Millennial versus orbital influences on ice marginal fluctuation: the southern signal

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Exposure ages on moraines in the southern hemisphere indicate that significant millennial-scale fluctuations of glaciers took place during the last deglaciation, not simply a steady retreat between the Last Glacial Maximum (LGM) and modern (Evans et al., 2005, Bentley et al., 2006, Lowe and Anderson, 2002). The millennial North Atlantic Deep Water (NADW) signal potentially had a large control on southern hemisphere deglaciation decoupled from the orbital deglaciation signal. We hypothesize that millennial-scale climate changes strongly influenced the ice sheets and glaciers of the southern hemisphere during the last deglaciation. Such advances would have created observable moraines around the southern high latitudes, yielding an interesting glacial chronology of the last termination.

In this study, we model southern hemisphere moraine deposition using a coupled ice-sediment model. The temperature forcing for the model was the Byrd ice core record (Sowers and Bender 1995), and Dome C ice core record (Jouzel et al., 2001) spanning the time period between LGM and modern. We decoupled the orbital deglacial signal and the millennial-scale signal using a high band-pass filter with cut-off at 10,000 years. We then applied the ice core records as the forcing to the glacier-sediment model while systematically varying the strength of the millennial scale signal.

Our results are examples of moraines deposited with varying degree of strength of Southern Hemisphere millennial-scale signals. These results can help us interpret deglacial history of the southern hemisphere based on exposure ages and the stratigraphic configuration of observed moraines on the Antarctic Peninsula and high latitudes of the Southern Hemisphere. There is evidence in Peninsula glacial deposits, and glacial moraines from the Southern Hemisphere that the last deglaciation was not necessarily the steady warming observed in EAIS ice cores.

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