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Regulation of carbon and oxygen air-sea fluxes in a medium-resolution ocean GCM

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While the air-sea fluxes of biogeochemically significant elements such as carbon and oxygen are affected largely by local ocean processes such as heat fluxes and biological production, these processes themselves are varied across the world ocean by predominantly physical processes operating over a range of spatial and temporal scales. The interactions between ocean physics, biogeochemistry and these air-sea fluxes are examined here in a state-of-the-art, medium-resolution (1 degree x 1 degree) ocean GCM, OCCAM. The biogeochemical cycles of carbon and oxygen (and alkalinity) have been coupled to an existing nitrogen model of the surface plankton ecosystem (ZPNDAmm), and the resulting model has been simulated under historical surface forcing. Comparisons are made with observational estimates of the fluxes of these gases, with particular focus on modelled small-scale spatial variability. The seasonal and inter-annual behaviour of the air-sea fluxes, and their patterns and modes of variability are also examined. The significance of this analysis for observational work, particularly in the context of the ongoing anthropogenic perturbation of CO2, is discussed.