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An assessment of CO_2 storage and sea-air fluxes for the Atlantic Ocean and Mediterranean Sea between 1985 and 2018

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The dynamic and thermohaline characteristics of the Atlantic Ocean linked to the Atlantic Meridional Overturning Circulation (AMOC) give it a specific role in the accumulation of heat and CO_2, either of natural or anthropogenic origin (Cant), from the surface layer to the deep waters, significantly mitigating the impacts of anthropogenic climate change. Here, we evaluate the annual mean, long-term trends, seasonal cycle and interannual variability of net sea-air CO_2 fluxes (FCO_2) between 1985 and 2018 based on observation products (pCO_2-products) and global ocean biogeochemical models (GOBMs) for the Atlantic from 30ºS to the Nordic Seas (~79ºN) and the Mediterranean. The mean contemporary FCO_2 (sum of anthropogenic and natural components) is estimated to be 0.362 ± 0.067 and 0.47 ± 0.15 Pg C yr^{-1} using pCO_2-products and GOBMs, respectively. The GOBMs show consistent growth trends in CO_2 uptake with rates similar to the atmospheric CO_2 growth, however trends obtained from CO_2-products show a sharp increase from the pre-2000 period to the post-2000 period. There is overall agreement between pCO_2-products and GOBMs results for mean values, seasonal cycle and interannual variability in all biomes, except for the North Atlantic subpolar biome, where pCO_2-products show lower mean values, larger trends, and a different seasonal cycle than GOBMs. The GOBMs and pCO_2-products show very concordant values in equatorial and subtropical regions, where CO_2 variability is strongly determined by temperature. For the period 1994-2007, GOBMs show concordant values in annual Cant storage rate with carbonate marine system observations (Gruber et al., 2019) with values of 0.506 ± 0.106 Pg C yr^{-1} vs 0.673 ± 0.066 Pg C yr^{-1}, respectively. The Cant storage rate agreement between GOBMs and observations are also registered in the different biomes, although in both permanently stratified subtropical in North and South Atlantic biomes, the storage rates in GOBMs show a larger spread with their mean values 30 and 40% lower than those estimated from observations. In general, the Atlantic accumulates more Cant than that inferred from the cumulative FCO_2 changes, partly due to a significant lateral Cant transport from the Southern Ocean (about 30%).