Antarctic sea ice variability and high-latitude fluxes

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The Antarctic sea ice region has long been known to exert considerable influence on weather and climate in the high southern latitudes. One of the reasons for this influence is that the presence of sea ice dramatically impacts on the interaction between the atmosphere and surface, and particularly on the surface fluxes of momentum, moisture, and latent and sensible heat. These effects, in turn, influence the boundary layers in both the atmosphere and ocean. The area covered by Antarctic sea ice varies seasonally from a minimum of about 4×10^6 km^2 in February to a maximum of 19×10^6 km^2 in September this dramatic seasonality significantly modulates the nature of the interactions. Our group has an ongoing program exploring these interactions, particularly in the marginal ice zones (e.g., Watkins and Simmonds 1998, Simmonds 2003, White *et al.* 2004, Simmonds *et al.* 2005).

To undertake this analysis and modelling work we make use of the most recent SMMR (years 1978-1987) and SSM/I (1987-2000) GSFC Antarctic sea ice data set (Cavalieri *et al*. 1999). We here show the variability of the sea ice edge (defined to be the location of the 15% concentration contour (Parkinson 2004)). Figure 1 shows the longitudinal structure of the mean edge in December, March, June and September. There is a significant seasonal cycle, at virtually all longitudes, and hence the nature of the interaction of the atmospheric boundary layer and the surface will change dramatically over the course of the year.

Sea ice coverage also undergoes considerable interannual variability which, again, has considerable implications for exchanges across the boundary. To quantify this variability the Figure 2 shows the configuration of the maximum and minimum sea ice extents observed in the record for the four key months, along with the interannual standard deviations about the mean. In December significant variability is apparent in the western hemisphere and off Queen Maud Land. The edge retreats back almost to the Antarctic coast in March over most of the eastern hemisphere and hence little variability is displayed there, while significant variability is seen to the east of the Ross Sea and in the Weddell Sea. During the ice growth phase (e.g., June and September) there tends to be more longitudinal symmetry in the variability, with temporal standard deviations of typically 1 degree (111 km) or more.

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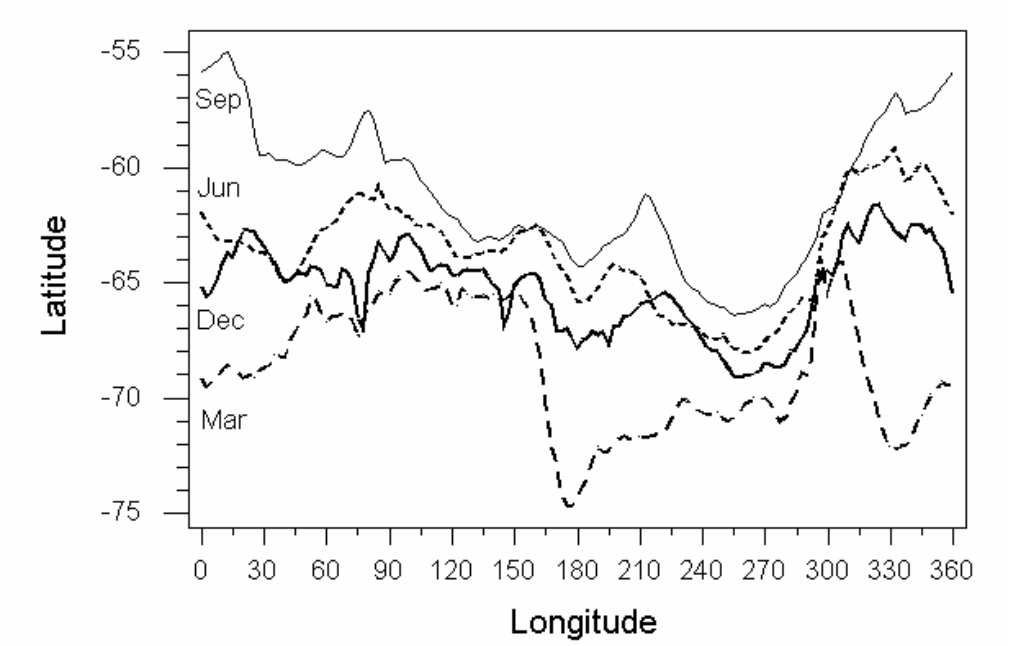

Figure 1: Mean latitude of sea ice edge as a function of longitude for December, March, June and September (1979-2000).

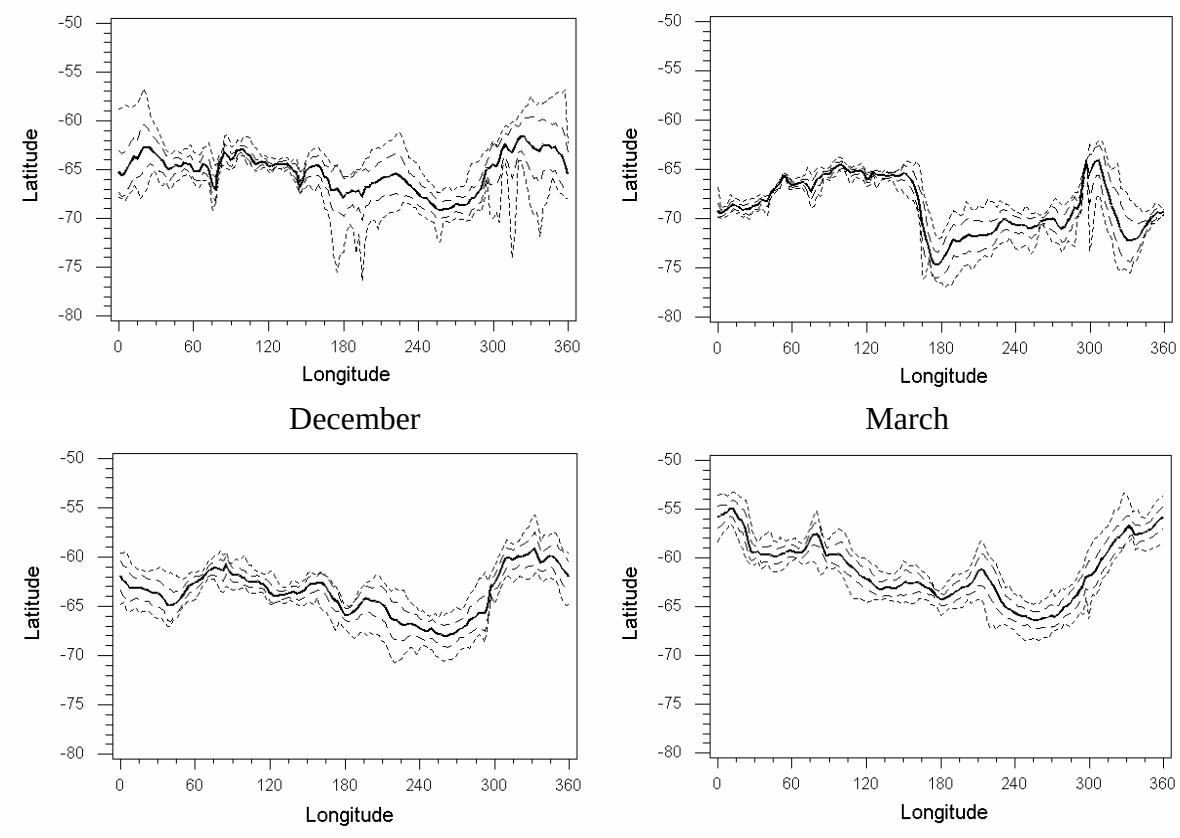

Figure 2: Mean latitude of sea ice edge (bold solid line) with maximum and minimum (short dashed lines) plus the standard deviation of the interannual variations (long dashed lines) in December, March, June and September.