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The Cryosphere Discussions

Interactive comment on "Drifting snow climate of the Greenland ice sheet: a study with a regional climate model" *by* J. T. M. Lenaerts et al.

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This paper discusses the spatial/seasonal distribution and relevance of snow sublimation on the GrIS. The authors distinguish between drifting snow sublimation and surface sublimation and compare it to other mass balance terms. Even if the authors do not have data to validate their model results, these results are still the best available estimate for sublimation processes and their interactions with the atmosphere on the GrIS. The paper is therefore a valuable contribution to understanding the mass balance of the ice sheet.

The paper is well written and clear and I recommend it for publication after revisions. My main revision point is the discussion about trends (from Figure 9). The authors discuss trends since 1990 and it is not clear why that year is chosen. Considering

that they have 52 years of model results, they might as well use the entire time period. Even if only the period since the 90-ies is considered, it looks like only the temperature trend and the surface sublimation trends are robust, and the trend in wind speed and drift sublimation are only there because of anomalous 1-2 years (1995-1996) with very high wind and high sublimation of drifting snow. If these year are omitted, the trend would not be there at all. My suggestion is to include at least 30 years in the trend-discussion or to remove the anomalous year in the mid-nineties, so the trends become more convincing.

Another helpful addition to the paper would be including scatterplots when discussing the correlations (spatial, figures 4 and 5) between e.g. a) snow density and amount of drifting snow or b) wind speed and drifting snow. This would help visualize some of the discussion on the spatial variability, because as it is, the correlations that the authors talk about are not always easy to see, especially because there is a lot of variability in the narrow coastal regions, which seem to be important for this study.

See line comments for further detailed suggestions.

Specific Comments:

- P1611, L7: What is the K-transect?
- P1611, L7–8: Is there any validation of how well the model captures snow density? If there is, it should be discussed, because it is quite relevant for this study.
- P1614, L5–7: It is actually not grain size, but optical grain size, effective radius or the specific surface area, which influences the albedo, and which is discussed in Flanner and Zehnder 2006. Please correct in the text.
- P1614, L16: I assume that AIS is the Antarctic Ice Sheet.
- P1616, L22–23: How do your estimates of the Greenland SMB compare with other estimates of the GrIS. Please discuss.
- P1617, L1: The process of increasing densification rate is well known and and was not first suggested by Lightenberg 2011. Please cite original references, such as Wakahama (1974).
- P1617, L2–4: Some original work on threshold friction velocity should be cited here, such as Li and Pomeroy (1997), Pomeroy et al. (1993) or work by Schmitt R.A. in the 1980-ies. Liston and Sturm (1998) have a fairly good reference list for threshold friction velocity.
- P1618, L1–6: Please discuss why the drifting snow sublimation (5c) is different from the drifting snow transport (5a). Is it because of temperature and rH differences in regions with the same wind speed? Maybe scatterplots between these two values might help (with different colored points for grid cells with a certain temperature and relative humidity).
- P1620, L1–15: see general comments.

- Except for figures 3, 6, and 9, the fonts on the figures are too small. Please adapt fonts so they match those in e.g. figures 3, so they are readable without having to blow up the figures.
- Figure 1 is not particularly useful and can be omitted.

References

Li, L. and Pomeroy, J. W. (1997). Estimates of threshold wind speeds for snow transport using meteorological data. *Journal of Applied Meteorology*, 36(3):205–213.

Liston, G. E. and Sturm, M. (1998). A snow–transport model for complex terrain. *Journal of Glaciology*, 44(148):498–516.

Pomeroy, J. W., Gray, D. M., and Landine, P. G. (1993). The Prairie Blowing Snow Model: characteristics, validation, operation. *Journal of Hydrology*, 144:164–192.

Wakahama, G. (1974). The role of meltwater in densification processes of snow an firn. In Nye, J., editor, *Snow Mechanics, Proceedings of a symposium held at Grindelwald*, number 114 in IAHS Red Books, pages 66–67.

Interactive comment on The Cryosphere Discuss., 6, 1611, 2012.