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Southern Ocean windstress and atmospheric CO_2

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The interaction between the ocean's circulation, atmospheric winds and atmospheric CO_2 has been put forward as a major feedback to explain glacial-interglacial CO_2-cycles (Toggweiler et al., Paleoceanography, 2006). The hypothesis assumes a reduction in Southern Ocean ventilation as a consequence of equatorward shifted westerlies during glacial periods. This would lead to an accumulation of respired CO_2 in the deep ocean and a drawdown of atmospheric CO_2.
In this study we use the Bern3D ocean-biogeochemistry model to test this hypothesis. The ocean component of the model is forced with monthly climatologies of temperature and salinity as well as an analytical profile for annual mean zonal windstress. The biogeochemical model component represents cycling of DIC, DOC, phosphate, alkalinity, oxygen, iron, and silicate. Primary production is controlled through availability of phosphate, iron and sunlight. Production of biogenic shells is computed using a competitive scheme favouring opal-shell producers over calcifiers.
A set of sensitivity experiments with systematically varied position and strength of the maxima in the windstress profile is carried out. Different values for mixing and transport parameters of the ocean model were chosen in order to examine the robustness of the model response. Resulting changes in atmospheric CO_2 as well as relevant physical and biogeochemical mechanisms are discussed.

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