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Land Subsidence In Jharia Coalfields, Jharkhand, India – Detection, Estimation And Analysis Using Persistent Scatterer Interferometry

Vamshi Krishna Rao Karanam[1,2], Mahdi Motagh[2,3], and Kamal Jain[1]
[1]Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, India (vk@ce.iitr.ac.in)
[2]Institute for Photogrammetry and Geo-Information, Leibniz University Hannover, Hannover, Germany
[3]Remote Sensing and Geoinformatics, GFZ German Research Centre for Geosciences, Potsdam, Germany

Subsidence due to coal mining is an increasingly prominent concern in the management of the coalfields. Jharia coalfields, Jharkhand are the oldest and one of the largest coalfields in India. Due to poor management of the coal mines in the past, land subsidence due to coal fires has become a common phenomenon in Jharia. Throughout the year, several factors such as coal fires, seepage of rainwater into mines, and illegal settlements above the abandoned mines contribute to the mining-induced subsidence. Due to such varied causes, subsidence in mining areas is temporally and spatially irregular. Traditional techniques using GPS, leveling, and total station are tedious, time-consuming, and can measure subsidence only on a point basis.

From the past few years, Interferometric Synthetic Aperture Radar (InSAR) has become a powerful tool to calculate and monitor the land subsidence. Persistent Scatterer Interferometry (PSI) is an advanced time-series interferometry technique, which calculates temporal deformation rates at mm scale with the help of stable pixels in the dataset referred to as Persistent Scatterers. The study aims at the detection and estimation of land subsidence in Jharia coalfield, Jharkhand, India, using the Persistent Scatterer Interferometry (PSI) technique. We used 30 C Band Sentinel-1 SAR images acquired in TOPSAR mode for a period of two years from 2017 to 2019, captured in a descending direction. Data acquired during the dry season are preferred to ensure good coherence. Potential subsidence zones are identified and demarcated using the Differential Interferometry technique in SNAP. PSI analysis is carried out using the StaMPS method. High temporal decorrelation due to the surrounding agricultural land cover and atmospheric interference are significant challenges for the PSI analysis in mining areas. The temporal baseline is adapted accordingly to reduce de-correlation. Atmospheric interference is removed using the TRAIN toolbox using the GACOS correction model. The results show an average subsidence rate in Jharia coal mines of approximately 4 cm/yr. Among the 23 underground mines in Jharia, 6 mines are subsiding at the maximum rate of 12 cm/yr. We identified subsidence in several small coal mines in multiple locations surrounding settlements and agricultural areas that can lead to contamination of groundwater when collapsed. Kustore underground mine covering an area of 1.2 sq. km is the largest subsidence zone in the study area just 200 meters away from the settlements.