Geophysical Research Abstracts
Vol. 16, EGU2014-14817, 2014
EGU General Assembly 2014

Application of InSAR to detection of localized subsidence and its effects on flood protection infrastructure in the New Orleans area

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The vulnerability of the United States Gulf of Mexico coast to inundation has received increasing attention in the years since hurricanes Katrina and Rita. Flood protection is a challenge throughout the area, but the population density and cumulative effect of historic subsidence makes it particularly difficult in the New Orleans area. Analysis of historical and continuing geodetic measurements identifies a surprising degree of complexity in subsidence (Dokka 2011), including regions that are subsiding at rates faster than those considered during planning for hurricane protection and for coastal restoration projects. Improved measurements are possible through combining traditional single point, precise geodetic data with interferometric synthetic aperture radar (InSAR) observations for to obtain geographically dense constraints on surface deformation.
The Gulf Coast environment is very challenging for InSAR techniques, especially with systems not designed for interferometry. We are applying pair-wise InSAR to longer wavelength (L-band, 24 cm) synthetic aperture radar data acquired with the airborne UAVSAR instrument (http://uavsar.jpl.nasa.gov/) to detect localized change impacting flood protection infrastructure in the New Orleans area during the period from 2009 - 2013. Because aircraft motion creates large-scale image artifacts across the scene, we focus on localized areas on and near flood protection infrastructure to identify anomalous change relative to the surrounding area indicative of subsidence, structural deformation, and/or seepage (Jones et al., 2011) to identify areas where problems exist. C-band and particularly X-band radar returns decorrelate over short time periods in rural or less urbanized areas and are more sensitive to atmospheric affects, necessitating more elaborate analysis techniques or, at least, a strict limit on the temporal baseline. The new generation of spaceborne X-band SAR acquisitions ensure relatively high frequency of acquisition, a dramatic increase of persistent scatter density in urban areas, and improved measurement of very small displacements (Crosetto et al., 2010). We compare the L-band UAVSAR results with permanent scatterer (PS-InSAR) and Short Baseline Subsets (SBAS) interferometric analyses of a stack composed by 28 TerraSAR X-band images acquired over the same period, to determine the influence of different radar frequencies and analyses techniques. Our applications goal is to demonstrate a technique to inform targeted ground surveys, identify areas of persistent subsidence, and improve overall monitoring and planning in flood risk areas.

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Acknowledgments: This research was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.