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The Cryosphere Discussions

Interactive comment on "Distinguishing ice-rich and ice-poor permafrost to map ground temperatures and -ice content in the Swiss Alps" *by* Robert Kenner et al.

Anonymous Referee #2

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The paper presents a new mapping approach for mountain permafrost in Switzerland accounting for ground temperature and ice content. The study is based on regression analysis using borehole temperature collected in the Swiss Alps. The overall interest of this study is to propose a statistical approach to distinguish ice poor and ice rich permafrost in a mapping exercice, and to provide a more detailed and more accurate map of mountain permafrost distribution in Switzerland, representing permafrost # gaps # in its altitudinal distribution resulting of the combination of topoclimatic factors and ground ice content. The approach and objectives of the study are sounds and well suited for the journal, but it is very hard to provide a detailed and constructive review on the scientific content at the current stage. The writting misses dreadfully concise-

ness and precision. The paper can only be accepted after major revisions, notably rewritting of most sections to make it easier to understand and to follow the different steps. I have tried to formulate general comments to in order to guide the rewritting but I finally dropped many detailed comments as it was too messy. General : One strinking thing is the lack of references to the international research context : most references to previous work and knowledge focus on studies conducted in Switzerland, if not on the research team. Given that this study is submitted to an international journal of broad significance, one could expect that the international and broad significance of the paper is clearly stated and explained. Abstract : it lacks of precise results about the predicted permafrost distribution and the improvments achieved using this innovative approach. Stating that allowed a clear improvement is inappropriate and would first need to be desbribed. In general, the abstract is rather coarse. I suggest to rewrite it based on the following outlines (or similar, this is just a suggestion) : 1. State about the overall context, relevance and objective/research gaps and research questions of the study, 2. Briefly explain the chosen method, 3. Provide key results (as quantitatively as possible) 4. Explain the main implications of the results and main answer to research question.

Introduction : Rather badly organised also. The study is introduced as early as L15 with # The permafrost ground ice map. ... #, but followed by decsription of the scientific background are given. This background is mainly based on studies from the 1st author and reference to the international context would be welcome. However, the lines dedicated to introducing the study (p3 L10-15) are very poor. Try to be more straightforward and precise in your description : what is the specific approach you choose ? Why (based on the background you described above) ? What are the main expected results to fill the research gap ? This is roughly what the authors propose, but it is too general and the reader to not exactly get what will be presented in the study.

Methods : Here again, it is difficult to follow as the organisation of the method description is messy. Try to be more specific and more logical with the titles in order to ease

the reader following the approach. It starts with # mapping #, then with a # sensitivity analysis #, # a testing of zone 1 for zone 2 # while zone 2 is presented only afterwards. Similarly, the subsections are very unequal (2.3 is very short and one can wonder about its relevance). The short paragraph introducing Section 2 (p3 L 17-22) does not reflect the main outlines of the appraoch as it should, it just give general information about the maps. I wish I would have found a flow chart describing the methodological approach and this should be considered in the revised version. For example, illustrate the # buffer # (P3L25), the # mapped with blue colors # or # mapped in yellow # (L27). P5 L19 : I wonder if the regression coefficients would rather be in the results section while the method should rather describe the statistical approach. The meaning of the regression coefficients has to be briefly expanied (results). Your sensitivity analysis lacks of reference to common statistical methods. It is not clear whether this # bisected # sample is a common way to test model senstivity or if you have randomly decided it. More technically, I think that there is a misuse of # PGIM # in Eq. 3 since the acronym refers to the map and Eq. 3 is the regression analysis.

Section 3. Isn't it part of the methods ?

Section 4 and 5 are better written. However, in my sense, description of map features (general and more detailed at selected areas) is lacking as this study is a mapping exercice. What do your results show in term of permafrost distribution ? What is the elevation belt without permafrost for example ? Giving such information will, in my opinion, strongly broaden the significance of the results. Statistics given in 5.4 could be merge with such results (map) and therefore moved in section 4. They would be easier to get in a Table. Unless I missed something, the data that you use in Figure 1 and 2 are not very clear also : is it annual average ? multi-year average ? others ? which measurmeent years ? Title of 5.5 is not coherent with the content, even if it deals with ground temperature and ice content, the focus is more on implication of such a map for its use. Finally, as mentioned in the general comment, one expect that the authors place their study in an international context, at least in the discussion, and

this terribly missing.

Conclusions : they are poorly written. They are very general. They have to be written again with precise results and implications.

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