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A C*-based Extended Multiple Linear Regression Method to Determine Decadal Changes in Anthropogenic CO_2 in the Ocean

Dominic Clement and Nicolas Gruber
Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Zurich, Switzerland

Major progress has been made by the international community (e.g., GO-SHIP, IOCCP, IMBER/SOLAS carbon working groups) in recent years by collecting and providing homogenized datasets for carbon and other biogeochemical variables in the surface ocean (SOCAT) and interior ocean (GLODAPv2). Together with previous efforts, this has enabled the community to develop methods to assess changes in the ocean carbon cycle through time. Of particular interest is the determination of the decadal change in the anthropogenic CO_2 inventory solely based on in-situ measurements from at least two time periods in the interior ocean. However, all such methods face the difficulty of a scarce dataset in both space and time, making the use of appropriate interpolation techniques in time and space a crucial element of any method. Here we present a new method based on the parameter C*, whose variations reflect the total change in dissolved inorganic carbon (DIC) driven by the exchange of CO_2 across the air-sea interface. We apply the extended Multiple Linear Regression method (Friis et al., 2005) on C* in order (1) to calculate the change in anthropogenic CO_2 from the original DIC/C* measurements, and (2) to interpolate the result onto a spatial grid using other biogeochemical variables (T,S,AOU, etc.). These calculations are made on isopycnal slabs across whole ocean basins. In combination with the transient steady state assumption (Tanhua et al., 2007) providing a temporal correction factor, we address the spatial and temporal interpolation challenges. Using synthetic data from a hindcast simulation with a global ocean biogeochemistry model (NCAR-CCSM with BEC), we tested the method for robustness and accuracy in determining ΔC_{ant}. We will present data-based results for all ocean basins, with the most recent estimate of an global uptake of 32±6 Pg C between 1994 and 2007, indicating an uptake rate 2.5±0.5 Pg C yr^{-1} for this time period. These results are compared with regional and global estimates from other methods interpreting the same dataset.