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Anthropogenic impacts on carbon uptake variability in the subtropical North Atlantic: 1992-2010

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Since 1860, anthropogenic emissions have increased atmospheric CO_2 by more than 120ppm. The global ocean has lessened the accompanying climate impacts, taking up $\sim$33% of the emitted CO_2, with the highest storage per unit area occurring in the North Atlantic. To investigate carbon uptake and storage in the subtropical North Atlantic, we compare three estimates of anthropogenic CO_2 (Cant) with dissolved inorganic carbon (DIC) observations. We use data from a repeat (1992-2010) subtropical transect, where we find an average DIC increase of 1.06 μmol/(kg yr). We separate the observed DIC into five components: preindustrial, dissolved hard-tissue, regenerated soft-tissue, Cant, and surface air-sea disequilibrium. Among them, Cant increases approximately linearly over time (0.39-0.62 μmol/(kg yr), depending on the method adopted), contributing to the total DIC rise. Simultaneously, we observe a biologically driven increase (0.38 μmol/(kg yr)) in carbon from regenerated soft-tissue. We link this variation to the possible ongoing Atlantic meridional overturning circulation slow-down (2009-2010) and the associated strengthening of the biological pump. We expand our analysis by assessing outputs from an Earth system model between 1860 and 2100. In the preindustrial control (i.e. with no influence of anthropogenic CO_2), we found a predominance of the biological pump in overall carbon uptake, while the industrial simulation leads to a comparable influence of the biological and physical pumps. We conclude that anthropogenic perturbation of the natural long-term variability in oceanic ventilation could affect the remineralized pool of carbon in the subtropical North Atlantic, potentially making it a higher sink for carbon than previously thought.