Cyanobacteria Assessment Network: Pilot study with Sentinel-2 derived chlorophyll data (CyAN-S2)

USEPA, NOAA, NASA, USGS, USACE – An Interagency Collaboration

USACE Harmful Algal Bloom Research & Development Initiative

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

Problem

Harmful Algal Blooms (HABs) are a global problem impacting the health and safety of both inland and coastal waters. Excessive algal biomass and toxin production negatively impact water uses such as recreation, consumption, livestock, fisheries, and irrigation. Algal, both phytoplankton and cyanobacterial, biomass can result in surface scums, taste and odor issues, hypoxia, reduced aquatic diversity, and negative socio-economic impacts. Despite ecosystem, economic, and public health concerns, toxins are infrequently assessed due to the cost, required expertise, and time necessary for proper analysis. Moreover, measuring indicators of algal biomass, such as chlorophyll-a, can be time and cost intensive. State and federal agencies are faced with the challenge of operating, maintaining, and monitoring hundreds to thousands of water bodies, covering large geographic areas with limited water quality staff.

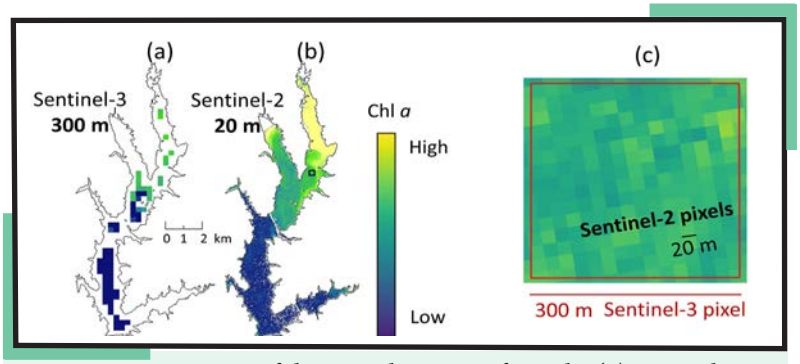

Figure 1. *Comparison of the spatial coverage from the (a) original CyAN project Sentinel-3 300m pixel resolution and (b) Sentinel-2 20m pixel resolution int he northern sectino of Jorndan Lake, North Carolina. An example of (c) a single Sentinel-2 finer resolution pixels.*

Objective

The US Army Corps of Engineers (USACE) manages >400 lakes and reservoirs that would benefit from monitoring chlorophyll-a with Sentinel-2 (S2) satellite imagery. This pilot project seeks to develop a national chlorophyll-a product capable of 10 to 60 meter spatial resolution (Fig. 1), which would enable satellite HAB monitoring for >270,000 lakes and reservoirs.

Approach

This one-year USACE-sponsored pilot project will build initial CyAN-S2 infrastructure and demonstrate its potential using HAB datasets in Florida, Ohio, and Oregon. Key steps include: (1) *in situ* and S2 data assimilation; (2) develop new validation approaches specific to higher-resolution S2 data; (3) explore initial S2 spatial and temporal compositing; and (4) produce a pilot study report. This pilot study will encompass 29 USACE reservoirs, including Harsha Lake in Ohio; 7 USACE reservoirs in Florida, including Lake Okeechobee and the Lake Watch program; and 18 USACE reservoirs in Oregon, including Detroit Lake. Cross validation of Sentinel-3 (S3) and S2 approaches will be accomplished using data from 212 lakes that are resolvable by both S3 and S2, which include 23 USACE reservoirs. This one-year pilot is an interagency collaboration, with USACE leading algorithm evaluation and aggregation of *in situ* data; USEPA leading development of a scoring rubric to be used during quality control review and validation; USGS leading harmonization and provision of in-situ chlorophyll-a observations and aquatic reflectance datasets; NASA leading strategic approaches to satellite image composites and data delivery; and NOAA leading the design methods and metrics for establishing quality control of the satellite data and temporal comparisons. The NOAA National Environmental Satellite, Data, and Information Service (NEDIS) has agreed to provide in-kind support for hosting the S2 national chlorophyll product both during the pilot phase and long-term.

Milestones

CyAN-S2 Pilot Study Report

Value to USACE Mission

Value to USACE Mission: Monitoring of smaller lakes and reservoirs is needed to proactively protect human, animal, and environmental health and economic prosperity and support the 2014 Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA), Clean Water Act, and Safe Drinking Water Act. Building a monitoring capability with S2 will provide timely data for >400 USACE-managed lakes and reservoirs and >270,000 lakes and reservoirs with a potential annual avoided cost of $42M/year.