

Review of the manuscript “**The importance of erosion for debris flow runout modelling from applications to the Swiss Alps**”

submitted to “**Natural Hazards and Earth System Sciences**”

by **F. Frank, B.W. McArdell, C. Huggel and A. Vieli**

Reviewer: M. Mergili

The authors use the debris flow module of the software RAMMS to explore how considering erosion or not affects the results of debris flow runout modelling. They first calibrate their erosion model in the Illgraben catchment, before applying and validating the calibrated model with data from the Spreitgraben catchment. The manuscript is generally well written and illustrated, and is certainly interesting for the audience of the journal. I would like to place a number of suggestions which could help to further improve the manuscript. All in all, I suggest a **minor-moderate revision**.

General comments

I have a few suggestions with regard to the structure and the clarity of the article:

1. The clarity of the description of the results has to be improved. For example, sometimes you mention that the best results were obtained with $\mu=0.20$ (e.g., [2394, 3]) sometimes with $\mu=0.20$ (e.g., [2394, 25]). It did not become clear to me to which settings/criteria the two different values refer. Please make this clearer. It could also enhance the readability of the paper to compile the best-fit parameters in a table (this could be done by extending Table 2).
2. You should consider moving some portions of the Discussion (e.g., at least part of the paragraph starting at [2397, 12]) to the results section.

Specific comments

2384, 21ff: Review this sentence, something seems to be wrong (it is probably the increase in rock fall activity which is related to snow melting processes, not the daily warming).

2385, 9: “... most far reaching ...”; “... valley of the Hasliaare River”

2385, 22f: It cannot be the reason to use a model that it has been developed at WSL ... it is enough as justification to write that it is widely used.

2387, Eq. 4: I suggest to use a different symbol for the slope, the one you use is too much associated with the internal friction angle.

2388, Eq. 5: I do not understand how the slope can directly be used to compute a stress ... shouldn't it rather be some kind of sin, cos, or tan of the slope?

2389, Eq. 6: You should add a third line showing what happens when dz/dt is above 0.25 m/s. This is explained in the text, but it would enhance the readability to show it also in the equation. Further, I suggest to use variables instead of the thresholds of 1 kPa and 0.25 m/s. You mention in the text that these thresholds may be adjusted. So, it would be better just to use variables and to mention the values used rather in the text.

2390, 9: "from the values determined ..." could be better.

2390, 24: "... entrained at a specific rate ..."

2391, 8ff: Better remove the sentence starting with "However ...". This reasoning, in my opinion, is not completely valid as varying the parameters could further improve the insight in the importance of erosion.

2391, 14: "... also works as expected ..." could be better.

2392, 13: "... more work needs to be done ..."

2392, 14: Better start a new sentence after the reference.

2393, 14: "... hence is difficult ..."

2394, 11: "... When choosing"

2394, 13: What do you mean with "standard diameter" here? Please explain or reformulate.

2395, 11: "... the simulation with ..."

2395, 14: I have the feeling that the sentence should not end after "considered", but that some information is missing here.

2397, 25: "Different propagations ..." does not appear to me as a good formulation.

2398, 12: "... with a specific thickness ..."

2398, 19f: Delete either "determine" or "assess"

2399, 3: "... larger flow heights, larger volumes ..."

2399, 14: "... modelled and observed erosion depths using the ..."

2399, 25: Better: "... different from the best-fit ..."

2400, 11: "... values of more than ..."

2401, 27: The statement that incorporating erosion improves the model result is not supported by Fig. 5. For this, the observed impact area of the flow would have to be indicated in the figure.

Apart from the issue raised in [2401, 27], the figures are well prepared, I only have one small suggestion: in the Figs. 4 and 6, the symbols for the observation should be more different from those for the modelling (e.g., by choosing not only a different colour, but also a different type of symbol). This could further enhance the readability of the figures.

The authors should feel free to contact me at martin.mergili@univie.ac.at in case they disagree with my comments or if they wish further discussion.

With best regards

Martin Mergili