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Topography induced amplification of high frequency seismic waves generated by landslides: from simulation to observation at Piton de la Fournaise volcano, La Réunion

Julian Kuehnert (1), Anne Mangeney (1,2), Yann Capdeville (3), Virginie Durand (4), Shipra Sethi (1), and Eleonore Stutzmann (1)

(1) Institut de Physique du Globe de Paris, Sismologie, Paris, France (kuehnert@ipgp.fr), (2) Universite Paris-Diderot, Paris, France, (3) Laboratoire de Planetologie et Geodynamique de Nantes, CNRS, Universite de Nantes, Nantes, France, (4) GFZ Potsdam, Potsdam, Germany

During their down-slope motion along the topography, landslides generate seismic waves in a wide frequency range. The recorded signals are used to deduce landslide properties and dynamics. For example, the landslide volume can be calculated from the recorded high frequency seismic energy (Hibert et al., 2011). Typical dominant frequency range of rockfalls in the Dolomieu crater, La Réunion is 1-20 Hz. In order to get reliable results, the energy is calculated by averaging the seismic signals recorded at different seismic stations. However, topography may significantly change the amplitudes at different stations, especially at high frequencies. To better understand these variations we use the Spectral Element Method in order to simulate the seismic wave propagation in a domain with detailed description of the 3D topography. We estimate topography amplification factors as a function of the topographic shape, the source position and its frequency content. Comparing the simulated to observed seismic signals from rockfalls at Dolomieu crater, we show that topography effects can explain the observed strong differences of amplitudes at different stations. As a result, we propose amplification factors for each station that could be used to better quantify the seismic energy at the source, and therefore to improve estimates of rockfall volumes.

Hibert et al. (2011). Slope instabilities in Dolomieu crater, Réunion Island: From seismic signals to rockfall characteristics. Journal of Geophysical Research: Earth Surface, 116(4):1–18.