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The Cryosphere Discussions

Interactive comment on "Derivation and analysis of a high-resolution estimate of global permafrost zonation" *by* S. Gruber

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I am grateful to Anonymous Referee #2 for the effort in evaluating and commenting this manuscript. Below, those parts of the Referee Comment that can be answered have been extracted and are marked "RC". The author response is marked "AR".

MODEL PARAMETERS

RC: In equation (1), the author also introduces two parameters: mu and sigma. The author did not explicitly describe how these two parameters are estimated and what are their physical meanings. At least, the author needs to further to clarify.

AR: Thank you. In the revised version, the physical meaning is now described as: "[. . .] where mu describes the mean temperature difference MAGT-MAAT and sigmaˆ2

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describes the spread of the distribution.“. Furthermore, I have changed the sign of mu_L in Equations (1) and (2) as well as in Table (1) to more consistently relate to this description. The method of estimation for those parameters is described in the original manuscript: “Model parameters [. . .] can be found based on two points for which MAAT and PE are estimated [. . .]” and the data or assumptions used are described in Section 3.2 “Model parameters”.

MAAT ISOTHERMS

RC: In the old IPA map, in some areas, the boundaries between permafrost zones were drawn by MAAT, such as in North America and Qinghai-Xizang (Tibet) Plateau when data were much more sparse. Using new data as in this study, the author may just directly try use MAAT isotherms to overlap with the IPA map to see how well it was done in the old days. At the same time, the author should compare these MAAT isotherms with his new modeling results to check the improvements.

AR: Figure 5 provides this comparison for two areas, but instead of showing MAAT isotherms, it shows Permafrost Extent corresponding to the boundaries between the classes used in the IPA map.

ABREVIATIONS

RC: Throughout the manuscript, the author uses PE, PZI, PR, PA, I found it is very difficult to follow. I strongly suggest that the author make it clear in one paragraph somewhere in the text.

AR: Abbreviations are explained when first used. Now, an additional paragraph has been added in the introduction to explain these abbreviations together as suggested: “In the following, I describe and utilize a model of permafrost extent (PE, the proportion of an area that is underlain by permafrost) as a basis for deriving a global permafrost zonation index (PZI). Based on this, aggregate values in terms of permafrost area (PA, defined as PE multiplied by pixel area) and permafrost region (PR, the area of a pixel

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with a PZI larger than a threshold) are derived."

WARM AND COLD CASE

RC: P10, lines 4 through 13, confused by the text here and values listed in Table 1. For warm case, MAAT is -2.0oC, while for cold case, MAAT is -1.0oC, a typo?

AR: It is correct that way and, given the changes to the sign of mu in Table 1 (see comment on model parameters) I hope now more easy to understand now. For a warm case, a lower MAAT relates to a certain extent of permafrost than for a cold case. After changing the sign of mu, cold and warm can now be better related to it, that is to the average warming of MAGT with respect to MAAT.

AVERAGING CRU30 AND NCEP30

RC: P12, lines 12-19, the average CRU30 and NCEP30 may not be a good approach for MAAT. For this study, I would trust CRU30 better. Some comparison studies show that over alpine regions, NCEP reanalysis data have huge errors against ground-based measurements (e.g., Ma et al., 2009).

AR: I agree that this is an important point, but it is also difficult to solve it by choosing one over the other dataset. This is because reliable observations are rare in the areas concerned and in the case of preferring CRU30 based on Ma et al. (2008), one would extrapolate a regional finding to other areas, globally. Figure 3 is aimed at communicating this problem based on the differences between CRU30 and NCEP30 to also caution other large-area simulations of the fact that this problem exists and is of high magnitude. Until a coherent global analysis is available, I believe the solution of averaging to be the most obvious (but still unsatisfying) choice. As a reaction to this Referee Comment and to support regional application, I will make products available digitally also for CRU30 and NCEP30 without averaging. Ma et al. (2008) is now referenced in the Section 4.2 "Evaluation of MAAT grids".

OTHER SMALL COMMENTS

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Unless mentioned above, all small comments have been taken into account and corresponding mistakes were corrected.

REFERENCE

Ma, L., Zhang, T., Li, Q., Frauenfeld, O.W. & Qin, D. 2008: Evaluation of ERA-40, NCEP-1, and NCEP-2 reanalysis air temperatures with ground-based measurements in China, Journal of Geophysical Research, 113(D15):D15115.

Interactive comment on The Cryosphere Discuss., 5, 1547, 2011.