Response to the review by Fuyuki Saito

We thank the reviewer for constructive and helpful commentaries. We would hereby like to address the concerns raised. Reviewer comments are shown in bold and our responses are shown in regular font type.

Description of the ice-sheet model: Section 2.1 describes the ice-sheet model briefly, but I feel it too short. A complete repeat of the previous papers are not necessary, but at least the description of the methods relating to the sensitivity experiments of the present paper should be included in detail.

We will improve the model description section based on the suggestions listed below (treatment of grounding line migration, modelling of proglacial lakes, and basal sliding).

Additionally, we will add an appendix which describes the till friction angle, basal hydrology and resulting basal friction.

(i) how to deal the grounding line migration in the model. it is all right without any special treatment, but mention explicitly.

We use a sub-grid friction scaling scheme to achieve good grounding-line dynamics at relatively coarse resolutions, similar to e.g. CISM (Leguy et al., 2014; The Cryosphere) and PISM (Feldmann et al., 2014; Journal of Glaciology). The IMAU-ICE model description paper (Berends et al., 2022; Geoscientific Model Development) showed that this enables IMAU-ICE to resolve the migrating grounding line to within a single grid cell. We will add several sentences explaining this in more detail.

(ii) how to deal the formation of proglacial lakes. I suppose that the depth of lake is the difference between the background sea level and the bedrock.

This is correct. We will explain these in more detail in the method section of the revised manuscript, and justify our choice for this simplification.

(iii) explicit equation of basal sliding, and the difference in how to apply between base-line and rough-water experiments.

The equations governing the basal roughness, basal hydrology, and the sliding law, will be added in an appendix. We will also include a more thorough description of the Rough Water simulation, in which the basal friction is treated the same regardless if the ice is floating or not.

Other points:

Abstract: There are no description of the method used in the present paper, even no explanation that the discussion is based on a series of numerical simulation. This must be clarified.

This is indeed an oversight in the abstract. We will add a few sentences describing the methods in the abstract. These include 1) explicitly mention we have conducted a numerical modelling study and 2) that we varied the representation of certain processes in this model to determine the effects of GIA, ice-dynamics and basal melt.

BMB experiments: Typical mass balance terms, both surface and base, over ice shelves in the baseline experiment should be mentioned, which will help to get typical ratio of surface/basal mass balance terms.

We will add a figure to the paper comparing BMB, SMB and ice volume to the supplementary information.

Figure 2. Plotting two points corresponds to PI and LGM may help.

We will add a point for LGM and PI. We have tuned the insolation to be able to simulate glacial cycle periodicity and obtain a reasonable LGM volume and melt at present-day. Though, since PI and LGM have different insolation at 65N, at 280 ppm CO_2 and PI insolation will be close to, but not exactly match, present-day conditions.

Figure 3. Better to mention in the caption that this is the result of baseline experiment.

We will add “Baseline” to the caption to show that this is indeed the Baseline experiment.

Figure 4 and main text. Please note the definition of the onsets of (de)glaciation in this paper. Why some points (e.g., 240ka in the total and Eurasia, 290ka in North America) are not detected as the onsets?

The onset and termination points were based on a few thresholds. First of all, the ice sheet needed to be big enough and melt for a long enough duration. However, we have decided to change these thresholds and rework the figure.

The following changes will be made to improve the figure.

1) The red “onset of deglaciation” points are now located at the right location (so only at glacial maxima).

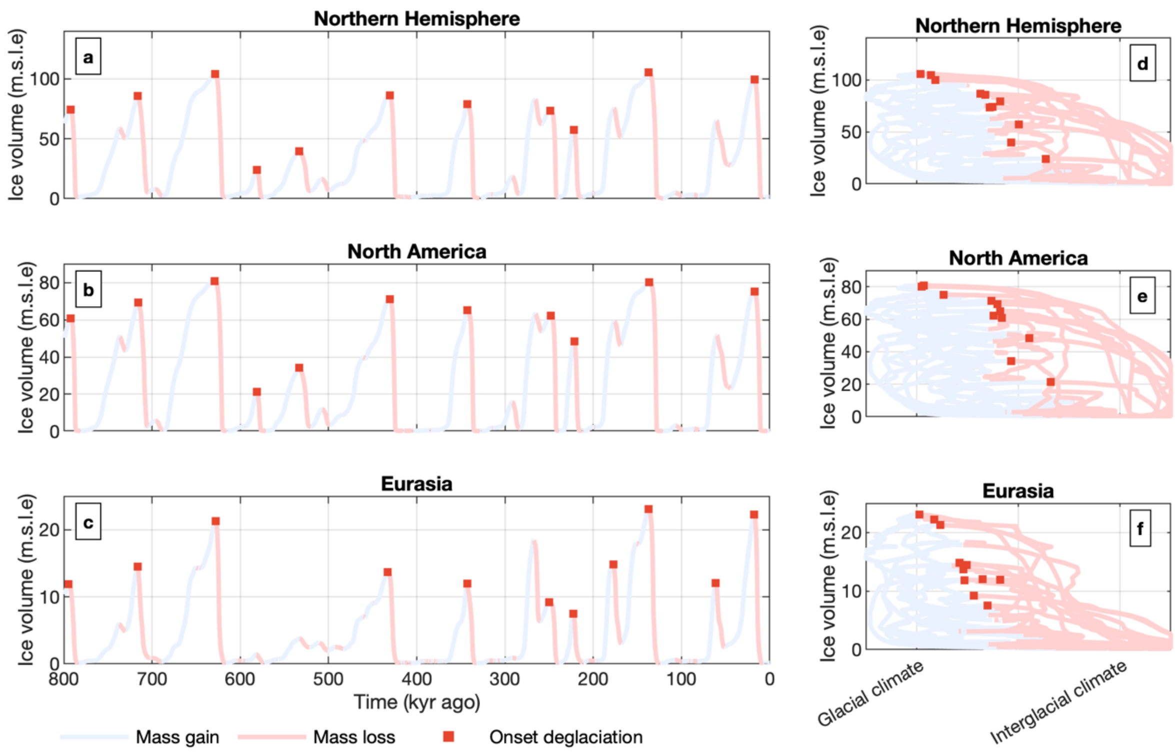
   An “onset of deglaciation” point is now added when the ice sheet melts at a large enough volume (at least 20% of the modelled Late Pleistocene maximum) and has melted enough ice (less than 20% of the maximum Late Pleistocene volume remaining). These thresholds will be added to the caption.

2) The blue "onset of glaciation" points have been removed as they added little to the overall story while making the figure more complicated.

3) "External forcing index" is replaced by "glacial" and "interglacial" climate to make the figure easier to understand.

4) Figure 7 (a similar figure) has been removed and replaced by 2D ice thickness maps.

We have added the reworked figure below which shows all the changes mentioned above:



Appendix Eq.(1) Please clarify that f_{snow} is no more than 1. I calculated by hand, and observed that f_snow become 1 when T - T0 is around -10K, and exceeds 1 when -11K. I am not sure my rough computation is correct, but please clarify the actual computation of f_{snow} (Of course it is all right if T - T0 is always more than -10K).

f_snow in the model is limited between 0 and 1, though this was not stated in the manuscript. Therefore, f_snow will not exceed 1 even when temperatures are well below 262K. We will add a sentence clarifying that f_snow is limited between 0 and 1.

Melt_{prev}. Again, it is hard to check whether the albedo is between 0 and 1 by this equation.

Eq (4). Need units of the coefficient 0.012.

Eq (21). Need unit(scale) of P_{PI,corr} to compute log. Or, is the first term e means exp() function, not e times ()?

We will add units to these equations. For equation 21, this should have been exp, and we will change it accordingly. A similar change will be made in equation 3.