The Cryosphere Discussions

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Comment on tc-2022-105

Anonymous Referee #2

Referee comment on "The stability of present-day Antarctic grounding lines - Part B: Onset of irreversible retreat of Amundsen Sea glaciers under current climate on centennial timescales cannot be excluded" by Ronja Reese et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-105-RC2, 2022

Comments to Reese et al. (2022)

This study investigates the committed grounding line retreat due to MISI for the present-day climatic forcing. The MISI hypothesis states that the ice flux across the grounding line increases when the ice thickness increases and hence, when the grounding line retreats on a retrograde sloping bed, a positive feedback arises. The assessment of the grounding line retreat due to MISI is achieved by performing long-term runs (10,000 years) into the future. The reversibility is also tested by running the simulations for 20,000 years using a pre-industrial forcing.

The simulations use (optimized) melt rates from PICO and the historical climate forcing provided by ISMIP6 for the period 1850-2015 (the actual SMB forcing is only defined from 1950 onwards and is kept constant before). I believe it is an interesting study that looks at the slow equilibration time of the ice sheets and the long-term feedbacks involved with respect to the marine-based parts of the Antarctic ice sheet. Below you can find my suggestions to improve the manuscript.

Main comments:

The manuscript shows that the main regions where the model parameters give grounding line retreat are the Amundsen Sea Embayment, the Filchner-Ronne Ice Shelf and the Ross Ice Shelf (along Siple Coast). In contrast to the observations, thinning is also identified along the Ross Ice Shelf and the Filcher-Ronne Ice Shelf in the simulations for the reference state. How realistic is the committed grounding line retreat in these regions when there is already a bias for the present day?

The modelled thinning rates in the Amundsen Sea Sector are rather low for the present day. To test for biases in the ocean forcing, a constant temperature anomaly is added to all ice shelves around the Antarctic. The Filchner-Ronne Ice Shelf and the Ross Ice Shelf are somewhat more closed off from oceanic heat, while the Amundsen Sea region might experience higher oceanic warming to match the observed thinning rates. Could it be more appropriate to apply a spatially variable ocean temperature anomaly to better match the observed thinning rates?

Specific comments:

L29: It makes more sense to me to report the regional warming around/above the Antarctic continent than the global mean.

L50: This is confusing, it sounds as if you use the present-day climate forcing to test for reversibility of the grounding line retreat. I guess not because on L66 you say that you use pre-industrial climate forcing for the reversibility simulations. Could you rephrase to make clear that the forward experiments include the present-day forcing?

L306: Could you report the RMSE for ice thickness, ice-stream velocities, deviations in grounding and floating area and the differences between the ensemble members?

L317: What is the rationale to look 10,000 years into the future? And why do you double the simulation time for the reverse experiments? On L372 you report that the ice sheet states evolve to a new equilibrium, but GL's might not have fully converged to a steady-state after 10,000 years.

L347: The sentence 'This as well as the choice of the sliding law, has been found also in previous studies' looks incomplete.

L367: You report the model drift during the historical simulations, but what is the model drift during the next 10,000 years?

L379: The ensemble members indicating substantial grounding line retreat occur for more slippery bed conditions or higher oceanic temperatures. Hence making the model more sensitive increases the chances that the tipping point is reached. Low values for the till effective overburden fraction strongly enhance the grounding line retreat. Could you add a word on the likelihood for the model parameter choices made?

Figure 6: Put a box around the figures to increase clarity, maybe add names for the ice shelves to make it more clear for the reader what we are looking at.