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The Cryosphere Discussions

Interactive comment on "Increased Greenland melt triggered by large-scale, year-round precipitation events" *by* Marilena Oltmanns et al.

Anonymous Referee #2

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General comments

This is a well-written, interesting paper that advances scientific understanding of Greenland melt events. The authors' distinction between cyclonic synoptic patterns triggering melt and anticyclonic conditions that extend the melt events is an important contribution to the literature. Their analysis of winter melt events, and comparison with more frequently studied summer melt, are also novel and well executed.

The most significant issue I have is with the title of the paper, which frames Greenland melt as triggered by precipitation events. Throughout the paper the authors do an excellent job of describing the conditions that trigger melt during cyclonic weather events, including the advection of heat and moisture that increases longwave radiation and can decrease albedo. However, the way the title is worded makes it sound as though the

precipitation itself is responsible for inducing melt, rather than the sum of all changes to the surface energy balance that occur during cyclonic conditions. (Certainly rain energy can contribute to melt, as shown by e.g. Doyle et al. [2015] and Fausto et al. [2016], but its magnitude is typically small in comparison to other fluxes.) I think a less confusing title would be one that doesn't imply that precipitation is the primary driver of melt – perhaps something like "Increased Greenland melt triggered by large-scale, year-round cyclonic moisture intrusions" – but I will defer to the editor, author, and other reviewers if they feel that the title is appropriate as is.

I have a few other minor comments detailed in the Specific Comments, concerning the definition of winter noted by the editor and some references to previous literature. Overall, it is my opinion that this paper will be an excellent contribution to The Cryosphere once these minor revisions are addressed.

Specific comments

1. I agree with the editor that April and September are not generally considered winter months and their classification as winter months could affect the results. Specifically, the trends in winter melt events in Figure 6a-c and the scaling of runoff and refreezing in Figure 10f may change if April and September are excluded. It would be helpful if these plots were reproduced (as supplementary material) with Oct–Mar rather than Sept–Apr data, with the sensitivity of these results to the definition of winter discussed in the paper.

2. Lines 16–17, p. 3: It is accurate that nonradiative fluxes increase relative to shortwave radiation in the winter, however Fausto et al. [2016] did not show this. Those authors found that nonradiative fluxes dominated over radiative fluxes in the West Greenland ablation zone specifically during *summer* melt events. A more appropriate citation on the seasonal cycle of shortwave vs. nonradiative fluxes is van den Broeke et al. [2011].

3. Lines 13–14, p. 11: Mattingly et al. [2018] found a similar seasonal pattern in

the surface mass balance response to “atmospheric river” events resembling cyclonic moisture intrusions. Those authors found that summer atmospheric rivers cause net SMB losses, while non-summer atmospheric rivers result in net SMB gains.

References

Mattingly, K. S. and Mote, T. L. and Fettweis, X.: Atmospheric river impacts on Greenland Ice Sheet surface mass balance, Journal of Geophysical Research: Atmospheres, 123, 8538–8560, 2018.

Van den Broeke, M. R. and Smeets, C. J. P. P. and van de Wal, R. S. W.: The seasonal cycle and interannual variability of surface energy balance and melt in the ablation zone of the west Greenland ice sheet, The Cryosphere, 5, 377–390, 2011.

Technical corrections: N/A

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