Parametrizing Gas Exchange Velocity at the Air-Sea Interface in Global Circulation Models

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The primary goal of this study was to improve the parametrization of the gas exchange velocity (or piston velocity) in ocean general circulation models. The parameterization is necessary is order to represent the local gas exchange, an otherwise sub-grid scale process, in coarse resolution biogeochemical models. We tested different functional dependencies of the gas transfer velocity on the wind speed, and studied the sensitivity of tracer uptake to these relationships. We accomplished this by using a simple relationship between the gas flux and the product of the piston velocity and the difference in gas concentration across the air-sea interface. The second and third moment of the wind was obtained by using 6-hourly reanalysis 10 m wind data from the ECMWF ERA-40 product. The parameterizations were calibrated using the gridded distribution of natural radiocarbon (^{14}C), available from GLODAP. Using our parametrization on a 2.8 deg resolution MIT biogeochemical model, we obtained globally averaged piston velocities on the order of 10.05 cm/hr (second moment) and 8.55 cm/hr (third moment). Although these velocities are roughly half of those calculated by OCMIP (about 17 cm/hr), the velocity for the second moment is still within the range of those obtained by Sweeney et. al (2007) of 14.6+/- 4.7cm/hr. We are now evaluating these parameterizations in a higher resolution (1 deg) data-assimilated ocean model by comparing simulated CFC and radiocarbon fields against observations.