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Biogeosciences Discussions

Interactive comment on "An algorithm for detecting Trichodesmium surface blooms in the South Western Tropical Pacific" *by* C. Dupouy et al.

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Author response on comment on bg-2011-C1590-C1596 Response to Anonymous Referee #1 (AR) C. DUPOUY and co-authors October 2011

I would like to thank the anonymous referee for his constructive comments which will greatly improve the quality of this manuscript. In my comments herein, I shall address each reviewer's comments and suggestions. Each comment from the reviewer is reproduced in blue italics and enclosed in quotation marks, after which our response is presented. We hope that incorporating these corrections will make the publication more clear and convince you of the utility of the algorithm in the South Western Tropical

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Interactive Discussion

Discussion Paper

Pacific Zone to detect surface blooms of Trichodesmium.

Following the referee' comments and suggestions, the manuscript has been revised as indicated below.

AR, C1591 1st paragraph: "While clearly a lot of work went into compiling the data in Tables 1 and 2, there is very little quantitative information here. This is especially important since they used this data to determine what dates had high Trichodesmium abundance, and from these data they developed their model. What threshold was used to define "high abundance" (P5658, L25), particularly from Table 1 which has no quantitative data in it? Furthermore it is hard to compare the text and the tables, as yeardays are used in the text and dates in the table. Be consistent. There are also discrepancies between the information in the text and table. The text says yeardays 6, 13, 18, 32, 35, 40, 44, 47, 49, 52, 59, 62, 66 were used from 2003, but the earliest dates in 2003 on either Table 1 or Table 2 from 2003 are Feb 5 (Table 2) and Feb 18 (Table 1), and presumably yeardays 6, 12 and 18 are all in January".

Following the referee's comments, the description of the Table's data has been partly rewritten in order to give more detailed information. This detailed information has also been published previously (Dupouy et al., 2004, IRD report). The threshold of a "High" abundance is now defined in the text. We associate extreme cases of surface blooms as compiled in Table 1 to a Trichodesmium abundance of 10000 trichomes per liter as this concentration is a minimum found in slicks. TRICHOSAT is therefore able to detect densities visible by eye, at the difference of the Westberry et al. (2005)'s algorithm, which can also detect T. at sub-bloom concentration (3200 trichomes/liter). About the date discrepancy, we have added the yeardays in Tables 1 and 2 and the text has been re-written as "In 2003, in situ observations were available on December 25, 2002, February 5 from Diapalis (Table 2), February 17- 20, and March 28, 2003 from the French Navy (Table 1). We chose SeaWIFS level2 GAC of January 6, 13, 18, February 1, 4, 9, 13, 16, 18, 21, 28, and March 2, 6; Yeardays: 6, 13, 18, 32, 35, 40, 44, 47, 49, 52, 59, 62, 66) as we were confident that the same bloom lasted for 3 summer

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months".

AR: C1591, 2nd paragraph: "It is odd that they do not show any radiance spectra at all in the paper". The schematics shown in Figure 1 are hard to interpret"

We do not show any radiance spectra in the paper. SeaWiFS Level2 GAC radiance spectra are presented adequately in the paper of Alvain et al., 2005 (their figure 1) which initially demonstrated the concept of radiance anomaly spectra (RAS). RAS can also be found in the Alvain et al. paper (their figure 3). On our figure 2, all non-tricho spectra are described by the "Envelope of all RAS", calculated from min and max of slopes and ordinates, respectively. Tricho RAS spectra are defined by low values of the slope and ordinate, and show spectral anomalies at 550 and 670 nm (trough and bump respectively) (drawn as the red envelope). As suggested by AR, the term "peculiar" will be corrected in the final text.

AR: C1591, 3rd paragraph: "The last line in the abstract states "This approach was validated with in situ observations of Trichodesmium surface accumulations for the period 1998–2010." However the only real comparison between in situ obs and the estimates from the TRICHOSAT algorithm are in Fig 8, which covers a period from Dec '02 – Sept '04. As they mention in the paper the correspondence between the two is striking. Perhaps too striking. There is only one mention in the paper of this figure, and no explanation (outside of the caption) of the data that went into it. It is comparing the percentage of pixels in the SP area, ie 5-25N, 160E-170W with the in situ observations of blooms taken someplace within this 20x30 area. How can they realistically justify comparing the Tricho percentage in this huge area against in situ observations made from within a very small subset of that area? And where exactly do the Nb numbers come from – all the observations shown in Table 1 and 2? If so why is it restricted to just this shortened time period? See other comments listed under Fig. 8."

We agree that the term "validated" was inappropriate. The TRICHOSAT algorithm was globally validated by comparing the response in summer (obs, slick detected) and in

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winter (no obs, no slick detected) in the South Pacific Region (Figure 3 and Figure 7). In fact, it was not our intention to validate the algorithm with Figure 8 (2004). Figure 8 was simply an illustration of what can be obtained if both observations and SeaWifs data are abundant. Observations from the French Navy were scarce before 2002. The 2004 striking coincidence results from the conjunction of favourable conditions - the French Navy was very active in the region - there was an exceptionally long bloom with numerous and thick surface blooms – good weather favored both visual observations (as these ones disappear or are no more visible if rain or wind disrupt them) and satellite coverage. The Nb numbers are observations taken from Table 1. Slick observations from this table 1 were summed to get a monthly Number Nb. These Nb were superimposed onto the curve of Tricho pixel from SeaWIFS, calculated from daily GAC, and also summed on a monthly basis. We also agree that is rather difficult to compare such scarce in situ observations with gridded satellite products obtained over the whole study region. The graph relates to the western tropical South Pacific area (SP, 5S-25S, 160E-170W) area, not the whole Pacific Ocean (5-25N, 160E-170W). We selected the SP area (5°S-25°S-160°E-170°W) because observations from the French Navy were obtained in this domain. New Figure 8. As suggested by the AR, Figure 8 was extended from 1998 to 2010 (see figure 8 pdf file). In the new figure, each red vertical bar represents the percentage of Tricho pixels within a single SeaWIFS GAC image. This figure allows the reader to follow the progression of this percentage day after day during each summer period. For the French Navy observations, we kept the monthly sum (black circles) as in the first version. See also comments on Figure 8.

Response to Specific comments

AR: 5655, L13. “Explain why iron enrichment can trigger Trichodesmium blooms” Iron is the limiting factor because iron is needed for the nitrogenase of Trichodesmium. We added a reference there (Capone et al., 1997).

AR: 5656, L5 and L7/8. “Isnt PHYSAT an acronym ?” “What is SCHIAMACHY sensor?” PHYSAT is an acronym for Phytoplankton group from SATellite (Alvain et al.,

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2005). The SCHIAMACHY SCanning Imaging Absorption spectroMeter for Atmospheric CartograpHY)- is a passive remote sensing spectrometer which allows to detect the absorption spectrum in the range 240-2380 nm and to detect the presence of cyanobacteria (Bracher et al., 2007).

AR: 5662, L 19. "The introduction of the name TRICHOSAT for the algorithm here is confusing". L27-28. "What constitutes a "large number?" Corrected. We corrected "large" for "sufficient" and "analyzed" rather than "screened".

AR 5669, "The 3rd paragraph should be moved to Discussions section." Done

Tables & Figures.

Table 2. AR: "The asterisk will mention which line is concerned (1998)".What is meant by the "Niskin" and "Bucket" entries at the bottom".

In February 2004, both bucket and Niskin bottle were used. Dates were reported. Transects made rather than "effected" (corrected).

Figure 2 AR "I'm afraid neither of these panels make much sense . . ."

The envelopes corresponding to RAS of all pixels and the one of Trichodesmium were highlighted. See new Figure 2 in pdf.

Figure 1 AR "It is hard to read the latitude and the longitude numbers in panel (a) and it is impossible to read the color bar . . .What are the numbers next to the dots on the bottom panel . . . It is very hard to see the blue dots. . ."

We have ameliorated Figure1 (b) and (c) as suggested. We also included a situation map (below) delimiting the WP and the SP areas (Figure 1a). See new Figure 1abc in pdf.

AR: "Is it possible to show the cruise tracks in such a way that negative observations would be evident ? i.e. where no blooms were observed ?"

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During winter, Navy observations, cruises and transects did not show the presence of slicks. We had thick and permanent slicks during one exceptionally calm October cruise in 2001 (Table 2) and during 2003 and 2004 February cruises (Table 2), and never in winter.

AR: "It also seems odd that this comes as Figure 2, and not as Figure 1. It could be easily cited in the introduction to orient he reader of the study area"

Figure 1 and Figure 2 have been inverted. We included a situation map showing limits of the WP and SP areas (Figure 1abc in pdf). An additional figure has been added (showing slicks photographs).

Figure 3 (becomes figure 7 in the new version) AR, "The axes labels are difficult to read on most of the panels. However I am not sure that the figure adds much to the paper". We simplified Figure 3 with only two rows: the upper row shows the selection by the algorithm and the lower row shows the results of TRICHOSAT for the three different seasons. See also comments on this figure (becomes Figure 7). See new Figure 7 in pdf.

Figure 5. AR, " It is hard to distinguish the red and brown curves in the top panel, consider making one blue. What is the difference between the top and bottom panels ? Are they just more variables ? this is confusing. Why do the vertical lines change from being in March 97-99 and in Feb. 01-10. Make the font larger on the plot."

Corrected. We made a multipanel plot with a separate panel for each variable (New Figure 5 in pdf).

Figure 6 AR: "Caption says that the land is black" and "It is really hard to make out the points in these plots. . .."A figure showing the climatological seasonal cycle (with std dev) using number of pixels (or total surface area) of Tricho would better make the point about Tricho seasonality."

The new Figure 6 shows the mean climatological seasonal cycle (mean of 1997-2010)

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(New Figure 6 in pdf).

Figure 8. AR: P5663. L25-28 “The similar symbols are confusing. This sentence does not make sense, the reproduction is not striking because of the in situ survey. The comparison between in situ and satellite obs can be made because the in situ survey, and their similarities, are striking.

We also agree that is rather difficult to compare such scarce in situ observations with gridded satellite products obtained over the whole study region. The graph relates to the western tropical South Pacific area (SP, 5S-25S, 160E-170W) area, not the whole Pacific Ocean (5-25N, 160E-170W). We selected the SP area (5°S-25°S-160°E-170°W) because observations from the French Navy were obtained in this domain.

As suggested by the AR, Figure 8 was extended from 1998 to 2010 (see New-Figure 8 in pdf).

In the new figure, each red vertical bar represents the percentage of Tricho pixels within a single SeaWIFS GAC image. The new figure allows the reader to follow the progression of this percentage day after day during each summer period. For the French Navy observations, we kept the monthly sum (black circles) as in the first version.

Their similarities are striking in 2004 and result from the conjunction of favourable conditions - the French Navy was very active in the region - there was an exceptionally long bloom with numerous and thick surface blooms – good weather favored both visual observations (as these ones disappear or are no more visible if rain or wind disrupt them) and satellite coverage. Despite the low number of in situ observations over the period 1998-2010, maximal observations are found in summer for other years too.

C1594. Technical corrections All the technical corrections suggested by the reviewer have been incorporated and improved the manuscript tremendously. We would like to sincerely thank again the anonymous referee for advices and constructive comments. Sincerely, Cécile DUPOUY and co-authors October 2011.

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Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C3785/2011/bgd-8-C3785-2011-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 8, 5653, 2011.

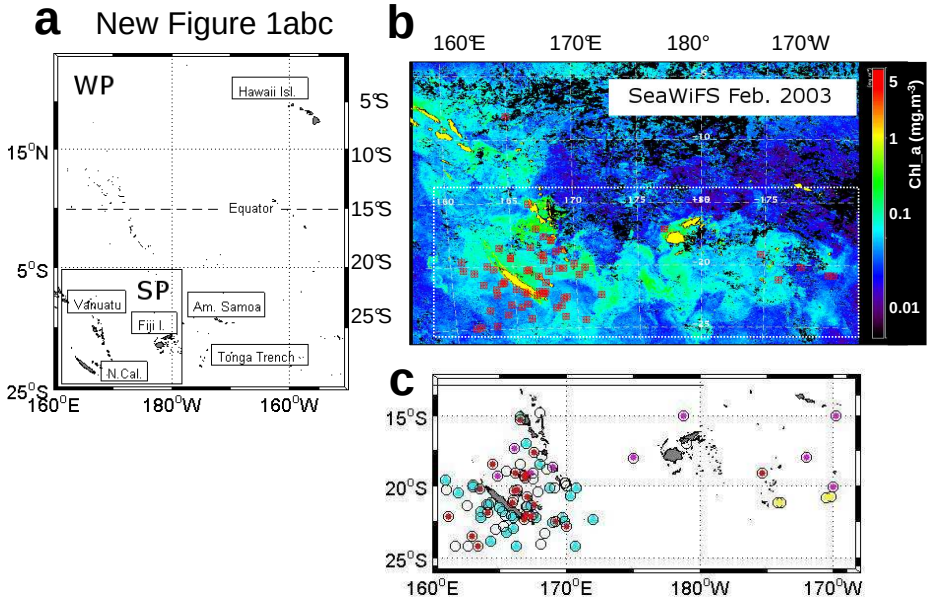

Fig. 1.

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Figure 2

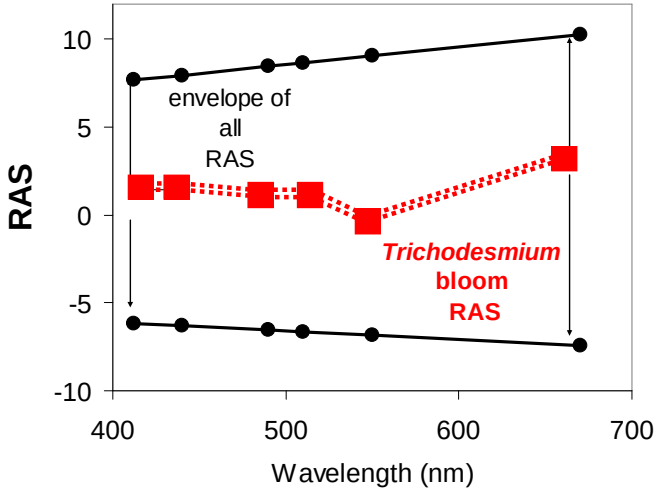

Fig. 2.

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Figure 3AB

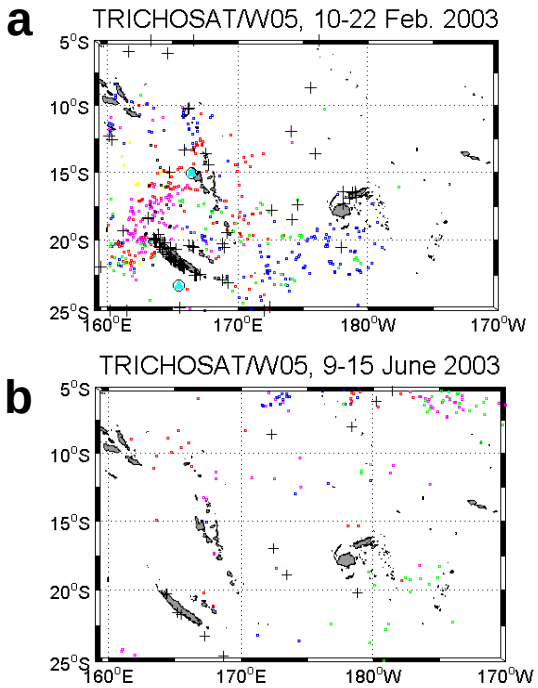

Fig. 3.

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Figure 4

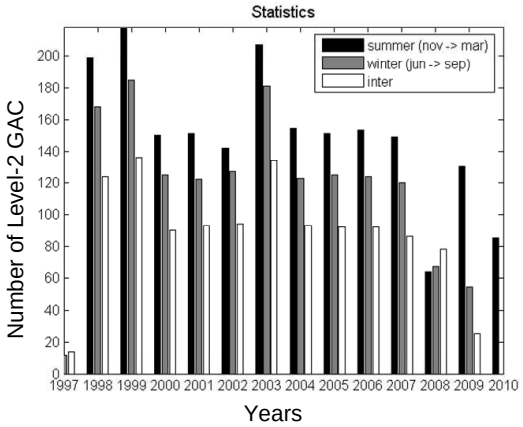

Fig. 4.

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Figure 5ABCD

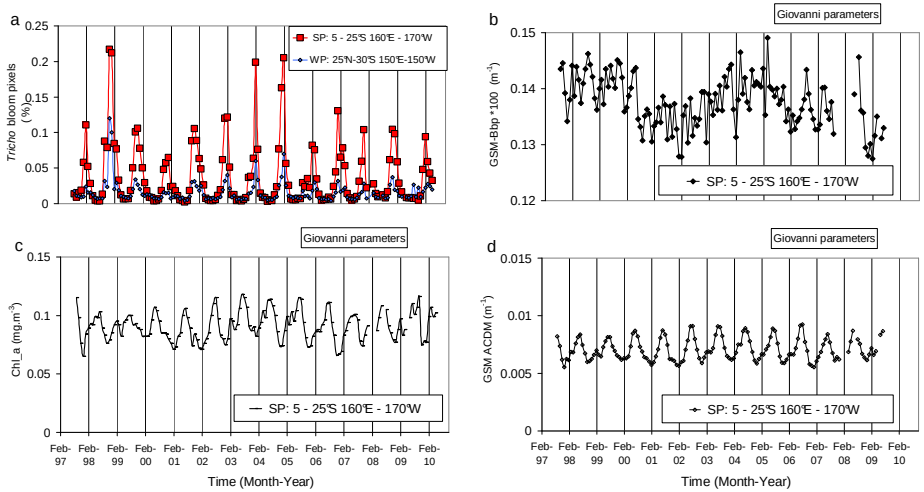

Fig. 5.

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New Figure 6

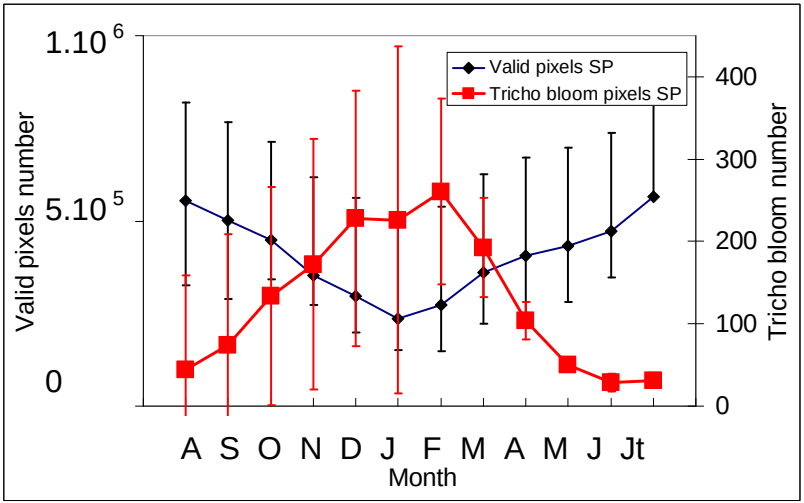

Fig. 6.

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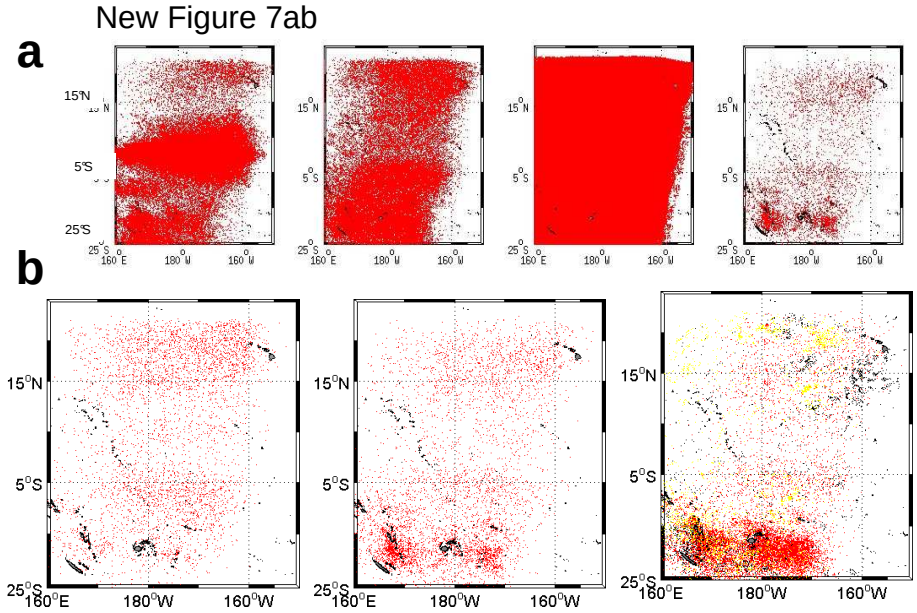

Fig. 7.

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New Figure 8

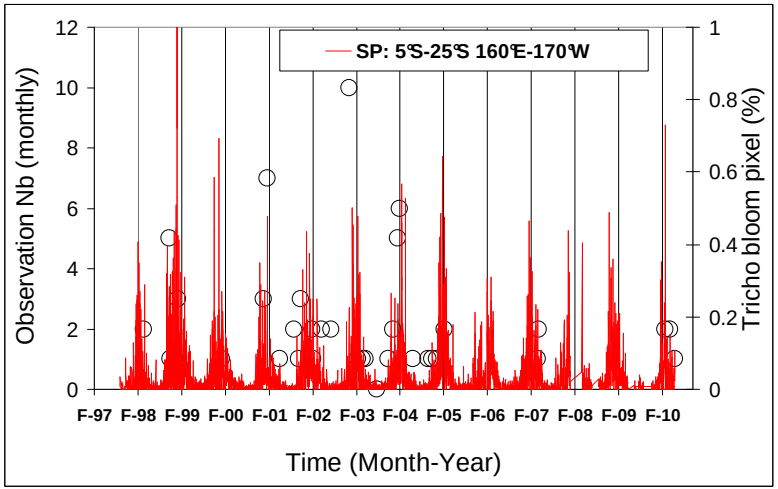

Fig. 8.

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Figure 1c
Additional material

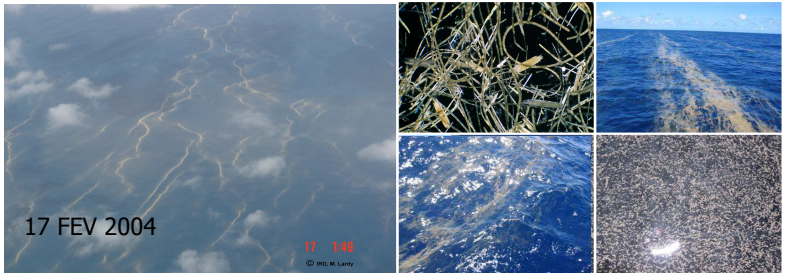

Fig. 9.

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