USING PERMANENT SCATTERER INSAR TO DETECT LAND SUBSIDENCE AND GROUND FISSURES: A CASE STUDY IN XI'AN CITY

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ABSTRACT

Large-scale ground water pumping in Xi'an city has resulted in significant land subsidence in last decades. It has also triggered the rejuvenation of the normal faults in the upper portions of the Quaternary deposits underlying the city, leading to surface rupturing and the development of ground fissure zones across the city. These ground fissure zones are structurally controlled in the sense that they are directly linked to the normal faults in the Quaternary deposits, all trending in an east-northeasterly direction. In essence, they are the surface expressions of the deeper faults under current drawdown conditions.

In this paper we presented a case study of land subsidence and ground fissures detection by using Permanent Scatterers SAR interferometry (PS-InSAR). Based upon the conventional interferometric SAR techniques, the PS-InSAR overcomes atmospheric delay anomalies and temporal and geometric decorrelation by exploiting the temporal and spatial characteristics of radar interferometric signatures collected from point-wise targets that preserve phase coherent over time. In this work we applied a linear regression model to retrieval land subsidence rate by using a series interferometric phase of the coherent target. For the displacement of ground fissures monitoring, which caused by the nonlinear displacement of land subsidence and fault motion, a time series interferometric analysis of coherent target has been carried out to retrieve the history of displacement. The results archived from ENVISAT ASAR images acquired from 2005 to 2008 has demonstrated the distribution and the magnitude of the land subsidence and ground fissures. The estimated land subsidence rate map indicated the maximum subsidence rate was more than 55 mm yr^{-1} and the maximum nonuniform motion of ground fissures was about 3-5mm yr^{-1} in Xi'an city. We validated the result from PS InSAR by using the field surveying and the result shown good agreement.

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Key words: Land subsidence, Ground Fissures ,Permanent scatter, InSAR, Xi'an city