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Suitability of simple rheological laws for the numerical simulation of long−runout volcanic avalanches

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The rheology of volcanic rock avalanches is complex and at present their physics cannot be described in a well constrained way. The problem lies in clearly defining the most suitable parameters for simulating the behavior of these natural flows. Existing models are often based on the Coulomb rheology, sometimes with additional velocity−dependent stresses (e.g. Voellmy), but other laws have also been used. The poster shows the characteristics of flows I obtained theoretically by varying the topography, source conditions and rheology in order to characterize the features produced under certain conditions, and thus help future modelers with their choice of which mechanical law corresponds best to the event they are studying. The Coulomb rheology, irrespective of whether there is any additional velocity–dependent–stress, forms pile−shaped deposits that do not resemble those of natural long−runout events. A purely viscous or a purely turbulent flow can achieve realistic velocities and thicknesses but cannot form a deposit. The plastic rheology, with (e.g. Bingham) or without an additional velocity–dependent–stress, is more suitable for the simulation of long-runout volcanic avalanches since it forms deposits with realistic thicknesses and velocities, and is able to generate the frontal lobes and the lateral levées which are commonly observed in the field. With the plastic rheology, levée formation occurs at the flow front due to a divergence of the driving stresses at the edges. These levées then channelize the remaining flow mass upstream.