Analyzing InSAR for Monitoring Tidal Flow in Louisiana’s coastal wetlands

Talib Oliver-Cabrera (toliver@rsmas.miami.edu) and Shimon Wdowinski (swdowinski@rsmas.miami.edu)
University of Miami - Rosenstiel School of Marine and Atmospheric Science

Abstract
InSAR (Interferometric Synthetic Aperture Radar) is a remote sensing technique that allows studying changes on the earth in the range of the centimeters and facilitate the task of monitoring those small or big changes. It is commonly used to study deformation on the continental crust. Recent studies have found that InSAR can also be used to study water level changes when there is woody vegetation above the water in the study area. This is the case of the wetlands, large, vegetated, and constantly flooded ecosystems. The coast of Louisiana is among the most important locations of wetlands in the US due to its high productivity. Louisiana coastal wetlands are being threatened by natural (sea-level rise) and human interference (infrastructure development), they represent the major part of the wetland loss of the country. Monitoring Louisiana’s coastal wetlands represent a big challenge for scientists due to the large amount of area and hostile environment. Radar Interferometry can provide useful information and ease the monitoring work.

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Vegetation
Coastal wetlands in Louisiana vary along the coast depending mostly on water conditions due to mixed inputs of fresh and salt water within the coastal zone. The changes of vegetation on the coast mark the extents of salt-water inputs, showing intermediate and fresh-water marshes in areas where the ocean tide cannot reach the land anymore.

Methodology
We use InSAR and tide gauge observations to detect and compare surface water level changes in response to ocean tide propagation through the Louisiana coastal wetlands. In order to detect water level changes, we used mainly high coherence interferograms with short temporal baselines (24, 46 and 72 days). The processing of the SAR acquisitions was done using the Repeat Orbit Interferometry PACage (ROI_PAC).

Data Acquisition
Our data consists on ALOS PALSAR (L-band), Radarsat-1 (C-band) acquisitions and tide gauge information over the coast of Louisiana. The SAR acquisitions were obtained from the ASF User Remote Sensing Access data pool and the tide gauge information from NOAA stations.

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* The authors would like to thank CONACYT and Fulbright fellowships as well as Hérech Fattahi and Sang-Hoon Hong regarding the interferometric processing support.
* Unlikely the ALOS interferograms for the Chenier Plane, Radarsat1 was able to detect fringe pattern due to the edges that are part of the morphology of the Chenier.

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Fringe discontinuity due to man made barrier blocking tidal flow.

Radarsat-1
* The interferogram shows tidal flow disruptions along the coast due to man made structures.

Unlikely the ALOS interferograms for the Chenier Plane, Radarsat1 was able to detect fringe pattern due to the edges that are part of the morphology of the Chenier.

Conclusions
* Interferometric processing provides detailed information of water-level changes.
* The satellite revisit orbit is short enough to allow the detection of this changes (46 days for ALOS and 24 days for Radarsat-1).
* InSAR observation provides useful constraints for coastal wetland flow models.
* It is possible to map the extents of the tide and direction of propagation.
* It allows the detection of disrupted flow caused by man-made structures.
* Interferograms are highly affected by the temporal baseline, due to the rapid changes of the soft-deformed vegetation in the coast.

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