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Erosion of a wet/dry granular interface

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To model the dynamic of landslides, the evolution of the interface between the erodible ground and the flowing material is still studied experimentally or numerically (ie. Mangeney et al. 2010, Iverson 2012). In some cases, the basal material is more cohesive than the flowing one. Such situation arises for example due to cementation or humidity. What are the exchange rates between these phases? What is the coupling between the evolution of the interface and the flow?

We studied the erosion phenomenon and performed laboratory experiments to focus on the interaction between a cohesive unsaturated granular material and a dry granular flow. Both materials were spherical grains, the cohesion being induced by adding a given mass of liquid to the grains. Two configurations were explored: a circular aggregate submitted to a dry flow in a rotating drum, and a granular flow eroding a wet granular pile.

First, we focused on the influence of the cohesion, controlled by the liquid properties, such as the surface tension and the viscosity. Then the flow characteristics were modified by varying the grain size and density. These results allowed us to present a model for the erosion mechanisms, based on the flow and fluid properties. The main results are the need to take into account the whole probability distribution the stress applied on the wet grains and that both the surface tension and the viscosity are important since they play a different roles. The latter is mainly responsible of the time scale of the dynamic of a wet grain, while the former acts as a threshold on the force distribution. In the second configuration, we could also control the inclination of the slope. This system supported the previous model and moreover revealed an interface instability, leading the formation of steep steps, which is a reminiscence of the cyclic-steps observed during river-channel incision (Parker and Izumi 2000). We will present the dynamics of such granular steps.

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