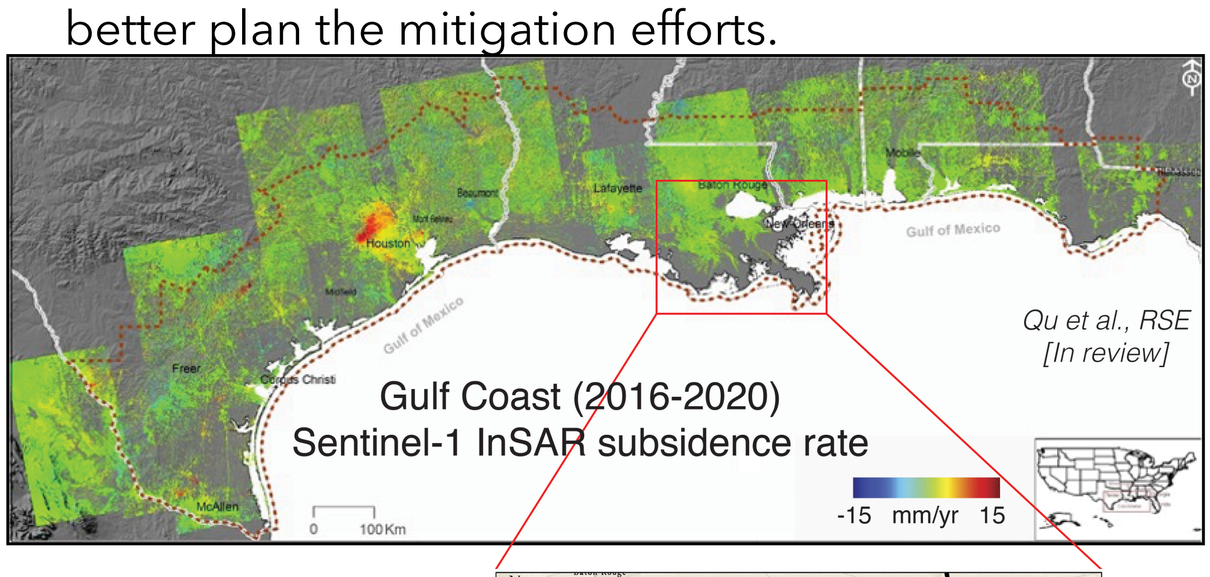
National Aeronautics and Space Administration

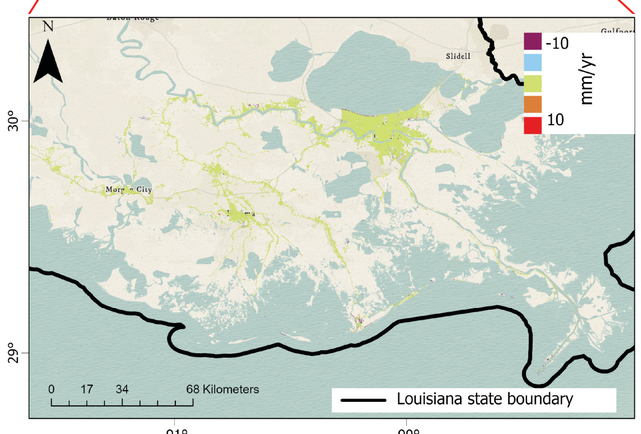
InSAR assisted Subsidence Monitoring in Southern Louisiana

Bhuvan Varugu - JPL Postdoctoral Fellow (334G),
Cathleen Jones (334G)

Motivation

- Coastal Louisiana is a hot spot for increased land loss (~5000 km^2/yr) due to relative sea level rise.
- Effect of increased flooding is exacerbated by land subsidence over the coastal wetlands.
- Multiple processes contribute to land subsidence at deep *[consolidation of Pleistocene soil layers]* and shallow levels [*fluid mining – groundwater, oil and gas]*.
- Spatially dense measurements are needed to capture the influence of multiple processes and better plan the mitigation efforts.





InSAR vertical deformation rates processed using SqueeSAR. Only few reliable pixels are obtained, and subsidence (~5mm/yr) can be seen on the barrier islands

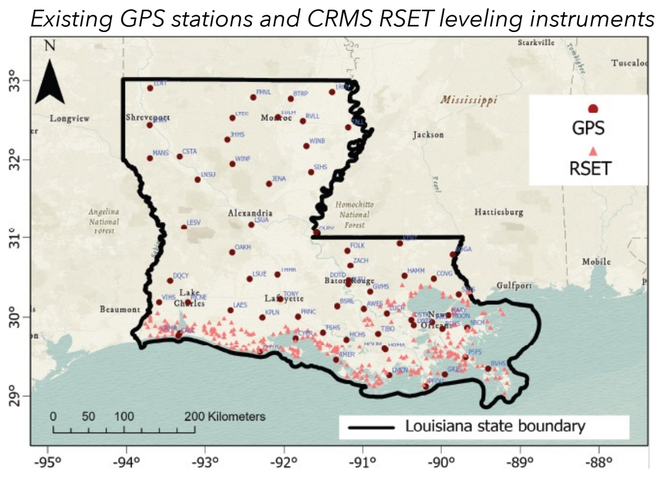
Existing Challenges

- Current subsidence measurements rely on a sparse GPS network and Rod Surface Elevation Table (RSET) measurements near the coast.
- Both GPS and RSET stations are anchored to depths > 15 m and thus fail to record subsidence occurring at shallow levels.
- Heavy vegetation and consistent inundation of wetlands fail conventional timeseries InSAR application, necessitating more ground measurements with GPS/GNSS.
- Yet, the challenge is to place the GPS stations optimally to measure subsidence from multiple sources and also serve as ground truth for future InSAR measurements (Ex: L-band NISAR).

Louisiana has >150000 plugged/ abandoned oil and gas well sites, which can be viable for installing new ground instrumentation.

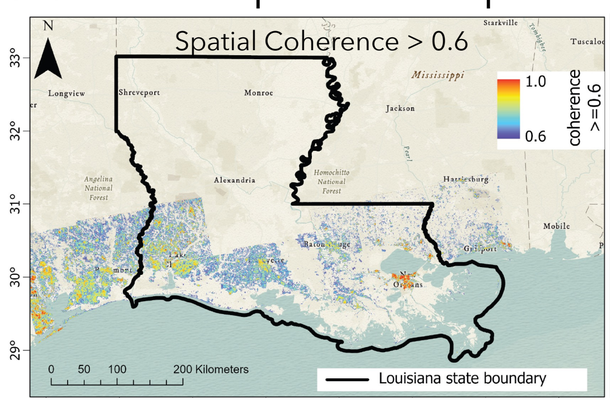
Goal: Increase the density of ground instrumentation across the state to better model the land subsidence.

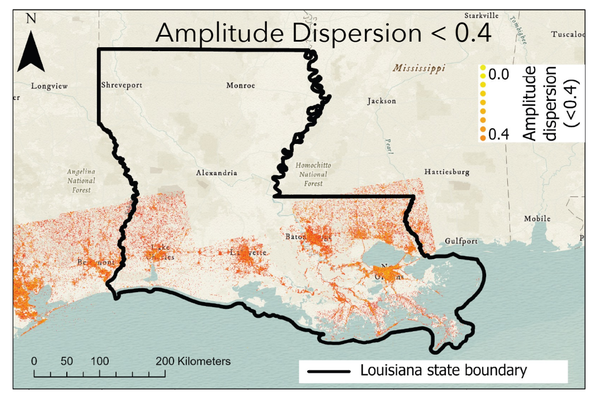
Existing GPS stations and CRMS RSET leveling instruments



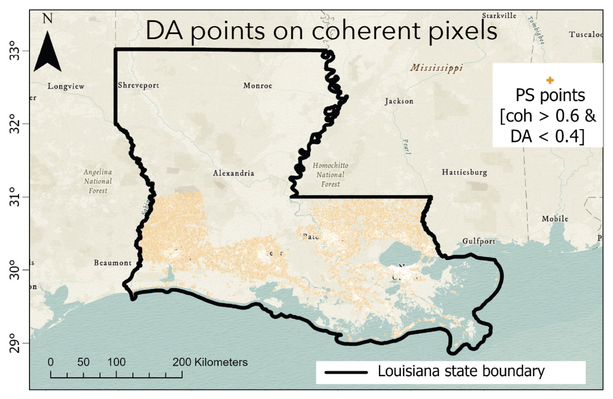
Methodology for co-locating GPS with InSAR

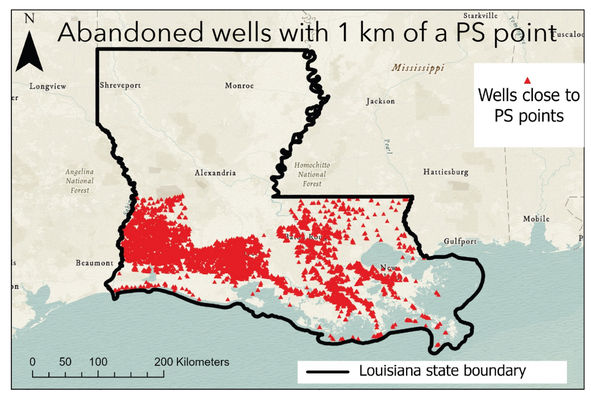
From 4 years of Sentinel-1 InSAR data, we took the time period with maximum spatial coherence and minimal unwrapping errors, Jun. 2019 – Jun. 2020, and identified stable InSAR pixels with Spatial coherence > 0.6 and Amplitude dispersion (DA) < 0.4.



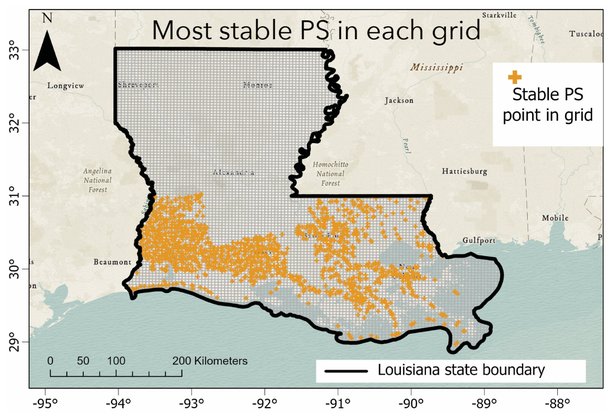


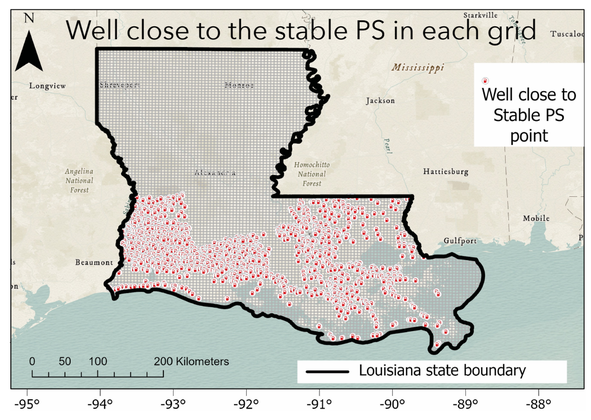
Located low DA pixels overlapping coherent areas (PS) with an oil well site in 1 km. Abandoned oil well sites can be viable locations for installing new GPS stations.





To downsize, we located the most stable PS point and the nearest well site on uniformly divided 5km^2 grids.





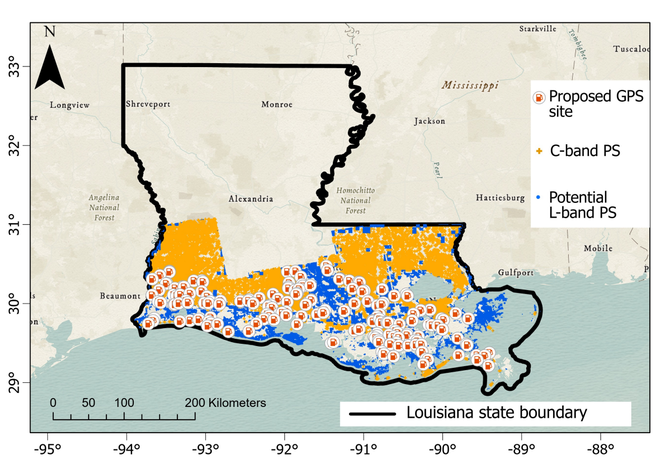
Relevance and potential for NISAR

- The work uses InSAR measurements as a guide to identify viable sites for establishing GPS stations.
- Together, InSAR and GPS offer a denser sampling to separate deep and shallow subsidence.
- Practical considerations such as visibility and site accessibility were added to downsize the number of sites.
- Areas between the current PS points with reasonable coherence(0.4<coh<0.6) can potentially have more PS points when NISAR is available.

Final well sites are proposed by taking practical considerations such as accessibility, soil strength, and visibility.

Blue Areas in between PS points containing reasonable coherence (0.4-0.6) in C-Band Sentinel-1 are expected to have more PS points in L-Band NISAR.

Relevance: L-Band NISAR can offer better measurements over vegetated areas and a dense GPS network can be a valuable ground validation.



National Aeronautics and Space Administration - Jet Propulsion Laboratory
California Institute of Technology, Pasadena, California
www.nasa.gov

Poster Number: PRD-EB#020