

Interactive comment on. “Calibration procedures and first data set of Southern Ocean chlorophyll a profiles collected by elephant seal equipped with a newly developed CTD-fluorescence tags” by C. Guinet et al.

Final Author Comments

We thank the reviewers for their useful comments and suggestions, which will definitely help us to improve the quality of our paper. The following changes were made according to the first review.

Specific comments:

Anonymous Referee 1

Spelling mistake indicated by the referee have been corrected (plus some other ones) and the sentences difficult to understand have been shorten/reformulated.

Page 857 23-26. I don't see how to refer to the TOPP – GTOPP program in that part of the text and this paper is not really developing the idea of using top marine predator to monitor oceanographic parameters but on the issue of producing a calibrated data set of chlorophyll a concentration. This is obviously not the focus of this work, and would require the addition of another paragraph about the increasing use of top marine predators to assess oceanographic conditions and in that case I should not only refer to the TOPP program but many others (SEAOS, MEOP, etc...).

Page 860. References about chl a concentration measurements obtained in the Southern Ocean were added ([Reynolds et al. 2001](#), [Marrari et al. 2006](#), [Uitz et al., 2009](#)).

Page 861. Considering the figure 7, I do believe it is easier to keep the caption associated with the figure and not presented in the text as it is just an example of data obtained along the track of a given individual.

Anonymous Referee 2.

Main comments

I agree with the referee that the different factors corresponding between the tag fluorometers and MODIS (i.e. mean 3.04, range 1.90- 8.74), and then the intercalibrated fluorometers and MODIS (i.e. mean 1.99, range 1.04 - 3.24) were confusing in the current version, I have modified the text accordingly to make it clearer. Furthermore a sentence was added to discuss about the relative importance of the various source of uncertainty and the following sentence was added.

“The surface [chl a] values derived from by offset and quenching corrected profiles were found to be related to the 8-day-9 km MODIS chl a values. On average MODIS values were 3.04 times (β_j , range: 1.90 - 8.74) lower than the corresponding tag fluorometer, and we found that on average, MODIS tended to underestimate HPLC related [chl a] by a mean 1.99 ($\delta \cdot \alpha_j \cdot \beta_j$, range: 1.04 - 3.21)

factor compared to the in situ estimates provided by the inter-calibrated fluorescence tag (Table 2, Fig. 9). The variability of β_j (i.e. the Fluorometer/MODIS relationship) was on average larger than the inter-fluorometer one, suggesting that a large part of the error is likely due to the poor relationship found between [chl a] provided by individual fluorometers and MODIS. However this work emphasises that despite the fact that all the fluorometers were identical, nevertheless some large differences could be observed between fluorometers with α_j ranging between 0.11 and 0.36 (mean: 0.24) and those differences in themselves require those fluorometers to be inter-corrected between each other."

We acknowledge in this paper that the calibration was conducted in the Mediterranean sea and this can be a limit of our work and the following sentences were added:

"Due to logistical constraints, all the inter-calibration were performed form at sea test conducted in the north-west Mediterranean sea. This could result in some differences in the absolute amount of chl a estimated from fluorescence data in the SO and this point should be investigated in greater details in future studies. This procedure, nevertheless, presents the major advantage of producing a data set in which all fluorometers are inter-calibrated with each other. Furthermore the long term relationship established between the reference fluorometer and HPLC in the north-west Mediterranean sea is likely to be robust as it was established over a broad range of years and seasons encompassing different phytoplankton assemblages."

Specific comments:

Page 864, line 12-14. As indicated in the text the relationship found between MODIS chl a and surface chl a provided by the tag was used as :

"In a last step when they are sufficient surface fluorescence measurements coinciding with MODIS one, MODIS data can be used as a common but weak relative (not absolute) reference between fluorometers as many issues are affecting the quality of the relationship : low number of corresponding values, a poor temporal and spatial correspondence when using 9 km weekly data."

Furthermore. In the method part I indicated that :

"All data points available and corresponding to a match between chl a provided by MODIS and the fluorometer for a given tag were used in estimating β_j ." As it is not the β_j coefficient which is used directly in the Bayesian approach, β_j being an outcome of that procedure.

Page 872 lines 18-20 : The detection limit of the Cyclops 7 fluorometer is $0.025 \mu\text{g.l}^{-1}$, but the HPLC detection limit is $0.05 \mu\text{g.l}^{-1}$; so it is unlikely likely that the mismatch between the lowest MODIS chl a (i.e. about $0.13 \mu\text{g.l}^{-1}$) values and fluorometer ones ($0 \mu\text{g.l}^{-1}$) can be explained by these detections limits.

A recent work which is currently under review, suggests that, the absence of zero values in the MODIS data set results from the use of an inaccurate ocean colour algorithm implemented for the Southern Ocean. The current algorithm tends to underestimate chl a concentration and overs estimate chl a concentration at high and low concentrations

respectively (Johnson R., Strutton P. G., Wright, S., McMinn, A., Meiners, K. M., Three Improved Satellite Chlorophyll Algorithms for the Southern Ocean, Journal of Geophysical Research, in review).

Figure 9. was modified according to the referee comment.

And the new figure is included below:

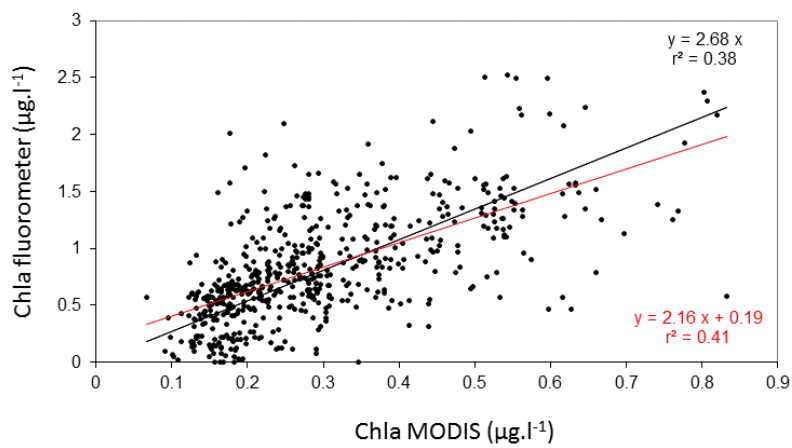


Figure 9. Relationship between the offset, quenching corrected HPLC inter-calibrated fluorometers with the corresponding 9 km weekly MODIS data. Both regressions with (in red) and without (in black) intercept are presented.