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Assessing the role of aggregate microstructure and composition for carbon fluxes in a global ocean carbon cycle model

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The ocean transfers carbon dioxide (CO_2) from the atmosphere to the sediment via the biological carbon pump which can have profound implications for the climate system. Carbon fluxes are strongly linked to primary production, the flocculation of phytoplankton cells in the euphotic zone and the subsequent processing by zooplankton and microbes. During these spatio-temporally variable processes, heterogeneous aggregates are formed and degraded that feature highly variable sinking speeds and are a vector for vertical carbon transport. In order to represent the resulting variable carbon fluxes and to project the future climate, a process-based parametrization of sinking velocity in Earth system models is desirable. We developed and implemented such a new parametrization in the global HAMburg Ocean Carbon Cycle model (HAMOCC) which explicitly represents the microstructure and composition of aggregates as both have a potentially significant impact on sinking speed and thus on vertical fluxes. The new parametrization is achieved within the Multi-scale Approach on the Role of Marine Aggregates (MARMA) project, where we address and parametrize aggregate-related small scale processes in the micro-to-millimeter range that potentially have wide implication for the global ocean and climate. It allows for an upscaling and incorporation of microscale processes in HAMOCC and an assessment of their relevance to the global carbon cycle. HAMOCC is coupled to the Max Planck Institute Ocean Model (MPIOM) and comprises the full inorganic carbon chemistry and features an extended representation of a phosphor-based NPZD (nutrients, phytoplankton, zooplankton, detritus) ecosystem model. In comparison to the former parametrization via the Martin curve, the new formulation for sinking velocity enables spatio-temporally variability and exerts an effective link to aggregate-size dependent microbial degradation and remineralization processes which likely affect the vertical carbon transfer. We will present an assessment of the effects of aggregate composition and microstucture on modeled spatio-temporal particulate organic matter fluxes.