

Biogeosciences Discuss., referee comment RC2
<https://doi.org/10.5194/bg-2021-122-RC2>, 2021
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Comment on bg-2021-122

Anonymous Referee #2

Referee comment on "Summertime productivity and carbon export potential in the Weddell Sea, with a focus on the waters adjacent to Larsen C Ice Shelf" by Raquel Flynn et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-122-RC2>, 2021

In this manuscript the authors present data on nitrogen (NO_3 , NH_4 , urea) and carbon uptake and nitrification at different locations in the Southern Ocean, namely, the Antarctic peninsula, Larsen C ice shelf, Weddell Gyre and Fimbul ice shelf. The manuscript presents a large set of valuable data in poorly studied and contrasted systems from the shelves into open waters of the Weddell Gyre. The manuscript is well written and the study is well worth publishing in Biogeosciences. However, given the large dataset and scope of the study (compare productivity, macronutrients and regenerated N uptake and assemblage composition and environmental variables), I believe and the results presented here would deserve a more thorough and robust analysis (including correlation or multi-correlation statistics) for the discussion points:

- In most of the figures presenting profiles it is not possible to distinguish individual profiles. Further, in particular for the LCIS, the location of the different stations is not reported in these figures. This is relevant given that stations sampled were located in areas with very different topography, sea-ice cover, freshwater input, circulation, water mass characteristics, mixed layer depths not to mention plankton biomass and composition.
- Line 632-641: NPP is compared to Zeu. However, the large variability in Zeu in this study is not explained. Information on irradiance and sea-ice cover would be relevant here. Further, the actual light regime experienced by the plankton is related to the MLD and most probably phytoplankton standing stocks. These are not shown and analyzed in Fig. 10.
- Lines 643-661: no graph is presented on the relation between NH_4 and urea uptake and substrate concentrations or NPP.
- Line 652-657: No graph showing the relationship between particulate stocks (POC, PON) and regenerated N concentrations and uptake is shown.
- Lines 706-716: Several studies have shown that floristic composition (diatoms vs other phytoplankton groups, and diatom assemblage composition) is probably more relevant. How do the uptake ratios change with proportion of diatoms and diatom assemblage composition? (see also comments in the annotated manuscript lines 466-470).

- Lines 737-750: Why not compare the uptake rates of N species and uptake ratios with assemblage composition? (i.e. vs % diatoms, % non diatom biomass, and vs dominant diatom species types?).
- Lines 885-897: this part is based on the assumption that diatoms do not take up NH₄. This is not accurate (see Mosseri et al., 2008 and Smetacek et al., 2012).
- Lines 921-935: this is all highly speculative and based on several assumptions (among others that *Phaeocystis antarctica* blooms lead to high C export). I would recommend to base this part on the actual observations of this study. This part of the discussion is also based on the influence of sea-ice cover, but no information on sea-ice cover is given in the manuscript. Water depth might be also relevant here. Further, some stations at LCIS show very low salinity. This has not been analysed and discussed at all (among others, are these low salinities due to sea-ice melt or glacial discharge?).

Additional comments are given in the annotated manuscript.

Other comments:

Based on Fig. 1, it seems there are large differences in water depth between stations (i.e. some stations were taken in the continental shelf others in open waters). Information on water depth and how this affects water mass characteristics and MLDs would be helpful, in particular for Larsen C profiles.

Lines 81-82: the importance of shallow MLD for phytoplankton growth in the SO is also more and more contested see Hoppe et al., 2017, Deep-Sea Research II, 138: 63-73. doi:10.1016/j.dsr2.2015.10.005; Smetacek et al., 2012, Nature, 487: 313-319. doi:10.1038/nature11229 and Behrenfeld 2010, Ecology, 91(4), 977-989 for a more general discussion.

Line 115: The blooming stage in all bloom forming *Phaeocystis* species (including *P. antarctica*) is the colonial form. These are not free living "small cells" but structures in the size range covered by diatoms.

Line 123-124: More recent literature strongly indicates that diatoms in the SO also take up among others ammonia (see: Mosseri, 2008 and Smetacek et al., 2012).

Figures 2, 3, 7: It is impossible to see the profiles properly due to the amount of information. Perhaps Larsen C data could be plotted in a different figure. See also comments in the manuscript for Fig. 2.

Figure 3 d-f: The x axis range could be reduced (in particular for Si data). This would allow to see differences in profiles for the locations.

Figure 11: It would be helpful (for comparison with the tables) to report the station names (L1...L10) in one of the panels. Further, it is not possible to distinguish the different symbols in the profiles in panel d.

Table 1 and 2: please specify in the header or legend that all ratios are molar ratios. Is it possible to report % sea-ice cover as well as water depth in either of these tables?

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2021-122/bg-2021-122-RC2-supplement.pdf>