

## **FIVE YEARS OF TLS ROCKWALL MONITORING AT THE KITZSTEINHORN (3.203 M), HOHE TAUERN, AUSTRIA: IDENTIFYING THE INFLUENCE OF GLACIAL THINNING ON ROCKFALL IN GLACIAL HEADWALLS**

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Since 1880 mean annual air temperatures in Austria have risen by 2 °C. This increase is more than twice the average global warming of 0.85 °C. As a result glacier retreat has evolved into one of the most visible consequences of climate warming in the European Alps. The rate of retreat has increased since the 1980s, with much of the volume loss being reflected by the lowering of the glacier ice surfaces and the exposure of fresh, frequently oversteepened rock surfaces. The potentially destabilizing effect of glacial thinning on the adjacent headwalls has so far rarely been considered by extensive monitoring campaigns and its contribution to recent rockfall activity is largely unknown.

The presented study addresses this research gap by compiling a detailed rockfall inventory based on a five-year terrestrial laserscanning monitoring campaign carried out in the summit region of the Kitzsteinhorn (3.203 m), Hohe Tauern Range, Austria. The monitoring campaign was started in July 2011, since then the headwalls of two glacial cirques were scanned at an interval of two to three months during the snow-free summer season. The scanned rock faces predominantly consist of calcareous mica-schist and differ in terms of height, slope inclination, slope aspect, and discontinuity orientation. The rock faces are underlain by permafrost, their combined surface area is approximately 100.000 m<sup>2</sup>. All investigated rock faces are situated directly adjacent to the Schmiedingerkees cirque glacier, which has retreated and thinned significantly in recent decades (downwasting rate approx. 1m/a).

Analysis of the obtained data shows the dramatic impact of glacial thinning on adjacent headwalls: about 66 % of the detected rockfall release zones and 80 % of the detected rockfall volumes were triggered from areas located less than 20 m above the current surface of the Schmiedingerkees glacier. Overall, more than 100 rockfall release zones were identified. The total rockfall volume exceeded 1.000 m<sup>3</sup>, the largest rockfall events reached volumes of several hundred cubic meters. With continuing warming, the significance of rockfall from deglaciating headwalls as a considerable threat to man and infrastructure is expected to grow throughout the foreseeable future.