

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

### **Anonymous Referee #2**

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### GENERAL COMMENTS

The manuscript by Kvale et al. describes in detail an attempt to better represent pelagic calcite production in the University of Victoria Earth System Climate Model through the inclusion of calcifying Plankton Functional Types (PFT) - specifically coccolithophores and Foraminifera. Considerable uncertainty remains over the ecophysiology of both of these plankton groups, including their biogeography, contribution to biogeochemical cycles, and fundamentally, the drivers of cellular calcification. Hence, attempting to represent them in Earth System Models is bound to be difficult and fraught with problems. Although the authors extensively state the rationale for their inclusion in biogeochemical models, what is not clear from the paper is whether this study represents a better representation than other modelling studies and what new insights are pro-

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vided by the inclusion of calcifying PFT in the UVic model. Does the model perform better than similar models?

Whether the authors succeed in better representing pelagic calcification in the Uvic model is unclear from either the abstract or conclusions of the paper - the abstract lacks any clear results to support the statement that "improvements to the representation of zooplankton calcification and carbon export therein" have been made. The modifications improve model performance with respect to carbon and nutrient fluxes, but with respect to what exactly - the model with/without calcifiers or the model compared to data or other similar models? As well as the abstract lacking any obvious quantification of the improvements that the model represents with regards to other models lacking explicit representation of pelagic calcifiers or compared with field data, the conclusion brings in further elements that complicate how calcifiers should be better represented in models. A revised paper needs clearer statements of the results and insights gained in both the abstract and conclusions.

On a more technical note, the authors must recognise that all of their coccolithophore parameterisations from the literature represent just one coccolithophore species, *Emiliana huxleyi*. Hence the true diversity of the PFT they are trying to represent is poorly examined or included in the model. Such a limitation needs to be thought about carefully when comparing model output to field observations (e.g., global coccolithophore biomass).

## SPECIFIC COMMENTS

Pg 1711, Lns 13-16: Balch et al. (2005) refers only to surface concentrations of calcite derived from satellite estimates, not production rates (ln 13!) or export fluxes (ln 16!).

Pg 1712, Lns 2-4: No evidence that coccolithophores as a PFT have any of these characteristics - they all refer to *Emiliana huxleyi*. Also the greater/enhanced/lesser susceptibility are relative to which other PFTs? Hence (pg 1714, ln 27) the new parameter values really reflect key physiological characteristics of *E. huxleyi* and not coccol-

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ithophores as a whole.

Pg 1716, In 18: What is the justification for a fixed production ratio of calcite relative to POC production. How well does this value fit with measured production ratios (and not export rain ratios)? How do the authors justify a shared CaCO<sub>3</sub>:POC production ratio for both coccolithophores and foraminera? Do these two groups have similar cellular levels of inorganic and organic carbon?

Pg 1719, In 22: Why are coccolithophores assigned a lower maximum growth rate than mixed phytoplankton - other than reading Le Quere et al., 2005, what is the justification - it would be useful here. What is the implication that in the end the Uvic model actually requires them to have similar growth rates to maintain a population (pg 1723, In 24-27)?

Pg 1727, Ins 25-27: How do Beaufort et al. (2011) show no significant correlation between calcification and coccolithophore biomass on a global scale? What evidence do they present for this?

Pg 1728-1729: What are the references to support the statement that coccolithophores only contribute 2% of NPP? What satellite and sample data are the authors referring to?

Pg 1731, Ins 17-21: Have the authors tested their assumption that inclusion of other PFT would improve the coccolithophore performance? Have the authors run a coccolithophore and diatom version?

Pg 1731, Ins 29: What is the influence of pH on calcification?

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Interactive comment on Geosci. Model Dev. Discuss., 7, 1709, 2014.

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