The Cryosphere

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Discussions

EGU

Interactive comment on "Permafrost Distribution Modeling in the Semi-Arid Chilean Andes" *by* Guillermo F. Azócar et al.

Anonymous Referee #1

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1   General comments

The manuscript is a valuable contribution to permafrost investigation in the Andes, a region where permafrost observations are very sparse. The study present a well-established approach of statistical permafrost modeling, and presents interesting results on the distribution of permafrost in a remote area in the Chilean Andes. The applied methods are adequate for the purpose of the study. The authors made a large effort to obtain the necessary input data (MAAT, PISR, a rock glacier inventory). Based on this data and a statistical modeling approach, they determine a permafrost favorability index (PFI) and estimate the permafrost distribution in the region. As the authors mention, observational data would be required to validate their model. So far, only a comparison with a global permafrost zonation index model (Gruber, 2012) could be

done, indicating however some substantial differences between the model outputs.

The observational data used in this study is prone to errors and uncertainties. These errors, and their effect on the model results, should be treated in more detail in this study. For example, the data availability is sparse in the region, and hence the uncertainties regarding the predictor variable MAAT are (assumed to be) larger than in other, better equipped regions. Therefore, an estimate of the errors of the input data should be given. Issues such as the quality as well as the representativeness of the station data must be discussed. Further, an estimation of the uncertainty of the rock glacier inventory should be made (if possible, through a validation with (the existant) ground data and by providing an estimate of the miss-classification rate).

Due to these shortcomings, I suggest to publish this manuscript in TC if the following specific comments are treated appropriately in the manuscript.

2   Specific comments

- Rock glacier inventory (Section 3.1):
    - Include a definition of the rock glacier classification (intact, active, inactive, relict)
    - Regarding the completeness of the rock glacier inventory in the area. Please answer these questions in the manuscript:
        * Does a validation of the inventory of the classified rock glaciers with ground observations exist?
        * How large is the fraction of miss-classifications?
        * Can you provide an estimate of the percentage of rock glaciers that are still missing in your classification?

- – Page 3, Lines 12-14: If the conditions for rock glaciers are not favorable in two of the investigated basins: how representative is the model there?
- – Page 3, Line 29: Classification of rock glaciers: The rock glacier classification is the main input for your modelling approach and must therefore be described more in detail.
- – Page 4, Line 1: How do the uncertainties in the rock glacier classification (active and inactive forms) influence the statistical modeling approach? Please account for the uncertainties in your modelling approach.

- The section "Methods" should be restructured. A possible structure of the section could be:

  - – 3.1 Response and predictor variables of the statistical permafrost model Introduction to the section: use text page 5, line 19-26
    - ∗ 3.1.1 Response variable: rock glacier inventory
    - ∗ 3.1.2 Predictor variables:
      - · Regionalization of MAAT
      - · PISR
  - – 3.2 Statistical permafrost favorability model
    - ∗ 3.2.1 GAM
    - ∗ 3.2.2 Model evaluation
    - ∗ 3.2.3 Model adjustment

- Section "Regionalization of MAAT":

  - – Please comment on data quality in the manuscript.Have you done any quality control previously to using the measurements?
  - – What is the difference between AAT and MAAT? Please provide a proper definition of the variables. So far, it is unclear why you need both variables.

C3

  - – Section 3.1.2: Stations in the Andes are often located in valley bottoms. They might therefore not reflect the conditions in high mountains. Please discuss the representativeness of the data used, and the impact on your modelling approach. For example, no station above 5000m is available, and except one all stations are below 4000m. Do you expect an error for AAT at high elevations? Please estimate or at least discuss the impact of this on your model.
  - – Many stations have only a few years of observations:: ïĊğ How does this influence the outcomes of model(Temp)? ïĊğ Can you exclude, for example, that the data availability is biased towards strong ElNiño/LaNiña years?

- 4.3 Statistical permafrost favorability model: Please improve the structure of this section such that the reader gets a clear idea on the influence of MAAT and PISR on permafrost availability.

- Sections 5.2 and 5.3: Please quantify the uncertainty of the permafrost favorability model outputs due to uncertainties in MAAT (and PISR), and the rock glacier inventory. Can you use a bootstrapping approach?

- Conclusion: the conclusions are quite weak. Instead of giving a short summary of what you have done, it would be more interesting if you answered, for example, questions like: What are the benefits of the chosen approach, what are the drawbacks? What is the relevance and the applicability of the study, e.g., for infrastructure, water availability, etc. in the region.

- Figure 2 should be rearranged. The MAAT model figures as an input to the predictor variable MAAT. Please point this out in the figure: the MAAT model could figure on the right side of the PFI model, as an input to the PFI model.

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3 Technical corrections

- The readability of the paper would improve if some more guidance in the beginning of each section/subsection was provided. Often, it is difficult to follow the storyline of the text.

- Write shorter sentences (instead of comma-separated sentences).

- Be consistent in notation (semiarid versus semi-arid)

Further technical corrections can be found in the attached file.

Please also note the supplement to this comment:
http://www.the-cryosphere-discuss.net/tc-2016-100/tc-2016-100-RC1-supplement.pdf