

['Comment on egusphere-2022-153'](#), Federico Di Traglia, 06 Jun 2022 [reply](#)

We thank the reviewer for his comments. They are addressed below. Our answers are in bold.

Dear authors,

Your work, although very interesting and with many methodological ideas for estimating slope instability in the absence of geomechanical/geotechnical data, is too speculative. That is, there are no counter-tests to your hypotheses. I find some main criticisms:

- identification of the "stable / unstable / less unstable" units: you have a profile with the different surfaces destabilized over time, you can use that to perform analyzes (for example Limit Equilibrium Methods, I recommend in 2D with Borselli's SSAP, <https://www.ssap.eu/>). As resistance parameters you can use those present in the literature (eg andesitic lavas, pumice, altered ashes, and so on) and carry out a series of tests by varying the parameters within the limits of the values found in the literature;

In our view, a detailed limit equilibrium analysis with geotechnical model is beyond the scope of our study. We aim at providing a first hypothesis on the geometry of geological layers and their relative stability, using a geomorphological and descriptive approach. This hypothesis could indeed be tested in future works with limit equilibrium methods, including a sensitivity analysis on the geometry of interfaces, on the geotechnical properties of materials, and on the presence and levels of aquifers. Given the uncertainty on all these parameters, such a sensitivity analysis is, in our view, too complex to be included in the current manuscript. However we agree that future works could include limit equilibrium studies, and this will be added in the discussion.

- palaeo-geographic reconstruction: since you are reconstructing the palaeo-geography of an entire flank of the volcano, I think that similar reconstructions were carried out by those who did geological mapping. Are your reconstructions consistent with those?

We are not reconstructing the paleo-geography of an entire flank of the volcano, we are only focusing on small portion of the West flank of Montagne Pelée. To our knowledge, this has not been done before in the case of the Montagne Pelée. However, the succession of eruptive periods considered is in line with recent studies, e.g. Boudon and Balcone-Boissard (2021).

- volume estimation: everything depends on point 1 (identification of the parameters). If you find the parameters, you could "test" your reconstruction by comparing it with some 3D instability models (for example using the parameters identified in 2D with SSAP within 3D models with SCOOPS-3D, <https://www.usgs.gov/software/scoops3d>). Since yours is a methodological draft, the proposed method should be tested with existing methods. Otherwise your results are too speculative.

As stated before, such an analysis would require a detailed sensitivity analysis that we think is beyond the scope of this study. However, your suggestion will be added in the Discussion.

Commentaires PDF

In realtà le fasi di allargamento dipendono sia dalle fasi di costruzione, ma soprattutto da quelle di distruzione dell'edificio. Ci sono vari studi sull'evoluzione morfologica degli edifici vulcanici che dimostrano che le fasi di smantellamento (catastrofico o progressivo) tendono a spostare il materiale vulcanoclastico sempre più a valle.

Consiglio di leggere:

De Rita, D., Giordano, G., & Milli, S. (1997). Forestepping-backstepping stacking pattern of volcanoclastic successions: Roccamonfina volcano, Italy. *Journal of volcanology and Geothermal Research*, 78(3-4), 267-288.

Manville, V., Németh, K., & Kano, K. (2009). Source to sink: a review of three decades of progress in the understanding of volcanoclastic processes, deposits, and hazards. *Sedimentary Geology*, 220(3-4), 136-161.

Di Traglia, F., Fornaciai, A., Favalli, M., Nolesini, T., & Casagli, N. (2020). Catching geomorphological response to volcanic activity on steep slope volcanoes using multi-platform remote sensing. *Remote Sensing*, 12(3), 438.

We agree. This will be added in the Introduction, along with the provided references.

Regarding debris avalanches and debris flows : in what sense are they associated? Is there a transformation of flow from rock avalanche to debris flow? Or is there the erosion and transport of the rock avalanches material by meteoric waters to form debris flows ?

Once materials are deposited at the bottom of the cliff, they can be remobilized by water (immediately or after several weeks/months) to generate debris flows. This will be clarified.

I cannot understand how you characterize the geological or geolithological unit

The different geological units are identified by changes in colors and textures. Between the UPD and LPd units, and between the UPd and Co units, these changes are also associated to slope breaks.

Sorry but it's not clear to me. If I understand correctly, you identify the "stable" units because they have not collapsed, while those that have been involved in the landslides that have already occurred are unstable. It's right? However, the stability / instability of a slope can depend on several factors, first of all the mechanical / technical characteristics of the material, and the slope. this is to say that a "stable" unit can become unstable if the morphology becomes leaning enough to cause it to collapse.

We agree and will clarify this point. By « stable », we meant « more stable », given the current morphology of the cliff.

Is the accuracy of 1 m on the z? of all the dem? or their difference? Please specify.

The 1 m accuracy corresponds to the horizontal resolution of the DEM. This will be stated more explicitly.

A propos du passage des horizons aux plans : It will certainly be my limitation, but I don't understand how you extrapolate the information on the plans.

The horizons are 1D features, but the curvature of the cliff implies they are not lines. Thus, the corresponding points can be used to fit planes.

I would not call them "stable", but "more stable than other units". I think it is more correct formally and it is a form that avoids misunderstandings.

Agreed