Modeling of Antarctic ice sheet response to atmospheric and ocean warming and its relation to past and future warming

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At present, the Antarctic ice sheet is the largest land freshwater storage, whose volume and geometry change in response to climate changes and contribute to global sea-level rise. Volume and geometry changes are controlled by the surface and basal mass balance of the Antarctic ice sheet and ice dynamics. In order to explore these changes, there have been many studies using ice sheet models to investigate the Antarctic ice sheet response to atmospheric and ocean warming during past warm periods like the mid-Pliocene and in future warming scenarios.

In this study, we use the three-dimensional ice sheet model SICOPOLIS to investigate the steady states of the Antarctic ice sheet in response to changes in surface air temperature and basal melting rates. We start from the present-day ice sheet as initial condition, and focus on the thresholds of these forcing parameters, time scales and mechanisms of large ice loss, and ice sheet irreversibility. We also analyze PlioMIP2 (Chan and Abe-Ouchi, 2020) and RCP data from experiments using the MIROC4m model in the context of the above-mentioned sensitivity experiments to relate Antarctic ice sheet response to past and future warming. We applied PlioMIP2 climate fields to SICOPOLIS to investigate the steady states of Antarctic ice sheet response during the mid-Pliocene.

References

Chan, W.-L. and Abe-Ouchi, A.: Pliocene Model Intercomparison Project (PlioMIP2) simulations using the Model for Interdisciplinary Research on Climate (MIROC4m), Climate of the Past, 16, 1523-1545, 2020.