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Interactive comment on "Dynamic response of Antarctic ice shelves to bedrock uncertainty" *by* S. Sun et al.

S. Sun et al.

sainansun1985@sina.com

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We thank referee 2 for these constructive remarks – we think that we have been able to respond to them. In particular, the question about the PIG grounding line led us to an additional result.

"The authors use a L1L2 model. For high slip ratios that model is essentially SSA and as such overly sensitive to bedrock undulations. However, I expect this issue to be circumvented in the study by redoing the inversion each time for each different bedrock realizations. (But was this done?) Even if this may not strictly be true, the importance of the study is not really diminished in any way, because the sensitivity to errors is a model property. The model used is a model commonly used to study flow of Antarctica and knowing the sensitivity of such a model to errors on bedrock topography very

important. I agree with the other reviewer that it is not clear from reading the paper if a new inversion was done for each bedrock realization. This is a fairly important point. If not, then the measured velocities are presumably not as well reproduced by the ensemble runs as they are for the reference run, and some of the differences might be related to this. I would like to see this clarified and addressed before publication."

We agree with this interpretation, and have added some discussion of the similarities and differences between the models in the appendix. An inversion was done for each bedrock. The text should now be clear.

"For PIG it appears from flux considerations that ice thickness at the grounding line might be underestimated in Bedmap2. Most modellers of PIG find that the GL advances in the initial stages. Did the authors run into this problem as well? If so, then it would be interesting to have some additional comments on the effect of a vertical shift of bed around the GL of PIG. Maybe some of the runs already done can give an answer to this question."

We do find that the ice near the GL thickens in the first few years of the simulation, and this is reflected to some extent in the delayed response – only after the ice sheet has thinned does the flow speed up enough to start thinning upstream. We think some of the runs can indeed answer the referee's question. If we compute the average perturbation of those runs that retreat earliest, we see a lowering of the ridge underneath the PIG grounding line, while the average for the delayed retreats is a raising of the ridge. We add a description of these results to the manuscript.

"I also wonder if the authors could make some further statements about the impact of errors depending on location. How different are calculated rates of VAF for a given change in bedrock around the grounding line as compare to upstream from the GL? I expect that the VAF will be much more sensitive to +/- 100 m shift in bedrock around the GL, but I don't think there are any clear quantitative statements to this effect in the literature. If the authors could provide such a statement in their paper that would enhance even further the value of this work."

We don't think we can add too much more to this discussion, expect to note that the stand out feature in the runs we have done is a variable delay in retreat, and that seems to be caused almost entirely by the perturbations at the grounding line.

"Minor comments: -The bedrock itself is hardly a boundary condition. It is the boundary itself. -is the spatial resolution not limited primarily by the spacing of radar profiles, rather than diffraction?"

Fixed.

Interactive comment on The Cryosphere Discuss., 8, 479, 2014.