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Interactive comment on "A multi-species coccolith volume response to an anthropogenically-modified ocean" *by* P. R. Halloran et al.

Anonymous Referee #2

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This manuscript represents a continuation and extension of the recent paper by Iglesias-Rodriguez et al (2008). Halloran et al. present size-distribution analysis of the < 10 μm fraction of a subpolar North Atlantic core covering the last 220 years. Over this period of time, this study shows an increase in the volume of larger coccolithophore species and comes to confirm the coccolith mass increase previously detected in the earlier work (Iglesias-Rodriguez et al., 2008). Both studies relate this increase in calcification with the present rise of atmospheric CO2 concentrations (Fig. 4 in Iglesias-Rodriguez et al., 2008) and contradict the most accepted view of a decrease in calcification associated with ocean acidification. Overall, I think the manuscript will be suitable for publication in BG if a more meticulous evaluation of the results is in-

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Interactive Discussion

Discussion Paper

cluded in the discussion section.

My main concern relates to the claim that the increase in coccolithophore mass correlates with the rise in atmospheric CO2. To show this, the authors refer to Fig.4 in Iglesias-Rodriguez et al. (2008) where average coccolith mass is compared to global atmospheric CO2 (ice core data + Mauna Loa observatory). The significance of that comparison is questionable and I wonder how the coccolith data compare with seawater pCO2. The pCO2 in surface seawater is not only controlled by air-sea gas exchange but also by biology and physical mixing and, with the exception of subtropical gyres, where seawater pCO2 mostly follows the increasing trend of atmospheric CO2, large variations in oceanic pCO2 can occur on relatively small spatial scales (Takahashi et al. 2002). Sediment core RAPID 21-12B is located in an area of low pCO2 (300-325 ppm; Takahashi et al (2002) and represents a sink area for atmospheric CO2. The evolution of oceanic pCO2 in this area and its growth rate may, or may not, have increased at the same pace than atmospheric pCO2. Even if it does, I think it is important to include this in the discussion (there must be surface water pCO2 data available for the last decades) and evaluate if the change of pCO2 conc. is large enough to cause a change in calcification (as seen in laboratory experiments and also pointed out by Referee G. Langer). Also, the other environmental problem associated with rising atmospheric CO2 concentrations is global warming. What is the temperature effect on coccolithophore calcification? Do all coccolithophore species respond uniformly? How can we separate the two effects, temperature and pH?

And finally, to better evaluate whether the decrease in the frequency of small particles is only due to the relative increase in the frequency of large particles, I wonder if coccolith concentration data (countings?) could add some valuable information. I have always found a bit confusing the exclusive use or either percentages or concentrations. If indeed small coccolithophores are today more lightly calcified, contrary to recent culture experiments (Iglesias-Rodriguez et al., 2008), this observation deserves more attention in the discussion section.

Technical comments:

Page 2926, line 9: It should say Fig. 4 instead of Fig. 3 Figure 1 is too small, particularly the top panel, where the main results of the paper are presented. Labels are hard to read. Legend of Figure 1 also includes the legend corresponding to Fig. 2. There is also a mention to a third figure that does not appear in the manuscript: Figure 3 presents the full dataset, negating this issue.

References

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Takahashi, T., S. C. Sutherland, C. Sweeney, A. Poisson, N. Metzl, B. Tilbrook, N. Bates, R. Wanninkhof, R. A. Feely, and C. Sabine (2002), Global sea-air CO2 flux based on climatological surface ocean pCO2, and seasonal biological and temperature effects, Deep Sea Research Part II: Topical Studies in Oceanography, 49(9-10), 1601-1622.

Interactive comment on Biogeosciences Discuss., 5, 2923, 2008.