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Anthropogenic CO_2 estimates in the Southern Ocean: storage partitioning in the different water masses.

P.C. Pardo (1), F.F. Pérez (1), A. Velo (1), S, Khatiwala (2), and A.F. Ríos (1)

(1) Instituto de Investigaciones Marinas, Vigo, Spain (pconde@iim.csic.es), (2) Lamont Doherty Earth Observatory, Columbia University, Palisades, NY, USA

One of the key issues in understanding the global carbon cycle and predicting future climate change is determining the role of the Southern Ocean (SO). Approximately, more than one third of the global anthropogenic CO_2 (CANT) uptake occurs in the SO (18% of the global ocean area), where the coldest source waters involved in the meridional counterclockwise overturning circulation are formed. Nevertheless, the distributions of CANT in the SO obtained from models and data-based methods present huge differences. Little storage of CANT has usually been associated with Antarctic Bottom Water (AABW) which is in contradiction with significant concentrations of CFCs observed along the continental slope and in Antarctic deep and bottom waters. The lack of accurate ocean carbon measurements could be the cause for hampering more exact CANT estimates. Besides, there is compelling evidence that sinking and ventilation in the SO is not only associated to the AABW but also to various less dense Antarctic waters located at intermediate and deep levels of the water column. In this study, data south of 45º S were chosen from GLODAP (http://cdiac.ornl.gov/oceans/glodap/Glodap_home.htm) and CARINA (http://store.pangaea.de/Projects/CARBOOCEAN/carina/index.htm) project databases (n=82792) in order to estimate CANT through different data-based methods. These methods go from the classical back-calculation methods (ΔC* and improved new ones taking into account the variability in the CO_2 air-sea disequilibrium term) to TTD and TROCA methods. Results from an eOMP together with a volumetric census of the water masses within the SO serve as base for partitioning CANT storages in the more representative water masses of the SO. Thus, South Mode Water and Antarctic Intermediate Water account for the CANT storage in intermediate layers while North Atlantic Deep Waters and Circumpolar Deep Water are responsible for injecting CANT at deep layers. The contributions of AABW and Shelf Waters to the CANT uptake and redistribution were also taken into account.