

## Response to reviews

Glacier-permafrost relations in a high-mountain environment: Five decades of kinematic monitoring at the Gruben site, Swiss Alps

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We thank the reviewer and the editor for the constructive comments. We revised the manuscript again based on the feedback. Please find below the individual feedback to all comments.

Best,

Isabelle Gärtner-Roer, with all co-authors

From the editor:

Dear authors

Many thanks for your revisions. You have adequately addressed most review comments – apart from some very valuable comments by Reviewer #2. In particular, I do not find the accuracies/uncertainties in the paper – though you state you would have added those, e.g. in the Methods sections. As far as I can see, only for the GNSS data the measurement errors are given.

This is correct and relates to a mistake on our side. We added the text in the last “response to reviews”, but forgot to add it to the manuscript. The following text is now added in chapter 3 (Geomatics):

“The error (root mean square) of single displacement measurements is about +/- 0.3 – 0.4 m or, in the case of a 5-year interval between two photo missions, about +/- 0.06-0.08 m/a and the error of the vertical changes is estimated to +/- 1 m or, +/- 0.17 – 0.2 m/a (Käab et al. 1997; Brunner, 2020). If a large number of measurements are analyzed in combination (as e.g. in Figure 8), the statement is an order of magnitude more accurate (+/- 0.006 – 0.008 m/a).”

Also, as pointed out by Reviewer #2, using the qualifier «significantly » requires providing the underlying statistics. → adapted in the text

Overall, I fully agree that your article comprehensively describes the monitoring of this extraordinary site, which allowed to understand the complex kinematics and glacier-rock glacier interactions. As pointed out by Reviewer #2, and being not familiar with the very many, different studies, I am also left wondering what was done in this study and which is based on earlier work.

We carefully reconsidered this aspect again and came to the conclusion that already the first lines (10-15) of the abstract clearly define what the new information is. The interpretation of these new measurements must relate to the scientific background from the comprehensive field investigations carried out during roughly half a century. This is carefully documented in the lines 69-83 of the introduction. The purpose of our paper - points (i) to (iii) - is then defined on the lines 90-99 of the Introduction. In the results chapter we show all the new data, beside the photogrammetric analyses

from Kääh (1997) for the long-term development (Figure 5), which was the explicit wish of the reviewers.

Nevertheless, I will accept the manuscript once you have addressed the above (and below) comments.

Thank you very much.

Some minor points

Please consider the comments by Reviewer #1 on the revised manuscript. → [done \(see below\)](#)

Please include an explanation into the captions of Figs. 4 and 5 what the numbers on the axes mean, something along the lines: "Axes are labeled with Swiss coordinates (in meters; CH 1903)." →

[explanation added](#)

I recommend using elevation rather than altitude (except for things that fly). → [done](#)

Line 223: Please use past tense when describing the state of lakes in 2016. → [done](#)

Jürg Schweizer.

Review by Lukas Arenson:

Manuscript should be accepted as is.

Thanks for revising the manuscript. The comments made by the reviewer on the initial version of the paper have been addressed satisfactorily in my view.

Thank you very much.

Some very minor editorial corrections:

- Line 56: delete in at the beginning of the line → [deleted](#)

- Line 98: add comma after cold → [done](#)

- Line 101: "perennially frozen" is not needed because an active rock glacier is by definition in a permafrost environment and therefore must contain ground ice. And "perennially" is probably no longer accurate anyway. → [deleted](#)

- Line 133: FOEN is missing in the references → [reference added](#)

- Line 146, and other places: there are still many places where the space between the number and the unit is missing. → [checked & done](#)

- Line 420: long-term → [done](#)

From the TC MS records:

With the next revision, please add the copyright icon to the figure source of Figure 4.

→ [done](#)