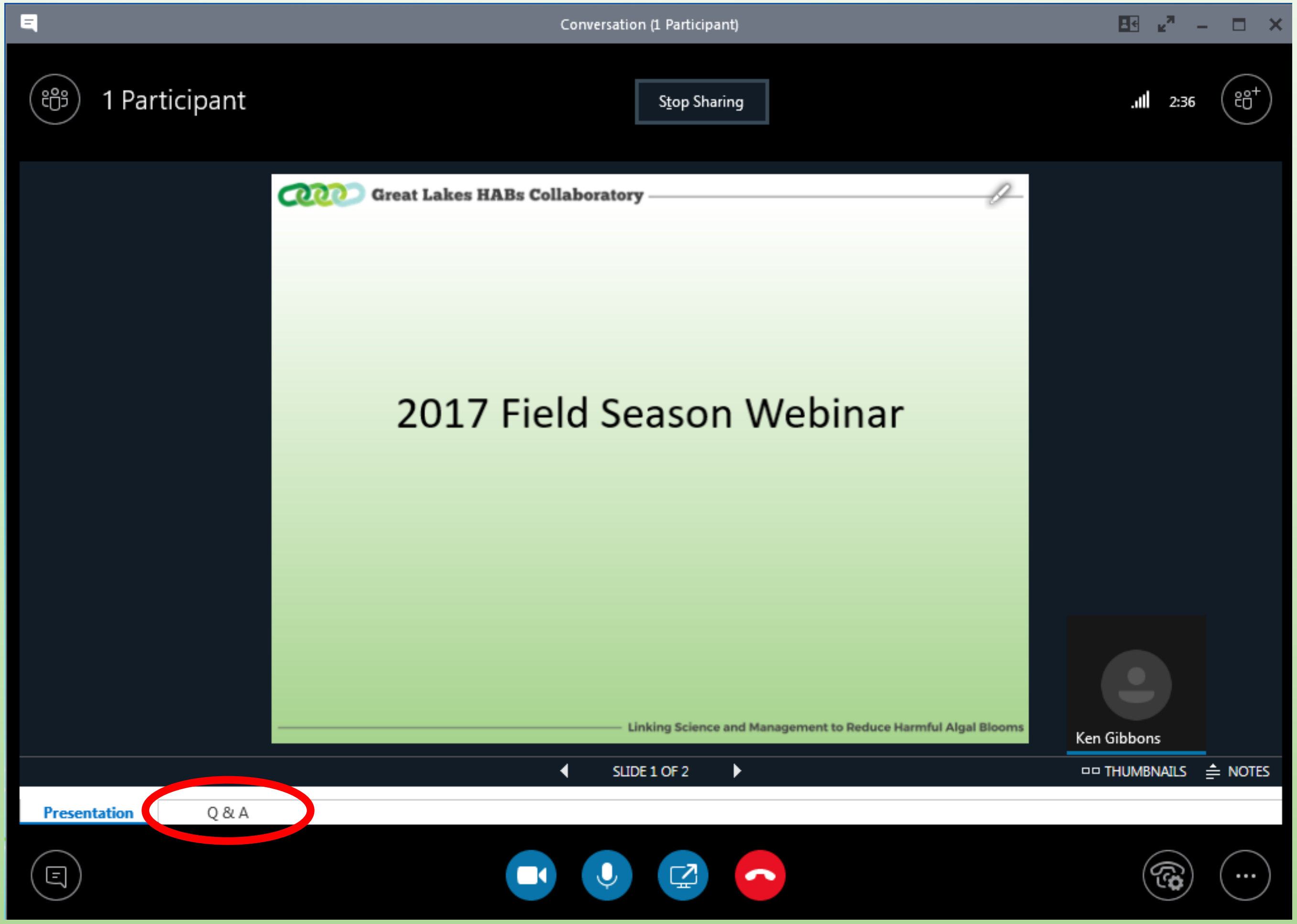
2017 Field Season Webinar

Ken Gibbons

Margo Davis

Type Questions into Q & A tab



Understanding Algal Blooms: State of the Science Conference

- Date and Time: September 14th at 9:30 am
- Location: Stranahan Center, 4645 Heatherdowns Blvd, Toledo, OH 43614

Sea Grant

The Ohio State University

USDA

Presenters

- Tim Davis, NOAA-GLERL
- Mike McKay, Bowling Green State University
- Todd Miller, University of Wisconsin-Milwaukee
- Brenda Moraska Lafrancois, National Park Service
- Ngan Diep, Ontario Ministry of the Environment and Climate Change
- Claire Holeton, Ontario Ministry of the Environment and Climate Change
- Justin Chaffin, The Ohio State University

NOAA-CIGLR's 2017 Lower Great Lakes HAB monitoring program

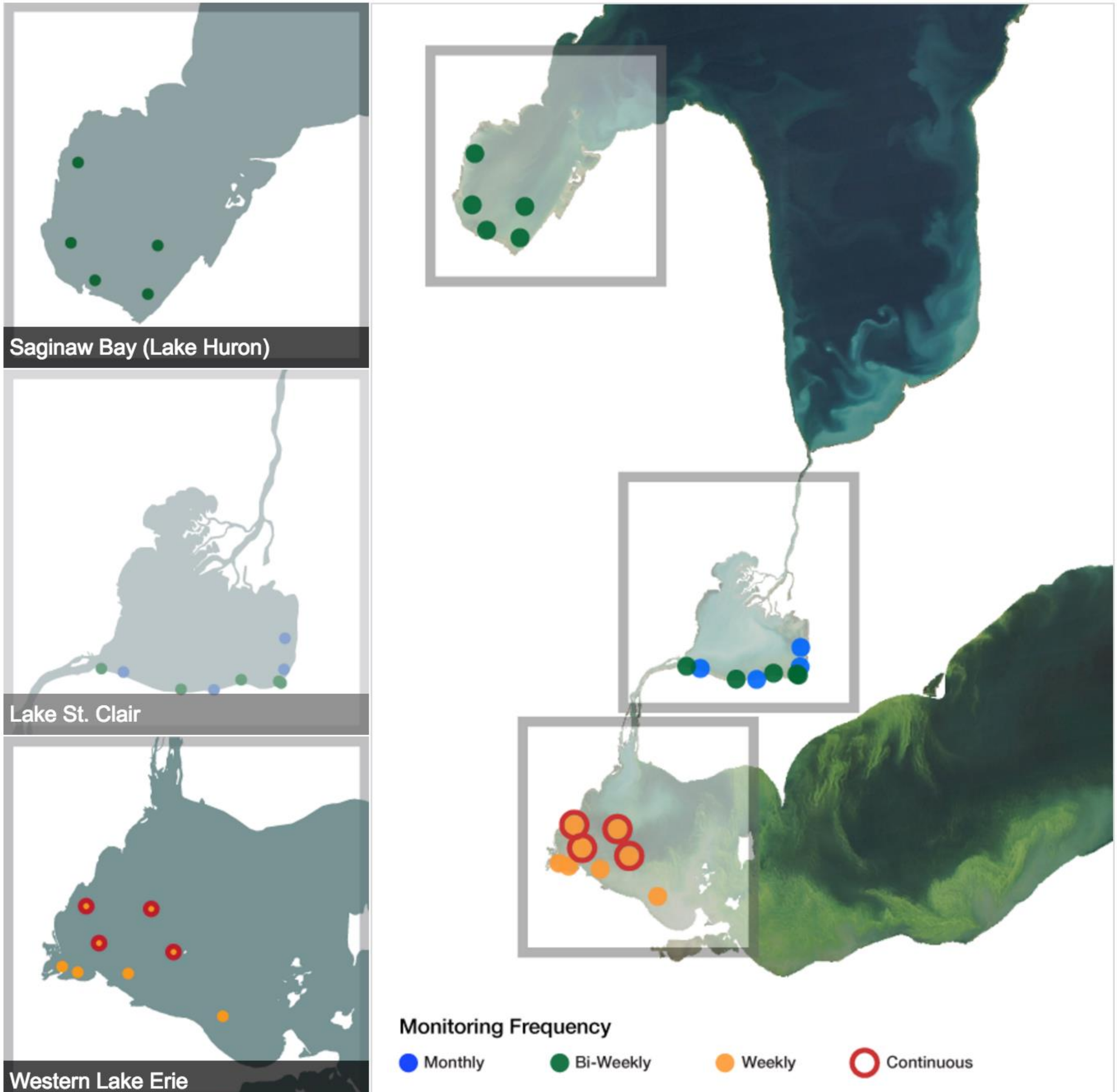
Timothy Davis

CILER
Cooperative Institute for Limnology and Ecosystems Research

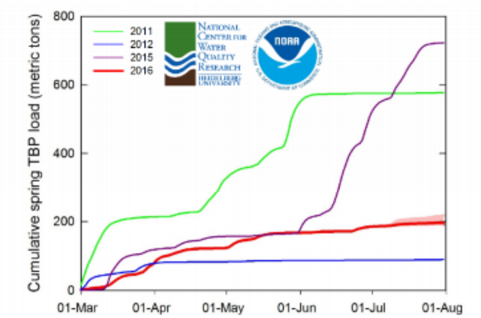
GLERL
Great Lakes Environmental Research Laboratory

NCCOS

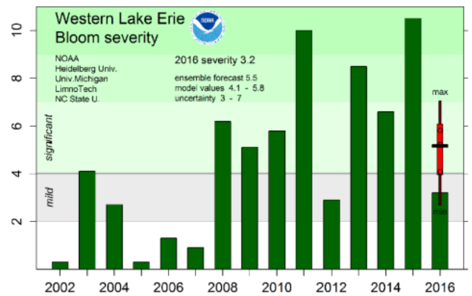
NOAA studies HABs throughout the Great Lakes



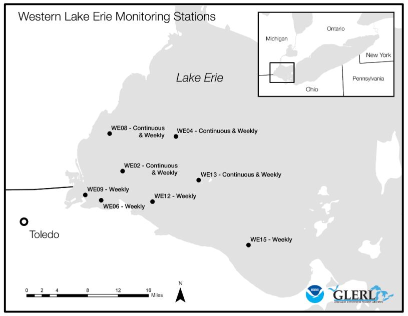
Bloom projection to data dissemination requires a multifaceted effort



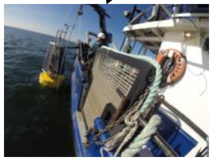
1) Project

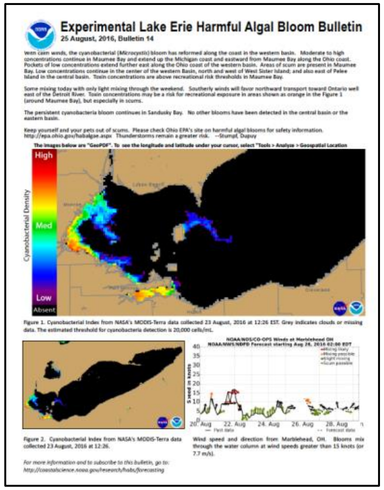


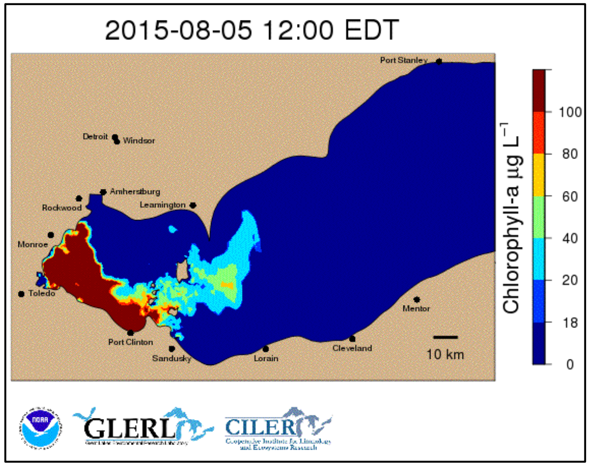
2) Predict



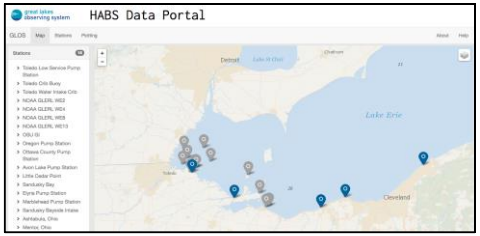
3) Monitor





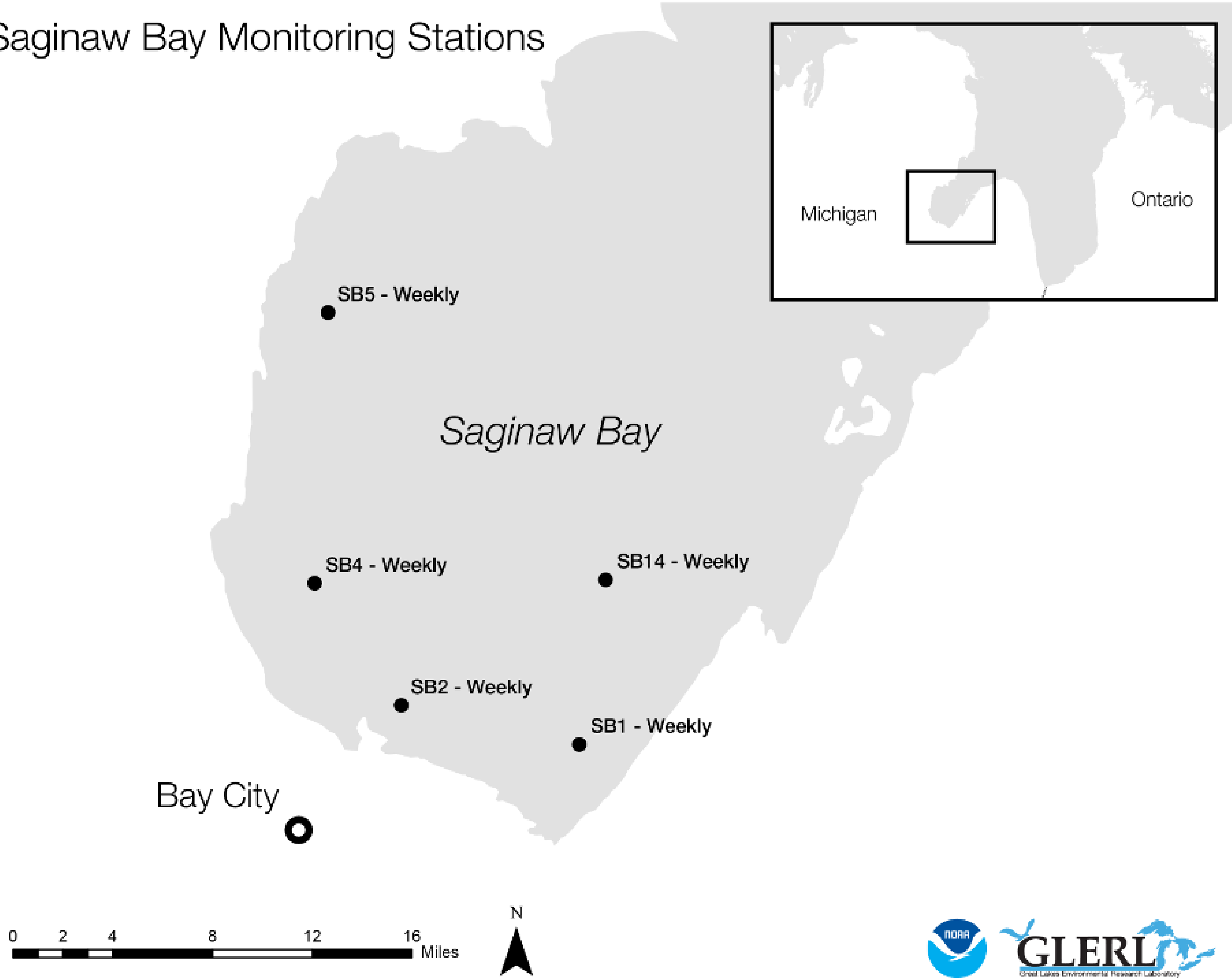


4) Forecast



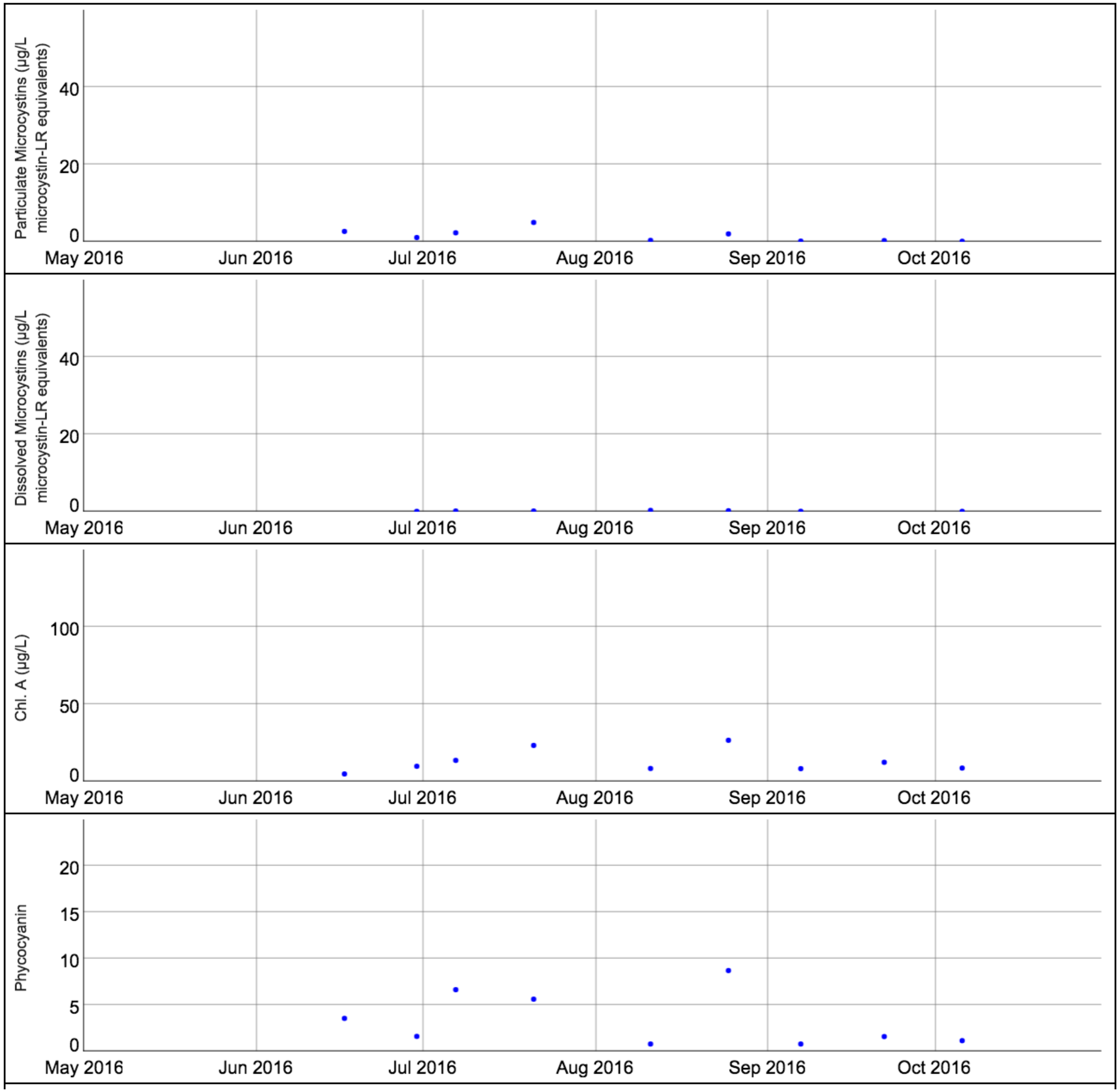
5) Disseminate Monitoring Data

Saginaw Bay Monitoring Stations

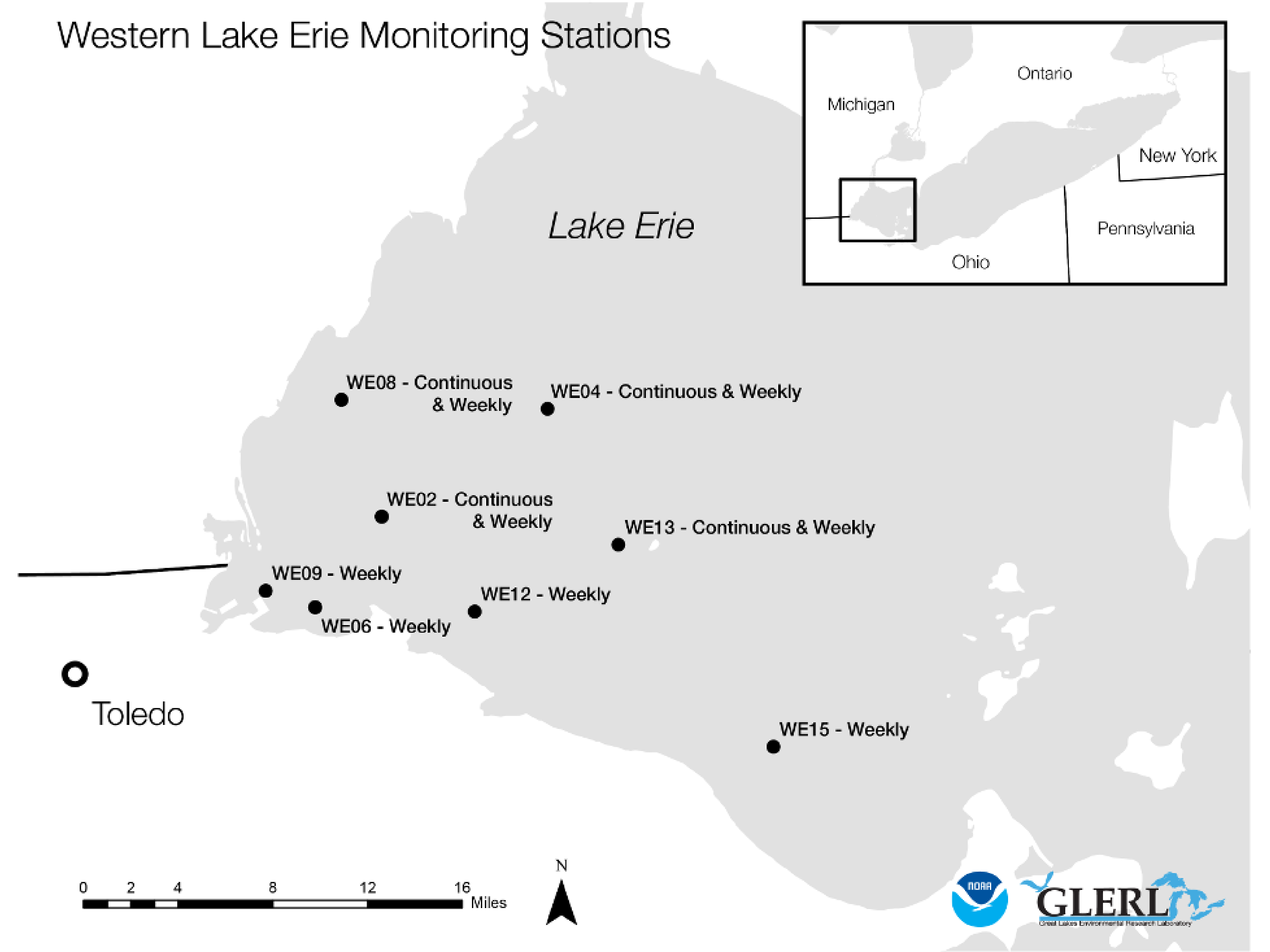


Station Name (Water Column Depth)

SB1 (~3.8 m)



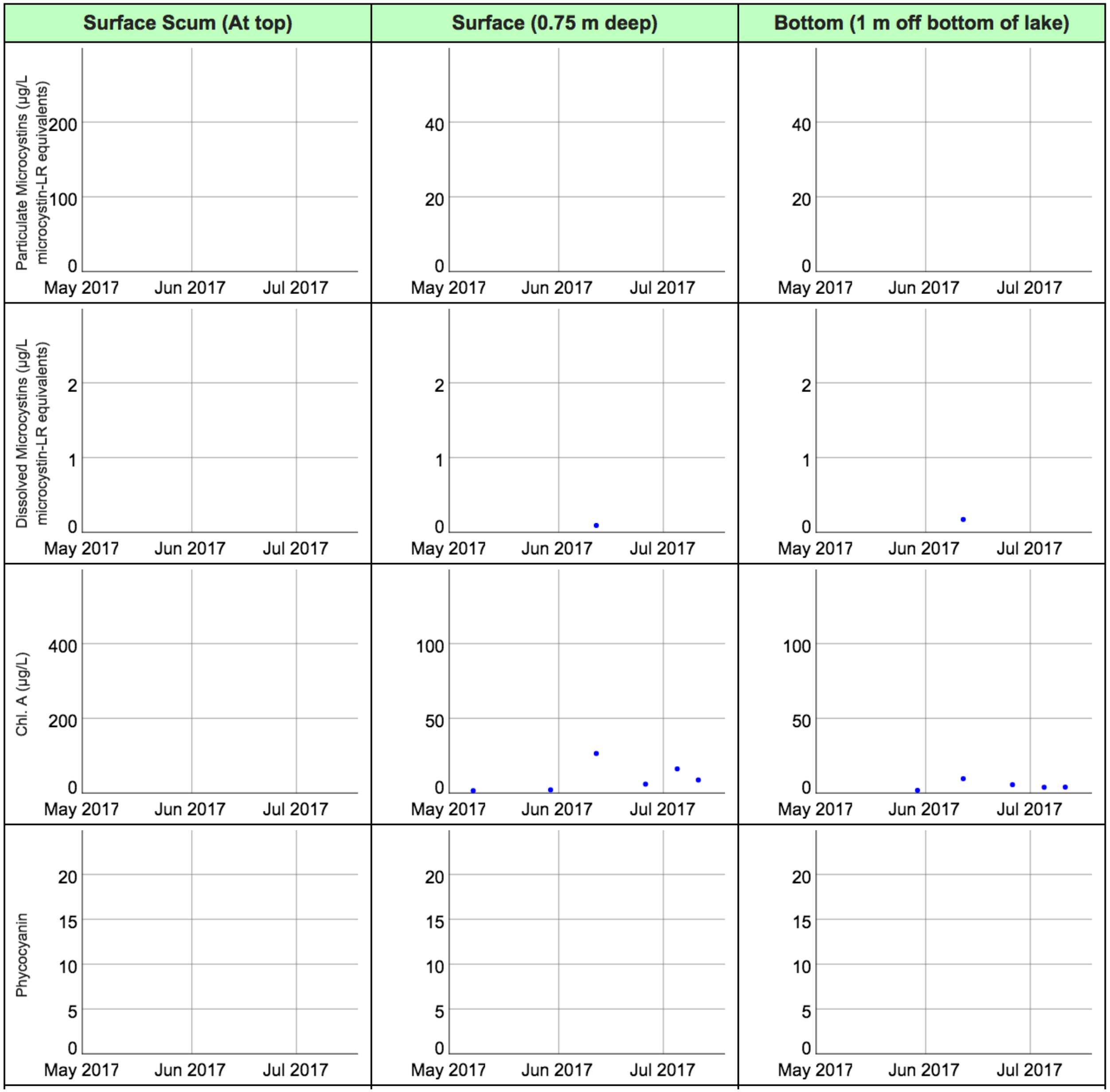
https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/SBMicrocystin.html



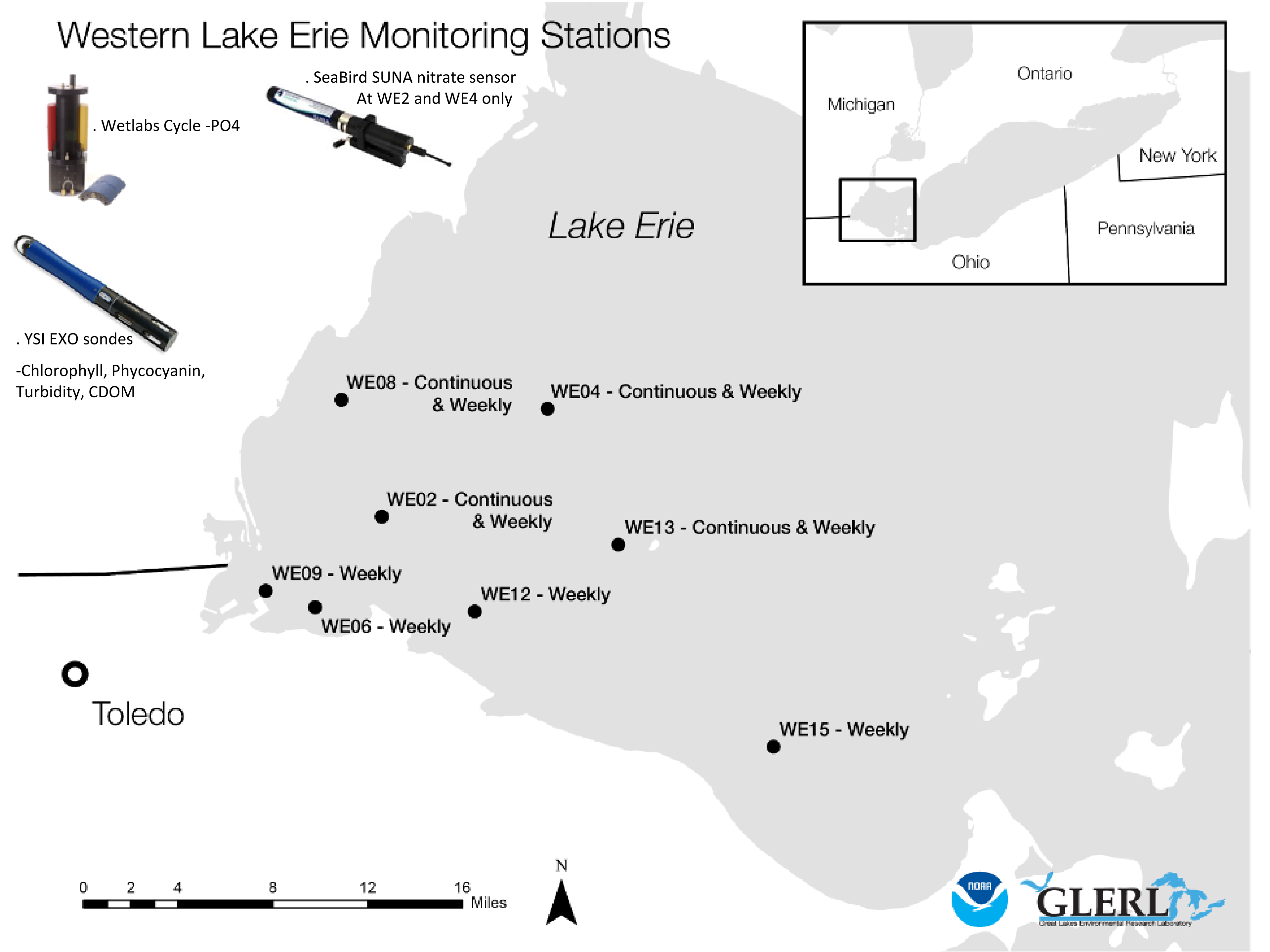
Western Lake Erie Monitoring Stations
Lake Erie
Ontario
Michigan
New York
Pennsylvania
Ohio
WE08 - Continuous & Weekly
WE04 - Continuous & Weekly
WE02 - Continuous & Weekly
WE13 - Continuous & Weekly
WE09 - Weekly
WE12 - Weekly
WE06 - Weekly
WE15 - Weekly
Toledo
0 2 4 8 12 16 Miles
N
NOAA
GLERL
Great Lakes Environmental Research Laboratory

Station Name (Water Column Depth)

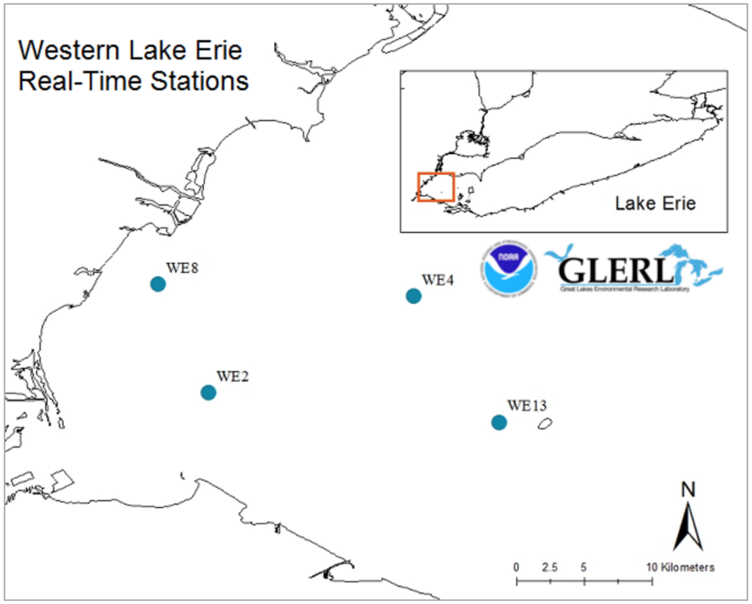
WE2 (~5 m)



https://www.glerl.noaa.gov//res/HABs_and_Hypoxia/WLEMicrocystin.html


Western Lake Erie Monitoring Stations
. Wetlabs Cycle -PO4
. SeaBird SUNA nitrate sensor
At WE2 and WE4 only
. YSI EXO sondes
-Chlorophyll, Phycocyanin,
Turbidity, CDOM
Lake Erie
Ontario
Michigan
New York
Pennsylvania
Ohio
WE08 - Continuous & Weekly
WE04 - Continuous & Weekly
WE02 - Continuous & Weekly
WE13 - Continuous & Weekly
WE09 - Weekly
WE12 - Weekly
WE06 - Weekly
WE15 - Weekly
Toledo
0 2 4 8 12 16 Miles
N
GLERL
Great Lakes Environmental Research Laboratory

Western Lake Erie continuous monitoring data



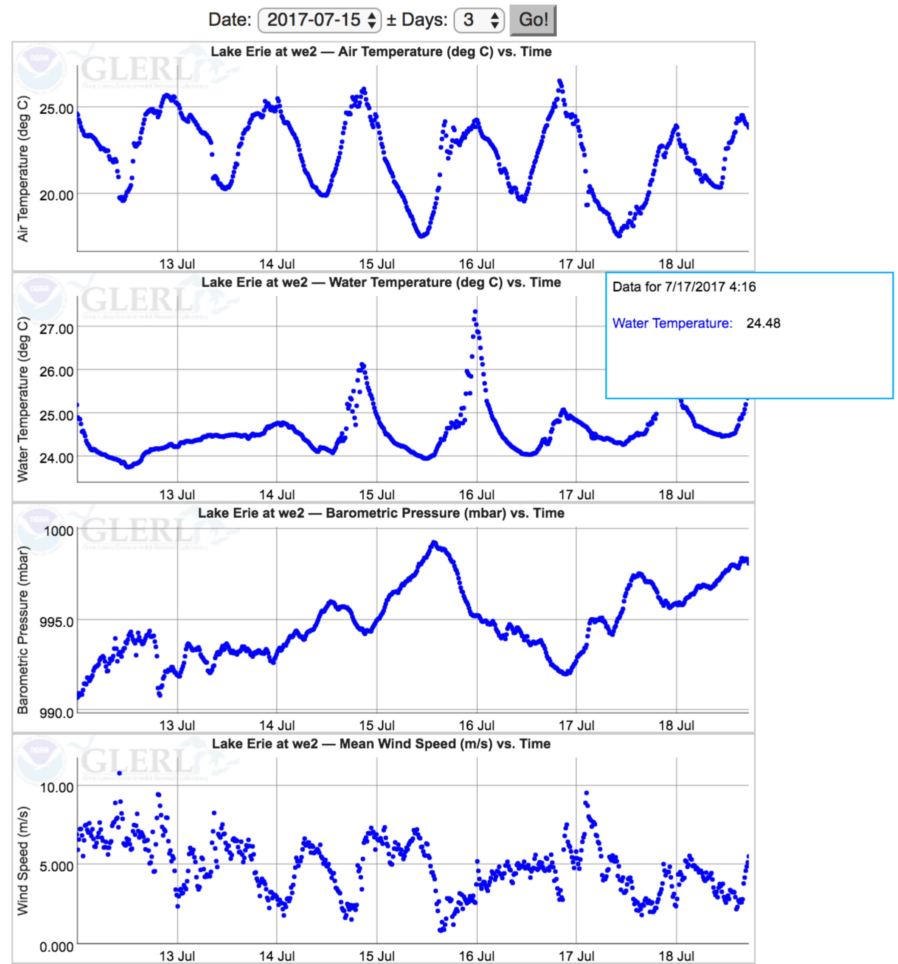
Display all variables for the following site:

WE2

OR - Select variables to compare between all sites:

Air Temperature	Turbidity
Water Temperature	Conductivity
Barometric Pressure	Phosphorus
Wind Speed	Chl. A
Wind Direction	Blue-Green Algae Phycocyanin
	Flourescent Dissolved Organic Matter
	Nitrogen (NO3)
	Dissolved Oxygen
	pH

Viewing mode will be indicated with light green background color.



https://www.glerl.noaa.gov//res/HABs_and_Hypoxia/rtMonSQL.php

NOAA Lake Erie HAB Bulletin now operational

Lake Erie Harmful Algal Bloom Bulletin

17 July, 2017, Bulletin 02

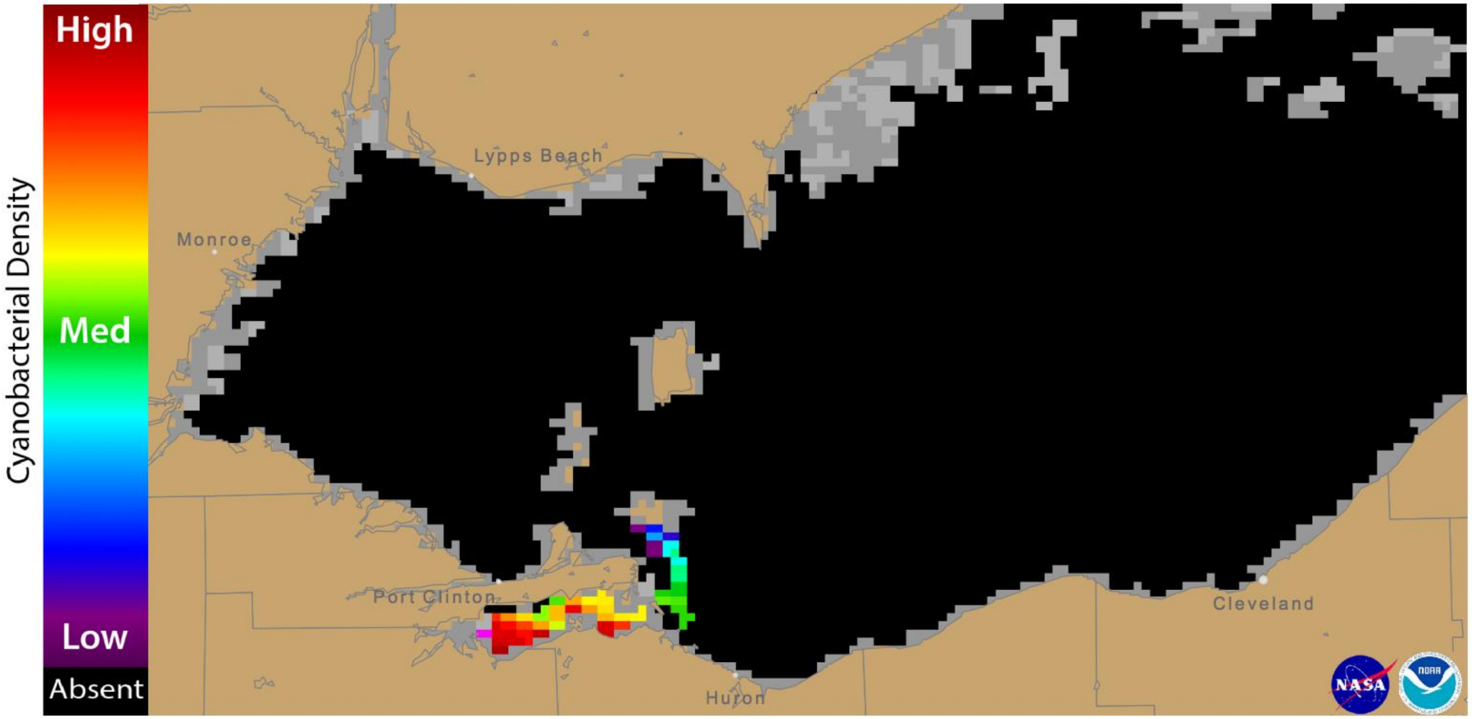
Cyanobacteria is present in Lake Erie, generally at low concentrations. Some *Microcystis* is present in the Maumee Bay area. This is typical for this time of year. The unedited imagery (not shown) from 7/15 indicated a sediment plume extending from Maumee River to Maumee Bay; however the pixels were removed from the edited image (shown) since *Microcystis* could not be distinguished from the sediment. Measured toxin concentrations are below recreational thresholds throughout the bloom extent.

Forecast winds (5-10kn) today through Thursday (7/17-20) may promote a slight potential for mixing of surface concentrations of *Microcystis*.

The persistent cyanobacteria bloom of *Planktothrix* continues in Sandusky Bay and extends into Lake Erie.

NOAA's GLERL provides additional HAB data: https://www.glerl.noaa.gov/res/HABs_and_Hypoxia. - Kavanaugh, Urízar

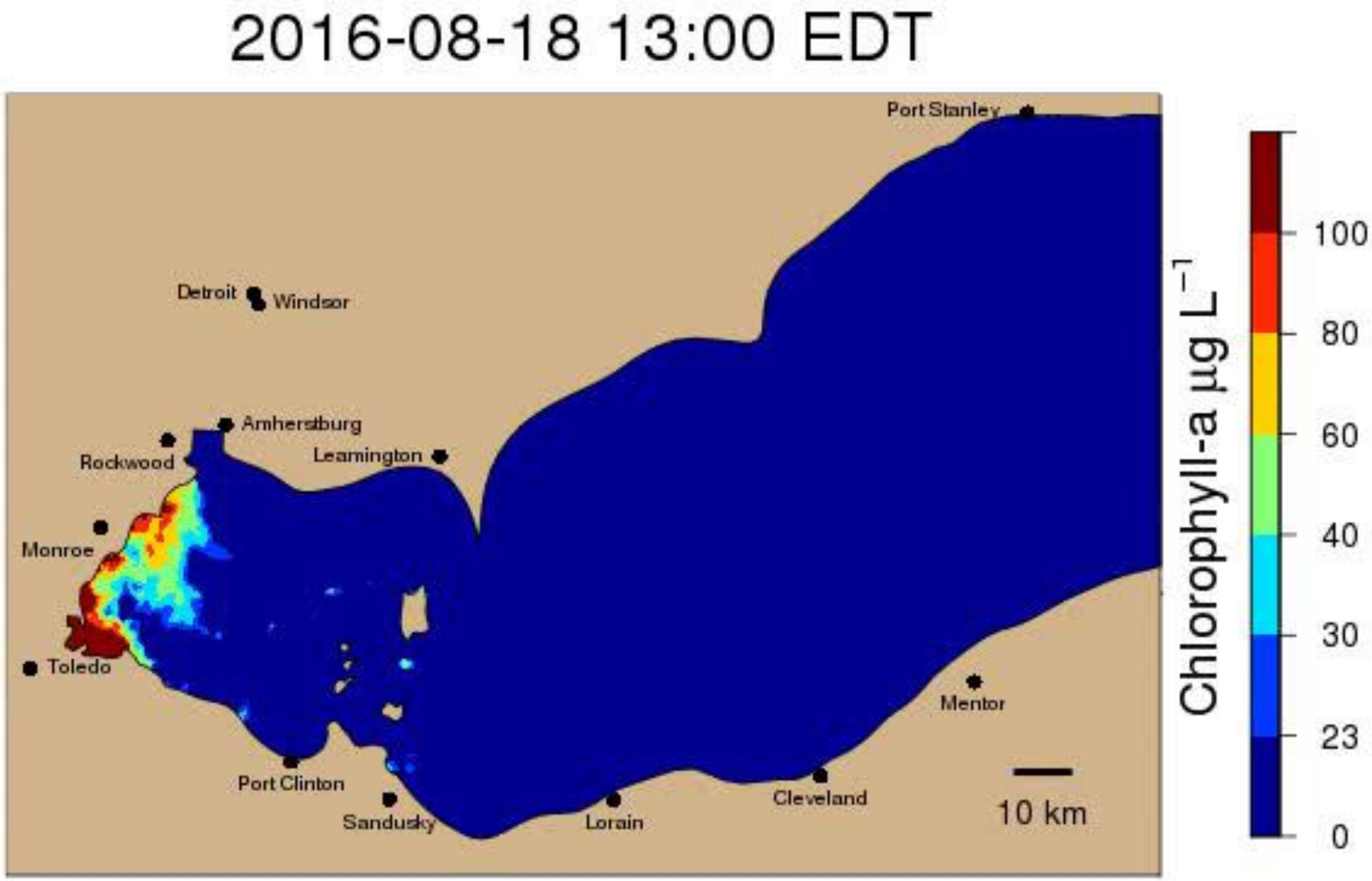
The images below are "GeoPDF". To see the longitude and latitude under your cursor, select "Tools > Analyze > Geospatial Location Tool".



https://www.glerl.noaa.gov/res/HABs_and_Hypoxia/bulletin.html

3D HAB Tracker provides short-term forecasts of bloom movement

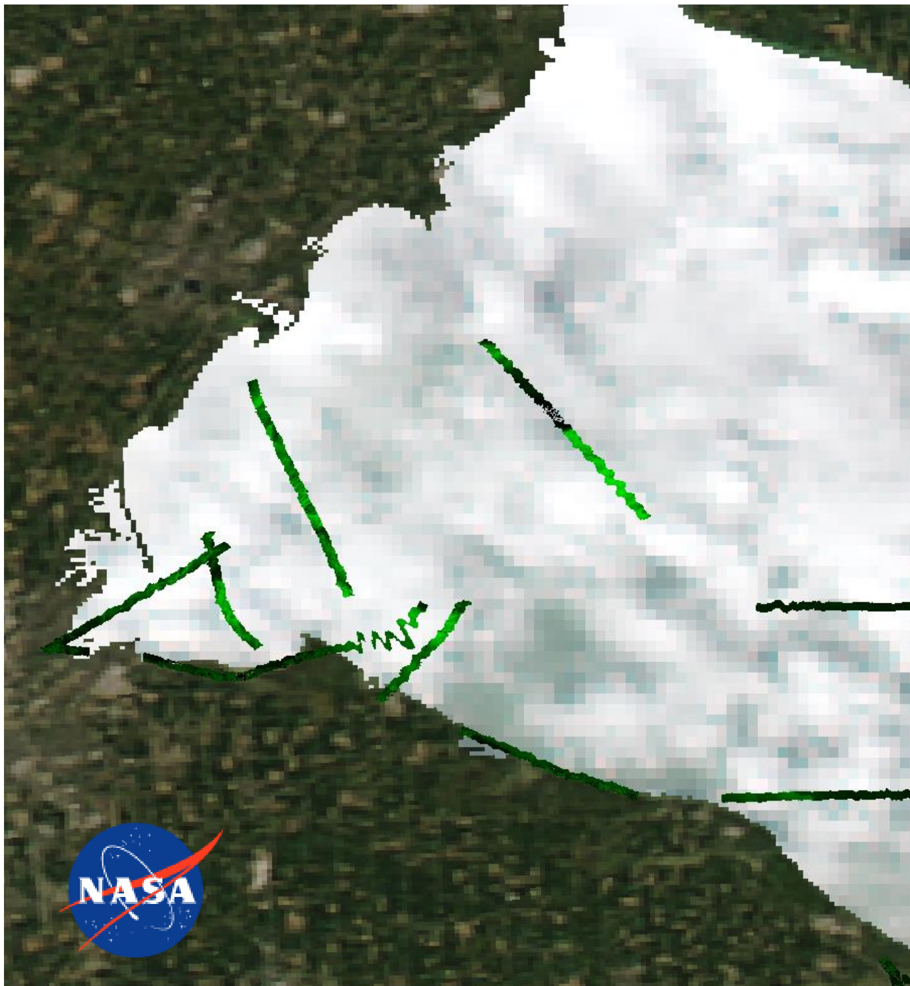
Lead PI: Mark Rowe, Eric Anderson

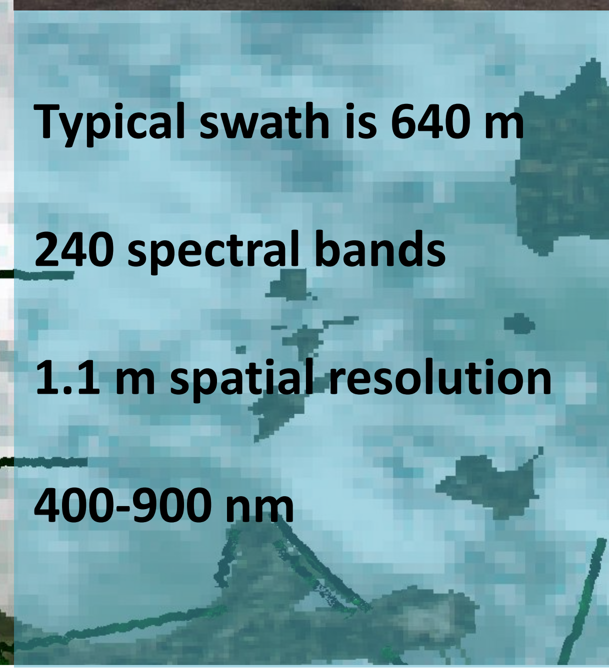


https://www.glerl.noaa.gov//res/HABs_and_Hypoxia/habTracker.html

Hyperspectral Detection of Cyanobacteria: Resonon Pika II Sensor

Lead PIs: Andrea VanderWoude and Steve Ruberg



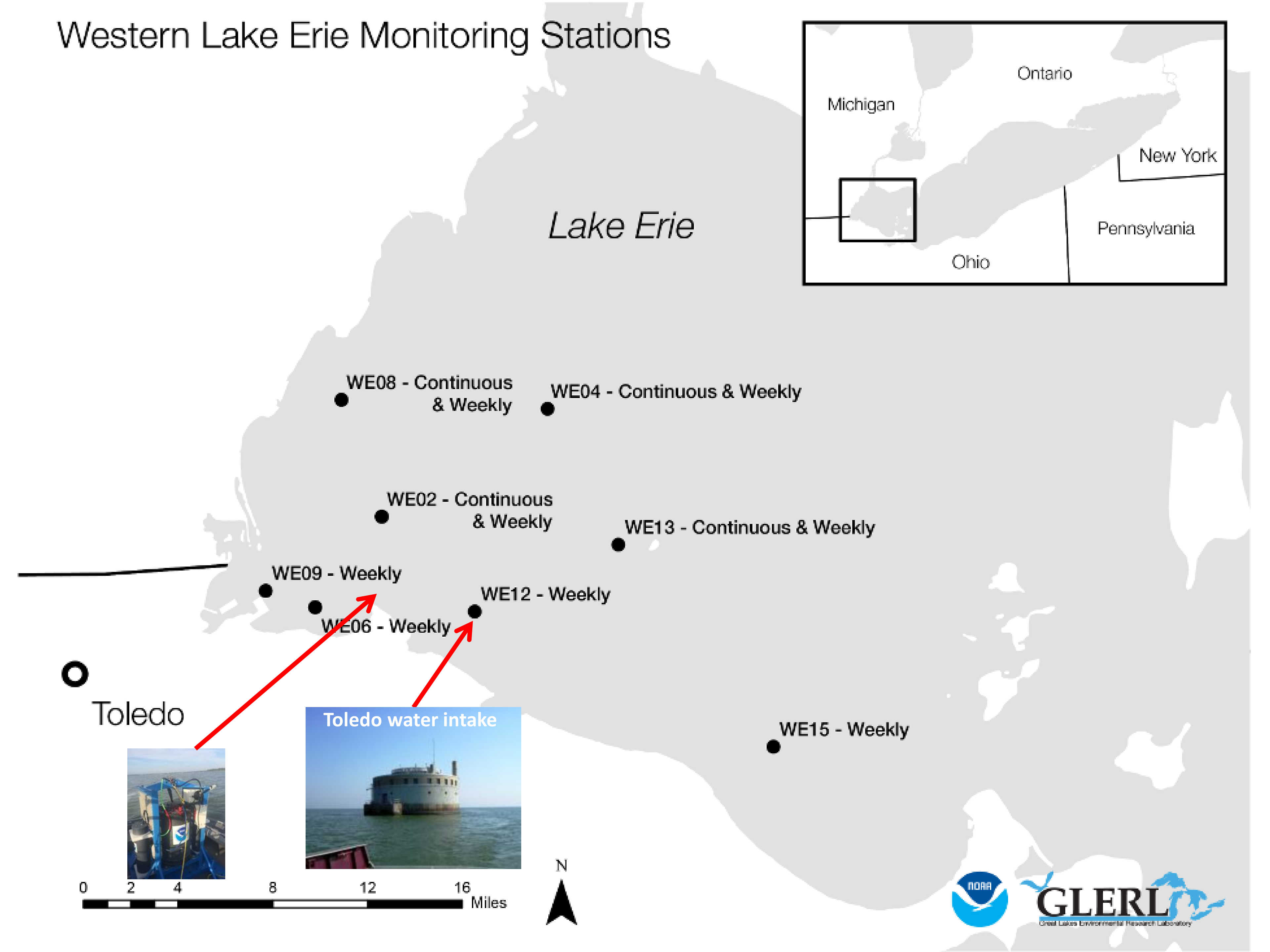


Typical swath is 640 m

240 spectral bands

1.1 m spatial resolution

400-900 nm


Western Lake Erie Monitoring Stations
Lake Erie
Michigan
Ontario
New York
Pennsylvania
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WE08 - Continuous & Weekly
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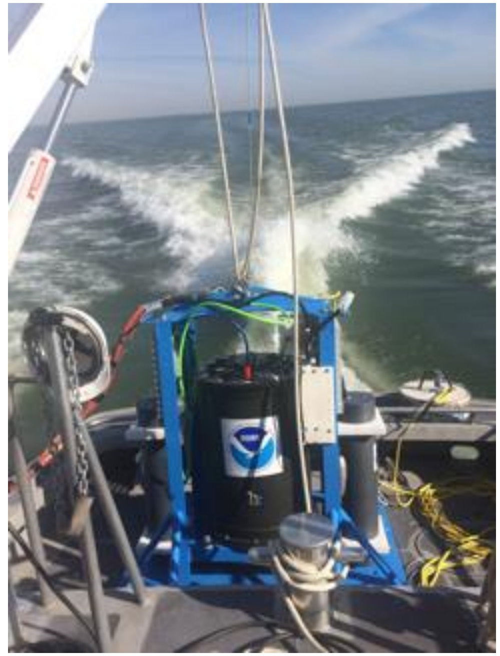
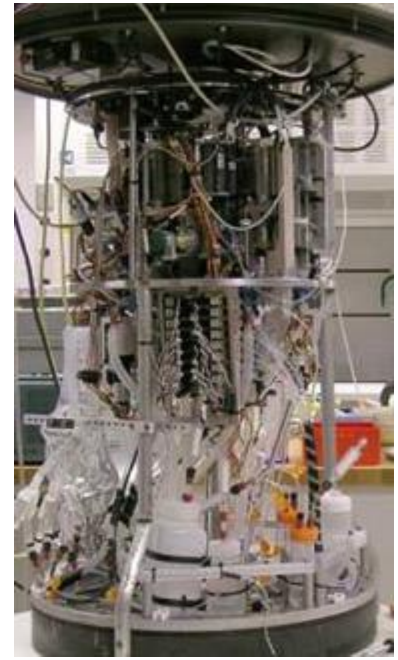
WE13 - Continuous & Weekly
WE09 - Weekly
WE12 - Weekly
WE06 - Weekly
WE15 - Weekly
Toledo
Toledo water intake
0 2 4 8 12 16 Miles
N
GLERL

Deployment of ESP*niagara* for near real-time detection of MCs



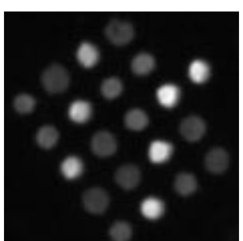


June — Test of communication system and general operations

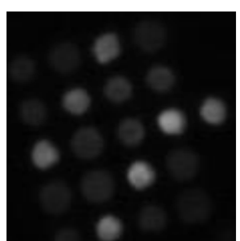
July — Deployment on July 11th and every other day surface sampling from July 17 – 25, then shallow and deep 27 - 31

Aug — Daily surface and bottom sampling from Aug 1 – 15 when it will be retrieved

Sept/Oct — Redeployment of ESPniagara for rest of field season

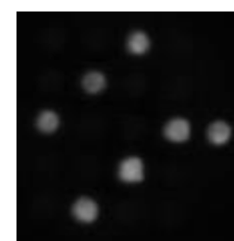


0.2 ng/mL MCLR



2.0 ng/mL MCLR

20.0 ng/mL MCLR



200.0 ng/mL MCLR

MC assay work being conducted by Greg Doucette and Tina Mikulski, NOAA NOS; Emily Davenport is the CIGLR ESP technician

Thank you for your attention!

QUESTIONS?

Sandusky Bay bloom 2017

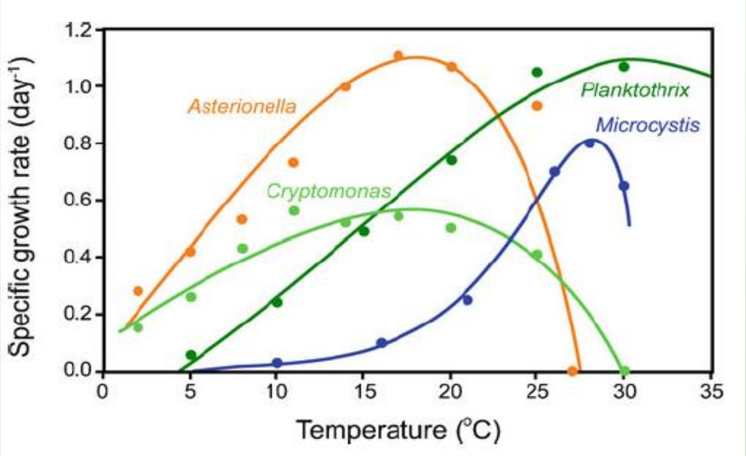
George Bullerjahn, Mike McKay, BGSU

Lauren Kinsman-Costello, Kent State

Laura Johnson, Heidelberg

Why is *Planktothrix* successful in SB?

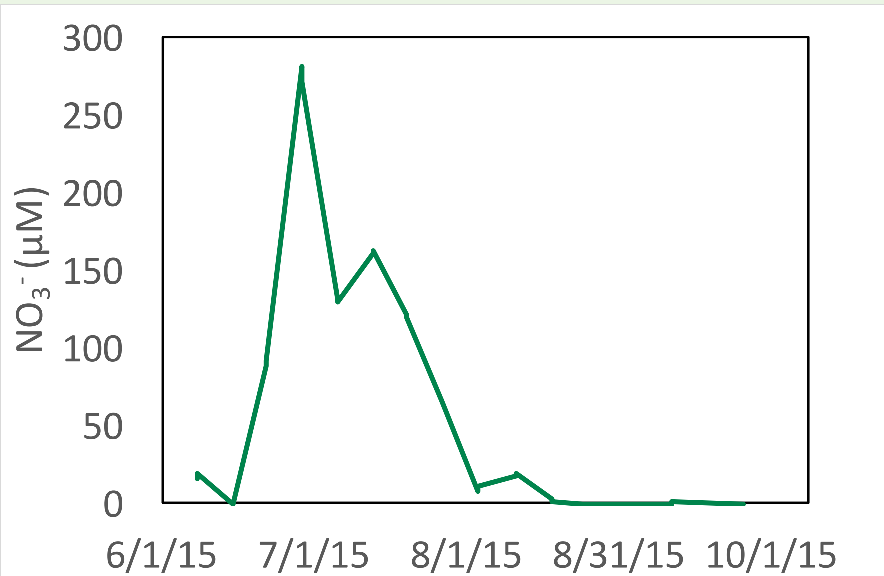
- Low light adaptation?
  - Scheffer et al. 1997
- Temperature?
  - Paerl 2012

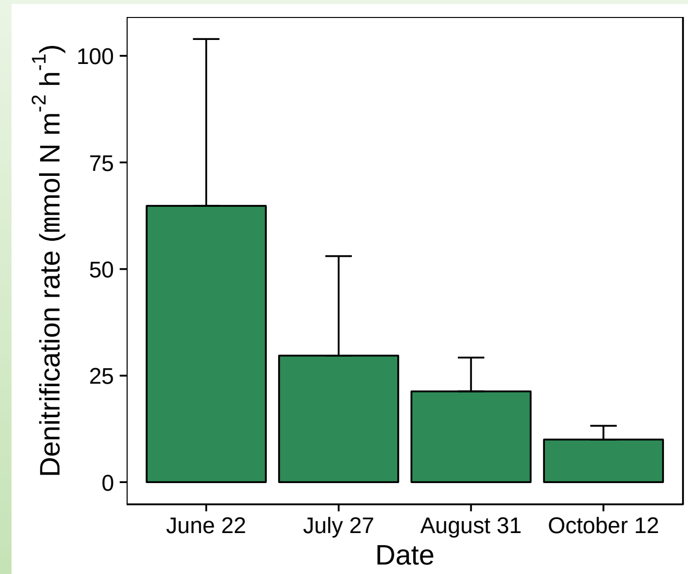


- Nitrogen availability?
  - *Planktothrix* can tolerate long-term N depletion
    - Current work, Davis et al. 2015, Steffen et al. 2014

C
P
NO_3
NH_4
Urea
P+ NO_3
P+ NH_4
P+ Urea

Nitrogen losses in the Bay are driven by denitrification (sta. EC 1163)

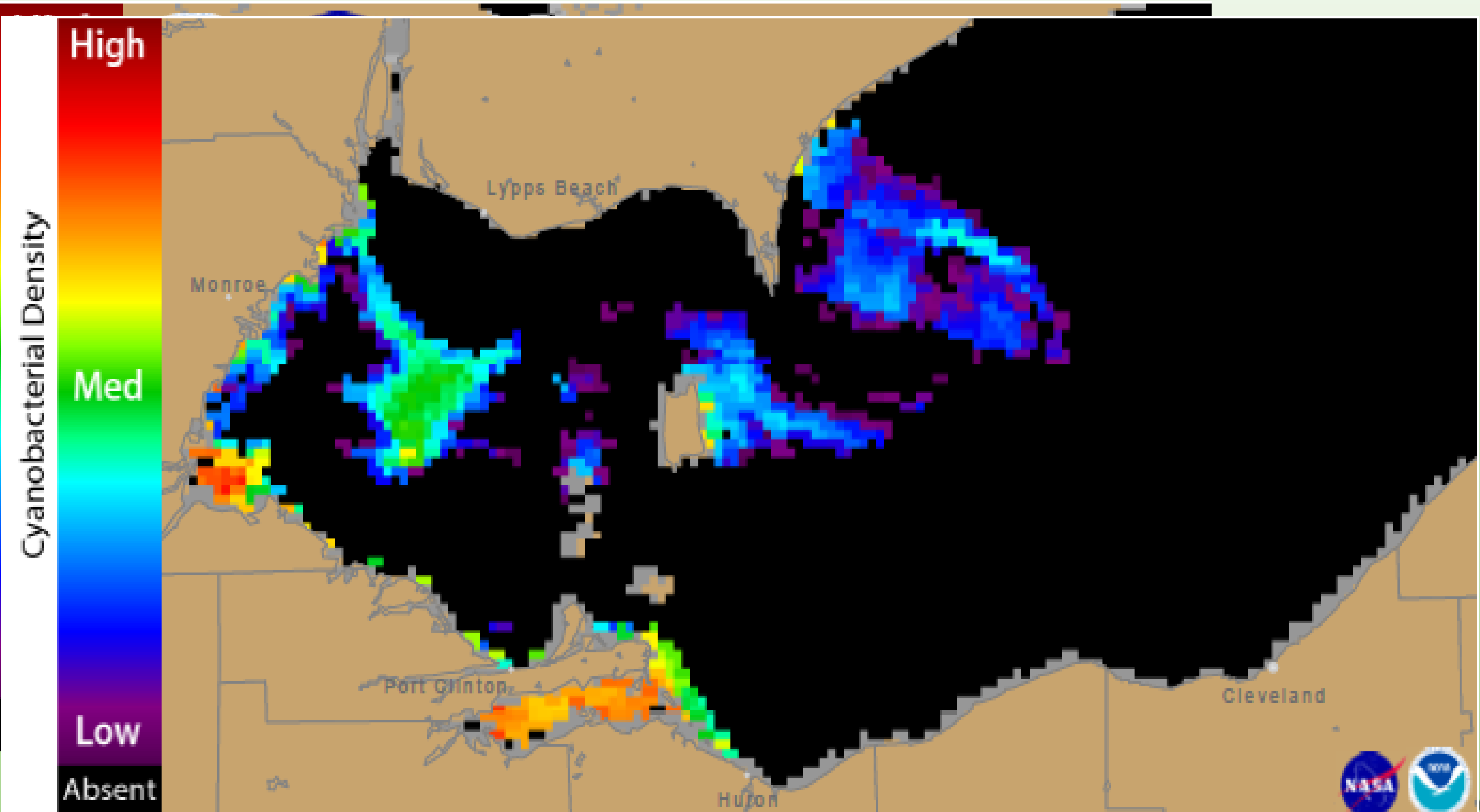




Work of Kateri Salk (MSU)
Rates are *ca.* 10 fold higher than areal rates in western Lake Erie (Small et al. 2016)

Great Lakes HABs Collaboratory

Even in a drought year, business as usual in Sandusky Bay!



2016 Summary – *Planktothrix*

- Low 2016 rainfall yielded lower nitrate than 2015
- Similar SRP values – due to internal loading??
- Extreme N:P ratios indicating strong N limitation
  - *Planktothrix* can survive long-term N depletion
- **The Sandusky bloom is an enduring phenomenon!**

Future work: Sandusky Bay Initiative

- Funds from statewide Healthy Lake Erie Fund
  - And ODNR/Sea Grant for baseline study
- Plan to build artificial wetlands and islands in the Bay
  - Re-purpose dredgings from the shipping channel
- Goal: reduce total nutrients, increase water clarity
- Limit nutrients, increase light transmission
- Baseline study begins summer 2017

Baseline study

- Assess water clarity in the Bay
- Determine *Planktothrix* growth at defined irradiances
  – What light levels are inhibitory? (Bullerjahn and McKay, BGSU)
- Assess internal loading of P from sediments
  – Determine role of sediments in nutrient availability (Lauren Kinsman-Costello, KSU and Laura Johnson, Heidelberg)
- Determine water flow from inner bay to outer bay
  – Modeling water retention time in the Bay

Work underway

- Eight sampling trips: June 5 – Aug 31
  - sediment cores, biomass, nutrients, pigment measurements, DNA/RNA
    - Measurements of internal loading of P
- Growth chamber incubations of biomass and cultured endemic *Planktothrix*
  - Growth inhibition seen above 200 μmol quanta m^{-2} s^{-1}
  - Parallel P vs I measurements
- Deployment of new buoy sonde in outer bay (May 30)
- Deployment of acoustic flow meter and sonde on Edison Bridge (June 28)
  - Long term assessment on water clarity and water movement

Evidence we’re doing stuff!

May 30, deployment from Gib III
41.46322, -82.76902

June 28, deployment at
41.469083, -82.853292

Thanks:

Stone Lab

ODNR

ODHE

BGSU personnel

Questions?

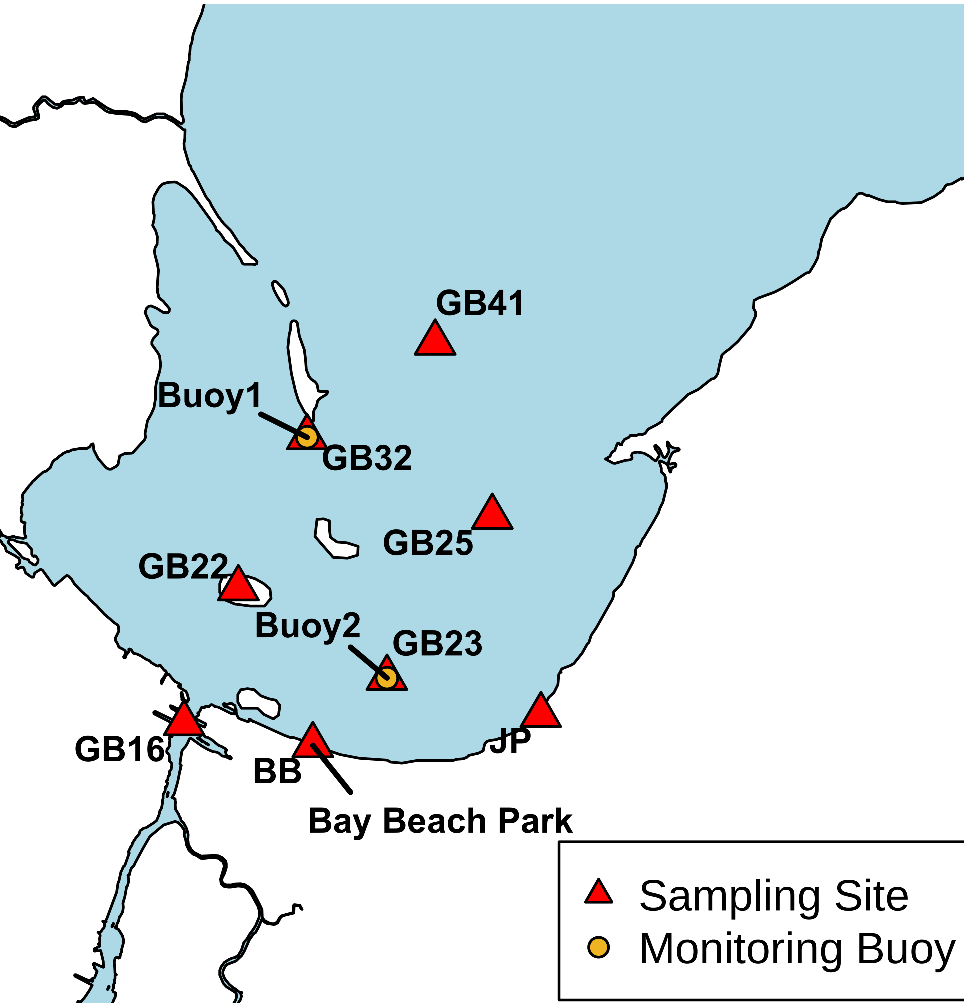
Assessing Cyanobacterial Harmful Algal Blooms in Green Bay: 2017 Field Season Kickoff

Todd Miller[a], Donalea Dinsmore[b], Sarah Bartlett[a,c], Erin Houghton[c], Gina LaLiberte[b], Tim Davis[d], Mary Evans[e], Joseph Duris[e], Carrie Kissman[f], Tyler Butts[f], Daniel Heimerl[f], Michael Zorn[g]

[a] University of Wisconsin - Milwaukee, [b] Wisconsin Department of Natural Resources, [c] New Water, [d] National Oceanic and Atmospheric Administration, [e] United States Geological Survey, [f] St. Norbert College, [g] University of Wisconsin – Green Bay

Sampling Locations and Questions

Sampling Locations in Lower Green Bay



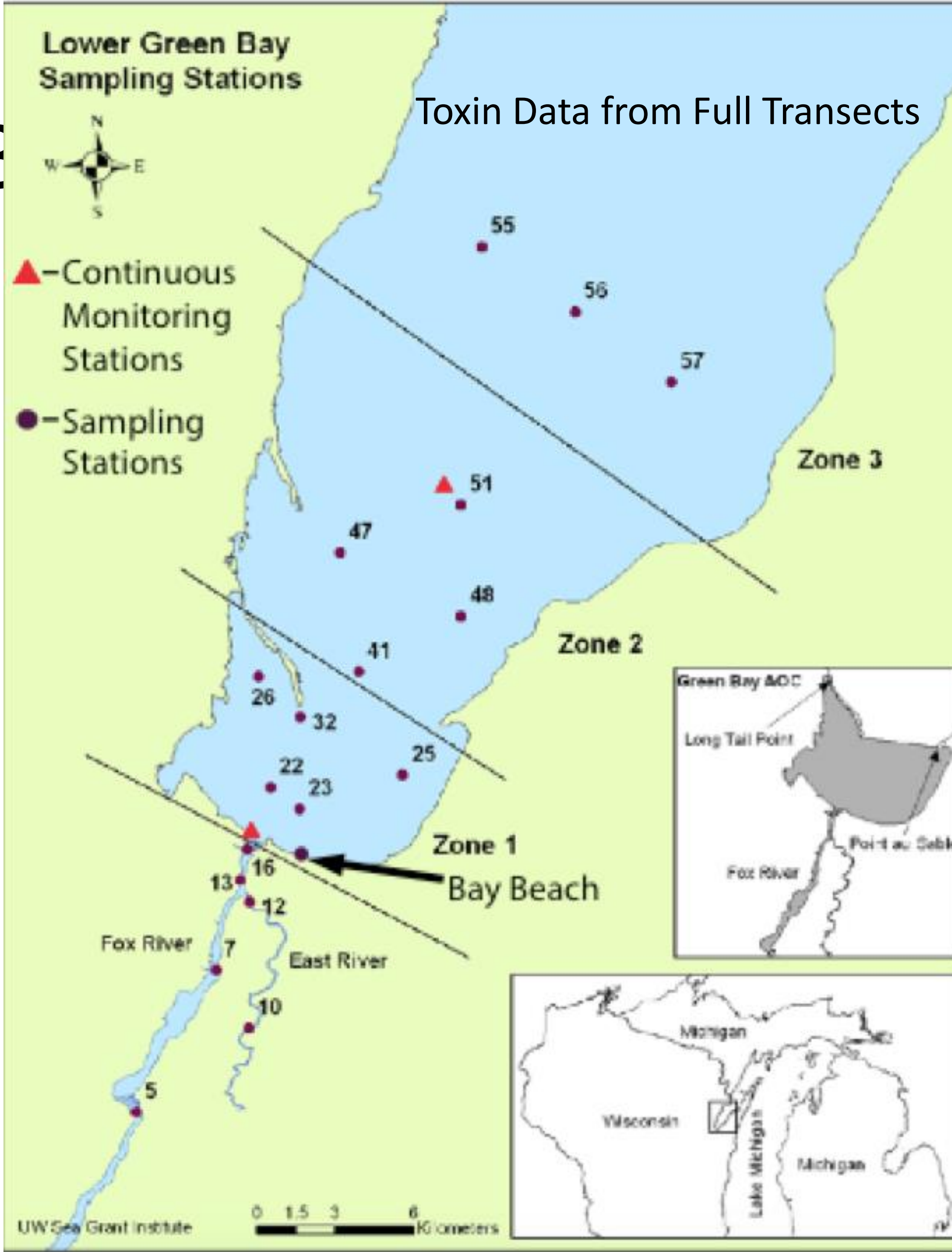
Research Questions

- Diversity and distribution of cyanotoxins in Green Bay
  - Weekly sampling along a transect + Bay Beach and Joliet Park
  - LC-MS/MS analysis of cyanotoxins
- Temporal modeling cyanotoxins in the Bay Beach area
  - Sampling 2- 3x per week
  - Physicochemical variables + cyanotoxins
  - Microscopic cell counts
  - Two water quality monitoring buoys
- Who are the microcystin producers in lower Green Bay and what are drivers of microcystin gene expression?
  - Quantification of toxin + 16S rRNA genes
  - RNA expression analysis of toxin genes

2017 Green B

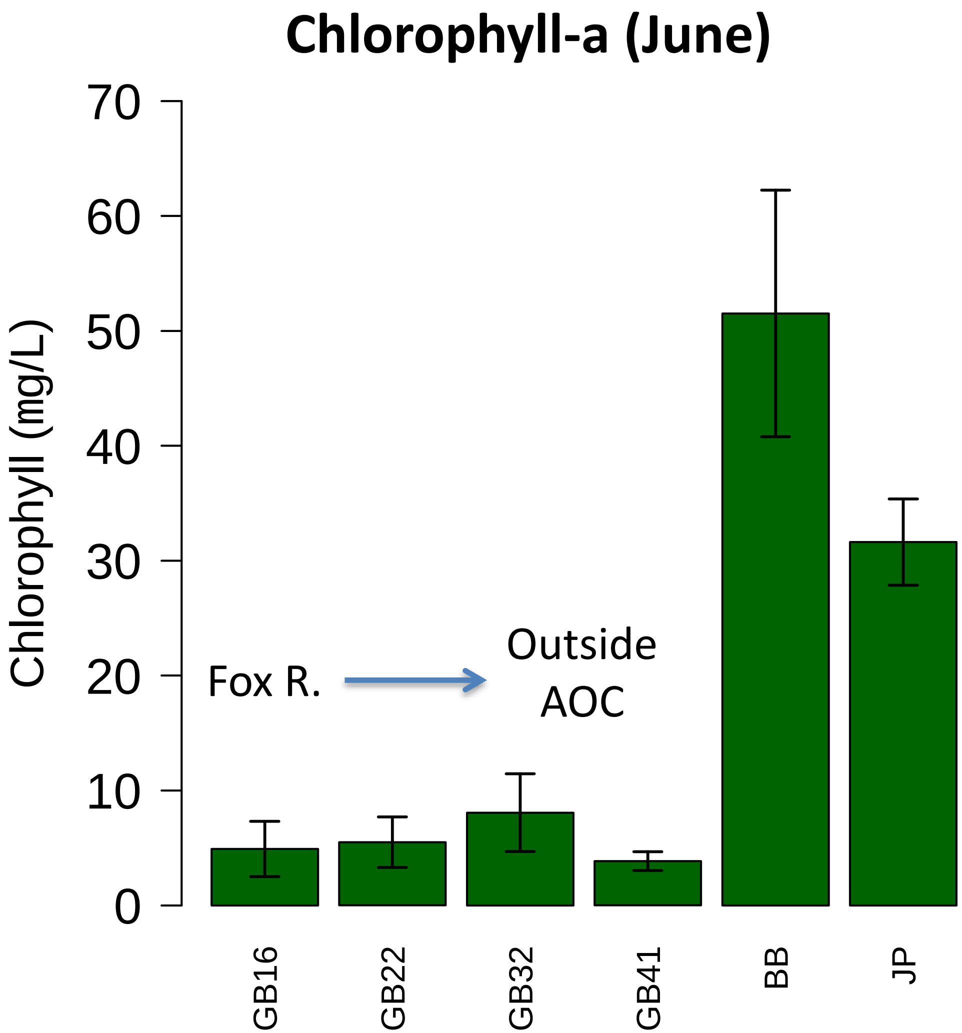
Data Collection in Progress

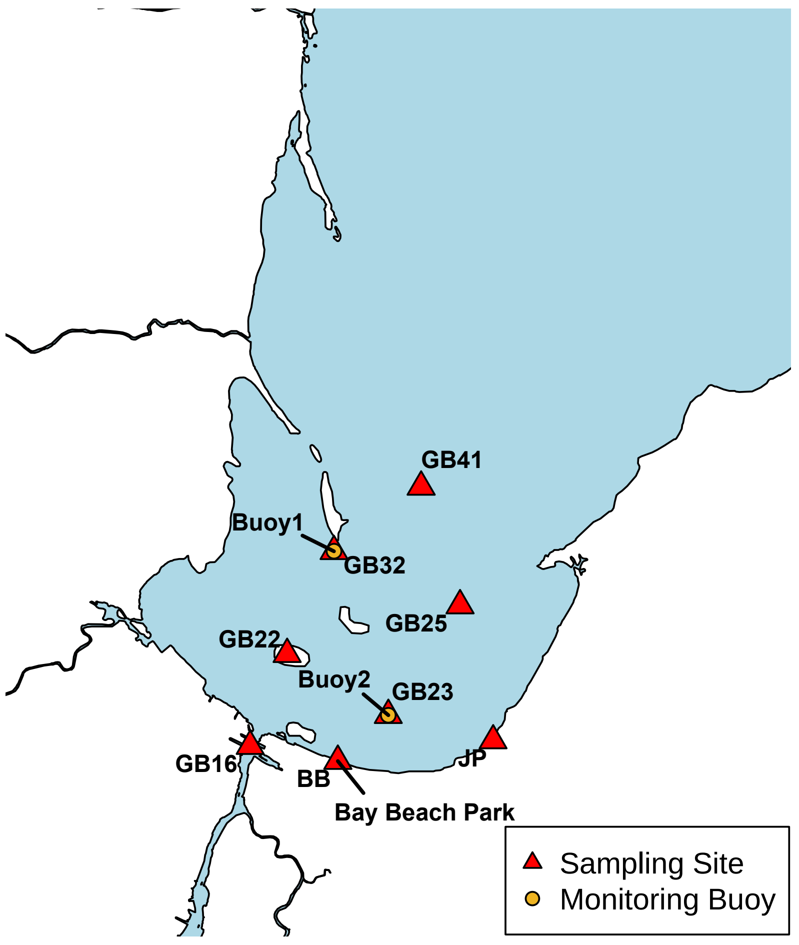
- Buoy Data
  - EXO2 Sonde
  - Chlorphyll and Phycocyanin Fluorescence
  - PAR
  - Wind Speed/Direction
  - CycleP on one buoy
- Toxins via LC-MS/MS
  - 12 microcystins, cylindrospermopsin, anatoxin-a, bioactive peptides
- Cell counts
- Pigments
  - Chlorophyll and Phycocyanin (spectrophotometry)
- Turbidity, VSS,TSS, Chloride
- Sonde Data
  - Water temperature
  - Dissolved Oxygen
  - pH,
  - ORP
- Toxin gene abundance, and expression
- Nitrogen
  - NH3, NO2, NO3, TKN, Urea
- Phosphorus
  - TP, SRP



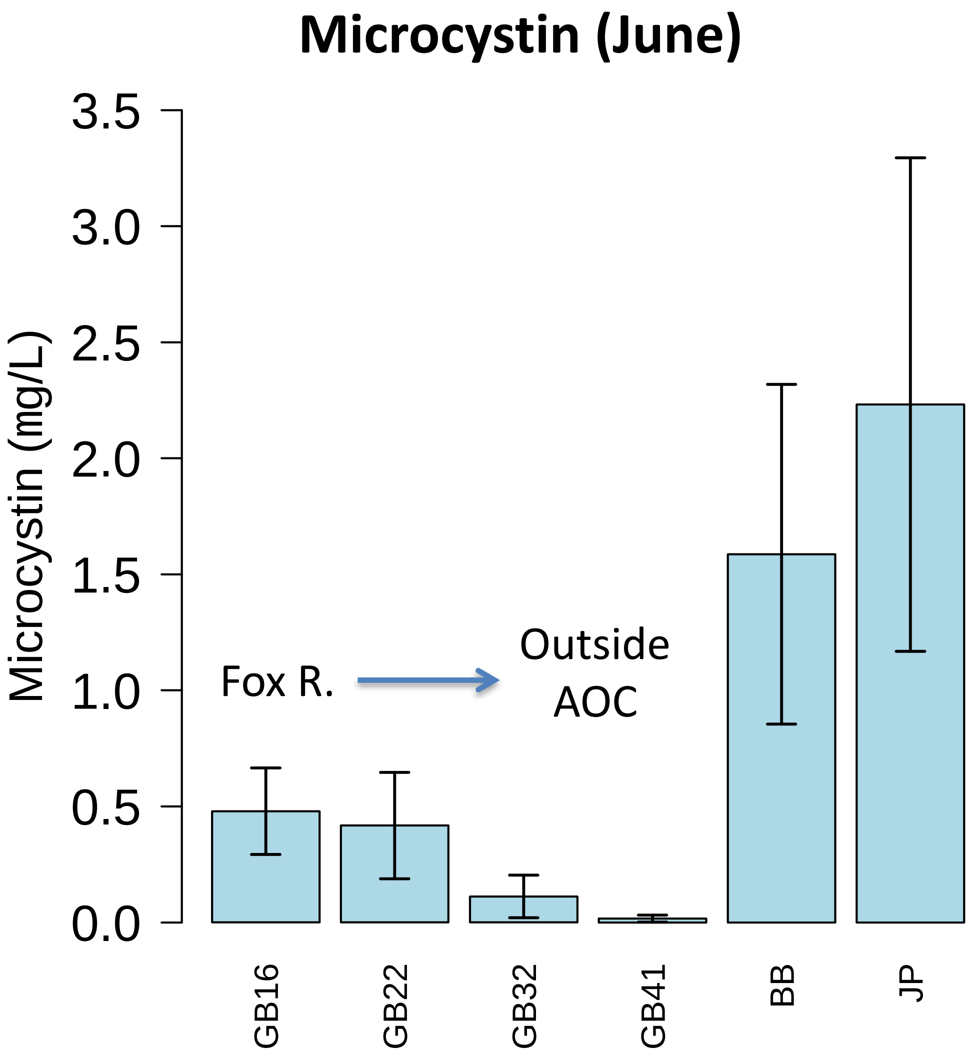
Late June Bloom, Bay Beach, Green Bay

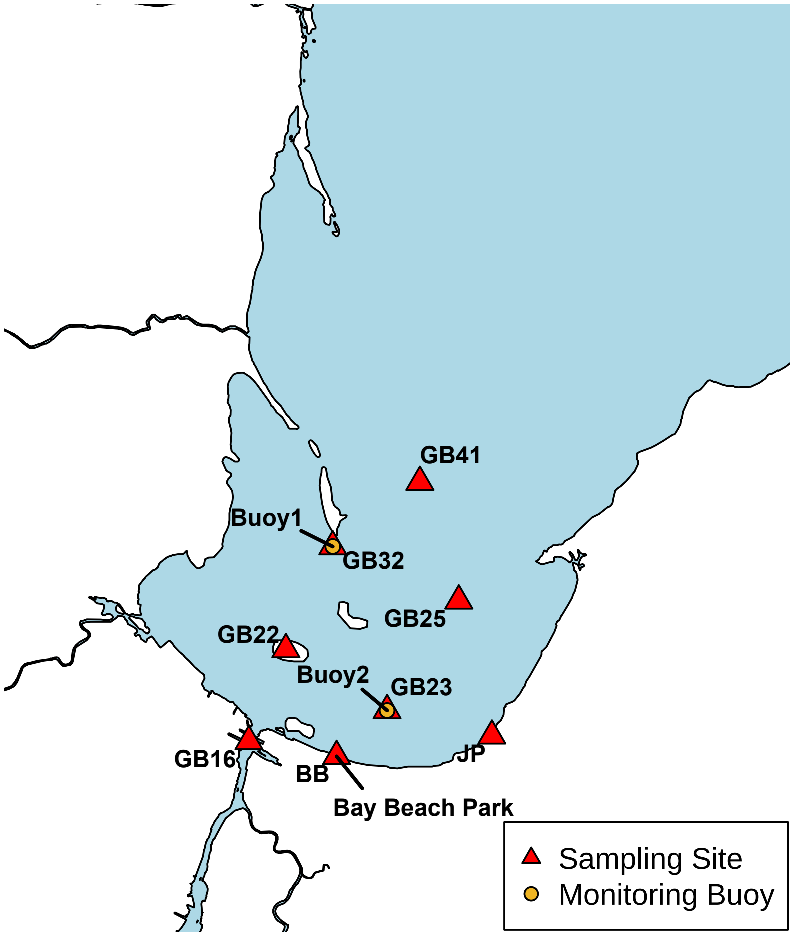
Chlorophyll in Lower Green Bay (June 2017)





Microcystin in Lower Green Bay (June 2017)





Lake Superior HABs:
Addressing an Emerging Issue at Apostle Islands National Lakeshore

Brenda Moraska Lafrancois (NPS)
Bob Sterner, Sandy Brovold, Nicole Farley, Kaitlin Reinl (UMD)

Great Lakes HABs Collaboratory, Summer Webinar

Acknowledgements

- University of Wisconsin-Milwaukee School of Freshwater Sciences
- Wisconsin State Lab of Hygiene
- Wisconsin Department of Natural Resources
- Great Lakes Restoration Initiative

Overview

- Background and study area
- Previous HABs events
- 2017 objectives and study design

Study Area

Blue-green Algae Observed in Lake Superior

By Northern Region July 25, 2012

Blue-Green Algae Spotted Again On Lake Superior

Blooms Spied Near Apostle Islands Sea Caves, No Evidence Of Toxins
By Danielle Kaeding
Updated:
Tuesday, September 13, 2016, 5:09pm

Dolichospermum lemmermannii

- Typically found in cold and temperate climates, oligo-mesotrophic and deep stratifying lakes (Salmaso et al. 2015)
- Potential toxin producer:
  - Anatoxin-a (Henricksen et al. 1997; Onodera et al. 1997)
  - Microcystin (Sivonen et al. 1992; Savela et al. 2015)
  - Saxitoxin (Rapala et al. 2005)

Expansion of bloom-forming *Dolichospermum lemmermannii* (Nostocales, Cyanobacteria) to the deep lakes south of the Alps: Colonization patterns, driving forces and implications for water use

Nico Salmaso [a,*], Camilla Capelli [a,b], Shiva Shams [a], Leonardo Cerasino [a]

[a] *IASMA Research and Innovation Centre, Istituto Agrario di S. Michele all'Adige – Fondazione E. Mach, Via E. Mach 1, 38010 S. Michele all'Adige (Trento), Italy*
[b] *Department of Biology, University of Florence, Via La Pira 4, 50121 Florence, Italy*

- Expanding in other systems, like deep lakes of the Italian Alps (Salmaso et al. 2015a, b)
  - First observed in shallower, wind-sheltered areas
  - In successive years, expanded over whole lake
- "The appearance of extended surface blooms has caused serious concerns..."

Gina LaLiberte, Wisconsin DNR

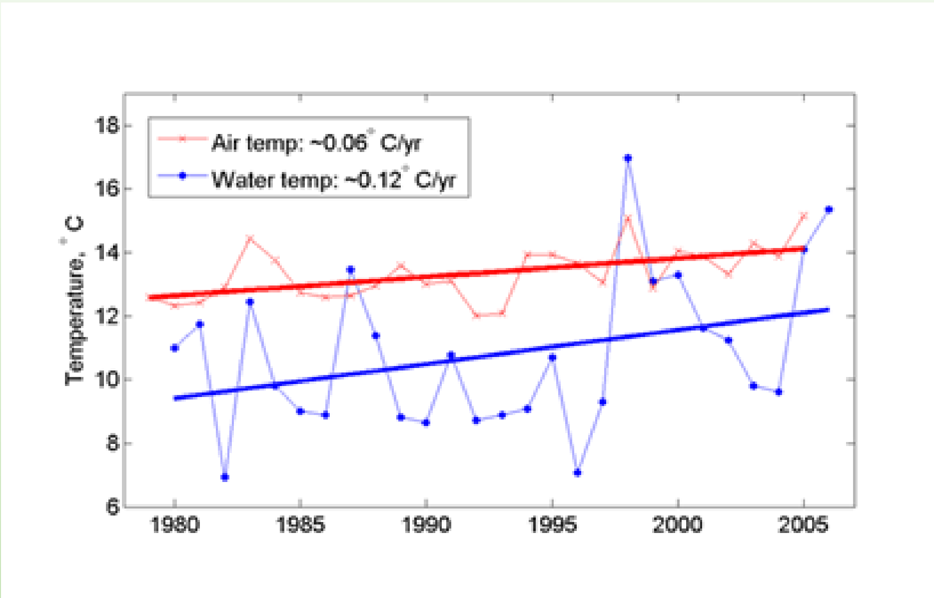

June 24, 2012

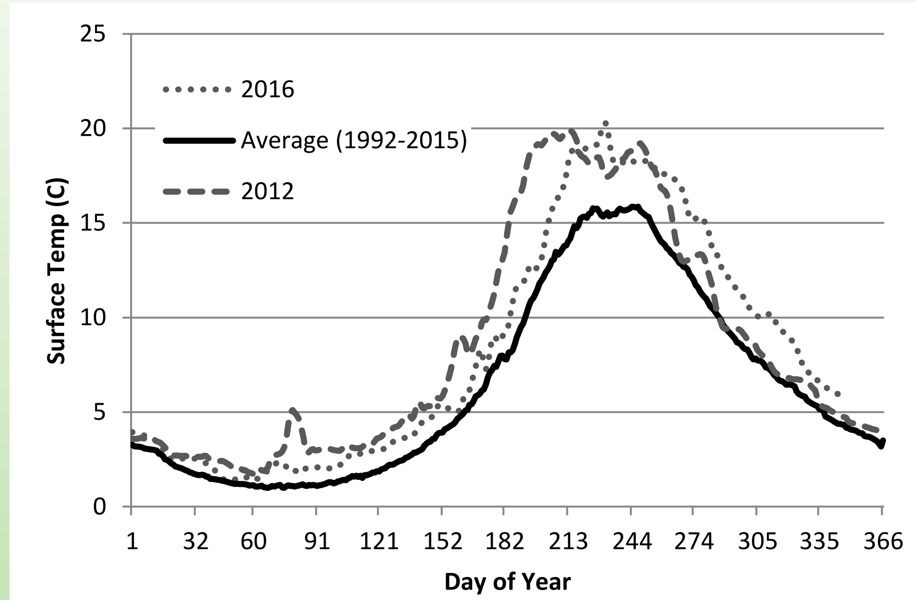
Climate Connections?

2012 HAB: "…extremely unusual. The floods flushed nutrients and sediments from the land into the lake. Combined with the warm weather, conditions may have been just right for the algae to multiply."

2016 HAB: A new usual?

Temperature Connections?





- Lake Superior water temp is rising faster than air temp since 1980 (Austin and Colman 2007).

- Lake Superior water temps were above average in years with HABs (NOAA GLSEA data)

2017 Objectives

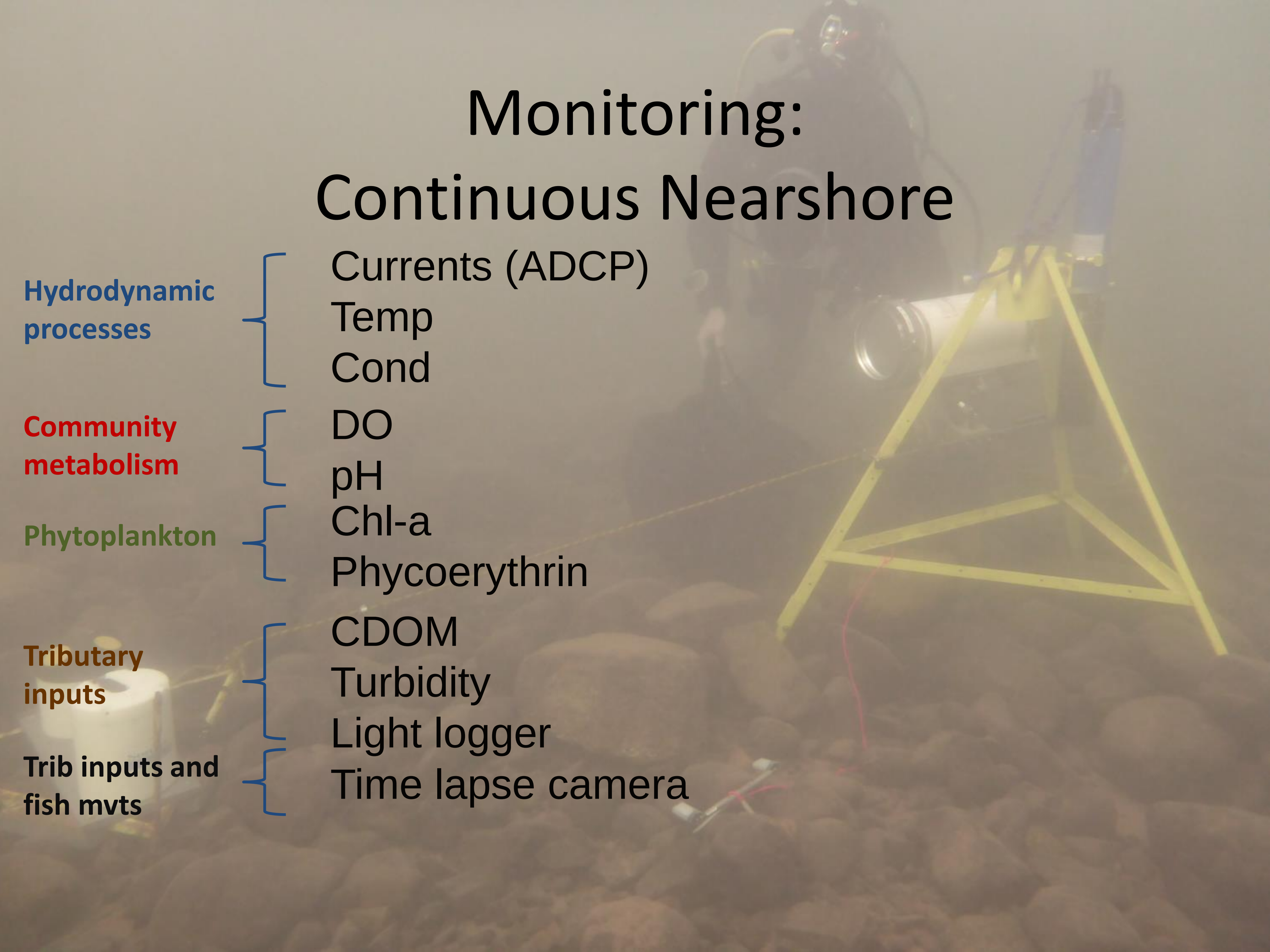
- Document baseline conditions
  - Water chemistry
  - Algal biomass; communities; toxins
- Relate algal biomass and HABs indicators to environmental factors
- Explore experimental and modeling approaches

Monitoring Design

△ Nearshore monitoring site

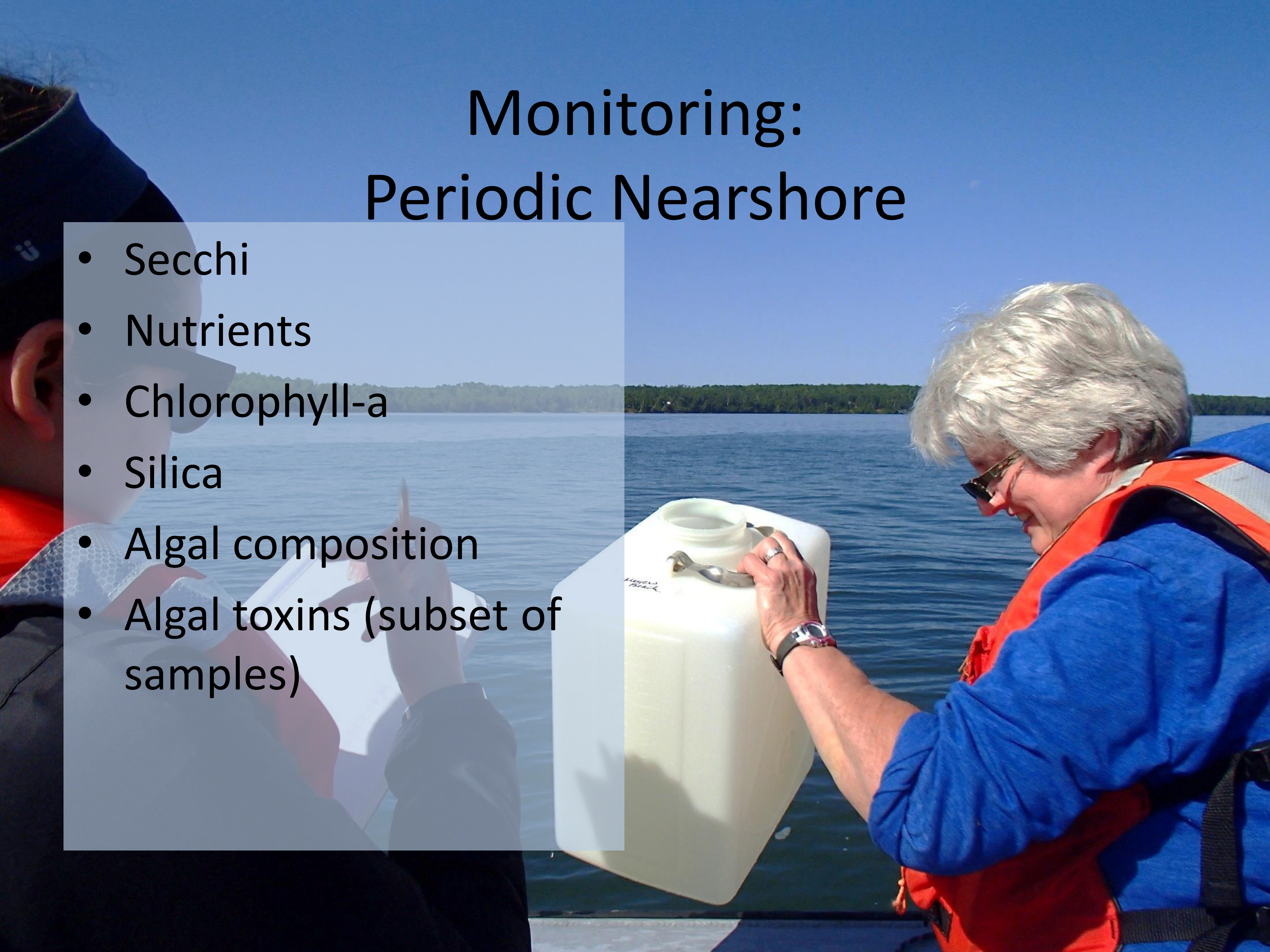
● Tributary monitoring site

Presenter: Brenda Moraska Lafrancois


Monitoring:
Continuous Nearshore
Hydrodynamic processes
Currents (ADCP)
Temp
Cond
Community metabolism
DO
pH
Phytoplankton
Chl-a
Phycoerythrin
Tributary inputs
CDOM
Turbidity
Light logger
Trib inputs and fish mvts
Time lapse camera

Monitoring: Periodic Nearshore

- Secchi
- Nutrients
- Chlorophyll-a
- Silica
- Algal composition
- Algal toxins (subset of samples)



Monitoring: Periodic Tributary

- Nutrients
- Chlorophyll-a
- Algal composition
- Silica

Outreach Plans

- NPS Interpretive Efforts
- Citizen Science
- Environmental education partnerships

Lake St. Clair-Thames River Water Quality and Harmful Algal Bloom Assessment: 2017 Field Program

Ngan Diep

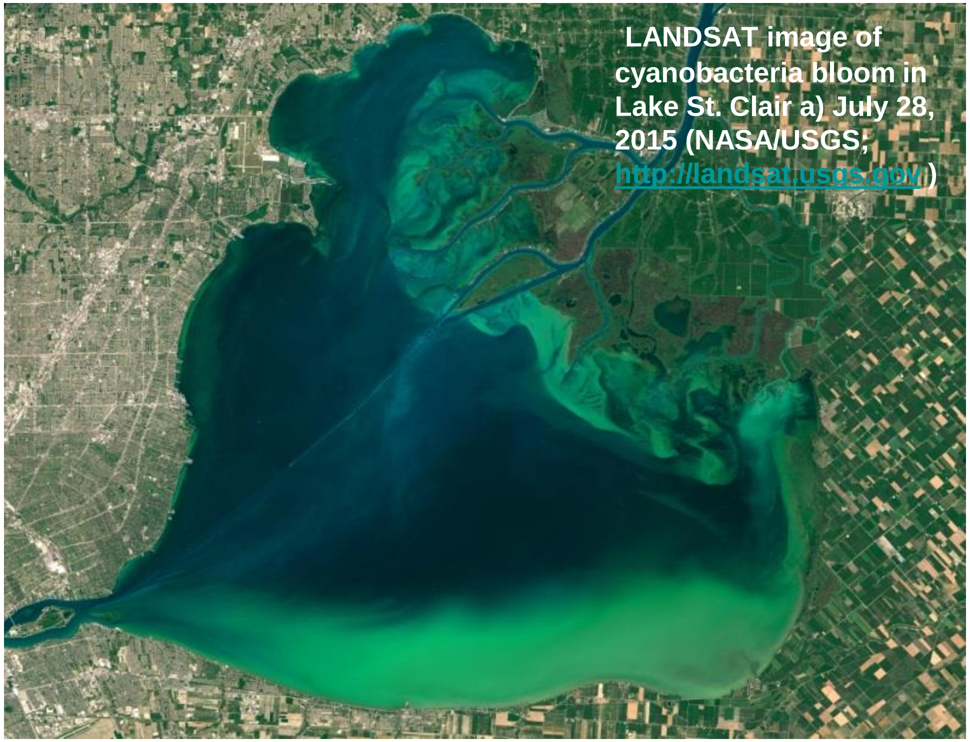
Great Lakes Unit, Water Monitoring Section, Ontario Ministry of Environment & Climate Change

In Partnership with

Alice Dove and Sean Backus

Water Quality Monitoring and Surveillance Division, Environment and Climate Change Canada

Lake St. Clair-Thames River



- Lake St. Clair is a shallow mesotrophic lake (≤ 6 m)

- Recent satellite imagery of Lake St. Clair indicate potential wide-spread cyanobacterial blooms

- Thames River is the largest Canadian tributary along Lake St. Clair and is identified as a priority tributary under Annex 4 – Nutrients of the GLWQA

- Identified a need to understand water quality conditions in Lake St. Clair and linkage between discharges from the Thames River to lake conditions

- Four year project: 2016 - 2019

Project Objectives

1. Assess the range of water quality conditions in Lake St. Clair with emphasis on the Thames River area

2. Assess the extent, occurrence, magnitude and frequency of potential harmful algal blooms (HABs) in Lake St. Clair

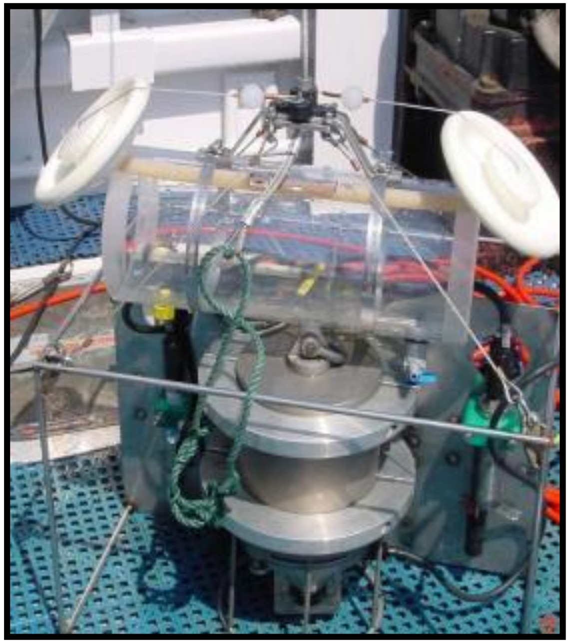
3. Assessment of the drivers and causal linkages underlying water quality patterns and cyanobacterial blooms in Lake St. Clair

4. Quantify the role of Thames River discharges on water quality conditions of Lake St. Clair and relative contributions of nutrients and materials to Detroit River and Lake Erie

Ontario

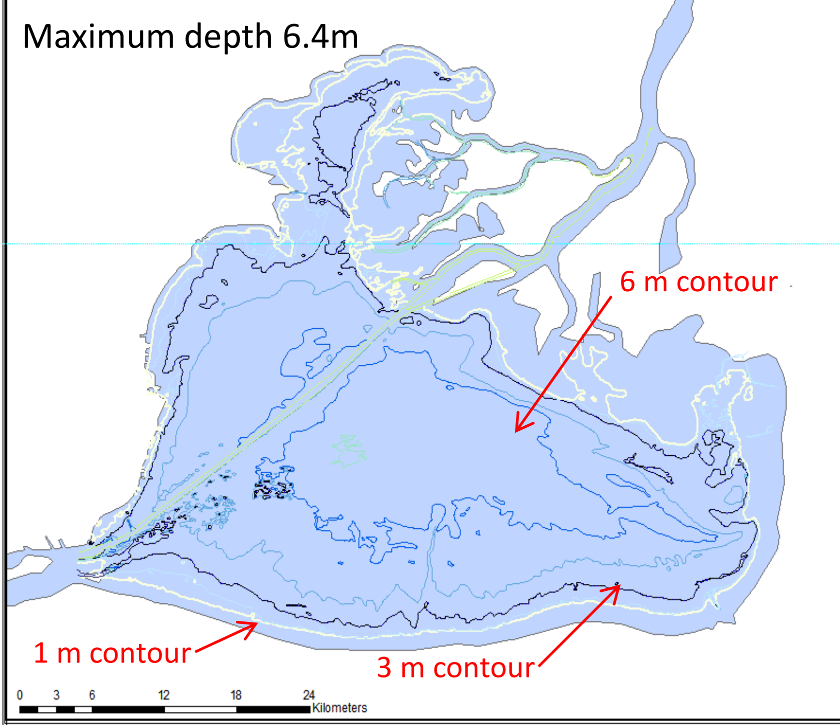
Intensive Nearshore Monitoring Program

- Environmental Sampling (WQ, SQ, Biota)
- Spatial Mapping
- Water Column Profiling
- Real-time Sensors
- Modeling



Survey Design

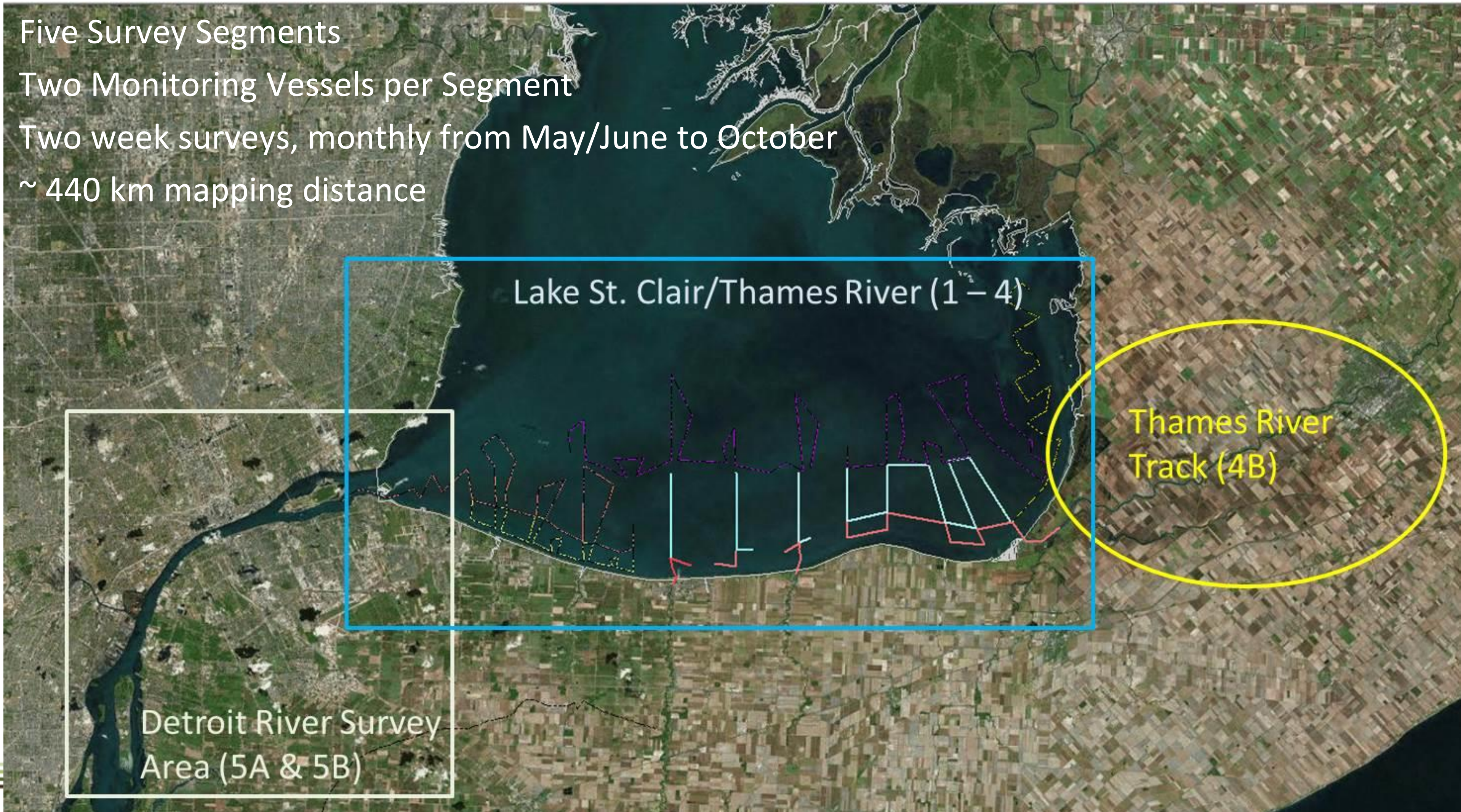
To capture the key limnological features, multiple sampling platforms were used to concurrently track water quality conditions:



- **<u>Spatially</u>**: across Lake St. Clair from Chenal Ecarte to upper Detroit River and Thames River
- **<u>Temporally</u>**: real-time sensors deployed across Lake St. Clair, the mouth of the Thames River and Detroit River to capture water quality trends over the ice-free season
- **<u>Across habitat types</u>**: sampling across Lake St. Clair at tributary, inshore (1 – 3 m) and nearshore (3 – 6 m) locations (two vessel approach)
- **<u>Using predictive tools</u>**: 3D hydrodynamic model to inform survey design and future modelling of Lake St. Clair system

Ontario

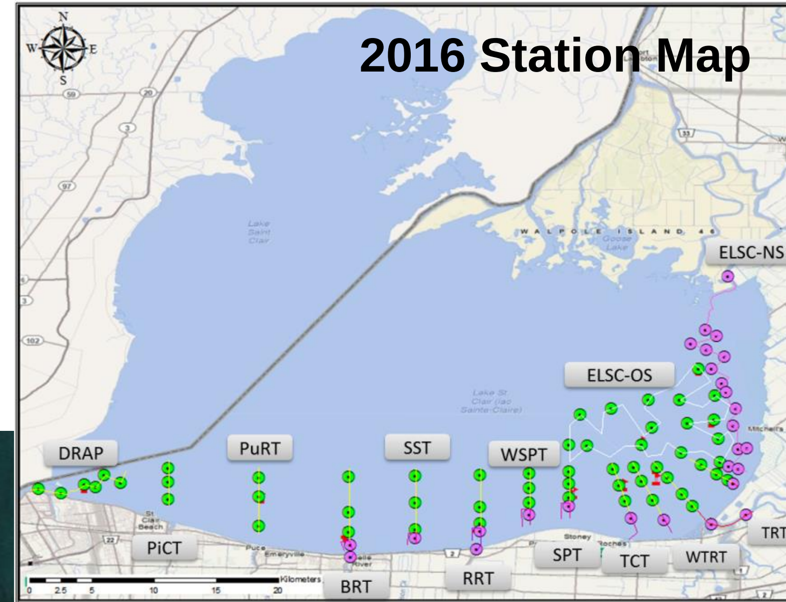
Monitoring Areas: Lake St. Clair, Thames River & Detroit River

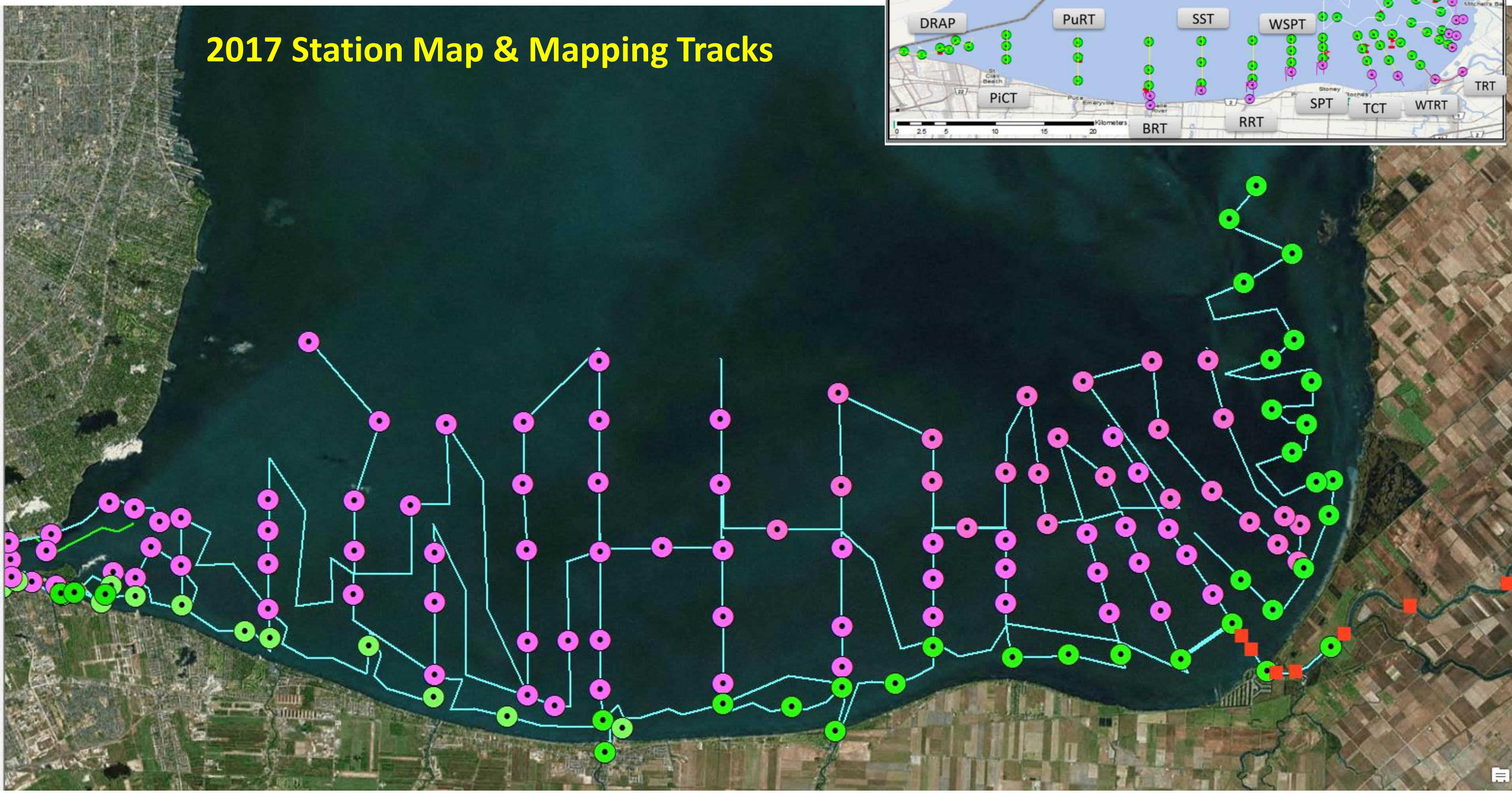


Ontario

- ~ 200 monitoring stations across Lake St. Clair, Thames River and upper Detroit River

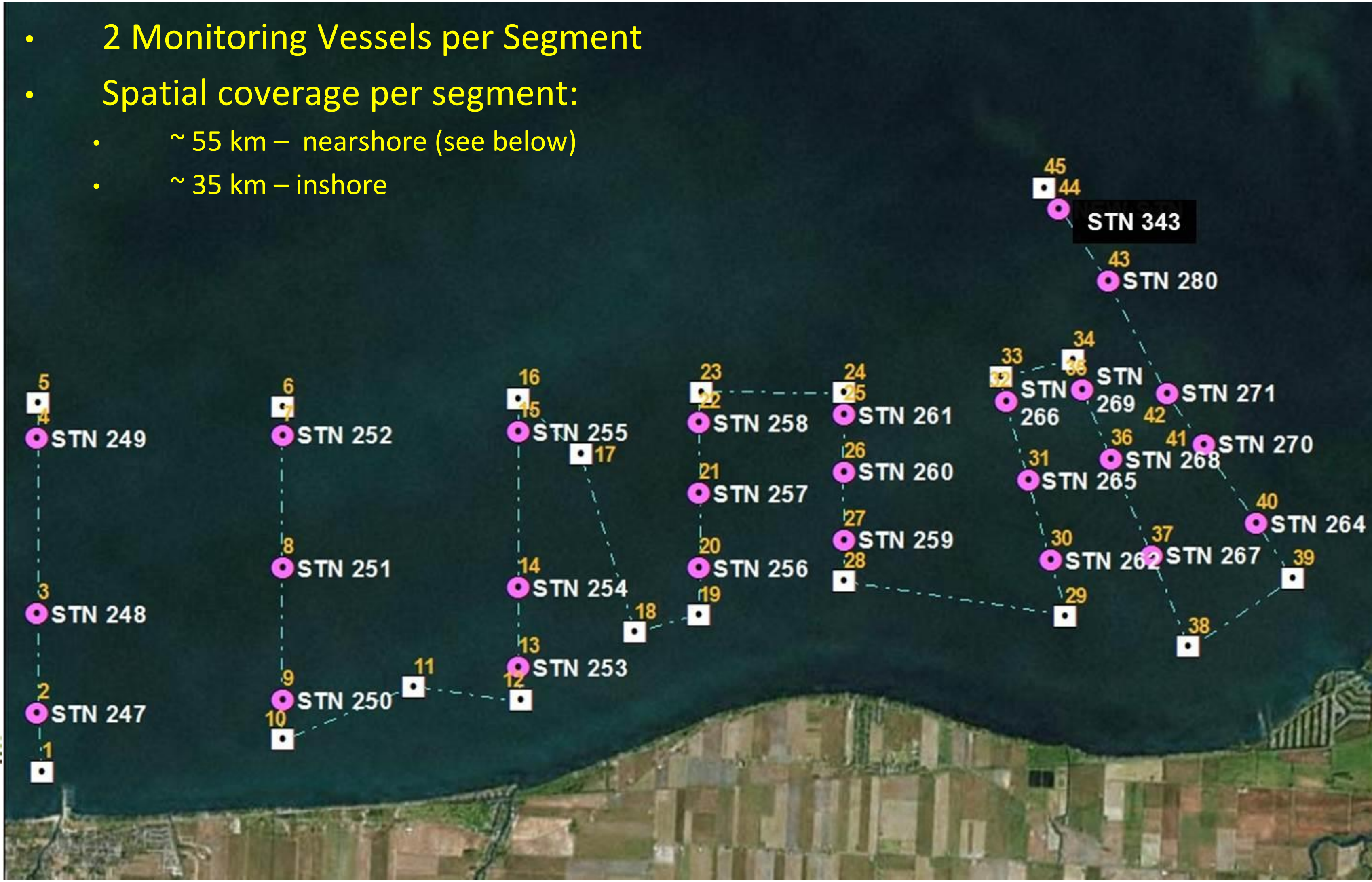
Parameters: total & dissolved phosphorus, soluble reactive phosphorus, nitrogen, chlorophyll, conductivity, chloride, phycocyanin, suspended solids, dissolved organic carbon, sulphate, bacteriodes, cations/anions



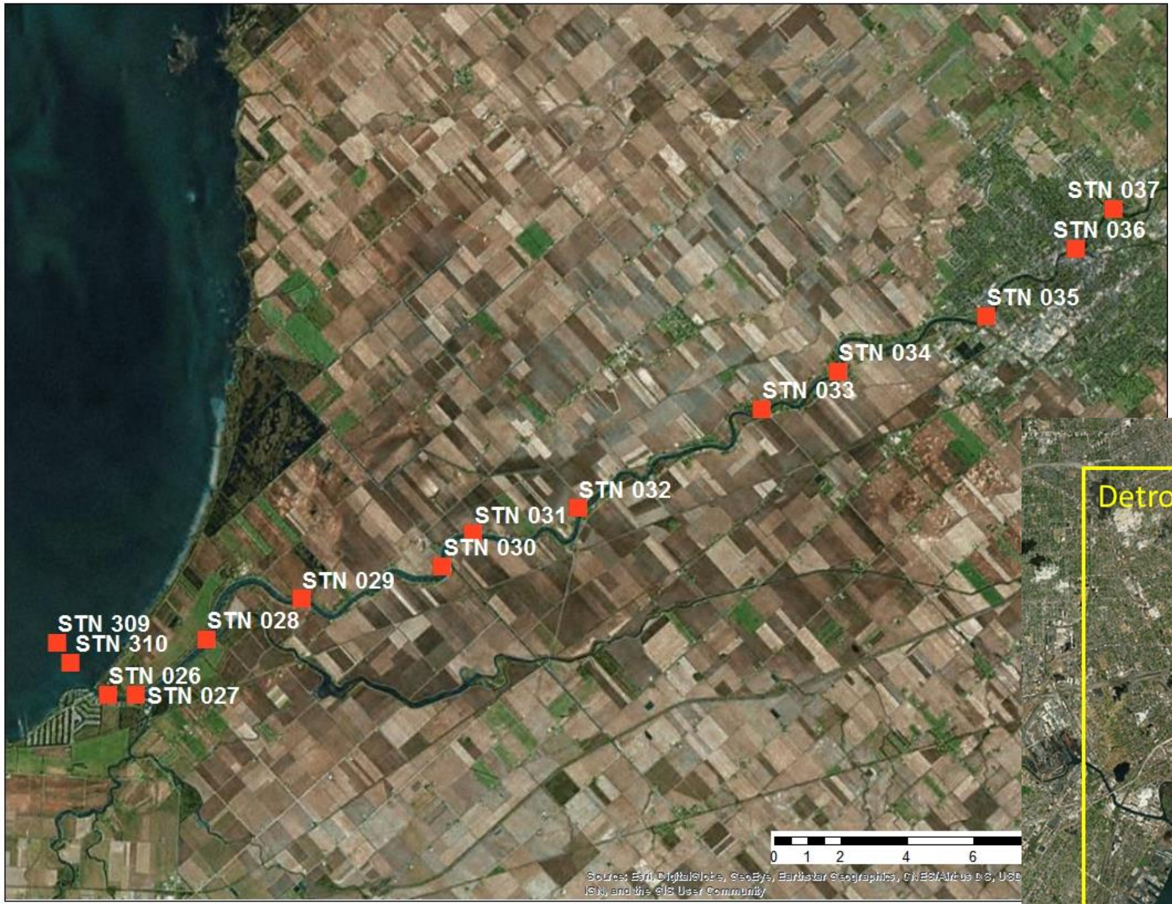


Segment 2A: South Shores Lake St. Clair

- 2 Monitoring Vessels per Segment
- Spatial coverage per segment:
  - ~ 55 km – nearshore (see below)
  - ~ 35 km – inshore



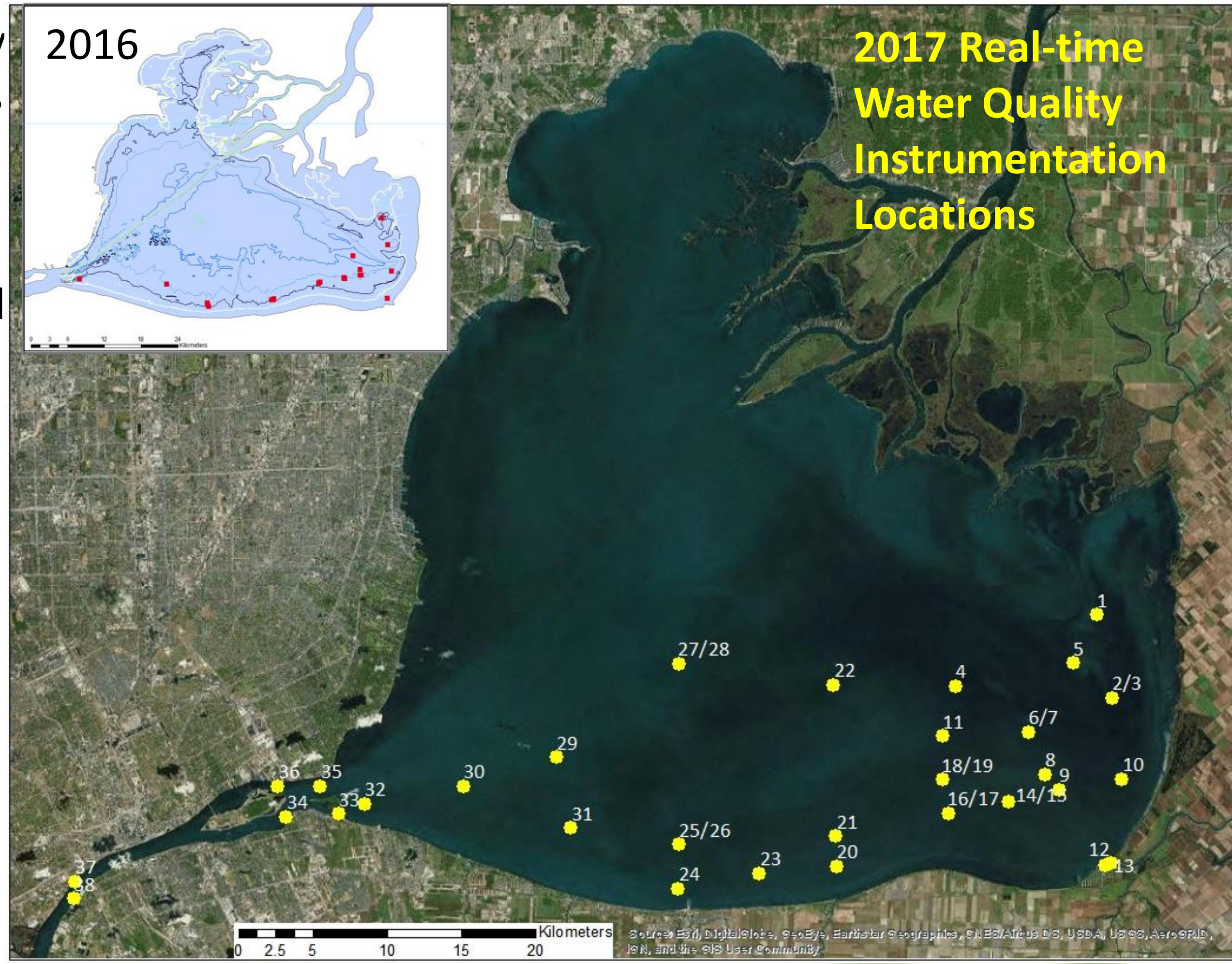
Thames River & Detroit River Mapping



- **Thames River**
  - 14 monitoring stations
  - 35 km mapping track
- **Detroit River**
  - 43 monitoring stations
  - 90 km mapping track (2 vessels)

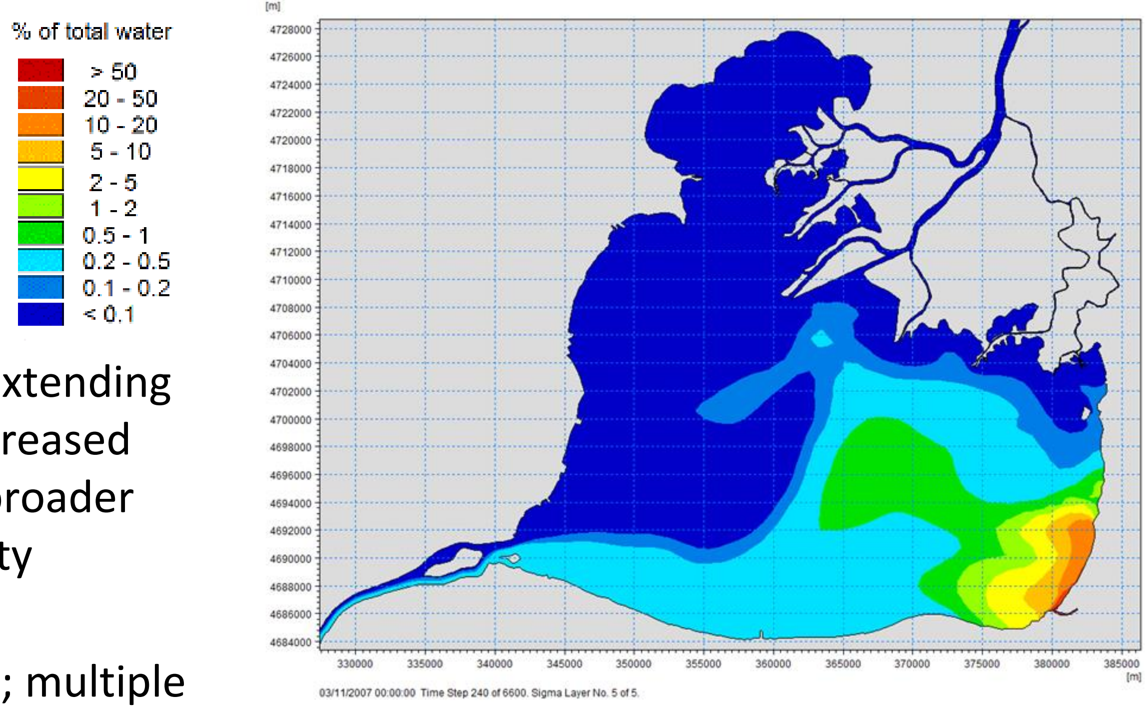
Temporal Patterns: Real-time Water Quality Sensors

- 38 real-time water quality instrumentation locations across Lake St. Clair and upper Detroit River
- Water quality data logged continuously throughout the ice-free season (May – Nov) in 10 to 30 min increments
- Sensors: current velocity and direction, turbidity, chlorophyll a, temperature, dissolved oxygen, PAR, phycocyanin, conductivity



Ontario

Summary



- 2017 field year in Lake St. Clair extending into upper Detroit River with increased sampling frequency to capture broader range of anticipated water quality conditions
- Large suite of water quality data; multiple platforms
- Real-time deployed water quality sensors
- Field-based water quality surveillance
- Spatial mapping across Lake St. Clair, Thames River and Detroit River
- Opportunities for collaboration

Acknowledgements

Great Lakes Field Operations: Wendy Page, Ryan Motostune, Brian Thorburn, Kyle McCouat, John Thibeau, Bo Lam, Trevor Gelaznikas, Emily Peets, Lance Boyce, Erin Nicholls, Robert Howard, Kayleigh Hutt-Taylor, Samuel Mansfield

Water Quality Monitoring Staff: Vi Richardson, Allison Puhl, Andrew Mummery

MOECC Laboratory Services Branch and ECCC National Lab for Environmental Testing

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In Partnership with Alice Dove & Sean Backus, ECCC

Environment Canada Environnement Canada

Ontario

Tracking Algal Blooms in Ontario's Lakes

Claire Holeton, Michelle Palmer, Kaoru Utsumi

Environmental Monitoring and Reporting Branch

Ministry of the Environment and Climate Change

July 24th, 2017 HABs Collaboratory: 2017 Field Season Webinar

What is the MOECC doing about blooms?

Ontario's 12-Point Plan includes:

Education and Outreach

- info on **ontario.ca** and new fact sheets

Nutrient Reduction

- legislation (e.g., Nutrient Management Act, Ontario Water Resources Act) & numerous programs have been implemented to reduce nutrient loading to Ontario waterbodies

Research & Monitoring

- MOECC partners with government, universities, NGOs, & other stakeholders on numerous efforts to understand algae & the factors that promote algal blooms

Blue-Green Algae Incidence Response

- provincial response to reports of algal blooms
- tracks the occurrence & prevalence of algal bloom reports throughout the province

More info at https://www.ontario.ca/page/blue-green-algae

Ontario

Ontario's algal bloom response

As a result of concern of health risks to humans and animals, algal blooms are a priority issue

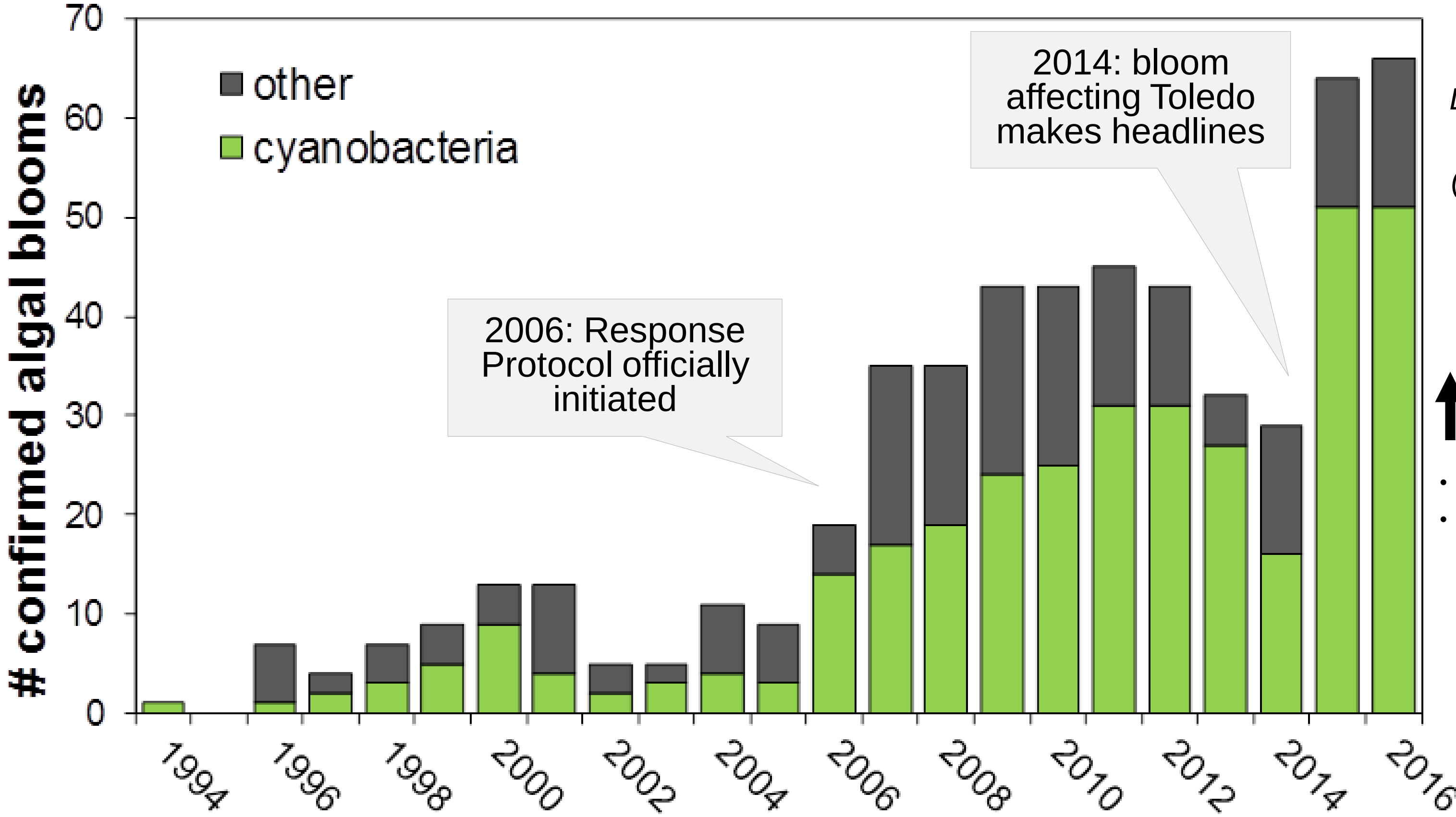
- The Ministry has a comprehensive protocol for responding to reports of blooms that involves communication and collaboration among the various stakeholders
- MOECC role is to gather, assess and provide basic scientific & technical information with which the Health Units can assess risks to humans
- Health Unit makes decisions as to whether notification of the public is required, and what actions should be taken

Complementary tools for bloom response

METHOD	Reports on:	Pros/Cons	Helpful for:
Microscopy	Algal taxa	• Most rapid • Identifies potential toxin producers (cyanobacteria) • Doesn’t measure toxins	<u>Screening:</u> Flags situations where toxin production may occur
ELISA	Total microcystins	• Rapid • Coarse measure, not specific to a toxin/variant	<u>Screening:</u> Flags samples with high toxin concentrations
Mass Spec	Individual toxin variants	• Allows assessment of drinking water standard (based on Microcystin-LR) • Slowest to report	<u>Follow-up:</u> Comparison with drinking water standard

Ontario

Increasing trend in # reported blooms

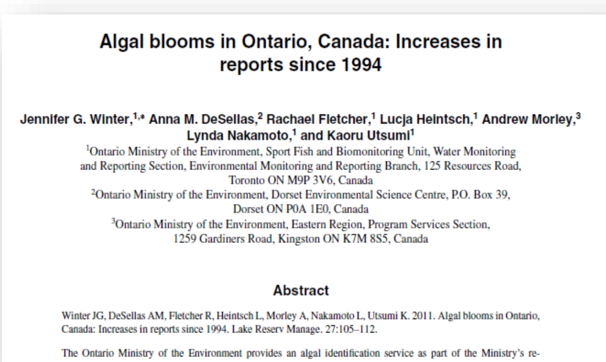


Winter et al. 2011, Lake and Reservoir Management

(with updated data)

↑ ***P* < 0.001:**

- total # blooms
- # cyano blooms



Algal blooms in Ontario, Canada: Increases in reports since 1994

Jennifer G. Winter,[1,*] Anna M. DeSellas,[2] Rachael Fletcher,[1] Lucja Heintsch,[1] Andrew Morley,[3] Lynda Nakamoto,[1] and Kaoru Utsumi[1]

[1]Ontario Ministry of the Environment, Sport Fish and Biomonitoring Unit, Water Monitoring and Reporting Section, Environmental Monitoring and Reporting Branch, 125 Resources Road, Toronto ON M9P 3V6, Canada

[2]Ontario Ministry of the Environment, Dorset Environmental Science Centre, P.O. Box 39, Dorset ON P0A 1E0, Canada

[3]Ontario Ministry of the Environment, Eastern Region, Program Services Section, 1259 Gardiners Road, Kingston ON K7M 8S5, Canada

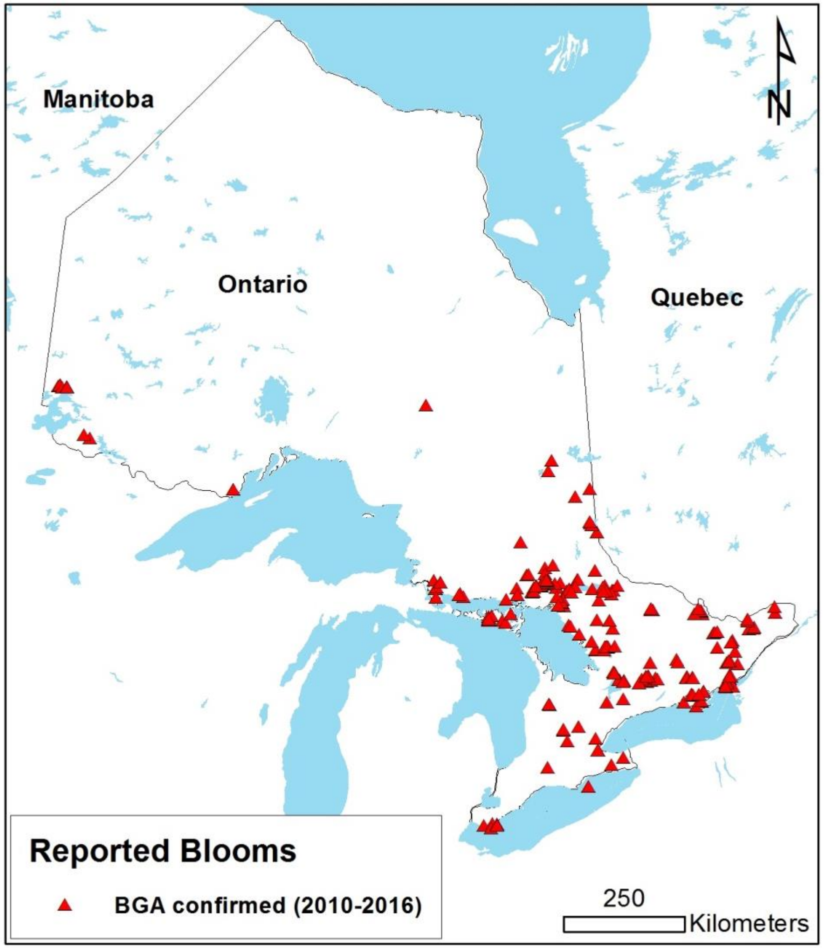
Abstract

Winter JG, DeSellas AM, Fletcher R, Heintsch L, Morley A, Nakamoto L, Utsumi K. 2011. Algal blooms in Ontario, Canada: Increases in reports since 1994. Lake Reserv Manage. 27:105–112.

The Ontario Ministry of the Environment provides an algal identification service as part of the Ministry's re-

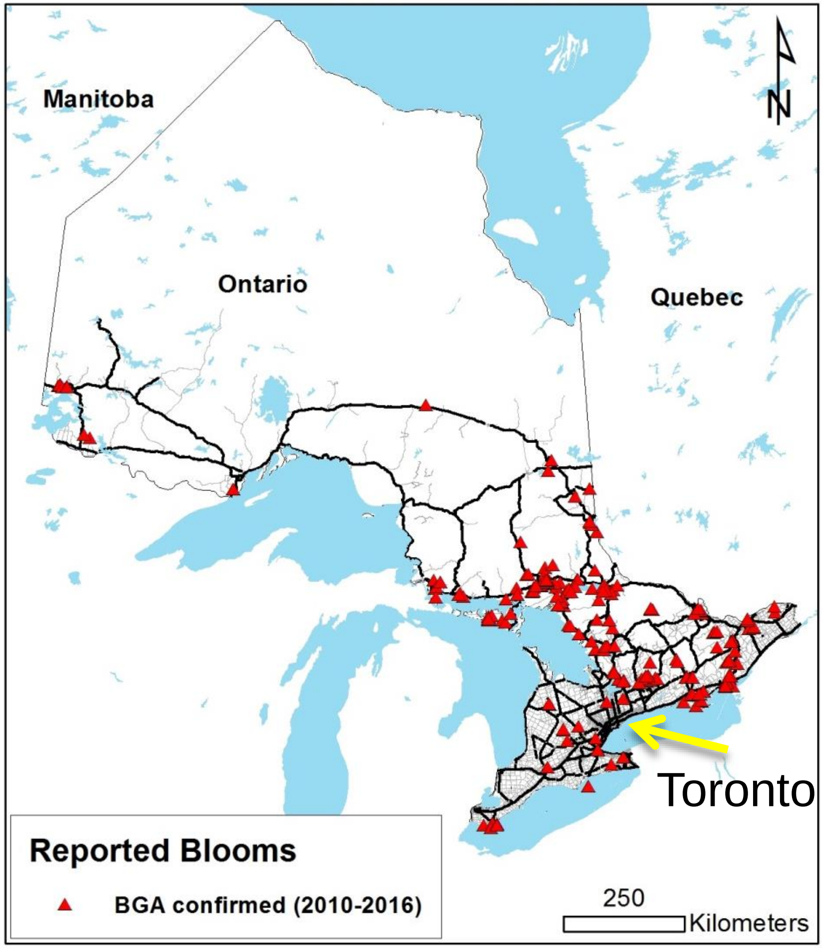
- The frequency of bloom reports in Ontario inland lakes is increasing
- The frequency of confirmed cyanobacteria blooms in particular is increasing

Locations of blue-green algal (BGA) blooms 2010-2016



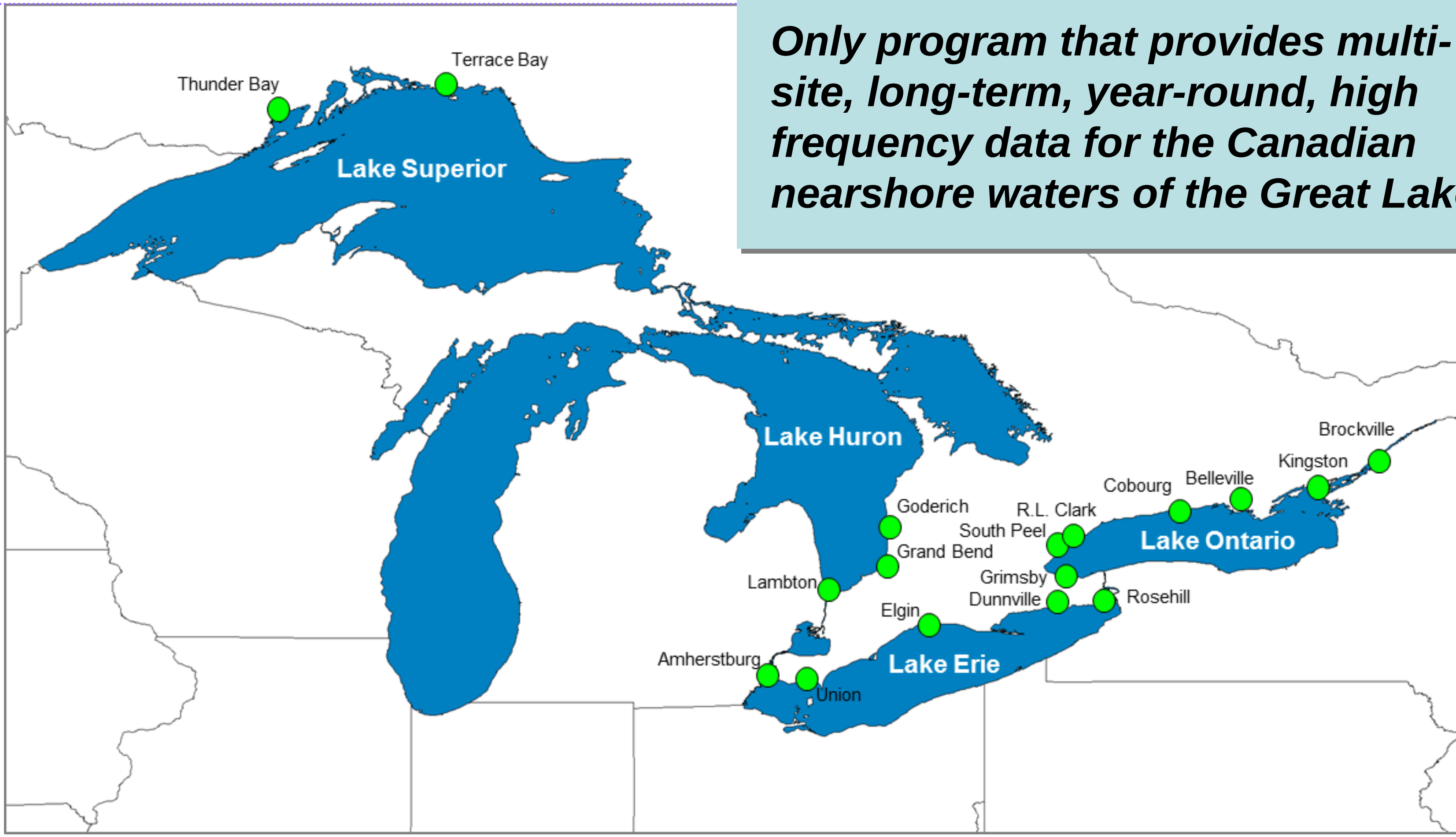
- Blooms are reported throughout Ontario
- Some lakes have recurring blooms, but many reports are from lakes with no previous reports

Locations of blue-green algal (BGA) blooms 2010-2016



- Blooms are reported throughout Ontario
- Some lakes have recurring blooms, but many reports are from lakes with no previous reports
- Reports cluster in populated areas adjacent to lakes
- Enhanced human activity & development near lakes may be promoting algal growth

Great Lakes Intake Program*



Only program that provides multi-site, long-term, year-round, high frequency data for the Canadian nearshore waters of the Great Lakes.

*4 intakes are also monitored in Lake Simcoe

Great Lakes Intake Program (GLIP)

GLIP monitors the cumulative effects of nutrients, climate change, invasive species & pollutant loading on nearshore water quality & informs decision making to restore, protect & conserve the Great Lakes – St. Lawrence River Ecosystem.

Objective: To monitor & assess water quality (as measured by nutrients & planktonic algae) of the nearshore Great Lakes using water treatment plant intakes as collection points.

Background: Algal monitoring initiated in 1962 in response to public concerns over algal blooms; trophic indicators were added in the 1970s to track the effectiveness of nutrient reduction initiatives.

Applications: The data have been used for measuring the response of nearshore water quality to phosphorus controls[1], zebra/quagga mussel invasion[2] and climate change[3].

(e.g. [1,2]Nicholls et al.1993 and 2001, J. Great Lakes Res., [1,2]Winter et al. 2012, J. Great Lakes Res., [3]Nicholls 1998. Limnol. Oceanogr.)

Where can I find more info?

- 12 Point Plan on Blue-Green Algal Blooms on ontario.ca https://www.ontario.ca/page/blue-green-algae
- http://Ontario.ca/open-data
  - Great Lakes Intake Program (search for “intakes”)
  - Great Lakes Nearshore stations (“nearshore”)
  - GIS layers (e.g., watersheds)
  - (etc.)
- *Contact:* **claire.holeton@ontario.ca**

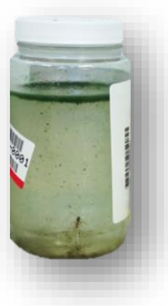
Ontario

Report triggers Protocol
(e.g. call to Spills Action Centre)

Bloom suspected
(visual cue)

On site follow-up may
include sampling

Analysis by MOECC
- Lab Services Branch (toxins)
- Environmental Monitoring & Reporting Branch (algae)



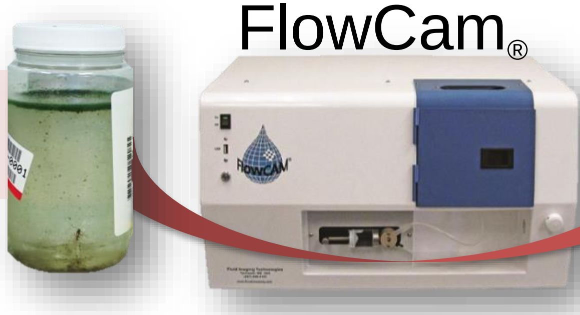
Coordinated Response
- Assessment of health risks (Health Unit)
- Risk measures (e.g. postings)

scientific & technical information

Supplemental techniques - particle imaging

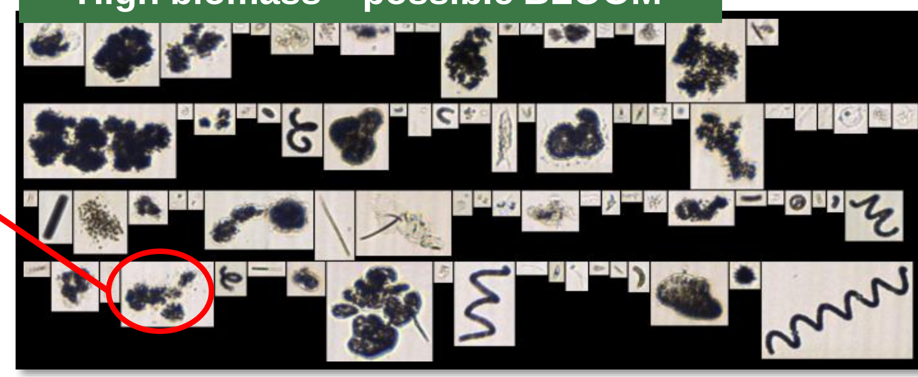
Is it a bloom?

FlowCam®

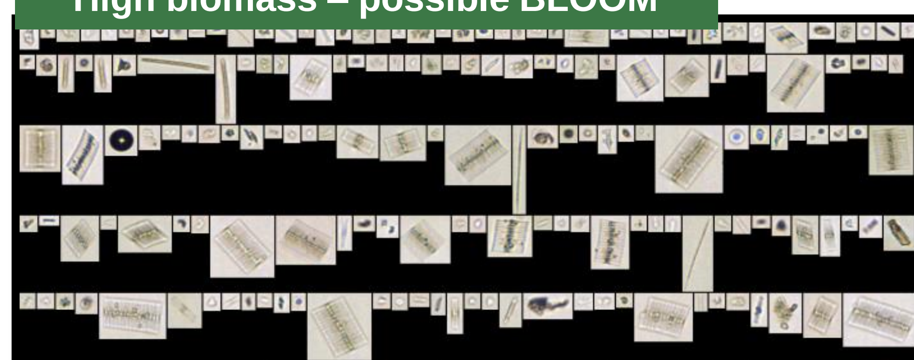


Low biomass – NOT a bloom

High biomass – possible BLOOM



High biomass – possible BLOOM



Is it cyanobacteria?

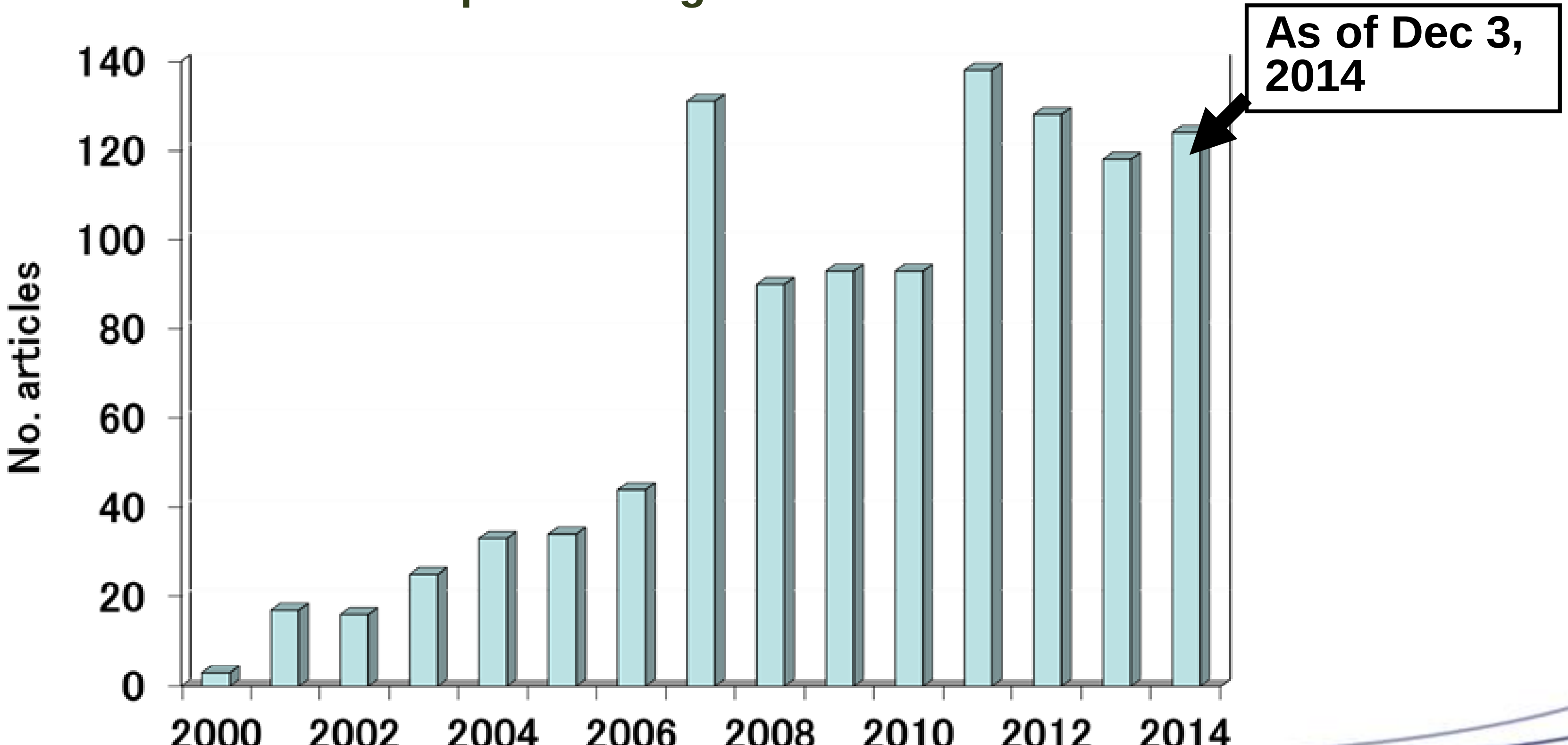
Confirm taxonomic identification

microscope (Utermöhl method)

Why have bloom reports increased?

1) Increased public awareness of algal issues

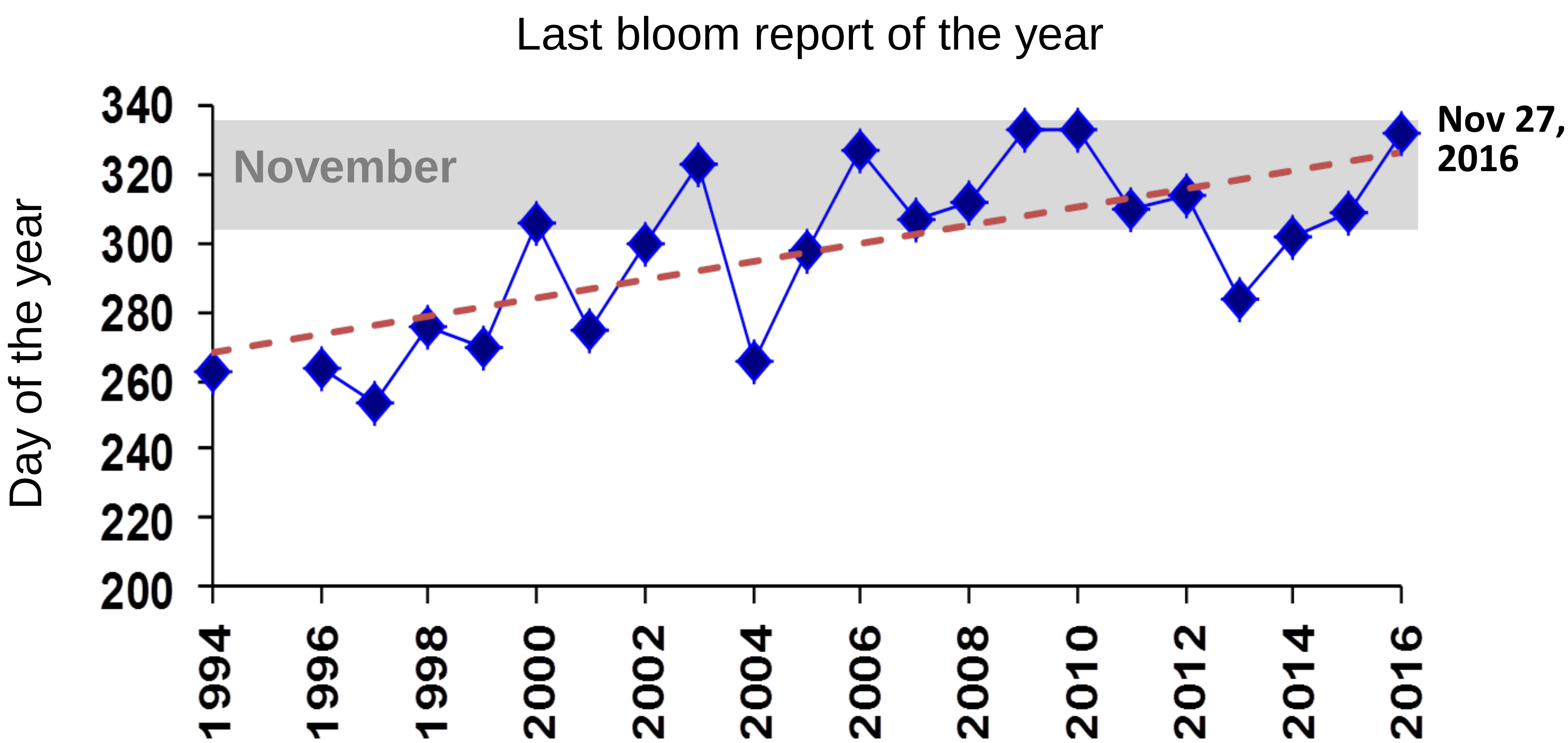
- outreach & education efforts by government, conservation authorities & cottage associations
- increased media reports of algal blooms



Ontario

Trend towards a longer bloom season

- Climatic changes can enhance conditions that support blooms
- Blooms are being reported later into the fall now than in the 1990s ($p < 0.001$)



Ontario

An Investigation of Central Basin Cyanobacterial Blooms

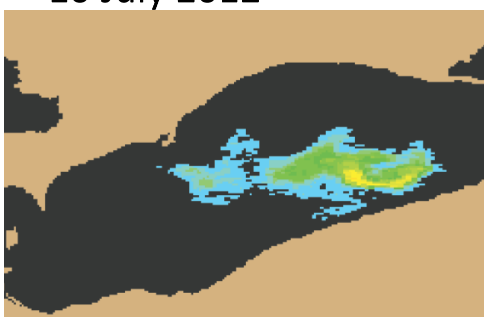
Justin D. Chaffin[1]
(chaffin.46@osu.edu)

[1]Stone Laboratory, OSU

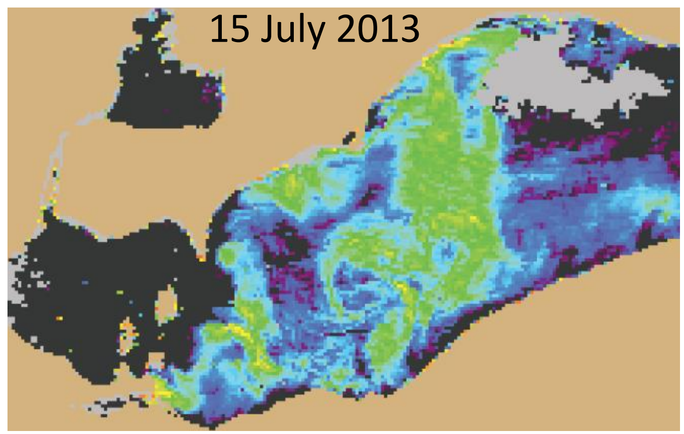
NOAA HAB Bulletins showed central basin blooms in 2012, 2013, 2015, and 2016

- Bloom spatial scale varied from year to year
- Timing of blooms was consistent: Early to mid-July
- Biomass in the ‘low’ to ‘medium’ CI range.

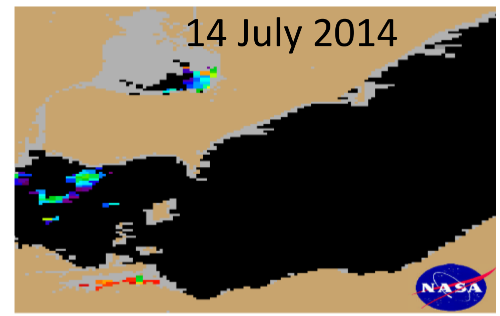
10 July 2012



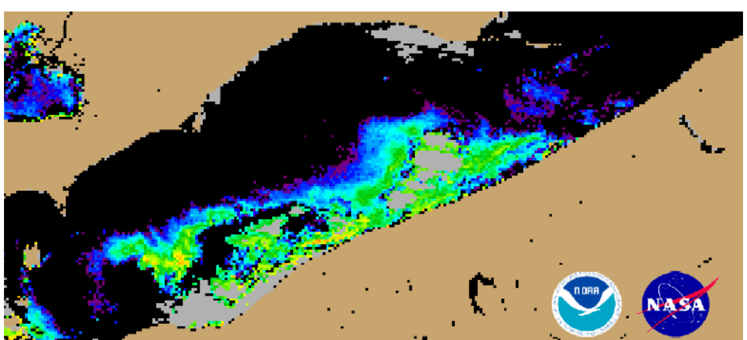
15 July 2013



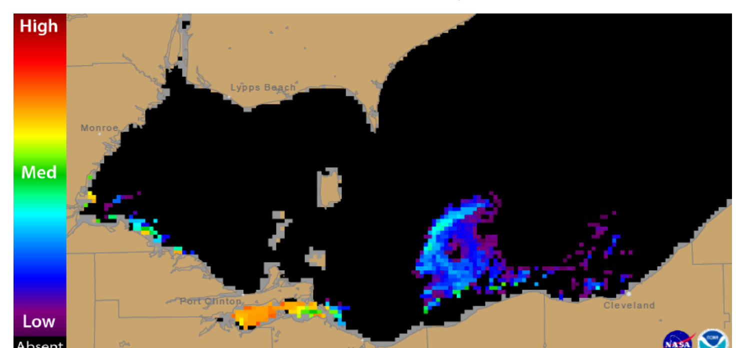
14 July 2014



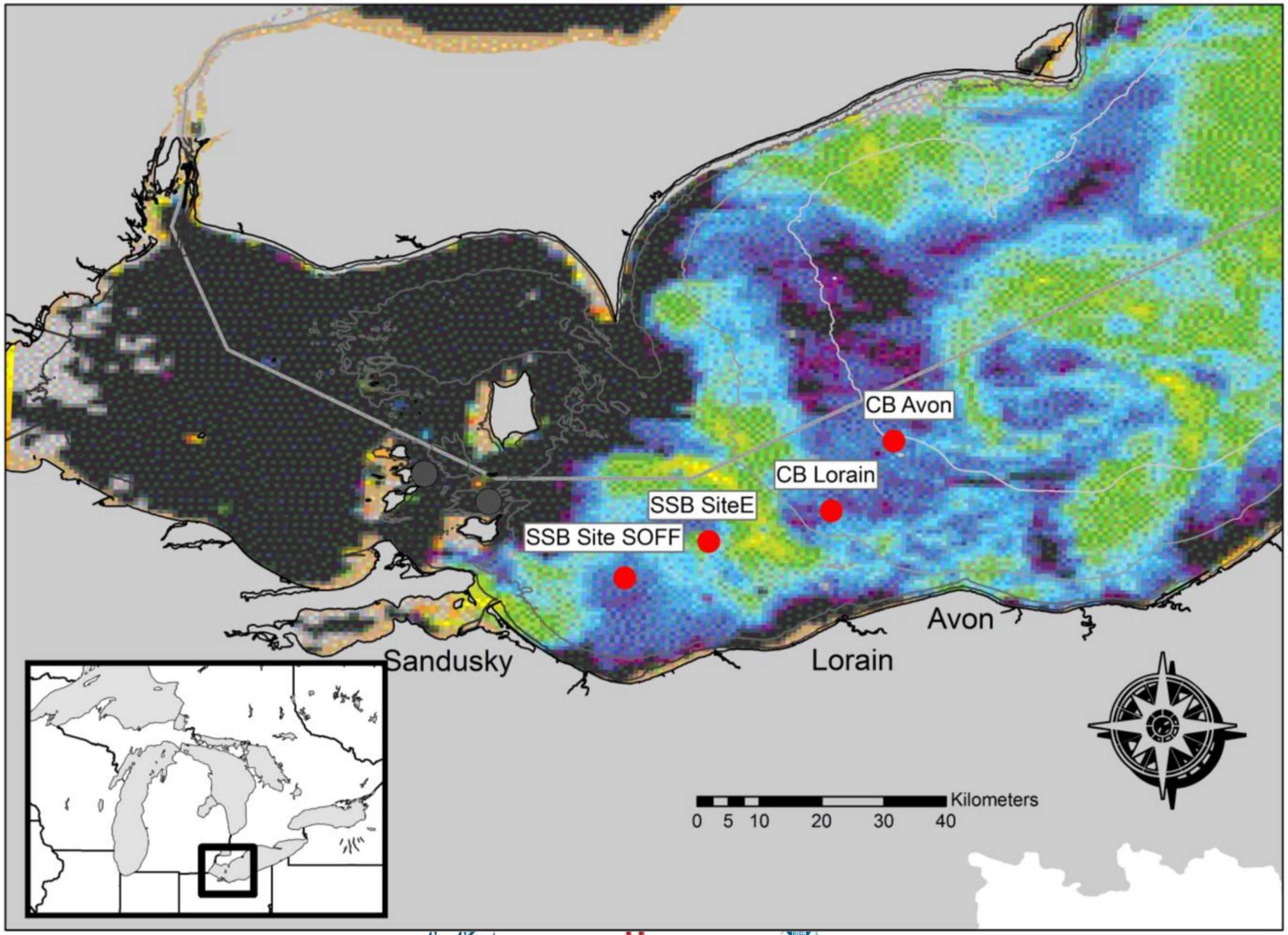
11 July 2015



10 July 2016



Fixed sampling locations since 2013



Event-based sampling

- Collect samples outside of normal 4 sites when spotted by HAB bulletin or by others.
- Ex: HAB bloom off Fairport Harbor (~30 miles east of Cleveland) July 6 2016

Brian Fowler, Lake Metroparks. 2016.

2017 Sample schedule

- Sampled:
  - June 2
  - June 21
  - July 3
  - July 11 (surface scum of *Dolichospermum* observed, surface chla 50 ug/L)
  - July 18
- Planned trips
  - August 1-11
  - August 21-31
  - September 11-22

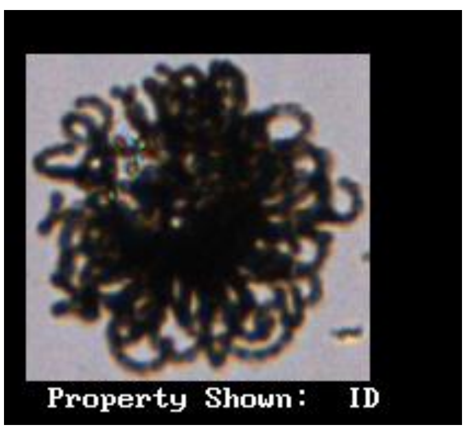
Parameters measured:

- Vertical profiles (0.5 m intervals):
  - Water temperature, dissolved oxygen, pH, NTU, chla-F, BGAPC-F
- Surface water samples (0-8 m intergraded sample):
  - Chlorophyll a
  - Phytoplankton
  - Total P, Total Kjeldahl Nitrogen
  - Nitrate, Nitrite, Ammonium, DRP, Silicate
  - Total Microcystins
  - Cyanotoxin genes for microcystins, saxitoxins, cylindrospermopsins
- Hypolimnion water samples (0.5 m above sediments)
  - Nutrients P, N, Si
- Secchi Disk depth

Dolichospermum in the central basin

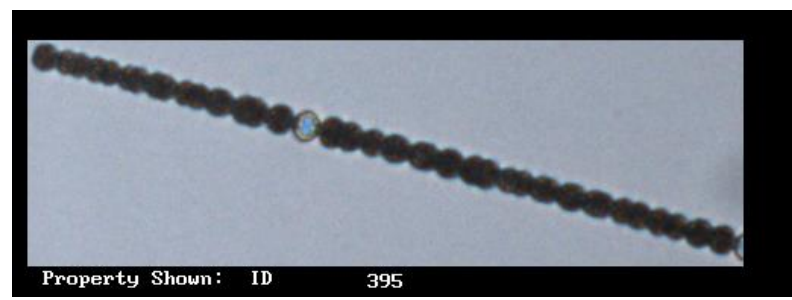
- Formally called *Anabaena*
- Nitrogen fixing cyanobacterium
  - But, nearly all colonies lacked heterocysts
- Not believed to be a microcystin producer in Lake Erie (Rinta-Kanto et al. 2009)
- Several species in central basin

D. lemmermannii



D. circinale

D. planctonicum

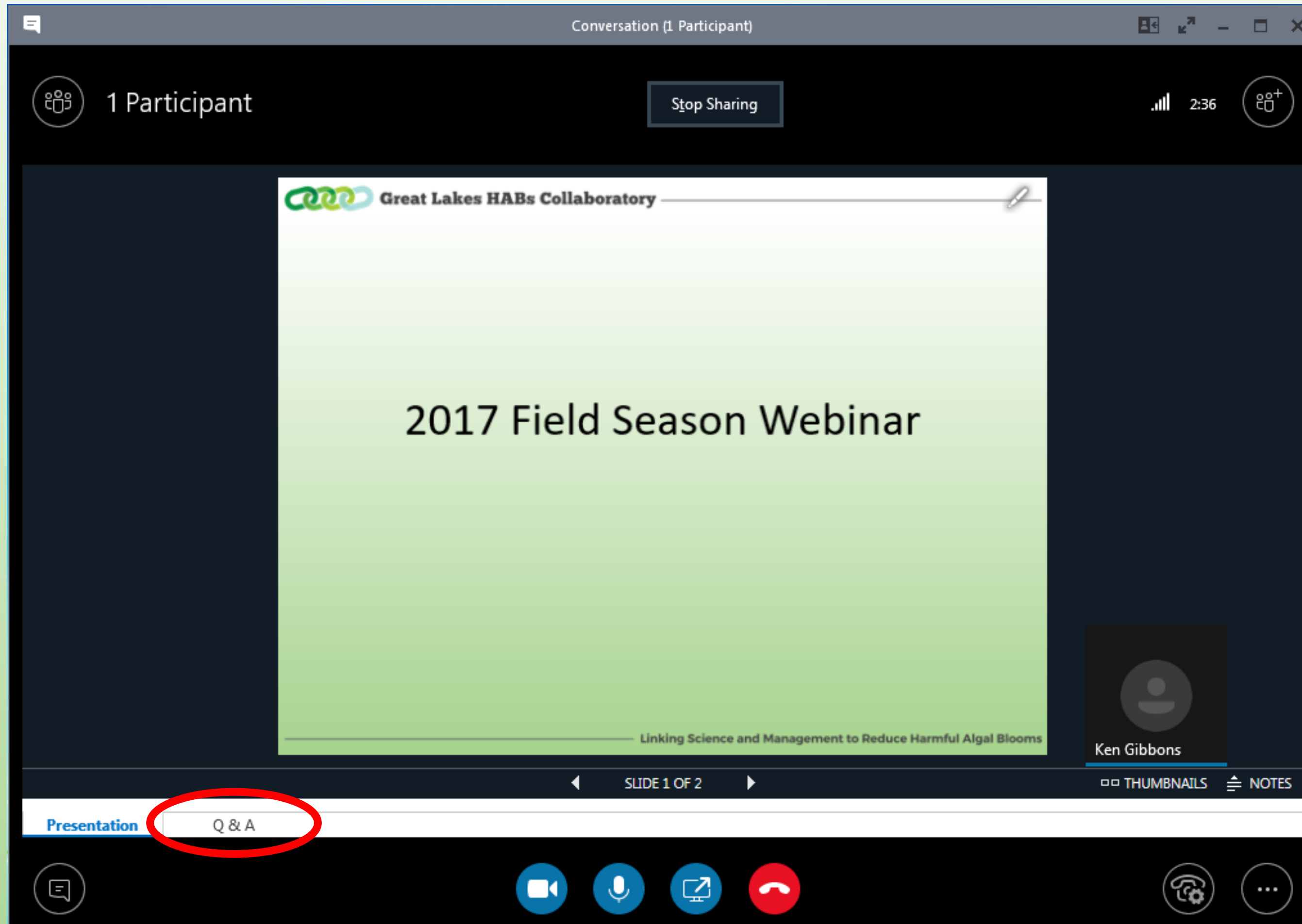


Funding:

OhioHigherEd
Department of Higher Education

Sea Grant
Ohio Sea Grant College Program

Type Questions into Q & A tab



Thank you!

A recording will be posted at:

http://www.glc.org/work/habs-collaboratory