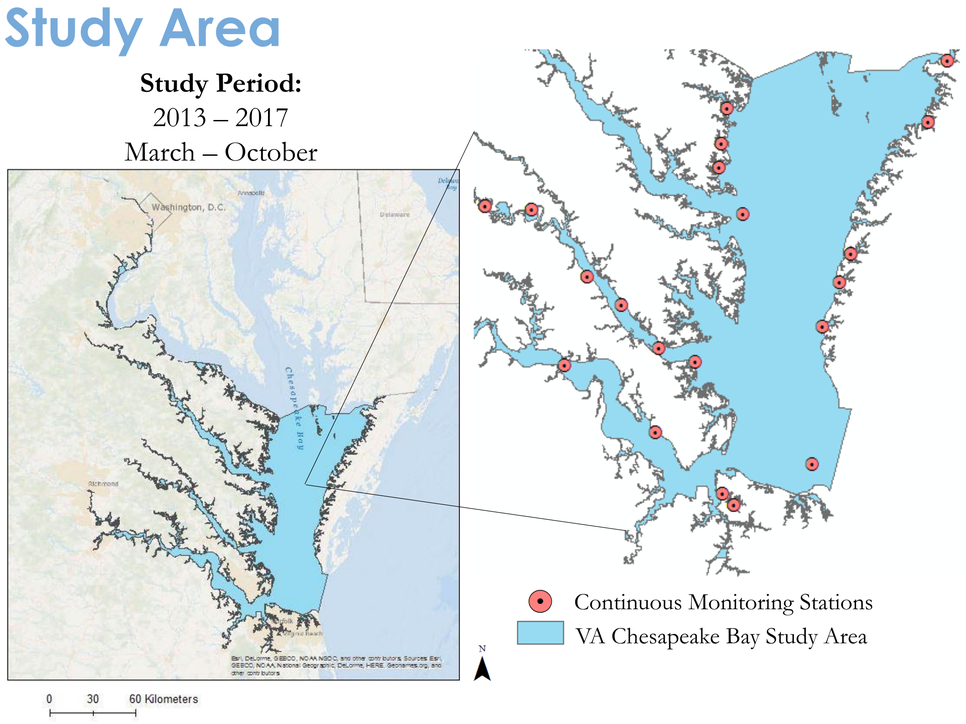
Assessing and Assisting Monitoring Efforts of Water Clarity to Identify Potential Areas of Submerged Aquatic Vegetation within Chesapeake Bay

Abstract

Submerged Aquatic Vegetation (SAV) is vitally important to the Chesapeake Bay, serving as one of the primary food sources for the organisms that inhabit it's ecosystems. This project evaluated the efficacy of remote sensing applications to monitor water quality parameters, specifically turbidity, to indicate areas that can potentially support healthy populations of SAV in the Chesapeake Bay. The resources and methods included visual analysis by utilizing Landsat 8 Operational Land Imager (OLI) and Sentinel-2 MultiSpectral Instrument (MSI) through the algorithms incorporated in ACOLITE software, allowing for atmospheric correction of spatial and temporal surface reflectance satellite imagery. By correlating Landsat and Sentinel derived output turbidity products with the Virginia Institute of Marine Sciences' *in situ* monitoring data, a model was created that provided an estimate of water clarity throughout the entire bay and its associated tributaries. This model can be used as an additional resource for the Virginia Department of Environmental Quality to aid the monitoring of turbidity variations within the Chesapeake Bay. These monitoring techniques will also assist in determining Total Maximum Daily Load calculations and the resulting effects on the growth of SAV.

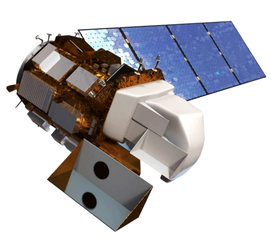
Study Area

Study Period:
2013 – 2017
March – October

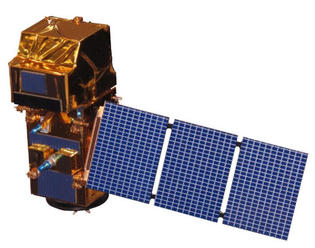


Earth Observations

Landsat 8 OLI



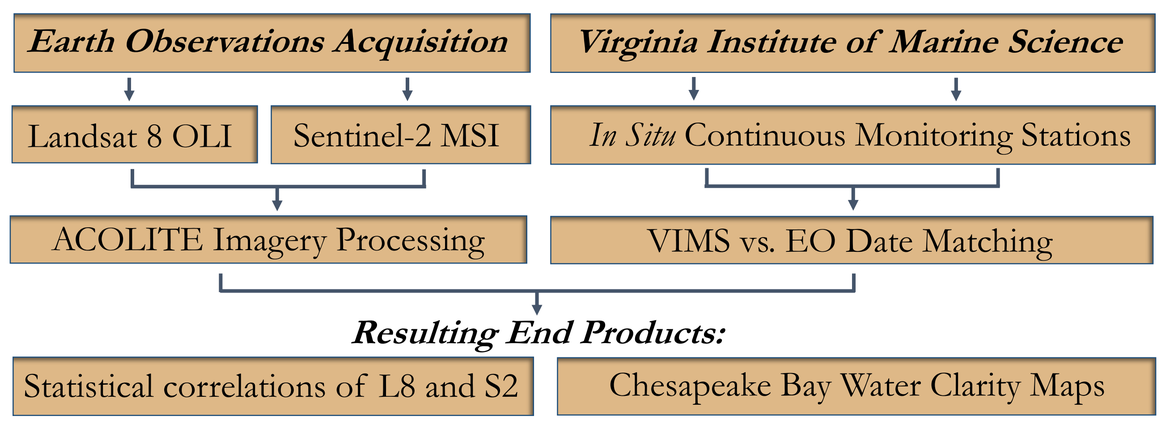
Sentinel-2 MSI



Objectives

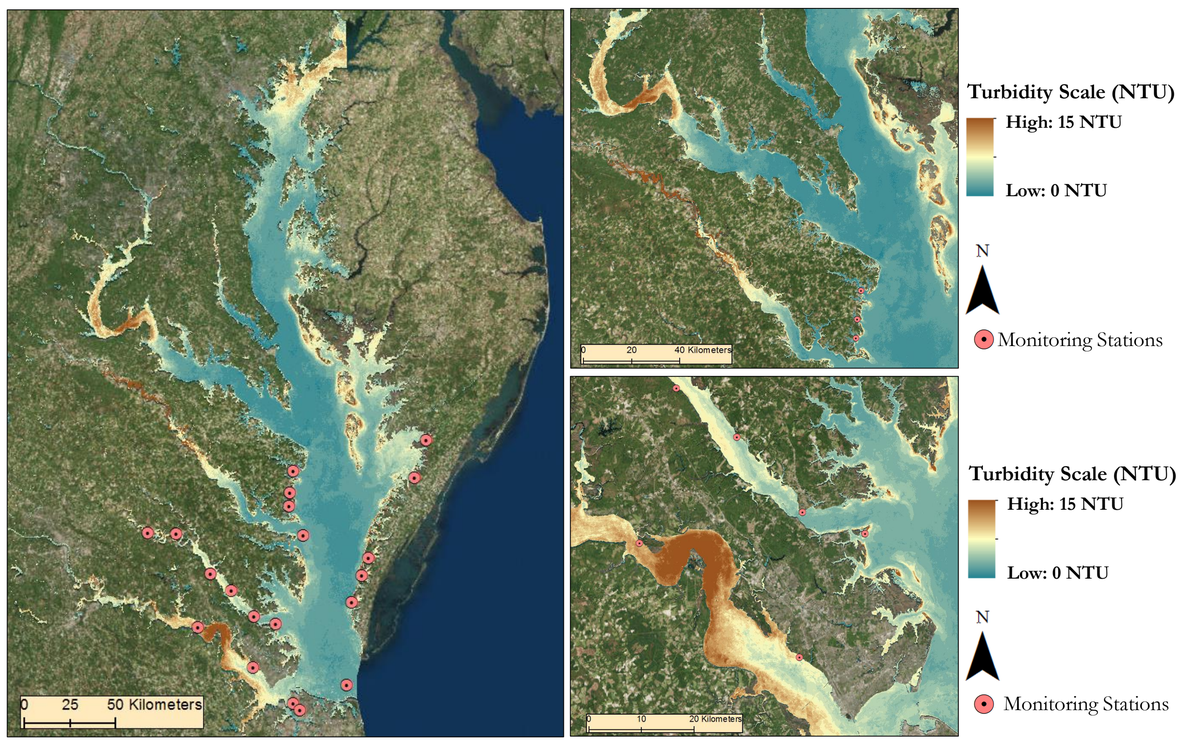
- **Determine** feasibility of using remote sensing techniques to help aid the measurement of water quality within the Chesapeake Bay
- **Correlate** and model satellite-derived water clarity metrics with continuous *in situ* monitoring data to validate methodology
- **Develop** an automated Python tool utilizing NASA and ESA Earth observations that eases the use of ACOLITE software processing
- **Produce** annual Chesapeake Bay-wide and tributary Water Clarity Maps identifying variations in turbidity, and its effect on SAV growth

Methodology

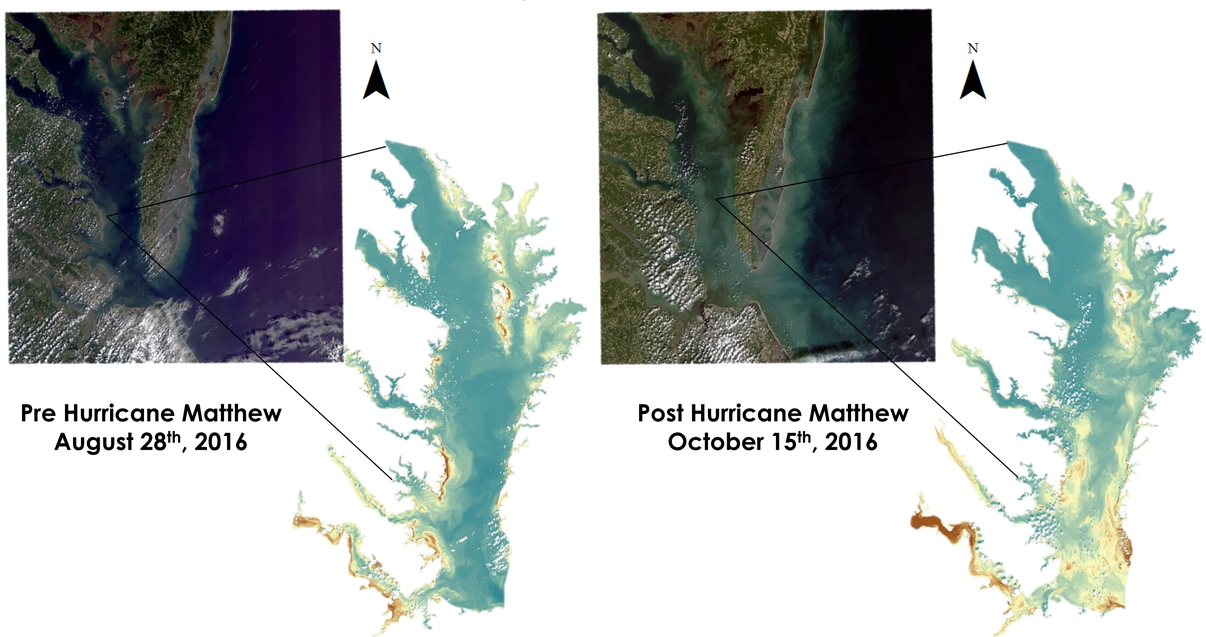


Preliminary Results

Landsat 8 Chesapeake Bay-wide 2013 Mosaic:



Landsat 8 Turbidity Products vs. RGB Imagery:



Conclusions

- ACOLITE provides useful atmospheric corrections for water monitoring applications, but is limited to satellite imagery from 2013 to present.
- Remote sensing over shallow waters is influenced by proximity to land, sediment upwelling due to tidal movements, and bottom effects.
- Earth observations can be used to assess and monitor water clarity and its effect on submerged aquatic vegetation across the Chesapeake Bay.

Team Members

Eli Simonson (Project Lead) | Antonio Alvarado | Will Crowley

Project Partners

- Virginia Department of Environmental Quality, Office of Ecology
- United States Geological Survey, Water Science Center

Acknowledgements

- Advisor: **Dr. Kenton Ross**, NASA Langley Research Center
- Previous Contributors**: Danielle Quick**, **Gregory Hoobchaak**, **Collin Henson**, **Cole Cowher**, **Amanda Clayton**
- Partners:
  - **Tish Robertson**, Virginia Department of Environmental Quality
  - **Peter Tango**, USGS Water Science Center

This material is based upon work supported by NASA through contract NNL16AA05C and cooperative agreement NNX14AB60A. Any mention of a commercial product, service, or activity in this material does not constitute NASA endorsement. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration and partner organizations.