite

• The OCR satellite “sees” the upper 1/5 of the euphotic zone (layer between surface and depth where 1% of the surface radiations still subsist)
  – ~ 5 m in a rich eutrophic system (NA bloom, upwelling)
  – ~ 30 m in the clearest waters (South pacific Gyre)

• The comparison with float data thus only holds for such “surface” layers

• Here we use the globcolour product 4 km x 4 km, one-day matchup (other combination possible, not tested yet).
DM-Chla: comparison with satellite.
The data base used

• ~100 floats with Eco-triplet [(Chla, bb(700))] essentially deployed as part of EU, France, Italy, UK projects.

• Acquisition of a wide range of trophic (Chla range) and environmental conditions (O2 minimum).

• => the database analyzed is assumed to be representative of open ocean conditions
DM-Chla: comparison with satellite.
http://seasiderendezvous.fr/mapmatchupcomp
To make available a tool to annotate/flag/label data

• The tool « seasiderendezvous.eu » is presently « in development » to be come a tool for helping in Chla and bb DM-QC.

• Any return suggestion on how to make it adapated to the user community is welcome