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Creating a rock glacier inventory of the northern Nyainqêntanglha range (Tibetan Plateau) based on InSAR time-series analysis

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The northern Nyainqêntanglha range on the southern Tibetan Plateau reaches an elevation of 7150 m and is mainly characterized by a periglacial landscape. A monsoonal climate, with a wet period during the summers and arid conditions during the rest of the year governs the landscape processes. Large parts of the mountain range are considered permafrost due to the high altitude and the associated low air temperature. Rock glaciers, which are bodies of ice-rich debris, are a typical landform. The recently published IPCC report on the cryospheres of high mountain areas highlights the sensitivity of rock glaciers to climate warming and emphasizes the importance of their study.

We study the distribution of rock glaciers of the northern Nyainqêntanglha range and our aim is to produce an inventory of active rock glaciers based on their surface motion characteristics. The lack of higher order vegetation and the relatively low winter precipitation enable us to employ Interferometric Synthetic Aperture Radar (InSAR) time-series techniques to study both seasonal and multi-annual surface displacement patterns. InSAR is a powerful microwave remote sensing technique, which makes it possible to study displacement from a few millimeters to centimeters and decimeters per year. It is thus suitable to detect sliding and creeping processes related to periglacial landscapes and permafrost conditions on the Earth's surface. We use both Sentinel-1 (2015-2019) and TerraSAR-X ScanSAR data (2017-2019) for our analysis.

In this study we differentiate rock glaciers from the surrounding seasonally sliding slopes by their significantly higher surface creeping rates with mean velocities of 5–20 cm yr^{-1}. We also observe that the velocity of rock glaciers is less dependent on the summer monsoon, which allows us to further differentiate between rock glaciers and other landforms. This method could potentially be used to create rock glacier inventories in other remote regions, as long as the snow cover in winter is thin enough to allow continuous InSAR time-series analysis. These rock glacier inventories are necessary to assess the effects of climate change on vulnerable high mountain regions.