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Integrated analysis of interferometric SAR, satellite altimetry and hydraulic modeling to quantify Louisiana wetland dynamics

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Wetland loss in Louisiana has been accelerating due primarily to anthropogenic and nature processes, and is being advocated as a problem with national importance. Accurate measurement or modeling of wetland-wide water level changes, its varying extent, its storage and discharge changes resulting in part from sediment loads, erosion and subsidence are fundamental to assessment of hurricane-induced flood hazards and wetland ecology. Here, we use innovative method to integrate interferometric SAR (InSAR) and satellite radar altimetry for measuring absolute or geocentric water level changes and applied the methodology to remote areas of swamp forest in coastal Louisiana. Coherence analysis of InSAR pairs suggested that the HH polarization is preferred for this type of observation, and polarimetric analysis can help to identify double-bounce backscattering areas in the wetland. Envisat radar altimeter-measured 18-Hz (along-track sampling of 417 m) water level data processed with regional *stackfile* method have been used to provide vertical references for water bodies separated by levees. The high-resolution (~40 m) relative water changes measured from ALOS PALSAR L-band and Radarsat-1 C-band InSAR are then integrated with Envisat radar altimetry to obtain absolute water level. The resulting water level time series were validated with in situ gauge observations within the swamp forest. Furthermore, we compare our water elevation changes with 2D flood modeling from LISFLOOD hydrodynamic model. Our study demonstrates that this new technique allows retrospective reconstruction and concurrent monitoring of water conditions and flow dynamics in wetlands, especially those lacking gauge networks.