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Erosion and basal forces in granular flow experiments

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Extreme mass wasting avalanche events such as rock, snow and ice avalanches, debris flows, and pyroclastic flows are among the most hazardous geological phenomena. These events driven by gravity, can travel for long distance and high speed, increasing their volumes as they can entertain material along their path. The erosion of material and its entrainment can greatly affect the overall dynamics of transportation, either enhancing or impeding the avalanche mobility depending on flow dynamics and characteristics of the substrate. However, the mechanisms and processes acting at the base as they travel over deformable or erodible substrates are still poor understood.

Experiments, simulations and field measurements indicate that large fluctuations can occur in basal forces and stresses, which may be the result of non-uniform load transfer within the mass, and rolling, bouncing and sliding of the particles along the bed. In dense granular materials, force distributions can propagate through filamentary chain structures that carry a large fraction of the forces within the system. Photoelastic experiments on two-dimensional, monodisperse, gravity-driven flows have shown that force chains can transmit high localized forces to the boundary of dense granular flows.

Here we describe the preliminary setup and results of 2D experiments on polydisperse granular flows of photoelastic disks down a small flume designed to acquire the forces exerted at the boundaries of the flow and to analyze their effects on an erodible bed. The intended outcome of this research is to provide better information on the complex mechanism of erosion and its effects on avalanche behaviour.