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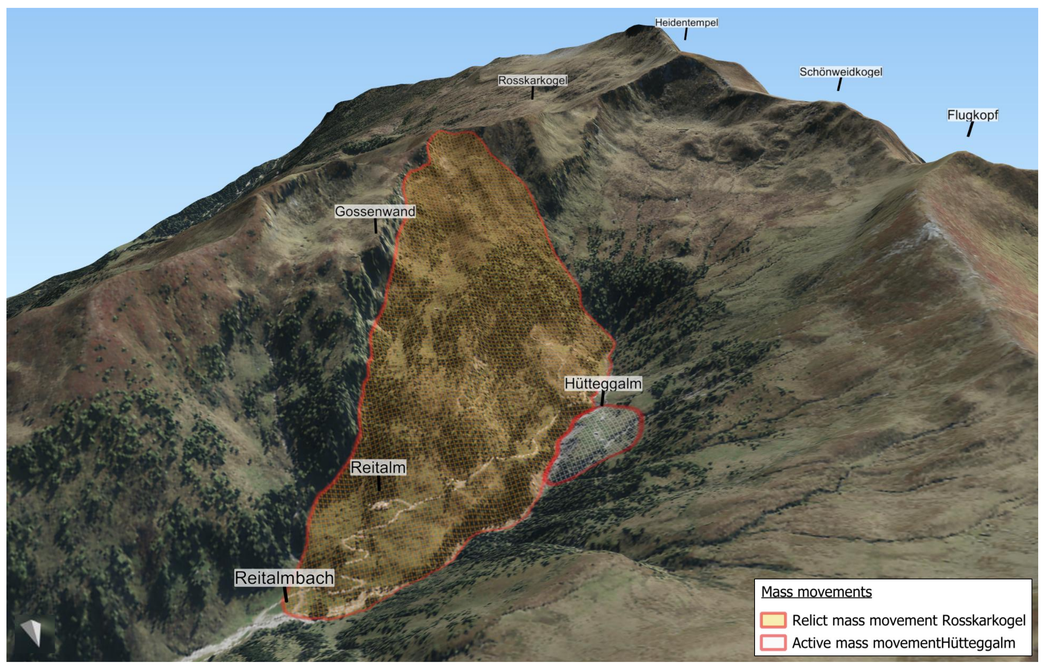
Geotechnical and geological investigation of a reactivated postglacial mass movement in the rear Reitalm Valley (Salzburg)

Recent Master's Theses at the Institute of Rock Mechanics and Tunnelling
Georg Kaml & Michael Kienzl

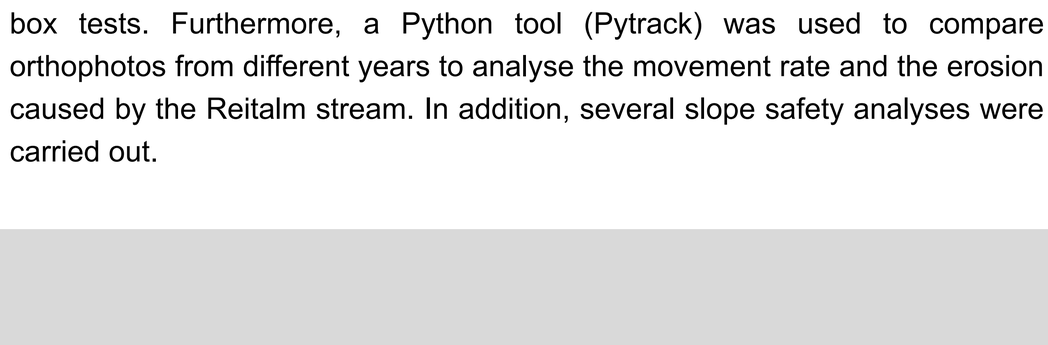
Introduction

On June 9, 2019, the Hütteggalm area in the rear Reitalm Valley, a side valley of the Großarl Valley in the Salzburg municipality of Hüttschlag, was reactivated as part of a large-scale post-glacial mass movement. This event caused cracks above the Hütteggalm and in the access road, rendering it temporarily impassable. Previous oral reports of mobilizations in the Hütteggalm area prompted an investigation in 2019 as part of a master's thesis at Graz University of Technology, also supervised by the Salzburg State Geological Survey. The project was continued through two master's theses at the Institute. The objectives of the investigation were to determine the geological conditions and triggering factors, to quantify the rate of movement and propose possible countermeasures.



Overview of the mass movements in the study area (Kaml, 2024).

The investigation area is situated on the eastern edge of the Tauern Window, known for its geological and tectonic complexity. It features three primary tectonic units: the Rauris nappe of the Penninic, which is part of the Glockner nappe, and two Sub-Penninic units, the Flugkopf- and Romate nappe, with the latter belonging to the Venediger nappe. All units are composed of metamorphic formations. Notably, a tectonic boundary in the Hütteggalm area differentiates the Rauris nappe from the Flugkopf nappe, marking a reactivated geological zone.



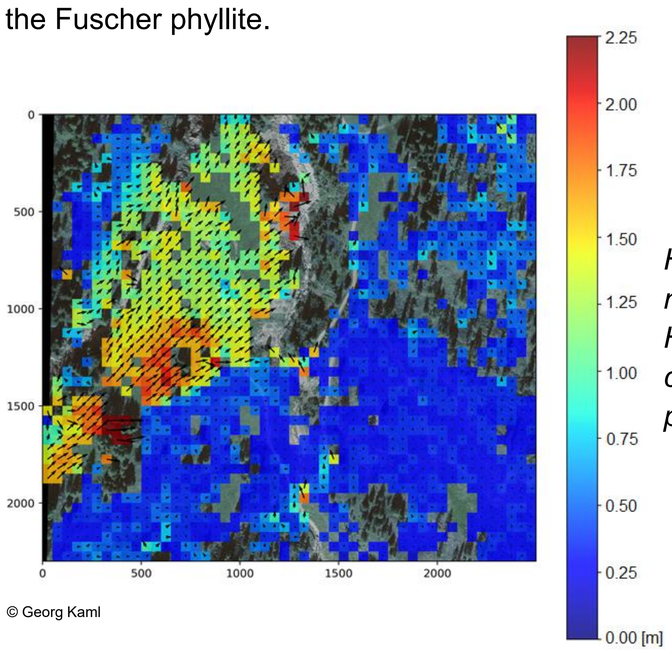
Profile section of the reactivated Hütteggalm area (including lithologies and tectonic nappe boundary).

Research objectives

In order to achieve the aims of both master's theses, the area was mapped over several days. The findings were integrated into a geological map of the rear Reitalm valley created with QGIS and geological profiles were generated based on it. Hydrological and meteorological data from surrounding measuring stations were evaluated and visualised in order to identify long-term trends. Samples of the relevant lithological units were analysed in the laboratories of the University of Graz and the Institute of Soil Mechanics and Foundation Engineering, including loss on ignition analysis, X-ray diffractometry and shear box tests. Furthermore, a Python tool (Pytrack) was used to compare orthophotos from different years to analyse the movement rate and the erosion caused by the Reitalm stream. In addition, several slope safety analyses were carried out.

Results

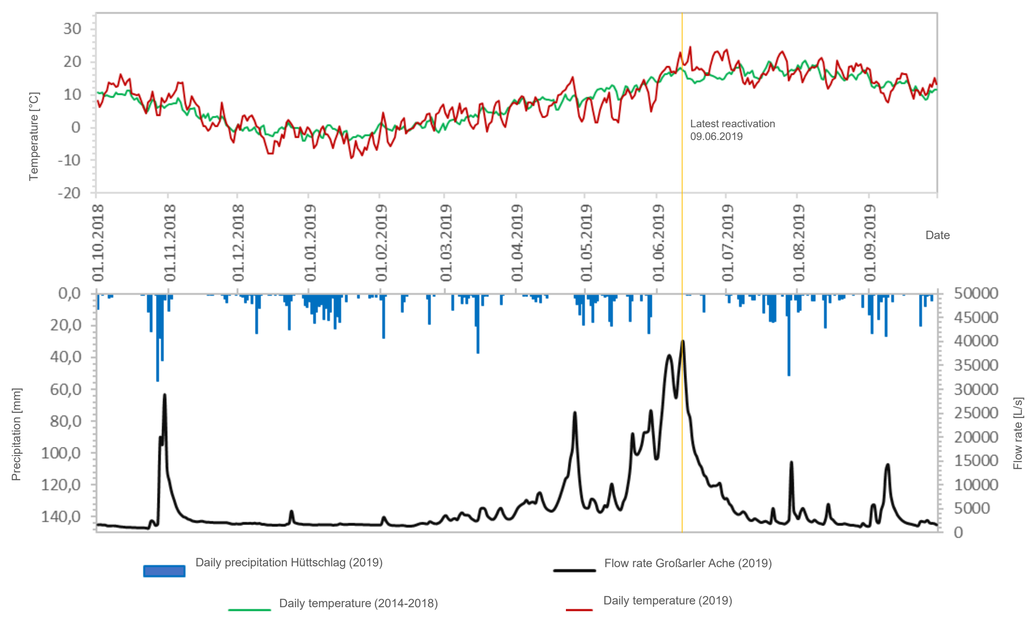
The area of the Hütteggalm, reactivated in 2019, was identified as a deposition area of the post-glacial mass movement of the Rosskarkogel on the counter slope. Factors triggering the mobilization included high water saturation from intense snowmelt combined with slope destabilization due to erosion by the Reitalm stream. Hydrological and meteorological data spanning 60 years indicate increasing temperatures and precipitation. The loss of vegetation from a severe windstorm in 2002 accelerated erosion, as observed in orthophotos. Slope stability analyses demonstrated failure in the reactivated area and the entire mass movement, highlighting probable failure zones. Mineralogical and soil mechanical analyses identified a talc shale fault zone as the slip surface, where the Fuscher phyllite slid while maintaining stratigraphic integrity. Through this movement, the phyllite was significantly fractured. It was demonstrated that the failure in the Hütteggalm area (2019) occurred within the Fuscher phyllite.



Heat map of the active mass movement at the Hüttegg-alm, visualised by colour coding and vector re-presentation (2018-2021).

Outlook

The future development of the mass movements in the rear Reitalm Valley can be partially estimated using the climatic trend analyses created by Kienzl (2024). These indicate an increase in daily precipitation of 1.5 millimetres and an increase in the average daily temperature of 1.6 °C between 1971 and 2019. In addition, the climate scenarios predict more frequent heavy precipitation events, which will lead to greater water inflow. This suggests ongoing erosion by Reitalm creek, particularly impacting the Hütteggalm. In general, an acceleration of erosion processes is expected. The Reitalm creek could cut deeper into the sedimentary material of the relict mass movement of the Rosskarkogel, which could lead to the reactivation of further areas, especially in steeper zones south of the Reitalm. The implementation of stabilization methods is considered hardly feasible due to high costs and uncertain effectiveness. Therefore, the described geological processes will probably have to be accepted. However, continuous monitoring and evaluation of results are important to reassess the situation from time to time.



Hydrological and meteorological data from eHyd (2024).

References

1 Kienzl, M. (2024): Geotechnisch- geologische Bestandsaufnahme einer reaktivierten postglazialen Massenbewegung im hinteren Reitalmtal [Masterarbeit]. Technische Universität Graz, Graz.
2 Kaml, G. (2024): Analyse der Bewegung, der lithologischen Eigenschaften und mechanischen Kennwerte der Massenbewegungen im hinteren Reitalmtal. [Masterarbeit]. Technische Universität Graz, Graz.

TU Graz – Institute of Rock Mechanics and Tunnelling
8010 Graz, Rechbauerstraße 12, Austria, Tel.: +43 316 873-8114
tunnel@tugraz.at, tunnel.tugraz.at

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