Review of Century-scale impacts of ice-sheet model initialization on Amundsen Sea Embayment, West Antarctica, by Goldberg, Holland and Naughten.

General Comments

Realistic regional configurations coupled ocean – ice sheet models have emerged very recently, and this manuscript presents the first (as far as I know) multi-centennial projection of the Amundsen Sea Embayment with this kind of model and at a relatively high resolution. The authors demonstrate that, even after grounding line retreats past a bedrock obstacle into the deepest and widest parts of its catchment, the ice sheet evolution is not independent of forcing. This is a very interesting result despite the acknowledged caveat that the evolution of ice damage and calving is not represented. There are many very minor aspects to improve, but the overall manuscript is clear and scientifically robust. I therefore recommend this manuscript for publication in The Cryosphere.

Specific comments

Title: It is up to the authors, but "multi-centennial" would seem more in line with the projections from 2000 to ~2300 than "century-scale".

The abstract really focusses on Thwaites while the manuscript is more balanced between Pine Island, Thwaites and Smith. Please also summarize the results regarding Pine Island and Smith.

L. 22: you could add "and Pine Island ice shelf (Shean et al., 2019)" to make clear that this is not a specificity of Thwaites.

L. 29-32: I am not sure it is correct that "Naughten et al. (2023a) […] saw no significant difference in the level of warming between the RCP 8.5 scenario and one in which a 2°C warming target is met", at least not after 2045, as far as I can tell from their Fig. 3.

L. 40: a pure depth-dependent parameterization is not suitable for representing the melt dependency on the ice slope.

When you introduce equation (1) specify that it is used to process CESM2-WACCM. And equation (1) could be written with "(.)" instead of *T*, as in eq. (5), to avoid having another *T* of different meaning in section 2.3.

The coupled model is limited to the Amundsen Sea. Is it fair to assume that the evolution of the ice sheet in the Ross, Bellingshausen and Weddell sectors until 2300 won't impact the evolution of the ice sheet in the Amundsen Sea?

Throughout the manuscript, please refer to the model as CESM2-WACCM rather than CESM2. The two models exist and they differ at least in the vertical extent of the atmosphere and in the representation of atmospheric chemistry.

L. 118-119: please indicate here that the transition is a function of the water column thickness.

L. 124: please indicate the units for the exchange velocity γ_{T0}.

L. 135: “where is” -> where there is (?)

L. 146-147: I don’t understand why sea level rises when grounded ice is lost. What does “lost” mean here, and why does it increase the domain mean sea level?

L. 152: what is “DIVA”?

L. 155: “all of Smith” should be clarified here or somewhere else. As far as I can see from the plots, this seems to refer to Smith and Kohler glaciers and the corresponding ice shelves: Crosson and Dotson.

Section 2.2.1: please indicate which period this snapshot is representative of?

Fig. 4: in the caption, indicate which period is used to produce these plots.

L. 199: “van den Akker et al. (2026)” -> (van den Akker et al., 2026)

L. 250: “oecean”

L. 268-269: I am struggling to see how the text corresponds to Fig. 5f.

L. 271: please add a statement for Pine Island as well.

Fig. 6 does not have Y-axis labels or units. The threshold at y=0.75 should be either removed or described in the caption (if kept, then indicating y=0.25 would also make sense w.r.t. the text). And why not extending the Y-axis limits for panel (b), it does not matter is the range is not the same as in panel (a), and it is important to see how high this goes (e.g., a value of 10 means that climate forcing is an order of magnitude more important).

L. 283-284: “For Smith, the ratio rises above 1 by 2050”, but falls again below 1 after 2085. Please also comment this behaviour. How can it be that there is a period over which the initial sate becomes unimportant followed by a period over which the initial state is important again? Is the conclusion that “the impacts of climate emerge relatively quickly (i.e. over 2-4 decades) for Pine Island and Smith” (L. 356-357) really valid for Smith given that they decrease afterwards?

L. 284-285: “aside from a small spike in 2160, the ratio for Thwaites remains < 25% until 2090”. I think the authors refer to the peak in 2060, not 2160. It could also be mentioned that the ratio remains below 1 until ~2140.

L. 285-286: I also find interesting that the Pine Island ratio becomes so high after 2120.

L. 286: “the ratio becomes significant for Thwaites (and other catchments)” -> the ratio is significantly greater than 1 over most of the simulated period for the three catchments.

L. 288-293: why not mentioning Smith in this paragraph?

Fig. 7: why showing ocean temperatures only in year 2100? This year is quite specific with a high emergence of the climate forcing dependence in the melt rates of all ice shelves (Fig. 6b), and there is natural variability, both of which would encourage averaging over a longer period, and even showing several distinct periods.

L. 329: "Reed et al. (2024)" -> (Reed et al., 2024)

Fig. 10 caption: indicate that this is Thwaites. And I don't see thin and thick black lines, I see grey and black.

L. 450: "Marine Cliff Instability" -> Marine Ice Cliff Instability

L. 466: "To the extent that ocean warming of the continental shelf is reversible": It seems to be reversible, to the extent that global warming is reversible (Caillet et al., 2023).

In the Discussion or Conclusion, it may be worth adding a comment about the fact that you regionally obtain much longer predictability than what McCormack et al. (2026) obtained at the scale of Antarctica.

References

Caillet, J., Jourdain, N. C., Mathiot, P., Hellmer, H. H. and Mouginot, J. (2023). Drivers and reversibility of abrupt ocean state transitions in the Amundsen Sea, Antarctica. *J. Geophys. Res. Oceans*, *128*(1), e2022JC018929, https://doi.org/10.1029/2022JC018929

McCormack, F. S., Morlighem, M., Pattyn, F., Robel, A. A. and Seroussi, H. (2026). Emergent decadal predictability in Antarctic contribution to sea-level rise. *Nature*, *654*(8119), 609-613. https://doi.org/10.1038/s41586-026-10614-4

Shean, D. E., Joughin, I. R., Dutrieux, P., Smith, B. E. and Berthier, E. (2019). Ice shelf basal melt rates from a high-resolution digital elevation model (DEM) record for Pine Island Glacier, Antarctica, *Cryosphere*, 13, 2633–2656, https://doi.org/10.5194/tc-13-2633-2019