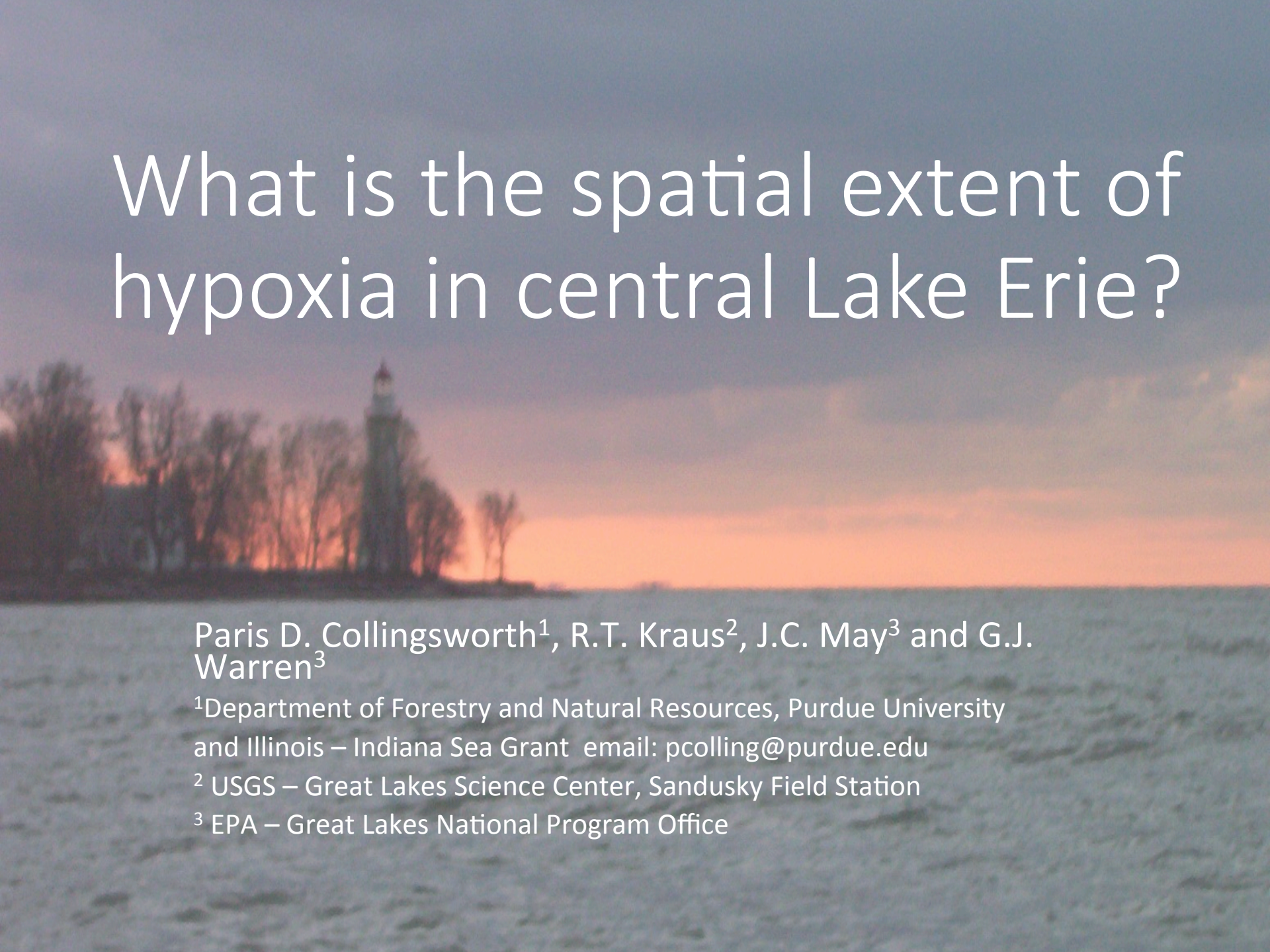
What is the spatial extent of hypoxia in central Lake Erie?



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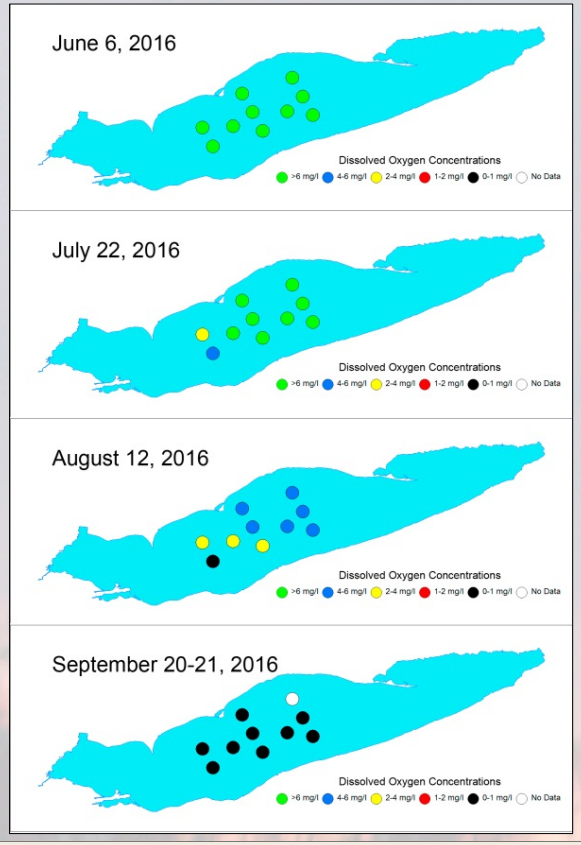
[2] USGS – Great Lakes Science Center, Sandusky Field Station

[3] EPA – Great Lakes National Program Office

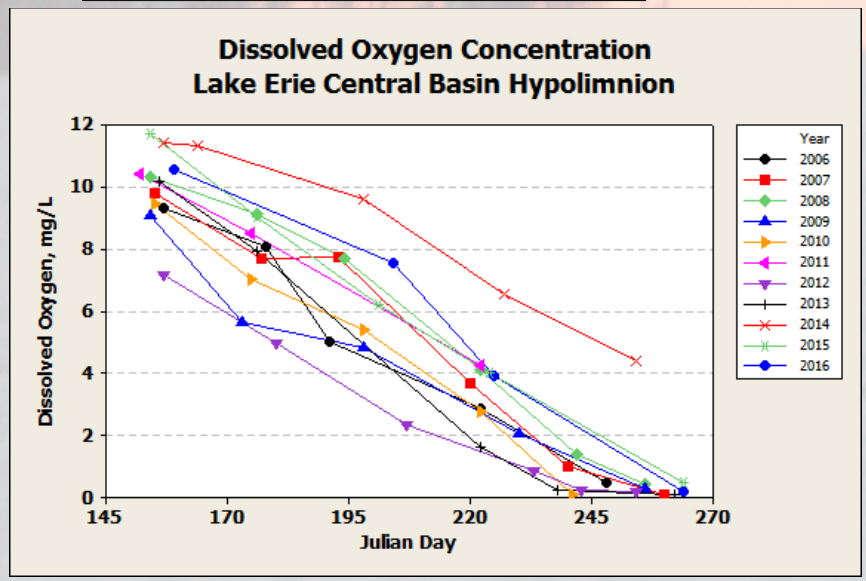
Re-eutrophication of Lake Erie

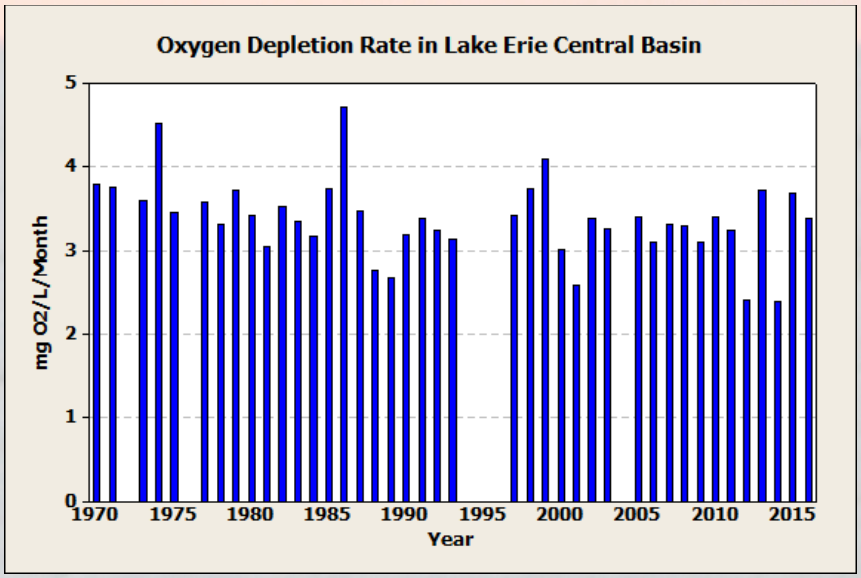
Background: D.O. monitoring

- GLNPO began monitoring program in 1983 in response to the QLWGA (1978)
  - Restoration of year round aerobic conditions in the central basin
  - Depletion rate in bottom waters



- GLNPO dissolved oxygen monitoring
  - 10 Stations in the central basin
  - Visited 6 times per year
  - SeaBird profiles
  - Calculate annual corrected oxygen depletion rate
- Contact info: may.jeffery@epa.gov



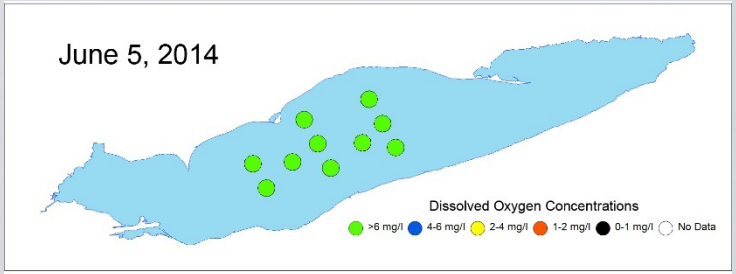


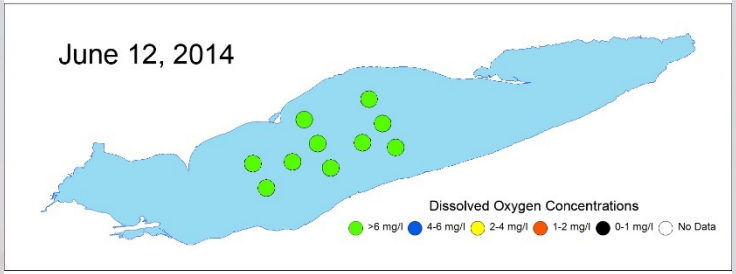
Background: D.O. monitoring

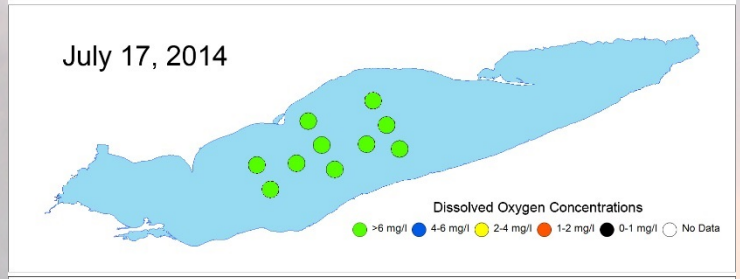
- GLNPO began monitoring program in 1983 in response to the QLWGA (1978)
  - Restoration of year round aerobic conditions in the central basin
  - Depletion rate in bottom waters
- New requirements under the 2012 Great Lakes Water Quality Agreement
  - Minimize the extent of hypoxic zones with particular emphasis on Lake Erie
  - Need baseline estimate of spatial extent of hypoxia

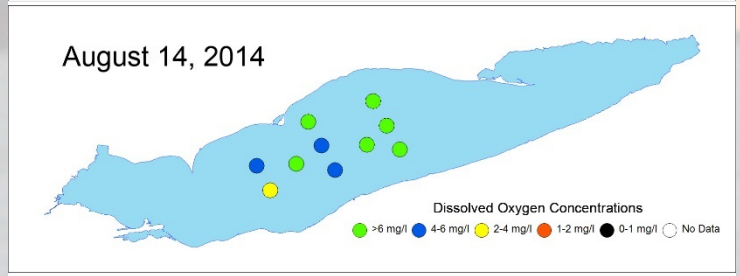
2014 Cooperative Science and Monitoring Initiative (CSMI)

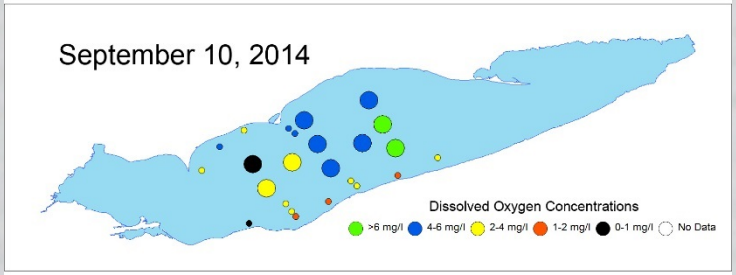
- Expand GLNPO DO monitoring program
  - Sample later in the season
  - Measure DO near shore
- Explore new methods
  - Augment GLNPO Seabird measurements using sensors and data loggers
  - Near shore and off shore stations



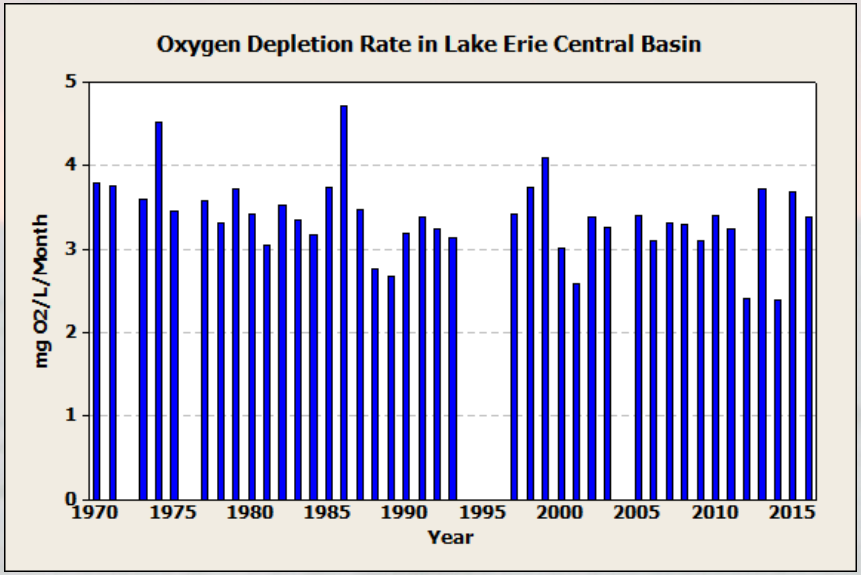








- GLNPO extended D.O. monitoring
  - Sampled 25 stations during peak hypoxia
- Contact info: may.jeffery@epa.gov

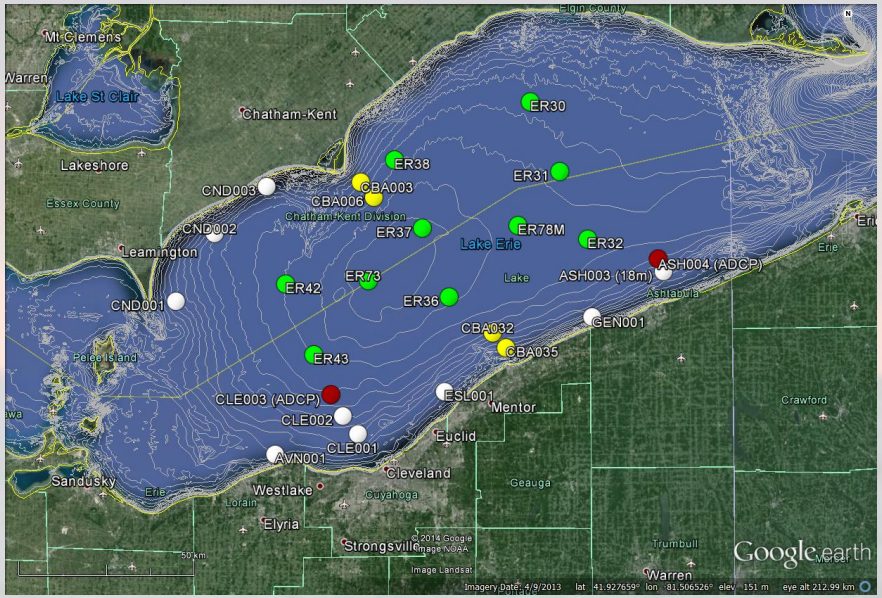


CSMI new methods

- Sensor-based
  - Onset U26 data logger
  - InterOcean acoustic release
- Increased temporal resolution
  - Measurement every 10 minutes

CSMI logger network

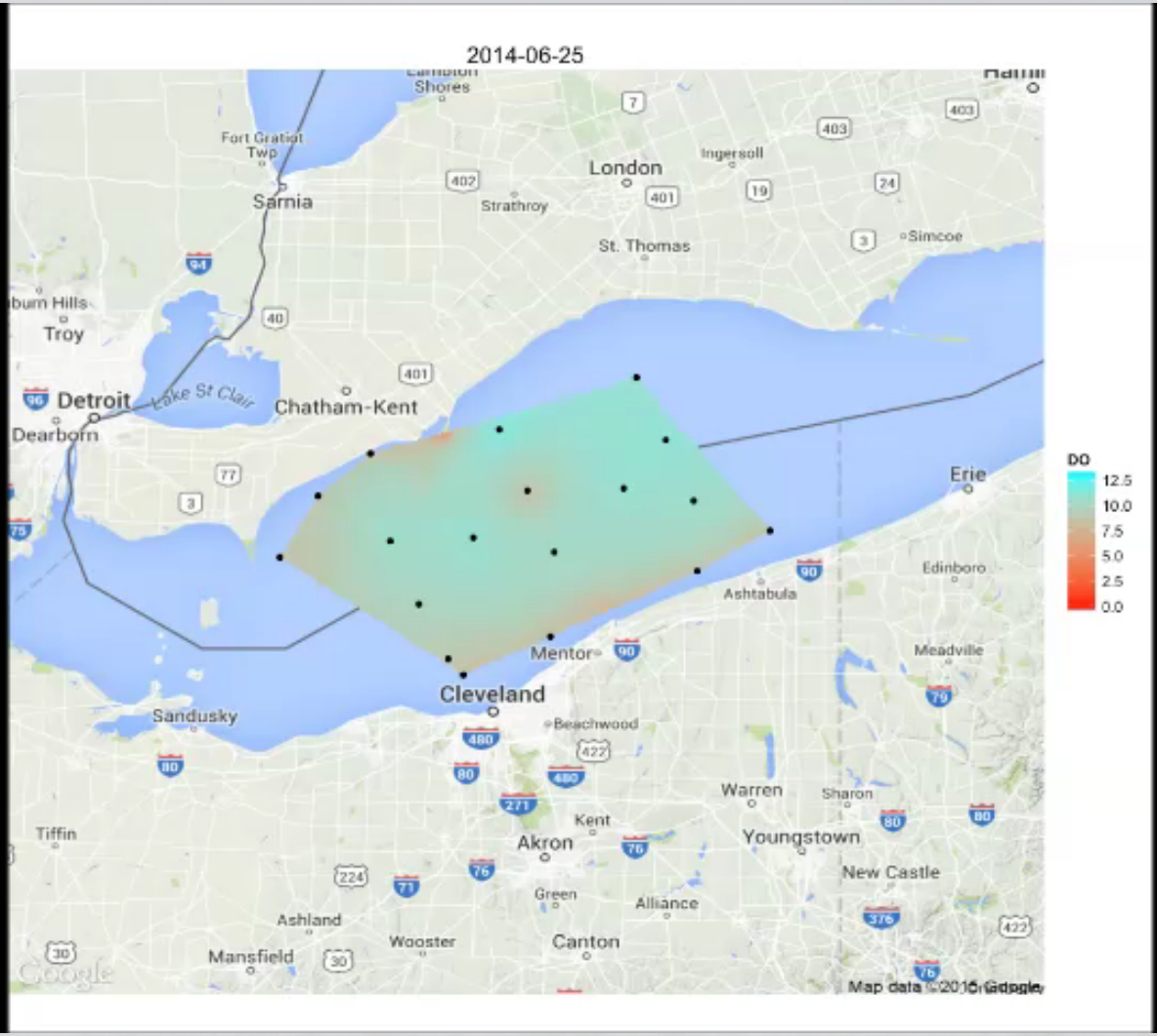
- Increased spatial resolution
  - 25 station
  - Cover about 7800 km^2
  - Depth ranges – 14 to 22 m
- Required collaborative approach
  - EPA – GLNPO, USGS, OHDNR



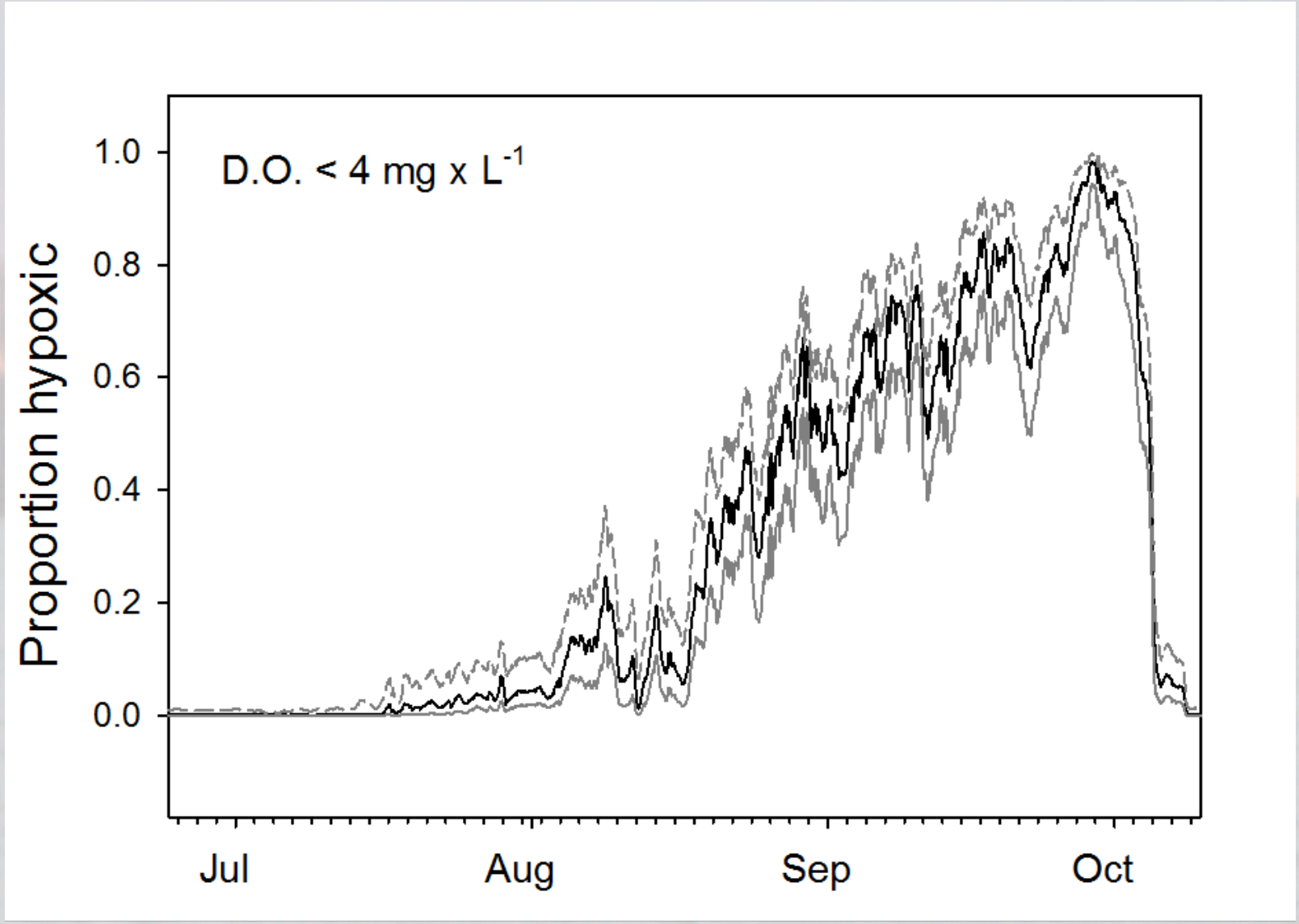
Statistical analyses

- Done in collaboration with U of IL – National Center for Supercomputing Applications
- Automate data analytics
  - Data ingestion, syncing and basic QA/QC
  - Interpolations
    - Calculate error term
- Spatial extent of hypoxia
  - Daily averages
  - Hypoxic area at DO less than 4 and 2 mg $\cdot$ L^{-1}

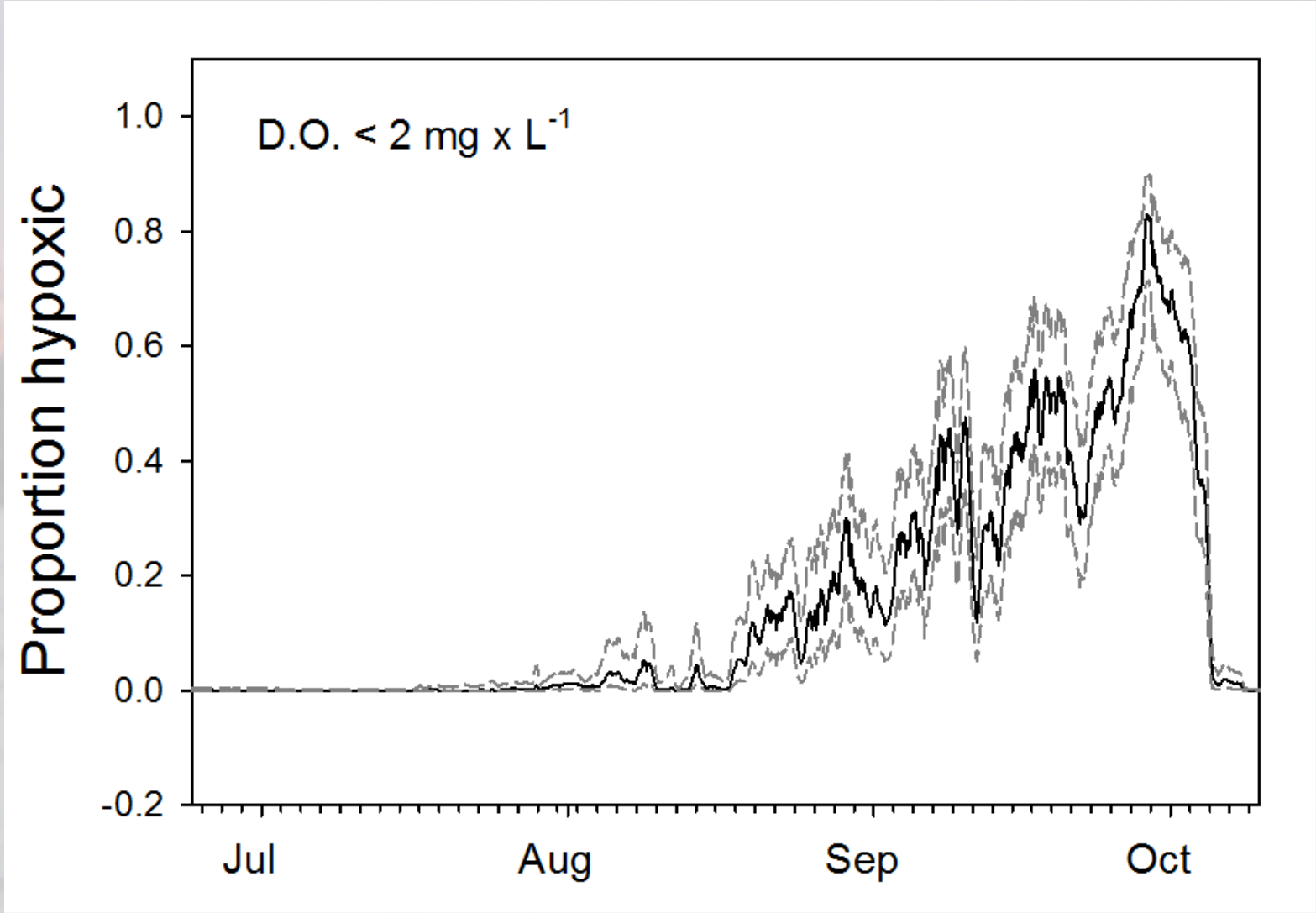
Daily averages – 2014



Spatial extent of hypoxia – 2014



Spatial extent of hypoxia – 2014

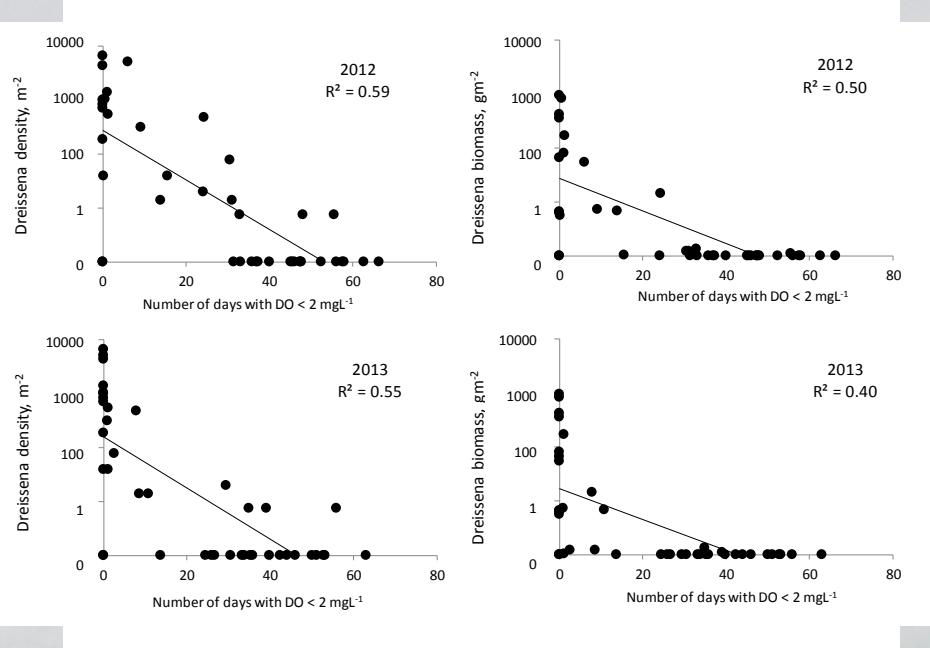


Hypoxia monitoring – future work

- Logger network data runs from 2014 - 2016
- Analyses 2014 – 2016 data
  - Bayesian spatio-temporal kriging
  - Identify external forcing factors
- Continue working with partners

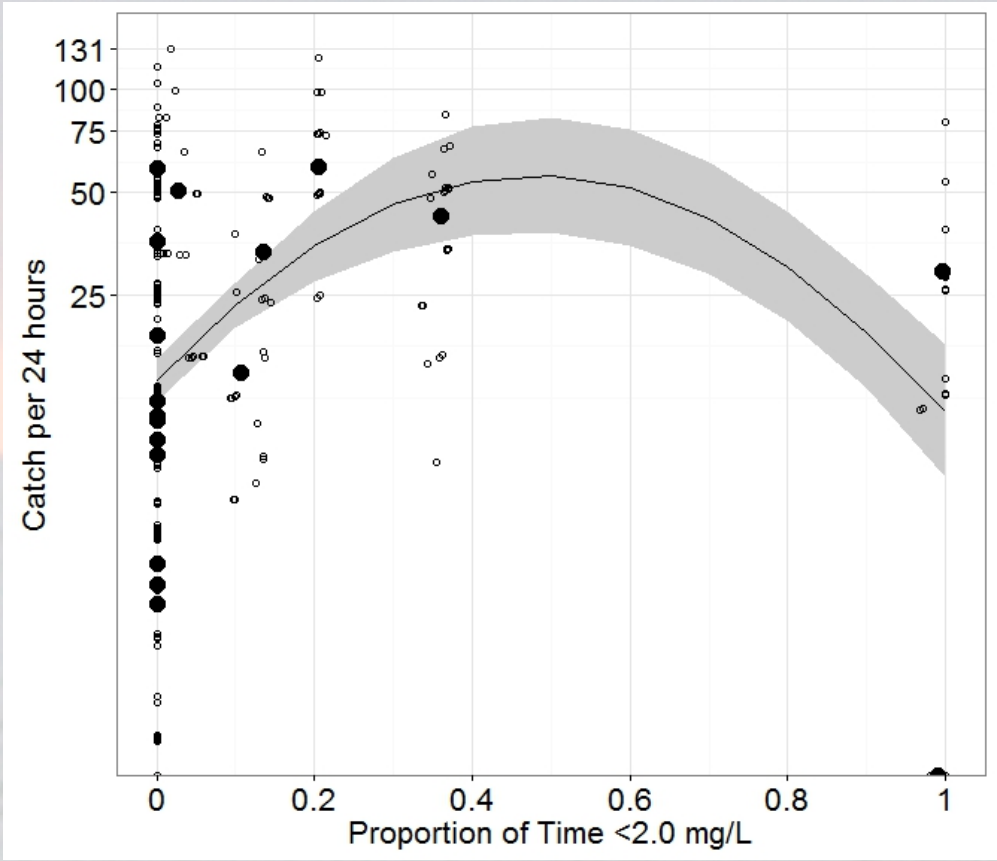
Hypoxia – impacts on species distribution

- Hypoxia influences on benthic organisms
  - Collaborators – EPA – GLNPO, USGS, SUNY Buffalo State, UM CILER
- Compared hypoxic extent with *Dreissena* distribution
- Important interactions between hypoxic zone and mussels



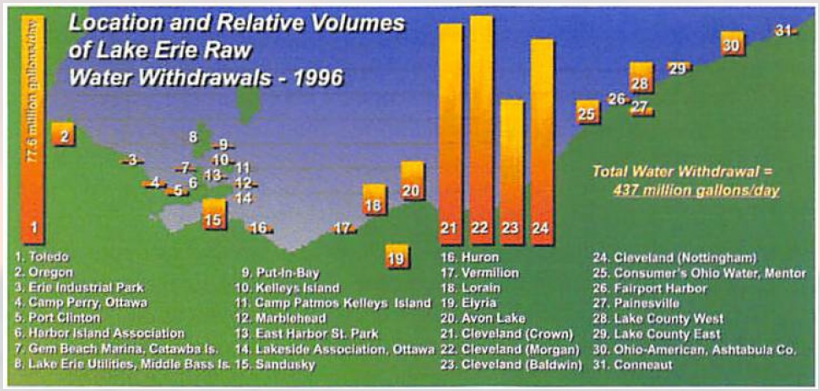
Hypoxia – impacts on fisheries

- Vulnerability to fishing gear (Kraus et al. 2015)
- Examine dynamic hypoxic zone effects on commercial fish catches



Hypoxia – impacts on ecosystem services

- Hypoxia degrades water quality near municipal intakes
  - Collaborators – USGS, NOAA – GLERL, UM - CILER
- Develop model to predict spatial dynamics of hypoxic zone
- See Mark Rowe's poster




Thank you