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Decadal variability of oceanic pCO2 observed in the Southern Ocean: contrasting trends before and after 2000.

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The decadal variability in surface ocean CO2 (pCO2) for the Southern Ocean has been estimated from seasonal observations between 1991-2007 in the Indian Ocean sector (Metzl, 2009) and winter circumpolar observations between 1986-2007 (Takahashi et al 2009). The results demonstrate that the oceanic pCO2 growth (2.1 $\pm$ 0.6 μatm/yr) was always greater or equal to the atmospheric growth rate (c.a. 1.7 μatm/yr) over the same period. The observed trend in oceanic CO2 is consistent with the positive phase of the Southern Annular Mode (SAM), in which enhanced ventilation of carbon rich deep water reduces the difference between the ocean and atmosphere (DpCO2) and hence reduces ocean CO2 uptake.
The SAM index shows a strong positive trend between 1980-1999, and only a very weak trend between 2000-2007. To explore the response of ocean pCO2 we use seasonal oceanic pCO2 measurements in the region 40°S-62°S (database of Takahashi et al, 2009) and find that the trend of surface ocean CO2 demonstrates a significantly different response before and after 2000; 2.3 μatm/yr over 1993-1999 and 1.3 μatm/yr in 2000-2007. Ocean process, such as the change in the ventilation of carbon rich deepwater driven by the SAM, likely dominates the trend in each period. The response of air-sea CO2 fluxes and solubility play only a minor role in modulating these trends.

References:

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