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

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We thank the reviewer for his/her constructive and helpful comments. Below, please find our point-by-point response (in blue color).

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

  We would like to stress that it is not our primary goal to include *more* PFTs but

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rather to account for those that are *most important* for the climate system. Concerning the sensitivity to climate stressors, we agree that this aspect is relevant and have thus decided to address it in a revised version of the manuscript.

- 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 shal- low 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.

  We fully agree that calcite and aragonite and the key organisms involved in the alkalinity dynamics need to be distinguished *if* the focus lies on the marine carbon cycle. Among the calcifiers, coccolithophores, however, are the most important group and mainly responsible for the vertical gradient in alkalinity. Other calcifying organism groups have been shown to be regionally important or are indeed assumed to be highly relevant for aragonite but only marginally for climate dynamics. From a climate perspective, the gain to represent calcifiers by more than one key group might be relatively small unless regional ESMs are applied; we

are not aware of any study showing the added value with respect to climate relevance. Most importantly, the vertical alkalinity gradient needs to be generated; the carbonate chemistry should be represented in ESMs. With one additional key group, the calcifiers, represented by coccolithophores these basic features of the alkalinity pump will be achieved. We will extend the discussion to clarify this issue in a revised version of the manuscript.

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