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Monitoring Land Subsidence and Fault Deformation Using the GPS–Enhanced InSAR Technique in the Long Point Fault Area, Houston, Texas (2015–2020)

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ABSTRACT

The Long Point Fault was one of the most active urban faults in Houston, Texas, which caused costly damages to private and public infrastructure and buildings adjacent to the fault trace during the 1960s to 1990s. The Interferometric Synthetic Aperture Radar (InSAR) has been proved to be a powerful tool to detect spatial and temporal surface deformation associated with faulting. However, the accuracy of InSAR observations is degraded by atmospheric delay and InSAR decorrelation associated with humid weather conditions and heavy vegetation in the coastal region. This study aims to delineate the ongoing ground deformation within the Long Point Fault area using the GPS-enhanced InSAR method. We present a GPS–enhanced InSAR method that aligns InSAR displacements to continuous displacement time series at 27 GPS sites within the SAR footprint to correct the long-wavelength errors. We correct each interferogram separately and implement the temporally Connected Small Baseline Subset (SBAS) method to generate the deformation time series. Relative to "uncorrected" InSAR, GPS–enhanced InSAR results achieved higher accuracy in terms of both displacements and average site velocities. The descending track 143 and ascending track 34 of C–band Sentinel–1A/B spanning 2015 to 2020 are utilized in this research. According to this study, the Long Point Fault is currently inactive. However, steady subsidence with an average rate of approximately 1 cm/yr is ongoing in this area, which is about one fourth of the historic subsidence rate in this area during the 1980s to 1990s. The rapid subsidence during the 1980s and 1990s was coincident with the substantial groundwater withdrawals during that time. The current dormancy of the Long Point Fault is coincident with the recovery of groundwater-level altitudes since the 2000s as a result of groundwater regulations enforced by the Harris-Galveston Subsidence District, which suggests a potential cause-and-effect relationship between groundwater withdrawals and local faulting.

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