Analysis of the Displacement along a Funicular with Large Baseline Interferograms on Point Targets

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In spring 1999, heavy rainfall following a period of exceptionally strong snowfall in the Alps during January and February triggered as many as 350 landslides in Switzerland with a total damage of about 60 to 75 Mio CHF. Above the town of Lauterbrunnen (Canton of Bern, Switzerland) the large landslide of Gryfenbach with an estimated mass of about 25 Mio m3 was strongly accelerated due to the heavy water saturation. The first section of the Lauterbrunnen-Mürren Mountain Railway (BLM), which was built in 1891 to facilitate the access to the village of Mürren located on a plateau above Lauterbrunnen, is crosscutting the landslide on it's southern fringe. Whereas average rates of displacement measured on the railway superstructures in the last 100 years were in the order of 10 to 20 mm/year before 1999, in the spring of that particular year a displacement rate of 10 mm/day was observed over a short time period. Overall, a displacement of several decimeters was observed, threatening the existence of the funicular. At the end of the summer 1999, however, there was a sensible slowing down of the displacement and regular operation of the funicular could be assured since then. An analysis of the displacement along the funicular was performed using ERS-1/2 SAR data of the time period 1995-2000. An initial interferometric point target analysis was performed with images acquired before the spring of 1999 and excluding all winter acquisitions with snow cover. The profile of displacement rate along the funicular shows in the region mostly concerned by the landslide average rates of about 2 cm/year in the satellite line-of-sight direction, with negligible displacements near the lower and upper stations. After 1999 the analysis was continued on single interferograms because of the very large displacements of several decimeters. For conventional spatial interferograms we observed that the interferometric phase is too high for interpretation in the case of pairs with more than 300 m baseline because of spatial decorellation and not accurate height correction. Therefore, we computed interferograms only on the point targets previously identified with the SAR data of the time period 1995-1998. The phase signal of these interferograms can be analyzed even for baselines larger than 300 m. With a series of such interferograms we could finally analyze the displacements along parts of the funicular even during the summer of 1999 and in 2000. This work showed that interpretation of single large baseline interferograms is feasible on selected point targets.