Geophysical Research Abstracts
Vol. 19, EGU2017-18168, 2017
EGU General Assembly 2017

Characterization of landslides dynamics using the generated seismic signal

Maxime Farin (1), Anne Mangeney (2,3), Julien de Rosny (4), Renaud Toussaint (5), and Phuong-Thu Trinh (6)

(1) California Institute of Technology, Seismology, Pasadena, CA, USA, (2) Institut de Physique du Globe de Paris, Seismology, Paris, France, (3) Equipe ANGE INRIA - Jacques Louis Lions - CETMEF, Paris, France, (4) Institut Langevin, Paris, France, (5) IPGS-EOST, Géophysique Expérimentale, Strasbourg, France, (6) ISTerre, University of Grenoble, Grenoble, France

Landslides, rock avalanche and debris flows represent a major natural hazard in steep environments. However, owing to the lack of visual observations, the dynamics of these gravitational events is still not well understood. A burning challenge is to deduce the landslide dynamics from the characteristics of the generated seismic signal.

Laboratory experiments of granular columns collapse are conducted on an inclined plane. The seismic signal generated by the collapse is recorded by piezoelectric accelerometers sensitive in a wide frequency range (1 Hz - 56 kHz). The granular column is constituted with steel beads of same diameter that are initially contained in a cylinder. The column collapses when the cylinder is removed. A layer of steel beads is glued on the surface of the plane to provide basal roughness.

We distinguish two successive phases of rise and decay in the seismic signal generated by the granular collapses. The rise phase of the seismic amplitude and its maximum are shown to be independent of the slope angle. The maximum seismic amplitude coincides with the maximum flow speed in the direction normal to the slope but not with the maximum downslope speed. The decay phase of the seismic amplitude lasts significantly longer as slope angle increases over a critical value. The decay becomes exponential for high slope angles $> 15°$. This change of signal shape on steep slopes seems to be related to the development of a different flow regime: a saltating front whose amplitude and duration also increase with slope angle.

In addition, we propose a semi-empirical scaling law to describe how the seismic energy radiated by a granular flow increases when the slope angle increases. The fit of this law with the seismic data allows us to retrieve the friction angle of the granular material, which is a crucial rheological parameter.

Finally, the conversion of the flows potential energy into radiated seismic energy is evaluated from 0.2% to 1%. It decreases as time, slope angle and flow volume increase and when the particle diameter decreases. These results explain the dispersion over several orders of magnitude of the seismic efficiency of natural landslides.