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University of Zurich[UZH]

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Characteristics of acoustic and micro-seismic signals in steep bedrock permafrost on Matterhorn, Switzerland

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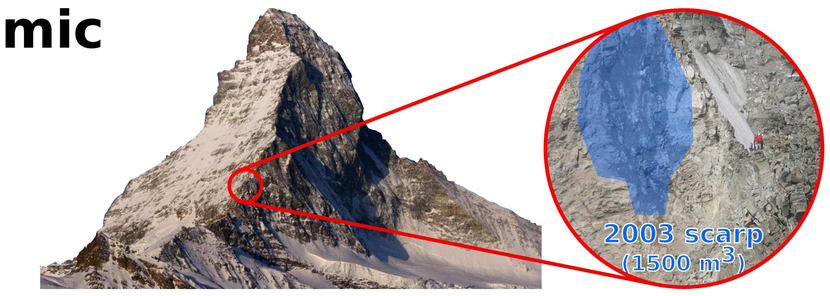


Problem statement

Change in permafrost conditions can lead to rock **slope destabilization**

➔ Rising **risk** due to coexistent growth of vulnerable socioeconomic activities

The **ability** to **detect precursor** events of a rock slope failure remains **limited**
➔ **Integrated signal** of a rock mass to **complement surface displacement**

Main findings

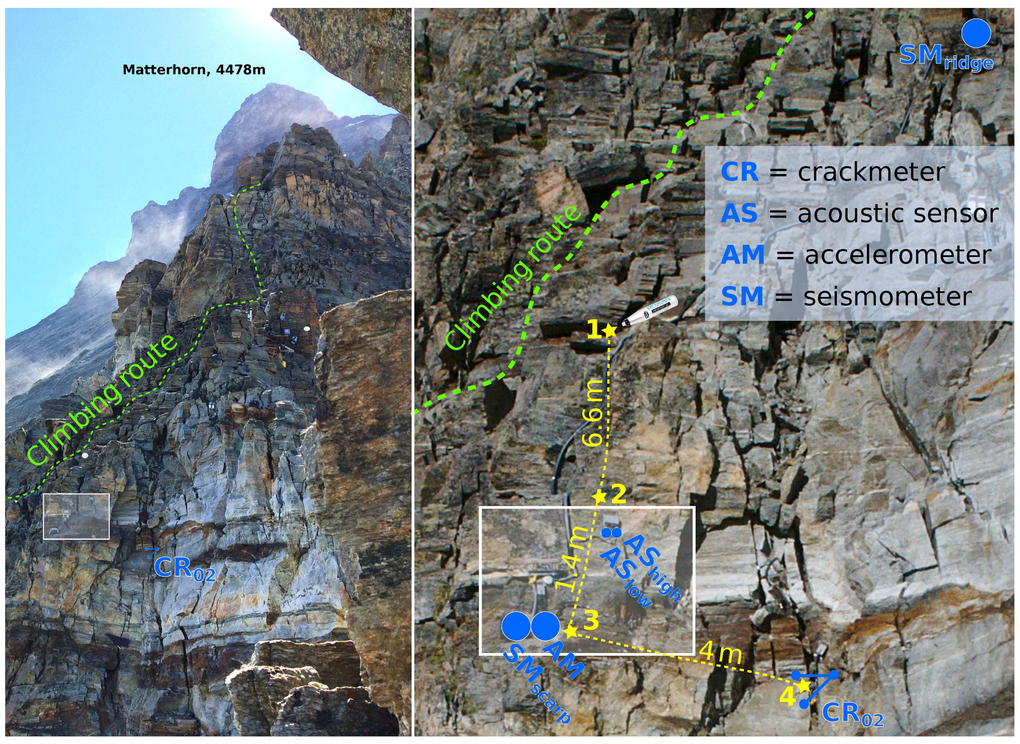
A Strong **change** in **waveform characteristics** with different propagation paths **disables feature detection** by cross-correlation

B Significant **signal amplification** in **frequency band 33-67 Hz**

C The **event energy rate** in this amplifying 33-67 Hz band is **not sensitive to temperature**, a **prerequisite** for successful **slope stability assessment**

Research design and experimental setup

1 We measured **acoustic emission** (AE) and **micro-seismic** (MS) **activity** generated in **steep bedrock permafrost** at Hörnligrat field site

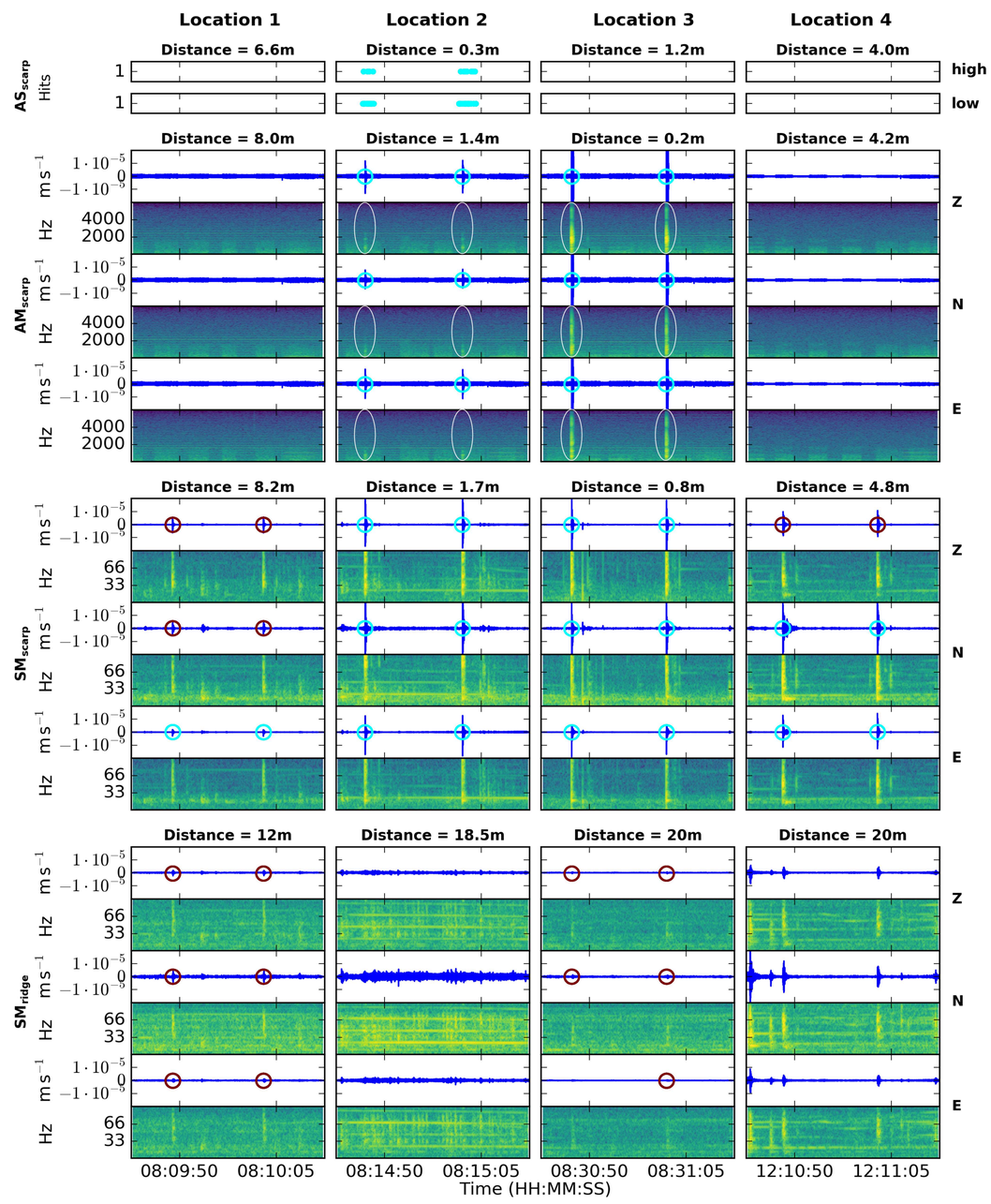


2 We explored the **AE/MS characteristics** through **artificial point sources** at location 1-4 (indicated with ☆) using a rebound hammer to **simulated surface detachement** events

3 We investigated the **sensitivity** of **triggered events** to **temperature**

A Results of artificial point sources at 4 locations

Seismograms and powerspectrograms (dB) of 2 events for each source location



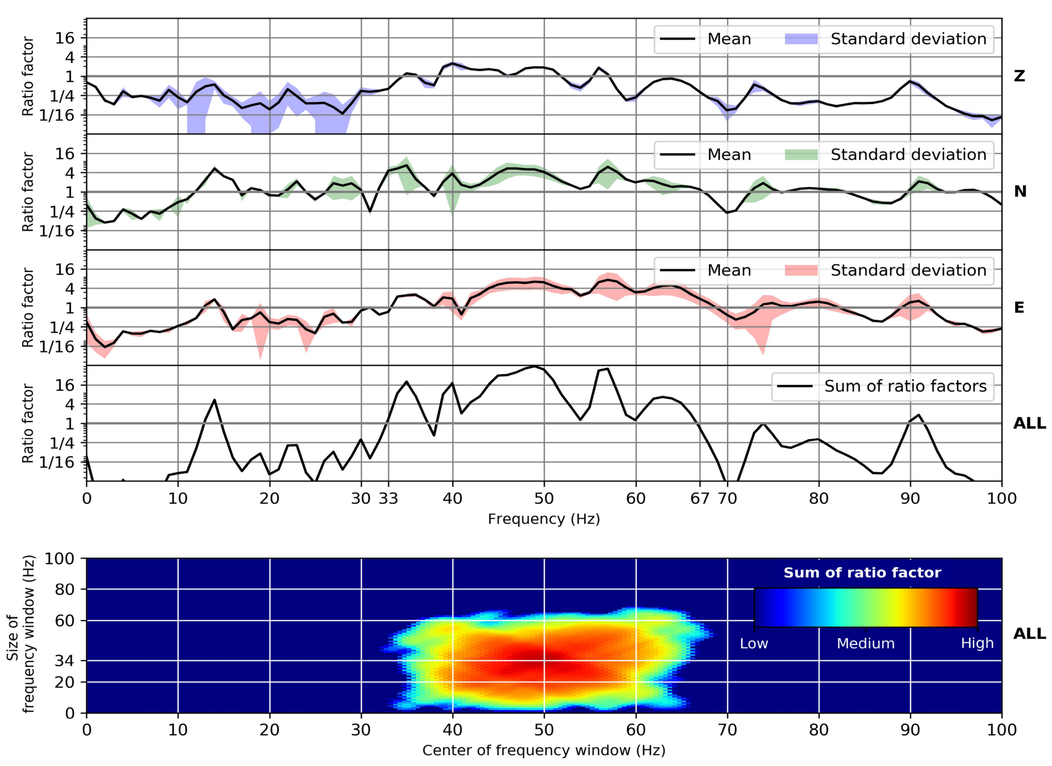
○ indicates triggered events with STA/LTA without filter
○ + ○ indicates triggered events with STA/LTA in frequency band 33-67 Hz
➔ Inexisting cross-correlation between signals with different propagation path

B Estimation of signal amplification

Principle of seismic reciprocity:

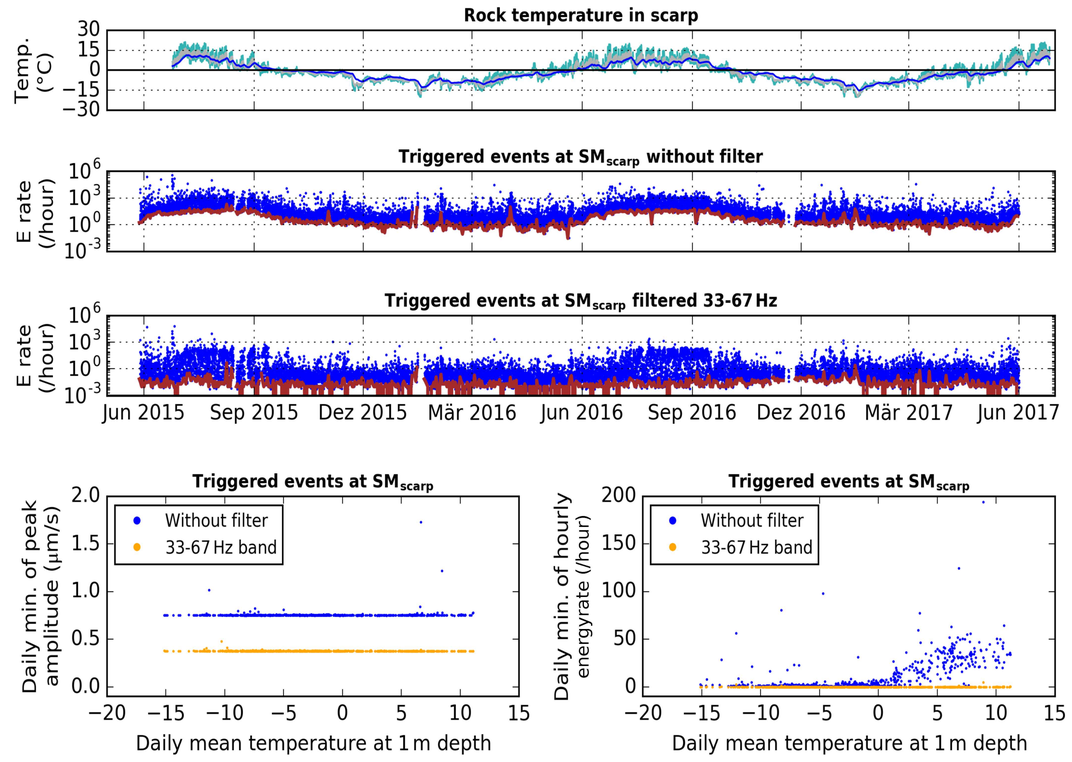
➔ 2 stations with 1 source = 1 station with 2 sources

Ratio between location 3 and location 4 in **signal frequency domain**. Nine artificial point sources at each location results in 81 combinations:



➔ Amplification in frequency band 33-67 Hz, origins remains unclear

C Temperature sensitivity of triggered events



➔ Parameters of the events in the band 33-67 Hz are not temperature sensitive

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