Continuous monitoring of near-surface damage in a freezing rock-wall
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The formation of ice within rock is believed to be an important driver of rock damage near the surface and up to several meters depth. In steep terrain, this process may be crucial for the slow preconditioning of rock fall from warming permafrost areas. Large thermal gradients than can occur close to the rock surface can yield thermal stresses that are also a potential source of damage.

So far most knowledge about these processes stems from theoretical studies or laboratory experiments. However, the transfer of corresponding theoretical insight and laboratory evidence to natural conditions characterized by strong spatial and temporal heterogeneity is nontrivial.

In order to address this problem we have developed a measurement system to investigate in-situ rock damage using acoustic emissions, rock temperature and liquid water content. The measurement system has been deployed on a rock-wall at Jungfraujoch, at 3500m.a.s.l. in the central Swiss alps, and has been continuously monitoring for a year-long period.

The results suggest that frost damage occurs (i) on a wide range of sub-zero temperatures, rejecting the concept of a frost cracking window proposed in previous studies, (ii) with intermittent dynamics (i.e. it is not a continuous process), and (iii) with a strong dependance on the local water saturation level of rock.