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Modeling the ocean carbon cycle in the Paleocene-Eocene Thermal Maximum with an Earth System Model

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During the Paleocene-Eocene Thermal Maximum (PETM; ∼55 million years ago) the climate underwent significant changes which affected the atmosphere, ocean and land system. A massive carbon release caused an intense heating of ocean and atmosphere, proven by a negative δ13C-carbon isotope excursion and carbonate dissolution in the ocean. In terms of released carbon and concomitant changes in ocean carbon cycle, the PETM serves as the most adequate analogue for ongoing ocean acidification in Earth's history. However the dimension of the acidification during the PETM is still uncertain based on the ambiguous amount and time scale of the carbon release. We use the fully coupled Earth System Model of the Max Planck Institute for Meteorology (MPI-ESM) which includes ocean and atmospheric general circulation models (MPI-OM & ECHAM respectively) and models of ocean biogeochemistry (HAMOCC) and land vegetation (JSBACH). Such modeling system enables us to simulate the closed carbon cycle in the oceanic, land and atmospheric compartments. Moreover, by using a three-dimensional ESM we get a more detailed representation of the ocean biogeochemistry and the underlying physical processes. The model integrations display the onset of the PETM over several thousand years under different background climates. Within these experiments we focus on the the horizontal and vertical distributions and regional gradients of ocean carbon variables. As this study is still in its initial stage, first model results and modifications implemented in HAMOCC for application to the PETM will be presented.