ON THE IMPORTANCE OF SOUTHERN OCEAN CIRCULATION CHANGES INDUCED BY WIND AND SEA ICE ON GLACIAL pCO_2

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ABSTRACT

A significant influence of changes in the westerly winds over the Southern Ocean was proposed as a mechanism to explain a large portion of the glacial atmospheric pCO_2 drawdown [*Toggweiler et al.,* 2006]. However, additional modelling studies do not confirm the size and even the sign of the impact of southern hemispheric winds on the glacial pCO_2 as suggested by Toggweiler [*Menviel et al.,* 2008*; Tschumi et al.,* 2008]. We here add to this discussion and explore the potential contribution of changes in the latitudinal position of the winds on Southern Ocean physics and the carbon cycle by using a state-of-the-art ocean general circulation model (MITgcm) in a spatial resolution increasing in the Southern Ocean (2° longitude; northern hemisphere: 2° latitude; southern hemisphere: $2°\cos(\alpha)$). We discuss how the change in carbon cycling is related to the upwelling strength and pattern in the Southern Ocean and how they depend on the changing wind fields and/or the sea ice coverage.

METHODS

We here used the MITgcm [*Marshall et al.,* 1997] with either a simple sea ice module (fixed sea ice distribution) or a fully dynamic-thermodynamic sea ice module. The carbon cycle was modelled in a way similar to the Ocean Carbon Model Intercomparison Project, Phase II; however export production is not modelled by restoring to a prescribed observed phosphate distribution, but with a dependency of export on phosphate concentration. The carbon module is the present version of the MITgcm DIC package [*Dutkiewicz et al.,* 2005].

Under glacial boundary conditions (GLAMAP SST and SSS [taken from *Paul and Schäfer-Neth,* 2003]) (a) the direct effect of a northwards shift (by 10°) in the westerly wind belt and (b) via its influence on sea ice coverage on ocean physics and the carbon cycle is investigated.

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