Environmental controls on bedrock fracturing and rockfall production adjacent to the rapidly thinning Schmiedingerkees glacier (Hohe Tauern Range, Austria)

The selected randkluft behind the Schmiedingerkees glacier (Kitzsteinhorn).

Since 1880 mean annual air temperatures in Austria have risen by 2 °C, more than twice the average global warming of 0.85 °C. Glacier retreat has evolved into one of the most visible consequences of this climatic change in alpine regions. While research has often focused on the effects of melting glaciers on their forefields, interactions between diminishing accumulation zones and oversteepened headwalls have received little attention. Recent findings of a four-year terrestrial laserscanning campaign (2011-2015) monitoring glacial headwalls on or in the area of the Kitzsteinhorn (3.203 m a.s.l.), Hohe Tauern Range, Austria, show the dramatic impact of glacier thinning on adjacent headwalls: 80 % of the detected rockfall volumes were triggered from areas located less than 20 m above the current surface of the adjacent, rapidly thinning Schmiedingerkees cirque glacier. The largest events reached sizes of several hundred cubic meters. Climate models predict continued climate warming and a mean summer temperature increase of 3 °C by the end of the century.

This project will contribute to an Austrian-Swiss-German research alliance 'GlacierRocks', which will establish the worldwide first research site for long-term monitoring of stability-relevant processes inside a randkluft system. Based on existing, and newly acquired monitoring data, this MSc project will gain first insights into rockfall preconditioning in randklufts and related geomorphological shaping of glacier headwalls. Drawing from two years of surface and borehole temperature measurements, four years of terrestrial laserscanning, and ongoing seismic monitoring as part of the Kitzsteinhorn Open Air Lab (see below). The project will adapt an existing numerical model developed to evaluate bedrock fracturing in the Finnish archipelago to evaluate changes in temperature, *in situ* stress, and critical fracturing thresholds in the randkluft of the Schmiedingerkees glacier. This will provide both insights into key controlling factors, and important new insights into rock slope instability in this critical region.

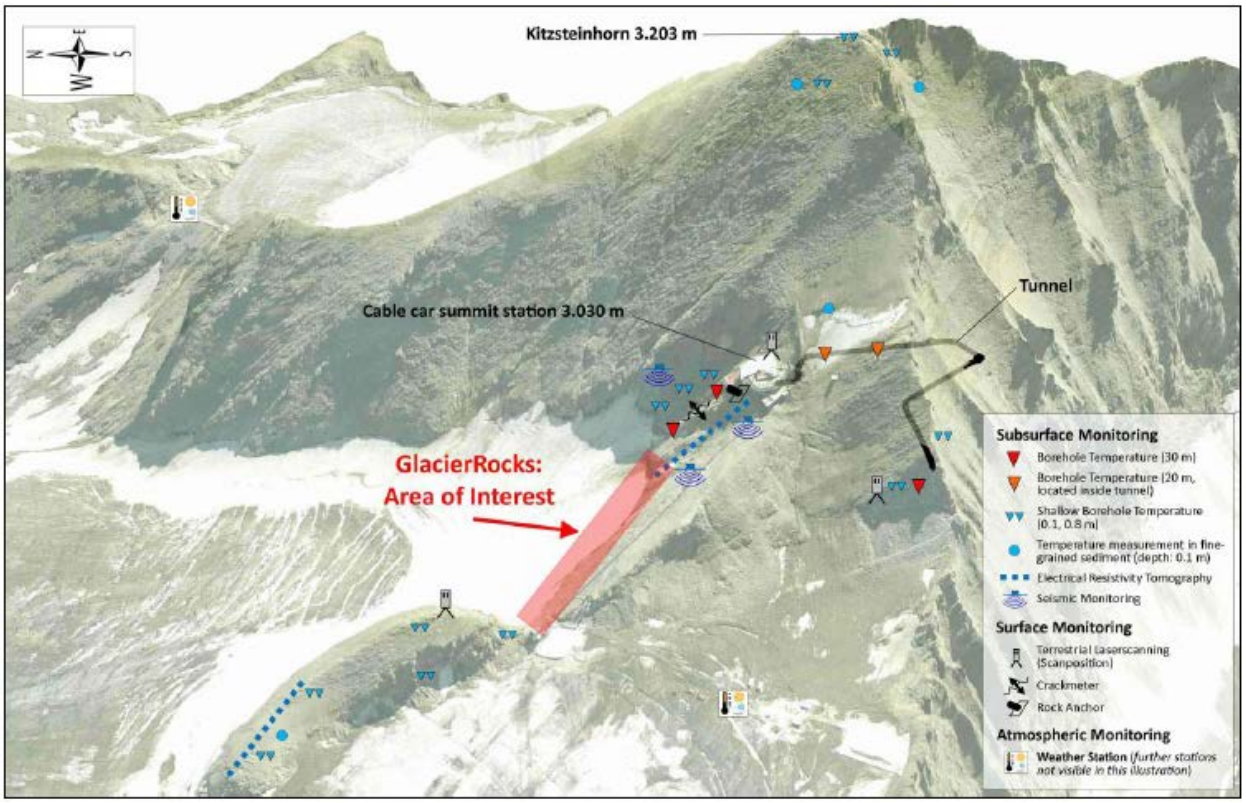

Illustration of the Kitzsteinhorn Open Air Lab and its current monitoring installations. The red box demonstrates the location of the proposed randkluft monitoring (*GlacierRocks*) and its integration into the existing research infrastructure.

Specific goals:

Access to the randkluft can be hazardous, and installation of monitoring systems will be undertaken by experienced alpinists. The condition of joints, intact rock, and the rockmass as a whole will, however, be a key required input for the numerical model. We envisage up to one week of field work in the surrounding area to gather relevant geotechnical data prior to embarking on the modelling phase of the project. Numerical analysis aiming to reproduce bedrock temperatures from climatic data will be undertaken using a fully coupled 2D or 3D thermomechanical model previously set up for COMSOL Multiphysics. While good geomechanical knowledge will be required, no prior modelling experience is expected.

Supervisors:

Dr. Kerry Leith and Dr. Matthew Perras (kerry.leith@erdw.ethz.ch, matthew.perras@erdw.ethz.ch)