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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Dome instability at Merapi volcano identified by drone photogrammetry and numerical modeling" *by* Herlan Darmawan et al.

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The submitted manuscript provides a useful integrated study of drone-based geomorphological analysis and thermal infrared data collection to assess the stability of the dome of Merapi volcano. Water percolation within the dome is taken into consideration as trigger of dome collapses. The effort to provide a Factor of Safety is commendable. Although pyroclastic flow modelling is only a small portion of the research work illustrated here, to prevent this paper from being misleading, the authors should acknowledge the fact that there is still a lot of work to do before it is really possible to predict the mobility of pyroclastic flows.

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Discussion paper

I have a few important comments:

1) There is the need to mention the actual basal friction that the authors have chosen when running Titan2D: Coulomb, Voellmy or Pouliquen-Forterre, for example. If this is not done, it would be impossible to fully characterize the simulations.

2) Please recognize in the text that Titan2D, as the name confirms, is a two-dimensional model whose results are adapted to a three-dimensional subsurface only later on by the software package.

3) It is also very important to disclose that, in Titan2D, the flows never stop and the computer operator has to introduce an arbitrary criterion to decide when the flows cease their motion and a deposit is formed [Ogburn and Calder, 2017]. The lack of acknowledgment of this shortcoming generates the false notion that the pyroclastic flow mechanics is understood.

4) The main problem with Titan2D is that it ignores completely the granular nature of pyroclastic flows. This is in contrast to the fact that block-and-ash flows are well documented worldwide to be dense granular flows of angular rock fragments [Nairn and Self, 1978; Saucedo et al., 2002]. It is therefore important to inform the readers that an effort is undertaken to understand how rock fragments dissipate energy when interacting among themselves and the subsurface within travelling flows [e.g., Cagnoli and Piersanti, 2015 and 2017]. Since the grain size strongly affects the mobility, it is important to state clearly the grain size of the simulated flows.

5) My previous comments boil down to two questions. Considering that, block-and-ash flows are controlled by gravity and topography, do you really need Titan2D to know: A) that dome collapses discharge their rock debris down the deep and narrow valley which the horseshoe-shaped crater morphed into and B) that deposits form at the base of the volcanic cone where a dramatic change of the slope angle occurs?

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References

Cagnoli B., Piersanti A., 2015. Grain size and flow volume effects on granular flow mobility in numerical simulations: 3-D discrete element modeling of flows of angular rock fragments. J. Geophys. Res. Solid Earth, 120, 2350-2366, doi:10-1002/2014JB011729

Cagnoli B., Piersanti A., 2017. Combined effects of grain size, flow volume and channel width on geophysical flow mobility: three-dimensional discrete element modeling of dry and dense flows of angular rock fragments. Solid Earth, 8, 177-188.

Nairn I.A., Self S., 1978. Explosive eruption and pyroclastic avalanches from Ngauruhoe in February 1975. J. Volcanol. Geotherm. Res. 3, 39-60.

Ogburn S.E, Calder E.S., 2017. The relative effectiveness of empirical and physical models for simulating the dense undercurrent of pyroclastic flows under different emplacement conditions. Front. Earth Sci. 5:83, doi:10.3389/feart.2017.00083

Saucedo R., Macías J.L., Bursik M.I., Mora J.C., Gavilanes J.C., Cortes A., 2002. Emplacement of proclastic flows during the 1998-1999 eruption of Volcán de Colima, México. J. Volcanol. Geotherm. Res. 117, 129-153.

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