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Assessment of precise spatial and temporal slope deformation with the GAMMA Portable Radar Interferometer in the Illgraben debris flow catchment, Central Swiss Alps

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An improved assessment of potential hazards related to gravitational mass movements, i.e. landslides, rock falls and rock slides, requires a quantitative understanding of mass displacement rates in space and time. This information particularly includes the exact spatial delineation of the deformation processes.
Remote-sensing techniques in general, and ground based radar interferometry in particular, is becoming a standard method for a high-precision detection and quantification of surface change at local scales. Here, we use the GAMMA Portable Radar Interferometer (GPRI) that combines both a high precision for change detection, and the capability of an exceptionally high temporal sampling rate of < 1min per 360° scan which allows observations of the dynamic behavior. The GPRI is a real aperture FMCW radar using fan beam antennas to illuminate the target area. The operational range lies between 50 m and ∼7 km.
We used the GPRI to quantify the 20-hour temporal evolution of a 50,000-80,000 m3-large rock slide that potentially feeds subsequent debris flow processes in the Illgraben catchment, Central Swiss Alps. In an first preliminary interpretation, we found that the rock slide translated as an entire block at a nearly constant slip rate of 1 mm per day. In addition, the high resolution data acquisition allowed to delineate the lateral boundaries of the slide block at a precision of less than 5 meters from a survey distance of 1.5 km. Furthermore, field mapping reveals a thickness of 6-10 meters of the sliding block, and that the slip plane parallels the boundary between meta-dolomite and quartzite beds. The combination of high-resolution surveying with GPRI and detailed geological mapping thus allows an improved determination of transfer rates and volume of a rock slide, which causes a potential hazard.