

Impact of radiation penetration on Antarctic surface melt and subsurface snow temperatures in RACMO2.3p3

By Van Dalum et al 2021

Van Dalum et al. updates in the subsurface scheme in RACMO2.3p3, by setting up different experiments where they change one parameter at the time. They go into depth on how the changes in the different parameters impact the albedo, melt and temperature of the snow. They compare the different experiments with an older version of RACMO and in situ data. They find that the albedo and melt are very sensitive to the parameterization of the subsurface, especially over the ice shelves.

Overall, I find this to be a very nicely written paper, with interesting and important results. However, some comments should be addressed before publication.

Major comment:

It is sometimes hard to figure out what version of RACMO you refer to, e.g. when you write RACMO2 is it then always the polar version or always the non-polar version, and in P3L67, you mention RACMO2 but which version. This is mainly a problem in sections 1 and 2, it decreases the readability of these sections. Please be more clear on this!

Minor comments:

General comment:

In some places such as P11L216-218 and P13L256 you use the wording significance/significantly, whereas, in other places, such as caption in Fig 3 and 7, you use the wording statistical significance. Are there differences between these two wordings? Have you performed a significance test for both kinds of wordings? Generally, the use of the word significant implies that the significance has been tested

In some of the section titles you abbreviate and in others there are no abbreviations, like section 2.2 Surface mass balance and energy budget and section 2.4.1 SMB, or in section 2.4.5 SSA and 4 Specific surface area comparison, please be consistent.

I find the use of the experiment name "Greenland settings/GRL" a bit misleading. I get what you mean, but there were several times when I read the manuscript where I thought of the Greenlandic ice sheet when I read GRL. I suggest that you consider changing this experiment name.

Specific comments:

P1L2: Is it not the same "2" in RACMO2 and in version 2?, so the second "2" is redundant?
"Regional Atmospheric Climate Model (RACMO2), version 2.3p3"

P2L45-53: Specify which time period you are studying

P2L56: Can you please defined what you mean by specific surface area (SSA)

P3L61: Same it P1:L2 comment, maybe just write RACMO2.3 since the RACMO abbreviation is already introduced in P2L45

P3L61: Maybe just write RACMO2.3 since the RACMO2 abbreviation is already introduced on P2L45

P3L61: Should there not be a “p” for polar in version 2.3?

P3L73: Is the alpha solely introduced to tune for this experiment? If so, maybe change the sentence to “and α is a newly introduced tuning parameter to make changes in this study/experiment”

P3L79-90: You write “The latest model version, RACMO2.3p3 (Rp3), includes several updates.” But as far as I understand you are only describing the TARTES scheme and how it works. That is only one update, right, not several? And then in P4L91 you talk about the SLED update, and finally in P4L97 talking about the layer update. Maybe, list all three updates in P3L79 and then go into details afterward, then it is easier for the reader to keep track of the updates.

P4L98-99: You state that the vertical resolution is increased, and Rp3 has 50-60 layers, does that mean the layer thickness decreased, or is it the number of layers that have increased?

P4L98-99: Is the number of layers constant over time and over the domain?

P4L99-101: Sentence is a bit hard to understand, maybe put in some commas like: “The impact of the aforementioned model updates, has for the Greenland ice sheet, been investigated extensively by comparing with in situ and remote sensing measurements

P4L106: Is that the polar version of RACMO2?

P4L107: kg m^{-2} should have a time unit when mm w.e has

P4L119: Just out of curiosity, (you do not have to state this in your manuscript) is the run-off time slope dependent, i.e is the run-off time the same over steep and flat terrain? and what happens if a layer refreezes and thus cannot be penetrated, is the water then treated as run-off?

P7L167: What timely resolution of the QSAT product do you use?

P8L173: Why do you limit the evaluation to the first 2 meters? Is that equivalent to the upper 20 layers in the model?

P10L193-194: What is meant by the sentence “differences with this model version cannot be too large and it is used as a benchmark”

P10L194: What is meant by the sentence “ All implemented changes lower the temperature,” is far as I read/understand figure 3, experiment a and b gets warmer and c, d, and e looks to become colder.

P11L212: showed instead of show

P17L315: Consider merging section 6 Surface mass balance and 6.1 melt into one, since melt is discussed in both.

P19L329: Just use QSCAT, since you already introduced this abbreviation in section 2.4.3

P20L349-352: This statement belongs in section 7

P21L364-365: The sentence “For some areas, however, the 2-m temperature is now somewhat too low.” does not sound like a conclusion, try to quantify the bias and rephrase

P25L480: The Mottram et al paper, is no longer in The Cryosphere Discussion, but in The Cryosphere

Figure comments:

Figure 4: In the legend the Obs dot is shown it full black, whereas on the plots it is shown as a red dot with a black outer edge, please change it to the same color.

Figure 4: In the caption, change the date to 5th of January or January 5th and the same for the other dates

Figure 7a: Please use a sequential color map instead of diverging

Figure 8: Please make it wider, it is hard to see the timely fluctuations

Figure 9: Can you make higher values in the colorbar, it looks like Delta melt for GRL is much higher than 150 mm per year

Figure 10: Same comment as Figure 9

Figure 11: Same comment as Figure 9

Figure 11a: Please use a more sequential color map