Localization of Rockfalls at Dolomieu Crater, La Réunion, through Simulation of Seismic Waves on Real Topography

Julian Kuehnert¹, Anne Mangeney¹, Yann Capdeville², Emmanuel Chaljub³,⁴, Eleonore Stutzmann¹, and Jean-Pierre Vilotte¹

¹ Localization of Rockfalls at Dolomieu Crater, La Réunion, through Simulation of Seismic Waves on Real Topography
² Laboratoire de Planétologie et Géodynamique de Nantes, Nantes, France
³ Univ. Grenoble Alpes, ISTerre, Grenoble, France
⁴ CNRS, ISTerre, F-38041 Grenoble, France

Rockfall generated seismic signals have been shown to be of great utility in order to detect and monitor rockfall activity. Furthermore, event locations were successfully estimated using methods which rely on either arrival times, amplitudes or polarization of the seismic signal. However, strong surface topography can significantly influence seismic wave propagation and thus flaw the estimates if not taken into account correctly.

On the upside, the imprint of topography on the seismic signal can be characteristic of the source position. We show that this additional information can be used to get a more detailed rockfall location estimation. In order to do so, the seismic impulse response is modeled on a domain with 3D topography using the Spectral Element Method. Subsequently, in order to locate events, station energy ratios of the synthetic seismograms are compared with energy ratios of rockfall signals in a sliding time window.

We test the method on rockfalls which occurred at Dolomieu crater of Piton de la Fournaise, La Réunion. The sensitivity of the method on the resolution of the modeled topography and the underlying velocity model is tested. We propose that the method can be applied for monitoring rockfall activity in a specific area with multiple seismic stations after calculating once the impulse response for the corresponding topography.