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**Biogeosciences Discuss., 10, 7549–7578, 2013, “On the consistency in variations of chlorophyll a concentration in the South China Sea as revealed by three remote sensing datasets”.**

**By S. Shang et al.**

We deeply appreciate the reviewers' time and effort to help improve the manuscript. We have revised the manuscript accordingly. Below are our replies to the detailed and constructive comments/suggestions.

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## **Reviewers' comments:**

### **Anonymous Referee #1**

#### **OVERVIEW:**

The objective of this study is to evaluate three standard chlorophyll products from the MODIS sensor for consistency in the South China Sea (SCS). A limited number of in situ measurements are also compared to the satellite derived products. The authors mainly use climatological data for their algorithm comparisons in various regions within the SCS. While the results show inconsistencies between the chlorophyll products, I would not consider this a novel concept or a thorough evaluation of satellite chlorophyll algorithms in the SCS.

There are no definitive results or final recommendations other than a suggestion for continuous improvements in remote sensing algorithms. The authors reference a submitted manuscript by Brewin et al. that evaluates 17 different chlorophyll algorithms; however they only include three global open ocean algorithms in their analysis. A better focus for this manuscript would be to evaluate relevant global and regional algorithms for the SCS using in situ data from this study and publicly available databases. The manuscript should also include more details on the optical complexity of this region and how changes in the optical properties influence the performance of the algorithms. If an algorithm is unable to accurately measure chlorophyll concentrations in optically complex waters, it likely will not be consistent with better performing algorithms.

Reply: We thank the reviewer for the critical comments. We want to emphasize that this is not an algorithm paper but a paper aiming at providing the users (oceanographers) a reference to choose a satellite product and interpret oceanographic processes. In other words, it is focused on products for the users and not on algorithms for the algorithm developers. For this reason, only three products are used in the paper because these are easily accessible, two of which have been widely used by the users, and the third one is an up-to-date product. The motivation of this work is that most users working on this region (SCS) randomly chose a product or several products in one study without acknowledging the possible uncertainties or inconsistency in these products, which might

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lead to erroneous interpretations. For example, Chl data in Lin et al. (2012) was from two sources and it is unclear which Chl product was used: “we use the monthly 9 km Chl-a concentration data derived by Sea-viewing Wide Field-of view Sensor (SeaWiFS), which is provided by the Distributed Active Archive Center (DAAC) of Goddard Space Flight Center (GSFC), NASA. Daily merged satellite Chl-a data obtained from the Ocean Color MEaSUREs project at UCSB [Maritorena et al., 2010] are used to investigate its intraseasonal variations.” As stated in the manuscript, while an increasing number of users from the oceanographic community are using the various Chl products to interpret biogeochemical processes or temporal changes, the consistency between these Chl products is generally unknown, especially for marginal seas such as the SCS. The objective is then to show the consistency and uncertainties of these products. Nevertheless, we added some discussions on the recommendations and future works.

The manuscript should be carefully edited for grammatical errors, coherency, flow, and sentence structure. In addition, the authors need to use definitive and conclusive words to describe the data and results. Descriptions such as “relatively consistent”, “similar”, “corresponds well”, “appeared to have” do not adequately (or statistically) describe the how well the algorithms measure chlorophyll concentrations. Statistical results and plots should be used.

Reply: We have made a significant revision to polish the language and to add more statistical results.

This region appears to be fairly well studied and yet several papers that were found during a simple search for satellite derived chlorophyll concentrations in the SCS were not cited in this manuscript.

Reply: The SCS is well studied because of its regional and global importance. We did not cite all relevant papers in order to save space, but now we added more references.

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At this time, I do not recommend this paper for publication. In order to be suitable for publication, I would recommend major changes including a new objective/focus for the overall manuscript, new data analyses in the results, and a much more detailed discussion section.

Reply: We clarified our objective/focus (see also replies above), and provided new data analysis, including regional tuning of the three standard algorithms based on a local in situ bio-optical dataset. We also added more detailed discussions on why the products are sometimes consistent but sometimes different, and on future works to help reduce the differences.

**Below are some specific comments listed by section.**

Abstract: Pg 7550, Ln 10-15: Revise run-on sentence.

Reply: Unclear what it means.

Introduction: Pg 7551, Ln 17: Define IOP

Reply: Corrected as suggested.

Data and Methods: At what depth were the in situ chlorophyll samples measured?

Reply: At the surface. Clarified.

Pg 7553, Ln 2: A 48 hour time window for satellite match-ups is too long, especially in a highly variable ecosystem. See Bailey & Werdell (2006) for recommended methods.

Reply: We originally tried to use a 3-hour window following the suggestions provided in Bailey & Werdell (2006), but that resulted in a handful of matching pairs due to the heavy and frequent cloud cover over the SCS. We now have changed to a 24-h window, and re-analyzed the entire dataset. Now we have 98 pairs of MODIS Rrs and in situ Chl match-ups.

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Pg 7553: How many pixels from the satellite data were used to compare to the in situ data?

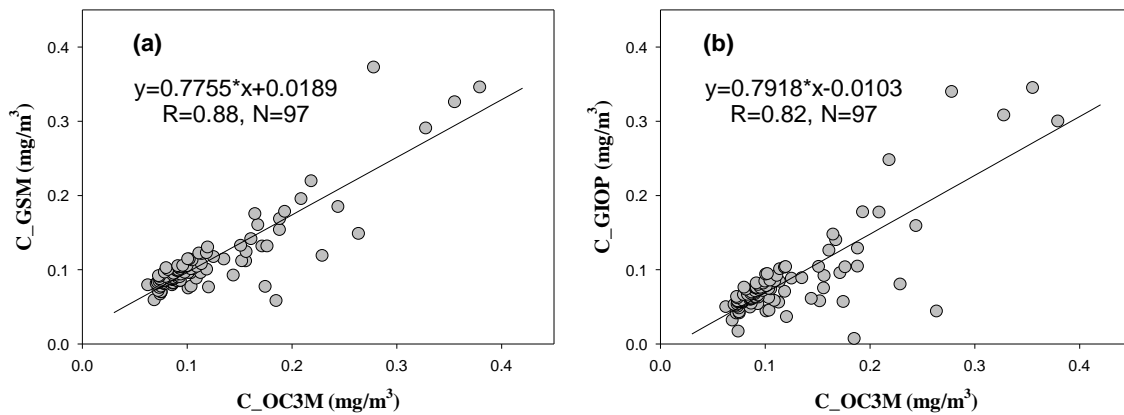
Reply: It is one pixel in order to have the maximum possible matchups.

Results: Pg 7554, Ln 8: Based on the data in Figure 3, it does not appear that the fall concentrations are the same as measured in the spring. If the fall is an important component of the seasonal cycle, it should be included.

Reply: Included as suggested.

Pg 7555, Ln 3-5: Where are the statistics describing the “strong correlation” and “best performance”?

Reply: On the “strong correlation”, a scatter plot is shown below and added in the revision.



On the performance assessment, we have deleted that sentence and changed wording: “When compared with the limited in situ data (red dots in Fig. 5b), differences were observed only for one data point in winter 2010 when both  $C\_GSM$  and  $C\_GIOP$  showed large departure from the in situ measurements. Note that this difference could be natural

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because one data point may not be representative of the state in a month.”

Pg 7555, Ln 4: Do the in situ data represent daily or monthly values? The large departure described in winter 2010 (Ln 6), could simply be because you are comparing a daily value to a monthly average.

Reply: We agree. The in situ data is daily. See also replies above.

Pg 7555, Ln24: “similar phenomenon was” should be “similar phenomena were”

Reply: Thank you for the correction. This sentence has been deleted because we now remove the part of Vietnam upwelling.

Pg 7557, Ln 26: This statement seems out of place.

Reply: The entire paragraph has been deleted.

Discussion: The evaluation of the chlorophyll algorithms should be the first part of the results section.

The discussion on the optical properties and how that relates to the performance of the various algorithms needs to be expanded.

Once you have determined the “best” algorithm to use in your various regions, the discussion could then focus on the seasonality or anomalous events you are able to detect with the satellite imagery.

Reply: Because our objective is not to evaluate algorithms but to demonstrate how different/consistent the spatio-temporal patterns can be based on different standard Chl products (easily accessed), we think it may be better to keep the current flow.

Figures: The figures, especially the time series figures, lack a consistent look. Fig 1: It is

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difficult to see the open black circles and green crosses.

Fig 7 & 8: The text is small and not clear.

Fig 11-13: Do the solid lines represent the 1:1 or regression line? Both should be included in the figure.

Reply: All figures revised as suggested. Thank you!