Response to Reviewer 1

We are grateful to the reviewer for the friendly and constructive review containing valuable remarks and suggestions for our present and future work. The suggestions will greatly improve our present paper.

The comments by the reviewer are in indented blocks and italic fonts.

Response to specific comments

> *The manuscript is well organized and clearly written, but I find the discussion of the results and comparison with data or other studies quite qualitative and think it would improve the paper if the authors would make more quantitative analysis of their results, see numerous comments below.*

Thank you very much for your positive opinion. In the revised version of our paper, we will quantify our analysis in all cases possibly.

> *The description of the forcing scheme is not clear (section 2.6) as it is not clear how the model applies the temperature defined in equation 8, as it seems that according to equation 10 the mass balance is only the difference between the modelled and measured elevation, divided by relaxation constant. Is this really the case, or is missing a description of a positive degree day method to compute the surface mass balance during the spin up period and current equation 10 would be one term of that forcing?*

The surface temperature defined in Eq. 8 applies directly to the surface of the ice sheet. Indeed, the first paragraph of this section is not fully clear. We will change the first paragraph by stating explicitly what our boundary conditions are. In our approach, the implied flux (now implied SMB, Eq. 10) is indeed only the difference between the observed and modelled surface elevation divided by a relaxation constant. We do not need any additional forcing in surface mass balance (SMB) for the palaeo runs, as the implied SMB flux (now named implied SMB) is the SMB that keeps the ice sheet on its observed shape, whereby the relaxation constant determines how close the model ice sheet is kept to the observed. The computation over the glacial cycle serves to yield the palaeo temperatures inside the ice sheet. The implied SMB at present-day is a by-product of this computation. In particular at the end of simulation, the implied SMB sustains the ice sheet near the observed present-day one. If there were not any model errors, the implied SMB would agree relatively well with the observed SMB. However, because there are model errors – in particular in areas where the model cannot resolve outlet glaciers – the implied SMB is nothing else than the observed SMB plus a correction of the errors of the ice sheet model. Please see also the figure, which we attached to our response to reviewer 2. We will add additional clarifications on this subject to Section 2.6.

> *The naming of the implied flux (equation 11) is confusing, suggest to call it something that indicates surface mass balance.*

This is good point. We will rename implied flux into implied surface mass balance, implied SMB.

> *The introduction section is comprehensive and gives a good overview of the current state of development of large scale ice sheet models, and there is an impressive reference list for this study. I find, however, that the first part of the introduction should have more references for the general statements (page 1, lines 21 and 22, as well as page 2 lines 1 and 2) or at least indicate that these are not the only papers stating those broad things, with "e.g." before that one reference.*

We will add at least five more new references, which we now found to the paragraph. After all, we cannot add all references. For the theme on accelerating mass loss, we consider to include an "e.g."

Response to minor comments

Thank you very much for all your comments. We will address all minor comments appropriately.