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Dissolved organic carbon dynamics in a changing ocean: A COBALTv2 Earth System Model analysis

Lana Flanjak[1,2], Aaron Wienkers[1,2], and Charlotte Laufkötter[1,2]
[1]Climate and Environmental Physics, Physics Institute, University of Bern, Bern, Switzerland
[2]Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland

Dissolved organic carbon (DOC) is a substantial pool of bioreactive carbon in the ocean, comparable in quantity to the atmospheric inorganic carbon reservoir. DOC plays an important role in the marine carbon cycle; its contribution to total organic carbon export corresponds to about 20%. Current modeling studies suggest a broad range of DOC surface concentration estimates, and the response of DOC concentration and export to climate change is unclear and has not yet been described in an Earth System Model. To address this knowledge gap, we make use of the ocean biogeochemistry and ecosystem model COBALTv2. We analyze DOC dynamics and export under the present and future climate conditions within the high-emission scenario. The COBALTv2 model, coupled to the GFDL's ESM2M Earth System Model, enables us to trace DOC from its primary sources, including phytoplankton activity and grazer-prey dynamics, to its sinks such as bacterial remineralization. We also account for the physical processes such as advection that influences DOC distribution. Preliminary findings suggest that the current distribution of DOC in the ocean may undergo significant changes, contingent upon the biological sources and sinks that are sensitive to ocean temperature increases. The relative contributions of different phytoplankton groups to DOC production are expected to shift across various ocean regions, along with the magnitude of heterotrophic respiration, which is the predominant DOC sink. This study contributes to understanding and forecasting of potential shifts in oceanic DOC dynamics under current and future climate conditions.