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Interactive comment on "Phosphorus limitation and heat stress decrease calcification in *Emiliania huxleyi*" *by* Andrea C. Gerecht et al.

Anonymous Referee #1

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The manuscript 'Phosphorus limitation and heat stress decrease calcification in Emiliania huxleyi' presents a new and valuable dataset that assesses the combined effects of two possible future environmental stressors on the coccolithophore Emiliania huxleyi. The study presents results of semi-continuous and batch culture experiments in replete (control; 10 μM) and P-limiting conditions (0.5 μM) at two temperatures (19°C and 24°C), performed with a clone of E. huxleyi isolated from the Oslo fjord.

Overall, this paper is well-structured and clear, and the rationale is justified. The new data presented are relevant, and add to a growing collection of experimental results that assess response of different coccolithophore species and strains to changing environmental conditions. The tables and figures are clear, detailed and appropriate. In general, the discussion is well-reasoned, with suitable reference to published and

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available studies. The authors successfully integrate their new data into the ongoing debate, and present this in a way that is accessible to readers across disciplines. There are, however, some areas that would benefit from additional clarification:

1) The environmental significance of the data is presented with appropriate caution in the main text, but becomes over-stated in the abstract and conclusions sections.

The main interpretations of the data presented are:

- A future rise in global temperature, accompanied by a decrease in nutrient availability may decrease CO2 sequestration by coccolithophores through lower overall carbon production

- The export of carbon may be diminished by a decrease in calcification and a weaker coccolith ballasting effect.

In general, the justification for these statements within the discussion section is well-balanced and makes appropriate reference to the contrasting results obtained from different species/strains and experimental setups (e.g., page 7, lines 19-31), which builds on points made in the introduction. However, these intricacies are not apparent in the concluding statements of the abstract and conclusions, which refer to 'coccolithophores' (e.g., page 1, line 14) and 'E. huxleyi' (page 9, line 33), without acknowledgement of potential species and strain-specific responses. These statements seem to require additional justification. The authors do exercise appropriate caution with their interpretations (e.g., using 'may' and 'based on this study'), but some additional context might strengthen their interpretations. For example, it would be beneficial to assess how widespread/dominant this strain of E. huxleyi is in comparison to those strains/species cited from other publications. Further recognition of the potential for acclimation is also important.

2) Assessing coccolith morphology

The criteria for classifying coccolith morphology as 'normal, incomplete, and mal-

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formed' should be included in Section 2.4 (Methods). At present, the significance of 'incomplete' coccoliths as those that have undergone secondary dissolution (rather than being 'incomplete' due to incomplete primary formation) is only discussed in Section 4.2. This is an important distinction, particularly for fellow scientists who attempt to apply the same morphologic criteria in other experiments. An additional image of a representative coccosphere from the cultures that had higher levels of malformation would also be a useful addition to Fig. 1.

3) Semi-continuous and batch culture experiments

The paper successfully highlights the reasons for performing both semi-continuous and batch culture experiments (i.e., production cannot be determined from the batch culture approach). It also describes the differences between the approaches with respect to real environmental scenarios (page 2, lines 3-7). In this regard, does the experimental approach have any relevance for the strain of E. huxleyi used? I.e., would the approach that most closely replicates it's original natural environment in the Oslo fjord be more representative for this strain?

Other minor comments:

- The uncertainty for the number of coccoliths per cell is much higher for the P-limited batch cultures at both temperatures (+/- 20 and 15). Is there a reason for this?

- Table 2 (page 5 line 16) is referred to before Table 1 (page 5, line 38)

- The significance of the red and blue colors in Figure 2 is missing

- There is no reference to the error bars in Figure 4.

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