**Author's reply to referee comments**

We would like to thank the referee for their valuable and constructive comments, which will help improve the clarity and quality of our manuscript. Below we provide point-by-point responses.

**Reply to referee comments 1 (RC1):**

**Main comments:**

**Comment (1):** From a general perspective, I recommend providing more detail in the Experimental setup section. Although the authors reference other papers for different part of the method, the originality of this study relies on the methodology itself, so it is essential to describe it as clearly as possible. See the minor comments, but feel free to go beyond them to improve clarity. For instance, I also suggest including a figure to illustrate the 4 methods used for considering the feedback. This section could also be made more consistent in the description of the different experiments, for example, by standardizing the variable names in the equations (see minor comment).

**Response:** We agree and will expand the *Experimental setup* section, standardize variable names, and include an additional schematic to illustrate the four methods.

**Comment (2):** The discussion is already well developed, but I recommend addressing these few following points:
- Discuss the influence of the differences in initialed topography for CISM and MAR topography (on which the SMB is computed).
- NorESM and other ESMs used do not account for evolving ice sheet topography. This could be a source of uncertainty as changes in topography of the ice sheet may influence large-scale climate circulation. What would be the potential influence on your results?
- On shorter time-scales, depending on the ocean conditions considered here (see minor comment), are there any uncertainties to mention? As the atmosphere warms and changes, ocean conditions also evolve. This may affect the mass loss of the ice sheet, and I guess this could add some uncertainties to the results obtained here, as far as ice sheet is not completely retreated inland.

**Response:** We appreciate these valuable suggestions and will incorporate these points in the discussion of the revised manuscript.

**Response to minor comments:**

**Comment:** L40: "Simplified physics" for atmosphere ocean and land/polar surface processes?

**Response:** We will specify that this refers to simplified representations of atmosphere, ocean, and surface processes.

**Comment:** L120: How CISM considers icebergs and their contribution to the total mass balance?

**Response:** The handling of ice bergs is mentioned in L. 122-123. We will further clarify and expand this description.

**Comment:** L120: Could you precise what CISM is considering for ocean conditions?

**Response:** The handling of ocean conditions are discussed in L.145-146. We will further clarify and expand these descriptions (see also response to comment L145-146).

**Comment:** L142: MAR v3.12 (Fettweis et al., 2017) à more recent reference actually using MARv3.12: Lambin et al. (2023)

**Response:** Thank you, we will use this more recent reference.

**Comment:** L142: As I guess MAR didn't run on CISM 4km grid, did you receive the SMB and ST products from MAR already interpolated on the CISM 4km grid? If not, could you precise how did you interpolated it on the 4km grid? And I guess that this interpolation is the first step before using it to calculate your SMB anomalies and remapped SMB? Precise if necessary.

**Response:** We will include a description of the interpolation procedure used to remap MAR outputs onto the 4 km CISM grid.

**Comment:** L145-146: "Outlet-glacier retreat is prescribed via retreat masks up to 2100, after which the mask is held fixed. " Does it mean that the ice sheet is retreating with a constant rate after 2100? Please clarify here.

**Response** The retreat mask is fixed after 2100, meaning the ice sheet can retreat further but cannot re-advance beyond the mask. We will specify this in the revised manuscript.

**Comment:** L141-147: When saying that the mean value is repeated, I guess you're talking about the SMB values used as forcing for the ice sheet model. Please clarify.

**Response:** Correct, we will clarify that this refers to repeated SMB values used as forcing.

**Comment:** L160: Could you also specify to what you refer with SMB_ref_ERA5 ? I guess it's the annual mean SMB for the reference period (1960-1989) from MAR-downscaled ERA5 SMB.

**Response:** Confirmed, it refers to the annual mean SMB from MAR-downscaled ERA5 (1960–1989). We will clarify this in the revised manuscript.

**Comment:** L163: An extra figure illustrating all your 4 methods could be interesting to well understand how these 4 methods are working, and what's common or different between them.

**Response:** We appreciate the suggestion and agree that a visual summary could help clarify the differences and similarities between the four forcing methods. We are currently exploring how to extend Fig. 1 to include an illustration of all methods and will aim to include this in the revised manuscript if we find a suitable approach.

**Comment:** L168: If I understand well, SMB(h_fixed) = SMB_ESM(t) from equation (2). If these 2 variables are referring to the same thing, could you rename with the same name? This way, it could be easier to compare methods.

**Response:** These are not equivalent. SMB(h_fixed) in Eq. 3 is equal to SMB(t) in Eq. 2. We will unify notation where appropriate and clarify the distinction.

**Comment:** L176: I would add "total" or "full-SMB" (+ and anomalies remapping) in this title to be clearer and not be confused with the title of point 2.3.4. Or call it remapping method.

**Response:** Agreed, we will revise the title to clarify that this refers to full SMB and SMB anomalies.

**Comment:** L222: As you used the mean SMB 2180-2100 to extend your simulations, I guess you also used a same lookup table from 2100 to the end of your simulations? If yes, could you precise it in the text as well as if it's a "mean lookup table" of 2180-2100, or the one in 2100,...? Otherwise, could you detail what's used after 2100?

**Response:** Correct, we use a mean lookup table from 2180–2100. We will state this more clearly.

**Comment:** L229-231: As I'm not sure to well understand how exactly you interpolate the SMB values from the lookup table with the new elevation of the model (and the basin classification), could you be a bit more specific for the points 2 and 3?

**Response:** We will provide a more detailed description of this process.

**Comment:** Figure 4: It could be useful to display the SMB differences here instead of in the Appendix. Differences are more visible. You could perhaps merge both Figure 4 and A1 into one and refer to this one in your Appendix. Because you're describing these differences in an entire paragraph (L268-274).

**Response:** We will merge Figure 4 and A1 to improve clarity and emphasize the SMB differences.

**Comment:** L278: I guess you didn't remove any drift of your model of these results. But, if you have quantified it, could you mention it and compare it to the differences you obtained here (3.4Gt) when explaining that this value is smaller than the uncertainty of your model, or detail this uncertainty?

**Response:** We account for historical "drift" as part of the physical response to past forcing. We will clarify this distinction and expand the discussion of uncertainty.

**Comment:** L375-376: "The runs suggest that any eventual ice sheet stabilization is highly sensitive to both the emissions pathway and the choice of ESM. " I suggest also to add, here, or in another paragraph talking about the RCM, that it's also dependent of the RCM used to downscale ESM's climate and "translate" it into SMB.

**Response:** Agreed, although our study uses only one RCM, we will acknowledge the influence of RCM choice and cite relevant studies.

**Comments referring to Typos:**

**Response:** Thank you, all noted typos will be corrected.