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Simulating the lava flow formed during the 2014-2015 Holuhraun eruption (Bardarbunga volcanic system, Iceland) by using the new F-L probabilistic code

Simone Tarquini (1), Mattia de' Michieli Vitturi (1), Esther H. Jensen (2), Sara Barsotti (2), Gro B.M. Pedersen (3), and Diego Coppola (4)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Pisa, Italy (demichie@pi.ingv.it), (2) Icelandic Meteorological Office, (3) Department of Earth Sciences, University of Iceland, (4) Dipartimento di Scienze della Terra, Università di Torino

The 2014-2015 fissure eruption in Holuhraun started when a new code (named F-L) was being developed. The availability of several digital Elevation Models of the area inundated by the lava and the availability of continuously updated maps of the flow (collected in the field and through remote sensing imagery) provided an excellent opportunity for testing and calibrating the new code against an evolving flow field. Remote sensing data also provided a constrain on the effusion rate.
Existing numerical codes for the simulation of lava flow emplacement are based either on the solution of some simplification of the physical governing equations of this phenomenon (the so-called "deterministic codes" - e.g. Hidaka et al. 2005; Crisci et al. 2010), or, instead, on the evidence that lava flows tend to follow the steepest descent path from the vent downhill (the so-called "probabilistic codes" - e.g. Favalli et al. 2005).
F-L is a new code for the simulation of lava flows, which rests on an approach similar to the one introduced by Glaze and Baloga (2013), and can be ascribed to the "probabilistic family" of lava flow simulation codes. Nevertheless, in contrast with other probabilistic codes (e.g. Favalli et al. 2005), this code explicitly tackles not only the direction of expansion of the growing flow and the area covered, but also the volume of the emplaced lava over time, and hence the supply rate. As a result, this approach bridges the stochastic point of view of a plain probabilistic code with one of the most critical among the input parameters considered by deterministic codes, which is the effusion rate during the course of an eruption. As such, a similar code, in principle, can tackle several aspects which were previously not addressed within the probabilistic approach, which are: (i) the 3D morphology of the flow field (i.e. thickness), (ii) the implications of the effusion rate in the growth of the flow field, and (iii) the evolution of the lava coverage over time.
Results obtained for the Bardarbunga eruption showed the high sensitivity of the output to gentle slopes, and hence the relevance of DEM quality in case of lava flow evolving on the very gentle slope of the Holuhraun area (about 0.4 degrees over the first 10 km of flow).

References

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