

Determination of glacier volumes in the Hohen Tauern (Eastern Alps) by ground penetrating radar (GPR)

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Climatic changes cause many glaciers in the Alps to retreat rapidly. Besides mass balances, the determination and monitoring of their total volumes are important aspects for understanding the interactions between climate and glacier kinematics.

The presented study focuses on 3 glaciers in the region “Hohe Tauern” in the Eastern Alps of central Austria: The Wurtenkees ($0,82 \text{ km}^2$) is located on Mount Schareck (3123 m) and the Goldbergkees ($1,42 \text{ km}^2$) and Kleinfleisskees ($0,87 \text{ km}^2$) are located on Mount Sonnblick (3106m). Mass balances are regularly determined since the mid 1980ies.

To estimate the total ice volume, GPR was applied along 30 profiles in the years 2002–2004. An antenna with a main frequency of 20 MHz was used by which maximum exploration depths of more than 100 m were achieved. Pointwise measurements were performed with an average distance of 2 m. The total length of all profiles is about 15 km.

Obtained data are of varying quality and the bedrock surface can be clearly identified in several profiles. The propagation velocity of the ice was derived from diffraction hyperbola analysis and has an average value of 0.16 m/ns. Two way travel times of the bedrock surface were migrated using a 3D approach and were converted to depth maps. Maximum depths of the Kleinfleisskees and Goldbergkees are 110 m, while the Wurtenkees exhibits a maximum depth of 60 m.

The maps of the ice thickness are verified by different strategies. Results from a gravimetric survey confirm the obtained results in case of the Wurtenkees. At some locations, thinning of the glacier correlates with the occurrence of crevasses as indicated by increased reflectivity. Estimation of the shear stress at the glacier bottom and its relation to the thickness are analysed using geostatistical tools and provide further verification of the depth maps.