

Review of the manuscript entitled “European Seasonal Temperature Change since the Last Glacial Maximum from Climate Models” by Fénisse et al.

Summary:

Temperature seasonality is important for interpreting proxy-based temperature reconstructions and evaluating climate-model performance. In this study, the authors compare simulations from PMIP3-CMIP5 and PMIP4-CMIP6 models with dynamically downscaled iLOVECLIM simulations to investigate changes in European temperature seasonality between the Last Glacial Maximum and the pre-industrial period. The results indicate a general decrease in temperature seasonality over southern Europe and an increase over northern and eastern Europe, although substantial inter-model differences occur near the Fennoscandian ice sheet. By separating the mean temperatures of the warmest and coldest months, the authors identify winter temperature as the principal source of both seasonality changes and inter-model spread. A series of iLOVECLIM sensitivity experiments further suggests that modifying the prescribed vertical radiative profile reduces the mismatch between iLOVECLIM and the GCM ensemble. However, two key issues require further clarification:

The Abstract and Conclusions lack quantitative precision. Although the simulations and sensitivity experiments provide highly quantitative results, the main findings are described largely with qualitative terms such as “slight,” “large,” “stark,” and “substantial.” Please report representative magnitudes and spatial ranges of the seasonality changes, differences between the GCMs and iLOVECLIM, the contribution of MTCO, and the extent to which the sensitivity experiment reduces the iLOVECLIM–GCM mismatch. This would make the conclusions more precise and enable readers to assess the robustness and climatic significance of the results.

The physical interpretation of the winter-temperature differences remains incomplete. The manuscript attributes the anomalous winter temperatures in iLOVECLIM mainly to its prescribed vertical radiative profiles and simplified vertical atmospheric representation. This explanation is plausible and broadly consistent with current understanding, but the underlying mechanism could be discussed further. Modern European winter surface temperatures are strongly affected by stratosphere–troposphere coupling through the polar vortex, planetary-wave propagation, tropospheric jet, and associated circulation changes. The sensitivity experiment demonstrates the importance of atmospheric vertical structure, but does not by itself establish radiative parameterization as the direct cause of the MTCO bias. The authors should discuss, with reference to relevant literature, whether differences in stratosphere–troposphere coupling could contribute to the contrasting winter responses among models. If the simplified atmospheric structure of iLOVECLIM precludes such analysis, this limitation and its implications for attributing the MTCO bias should be stated explicitly.

Specific Comments

Could the authors compare the similarities and differences between the PMIP3–CMIP5 and PMIP4–CMIP6 results? This comparison could be supported by previous studies assessing changes across PMIP/CMIP generations.

Please define or indicate the boundary between northern and southern Europe, as the division varies among geographical and climatic classification schemes.

Because the analysis includes only two time slices, it is not accurate to describe the results as the full evolution “since the LGM.” Terms such as “changes between the LGM and pre-industrial period” would be more precise, including in the title.

Please discuss the physical mechanisms underlying the meridional and zonal patterns shown in Fig. 3, rather than describing the spatial changes alone.

Related to General Comment 2, the sensitivity experiments suggest that the simplified vertical atmospheric structure may contribute to the underestimated temperature seasonality. Could the relevant vertical structures and circulation characteristics be compared directly between iLOVECLIM and the GCMs?

Minor comments:

Line 1: Consider replacing “since the Last Glacial Maximum” with “between the Last Glacial Maximum and the pre-industrial period,” because only two time slices are compared.

Figure 5: Please explain what the red line represents. The meaning of “common ice-sheet extent” is also unclear and should be defined explicitly in the caption.