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Passive seismic monitoring of landslides' creep: Case studies at Super-Sauze (Southeastern France) and Pechgraben (Upper Austria) clay-rich landslides

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Landslides developed in clay-rich formations are characterized by unpredictable reactivation. In recent years, seismic monitoring of active landslides detected a variety of - generally weak - seismic signals triggered by the unstable slope. Evaluating landslide seismicity and characterizing its occurrence in space and time enable thus to monitor and map dynamics of the landslide in near real-time. Passive seismic monitoring appears therefore as a promising approach to complement surveillance and early warning systems of active landslides. However, extreme scattering of the waveforms in the heterogeneous material composing the slopes combined to the inherent difficulty of operating seismic networks with optimal geometry in rugged terrains severely challenge standard approaches to event location and consequently impedes source processes interpretation.
In this study, we investigate continuous seismic sonograms of the well-instrumented Super-Sauze landslide (Southeastern France) and compare observations with newly acquired seismic data at the Pechgraben landslide (Upper Austria). Despite varying displacement rates (mm.d-1 – cm.d-1) and hydrological conditions, comparable signals that range from impulsive earthquake-like signals to minute-long tremor sequences are detected at both landslides. In addition to beam forming methods, we use waveform attenuation patterns to evaluate the signal source location. Source sizing is then benchmarked with calibration shots carried out at the two landslides. First results indicate that endogenous seismicity rates correlate positively with higher displacement rates and that signals seem to be preferentially originated close to shearing boundaries at the edge or within the slides. Using these arguments we suggest creeping processes as potential signal source origin for the observed signals.