The Cryosphere
Discussions

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Interactive comment on "A new spatially and temporally variable sigma parameter in degree-day melt modelling of the Greenland Ice Sheet 1870–2013" *by* A. E. Jowett et al.

Anonymous Referee #1

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General comments:

Jowett and co-authors introduce a very comprehensive study about the temperature standard deviation parameter (sigma) for the Greenland ice sheet since it was introduced by Roger Braithwaite and Niels Reeh + colleagues in the statistical positive degree day (PDD) method. They use two reanalysis datasets (Era-Interim and Twentieth Century Reanalysis) to downscale the 2-m temperature to determine a unique (spatially and temporally variable) sigma value on 5x5 km grid, which covers the time period of 1870-2013. They validate their unique sigma values using temperature measurements from all available long-term monitoring efforts on the ice sheet (GC-NET and PROMICE) and on land (DMI) in Greenland. They also do some trend analysis for

the temperature variability for the whole time period. Everything in this paper is clear and solid scientific work, they reach solid conclusions based on their analysis, interpretation and validation work, all in all, I really think it is a good piece of work, but to what end, I might ask? This is the one big question I keep asking myself after having read this study.

What is the scientific relevance/significance for a temporally and spatially varying sigma parameter based on model data (reanalysis datasets), for understanding future or present-day surface mass balance (SMB) of the Greenland ice sheet? I do get that it is important for the PDD method, but what is unique about this dataset in relation to the PDD method you cannot get elsewhere? I will try to elaborate with some examples:

Is the new sigma value designed for use in SMB studies of the Greenland ice sheet using the PDD method? Please state how you think this study would advance our knowledge or the broader implications in the area of modelling the SMB for the Greenland ice sheet. For example, if I wanted to study the variation of the SMB for the Greenland ice sheet, I would force a regional climate model (RCM, for example, RACMO, MAR, HIRHAM5) with the whole reanalysis dataset (all meteorological parameters relevant for energy balance modelling) downscaled to the RCM grid, using, for example, the downscaling method described in the paper. Why choose the PDD-method when you can use a RCM. Would the PDD approach do better, who knows, but that would be something a SMB model intercomparison study would show. However, model intercomparison is clearly not the focus of this study.

Is the new sigma value designed for use in large scale ice sheet models of the Greenland ice sheet (for example, PISM, SICOPOLIS, etc.), which most commonly use the PDD-method for SMB calculations? If yes, again please state how you think this study would advance our knowledge in this area. Regardless, adding 144 years back in time to have a more realistic unique sigma parameter in the ice sheet SMB parameterization will not have, in my opinion, a significant impact on the overall volume change in the ice sheet model. If you do see a significant change on the simulated volume change,

then I would change the focus/framing of the paper toward that.

I would suggest a totally different focus/framing of this study, with the sigma value being a small part of that. For example, maybe you could compare RCMs and PDD SMB results for the reanalysis dataset period mention in the study similar to Vernon et al. (2013) from The Cryosphere (TC). Are they significantly different and so on? Analyze climate trends and so on. If not, the study might be more suitable for a dataset/method journal, such as, journal of glaciology or Geoscientific Instrumentation, Methods and Data Systems (GI).

While the study is sound, it lacks, in my opinion, broad implications of significance and how it can help us better understand present and future changes in Greenland ice sheet surface mass balance. I am sorry that I cannot be more encouraging at this time.

Specific comments:

The authors state in their conclusion (around line 5) that they were motivated to answer the call of Seguinot and Rogozhina (2014) of more realistic sigma values under climate conditions different from today. I do not believe this work answers this question/call not even a little bit. I think, what Seguinot and Rogozhina are after in their publications, is sigma values during the glacial period i.e. on a much longer timescale ($\sim$10.000 years). Also, when you look at the climate history of the Greenland ice sheet, $\sim$100 years back in time before present is really not that different compared to last glacial maximum.

Interactive comment on The Cryosphere Discuss., 9, 5327, 2015.