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A flexible open-source toolkit for lava flow simulations

Sophie Mossoux, Adelin Feltz, Sam Poppe, Frank Canters, and Matthieu Kervyn
Department of Geography, Vrije Universiteit Brussel, Brussels, Belgium (smossoux@vub.ac.be)

Lava flow hazard modeling is a useful tool for scientists and stakeholders confronted with imminent or long term hazard from basaltic volcanoes. It can improve their understanding of the spatial distribution of volcanic hazard, influence their land use decisions and improve the city evacuation during a volcanic crisis. Although a range of empirical, stochastic and physically-based lava flow models exists, these models are rarely available or require a large amount of physical constraints.

We present a GIS toolkit which models lava flow propagation from one or multiple eruptive vents, defined interactively on a Digital Elevation Model (DEM). It combines existing probabilistic (VORIS) and deterministic (FLOWGO) models in order to improve the simulation of lava flow spatial spread and terminal length. Not only is this toolkit open-source, running in Python, which allows users to adapt the code to their needs, but it also allows users to combine the models included in different ways.

The lava flow paths are determined based on the probabilistic steepest slope (VORIS model – Felpeto et al., 2001) which can be constrained in order to favour concentrated or dispersed flow fields. Moreover, the toolkit allows including a corrective factor in order for the lava to overcome small topographical obstacles or pits. The lava flow terminal length can be constrained using a fixed length value, a Gaussian probability density function or can be calculated based on the thermo-rheological properties of the open-channel lava flow (FLOWGO model – Harris and Rowland, 2001). These slope-constrained properties allow estimating the velocity of the flow and its heat losses. The lava flow stops when its velocity is zero or the lava temperature reaches the solidus.

Recent lava flows of Karthala volcano (Comoros islands) are here used to demonstrate the quality of lava flow simulations with the toolkit, using a quantitative assessment of the match of the simulation with the real lava flows. The influence of the different input parameters on the quality of the simulations is discussed.

REFERENCES:
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