

Interactive comment on “Variations of net primary productivity and phytoplankton community composition in the Southern Ocean as estimated from ocean-color remote sensing data” by S. Takao et al.

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We are grateful to you for your very positive and constructive comments. Following the helpful suggestions from you and another reviewer, we believe our manuscript has been modified significantly. Below are our replies to your comments. RC = Referee's Comments; AR = Authors' Response

RC 1: Why the SeaWiFS period is limited to 1997-2007 only? Good quality observations are available at least until 2009 and I think the extension of the period could

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strengthen the authors' results, unless the authors have chosen this period only for other reasons?

AR 1: As you kindly suggested, the extension of the SeaWiFS period could strengthen our results. However, we have found that sufficient data are unavailable for statistics during January 2008 and December 2009 (i.e., 7 out of 24 month data are only available in the period. In addition, less than 2 daily data are available per month at the maximum). In particular, because SeaWiFS data from January to February 2008 are unavailable, we cannot obtain the net primary productivity (NPP) and the dominant ratio (DR) for the PFTs during austral summer of 2008.

RC 2: I think the authors should also look at specific regional climatic variations such as those characterized by the SAM index, rather than focusing only on recent climate change. Could they discuss that also?

AR 2: We agree that it is important to assess the impact of regional climatic variations (e.g., the SAM index) on biological processes such as NPP and/or PFTs. Indeed, previous studies have shown the link between the SAM and chlorophyll a concentration, and/or net primary production (Lovenduski and Gruber, 2005; Arrigo et al., 2008; Johnston and Gabric, 2011). In the revised manuscript, we have discussed impacts of the SAM on NPP, dominant phytoplankton groups, and SST.

RC 3: Could they explain why they have used matchup with +/- 2 days? The classical definition for matchup is for 'Day 0' only.

AR 3: Yes, the classical definition for the matchup is for 'Day 0' only. However, 4 matchup data were available to validate PHYSAT for Day 0 in our study. Thus, we have decided to increase the number of coincident SeaWiFS data by increasing the search period to +/- 2 days.

RC 4: In the 4.1 section the authors cite significant fraction of diatoms in the physat method based on the Alvain et al 2008 paper. A more recent study with daily measure-

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ments and a larger database have been published in Alvain et al 2012 (Optics express vol. 20) with 73% instead of 57% of good agreement with results based on pigment. This value is more in agreement with the authors result in the southern ocean. Could the authors update their paper?

AR 4: Thank you for pointing them out. In the section 4.1, we have updated our discussion on the fraction of diatoms using Alvain et al. (2012).

RC 5: It's not very clear if the data used for results page 4376 lines 3 to 9 (for example) are based on 3 months means or not? Should it be possible to clarify this in the text?

AR 5: According to your suggestions, the whole paragraph has been rewritten as follows (also see P. 4376, L. 3-13 in the submitted manuscript): 'No significant correlations between the DR for each phytoplankton group determined by PHYSAT and seasonal mean SST values were found in the Indian sector of the Southern Ocean throughout the year except in the STZ during spring (Table 5b). This suggests that other environmental factors are more important than the direct effect of temperature on phytoplankton community composition in our study area. During spring (September–October) in the STZ, Zubkov et al. (1998) reported that the abundance of *Prochlorococcus* estimated by flow cytometry reached maxima in equatorial waters, and their cells completely disappeared south of 38S, while *Synechococcus* spp. occurred with high concentrations in the upwelling region and in the frontal region, and were still present south of 38S. As a result, SST correlated with not only the abundance of *Prochlorococcus* positively, but also *Synechococcus* spp. negatively in the STZ (Zubkov et al., 1998). Their results were consistent with ours based on satellite remote sensing data in the STZ during austral spring (Table 5b).'

RC 6: I find the organization of the paragraph 3.1.1, 3.1.2 and especially the 3.2 rather difficult to read. Should it be possible to clarify the text by a specific paragraph for each area or by the insertion of a table or something like that?

AR 6: We have restructured the paragraphs 3.1.2 and 3.2 in the revised manuscript.

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The results of inter-annual variations and the trends over the period 1997-2007 have been divided into two sections (i.e., '3.1.2 Inter-annual variations' and '3.1.3 Trends over the period 1997-2007'). In addition, the paragraph '3.2 Relationships between NPP, dominant phytoplankton groups, and SST' has been also divided into three sections (i.e., '3.2.1 Relationships between NPP and SST', '3.2.2 Relationships between NPP and dominant phytoplankton groups', and '3.2.3 Relationships between dominant phytoplankton groups and SST', respectively).

RC 7: Figure 4: should it be possible to add the stars also in the figure b?

AR 7: Following your kind suggestion, we also have added stars in the figure b as well.

Reference:

Alvain, S., Loisel, H., and Dessailly, D.: Theoretical analysis of ocean color radiances anomalies and implications for phytoplankton groups detection in case 1 waters, *Opt. Express*, 20, 1070–1083, 2012.

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Lovenduski, N. S. and Gruber, N.: Impact of the Southern Annular Mode on Southern Ocean circulation and biology, *Geophys. Res. Lett.*, 32, L11603, doi:10.1029/2005GL022727, 2005.

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