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 its ecosystems. This project evaluated the efficacy of remote sensing applications to monitor water quality parameters, specifically turbidity, to identify 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.

Methodology

Earth Observations Acquisition
Landsat 8 OLI  Sentinel-2 MSI

Virginia Institute of Marine Science
In Situ Continuous Monitoring Stations

ACOLITE Imagery Processing
VIMS vs. EO Date Matching

Resulting End Products:

Statistical correlations of L8 and S2
Chesapeake Bay Water Clarity Maps

Preliminary Results

Landsat 8 Chesapeake Bay-wide 2013 Mosaic:

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.

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- Tish Robertson, Virginia Department of Environmental Quality
- Peter Tango, USGS Water Science Center

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Project Partners

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

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 uses 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

Contribution Details

- Post Hurricane Matthew
- Landsat 8 OLI Turbidity Products vs. RGB Imagery:

Low: 0 NTU
High: 15 NTU

Continuous Monitoring Stations
VA Chesapeake Bay Study Area

Study Area

Study Period:
2013 – 2017
March – October

Landsat 8 Turbidity Products vs. RGB Imagery:

Pre Hurricane Matthew
August 28th, 2016

Post Hurricane Matthew
October 15th, 2016

Acknowledgements

Future work

Current...