Final Response to Jef Vandenberghe

We thank Jef Vandenberghe for his time invested to read the manuscript in such a careful and thorough manner. The suggestions/corrections led to further improvements in the manuscript. The comments have been carefully considered and responded. Please find below our response to each comment.

General comments:

1. I find the objectives clearly described in the Introduction and adequately discussed in the final Discussion. The methodology is well explained also for non-specialists in modelling (section 2) The analysis of the results is fine to me, although they may be better structured and organized.

The manuscript was revised carefully based on your review and on that of one anonymous reviewer. We hope that these improvements also helped the structure of our analysis.

2. Also the first part of the Abstract (l 1-8) suffers from poor cohesion.

We changed the first part of the abstract and added the aims of our study explicitly.

3. Since I am not a climate modeller nor permafrost modeller, I have no real comments on those aspects.

We chose both global climate models and the regional climate model that are well established and widely used. Thus, we think that the choice of the models is well justified and we do not expect incorrect statements due to insufficient/erroneous models.

4. Section 3.1: state why the analysis in this section is relevant for the objective of this study.

We included the following paragraph to point out the relevance of this section:

“In this section, we present the large-scale characteristics of the LGM climate derived from global climate model data that are used for dynamical downscaling in comparison with the respective PI simulations. It is important to investigate the climatic mean state and possible biases of the global projections in order to be able to interpret the regional simulations accurately.”

5. wind circulation:

-l 50-52: please allude here to the hypothesis of proxy evidence for northern and western winds during LGM in NW Europe (eolian sands and loess and morphology) as forwarded in papers by Renssen et al 2007 (JQS22 (3), p 281-293) and papers by Schwan (Sedimentary Geology).

We added the suggested literature and the hypothesis on westerly to northwesterly winds in ll. 51-52.

-Further in l 193-203 you derive and discuss especially western and d northwestern wind, This seems contradictory to me. Please, explain better.

Winds southward of the Fennoscandian Ice sheet are easterlies/northeasterlies. These are the strongest in the model domain in annual mean and each season for one regional simulation (WRF-MPI) and in winter for both simulations. We included this statement in ll. 216-217. Additionally, we corrected the sentence in l. 219 to "whereas in WRF-MPI the winds have a more **southwestern** component".

Minor comments:

-l 6 and 7: 'large-scale circulation' and 'LGM climate': obtained by modelling?

Yes, climate and large-scale circulation are obtained by the climate models. Therefore, we changed the sentence to

"Our results show that the permafrost **extent and ground cracking regions deviate from proxy evidence when the simulated large-scale circulation in both global and regional climate models favours** prevailing westerly winds."

-l 12-13: sentence is vague

We changed the sentence to "This enables the reconsideration of **the role of sand wedge casts to identify past permafrost regions**."

-l 17: this definition of permafrost is much older than 2005

This reference is a glossary on permafrost and related terms which was revised in year 2005, but was originally based on a publication from 1988. We included "e.g." in front of the citation.

-l 31: '130 ka': at the coldest phase of LGM

We changed the sentence to

"**During the coldest phase of the LGM,** the sea level was about 130 m lower than today..."

-l 38: these climate comparisons concern France

In ll. 29-40, we refer mainly to global climate changes.

-l 56: suggest to refer to refer also to Huijzer & Isarin 1997 in QSR and Vandenberghe 1983 in Polarforschung

We included the references as suggested.

-l 55-57: ‘ice-wedge pseudomorphs most reliable for pf reconstruction’. Ok, but why not mentioning the large cryoturbations (as evidence of former permafrost degradation) and the deep large sandwedges that formed in permanently frozen subsoil (e.g. papers by Ghyssels in PPP: LGM wedges in Belgium) and by Murton (Canada).

We mention that there is “a variety of fossil periglacial features”, where cryoturbations are also included and that among those features, “ice wedge pseudomorphs are the most reliable”. As the later analysis focuses on ice-wedge pseudomorphs and sand wedges, we decided to point out their role on the derivation of past permafrost distributions, but the references we cite at this point, also address cryoturbations (e.g., Bertran et al., 2014, Vandenberghe, 1983, and Vandenberghe et al., 2014).

-l 65-66: (see also comment in l 254) these wedges are formed in the subsoil that is affected by deep winter frost (and thus are shallow) as is also stated in l 254-255.

We included “shallow” to clarify that we are aware of this fact.

-l 73: please insert ‘as reported by’ after ‘earliest reconstructions’

Changed as suggested.

-l 89 and 243: ‘effects of snow for SFI’: OK, although estimates of snow presence/thickness at LGM are speculative. But, if you mean the use of SFI only in models, please state that clearly.

Indeed, we only apply the SFI on climate model data. We stated this more clearly in l. 97 and in the Data and Methods section.

-l 143: I suppose you jump here to modelling experiments as SFI is difficult to estimate from proxy data in paleo-records. Thus, I suggest starting a new paragraph here.

Also for MAAT, we use climate model data. We clarified this in l. 155.

-l 254: I suggest also to refer to similar structures on the Ordos Plateau in China (small-sized or shallow sand wedges formed under conditions of deep seasonal frost): Vandenberghe et al 2004 in PPP and 2019 in QSR.

The suggested reference is introduced in ll. 85-88 as follows “A similar pattern has also been highlighted in China by Vandenberghe et al. (2019). The sand wedges reach up to 1m wide in southwest France near 45°N in the periphery of coversands. Optically Stimulated Luminescence dating of the sand fill by Andrieux et al. (2018) have demonstrated that these large epigenetic sand wedges resulted from repeated periods of growth throughout the Last Glacial.”