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Interactive comment on "Warmer winters causes an increase of chlorophyll-a concentration in deeper layers: the opposite role of convection and self-shading on the example of the Black Sea" *by* Elena A. Kubryakova and Arseny A. Kubryakov

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We would like to thank Vladimir Silkin for comments and valuable and constructive suggestions for improving the paper.

Comments and Recommendations (CR)

CR1. "In the Introduction, it is necessary to formulate the research objectives more clearly. In particular, the sentence on line 68 should be moved to the end of the Introduction".

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Discussion paper

Answer CR1. Thank You for this comment. We agree and have rewritten the Introduction part to formulate the research objectives more clearly. We also moved part of the text from Introduction to the "Section 2.1 General information about the study area". The revised part of the Introduction: "In our study, we use the measurements of biogeochemical-Argo floats in the Black Sea to investigate the effect of winter mixing and irradiance on the vertical distribution of Chl in two years with contrasting winter conditions – warm in 2016 and cold in 2017. The analysis revealed that the decrease of nutrient fluxes in the years with warm winter is partly compensated in the summer period, when, in conditions of low Chl, light is able to penetrate in the deeper layer with a larger amount of nutrients. The structure of the manuscript is as follows. Section 2 gives information about the study area and used data and methods. Section 3 presents the differences between main physical (Section 3.1) and bio-optical (Section 3.2) characteristics in the warm 2016 and cold 2017 years. Discussion and conclusions are presented in Sections 4 and 5."

CR2. "On lines 78 - please provide a reference".

Answer CR2. We have added the reference in this part of the text – (Titov, 2004).

CR3. "In the Results, provide only the authors' results and move the comments and reference to the Discussion (Lines, 144-145, 157-158, 160-163, 173-183, 201-205, 2016, 234, 244, 265)".

Answer CR3. Thank You. We agree and have moved part of this text to the Discussion and part to the "Section 2.1 General information about the study area". We kept the minimum amount of the references in the Results Section, only those needed to explain the obtained features of the Black Sea bio-optical properties.

Individual comments and recommendations (ICR)

ICR1. "Line 19 and 201-chlorophyll concentration and productivity are not the same things".

Answer ICR1. We agree and have corrected it as: "in the year with intense winter mixing, Chl in upper layers is higher" on line 19 and changed on "to an increase of Chl" on line 201.

ICR2. Line 35 - "the biomodelling study" rewrite as "the modeling study".

Answer ICR2. It was rewritten.

ICR3. "Line 85 - Cold intermediate layer mark as CIL and use it later in the article".

Answer ICR3. The cold intermediate layer was marked as CIL on line 85. And since now CIL is used in the paper.

ICR4. "Lines 50-55. Rewrite these sentences "At the same time, high values of irradiance may cause photoinhibition and decrease of Chl near the surface (Platt et al., 1982) caused by several effects including non-photochemical quenching, photoinhibition, and photoadaptation (Falkowski & Raven, 2013). The latter is partly associated with the increase of Chl content per cell (MacIntyre et al., 2002), documented for the Black Sea in (Finenko et al., 2002, 2005; Churilova et al., 2019)". Here it would be best if you replaced photoadaptation with photoacclimation, since changes in the chlorophyll content in the cell are acclimation. Further, the chlorophyll content in the cell increases when the light intensity decreases. Therefore, it decreases at the surface".

Answer ICR4. Thank You. We agree and have rewritten this sentence. In the revised manuscript: "At the same time, high values of irradiance cause the decrease of Chl and fluorescence near the surface (Platt et al., 1982) due to several effects including non-photochemical quenching, photoinhibition, and photoacclimation (Falkowski & Raven, 2013). The later lead to the decrease of Chl content per cell (MacIntyre et al., 2002), which is observed in the upper layers of the Black Sea in the summer period (Finenko et al., 2002, 2005; Silkin et al., 2013; Churilova et al., 2019)."

ICR5. "Line 110-111. Rewrite this sentence".

Answer ICR5. We have rewritten this sentence as "We used the product

"CHL_ADJUSTED", which includes the correction on non-photochemical quenching (Roesler et al., 2017) and the correction on the contribution of fluorescence by non-algal organic matter (Xing et al., 2017)". The data was downloaded from IFREMER data archive (ftp://ftp.ifremer.fr/ifremer/argo).

ICR6. "Line 121. More correct to write Kd(z) rather than Kd(λ) since this parameter changes with depth".

Answer ICR6. We have corrected this formula and excluded λ from it, as we use here only Kd of PAR K_d (z)=lnâĄą((E_d (z+dz))/(E_d (z)))/dz

ICR7. "Line 129-decode DAC".

Answer ICR7. We have rewritten this sentence as: "Bio-Argo data have a high time resolution (from 1 to 5 days) and vertical resolution (1 m), is regular and is publicly available at http://doi.org/10.17882/42182 or can be downloaded from the Data Assembly Centers (such as http://www.coriolis.eu.org/)."

ICR8. "Line 187-there is no dot at the end of the sentence".

Answer IC8. Thank you, the dot was added.

ICR9. "Line 315-chlorophyll and biomass are not the same things".

Answer ICR9. We have rewritten this sentence as "On the opposite, in the year with relatively low winter nutrient fluxes (as in 2016 in the Black Sea), the growth of phytoplankton and related to it Chl decreases".

ICR10. "Figure 4 is missing the dimension for PAR".

Answer ICR10. We have added the units to all figure captions.

ICR11. "In the caption to Figure 7, there is no designation of the curves (red and blue)".

Answer ICR11. Thank you. The curves designation was added: red line – 2016, blue line – 2017.

Please also note the supplement to this comment:
https://bg.copernicus.org/preprints/bg-2020-366/bg-2020-366-AC3-supplement.pdf

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