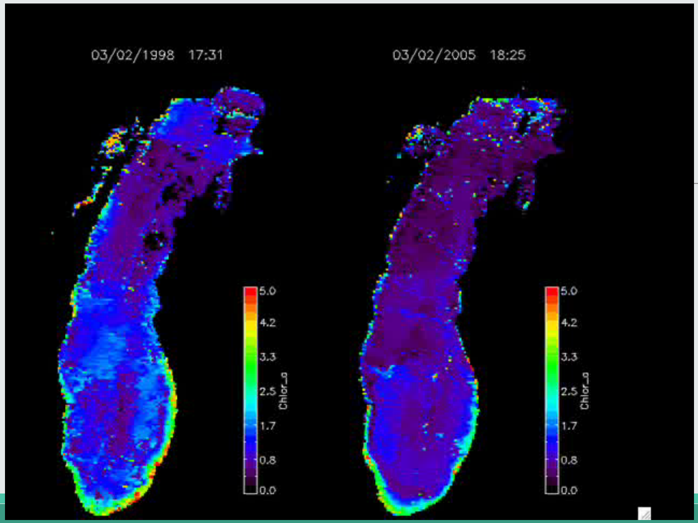
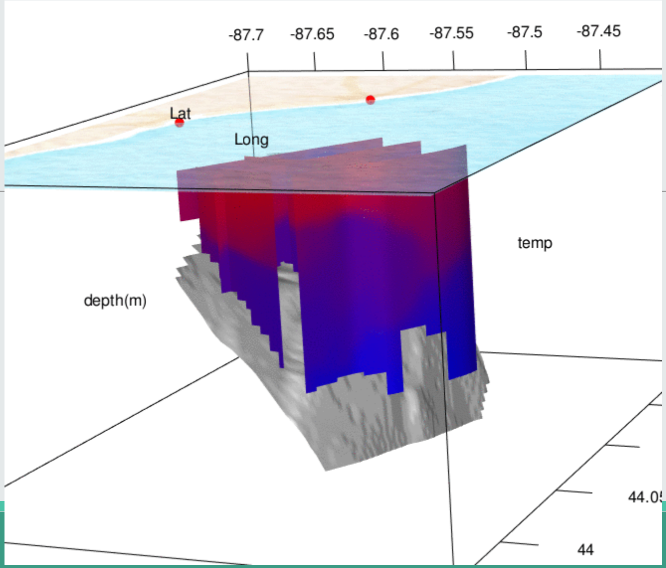
Scaling Up Ecosystem Monitoring in the Great Lakes

DR. PARIS COLLINGSWORTH

PURDUE UNIVERSITY, FORESTRY AND NATURAL RESOURCES



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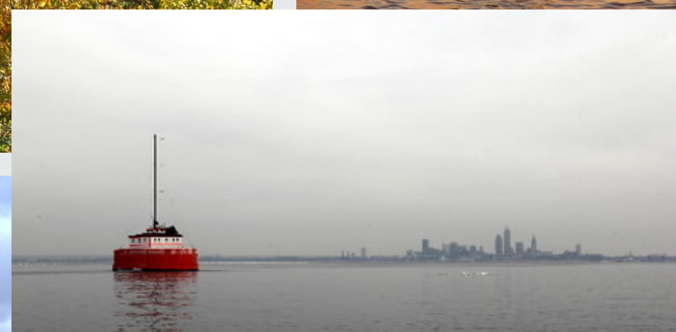


AMERICAN INTEGRITY



ALGAL BLOOM
ADVISORY
A harmful algal bloom has been
detected at this location.
Users are encouraged
to avoid ingesting water and

Outline

Introduction

Ecosystem monitoring in the Great Lakes

Applied research

Data access

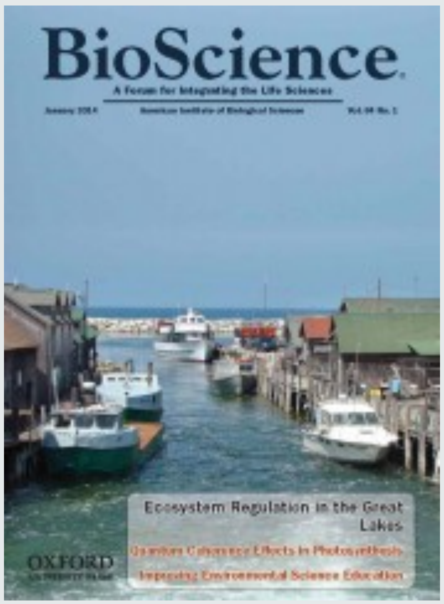
Ecosystem monitoring in the Great Lakes

Began with the signing of the Water Quality Agreement

- Status and trends in open water
- Nutrients and biology

Documentation of ecosystem changes

Ecosystem monitoring in the Great Lakes



Ecosystem monitoring in the Great Lakes

Began with the signing of the Water Quality Agreement

- Status and trends in open water
- Nutrients and biology

Documentation of ecosystem changes

Need for modernization and wider distribution of data

My position

Research assistant professor

- Food web structure in Great Lakes
- Biotic responses to ecosystem stressors

Liaison to EPA – GLNPO

- Applied research to address management issues
  - Optimization of existing monitoring programs
- Access to monitoring data
  - greatlakesmonitoring.org

Outline

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Ecosystem monitoring in the Great Lakes

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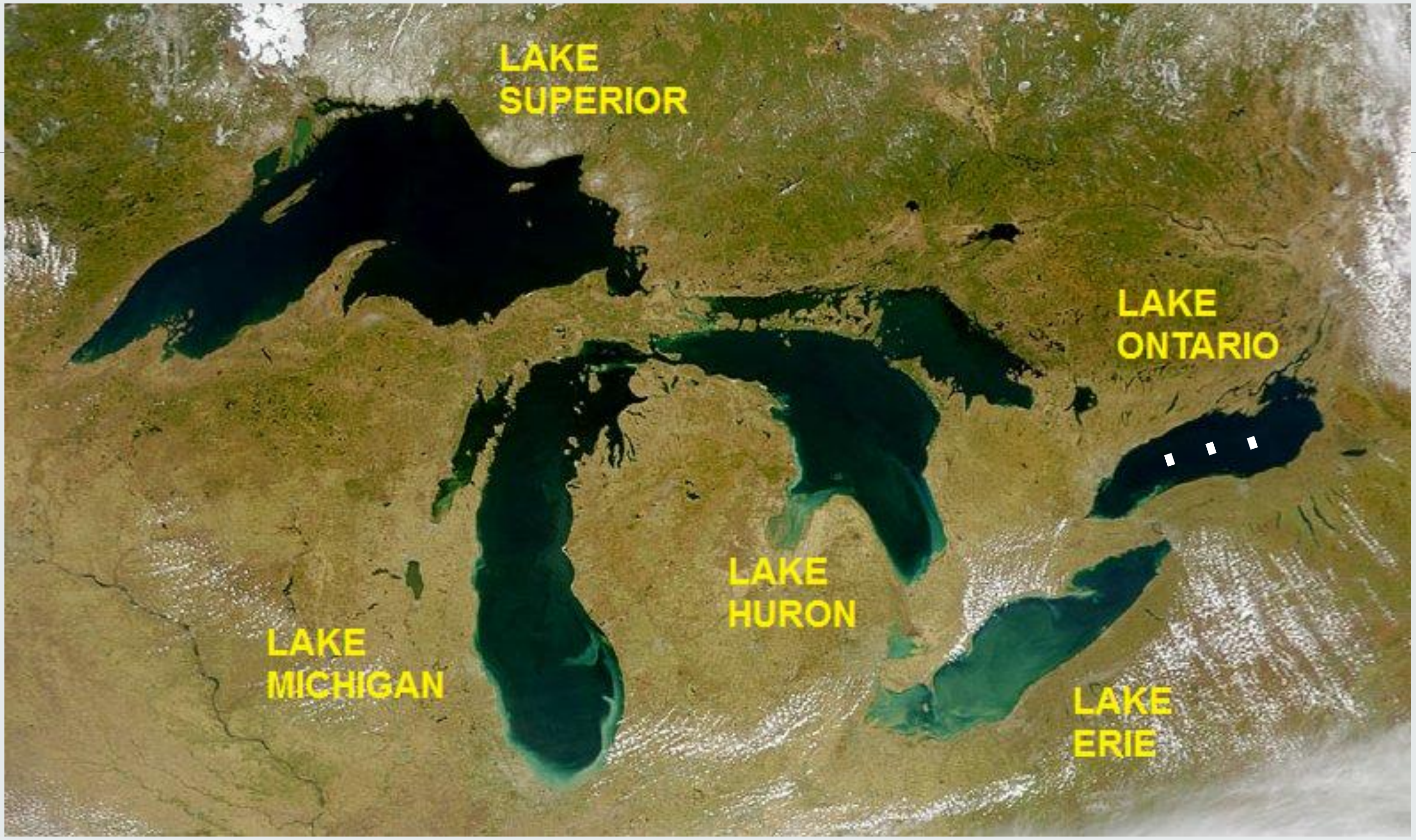
Applied research

Maintain efficiency of EPA-GLNPO monitoring at increasing spatial scale and temporal resolution

Applied research

Maintain efficiency of EPA-GLNPO monitoring at increasing spatial scale and temporal resolution

- Local-scale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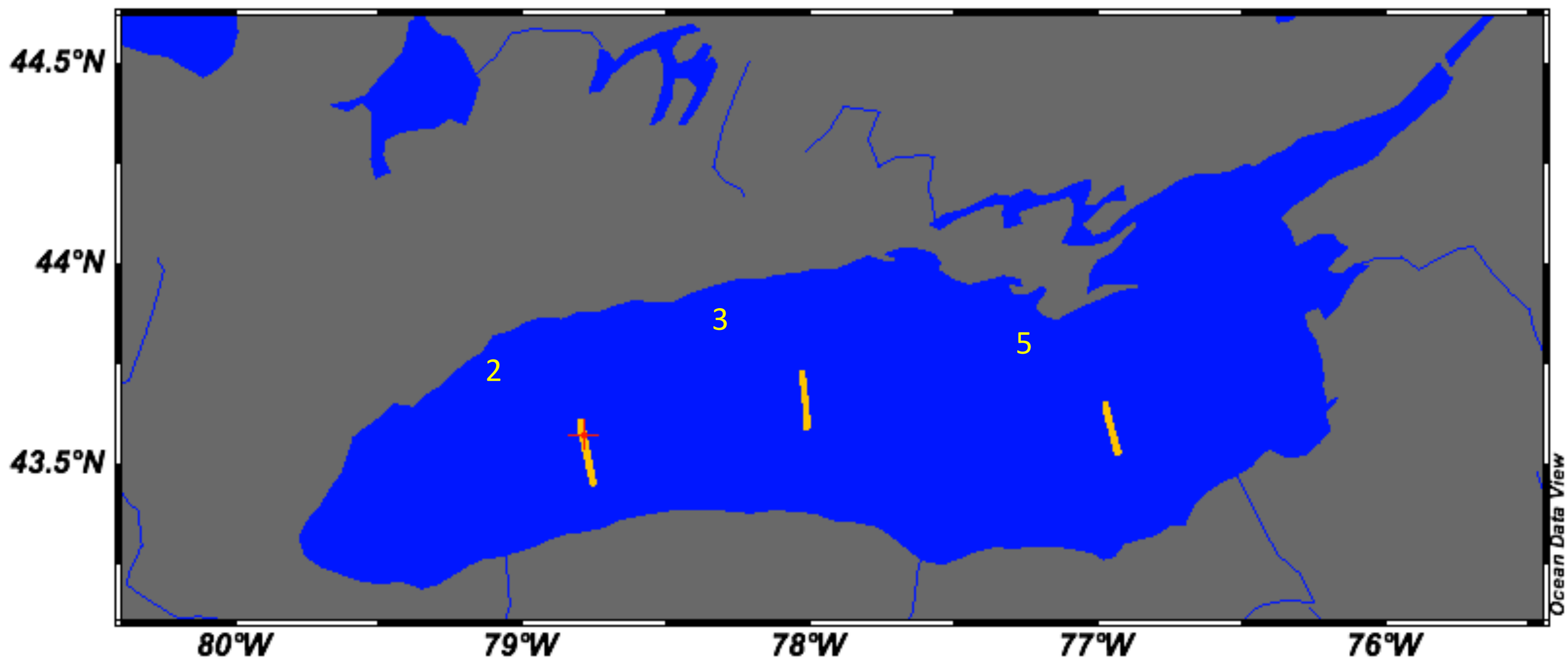
Collaborators

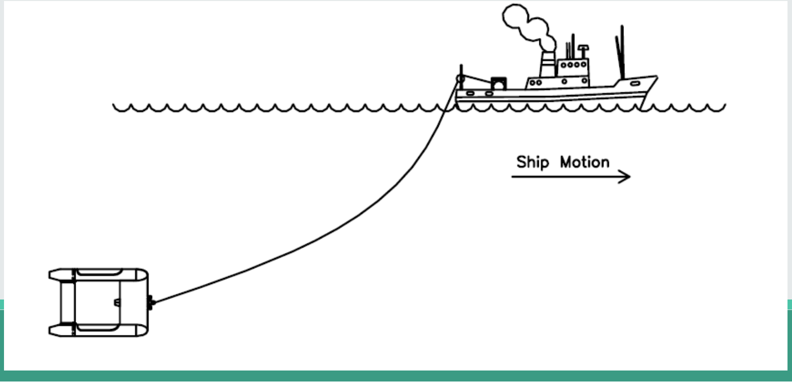
Drs. Jim Watkins and Lars Rudstam
Cornell University

Dr. Glenn Warren
EPA-GLNPO

High resolution mapping of the deep chlorophyll layer in Lake Ontario



TRIAXUS 3D Towed Undulating Vehicle



Triaxus capabilities

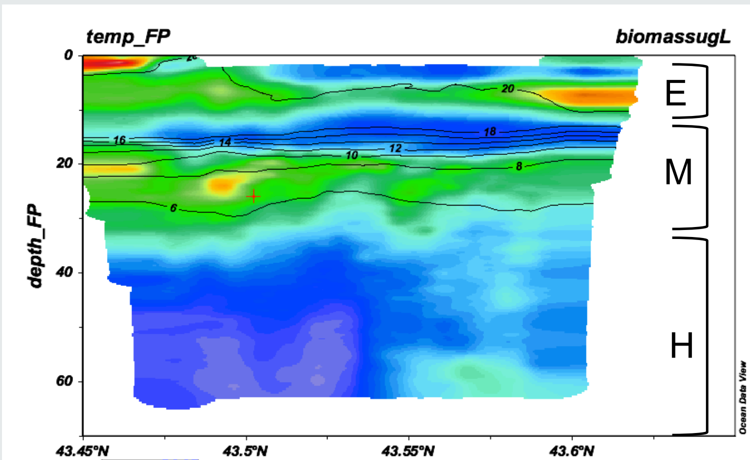
Sensors:

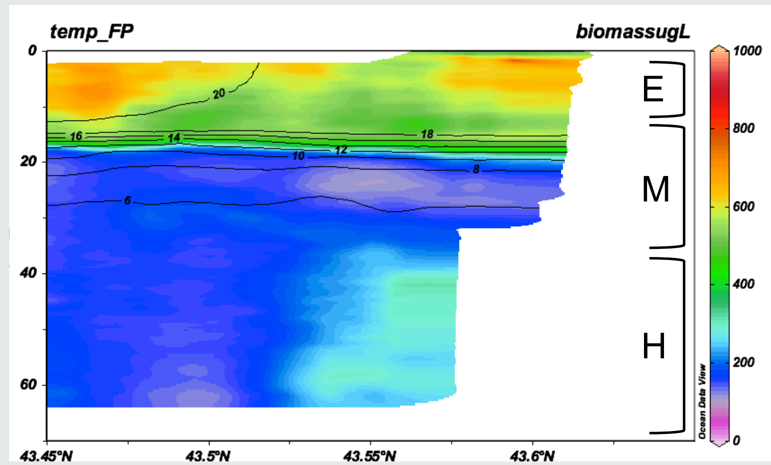
- SeaBird CTD & D.O. probe
- Nitrate Analyzer
- Flouroprobe
- Active Fluorometer
- Laser Optical Plankton Counter (LOPC)

Towed behind the R/V Lake Guardian

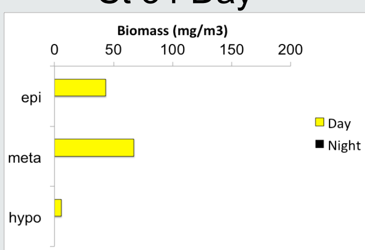
- Data intervals – sub second to once every 9 seconds

Transect 2 LOPC Zooplankton Biomass

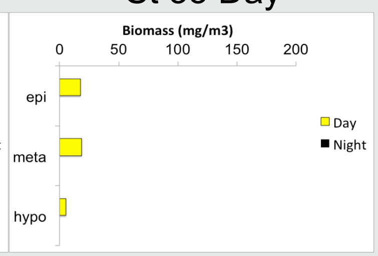




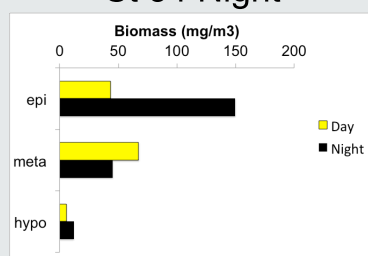
St 34 Day



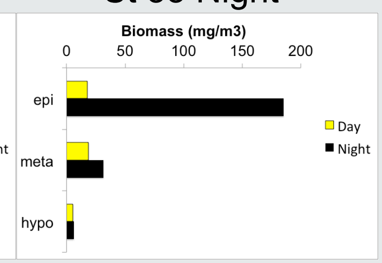
St 33 Day



St 34 Night



St 33 Night



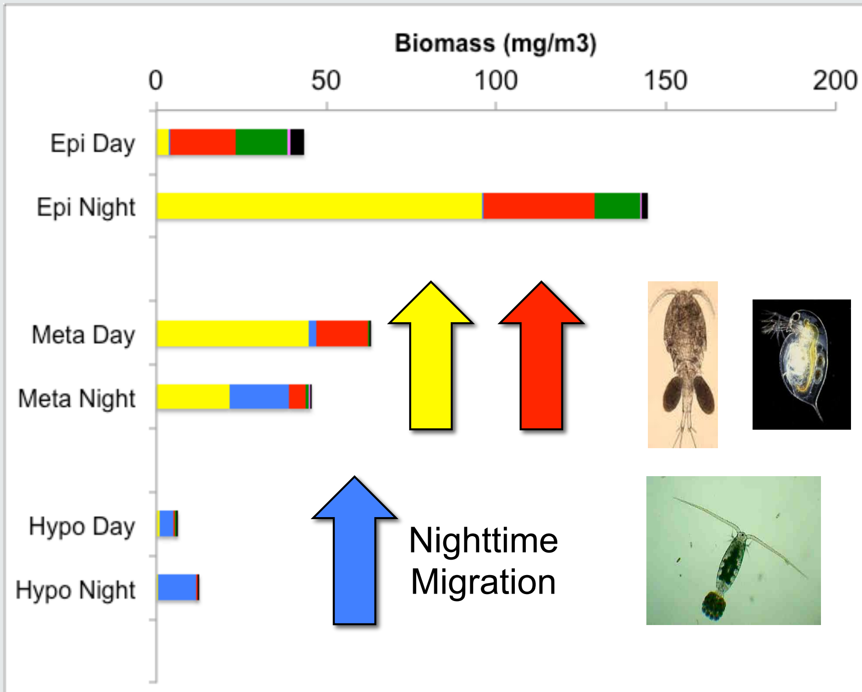
Day

Closing Net Data

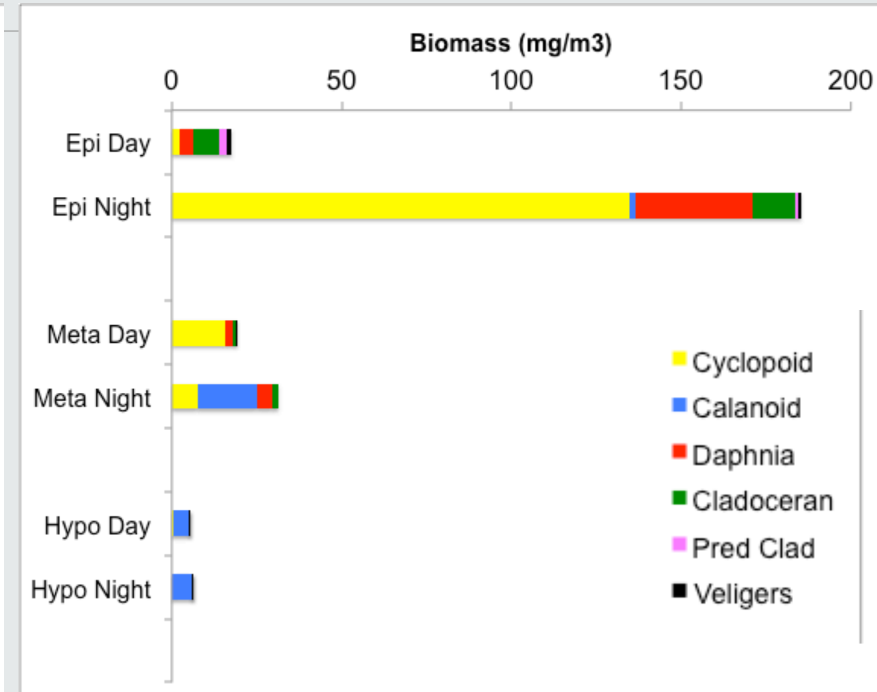
Night

Species Composition

Station 34 (South End)



Station 33 (North End)



DCL results

Significant primary and secondary production in DCL
- Previously unstudied

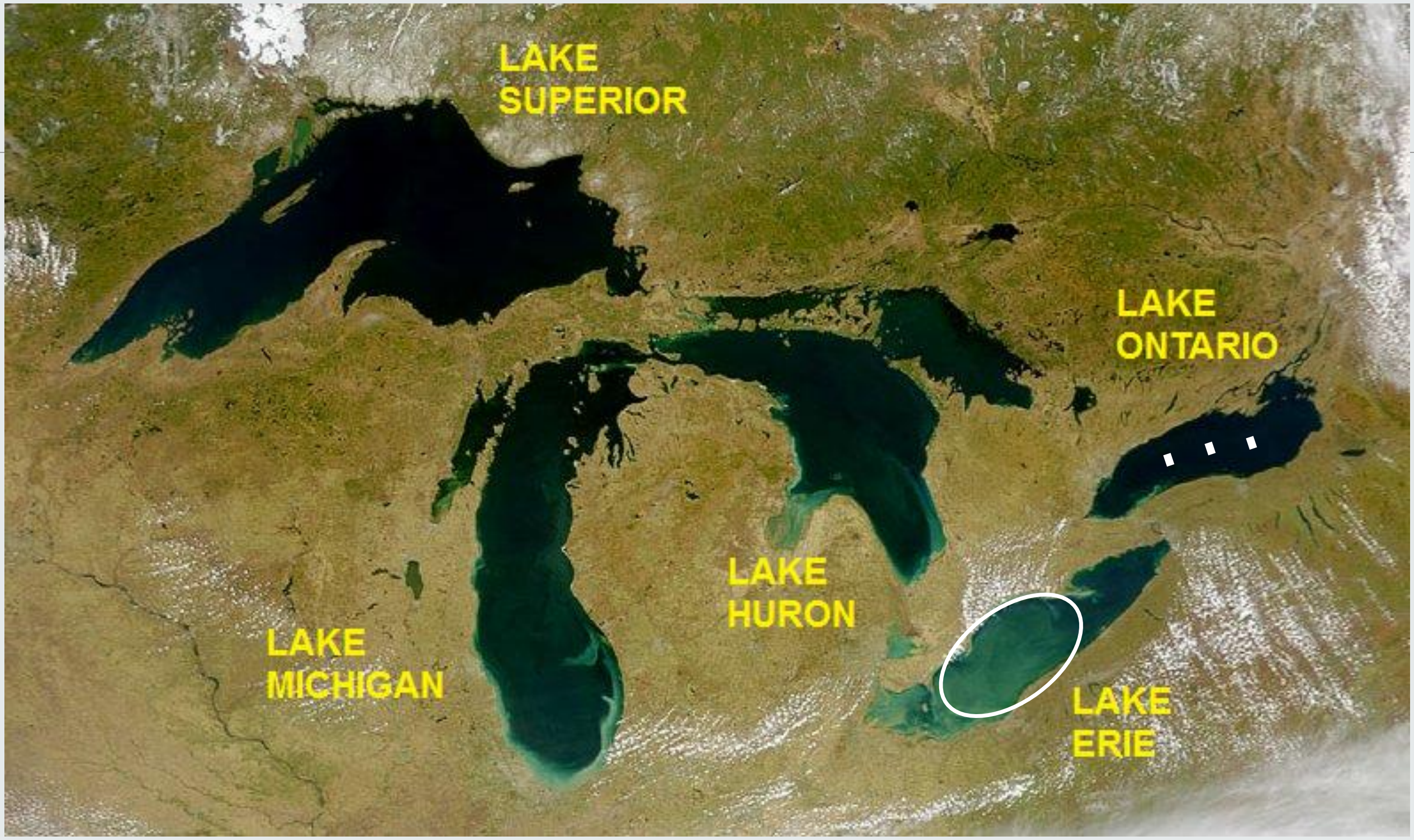
Biotic response
- Diel vertical migration of zooplankton
- Incomplete community composition

Future directions
- Expand sampling beyond L. Ontario

Applied research

Maintain efficiency of EPA-GLNPO monitoring at increasing spatial scale and temporal resolution

- Local-scale
- Basin-scale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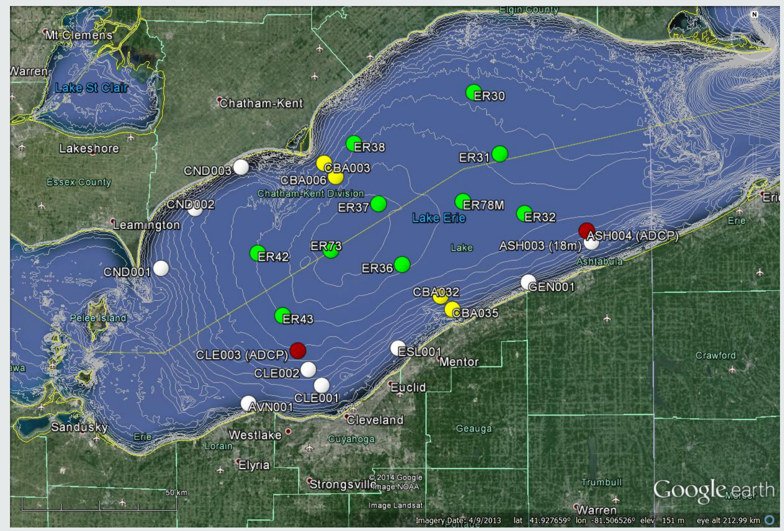
Hypoxia monitoring in Lake Erie



Collaborators

Dr. Richard Kraus, Director
USGS – Lake Erie Biological Station

Dr. Barbara Minsker and Wenzhao Xu
University of Illinois
National Center for Supercomputing Applications

Dr. Glenn Warren
EPA-GLNPO

Background: Hypoxia

Fulfill requirements of new water quality agreement
- Calculate depletion rate
- Estimate spatial extent

Supplement EPA-GLNPO monitoring
- 10 stations in the central basin
- Profile data every 2 weeks

Dynamic hypoxia in Lake Erie

Home > Fish Science > Lake Erie's dead zones more dynamic than once believed; impact fish distribution, study shows

Lake Erie's dead zones more dynamic than once believed; impact fish distribution, study shows

By Alex Card on April 21, 2015

In addition to its size, sea-like hydrology and formerly flammable tributaries, Lake Erie is known for its dead zones. Formed when decomposing organic material on the lakebed consumes oxygen in the water, these dead zones — as their name suggests — are hardly suitable for life.

A new study, led by U.S. Geological Survey scientist Richard Kraus, shows that Erie's dead zones are far more dynamic than previously thought, changing size and location in a matter of hours. Published in the Canadian Journal of Fisheries and Aquatic Sciences, the study illuminates challenges to fishery management and stock assessments posed by the shifting hypoxia.

Kraus serves as chief of the Lake Erie Biological Station, a research center that helps fishery and resource managers do their jobs. For the past couple of decades, Kraus said, routine recruitment surveys targeting yellow perch have revealed some odd findings.

"Some of the samples that they take in the vicinity of the dead zone, or within the dead zone, wind

Dead zone data helps protect vital fishery

Officials in charge of safeguarding Lake Erie fish populations are adjusting their monitoring practices with help from surprising new research showing that the lake's 'dead zone' is more dynamic than ever believed.

Every summer, the bottom of Lake Erie loses so much oxygen, due to natural conditions and nutrient-triggered algal blooms, that fish and other aquatic wildlife are forced to flee or suffocate. Scientists have long believed that the hypoxic water spreads out from the lake's central basin. But a three-year investigation of dissolved oxygen levels suggests that dead zones can spring up across the lake and disappear just as quickly.

"We were in awe when we looked at the data from the first season," said Richard Kraus, a biologist with the U.S. Geological Survey (USGS) Great Lakes Science Center. "Sometimes an area would switch from normal to hypoxic conditions in a matter of hours."

Kraus, along with researchers at the Ohio Department of Natural Resources (Ohio DNR), Ohio State University, the U.S. EPA Great Lakes National Program Office, and IISG, discovered the changing oxygen levels using a variety of sensors, including ones that continuously recorded lakebed temperature and oxygen levels for several months. The multi-pronged study also examined the impact of hypoxia on fish habitats and field sampling.

The results have major repercussions for efforts to measure and maintain sustainable fish populations—a particularly important task in Lake Erie, which supports one of the largest freshwater commercial fishing industries in the world.

Lake managers rely on population estimates to set annual limits on how many walleye, yellow perch, and others can be fished from the lake. These estimates are calculated using models that assume that the number of fish and the effectiveness—or catchability—of different fishing gear is similar throughout the lake and across seasons.

But dynamic dead zones mean inconsistency. Fish and other aquatic wildlife cluster around the edges of hypoxic waters to avoid suffocation, turning the lake into an ever-changing patchwork of high- and low-density habitats.

"Without the high-resolution data collected in this study, we would not have been able to see the fine details of how hypoxic waters move and impact where fish are found," said Paris Collingsworth, IISG Great Lakes ecosystem specialist.

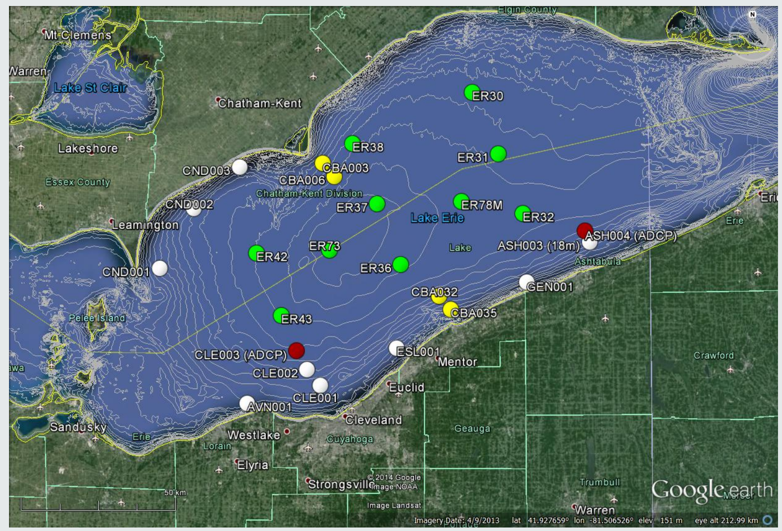
Knowing this will help managers adjust their sampling and analysis strategies to capture a more accurate picture of species behavior and numbers. In fact, groups like Ohio DNR and USGS have already made changes to their annual surveys based on study recommendations. For example, field researchers now plan to monitor dissolved oxygen levels more extensively throughout the survey to determine whether a nearby dead zone is triggering unusually high or low catch results.

Researchers also expect these results to ultimately lead to commercial catch limits that more effectively balance industry and conservation needs.

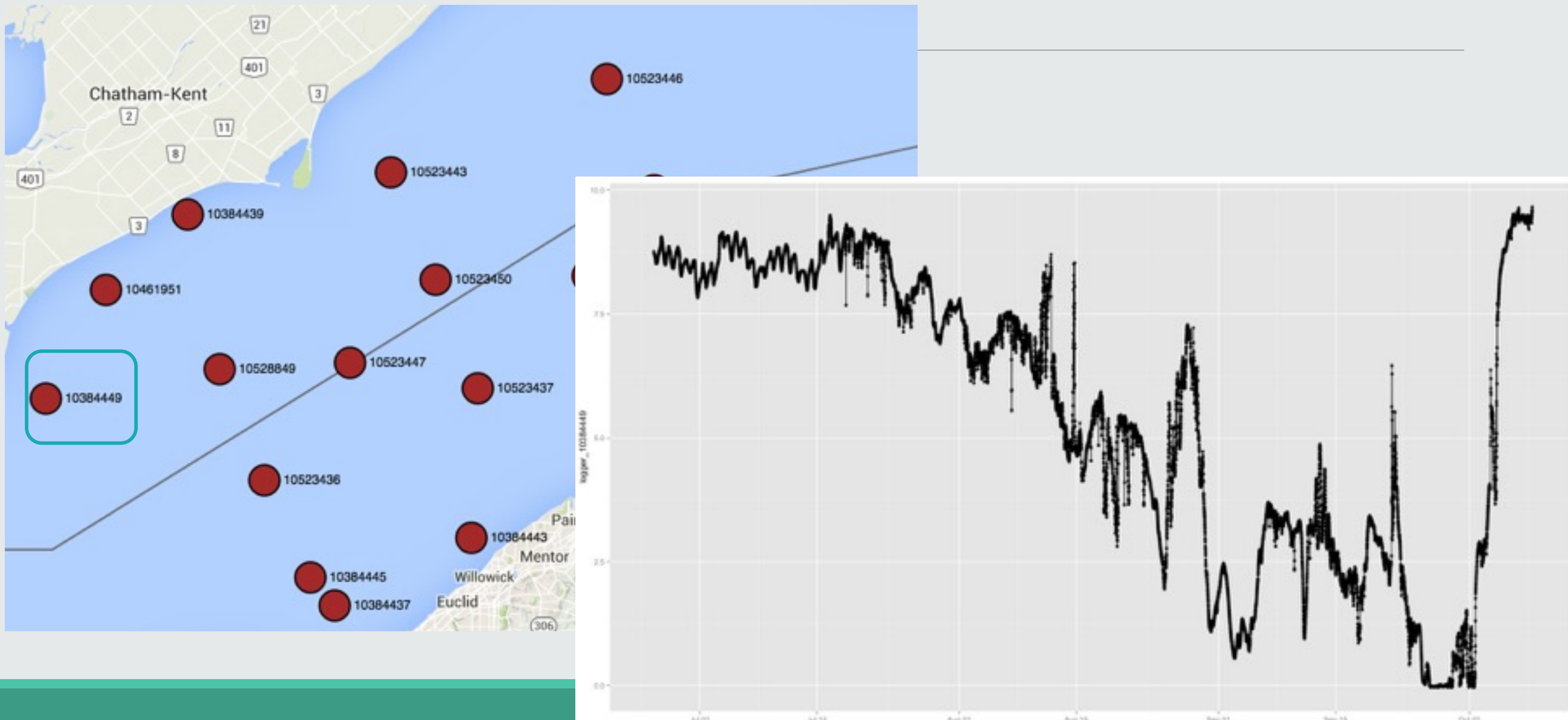
Hypoxia monitoring in Lake Erie

ACOUSTIC RECEIVERS WITH D.O. LOGGERS

HYPOXIA MONITORING NETWORK



Logger data



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Willowick
Euclid
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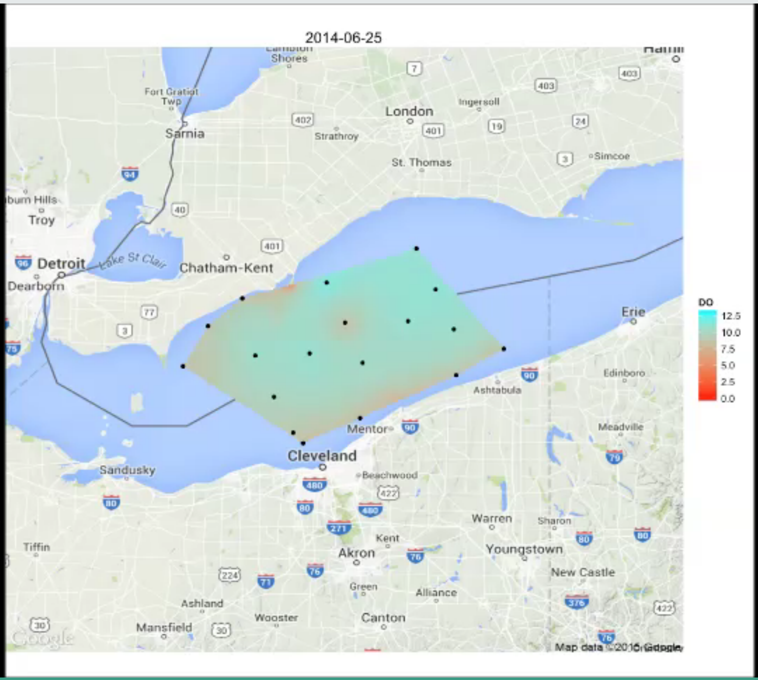
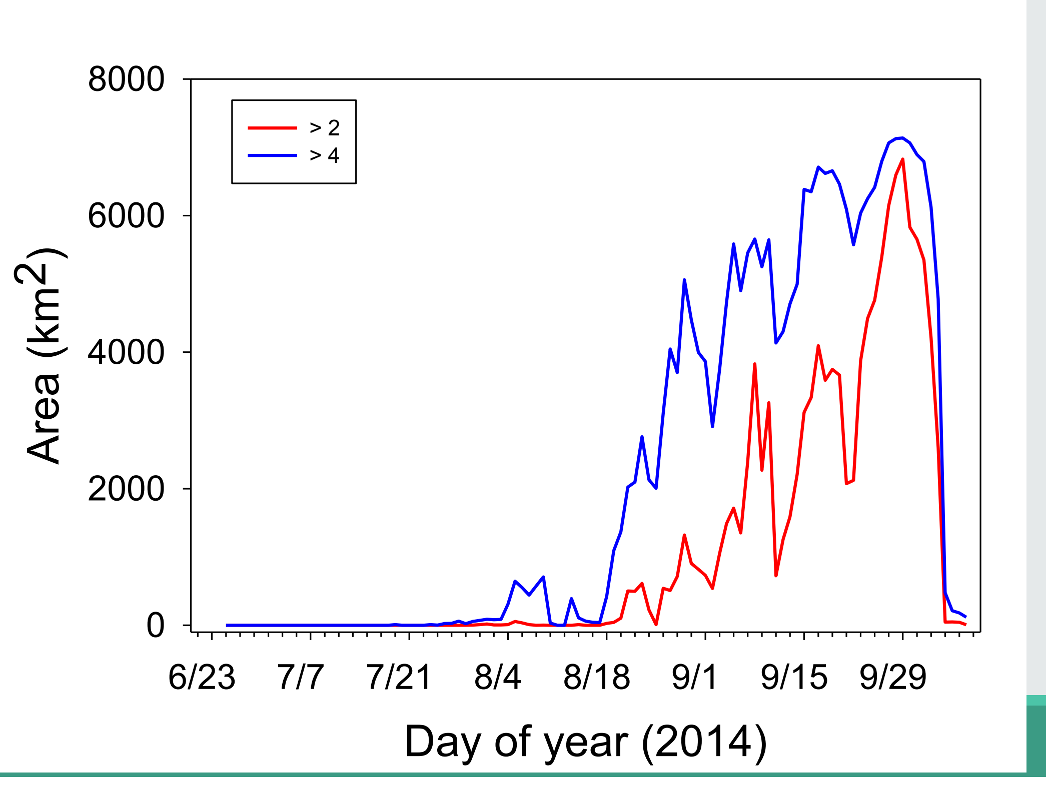
Daily averages



Spatial extent of hypoxia



Hypoxia results

Hypoxia is much more dynamic than previously believed

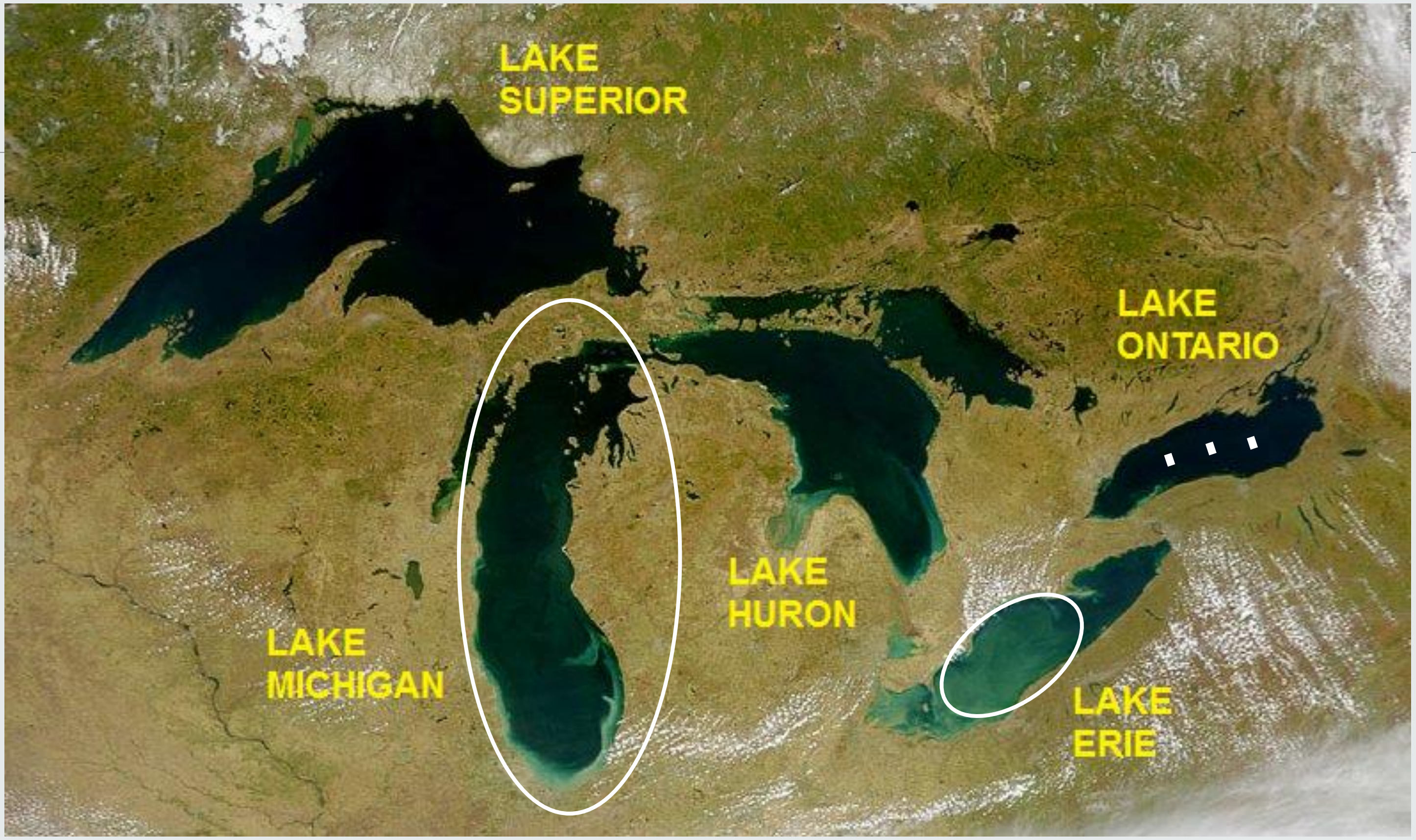
Future directions

- Multi year data and high resolution current profiles
- Early season estimates of benthic production
- Build a 4D predictive hypoxia model

Applied research

Maintain efficiency of EPA-GLNPO monitoring at increasing spatial scale and temporal resolution

- Local-scale
- Basin-scale
- Lake-scale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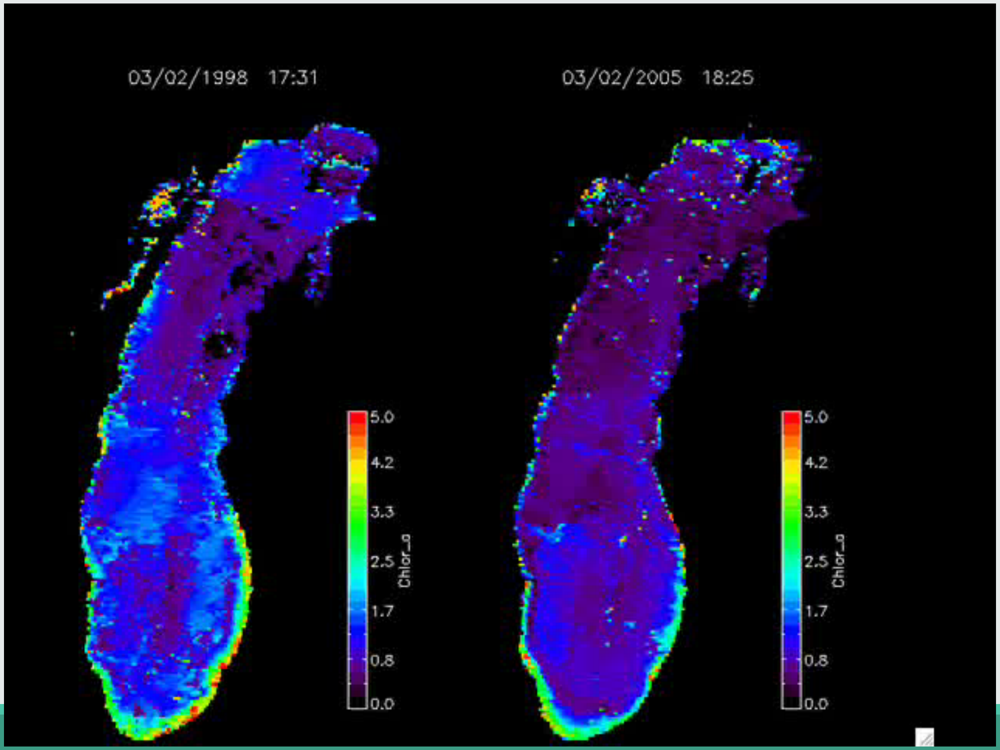
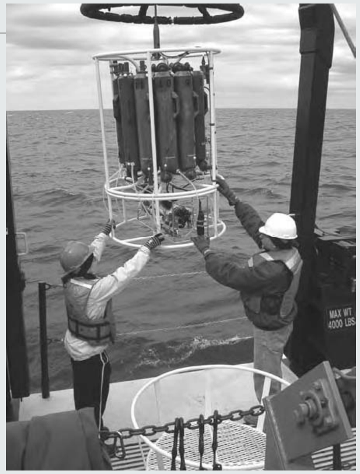
Temporal trends in primary productivity in Lake Michigan



Collaborators



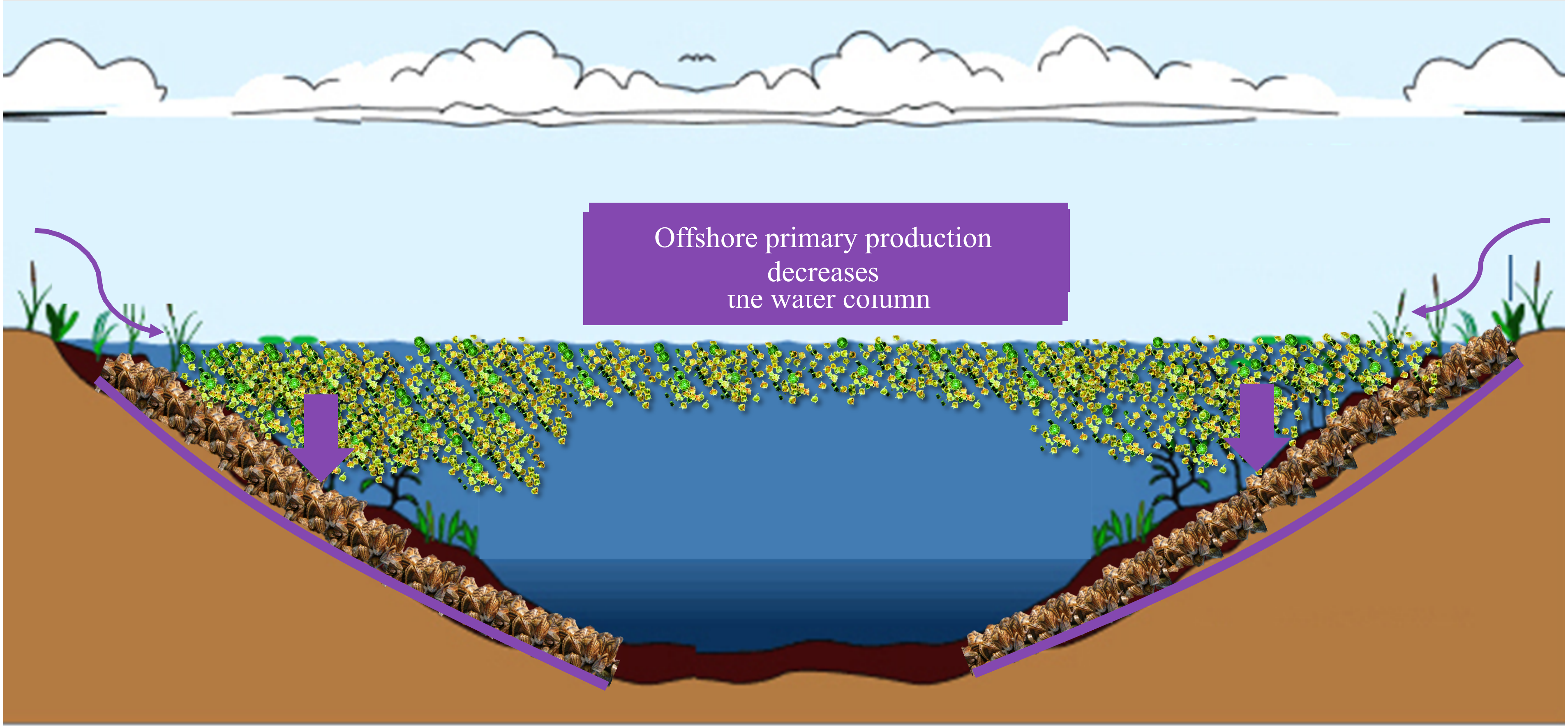
Dr. Barry Lesht
University of Illinois - Chicago

Margaret Hutton
Purdue University

Dr. Glenn Warren
EPA-GLNPO

NEARSHORE NUTRIENT SHUNTING

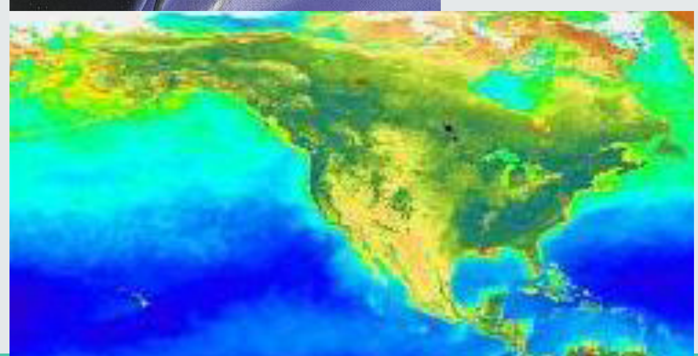
HECKY ET AL. 2004



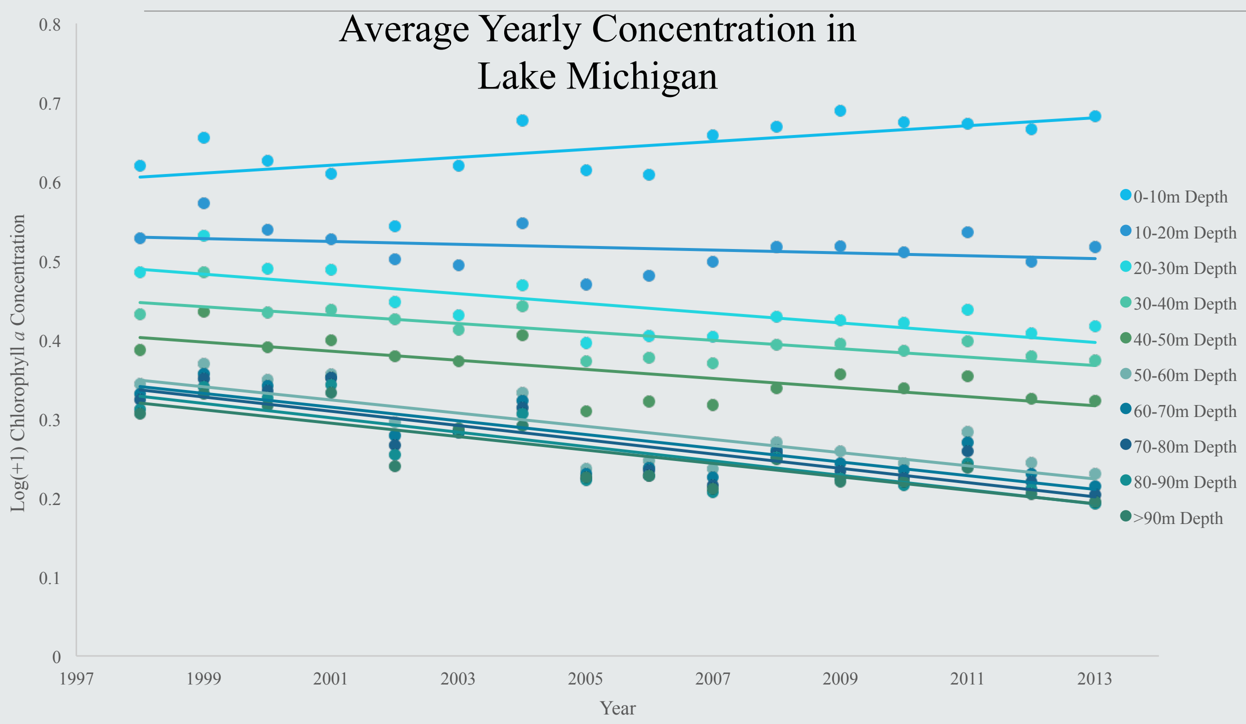
Background: Nearshore productivity

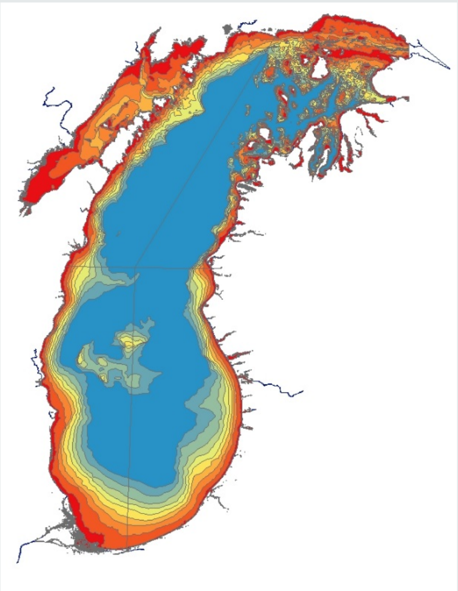
Satellite imagery analysis
- Algorithms to quantify surface chlorophyll
- Long time series for lake wide concentrations

Detailed lake-wide chlorophyll maps
- Temporal and spatial variability



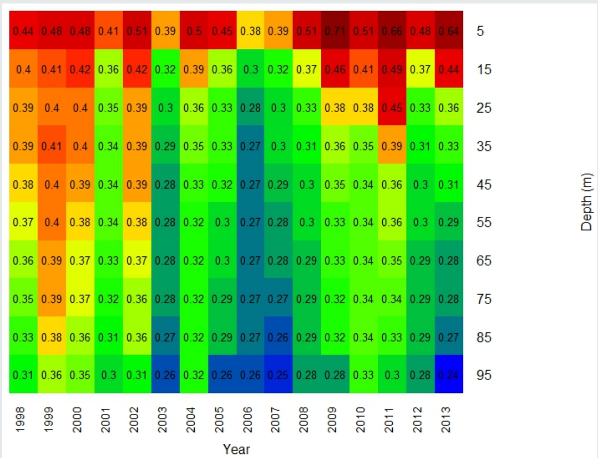
Trends in chl *a* concentrations from nearshore to offshore

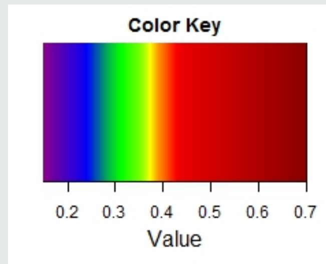




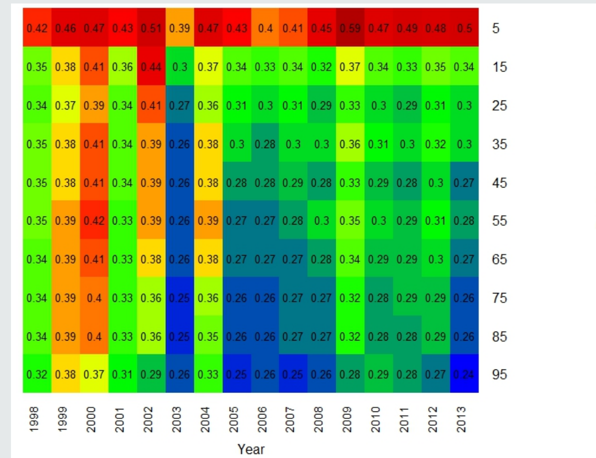
Changing in Chlorophyll *a* also vary Based on Region of Lake Michigan

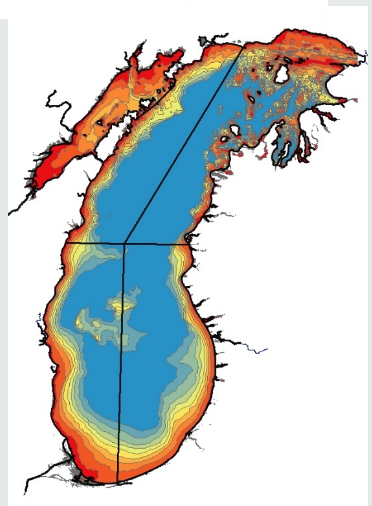
September, Northwest



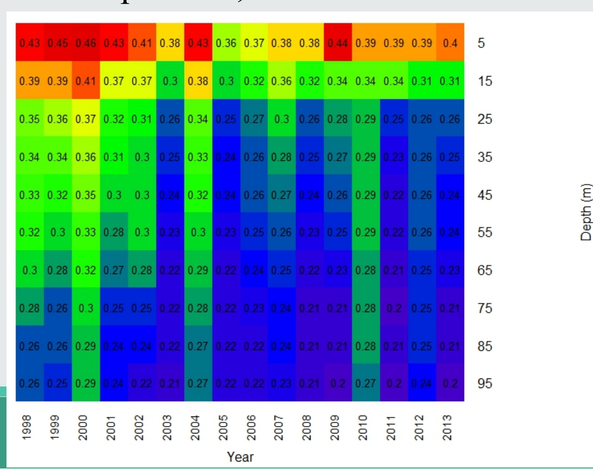


September, Northeast

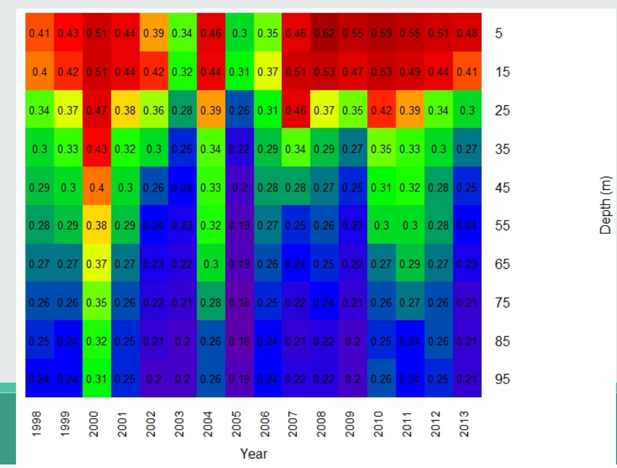




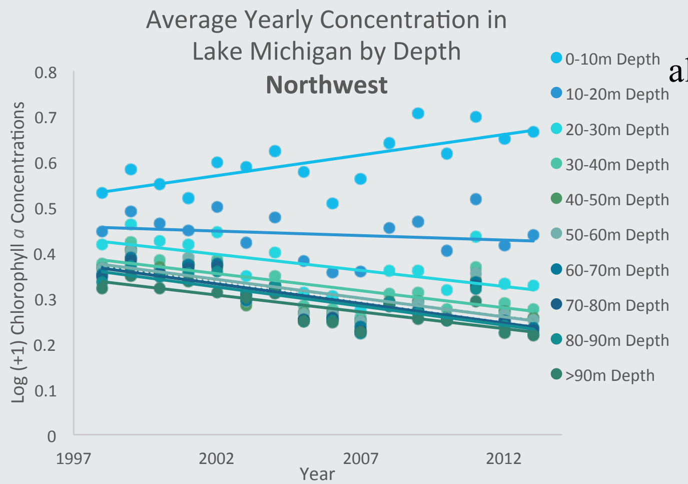
September, Southwest

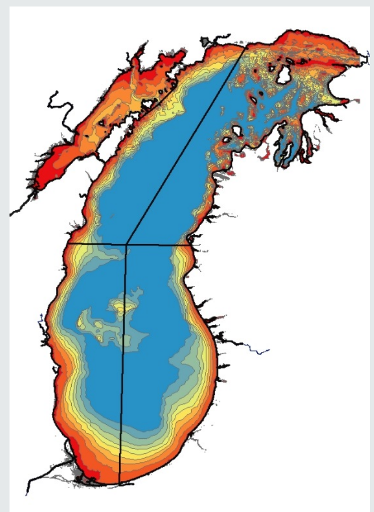


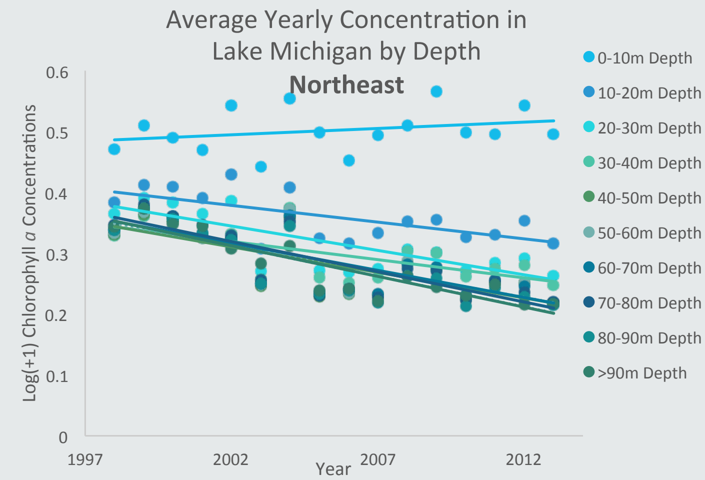
September, Southeast

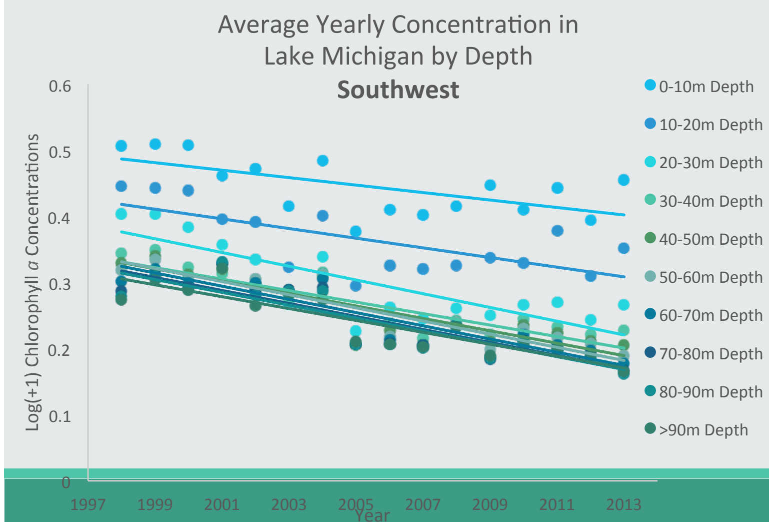


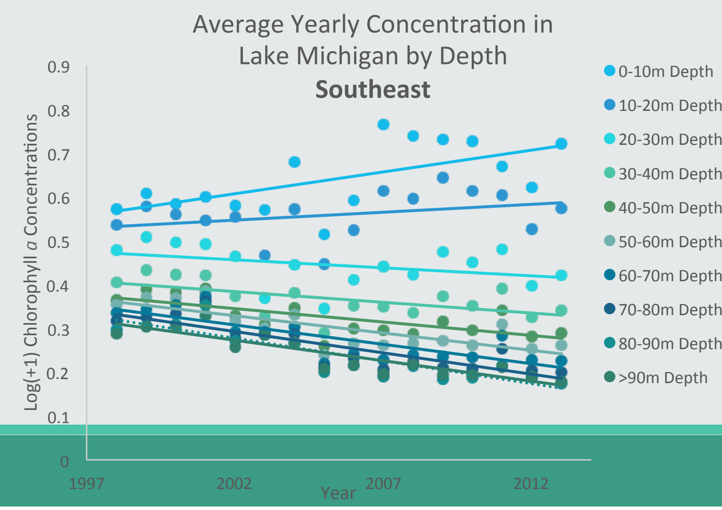
Changing in Chlorophyll *a* also vary Based on Region of Lake Michigan











Satellite results

Declines in offshore chlorophyll

- Reinforce results from traditional monitoring
- Nearshore chlorophyll stable or increasing

Regional differences

- Offshore declines more dramatic in southern basin
- Larger nearshore increases in northern basin

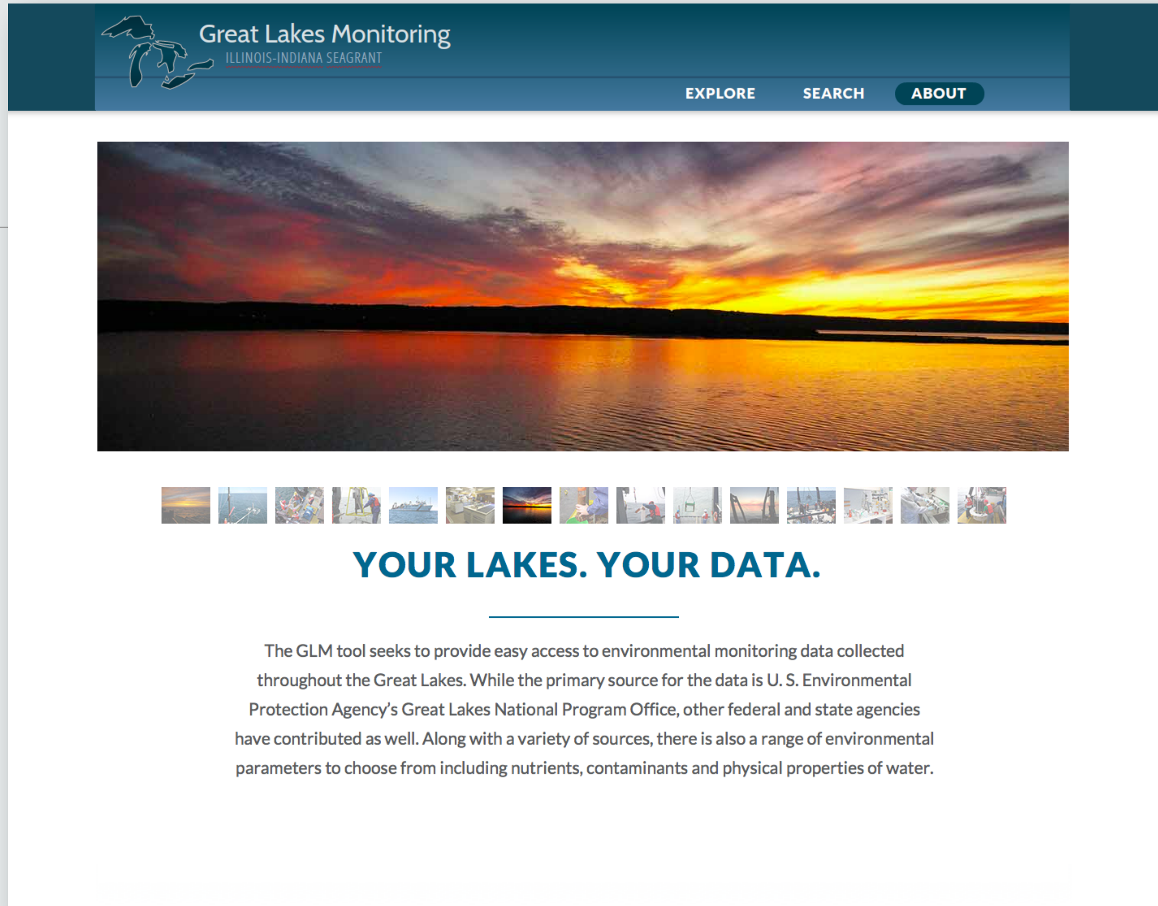
Outline

Introduction

Ecosystem monitoring in the Great Lakes

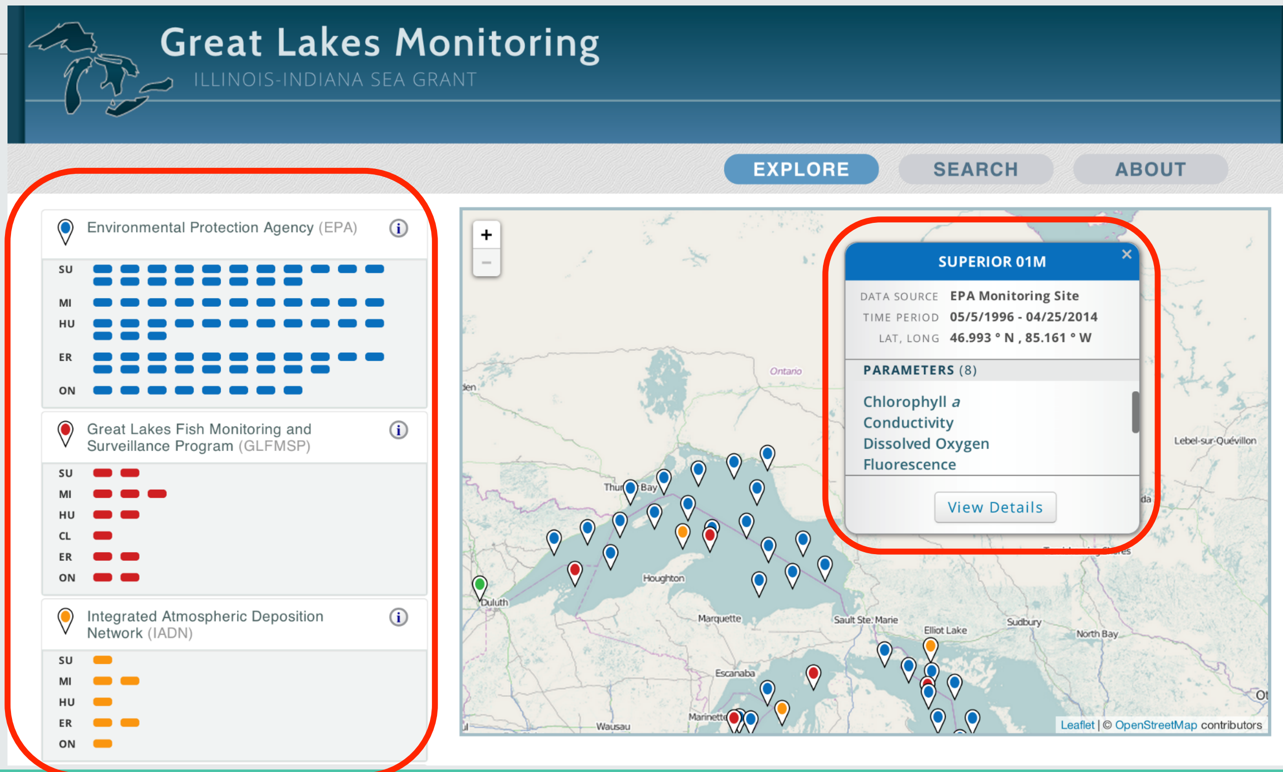
Applied research

Data access

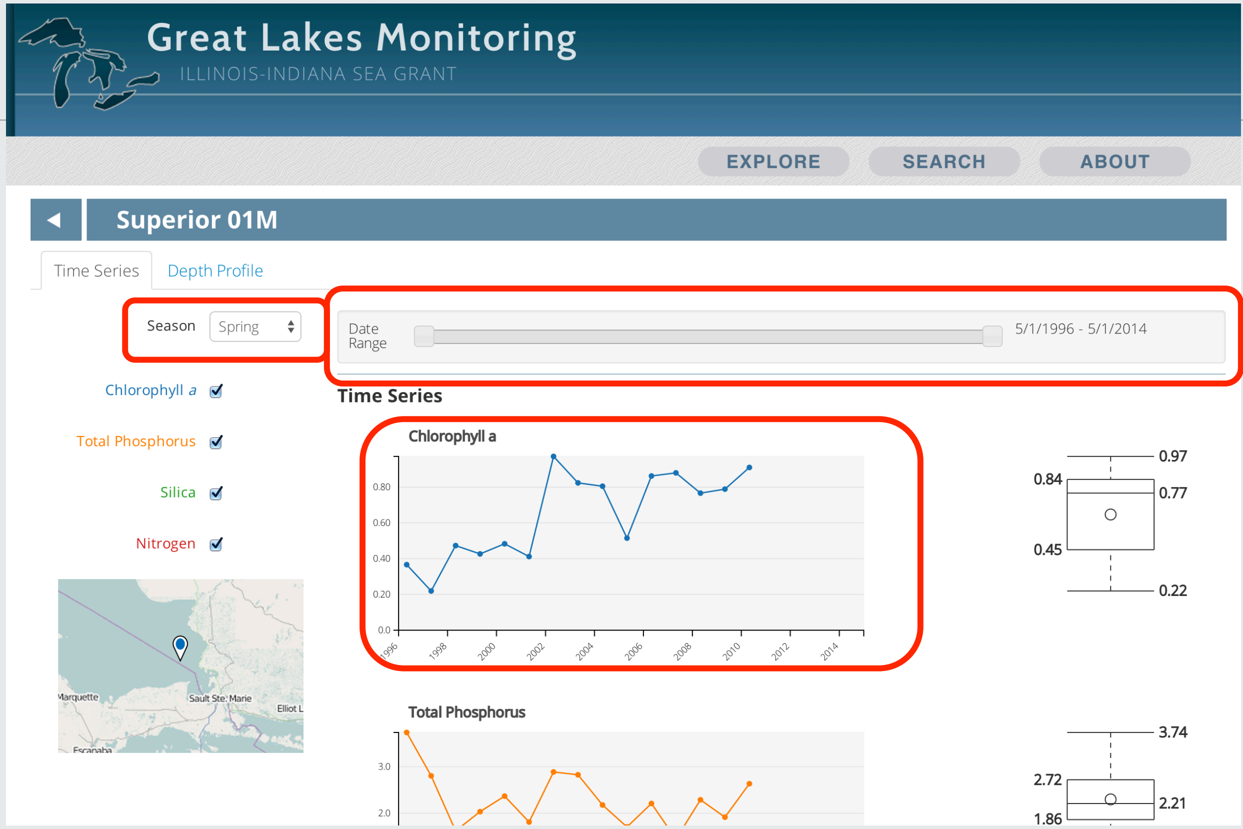


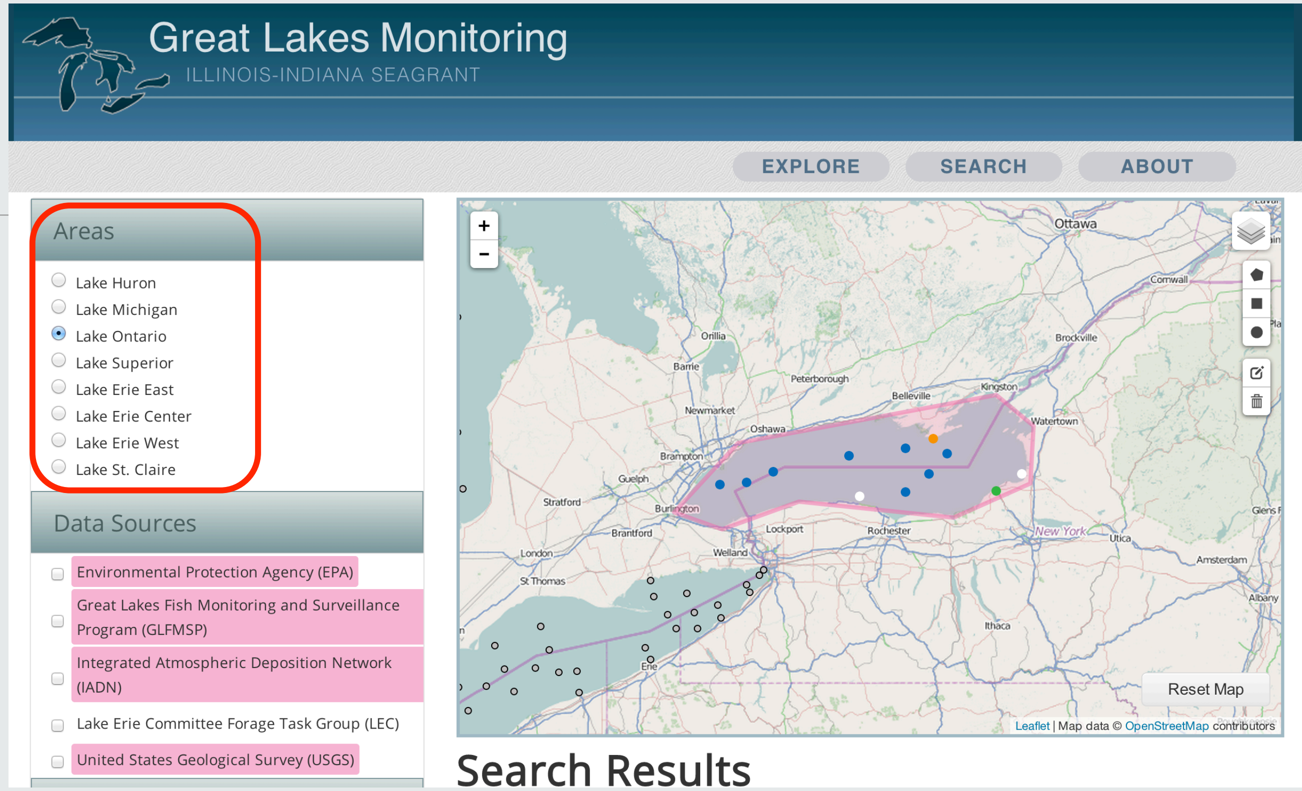
http://greatlakesmonitoring.org

Explore the Data



Explore Individual Site




Great Lakes Monitoring
ILLINOIS-INDIANA SEAGRANT
EXPLORE
SEARCH
ABOUT
Areas
Lake Huron
Lake Michigan
Lake Ontario
Lake Superior
Lake Erie East
Lake Erie Center
Lake Erie West
Lake St. Claire
Data Sources
Environmental Protection Agency (EPA)
Great Lakes Fish Monitoring and Surveillance Program (GLFMSP)
Integrated Atmospheric Deposition Network (IADN)
Lake Erie Committee Forage Task Group (LEC)
United States Geological Survey (USGS)
Ottawa
Orillia
Barrie
Peterborough
Belleville
Kingston
Brockville
Cornwall
Newmarket
Oshawa
Watertown
Brampton
Guelph
Stratford
Burlington
Brantford
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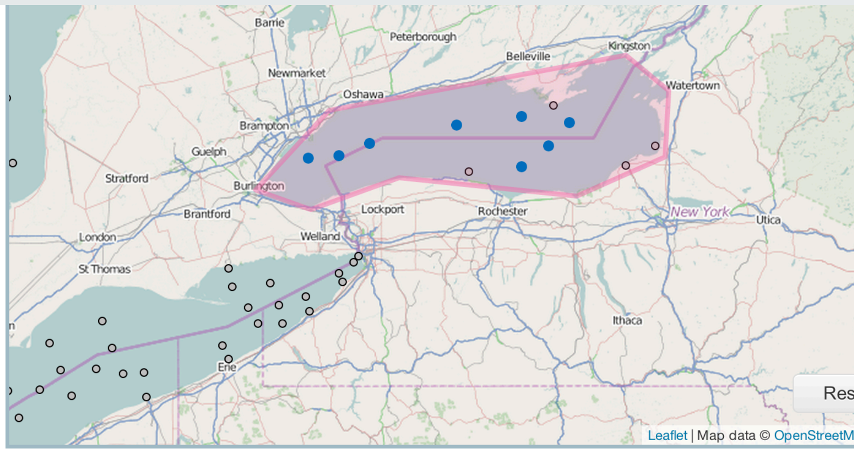
Leaflet | Map data © OpenStreetMap contributors
Search Results

Search Results



Search Results

Sites: 8

Data Sources:

epa glfmsp iadn usgs

Measurements:

Chlorophyll *a*

Dates: August 10th 1985 - April 19th 2014

Graphs go HERE

Download as JSON | Download as CSV | Permalink

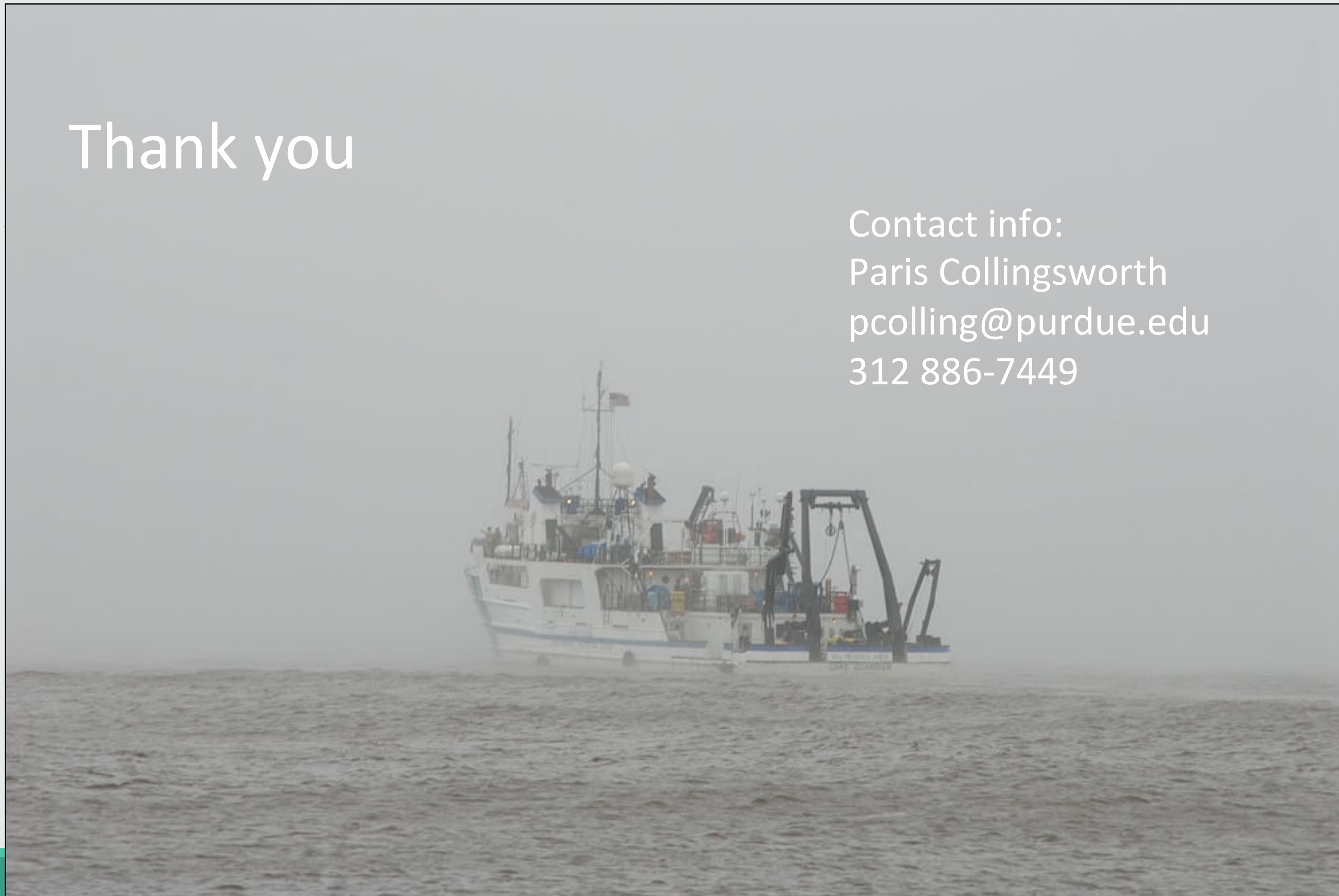
Impacts

Incorporating applied research results into management programs

- Developing new ecosystem models in Lake Ontario
- Developing decision rules for handling dynamic hypoxia effects on annual fish surveys
- Developing lake-wide productivity maps for the Great Lakes

Improving access to ecosystem monitoring data

- Putting data in the hands of decision makers



Thank you

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