

## ***Interactive comment on “The added value of high resolution in estimating the surface mass balance in southern Greenland” by Willem Jan van de Berg et al.***

### **Anonymous Referee #3**

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The authors present a thorough and systematic comparison of the performance of the RACMO2 regional climate model run over a South Greenland domain for a series of consecutively increasing resolutions (60, 20, 6.6 and 2.2 km). This is a very valuable undertaking and I cannot recall having seen this done for this or other models in this part of the world. This makes it particularly useful as a reference for other modeling groups and further experimental design. The authors also include a second half of the manuscript that aims to give context to the resolution-dependent results by testing the sensitivity of melt and SMB to changes in various physical parameterizations.

The manuscript is generally well-written and well-structured and deals with an inter-

C1

esting and important subject. It was a pleasure to read, although it did become a bit difficult and long to read at times (see detailed comments below). I have only two real concerns (see below) but I believe that the authors can address this with proper disclaimers. I therefore suggest to accept the manuscript with only minor revisions.

#### Major comments

Normally, I would consider the 6.6 km run to be within the grey-zone for hydrostatic physics and the 2.2 km run should be expected to be well within the range where it could break down. The authors do comment on this (eg. L ~365), but concerns about running hydrostatic at 2.2 km should have a more prominent place, including in the abstract, introduction and model-setup section.

The second part of the study where certain physical parameterizations are experimented with is the weakest part of the paper. They do not follow naturally from the former part of the paper and do perhaps even blur a bit the picture from the first, very stringent and systematic half of the paper. Also I am not convinced that the particular processes that are chosen for this set of sensitivity tests are adequately argued for. I gather that this part has been included to provide some sort of comparison of the magnitude of the resolution-change effects, but if that is the case then this comparison should be made explicitly.

#### Minor comments/typos

L11: “almost as well”

L36: “can the SMB be measured”

L50: “type of statistical”

L51: drop “do” before “correlate”

L140: “coarse”

L184: west of Tasiilaq?

C2

Fig 3/4: Consider adding texts to the panels labeling them. That way the figure can almost be read without reading the caption.

Fig 5 etc: Taylor Diagrams are tricky to read for the untrained and the authors do a pretty good job of explaining them. But they could help the reader even more along the way. Also, there are details within the cluster of symbols situated in the lower right corner of Fig 5b. I suggest to include a blow-up of this part of the figure to allow the details to be visible.

L269: drop “of” before “6.6”

Table 4: The caption says “downscaled” several times, but it does not say which resolution is downscaled to.

Caption to Fig 7, second line: “ablation (dots)” should this be “(circles)”?

Fig 7: For some reason, it took me a while to realize that the legend in the top right corner of panel b actually applies to all panels. Can it be placed differently to make this more obvious?

L386-388: Very complicated sentence.

L429: This over-compensation would only occur over ice where the Smeets and van den Broeke-formulation is used, right? Please make this clear.

L438: Why is SMB reduced if melt is reduced?

L451: What happened to the content of section 3.5.5?

L458: as->and

L481: treating L501: I don't really understand the “thus” in this sentence. Do you rather mean “i.e.”?

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-256>, 2019.