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InSAR time-series analysis of periglacial sediment flux at Lake Nam Co, Tibet

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Our study area of Nam Co, Tibet, has experienced significant changes to its geosphere in recent decades, which are likely driven by climate change. Interferometric Synthetic Aperture Radar (InSAR) time-series data is well suited to study periglacial processes in the study area, which often cause creep on the scale of millimeters to centimeters per year. The lack of vegetation and the limited amount of snow cover reduces the risk of decorrelation. This allows time-series analysis of InSAR data with very few temporal gaps and good spatial coverage. The atmospheric system at Nam Co poses some challenges, as strong monsoonal rains may cause decorrelation during the summer months. In this study we are using the Small BAseline Subset (SBAS) technique to track periglacial landform changes within the Qugaqie Basin at Nam Co. We employ ESA's Sentinel-1 radar satellite and validation will be performed with TerraSAR-X ScanSAR data. A geomorphological map of periglacial landforms, like rockglaciers and protalus ramparts, is used to corroborate the surface changes displayed in the time-series data.
The high resolution time-series data shows mean surface velocity rates of 10 – 30 mm/yr in the Qugaqie basin. Some slopes creep with rates of up to 50 mm/yr. Fast moving areas, match the periglacial landforms mapped through optical remote sensing and field observations. The annual freezing and thawing cycle of the active layer is also clearly represented within the time-series data. The exact onset and duration of both freezing and thawing periods, as well as the amplitude of the resulting surface displacement vary throughout the basin. Most areas in the bottom of the main valley experience uplift through freezing of the active layer from September to January and subsidence through subsequent thawing from April to August. The amplitude of this annual cycle is to 4 – 7 mm. This fits the monsoonal climate of this area, as the thawing period corresponds well to the rise in temperature and the freezing period begins once the temperature start to drop again. On the slopes we observe a similar annual cycle of vertical displacement but on a smaller scale and a very significant temporal shift, causing it to seemingly correspond with the onset of precipitation, rather than temperature.
The next step in this research will be to validate the Sentinel-1 time-series results with TerraSAR-X ScanSAR data of the same area. To further validate the linear trend of our satellite data, terrestrial laser scans of a few key areas were recorded in July 2018, which will be repeated in September 2019.
This project is part of the TransTiP research group (https://www.tu-braunschweig.de/irtg-transtip), a newly formed international graduate school focused on studying the effects of climate change on the TP.