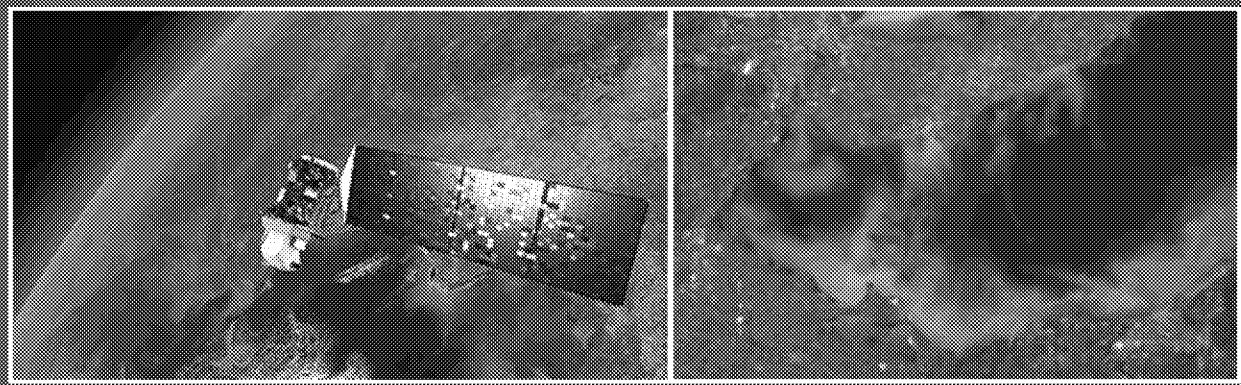
United States Environmental Protection Agency

Cyanobacteria Assessment Network (CyAN) for Freshwater Systems:

Early warning indicator for toxic & nuisance blooms using ocean color satellites

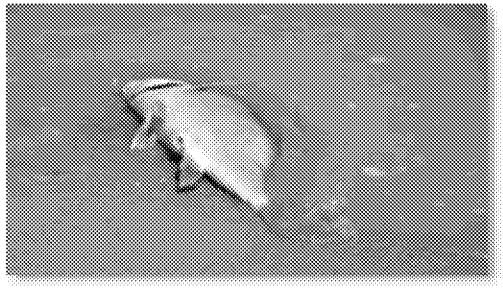


Darryl Keith
US EPA ORD Atlantic Ecology Division (AED)

New England State Commissioners' Visit to AED
June 19, 2018

Office of Research and Development

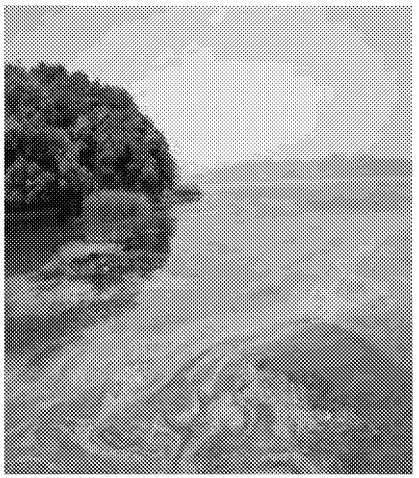
HABs: Overall Problems



Harmful algal blooms (HABs) have the potential to generate adverse health, ecosystem and economic impacts.

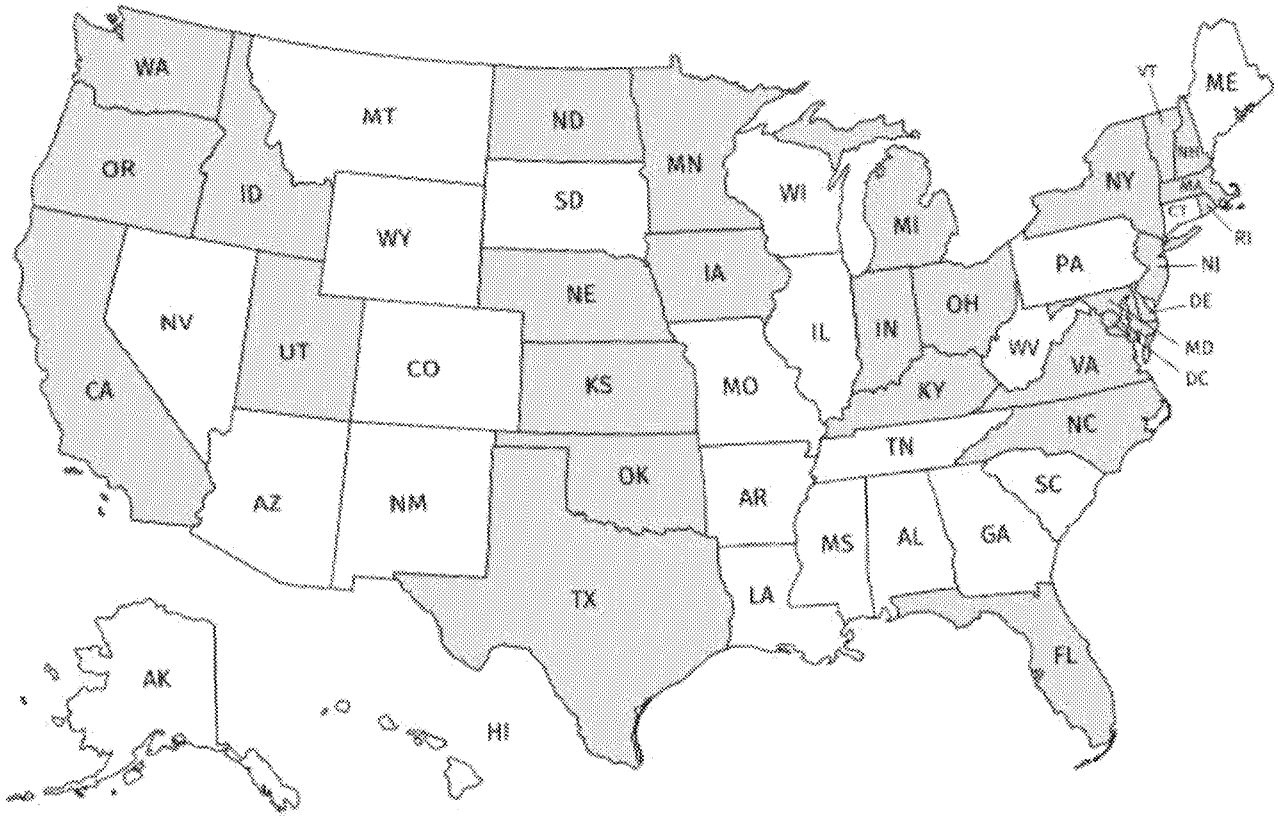
- Many different types of toxins
- Pure toxins in laboratory studies exert toxic effects on liver and nervous system
- Exposure through ingestion
- Exposure though recreational activity body contact—associated with gastrointestinal effects, breathing difficulty, skin irritation, and animal deaths

- Water treatment facilities alter operational practices and/or invest in new equipment → economic burden
- Health effects → beach closures → loss of recreational/aesthetic value → economic burden
- Large blooms upset water chemistry (pH, dissolved oxygen) and limit the penetration of sunlight → declines in fish populations → loss of recreational/aesthetic value → economic burden, long term ecosystem damage
- Large blooms are odorous and unsightly → reluctance to swim → economic burden



HABs: Overall Problems

During the 2017 bloom season, US EPA was aware of blooms, beach closures and/or health advisories in 27 states and DC.



EPA United States Environmental Protection Agency

CYAN

Cyanobacteria Assessment Network

https://www.epa.gov/water-research/cyanobacteria-assessment-network-cyan

Program Vision Statement

- *CyAN will use NASA, USGS, NOAA and European Space Agency satellite data products to improve the decision-making ability of water managers responsible for monitoring and assessing both freshwater and estuarine systems.*

- *Using the CyAN app, managers and the public will have the opportunity to access satellite imagery on their mobile device and view a map of their surroundings in terms of water quality.*

EPA United States Environmental Protection Agency

CYAN

Cyanobacteria Assessment Network

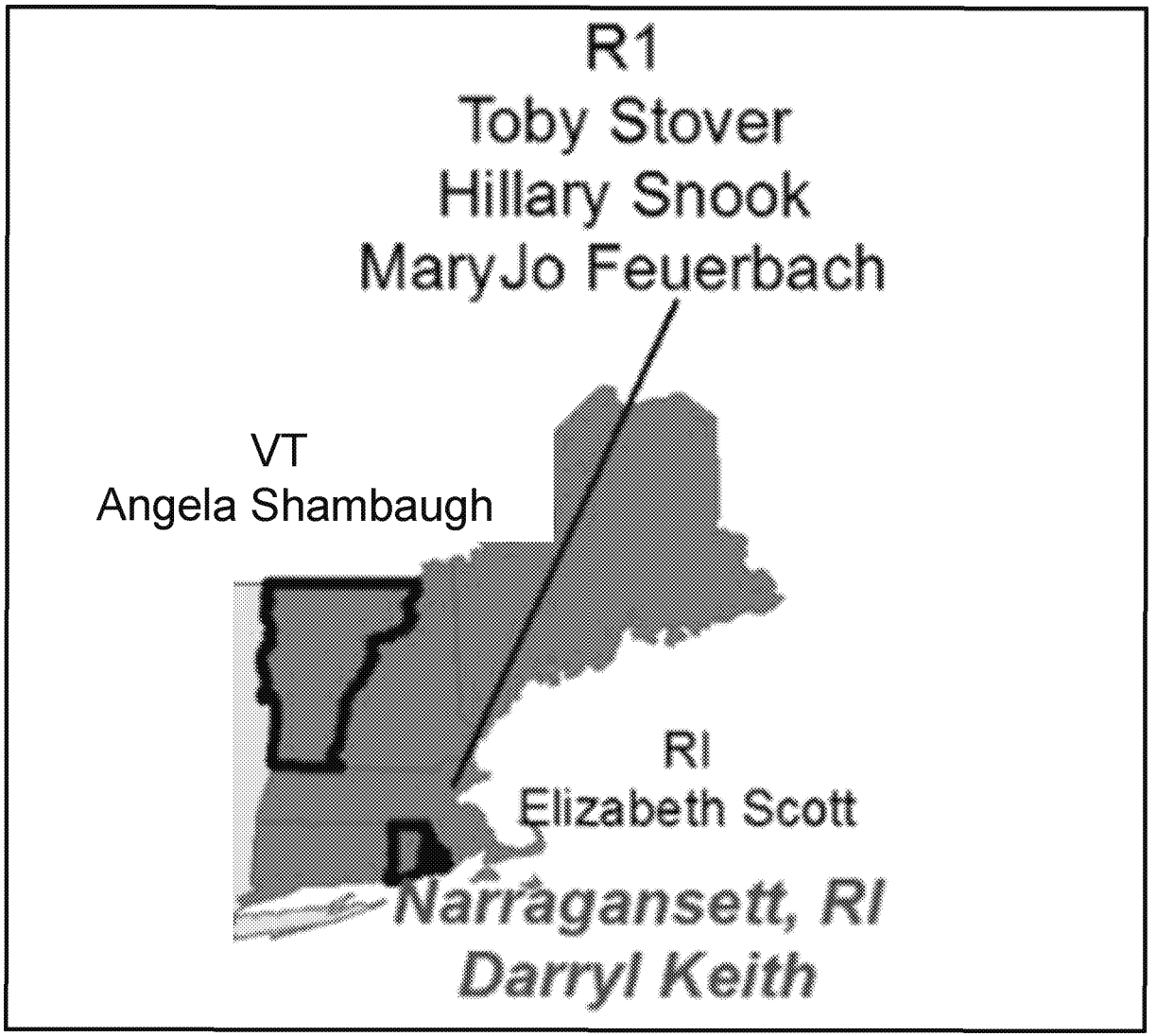
- ***Problem:*** How to support the use of US waters with satellite monitoring?
- ***Opportunity:*** Water quality indicators can be monitored with satellites and used to protect public health.
- ***Approach:*** Strengthen cross-agency research to mainstream satellite capabilities for water quality management decisions.
- ***Results:*** New methods and tools to monitor cyanobacteria HABs.
- ***Impact:*** Scalable information across any geo-political boundary, and ability to prioritize locations for management actions.

NOAA USGS NASA

Schaeffer et al. 2015. Agencies collaborate, develop a cyanobacteria assessment network. Eos. 96:16-20.

Cyanobacteria Assessment Network

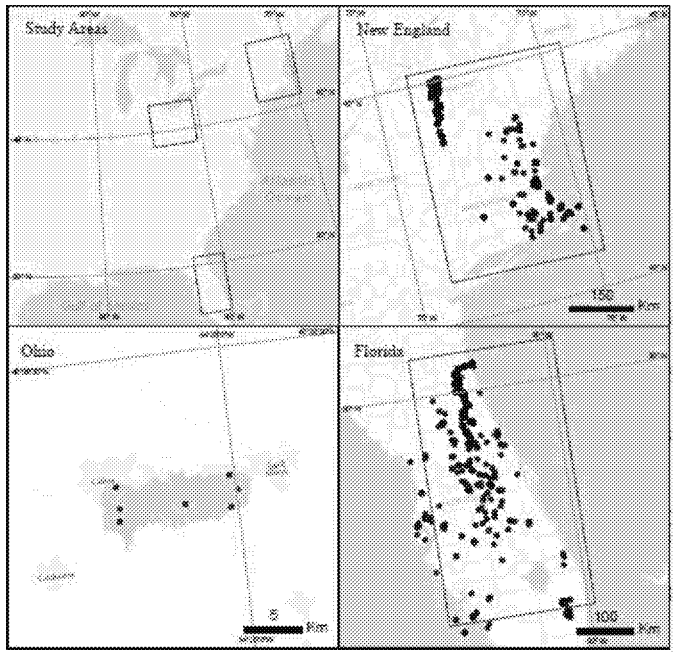
New England Partners



Remote Sensing

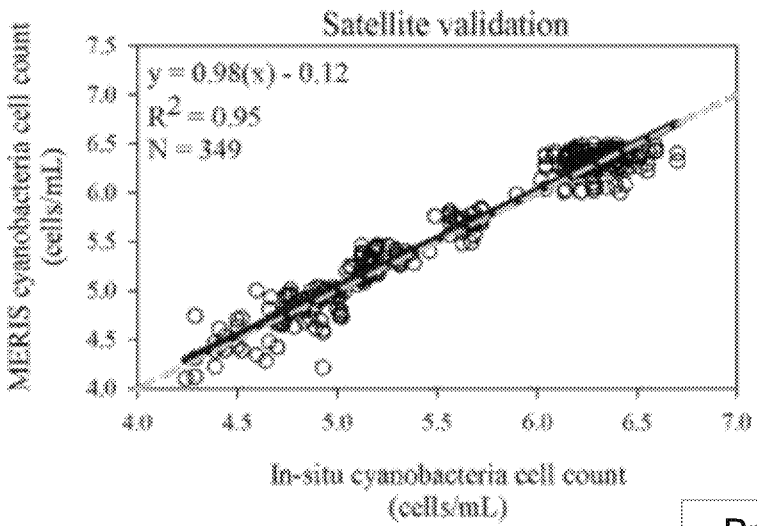
United States Environmental Protection Agency

Uniform and systematic approach for identifying cyanobacteria blooms.

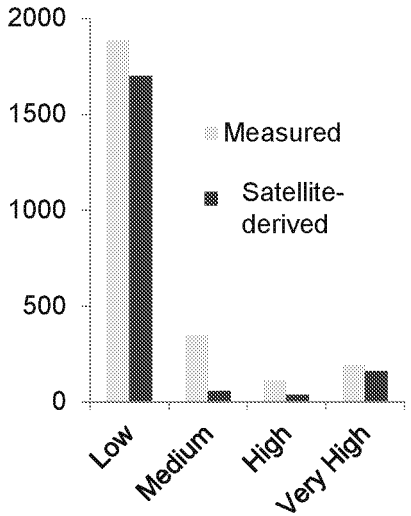


Retrieve satellite data from lakes and reservoirs

Derive numerical models which predict cyanobacteria abundance



Validate predictions using data from state environmental and health agencies



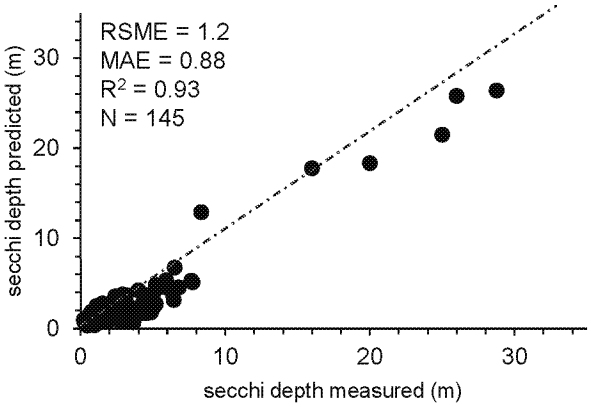
Present validated results in a meaningful format.

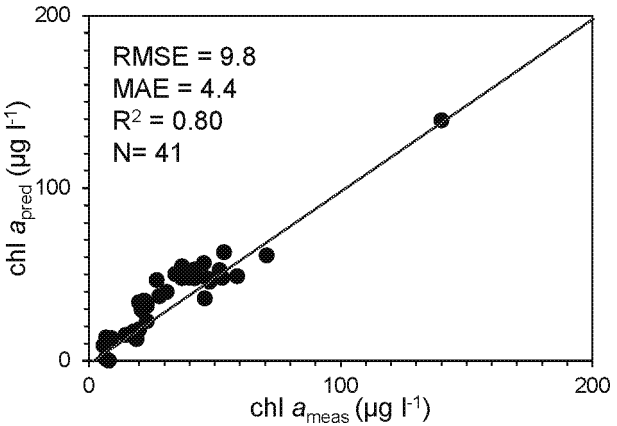
MERIS = Medium Resolution Imaging Spectrometer

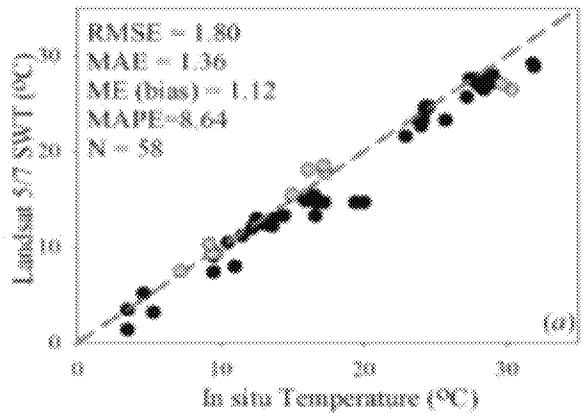
Satellite Application to Water Indicators

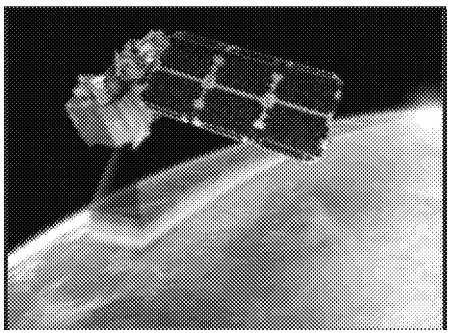
(measured vs model results)

- ***Problem:*** How do we quantify water quality in smaller lakes?
- ***Action:*** Testing Landsat-8 and Sentinel-2 satellite algorithms.
- ***Results:*** Some promise with chlorophyll-*a* and water clarity; excellent results with temperature.
- ***Anticipated Impact:*** Provide measures from 1980-present for 170,240 lakes and reservoirs.





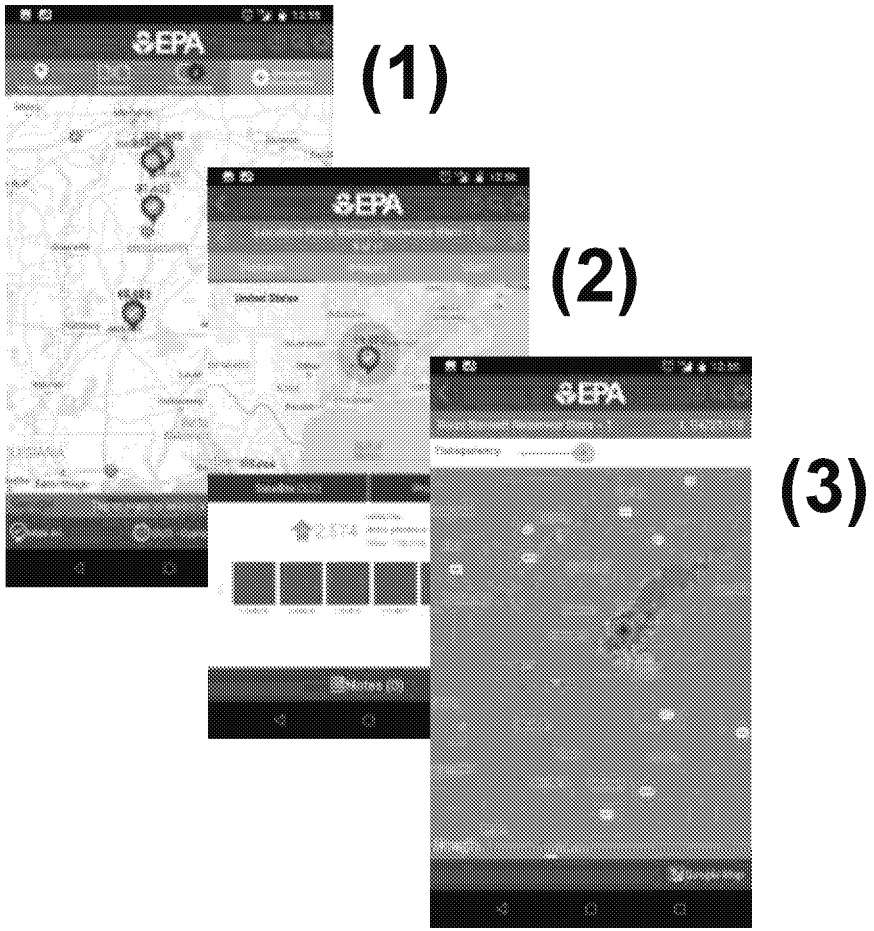




Keith et al. (*2017*). Monitoring algal blooms in drinking water reservoirs using the Landsat 8 Operational land Imager. International Journal of Remote Sensing. 38:9, 2818-2846

Android Phone Application

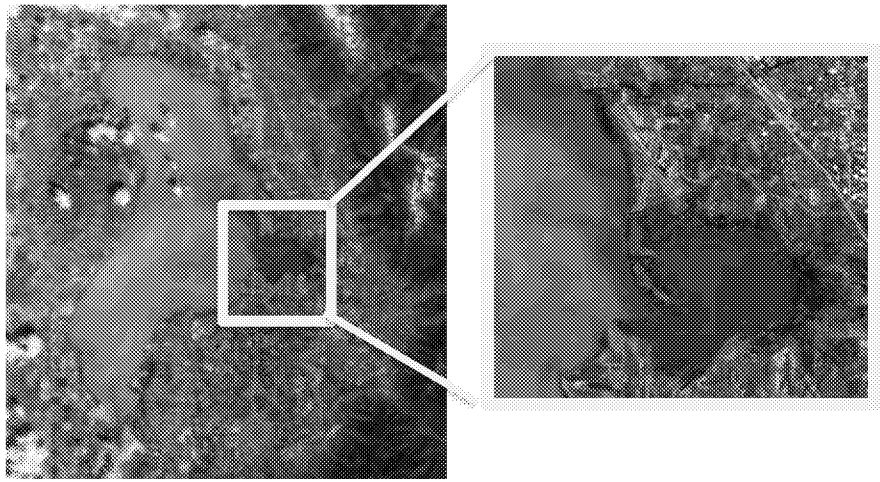
- Cyanobacteria estimates derived from European Sentinal-3 satellite
- Populate database that can be accessed by Android app
- (1) View available data
- (2) Zoom to targeted lake or reservoir ... see stats on bloom
- (3) View image of harmful algae bloom



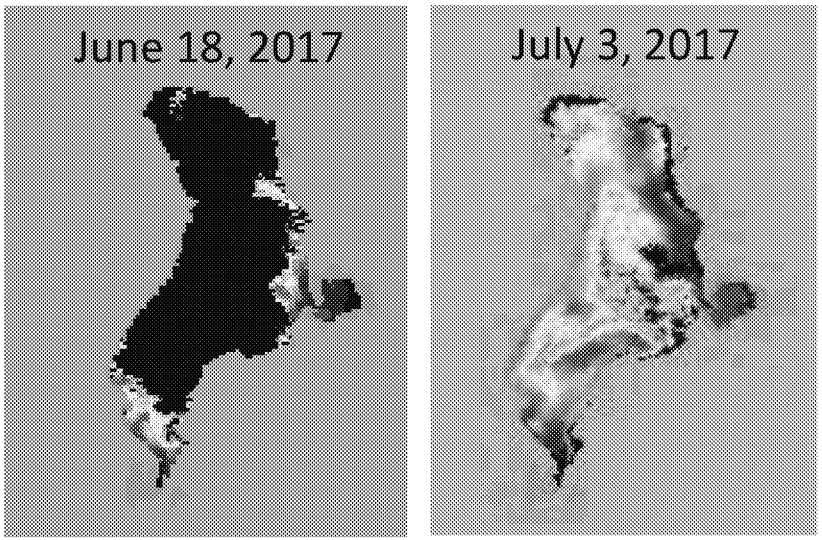
Actions and Impact: Utah Lake, UT

EPA United States Environmental Protection Agency

- Utah Department of Environmental Quality (DEQ)/Division of Water Quality (DWQ) conducted routine monthly sampling June 12, 2017.
- CYAN imagery provided the following week indicated a bloom was developing in a Utah lake used for recreation.
- Utah DEQ/DWQ scientists returned to the area June 22, 2017.
- On June 29, Utah DEQ issued an advisory warning that the public and pets should stay out of Utah Lake and Provo Bay.



Sentinel-2 image showing an algal bloom in Provo Bay.



Sentinel-3 image showing areas of highest cyanobacteria concentrations.

Satellite remote sensing data provided by ORD augmented state monitoring and ensured public health and safety

Contacts

United States Environmental Protection Agency

Darryl Keith
Atlantic Ecology Division
US EPA Office of Research and Development
401-782-3135
keith.darryl@epa.gov

*The CyAN Mobile App is currently available for beta testing; if interested please contact:

Blake Schaeffer
US EPA Office of Research and Development
919-541-5571
schaeffer.blake@epa.gov