EGUsphere, referee comment RC2
https://doi.org/10.5194/egusphere-2022-814-RC2, 2022

Comment on egusphere-2022-814

Emma Cavan (Referee)

Referee comment on "Drivers of particle sinking velocities in the Peruvian upwelling system" by Moritz Baumann et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-814-RC2, 2022

The authors present results from a mesocosm study off Peru investigating the drivers of particle sinking rates in the ocean. Understanding what controls sinking rates of carbon-rich particles is important so we can calculate the magnitude of sinking carbon by ocean life. Sinking rate parameterisations are often over simplified in models compared to reality due to this knowledge gap. In particular upwelling systems are of special interest due to their often high productivity compared to locations of the same latitude elsehwere. The methods followed in this study seem robust as are the statistics applied. This article is a good fit for the journal and special issue and should be published after corrections.

The manuscript is exceptionally well written. In addition I applaud the team's efforts to run these mesocosm experiments to get this data, which must be no simple feat. My main comments to improve the manuscript are around representing more methods as figures/tables in the manuscript, with less reference to other manuscripts, particularly Bach 2020 which explains the set-up. Althought this is part of a special issue the reader needs to understand the methods used without referring constantly to another manuscript. I also have other comments about acknowledging limitations of the approaches used and drawing out more from the data you have, although the latter is really up to the authors and is more a suggestion.

My comments are as follows:

- Please include a figure showing a map of mesocosms and a diagram of a mesocosm with the set up.

- A table with initial nox conditions in the mesocsms and how these changed after addition of OMZ waters. I can see these exist in Bach et al 2020 but without these the methods are not fully understandable if only reading this manuscript.

- There must be images of the particles, can you show these to show as example 1) particle type, and 2) a porous and non-porous particle. I was surprised there was not any mention of particle type and wonder if perhaps if this data is being saved for another manuscript, if not please include the data here. If it is, please summarise what the particles were and if composition changed over time.

- in line 234 you state seabirds stimulate *new* production, it's a bit pedantic but isnt this regeneration of nutrients and so they are stimulating production, but by definition (F-ratio) its regenerated nutrients (ammonium) not nitrate.

- consider putting some of Fig.1 plots on same scale so can compare Sv.

- Did you compare the means of your variables with time for the different OMZ water treatments? I can see from your statistics and figures there is no difference in magnitude, but there might be interesting (or not) subtle differences in the trends of some of your variables. For instance instead of just the solid black line you could have a blue and red one too. If there isnt any thing interesting to be seen with time then this can just be stated.

- in your discussion around size vs Sv you note that a low sample number (n) could be the reason. We also looked into this using the Cavan et al 2017 data from Guatemala, but published the size vs Sv in a seperate paper (Cavan et al 2018, JGR), https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018JG004392. You can see in Fig.1 below 1250um theres a signal of size vs Sv, but above this there is not, which we hypothesised was due to a low sample size. This could be useful to further back up your discussion (~ line 387) and is from a similar location.

- As the main motivation for this study is to improve models it would be helpful to expand discussion on your coefficients for the size vs Sv relationship, ~ line 395. what was the range reported by Cael? Were your coefficients on the lower or higher end, how do they compare with global values, does this location have a lower or higher slope than others? What does this infer about biology? What else needs to be done to get this paramterisation in models and how would a modeller scale the coefficients with location/chl/temperature etc. to represent this location differently?

- A large proportion of the discussion is given to the opal ballast, which the authors find is not a key driver here (would we expect that in the tropics?) and the wider community has already shown ballast is often not a driver. I would encourage the authors to bring out more novel aspects, particularly around porosity which has only more recently been quantified and could be really important in driving fluxes. For instance, pellets that are more porous (e.g. salps) are less efficient vectors of carbon to the deep. I think some interesting discussion could be had here at the authors discretion.

Some discussion around particular limitations is needed, especially:

- The use of mesocosms, what are the limitations of artificially manipulating the ecosystem in this way? are there wall effects for example?

- What is the mixed layer depth? and as the mesocsms are only 19 m deep, do you think the particles you sample would actually be exported out of the mixed layer? many would be recycled before reaching the mixed layer if its much deeper than 19 m.

- I am really glad to see the seabird discussion, but did you count seabirds per mesocosm and compare to N or P? Can you absolutely prove that seabirds increased N and P in the mesocsoms? I think its still fine to mention the birds in the manuscript but need to acknowledge you hypothesise the affect the birds had rather than can prove it. This sets up a nice future experiment to be had.

- Are there limitations to your methods of measuring Sv? might the material have aggregated once settled and before you sample it? there are also limitations to the flow cam method which need to be ackowledge. Around line 391 would be a good space to introduce discussion on this.