

Comprehensive Satellite-Based Algorithms for Browscale CyanoHAB Detection and Monitoring

USACE Harmful Algal Bloom Research & Development Initiative

Delivering scalable freshwater HAB prevention, detection and management technologies through collaboration, partnership and cutting-edge science

Lead PI: Richard Johansen, ERDC, Richard.A.Johansen@usace.army.mil

Problem Satellite-derived algorithms to estimate cyanoHAB water quality indicators tend to be locally optimized for a particular study, limiting the use of satellite-based remote sensing approaches across geographies and bio-physical conditions.

Objective Improve the accuracy and estimation of satellite-derived cyanoHAB algorithms under varying conditions to aid district managers in their monitoring efforts

Approach Aggregate recent (2019-2022) HAB/water quality data from across the entire continental United States with coincident remote sensing imagery to evaluate the performance of eight Sentinel-2 algorithms for the quantification of HAB-associated pigments (Chl-a & phycocyanin). Develop a baseline dataset to demonstrate the ability of these simple algorithms to be utilized as regional or global algorithms across the multiple variants: water quality parameter (chlorophyll-a, phycocyanin), data acquisition method (i.e. sonde, lab, etc.), geographic region, and seasonality.

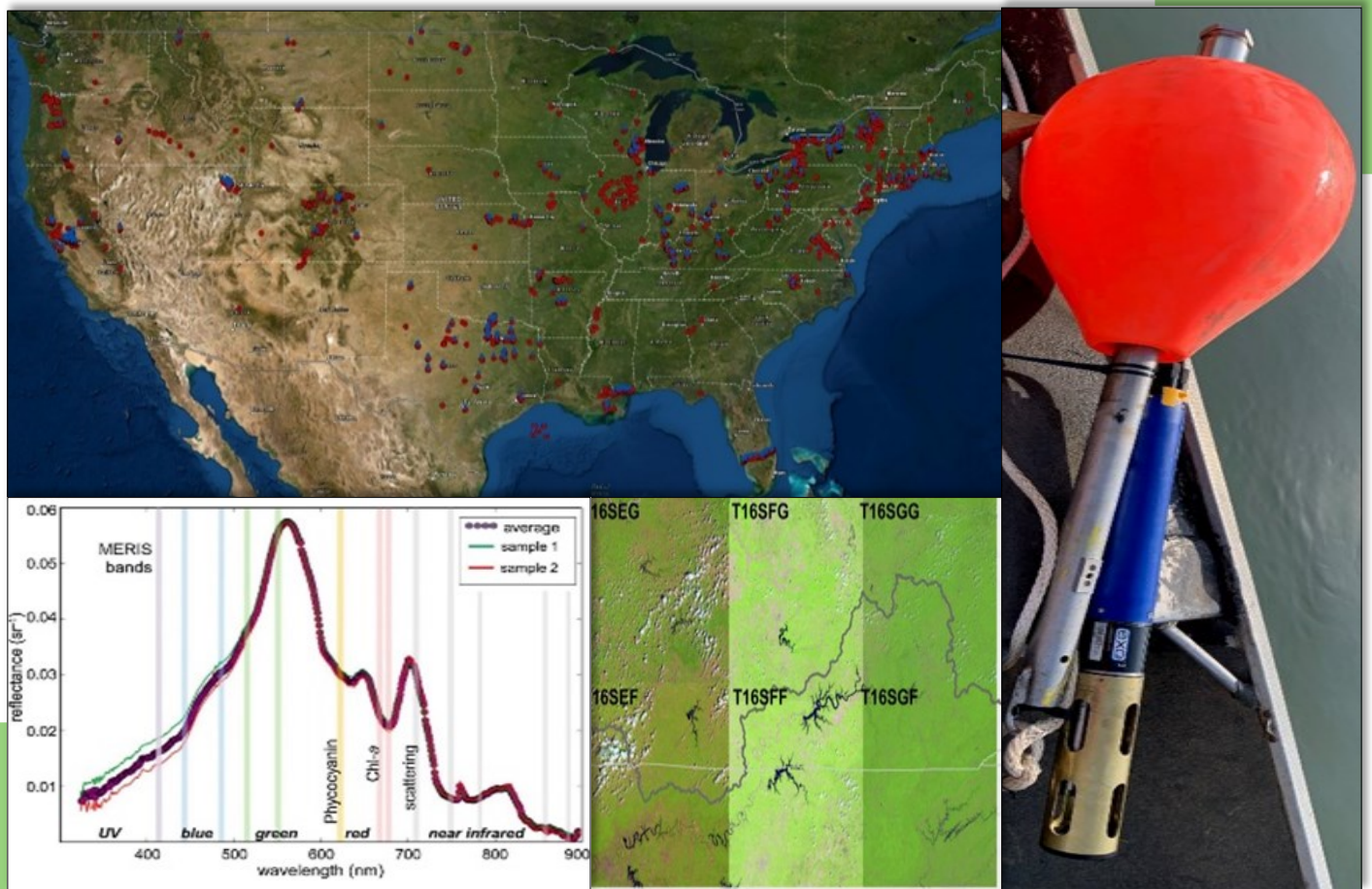


Figure 1: After preprocessing a total of 618 water quality sites were selected to be matched up with coincident remote sensing imagery from 01-01-2019 through 05-31-2022. Each algorithm was developed from pixel spectra which correlated to a specific ground sample site location and date, and then was evaluated using k-means cross validation.

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Results

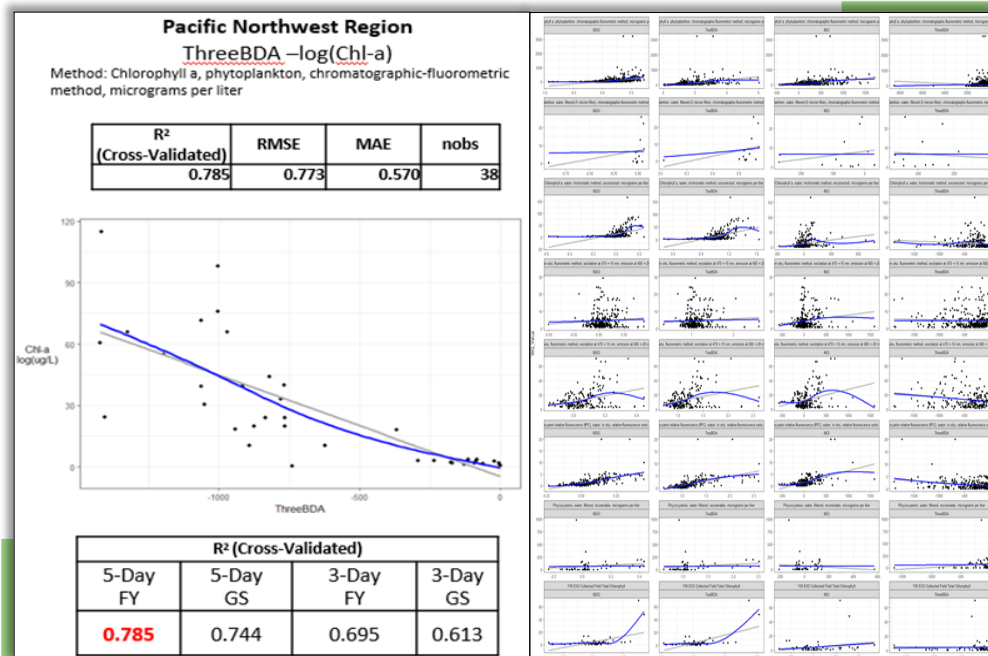


Figure 2: Sample results from iterating through the described approach for each variate, which produced thousands of algorithm performances for all possible combinations.

Major Milestones

Date	Milestone
FY21, Q4	Literature Review: Satellite-based spectrally-derived algorithms for the detection and quantification of HABs (Complete)
FY22, Q4	Database of satellite-derived HAB algorithms (Complete)
FY23, Q4	Webinar: Selecting satellite-based algorithms for detection and estimation of HABs (Not Started)
FY23, Q4	Technical Report/Journal Article: The development of generalizable regional satellite-based algorithms for broad-scale cyanoHAB detection and monitoring (In Progress)
Costs	FY21:\$25K FY22:\$115K FY23:\$130K TOTAL:\$270K

Partnership/Leveraging Opportunities This work will leverage ongoing field studies within USACE's Aquatic Nuisance Species Research Program, such as HABITATS, which include collaborations with New York State Department of Environmental Conservation and Florida Department of Environmental Protection. In addition to government collaborations, commercial products are being evaluated, modified, and optimized in the RAFT study.

Value to USACE Mission This effort intends to aid district managers in HAB monitoring efforts by providing technical guidance on the selection of the most appropriate spectrally-derived algorithms and helping transform district water quality monitoring practices reducing the need for specialized remote sensing skills or geospatial backgrounds.

USACE District Liaison: Gerard (Tony) Clyde of Tulsa District and Erich Emery of the Great Lakes and Ohio River Division

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