**The Cryosphere**
Discussions

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# *Interactive comment on* "Measured and Modeled Snow Cover Properties across the Greenland Ice Sheet" *by* Sascha Bellaire et al.

### Anonymous Referee #2

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Synopsis The study 1.) uses GC-Net data to evaluate an NHM-SMAP regional climate model simulation and 2.) uses other field data (density cutter, depth of 2012 melt layer, SMP hardness data, Icecube SSA data) to evaluate SNOWPACK snow model simulations of density. The study concludes bulk density is accurately simulated but detailed stratigraphy is not accurately simulated at the level of detail observed in the field data.

Critique

The study does not spend time evaluating the development of stratigraphy over time despite the fact that GC-Net stations record surface height hourly. Therefore, the work would seem to benefit and deepen in value by evaluating SNOWPACK performance in development of stratigraphy by using selected sequences of snow accumulation (and

erosion) in GC-Net surface height data.

Could SNOWPACK not just be driven by GC-Net data?

The study would be improved by including discussion of results in comparison to those of the following and other relevant studies... Kuipers Munneke, P., S.R.M. Ligtenberg, B.P.Y. Noël, I.M. Howat, J.E. Box, E. Mosley-Thompson, J.R. McConnell, K. Steffen, J.T. Harper, S.B. Das and M.R. van den Broeke, 2015. Elevation change of the Greenland Ice Sheet due to surface mass balance and firn processes, 1960–2014. The Cryosphere, 9:2009-2025.

The use of different new snow densities to tune the model produces better fits but could also mask other error sources or process that the study could reveal.

Throughout, if adjectives like "good" are to be used, they should be accompanied by quantities allowing the reader of the article to judge for themselves model performance. Better would be to greatly reduce the use of adjectives.

The agreement of precipitation vs the simple explanatory factors of latitude and longitude may be useful for the accumulation area but below equilibrium line altitude, the relationship will break down. So, to not over interpret, refer only to the upper accumulation area when making points about the utility of the regression approach.

pg 8 line 21-23 interpretation of SSA vs SSA derived from SMP is speculative and is a point I don't find to be convincing. I think you should suggest other factors that could cause the bias and make some 'further investigations'.

Minor points

A more sophisticated treatment of the rain threshold than +1.2 C seems worthwhile, especially when the modeling is applied at lower elevations where rain is more common.

Equations 1 and 2 are unnecessary. Don't use the abbreviation GrIS, does not save

significant text volume Figure 3 solar irradiance clustering below the dashed line and above 200 W per square m suggests a time offset. Try adjusting the time coordinate of the GC-Net data and I suspect you will find a tighter relationship. Figure 8, for density plots, use square edged line style to more realistically represent the density cutter data regarding solar irradiance, please replace "incoming" with "downward" throughout

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2017-55, 2017.