Coastal Wetlands (CW) provide numerous ecological functions that support a large variety of life forms and serve as economic bases for human societies. Therefore, it is imperative to track and quantify both short and long-term changes in these systems. In this dissertation, CW dynamics related to hydro-meteorological signals were investigated using a series of LANDSAT-derived normalized difference vegetation index (NDVI) and hydro-meteorological time-series data in Apalachicola Bay, Florida, from 1984 to 2015. Based on spectral analysis, NDVI in forested wetlands exhibited more persistence compared to that for scrub and emergent wetlands. NDVI fluctuations generally lagged temperature by approximately three months, and water level by approximately two months. This analysis provided insight into long-term CW dynamics in the Northern Gulf of Mexico. Long-term studies like this are dependent on optical remote sensing data such as Landsat, which are frequently partially obscured due to clouds. This result in sparse and often unusable images during meteorologically active seasons. Therefore, a multi-sensor, virtual constellation framework is proposed and demonstrated to recover the information lost due to cloud cover. Tri-Sensor Fusion (TSF) creates a simulated constellation for NDVI by integrating data from three compatible satellite sensors. The visible and near-infrared (VNIR) bands of Landsat-8 (L8), Sentinel-2, and the Advanced Spaceborne Thermal Emission and Reflection Radiometer were utilized to estimate NDVI and compensate for each satellite sensor’s shortcomings in visible coverage area. The quantitative comparison results showed a RMSE and Coefficient of Determination of 0.0020 sr-1 and 0.88, respectively between observed and estimated L8 NDVI. Statistical test results and qualitative performance evaluation show that TSF was able to synthesize the missing pixels accurately in terms of the absolute magnitude of NDVI. The fusion improved the spatial coverage of CW and increased the continuity of NDVI data for long-term studies.

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The public is welcome to attend.