

## ***Interactive comment on “Sensitivity of the Greenland mass and energy balance to uncertainties in key model parameters” by Tobias Zolles and Andreas Born***

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Review of Zolles and Born

Characterizing model sensitivities is an important step towards reducing uncertainties in model projections, making the manuscript both timely and useful. The model setup based on Sobol Sequences is carefully done and the use of global sensitivity analysis appropriate, GSA should become a mainstay in a modeler’s toolbox. My main criticism relates to the structure and language of the paper, not the science. The manuscript lacks clarity and precision. To improve readability and to make the manuscript more engaging and flow better, I suggest some reorganization and rephrasing:

C1

- When possible, switch from passive to active language (e.g. “Here we set  $x = 20$ ” instead of “ $x=20$  is being used in this setup”). “Figure Z shows what X depends on Y” could be rephrased to “We find that X strongly depends on Y (Fig Z)”.
- When presenting and discussing results, make sure that figures and tables are referenced whenever applicable. This makes it easier for the reader to follow.
- Try to reduce the frequent use of “this” and “these” to improve clarity and readability.
- I think the equations underlying the different parameterizations that are part of your uncertainty quantification are not crucial for the message of the paper. Consider moving the details to an appendix.
- Since you only analyze and discuss main effect Sobol indices, you could simplify the paper by removing mentions of total effect indices, unless you have a good reason to keep them. (A single sentence what total effects are and why you exclude them may be sufficient).
- Before submitting I recommend having the manuscript proof read by a native speaker to iron out remaining minor issues.
- I agree with the other reviewer that more focus and precision is needed in the results section.

To the best of my knowledge, a novelty of this manuscript is to present spatial patterns of the Sobol indices. Aschwanden et al (2019) and Bulthuis et al (2019) only showed Sobol indices of scalar quantities. It may be worth pointing this out.

Fig. 6 vs 7: In Fig 6, the mean is always lower than the median, which is not the case in Fig 7. What does this say about the underlying PDFs?

In equations I recommend using roman font for sub- and super-scripts if they do not describe variables, e.g.  $Q_{\text{in}}$ . Use of  $SMB$  and variables like  $SW$  are always tricky. Writing  $(1-\alpha) SW_{\text{in}}$  could be interpreted as  $(1-\alpha) * S$

C2

\* W\_{in}.

Rewrite paragraph about the global sensitivity analysis (p 7, l 12-20). I wonder if it would be better to first outline how you designed the ensemble and what method was used to draw from the parameter space, and then introduce the global sensitivity analysis that you use to analyze your ensemble.

Please find technical comments attached. I've tried to make suggestion how to rephrase sentences here and there, but these comments are not exhaustive.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2019-251/tc-2019-251-RC2-supplement.pdf>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-251>, 2019.