Recent surge of the South Rimo Glacier, Karakoram: Dynamics Characterization using SAR data

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Glacier surging is an unique dynamic pattern that involves a long term quiescent phase and a sudden surge phase. The surge causes abnormal glacier movement, such as high flow velocity, transportation of large amount of ice mass, and dramatic thickening and advancing of the glacier terminus. Glacier surge not only confound the understanding of regional glacier dynamics, but also pose threats to local residents by invoking glacier lake outburst floods.

In this work, we reported the recent surge event of the South Rimo Glacier, one of the largest glaciers in Karakorum. The surge happened between 2018-2020 with very little terminus advancement, and thus it is difficult to interpret the dynamics of the event simply by visual inspections of satellite images. We studied both the topography evolution and the surface velocity change of the glacier before and during the surge. By differencing a series of digital elevation models (DEMs) produced from the TanDEM-x CoSSC data acquired between 2011 and 2017, we found that the South Rimo glacier started accumulating height in the middle stream since 2013. A bulge was built in the reservoir region since 2014 and reached its maximum height (27.51m higher than 2011) before the surge activation in 2017. Velocity maps between 2016-2020 were obtained from SAR offset tracking using Sentinel-1 images. It was shown that the surface velocity greatly increased in 2017 at areas around the bulge. The peak velocity was found in the mid of 2019 at about 10 m/day, which is of three magnitude higher than the velocity during the quiescent phase. Our work characterized the development of the recent surge of the South Rimo Glacier, and highlighted the value of high resolution DEM products and velocity maps in pre-identifying glacier surge and mitigating related hazards.