Biogeosciences Discussions

Biogeosciences Discuss., referee comment RC1
https://doi.org/10.5194/bg-2021-315-RC1, 2021

Comment on bg-2021-315

Anonymous Referee #1

Referee comment on "Physical mechanisms for biological carbon uptake during the onset of the spring phytoplankton bloom in the northwestern Mediterranean Sea (BOUSSOLE site)" by Liliane Merlivat et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-315-RC1, 2021

Review of “Physical mechanisms for biological carbon uptake during the onset of the spring phytoplankton bloom in the northwestern Mediterranean Sea (BOUSSOLE site)” by Merlivat et al.

This manuscript addresses the question of what mechanisms trigger the start of the spring phytoplankton bloom and associated DIC drawdown in the Northwest Mediterranean Sea. To do this they used a suite of autonomous at sea and satellite data (2016-2019). They argue that reduced wind stress and positive air-sea heat flux leads to stratification and elevated mixing layer irradiance levels, which leads to growth of previously light-limited phytoplankton (nutrients assumed to be replete due to prior deep winter mixing). Whilst I do not believe this is an especially novel finding, a nice dataset is nevertheless brought together. My main recommendation is addition of calculated light data where possible (i.e., calculating and presenting average mixing layer irradiance) – further details provided within the comments below.

Lines 46–55 of the introduction would benefit from supporting references.

Lines 57–59: I think it would be beneficial here to outline the mechanism by which atmospheric forcing is important for bloom initiation (i.e., by regulation of the mixed/mixing layer depth and thereby light availability).

Lines 60–61: I think the justification for hourly-daily timescale observations should be expanded on a little; for example, bloom initiation might be rapid and the bloom duration transient, therefore stressing why driving factors need to be observed at high frequency.

Lines 77–80: I think this sentence needs adjusting – the 'variability' in atmospheric forcing is not the factor leading to deep convection, rather the combination of atmospheric cooling and strong winds?

Lines 143–144: Provide here the mixed layer depth criterion that was used in Holte and Talley (2009)?

Line 164: Suggest 'sunlight-induced fluorescence quenching' rather than 'quenching' alone

Line 199-200: How did the authors objectively define the 'onset period of the bloom'? (Also Fig. 3 vertical dotted line)

Figure 3. Can satellite chlorophyll-a concentration be added to these plots (e.g., 8-day averages)? The labels are also cut off from panels 'a' and 'g'. Also a 'red dotted line' is mentioned in the figure caption, but I cannot see it in the figure?

Figure 4: I don't understand panel b: How is the euphotic depth being added on, with an x-axis of wind stress? How does wind stress increase with water depth? Or is the y-axis "Mixed layer depth" or 'Euphotic depth"? If so, better to add both these labels on, otherwise it is confusing!

Lines 275–289: Please can the authors calculate the average mixing layer irradiance and show this on Figures 2 and 3? This will be a function of the incident irradiance, the mixing depth, and the diffuse attenuation coefficient (see e.g., Behrenfeld et al. 2005 Section 2.1; Venables and Moore, 2010 Eq. 2). The diffuse attenuation coefficient can be estimated from surface chlorophyll-a concentrations. It is difficult to imagine how average mixed layer irradiance is changing (i.e., if this is increasing as the authors imply) without doing and presenting the results of this calculation. This is also needed to support the final statement in lines 288–289. It is also relevant for how the problem is framed in the abstract.

Concluding remarks section: It would be nice if the authors could use their findings to make a comment on the relative support of the different mechanisms proposed for initiation of the spring boom discussed in the introduction (i.e., from the perspective of surface DIC drawdown, whereas other studies have mostly focussed on chlorophyll)

References

Behrenfeld, M.J., Boss, E., Siegel, D.A. and Shea, D.M., 2005. Carbonâ□□based ocean productivity and phytoplankton physiology from space. *Global biogeochemical cycles*, *19*(1).

Venables, H. and Moore, C.M., 2010. Phytoplankton and light limitation in the Southern Ocean: Learning from highâ□□nutrient, highâ□□chlorophyll areas. *Journal of Geophysical Research: Oceans*, *115*(C2).