How far can rockslides travel and why?
Experimental study on the main parameters influencing run-out

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Forecast of rockslides departure and propagation is of fundamental importance in the management of risks in mountainous areas. The main goal of the INTERREG IIIA "Rockslidetec" project, between Italian, French and Swiss partners, is to develop methodological tools to detect potential departure zones of rock avalanches and to define areas that could be affected by their occurrence.
In this framework the EPFL rock mechanics laboratory is carrying out research with a physical model to study at small-scale the parameters influencing propagation and verify or establish laws able to describe this influence.

Experimental set-up
The model, see figure 1, mainly consists of two rectangular panels placed one after the other with a joined side: the first panel is fixed horizontally on the soil and the second one can be positioned at different angle. The granular material used for the experiments (gravel for aquarium D=2-4mm) is laid out in a wooden box (20x40x65cm) placed on the inclinable panel.
With the use of an elastic rope the box can be opened in an almost instantaneous way and the granular material is suddenly released, simulating a rock avalanche.
Each test is filmed by a high speed camera placed at a height of 7 m from the horizontal panel. The camera has been calibrated using MATLAB and with the resulting distortions parameters we are able to obtain undistorted films.
During the experimental campaign we have been changing some parameters such as the volume of the material (40, 30, 25, 20, 15, 10l), the number of consecutive releases, called rates, at which the volume is released (all in once, 2 and 4 rates), the height of release (0.5m, 0.67m, 1m) and the inclination of the movable panel (90° and 45°).
We make a straight measurement of the length and width of the final deposit. Afterwards, by means of an image processing software (WINanalyze), one can follow the front of the mass and compute its velocity and acceleration (figure 2).

Preliminary results
Until now about 100 tests have been made. With these first experiences we have started to study the influence of height, volume and way of deliverance as well as inclination on length and width of the final deposit. For example the left hand side of figure 3 illustrates the relationship between the final deposit length and the cubic root of the volume for vertical drops from 1 meter height. At the same time, the right hand side emphasises the influence on the deposit shape of the number of consecutive releases(40 litres in 1 rate, 2 rates: 20+20l and 4 rates: 10+10+10+10l).

Considerations and future tests
From these preliminary experiences it has been possible to find out which are the

most important parameters influencing a granular flow and to deduce first qualitative trends. Tests with the described model will go on studying different slopes.
A bigger model will be built to study the influence on rock avalanches run-out of other parameters, such as roughness of the panels, use of various materials and use of blocks in several forms and disposition. Next to come is a system to observe the 3D development of the mass during the slide.

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Figure captions
Figure 1: the model
Figure 2: displacement, speed and acceleration of the front of a 40 litres mass released from 1m on a 45° panel
Figure 3: influence of the volume and the number of rates (vertical panel)

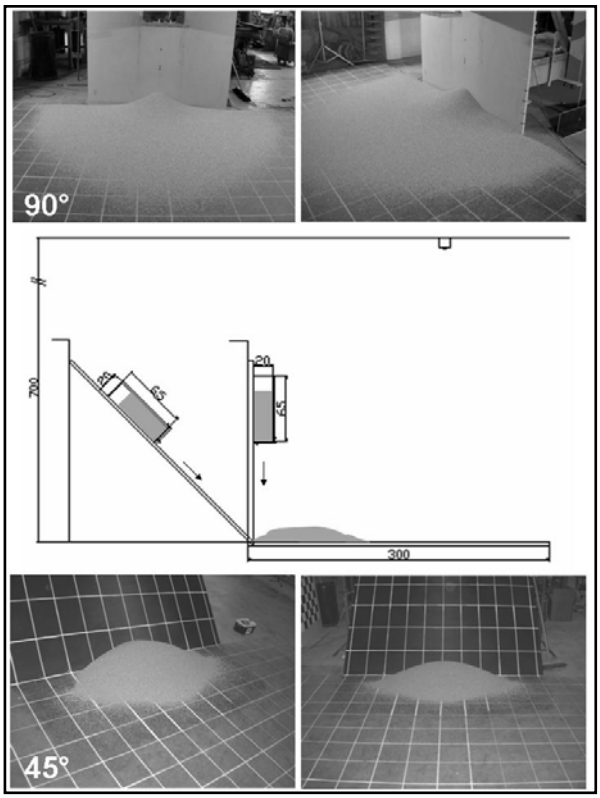

Figure 1 : the model

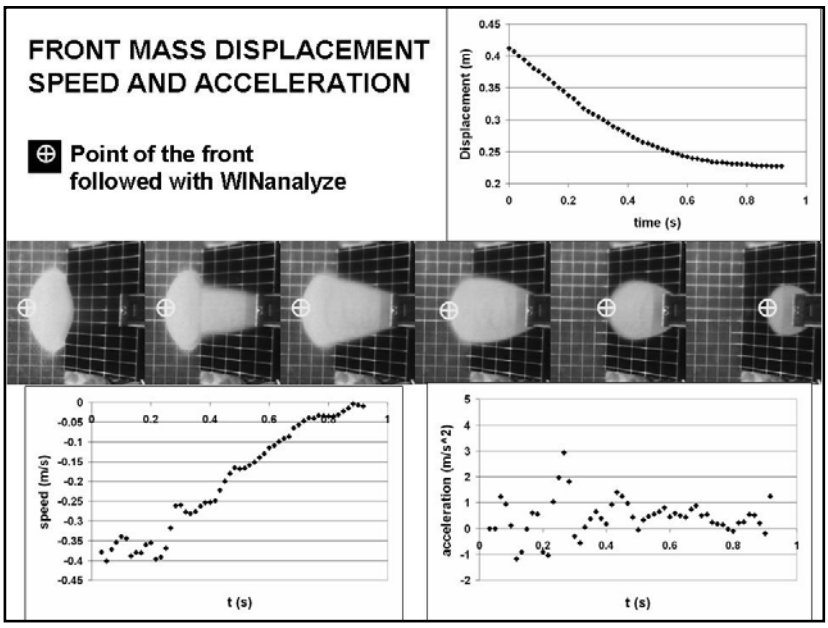

Figure 2 : displacement, speed and acceleration (40l, 45°)

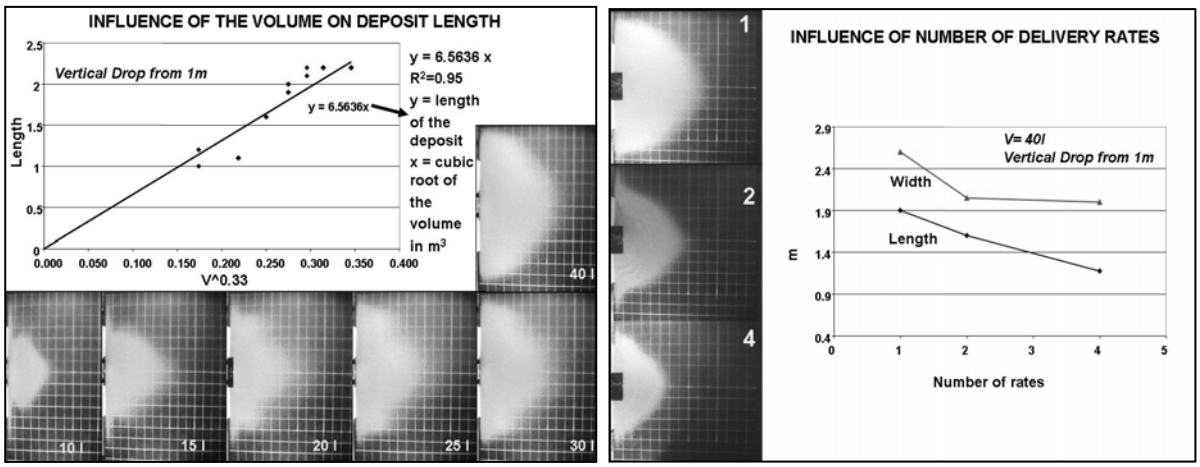

Figure 3 : influence of the volume and of the number of rates (90°)