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Pre-survey feasibility assessment of the persistent scatterer technique

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The remote sensing technique persistent scatterer synthetic aperture radar interferometry (PS-InSAR) is a powerful method for detection and monitoring of landslides with accuracy up to a few millimeters. However, precondition for reliable PS-InSAR processing is a stack of at least 15 to 50 SAR images. This makes processing very time-consuming and expensive. Furthermore, successful PS-InSAR application requires a high number of measurement points within the area of interest – so-called persistent scatterers (PS) which are scatterers of high coherent values. But estimation of the number and the distribution of the PS within the site prior to the recording and processing of several SAR images is very complicated.

Therefore, we developed three new methods for PS estimation prior to the acquisition of the SAR data. These methods are based on freely available or low-cost optical remote sensing data, land cover data (e.g. GlobCover and CORINE) as well as topographic maps and OpenStreetMap data. By means of empirical approaches these geodata were compared with results of real PS-InSAR processing of several sites.

First, the well-known normalized difference vegetation index (NDVI) processed with optical remote sensing data was used in an entirely new approach to estimate PS prior to the SAR data acquisition of the area of interest. Result of this method is an estimation of the probability for each pixel of the NDVI image to get a PS at a certain NDVI value. When using freely available middle spatial resolution optical data (e.g. Landsat and ASTER) this PS estimation procedure works very well in areas of sparse vegetation. World-wide application of this method requires high spatial resolution optical sensors. Then, the NDVI-based PS estimation method can also be applied at areas covered by denser vegetation.

The second PS estimation method is based on freely available land cover datasets. Result of this method is an estimation of the PS density (PS/km^2) for each type of land cover within the area of interest. Due to the developed so-called relative PS density, this PS estimation method can be used for all SAR sensors and all PS-InSAR algorithms. The validation of the land cover based PS estimation method by comparing its results with real processed PS (based on real SAR data) showed a very good match (for higher spatial resolution land cover data) or a relatively good match (for lower spatial resolution land cover data), respectively.

Using topographic maps and OpenStreetMap data, the third method estimates (I) the PS density, (II) the distances between the estimated PS and (III) their distribution within the area of interest. Additionally, the distance between the PS is classified regarding to the applicability for PS-InSAR processing. Finally, the results were validated using real PS-InSAR data.

For the development of these methods data from several sites of different climate and land cover were chosen to guarantee wide usability of the PS estimation procedures. The methods enable a wide area suitability analysis. This is especially interesting for geological surveys and for companies working in the field of InSAR processing.