

**RAPID REGIONAL ASSESSMENT OF ROCK GLACIER ACTIVITY BASED ON DINSAR
WRAPPED PHASE SIGNAL**

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AUTHORS' RESPONSE TO EDITOR'S COMMENTS

Dear Editor,

We thank you for your review of our manuscript, that we greatly appreciated. Below we provide a detailed explanation of how we addressed your points while undertaking the requested minor revision.

Best regards,
Federico Agliardi
(on behalf of all the authors)

General comment by the editor:

.... From your author's replies and changes in the manuscript I can state that you addressed most of the reviewer's comments and especially clarified well the scope of the paper with all the advantages and disadvantages to the alternative approaches mentioned by the reviewer. Most of my comments address unclear text passages, whereby changing the wording the meaning of the statements can be clarified.

After addressing these comments, I believe that the manuscript can be quickly accepted.

Reply: We thank you very much for your review. Here and in the manuscript, we have addressed all the points raised by your review. We have accepted all minor phrasing and grammar suggestions and typo corrections directly in the text. Below we provide detailed responses to the remaining points.

Comment to Line 38: Vonder Mühll and Haeberli 1990

Reply: We thank the editor for pointing out the recurrent mistake in citing Vonder Mühll (whom we repeatedly cited as Mühll). We fixed this issue in the text and in the reference list.

Comment to Line 61: I agree with the former reviews that this statement sounds misleading, given that there are certainly more than 100 field case studies of individual rock glaciers. In your author reply you were mentioning that you mean it would be impractical to make extensive site investigations of all rock glaciers in a regional assessment, as in this present paper. To this, I agree! But then you have to formulate it accordingly, e.g.: "As site accessibility, geomorphological and dynamic complexity, and budget constraints limit the possibility to systematically characterize hundreds of thousands of inventorised landforms, regional assessments based on detailed field studies remain limited."

Reply: We agree with the editor and replaced the statement *“Nevertheless, site investigations remain confined to few case studies, due to site accessibility, geomorphological and dynamic complexity, and budget constraints, that limit the possibility to systematically characterize hundreds of thousands of inventories landforms.”* with the statement *“Nevertheless, as site accessibility, geomorphological and dynamic complexity, and budget constraints limit the possibility to systematically characterize hundreds of thousands of inventoried landforms, regional assessments based on detailed field studies remain limited”*.

Comment to Line 71: “RGIK”

Reply: Added.

Comment to Fig.3 caption: Why 240 ? This should be justified/mentioned in the text

Reply: The reason is explained at Lines 248-249: *“We used a threshold of $R=240$, calibrated by comparing the relative frequency of intact and relict features mapped by Scotti et al. (2013) with the modelled presence or absence of permafrost (Fig.3c)”*. For clarity, we rephrased the entire period at lines 145-149 as follows: *“Since permafrost conditions may have changed since product publication, to obtain a conservative estimate of likely permafrost extent (i.e. consider only the API class “permafrost in nearly all conditions”) we recoded the map by the red (R) band values of the APIM RGB colour code (range: 0-255) and then filtered the areas with R values below a specified threshold. We used a threshold of $R=240$, tuned to optimize the relative frequency of intact and relict features mapped by Scotti et al. (2013) in the resulting areas of modelled presence or lack of permafrost, respectively (Fig.3c)”*.

Comment to Fig.3: How did you classify landforms, which were partly in different classes in the APIM model (e.g. a RG extent in different RGB classes) ?

Reply: As explained above, we used a threshold to discriminate between areas bearing or lacking permafrost, to support the activity classification proposed in Table 4. Therefore, our landforms can only fall in two classes of permafrost occurrence (“yes” or no”; Table 4). Considering that periglacial landforms can be considered active also when only a part of the mapped outline hosts permafrost (i.e. a subunit, not distinguished here), we considered outlines partly in “yes” condition as hosting permafrost for the sake of activity classification.

Comment to Lines 206-207: Is this sentence true for all other studies you mentioned in the previous sentence or only for the cited one (Brencher et al. 2020) ? If only for the cited one, I would propose to change the previous sentence to: “Brencher et al. (2020) used a similar approach, considering ...” and not generalising it to all “other authors”

Reply: Done, thank you.

Comment to Line 227: intact rock glaciers are by definition permafrost - would it be more accurate to write “ground ice”?

Reply: We agree and replaced “permafrost” with “ground ice”.

Comment to Line 290: temporal baselines?

Reply: Yes, thank you for pointing out the missing word. Fixed.

Comment to Line 311: Activity types?

Reply: Like in landslide science, we use the term “style of activity” to include additional information on activity other than simply “active”, “inactive” etc. In this case, we comment on the distribution of landform activity over different temporal baselines and related complexity (e.g. Fig. 8)

Comment to Line 331: activity type ? Else, it is not clear what is meant by "style" in this context

Reply: See previous comment and reply.

Comment to Figure 8: Explain explicitly in the caption what is meant by the white and grey boxes

Reply: Done, thank you.

Comment to Line 381: which "values" do you mean here ?

Reply: Thank you for the comment, we replaced “slope values” with “slope inclination”.

Comment to Line 407: is the x-axis directly showing temperature differences (in °C ?) as PC1 ? Then the unit could be given as well. What is then the unit of the y-axis (the Activity index) ?

Reply: No, the x-axes of diagrams in Fig.11 show the (non-dimensional) value of PC1. The comment on the 5° difference between the LST of relict vs active landforms comes from the examination of our LST data, to support the comment of PCA result.

Comment to Line 410: this is not surprising as LST depends also very strongly on elevation - so, these two variables are not independent!

Reply: We agree. LST depends (often in non-obvious way) on many environmental and topographic factors. PCA results here allow identifying some of these dependences and validating our classification on them, too.

Comment to Line 435: what is meant by that ? (“ordinal index”)

Reply: Here we mean that the Activity Index is a continuous scalar number and not a discrete categorical one. In fact, we need to specify the threshold AIT to obtain a discrete classification (active, inactive, transitional, relict). For better clarity, we replaced “ordinal” with “scalar”.

Comment to Line 453: what is meant by "Compared" here ? "Similar to" or "In contrast to" ?

Reply: We thank you for outlining a possible ambiguity. We replaced “compared to” with “different from”.

Comment to Line 457: See comment to previous sentence: Do you mean here "Similar to" or "In contrast to" ?

Reply: See previous comment and reply.