4.2. Assessing rock glacier activity as proxy for permafrost distribution in the Austrian Alps using radar interferometry and image correlation techniques

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Abstract: Permafrost plays a critical role in the geohydrological cycle and landscape evolution of high mountains. Permafrost conditions are currently undergoing strong changes due to rising air and ground temperatures. Changes in permafrost temperature can lead to slope instabilities like rockfall and rockslide and are increasingly observed in the European Alps. The estimation of permafrost distribution in the Austrian Alps is mainly based on temporally and spatially limited data. The most recent country-wide estimation was produced more than ten years ago. With respect to the dynamics of temperature changes in Austria an update of the knowledge base of permafrost in Austria distribution is urgently needed, but data on permafrost occurrence or subsurface temperature is only available for few selected sites. We apply rock glaciers as indirect indicator of permafrost conditions to ascertain a country-wide state of the art knowledge on permafrost distribution. Active rock glacier creep is initiated by ground ice and is regarded as indicator for permafrost conditions. Recent studies have shown that interferometric SAR is suitable to measure rock glacier velocities at high spatial and temporal resolutions. In this work, we use SqueeSAR (TRE ALTAMIRA) processed Sentinel-1 data over two years (2020-2022) and digital image correlation (DIC) of repeated airborne imagery and digital elevation models using SAGA IMCORR tool to identify active rock glaciers in Austria. The identified rock glaciers deliver the base data for permafrost distribution modelling using a topoclimatic approach. Rock glacier movement rates derived by SAR and DIC are compared to published rates for selected sites. Our preliminary results indicate that the quantified creep rates correspond well with existing measurements. Furthermore, the calculated motion rates of the DIC cover several directions of motion, it seems possible to distinguish between the real flow motion and a thawing motion. This allows a more accurate classification of the RG activity, which is also applicable to the SqueeSAR data since the motion rates of active RGs exceeds the measurable quantities from SAR data.