Monitoring of rock glacier flow velocity variations using imagery, laser scan data and ground-based interferometric synthetic aperture radar (GBInSAR) at the Finstertal reservoir (Austria)

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Rock glaciers are geomorphological phenomena of mountain permafrost which slowly move downslope as a consequence of the ice deformation. During the last few decades, many rock glaciers in the Alps are showing an increase of flow velocities which is most probably caused by climate change. However, the factors influencing the flow velocities (e.g. air temperature, meltwater infiltration, internal rock glacier characteristics) are not fully understood. Data about the annual, inter-annual and diurnal rock glacier flow velocities are essential to understand the influence of climatic factors on rock glaciers.

This study focused on the Finstertal rock glacier, located in the Eastern Alps, where flow velocities are reconstructed since the 1970s based on aerial imagery, airborne and terrestrial laser scan data. Since 2014, a terrestrial laser scanning (TLS) based monitoring is implemented. The maximum flow velocities of the Finstertal rock glacier increased from 0.1 m/year (time period 1970-1997) to 1.4 m/year (time period 2015-2016) and is currently about 1.3 m/year (time period 2018-2019).

The accuracy of aerial imagery and laser scan data is in the range of centimetres and well suited to analyse the annual variability of rock glaciers. Imagery and laser scan data are not suited for shorter time intervals, where the absolute displacement of a rock glacier is smaller than the measurement accuracy. Consequently, for the understanding of interannual and diurnal variations in rock glacier flow velocities, other measurement methods are needed. Ground-based interferometric synthetic aperture radar (GBInSAR) is able to detect spatial deformations in the range of sub-centimeters.

Therefore, to get a more detailed understanding of the rock glacier flow velocity variations, a GBInSAR was installed on Finstertal hydroelectric dam to measure the rock glacier flow velocities between October to November 2019. In this study, preliminary results on diurnal flow velocity variations of Finstertal rock glacier, based on GBInSAR, are presented, and compared to annual variations derived from aerial imagery and laser scan data.