Climatic forcing of WAIS mass balance on glacial-interglacial and longer timescales

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The numerical modeling effort associated with the ANDRILL program is using a hierarchy of models to explore the climatic and glacial evolution of Antarctica on Cenozoic timescales. Modeling work over the past several years has concentrated on the development of a combined ice sheet-shelf model, the adaptation of a Regional Climate Model to the Antarctic region, GCM-ice sheet coupling, and the development of asynchronous coupling techniques allowing long time-continuous climate-ice sheet simulations on orbital and longer timescales. To complement recent findings by the ANDRILL field program, simulations to date have concentrated on the Plio-Pleistocene, and in particular on Marine Isotope Stage 31 (~1.07 Ma); a super-interglacial interval when the Ross Embayment appears to have been ice-free and WAIS was partially or completely collapsed. Here, we show results from GCM, RCM, and coupled AOGCM model simulations exploring the potential range of surface mass balance forcing and oceanic, sub-ice-shelf melt in response to MIS31 orbits and interglacial greenhouse gas concentrations. The climate model output is used to drive an ice sheet-shelf model and the results are compared with 5-myr time-continuous sheet-shelf simulations forced by parameterized climate and sub-ice melt deduced from orbital solutions and deep-sea-core $d^{18}O$. Our climate model results reinforce the conclusions of the parameterized 5-myr ice sheet-shelf simulations, and point to the overriding importance of sub-ice melt to Ross Ice Shelf and WAIS variability on these timescales. However, more explicit, high-resolution ocean modeling of West Antarctic embayments and continental shelf flow may be needed to directly address the potential impact of increasing ocean heat content in past and future scenarios of WAIS retreat.