



EGUsphere, author comment AC1
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Reply on RC1

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:

"I was left with the view that a surprisingly complex statistical model had been used to analyse the shapes of a lot of chlorophyll profiles (which implicitly have been assumed to be temporally static?) But I did not feel I had learnt anything useful about the general properties of sub-surface chlorophyll layers."

We think this is related to the high number of sub-analyses that were presented in the paper. We wanted to show the relationship between the different density layers and the vertical distribution of Chl-a, and we thought that reporting the information at the level of each Chl-a shape was actually helpful. On the contrary, it created more confusion, and we are considering now focusing on describing how AMLD and BMLD can be used to investigate Chl-a throughout the water column without considering each Chl-a shape (his subdivision can be part of a future analyses/paper). Your comment "*I think the key, interesting point that is being made (though not clearly articulated) is that descriptions of ocean mixed layers are largely informed by starting with the surface ocean and working downwards from there. In shelf seas, particularly where tidal mixing plays an important role, working upwards from the seabed makes more sense*" was summarising the scope of the paper, and we intend to make this message coming across easier.

"I think the paper needs to lift itself out of the statistics and focus much more on the resulting chl shapes and the processes underpinning them."

We agree that there is a need of understanding the processes underpinning each Chl-a shape, although we think that this paper may be more suitable to describe the use of BMLD by comparing it to the other characteristics of the density profile (e.g., AMLD), and methods. The investigation of different processes underpinning each Chl-a shape can be expanded by involving further physical variables, which we think would be more suitable for another paper (research question). Hence, we suggest deleting all the sections referring to Chl-a shape and focusing on the different interpretations that can be obtained by investigating Chl-a in association with either AMLD or BMLD.

"the paper needs to be more concise and clearly argued if you want it to have some

impact.”

We hope that reducing the number of analyses and details will improve the readability. The methods are going to be eased, and repetitions between methods and results will be solved into a unique section that describes the use of the algorithm.