Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., author comment AC1
https://doi.org/10.5194/nhess-2022-138-AC1, 2022

Reply on RC1

Jakob Rom et al.

Author comment on "Spatio-temporal analysis of slope-type debris flow activity in Horlachtal, Austria, based on orthophotos and lidar data since 1947" by Jakob Rom et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-138-AC1, 2022

Thank you very much for your valuable review. Please find the authors' response below. We refer to each of the reviewer's comment, which are shown in italics.

Main:

Transport-limited vs supply-limited hillslope systems. In lines 101-103 the authors state that the debris flows in Horlachtal occur in transport-limited hillslope systems. However, in the discussion the authors argue that highly active periods affect debris-flow activity in the following years by reducing magnitude and frequency as a result of depleted sediment storages (e.g., lines 472-482). This is a textbook example of supply-limited conditions, and therefore the statements in lines 472-782 and 101-103 are in direct contrast with each other.

Comments from the authors:

In principle, the debris flows in the Horlachtal are transport-limited.

In the vast majority of the cases, the debris flow material originates on the one hand from glacial morain material covered with rockfall debris (talus slopes). On the other hand, it originates from rockfall material deposits temporarily stored in the catchments of the debris flows.

If there is a heavy precipitation event or several events within in a short period, the rockfall deposits in the catchments may be emptied. In addition, some debris flow channels are strongly incised into the talus slopes. Thus, those debris flows can no longer mobilise the morain material that easily. Only in these occasional cases we expect a short-term change from a transport-limited system to a supply-limited system.

We will elaborate this statement more clearly in the manuscript.

Relation between rainfall magnitude and flow magnitude. On a related note, in transport-

limited systems one would expect a correlation between triggering rainfall magnitude and debris-flow magnitude. In contrast, such a correlation becomes weaker and would typically be absent in supply-limited systems because flow magnitudes also are limited by the volume of sediment available. It would therefore be of interest to compare triggering rainfall to flow magnitudes, or given the data availability perhaps maximum rainfall magnitudes in a given period versus the maximum debris-flow magnitudes in the same period (this should at least be possible for sub-catchment ZT judging from the information in section 5.2.2). It may be needed to normalize by catchment size or another morphometric characteristic of the source catchment as this also affects flow magnitude.

Comments from the authors:

We have already done these analyses, which showed no correlation between rainfall magnitude and volume.

However, the debris flow triggering thunderstorms are far too local to be able to make a well-founded statement here. We think that even for ZT, the precipitation measuring station is still too far away.

Catchment morphometry versus flow magnitudes. In section 4.3 the volume of 404 debris flows is compared to a number of morphometric parameters of their source catchments. A key component of such an analysis is information on how many events are generated from each studied source catchment. If each catchment in the dataset generates multiple flows there is stronger statistics, while if each catchment only produces 1 flow this introduces uncertainty since this one flow may have been relatively small or large. It would be good to elaborate on this in the manuscript.

Comments from the authors:

Thanks for the advice!

We can include this suggestion into our analyses. If we only take those catchments into account that produced at least two debris flows in the period studied, the sample size is reduced from 404 to 296.

The correlations now are a little bit weaker, but the statements from the analysis do not change as a result. We can add these data to Tab. 3. Now, the table not only shows correlation parameter for all debris flows but also are complemented by those catchments, which produced at least two flows ($n > 1$). You can see the adjusted Tab. 3 in the attached document.

Conclusions. I suggest to shorten the conclusions and also remove the subsections.

Comments from the authors:

Reviewer 2 also made a similar comment. We will adjust the conclusion section accordingly.

Details:

Lines 97-98: Please elaborate on how these type 2 debris flows in Zimmermann (1990) or type 1 in Wichmann (2006) and Rieger (1999) are defined, e.g., describe their characteristics.

Lines 162-163: Two times "The approach".

Line 2019: Parameter should be parameters.

Lines: 270-274: "The mapping of the debris flows showed a concentration of these processes in the parallel sub-catchments GT, LT and ZT. As those debris flows show such a different picture when comparing them to the activity in the other sub-catchments, and because of the similarities in the geomorphological and geographical settings, the analyses concerning deposition volumes were carried out exclusively in GT, LT and ZT." It is unclear how the debris flows of sub-catchment GT, LT, and ZT differ from those of the other catchment. As such, this statement raises a lot of questions. Please clarify.

Line 300. Include space in "manyevents".

Lines 297-301. To me the most striking feature in Fig. 8 is the strong increase in flow volume around 1990. Therefore, it would be good to also describe that here.

Line 532. Include space in "adetailed".

Comments from the authors:

We will adjust the manuscript according to these comments.

Figures:

Overall: In many figures the font sizes are too small and should be enlarged.

Figure 2: It would be more informative to not only plot mean temperatures and precipitation, but rather plot a band indicating the values range. For example, mean +- std or 25-50-75 percentiles.

Comments from the authors:

We will try to implement this and expand Fig. 2 accordingly.

Figure 5: For readability the font size on the axes should be enlarged.

Figures 6 and 8: Given the unequal intervals of the time slices the left panels of these figures are not informative. I therefore suggest that the authors only present the data on the right panels, and combine debris flow frequency (Fig. 6) and magnitude (Fig. 8) in one figure. Do not denode panels as left and right, but annotate as "a" and "b". In addition, also for these figures the font size is too small and I suggest enlarging the font. In addition, for the magnitudes it would be beneficial to also include uncertainties with dashed lines.

Comments from the authors:

We will also adjust these figures according to the comment.

Figure 12: For comparability it would be better to present the magnitude-frequency curves in panels b and c together in one panel. Also gridlines would help interpretation of the figures. Again, font sizes should be enlarged in this figure.

Comments from the authors:

The comments on the figures can be implemented as such.

Please also note the supplement to this comment:
https://nhess.copernicus.org/preprints/nhess-2022-138/nhess-2022-138-AC1-supplement.pdf