A multi-sensor monitoring system of surface water level changes in wetlands

Shimon Wdowinski, Heming Liao, and Boya (Paul) Zhang
Institute of Environment, Department of Earth and Environment, Florida International University, Miami, FL, 33199

Wetlands store roughly 10% of global surface water in the terrestrial portion of the water cycle, cover roughly 9% of the Earth's surface, and provide critical habitat for a wide variety of plant and animal species. Over the past century, many wetland areas have been lost, degraded, or stressed mainly due to anthropogenic activities, as water diversion, agricultural development, and urbanization, but also in response to natural processes, as sea level rise and climate change. Global and regional monitoring of wetland health and response to their natural and anthropogenic stressors are important and are best conducted using space-based remote sensing techniques, due to wetlands' vast extent and often inaccessibility.

Several space-based remote sensing technologies provide high spatial resolution observations of wetland water level and its changes over time. These techniques include Synthetic Aperture Radar (SAR), optical imagery, radar and laser altimetry, and Surface Water Ocean Topography (SWOT). SAR observations include two independent observables, amplitude and phase; each observable is sensitive to different hydrological parameters. Radar and laser altimetry missions provide cm-level accuracy water level measurements along the satellite track. The SWOT mission, which is scheduled for a February 2022 launch, will use radar interferometer for repeated measurements of cm-level water level measurements over a 50-100 km wide swaths. As part of a NASA supported project, we develop a space-based multi-sensor monitoring system of surface water level changes in wetlands. The multi-sensor system will generate detailed multi-temporal maps of wetland inundation extent, water levels, and water level changes. The development of the multi-sensor monitoring system will be conducted over the south Florida Everglades, which can be considered as a natural laboratory due to its variable land cover and the availability of ground-based hydrological observations. Preliminary results based on Interferometric Synthetic Aperture Radar (InSAR) observations yielded detailed maps of water level changes of the entire Everglades wetlands with 100 m spatial resolution and 3-4 cm accuracy level. After development, the system will be tested in two other wetland areas located in Louisiana, and Peace–Athabasca Delta (Alberta, Canada).