Inter-annual variability of the carbon dioxide oceanic sink south of Tasmania

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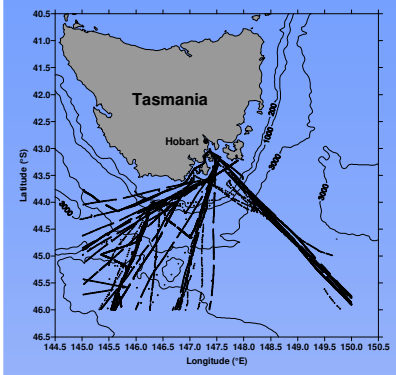
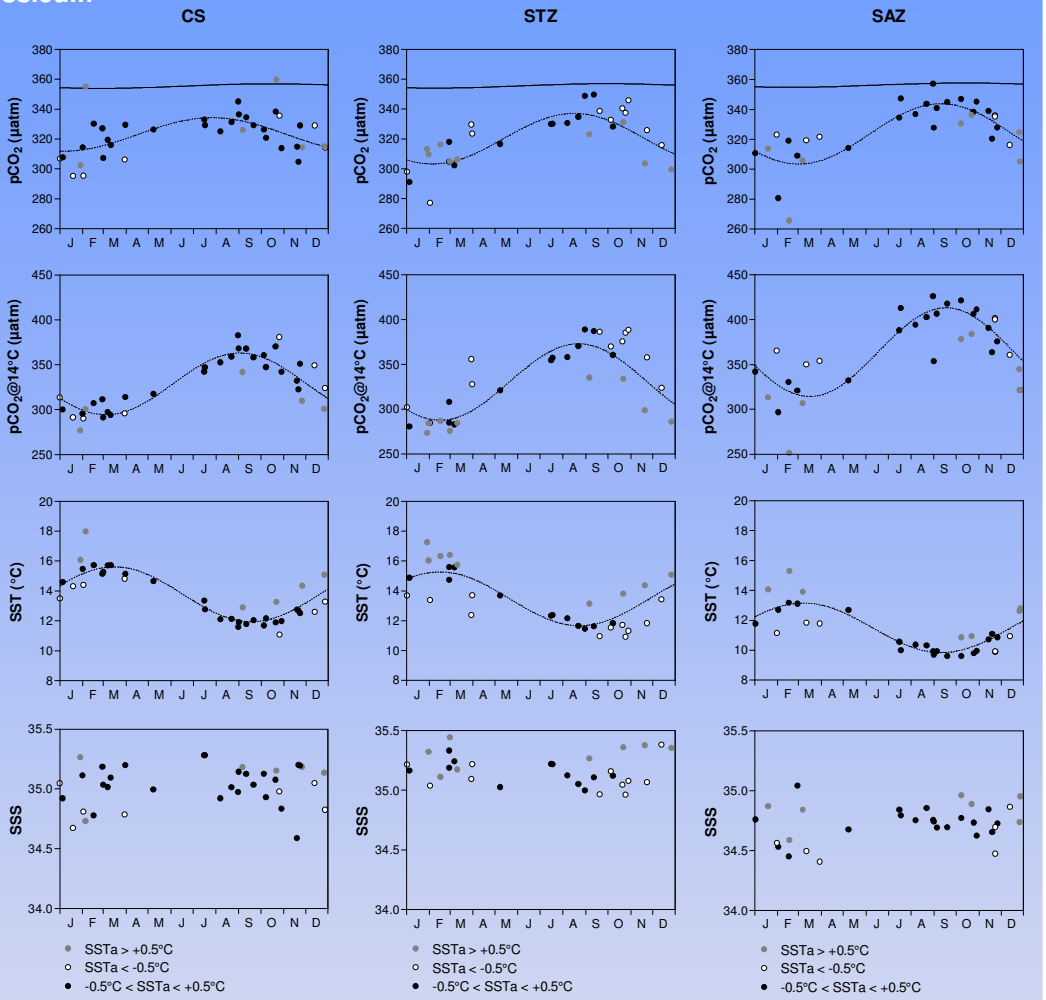
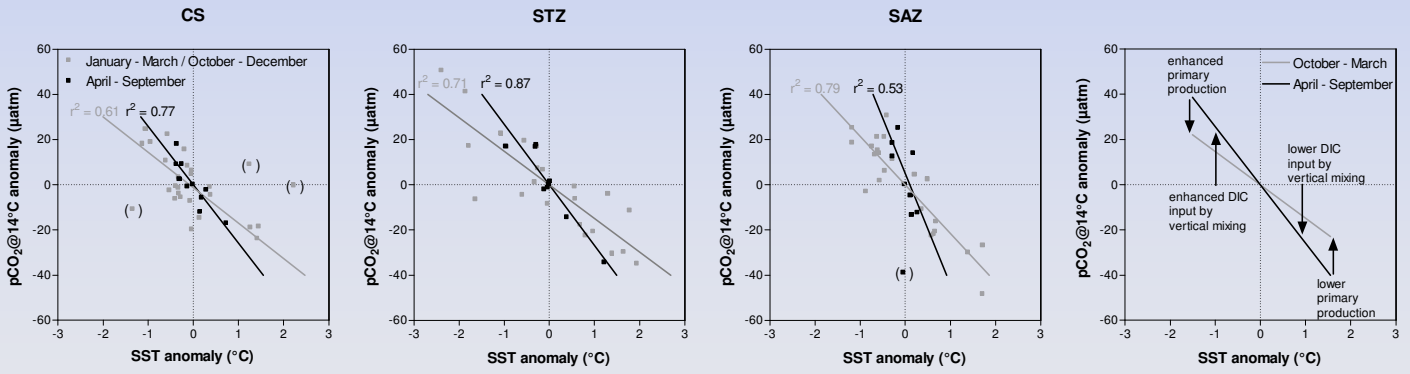


We compiled a large data-set from 22 cruises spanning from 1991 to 2003, of the partial pressure of CO_2 (pCO_2) in surface waters over the continental shelf (CS) and adjacent open ocean (43 to 46°S; 145 to 150°E) south of Tasmania. Monthly Sea surface temperature (SST) anomalies (as intense as 2°C) are apparent in the subtropical zone (STZ) and subantarctic zone (SAZ).





These SST anomalies also propagate on the CS, and seem to be related to large scale coupled atmosphere-ocean oscillations such as the Antarctic circumpolar wave (ACW) or the southern annular mode (SAM). Overall, anomalies of pCO_2 normalized to a constant temperature are negatively related to SST anomalies. This seems to be related to a depressed winter-time vertical input of dissolved inorganic carbon (DIC) during phases of positive SST anomalies, in relation to a poleward shift of westerly winds, and concomitant local decrease in wind stress. We also investigated the potential effect of SST anomalies on air-sea CO_2 exchange. The general trend is an increase of the sink for atmospheric CO_2 associated with positive SST anomalies, although strongly modulated by inter-annual variability of wind speed. Assuming that phases of positive SST anomalies are indicative of the future evolution of regional ocean biogeochemistry under global warming, we show using a purely observational based approach that some provinces of the Southern Ocean could provide a potential negative feedback on increasing atmospheric CO_2.

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