Southeast Pacific sea ice and ENSO co-variabilities

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The subantarctic region in the southeast Pacific Ocean is host to very high levels of atmospheric variability (e.g., Simmonds and Murray, 1999). A number of studies have explored the relationship between interannual variations in sea ice conditions in this region and measures of ENSO activity (e.g., Simmonds and Jacka 1995 (SJ), Yuan and Martinson 2000). SJ found that for the period 1973-1992 the Southern Oscillation Index (SOI) was significantly and positively correlated with late winter and spring sea ice extent in the sector 225 - 255^{o}E when the former led by up to 12 months (their Fig. 3c). We here update their analysis using more the more recent sea ice data in this sector obtained from the passive microwave sensors aboard the SMMR and SSM/I satellites, covering the period 1979-2000.

In the manner of SJ we present in the top panel of Fig. 1 the plot of the correlations (over 1979-2000) of the SOI and sea ice variabilities. These correlations with winter and spring sea ice exceed 0.4 when the SOI leads by up to eight months (and even longer in winter). (The synchronous correlations are quite modest.) The plot shows considerable similarity to that of SJ.

Cullather *et al*. (1996) showed that the association between the SOI and an aspect of the subantarctic circulation (between 180 and 240^{o}E) changed dramatically around 1990. We have performed correlation analyses similar to the above for the two 11-year periods which make up our total record (i.e., 1979-1989 and 1990-2000). The results are shown in the middle and bottom panels of Fig. 1. There are a number of common features in the plots, including the observation that late-year sea ice extent variations are positively correlated with mid year SOI. However, overall, the apparent associations between sea ice and the SOI are different in the two periods. In general the winter and spring sea ice variability shows only very modest associations with the SOI in the previous 12 months in the 1979-1989 interval. By contrast, the correlations are for the most part larger in the second half of the record, and winter sea ice extent is correlated with the SOI (coefficients exceeding 0.6) for leads of up to 12 months.

Cullather, R. I., D. H. Bromwich and M. L. VanWoert, 1996: Interannual variations in Antarctic precipitation related to El Niño Southern Oscillation. *J. Geophys. Res.,* **101,** 19109-19118.

Simmonds, I., and T. H. Jacka, 1995: Relationships between the interannual variability of Antarctic sea ice and the Southern Oscillation. *J. Climate,* **8,** 637-647.

Simmonds, I., and R. J. Murray, 1999: Southern extratropical cyclone behavior in ECMWF analyses during the FROST Special Observing Periods. *Wea. Forecasting,* **14,** 878-891.

Yuan, X. J., and D. G. Martinson, 2000: Antarctic sea ice extent variability and its global connectivity. *J. Climate,* **13,** 1697-1717.

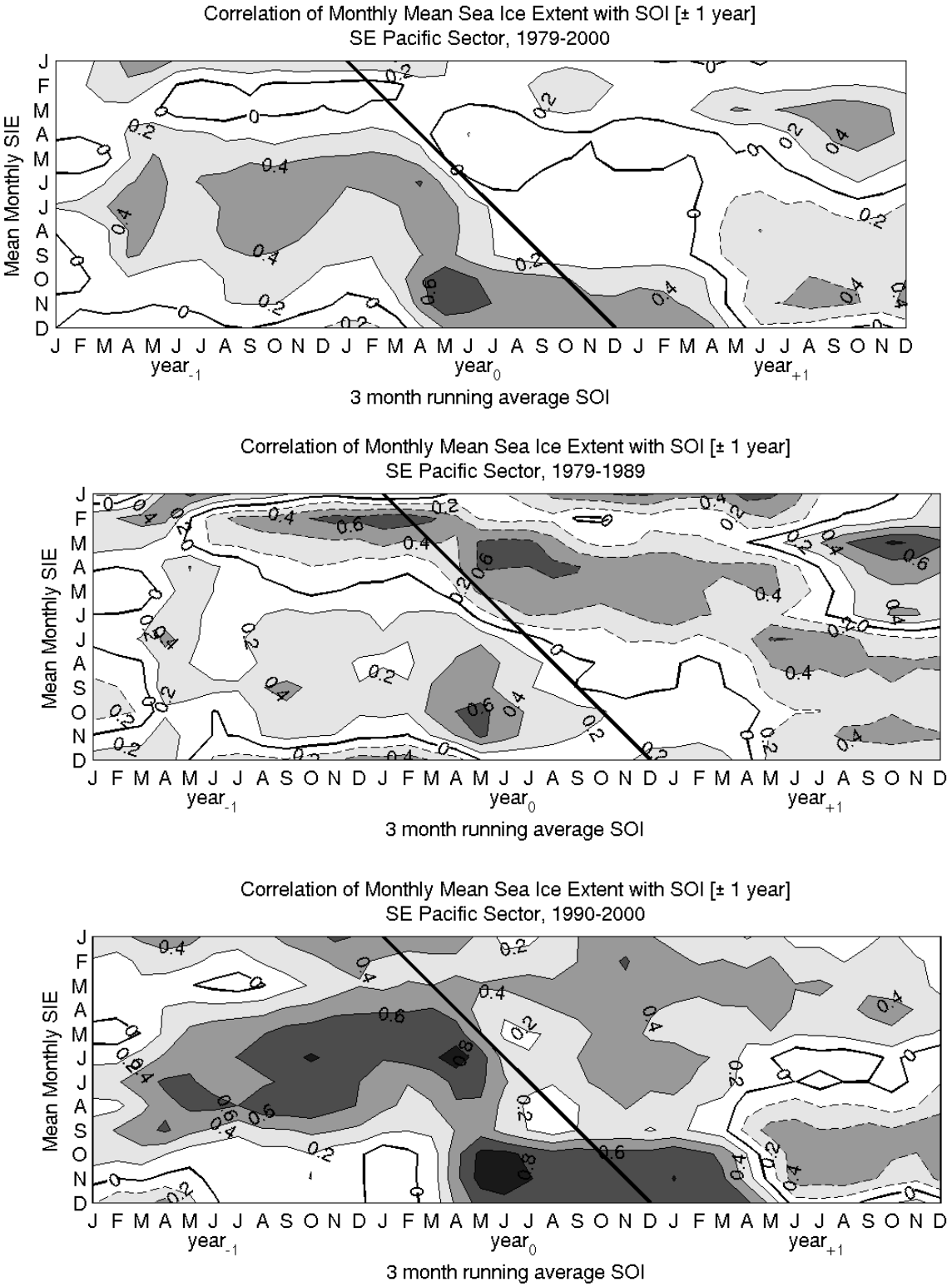

Figure 1: (top) Correlation (1979-2000) between the 3-month running average of the SOI and the Antarctic sea ice extent, averaged over the southeast Pacific Ocean (225 - 255^{o}E). The calendar months for the SOI are given on the abscissa, extending from the year before the sea ice data (SOI leads), the same year, to the year after (SOI lags). The contour interval is 0.2 and the bold diagonal line joins up points of synchronous correlation. (middle) As for 'top' but for 1979-1989. (bottom) As for 'top' but for 1990-2000.