

Harmful Algal Blooms Monitoring, Modeling and Remote Sensing: Advancing predictions of bloom intensity and movement

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HABs Research: Multi-disciplinary Team



Monitoring & Experiments

Tim Davis

Tom Johengen

Remote Sensing

Steve Ruberg

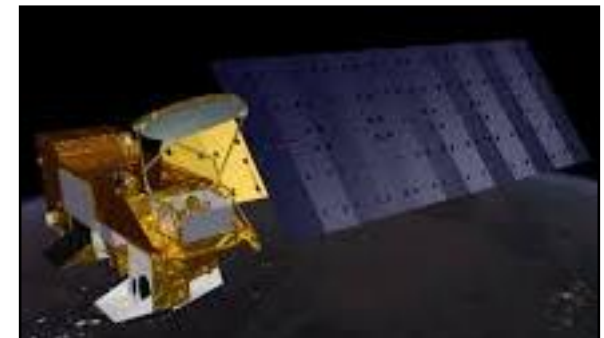
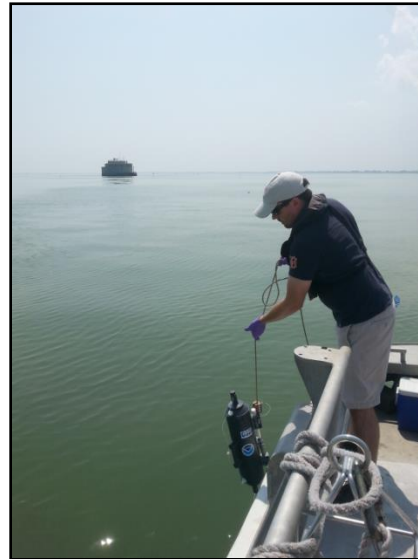
Rick Stumpf

Modeling

Eric Anderson

Communications

Sonia Joseph Joshi





Experimental Lake Erie Harmful Algal Bloom Bulletin

National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory

20 August, 2015, Bulletin 12

The *Microcystis* cyanobacteria bloom continues across a large part of the western basin along the Michigan and Ohio coasts. Recent southwesterly winds have pushed the bloom well into the central basin, with moderate to high concentrations extending eastward to far offshore of Cleveland. Scum has been rare the last few days, owing to the strong winds. Strong mixing has reduced the bloom on the Ontario coast to below detection, but cells are present. Microcystin toxins are still present in the bloom, but the concentration has decreased in general. Scum areas, when present, remain a risk.

Strong, 20 knot southwesterly winds are expected through tonight, creating strong mixing today and into Friday. Wind will diminish Friday into the weekend, favoring scum development, particularly on Saturday and early Sunday. Increasing winds late Sunday and Monday favor some mixing. Slight eastward movement is expected today, with little movement over the weekend. With the calm winds, low to moderate bloom concentrations may re-appear near the Ontario coast on the weekend. The persistent bloom in Sandusky Bay continues. No other blooms are evident in the central and eastern basins.

Please check Ohio EPA's site, <http://epa.ohio.gov/habalgae.aspx> for safety information, including updates on the State Parks. Keep your pets and yourself out of the water in areas where scum is forming.

-Tomlinson, Stumpf

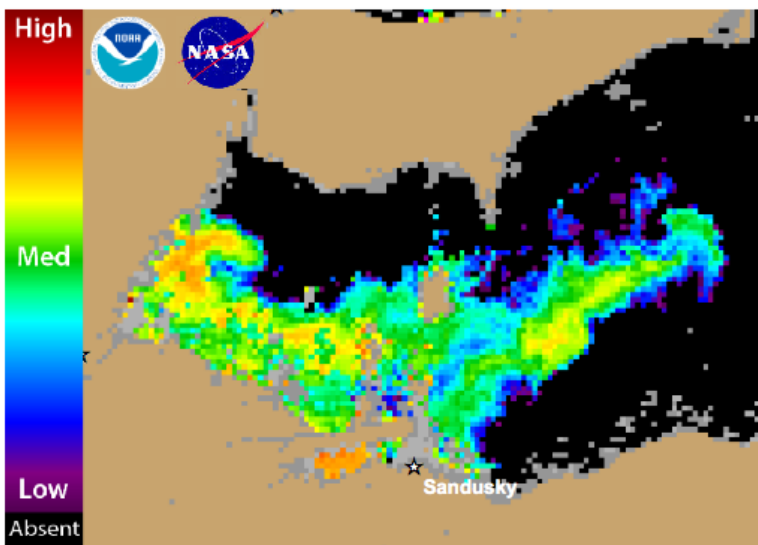


Figure 1. Cyanobacterial Index from NASA's MODIS- Terra data collected 19 August, 2015 at 11:00 EST. Grey indicates clouds or missing data. Black represents no cyanobacteria detected. Colored pixels indicate the presence of cyanobacteria. Cooler colors (blue and purple) indicate low concentrations and warmer colors (red, orange, and yellow) indicate high concentrations. The estimated threshold for cyanobacteria detection is 20,000 cells/mL.

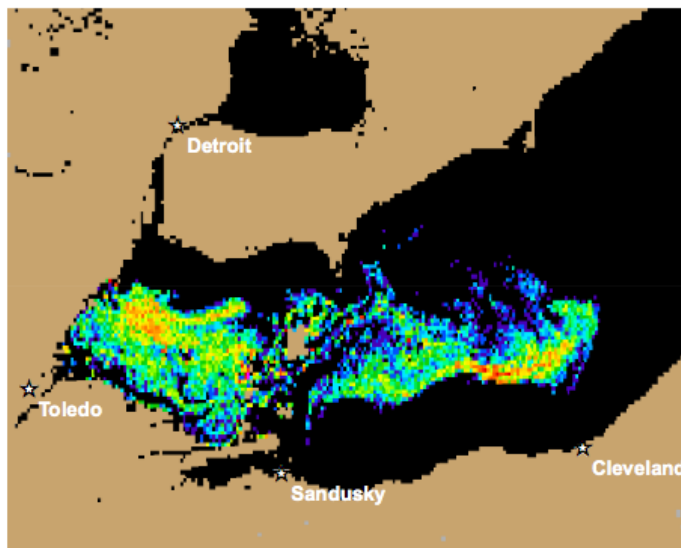


Figure 3. Forecast position of bloom for 23 August, 2015 using GLCFS modeled currents to move the bloom from the 19 August, 2015 image.

HAB Tracker

http://www.glerl.noaa.gov/res/HABs_and_Hypoxia/habsTracker.html

Monitoring

Tim Davis
Duane Gossiaux
Tom Johengen
Ashley Burtner
Danna Palladino
Russ miller
Heidi Purcell
et al.

Remote Sensing

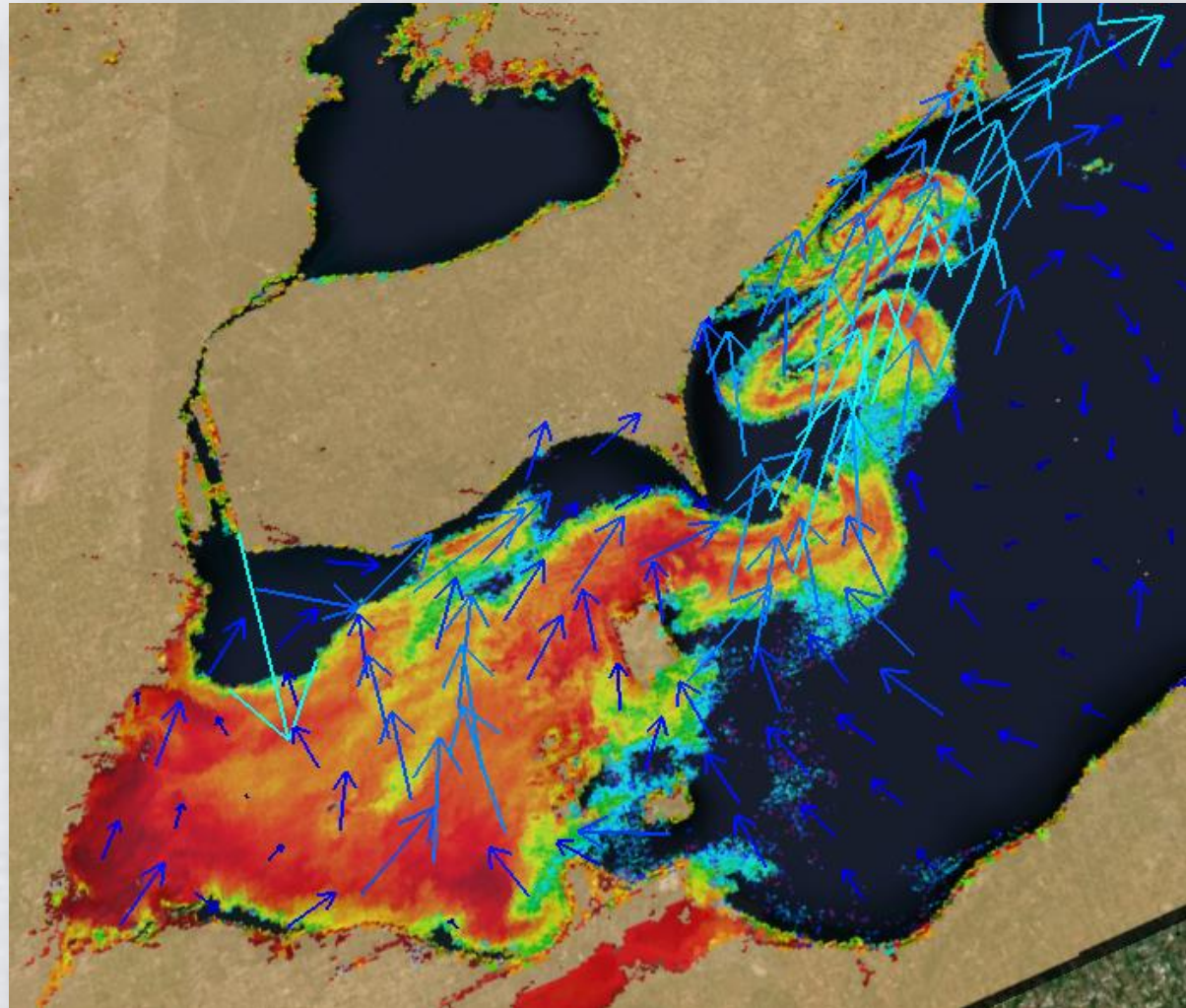
Steve Ruberg
Andrea van der Woude
et al.

Modeling

Eric Anderson
Greg Lang
Mark Rowe

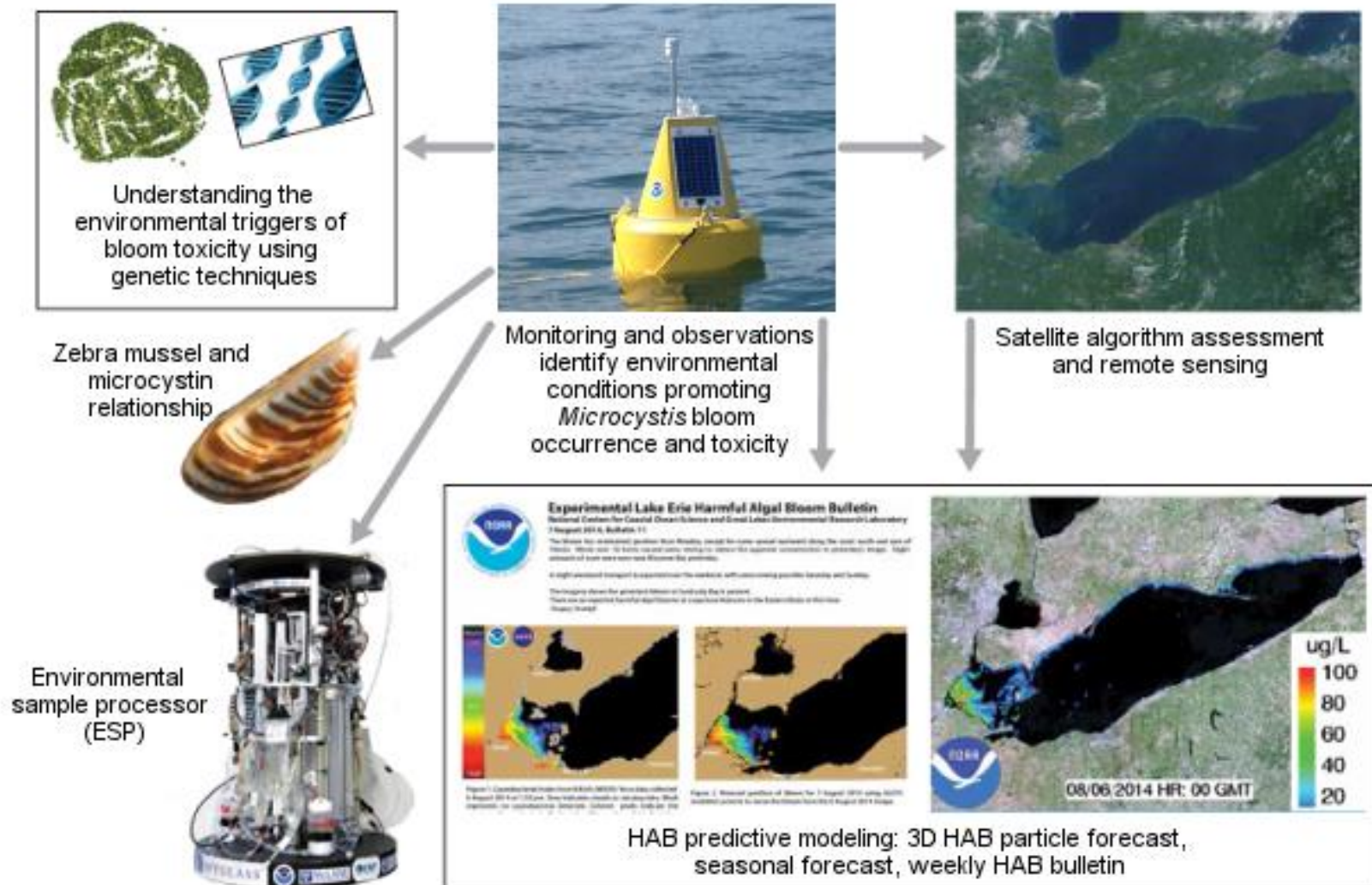
Communications

Sonia Joseph Joshi
Joe Smith



An integrated approach to studying HABs

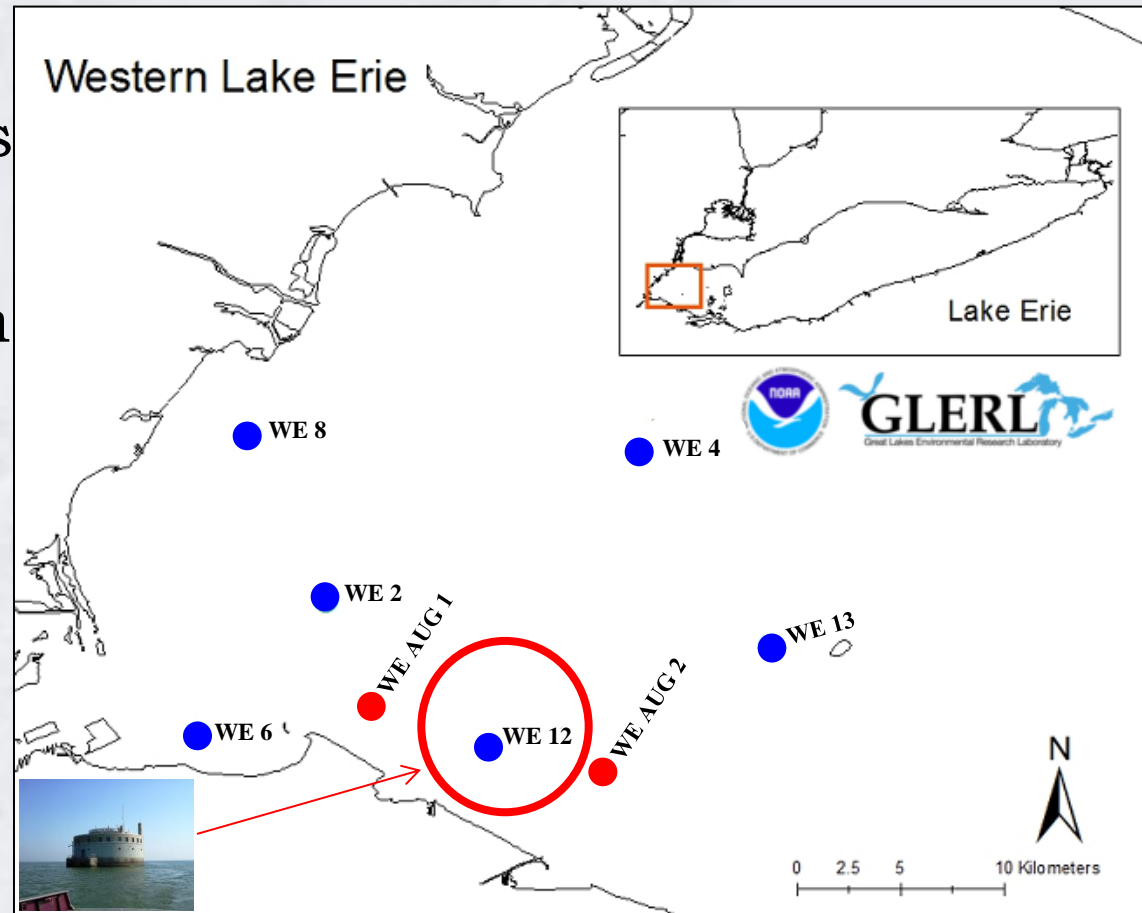
Developing Predictive Models to Improve Coastal and Human Health and Beach Forecasting - HAB Component



- Weekly forecast
- Weekly monitoring (GLERL)
- Satellite-derived Cyanobacteria Index (CI) via Rick Stumpf
- Translated to virtual 2D surface particles (GNOME)
- 5-day forecast of 2D currents from GLCFS (POM - GLERL)

- **Daily** forecast
- Weekly monitoring (GLERL)
- Satellite-derived HAB: FLH + CI algorithms w/ **atmospheric corr.**
- Translate to **3D** particles (P3D model)
- 5-day forecast of **3D currents** from new Lake Erie FVCOM (LEOFS)

- June – October
- Surface water samples
- Ground-truth for remote sensing (bloom extent, distribution)
- Parameters:
 - Temperature
 - Kpar
 - CHN
 - SRP
 - Particulate P
 - Total P
 - $\text{NO}_3 + \text{NO}_2$
 - NH_3
 - Fluorescence
 - Chlorophyll
 - Particulate and dissolved microcystins
 - Phytoplankton community composition
 - Phycocyanin
 - DNA



Monitoring

- **15-min CTD and optical**

- **Hourly SRP**

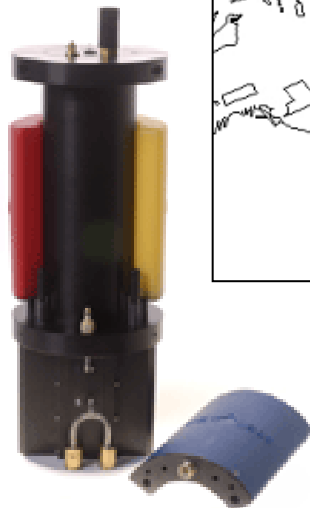
Sensors:

- . Turner C6, Cyclops sensors

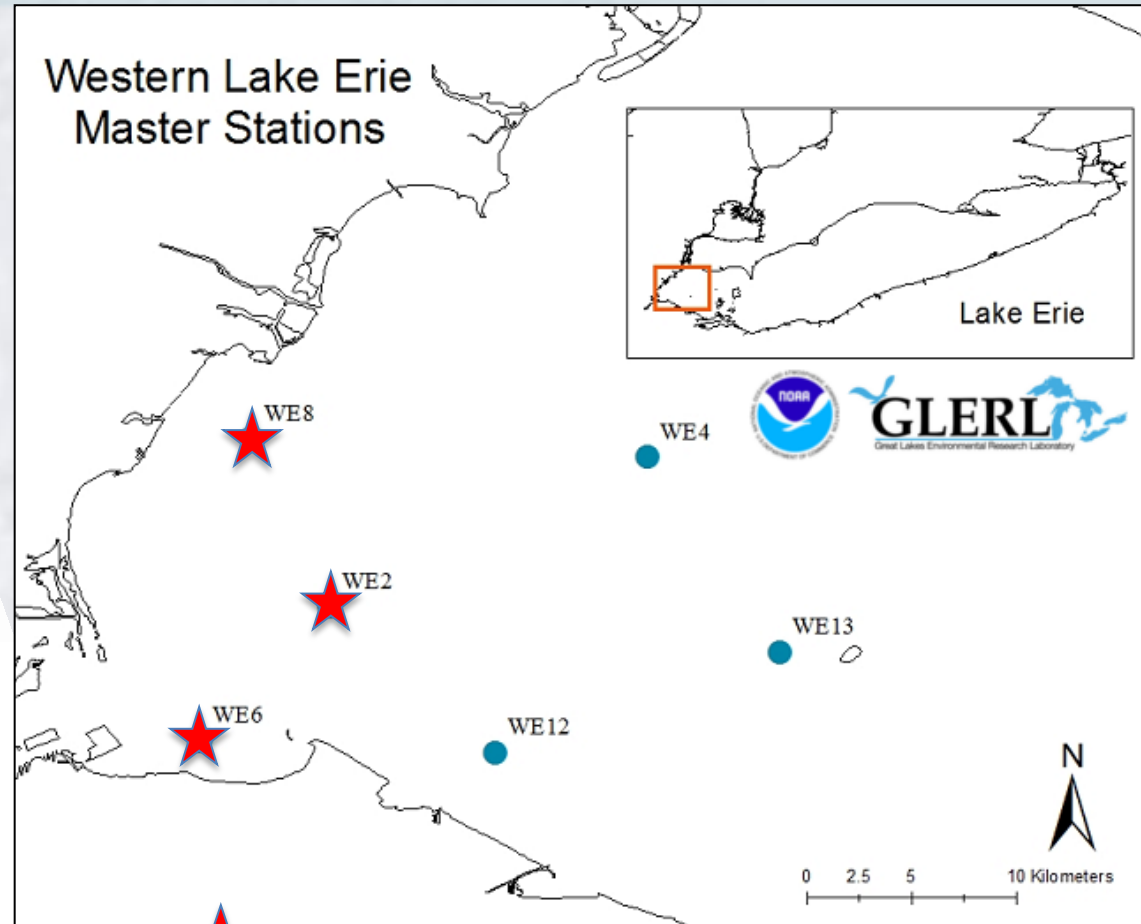
- . Chlorophyll, Phycocyanin, Turbidity, CDOM



- . Wetlabs Cycle -PO₄

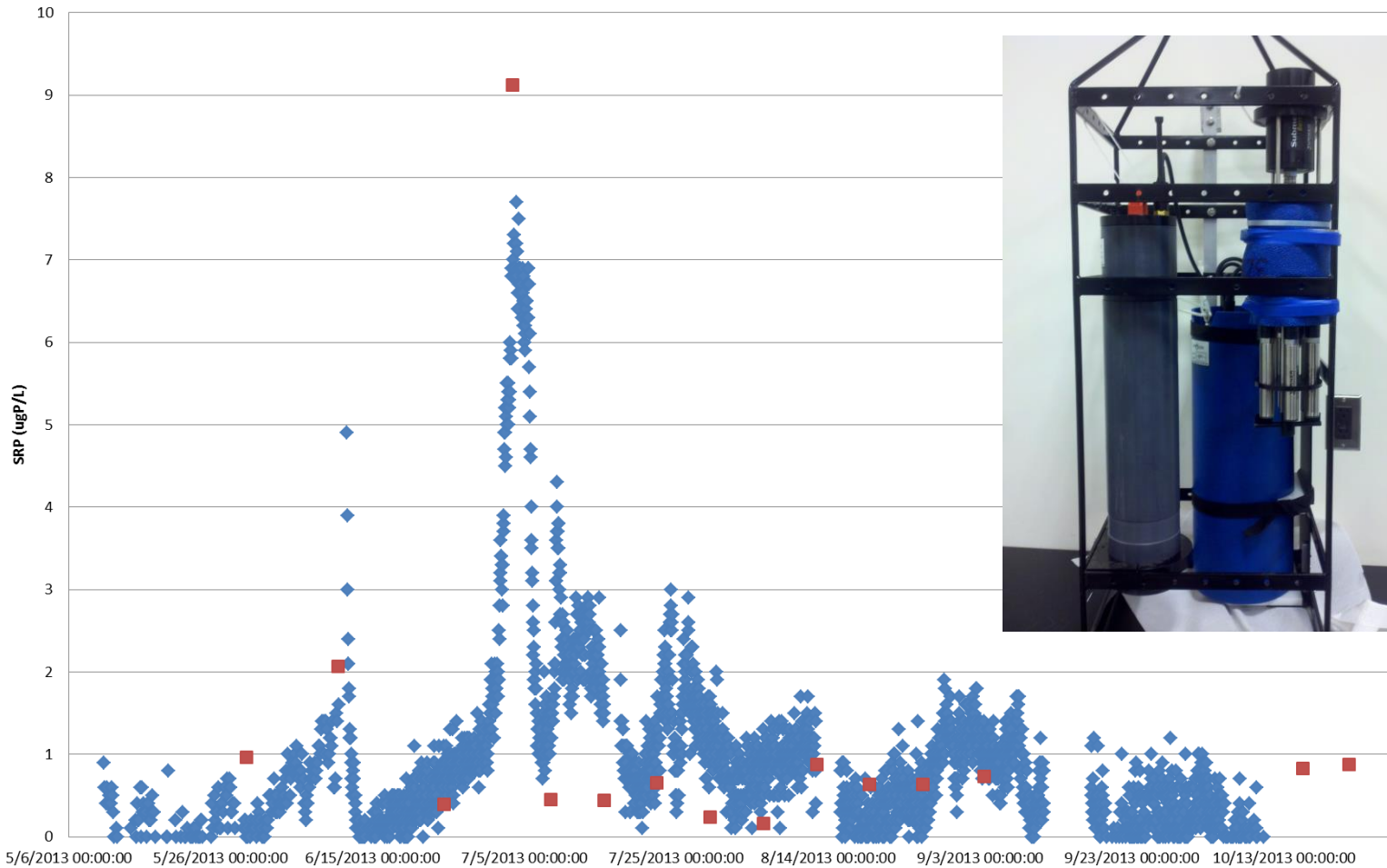


Continuous Monitoring



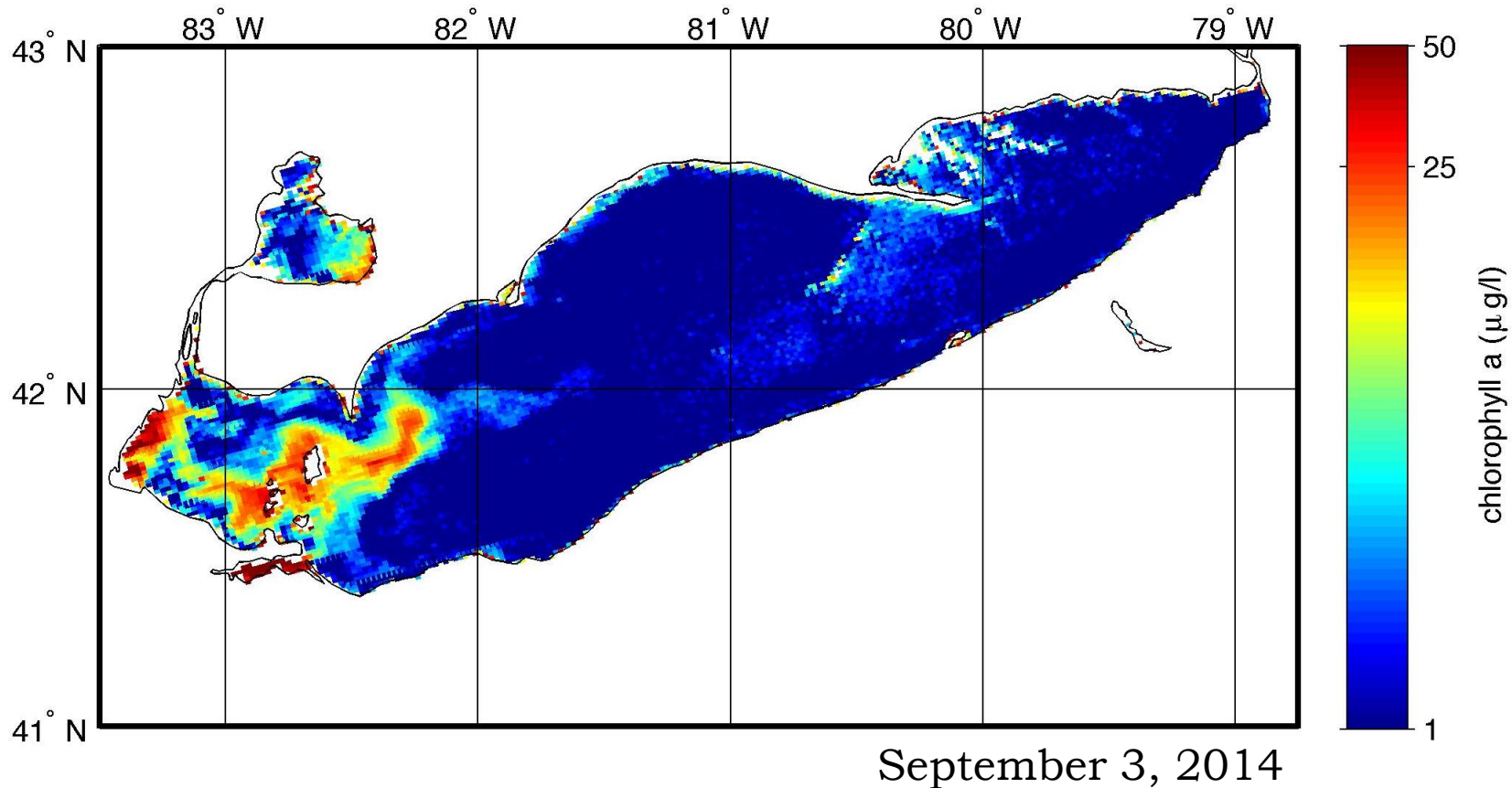
 = Real-time observation station in 2014

Dissolved-P – Toledo Channel Marker Light 2 (WE4)

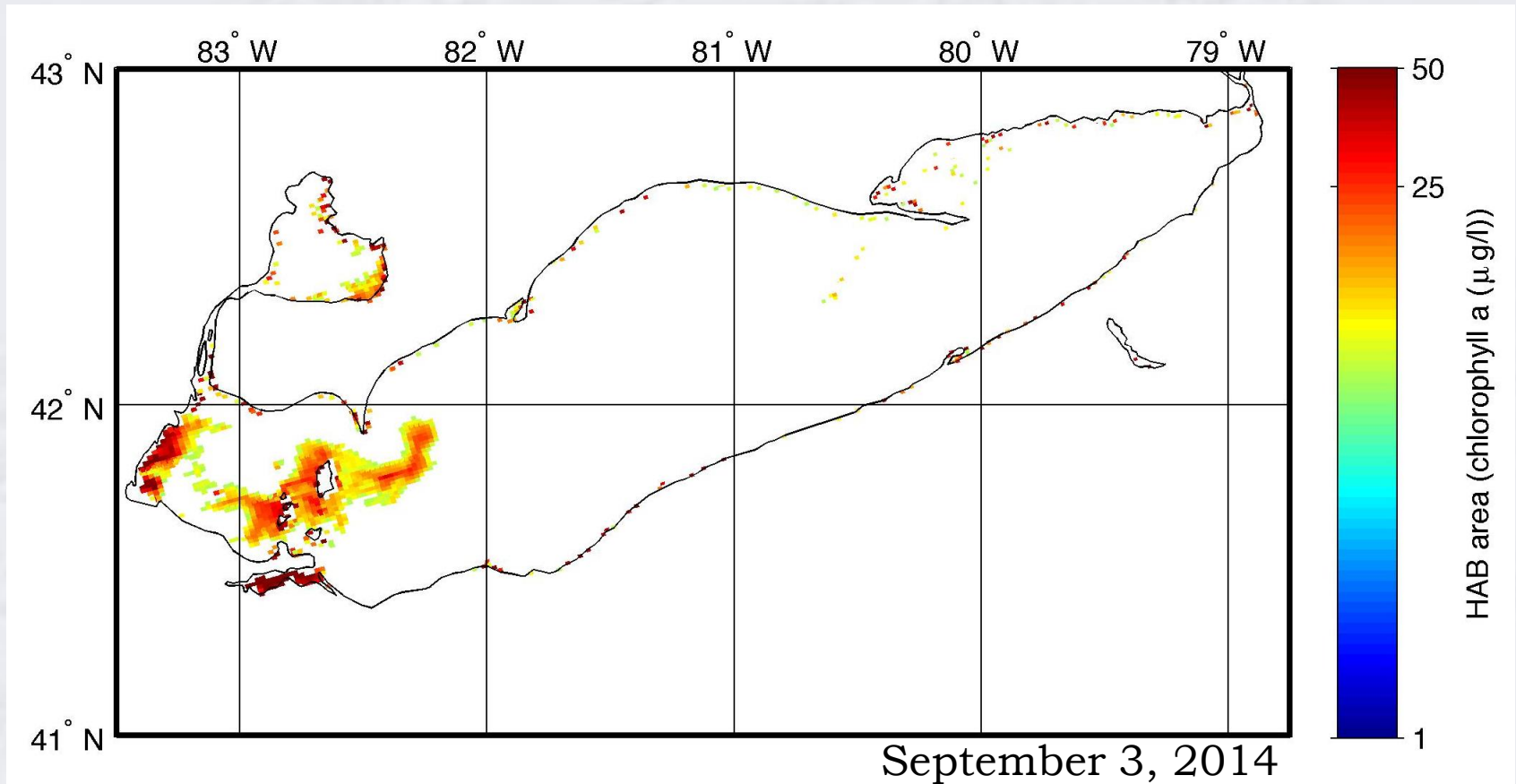


◆ Cycle
■ Quattro

FLH & CI after converted to chlorophyll



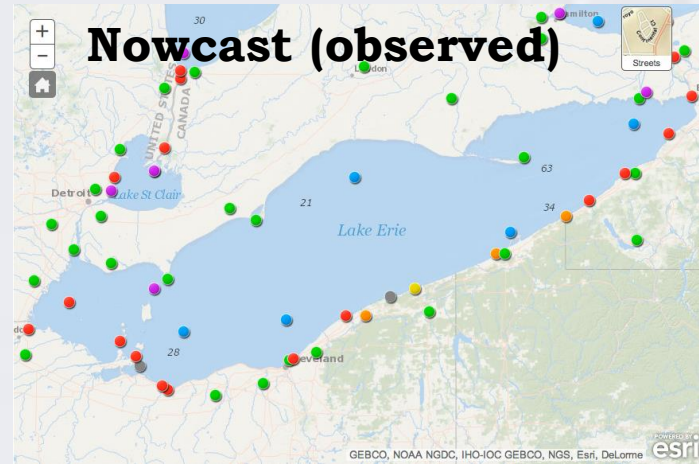
HARMFUL ALGAL BLOOM EXTENT



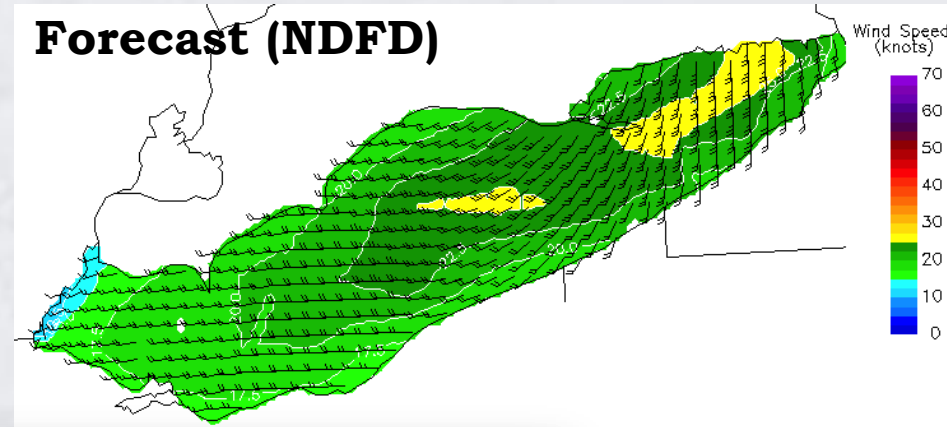
Modeling

Hydrodynamic Forecasts

Nowcast (observed)

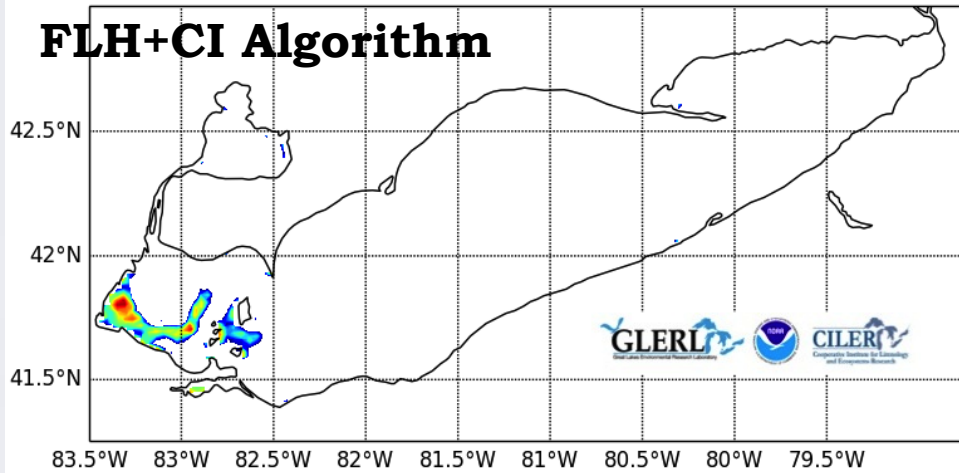


Forecast (NDFD)



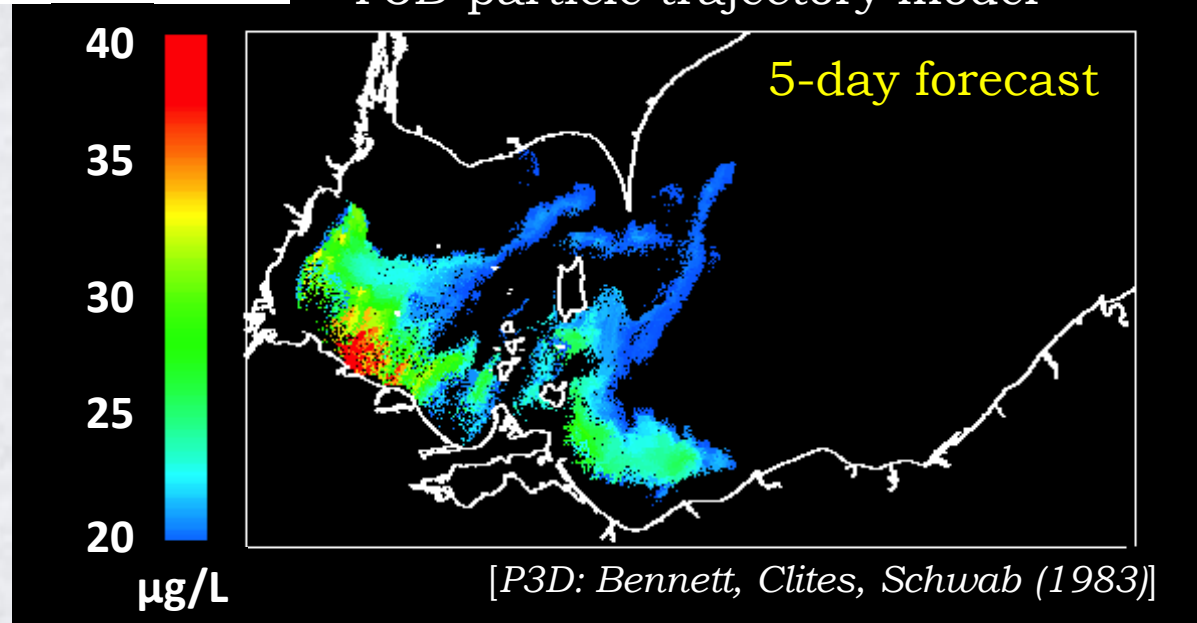
- Daily nowcast/forecast (120 hrs)
- Hourly currents
 - HAB advection



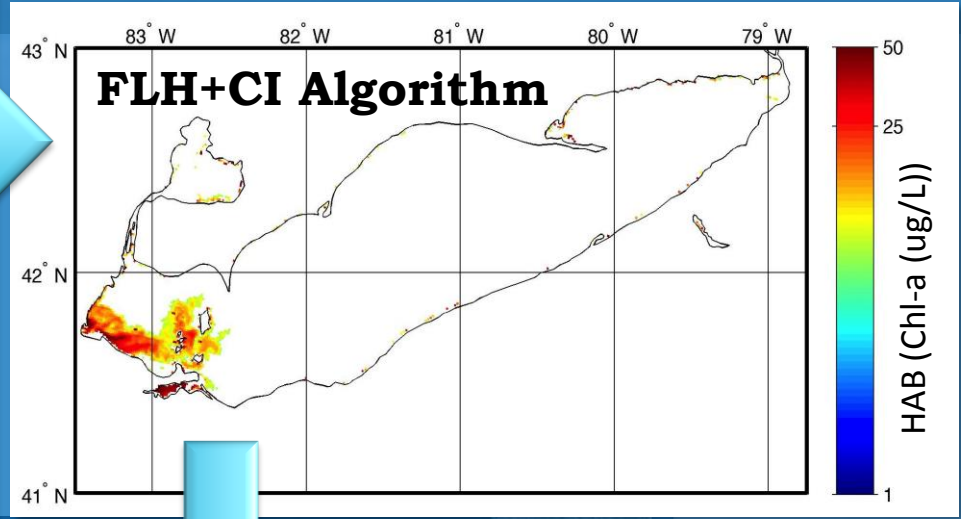


P3D particle trajectory model

- Daily forecast
 - reinitialize model with new satellite data -OR-
 - continue with last particle positions
- P3D
 - Horizontal diffusion calibrated to drifters
 - vertical distribution/mixing ongoing



NASA/MODIS



Great Lakes Coastal Forecasting System (GLCFS)



Weekly bulletin
Real-time monitoring
Daily forecast



Water intake managers

OAR/GLERL



NOS/CO-OPS

NWS/NDFD



Thank You!

Questions?

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HABs monitoring and real time data:

[http://www.glerl.noaa.gov/res/HABs and Hypoxia/](http://www.glerl.noaa.gov/res/HABs_and_Hypoxia/)

Sign up for Lake Erie HABs Bulletin:

<http://coastalscience.noaa.gov/research/habs/forecasting>

Or

[http://www.glerl.noaa.gov/res/HABs and Hypoxia/](http://www.glerl.noaa.gov/res/HABs_and_Hypoxia/)