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Interactive comment on "Explicit planktic calcifiers in the University of Victoria Earth System Climate Model" *by* K. F. Kvale et al.

Anonymous Referee #1

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This paper reports development of the University of Victoria intermediate complexity Earth system model to include calcification. A fair case is made for why it would be valuable to include planktic calcifiers in such models, and their approach to doing so is described. However, it is not obvious that this attempt to include planktic calcifiers is an improvement on previous attempts. If anything, this attempt seems to include a large number of arbitrary steps that, although they could be reasonable, are not justified, and hence a compelling case is not made for why we should believe this scheme, either on its own merits or in comparison to previous attempts. In addition, the model output in terms of where planktic calcifiers are successful and abundant in the model ocean does not seem to agree particularly well with the real world situation or to be an obvious improvement over previous methods. Thus there is also no justification from model results suggesting that we should prefer this model formulation. Although a large

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amount of model development work has clearly taken place, I do not recommend this paper for publication in anything like its current form because it is not clear to me that it constitutes any advance in our understanding. I think the paper would need to contain either (1) justification from (new?) observations or experiments for the choices made in this model setup, and why these choices are better (more realistic) than the choices made in other models, and/or (2) justification from the improved quality (realism) of the model outputs as to why to prefer this scheme.

1712/L2: not so, coccolithophores are not particularly successful at low phosphate concentrations (Lessard et al, 2005).

1713/13: Diatoms, including mat-forming diatoms, are an important part of the shade flora.

1713/24: This gives a false impression; coccolithophores or planktic calcifiers have been included previously in several global scale models (whether or not they are fully coupled climate models), with varying degrees of success (Gregg & Casey; LeQuere et al., 2005; Moore et al., 2002).

1719/1720: several aspects of the representation of phytoplankton growth and competition are unconventional in this model, and are not fully explained or justified. For instance, it is of concern that an arbitrary factor is included in the growth equation of all phytoplankton groups. A tuneable iron half saturation constant, which is allocated a different value for each PFT, without any reference to values obtained in experiments, is tuned in order to obtain more satisfactory results,. This has the side-effect of reducing the value of any similarity that is obtained between results and reality, because it could all be down to tuning of this parameter rather than constituting evidence that the model representation as a whole is along the right lines. The representation of light limitation is also highly unusual and is neither explained nor justified, likewise the use of a new method (rather than the standard Q10) for the effects of temperature on growth. The effect of light scattering by coccoliths is highly complex and neither a derivation nor a

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reason is given for using this formulation. Taken together, this all gives an impression of an excess of arbitrariness in terms of model setup, and a lack of confidence that what is going on in the model bears relation to what is happening in reality.

To be fair to the authors, the underlying problem here is that there is just no solid basis on which to build such a model. Despite decades of efforts, the nature of the ecological niche is simply not well known, whether for coccolithophores, foraminifera or pteropods. Although several hypotheses have been advanced, there is no strong body of evidence behind any of them, and therefore no scientific consensus as to the mechanism which should underpin a model of this sort. This study falls foul of the problem of “trying to run before we can walk” (Anderson 2005).

Anderson, Thomas R. "Plankton functional type modelling: running before we can walk?." Journal of Plankton Research 27.11 (2005): 1073-1081.

Lessard EJ., A. Merico and T. Tyrrell. 2005. Nitrate: Phosphate Ratios and Emiliania huxleyi Blooms. Limnology and Oceanography, 50: 1020-1024.

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