Reply on RC4

walker smith

Author comment on "Primary productivity measurements in the Ross Sea, Antarctica: a regional synthesis" by Walker O. Smith Jr., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-351-AC4, 2022

Response to Reviewer 4 – Statistics

First, I have to admit wholeheartedly that statistics are not my area of expertise or even comfort. In addressing this comment, I had numerous discussions with a number of my colleagues here at SOO/SJTU (principally Dr. Yisen Zhong) who are far more versed in statistical methods than I. In truth, the discussions were very interesting to me, and thought provoking. In summary, this is what I learned and decided to do:

- The group data (the dominant species) is not categorical, which makes using an ANOVA problematic.
- I then turned to an ANCOVA, but as the reviewer commented, transforming the 1% isolume data using a log transform makes things difficult or impossible, as that then impacts the group designation.

In short, I became convinced - based on advice from those that know much more about these methods than I - that there is no simple, definitive or intuitive statistic that can provide a clear separation of the effects of phytoplankton functional groups on integrated chlorophyll and irradiance attenuation (euphotic zone depth).

However, as I was intrigued by the possibility of a difference that might be reflected in these data, I replotted Figure 6 into separate panels (now Figure 6a, b). These show the best-fit power relationship

$$y = y_0 + a \, x \, \exp(-bx)$$

where y is the 1% isolume depth and x the integrated chlorophyll concentration) between integrated chlorophyll and the depth of the 1% isolume. For those stations that are dominated by *Phaeocystis antarctica,* it is a highly significant relationship (p<0.0001). I also plotted the same relationship at stations with a diatom dominance. It too was significant (but with a much lower R^2 value), but to me the most impressive part was that the fitted a and b values for the haptophyte stations were 165 ± 10.0 and 0.109 ± 0.009, while that at the diatom stations were 28.8 ± 8.13 and 0.048 ± 0.0.0198 (means and standard errors). To an observationalist like myself, that is a notable difference. In the manuscript, however, I simply pointed out the apparent differences between the two groups, noting that it is consistent with other observations on changing amounts of chlorophyll per cell that have been observed in the Ross Sea. I also recognize that there

is a temporal component in both data sets, with diatoms largely occurring is summer and haptophytes in spring. I also completed the same analysis on the mixed assemblages, and found that their response was intermediate between the other two functional groups.

To summarize, I removed all mention of statistics, changed Figure 6 to emphasize the potential difference between functional groups, removed the original bulk fit equation and replaced it with regressions for diatoms and *P. antarctica*.

I might also add that this has stimulated additional thoughts on these relationships which are outside the scope of this paper – why both seem to approach 20 m isolume depths, the interpretation of the changes in the shapes of the curves, and more. It was an excellent learning experience, and I thank the reviewer for pushing me through this!

Please also note the supplement to this comment:
https://essd.copernicus.org/preprints/essd-2021-351/essd-2021-351-AC4-supplement.pdf