Air-sea CO_2 fluxes in the global coastal ocean: Simulated trends and anthropogenic uptake

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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 the air-sea CO_2 flux (FCO_2) in the coastal ocean, we compared observed to simulated estimates of FCO_2 at ½ degree global resolution. The sampling of model results is performed using a global segmentation of the coastal ocean. To evaluate the mean state of the global coastal FCO_2, we use observation-based FCO_2 estimations from coastal CO_2 measurements following the global segmentation. According to our model, the global coastal ocean absorbed 0.26 Pg C yr^{-1} +/- 6% (-0.86 mol C m^{-2} yr^{-1}) of total carbon (natural + anthropogenic) during the 1993-2012, similar to previous estimates. At the global scale, the anthropogenic carbon sink is 2.5 Pg C yr^{-1} during the 2003-2012, consistent with previous estimates. Yet only 4.5% of that (0.1 Pg C yr^{-1} +/- 10%) is absorbed by the global coastal ocean, i.e. less than the expected 7.5% due to the proportion of the global ocean surface area. A comparative study is performed using similar configurations at 2 degree and ¼ degree global resolution.