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Reversibility experiments of present-day Antarctic grounding lines: the long-term perspective

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The stability of the grounding lines of Antarctica is a fundamental question in glaciology, because current grounding lines are in some locations at the edge of large marine basins, and have been hypothesized to potentially undergo irreversible retreat in response to climate change. This could have global consequences and raise sea levels by several metres. However, their long-term reversibility for the current ice sheet geometry has not yet been questioned, i.e., if the present-day climatology is kept constant, will the grounding lines remain close to their currently observed position or will they retreat substantially?

Here we focus on the long-term evolution of Antarctic grounding lines over millennial time scales. Using the Parallel Ice Sheet Model, an initial equilibrium state is created for historic climate conditions around 1850. Then the model is run forward until 2015 with atmospheric and oceanic changes from ISMIP6 to reflect recent trends in the ice sheet. After 2015, we keep the present-day climatology constant and let the ice sheet evolve towards a new steady state, which takes several thousand years. An ensemble over model parameters related to sliding and ocean forcing allows us to analyse the sensitivity of the grounding line evolution to model uncertainties. Since we start from a historic equilibrium state, we can use this approach to assess if the increase from historic to present-day climatology might push Antarctic grounding lines across a tipping point into a different basin of attraction that is characterised by a substantially retreated steady-state grounding line position.

This work is part of the TiPACCs project and complements an overview presentation on the reversibility of present-day Antarctic grounding lines (EGU22-5176) as well as a presentation exploring the short-term reversibility experiments in more detail (EGU22-7802).