

Interactive comment on “A daily, 1-km resolution dataset of downscaled Greenland ice sheet surface mass balance (1958–2015)” by Brice Noël et al.

Anonymous Referee #1

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The main purpose of this paper is to present a new 1-km resolution RACMO2.3 dataset, describing the methods used and the successes and failures of the new data, particularly in comparison to the previous standard 11-km RACMO2.3 output. Certainly a 1 km dataset would be widely used and a great asset to the research community.

Overall, I think the authors need to do a better job of making the readers job easy. A reader is going to be interested in this paper to learn about the 1km product, the advantages and disadvantages it has, and how and when to trust the data. To do this, it's important that the authors do more to translate the technical methods into explanations of actual physical processes and mechanisms. Several examples are mentioned more explicitly below, but a primary example is the sentence at 367: “The extreme eleva-

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tional SMB gradient that results over the narrow ablation zone is then poorly captured at 11-km, and hence also poorly represented at 1-km.” This sentence raised a big red flag in my mind. Isn’t the whole point of this downscaling that it can succeed at better representing things like a narrow ablation zone? With better explanation this might not seem so surprising or at least allay doubts the sentence raises about the broader success of downscaling.

The explanation of some of the downscaling methods is not clear. For example, around line 158, the requirement of 6 adjacent ice-covered pixels is confusing. Please clarify: will a pixel only be considered if at least 6 of its neighbor points are ice-covered? In section 3.2, you’ve explained by 6 points are chosen, but need to provide an explanation for how you decide which 6 points to use. Also, the wording through here can be confusing – e.g., in line 168, does this refer to the 11km or the 1km data?

Comments by line number:

~231-255. This section needs more explanation and translation. The job of the authors is to make the readers job easy. I also thought that the fscale value seems large. Could you add more comment on this? Speculation on how much this influences results? A reader is trying to assess how “true” the results from RACMO2.3 1km product are and some additional comment is needed here to make this clear.

206-207. Can you please provide a citation or additional information about why this is a reasonable assumption?

209. Why is this correction only applied when there’s both surface runoff and melt? Shouldn’t this be corrected for even when there’s only melt because it may actually push the conditions at that pixel into a runoff regime instead of just refreezing or no runoff? Seems like this would influence the correct modeling of runoff extent.

285. How are the climate conditions at Helheim “peculiar”? I’m not aware of any research that discusses conditions there being particularly different than many other

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outlet glaciers. This needs further explanation and/or citation.

297+. This is another area where more explanation would be helpful. Rather than just stating that the bias was removed, can you provide any explanation for the mechanisms possibly responsible for this bias? A justification for this adjustment beyond just making the data fit? This is an important opportunity to build confidence in the model and understanding of what the model does/does not do.

325+. Add % in parantheses with all numbers since you started to do this in this section.

448. The end of the paper does not provide a useful summary conclusion. A useful conclusion would provide a final plain language assessment of the 1km product, the main focus of the paper.

Figure 1. Recommend adding legend to figure for yellow and white points.

Figure 4. This figure is confusing. One simple improvement for a) would be changing the ends of the lines that the arrows are on – the arrow should point from the description to the item it's describing. Also, you should 8 sample points here even though the methods indicate 6 were used – the figure should be as close to the actual case as possible. The panel b was poorly referenced in the text and also confusing.

Figure 7. I found it difficult to compare these plots because they all have different axes. How does the agreement look when all put on the same axes? The location labeling in Figure 1 is poor – it's not entirely clear where these transects are and they should probably be represented by something other than overlapping yellow dots. 79N and Helheim have the same agreement problems near the terminus, but only 1 is mentioned in the text.

Figure 8. How well-paired are these? Since it's the agreement between blue and red that is part of the main point, it's important to have a sense about the how well the points pair with each other. The upper right points seem to suggest that it's quite close

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– is this similar for all points?

Figure 9. Panel labels should be added since these cover such a wide range of variables/values.

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