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Analysis of the runout time and distance of slow-moving gravitational flows: possible modelling concepts and simulations.

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Mud/debris flows are in general fast-moving gravitational flows with a velocity from 1 to more than 10 m.s-1. A number of gravitational flows models have been developed based on a two dimensional finite difference solution of a depth–averaged form of the Navier-Stokes equations of fluid motion. In these models, the flows are treated as a one phase medium which behaviour is controlled by different rheological characteristics depending on the liquid/solid ratio. It appeared that these models are not able to describe accurately both the run-out time and the run-out distance of shear flows with a relatively lower velocity. For example, a mud flow with an initial volume of about 100m3 failed in May 5th 1999 suddenly from a secondary scarp of the Super-Sauze mudslide (Southern French Alps) and reached a distal point of 105 m from the source area. It flowed on the hillslope in the first 30 min with a mean velocity of 2 m.min-1 until a distance of 50 m from the source area, and then continued flowing at a slower mean velocity of 1 m.min-1. Similar patterns of velocity and runout distance for small volume mudflows triggered in May 2008 at Super-Sauze have also been observed.
Three strategies are used to adapt the current run-out models to these relatively slow-moving gravitational flows. These are related to (1) a change in pore pressure dissipation rate and rheological behaviour during the run-out, (2) the ignorance of inertial forces in the equation of motion, (3) the assumptions of a rigid plug in the velocity profile and of low shear rates. The application of the model and results of the simulation to the case studies mentioned above are discussed.