



Climate and marine carbon cycle response to changes in the strength of the southern hemispheric westerlies

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It has been previously suggested that changes in the strength and position of the southern hemisphere westerlies could be a key contributor to glacial-interglacial atmospheric CO₂ variations. To test this hypothesis, we perform a series of sensitivity experiments using an earth system of intermediate complexity. A strengthening of the climatological mean winds over the Southern Ocean induces stronger upwelling and enhances the formation of Antarctic Bottom Water. Enhanced Ekman pumping brings Dissolved Inorganic Carbon (DIC)-rich waters to the surface, leading to a reduction of the mean CO₂ uptake in the Southern Ocean. However, enhanced upwelling also supplies more nutrients to the surface, thereby enhancing marine export production in the southern hemisphere and decreasing the atmospheric CO₂ concentration. The net response is small (~5 ppmv) compared to the full glacial-interglacial CO₂ amplitude of ~90 ppmv.