The Great Lakes HABs Collaboratory: building a boundary space for scientists and mangers

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Great Lakes Commission
ASLO Winter Meeting 2019

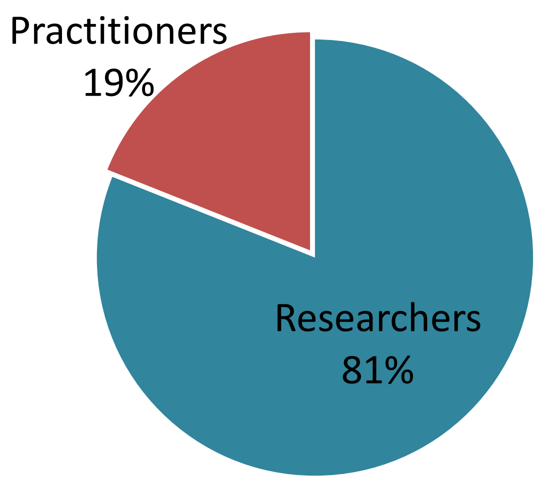
Theory of Change: Need for a HABs Boundary Organization

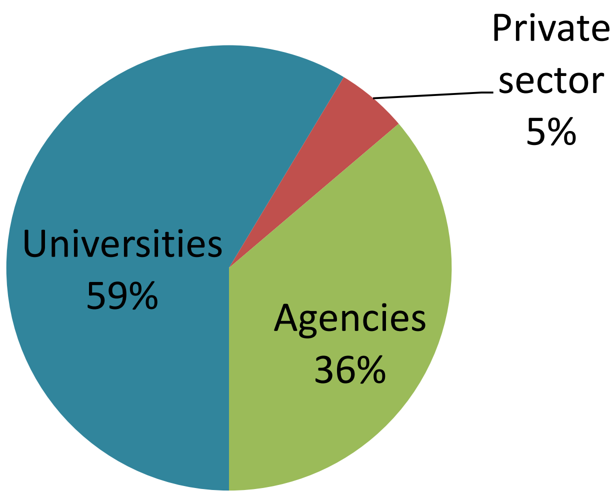
- Eutrophication is a serious problem globally and in selected regions of the Great Lakes.

- Harmful algal blooms (HABs) are most prominent in three major bays: Green Bay; Saginaw Bay; and Western Lake Erie Basin.

Validating Need for A HABs Collaboratory

- 58 interviews
  - 47 researchers and 11 practitioners
  - 34 from universities, 3 from private sector, 21 from 5 different agencies

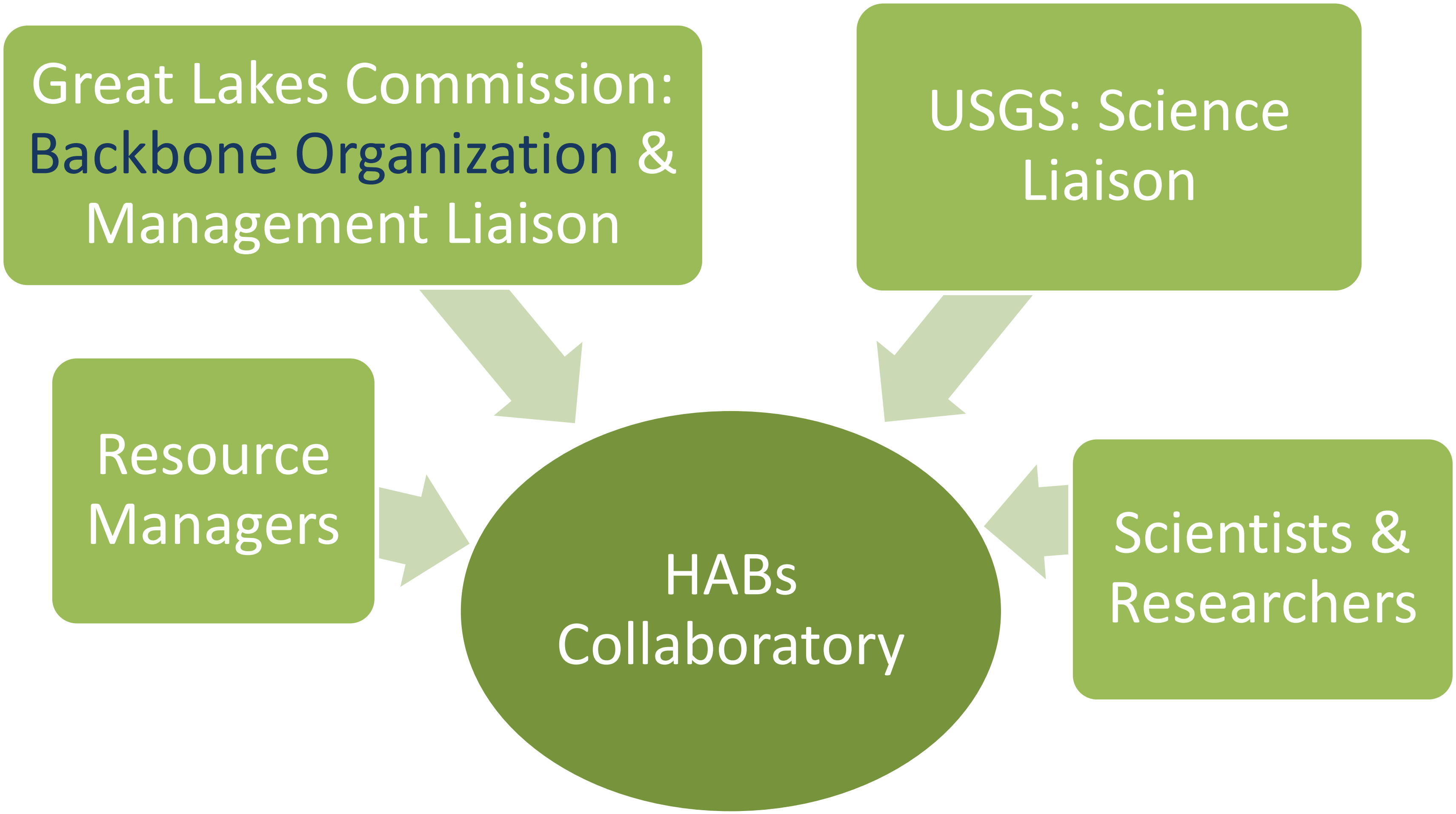




Collective Impact Model

- A technique used to address large-scale problems
  - Encourages cross-sector collaboration
- Stakeholders agree on a common agenda and shared measures

Collective Impact Model Applied to HABs Collaboratory



What is A “Boundary Organization”?

In the Literature

- Guston, 2001
  - use of boundary objects/standardized packages
  - expertise from policy and science along with professionals that mediate those sides
  - accountability to both science and policy
- Gustafsson et al., 2018
  - authority is negotiated and gained through stakeholder engagement
  - trust that the process of engagement is fair
  - boundary objects that are Credible, Relevant and Legitimate (CRELE).

Science → Policy

My Contribution to the Concept

- Pebbles, 2019 (forthcoming)
  - includes Gustafsson et al. characteristics, but further adapted
  - trusted and well facilitated processes are used to engage policy makers and policy practitioners
  - identify policy-relevant research priorities

Science → Policy

and

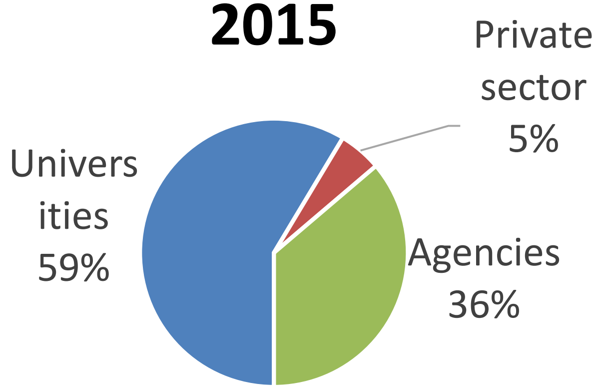
Policy → Science

Initial Priorities/Unmet Needs

- Triggers: What triggers and/or controls toxicity?
- Nutrients: What is the effect of timing and pulses of nutrient input on extent and duration of HABs?
- Toxicity: What (environmental and biological) factors determine whether a bloom is toxic and how toxic it is? (N, micronutrients, genetics, microbial community)

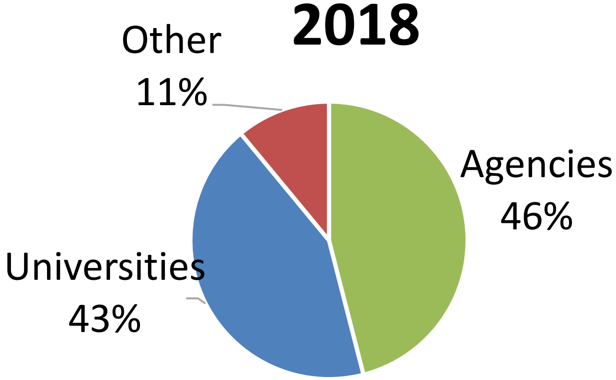
Membership

2015



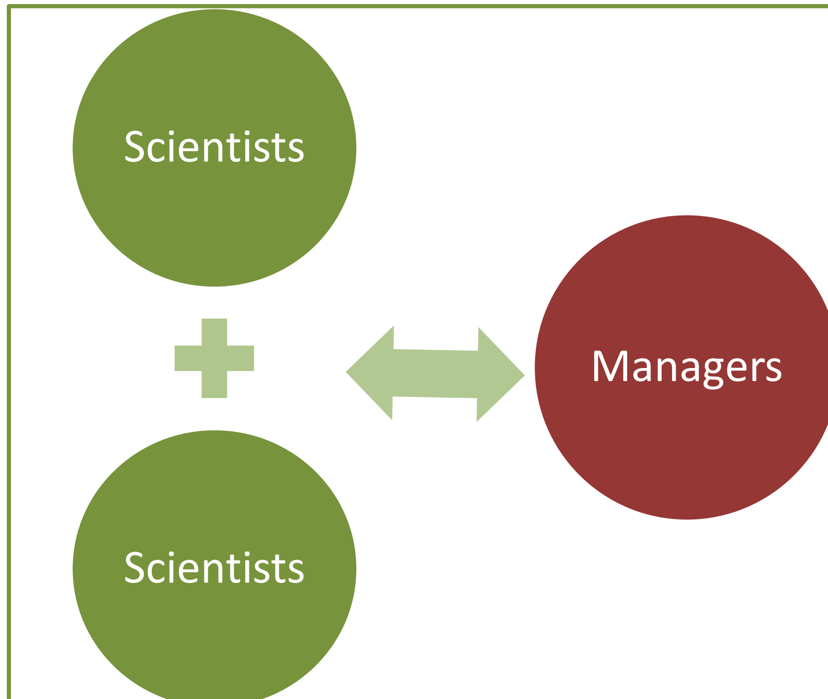
~75 members

2018



250+ members

- Multidisciplinary group, 250+
- Over half actively conducting HABs research



Applying Collective Impact

Steering Committee

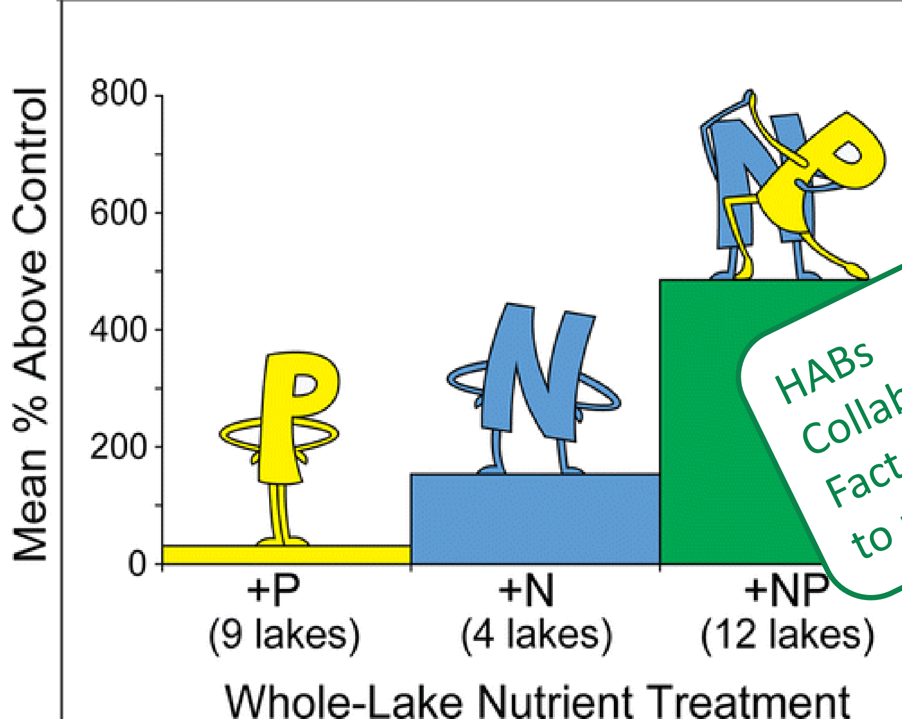
- ***Silvia Newell, Wright State University***
- ***Michelle Selzer, Michigan Office of the Great Lakes***
- Eric Anderson, NOAA-GLERL
- Raj Bejankiwar, International Joint Commission
- Jan Ciborowski, University of Windsor
- Timothy Davis, Bowling Green State University
- Mary Anne Evans, U.S. Geological Survey
- Donna Hill, U.S. EPA
- Gina LaLiberte, Wisconsin Department of Natural Resources
- Todd Miller, University of Wisconsin-Milwaukee
- Dale Robertson, U.S. Geological Survey
- Brannon Walsh, U.S. EPA

Webinars

- Current and Emerging HABs-related Technology in the Great Lakes
- 2016 and 2017 Field Season
- 2017 Modelling Webinar
- HABs Collaboratory and Invasive Mussels Collaborative Joint Webinar
- 2016 State of the Science Webinar Series
  - Data and modeling
  - Sources and movements
  - HABs and safe drinking water
  - Detection, composition and effects
  - Public health
  - Monitoring and forecasting
  - Sources and toxicity
  - Educate & engage

Publications

It Takes Two to Tango: When and Where Dual Nutrient (N & P) Reductions Are Needed to Protect Lakes and Downstream Ecosystems
Paerl et. al 2016



Traditional scientific papers discuss this

- Nitrogen role in HAB biomass and toxicity
- What are the different forms of nitrogen and why is this important?
- …y does nitrogen enter …reat Lakes?
- …e directions for nitrogen research
- Strategies to reduce nitrogen loading

HABs Collaboratory Fact Sheet linking to management

Publications

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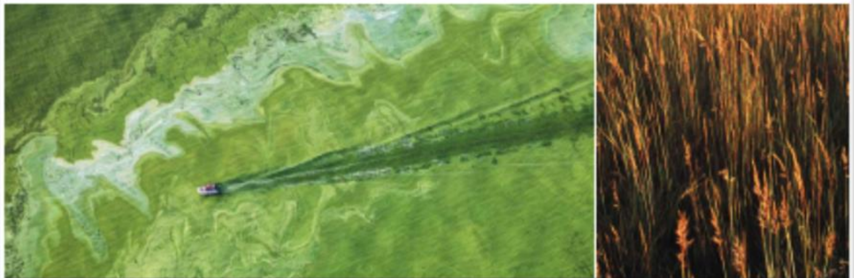
UNIVERSITY OF MICHIGAN

GRAHAM.UMICH.EDU/WATER



Informing Lake Erie Agriculture Nutrient Management

The US EPA and Environment Canada recently announced new phosphorus (P) loading targets for Lake Erie that are expected to reduce the occurrence and severity of harmful algal blooms (HABs) in the lake's western basin and low oxygen conditions (hypoxia) in the central basin. The Maumee River contributes 48 percent of the phosphorus to the western basin of Lake Erie, and has been identified as the primary driver of HABs. Therefore, the targets limit March-July loadings from the Maumee River to 186 metric tonnes of dissolved reactive phosphorus (DRP), and 860 metric tonnes of total phosphorus (TP) — a 40% reduction from 2008 values.

Six groups of modelers from universities, government, and industry came together to evaluate potential options for agricultural management to reduce phosphorus loads. The project team focused on agricultural nonpoint sources of P, because approximately 85 percent of the P leaving the watershed at the outlet of the Maumee River is from farm fertilizers and manure (Figure 1), even though the total load from the Maumee is only 10% of fertilizer and manure applications in the watershed.

We used multiple models to simulate a range of potential outcomes and raise confidence in model results. Five of the six models used USDA's Soil and Water Assessment Tool (SWAT) - a state-of-the-art watershed model commonly used to test how land management actions influence water quality outcomes. Even though they used the same base model, each group's model was different because of the critical different decisions they make about spatial discretization, input data sources, subroutines to use, land management operations, model parameterization, and calibration approaches. Each of these decisions contributes to real differences between and among SWAT models. The sixth model was a USGS **SPA**tially **R**eferenced **R**egressions **o**n **W**atershed attributes (SPARROW) model.

Phosphorus Delivery (tonne/y, %)

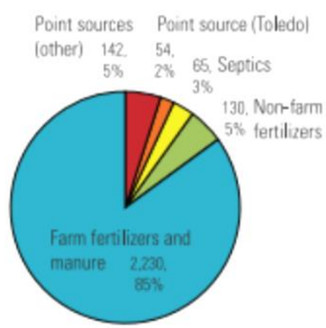
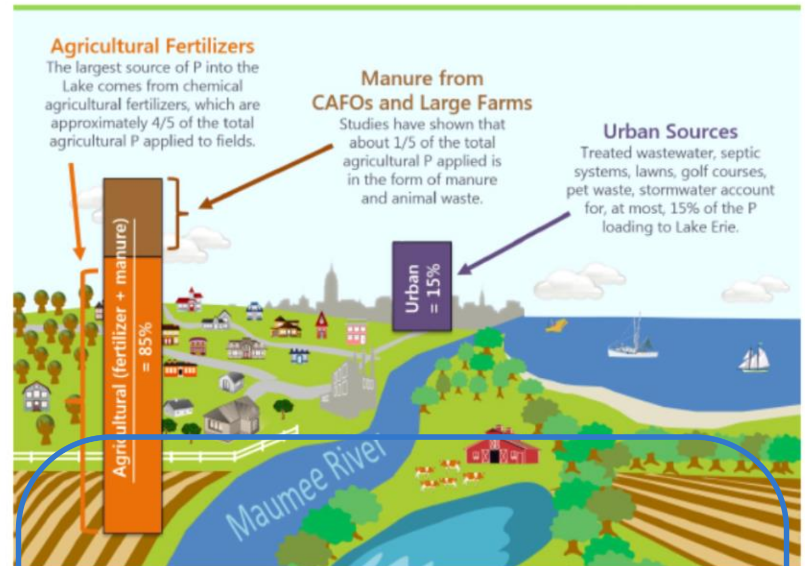


Figure 1: A conservative estimate of the contribution of farm fertilizers and manures to the total Maumee River phosphorus load. The estimated delivery from farm fertilizers and manures (2,230 t/y) is approximately 10% of what we estimate is applied to those farm fields (25,300 t/y). This chart was developed by subtracting the known inputs of point sources, failing septics and non-farm fertilizers (assuming 100 percent delivery to the lake) from the average load from the Maumee River 2005-2014. The delivered load from farm fertilizers and manures also includes legacy sources in soils and streams.

Each group used the same inputs of climate and point sources, and ran their models of the Maumee River watershed for the same time period (2005-2014). Models were validated to observed streamflow and water quality data to increase confidence in their simulation of watershed processes. Agricultural, environmental, and policy stakeholders from the Lake Erie region were consulted to develop agricultural land management scenarios to test in the five SWAT models. Twelve bundles — combinations of one or more agricultural conservation practices — were tested and included a variety of practices — in-field, edge-of-field, and structural

Great Lakes HABs Collaboratory
Linking Science and Management to Reduce Harmful Algal Blooms

Phosphorus (P) and HABs: Sources of P from the Maumee River



More information and definitions are provided on the back of the page.

Why P?

P has been shown to be the main driver of HABs and hypoxia; because of this, P load reduction targets have been set for Lake Erie by the Great Lakes Water Quality Agreement. In freshwater systems, P is typically the limiting nutrient – meaning there is enough nitrogen in the system to maintain growth. While P is the focus here, nitrogen is also an important factor in bloom growth and toxicity. For more information about nitrogen, see the "What About Nitrogen" fact sheet.

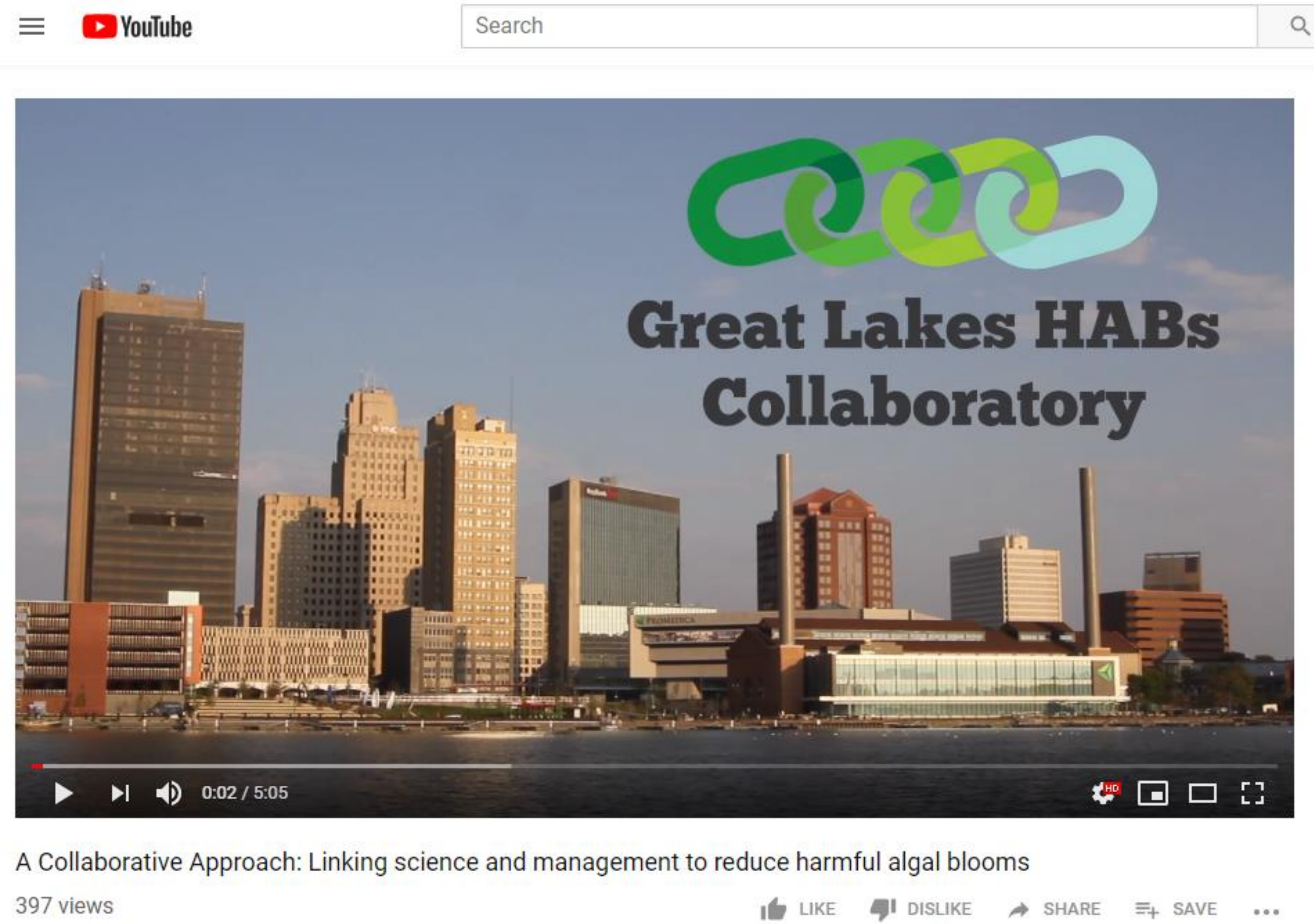
Does P timing matter?

The season that P enters the lake is very important for ecosystem processes. The algae that form HABs prefer warmer temperatures, therefore the P entering during the spring (which typically has more rain and is when fertilizer is applied to farm fields) drives the HABs. For hypoxia, the effects from P are driven by how much P is loaded into the Lake over the year, not by what happens season to season. This is why the Great Lakes Water Quality Agreement requires different targets for springtime phosphorus inputs and annual inputs.

What about other P sources?

Internal loading in the lake is recycled P from sediments and plants. It is believed to be a small source of P (1/10 of the load from the Maumee River). This is shown by small HABs that have occurred in drought years like 2012. Dredging impacts are too small to detect.

The Detroit and Maumee Rivers provide almost equal annual average loads of P into Lake Erie. However, the *concentration* of P from the Detroit River is much lower than the Maumee River. The concentrations from the Detroit River are not high enough to stimulate HABs, however they contribute to hypoxia.



http://bit.ly/HABsCollabVideo

Expanding the Impact

- Annex 4
  - HABs Collaboratory RFP will provide small grants to support science needs identified by the Adaptive Management Task Team

- CSMI 2019 Lake Erie
  - Exploring how to best support CSMI researchers and showcase this work (e.g., interactive maps)

- ErieStat

  Using HABs science to support tracking progress toward P reduction goals for Lake Erie

Keeping in Touch

Website:
https://www.glc.org/work/habs-collaboratory

@GLHABsCollab

Join the List-Serv:

habscollaboratory+subscribe@great-lakes.net