

Answer to the anonymous referee 2

We would like to thank the referee for providing feedback on our study a second time. We add the remarks from the reviewer from the initial review in this document too:

“There is no proper response to reviewers document. The points in my original review have not been adequately addressed (e.g. use of ERA5-v.ERA-I reanalysis dataset) or those that have are unclear (labels on Fig. 4; large dew-point changes shown in Fig. 4). I suggest a revision is necessary which addresses point by point all the points in the original reviews. Until this is done, I am unable to recommend acceptance.”

We realize that our reply in the first round of revisions was too brief. We therefore include the original comments here again, along with a more detailed explanation.

“ERA-5 data are available back to 1950 and are based on a superior model. Why was the older and shorter ERA-I dataset used?”

The primary objective of our study is to quantify the effects of using either transient or climatologically averaged data. All comparisons are done within this consistent framework that does not directly depend on the overall realism of the simulations. Hence, we do not expect a qualitative difference between the two reanalysis data sets. It is possible that the superior data set results in a slightly better simulation of the average SMB over Greenland, not least because of its higher resolution and a better representation of the ablation region. In addition, significant differences of ERA5, e.g., about 1K colder temperatures over Greenland when compared to ERA-interim (Krebs-Kanzow et al., 2023) would lead to a different calibration of BESSI. While it is conceivable, for a nonlinear system, that this change in model parameters does not only change the average state but also its sensitivity to variations, we deem this possibility unlikely and outside the scope of this present study. Lastly, our study uses a model version of BESSI that was calibrated using ERA-interim and data from the RACMO2 model that also used ERA-interim as input data. It is the same model version that was used in the GrSMBMIP project (Fettweis et al., 2020). These considerations added to our decision to continue using the ERA-interim data set for this study.

We added the following paragraph to the manuscript. A version of this text was also included in our first revision, but we failed to highlight this in our point-by-point reply. This new text can be found in the revised manuscript on page 14.

“The last 40 years, using the ERA-interim forcing, with its temperature trend (Hanna et al., 2021) can be considered an upper boundary for a “steady state climate”. Similar results are to be expected for the improved 5-th generation ECMWF reanalysis, ERA-5 (Hersbach et al., 2023), but due to prior tuning of BESSI with ERA-iterim and ERA-iterim forced data, this study was conducted using these data sets. It is the same model setup apart from long-wave radiation down-scaling, which was used in the GrSMBMIP project \citep{SMBIP2020}. We do not expect any qualitative changes for changing to ERA-5 data, though the extended length of the ERA-5 dataset ranging back to 1940 would require less repetitive cycles of the same forcing to reach a simulation length of the order of 500 years.”

Figure 4 caption comment “If transient variables are taken individually the precipitation lowers SMB the most”, I don't fully follow this. To me the means look quite close for panels e & f for precipitation.

Other climate variables have their respective climatological and transient forcings affecting their means by typically greater amounts.

Also, the labels "all climatological except" and "all transient except" at the top of Fig. 4 seem unclear and should be clarified.

In addition to adjusting the caption in the first revision, we changed the labels to include more information within each panel. This now includes directly highlighting the parameter to focus on. After consulting with several colleagues from within and outside our field, we decided to keep the original structure using 2x6 panels structure, but modified the labels for each column and row.

p.8, l.133 "...which is in line with the low effect the dew point change has (fig. 4 k, l)" – it looks like there is quite a large change in the means of dew point relative to other climate variables, so can this point be clarified?

We furthermore investigated the effect of the transient dew-point. Which has a rather large effect on the otherwise climatological forced SMB (fig. 4k). We analyzed total SMB, melt, and the turbulent latent heat flux over Greenland for this, comparing the simulations for 4a and 4k. The results are added to the results section Climatological forcing / Intra-annual variability around line 130-150. As the effect of the dew-point on the SMB is two fold in case of melting conditions and dry conditions, it varies over space and time. While in the melting region a lower dew-point will result in an increase in SMB (cooling due to more sublimation), it will result in a decrease (mass loss) in the dry region, to said sublimation. Drawing conclusions out of this dewpoint effect for different climate states is therefore more difficult than for the other parameters and we therefore did not focus on it in the initial submission.

Answer to Robinson Alexander

We would like to thank the reviewer for the second assessment of our work:

The authors have thoroughly revised the manuscript, and I believe it has improved significantly. I would offer only the following minor suggestions for improvement before publication:

L16: sea level rise => sea-level rise

L17: becomes the dominant component => becomes dominant

L70: Consider deleting this line and instead simply stating something like "as explained below", since here you have not yet defined the terminology F-BWD etc. You could put this specific example below after defining the terms.

L80: "less" here is not clear, can you rephrase somewhat?

L82: temperature ordered forcing => temperature-ordered forcing

L121: The daily climatology => Forcing with the daily climatology

L123: which comprises of => which is comprised of

L125: that daily climatologies => that using daily climatologies

L140: effect of => effect of using

L154: monthly some => monthly sum

L154: even than => even then

L166: this simulations => this simulation's

L167: it was => so it was

L190: steady state climate => a steady-state climate

L190: climate, similar => climate. Similar

L192: interim.. => interim.

L194: inter annual => inter-annual

L203: bases => basis

L204: a physical more reasonable way => a more physically reasonable way

L206: ways how to => ways to

L223-224: Not a complete sentence, please revise.

L224: we cannot => and we cannot

L230: As not in all cases transient data will be easily available => As transient will not always be readily available

L238: "They all share the same climatology ..." <= This sentence is unclear, please revise.

L247: Though => However

L250: transient climate => transient climate data

Best regards,
Alex”

We applied all the changes listed above and thank the reviewer again for their work.