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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Debris flow modeling at Meretschibach and Bondasca catchment, Switzerland: sensitivity testing of field data-based erosion model" *by* Florian Frank et al.

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»General comments

This paper aims to simulate debris-flow process by considering bed erosion along the path. As erosion is a complex natural process and plays a very crucial role both in debris-flow dynamics, transportation, run out and deposition process, it is a very important research topic. To do so, this paper attempts to combine an empirical entrainment model which has been previously introduced by authors into the RAMMS model. The sensitivity of the developed model is tested by applying the model to two debris-flow events in Switzerland. The results show some interesting erosion and flow patterns.

Generally, this is a straight-forward development of the RAMMS model for the simulating bed erosion in debris flows. The paper is well illustrative and authoritative. The authors build upon their previous work and extend the RAMMS model to the erosion simulation. It is a major contribution and is sound. However, in my opinion, the major limitation of this paper is that the described debris-flow entrainment model is rather sensitive to the empirical coefficients, and these coefficients are not well illustrated in the paper. Indeed, the authors show us a sensitivity analysis of erosion volume to the initial volume, erosion rate and calibrated parameters ξ and u in Fig.7. As they mention, the value of these parameters are suggested by the previous study in the same region, e.g., the erosion rate dz/dt = 2.5cm/s. However, the rational range of these parameters may be different in other regions, there is a need to explain how to determine these parameters. The paper could be improved and made more accessible by further exploring these empirical parameters. I recommend this paper for publication after major revisions.

»Specific comments

Page 6, 195-196. The authors mention that the slope angle Φ in the deceleration term Sf is similar to the internal friction angle of the material. Does it mean that Sf will be the same when at a steep slope and a gentle slope? Please check it.

Page 7, 221-222. The critical shear stress τc determines the maximum potential erosion depth em, the erosion will not be existed at the area where $\tau<\tau$c. For this reason, the critical shear stress is a key parameter for controlling the shape of erosion area and erosion depth. But the authors superficially use an empirical value 1kPa in the paper, and no sensitivity analysis is made. It seems that they could simply test and provide results on how sensitive the simulation is to the choice of the critical shear stress τc.

Page 11, 360. The total erosion volume remains approximately constant when the initial volume exceeds a certain value. How to explain this phenomenon? Is this because the maximum erosion depth em is reached as controlled by the critical shear stress

τc=1kPa? As such, it seems that the choice of τc as a model parameter should be discussed to a greater degree, especially if you want your method to be used more widely on debris flows of varying properties.

Page 12, 396-397. As I see in Fig.3, there is no significant difference of runout distance in B2 (u=0.6) and B3 (u=0.7). Please check the sentence “u controls the runout distance”.

Page 27, 675. The total erosion volume in both cases show an abrupt decrease, and then a significant increase with the initial release volume, i.e., 1-2m3 in Meretschi and 10-20m3 in Bondasca. Is there any rational explanation on it?

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