Submitted Abstract

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Title	Seismic And Infrasonic Constraints On Rock Damaging And Mass Movement Monitoring Of An Active Rock Slope (Spitze Stei, Switzerland).
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Abstract

In recent years, the rock slope near Spitze Stei has exhibited elevated displacement rates that exceed 10cm per day, which suggests a growing instability of 20 million m3. At the Spitze Stei slope, first-hand observations of rock falls from the slope terminus have been linked to the recently increased slope dynamics. The deformation of the Spitze Stei slope is heterogeneous: the difference in lateral velocity induces the formation of rock compartments separated by deep-reaching fractures. Moreover, borehole imaging and geological mapping show the presence of degrading permafrost and suggest active glide planes and shear zones that contribute significantly to slope displacement.

Climatic factors (such as freezing-thawing cycles, rain, and temperature changes) can cause mechanical changes within the slope and possibly at gliding planes that affect slope stability. Seismic waves propagating within the slope are sensitive to these mechanical changes, and we can measure the changes through seismic interferometry. At the same time, mass movements, such as slope failures, generate both seismic (when impacting the Earth surface) and infrasonic (primarily when the air is pushed aside by an accelerating mass) waves. We can use these seismo-infrasonic signals to detect in time and space the mass-movement events and characterize their source mechanism.

Here, we aim to understand how climatic factors affect the Spitze Stei slope. To this end, we use seismology to analyze sub-surface processes at the slope and detect mass movements with seismic and infrasonic measurements. In October 2021, we installed three seismometers directly at the slope that continuously recorded seismic noise. We also installed an infrasound array ~1500 m in front of the slope terminus to strengthen mass-movement detection.

We first show the initial results of a joint analysis of seismic and infrasonic signals of slope failure activity at the Spitze Stei slope. In particular, we investigate the differences between seismic and infrasonic data features (including waveform characteristics and spectral content). This analysis is a first step towards compiling mass movement time series as the Spitze Stei slope through machine learning methods. We also use ambient seismic noise to analyze sub-surface processes through seismic interferometry and derive the resonance frequency of rock compartments. Spitze Stei gives a perfect opportunity to study the preparation phase of slope instability and investigate precursory mechanical damage in a slope impacted by climatic triggers.