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Large scale rock slope release planes imaged by differential ground based InSAR at Randa, Switzerland

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In April and May of 1991 a steep rock slope above the village of Randa (Valais, Switzerland) failed in two events, releasing a total rock volume of 30 million m3. The rock mass behind the back scarp contains several million cubic meters of unstable gneisses and schists which are moving with a maximum rate of about 2 cm/yr. Different geodetic, geotechnical and geophysical techniques were applied to monitor this new instability and to determine its spatial extent. However, the boundaries of the instability could only be roughly estimated so far. For this reason five ground based differential InSAR surveys (GB-DInSAR) were carried out between 2005 and 2007 from the opposite valley flank at a distance to target of 1.3 to 1.9 km. These surveys provide displacements maps of four different time intervals with a spatial resolution of 2 to 6 m and an accuracy of less than 1 mm. These datasets reveal interesting new insights into the spatial distribution of displacements and significantly contribute to the kinematic interpretation of the ongoing movements. We found that the lower boundary of the instability is a narrow rupture plane which coincides with a primary lithological boundary on the slope. The intersection line between this basal rupture plane and the steep rock cliff extents over at least 200 m meters. It is possible to identify this structure on helicopter-based high resolution images and a LiDAR DTM of the failure surface. The eastern boundary of the instability also presents itself as a sharp line separating stable bedrock from a strongly fractured rock mass moving about 1 cm/yr along the line of sight. This lateral release plane is formed by a steeply east dipping tectonic fault plane, with subhorizontal striations and an exposed surface area of about 10'000 square meters. In the north-east of the instability the lateral boundaries crop out on surfaces that have an acute angle to the line of sight or lie in the shadow of the radar. Here the boundaries of the instability most probably correlate with faults which were mapped on the surface or can be seen on the DTM. Inside the moving rock mass several discrete structures can be identified along which active movements take place. In this contribution we discuss the ability of GB-DInSAR to detect release planes and active fractures of large scale landslides in fractured rock masses, which is not possible with any other method in inaccessible terrain. The identification of such structures provides essential information for kinematic analysis and the understanding of failure mechanisms in fractured rock masses.