OPTICAL SATELLITE-DERIVED BATHYMETRY ON TURBID COASTS FOR ANALYSIS OF NEARSHORE MORPHODYNAMICS

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ABSTRACT

Numerous studies of coastline change demonstrate significant erosion on the beach face following tropical cyclones, but the location(s) of deposition of this remobilized sand remains uncertain. Ship-borne data collection and bathymetric lidar surveys are acquired too infrequently to accurately track changes in the upper shoreface following storms. However, deriving bathymetry from optical satellite imagery, which is captured regularly over large swaths, can increase the temporal history of shoreface evolution.

Guided by the Beer-Lambert Law, which suggests a relationship between satellite surface reflectance and water depth, bathymetric lidar is used to calibrate satellite image-specific reflection-depth equations that are applied to satellite images to create bathymetric DEMs. A major challenge to this approach is turbidity that can obscure bathymetry and result in higher optical surface reflectance. By extracting an envelope of tenth-percentile surface reflectance values at each depth and limiting satellite imagery used seasonally and to days with low wind speeds, this turbidity signal can be minimized.

Using optically-derived bathymetry to assess change in the characteristics of subtidal bars in the upper shoreface before and after tropical cyclones may account for sediment lost from the beach face via storm surge. An application of this workflow on the Texas Gulf Coast before and after Hurricane Harvey shows increased wavelength and amplitude for nearshore bars following the storm. Future work is evaluating the extent to which these larger bathymetric features account for sand lost from erosion of the beach, and whether estimated patterns of upper shoreface evolution can, in general, balance sand mass associated with shore-zone change driven by tropical cyclones on the Texas coast.

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