Monitoring land subsidence in the Choushui River Fluvial Plain by utilizing the SBAS-PSInSAR method

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Abstract

Land subsidence is an environmental issue caused by various natural processes or human activities. Among those, long-term groundwater extraction is recognized as the main cause of subsidence around the globe. Land subsidence may cause unexpected damage to buildings and infrastructures, leading to a substantial financial burden for governments. Therefore, monitoring subsidence is essential to update the sinking progress and help decision-makers promptly establish appropriate policies to control the impacting factors. In this study, the research area is the Choushui River Fluvial Plain (CRFP), located in the central region of Taiwan. The CRFP is an important agricultural region and the area through which a section of the Taiwan High-speed Rail (THSR) passes. Monitoring and understanding land subsidence patterns in the CRFP is important for local authorities to diminish the impact of subsidence on civilian lives and public transportation. This study applied SBAS-PSInSAR and 239 SAR images to monitor surface deformation in the CRFP from 2016 to 2021. The SBAS-PSInSAR results were calibrated and validated by GPS measurements and leveling survey data. The results revealed the appearance of three subsidence bowls in Changhua county, which were previously unable to detect by point-wise measurements. The central part of Yunlin county suffered the most severe subsidence, with the cumulative displacement reaching over -350 mm. Furthermore, the average deformation velocity time series showed that the sinking rates in subsidence bowls suddenly accelerated in 2020 – 2021, after having been recognized as slowing down in previous years. In addition, the SBAS-PSInSAR results also provide the subsidence profiles along and across the THSR, which indicated two significantly subsiding spots. The acceleration of subsiding velocities reminds authorities and researchers of the complexity of subsidence patterns in the CRFP. Besides, the results also confirmed the reliability of the SBAS-PSInSAR method for further monitoring of subsidence in the CRFP.

Keywords: land subsidence, SAR interferometry, small baseline subset, persistent scatterer, subsidence profile