

## General comments:

The authors of the study titled "The vulnerability of buildings to a large-scale debris flow and outburst flood hazard chain that occurred on 30 August 2020 in Ganluo, Southwest China " present a comprehensive analysis on damage resulting from a debris flows and dam break event. Their study presents a systematic investigation using modeling of the debris flow and outbreak event, analysis of damage patterns, and a vivid discussion of the ensuing damage from the hazard chain. Their results are very interesting and make a meaningful contribution to the growing field of multi-risk management and mitigation.

My recommendations for this manuscript mainly revolve around improvements to writing and presentation of the information in this study. Though the results are very detailed and methodology clearly described, the presentation of results and the writing may require editing, as well as additional information and figures to support some statements. In the results section, the model and description of damage caused by the flood are combined. Furthermore, the results are missing information on validation and verification from their HEC-RAS simulations to give readers an idea of the performance of the model. There are segments in the results that describe the model performance, but an overview of the performance is not clear in this current version. Furthermore, the presentation in this paper could be improved by creating a segment with figures dedicated to describing and presenting the damage to buildings before discussing the model results. I therefore recommend minor revisions that the authors may want to consider for their manuscript, before publication.

## Specific Comments:

L55-67: The authors could further expound on how they arrive at “..this approach may not apply directly to debris flow-dam-burst flood hazard cascade.” Although the literature preceding establishes the importance of their approach, L65-67 seems to be missing a connection.

L68-69: This statement could be improved with support from a reference.

L86-87: It may be more appropriate to refer to Fig 1 here.

L142-143: Information on the period of time before and after the disaster these drone photos were taken would be nice to state.

L152-153: Does this error represent both vertical and horizontal accuracy?

Table 1: Description parameters are clear, although some lines may require the reference ( i.e. the method for calculating  $nc$  was deduced from analysis of viscous debris flows in Huoshao gully in China.). It was unclear to me if some information were statements from the reference under the Category of Calculation column.

L199: This line may need a return period analysis or a reference to support this claim.

L210: 1,050,000 could be abbreviated to 1.05 M to improve readability

Figure 2: X-axis dates and times are difficult to read, authors may want to consider improving this figure by nesting times within dates on the axis. Furthermore, the star indicating the date and time of the event is not indicated in the caption, and could be made clearer visually with a larger or more emphasized icon.

Figure 5: Y-axis title has a typographical error.

L235-236: Unclear where the buildings are. In neither figures prior (Fig. 4 or Fig. 1) are the buildings depicted. Although Fig. 3 illustrates this, it would be appropriate to either add another panel to Fig. 6 showing the buildings, or to locate them already in Fig. 4.

Figure 6. Insert captions a and b area uncles; legend is not readable (too small) and the figure caption does not indicate which figure corresponds to which.

L247: The authors should consider supporting this claim with a time series from their simulations. This statement is missing a supporting figure or data. Until this point, they only present the spatial aspect of the flood event (Fig. 6.).

L247-250: These lines may be better in the methodology section rather than in the results section.

L251-253: How do these observations line up with the model results? A location indicator in Fig. 6 may improve the presentation and connection for this statement.

L256-257: The estimated volume of the barrier lake could be presented in this line.

L260-262: It is unclear what two scenarios are being introduced in this line. This may be a good point to begin a new paragraph, and clearly indicate what scenarios are being introduced in Fig. 7.

L262-264: This is a very important statement, but may not be appropriate here. Authors may want to consider separating the paragraph that locates the flood-damaged areas with an improved figure so that readers can spatially locate the flooded areas and damaged buildings with the model results.

L267: It is unclear where this scenario was formally introduced.

L267-279: It is unclear from the presentation of this statement if this was observed by the authors during their field investigation or is this based on literature.

L283-284: This statement could be combined in a separate paragraph describing the damage, and would be better appreciated by readers if located or indicated in any of the figures.

Figure 7. Legend size could be increased to improve readability.

Figure 8. Caption could be improved to indicate that sections here refer to sections in an earlier Figure.

Section 4.4: The authors may want to consider reporting this section and description of the damages earlier in the results. This would greatly enhance readability and garner appreciation for the magnitude of the event before reading into the model results.

L302-310: The authors may want to refer to Fig. 3 when describing this process.

L'308-310: Connecting this statement to the time series in Fig. 2 could help readers appreciate this description.

L316-317: This would be better in a summary section of the damage. It is difficult to follow the presentation of the event.

Figure 9. This figure could be presented earlier to improve readability. The current order of the sections make it difficult to follow.

L346-348: It is unclear if statements on the different damage zones are not static because they were determined by the damage observed or the model results. The authors may want to further expound or clarify this detail.

L380-381: This statement requires reference to a figure.

Figure 11. Building labels are difficult to identify, authors may want to consider enhancing the text color to improve identification and readability.

L384-392: Building references require references to Figure 11.

L393-394: Building 26 requires reference to Figure 11.

Figure 12 and Figure 13: Figures could be enlarged, and presented separately instead of in two columns to improve readability.

L427-428: The authors may want to expound, reference or describe the different damage patterns to buildings in their study that leads to this disparity.

L428-432: This may be more appropriate in the discussion section.

Figure 14 and Figure 15: Figures could be enlarged, and presented separately instead of in two columns to improve readability.

L444-449: May consider rewriting these sentences, as they run over each other and are difficult to read. It is also unclear how the supporting references support the final statement in its current state.

L453-466: This paragraph may be more appropriate in a limitations section in the discussion, rather than in the results.

L465-466: The authors could consider describing the detailed data required from the insights in this study to direct future research and add outlook from their work and experience.

L469-478: References to appropriate figures from earlier sections may greatly improve readability and aid readers in understanding where statements in this summary paragraph are derived from.

Figure 17. The authors may want to consider moving this figure to the results section or creating a section to show this. This is an important result, and may require information on the model verification and validation results supporting the areas delineated in this map.

L510-521: The authors may want to consider starting the section with this paragraph.

L520-521: Unclear if this is a conclusion from this study or a statement from a reference or literature review.

L514-515: The authors raise an important point, but could enhance their discussion by adding insight to how these physical characteristics can affect vulnerability.

L540-541: Unclear if this is applicable to only this study site or if this a general application to other study areas, based on the results and methodology presented.

L549-544: This is an important conclusion. Further support in the discussion section would aid readers, give outlook, and inform future research directions.