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The runout of granular material: from analogue to numerical modelling

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Rock avalanches are catastrophic events in which important granular rock masses (>106 m3) travel at velocities up to ten meters per second. The mobilized rock mass travel long distances, which in exceptional cases can reach up to tens of kilometers. Those highly destructive and uncontrollable events, give important insight to understand the interactions between the displaced masses and landscape conditions. However, as those events are not frequent, analogue and numerical modelling plays a fundamental role to better understand their behaviour.
The objective of the research is to explore the propagation of rock avalanches and to compare a simple numerical model with analogue modelling. The laboratory experiments investigate the fluidlike flow of a granular mass down a slope. The flow is unconfined, following a 45° slope and spreading freely on a horizontal depositional surface. Different grainsize of calibrate material (115, 545 and 2605 μm) and substratum roughness (simulate by aluminium and sandpapers with grainsize from 16 to 425 μm) were used in order to understand their influence on the motion of a granular mass. High speed movies are recorded to analyse the behaviour of the mass during the whole experiment.
The numerical model is based on the continuum mechanics approach and solving the shallow water equations. The avalanche is described from an eulerian point of view within a continuum framework as single phase of incompressible granular material following Mohr-Coulomb friction law. The combination of the fluid dynamic equation with the frictional law enables the self-channelization of the mass without any topographic constraints or special border conditions.
The results obtained with the numerical model are similar to those observed with the analogue. In both cases, based on similar initial condition (slope, volume, basal friction, height of fall and initial velocity), the runout of the mass is of comparable size and the shape of the deposit matches well. This preliminary version of the code gives encouraging results in agreement with those obtained with laboratory experiments.