EMS Annual Meeting Abstracts
Vol. 16, EMS2019-90, 2019

Microclimate and temperature distribution inside a randkluft system – first observations and insights

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Glacier mass loss is a significant evidence of climate change in cold, high mountain regions. Rockfall from freshly exposed glacier headwalls has been documented as an increasing risk factor for man and high-alpine infrastructure. Recent findings of a seven-year terrestrial laser scanning campaign (2011-2018) monitoring glacial headwalls at the Kitzsteinhorn (3.203 m a.s.l.), Hohe Tauern Range, Austria, show the dramatic impact of glacier thinning on adjacent headwalls: 60 % of the detected rockfall volumes were triggered from areas located less than 10 m above the current glacier surface. Despite these implications, little is known about the thermal, mechanical and hydrological processes that operate at the glacier-headwall interface (randkluft). Systemic in-situ monitoring of stability-relevant parameters are lacking, leaving fundamental gaps in the understanding of rockfall preconditioning in glacial headwalls and the geomorphological evolution of glaciated catchments.
In this contribution we introduce the research project GlacierRocks – Glacier-headwall interaction and its influence on rockfall activity, which started in 2017. GlacierRocks is currently establishing the worldwide first research site for long-term monitoring of stability-relevant processes inside a randkluft system. Based on the acquired monitoring data GlacierRocks is pursuing three overall aims at (1) gaining a better understanding of rockfall preconditioning in randklufts and related geomorphological shaping of headwalls, (2) analyzing poorly understood glacial thinning dynamics near headwalls, and (3) estimating present and future rockfall hazard potential in headwalls on a regional scale. The study site is located in the summit region of the Kitzsteinhorn (3.203 m a.s.l.), which is home to an interdisciplinary Open Air Lab (OPAL) focusing on permafrost and rockfall monitoring.
Rock temperature, frost cracking, glacier ice temperature, glacier ice motion, randkluft depth/width changes and a series of meteorological parameters are continuously monitored. First observation results from combining geomorphological, glaciological and meteorological methods to investigate the three system components (headwall, glacier, randkluft) show the high importance of randkluft closure for the temperature of the randkluft system and the fast spring warming at times of high snow melt rates.