EGU25-13168, updated on 10 Mar 2026
https://doi.org/10.5194/egusphere-egu25-13168
EGU General Assembly 2025

Multi-instrumental insights into the dynamics of an active rockslide near Spitze Stei, Switzerland

Małgorzata Chmiel[1,2], Fabian Walter[2], Lena Husmann[2], Giacomo Belli[3], Clément Hibert[4], Nils Hählen[5], and Christian Kienholz[6]
[1]Géoazur, OCA, Campus Azur du CNRS, France
[2]Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland
[3]Department of Earth Sciences, University of Firenze, Firenze, Italy
[4]Institut de Physique du Globe de Strasbourg, University of Strasbourg/EOST, Strasbourg, France
[5]Natural Hazard Division of Canton Bern, Interlaken, Switzerland
[6]GEOTEST AG, Zollikofen, Switzerland

In recent years, the rockslide near Spitze Stei (Kandersteg, Switzerland) has shown elevated displacement rates exceeding 10 cm per day, indicating a growing instability of 20 million m^3. This increased activity triggers frequent mass movements, including rockfalls, gravel flows, and debris avalanches, which elevates the potential for major events with secondary consequences such as debris flows and flooding.

To mitigate the risks associated with the Spitze Stei rockslide, extensive monitoring has been in place since 2018, including borehole measurements of temperature and water pressure and surface displacement observations. These measurements underline the presence of degrading permafrost and planes of enhanced gliding and shear deformation. However, the limited spatial coverage of these methods makes it challenging to understand slope-wide subsurface processes, which are crucial for characterizing instability and identifying mass movement triggers, especially in complex, highly active rockslides with multiple rock compartments.

Our study addresses these challenges through a passive seismic experiment to quantify mass movement activity and investigate subsurface processes at Spitze Stei. In this talk, I will discuss the two main research questions that motivate our study:

- Are there correlations between meteorological factors and rock slope stability that reflect climate-induced changes? How can they be quantified?
- Can seismology constrain subsurface processes, such as freeze-thaw cycles, water pressure variations, and progressive damage that affect rock slop stablitity? How these processes impact the dynamics of the rock slope?

To address these questions at the Spitze Stei rockslide, we develop a machine learning approach combining seismic and infrasound data to monitor rock falls, avalanches, and possibly stick-slip

tremors reflecting frictional sliding within the slope. Furthermore, we use interferometric seismic noise analysis to detect small changes in elastic properties within the rock slope, which may be related to stability changes and permafrost degradation.

The rich ancillary data acquired at Spitze Stei offers a unique opportunity to validate our seismic methods against independent measurements and refine the interpretation of our results. Such analysis enhances warning efforts, deepens our understanding of triggering factors and their thresholds, and establishes a foundation for continuous seismic monitoring of rockslide dynamics in the context of climate change.