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Biogeosciences Discussions

Interactive comment on "The Mediterranean subsurface phytoplankton dynamics and their impact on Mediterranean bioregions" *by* Julien Palmiéri et al.

Anonymous Referee #3

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Second submission review of:

The Mediterranean subsurface phytoplankton dynamics and their impact on Mediterranean bioregions

by Julien Palmiéri, Jean-Claude Dutay, Fabrizio D'Ortenzio, Loïc Houpert, Nicolas Mayot and Laurent Bopp

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General comments

This paper discusses the differences in regionalization of the Mediterranean Sea into

spatial clusters, relative to surface chlorophyll satellite data and biogeochemical model output, as well as vertical chl profiles obtained the same model and compared to ARGO float in situ data. The topic is extremely interesting, given its ecological implications of the different regions' behavior. However, I unfortunately have to recommend rejection of the paper, but with the strong encouragement to analyze well the cause of the profound discrepancies between the model and the data and then to re-submit a new manuscript. Indeed, the model - data (satellite or ARGO) differences are so pronounced that they should be tackled quantitatively and the model should be analyzed in order to ameliorate its results. Instead, in many instances, comments are only qualitative, where they should be crucially quantitative. For example with percent difference maps/profiles, etc. and less words. In sum, I feel that the model is inadequate for this use and should be thoroughly revised. See particular comments below, concerning technical aspects. Moreover, descriptions in the Discussion are very tortuous, long and difficult to understand, also due to the necessity of English correction and because very often the figures are only scantily cited in the text, so that the reader remains confused. See the conceptual comments, among the particular comments below.

Form

The English of the manuscript needs correction. I have tried to help, in the particular comment section below.

Particular comments and suggested text corrections

NOTE: hereafter "->" means "replace"

Abstract

1 Introduction

Page 2 Line 20. "principally the remote sensing" -> "e.g. principally remote sensing". Line 28. "permit the vertical profile of phytoplankton biomass to be estimated" -> "to obtain estimations of the vertical profile of phytoplankton biomass".

Page 3 Line 3. "papers" -> "studies" Line 10. "through to" -> "all the way to". Line 13. "into the" -> "in the" Line 16 "Winter" -> "winter" (check for capitals in season names, some are lowercase, some uppercase) Line 16. "In general, DCM deepen" -> "In general, the DCM deepen" Line 21. "Overall, DCM" -> "Overall, the DCM" Line 23. "serve to make" -> "make" Line 28. "at this time" -> maybe not necessary, since you say "remain", which implies "nowadays".

2 Methods

2.1 The Mediterranean biogeochemical model: PISCES-MED12

Page 4 Line 14. "2 size class". -> "2 size classes". Line 16. "nutrient proceeds" -> "nutrients proceeds". Line 25. "Gibralter" -> "Gibraltar" Line 31. "Dissolve" -> "Dissolved " Line 33. "calculated on the" -> "calculated at the"

Page 5 Line 3. "Mediterranean sea" -> "Mediterranean Sea" Please correct throughout text.

2.2 Remote sensing fields

Line 14. "Evaluation" -> "The evaluation" Line 17. "over-estimates" -> "overestimates". No need for hyphen. Line 18. "a 8 years period" -> " an 8-year period"

2.3 Biogeochemical-Argo floats

Line 27. "point to point" -> "point-to-point" or "pointwise" Line 28. "where 1)" -> "because 1)" Line 28. "there is enough data" -> "there are enough data" Line 30. "Liguro-Provençal" -> "the Liguro-Provençal...2- the Algerian... etc.". Add "the" to all items.

Page 6

2.4 Bioregionalization

Line 8. "filtering used model" -> "the filtering used the model" Line 12. "same procedure apply" -> "the same procedure applies" Line 22. "of cluster" -> " of clusters" Line 23.

"disturbing method" -> "disturbing methods" Line 25. "both disturbed" -> "both the disturbed" Line 32. "(Chlsurf > 1 ug l-1)" should this not be Chlsat?

3 Results

3.1 Model Surface and subsurface chlorophyll evaluation. Eliminate full stop.

Line 30. "both satellite-estimated and model" -> "both satellite estimates and model"

Page 7

Line 1. "Gulf of Lion" -> "Gulf of Lions" (plural in English). Please search and correct throughout text. Line 2. "Maghrebin coast" -> "Maghreb coast" search and replace throughout text, please. Line 4. "produced" -> "reproduced" Line 5. "satellites estimates" -> "satellite estimates".

Conceptual comment Line 6. "elevated surface Chl values in the Eastern basin". I have a problem concerning the model result (Fig 1b), in that I see, besides the Maghreb coast underestimated chl with respect to satellite chl., i.e.:

1) the central-southern Adriatic Sea chl is much higher that the satellite estimate 2) The Adriatic Sea cross-shore gradients are much weaker in the simulations, as if the coastal (chl-rich) current were absent 4) the southern Eastern basin simulated chl is quite lower than the sat chl 5) the North Aegean simulated chl is a "low" while the sat chl is a "high"

Therefore, at least from a graphic view, there are major discrepancies between satellite and simulation, which rings a sort of alarm bell to me, concerning model performance in general, i.e. also sub-surface.

Next, on line 9 the Authors state that "...remote sensing estimates are generally known to overestimate surface Chl...". So satellite imagery does not necessarily provide a picture of "reality" in sfc Chl, with which the model can be compared.

So where does the truth lie?

Consequently I think that the Authors should comment on this problem more thoroughly, because if satellite imagery does not provide the truth, then why compare the model to the imagery? Or maybe the errors in the imagery are slight with respect to reality, so that model results can be compared to sat chl and e.g. all simulated values that are off by less than XX % from sat values are good? In short, to my opinion the issue is crucial to the rest of the presented results, and thus should not "die out" in two sentences (page 7 lines 9-12) but should be tackled deeply: which simulated values are OK and which aren't?

Line 8. "model surface" -> "the model's surface" By the way, how is the model's surface chlsurf defined? Which model level? Which depth? Line 8 "under-estimates" -> "underestimates" Line 11. "where low Chl values are especially overestimated" -> "where low Chl values especially are overestimated" Line 18. "toward" -> "towards" Line 20. "In this purpose" -> "To this purpose" Line 21. "release" -> "released" Line 22. "figure 4 in the 5 areas defined figure 2" -> "in Figure 4 in the 5 areas defined in Figure 2"

Lines 23. "It shows that the model succeeds in capturing the overall chlorophyll dynamics." I'm afraid not, because: 1) all the relevant non-zero features in the chl profiles are completely different in the model w/respect to the ARGO floats 2) the variability of model results is very low (e.g., the model DCMs vary very little).

In short, I think that the model is inadequate, in that e.g. there are probably some modules which need re-working. My suspects lie in the nutrient "compartment" (is the adoption of the Redfield ratio OK?) and in the treatment of air-sea interaction strength, forcing mixing and consequent nutrient upwelling (are the ECMWF data OK for forcing? This can be easily seen by comparison of model density profiles with Argo density data). That is, if the purely biological compartments of the model are faultless. But I can't be sure.

Page 8

3.2 Surface chlorophyll phenologies and bioregions

Line 7. "For parsimony... common..." I am not sure what the "parsimony" criterion is. Also, how did you choose the 4 satellite clusters (depicted in Fig.5)? That is, how did you declare a cluster to be "common", given the evident difference in shape among same-colored clusters in Fig. 5? Also, where is the 5th cluster, if Fig. 5 chlsat is practically full?

Line 15. "of cluster to 4" -> "of clusters to 4" Line 15. "Intermittently" -> "Bloom - intermittently" Line 20. "provide" -> "provides" Lines 23-24. "This amplitude is greatest... amplitudes". The chlsat curves in Fig. 5a don't seem to differ much (nor do those in Fig. 5b). Only the blue and yellow curves have slightly higher values in summer than the red and green curves. Line 33. "exit" -> "stand out"

Page 9

Lines 10-13. Again, I disagree: the inadequacy of the model is also expressed by the important differences between satellite and model clusters, such as the North Ionian being no bloom for the satellite and intermittent bloom for the model.

"3.3 Phytoplankton dynamics in the whole epipelagic layer" -> "3.3. Phytoplankton dynamics in the epipelagic layer"

Line 21. "wide" -> "thick" Line 25. "but an additional maxima now manifests" -> but an additional maximum now appears" Lines 29-30 "in red", "in "blue" -> "red curve", "blue curve"

Page 10

Line 1. "That result" -> "This result" Line 2. "that Chltot phenology is also different from Chlsurf one" -> " that the Chltot phenology is also different from the Chlsurf one"

3.4 Phytoplankton dynamics in the deep chlorophyll maximum

Line 12. "Gulf of Lion" -> "Gulf of Lions (Fig. 7a)". Another defect of this paper, to my opinion, is that the Authors seldom cite the figure numbers while describing them,

which in some cases can make the reading most cumbersome and difficult. Please correct this where necessary.

Line 13. "at its most oligotrophic" -> "in its most oligotrophic state (Fig. 7b)". Same comment as above.

Line 14. "180 meter" -> "180 meters". BTW why not use "m" in the text? Line 14. "Simulated" -> "The simulated"

Lines 16-18. "Chlorophyll... model". Again, I don't see the realism of the model: there is a very big difference in the model and Argo profiles!

Line 25. "in DCM" -> "in the DCM" Line 27. "The amplitude...". In Fig. 8 the cluster maxima are equal, so I don't understand the statement. Line 27. "receipt" -> "reception"

Page 11

4 Discussion

4.1 Bioregions and Mixed Layer Depth

Line 4. "ChlSurf" -> "ChlSat", according to definitions Line 5. "Spring-blooms" - "Spring blooms"

4.2 Modelled chlorophyll maximum and total chlorophyll phenologies

Line 30. "figure 2" -> "Figure 2" Line 31. "specific layer" -> "a specific layer". Again, how do you define ARGO Chlsurf? Line 32. "vertical sum of Chl (Chltot; 0 - 300 m, as done in the model)," - > "the 0-300 m Chl integral" Line 33. "(Figure 11)". This figure should maybe come before Figure 10, since it is cited first.

Page 12

Line 5. "is globally" -> "are globally" Line 10. "what is not seen" -> "which is not seen" Line 16. "being" -> "are" Line 23. "Only differences compare". Unclear Line 23.

"underestimated surface chlorophyll" -> " underestimated model surface chlorophyll"...? Line 24. "As well," -> "Also" Line 26. "when surface" -> "when the surface"

4.3 Underestimated chlorophyll and DCM depth. -> eliminate full stop

Page 13

4.4 Phytoplankton dynamics in the oligotrophic bioregion.

Line 17. "upward nutrients flux" -> "upward nutrient flux" Line 24. (as DCM" -> "(as the DCM" Lines 27. "phytoplankton biomass" -> "0-300 m phytoplankton biomass integral"

Page 14

4.5 Surface versus total chlorophyll bioregionalization

Line 8. "that results" -> "that result" Line 21. "intermittently bioregion (yellow)" -> "Bloom-intermittently bioregion (yellow)". To which Figure does this refer? Again cite figures more often, otherwise it's very difficult to follow.

Page 15

5 Conclusions

Line 18. "coherent, with patterns" Eliminate comma. Line 30-31. "phytoplankton "migration" from the surface layer to the DCM." Since the model provides both Chl and phytoplankton, is this migration seen in the model water column? Is there any evidence of this in situ data studies? Lines 33. "nutrients concentration" -> "nutrient concentration "

Figures and captions

Figure 1 caption. "same 8 years period" -> "same 8-year period"

Figure 3 caption. "model (blue) and satellite estimated" -> "model- (blue) and satellite-estimated"

Figure 3 caption. "The upper pictures (A) include the whole Mediterranean Sea, in the middle (B) the Western basin, and down (C) the Eastern basin (Levantine and Ionian sub-basin)." -> "The (A) entire Mediterranean Sea; (B) Western basin; (C) Eastern basin (Levantine and Ionian sub-basin)." No need for "upper", "middle", etc. since you provide letters to the panels.

Figure 5 caption. "the different clusters resulting" -> "the 4 clusters discussed in the text, resulting" Figure 5 caption. "up", "down" -> "top", "bottom" Please replace in all interested figures ("middle" is OK).

Figure 5, top panels. "chl surf - sat" -> "chlsat" and "chlsurf - PISCES" -> "chlsurf", to be consistent with your definitions in the M&M section.

Figure 6 caption. "the sum of chlorophyll on the 0 - 300 m depth layer" -> "chlorophyll integrated over the 0 - 300 m layer"

Figure 7 caption. "(in ug l-1 ; 10 first meters average)(up)" -> "(in ug l-1); 10 first meters average (top)", "down" -> "bottom"; "in meter ;" -> "in meters;"; "on the water" -> "in the water"

Fig. 8 caption. "maximum chlorophyll layer" -> "maximum chlorophyll depth" (If I understand well).

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