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Excess carbon in an isopycnic ocean carbon cycle model

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A new isopycnic ocean carbon cycle model has been developed on the basis of the physical model MICOM and the ocean biogeochemistry model HAMOCC5.1. Isopycnic models represent the ocean as layers of constant density and thus mimic the interior structure of the ocean. This enables them to represent processes like tracer advection and diffusion without the spurious diapycnal mixing inherent in models that represent the ocean as layers of constant depth. Disadvantages of isopycnic models include the problem of massless layers and the need to add a mixed layer with varying density to handle the outcropping of the isopycnic layers at the surface and air-sea exchange processes. HAMOCC5.1 was designed for use with a z-level model and thus had to be adjusted for an isopycnic coordinate ocean model. This involved amending the sinking scheme to incorporate the transport of sinking particles through massless and thin layers. In addition, the euphotic zone is now redefined every timestep as layers change thickness. We also developed a method to constrain the effect of phytoplankton growth to the depth of the euphotic zone for mixed layers thicker than this. Biogeochemical tracers in the model are initialised from homogeneous conditions. While this makes a long spin-up necessary, it clearly identifies strengths and weaknesses of the model through its ability to reproduce the observed tracer distributions. Our spin-up run has been forced with climatological atmospheric data based on the NCEP Reanalyses and restored to observed surface salinities and temperatures to ensure a reasonably stable ocean circulation.

We will present results of the spin-up run for model evaluation and preliminary results from an experiment forced by CO2-emission data from 1860-2000 to identify the main storage areas for excess carbon in the model. Partial funding: EU FP7 Integrated Project CARBOOCEAN (Contract: 511176 GOCE)