TCD

**Interactive
comment**

Interactive comment on "Melt at grounding line controls observed and future retreat of Smith, Pope, and Kohler Glaciers" *by* David A. Lilien et al.

Anonymous Referee #2

Received and published: 15 June 2019

General Comments

In this paper, the authors present the results of from a model of the Smith, Pope, and Kohler glaciers using varying sub-shelf melt forcings and marginal shelf weakening. The experimental design is thoughtfully considered and thorough, with a large number of combinations of model setups tested. Any limitations to the model are also thoroughly discussed at the end of the paper. After backtesting the model over the previous 25 years and comparing to observations, the model is run forward in time to predict the retreat of the grounding lines of Smith, Pope, and Kohler glaciers over the next century. The authors find that the glaciers are likely to contribute at least 6mm of sea level rise over the next 100 years. They also predict that Smith glacier could retreat to the ice divide with the Thwaites glacier catchment within the next 100 years, further

Printer-friendly version

Discussion paper

undermining the ice sheet in the Thwaites drainage. This is an interesting and important result that will likely be of special interest to the broader community of researchers studying the Amundsen Sea region of the Antarctic Ice Sheet.

I recommend that the paper be accepted for publication subject to the following comments/corrections.

Specific Comments

P. 2, lines 40-41: If the grounding line is retreating to deeper seabed, the warm water will need to flow down over the shallower seabed to get to it, meaning that the grounding line is no more vulnerable to warm ocean water than it was before. Do you mean that the grounding line is more vulnerable to melting due to the reduction in the freezing point with depth?

P. 7, line 212: It would be interesting to know how the Cryo2 melt rates compare to flux divergence melt rates for the 2010-2016 period. Have you looked into this?

P. 8, line 277: "5-km retreat" looks more like ∼1km retreat to me.

P. 9, line 308: Referral to Figure 4a-c, but control melt results aren't shown.

P. 9, line 314: Referral to Figure 5a-c to see stabilization after 5 year forced ungrounding, but the first five years of grounding line retreat are covered by the figure label (especially for Smith).

P. 9, lines 314-315: "retreat subsequently ensues on each of the three glaciers..." This doesn't appear to be true for S2016 melt on Pope or Kohler.

P. 10, lines 320-322: "...by the end of the 50-year simulations..." To my eye, the only one that consistently approximates the J2010 free GL results is J2010 5-yr GL.

P. 10, line 335: Define "significant" (>40km?)

P. 11, line 357: "...those with the J2010 melt parameterization..." (with the exception of

the control melt-scaling)

P. 11, lines 375-378: "While our rescaling..." What does this mean for Cryo2 melt rates from 1996-2010? The Cryo2 melt distribution also doesn't allow the ice shelf to deepen into melt as you go back in time – does this mean that melt rates near the grounding line would be comparatively high for the Cryo2 distribution in 1996?

P. 12-13, Section 4.1.2: Should at least part of this be in the Results section?

P. 13, lines 423-425: It looks like the SSA simulations thin too little for all three glaciers upstream of their grounding lines.

Figure 2: You say "shelf total melt rates are most sensitive to melt rates between ~250 and 600 meters." Why not choose two depths where the PDF values are equal, e.g. ~250 and ~800m?

Table 1: Simulation number 8 has an asterisk indicating that the retreat was entirely forced, but in Figure 5 we can see that the retreat continues beyond the 18y grounding line for Smith glacier.

Figure 4: The important first 5 years of grounding line retreat are covered by the plot labels for Smith and Kohler glaciers. Similar for Figure 5.

Technical Corrections

P. 2, lines 49-50: I found this wording confusing – it sounds like "committed" is a verb. Maybe reword it?

P. 4, line 121: "allows us to"

P. 5, line 155: "We ran a suite"

P. 6, line 178: I think this should say something like "...errors due to the assumption are alleviated through choice of the sliding coefficient..."

P. 7, line 232: Perhaps a matter of taste, but I like the word "margins" more than "edge."

Edge makes me think of the calving front.

P. 8, line 279: 20011 → 2011

P. 10, line 321: should say "...using all four melt distributions...?"

P. 10, line 329: I think the referral to Figure 6 is repetitive, given that the whole paragraph is referring to the figure. You could make it a referral to Figures 6c-d if you want to be specific.

P. 11, line 374: mix → mixes

P. 11, line 379: instantiate → induce (or trigger)?

P. 12, line 391: "simulations with marginal"

P. 12, line 401: indicate → indicates

P. 12, line 405: 19 → 21

P. 14, line 458: across → along?

P. 14, line 463: "There is a variety..."

P. 14, line 470: complicate → complicates

P. 14, lines 482-483: The way this is worded makes it sound like it was the SSA simulations that required HPC. Maybe say "... allowing the use of local workstations rather than requiring high-performance computing resources."

P. 15, line 509: have → "has" or "may have"

P. 15, line 528: "not be an indication" ?

P. 16, line 531: "we did not have"

Figure 1: I assume there should be a box showing the study area on the map of Antarctica – I can't see one on my printed copy.

Figure 3, line 759: "thick for 1Obs, thin for 2Obs."

Figure 5, line 779: double periods

Figure 5, line 782-782: "Color of the line indicates year" already stated in line 781.

Figure 6: Axis labels are overlapping for 6a and 6c.

Figure 6, line 790: "difference...result" → "difference . . . results" or "differences . . . result"

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2019-105, 2019.