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Comment on nhess-2021-49

David Jessop (Referee)

Referee comment on "Quantifying location error to define uncertainty in volcanic mass flow hazard simulations" by Stuart R. Mead et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-49-RC3, 2021

This is a review of "Quantifying location error to define uncertainty in volcanic mass flow hazard simulations" by Mead et al. This manuscript aims to quantify "location error", that is the difference between observed and simulated deposit locations. A lack of model uncertainty quantification, i.e. location error, along with "model complexity", i.e. uncertainty over the best-adapted physical model or correct values of model parameters are cited as reasons that mass flow simulations are not more widespread in volcanic hazard assessment. Thus efforts to quantify and/or constrain these errors are to be applauded. This work is such an efford. It takes a novel fuzzy logic approach to the quantification. Several common rheological models for debris flow modelling are assessed within this framework. Data from the 2012 debris avalanche of the Upper Te Maari crater, Tongariro volcano, NZ is used as a benchmark in this study. I find that the study is generally interesting and novel, though some points require clarification.

Comments:

L038-041: The implication is that scaled, experimental models are (over)simplified and hence unsuitable as benchmarks, as opposed to real-world flows. I think the truth is somewhere inbetween: real-world flows (or more realistically their deposits) are often subject to erosion, slumping or alteration before being surveyed. Furthermore, given uncertainty over the initial state of the topography (cf. 10 m initial DEM), the uncertainty of deposit depth estimation may be as large or larger than the location errors cited in this study.

L053: The term "Confusion matrix" is not completely commonplace. As a courtesy to the

readers, could the author's please give a short definition of what they mean by this?

L073: Similarly, please define "fuzziness" and "fuzzy comparisons".

L062: I think the sense of this sentence should be reversed: errors increase as flow depths decrease, i.e. as flow thins towards distal regions. Also, please add a reference here.

L103: Please give (characteristic?) resolution of post-event DEM.

- Section 3: Please give details of the numerical solver as well as the physical models used.
Also, whilst the two-fluid and Veollmy-Salm rheological models may be as implemented in Titan2D, are the solver and numerical routines the same? I mean, would we expect "exactly" the same result if we used Titan2D for the same topography, initial and boundary conditions?

- I'm still unsure as to how important/relevant is "location error" compared to the model complexity and uncertainty over model parameters. In the modelelling done here, were any attempts made to sample a suitable parameter space and see how much this affected results?

L304, L335 (and elsewhere, i.e. abstract and conclusions): using the term "length scale" to describe the "lambda" parameter may be confusing, as many readers understand "length scale" to mean a characteristic physical length of the flow rather than an integer number of compuational cells. Would "network extent" be a more suitable term?

- Discussion: I think the suitability of the chosen DEM/case study to quantify this study needs to be discussed. For instance, what would be the effect of coarsening (subsampling) the grid? This links back to a point made above, but I feel that it's a little risky to talk about a single benchmark study. A risk is that models get tuned to fit that case study and may not be applicable to other scenarios. Please discuss this further.

Typos/text errors:

L032: should be "Model's predictive accuracy"
L052: "...but GLOBAL METRICS can disguise..."?
L104: "The mud-sand matrix-supported debris..."

L105: "poorly-sorted clasts"
L133: "high-gradient slopes"
L144: "universally-accepted constitutive laws..."
L170: "momenta" ?