Improving Flood Extent Mapping of the Coastal Storm Modeling System (CoSMoS) Tool with NASA Earth Observations and UAVSAR within Southern California

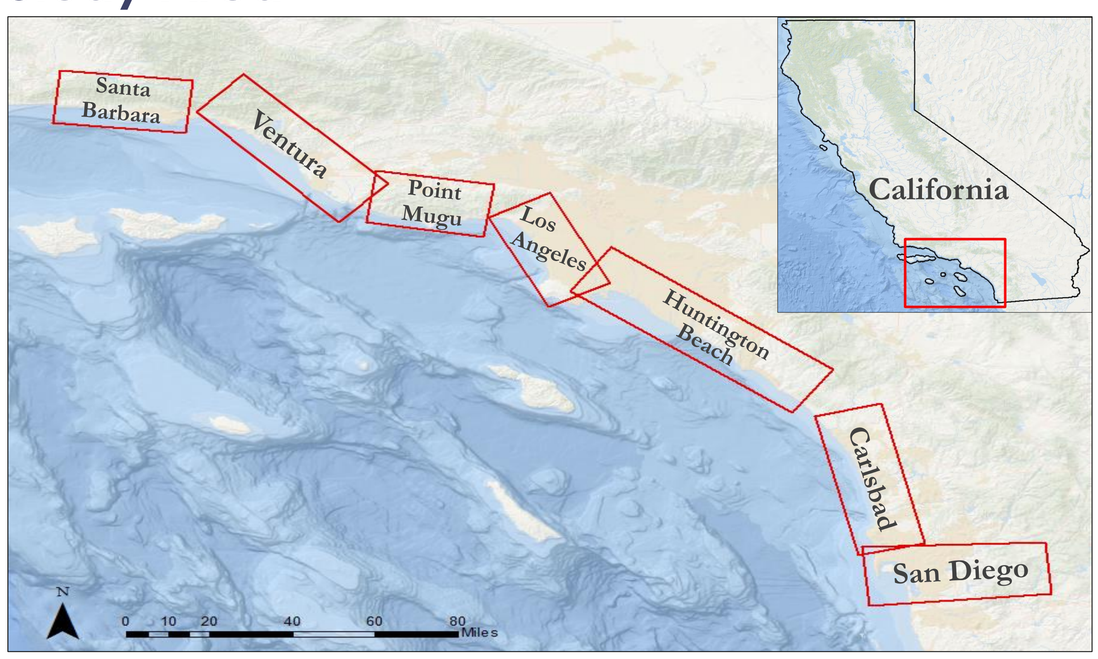
Abstract

The Southern California coast, from Point Conception to the Tijuana River wetland, has become more sensitive to flooding as king tides have increased in magnitude. These king tides are thought to be intensifying due to numerous environmental factors such as storm surges, strong winds, and sea level rise as the result of a changing climate. Subsequently, king tides cause flooding along the southern coast, and it is predicted that the previously minor damages incurred from these tides will become more severe and hazardous to those who live on the coast. The US Geological Survey (USGS) Pacific Coastal and Marine Science Center has created their own flood prediction model, the Coastal Storm Modeling System (CoSMoS). The USGS currently uses their model to predict areas that may flood preceding a high tide and this project aimed to make the model more accurate by mapping landward extents. To do this, different remote sensing methods were used in conjunction with Earth observations such as NASA's Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) and Landsat 8 Operational Land Imager (OLI). The team acquired imagery reflecting baseline tide levels and king tide events. The imagery underwent a change detection algorithm which produced a shapefile that highlighted areas most affected by extreme high tide events. The USGS Pacific Coastal and Marine Science Center will use this shapefile to validate their storm flood models, including the CoSMoS.

Objectives

- **Create** a flood extent shapefile using optical and UAVSAR imagery that allows the user to calibrate the CoSMoS model
- **Utilize** optical imagery to map the flood extent along Southern California's coast for the current time period
- **Use** coherence models on radar imagery to map the flood line extent

Study Area



Methodology

Data
UAVSAR
L-Band
HH, HV, VH, VV Polarizations

Processing
Total Power
Sum Aggregates
Freeman
Cross Products
Co-Cross Ratio

End Products
Coherence Images
Change Detection Maps
Flooding Extent Shapefiles

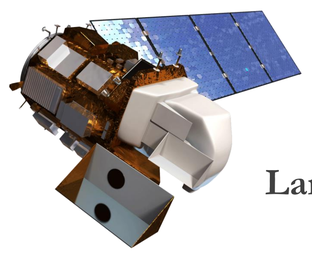
Data
Landsat 8
Operational Land Imager (OLI)

Processing
TOA Correction
Run MNDWI
Threshold for Water and Non-Water

End Products
Change Detection Maps
Water Extent Maps

Earth Observations Sensors

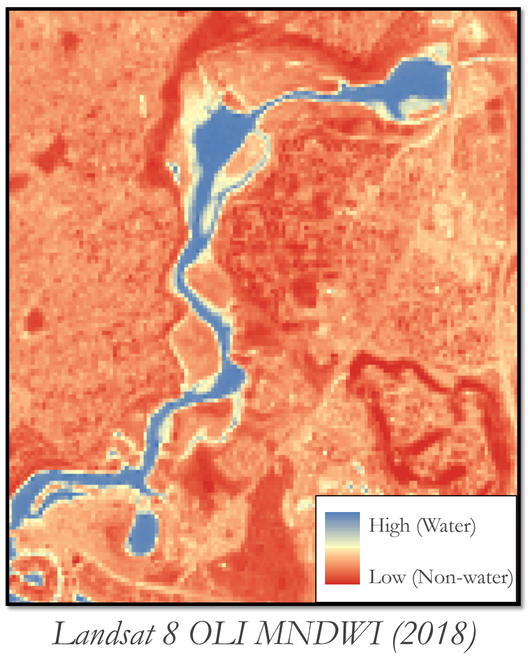
UAVSAR



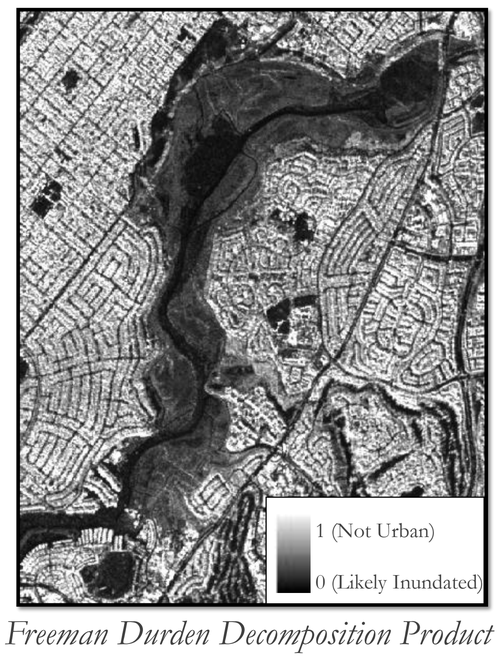
Landsat 8 OLI

Results

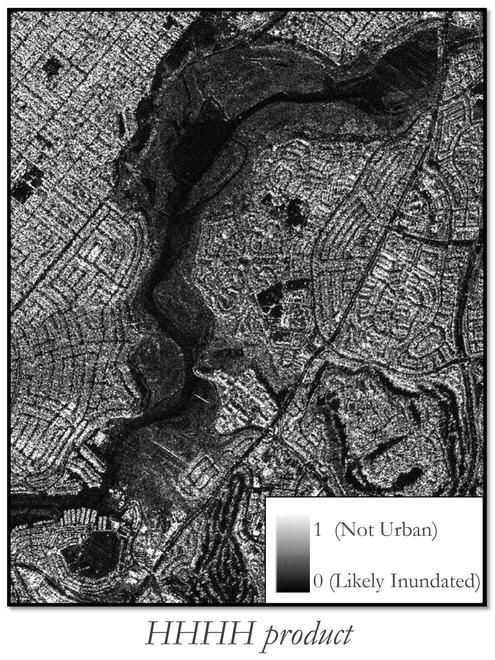
Upper Newport Bay, Newport Beach, CA



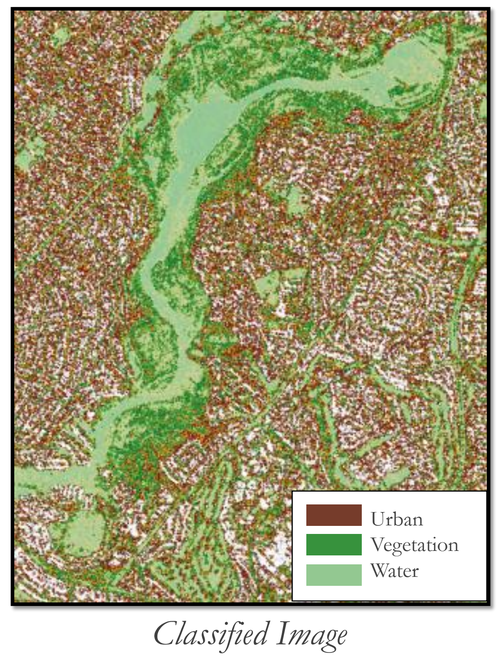
Landsat 8 OLI MNDWI (2018)



Freeman Durden Decomposition Product



HHHH product



Classified Image

Conclusions

- In general, the Modified Normalized Difference Water Index (MNDWI) can be used to decipher water and non-water areas in the Landsat 8 imagery. Difference maps between the MNDWI's can highlight areas that have or have not flooded within the time frame.
- Inundated areas were strongly noticeable in the HHHH and the Freeman Durden Decomposition products.
- Flood extent maps created from Landsat 8 and UAVSAR can assist the USGS in validating and improving the accuracy of CoSMoS.

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USGS science for a changing world

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