Recent glacier surges in Svalbard measured from repeat ASTER satellite optical stereo images

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A large number of Svalbard glaciers is believed to surge from time to time. Surging is therefore a major process of glacier mass turnover on the archipelago. In addition, questions arise how the frequency and magnitude of these surges are influenced by the pronounced atmospheric warming currently observed in the Arctic. Due to the remoteness of most glaciers in Svalbard, difficult weather conditions, and the large area to be covered, monitoring of glacier surges has to rely heavily on a combination of optical and microwave spaceborne methods. In this contribution we explore to what extent repeat ASTER satellite optical stereo images can be used to observe two recent glacier surges on Svalbard: (i) Tunabreen calving into the Tempelfjorden, and (ii) Skobreen, a tributary glacier to Paulabreen, which calves into the Rindersbukta. From the ASTER imagery and an additional Landsat ETM+ scene we compute repeat digital elevation models and measure selected surface velocity vectors between 1999 and 2005. In addition we map changes in crevasse pattern and frontal positions. For Skobreen the remote-sensing-derived measurements complement images from an automatic terrestrial camera that give daily resolution and in total document the frontal variations.

It turns out that for Tunabreen first signs of surging can be observed from the images available for 2003. In 2004 and 2005 the glacier shows heavy surging, indicated by enhanced surface speeds, heavy crevassing, and advance of the calving front. For Skobreen, first indications of a surge can be seen from the 2003 images. Full development of the surge is indicated in the 2005 images. The ice mass from the Skobreen surge has major impact on the geometry and dynamics of Paulabreen, which it enters.