Application of high resolution satellite imagery to assess storm tide-related flooding

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The overall goal of the proposed study is to demonstrate the efficacy of employing high resolution satellite imagery to improve coastal inundation models that are presently employed by NOAA (NWS and NOS), USACE, and FEMA, and those state-of-the-art coastal and estuarine models that are under development and will soon be applied operationally. It is expected that the employment of satellite imagery will break new ground for wetting/drying algorithm verification and overall model validation. Because of the unique approach taken with satellite imagery, model validation is possible for water surface elevations and the extent of the wetting front over large expanses of the coast with significant spatial and temporal variations.

A change detection approach has been adopted to determine the coastal flood wetting front. It is an active microwave based technique which makes use of satellite images from Radarsat 1 (SAR) obtained from the Alaska Satellite Facility. The spatial resolution of the obtained images ranges between 9m (fine mode) and 25m (standard mode). The approach consists of comparing two images acquired under two extreme conditions (e.g., low tide vs high tide). The main difficulty to overcome when using SAR imagery to identify flooded areas is that the signal returned to the satellite may be similar to one returned from land because of the speckle noise and ocean surface roughness. A simple grey-value threshold based technique is insufficient to distinguish between land and water in a single image. Therefore, the application of appropriate filters was necessary to reduce the noise in the images and allow for a better identification of inundated areas.

For this purpose, a multi-temporal image enhancement technique was applied to determine flooded areas. This technique assigns red, green and blue color to two different black and white SAR images covering the same scene and taken at two different acquisition dates but with similar radar configurations. One of the two images illustrates normal conditions (i.e. reference image) and the second image corresponds to the flood event. The hue of the color in the false color composite image indicates the date of the change while the intensity of the color represents the degree of change. The methodology was applied to Tampa and Apalachicola zones located in western Florida. However, the methodology is perfectly expandable to coastal areas in the north-eastern region. The multi-temporal false color composited image obtained clearly shows flooded areas during high tide or after the hurricane. The intensity of the red color which is corresponds to inundated areas, represents the severity of the flood. These preliminary results show great potential for satellite imagery to monitor coastal flooding, to delineate inundated areas at high spatial resolution and improve hydrodynamic model verification and validation.