Final Response to Referee #2

We appreciate the time the reviewer has invested to read the manuscript in such a careful and thorough manner. The comments have been carefully considered and responded. Please find below our response to each comment.

1. Regarding the results presented in Fig. 3, the statement "The LGMLGM climate agrees with the pollen-based paleoclimate reconstructions at most sites" (l.198) is not very convincing. I will not say that only "few locations show considerable differences" (l.199) since 5 out of 14 sites show temperatures reconstructed in July significantly different from the simulations and since 6 out of 14 sites show precipitation in July significantly different from the simulated ones.

RESPONSE:

We thank you for this comment. We agree that the statement in the manuscript is not yet convincing. We have instead considered not only the site as sample, but also the two variables and the two months (14 x 2 x 2 samples). This means that 14 sites offer 56 samples, from which 15 samples do not agree with modelled climate (5 temperature and 6 precipitation samples in July, and 4 precipitation samples in January). To clarify this, we will explain it better and reformulate these sentences in the revised manuscript taking into account that some samples show significant differences, especially in July.

2. The regional character of the January precipitation in Southern Europe during the LGM compared to PD (higher LGM precipitation) is not supported by the data, as noted by the authors. They discuss this point but the cited works are not well cited or at least the text as written is misleading for the reader. Roucoux et al. (2005) effectively suggest that the LGM is not the driest and coldest interval of the last ice age, but wetter than the periods before and after it. However, in Roucoux et al. (2005) these colder and dryer periods are the Heinrich events and not the recent period. The Estanya lake record in the NE Iberia (Morellon et al. 2009) is also cited as showing wetter LGM conditions. This is ok but unlike the simulations, these lake data show that the LGM is wetter than the H1 in the NE of the Iberian Peninsula but much drier than the Holocene and in particular the final Holocene. The same applies to the modelling work of Ludwig et al, 2018, showing that the LGM is wetter than H1 but drier than the pre-industrial period. Citing all these works for justifying that other data or modelling experiments show

wetter conditions during the LGM but avoiding to say "wetter than what" is misleading for the reader. In any case, they cannot be used as a justification to explain that the simulations show wetter winter conditions at the LGM than at the PD. A comparison with a larger number of sites would be beneficial for the evaluation of the simulations.

RESPONSE:

We thank the reviewer for pointing out that the discussion of the literature is misleading for the reader. We would like to mention that we used these publications to highlight the uncertainties related with past climates. To avoid any further misleading, we will certainly double-check the literature and reformulate this paragraph in the revised manuscript as follows:

"For example, there is large model-proxy disagreement in January precipitation over the Iberian Peninsula. Based on evidence for the presence of certain tree species in the northwestern part of the Iberian Peninsula, Roucoux et al. (2005) suggested that the LGM was not necessarily the period of the most severe, i.e., cold and dry, climatic conditions everywhere. Roucoux et al. (2005) and Ludwig et al., (2018) also suggested that this same region during LGM sensu strictu was warmer and wetter than the end of Marine Isotope Stage 3 (MIS3, ca. 23 ka; Voelker, A. H. L. et al., 1997; Kreveld, S. et al., 2000) and the start of the Heinrich even 1 (H1, ca. 19 ka; Sanchez Goñi and Harrison, 2010; Álvarez-Solas et al., 2011; Stanford et al., 2011). This could be a hint that model-proxy comparison fails because the proxies refer to 21 $\pm$ 2 ka (Wu et al., 2007), i.e., either the end of MIS3 or beginning of H1. Compared to the pre-industrial period, Beghin et al. (2016) found evidence that the interior and northwestern Iberian Peninsula presented wetter conditions during the LGM, which can be explained by a southward shift in the North Atlantic storm track during LGM compared to present day as suggested by many studies (e.g.; Hofer et al., 2012a; Luetscher et al., 2015; Merz et al., 2015; Ludwig et al., 2016; Wang et al., 2018; Raible et al., 2020). "

3. It would be good to add sites whose reconstructions are available in the literature and not only those from a compilation made more than 14 years ago.

RESPONSE:

We appreciate this suggestion. We also agree that adding more sites would be beneficial for the evaluation. At the moment, we are not aware of a more recent publication on terrestrial temperature and precipitation reconstructions for the LGM. Nevertheless, we will search for other studies to be included in the revised manuscript.

4. A strong added value to the paper would be to estimate the temperature and precipitation (with a MAT or another method) over the 71 sites used in Figure 6. Doing a modeldata comparison on the basis of 71 sites instead of the 14 currently used would bring more robustness to the validation of the simulations by the data. Nevertheless, I would understand that it is a too much work for this paper.

RESPONSE:

We would like to mention that we do carry out a model-data comparison using tree cover. However, we agree that further model-data comparisons using additional reconstructed information from these 71 sites would certainly add more value. This would surely be an effort that is beyond the scope of this study. We will therefore consider this comment in the outlook of the revised manuscript.

5. The authors chose to compare simulated tree cover % to the available arboreal PFT % from pollen records to evaluate the model simulations. However, it would be great to take into account in the discussion that arboreal PFT % "is a relative rather than absolute metric of landscape openness" as stated by Davis et al. 2015. p. 6,

RESPONSE:

We agree that It is currently not possible with any method to make reliable quantitative reconstructions of tree cover using LGM pollen assemblages. We clarify this in the revised version as part of the discussion.

6. l. 179: "Fig. 3" instead of "Fig. 4".

RESPONSE:

We thank the reviewer for pointing out the mismatch in the figure references. We have changed this as suggested.

Once again, we would like to thank the referee for reviewing our manuscript so carefully and we are looking forward to meeting his/her expectations.

Best regards,

Patricio Velasquez (on behalf of the author team)

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