LARGE SCALE LAND SUBSIDENCE MONITORING WITH A REDUCED SET OF SAR IMAGES

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ABSTRACT

Land subsidence is a common geohazard in many countries of the world, which cause damages for many urban areas and civil infrastructures. In China, the Northern China Plain, the Yangtze Delta region and the Fen-Wei graben are the major regions which suffering a heavy land subsidence in the past several decades.

For well understanding the development of land subsidence, many kinds of techniques, such as optical leveling, bedrock marking, layered marking and GPS, has been exploited to measure the detailed displacement. However, the large amount of man-power required during such measurement campaigns make them relatively expensive and time consuming. Moreover, displacement observations can only be made at a relatively small number of observation points with a low temporal frequency. All these disadvantages limited the point-wise based surveying technology applied for deformation with a wide coverage and frequent variations. The recently development of spaceborne SAR interferometry provides an efficient tool for large spatial scale surface subsidence monitoring with a high accuracy and precision.

This paper presents the technique and results obtained on the North China Plain (NCP) for large scale land subsidence monitoring by using Permanent Scatterers interferometry (PSI) with a reduced set of SAR images. We combine the classical PS InSAR and small baseline subset (SBAS) technique in the data processing chain. Comparison with the reference PSI technique which uses large number of images to generate the differential interferograms with respect to a common master image for each available acquisition, we introduce a small baseline method for interferogram formation and to estimate the average deformation rate and DEM error by exploiting the differential phase series of each coherent point target. Images with a small spatial baseline and temporal span are combined for interferogram stack generation and also to increase the observation sampling and minimize the effects of the DEM inaccuracies and decorrelation. In particular, the proposed algorithm extends the capability of SBAS for PS candidate identification from single look SAR data rather than the multi-looked image used in SBAS technique. The sub-look correlation and amplitude stability method are jointly developed for small number of SAR images, which enable the deformation map with the full spatial resolution. Presented result in this work provides subsidence map with an extent of 100×200 km^2 derived from a reduced set differential interferograms generated with ENVISAT ASAR data acquired from 2004 to 2007 relative to the Tianjin and Beijing area in the North China Plain. The estimated subsidence rate has been validated with the precise leveling measurement and the stand deviation between the two groups of data is $\pm4.6mm$.

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Index Terms— *Land subsidence, SAR interferometry, permanent scatterer, small baseline, precision validation*