

Response of sea surface fugacity of CO₂ to the Southern Annular Mode (SAM) shift south of Tasmania

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Using observational data collected south of Tasmania during 14 austral summer cruises during 1993-2011, we examined the response of sea surface fugacity of carbon dioxide ($f\text{CO}_2$) to the Southern Annular Mode (SAM) shift, which occurred around 2000. In the southern part of the Southern Ocean (SO) or the Polar Zone (PZ) and the Polar Frontal Zone (PFZ), $f\text{CO}_2$ increased faster at the sea surface than in the atmosphere before the SAM shift, but not after the shift. In the northern part of the SO or the Sub-Antarctic Zone (SAZ), however, surface $f\text{CO}_2$ increased faster than atmospheric $f\text{CO}_2$ both before and after the shift. The SAM shift had an important influence on the surface $f\text{CO}_2$ trend in the PZ and PFZ, but not in the SAZ, which we attribute to differences in regional oceanographic processes (upwelling vs. non-upwelling). The SAM shift may have reversed the negative trend of SO CO₂ uptake.

Keywords: Southern Ocean, Southern Annular Mode shift, Carbon cycling