Response to review

Brief communication: The Glacier Loss Day as indicator for extreme glacier melt in 2022

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Dear editor and reviewers,

First, we would like to thank the editor and the reviewers for their second evaluation of our work. We have now implemented the minor requested changes.

In this response-to-review document we try to clarify and address each of the suggestions, comments and questions made during the review. Therefore we have copied the comments in blue boxes and have addressed them one by one. In the response we use italic fonts to quote text from the revised manuscript. Additional to the revised manuscript, we have uploaded a version of the manuscript with highlighted track changes that indicate where the manuscript has changed (red=removed; blue=added).

Yours sincerely, Annelies Voordendag & co-authors

Response to reviewer #1

Minor comments

R1-0: The second version of the paper is now much more clear and improved, specifically regarding potential confusions for the reader between thickness changes and mass balance . In addition, the limitations form the limited observed area with the TLS are better discussed. I have only minor and technical points to mention.

The authors thank the reviewer for its second evaluation of our work.

R1-1: Fig. 1 and associated text. Your fit seems to result in a Gumbel (no lower bounded) distribution. Please specify, and clarify (in the figure caption) if "mean" and sigma are the position of the centre of the distribution and the scale parameters, respectively or still denote the Gaussian mean and SD.

We have fitted a generalised extreme value (GEV) distribution, not a left-skewed Gumbel distribution. That means that the shape parameter is not zero in the fit and that the distribution is unbounded on the lower and upper end (fitted parameters of the GEV: shape=0.380, location=-0.926, scale=0.775). As far as we understand, the GEV is more suited here as the mass balance estimates could be extreme in both directions (very negative and very positive), although we can see that the GEV is rather left-skewed. On the secondary y-axis, we now show the GEV's median and other quantiles instead of the GEV's mean and sigma. This is more meaningful as the GEV is skewed to the left. In addition, with the quantiles of the GEV on the secondary y-axis, it is now clearer that the 2021/22 annual MB value is more negative than the 0.1%-quantile of the GEV, which also shows visually that the return period exceeds 1000 years. We clarified this in the caption of the figure:
A fitted generalized extreme value distribution of these observations is added with the respective quantiles on the secondary x-axis to emphasize the extremity of the year 2021/22.

R1-2: Line 12: You should better consider the complete mass balance record (and not the last 30-year record) as a 1000-year return period is a high estimation (14 times the HEF mass balance period of record).

With the 70-year mass balance series, we also found a return period of more than 1000 years. We have rewritten the text:
The return period for the 2021/22 annual mass balance exceeds 1000 years when considering the 70-year mass balance series for the generalised extreme value distribution fit.

R1-3: Lines 67-68. Do you refer to mass fluxes at the boundaries of your integration area? Reformulate if necessary.

We reformulated this sentence:
The effects of ice flow divergence on the surface elevation changes (see Cuffey and Paterson, 2010, Sect. 8.5.5) are omitted as ice flow velocities are very low (<10 m year^{-1} (Stocker-Waldhuber et al., 2019) and by integrating the elevation changes over the entire glacier area (e.g. Kuhn et al., 1999; Zemp et al., 2010; Klug et al., 2018).

Script and spelling

Title and in the text, maybe use: « record-breaking » instead of « record »?

We decided to remain with "record".

Degree day or degree-day? Snow fall or snowfall?

In both cases, both are possible. In our text we consequently used "degree day" and "snowfall".

Response to the review of Aaron Cremona

R2-1: The authors implemented successfully all but one comment, i.e. R2-5. "Cremona et al. (2023) upscaled the mass loss on three Alpine glaciers from six automated ablation stake readings to the full area of the respective glaciers by applying a mass balance model." As already specified in the first round of review, Cremona et al. (2023) upscaled mass balance from six point observations not only to the full area of the respective glaciers but to the scale of the entire Swiss Alps.

We have adjusted this and the text now reads:
Cremona et al. (2023) upscaled the mass loss on three Alpine glaciers from six automated ablation stake readings to the full area of the respective glaciers by applying a mass balance model, and eventually also upscaled this to the scale of the entire Swiss Alps. The authors do, however, not explicitly indicate a GLD for these glaciers.

R2-2: From my perspective, the paper can be accepted once this minor revision is corrected.

We thank Aaron Cremona for his evaluation of our revised manuscript and hope that the manuscript is now fit for publication.

References

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