

ABSTRACT

Sinkhole Mapping and Analysis of Cebu City through the Integration of Persistent Scatterer Interferometry and Artificial Neural Network

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Keywords: Artificial Neural Network, Deformation Velocity, Persistent Scatterer Interferometry, Sinkhole, Sinkhole Susceptibility

This study integrates Persistent Scatterer Interferometry (PSI) and Artificial Neural Network (ANN) to assess sinkhole susceptibility in Cebu City, an area extensively underlain by karst formations. The presence of 312 documented sinkholes, as validated by the Mines and Geosciences Bureau Central Office, highlights the need for advanced techniques to predict sinkhole occurrences, particularly in densely populated areas. A 5 × 5-meter Interferometric Synthetic Aperture Radar - Digital Elevation Model (IFSAR-DEM) was used to derive geomorphometric indices as input parameters for the ANN-based sinkhole susceptibility map. Concurrently, Sentinel-1 Single Look Complex (SLC) imagery was processed using PSI to measure ground deformation. ANN results show that 22% of the sinkhole susceptibility map is classified as high to very high susceptibility, equally divided at 11% for each class. Moreover, of the 28,285 Persistent Scatterer (PS) points analyzed, 25,052 exhibit subsidence, with an average velocity of -2.973 mm/year, ranging from -25.63 mm/year to -0.00013 mm/year. Integrating both data, a spatial mismatch was observed between areas of high sinkhole susceptibility and zones of significant subsidence. Notably, some high-susceptibility areas show uplift, while several built-up areas with low to moderate susceptibility exhibit subsidence. These discrepancies suggest that PSI primarily captures surface deformation due to anthropogenic activities such as groundwater extraction, rather than subsurface karst processes linked to sinkhole formation. While ANN models offer valuable insights into potential sinkhole-prone zones, PSI data may have limited applicability in this geologic setting. Nonetheless, PSI remains a viable tool for long-term ground deformation monitoring and broader geohazard assessment.