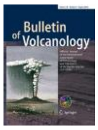

Testing the suitability of frictional behaviour for pyroclastic flow simulation by comparison with a well-constrained eruption at Tungurahua volcano (Ecuador)

Karim Kelfoun [1, 2], Pablo Samaniego [3], Pablo Palacios [3], Diego Barba [3]

[1] IRD—Instituto Geofisico, Escuela Politecnica Nacional, Quito, Ecuador

[2] Laboratoire Magmas et Volcans, Université Blaise Pascal, CNRS, IRD–OPGC, Clermont-Ferrand, France

[3] Instituto Geofisico, Escuela Politecnica Nacional, Quito, Ecuador

Abstract

We use a well-monitored eruption of Tungurahua volcano to test the validity of the frictional behaviour, also called Mohr–Coulomb, which is generally used in geophysical flow modelling. We show that the frictional law is not appropriate for the simulation of pyroclastic flows at Tungurahua. With this law, the longitudinal shape of the simulated flows is a thin wedge of material progressively passing, over several hundreds of metres, from an unrealistic thickness at the front (<<1 mm) to some tens of centimetres. Simulated deposits form piles which accumulate at the foot of the volcano and are more similar to sand piles than natural pyroclastic deposits. Finally, flows simulated with a frictional rheology are not channelised by the drainage system, but affect all the flanks of the volcano. In addition, their velocity can exceed 150 m s^{-1}, allowing pyroclastic flows to cross interfluves at bends in the valley, affecting areas that would not have been affected in reality and leaving clear downstream areas that would be covered in reality. Instead, a simple empirical law, a constant retarding stress (i.e. a yield strength), involving only one free parameter, appears to be much better adapted for modelling pyroclastic flows. A similar conclusion was drawn for the Socompa debris avalanche simulation (Kelfoun and Druitt, J Geophys Res 110:B12202, 2005).

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