Geophysical Research Abstracts
Vol. 20, EGU2018-8595-1, 2018
EGU General Assembly 2018

20 years of landslide activity in Alaska from automated machine-learning based seismic detection

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Detection of landslide occurrences and measurement of their dynamic properties during run-out is a high research priority but also a technological challenge. Seismology has started to help in several important ways. Taking advantage of the densification of global, regional and local networks of broadband seismic stations, recent advances now permit a seismic detection and location of landslides in near-real-time. This seismic-based detection could potentially greatly increase the spatio-temporal resolution at which we study landslides triggering, which is critical to better understand the influence of forcings such as rainfalls, temperature rise and earthquakes. However, detecting automatically seismic signals generated by landslides still represents a challenge, especially for small volume events. The low signal-to-noise ratio classically observed for landslide-generated seismic signals and the difficulty to discriminate these signals from those generated by regional earthquakes or anthropogenic and natural noises are some of the obstacles that have to be circumvented.

We present a new method for automatically constructing instrumental landslide catalogues from continuous seismic data. We developed a robust, versatile and fast solution, which can be implemented in any context where a seismic detection of landslides or other mass movements is relevant. The method is based on a spectral detection of the seismic signals and the identification of the sources with a Random Forest machine learning algorithm. The spectral detection allows detecting signals with low signal-to-noise ratio, while the Random Forest algorithm achieve a high rate of positive identification of the seismic signals generated by landslides and other seismic sources. The processing chain is implemented to work in parallel on High Performance Computing centres which permits to explore years of continuous seismic data and to constitute event databases rapidly. We present here the results of the application of this processing chain for 20 years of continuous seismic records acquired by the Alaskan permanent seismic networks. The produced instrumental catalogue allow us to investigate the impact of climate seasonality and high magnitude earthquakes on the landslide activity in the region. Space and time clusters of landslide events are identified and discussed.