

Review of *The Cryosphere* Manuscript egusphere-2022-1371:

“Sensitivity of the Regional Climate Model MAR’s snowpack to the assimilation parametrization of satellite-derived wet-snow masks on the Antarctic Peninsula”

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Reviewed: July 28, 2023

Reviewer: Charlie Zender, zender@uci.edu

Recommendation: Accept subject to minor revisions

I have voluntarily disclosed my identity in all manuscript reviews since 2004. The authors are free to contact me at zender@uci.edu.

General Comments

This manuscript reports on the sensitivity of the MAR model to different assimilation methods for satellite-observations of wet snow over the Antarctic Peninsula. The manuscript summarizes a fairly comprehensive battery of numerical experiments to help identify the strengths and weaknesses of various assimilation datasets and methods. It will be of interest to *The Cryosphere* readers who are interested in understanding and reducing the uncertainties and biases of a cutting-edge Regional Climate Models (RCMs) for polar regions.

I was invited to weigh-in on the suitability of the revised (not the original) manuscript for publication. Reviewers 1 and 2 delivered substantial comments on technical as well as overarching goals of the original manuscript. The authors responded with major revisions that attempted to address all of many points raised. The authors characterize the reviews this way: “The majority of the highlighted issues of the paper come from its writing style.” This may be true in terms of the number of comments, yet the reviews contain many substantial and trenchant scientific concerns.

That said, the authors have adequately addressed the vast majority of the reviewers comments of all kinds. In particular, the addition of tables, adoption of consistent and systematic naming conventions, and clarification of manuscript intent greatly clarified and focused the manuscript’s content. The revised manuscript is of sufficiently high quality to warrant publication after addressing a few more scientific points, and another thorough edit to address the English syntax/spelling issues.

Specific Comments

1. The methodology used to assimilate the RS data is impressive. Nice work!

2. L206: “as very little [sic] melting events are expected”. Winter-season melt is not uncommon on Larsen C during Foehn events. More than 20% of annual melt at AWS18 in Cabinet Inlet on Larsen C has occurred due to sensible heating by foehns during polar night (*Kuipers Munneke et al., 2018*). *Laffin et al. (2021)* and *Laffin et al. (2022)* quantify seasonal and regional behavior of such foehn-induced melt on the eastern AP.
3. Lines 231–239 repeat lines 221–229 verbatim. Oops :)
4. Large portions of lines 280–292 repeat lines 272–279 verbatim.
5. Where is the exact region of the Antarctic Peninsula (AP) simulated by MAR defined? Tables 4 and 5 and Figures 7–9 appear to tabulate the entire AP, and then some. Where is the region for which the mass budgets are computed defined? The present results cannot be reproduced without a clear definition of the boundaries.
6. Line 355 defines the accumulation portion of SMB as comprising snowfall and rainfall. However, the ablation portion only mentions runoff and sublimation, not evaporation. This seems inconsistent, as evaporation from the liquid phase does reduce SMB during melt (or rainfall) events just as sublimation reduces SMB during dry weather.
7. Line 355: In accord with Reviewer 1’s suggestion, the revised manuscript should explicitly state that MAR is configured not to represent snow drift, so it is not included in the SMB.
8. The relative roles of the three assimilation parameters studied in influencing densification, runoff, and SMB is interesting. The manuscript reaches conclusions that will be helpful in advancing assimilation methods and reducing biases in RCMs.
9. The maximum volumetric liquid water content of firn prior to percolation adopted by MAR and used in this study is 5%. Where does the experimental support for this limit described? Please comment on the expected sensitivity the assimilation to the value chosen for this parameter within its uncertainty range. Please cite or describe the original source/justification for this limit the first time it appears in the manuscript.

Technical Corrections

The revised manuscript contains fewer, though still many, instances of poor English syntax, verb use, spelling, and adjective placement. A fluent English speaker could catch those remaining instances. On the whole, though, I understood the intended meaning of virtually the entire manuscript, including the awkwardly written sentences. The following list is very incomplete, and meant to be illustrative rather than comprehensive of the editing task that remains:

1. L29: “thought” not “taught”
2. L55: “RCMs” not “RMCs”
3. L62: “quantify the surface meltwater quantity” is redundant
4. L83: Replace “one is called” by “AMSR2 is”

5. L83: “Platform” not “Plateform”
6. Figure 2 caption: “Temperature brightness (K) the 09-06-2019” is bad English
7. Figure 3 caption: should “between (a) and (b)” be “between (b) and (c)”
8. L271: “2.3.3 Experiments conducted” not “2.3.3 Experiences conducted”
9. L308: “are punctual when”?
10. L347: “almost similar” is almost redundant, just say “similar”

References

- Kuipers Munneke, P., et al. (2018), Intense winter surface melt on an Antarctic ice shelf, *Geophys. Res. Lett.*, *45*(15), 155–165, doi:10.1029/2018GL077899. [2](#)
- Laffin, M. K., C. S. Zender, S. Singh, J. M. van Wessem, C. J. P. P. Smeets, and C. H. Reijmer (2021), Climatology and evolution of the Antarctic Peninsula föhn wind-induced melt regime from 1979–2018, *J. Geophys. Res. Atm.*, *126*(2), doi:10.1029/2020JD033682. [2](#)
- Laffin, M. K., C. S. Zender, M. van Wessem, and S. Marinsek (2022), The role of föhn winds in eastern antarctic peninsula rapid ice shelf collapse, *The Cryosphere*, doi:10.5194/tc-16-1369-2022. [2](#)