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Reply on RC2

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-AC2, 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.

Major comments:

The scientific challenge of the manuscript need to be further sorted out. The author hopes to explore the spatial and temporal distribution characteristics of local slope-type debris flows, however, there seems to be no clear rule or conclusion until the end of the manuscript.

Comments from the authors:

We will try to be more precise about the objectives at the beginning of the manuscript.

The results indicate that the slope-type debris flow activities in the Horlachtal region show three active periods. However, they seem to be artificially divided. Under this premise, whether the statistical results of debris flows in different periods, especially the quantity, are in line with the actual situation. In reviewer's opinion, people can get good statistical results they want by adjusting the time interval. Therefore, the basis of three active periods may need clarifications and solid reference.

Comments from the authors:

The used method influences the boundaries of the active periods. As a consequence, these boundaries are not chosen randomly, but are determined in advance by the availability of historical and recent aerial image surveys.

The only way to compare these periods with alternating durations is to normalise by the number of years between the periods.

This is already described in the manuscript in lines 395-397:*The calculations of 'debris*

flows per year' suggest a uniformly distributed debris flows activity throughout the respective epochs, which is far from reality, and hence these calculations should be treated with caution".

It is therefore due to the methodology that this approach is somewhat problematic in order to be able to delineate the "real" active periods with high accuracy.

The available precipitation data do not help a lot to further limit the active periods because the heavy rainfall events occur too local.

We will try to elaborate on this more clearly in the discussion.

In Abstract, authors points out that local thunderstorms are the triggering factors of debris flows. In this manuscript, only very limited words are used to describe this phenomenon. In reveiwer's opinion, the existing materials cannot support this conclusion. Furthermore, this conclusion does not seem to be closely related to the subject of the manuscript, and it is not the main result of the study. Therefore, reviewer does not believe it is appropriate to mention in the Abstract as the main conclusion of the manuscript.

Comments from the authors:

The thunderstorms as debris flow triggering events were not the focus of our analyses. We will therefore cut the keyword from the abstract.

The manuscript mainly focuses on the spatiotemporal statistics of debris flows. However, the analysis of the causes of these laws and their physical mechanisms is relatively limited. The susceptibility of debris flow is affected by some important factors such as soil properties and vegetation conditions. In the analysis, the influence of the above factors should be further discussed in combination with the characteristics of the study area.

Comments from the authors:

Thanks for the advices!

In the vast majority of the cases, the slope-type debris flows in the study area are generated in the hydrological catchments (consisting of bedrock) respectively at the contact zone of the catchments with the talus slope.

In Horlachtal, no trees or higher vegetation grow in the catchments. There is also hardly any soil formation there due to the altitude and the high morphodynamics. If there is any soil formation, then only shallow initial soils.

Whether a debris flow is triggered or not is therefore less influenced by the factors mentioned above, but is (since transport-limited systems are predominant) mainly influenced by precipitation event intensity and the conditions in the catchment area of the debris flow, which lies exclusively in bedrock with no noteworthy vegetation or soils.

We can address this more clearly in the discussion.

The structure of the manuscript needs to be further streamlined and optimized. For example, "Methodological limitations" are suggested to be placed after the discussion, rather than before each discussion, which will hinder readers' understanding of the research conclusions. In addition, "Conclusions" in the current manuscript need to be modified. It is recommended to refer to other literatures published in NHESS for further simplification to show the insight, impact and implication of current study.

Comments from the authors:

We appreciate the suggestions for the structure of the manuscript and we will try to implement them.

Reviewer 1 had similar comments on the conclusion. We will revise the section accordingly.

Minor comments:

It is recommended to further modify the figures:

The font sizes in Figures 5, 6, 8, 9, 10, 11, and 12 are too small, It is recommended to adjust according to the journal requirements;

For debrs flow volume, uncertainties of the calculations are presented by error bars in Figure 8, so other volume related figures may alos need erro bars?

Comments from the authors:

We will try to implement the comments on the figures as noted.