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

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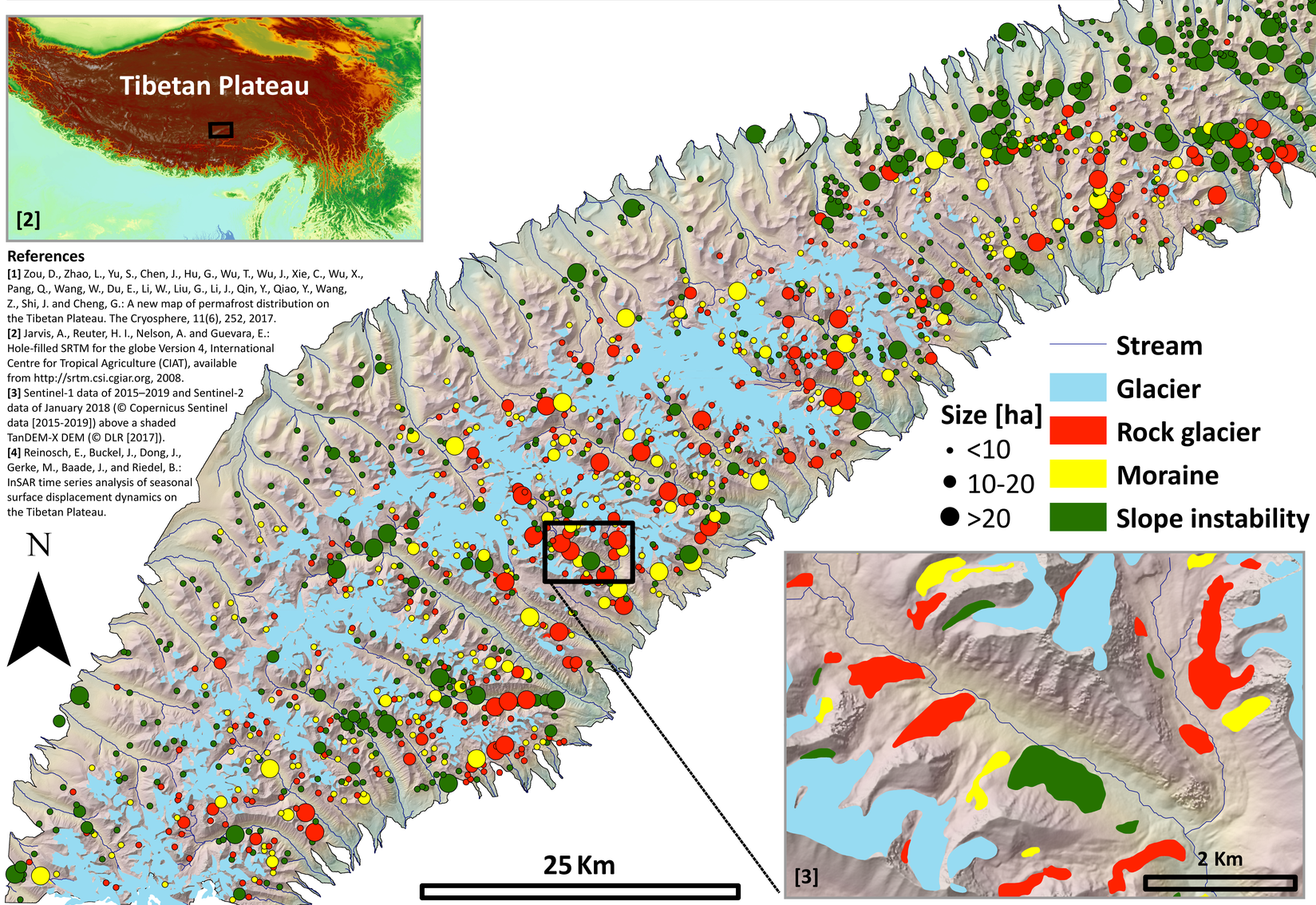
Geo-ecosystems in Transition on the Tibetan Plateau (TransTiP)

The northern Nyainqêntanglha range on the southern Tibetan Plateau features an elevation of 4280 to 7150 m. Large parts of the mountain range are considered permafrost [1] due to the high altitude and the associated low air temperature. Rock glaciers (bodies of ice-rich debris) are a typical landform. We are in the process of creating an inventory of actively moving landforms in this area with a focus on rock glaciers based on Sentinel-1 data. There are over 500 rock glaciers in our study area, with up to 90 ha surface area.



References

[1] Zou, D., Zhao, L., Yu, S., Chen, J., Hu, G., Wu, T., Wu, J., Xie, C., Wu, X., Pang, Q., Wang, W., Du, E., Li, W., Liu, G., Li, J., Qin, Y., Qiao, Y., Wang, Z., Shi, J. and Cheng, G.: A new map of permafrost distribution on the Tibetan Plateau. The Cryosphere, 11(6), 252, 2017.

[2] Jarvis, A., Reuter, H. I., Nelson, A. and Guevara, E.: Hole-filled SRTM for the globe Version 4, International Centre for Tropical Agriculture (CIAT), available from http://srtm.csi.cgiar.org, 2008.

[3] Sentinel-1 data of 2015–2019 and Sentinel-2 data of January 2018 (© Copernicus Sentinel data [2015-2019]) above a shaded TanDEM-X DEM (© DLR [2017]).

[4] Reinosch, E., Buckel, J., Dong, J., Gerke, M., Baade, J., and Riedel, B.: InSAR time series analysis of seasonal surface displacement dynamics on the Tibetan Plateau.

Methods

We performed an InSAR time-series analysis of Sentinel-1 data (2015-2019) to determine the surface displacement of landforms in this mountain range [4]. We isolated landforms with a downslope velocity greater than 4 cm/yr and used their surface roughness (slope variability and aspect variability) to catigorize them as either rock glaciers, moraines or slope instabilities (e.g. rock slides).

Rock glacier: High aspect and slope variability
Moraine: Medium aspect but high slope variability
Slope instability: Low aspect and slope variability

Open question

Which other parameters besides surface roughness can be used to distinguish between the landform types (shape, surface velocity, elevation etc.)?