



A time series of TanDEM-X digital elevation models to monitor a glacier surge

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Bivachny Glacier, a tributary of the more than 70 km long Fedchenko Glacier in the Pamir Mountains, Central Asia, is a surge-type glacier with three known surges during the 20th century. In 2011, the most recent surge started which, in contrast to the previous ones, evolved down the whole glacier and reached the confluence with Fedchenko Glacier.

Spatial and temporal glacier volume changes can be derived from high-resolution digital elevation models (DEMs) based on bistatic InSAR data from the TanDEM-X mission. There are nine DEMs available between 2011 and 2015 covering the entire surge period in time steps from few months up to one year. During the surge, the glacier surface elevation increased by up to 130 m in the lower part of the glacier; and change rates of up to 0.6 m per day were observed.

The surface height dataset was complemented with glacier surface velocity information from TerraSAR-X/TanDEM-X data as well as optical Landsat imagery. While the glacier was practically stagnant in 2000 after the end of the previous surge in the 1990s, the velocity increase started in 2011 in the upper reaches of the ablation area and successively moved downwards and intensified, reaching up to 4.0 m per day.

The combination of surface elevation changes and glacier velocities, both of high temporal and spatial resolution, provides the unique opportunity to describe and analyse the evolution of the surge in unprecedented detail. Especially the relation between the mobilization front and the local mass transport provides insight into the surge dynamics.