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# The global coastal ocean: trends and variability in air-sea $CO_2$ fluxes

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The coarse spatial resolution of typical global ocean models is inadequate to study the coastal ocean. But state-of-the-art global ocean models have seen tremendous improvements in resolution in the last 10 years. Those new high-resolution models are now beginning to be coupled with biogeochemical models to study the carbon cycle, an effort that allows us to begin to assess the exceptional nature of the coastal ocean, at the global scale. As a first step to gauge how the ocean biogeochemical and global circulation model NEMO-PISCES represents air-sea $CO_2$ fluxes in the coastal ocean, we compared observed to simulated fluxes at 1/2° global resolution. Simulated fluxes in polar regions, upwelling zones, and areas influenced by estuaries have phasing delays of up to 1-3 months and seasonal amplitudes that are underestimated by up to a factor of two. The air-sea $CO_2$ flux is driven by the difference between atmospheric and oceanic $pCO_2$, with variability in the latter mainly responsible for flux variability. In order to determine the drivers of oceanic $pCO_2$ variability, the signal has been decomposed into contributions from changes in dissolved inorganic carbon, total alkalinity, temperature, and salinity. In the high latitudes, seasonal variability in surface ocean $pCO_2$ is driven mainly by variability in dissolved inorganic carbon whereas in low latitudes it is driven by temperature variations. Variability in total alkalinity also plays a role in regions influenced by estuaries. According to our model, the global coastal ocean (regions where depth $<$ 500 m) absorbs 0.35 Pg C $yr^{-1}$ of total carbon (natural + anthropogenic) during the 1998-2007, similar to previous estimates. Globally our model took up 2.34 Pg C $yr^{-1}$ of anthropogenic carbon during the 1998-2007, consistent with previous estimates. Yet only 6% of that (0.14 Pg C $yr^{-1}$) is absorbed by the global coastal ocean, i.e., less than its 9% proportion of the global ocean surface area. The same analysis is being carried out with a 1/4° version of the same model.