

Modelling the response of the ocean carbon cycle to climate change: is DOM necessary?

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Two simple marine ecosystem models are compared; both are versions of the Hadley Centre Ocean Carbon Cycle (HadOCC) model. The first is a Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) model while the second also features Dissolved Organic Matter (DOM). Both models are based on nitrogen, and have related flows of carbon (and alkalinity) coupled by means of C:N ratios.

The models have been spun-up to (separate) near-equilibrium states, and the flows of nitrogen and carbon through the ecosystems have been calculated. The NPZD+DOM model shows slightly higher global primary production than the NPZD model, and the different pathways by which the nutrient is recycled are shown. In the NPZD+DOM model, some of the export of fixed carbon from the euphotic zone is in the form of DOM, while in the NPZD model that mechanism is not available, and the consequences for the magnitude of the sinking flux at various depth levels is examined.

Transient simulations have also been run using the two models, corresponding to the years 1855 to 2095. The atmospheric $p\text{CO}_2$ and the climatological forcings were varied according to observations and model projections as appropriate. The response of the two models to the atmospheric carbon and climate perturbations is found to be very similar. This implies that, for the purposes of modelling the response of the ocean carbon cycle to climate change, it is not necessary to represent dissolved organic matter explicitly.