WAIS collapse before GIS collapse! (~1 million years ago)

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Kawamura et al. (*Nature*, 448, 912-916, 2007) showed that "orbital-scale Antarctic climate change lags Northern Hemisphere insolation by a few millennia, and that the increases in Antarctic temperature and atmospheric carbon dioxide concentration during the last four terminations occurred within the rising phase of Northern Hemisphere summer insolation." However, recent studies of Antarctic records of Marine Isotope Stage 31 (MIS-31, 1.08 – 1.06 Ma ago), including Scherer et al. (GRL, L03505, 2008) and new results from ANDRILL – McMurdo Ice Shelf Project (AND-1B), show that Antarctic warming, RIS collapse, and WAIS retreat led NH interglacial warmth by ~7 ka. SH and subsequent NH warmth and ice sheet response coincided with unusually high precession-paced insolation peaks at both poles (1.079 and 1.072 Ma, respectively). During MIS-31, Southern Ocean and Antarctic surface waters were warmer than today with very limited sea ice, and probably warmer than that at any time in the last ca. 2.5 Ma.

Typical Pleistocene interglacials are characterized by a “sawtooth” pattern, reflecting stepwise ice sheet growth and rapid deglaciation. However, the benthic oxygen isotope record of MIS-31 includes a two-stepped rise (lightening) consistent with early WAIS collapse prior to the global $\delta^{18}O$ and eustatic peak.

This study shows a direct (and in phase) sensitivity of ice shelves and sensitive ice sheets to insolation forcing. The response seen in the geologic record has been simulated by the Pollard/DeConto coupled GCM/ice sheet model (Nature, in review). The remaining question is, what does this teach us about the sensitivity of the modern WAIS and GIS to ongoing warming driven by atmospheric CO_2, rather than insolation.