Empirical Estimates of Interannual Changes in Air-Sea CO_2 Fluxes

G. Park[1], R. Wanninkhof[1], S. Doney[2], T. Takahashi[3], R.A. Feely[4], C. Sabine[4] and K. Lee[5]

[1]NOAA Atlantic Oceanographic and Meteorological Laboratory, 4301 Rickenbacker Causeway, Miami, FL 33149; 305-361-4358, E-mail: Geun-Ha.Park@noaa.gov
[2]Woods Hole Oceanographic Institute, Woods Hole, MA 02543
[3]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964
[4]NOAA Pacific Marine Environment Laboratory, Seattle, WA 98115
[5]Pohang University of Science & Technology, Pohang, South Korea

The ocean is the primary long-term sink for taking up anthropogenic CO_2, on average, 1.5-2 Pg C per yr, or about 20-30% of the current annual release of anthropogenic CO_2. However, the oceanic uptake of CO_2 is highly variable in time and space, and the interannual variability is not well constrained. Here we present updated estimates of interannual variability, based on correlations of partial pressure of CO_2 in surface water (pCO_2SW) with temperature (Park et al., 2006), which yields a net uptake of 1.44 Pg C per yr. The interannual variability, expressed as a standard deviation, is ±0.12 Pg C per yr over the past 26 years (Figure 1). The results are based on the new climatology of Takahashi et al. (2009), updated algorithms between sea surface temperature (SST) and pCO_2SW in the Equatorial Pacific accounting for the temporal changes in the El Nino/Southern Oscillation (Feely et al., 2006), and new wind speed (6-hour National Center for Environmental Prediction/Department of Energy Reanalysis II) and Sea Surface Temperature (SST) (NOAA/Optimum Interpolation SST V2) records. The relationship of gas transfer velocities with wind has been adjusted to be consistent with the global uptake of bomb ^{14}C (Sweeney et al., 2007).

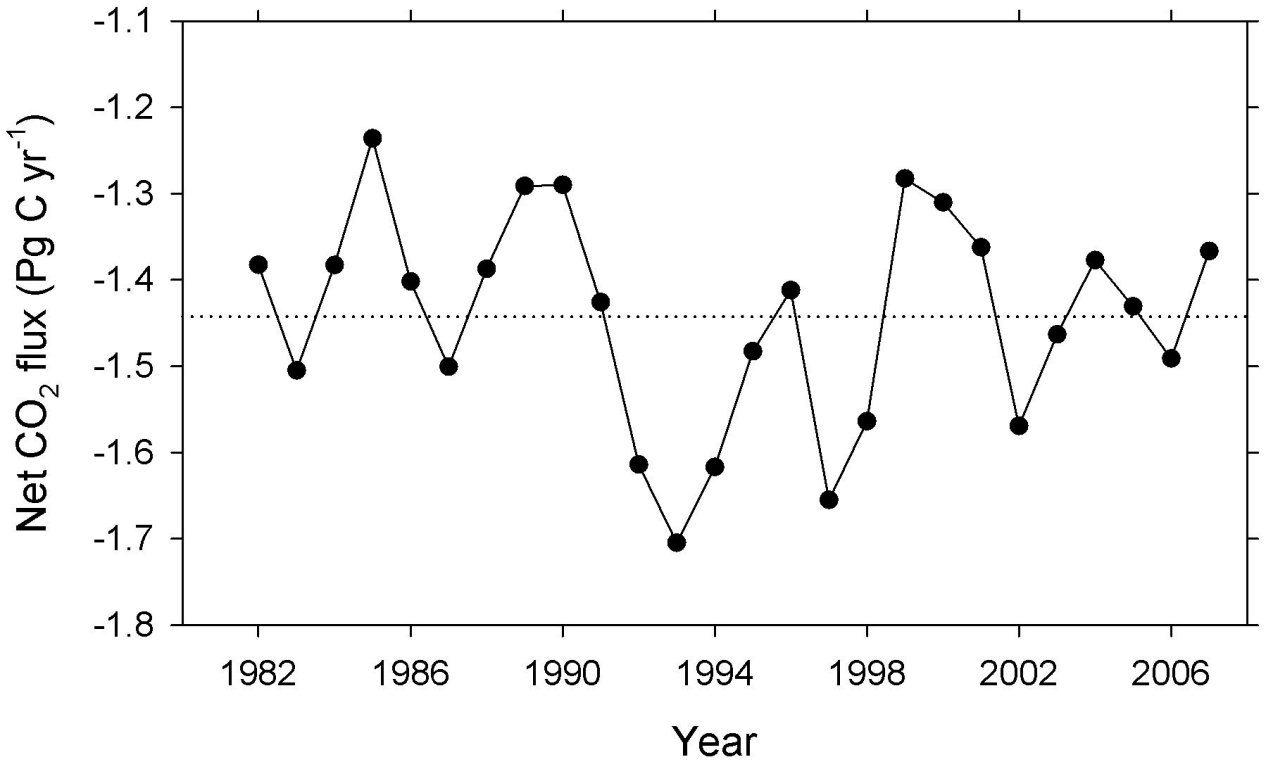

Figure 1. Interannual variability of air-sea CO_2 flux deduced from the empirical estimates based on SST. Negative values correspond to net oceanic CO_2 uptake.