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The Cryosphere Discussions

Interactive comment on "Climate of the Greenland ice sheet using a high-resolution climate model – Part 1: Evaluation" *by* J. Ettema et al.

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This paper firstly presents the improvements made by Dr J. Ettema on the regional climate model RACMO2 developed by the KNMI for adapting it to the GrIS. Afterwards, the GrIS adapted version of RACMO2 coupled with the new snow model is successfully validated over the GrIS with weather station measurements.

This paper is well written and the TC journal is just right for this kind of paper which will likely be the reference for future papers using RACMO2 over GrIS. The improvements made to RACMO2 are well described and justified. While the validation is concise, the useful surface variables are well evaluated with measurements. The section about the surface energy balance is the most relevant in this paper and innovative compared to previous paper validating RCMs over GrIS although this comparison is limited to a small

area (K-transect) of the GrIS. In average, RACMO2 seems to compare very well with observations which opens RACMO2 to new perspectives over the GrIS. However, some analyses more in depth and summarizing tables (detailed hereafter) miss and should be added for improving the robustness of this validation before publication. I suggest to accept this paper for publication with the suggested additions listed hereafter and from Reviewer #1 if they do not ask a too big job for the authors.

My issues (the most important ones are in bold) are:

1. Sec 4.0: the authors should insist here that the model is not reinitialised or post-calibrated during the simulation. In addition, the validation is made here at the end of the simulation (beginning in 1957) showing that the model does not deviate.

2. **Sec 4.1**: Only annual mean 2-m temperature is validated in Fig 4a which could mask seasonal biases of opposite sign. Fig 4b seems to show that RACMO2 is too cold in winter and too warm in summer but this validation is limited here to 3 sites. I think that a table showing the biases for the main observational sites and for the 4 seasons should be useful here. The variability (i.e. the standard deviation) of the seasonal means should also be validated. Finally, this table should show which period is used to make the comparison and the statistics (Correlation and RMSE) for each station.

3. Sec 4.1: A map showing the temperature biases at each observational sites will help to better interpret the validation and to understand the comments written pg 574 lines 10-24.

4. **Pg 574 line 21**: the authors should insist that the surface scheme used over tundra and ice sheet is not the same. Differences in the surface scheme could explain why there is a warm bias over ice sheet and cold bias over tundra.

5. Sec 4.1: The 2-m temperature could be compared to the GrIS temperature parametrisation from Fausto et al. (2009, J. of Glaciology, vol 55, no 189, pp. 95-105(11)) allowing a validation at the scale of the whole ice sheet.

6. **Sec 4.1**: If the K-transect measurements are available at a higher temporal resolution than daily value, a validation of the simulated daily cycle/amplitude in summer should be shown, to see notably if RACMO is able to reproduce the daily cycle inducing melt during day and refreezing during night at the beginning and the end of the melting season.

7. **Sec 4.1**: A plot showing both modelled and observed time series of annual mean 2m-temperature at some DMI weather stations over 1958-2008 should be shown here to validate the interannual variability in the model.

8. Fig 4b-Fig5-Fig 6b: If the authors have the data, it should be interesting to add on these plots the ECMW reanalysis outputs for showing the interest of this RCM compared to the reanalysis.

9. Figs 5, 8, 9, 11, and 13: These figures compare RACMO2 to measurements only during 2004. Why is this year chosen in particular ? I think that similar figures for other years and S9 could be included as supplementary material if the comparison is different. This will allow to be more general in the interpretation of the comparison at the daily time scale and not to be limited to only one site and one year.

10. Sec 4.2: As for the temperature, a table listing the wind speed seasonal biases for the principal weather stations of Fig. 6a should be useful here.

11. Pg 576 line 8: the authors describe the seasonal cycle of wind speed along the K-transect but no figure showing this cycle is shown. Perhaps, Fig 6b, instead of showing the wind speed bias, should show the real values of both modelled and observed monthly mean wind speed.

12. Sect 4.3: why do the authors not show a figure similar to Figs 4b and 6b with specific humidity, allowing a validation for S5 and S9 in addition to S6?

13. Pg 578 line 13: the authors found a bias in the simulation of the RH. Is this bias repeated repeated in other years than 2004 ?

14. **Sect 4.4**: a table summarizing the biases in the seasonal mean energy fluxes at S5, S6 and S9 should be useful here as complement of the text.

15. Sect 4.4.1: Fig 9 shows a too early decrease and a too late increase of the snow albedo. Are these delays repeated in other years than 2004 ?

16. **Sect 5**: a table summarizing the main biases (season by season if it is possible) averaged over all the weather stations available is needed here as reference for future improvements in the RACMO2/GR model. It could a table with only +, -, $\sim$, = for comparing RACMO2 performances to observations.

Interactive comment on The Cryosphere Discuss., 4, 561, 2010.