Towards Integration of GNSS and GB-SAR Measurements: Exemplary Monitoring of a Rock Fall at the Yangtze River in China

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SUMMARY

Monitoring of artificial or natural objects is essential to reduce the risk of hazards. In order to get more accurate and reliable monitoring results, a huge research effort was made in the last decades. The reliability of monitoring can be improved by integration of at least two independent measuring techniques and in this paper, a first approach to integrate GNSS and GB-SAR measurements, while monitoring a rock fall at the Yangtze River near the Three Gorges Dam in China is presented. The site is unstable due to natural conditions such as the active geological structure, variation of water level, and human interventions like coal mining.

Nowadays the ground-based Synthetic Aperture radar (GB-SAR) is gaining more importance in the field of monitoring, because of its high temporal and spatial resolution and its high accuracy in detection of movements and displacements in the line of sight (LOS) direction. In contrast GNSS has a low spatial resolution (pointwise measurements). The advantage of the GNSS is the ability to detect 3D-displacements precisely.

Using both techniques, a first trial was made; the aim of this investigation is the detection of possible problems that could occur during the measurement or data processing and to judge the measuring and integration concept proposed here. In this trial, two GNSS-reference stations and the GB-SAR instrument (IBIS-L) were installed in a stable area; about 700 m away from the movement area. Another two GNSS-rover stations were installed in the rock fall area. In order to detect the positions of the GNSS-rover stations in the GB-SAR data and thus to compare the GNSS-results with those obtained by GB-SAR, two RADAR corner cubes were installed near the GNSS-rover stations. Furthermore, the meteorological data are measured in order to investigate the correlation between atmospheric parameter variations and GB-SAR

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observations.

During the measurements campaign the results of GNSS show no significant displacement, in contrast the results of GB-SAR show a LOS-displacement of several mm, which are traceable to atmospheric changes. After the atmospheric correction using ground control points (GCPs) and transformation to the GNSS-coordinate system the displacement time series obtained by GB-SAR are comparable with those measured by GNSS. The atmospheric correction issue should be further investigated in the future. Furthermore, the corner cubes could not be realized unambiguously in the data of the GB-SAR. Using bigger corner cubes and improving their orientation could be helpful in the next measurement campaign.