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Climate change simulations using the two NASA-GISS climate models coupled to ocean biogeochemistry

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Results from twin control simulations of CO_2 gas exchange between the ocean and the atmosphere are presented here using the two NASA-GISS climate models, in which the same atmospheric component (modelE) is coupled to two different ocean models, the Russell ocean model and HYCOM. Both climate models are also coupled to the same ocean biogeochemistry module (NBOM) which estimates prognostic distributions for biotic and abiotic fields that influence the air-sea flux of CO_2. The two coupled models are spun-up to equilibrium first without ocean biogeochemistry and then with it. The model differences are mainly attributed to the different ocean model and in particular vertical processes such as mixing and vertical advection. The surface flux is shown to depend crucially in surface wind differences as well as the distributions of pCO_2 in the two models. HYCOM takes longer to reach equilibrium despite the fact that vertical mixing is lower and therefore should be bringing the mixed layer depth faster into equilibrium. The global meridional overturning circulation can explain much of the differences in the biological pump in the two models together with the differences in mixed layer depth which are responsible for different SST distributions in the two models and consequently different atmospheric feedbacks (in the wind, net heat and freshwater fluxes into the ocean).