In the following, the reviewer comment are in blue and our response in black.

The manuscript presents the results of a fully coupled Northern Hemisphere ice sheet—climate model applied to the last two glacial terminations. The manuscript is well-written and nicely illustrated. The description of the model, coupling and sensitivity analysis is mostly clear but could benefit from some minor additions. Overall, I enjoyed reading this paper and I am sympathetic to the aims. I am not suggesting the authors conduct additional experiments. I hope my comments help in improving the manuscript.

Thanks for your your positive evaluation of our manuscript and your useful comments. We have taken them into account for our revised version. Detailed answer to your individual comments are provided in the following.

Comments

Alternative PGM ice sheet geometry:

The manuscript would benefit from a more detailed explanation of how the alternative ice sheet geometry has been applied. In the methods section, it is only briefly mentioned in L169 and in the results (L345 to L348). It would be valuable to explore the regional and large-scale impacts on the climate resulting from this new ice sheet configuration as well as its implications on the timing and on the deglaciation history during the TII.

We agree that we did not put too much weight on these sensitivity experiments in the initial version of our manuscript. The alternative ice sheets have been obtained by changing regionally the ablation parameters during the ice sheet spin-up (uncoupled experiments). These parameters were increased in North America (more melt) and reduced in Eurasia (less melt). Then we simply used these new ice sheets as initial ice sheet conditions for our transient alternative TII experiments. We added a few sentences in the revised manuscript to make it clearer.

We have also included a figure that present the individual ice sheet volume evolution (Fig. RA1) through TII for the three initial ice sheet states. As shown in this figure, there is no major differences between these experiments using alternative geometries and the reference experiment. The largest Eurasian ice sheet helps maintaining a colder Northern Hemisphere climate. This tends to delay the retreat of all the Northern Hemisphere ice sheets, including the North American one. Although initially smaller compared to our reference configuration, the North American ice sheet retreats almost one thousand years later when using the largest Eurasian ice sheet. These additional elements of discussions have been added in the revised manuscript.

The revised manuscript now contains a discussion section in which we present the atmospheric circulation differences between the PGM and the LGM, focusing on the impact of these different ice sheet topographies.

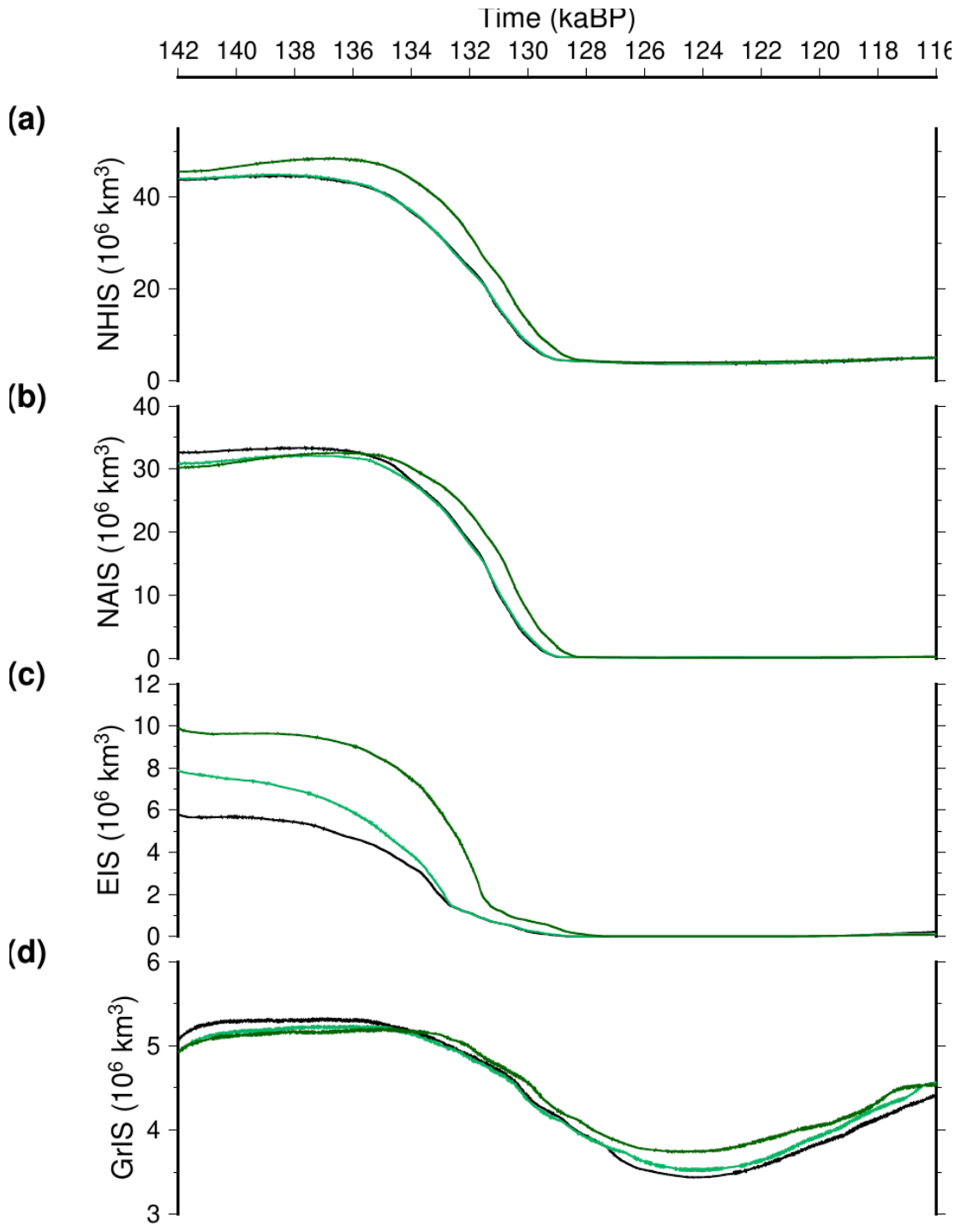

Figure RA1. Temporal evolution of individual ice sheet total ice volume across TII using different initial ice sheet geometries. **(a)**: Total North Hemisphere ice sheet volume. **(b)**: North American ice sheet volume. **(c)**: Eurasian ice sheet volume. **(d)**: Greenland ice sheet volume. The experiment that uses the reference ice sheet is in black while the experiments with slightly larger (+36 %) and larger (+71 %) Eurasian ice sheet volume are in light and dark green, respectively.

Atmospheric resolution:

It would be beneficial to include a discussion on the limitations due to the climate resolution. The simulations are based on the intermediate complexity climate model iLOVECLIM, with an atmospheric resolution of T21. Previous studies have established the implications of coarse-

resolution climate models in the modelling during the last glacial maximum and the deglaciation (eg. Lofverstrom et al., 2018; Lohmann et al., 2021).

It is true that the atmosphere in iLOVECLIM is simplified. The dynamical core uses the quasi-geostrophic approximation with some additional ageostrophic terms for a better representation of the Tropical circulation, in particular Hadley cells (Opsteegh et al., 1998). We agree that the atmospheric model resolution, but also simplification in its physics, can have important impact on the simulated ice sheets. This is now discussed, also with respect to the existing literature, in the new discussion section of the revised manuscript.

Other concerns:

To make the paper more accessible to a broader audience, including non-modellers, it may be helpful to explicitly state that the primary aim is not to precisely replicate the timing and pattern of deglaciation but rather to explore the model's sensitivity throughout both terminations. This clarification can aid in ensuring that readers from various backgrounds can appreciate the study's objectives and outcomes.

We have added the following towards the end of the introduction:
“Using a relatively simplified setup, we do not aim to precisely match the available proxy data but instead we aim at better understanding the role of external forcings (orbital configuration and greenhouse gas concentration) on glacial terminations.”

Technical comments:

L231. “In ?”

Sorry for this, it should have been “In Quiquet et al. (2021)”. Corrected.

L245. its written “kyrs” while in some other parts of the text is written “kyr” (eg. L283). Moreover, in other parts is written “ka” (L292). Please check.

Thanks for pointing these inconsistencies. We now use “ka” for durations and “kaBP” for dates.

Figs. 1 - 13. It is written “kaBP” while in Figs 14 and 15 “ka BP”.

We have changed Fig. 14 and 15 to be consistent with the rest of the paper.

Fig 7. Keep the design of the other figures

Changed, we have put all the y-axis on the left-hand side of the figure.

Fig 12. Replace “rhe” for “the”

Corrected.

Fig. 13. Include legend

Done.

Fig 14 and 15. Keep the design of the other figures

In the rest of the paper, the two terminations are shown in the same panel using two different colours. It is true that here we have separated the two terminations in two distinct panels. The reason is that we have to show 5 different experiments (ALL, ORB, GHG, ICE and VEG) for the two terminations. Grouping all this information in one panel would have made the results difficult to read. We have kept our representation with two panels but we have made some small adjustments to make the design of this figure more in line with the rest of the paper (x-axis separated from the y-axis for example).

Lofverstrom, M., & Liakka, J. (2018). The influence of atmospheric grid resolution in a climate model-forced ice sheet simulation. The Cryosphere, 12(4), 1499-1510.

Lohmann, G., Wagner, A., & Prange, M. (2021). Resolution of the atmospheric model matters for the Northern Hemisphere Mid-Holocene climate. Dynamics of Atmospheres and Oceans, 93, 101206.

Reference

Opsteegh, J. D., Haarsma, R. J., Selten, F. M., and Kattenberg, A.: ECBILT: a dynamic alternative to mixed boundary conditions in ocean models, Tellus A, 50, 348–367, https://doi.org/10.1034/j.1600-0870.1998.t01-1-00007.x, 1998.