

Interactive comment on “A simple model of mélange buttressing for calving glaciers” by Tanja Schlemm and Anders Levermann

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Received and published: 25 May 2020

I like this paper. It makes a significant and important contribution to the emerging understanding of how iceberg mélange can limit calving losses, especially with respect to the important issue of marine ice sheet instability. The model shows that, under certain assumptions, the evacuation of mélange places an upper limit on calving losses. This is an important idea and indeed is probably the only plausible process that might limit rates of ice loss from parts of West Antarctica if fringing ice shelves are lost and ice cliffs retreat into deepening water.

However, the model is illustrative rather than predictive. Both the calving laws and the mélange flux equations are untested against observations and cannot be used in their

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current form to predict actual ice sheet evolution. Many of the functions are chosen for convenience rather than known fidelity. This of course is a useful modelling strategy, and the untested nature of key equations does not diminish the importance of the paper or undermine the analysis. The paper yields several important insights and is likely to be well cited and influential. On the other hand, the model cannot necessarily be applied to real-world situations simply via calibrating model parameters, and there may also be structural issues.

For example, backstress from mélange does not always come from fjord walls, but also via grounding of bergs on the sea bed. In some circumstances, the effect of mélange buttressing may be better posed as a force balance and ice-margin position problem, rather than a rate problem as developed here. But I am not suggesting that the analysis needs to be augmented or changed in any way, only that in a couple of places statements should be added to acknowledge the limitations. I suggest:

1. In the abstract, line 5: delete 'but robust'. The robustness of a model can only be evaluated with respect to its predictive or diagnostic power, which is not addressed in this paper.
2. Add a sentence or two to Section 5 to mention the possible limitations of model structure.
3. In p 15, line 20, the authors state that an advantage of their model is that it employs a limited number of parameters that can be calibrated against observations. But this may not be possible. I suggest simply deleting this sentence.

The text is very clearly written, and I only spotted a few typos.

Abstract, line 2: 'calf' should be 'calve'

P 7, line 15: delete 'a'

P 7, line 16: 'instable' should be 'unstable'

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The authors should be congratulated for their original and very useful contribution.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-50>, 2020.