



EGUsphere, author comment AC3
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Reply on RC3

Arianna Zampollo et al.

Author comment on "The mixed layer depth below the pycnocline (BMLD) as an ecological indicator of subsurface chlorophyll-a" by Arianna Zampollo et al., EGU sphere,
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Dear reviewer,

We are very thankful for your time and your comments on the paper. According to all the reviewers, we identified some common issues that came across, and we have planned to improve the manuscript following all your advice.

The main points we want to work on are: i) better defining the scope of the paper by deleting the Chl-a shapes from the analyses, ii) simplifying the methods, and iii) providing the code to let users trying with the proposed algorithm.

Below, we describe the main changes we are going to introduce into the paper to address the above points.

The scope of the paper will be clarified by focusing on the BMLD (base of the pycnocline) and its use as a proxy for the depth of maximum Chl-a (DMC) in shelf waters. To date, the paper is packed with many details regarding the co-occurrence at the same depth of any density layer (that we will rename as "level") (e.g. AMLD, BMLD, DHP and Max N2) and DMC. The current structure of the paper reports first the comparison for all the profiles together (section 3.2) and then the comparison for each Chl-a shape (section 3.3). However, the length of the paper and the amount of information has increased the confusion among all the reviewers, who struggled to identify the main scope of the paper and often focused mainly on issues referred to Chl-a shapes. On the contrary, we have written this paper to promote a different point of view in investigating subsurface Chl-a by using density profiles. Hence, the main aim of the paper is to highlight the BMLD as a useful tool to predict and investigate DMCs in shelf waters. The vertical distribution of DMCs nearby BMLDs suggests that this variable has an ecological relevance when we investigate the vertical distribution of Chl-a subsurface patches, and we suggest its use in further research (enlarging these applications in the Discussion). However, this point does not come across easily, and we decided to delete all the analyses related to Chl-a shapes to focus mainly on the use of the BMLD and its potential. The following paragraphs will be deleted: 2.2 in the methods will not include Chl-a shape identification, 3.3 in the results, 4.1 and 4.2 in the discussion. However, understanding the physical processes underpinning the vertical distribution of each Chl-a shape is an open question, and the presented results showed how each shape exhibits a different association of DMCs with the pycnocline. Hence, we are interested in detailing this question in another paper, to avoid hiding the main scopes of this paper, which are i) proposing a method to extrapolate

the base of the pycnocline from density profiles and ii) evaluating its association with the vertical distribution of Chl-a (regardless the Chl-a shape).

The second and third points ("*simplifying the methods*" and "*providing the code to let users trying with the proposed algorithm*") are ensuring that the reader fully understands the method and its potentialities. For this reason, we will reduce the number of details regarding the algorithm in paragraph 2.4 and we will focus on the requirements, limitations, and circumstances in which the method can be used. Since paragraph 3.1 describes what is considered a correct or wrong identification, and is a repetition of the methods, we decided to integrate it into the methods together with figure A1. Moreover, we will upload the code of the function on GitHub, where an example will be also provided. The details regarding the structure of the function will be reported in the supplementary material to allow people to replicate, improve and use the code. Therefore, Figure 3 and part of the methods will be moved to supplementary materials.

The removal of Chl-a shapes from the paper will change the discussion section, which will be reduced and will focus on describing the relationship between density and Chl-a profiles. We will review the physical variables that are playing a role in the definition of BMLD and AMLD, and their association with the vertical distribution of maximum Chl-a in the water column. Figure A2 will be moved to the main text to better understand the vertical distribution of the depth-integrated Chl-a with regard to each density layer (AMLD, BMLD, DHP and Max N²).

Here we respond to your main specific comments:

"However, even if on one side these novel methods are an added value of the MS, on the other hand their description is probably excessively detailed and not easily readable resulting in a quite long MS that probably lacks of clarity also in the results, discussion and conclusions."

Thank you for your comment. We agreed the paper is long and many details in the methods (section 2.4) can be moved to supplementary materials. As we mentioned in the first section of this response, we intend to shorten the manuscript and delete the sections with Chl-a shapes, which can be part of a further paper focused on understanding the physical variables underpinning each Chl-a shape.

"Improve the methods section readability, reducing the description of the methods and avoiding non-necessary details and repetitions in the methods."

We hope that reducing the number of analyses and details will improve the readability. The methods will be eased, and repetitions between methods and results will be solved into a unique section that describes the algorithm's use. Moreover, the details of the algorithm will be moved to supplementary materials, and the code will be provided in a GitHub repository.

"the results section could be focused on the most relevant results and significantly shortened."

Deleting the sections referring to Chl-a shapes will strongly decrease the amount of information in the paper, and clarify the BMLD's uses (main aim).

"Discussion section is quite long and one of the focus of the MS (wind farm impacts) risks to be lost by the reader. The Authors should consider to focus the Discussion on few relevant themes."

As described before, we intend to reduce the discussion and focus on the density and Chl-a profiles. The discussion will focus on describing the relationship between density and Chl-a profiles, reviewing the physical variables that are playing a role in the definition of BMLD and AMLD, and their association with the vertical distribution of maximum Chl-a in the water column. Moreover, we consider it essential to mention that understanding the vertical distribution of density and Chl-a is important to guide the investigation of disturbances' effects (climate change and offshore renewable energy) on the right physical variables. Identifying a tight overlap between BMLD and DMC suggests that physical variables close to the seabed (e.g. bottom temperature) are indeed key variables to address the effects of disturbances on primary production. On the contrary, the exclusive investigation of the surface processes (up to AMLD) may lead to partial conclusions about the effects due to climate change or man-made structures. Hence, describing the implications of BMLD in characterising the effects of climate change or man-made structures e.g. wind turbine foundations (which are likely to impact the mixing of the water column) on the ecosystem is useful to give a context of the potential uses of these variables in further investigations.