

Interactive comment on “Impact of updated radiative transfer scheme in RACMO2.3p3 on the surface mass and energy budget of the Greenland ice sheet” by Christiaan T. van Dalum et al.

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Dear authors, cc: referees,

Now, you have received two referee reports and one short comment. I would like to thank the reviewers and Vincent Verjans for providing constructive comments/suggestions. I believe they will increase the quality of the manuscript certainly, so I hope that you revise the manuscript considering these comments/suggestions thoroughly.

I also list my specific remarks as follows:

Title: I agree with the comment by Referee #2 on the current title. When I first read the title, I imagined you would discuss a radiative transfer scheme in atmosphere; however, it turned out that the main purpose of this study is to discuss impacts of a radiative transfer scheme for snow and ice. Can you specify in the title that you focus on a radiative transfer within snow and ice in this present study?

Sect. 6.3: I agree with Vincent Verjans that the discussion in Sect. 6.3 is a bit difficult to follow due mainly to typos. Please check and reformulate the subsection carefully.

Throughout the manuscript, you explicitly indicate “snow melt”. But do you really want to distinguish snow melt and ice melt in this study? I think indicating just “melt” throughout the manuscript may be enough.

L. 23: The intention of “darkening of the snow pack” is unclear. Please clarify.

L. 36: “ground” -> “subsurface conductive”

L. 79: Please define Bands 13 and 14 here.

L. 116: “(4 minutes)” should be indicated earlier in this section, e.g., L. 100?

L. 107: The direction of the flux $F(z)$ should be introduced.

L. 118: More detailed explanation of “maximum skin layer equilibration depth (SLED)” is needed.

L. 143: For “grain radius”, you should specify whether it is geometrical or optical. This is also the case for other parts that mention snow grain size. For example, this point is particularly important when readers see Figure 8.

L. 147: For Rp3 WIE, you should mention whether the internal energy absorption is discarded or added to the surface; I realized that this point is explained at L. 368. But L. 147 may be the better place to explain that.

L. 177: “The SMB changes are typically significant with respect to the inter-annual

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variability if they exceed 20 mm w.e. yr⁻¹”: From which figure can we see this?

L. 254; “net absorbed longwave radiation” -> “net longwave radiation”

Figure 7: It is difficult to distinguish Rp2 and Rp3 in this figure. Can you update the figure? A similar comment is provided by Referee #1.

L. 258: “net absorbed shortwave radiation” -> “net shortwave radiation”

L. 260: Please specify “the onset of the accumulation season”.

Figure8 caption: “(a), (b) Grain radius and (c), (d) absorption of solar radiation” -> “(a), (b) Grain radius and (c), (d) absorption of solar radiation simulated by Rp3”

L. 288: “visible light” -> “UV and visible light”

L. 294: “drops” -> “reductions”

L. 308: “temperature profile” -> “temperature profiles”

Figure 10 caption: “temperature profile” -> “temperature profiles” * There are two places.

L. 329: “temperature profile” -> “temperature profiles”

L. 349: Please consider adding a reference for this argument.

L. 367: “the SMB, snow melt and refreezing difference” -> “differences in the SMB, snow melt and refreezing”; Please also check whether “snow melt” is an appropriate word or not as mentioned above.

L. 369: “melt” -> “meltwater”

L. 372 ~ 373: “More importantly, however, is that internal radiative heating reduces refreezing in the ablation zone (Fig. 12c), especially in the southwest, but also in the northwest and northeast (area C, D and B of Fig. 2c, respectively), so that runoff increases, reducing the SMB.”: This sentence seems strange to me. Please check the

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sentence as well as Fig. 12 carefully. It seems to me that the SMB in the ablation area is simulated to be higher for the Rp3 than Rp3 WIE.

L. 372: “area C, D and B” -> “areas A and B”

L. 373: “melt” -> “meltwater”

L. 378 “albedo decrease” caused mainly by what?

L. 403: “resolution” -> “horizontal resolution”

Appendix A: The first diffusion equation contains a typo.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2020-259>, 2020.

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