

SAR and GNSS detection of crustal movements related to fluid injection and hydrocarbon extraction, Louisiana.

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Extraction and injection of fluids have been related to local uplift and subsidence detectable with InSAR analysis in some areas along the Gulf of Mexico passive margin. In this research, we quantify displacement in the direction of the Line of Sight (LOS) across the Sabine Uplift and North Louisiana salt basin, and we evaluate the potential role of fluid injection in these patterns. We compare our deformation results with seismicity patterns from a temporary array in Louisiana and permanent stations in nearby states. We found that areas near the injection wells in the Louisiana – Texas border show more motion towards the satellite, probably indicating uplifting.

We use Sentinel-1 data captured along ascending track between 63 between 2016 and 2022 to create an InSAR displacement time series. We used the Small Baseline Subset (SBAS) method with over 350 interferograms and discarded those with the lowest coherence. The SAR data is processed in the open software ISCE and MintPy. Due to the large size of the study area, we create several InSAR time series, each with a different reference point to reduce the impact of spatially correlated noise. To corroborate our measurements, we use continuous GNSS data from 28 CORS stations in the study area processed by the Nevada Geodetic Laboratory (NGL). We removed plate velocity from the InSAR time series using the plate-fixed information from the NGL. GNSS information also allows us to determine whether our observations from the InSAR time series are influenced by seasonal changes, and to isolate anthropogenic signals.

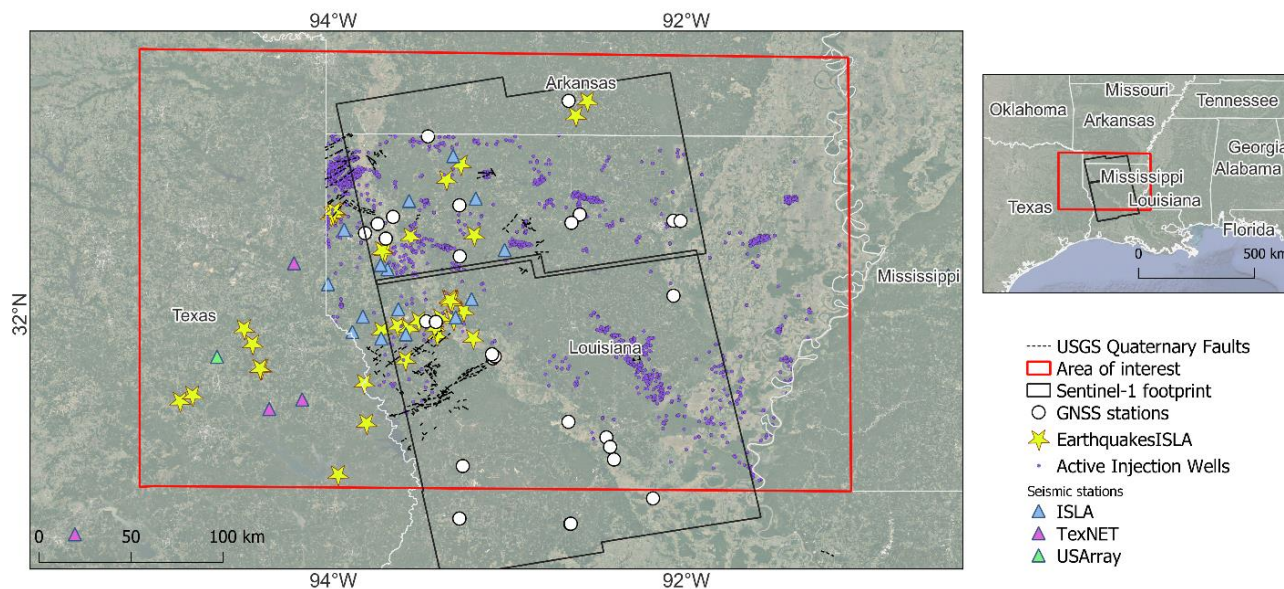


Figure 1: Study area location. Earthquakes from ISLA project (Ebinger, et al.), Injection wells from SONRIS (n.d.), faults from Wheeler et al., (1998), GNSS information from Nevada Geodetic Laboratory GPS Networks Map (Blewitt et al., (2018), UNAVCO, (2006)), last access on March 1, 2023