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Biogeosciences Discussions

Interactive comment on "From the shape of the vertical profile of in vivo fluorescence to Chlorophyll-a concentration" *by* A. Mignot et al.

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Details answers to the review (Referee #1):

SPECIFIC COMMENTS:

Referee#1: P5, 3-5: Please provide reference for Zpd.

Authors: The definition of Zpd is found p.3702 l.11: "The first penetration depth, Zpd (m) is defined as Ze/4.6. Note that this quantity is also used for ocean color remote sensing studies, where it delineates the surface layer actually "seen" by the satellite. "

Referee#1: P6, 21: the sentence "All fluorescence and . . ... calibrated and validated." This sentence is too ambiguous.

Authors: The sentence was indeed unclear because we spoke of “calibration”. The fluorescence data used here were only validated meaning that spurious data (e.g. spikes in the fluorescence profile) had been corrected or removed. The fluorescence data are not calibrated in units of Chla. The sentence has been corrected.

Referee#1: P9, 13-15: Why were there the Gaussian profiles under eutrophic conditions?

Authors: We agree with this remark that the vertical shape of Chla is not well defined for the eutrophic conditions. Nevertheless, in our dataset, we still notice a very shallow DCM, in both fluorescence and HPLC profiles, under eutrophic conditions.

Referee#1: P10, 14-17: the sentence “Several studies (Herland and Voituriez, 1979; Varela et al., 1992; Estrada et al., 1993; Ediger and Yilmaz, 1996 and Mantyla et al., 2008) found that the depth of the DCM, Zmax, was tightly coupled with the upward nutrient flux (high upward nutrient flux, corresponds to a shallow DCM), and consequently to the Chl-a concentration in the upper layer, Chlsurf .” This sentence is difficult to read. Rewrite.

Authors: The new sentence is: “Several studies (Herland and Voituriez, 1979; Varela et al., 1992; Estrada et al.,1993; Ediger and Yilmaz, 1996 and Mantyla et al., 2008) have demonstrated that the depth of the DCM, Zmax, was tightly coupled with the upward nutrient flux (a high upward nutrient flux corresponds to a shallow DCM and reciprocally). Since the Chla concentration (Chlsurf and Chlze) and Zmax are inversely related (Fig. 4a), we state that the upward nutrient flux also controls Chla concentration.”

Referee#1: P10, 17-20: If the increase in water transparency was due to decrease in Chl concentrations, [Chlze] would not increase with deepening of Ze.

Authors: You’re right, [Chlze] decreases with a deepening of Ze.

Referee#1: P11, 13-24: I would like to have seen some attempt to examine the direct relationships between Zm, Chlsurf and Chlzm (column integrated content with Zm). It would have beeninformative to present some attempt so that the reader can assess the differences with the previous studies.

Authors: We agree with this statement. Unfortunately, we do not have the ancillary data necessary to propose some attempt about the relationship between Zm and [Chlzm]. Note that the paper aims at developing a method which a priori does not require such ancillary information. (Furthermore, as an extension of this study, we have begun to download fluorescence profiles from large databases and the ancillary data are genrally missing).

Referee#1: P11, 26-28: You should properly explain about the daytime-fluorescence quenching because this process is important for the relationship between in vivo fluorescence and Chl a concentration.

Authors: This was not the aim of the section to detail the mechanism of quenching which has been clearly detailed in the references given in the text (e.g. Cullen and Lewis, 1995; Holm- Hansen et al., 2000; Sackmann et al., 2008). We nevertheless propose a new sentence which briefly describes the issue of quenching. " The fluorescence signal is depressed in the upper layer of the water column, when the phytoplankton is exposed to high irradiance."

Referee#1: P12, 13-21: the sentence "For gaussian profiles, a group of stations mainly representative of spring bloom conditions in temperate areas (e.g. POMME2 and some BOUSSOLE cruises) have, for the same Chlsurf value, a much deeper Z1/2 and larger dz than for the global trend. For the same stations, Zmax (shallow) remains poorly scattered with respect to the global trend. These stations correspond to the typical situation described in Fig. 9a. Another distinct group of stations also suffers from an overestimation of dz due to the daytime-fluorescence quenching (Fig. 7c) while Z1/2 and Zmax remain weakly scattered withrespect to the global trend. This is another typical case (Fig. 9b) where fluorescence quenching is superimposed onto a DCM (many stations of the subequatorial and the sub-tropical South Pacific: BIOSOPE and

OLIPAC cruises).” Unclear. This sentence needs to rewritten.

Authors: The new sentence is: “For gaussian profiles, we identified two typical situations of quenching that change the shape of the fluorescence profile (Figs. 9a and b). In the first situation (Fig. 9a), a fake DCM appears near the surface, due to the depress of fluorescence at the surface. As a consequence, a group of stations mainly representative of spring bloom conditions in temperate areas (e.g. POMME2 and some BOUSSOLE cruises) have, for the same Chlsurf value, a much deeper Z1/2 and larger dz than for the global trend (Figs. 7b and c). At the same time Zmax, which is very shallow, remains poorly scattered with respect to the global trend (black line on Fig. 7a). In the second situation (Fig. 9b), the fluorescence quenching enlarges the width of the DCM. The depth of the DCM remains unchanged. As a consequence, a group of stations (representative of the subequatorial and the sub-tropical South Pacific: BIOSOPE and OLIPAC cruises), reveal an overestimation of dz (Fig. 7c), while Z1/2 and Zmax remain weakly scattered with respect to the global trend (black line on Figs. 7 a and b).”

Referee#1: Also, explain why Zmax remains poorly scattered.

Authors: Zmax remains poorly scattered because, in the two typical cases of quenching identified (Figs. 9a and b), the surface depression of fluorescence weakly affects the depth of the DCM.

Referee#1: P14, 15-16: How did you derive the equations 10 and 11?

Authors: Equations 10 and 11 are derived from the equation 2. We resolve this equation for z=0 and z=Zmax, which give F(z)= Chlsurf equation (10) and F(z)=Chlmax equation (11)

Referee#1: P14, 22-25: Please show the error in the regression slope between Fc and F. Also, was there a difference in slopes among the oceanic regions?

Authors: We are not sure to catch the meaning of the question.

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Referee#1: P15, 15-27: You should describe more carefully about the results of statistical analysis. For example, the r2 alone is no statistical meaning.

Authors: We use the coefficient of determination r2 to assess the quality of the linear regression fitted within the log-10 transformed data. We are then able to compare the quality of the 3 linear regression (gaussian, sigmoid and both).

Referee#1: What are the meanings of RMSE and APD in this study? Why are the Chla-calibrated fluorescence values underestimated for gaussian profiles and overestimated for sigmoid profiles?

Authors: The meanings of RMSE and APD are described in the paragraph "3.4 Statistical indicators". The RMSE indicate the scatter of the data between fc and Chla. The APD is the absolute percent deviation between fc and Chla. The under or over estimation of Chla-calibrated fluorescence values fc are estimated with the median RPD . A negative median RPD implies that fc are in average lower than the HPLC Chla value, and inversely for a positive median RPD.

Referee#1: P16, 24-28: the sentences "For given trophic conditions, a certain "natural" noise characterizes the relationship between shape and concentration. It was not the purpose of this study to analyze the sources of this noise (except for the specific and well-identified case of fluorescence quenching). A consequence of this noise is that the parameterization proposed here, like any global parameterization (Uitz et al., 2006), is of global relevance. " Unclear. Please rewrite to clarify.

Authors: The new sentence is: "For given trophic conditions, a certain "natural" variability characterizes the relationship between the depth-dependent shape parameters and the Chla concentration. It was not the purpose of this study to analyze the sources of this variability (except for the specific and well-identified case of fluorescence quenching). As a consequence, the parameterization proposed here, is only of global relevance, smilarity to the Uitz et al. (2006) parameterization."

TECHNICAL CORRECTIONS: P2, Equation 1: Typographical errors of units (E, not d-1 but s-1 or time-1; a*, not m-2 but m2). P9, 13: Miswriting “r2= 0, 59”

Authors: All the technical corrections have been done.

Interactive comment on Biogeosciences Discuss., 8, 3697, 2011.