

Author's response to reviewers on

# " Modeling present and future rock wall permafrost distribution in the Sisimiut mountain area, West Greenland"

by Marcer et al., The Cryosphere Discuss.,

<https://tc.copernicus.org/preprints/tc-2022-189/>

## Contents

Editor .....	2
Point-by-point reply to editor comments .....	2
Referee #1 .....	5
Point-by-point reply to R1 comments .....	5

## Editor

Dear authors,

I am sorry for the long time required for my evaluation, but I was tracking all changes from the original version of the paper submitted to the last revision and this consumed more time than expected. The manuscript has considerably improved from the first version submitted, as also pointed out by the external reviewer. I agree with such evaluation and I decide to accept the manuscript for publication.

I am still requesting minor revisions, to give you the opportunity to include the suggestions provided by the external referee and those from my side indicated in the attached PDF. Please consider including those changes and use this opportunity to read the manuscript to check the English along the paper and improve formulations. This has also been recommended by the external reviewer.

Best regards,

Adrian Flores Orozco

Dear Editor,

Thank you for your thorough evaluation and valuable feedback. We appreciate the acceptance of our manuscript. We implement the suggested revisions and carefully review the manuscript for language improvements, as recommended. We are grateful for your time and consideration.

## Point-by-point reply to editor comments

[6] 1.1.2020-31.12.2022?

The period depends on the logger, we change the text as “*..the period September 2020 - September 2022..*”

[15] Influence of snowpack has not been addressed

Influence of snow is discussed and assessed at 391

[42] meteorological

Agreed, Text changed accordingly

[47] resistivity

Agreed, Text changed accordingly

[56] ground surface temperature

Agreed, Text changed accordingly

[83] are you instigating many or just one? It seems only one ...

There are several rock glaciers in the region. Only one is within the boundaries of the figure.

[87] rock glacier

Agreed, Text changed accordingly

[110] could you provide formation about the position of those boreholes, their distance to the study area?

Boreholes location is shown in Figure 1. In addition, we added: *“within the town’s urban area”* L111.

[128] by Duvillard et a. (2020), consisting

Agreed, text changed accordingly

[138] could you describe what is the minimal and maximum levels? also briefly explain this configuration for the audience in TC?

Agreed, text updated to:

*“For the data collection, we use the Wenner configuration. This configuration corresponds to have the voltage electrodes M and N in between the current electrodes A and B with an equal spacing between the electrodes. This array is characterized by an excellent signal-to-noise ratio (Dahlin and Zhou, 2004; Kneisel, 2006).”* L139-141

[141] More details on the data processing, in particular the filtering of the data are needed.

Agreed, text updated to:

*“We cleaned 4% of the measures acquired before the inversion (549 measures acquired, 528 inverted) by filtering out the outliers and the data characterized by high standard deviations (higher than 10%) from the pseudo section and the apparent negative resistivity.”* L143-145

[144] Why 10% as the threshold value? How many iterations were needed? Could you also explain what is the RMSE? - it is strange to have an acronym that is not introduced before, also how this parameter is actually computed.

We conducted 5 iterations but opted for the 3rd iteration, as the model converges with an RMS close to 10% by the third iteration. Iterations 4 and 5 tend to overly smooth the model. Text is updated to:

*“The inversion was stopped when the convergence criterion is reached. In this study, the convergence criterion is met when the change in the Root-Mean-Square Error (RMSE) between two iterations is below 10% (default criterion in RES2DINV). In the present case, convergence is reached at the third iteration.*

[156] provide information on the temperature steps defined and the time that each of these steps was taking

The temperature steps are visible at figure 3b, reference now added to the text (L162). Time spend at each step is already in text (L161).

[179] downscaled

Agreed, text changed accordingly

[215] from

Agreed, text changed accordingly

[246] allows

Agreed, text changed accordingly

[263] .

Agreed, text changed accordingly

[318] The role of the fracture needs to be better explained. Also i recommend to elaborate more on the possible factors affecting the resolution of the resistivity image.

Agreed, text updated to:

*“We suggest that the ERT data at this location are influenced non only by bedrock temperature but also by weathering (resulting from the formation of kaolinite, see Richard et al., 2010) and fracturing. We have assume that the rock is isotropic and that the laboratory measurements are representative of the scale investigated in the ERT tomogram (sensitivity close to the electrode spacing close to the ground surface).”*

We add the following reference:

*Richards K., A. Revil, A. Jardani, F. Henderson, M. Batzle, and A. Haas, Pattern of shallow ground water flow at Mount Princeton Hot Springs, Colorado, using geoelectrical methods, Journal of Volcanology and Geothermal Research, 198, 217-232, 2010.*

[320] improve English

Text changed to *“Overall, we consider...”* L327

[330] indicates an

Agreed, text changed accordingly

[365]Shown

Agreed, text changed accordingly

[390] Check English

Sentence is simplified to *“This indicates that, when there is snow cover, our model registers colder temperatures compared to the actual deep rock temperatures.”* L398-399

[395]from

Agreed, text changed accordingly

[462]an

Agreed, text changed accordingly

## Referee #1

I have carefully reviewed the revised manuscript titled "Modeling present and future rock wall permafrost distribution in the Sisimiut mountain area, West Greenland" submitted by Marcer et al. I would like to acknowledge that the authors have diligently addressed all the comments and concerns I raised during the review of the manuscript. The revisions made by the authors have substantially improved the overall quality and clarity of the manuscript. However, I would like to bring to your attention a few remaining minor issues that need correction before the manuscript can be considered for publication. Firstly, there are still some typographical errors and technical issues present in the manuscript that require attention. I recommend a thorough proofreading to ensure the text is free from any inadvertent mistakes. Additionally, I have observed an imprecise interpretation and description of the ERT imaging results, which needs to be addressed. I have attached a PDF document containing my comments for your reference and further consideration. I believe that once these minor issues are addressed, the manuscript will be ready for publication in The Cryosphere and am confident that the final corrections will further enhance the overall quality of the manuscript.

Thank you for your detailed review and constructive feedback on our manuscript. We appreciate your acknowledgment of the improvements made in response to your earlier comments. We address the remaining typographical errors, technical issues, and the imprecise interpretation of the ERT imaging results as per your suggestions – see attached marked-up manuscript and point-by-point reply to the comments.

Your insights have been fundamental in enhancing the quality and clarity of our work. Thank you for your continued support through this process.

### Point-by-point reply to R1 comments

[105] Maybe merge these two sentences.

The second sentence is not bringing additional information and has been removed

[175] Duvillard et al. (2020)

Agreed, text changed accordingly

[176] We conducted the ERT measurements in ... ?

Agreed, text changed accordingly

[375] This reference might not be necessary as QGIS is an established software?

Although we agree, this was requested by R2 in the previous round. We let the editor decide whether it is requested by the journal.

[384] These maps?

Agreed, text changed accordingly

[394] Remove?

Agreed, text changed accordingly

[429] MRST?

I think MARST was not introduced?

Agreed, text changed accordingly

[486] throughout?

Agreed, text changed accordingly

[490] Maybe rephrase to avoid this double usage of "consider"?

Agreed, text changed accordingly

[531] Maybe you could provide here a short statement why you prefer the regional evaluation?

Rephrased: *"While it is possible in principle to utilize weather station data to drive our model and enhance its performance, our preference is to evaluate the model uncertainties using data available for the whole Greenland. This provides an estimation of model performance consistent with the long-term goal to employ this approach for regional-scale use, i.e. in areas where weather station data may not be available."* L359-362

[546] shown in

Agreed, text changed accordingly

[547] consistently lower than? To avoid using "below" twice in this sentence.

Agreed, text changed accordingly

[579] a

Agreed, text changed accordingly

[583] Something is missing here. Maybe ", which is the reason ..."?

Text updated according to Editor comment *"This indicates that, when there is snow cover, our model registers colder temperatures compared to the actual deep rock temperatures. This temperature range describes our uncertainty range when predicting rock permafrost conditions in areas where snow may or may not accumulate, i.e. generic bedrock terrain."* L398-401

[600] "than indicated by the ERT imaging result" bc the ERT does not predict subsurface thermal condition but solves for the electrical properties in the subsurface, which are influenced by the thermal conditions.

Agreed, text changed accordingly

[601] The ERT does not estimate the permafrost extent. The interpretation of the electrical images can overestimate the permafrost extent.

Agreed, text changed accordingly

[635] the interpretation of the ERT imaging result.

Agreed, text changed accordingly

[648] to the

Agreed, text changed accordingly

[743] present

Agreed, text changed accordingly

[745] ERT investigations?

Agreed, text changed accordingly

[759] affect

Agreed, text changed accordingly