Survey of landslide activity and rockglacier movement in the Swiss Alps with TerraSAR-X

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Landslides are a natural hazard of special relevance to mountainous areas with severe human and economic consequences. Consequently, an efficient survey of unstable slopes in these regions is important. Repeat-pass differential SAR interferometry (InSAR), in general, and Interferometric Point Target Analysis (IPTA), in particular, are powerful techniques for mapping land surface deformation from space at fine spatial resolution over large areas [1-4]. Potential and limitations of InSAR and IPTA for the periodical survey of alpine displacements were investigated in [5-8]. Overall, satellite SAR data at C-band perform relatively well during the snow-free season for built-up and rocky areas. Severe limitations to the spatial coverage arise from decorrelation over vegetated (forests and meadows) and snow-covered areas and from layover and shadowing caused by the very rugged topography. In addition, only the satellite line-of-sight component of the displacement can be determined with InSAR. L-band interferometry has the capability to complement the existing applications based on C-band, because of its capacity to better penetrate the vegetation canopy, and thus to achieve interferograms with higher coherence over vegetated areas. Furthermore, the larger wavelength is more appropriate for the mapping of rapid displacements [9,10].

The German TerraSAR-X mission was successfully launched on June 15, 2007. This SAR system operates at X-band and has a 11 days repeat cycle. In order to assess the potential of TerraSAR-X interferometry for the survey of landslide activity and rockglacier movement in the Swiss Alps a series of four TerraSAR-X stripmap mode data (single polarization, 3 m resolution, 30 km swath width) was acquired during the late summer of 2008. TerraSAR-X interferograms with short baselines (i.e. less than about 100 m) and acquisition time intervals between 11 and 33 days are considered in our analysis. For topographic reference and orthorectification an external Digital Elevation Model (DEM) with a pixel spacing of 25 m (DHM25 © 2003 swisstopo) is used. The differential

interferograms are employed for a large-scale motion survey, determining the position, extent, contour, and approximate velocity of an unstable slope. Multiple interferograms are preferred for a cross-validation of the results, avoiding misinterpretation of topography, atmosphere and noise as displacement. We will present selected results for rockglaciers and landslides in the Oberwallis region in the Swiss Canton of Valais. The TerraSAR-X interferograms are discussed together with in-situ information and interferograms derived from ENVISAT ASAR, JERS-1 SAR and ALOS PALSAR data. Our application strongly benefits from the higher spatial resolution of the TerraSAR-X data in comparison to the C- and L-band sensors used in the past, because many of the instabilities are of relatively small size.

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