The Cryosphere Discuss., 8, C477–C481, 2014
www.the-cryosphere-discuss.net/8/C477/2014/

The Cryosphere Discussions
Open Access

Interactive comment on "Sensitivity of the dynamics of Pine Island Glacier, West Antarctica, to climate forcing for the next 50 years" *by* H. Seroussi et al.

R. Gladstone (Referee)

rupertgladstone1972@gmail.com

Received and published: 22 April 2014

Review of "Sensitivity of the dynamics of Pine Island Glacier, West Antarctica, to climate forcing for the next 50 years".

The authors present a sensitivity study for short time scale (50 years) change in the Pine Island Glacier (PIG). This is not the first such study, but is novel in that a different ice sheet model is used, different forcings are used (in particular the ice shelf basal melt comes from a high resolution ocean model), and the experimental design is slightly different. This study is a useful contribution, and is clearly written. Their conclusions are qualititatively similar to previous studies in that the dynamic regime of PIG is most

sensitive to basal melting due to ocean circulation patterns.

An important outstanding question in this area is whether positive feedbacks relating to marine ice sheet instability will cause rapid acceleration of PIG retreat, or whether PIG contribution to sea level rise will remain modest. This study supports the latter answer, and because of the importance of this question I suggest some additional simulations be shown to demonstrate the robustness of this interpretation.

My main concern is that the authors have not satisfactorily demonstrated the robustness of the insensitivity of PIG dynamics to basal melting under newly ungrounded regions as the grounding line retreats. They have carried out relevant simulations reported as "not shown", but I feel these simulations really need to be presented in the main paper.

The authors also need to demonstrate that their results are not sensitive to changes in resolution, and that their region of high resolution is sufficient to capture grounding line retreat. I would suggest they show a plot of the model grid (with a colour scale for resolution if the resolution is too fine to show individual elements) with both the initial and final (alpha = 3 scenario) grounding lines shown. I would suggest they also repeat their control and one of their sensitivity simulations with resolution in the vicinity of the grounding line either halved or doubled, to show that this does not impact on the results.

General comment on grammar: look up the use of the semi-colon. There are a few places where you should use a semi-colon rather than a comma (e.g. first line of conclusions).

Line by line comments follow.

P1876

L9-15 Which satellite observations? Please expand. A list of references is not sufficient. Please provide at least one line summarising the data from this reference (e.g.

TCD
8, C477–C481, 2014

"obtained from satellite Joe using laser altimetry"). The SMB reference is a Greenland one. Presumably you are using RACMO modelled SMB. State this explicitly and provide the correct reference for Antarctica. And are these data sets really ALL from 2008? If not, indicate which ones represent 2008 and which represent other periods. Later on you say "The data used to initialize the model are acquired on different years" so I am a bit confused about the significance of 2008.

L16-17 Which year is this grounding line position?

P1877

L4 Please indicate the resolution in regions the grounding line retreats to during the sensitivity experiments. Does the grounding line remain in regions of 500m resolution for all simulations? Or does it retreat into coarser resolutions?

P1878

L6 clarify that your ice front variations correspond to retreat not advance.

L9 "twice" in terms of absolute change or a multiplication factor?

L16-25 any speculation on the cause of the floating adjustment? Is it purely due to interpolation of coarse data sets or is there a "real" signal in there?

P1878

L26 onwards. Is this acceleration due to recent retreat of the g.l.? Perhaps if the g.l. was initialised slightly further ocean-wards the control simulation would show less change? This is not a criticism, I am just speculating.

P1879

L11 Clarify that this -7 to 20 mm is over the 50 year period, not a change per year.

P1880

L22-24 This is a rather sweeping statement. Have you discussed which parts of PIG

TCD
8, C477–C481, 2014

are “unconfined”? Certainly the largest front retreat simulation shows an impact on dynamics.

P1881

L12-24 Why is the stress transferred further upstream in the current study? Which study is “right”? Did the other studies mentioned have more simplifications in their stress model?

P1883

L11-19 I think it would be good to show the “hot shown” simulations here. I personally find it surprising that extending the melting beneath newly ungrounded ice doesn’t affect your results. I would need to see some results from the relevant simulations to be fully convinced of this.

P1884

L22 Pattern? You haven’t talked about the pattern much, but more about the magnitude. If, as you say, the omission of basal melt from newly ungrounded regions isn’t important then perhaps the pattern of basal melt isn’t important, only its magnitude is? Or maybe what you are working towards is this: buttressing is important in the portion of the floating shelf nearest the grounding line due to the geometry of the embayment, but is not so important near the ice front. In this case then any basal melting in the buttressed region would reduce buttressing, and any ice front retreat into this region would reduce buttressing, causing faster flow. But melting nearer the calving front, or modest retreat of the calving front, isn’t going to impact much. This is also consistent with your front retreat sensitivity experiments.

L23-24 I don’t quite follow this line. Ocean circulation changes and melting remains constant? Perhaps you need to omit the word “changes”? Changes can’t remain constant! Or maybe I didn’t understand what you wanted to say?

Figure 4: the text in the figures is very small and hard to read. Colour looks the same

TCD
8, C477–C481, 2014

for alpha 2.5 and 3 (b). Dashed lines not explained in caption (c). Perhaps dashed lines are for start of simulations and solid lines are for end of simulations? Best to make this clear in the caption. Would be good to see “control” simulation in each subplot. E.g. alpha =1 is control for top panels. Is front 1 already a retreat in middle panels? If so please add “control” to middle plots. At bottom beta = 1 would be the control I think.

Interactive comment on The Cryosphere Discuss., 8, 1873, 2014.