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Interactive comment on "SEMIC: an efficient surface energy and mass balance model applied to the Greenland ice sheet" *by* Mario Krapp et al.

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We are grateful to the referee for reading our manuscript and we thank for her/his comments.

In the following we reply to each of the referee's comments. We highlight individual parts of the comments that we are going to address in italics. Our response is put below each comment together with our proposed changes to the manuscript; where these changes will appear in the revised manuscript is put in parentheses.

- *page 3, line 19: rho of w (density of water) should be defined here.*
  - Yes, we need to define ρ_w here and will do so in the revision. (page 3, line 19)

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- *p.3, l.26 "For faster computation. . . " - faster than what? Please clarify.*
  - We meant faster computation because of the daily time step. Of course this is relative, so we will delete that phrase and instead simply state: *We use a time step of one day.* (p.3, l.26)
- *p.5, l.15: please add comma after "A set to zero".*
  - We will add a comma to clarify that sentence. (p.5, l.15)
- *p.6, l.3 water density is defined here but should be defined earlier on p.3 (see above).*
  - In the revised manuscript, ρ_w should be already defined before as mentioned in the first bullet point.
- *p.6, l.18 "We neglect refreezing of melted ice and treat ice melt as runoff." - what is the basis of this assumption? Is it reasonable and realistic for the GrIS? Adding a sentence or two of justification here would be helpful.*
  - Ice itself does not retain any meltwater at the surface and we assume that it has a water holding capacity of effectively zero. If a snow pack is present we assume that it can retain melt water. However, it turns out that we have missed adding a refreezing fraction f_R to the rhs of Eq. (16c), which reduces the potential refreezing according to this parameter. In the revised manuscript f_R is one of the free model parameter and included in the parameter calibration (varying between 0 and 1).
  - In the revised manuscript Eq. (16c) should read: $R = R_{\text{rain}} + R_{\text{melt}} = f_R(R_{\text{pot,rain}} + R_{\text{pot,melt}})$ with f_R being the refreezing fraction and a free model parameter.

- To explain the neglect of refreezing of melted ice, we suggest the two sentence from above: Ice itself does not retain any meltwater at the surface and we assume that it has a water holding capacity of effectively zero. If a snow pack is present we assume that it can retain melt water. (to be added to p.6, l.18)

- *p.7, l.8: "Tmin is set to 263.15K as originally proposed" - How reasonable is this assumption and is it supported by in situ and/or satellite data? What is the sensitivity of model results to varying it by several degC plus and minus?*

  - After revising the albedo parameterisation we decide not to use the proposed approach by Slater et al. (1998). We find that $\alpha_{s,\max}$ and $\alpha_{s,\min}$ are only a couple of per cent apart of each other, (0.77 and 0.80, respectively in the submitted manuscript, see Table 1). This means that the overall effect of this parameterisation will be at max 3 per cent, which is not much added value in our opinion. Instead, we decided to reduce the complexity of the albedo parameterisation and the number of free model parameters. Hence, $\alpha_{s,\min}$ and $T_{\min}$ are no longer needed. However, for other (future) application we keep the albedo in the model to be chosen by the user optionally but will not mention it in the manuscript to avoid confusion.
  - We propose to simplify Sect 2.4 (Snow albedo parametrisation) in the manuscript. The albedo parameterisation simplifies to $\alpha = \alpha_s - f_a(\alpha_s - \alpha_{bg})$, i.e., Eq. (19). Eq. (18a,b) are no longer needed. Changes in Sect. 2.4 and throughout the revised manuscript will be made accordingly. (Sect. 2.4, p7-8)

- *p.8, l.1 reword to "we refrain FROM USING. . . "*

  - We will revise this part of the manuscript because of justified comments by the second referee, who suggests to use more than three years for the

calibration to make a more robust parameter estimation. (p.8 ll.1-4)

- *p.8, l.15 -> "are close TO their expected trajectories."*
  - We will change the sentence as proposed.
- *p.8, l.24: -> "while also allowing THE ASSESSMENT OF variables with different units."*
  - We will change the sentence as proposed.
- *p.10, ll.4/5: "While melting over the northern part of the ice sheet is overestimated by SEMIC, it is underestimated over the southern part of the ice sheet" - this seems opposite to what I interpret from studying Figure 3 - please check.*
  - No, the difference between SEMIC and MAR is positive in the northern part and negative in the southern part of the ice sheet. Here, melt is defined as positive quantity, althought the loss of mass by melt is negative in a physical sentence. But apparently this is be confusing so we suggest to add a sentence here. For example this might be helpful:
  - Note that melt is defined as a positive quantity but is subtracted from the surface mas balance (p.10 l.5)
- *p.11, l.8: -> "However, the surface mass balance itself is less sensitive TO A than melting."*
  - We will change the sentence as proposed.
- *p.19, Figure 3 caption -> "The outlined contourS SHOW the boundaries. . . "*
  - We will change the sentence as proposed.

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Mario Krapp (on behalf of the authors)

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