



## Anomalous surface ice motion during the 2008 drainage of Gornersee, Switzerland

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Gornersee is an ice-marginal lake dammed by the valley glacier Gornergletscher, Switzerland. Gornersee drains periodically almost every year in the early summer. During the drainage in June 2008, the ice flow of Gornergletscher downglacier of Gornersee was intensively monitored. We positioned targets on the ice surface to determine the local ice movement and flow speed of Gornergletscher by either differential GPS technique or an automated total station. We also employed a portable real aperture radar (Gamma Terrestrial Interferometric Radar, GTIR) for interferometric imaging. The GTIR allowed to track the surface displacement of Gornergletscher over a continuous area of about  $4 \text{ km}^2$ . The GTIR captures the spatial distribution of the ice surface displacement in high resolution but only in the line of sight of the radar. On the other hand, the local point measurements give detailed temporal information on the ice flow in three-dimensional coordinate space. The interferometric radar and the traditional point measurements of the surface ice displacement thus complement one another.

During the drainage of Gornersee, we detected a pronounced perturbation of the surface displacement of Gornergletscher. With the combined results of the GTIR and the traditional point measurements we are able to accurately determine both the spatial variability and temporal progress of the ice flow disturbance caused by the lake drainage. The observed surface displacement mainly consists of vertical motion and a horizontal flow component perpendicular to the ordinary downglacier flow direction. This deflection of the ice movement trajectory occurs when the glacier surface rises during the lake drainage. Towards the termination of the lake drainage, the ice readopts to its precedent pre-drainage flow trajectory meanwhile the glacier surface lowers. The spatial variability of this combined surface movement is determined by the GTIR. During the drainage of Gornersee, high lake discharge overcharges the subglacial drainage system of Gornergletscher. The vertical uplift and lowering of the glacier surface we attribute to the storage and release of lake water at the glacier bed. The observed lateral flow deflections are clearly related to this storage process but the actual causing is not clear.