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Assessing rock glacier velocities on the Tibetan Plateau using satellite SAR interferometry

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The information pertaining to rock glacier kinematics plays a crucial role in addressing various scientific inquiries related to permafrost distribution, mountain hydrology, climate change, and geohazards in alpine regions. However, our understanding of rock glacier kinematics on the Tibetan Plateau remains incomplete, with limited observations only made in a few local regions. To fill in this knowledge gap, our study employed the Interferometric Synthetic Aperture Radar (InSAR) technique to comprehensively assess the moving velocities of rock glaciers across the entire Tibetan Plateau. The velocities were assessed using two different methods: the processing of single interferometric pair data and the time series analysis. By utilizing the single interferometric pair data from Sentinel-1 and incorporating time series analysis results using LiCSAR products, we derived the downslope velocities of 41,441 rock glaciers as included in the plateau-wide inventory, i.e., TPRoGI [v1.0]. Our results revealed that a significant proportion of rock glaciers exhibit downslope velocities of 3-10 cm/yr (39.5%) and 10-30 cm/yr (32.7%). Around half of the rock glaciers on the plateau fall into the transitional category (53%), active rock glaciers also occupy a substantial portion (45.6%). Both active and transitional rock glaciers exhibit widespread distribution in the northwestern and southeastern plateaus. The average downslope velocity of the rock glaciers is 15 cm/yr. Rock glaciers on the western and northern plateaus tend to move faster (mean velocity = 26 cm/yr) than those on the eastern and southern plateaus (mean velocity = 12 cm/yr). Our assessment is valuable for the future monitoring of rock glacier kinematics on the Tibetan Plateau in the context of Rock Glacier Velocity (RGV) as an associated parameter of Essential Climate Variable (ECV) Permafrost.