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Influence of topography on high frequency seismic signal generated by landslides

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Landslides generate seismic waves during the flow which can be recorded at very large distances (a few hundreds of km for large landslides). The recorded signals result from the combination of the landslide seismic source and the seismic wave propagation which both are affected by topography. Wave propagation is influenced by topography especially in the near-field at higher frequencies. The landslide seismic source is determined by topography as the generated forces are partially due to the interaction of the flow with the topography. This interaction results in a variation of stress applied by the landslide to the ground. As a consequence, seismic signals can be used to get information on the landslide properties and dynamics. Studies on the long period seismic signal (20-100s) have helped to discriminate between different landslide scenarios (e.g. Favreau et al., 2010). This was possible because the topography poorly affects wave propagation at these long periods. Going towards higher frequencies (>1 Hz) the influence of the topography on the recorded seismic signal should be quantified in order to extract information on the landslide properties and dynamics.
We address this issue here by combining numerical simulations of the landslide and the generated seismic waves. The time dependent spatial distribution of the forces applied on the ground by the landslide are obtained using a 2D depth-averaged continuum model of granular flows on 3D topography (Shaltop). The generated seismic waves are modeled using the spectral element method. Observed seismic data from rockfalls at the Dolomieu Crater of Piton de la Fournaise (La Réunion) is compared with the simulations by focusing on topography effects.

Favreau, P., Mangeney, A., Lucas, A., Crosta, G., and Bouchut, F., 2010. Numerical modeling of landquakes, GEOPHYS. RES. LETT., 37, L15305.