Global Ocean Carbon Uptake: Magnitude, Variability and Trends

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The anthropogenic global-integrated sea-air Carbon Dioxide (CO_2) flux from 1990 to 2009 are determined from models and data-based approaches as part of the Regional Carbon Cycle Assessment Project (RECCAP). Numerical methods include ocean inverse models, atmospheric inverse models, and ocean general circulation models with parameterized biogeochemistry Ocean Biogeochemical General Circulation Models (OBGCMs). The median value of different approaches shows good agreement in average uptake. The best estimate of anthropogenic CO_2 uptake for the time period based on a compilation of approaches is -2.0 Pg C yr^{-1}. The interannual variability in the sea-air flux is largely driven by large-scale climate re-organizations and is estimated at 0.2 Pg C yr^{-1} for the two decades with some systematic differences between approaches. The largest differences between approaches are seen in the trends. The trends range from -0.13 (Pg C yr^{-1}) $decade^{-1}$ to -0.50 (Pg C yr^{-1}) $decade^{-1}$ for the two decades. The OBGCMs and the data-based sea-air CO_2 flux estimates show appreciably smaller decadal trends than estimates based on changes in carbon inventory suggesting that methods capable of resolving shorter timescales are showing a slowing of the rate of ocean CO_2 uptake. RECCAP model output for five decades shows similar differences in trends between approaches.

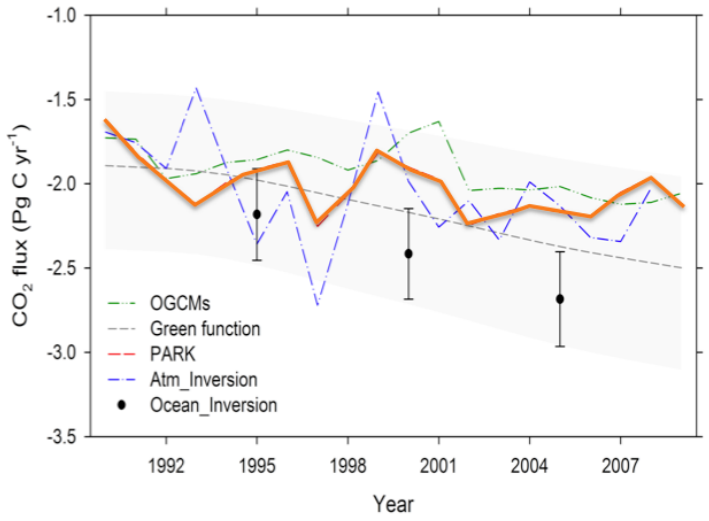

Figure 1. A 20-yr record of annual globally integrated sea–air CO_2 fluxes for the different modeling approaches. For the ocean biogeochemistry general circulation model (OBGCMs) and atmospheric inverses, the lines are plotted through the annual median values.