



InSAR Time-series Investigation of Anthropogenic Land Subsidence in the Coastal City of Semarang, Indonesia

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Semarang, one of the major cities in Indonesia, has been experiencing rapid urban and industrial development in recent decades, which increased the need for land reclamation and for groundwater supply in the area. As a result of groundwater extraction and soil compaction, Semarang is undergoing rapid land subsidence that not only poses a threat to infrastructures and properties but also increases flood risk in the coastal areas. In this study, we utilize Interferometric Synthetic Aperture Radar (InSAR) time-series analysis to assess the spatial extent and temporal behavior of land subsidence in Semarang. The SAR dataset we use includes 21 ALOS PALSAR images and 110 Sentinel-1 images. ALOS data, acquired in ascending orbit, span the time between December 2006 and November 2011. Sentinel-1 data cover the more recent period of October 2014 to December 2017 and are acquired in both ascending and descending orbits. InSAR time-series of displacements are obtained by applying Persistent Scatterer Interferometry (PSI) approach on the SAR data. The results identify the eastern part of Semarang city is subsiding with a rate exceeding 10 cm/yr at some locations. The overall extent, pattern, and magnitude of displacement from ALOS and two Sentinel-1 datasets are in agreement without significant differences. We compare the time-series of displacements from the older period (ALOS) and recent period (Sentinel-1) to characterize the temporal variations of displacement. The main component of ground displacement is vertical as suggested by field measurements. To assess this for the whole subsidence area, we take advantage of InSAR measurement from different geometries provided by two tracks of Sentinel-1 and decompose line-of-sight measurements to vertical and east-west components. The results are also compared with independent measurements at some locations where continuous GPS data are available.