LimnoTech
Water Environment | Scientists Engineers

WAYS TO DEAL WITH ALGAL BLOOMS: MONITORING, MODELING, AND MITIGATING

JOHN F. BRATTON, PHD, PG

ALGAL BLOOM INTRO

Causes

Excess watershed nutrients

Internal nutrient loading

Warm water

Long residence time

Little mixing

Challenges

Taste and odor issues

Toxins (drinking, aerosols, contact)

Fouling

Analytical difficulties

Public communication

Dynamic conditions

Multiple species

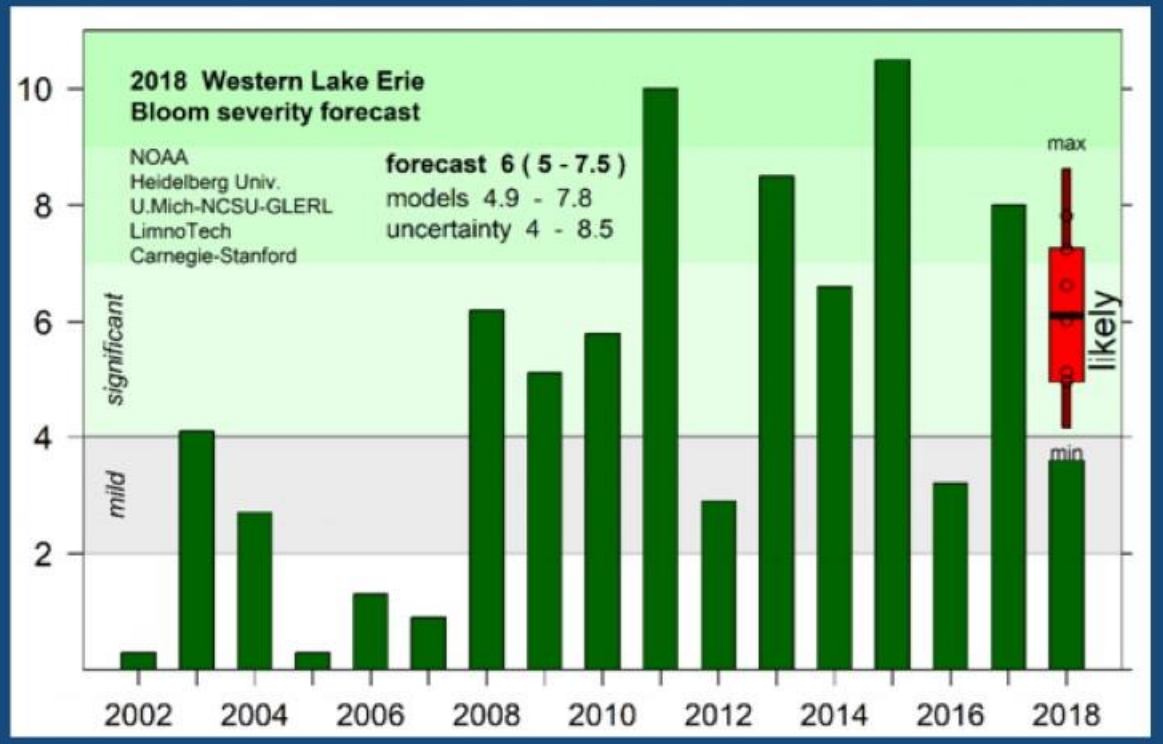
Benthic and planktonic

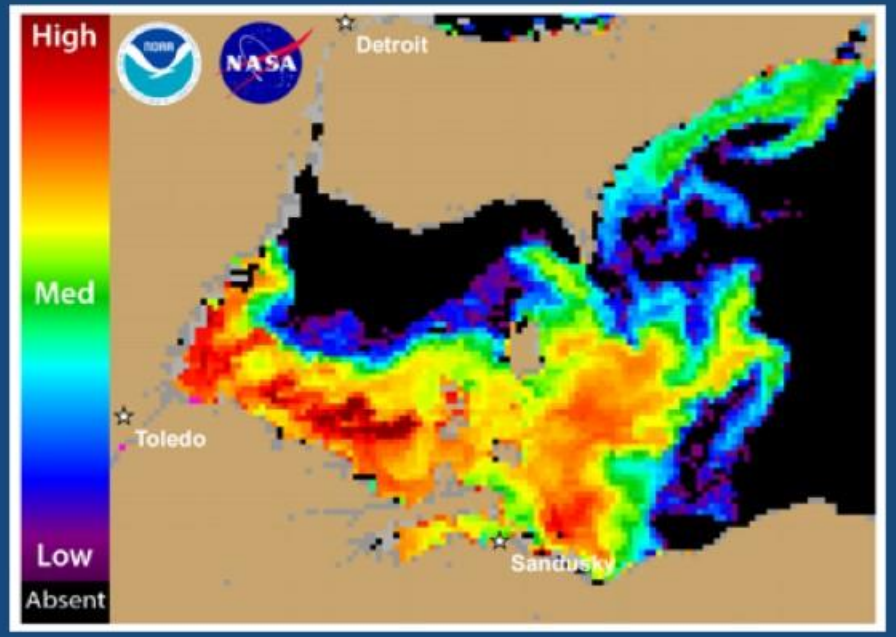
Huge variety of treatments

Non-point nutrient mitigation

2015

- Largest bloom ever recorded in Lake Erie



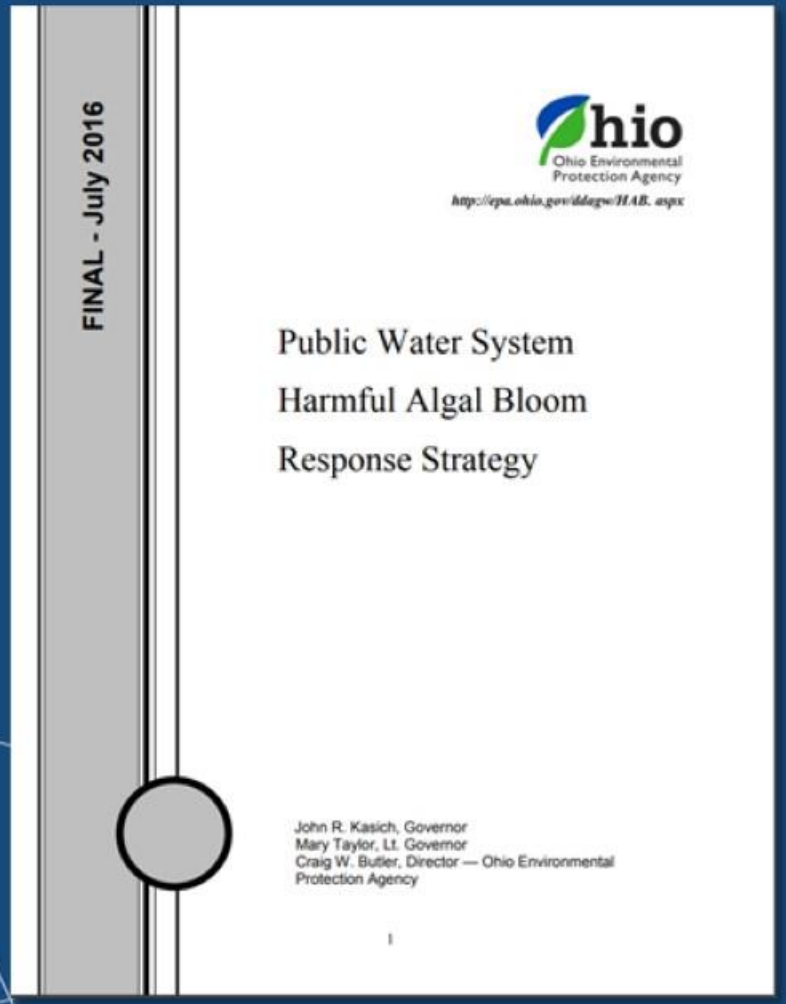


2015

- Largest bloom ever recorded in Ohio River

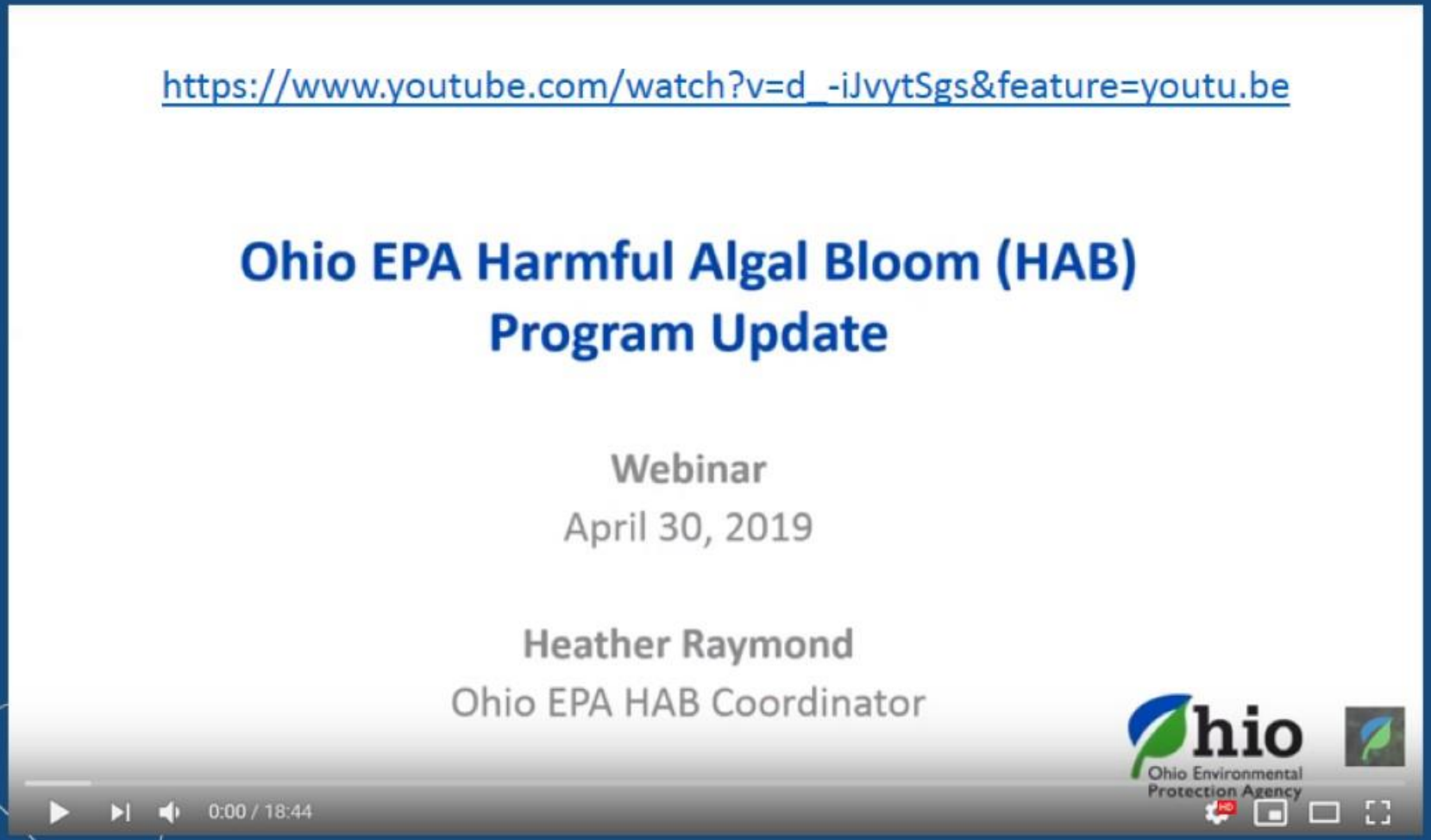
PERSPECTIVE

- Ohio is a leader in HABs management and research



PREPAREDNESS

https://www.youtube.com/watch?v=d_-iJvytSgs&feature=youtu.be



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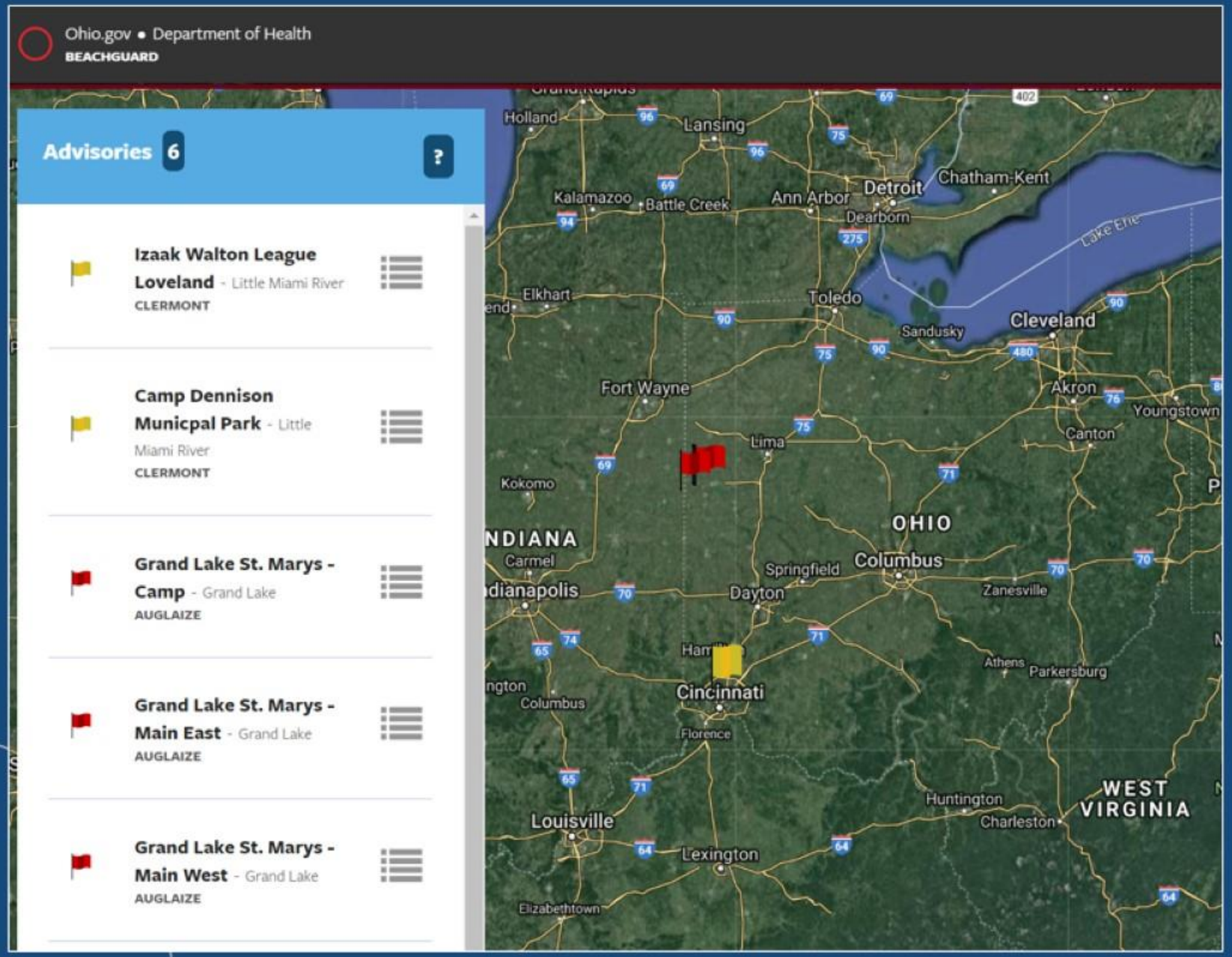
Ohio.gov • Department of Health
BEACHGUARD
Advisories 6
?
Izaak Walton League
Loveland - Little Miami River
CLERMONT
Camp Dennison
Municpal Park - Little
Miami River
CLERMONT
Grand Lake St. Marys -
Camp - Grand Lake
AUGLAIZE
Grand Lake St. Marys -
Main East - Grand Lake
AUGLAIZE
Grand Lake St. Marys -
Main West - Grand Lake
AUGLAIZE
Holland
Lansing
Kalamazoo
Battle Creek
Ann Arbor
Detroit
Dearborn
Chatham-Kent
Lake Erie
Elkhart
Toledo
Sandusky
Cleveland
Fort Wayne
Akron
Youngstown
Canton
Lima
Kokomo
OHIO
NDIANA
Carmel
Springfield
Columbus
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Dayton
Zanesville
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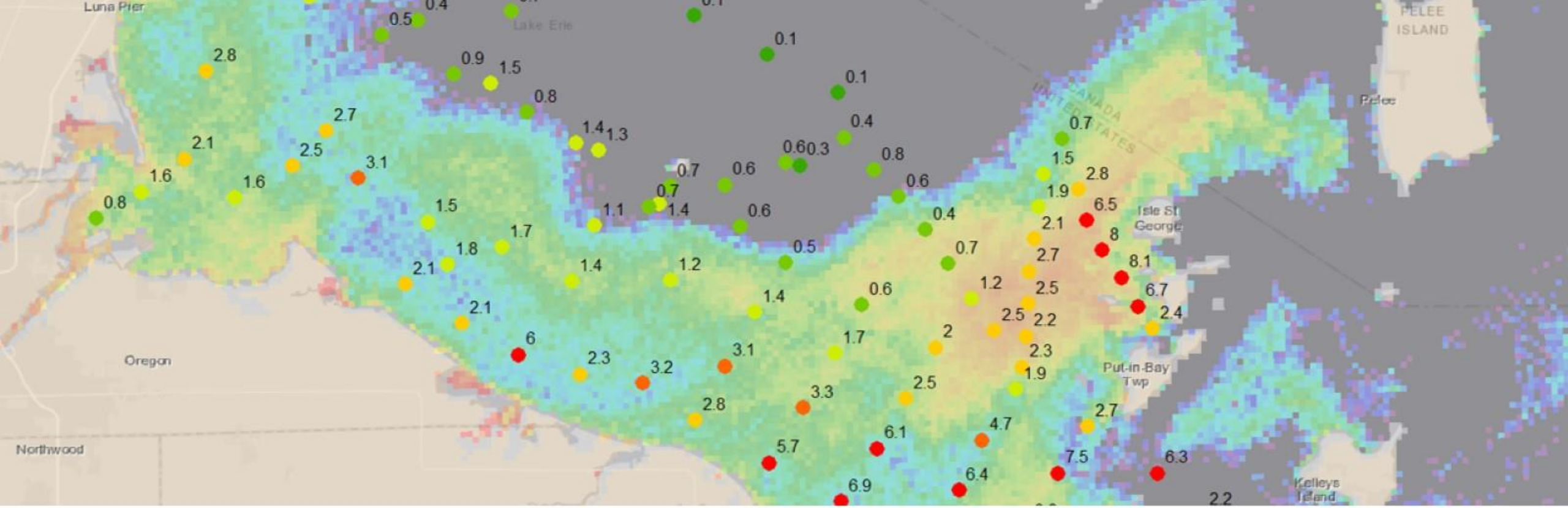
Columbus
Florence
Huntington
Charleston
WEST
VIRGINIA
Louisville
Lexington
Elizabethtown



HABS MANAGEMENT

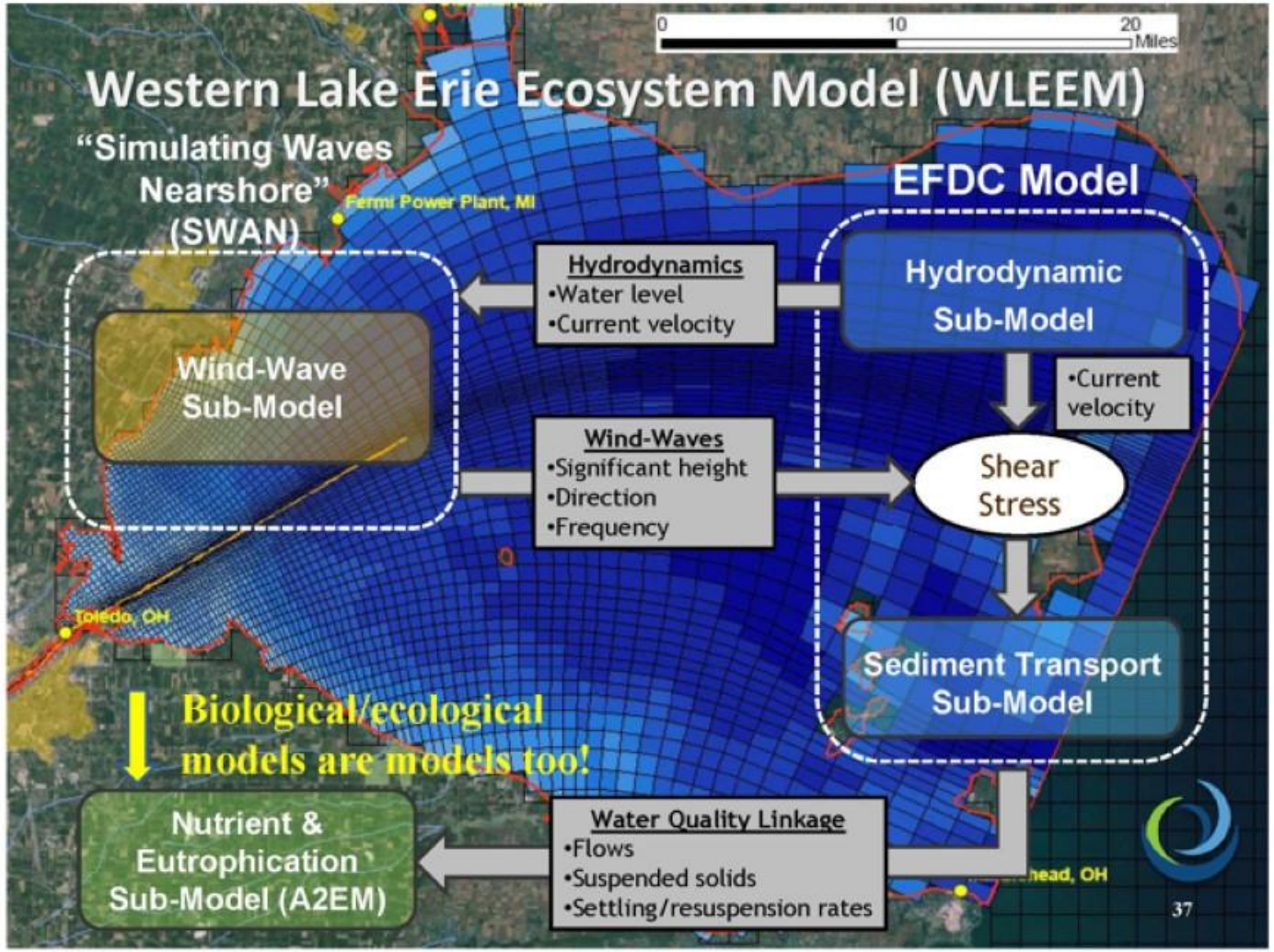
Monitoring, Early Warning Systems ●● Modeling and Forecasting ●● Data Management, Decision Support
Control, Mitigation, Treatment ●● Research and Development

MONITORING

- Lake Erie real-time observing network of buoys and drinking water plant intakes; basin-wide “HABs Grab” sampling and research programs
- Continuous watershed monitoring in Maumee and other Ohio Rivers
- Sensors and analytes include algal pigments, nitrate, phosphorus, weather, waves, webcams, thermistor strings
- Satellites, drones, aircraft
- EnviroDIY

MODELING

- Linked and mechanistic watershed and water body modelling and forecasting
- Lake Erie Ecosystem Model
- Lake Ontario Ecosystem Model
- Lake Okeechobeee
- Lake Champlain
- Utah Lake



MODELING

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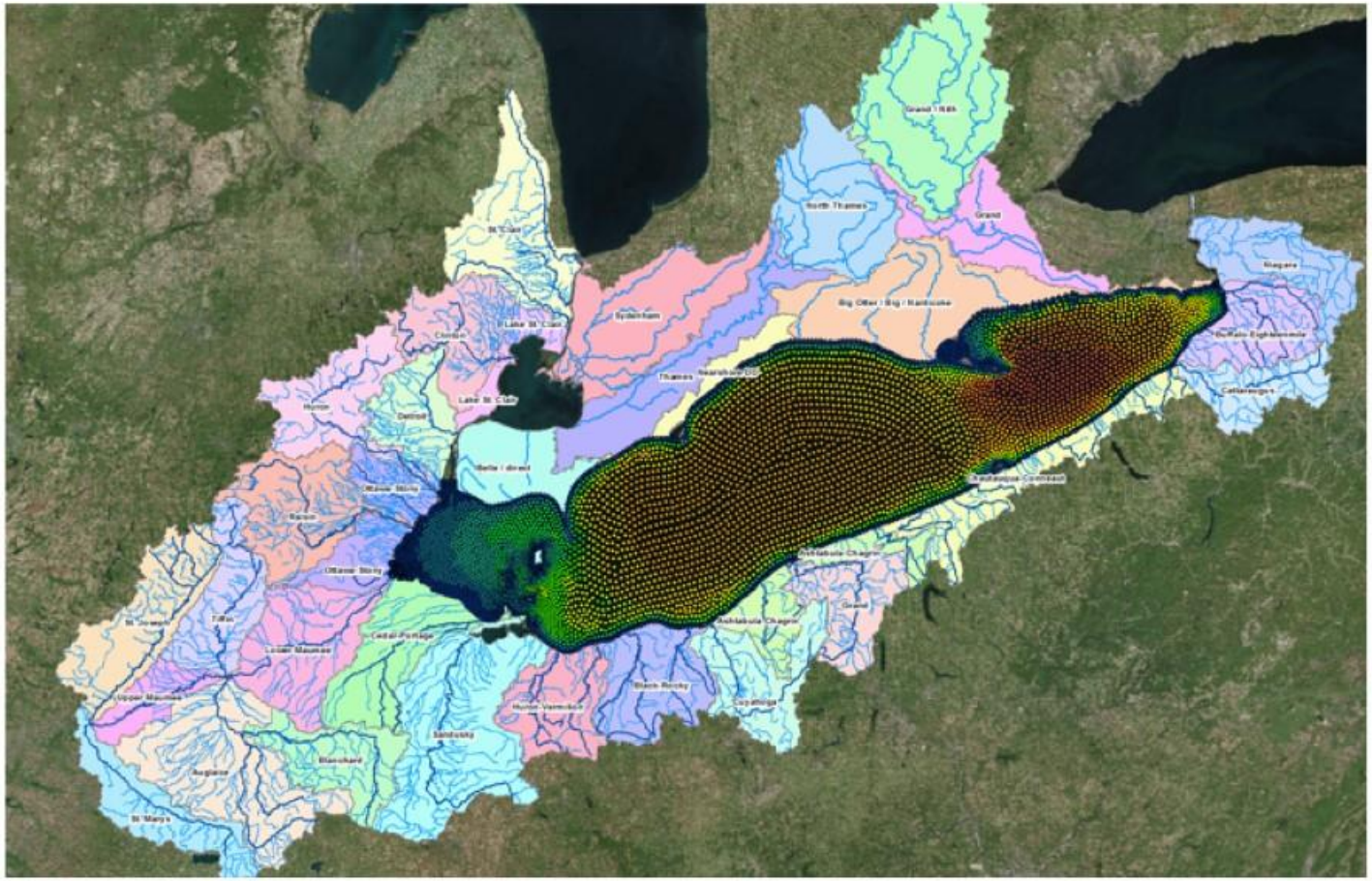
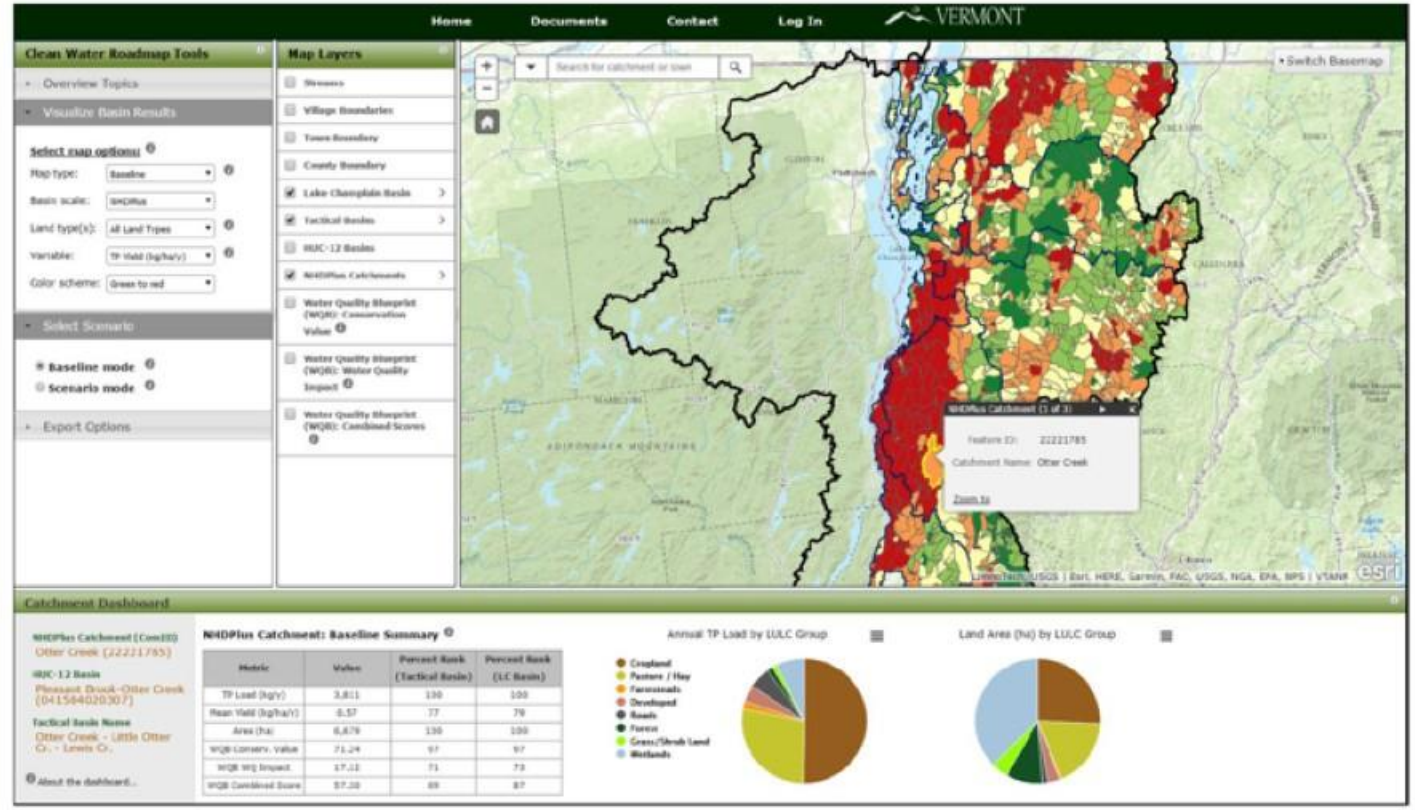


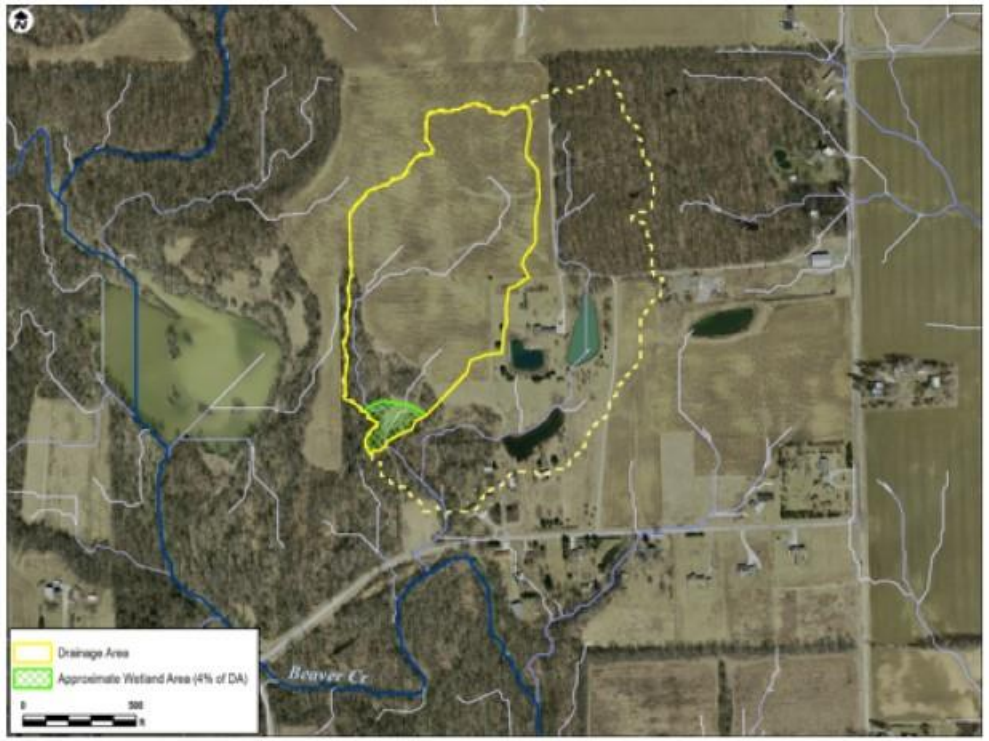
DATA AND DECISIONS

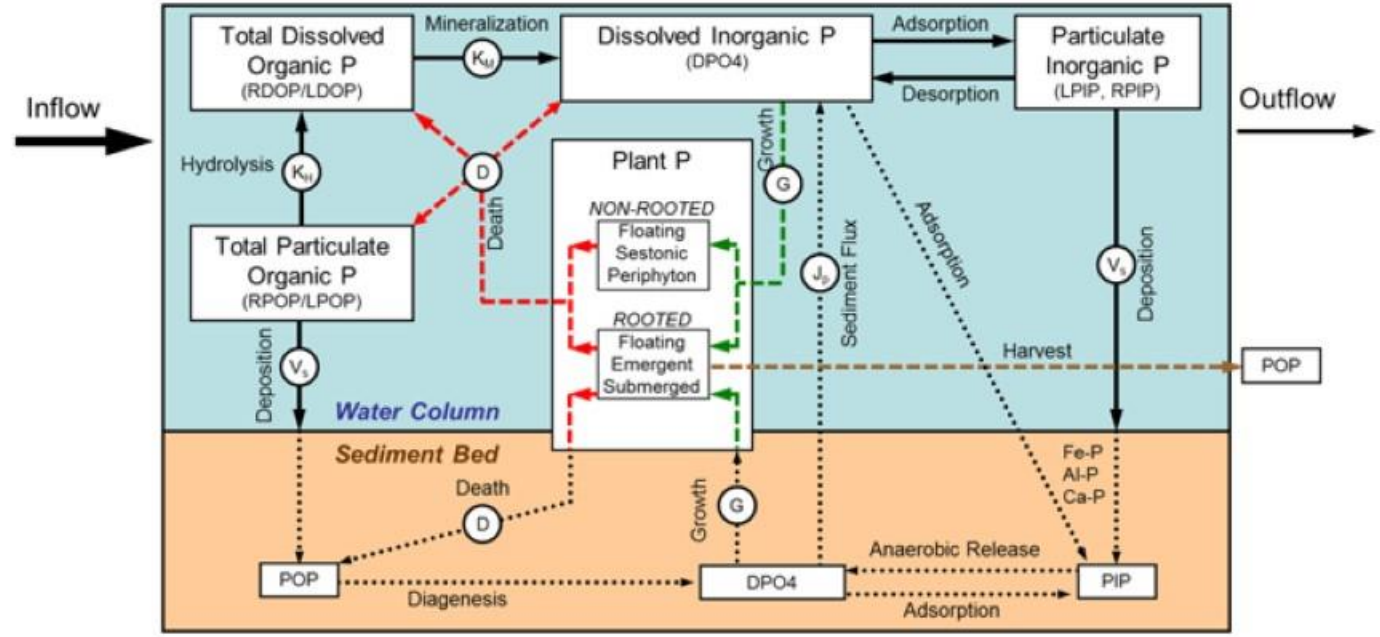
- Lake Champlain Clean Water Roadmap
- Great Lakes Observing System HABs Data Portal, Great Lakes Buoy Portal, Heidelberg Portal and Maumee Portal (in development)
- Big Data, Internet of Things, machine learning
- Nutrient Modeling Toolbox and Decision Tool



MITIGATION

- 4R Nutrient Stewardship evaluation
- Siting and design of agricultural nutrient treatment wetlands
- Green infrastructure planning for cities and counties
- Technical assessments to support policy development for state, federal, and bi-national agencies





MITIGATION

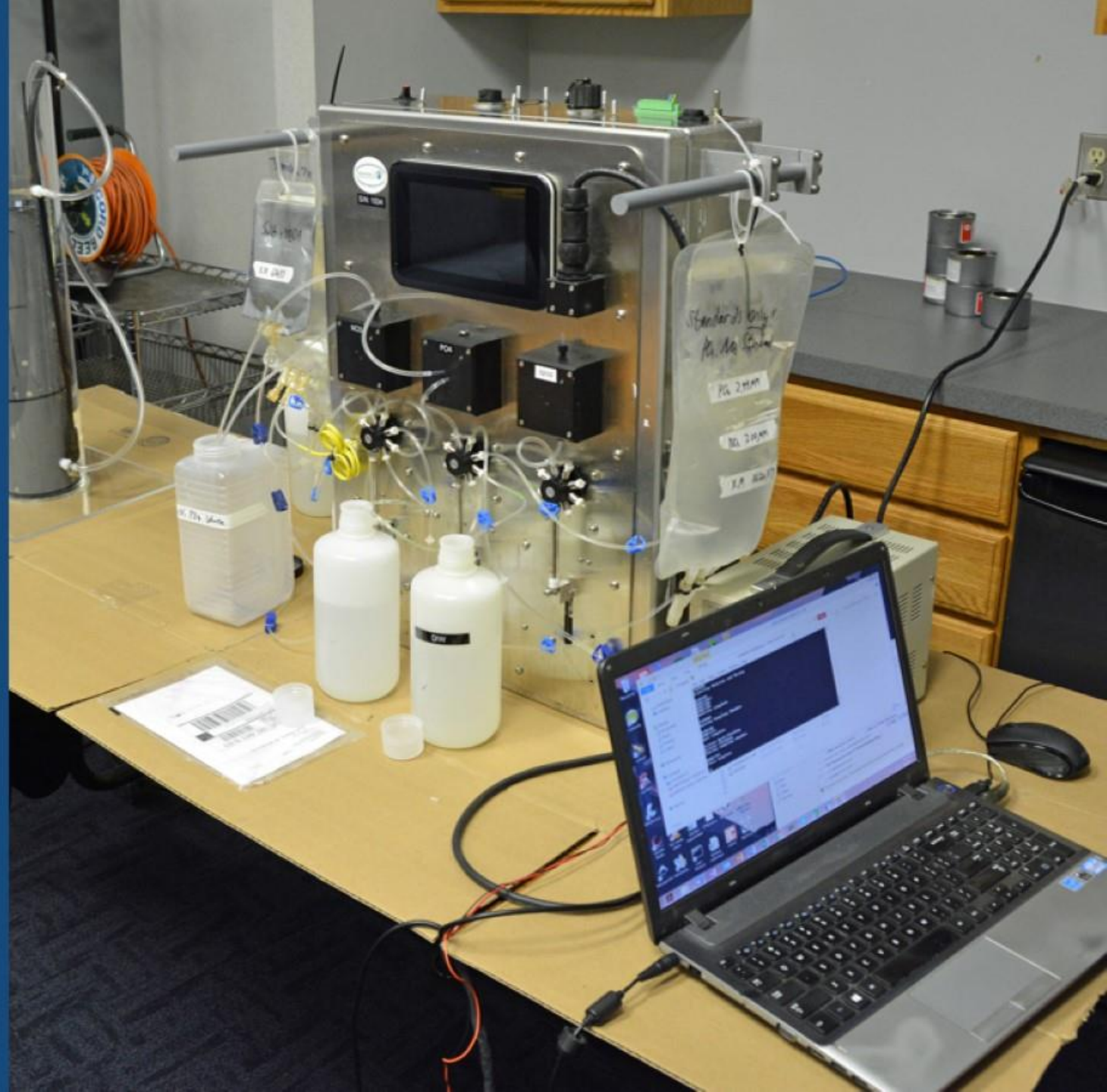
Management Action
Algaecides
Hypolimnetic aeration/oxygenation
Inflow/end-of-pipe chemical treatment (e.g. alum based compounds)
Biomanipulation through Fisheries Mgmt (Long-term)
Biomanipulation through Fisheries Mgmt (Short-term)
Drawdown
Shoreline restoration/riparian management
P coagulants (Alum & alum-based compounds)
P coagulants (Ca & Fe)
P coagulants (Other)
Dilution and flushing
Mechanical harvesting
Native plant community restoration
Herbicides
Dredging
Microbes and enzymes
Shading Dye
Artificial Circulation
Hypolimnetic withdrawal

GRAND LAKE ST. MARYS ALUM TREATMENT

FLORIDA ALGAE SKIMMING (AECOM)

RESEARCH

- Model development
- HABs toxin production
- New sensor technologies
- Effectiveness of mitigation practices
- NOAA Cooperative Institute
- OSU, BGSU, Case Western, U-Toledo, UK, USACE ERDC, USEPA-Cincinnati, NOAA NCCOS



PEER-REVIEWED PUBLICATIONS

Contents lists available at ScienceDirect

Journal of Great Lakes Research

journal homepage: www.elsevier.com/locate/jglr

Development of the Western Lake Erie Ecosystem Model (WLEEM): Application to connect phosphorus loads to cyanobacteria biomass

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ABSTRACT

Since the mid-1990s, Lake Erie has experienced re-eutrophication symptoms including harmful algal blooms in the western basin and summer hypoxia in the Central Basin. The 2012 Protocol for the Great Lakes Water Quality Agreement (GLWQA) required phosphorus objectives and management recommendations to be set for all the Great Lakes, beginning with Lake Erie. To inform setting revised loading targets for the Lake Erie portion of the GLWQA, modeling was performed. The development and application of one of those models, the Western Lake Erie Ecosystem Model (WLEEM), is described here. WLEEM is a three dimensional, fine-scale, process-based model that links hydrodynamic, sediment transport, and in-lake biogeochemical and ecological processes. WLEEM was applied here to assess system sensitivity to a range of variables, and ultimately to develop a robust phosphorus load – cyanobacteria response relationship to determine a maximum load of total phosphorus from the Maumee River during the period of March–July that would produce a mild cyanobacteria bloom (<7830 MT cyanobacteria biomass) in Western Lake Erie. The maximum total phosphorus load from the Maumee River for that period to produce a mild bloom was determined to be 890 metric tons. Given the natural variability of systems like this, tools like WLEEM used in a dynamic operational modeling mode, consistent tributary and lake monitoring, and ongoing research will be essential components of effective mitigation and science-based adaptive management of eutrophication in Lake Erie and other nutrient-impacted water bodies.

Lake and Reservoir Management

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The Lake Okeechobee Water Quality Model (LOWQM) Enhancements, Calibration, Validation and Analysis

R. Thomas James , Victor J. Bierman Jr. , Michael J. Erickson & Scott C. Hinz

Water Research

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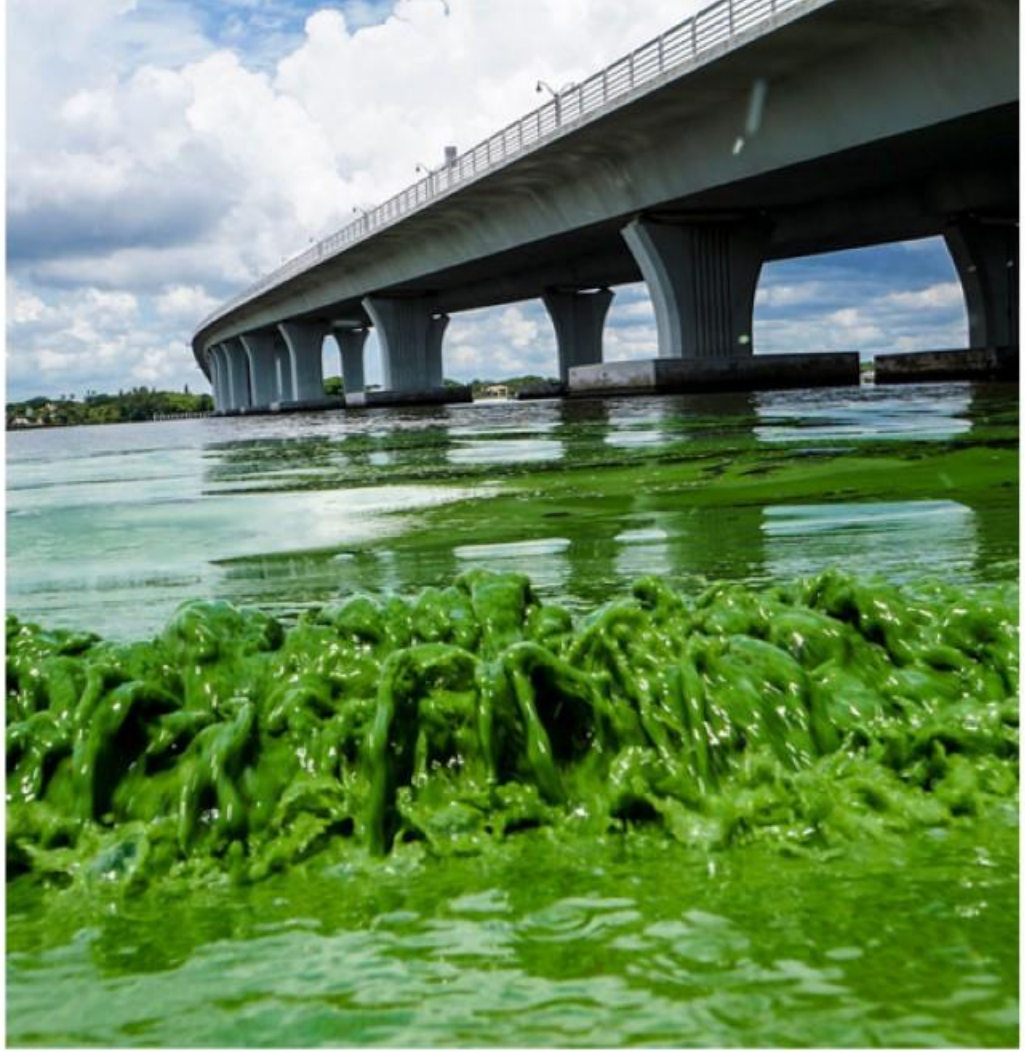
Using models of farmer behavior to inform eutrophication policy in the Great Lakes

Robyn S. Wilson [a], Derek A. Schlea [b], Chelsie M.W. Boles [b], Todd M. Redder [b]



AREAS WITH BIG PROBLEMS

Ohio River

Ohio Inland Lakes (e.g., GLSM)

South Florida

Upstate New York

Western lakes and reservoirs

San Francisco Bay-Delta

Great Lakes

THANK YOU

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