

## ***Interactive comment on “LGM permafrost distribution: how well can the latest PMIP multi-model ensembles reconstruct?” by K. Saito et al.***

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General:

The paper is a clearly presented evaluation of the potentials of PMIP3 modelling in progressing in the reconstruction of the spatial extent of permafrost and the subsurface thermal states in different kinds of permafrost. It is especially positive to see that the numerical results are confronted with ‘evidence-based’ permafrost reconstruction. The comparison of the new findings with the results based on PMIP2 modelling is interesting. The objectives of the research are well defined at the end of section 1 (p. 1569-1570), while in the last section, apart from the conclusions, suggestions are

given for continued future research in the investigated domain (e.g. perspectives to be expected from transient permafrost modelling). As a consequence, I have no hesitation to recommend this relevant paper for publication in CP.

One major concern, a few minor comments and suggestions:

1. The transfer from an areal zonation of frozen ground to temperatures as derived from GCMs is not trivial (p. 1572, from l 11 onwards to the end of the section on p. 1573). In such a case the authors have to be careful with their definitions: on l. 14-15 p. 1572 they state 'if the top soil layers freeze and thaw annually, it is seasonally frozen'. This has no sense as seasonally frozen ground freezes and thaws annually (as correctly written in l. 9-10) while the uppermost soil layers in ALL permafrost ground thaw in summer. The next sentence (l. 15) is difficult to understand 'if the temperature remains above 0°C, it is not freezing.' Maybe the authors mean 'temperatures all over the year', which is evident?

But more important is the determination of frozen ground zones by Tsl-based criteria from l. 19 on p. 1572 onward. It is very confusing and strange to see appearing now other definitions of continuous- discontinuous-seasonal frozen ground then those used commonly and before in the paper (top os section 2.2 p 1571-1572). Now the zonation is time-based (entire period, half of the period, 30% of the period) instead of area-based. Firstly, it is absolutely not clear why this is done. Secondly, the basic arguments for the new definitions are not given. Thirdly, it is very confusing to introduce definitions that are different from commonly applied ones.

2. Minor: -p 1568 l 9: One of the first papers recognizing the important effects of the water content of he upper soil was by Renssen et al. 2000 in EPSL. -p 1568 l 29: I suggest to add reference to French 2007 in addition to a reference to Saito 2013. -p 1572 l21-25: add the abbreviations you use later on (pr- tr-sf . . .) -p 1576 l 2-3: In my opinion, the discrepancies you mention could also be due to your definitions of Tsl at p 1572. -p 1577 l 2 and p 1580 l 3: I suggest to add references to Vandenberghe et

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al. 2008 and 2012. p 1579 | 8-10: The max. ALT is also dependant on local factors as vegetation and snow cover as you mentioned before. p 1579 | 21: better to replace 'Vandenberghe et al 2004' by 'Vandenberghe et al, 2012'. p 1580 | 13: I suggest to insert 'at large scale' after 'distribution'. And I suggest to remove 'other'.

3. - The results of the modelled areal extent as described on p. 1577 from l. 14 onward are very interesting. But –as a suggestion- the interpretation of the differences between the 2 modelling approaches and the differences between the extent of individual permafrost zones at 0 k and 22 k could be further expanded. -On p 1581 | 14-17, I suggest to compare the modelled 5°C increase since 21 k with the 13-15°C difference reported from 'evidence-based' reconstructions in Europe and China (e.g. Vandenberghe et al. 2004; Huijzer and Vandenberghe 1998 in JQS).

Technical remarks: -references: In addition to the missing references reported by referee 1, I mention one more missing reference and some inaccuracies and advise to remove many references from the list that are not used in the text: additional missing reference: Peltier et al. 2010

-textual: p 1567 | 13: change 'Franzel' by 'Frenzel'; p 1568 | 14: change 'Talog' by 'Taylor'; p 1568 | 16: 'Koven et al. 2013': in Ref list it is written '2012'. p 1568 | 20: 'Boeckl et al': in the Reference List it is written 'Boeckli' and you should indicate whether it is a or b; p 1568 | 25: replace 'uases' by 'uses' p 1569 | 19-20: I suggest to replace 'and H. French, personal communication, 2013' by 'coord.' p 1577 | 2 and p 1580 | 3: replace 'NachaeV' by 'Nechaev'. p 1589 | 25: insert 'the' before 'Introduction'. p 1581 | 3: insert '°C' after '10'. p 1581 | 4: insert ', the' before 'southwestern'.

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