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Effects of varying complexity in the representation of marine biological processes in Earth System Models

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The role of marine biota in the climate system and specifically the relative importance of climate relevant biological processes is still not well understood. While the complexity of Earth system models with respect to marine biota has increased over the past years, the relative importance of biological processes in driving climate relevant mechanisms such as the biological pump and light absorption is still unclear. In particular, the effect of few versus many biological processes in ecosystem models on the global energy and heat budget has not been studied in detail. To shed light on the role of biologically mediated feedbacks, we use two different Earth System Model configurations: the simple biogeochemical model (BIOGEM) and the more complex ecosystem model (ECOGEM) are coupled to an Earth system model (cGENIE). Both ecosystem models represent the marine biological pump: the uptake of carbon and nutrients by phytoplankton is limited by light, temperature and nutrient availability. In the first model, the uptake is returned instantly to dissolved organic matter and dissolved inorganic nutrients in the ocean interior. The second model considers several physiological processes and biological interactions, such as photoacclimation, light attenuation, predation, prey assimilation, respiration and death. In addition, the light absorption feedback as a biogeophysical feedback mechanism is implemented in the more complex model configuration. Here, we present first results of the model comparison.