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Reconstruction of the Magnetkoepfl rockfall event – Detecting rock fall release zones using terrestrial laser scanning, Hohe Tauern, Austria

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Instability of rock faces in high mountain areas is an important risk factor for man and infrastructure, particularly within the context of climate change. Numerous rock fall events in the European Alps suggest an increasing occurrence of mass movements due to rising temperatures in recent years. Within the MOREXPERT project ('Monitoring Expert System for Hazardous Rock Walls') a new long-term monitoring site for mass movement and permafrost interaction has been initiated in the Austrian Alps. The study area is located at the Kitzsteinhorn (Hohe Tauern), a particularly interesting site for the investigation of glacier retreat and potential permafrost degradation and their respective consequences for the stability of alpine rock faces.

To detect and quantify changes occurring at the terrain surface an extensive terrestrial laser scanning (TLS) monitoring campaign was started in 2011. TLS creates three-dimensional high-resolution images of the scanned area allowing precise quantification of changes in geometry and volume in steep rock faces over distances of up to several hundreds of meters. Within the TLS monitoring campaign at the Kitzsteinhorn a large number of differently dimensioned rock faces is examined (varying size, slope inclination etc.). Scanned areas include the Kitzsteinhorn northwest and south face, the Magnetkoepfl east face as well as a couple of small rock faces in the vicinity of the summit station.

During the night from August 27th to August 28th 2011 a rock fall event was documented by employees of the cable car company. The release zone could not immediately be detected. The east face of the Magnetkoepfl covers approximately 70 meters in height and about 200 meters in width. It is made up of calcareous mica-schist and displays an abundance of well-developed joint sets with large joint apertures. Meteorological data from a weather station located at the same altitude (2.950m) and just 500m away from the release zone show that the rock fall event occurred after a long period of warm weather. Prior to the rock fall event temperatures had not fallen below 3°C for more than two weeks. On August 27th a cold front with heavy rain reached the area and temperatures decreased to -4°C. Within the next couple of hours the Magnetkoepfl rock fall event occurred. Additionally numerous smaller rock fall events were triggered in the same period.

The last laser scan prior to the rock fall event was carried out on August 17th 2011. The first scan after the event was conducted on December 15th 2011. Both scans were carried out from the same position using a RIEGL LMS-Z620. The scans were performed with a resulting spatial resolution of approximately 25cm over a distance of about 300m. Analysis of TLS data delivered a very precise identification of the release zone yielding a rock fall volume of approximately 140m^3.