

Interactive comment on “Ideas and Perspectives: Climate-Relevant Marine Biologically-Driven Mechanisms in Earth System Models” by Inga Hense et al.

Anonymous Referee #2

Received and published: 16 August 2016

The manuscript is a very nice review of the state of ocean biogeochemistry as implemented in current Earth System Models. (ESMs). It proposes that to better account for climate relevant mechanisms arising from element cycling in the ocean, three mechanisms (carbon pumps, gas and particle transfer, biophysical) should be included, which ideally could be represented by five plankton functional types. The manuscript is clearly organized, well written and addresses the currently much debated topic of climate-carbon cycle feedbacks. It is therefore of interest to a large community of climate scientists.

The state of current knowledge of the individual mechanisms (carbon pumps, gas and particle transfer, biophysical) is well documented from the recent literature. However,

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to better convince the reader of the actual need to include more PFTs in ESMs, it would be nice to include a section on the sensitivities to the most common stressors (temperature, pH, oxygen).

Lines 79-81 state that marine calcifiers are needed as a functional group to correctly simulate alkalinity fields. This is a strong statement, which may need to be modified and/or explained in more detail. Model simulations including calcification as part of phytoplankton production have shown difficulties in accurate alkalinity representation, because of small biogeochemical effects compared to large circulation signals (e.g. Koeve et al. GMD 2014). Therefore, the expression 'correctly' is probably overstating what models are presently able to reproduce. Furthermore, the text reads as if one PFT would allow representing ocean calcification as a whole and (if at all) current models are including phytoplankton calcifiers based on coccolithophorids. However, the inclusion of aragonite producers (Gangstoe et al. BG 2008) showed that shallow calcite dissolution and thus alkalinity fields could be better simulated compared to pure consideration of coccolithophorids. Other calcifying organisms such as corals and foraminifera may play equally important roles in different ocean regions. Because of the very different organisms, probably contributing comparable amounts to global calcification, some more critical discussion if/how this could be solved by a single PFT would be desirable.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-289, 2016.

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