Quantifying Seasonal Deformation Associated with Ocean and Surface Hydrologic Loading with GNSS Observations in South Louisiana

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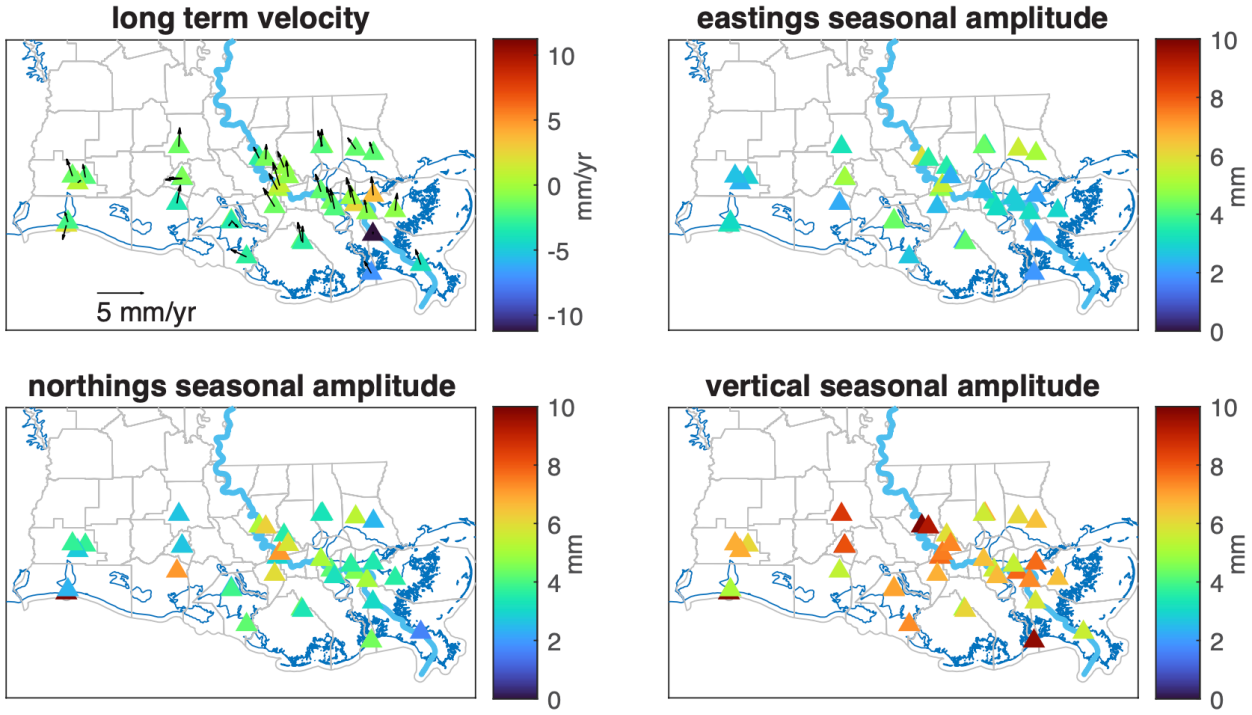
Subsidence across south Louisiana has been identified as one of the causes of coastal land loss, with broad impacts and societal implications. In addition to the long-term signal of land subsidence, many areas across South Louisiana have consistent seasonal deformation signals. Understanding these seasonal elevation changes is important, both for understanding land motions in South Louisiana and other areas along the Gulf of Mexico as a whole, and for understanding the effect various coastal land loss mitigation strategies may have at different times of year. We analyze GPS data from 63 stations across South Louisiana, using position estimates made publicly available by the Nevada Geodetic Lab. We estimate both long term velocities and the amplitude of seasonal changes in the east, north and vertical directions. We then use principal component analysis and reconstruction independent component analysis to assess the relationship between seasonal changes in subsidence that could be associated with changing water loads in the nearby rivers and ocean. Our results confirm that most areas of South Louisiana are subsiding at rates from 1 – 10 mm/yr, and experience reversible seasonal subsidence of ~ 5-10 mm each year. The spatiotemporal patterns of seasonal motion suggest a dynamic interplay between multiple hydrologic basins that must be carefully considered when assessing coastal land loss mitigation strategies.



Long term velocities (a) and amplitude of seasonal variations across South Louisiana in the b) eastings, c) northings, and d) vertical dimensions.