Geophysical Research Abstracts
Vol. 15, EGU2013-9254-2, 2013
EGU General Assembly 2013

Experiments on the dynamics of sub-aerial two-phase debris flows

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Debris flows are a threatening natural phenomena to human life, infrastructure and the environment in mountain areas. They exhibit changing flow regimes from initiation to deposition. While regions are liquefied due to high fluid pressure during the motion, other regions contain coarser material with high internal friction exhibiting granular flow features. Existing models have significant limitations and many assumptions are required to fit these extremely complex fluid-particle interaction flows.

In this work, a laboratory experiment has been designed to model debris flow motion, to measure crucial features such as bulk velocities, particle distribution and deposition patterns. The experiments were conducted in a flume of 1.5 m long, 0.15 m wide, 0.23 m deep. The chute angle was constant at 27°. Flows were generated by releasing glass bead-glycerol and glass bead-water mixtures from behind a lock- gate at the top of the chute. The evolution of the flow was captured with high speed video, and PIV analysis provided velocity profiles over the entire flow depth and along the slope. Shear and normal stresses were measured at the basal surface in addition to the fluid pore pressure.

Data from a wide parameter space, testing the influence of different terrain roughness, fluid viscosity and particle size and dispersion, have been analysed to find the dependence of mean flow velocity and velocity profile on the multiphase mixture properties. These are a significant step in providing rigorous validation to depth-averaged models.