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CONTROL OF THE ANTARCTIC ICE SHEET BY OCEAN-ICE INTERACTION

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We will discuss a simple grounded ice-sheet model in which the net oceanic evaporation influences the ice cap volume in two ways, through changes in: (i) the accumulation rate, and (ii) the mean sea level. The results are calibrated by comparing the predictions for forcing by the net evaporation changes derived from the sea surface temperature (SST) time series of Howard (1997), with sea level time series data. A set of analytical expressions will be presented for the related properties of the coupled ocean-ice system applicable over time scales of 100 kyr, which show in particular that the Antarctic ice cap volume changes are due mainly to the effects of the northern hemisphere ice sheets on sea level (which influences ice calving) rather than directly to changes in SST, and hence the ice cap volume is greatest during interglacial periods. This conclusion, which is independent of the specification of the melting regime for the northern hemisphere ice sheets, strongly suggests that the changes in accumulation flux estimated from the Vostok proxy temperature data have been overestimated. A simple expression will also be presented for the lag of the ice cap volume to SST, and it is found that the predictions for mean sea level variability are similar to observations for a melting flux of the northern hemisphere ice sheets about twice their accumulation flux due to the net oceanic evaporation, except possibly during major deglaciations when these two fluxes appear to be of similar magnitude.

Reference: Control of the Antarctic ice sheet by ocean-ice interaction. (in press) John Bye, Joel May and Ian Simmonds. Global and Planetary Change