Review of "Disentangling the drivers of future Antarctic ice loss with a historically-calibrated ice sheet model", by Coulon, et al

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1 Overview

In this work, the authors use a set of ice sheet models calibrated to match the historical record for the Antarctic Ice Sheet and run an ensemble of simulations under different climate scenarios to try to extract the drivers of future Antarctic ice loss and contribution to sea level rise. In particular, they examine the varied roles that oceanic and atmospheric forcing play in the different climate scenarios. I found that the experiment was well thought-out, the results are clearly presented, and the paper itself was clearly written. I believe that this work represents a significant advance and is suitable for publication after a few minor issues are addressed.

Overall, I am skeptical of the 16 km resolution used in this study. While the use of the Schoof criterion means that the method as a whole is somewhat impervious to resolution, there is some evidence that these sorts of approaches aren't the most accurate (i.e. [3]). That said, I suspect the model is sufficient for the broad-strokes purposes of this study.

2 Specific Points

1. line 110: I think the first use of the term "committed sea level rise" was in Price [2]
2. Figure 2: The colormap used for probability is unfortunate in that the shading used to represent "no probability" is indistinguishable from the middle-scale shading (around 50% probability). Would a monochrome color scale make more sense here?
3. Figure 5: The "present-day" (control) experiment would be useful to include in this figure for comparison purposes.
4. Figure 6: It would be clearer if you point out the components which have opposite signs with regard to contribution to SLR (for example, surface

melt and runoff appear to be opposite signs). I think that using the conventions you're using makes it easier to tell when SMB components balance, but you should make that clear in the caption.

5. lines 350-360: You should probably also mention hydrofracture as an impact of changes in SMB on ice shelves (which is a mechanism via which atmospheric forcing can mimic ocean forcing and its impacts on buttressing).

6. line 555: Is the assumption of spatially constant viscoelastic properties appropriate? I'm not an expert, but I've seen a fair bit of recent work on how soft the bedrock under WAIS is relative to the rest of the AIS, and its impacts on ice sheet dynamics. Amusingly, I can cite work by Coulon, et al to make this point.[1] If you feel that the model used here is reasonable, I think you need to justify that given the existence of a body of work which seems to suggest otherwise.

7. line 686 (code availability) – I think you need to specify a particular version of the code. Specifying a dev branch won't be sufficient to fully reproduce the results here.

3 Minor corrections and typos

1. line 39: "compensate" – would "offset" be a better word here?

2. line 66: "allowing to quantify" → "allowing us to quantify"?

3. line 109: "allowing to investigate"...

4. line 111: "amount" → "number"

5. line 202: You use "Amundsen Sea Sector" here, while elsewhere you use "Amundsen Sea Embayment" – are they referring to the same region? If so, it would be better to be consistent.

6. Figure 1 caption: "area represent" → either "areas represent" or "area represents"

7. line 334: "Figure... illustrate"

8. line 379: Should the reference to Figure 2D here be to 2a?

9. Figure 7 caption: "aggregated fluxed" → "fluxes"

References

[1] Violaine Coulon, Kevin Bulthuis, Pippa L. Whitehouse, Sainan Sun, Konstanze Haubner, Lars Zipf, and Frank Pattyn. Contrasting response of West and East Antarctic Ice Sheets to glacial isostatic adjustment. *Journal of Geophysical Research: Earth Surface*, 126(7), 2021.

[2] S. F. Price, A. J. Payne, I. M. Howat, and B. E. Smith. Committed sea-level rise for the next century from Greenland ice sheet dynamics during the past decade. *Proceedings of the National Academy of Sciences*, 108(22):8978–8983, 2011.

[3] Ronja Reese, Ricarda Winkelmann, and Hilmar Gudmundsson. Grounding-line flux formula applied as a flux condition in numerical simulations fails for buttressed Antarctic ice streams. *The Cryosphere*, 12(10):3229–3242, October 2018.