Large-scale time-series InSAR analysis of the Sacramento-San Joaquin delta subsidence using UAVSAR

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The Sacramento-San Joaquin delta (Delta) contains more than 1700 km of levees that protect various reclaimed lands from flooding. Most of the delta is experiencing subsidence at rates that can exceed 5 cm/yr locally, and which can affect the structural integrity of the levees. In-situ and airborne LIDAR monitoring of this extensive levee network is expensive, making Interferometric Synthetic Aperture Radar (InSAR) an attractive, cost-effective alternative that can provide uniform and consistent monitoring. InSAR has proven to be a powerful technique to study surface displacements at high accuracy (few mm/year), over large regions (up to 250 km wide swaths), and at a high spatial resolution (up to a meter). However widespread usage of InSAR, particularly within the application community, is challenged by several technical issues, the most significant of which are decorrelation noise introduced by a change of scattering properties (e.g., moisture and vegetation), and noise due to variation in atmospheric properties between different SAR acquisitions (i.e., tropospheric delay). These effects are particularly limiting in the rural/agricultural setting of the Delta. We demonstrate the usage of InSAR for spatially comprehensive subsidence monitoring both at the scale of the levees and at a scale that captures the intra-island variability. The study uses data collected over a period of six years (2009-2015) with NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) instrument, which is the prototype airborne instrument for the NISAR mission. We mitigate atmospheric noise by estimating a correction from state-of-the-art weather models, and reduce decorrelation noise by utilizing L-band SAR and using advanced time-series InSAR processing methods. Our analysis includes nine UAVSAR flight lines that cover altogether an area of approximately 8500 km^2, including the Delta and the surrounding areas.