

Interactive comment on “Responses of coccolithophores to ocean acidification: a meta-analysis” by J. Meyer and U. Riebesell

Anonymous Referee #1

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This is a well written and coherently argued piece of work, advancing our understanding of how OA may affect coccolithophores. It was a pleasure to read a manuscript in which the arguments are so easy to follow because of the high standard of the writing. In my opinion the arguments are generally sound and the conclusions mostly consistent with the results obtained. I recommend publication following minor amendments.

This paper uses previously established methods of meta-analysis (Kroeker et al) to evaluate the likely impacts of OA on coccos. The paper essentially repeats earlier meta-analysis work but now with additional data (more studies), and considering only the impacts on coccolithophores. The analysis helps clarify our understanding of likely impacts on coccos, an important issue. Some limitations of the analysis are acknowledged, others not.

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General comments:

The main comment I have is that whereas some limitations of lab experiments are acknowledged (age of cultures, lack of evolution), other major ones are not, and need to be. In particular, the experience with OA impacts on N₂-fixation suggests that meta-analysis is not always the best way of elucidating the right answer. The large majority of experiments conducted have found that OA stimulates an increase in N₂-fixation. However, they were all carried out at elevated iron concentrations compared to the open ocean. The study of Shi et al (2012), at more realistic iron, found the opposite effect. This should ring alarm bells for meta-analysis studies because even if an infinite number of lab studies were to be carried out then the overriding majority conclusion could still be completely wrong if they were mostly carried out under unrealistic environmental conditions, and if that difference alters the response obtained. This doesn't mean that the results of this study are not valuable (no single approach to studying OA is perfect), but it is helpful in the interpretation to consider the possibility of this sort of error. Another potential source of error is that lab experiments are carried out on monocultures isolated from the ecosystem with which they normally closely interact. However, this does not hold for the mesocosm experiments.

Specific comments:

14858/23: the other limitations should also be acknowledged.

14859/13: the impacts are not likely to be large on a centennial scale, see for instance the work of Christoph Heinze. The word "Thus" is in any case not justified, because showing that there is an effect is very different from showing that the effect is significant.

14859-14860: it would be helpful if at this point it could also be explained how this paper differs from previous studies by Findlay et al and Ridgwell et al.

14860/15: how many studies?

14862/15: how many experiments were excluded on this basis?

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14863-14864: the precise equation/method for allocating weights should be provided, and the weights listed as an extra column in table 1.

table 1: the criterion for distinguishing "some response" from "no response" should be described in the caption or the main text.

14870/2: "Another proposed explanation for the high difference in variance between..."

14871/3: "2009), overall there is nevertheless a generally negative..." (these results do not say anything about how large the strain-specific variations are)

14871/11: "lead to a reduction in" rather than "minimize"

14871/21: although it should be noted that this effect is not observed in *E. huxleyi*, which has been most intensively studied.

14872/5: an increase in calcification rate at high CO₂ does not necessarily mean that the species is benefitting from the high CO₂ (resources can be reallocated, e.g. at the expense of reproduction rate).

14872/21-25: I think there are insufficient data (N=3) to conclude that the most prevalent species are the ones most affected.

14874/17-19: but this would imply that they calcify to no purpose, which is hardly likely.

table 1: add extra column for weightings. spelling mistakes in specifics column. "- no response" in caption.

figs 1-3: remind readers in the captions that these are responses relative to 280 ppmv.

Shi, D., Kranz, S. A., Kim, J. M., and Morel, F. M.: Ocean acidification slows nitrogen fixation and growth in the dominant diazotroph *Trichodesmium* under low-iron conditions, *P. Natl. Acad. Sci.*, 109, E3094–E3100, doi:10.1073/pnas.1216012109, 2012.

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