Monitoring Rockfall and Frost Weathering in the Eastern Alps

Matthias Rode(1), Oliver Sass(1)

(1) Institute of Geography and Regional Sciences, University of Graz, Austria

ABSTRACT

The detachment of rock fragments from alpine rockwalls is mainly assigned to frost weathering. Rock moisture distribution during freeze-thaw events is key to understanding this process. As freeze-thaw cycles of different duration and intensity can contribute to rock shattering, these events can only be adequately investigated by means of a continuous monitoring program. To achieve this aim, small-scale geoelectric survey lines have been installed in three study areas (Gesäuse, Dachstein, Kitzsteinhorn) in the framework of the initiated ROCKING ALPS project. For investigating the impact of observed moisture fluctuations on weathering, regular laser scan measurements (TLS) are carried out at several monitoring sites. The achieved datasets will provide valuable input for sediment budget studies on the one hand, and hazard zonation and protection measures on the other.

INTRODUCTION

A key to understand the process of weathering and rockfall is to gather data on **rock moisture distribution** and **pore water displacement** during freeze-thaw events.

The current gaps of knowledge are:

(1) rock moisture in high temporal and spatial resolution,

(2) pore water movement during freeze-thaw events and

(3) connection of moisture and rockfall data.

The planned 2D-resistivity measurements combined with rockfall monitoring have the potential to close these gaps.

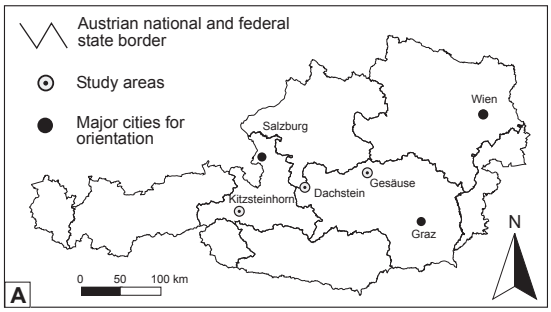
STUDY AREA

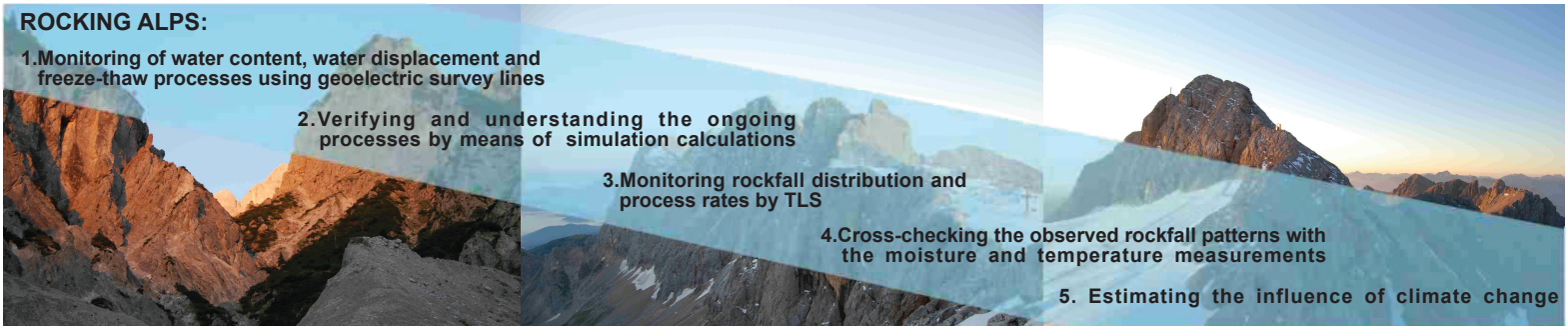
Investigations are planned in three areas of the Eastern Alps (Fig. A) of different elevation and lithology.

(1) **Gesäuse** (north-eastern Limestone Alps). The prevailing rock types are Dachstein limestone, and the Wetterstein dolomite. The monitoring sites are at 800 - 1200m

(2) The **Dachstein** area reaches a summit height of up to 2.995 m. The steep rockwalls are also built up of Dachstein limestone.

(3) The **Kitzsteinhorn** (3203 m) in the Hohe Tauern range consisting of calc-mica schist with permafrost.





RESEARCH METHOD: 2D-resistivity profiling

The instruments will control two (or more) survey lines in the study areas for three years:

Gesäuse: electrode spacing 0,06m

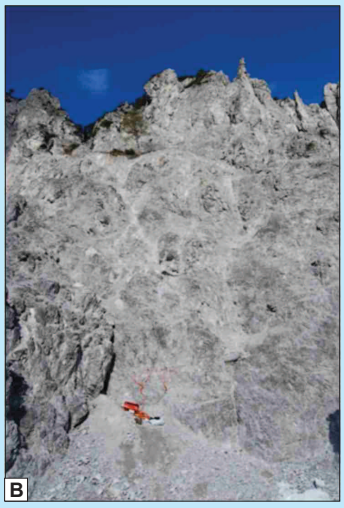
Dachstein: electrode spacing 0.06m and 0,3m

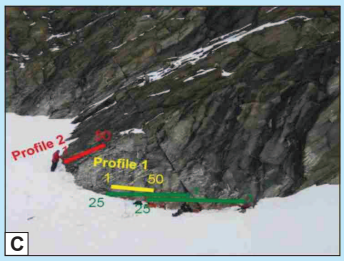
Kitzsteinhorn: electrode spacing 2m and 0,3m

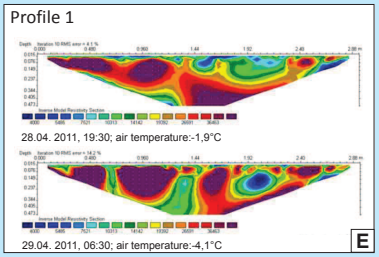
The 2D-resistivity profiles will be converted to water contents using calibration functions. **Frozen areas** will be delimited according to their **high electrical resistivities**.

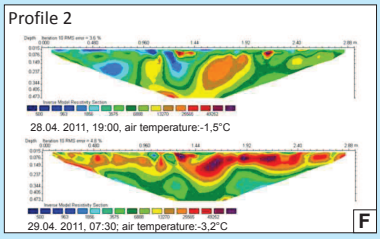
FIGURES

- B 2D-geoelectric in the Gesäuse
- C 2D-geoelectric at the Kitzsteinhorn
- D Geotom, 2D-Geoelectric instrument
- E Inversion modell of profile 1 from Fig. C
- F Inversion modell of profile 2 from Fig. C









RESEARCH METHOD: Infrared thermography

Dataloggers will provide temperature and moisture at a high temporal resolution.To tie the datalogger and geoelectrical measurements and TLS closer together, georeferenced infrared photos will be taken at regular intervals.

Detecting areas of lower temperatures like e.g. at the rockwall foot
Depicting of areas of high or low temperature amplitudes
Comparing moisture and rockfall patterns

RESEARCH METHOD: Terrestrial Laser Scan

The **TLS** measurements will be performed in the immediate **vicinity of the geoelectric profile lines** to enable direct cross-check of the data.

We project a combination of high precision scans from small test areas **(10 x 10 m)** and lower resolution scans from larger areas **(c. 100 x 100 m)**.

FIGURES

- G 2DInfrared photography with reflectors (Fig. I)
- H Laser scan on the same rock wall (Fig. I)
- I Infrared photography and TLS in the Gesäuse