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Slopes instability of the Dolomieu crater in La Reunion from seismological observations and numerical modeling.

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The intensity of volcanic activity and seasonal rains associated with the instability of the natural slopes has caused many rockfalls in the Dolomieu crater located on top of the volcano Piton de la Fournaise in La Reunion Island. These phenomena, that involve individual blocks up to larger volumes, are expected to be related to the volcanic activity. The unpredictable nature and destructive power of gravitational flows make in-situ measurements extremely difficult. The seismic signal generated by these slope instabilities provides thus a unique tool to trace back these events and retrieve their characteristics (volume, duration, localization, ...).

The permanent seismic network set on Le Piton de la Fournaise volcano is particularly well suited to the study of seismic signals related to gravitational collapse and of their relation to volcanic activity. Using this network and the new seismic broadband stations recently installed, the seismic signals generated by slope instabilities have been acquired and analyzed. In a first step, signal processing techniques have been developed to distinguish the seismic signal generated by rockfalls from that generated by other seismological events that affect the Piton de la Fournaise Volcano. A localization method has been developed based on inversion of waves arrival time.

We focus on the 2006-2007 period, during which the crater has undergone a major collapse. This event has considerably destabilized the Dolomieu crater edges, providing a good opportunity to study the evolution in time of the rockfall activity. Analysis of the seismic signal and simple scaling laws for granular flows made it possible to derive interesting relations between the energy of the seismic waves and the characteristics of rockfalls. The role of the local topography in these relations has been investigated using numerical modeling of dry granular flows and the Digital Elevation Model of the Dolomieu crater constructed by photogrammetric techniques. Good agreement is found between the scaling laws obtained theoretically and those derived from seismic observation providing insight into the effect of the source parameters on the generated seismic signal. The detection methods and the scaling laws developed here provide useful tools for monitoring of rockfall activity, in particular in relation with the volcanic activity. These works were conducted within UNDERVOLC project.