Landslides and rock fall processes in the proglacial area of the Gepatsch glacier, Tyrol, Austria - Quantitative assessment of controlling factors and process rates

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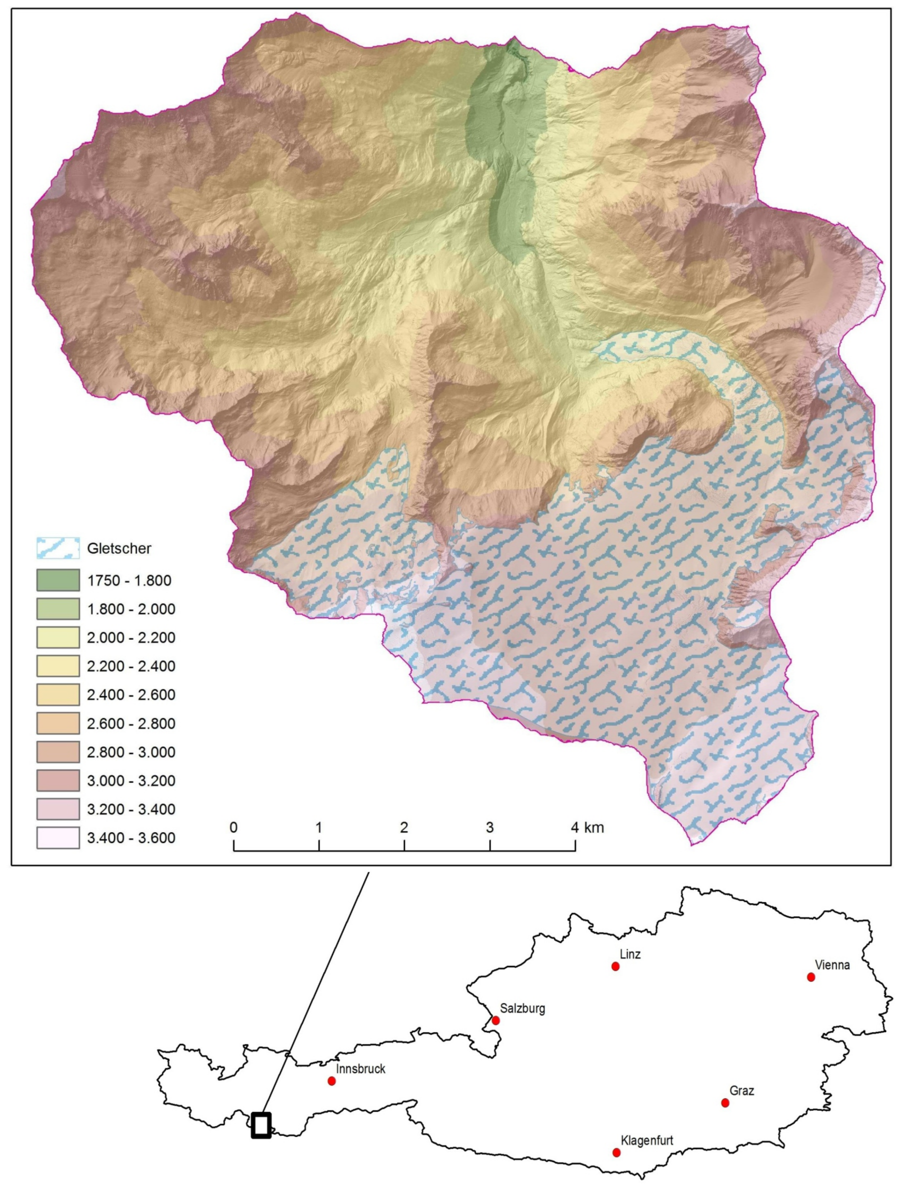
1. Introduction and study area

Due to the rapid deglaciation since 1850, lithological structures and topoclimatic factors, mass movements like rock fall, landslides and complex processes are important contributers to sediment transport and modification of the earth's surface in the steep, 62 km² large high mountain catchment of the Gepatsch reservoir. This study aims to quantify rock wall erosion processes and their contributing factors like rock mass strengh and topoclimatic conditions in the light of contemporary glacier recession.
The poster presents the methodology and first results of the study, which will be continued for three years by the department of Applied Geology of the University of Erlangen-Nürnberg as a part of the PROSA joint project.

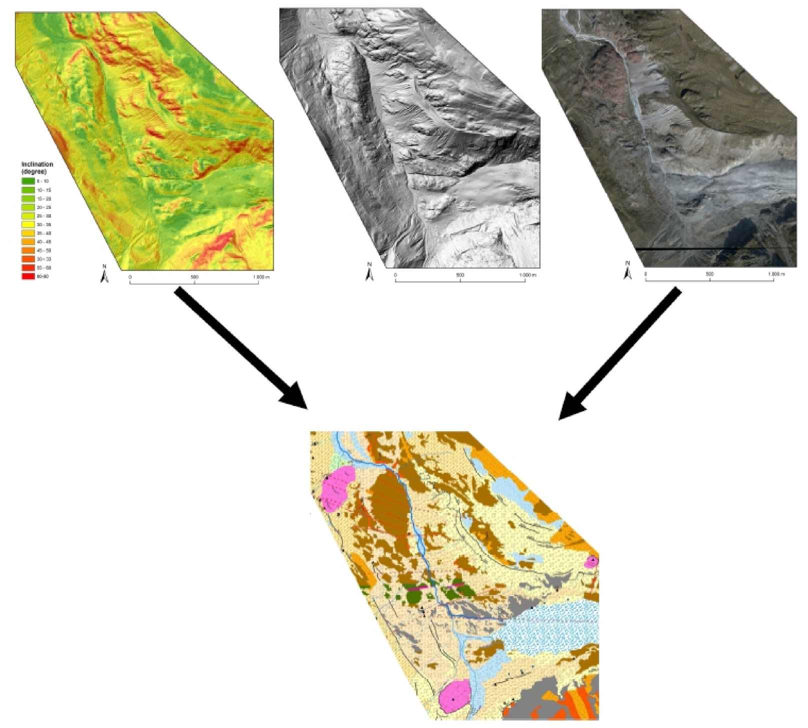


Situation of the study area, underlaid by hillshade

References

• Ballantyne, C.K. (2002): Paraglacial geomorphology. In: Quaternary Science Reviews 21: 1935-2017.
• Brunner, K. (1978): Zur neuen Karte "Gepatschferner 1971" Maßstab 1:10000. Zeitschrift für Gletscherkunde und Glaziologie 14(2): 133-151.
• Selby, M.J. (1980): A rock mass strengh classification for geomorphic purposes: with tests from Antarctica and New Zealand. In: Zeitschrift für Geomorphologie 24: 31-51.
• Selby, M.J. (1982): Controls on the stability and inclination of hillslopes formed on hard rock. In: Earth Surface Processes and Landforms 7: 449-467.

2. Geotechnical and geomorphological mapping



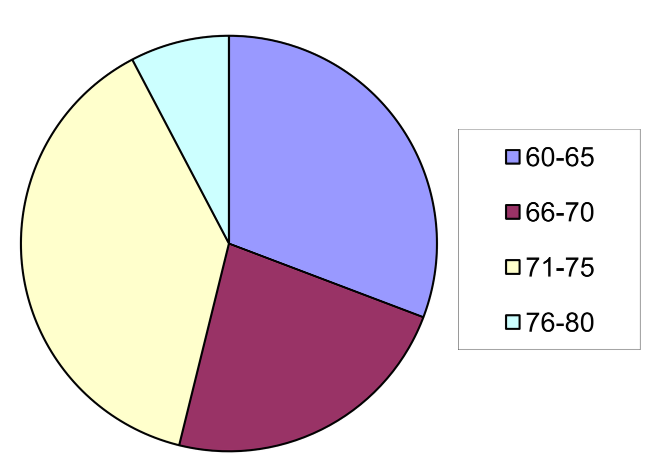
Geomorphological and geotechnical mapping based on the interpretation of DEMs and Orthofotos.

The utilization of digital elevation models, orthofotos and historical datasets facilitates geotechnical-geomorphical mapping in the steep high mountainous terrain. The DGM with one meter resolution is generated from high resolted airborne laser-scanns which are conducted by the University of Vienna.
Nevertheless, mapping of important geotechnical features, like rock mass properties, grain size distributions and detailed investigations of mass movements have to be carried out in the field.

Mapping of controlling factors of rock fall activity: rock mass strength

The assessment of rock mass strengh (RMS) is on purpose of dividing the bedrock areas in sections of homogenous rock mass properties in order to calculate the specific rock wall backweathering rate for certain rock wall types. To make the results comparable, both with other locations inside the study area and with other quantitative rock fall studies, it is usefull to apply a established rock mass classification scheme. Different rock mass rating systems were tested in the field and finally the rock mass rating system after Selby (1980) was chosen. The rock mass parameters are determined directly in the field. Allmost all rated rock walls have RMS-values between 60 and 75, so they belong to the categories ‚moderate' and ‚strong'.

RMS- values of the rated rock walls



Frequency distribution of RMS-values of the mapped rock walls in the study area.

In order to map rock fall activity in a proglacial high mountain area, geomorphic and topoclimatic factors have to be taken into account. According to field observations and the first results, a strong connection between rock fall activity and the following geofactors is obviously:

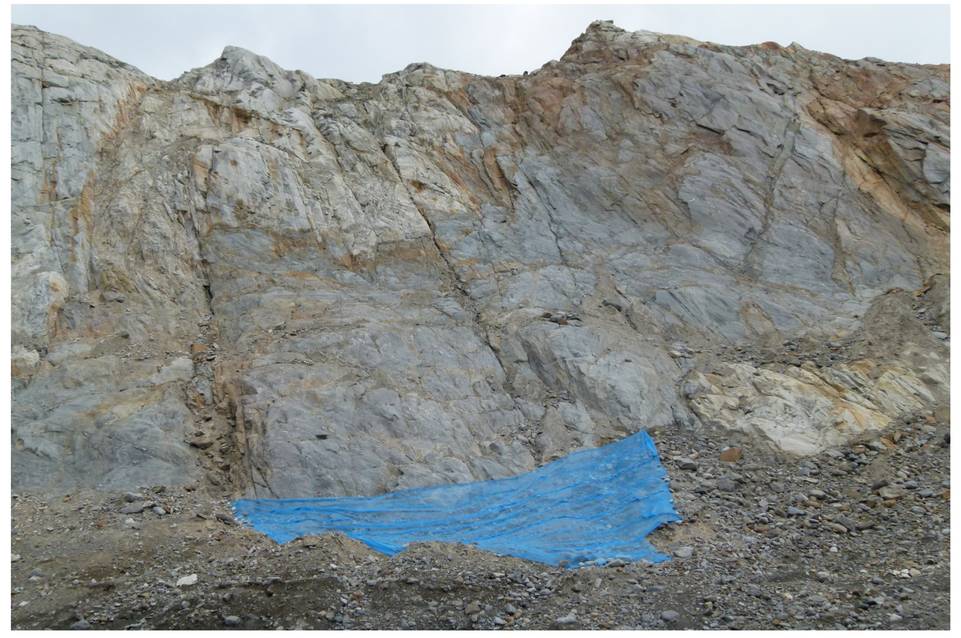
- **altitude, exposition and inclination**
- **permafrost distribution**
- **timing of deglaciation**

An important task in the upcoming years is to incorporate these parameters into the rock fall susceptibility study.

Two bedrock areas with similar RMS-value but different rock fall activity due to exposition and 'exhaustion effects' occured after the deglaciation (see Ballantyne, 2002). The inactive scree slope indicates a 'strength equilibrium slope' (see Selby, 1982).

3. Assessment of process rates & first results: rock fall

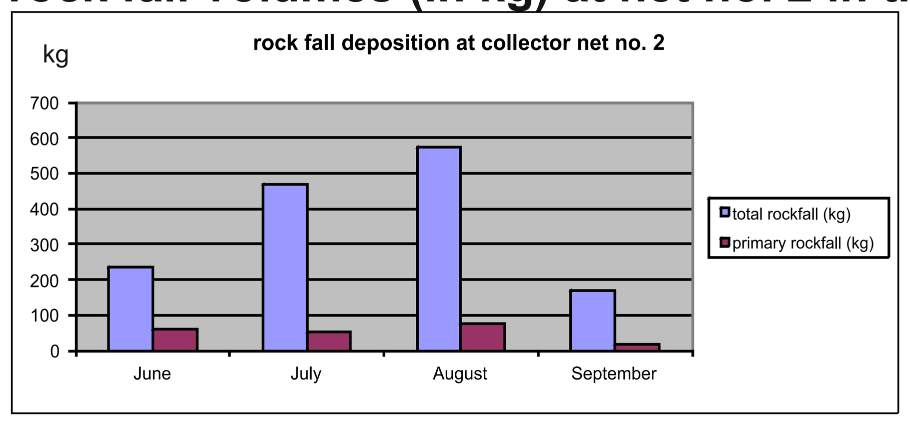
A: Contemporary process rates

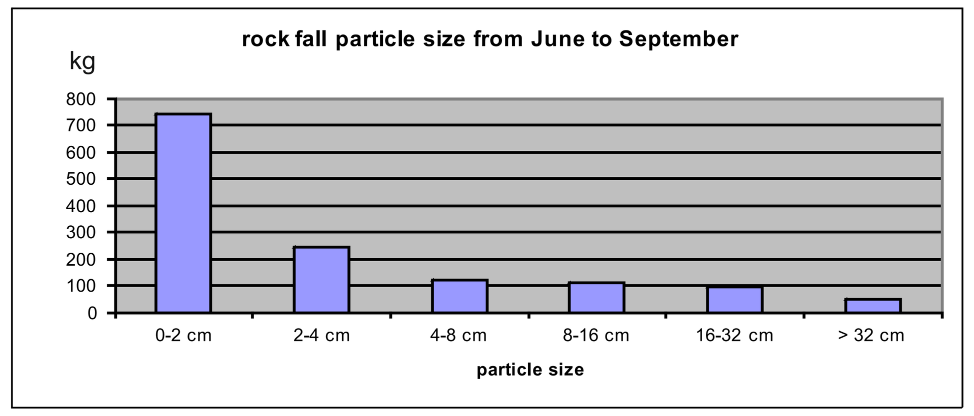


Rock fall collector net no. 2, few meters above the current glacier margin. The rock wall catchment of the collector net is about 800m².

Terrestrical laserscanning of a highly active rockfall scar (in cooperation with D. Morche and H. Baewert (University of Halle).

rock fall volumes (in kg) at net no. 2 in the summer months of 2012



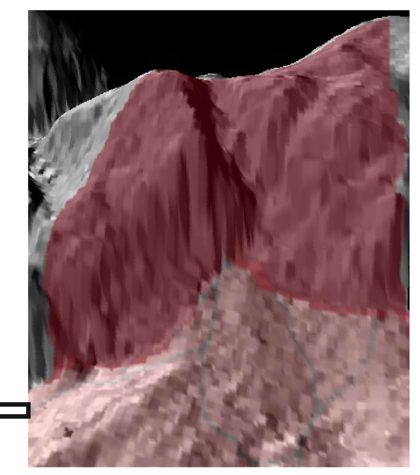


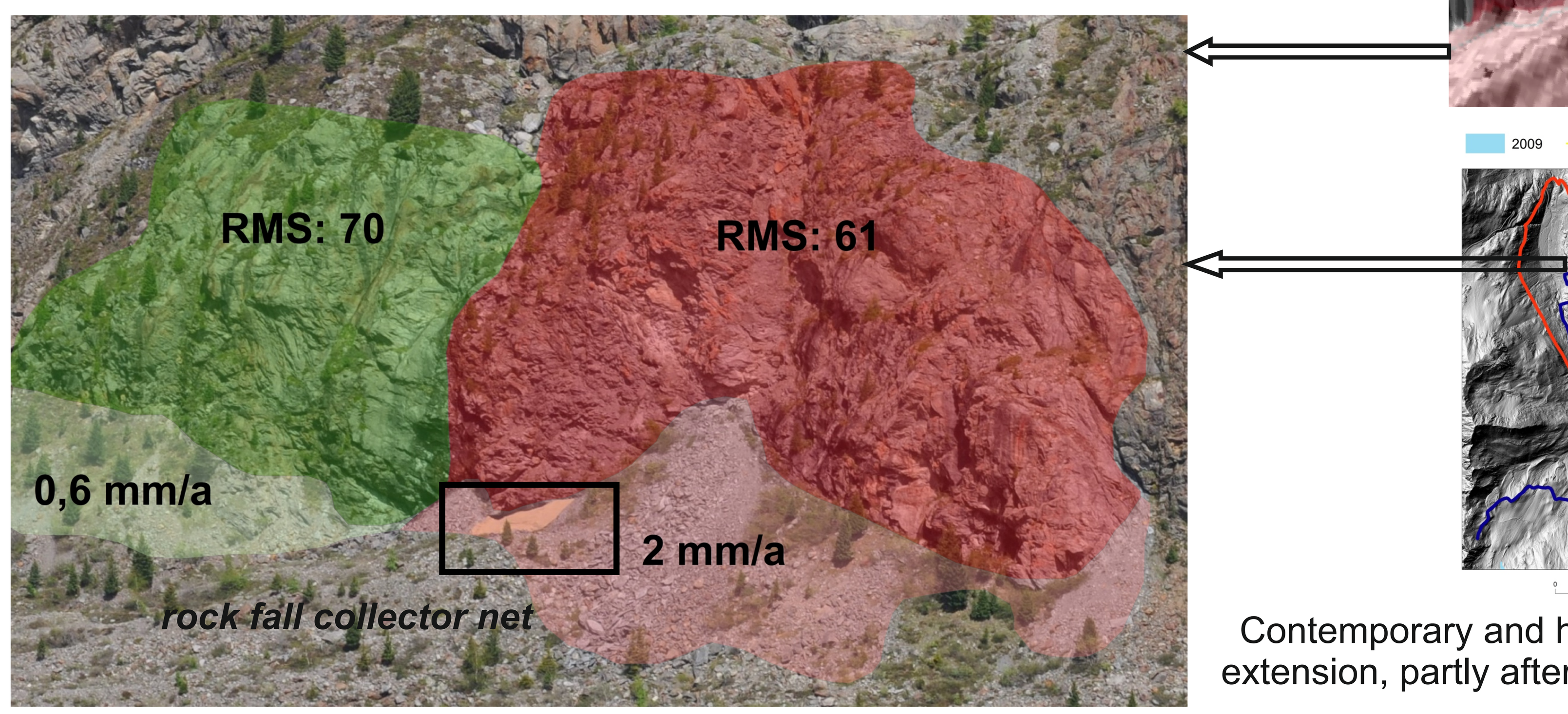
B: Longer term process rates

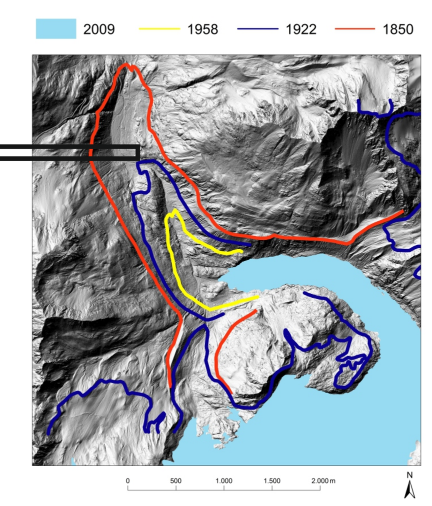
Assessment of rock wall retreat rates at several locations

- deposition timeframe (historical glacier extensions)
- catchment size of the talus slope (DEM 1m - DEM 10m)
- volume of the talus deposition (field estimation)

= ***Average annual backweathering rate***







Contemporary and historical glacier extension, partly after Brunner, 1978).

An example of rock wall backweathering rates and RMS-values of two bedrock areas in the proglacial area of the Gepatsch glacier. The deglaciation of these rock walls took place after 1891. According to the direct measurements (rock fall collector net in the center of the figure), the contemporary rock wall backweathering rate is at least one order of magnitude lower than the integral backweathering rate since the onset of deglaciation.