

Biogeosciences Discuss., referee comment RC2
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Comment on bg-2021-123

Anonymous Referee #2

Referee comment on "Biological production in two contrasted regions of the Mediterranean Sea during the oligotrophic period: an estimate based on the diel cycle of optical properties measured by BioGeoChemical-Argo profiling floats" by Marie Barbieux et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-123-RC2>, 2021

Review Barbieux marie et al. Biogeosciences

General comments

The study aims to derive community production estimation from a dataset obtained by two BioGeoChemical-Argo (BGC-Argo) profiling floats deployed in the Ligurian and Ionian Seas. The authors mainly used the infradiel variability of c_p and b_{bp} measurements along the water column to investigate the diel variations of the bio-optical properties and thus of the production (estimated in particulate organic carbon). The authors compared the results between two contrasted areas of the Mediterranean Sea.

The study is well-done and convincing. The draft is well-written, well-structured and organized, starting an informative and well-documented introduction.

Below some more specific comments:

Abstract

Lines 18-19: "...marine biological production of organic carbon" ... I suggest to be more precise: organic carbon is referred to particulate O.C.?; marine biological production is referred to phytoplankton, bacteria, zooplankton?

Line 30: SCM layer (16-42%): I imagine that it is also (mainly?) dependent on the depth, i.e. on light availability?

Lines 32-33: "the SCM is permanent induced by phytoplankton photoacclimation..." What does it mean?: does this SCM only the result of physiological acclimation/regulation of microalgae (increase of chl.a per cell)? Or/and to the fact that microalgae actively accumulate to this depth for many reasons (light, nutrient, stratification,...)

Introduction

Line 40: "Primary production is an essential component..." instead of component, process? Flux?

Lines 57-60: what about active fluorescence measurements (FRRF?, etc.)

Line 99: "...and found weak results for the diel b_{bp} cycle..." in which sense?, rephrase/explain

Line 136-137: "...with an SCM induced mostly by photoacclimation (e.g., Mignot et al. 2014; Barbeau et al. 2019)". Please explain?

Methods

Lines 167-175: move to the section 2.2. (BGC-floats)

Lines 196-201: "fluorescence-to-Chl ratio". If I understand well, the authors applied two successive types of correction: one related to NPQ and one on the differences between chl.*a* fluo and chl.*a* concentration. The last is considered basically from the chl.*a* fluo/chl.aratio = 2, applied on the two contrasted systems Ligurian and Ionian seas. I was wondering if using the same value for the two contrasted sites can represent an "error" for the interpretation of the results. The environmental (light, nutrients) and biological

properties (microalgal communities) of the two sites are strongly different, that probably might affect the ratio fluo/chl.a.

The authors reported that they measured chl.a concentration with HPLC during the cruises they set-up for the deployment of the floats (lines 365-370). Can the authors use these data to retrieve a more precise chl.a fluo/chl.a ratio for the two sites?

Lines 242-247:

the difference of float cycle (noon-noon vs sunrise-sunrise) between the two sites might be a problem for the comparative interpretation of the data? Since Lig cycle was run every four days, while Lion did every day, one solution would be to use the cycle noon-noon also at Lion to be similar to Lig.

Did the authors try to modify the cycle to look at the potential differences in using another starting point?

Lines 267-277: "daily solar cycle"

268: "Abundance of microorganisms". Which kind of microorganisms is referred to?: phytoplankton, bacteria? Do zooplankton affect the c_p or b_{bp} as well?

line 272: cell division. Since cell division is strongly dependent on the species and on the physiology of the species which is modulated by diel light cycle, I suggest adding some information on the physiological changes (e.g., photoacclimation) together with abundances as key-factors determining the success in term of production/division of a community (e.g., Doney, et al (1995) Photochemistry, mixing and diurnal cycles in the upper ocean. *J. Mar. Res.*, 53; Litaker, R. W., et al. (2002) Effect of diel and interday variations in light on the cell division pattern and in situ growth rates of the bloom-forming dinoflagellate *Heterocapsa triquetra*. *Mar. Ecol. Prog. Ser.*, 232, 63–74; Brunet C. et al. 2008. Phytoplankton diel and vertical variability in photobiological responses at a coastal station in the Mediterranean Sea. *J. Plankton Res.*, 30: 645-654.

Line 277: what is the link between microorganism respiration and particle size/refractive index?

Line 308: what does "quasi 1-D framework" mean? It seems to me 1-D?

Line 325: "ZSCM the depth of the SCM": does the ZSCM refer to the maximum chla fluo depth?

Results&discussion

Line 382: remove "in this section"

Line 402: "...the Ionian Sea SCM is located twice as deep (97 m) and is uncoupled from any cp and bbp maxima that occur at shallower depth." Did the authors have an explanation for this spatial uncoupling between cp and scm? And why was the cause of the cp maximum in the surface layer?

I am also wondering if the chl.a maximum at 100 m depth might be called DCM rather than SCM ?

Line 407: "whereas the Ionian SCM is induced by photoacclimation of phytoplankton cells." What does it mean? Is there a chl.a maximum? Did the authors suggest that this chl.a maximum is not due to accumulation of microalgae but to an intracellular increase of chl.a due to low light? Can it be a mix of the two (increase in phytoplankton as well as in chla per cell)?

Moreover, the difference between the two systems might be attributed to the fact that SCM depth was 40 m deep in one case and almost 100 m deep in the other. One belongs to the euphotic depth, while the other does not. Microalgal communities seem to be significantly different. All those environmental/ecological properties might explain the low productivity rate in the Ionian sea, compared to the highly productive Ligurian sea.

Indeed, other studies (Combet et al., 2011, biogeosciences) reported an increase of POC at depth in the Ionian sea in correspondence of chl.a maximum in summer.

More generally, I think that light data/information is lacking sometimes. Light is the one of the main driver of primary production as well as of the diel variations of microalgal communities. I suggest adding a figure showing characteristic light profiles. the fig. 10 "only" reports the daily integrated light at the SCM in both sites.

Figure 4: I think that there is a mistake on the colors: chl.a is higher in surface than in scm?

Figure 8 is not very informative like this. Please, change the type of figures, we do not really appreciate the potential changes in chla in the three size classes. Also because the right panels report the time variations for only four days.

Table 3: some values are negative:

- Did the authors estimate the mean of these two parameters mixing positive and negative values ? does it really make sense?
- How can be explained the negative value found for $\partial\Delta$ of cp in the euphotic layer in the Ligurian sea, in correspondence with the huge variability (2603.1%)? It would reveal the very high spatial variability in this zone, but the $\partial\Delta$ of cp was positive for both the surface and SCM layers.

Another point: from the fig.3, for the Ligurian sea, euphotic depth includes SCM and surface, while for the Ionian sea, SCM is generally below than the euphotic depth. Does it useful to compare the relative daily variations ($\partial\Delta$ and $\partial\Delta$, respectively) in the diel cycle of cp and bbp in the euphotic depth between the two systems?

Line 435: efficient?

Line 451: "We compare the cp- and bbp based estimates with primary production estimates computed with the model of Morel (1991)." Is it necessary to use the bbp estimate since the lack of correlation with scm for instance? It does not seem to be relied on phytoplankton production.

Line 544: an/a (correct)

Line 546: "the SCM reflects photoacclimation..." the SCM is greatly deeper (below the euphotic depth and the mixing layer), Light is strongly lower than in the Ligurian system SCM, maybe temperature is lower, chl.a is less...consequently the production might be lower than in the other system.

Lines 595-596: no need to present the data in absolute and in %.

Lines 613-614: Please explain

Line 633: "...increase their intracellular Chl." And/or the fluo/chl.a ratio in relation with the little (or absence) of high-light-induced chl.a quenching

Conclusions

To me, this section is too long, and is like a discussion. Many points raised by the authors in this section were already presented/discussed. I suggest reducing the length of the conclusions.