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Penetration of Anthropogenic ^{12}C, ^{13}C and ^{14}C into the Ocean: An Ocean GCM Simulation

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Measurement and modeling of oceanic [ΣCO_2], $^{13}C/^{12}C$ and $^{14}C/^{12}C$ will serve to narrow uncertainties in predicted oceanic absorption of anthropogenic CO_2. Furthermore, the ability to predict and simulate the penetration of the fossil-fuel carbon and bomb ^{14}C into the oceans are potential tests of ocean general circulation and carbon cycle models. Such model results should be useful in helping to guide measurement efforts, so that measurements might be made where the signal is strongest.

We have developed an inorganic carbon cycle model that computes perturbations to steady-state concentrations of total inorganic ^{12}C, ^{13}C and ^{14}C. This model is based on a detailed calculation of the speciation of total dissolved inorganic carbon and the fractionation of carbon isotopes that occur during air-sea gas exchange. This model is coupled to a version of the GFDL ocean general circulation model that incorporates (1) a dynamic sea-ice model and (2) the Gent-McWilliams parameterization for the impact of isopycnal eddies on advection and diffusion in the ocean.

We will present results of our three-dimensional simulations of the penetration of anthropogenic carbon, and carbon isotopes, into the ocean, from pre-industrial times, through the bomb era, to the present. Our calculations will produce three-dimensional fields for the perturbation to ^{12}C, ^{13}C and ^{14}C concentrations as a function of time. Not only will this calculation be directly relevant to the estimation of oceanic CO_2 absorption, it will also shed light on the impact of ignoring fossil fuel carbon when doing bomb radiocarbon calculations.

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5. PS-06 CO2 in oceans

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7. none

8. no