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Monitoring glaciers and indications of subglacial volcanic activity using small-scale Top-Hat reflectors - An IsViews experiment on Myrdalsjökull, Iceland

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Subglacial volcanic eruptions often provide indications of activity some time before the actual catastrophic event. Surface undulations appear on top of the ice cap and meltwater torrents can occur at the glacier margin. Even large scale uplifts of ice caps have been observed. Within the project IsViews a processing chain, based on high spatially and temporally resolved remote sensing imagery, will be developed in order to automatically identify such early indications. The main data used for this analysis are acquired by the TerraSAR-X, TanDEM-X and RapidEye satellites. First investigations concerning the feasibility of the near real-time warning system and the general baseline conditions are carried out on two large plateau glaciers in southern Iceland, namely Mýrdalsjökull and Vatnajökull.

Within the 2013 IsViews field work an experiment was started in order to test a new way of glacier monitoring. Two test sites were established on the Mýrdalsjökull ice cap (one at the equilibrium line and one below), each consisting of a permanent GPS station and two nearby RADAR reflectors. These RADAR reflectors are specially designed Top-Hat reflectors, which are cheap to manufacture, small (50 cm diameter) and lightweight and therefore easy to handle, transport and deploy. Their special design makes them visible in SAR images independent of orientation, so different acquisition geometries and even different sensors can be used. The drawback of the small, low reflecting Top-Hat can be overcome by using the newly implemented Staring Spotlight Mode of the German SAR Satellite TerraSAR-X, providing an unprecedented resolution of down to 20 cm in the azimuth direction.

The reflectors, as point targets, allow absolute positioning within the cm-level in the TerraSAR-X data. Time series of SAR data can be used to derive position and altitude changes of the reflector itself and possibly even melting rates by exploiting the different signal paths. The visibility of the Top-Hat reflectors has been confirmed in various test acquisitions shortly after their deployment, and initial position measurements have been carried out. Further acquisitions will be recorded once the reflectors emerge from the winter snow cover, and correlation of the measurements will be performed once the data of the GPS stations are received in March 2014.

The ease of deploying these new reflectors combined with the high-resolution capabilities of the TerraSAR-X satellite provides new monitoring possibilities, not only for glacial flow dynamics but also for rock movements and deformation of infrastructure.