NASA Science Mission Directorate
Earth Science Division
Applied Sciences Program

Cyanobacteria Assessment Network

Blake A. Schaeffer

NASA Water Resources PI Meeting
April 26-28, 2016

Project Title: Cyanobacteria Assessment Network

Mission:

Support the environmental management and public use of U.S. lakes and estuaries by providing a capability of detecting and quantifying algal blooms and related water quality using satellite data records.

Objectives:

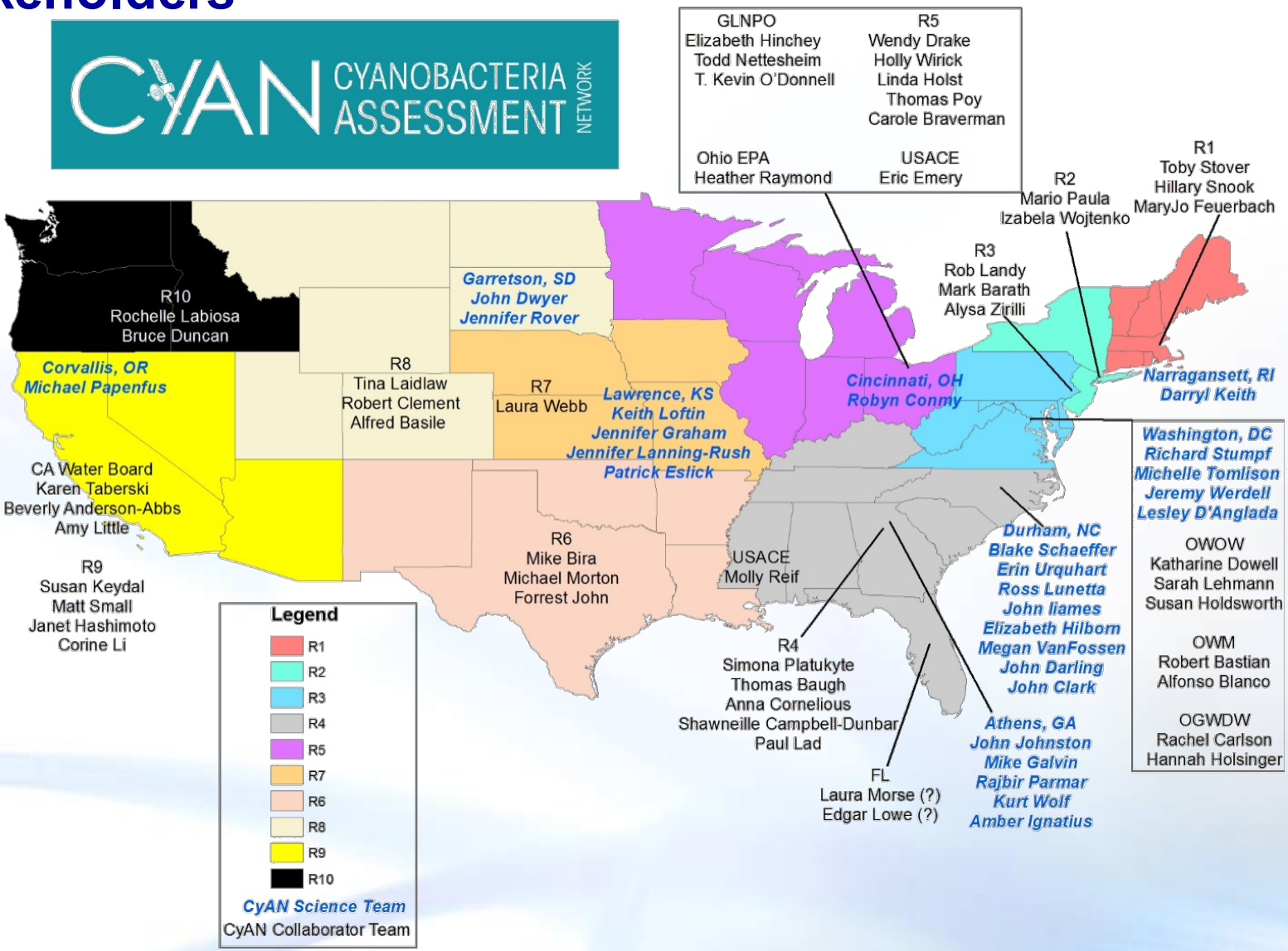
A. Create a standard and uniform approach for early identification of algal blooms that is useful and accessible to stakeholders of freshwater systems using the new set of satellites: Ocean Land Colour Instrument (OLCI) on Sentinel-3, Sentinel-2, Landsat and future NASA missions;

B. Develop an information dissemination system for expedient public health advisory postings

C. Better understand the connections between health, economic and environmental conditions to cyanobacteria and phytoplankton blooms.

Stakeholders

CYAN CYANOBACTERIA ASSESSMENT NETWORK



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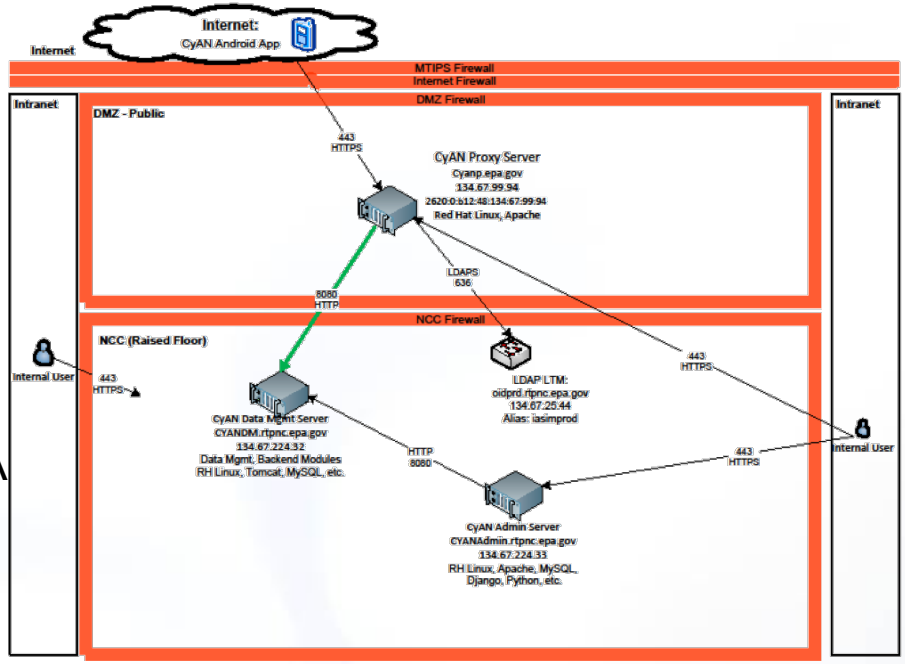
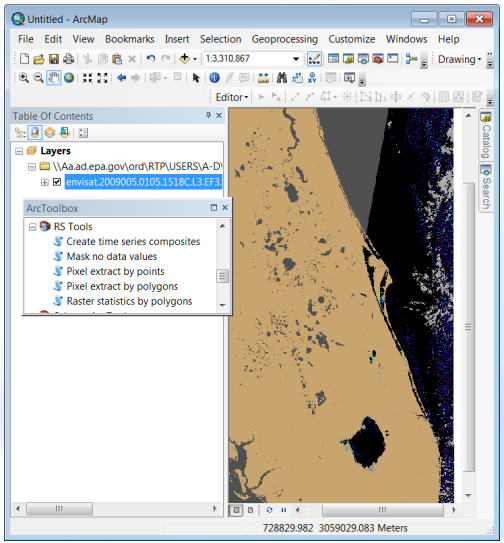
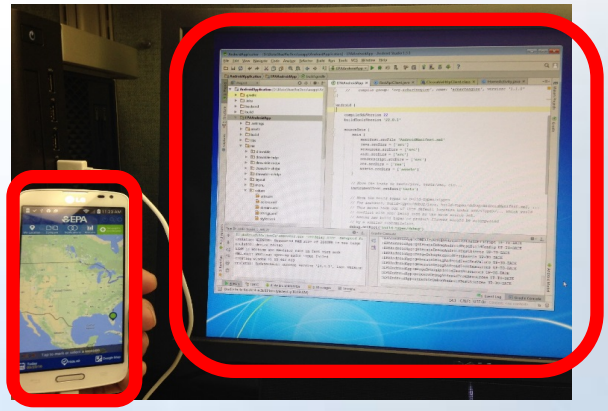
Tools

- Mobile Application Infrastructure
  - Administrative website
  - Data management module
  - Processing module
- EPA National Computing Center deployment
  - FedRAMP compliant, FISMA approved.
  - Proxied access, fire walls abound.
  - Future Cloud deployment possible
- Mobile app debugging:
  - IDE breakpoints, view code execution/results, see immediate effects of code changes.
- geoTIFF product configuration for GIS analysis
  - ArcGISToolbox for data extraction from geoTIFFs, beta testing by California







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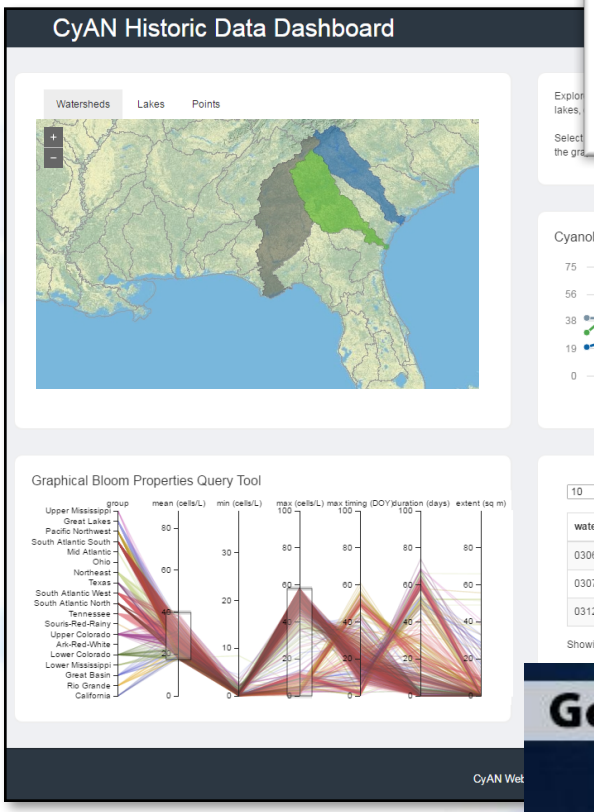
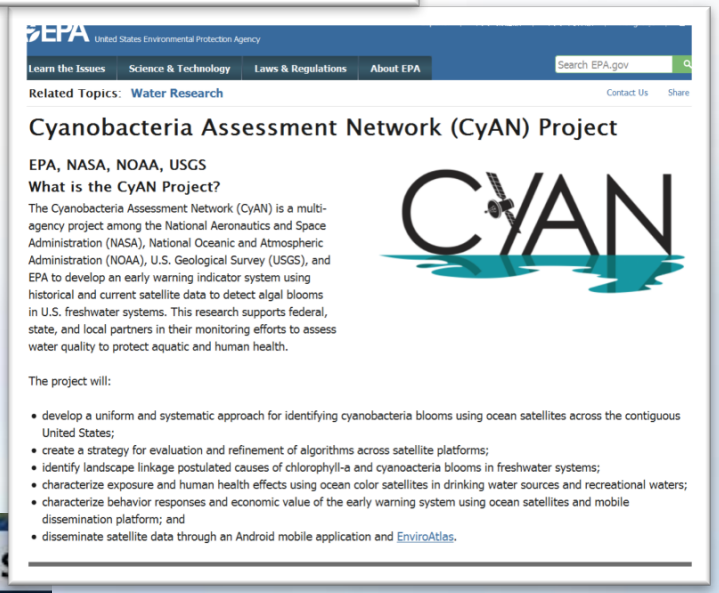
Tools

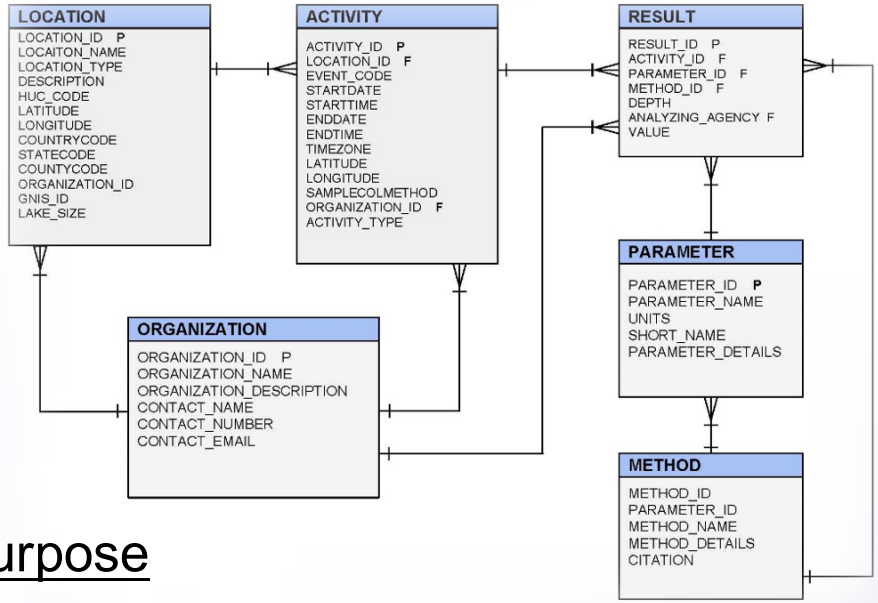




Approach

Target Data Criteria for Database Schema

- Natural and manmade lakes and ponds
- GoM Coastal data
- Temporal/spatial datasets within waterbody
  - Low, medium, and high concentrations for phytoplankton, pigments, toxins, WQ variables
- Sample metadata, methods, QA/QC plans



Tiered Criteria for Field Data Fitness of Purpose

Quality Control Tiers

- Documentation -Study Design, Sample Collection/Processing, Analytical Methods
- Converging Lines of Evidence -Agreement between field values at a threshold basis

Interpretative Thresholds for Data Comparison, Algorithm Development and Validatio

- World Health Organization Health Thresholds for Microcystins
- Using microcystins, chlorophyll, and cyanobacterial abundance
- Trophic Status Thresholds (e.g. Chlorophyll, Secchi Depth, Nutrients)

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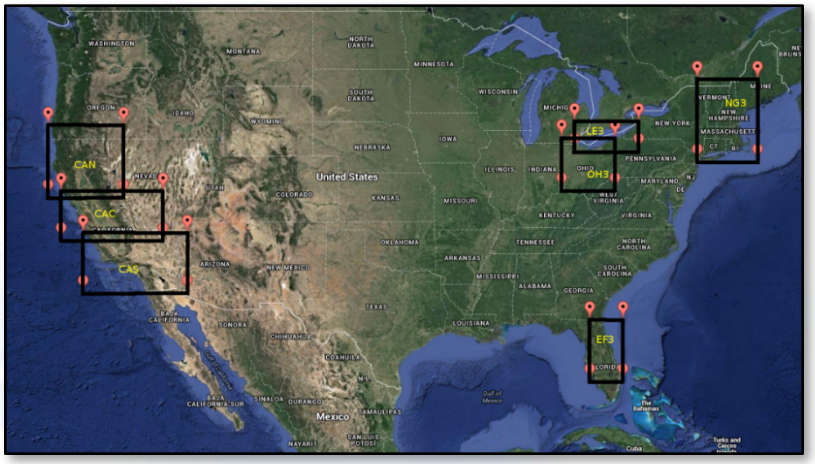
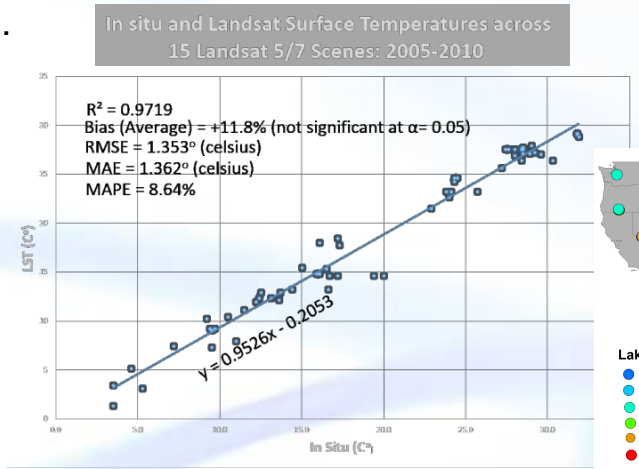
Approach

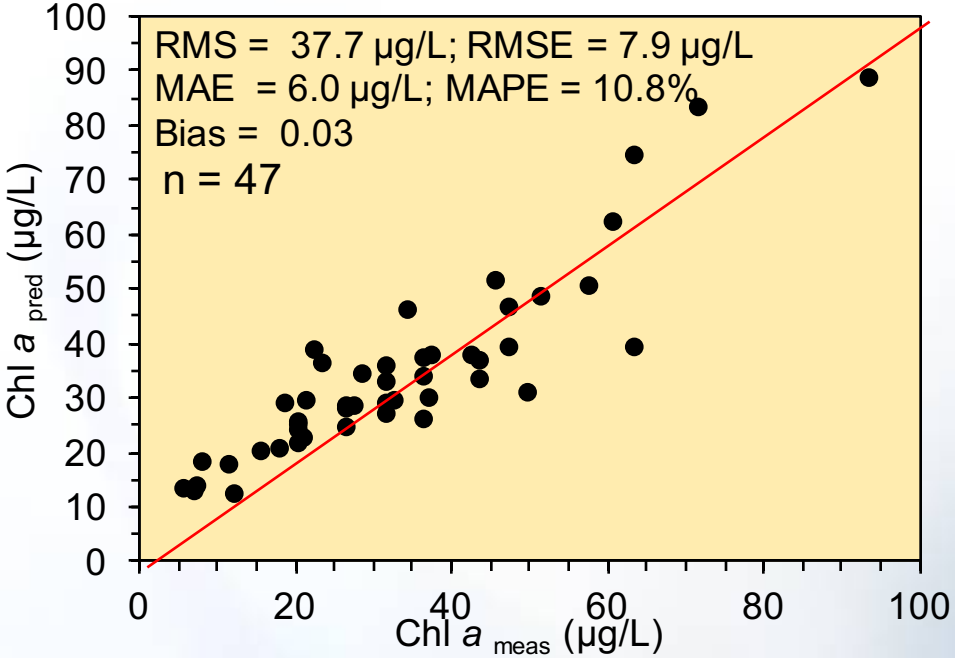
- Preliminary versions of NOAA cyanobacteria algorithms implemented into NASA standard processing software.

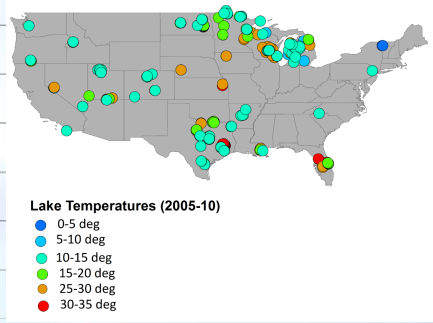


- Initial validation of Landsat 5/7 surface water temperature.



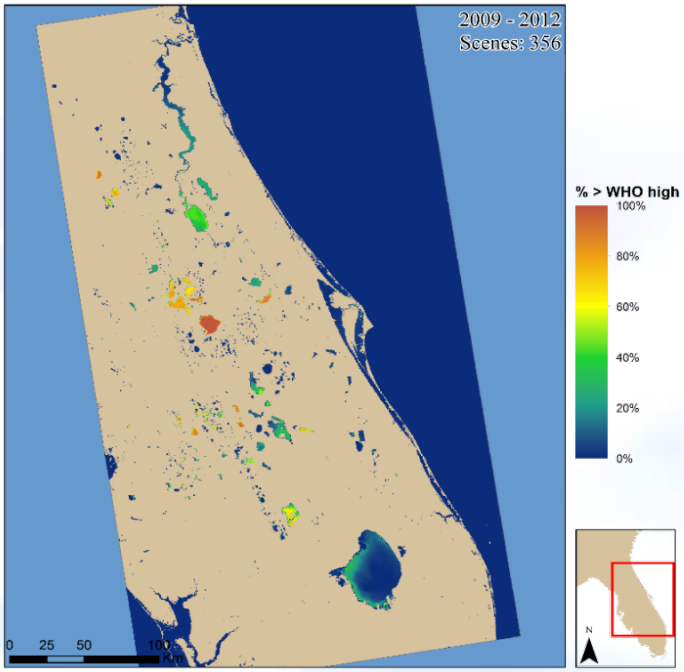
- 3 band reflectance model derived from USGS Landsat 7 & 8 surface reflectance products to predict chlorophyll (chl *a*) concentrations in lakes and ponds.

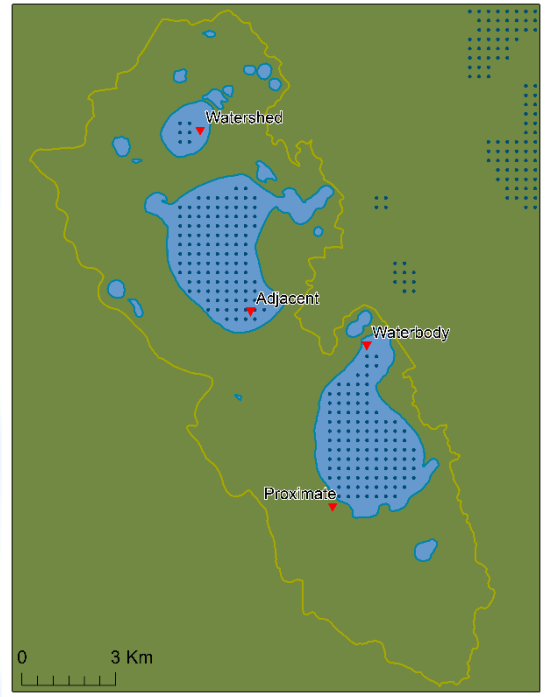


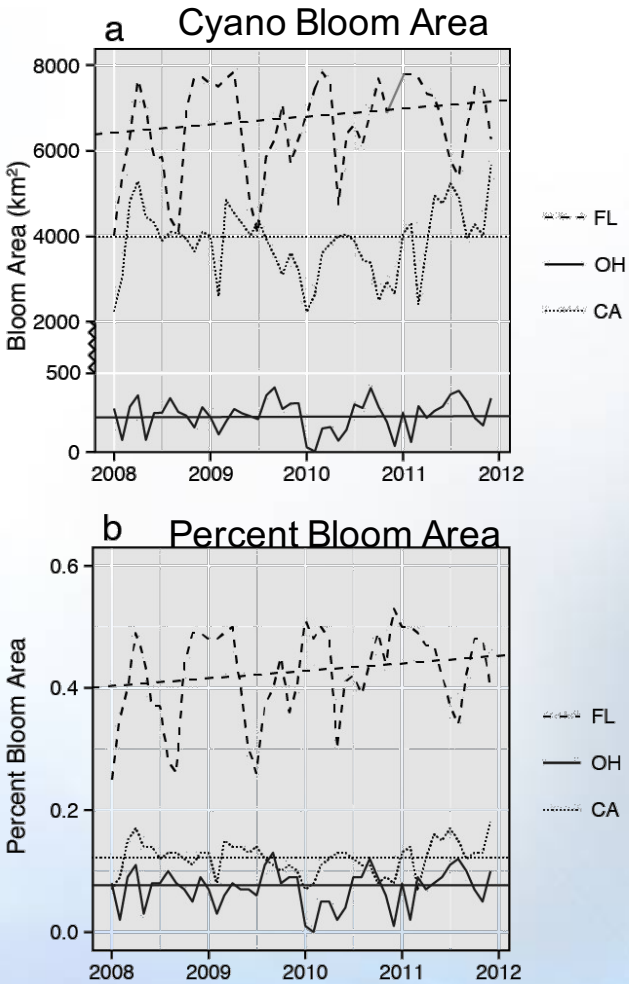


Approach

- Statistical time series analysis of blooms in FL, OH, and CA (2008-2011)
- Heat maps and surface drinking water intake monitoring methods



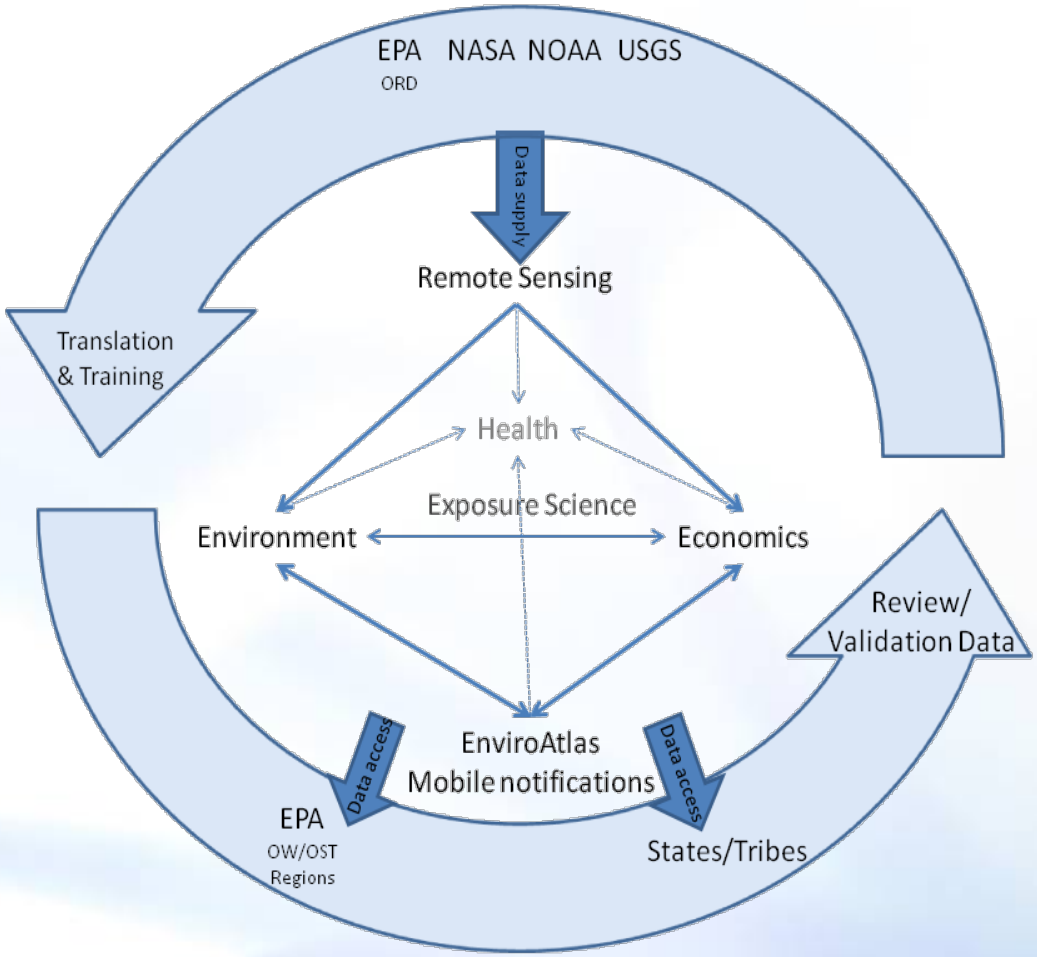




Impacts

- ASDWA Drinking Water HABs and Toxins Discussion Group, 12/8/2014. Webinar.
- Inland HAB Discussion Group, 12/10/14. Webinar.
- OSTP subcommittee on Water Availability and Quality. 1/12/15
- EPA Region 4 State Agency Water Directors Meeting. April 14, 2015. Atlanta, Georgia.
- EPA Region 6 Regional Technical Assistance Group (RTAG) Meeting. May 13, 2015.
- Environmental Protection Agency Safe and Sustainable Waters Resources L'eau Down. June 8-10, 2015. Washington DC
- EPA Region 9 State Agency Water Directors Meeting. June 18, 2015. San Francisco, California.
- Office of Water, Office of Wetlands, Oceans and Watersheds 303(d) Nutrient Group. Webinar. June 23rd.
- Water Quality Monitoring. Water Cycle Strategy Meeting. Google Headquarters.
- Ann Dunkin EPA Chief Information Officer. Cincinnati, Ohio.
- EPA Region 8 Harmful Algal Bloom workshop. September 30-October 1, 2015. Rapid City, South Dakota.
- Harmful Algal Bloom and Hypoxia Research Control Act. Webinar. October 29, 2015.
- Regional Science Liaison Meeting with Office of Research and Development. CyAN mobile application demo. Cincinnati, OH. November 3rd.
- *Crawford and Schaeffer. 2016. Using satellite remote sensing to derive numeric criteria in coastal and inland waters of the United States. Ocean Sciences Meeting. New Orleans, LA.
- EPA 2016 Recreational Waters Conference. New Orleans, LA April 12-15.
- EPA Region 8 HABs Webinar. February 25th, 2016.
- HAB Workgroup Meeting. New England Interstate Water Pollution Control Commission. Lowell, MA. March 15th, 2016. Conference line.
- EPA Region 10 Workshop. Seattle Washington. March 29-30th, 2016.
- EPA Region 5 HAB Workshop. Chicago, OH, April 27-28, 2016.

Transition Strategy



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Highlights

COMMITMENTS TO ACTION ON BUILDING A SUSTAINABLE WATER FUTURE

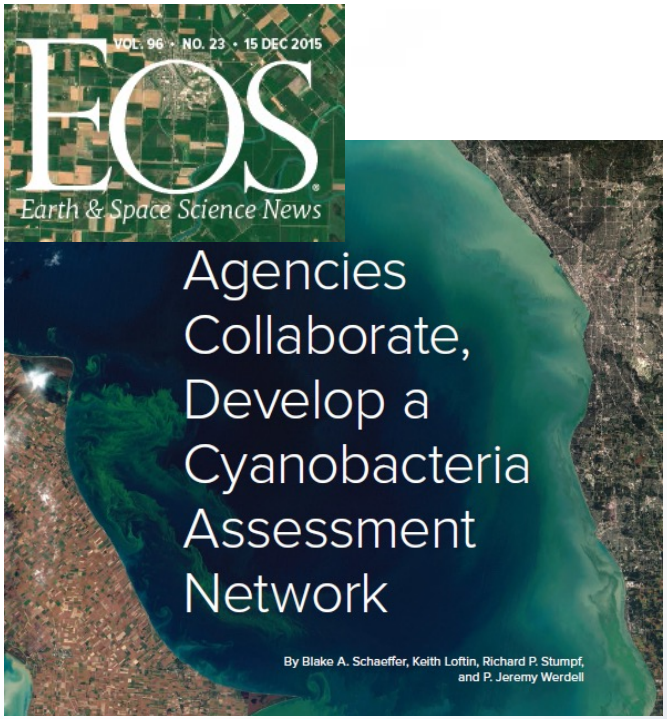
THE WHITE HOUSE
WASHINGTON

The Executive Office of the President

The Columbus Dispatch

THE BLADE

One of America's Great Newspapers



WIRED — Incredible Images of Algal Blooms Taken From Space

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INCREDIBLE IMAGES OF ALGAL BLOOMS TAKEN FROM SPACE

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EPA Issues Health Advisories to Protect Americans from Algal Toxins in Drinking Water

Publications

Schaeffer, Loftin, Stumpf, & Werdell. 2015. Agencies collaborate to develop a Cyanobacteria Assessment Network (CyAN). Eos, Earth and Space Science News. Cover Article. 96(23): 16-20.

Mattas-Curry, Schaeffer, Conmy, and Keith. 2015. A space satellite perspective to monitor water quality using your mobile phone. North American Lake Management Society Lake Line Magazine. 35(2) 28-31.

Shao, Lunetta, Wheeler, liames, & Campbell. 2016. An evaluation of time-series smoothing algorithms for land-cover classifications using MODIS-NDVI multi-temporal data. Remote Sensing of Environment. 174:258-265.