

Harmful Algal Blooms (HABs): *Responding to State and Regional Needs*



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US EPA ORD National Risk Management Research Laboratory

**Region 5 and Neighboring States' Visit to US EPA Cincinnati
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HABs: Overall Problems

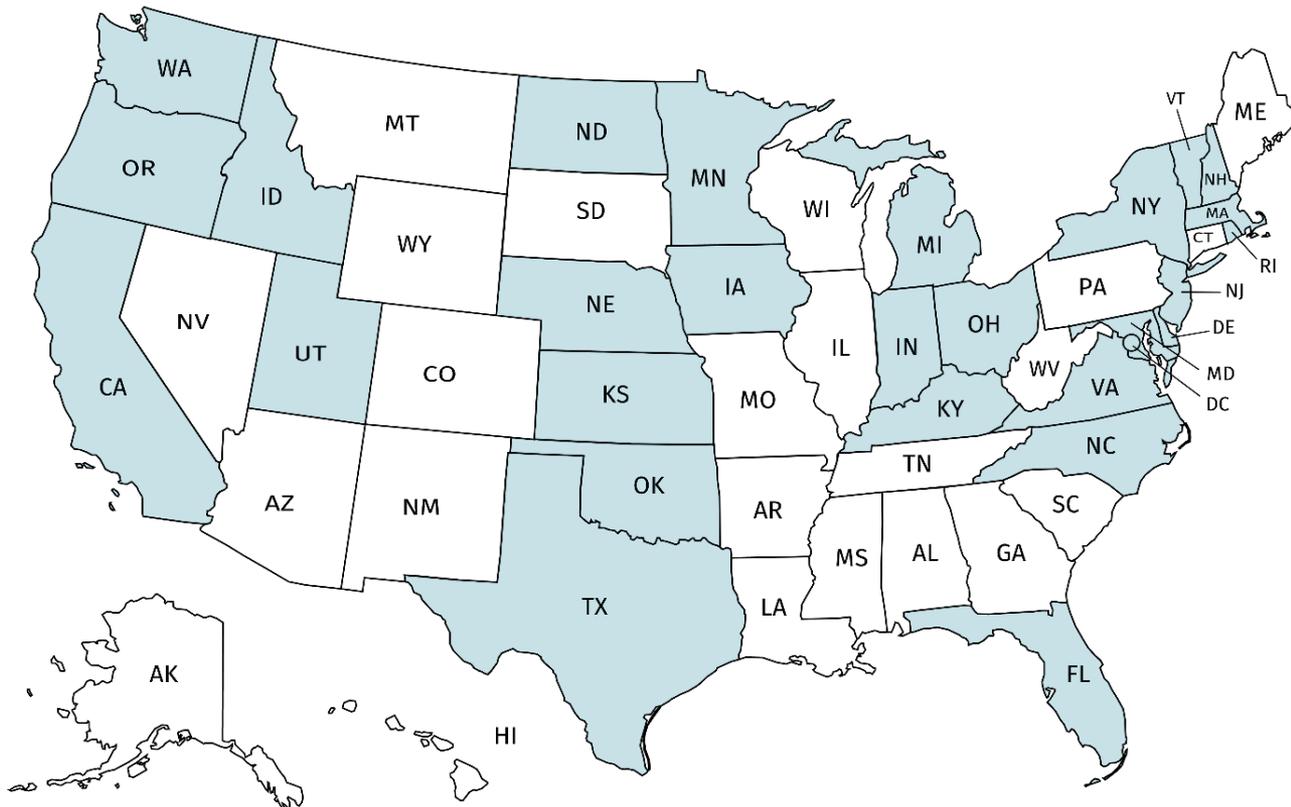
HABs have the potential to generate adverse health, ecosystem and economic impacts.



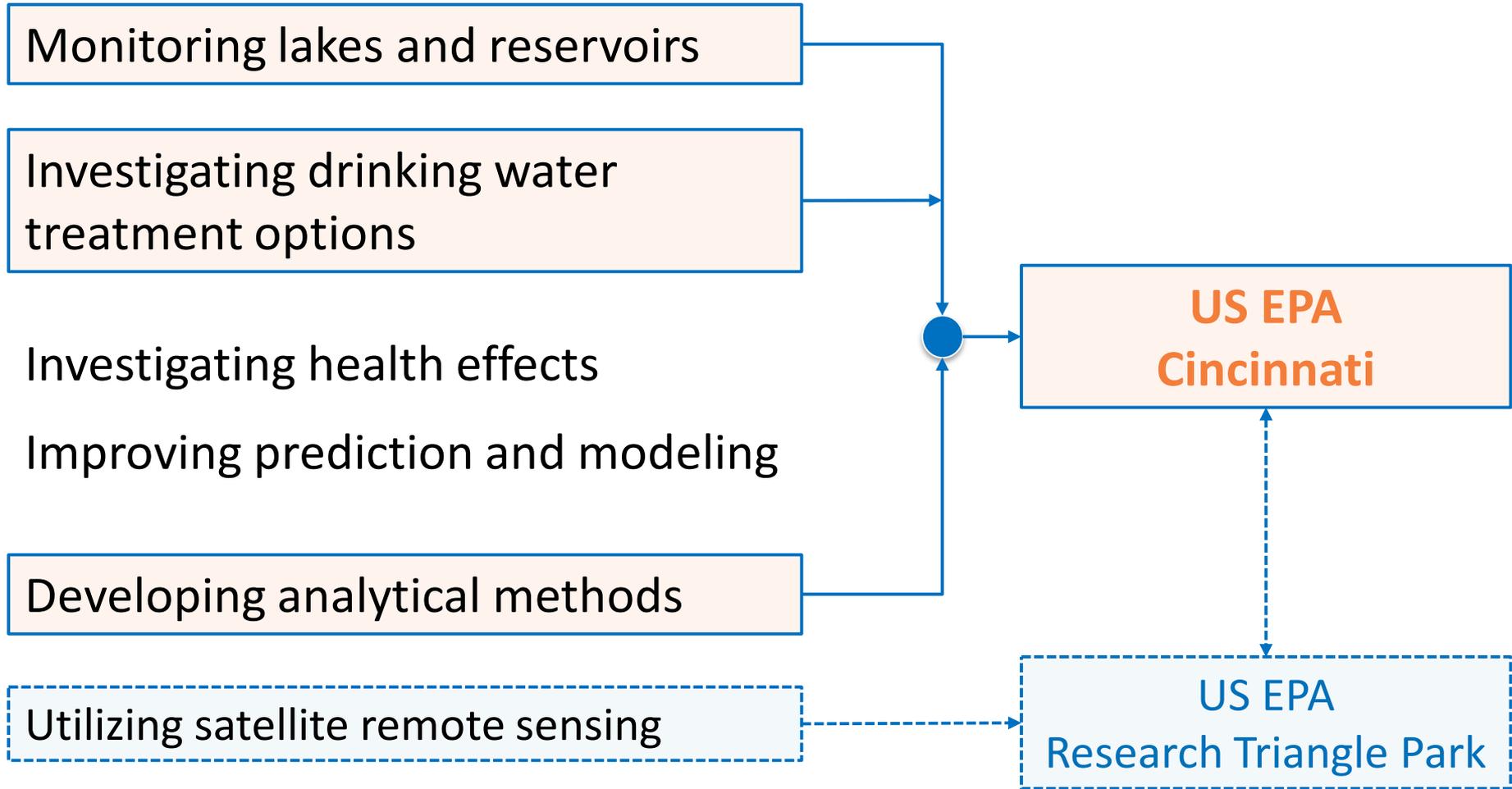
- Many different types of toxins
 - Pure toxins in laboratory studies exert toxic effects on liver and nervous system
 - Exposure through ingestion
 - Exposure through recreational activity body contact—associated with gastrointestinal effects, breathing difficulty, skin irritation, and animal deaths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

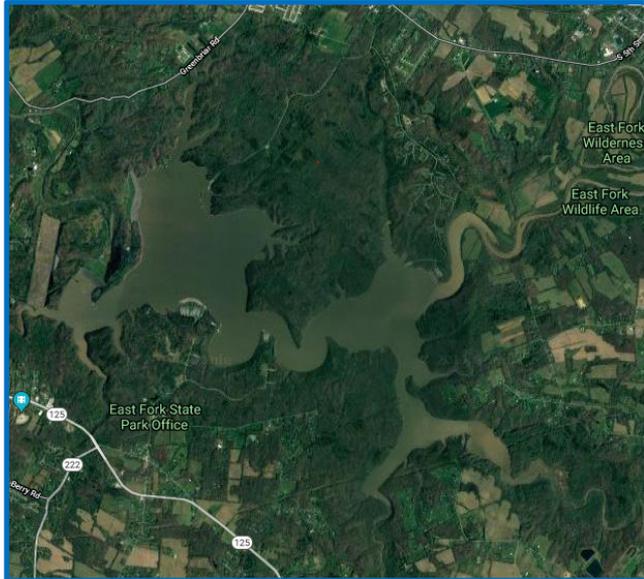
During the 2017 bloom season, US EPA was aware of blooms, beach closures and/or health advisories in 27 states and DC.



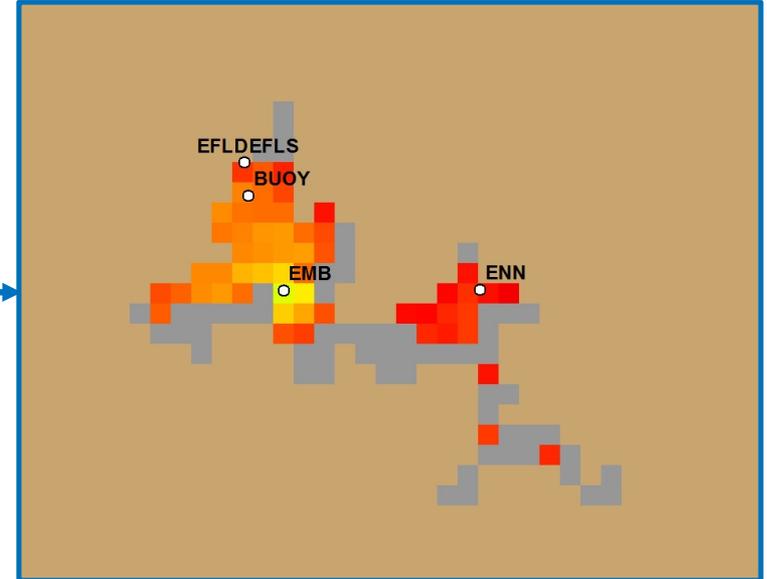
Actions: Research Approach



Actions: Monitoring and Remote Sensing



Overlay Satellite
Data

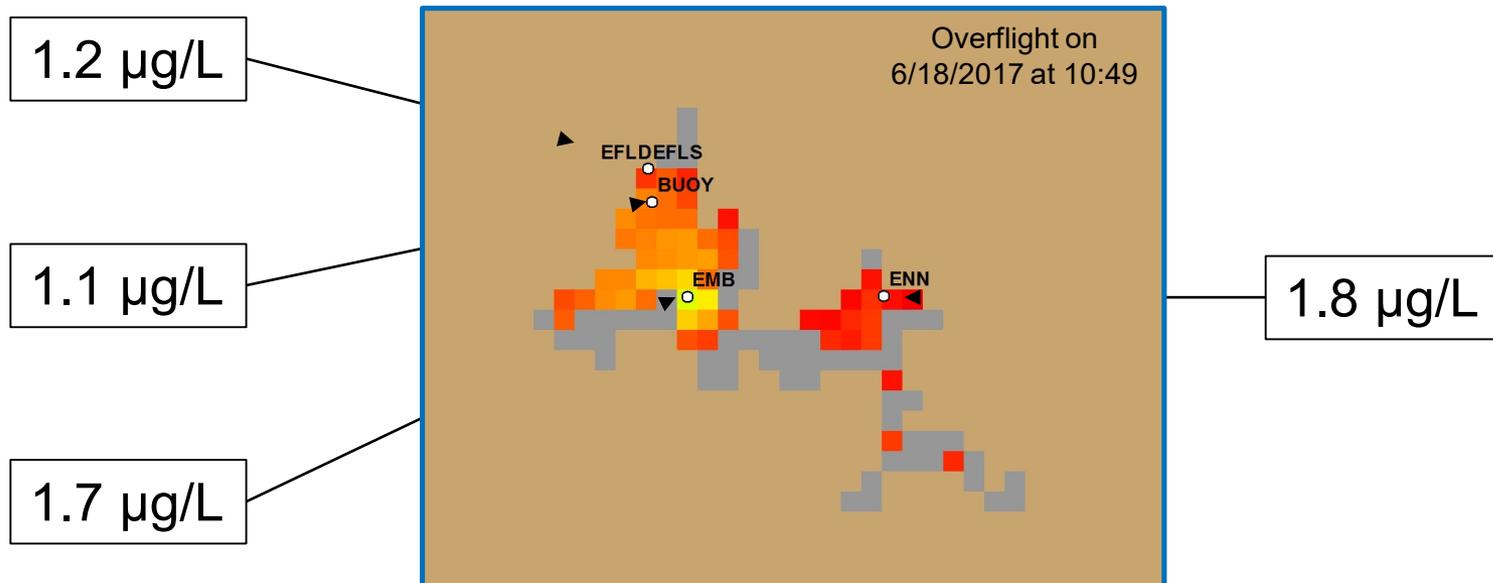


Optical signature of cyanobacterial pigments:

-  = Low Concentration
-  = High Concentration
-  = No Data

Actions: Monitoring and Remote Sensing

Integrate satellite data with “on the lake” sampling results for toxins (microcystins)



EPA health advisory concentration =
0.3 µg/L for pre-school aged children

Impact: Monitoring and Remote Sensing

Monitoring and Remote Sensing

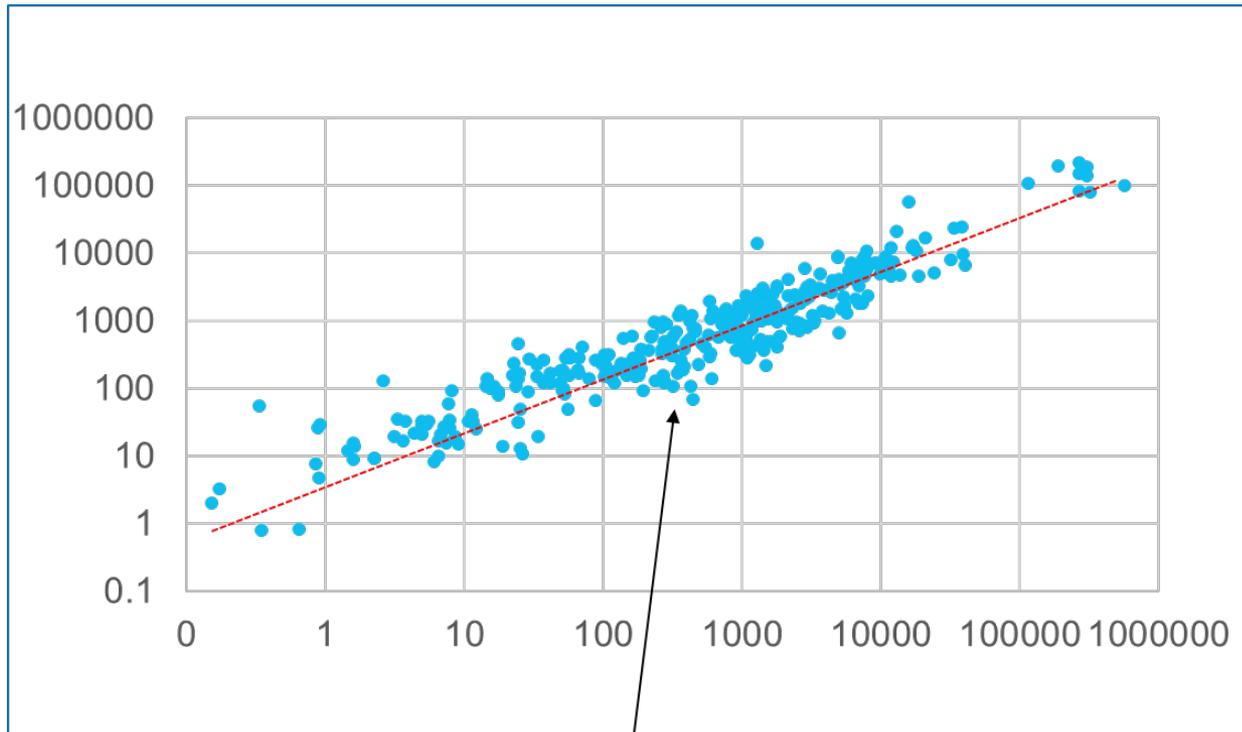
Ultimate goal is to combine satellite, buoy-deployed sensor and grab sampling data for pigments, nutrients, toxins, microbial species, water quality and weather

Better Guidance Information

- Beach closure decisions
- Forecasting bloom peaks and toxin production
- Response to reports of human and animal illnesses

Actions: Analytical Methods

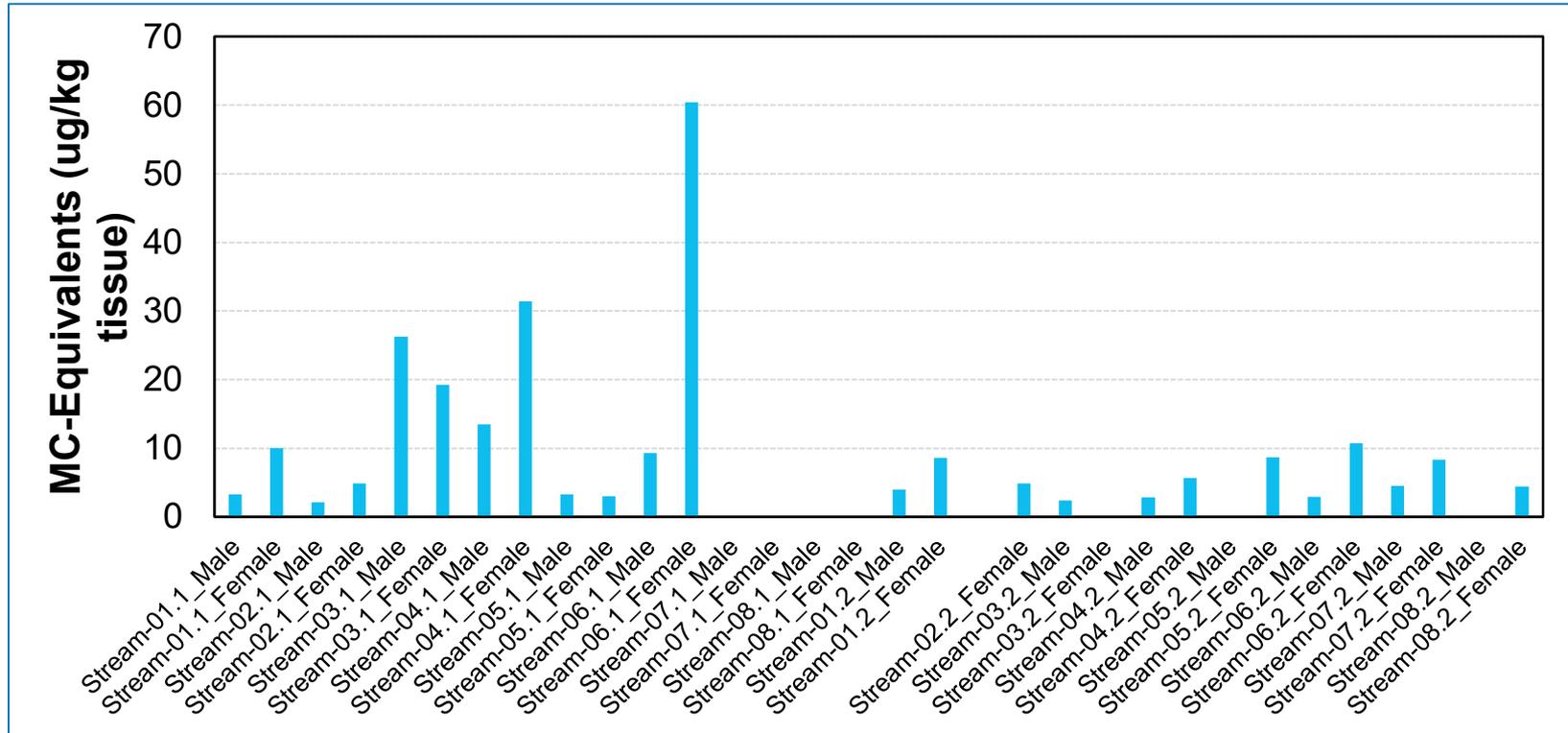
Collaboration with Ohio EPA to validate quantitative PCR method
(Rapid detection of genetic material from toxin-producing cyanobacteria)



Agreement for samples split between
Ohio and federal EPA laboratories

Actions: Analytical Methods

Toxin Analysis in Fish Tissues



Fathead minnows exposed to toxins in artificial streams

→ toxins successfully recovered from whole-fish tissue samples

Impact: Analytical Methods

Analytical Methods



Feeds back to the monitoring component



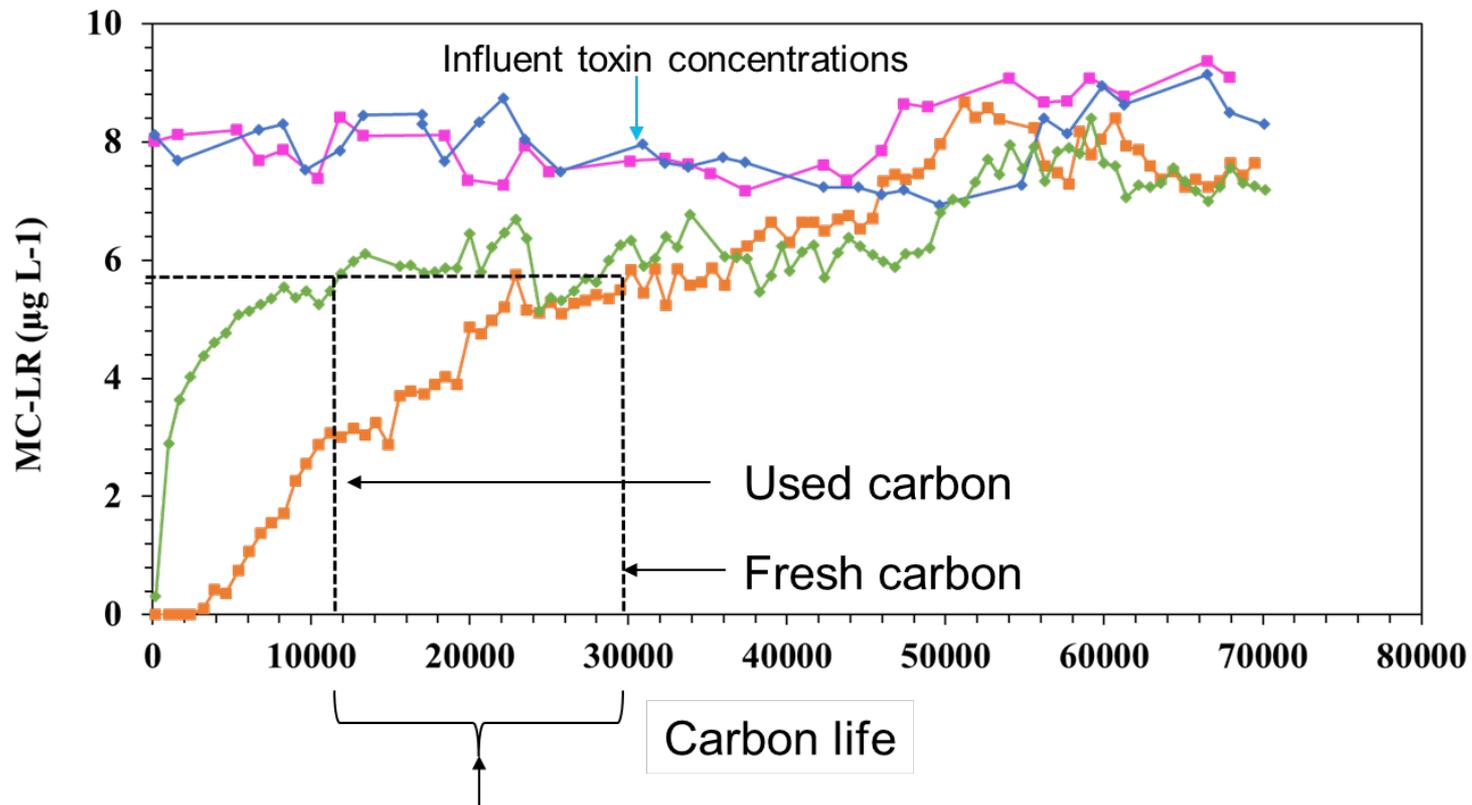
Better Guidance Information



- Beach closure decisions
- Forecasting bloom peaks and toxin production
- Response to reports of human and animal illnesses
- Response to concerns from fishermen

Actions: Drinking Water Treatment

Toxin Removal through Granular Activated Carbon (GAC) Impact of prior GAC use



Prior use decreases the ability of GAC to remove toxins

Impact: Drinking Water Treatment

Drinking Water Treatment

Better Guidance Information

- Day-to-day treatment plant operation decisions (chemical dosing)
- Medium-term treatment plant operation decisions (timing carbon replacement)
- Long-term capital spending decisions

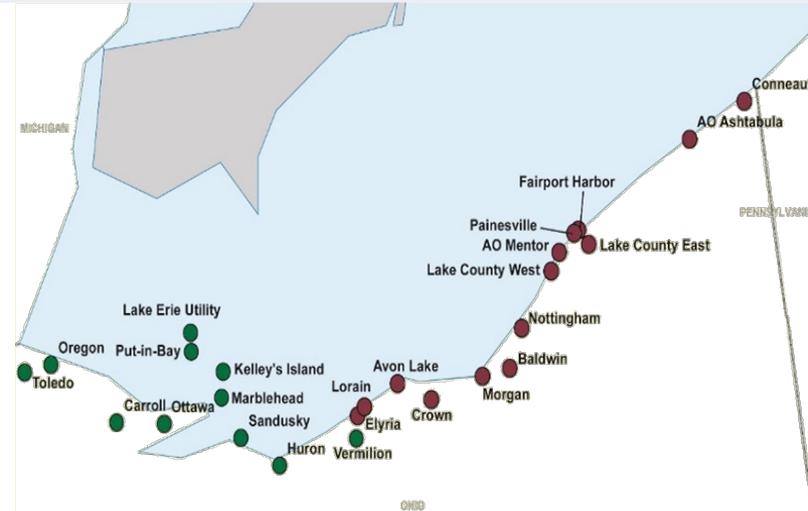
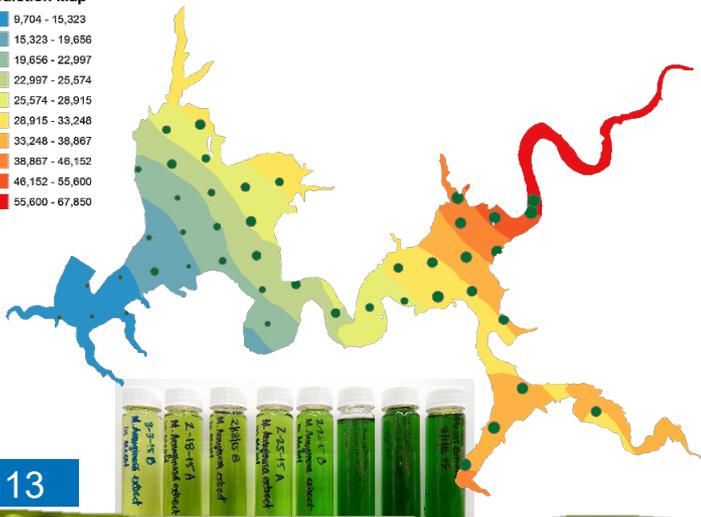
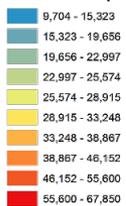
Actions and Impact: Ohio Lakes

Providing Technical Assistance to States

Lake Erie

- Monitoring cyanobacteria toxins through multiple years in numerous treatment plants
- Conducting bench- and pilot-testing
- Satellite monitoring program

BGA-PC (cells/mL)
Prediction Map



Harsha Lake

- Nutrient and HAB bloom dynamics
- Treatment performance at local water utility
- Nutrient trading program: reduce nutrient loadings at lowest cost by expanding the number of participants that have incentives to purchase credits



Actions and Impact: Toledo, OH

Providing Technical Assistance to States

Do Not Drink Advisory Issued by the State

In August 2014, Ohio EPA requested ORD's technical assistance to analyze drinking water for the presence of cyanobacterial toxins resulting in a harmful algal bloom.

ORD Technical Assistance

- Samples flown directly to Cincinnati on numerous occasions
- Performed multiple analyses around the clock until the crisis was resolved
- Provided technical assistance to the city and state 24/7:
 - Confirmed extent of problem the potential for resolution, via treatment
 - Resolved sample handling and analytical procedures
 - Helped brief Ohio EPA Administrator, Mayor of Toledo, Governor and Members of Congress at various times during the event



“Your efforts were instrumental in restoring safe drinking water to over ½ million Ohioans and exemplifies a great example of how local, state and federal agencies are able to work together, mobilize essential resources and address critical issues.”

***—Governor John R. Kasich
(in a letter to US EPA staff)***

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Other

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- **Toxin analysis** (in water): Heath Mash (mash.heath@epa.gov), Toby Sanan (sanan.toby@epa.gov); (in fish tissue): Toby Sanan (sanan.toby@epa.gov), Jim Lazorchak (lazorchak.mim@epa.gov)
- **Microbial analysis** (Ohio EPA collaboration): Jorge SantoDomingo (santodomingo.jorge@epa.gov); (metabolic activity): Jingrang Lu (lu.jingrang@epa.gov)
- **Drinking water treatment** (granular activated carbon): Jonathan Pressman (pressman.jonathan@epa.gov); (physical removal, potassium permanganate): Nicholas Dugan