

The Cryosphere Discuss., referee comment RC2
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Review of Urruty et al.

Alexander Robinson (Referee)

Referee comment on "The stability of present-day Antarctic grounding lines – Part 1: No indication of marine ice sheet instability in the current geometry" by Emily A. Hill et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-104-RC2>, 2022

This study presents a comprehensive evaluation of the possibility for large-scale, internally driven retreat of present-day Antarctic grounding lines. Two different ice sheet models were spun-up to approximate a steady-state with the present-day geometry of Antarctica, while a third model was spun-up to approximate the ice sheet after transient historical forcing since 1850. Perturbation analysis was then used to determine whether a temporal increase in basal melting over 20 years could cause the ice sheet to undergo strong grounding-line retreat that would continue after the forcing was removed. In all experiments, the present-day geometry was found to be a stable configuration, in the sense that all major grounding lines essentially returned to their original position.

This study is very interesting, timely and well done. The experiments are designed to test a specific hypothesis, and the results are convincing. Furthermore, overall the authors do a good job of discussing the various caveats to their methods and using the complementary strengths of the different models and experimental setups to confirm their findings. Particularly, I think the value of the study comes across quite well in the discussion section.

In contrast to the first reviewer, I find no major impediments to publication. I do agree that some of the framing in the Introduction and Methods could be more precise, with a few comments noted below. But I would recommend publication after only minor revisions.

Specific comments

L46: Delete "In the future," as it doesn't seem to fit. Maybe instead add an "also" to become "have also shown potential"

L51: larger event => larger one

L52: marine basins => marine basins,

L57: "The aim of this paper is to determine if stable grounding-line positions exist in the current geometry of the ice sheet." <= Rephrase here. The current geometry has been stable for several thousand years now.

L63: "control parameter that satisfies the steady state condition" <= It should be a control variable that satisfies the steady-state condition, right? The perturbation is applied to a parameter and the control variable (e.g., grounding-line position) is allowed to evolve. Please revise.

L71-73: "The existence of such stable steady states is also strong indication that the currently observed retreat of Antarctic grounding lines is purely driven by changes in the external drivers such as oceanic forcing." <= It could also be an indication that the ice-sheet continues to evolve due to past climatic forcing, since as mentioned, in reality it is not in steady state. Consider adding some nuance here, which would flow better into the next paragraph which treats this point.

L74: ice sheet state => ice-sheet state

L100: set-ups => setups

L205: What is the motivation for this formula for error in grounding-line position? Add a sentence or two, as there could be many ways to define this error.

L287: 500 years => 480 years [right?]

L415: "The spin-up procedure..." <= Fragment, please revise.

L440: firstly => first

L536: committing => producing

