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Biogeosciences Discussions

Interactive comment on "Environmental drivers of coccolithophore abundance and calcification across Drake Passage (Southern Ocean)" *by* Anastasia Charalampopoulou et al.

Anastasia Charalampopoulou et al.

alex.poulton@noc.ac.uk

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Response to Anonymous Referee #1

This paper is well written and presents new data on coccolithophore distribution and calcite production in the Drake Passage. There is also a lot of accompanying physical and chemical data that are not usually taken on such cruises. Although conclusions are not definitive they will contribute to the ongoing discussion of the role of coccolithophores in the Anthropocene.

Response: We thank the reviewer for their positive comments.

Line 13 Although coccolithophore diversity or abundance?

Response: We actually mean in terms of both numerical abundance and species diversity and have now clarified the opening statement in the abstract to better reflect this.

Line 19 Although CP represents less than 1% of total carbon fixations How does this compare to what has been written about the Great Calcite Belt? How does the unique doubling time of coccolithophores influence the equation?

Response : At the time of this article being submitted to Biogeosciences there was no published information from the Great Calcite Belt, but now Balch et al. (2016, Global Biogeochemical Cycles 30) is available to compare our Drake Passage rates with. Generally, ratios of calcification relative to primary production (photosynthesis) across the Atlantic sector of the Great Calcite Belt (south of ∼50oS) are similar to ratios seen in Drake Passage (<0.02 or ∼2%), although ratios are slightly elevated in the Indian sector of the belt (0.02-0.06 or ∼2-6%). It should be noted that the Great Calcite Belt spans ∼45-55oS and hence is more northerly than most of our Drake Passage (54-64oS) observations. We have now added direct reference to the Balch et al. (2016) study in our revised manuscript, specifically line 550 ('The ratio of CP to primary production for the bulk phytoplankton community (data not shown) was also similar to (sub-) tropical communities (0.001-0.069; Poulton et al., 2007) and lower than those generally in the Great Calcite Belt (Balch et al., 2016)'). We have also added this reference to citations and comments about iron control on coccolithophores (Ln 643: 'More recently, iron has been shown to control the distribution and growth of coccolithophores in the Great Calcite Belt (Balch et al., 2016) in the southern hemisphere') and the role of upwelling/frontal influences (Ln 454 and Ln 457).

Line 71 Length of (what) exposure.

Response: Here we were referring to the length of exposure to high pCO2 (low pH) and we have now clarified this in the revised manuscript (Ln 73).

Line 113 Sampling What is the importance of the temporal timing of the sampling?

Would it make a difference? Jan or March?

Response: Seasonal studies of coccolithophores in the Southern Ocean are extremely limited, and we have only one cruise worth of data. We interpret the reviewers question as 'whether seasonality would have any influence on our conclusions' (see Lns 673-692). Although we can only speculate, seasonal changes in cell numbers (and hence bulk calcification rates) may occur, though the dominant morphotype (B/C) is unlikely to change, and hence cell-specific rates may remain largely unchanged (without significant changes in growth conditions). Hence, our conclusions on B/C morphotype dominance and low cell-specific rates compared to the subpolar North Atlantic are unlikely to change. Our statistical relationships between environmental conditions and coccolithophore dynamics are also unlikely to change seasonally – the relationships primary exist because of the strong latitudinal gradients in temperature, irradiance and saturation state, which may vary seasonally along the survey track, but we would argue that strong latitudinal differences will remain despite such seasonality.

Line 117 samples were collected from the upper 100m of the water column Is it possible to get the depths of the samples? Later line 139 "5 CTD depths over the upper 100 m". Also in Figure 4: line 949 Abundance of Major coccolithophore species Which depths?: : :Not clearly stated the difference between Fig 5 surface distribution of coccolithophores and Fig 4.

Response: We apologise for not making this clearer in the previous draft. Water samples were collected from 5 m, 10 m, 50 m, 75 m and 100 m (note added to Ln 145). Both Figure 4 and 5 include surface water (5 m) abundance and calcification rate data: hence there is no difference between surface species distribution and rate data. We have now altered the Figure legend for Fig. 4 to reflect the sampling depth.

Line 136 as well as the criteria of Orsi et al What criteria?

Response: Orsi et al. (1995) use water mass properties (salinity, temperature, density) to differentiate the different fronts/water masses across the Antarctic Circumpolar Cur-

rent (ACC). This is now clarified in the text: "...as well as the hydrographic criteria of Orsi et al. (1995)..." (Ln 138).

Line 320 How do the coccolithophores assemblages found in the Drake Passage compare to other publications of coccolithophores in the southern ocean?

Response: We are a little confused with this comment with regards to Ln 320 (now Ln 337 onwards) which is in the Results section - the first section of the Discussion directly addresses this issue (Lns 444 onwards).

Line 322 Drake Passage: including???? "Including" is not a clear word.

Response: We have now deleted 'including' to clarify.

Line 430 A previous study across the Drake Passage When was this study undertaken?

Response: The Holligan et al. (2010) study was carried out in December 2006. We have now added this to Ln 450.

Line 497 Winer et al Winter et al

Response: We thank the reviewer for spotting this mistake and have now corrected it.

Line 528 coccolithophoroes contributed only a small fraction What were the main contributors

Response: Our estimates of a 1% contribution from coccolithophores to total carbon fixation is based on information on the coccolithophores and we can only speculate as to what other phytoplankton groups contributed to the majority of primary production. Diatoms and small flagellates (e.g., Cryptophytes) are likely to be a high proportion of the primary production (see e.g., Sommer and Stabel (1986), Pedros-Alio et al. (1996)).

References Pedrós-Alió C, Calderón-Paz JI, Guixa N, Navarrete A, Vaqué D, Microbial plankton across Drake Passage. Polar Biology 16(8), 613-622 (1996). Sommer U, Stabel H-H, Near surface nutrient and phytoplankton distribution in the Drake Passage during Early December. Polar Biology 6, 107-110 (1986).

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