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Reply on RC2

Andrew Mitchell et al.

Author comment on "Variable hydrograph inputs for a numerical debris-flow runout model" by Andrew Mitchell et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-352-AC3, 2022

Lines 35-46: well said.

Thank you, we think the fact our models are not as complex as reality is an important point to have in mind when interpreting results.

Lines 47-54: again, well said. Maybe, you can also mention one additional point related to rainfall distribution. The actual area contributing to debris-flow initiation is often considerably smaller than the whole basin (e.g., Berti et al., 2020; Coviello et al., 2021).

Thank you. The following sentence has been added: "The proportion of the catchment area contributing to a debris flow event may also vary substantially, from isolated sediment sources subjected to a "firehose effect" triggering mechanism (e.g., Berti et al., 2020), to much more diffuse sources leading to debris-flow initiation in only part of a catchment area (Coviello et al., 2021)."

Line 82: the word "model" is repeated, please check the wording.

Good observation, the first instance is redundant and was removed from the manuscript.

Section 2 Methodology: few sentences summarizing the different steps would be useful to understand the work flow from the beginning.

Good suggestion. We have added the following statement to contextualize the methodology section: "To explore the effects of inflow hydrograph shape on simulated runout, we first investigated a simple model and progressively added complexity. In this section, we describe the runout model used, the simple synthetic topography used to test triangular hydrographs, and complex hydrographs derived from records of real events. Finally, we applied the complex hydrographs to cases with natural terrain. This approach allows us to examine the interplay between inflow conditions, flow resistance and simulation outputs."

Line 90: "we used a model based on… Lagrangian model that…", please check the wording.

To remove the two models in one sentence, the start of the sentence was modified to read: "In this study, we modified Dan3D…"

Lines 182-184: why did you select a value c = 0.2 to define the upper peak-discharge limit of this second test?

This value was selected from an analysis of the real event hydrographs, as shown in Figure 3 (now Figure 4). The examination of the hydrographs is now mentioned in the manuscript, as follows, when the selection of c is first introduced: "The *c* value we selected is an upper envelope value from the real event hydrographs compiled in this study (Section 3)."

Figure 6: the figure is ok but the five lines above it already contains the key message. Does the reader need a colored 3D plot presenting the variation of Froude number to understand the story? In my opinion, this figure can be moved to the appendix or supplement.

Good point, the figure has been moved to the Appendix, and only the text explaining the Froude number evaluation remains in the main text.

Line 391: "the red outline on the impact…" the line is yellow, am I right? In the caption, please refer to panels using (a), (b), etc.

You are correct, the outline is yellow. Apologies for the confusion. References to the specific panels have been added to the caption.

Lines 408-415: everything is fine, maybe I would just add one sentence to clarify if your results are consistent with other studies investigating the impact of topography and flow resistance parameters on the modeled discharge.

Thanks very much for this comment. The authors are not aware of other studies that have specifically investigated the influence of these parameters on modeled discharge. Other numerical runout modelling studies have found that simulated deposition areas and flow depths are influenced by DEM resolution and resistance parameters (e.g., Arattano et al., 2006; Schraml et al., 2015; Zhao & Kowalski, 2020), however these did not specifically investigate discharge, so we prefer to leave the text as is.

Lines 416-427: good discussion. I am wondering if a figure with a concept illustration of a simplified channel summarizing the two cases (in two panels?) could be useful: case (1) if channel slope > f value, then the downstream estimate peak discharge can be used as it is; case (2) if channel slope < f value, then higher inflow peak discharge is probably needed.

Thank you for the suggestion. We have decided to make an explicit link back to Figure 5 (Figure 4 in the original manuscript), as opposed to creating a new figure. The following text has been added: For example, the peak discharge for all cases shown in Figure 5 (a) and (b) where the local channel slope is greater than the *f* value, the modelled discharge is approximately equal to the inflow peak discharge. Further in the simulation, the peak discharge is attenuated significantly where the local channel slope is less than the *f* value, Figure 5 (e), relative to the inflow hydrograph and the case where the local channel slope is still greater than the *f* value (Figure 5 (d).

Section 5: here, you move to British Columbia, Canada, and test the methodology described in the previous sections on two debris-flow fans (Currie D and Neff Creek). This is ok but I would suggest adding a couple of introductory sentences to this section just to avoid that it sounds somehow disconnected from the previous ones.

Thank you for this suggestion. The following statement has been added to make the link from the previous section to the case histories: "In the previous section, we detailed how

variations in flow resistance and inflow conditions affected debris-flow depths and velocities using an idealized synthetic topography. In this section, we apply the scaled, real hydrograph inputs to the much more complex topography of two natural debris flow sites in southwestern British Columbia, Canada."

Data availability: given the Copernicus data policy, consider making hydrograph data available through an official repository.

Excellent suggestion, the data is currently under review with the Pangaea repository.