

Hansen et al. 2021

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Reply to editor's comments on

“Downscaled surface mass balance in Antarctica: impacts of subsurface processes and large-scale atmospheric circulation”

by

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Dear Editor Alexander Robinson,

On behalf of my co-authors and myself, I would like to thank you for your comments on our manuscript.

In the following, we provide a point-by-point answer to the issues raised by you. All issues will be followed by our suggestions for improvement to the manuscript highlighted in **red**.

Best regards,
Nicolaj Hansen

1. I find that the Introduction is clearly missing an explicit paragraph stating the goals of the study and what you will show. Right now, hints of this are mixed in with general introductory information, but this is confusing (see specific comments below).

We have written a final paragraph dedicated to this, at the end of the introduction:
“The aims of this study are thus; to estimate present day Antarctic SMB using our subsurface model forced with the RCM HIRHAM5, compare and evaluate the two subsurface model versions against each other and in-situ data. Furthermore, we estimate the MB, using our modelled SMB results combined with discharge values, and compare it with GRACE, and finally we investigate the relationship between the SAM and the SMB. This is done in the following structure; first a method section, where the RCM HIRHAM5, the two subsurface models and their set-up are described. Followed by a result section, where the modelled SMB results are shown, including evaluation against in-situ measurements of SMB, firn temperature and density. Then the discussion, where, besides the results, the MB is estimated and evaluated against GRACE data is discussed and also the influence of SAM on SMB. Finally, a conclusion in the end.”

Specific comments:

2. L23: contributes to sea level rise by 0.3 ± 0.16 mm yr⁻¹ => contributes 0.3 ± 0.16 mm yr⁻¹ to sea-level rise
 Changed
3. L26: in induce ice sheet dynamical instability => in inducing ice-sheet dynamic instability
 Changed
4. L31: Rephrase, as you have not yet introduced any particular modeling approach. Perhaps simply delete and mention it elsewhere.
 As the comment on blowing snow came from one of the reviewers we believe it should stay. However, your point about modeling is very true. So the sentence has been rephrased to:
“...However, blowing snow is not taken into consideration in this study, so the SMB is defined here as:...”
5. L33: higher altitudes => higher altitudes,
 Changed
6. L37: dynamical => dynamic [and elsewhere]
 Changed

7. L51: Again, here it is strange to mention what you do with HIRHAM, as you have not yet introduced that you have a model, or what you plan to do with it. I would remove this sentence.

We have added a sentence in L37, see below

“...Here we focus on the SMB component of the mass balance, to pin-point the immediate forcing to ice sheet dynamic instability. To estimate the SMB we use an atmospheric Regional Climate Model (RCM) to force a subsurface model, which outputs the SMB.

Regional Climate Models are most often used....”

By adding the new sentence from, we believe that this sentence could still stand, by adding “RCM” before HIRHAM5

8. L56: "we also compare our model results" <= Again, what model results?

We have added SMB in that sentence:

“...we also compare our modelled SMB results...”

9. L73: sea ice extent => sea-ice extent

Changed

10. L84: global circulation models, for full => global circulation models. For a full

Changed

11. L103: physically state => physical state

Changed

12. L110-113: Run-on sentence. Please separate.

Done

13. L114: on the layer's => on a layer's

Changed

14. L117: Delete "However"

Done

15. L120: This phrase doesn't seem to make sense: "that mass is advected through layers of fixed mass". How can mass be advected through layers of fixed mass? Please revise.

As mass is added on top of the subsurface model, the scheme advects mass downward to ensure the constant w.eq. layer thicknesses. To make it more clear we have removed the sentence “that mass is advected through layers of fixed mass”. It is rewritten to this:

“This fixed model implies an Eulerian framework, meaning that when snowfall occurs at the surface, it is added to the first layer and an equal mass from that layer is shifted to the underlying layer. The same goes for each layer in the model column.”

16. L127: dynamical => dynamic

Changed

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17. L166-167: 3d => 3D; 2d => 2D [and elsewhere]

Changed

18. L231,L233: data set => dataset [and elsewhere]

Changed

19. Fig. 3, caption: the charge => the change [?]

Corrected

20. L257: overestimates => overestimate

Corrected

21. L258: underestimates => underestimate

Corrected

22. L261: are consistent => is consistent

Corrected