The continued accumulation of anthropogenic carbon in the global ocean during the 2010s

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Surface ocean pCO_2-based estimates and models indicate that the ocean sink for anthropogenic CO_2 (C_{ant}) has continued to increase unabatedly over the past decade. However, the most recent global and observation-based estimate of the accumulation of C_{ant} in the ocean interior by Gruber et al. (2019) does not extend beyond 2007, preventing an independent assessment of this increase in the magnitude of the sink.

Here, we exploit about 50,000 additional observations of dissolved inorganic carbon (DIC) and other relevant biogeochemical parameters, to extend the Gruber et al. analysis based on the eMLR(C*) method to the 2010s. These data were collected from all major ocean basins over the past decade by GO-SHIP and associated programs, and assembled through GLODAPv2.2020 into an internally consistent data product. We refine the eMLR(C*) method in three ways to achieve the updated storage estimates: (1) the uncertainty assessment is improved, based on a coupled analysis of observations and synthetic data generated from an ocean biogeochemical model, (2) the robustness of the multiple linear regression models is increased, using more stringent predictor and model selection procedures, and (3) the mapping of the C_{ant} fields relies on a MLR ensemble approach that takes into account co-occurring temporal changes of the predictor variables salinity, temperature and oxygen.

Initial results show that the ocean has continued to act as a strong C_{ant} sink with an average uptake rate of 2.8 ± 0.3 Pg C yr^{-1} between the reference years 2007 and 2015. This represents a small increase in rate compared to 2.6 ± 0.3 Pg C yr^{-1} determined for the 1994 through 2007 period. This increase is slightly smaller than expected on the basis of the growth of atmospheric

CO_2 over the period, but associated uncertainties are too large to make a conclusive statement about whether the ocean carbon sink is slowing down. Initial analyses of the synthetic data indicate that variable ocean circulation and limited sampling, especially the small number of cruises in the Indian Ocean, represent the biggest sources of uncertainty for the eMLR(C*)-based estimate. However, our preliminary sink estimate is in good agreement with recent air-sea CO_2 flux-based uptake estimates, based on an ensemble of surface pCO_2 interpolation techniques once these fluxes are adjusted for the river carbon input driven outgassing of natural CO_2.