Biogeosciences Discussions

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Comment on bg-2021-105

Anonymous Referee #1

Referee comment on "Distribution of coccoliths in surface sediments across the Drake Passage and calcification of *Emiliania huxleyi* morphotypes" by Nele Manon Vollmar et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-105-RC1, 2021

The MS by Nele Manon Vollmar and colleagues examined 28 surface sediment samples in order to determine the geographic distributions of coccolithophore species in the south Chile and across the Drake Passage. In addition, authors estimated the mass and length of *Emiliania huxleyi* coccoliths using two approaches and evaluated the distribution of coccolithophore species and *E. huxleyi* morphotypes in relation with environmental parameters. Coccolith abundance, diversity and coccolith mass of *E. huxleyi* decreased with increasing latitude. Overall, the manuscript is well written and provide new data on the distribution of coccolithophore species in the sediments of the Southern Ocean. This information is important to improve paleoceanographic reconstructions in the region and to assess possible changes in the distribution of coccolithophores associated to ongoing environmental change in the region. However, there are some important points in the methods, results and discussion that need clarity. Below I list several suggestions, which I hope contribute to clarify some issues and help the authors to improve their MS.

Lines 9-10 Results of the relationship between coccolithophore species and environment are barely discussed. Why not salinity, phosphate or other relevant environmental parameters are mentioned in the discussion? I believe Figure 10 is not even mentioned in the discussion.

Line 30 The content of this paragraph is correct but too descriptive. It should be placed in material and methods.

Line 46 Carbon is not respired. Please rephrase.

Line 57 Please note that diatoms dominate in the subantarctic waters in terms of biomass. In fact, coccolithophores account for small fraction of the primary production in all the zonal systems of the Southern Ocean. In terms of cell numbers, it is likely that coccolithophores dominate even south of the polar front. While the content of this sentence is correct, it is somewhat misleading, so please, re-write clearly stating the role

of each group. Moreover, some of the references do not report diatoms. Please find more appropriate references, for example:

Smith, H.E.K., Poulton, A.J., Garley, R., Hopkins, J., Lubelczyk, L.C., Drapeau, D.T., Rauschenberg, S., Twining, B.S., Bates, N.R., Balch, W.M., 2017. The influence of environmental variability on the biogeography of coccolithophores and diatoms in the Great Calcite Belt. Biogeosciences 14, 4905-4925.

Line 74 The poleward expansion of *E. huxleyi* in the Southern Ocean remains as a hypothesis that need to be proven. Please provide robust evidences (i.e. references) of leave it as a hypothesis.

Line 76 “Here, any ocean acidification effect appears outweighed by surface-ocean warming.” This sentence is unclear, any effect on what? Please rephrase and also provide reference/s to support your statement.

Line 82-83 “However, the number of coccolithophore studies in surface sediment in this area is very limited, and they mostly focus on assemblages." Please provide references.

Line 91 It is unclear why authors analysed the coccolith mass of this species. Please clarify the purpose of this analysis.

Line 131 Delete “coccolithophores”.

Line 131 If possible, include information about the model of the multicorer sampling device.

Line 134 It is unclear if this dating was made on any of the samples analysed in this study or if it was undertaken in nearby samples. Please clarify.

Line 145 The sentence "were aimed to be counted" is not clear enough. Do authors mean that they actually counted at least 100 coccoliths or this target number was not always met?

Line 166 Since one of the aims of the study is to compare results with modern living assemblages, why not using the classification of Savedra-Pellitero et al. (2019)?.

Line 175 Does this mean that an average of 27 *E. huxleyi* coccoliths were analysed per sample? If this is correct, the dimensions of a some morphotypes in some samples are based on a very low number of specimens. Authors should provide statistical evidence that the sample size is representative of the different populations (i.e. morphotypes). Please provide a table indicating the number of coccoliths of each morphotype that were analysed in each sample.

Line 184 This explanation is not clear enough. Could you please explain how these constants with ranges were applied to the coccoliths measured in the sample?.

Line 195 The description provided by Poulton suggests that they lumped together B/C and O. In his figure 1c, the coccosphere looks like the B/C described here. Did you double-check this identification with him? Please verify.

Line 199 replace "approache" by "approach"

Section 3.4 Authors should explain the objective of each of the statistical analyses and data transformations.

Line 200 If the morphometric-based approach brings higher values than the birefringence-based method, why the analysis on the living assemblages in the Drake passage suggests higher values?. Please explain better.

Line 233 Please acknowledge the limitations of this comparison. Coccolithophore living communities may experience important seasonal changes through the year and, therefore the assemblages collected in a single water sample cannot be considered representative of an annual cycle.

Line 236 Include subheading

Line 262 Do you mean "at the deepest stations"?

Line 286 Many physical and chemical parameters that might influence coccolithophore community composition and abundance are known to decrease close to monotonically poleward across the Southern Ocean. These include temperature, salinity, alkalinity, pH and the saturation state of calcite. Thus, it is not easy to separate their possible influences

on coccolithophore distributions. This problem has been previously noted by Charalampopoulou et al. (2016) in the Drake Passage. This should be taken into consideration when performing and interpreting the statistical analyses. Did authors consider this problem? And if so, how did you deal with it?

Charalampopoulou, A., Poulton, A.J., Bakker, D.C., Lucas, M.I., Stinchcombe, M.C., Tyrrell, T.J.B., 2016. Environmental drivers of coccolithophore abundance and calcification across Drake Passage (Southern Ocean). 13, 5917-5935.

Line 289 Please clarify how many specimens of *E. huxleyi* coccoliths were used to estimate the relative abundance. You can provide the average value including the minimum and maximum numbers for all samples.

Line 295 as authors state in the discussion it is very likely that at least a fraction of the type O coccoliths belong to B/C. Did you try to find correlations between this morphotype and any dissolution indicators (e.g. CEX)?

Line 300 Type O coccoliths display an almost identical size range than those of B/C. Could this be taken as an indication that both morphotypes belong to the same type/variety of *E. huxleyi*? What about their geographical distribution? Is there a relationship between abundance of type O and dissolution?

Line 310 Coccolith mass values estimated here should be compared with previously published works in the Southern Ocean.

Line 317 please be more precise and include a proportion or order of magnitude in the latitudinal comparison.

Line 321 It makes sense that studies based on plankton samples are less diverse since they only capture a "moment" of the annual cycle while sediment samples must encompass hundreds of years. Also, the mentioned studies covered different latitudinal ranges. So, I wouldn't consider these results "surprising".

Line 328 “unusually high” compared to what?

Line 346 This is somewhat confusing, the best way to assess algal biomass concentration in a region is to look at satellite chlorophyll-a in the region. High abundance of coccolithophores doesn't necessarily imply high productivity since they only account for

small fraction of the phytoplankton community. So please, rephrase.

Line 367 Please cite Cubillos et al. (2007) paper here.

Line 377 why shape? please clarify.

Line 380 what does "quite common" mean? please be more precise.

Line 413 not only south the PF. Did any of these studies reported descriptions of the seasonal cycles of coccolithophores?

Line 418 What do you mean with "selectively enriched"? Are you suggesting selective dissolution? Please explain better.

Line 519 This is an important point. Please note that even in the same coccosphere type B/C and Type O coccoliths can be observed. See Figure 3 of Cubillos et al. (2007) paper. Please discuss this point. Did authors compared the spatial distribution of B/C and "O" in terms of absolute abundances and relative abundances? is it similar between them?

Line 521 Müller et. al. did not assess the response of type "O". Do you know any culture experiments with this morphotype? I find this statement quite speculative. The fact that type O displays slightly morphological differences with the rest of *E. huxleyi* morphotypes does not necessarily imply that they have different physiological responses. Please be more cautious.

Line 525 Please compare your values and distributions with similar studies conducted in the Atlantic and Indian sectors of the Southern Ocean:

Horigome, M.T., Ziveri, P., Grelaud, M., Baumann, K.H., Marino, G., Mortyn, P.G., 2014. Environmental controls on the Emiliania huxleyi calcite mass. Biogeosciences 11, 2295-2308.

Rigual-Hernández, A.S., Sánchez-Santos, J.M., Eriksen, R., Moy, A.D., Sierro, F.J., Flores, J.A., Abrantes, F., Bostock, H., Nodder, S.D., González-Lanchas, A., Trull, T.W., 2020. Limited variability in the phytoplankton Emiliania huxleyi since the pre-industrial era in the Subantarctic Southern Ocean. Anthropocene, 100254.

Line 586 Please clarify that pteropods are made of aragonite which is substantially more prone to dissolution than calcite. As it reads now, this statement is misleading for the reader.

Line 586, second sentence. Authors cannot be completely sure that the dissolution in the sediments is necessarily enhanced by anthropogenic ocean acidification. Please rephrase being more cautious with your words.

Figures

Please include the name of the fronts and zonal systems in the maps

Figure 10. Please discuss in detail the role of the most important environmental factors in the distribution of coccolithophore species in the sediments.

Table 3. "All measurements in μm." Mass cannot be measured in micrometers, please correct. Also please include the name of the authors of the method in the column "methods", it would facilitate the interpretation of the table.

Supplementary materials

All coccolith counts and morphological measurements should be provided as supplementary materials.