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Detecting very slow ground movements using PS interferometry in the Lanzhou loess area of Gansu Province, China.

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Ground instability monitoring and control traditionally rely on qualitative, often subjective geomorphological assessments and, where affordable, on relatively expensive in situ investigations. Due to limited opportunities for in situ instrumentation (cost, reliability and robustness) there is often a serious lack of monitoring data. The use of PSI (Persistent Scatterer Interferometry) results, provides a welcome opportunity to test and calibrate existing slope deformation models against independent monitoring data. The advantages and limitations of PSI for ground instability detection and monitoring are evaluated for the semi-arid loess area of the city of Lanzhou (Gansu Province, China) home to over 3 million people. In this tectonically active region, ground instability in the loess and underlying bedrock is widespread and Lanzhou pays an increasingly high price due to lost lives and livelihoods as the city and its environs continue to develop in an unstable terrain.
More than 40 ENVISAT ASAR datasets (period 2003-2010) were pre-processed to obtain stacks of co-registered differential SAR interferograms. Then the SPINUA algorithm was used to perform multi temporal analysis on the co-registered DInSAR stacks in order to correct for spurious effects such as atmospheric artefacts and DEM error, and obtain precise displacement information over selected radar targets (PS). The analysis resulted in the identification of over 140,000 PS in the greater Lanzhou area (about 300 km2).
The PSI displacement map of Lanzhou reveals several zones characterized by the presence of moving PS (with average velocities typically from a few mm/yr to several mm/yr). The optical image interpretation and first reconnaissance field checks indicate that we detected only a limited number of moving radar targets potentially indicative of unstable slopes. Instead, the majority of the detected moving persistent scatterers appear to be associated with local subsidence and settlement/structure instability processes. It may often be difficult to ascertain the exact origin of low strain rates, especially when these are detected on steep slopes, because these can arise from different causes (e.g. subsidence and local settlements, shallow seasonal creep, true slope/landslide movements, volumetric changes of geological/artificial materials, tectonics, and instability of structures that act as radar targets). Thus, ground truthing in the form of correlating displacements with information on local geology, geomorphology and slope history, as well as detailed in situ inspections is essential for the correct interpretation of any PSI displacement map.

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