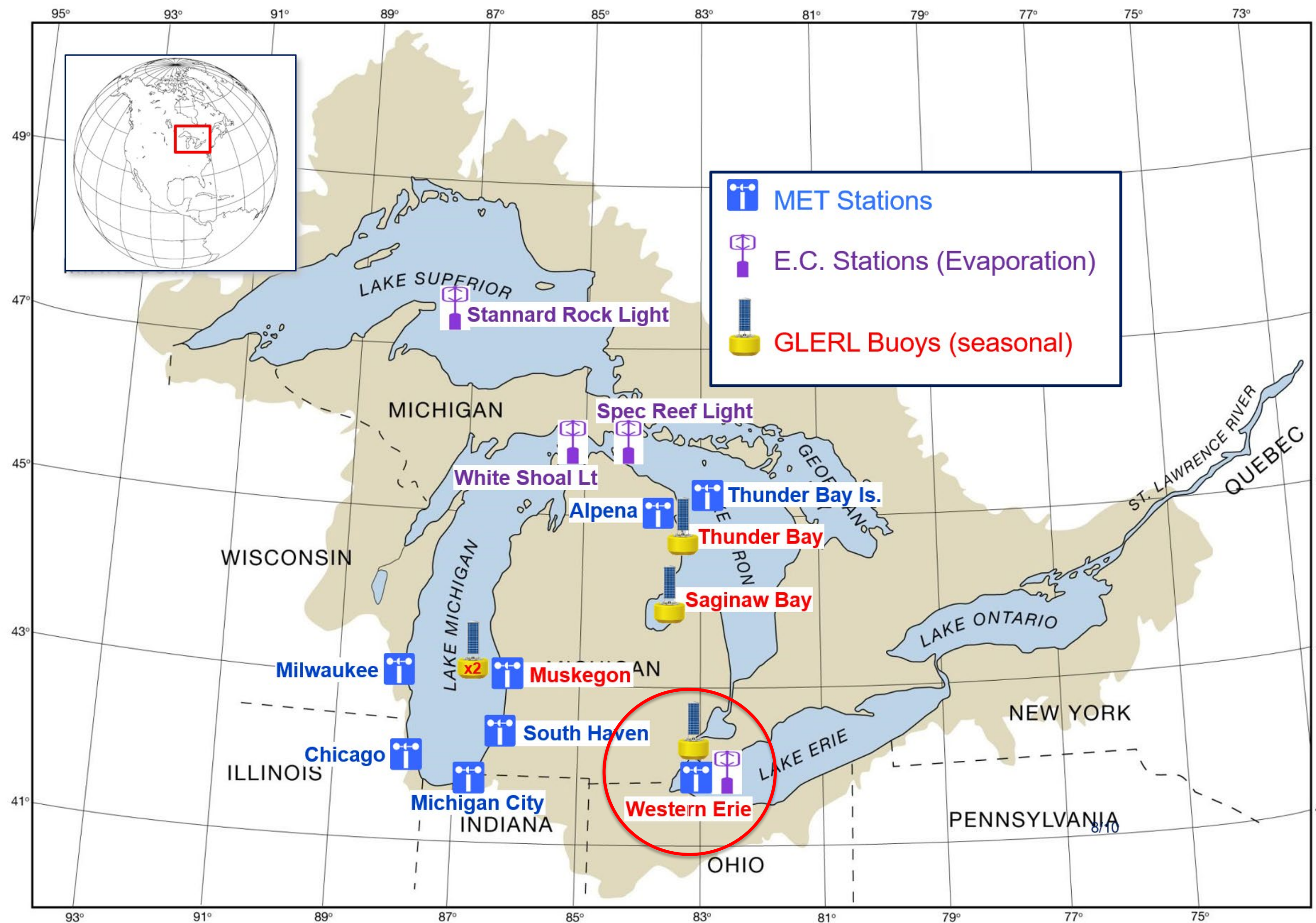


NOAA Great Lakes Restoration

The Great Lakes Restoration Initiative is committed to linking science to decision making. Under GLRI Focus Area 5, there is a clear commitment to assess the overall health of the Great Lakes ecosystem. The NOAA Great Lakes Environmental Research Lab's Synthesis, Observations, and Response (SOAR) GLRI funded project provides environmental information about coastal conditions to researchers and regional managers on Lakes Michigan, Huron and Erie. The implementation of the project includes the deployment and support of on-water and remote sensing platforms where observations from these systems are used to report on restoration progress and aid in decision support for regional managers. The project provides information to drinking water managers and insight into the success of bi-national collaboration on nutrient reduction.

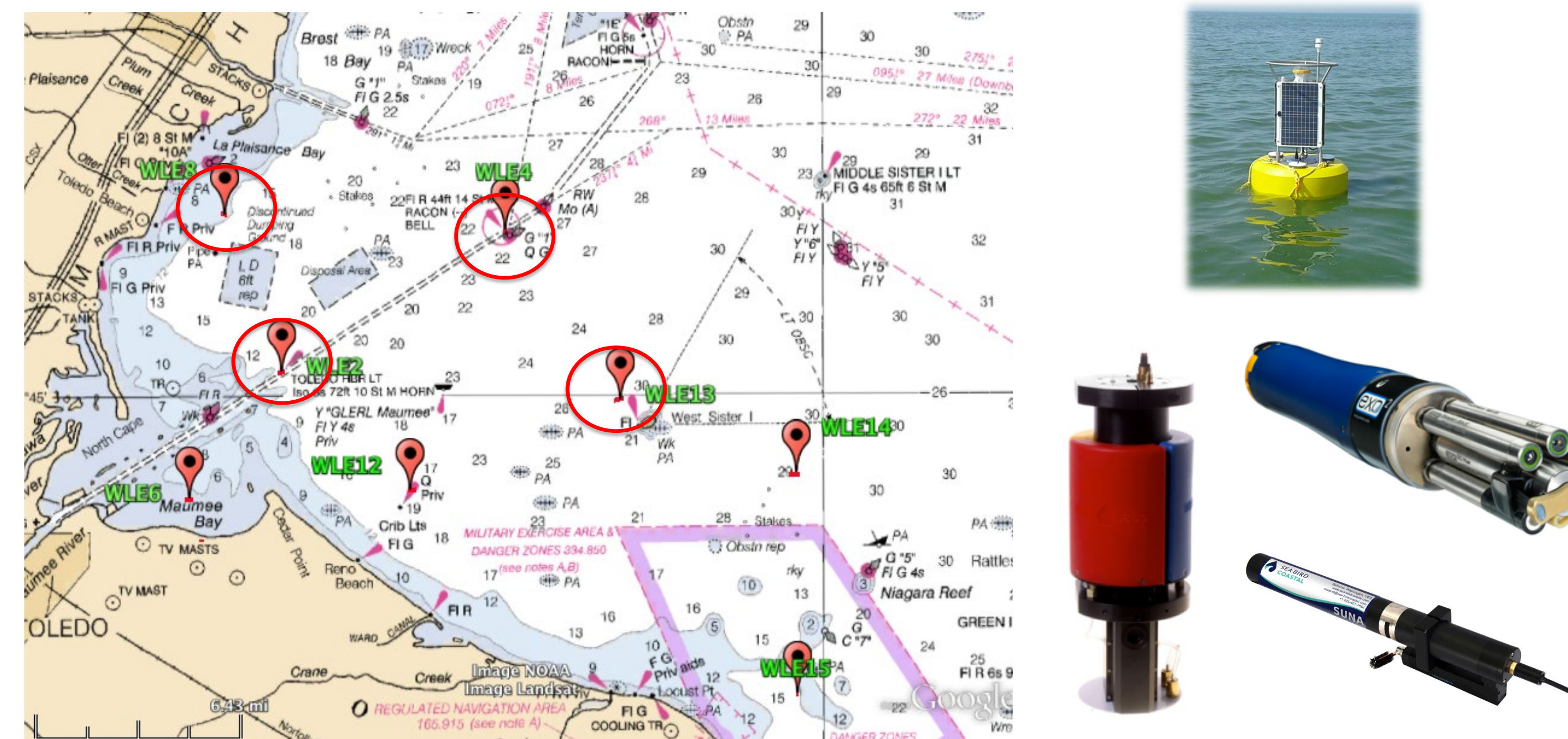


Real-time Coastal Observation Network (ReCON) nodes with western Lake Erie observation stations circled in red.

The SOAR project leverages previous work on the NOAA GLERL Real-time Coastal Observation Network funded through the Integrated Ocean Observation System Great Lakes Observing System regional association and NOAA GLERL base funds. The project monitors and reports on hypoxic conditions, algal blooms, and nutrients using real-time sensor networks, hyperspectral flyovers, and satellite remote sensing. These observations are improving our understanding of nutrient fluxes related to river loading and wind driven re-suspension events, and the relationship between cyanobacterial growth and toxicity.

Western Lake Erie Observations

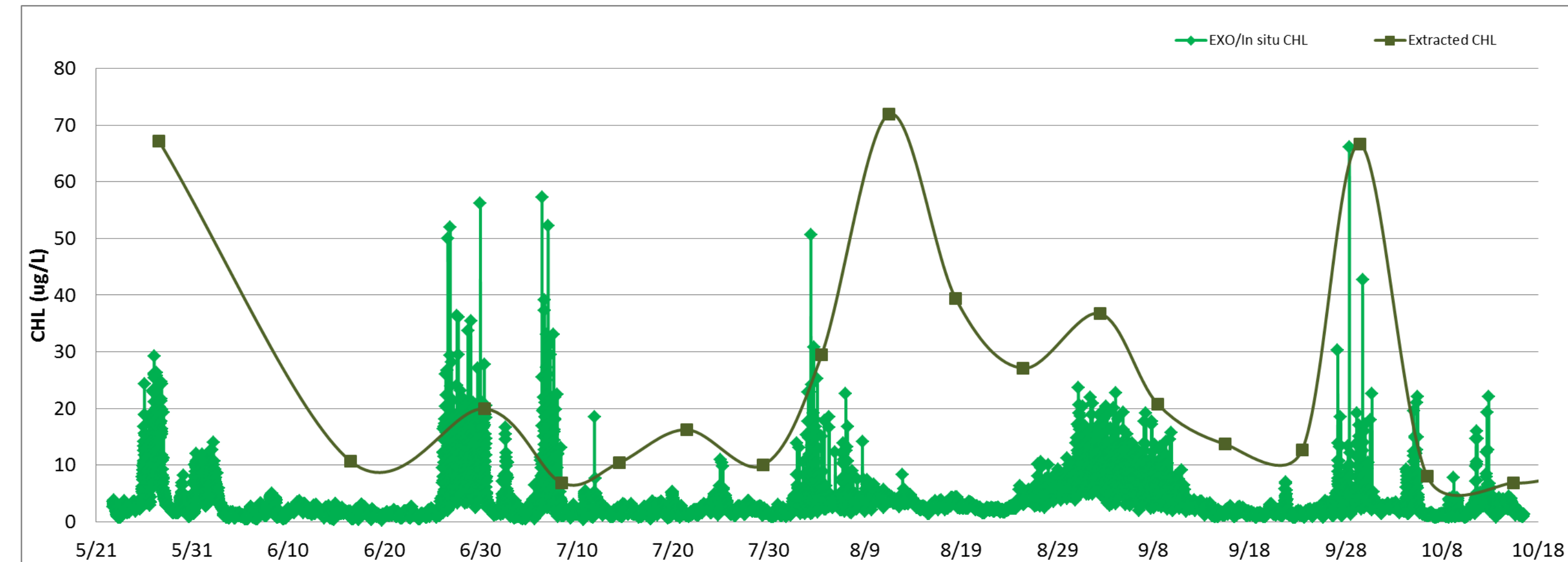
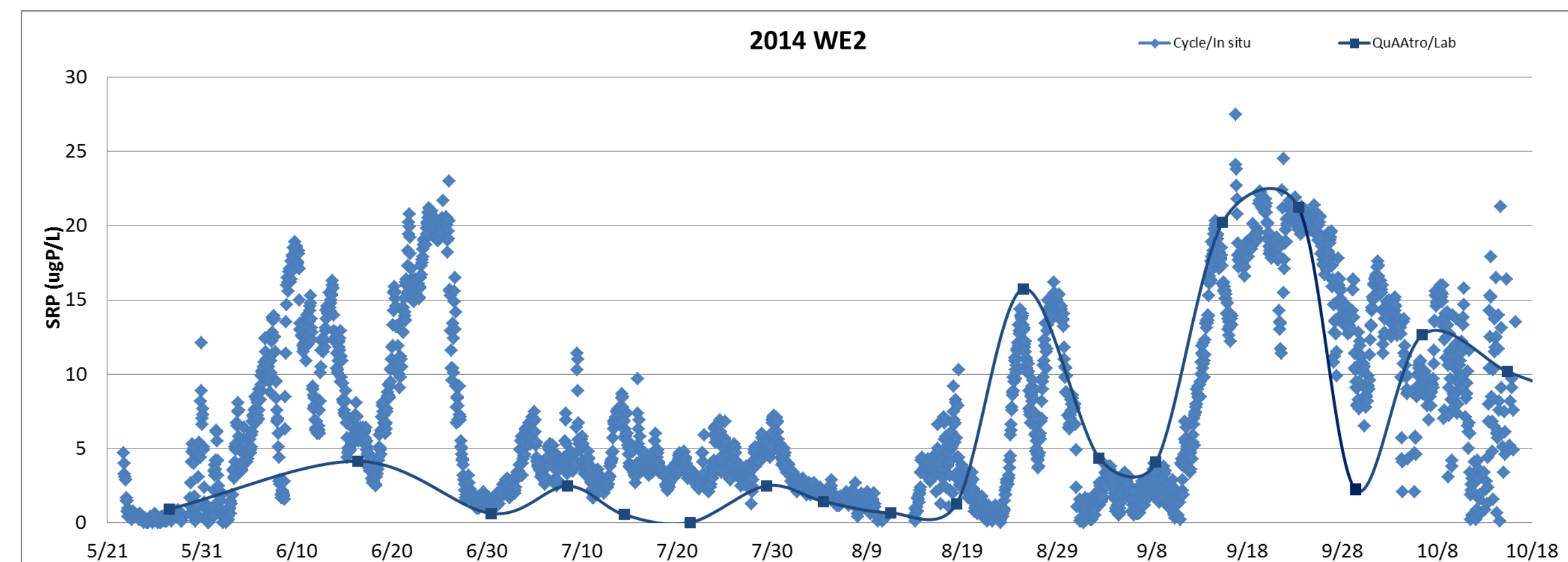
Observations from buoys, aircraft, and satellite provide situational awareness and feedback on the success of US and Canadian harmful algal bloom control measures.



Western Lake Erie weekly vessel sampling stations with location of SOAR/ReCON buoys circled in red. Real-time nutrient and water quality observations are collected from the Seabird Cycle P, Seabird SUNA, and the YSI EXO.



Aerial image of HAB looking southwest towards Maumee Bay and stations WLE2 and WLE6 from August 19, 2019. The freighter CSL Laurentian (225.5m) in the lower left is in the Toledo shipping channel entering the Port of Toledo in northwest Ohio. The slightly darker area is hyperspectral imagery collected at about the same time as the aerial photo. Photo by Zack Haslet, Aerial Associates.



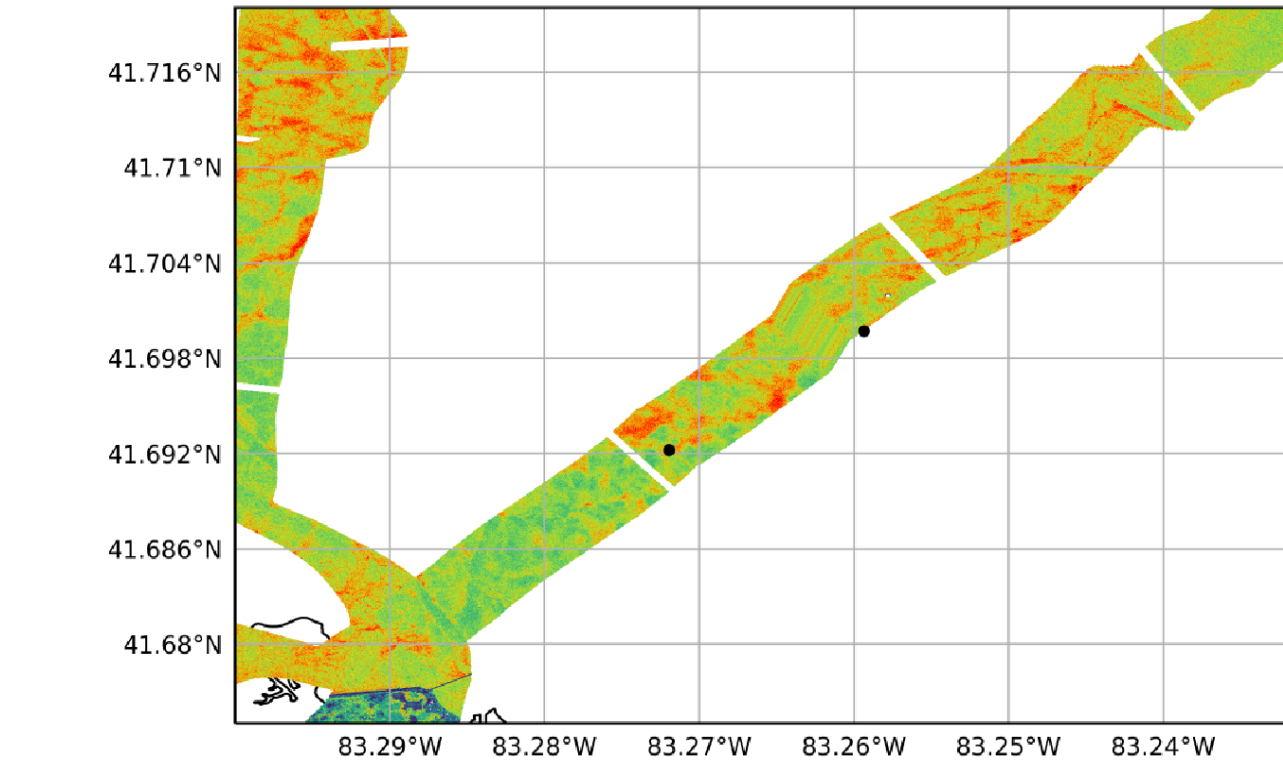
Top, 2014 station WLE2 time-series phosphorus observations from Cycle P (blue) and lab values (black). Bottom, YSI EXO chlorophyll sensor time-series (green) and lab values (black).

NOAA GLERL Hyperspectral Imagery for 08-19-2019 Over Municipal Water Intake Locations

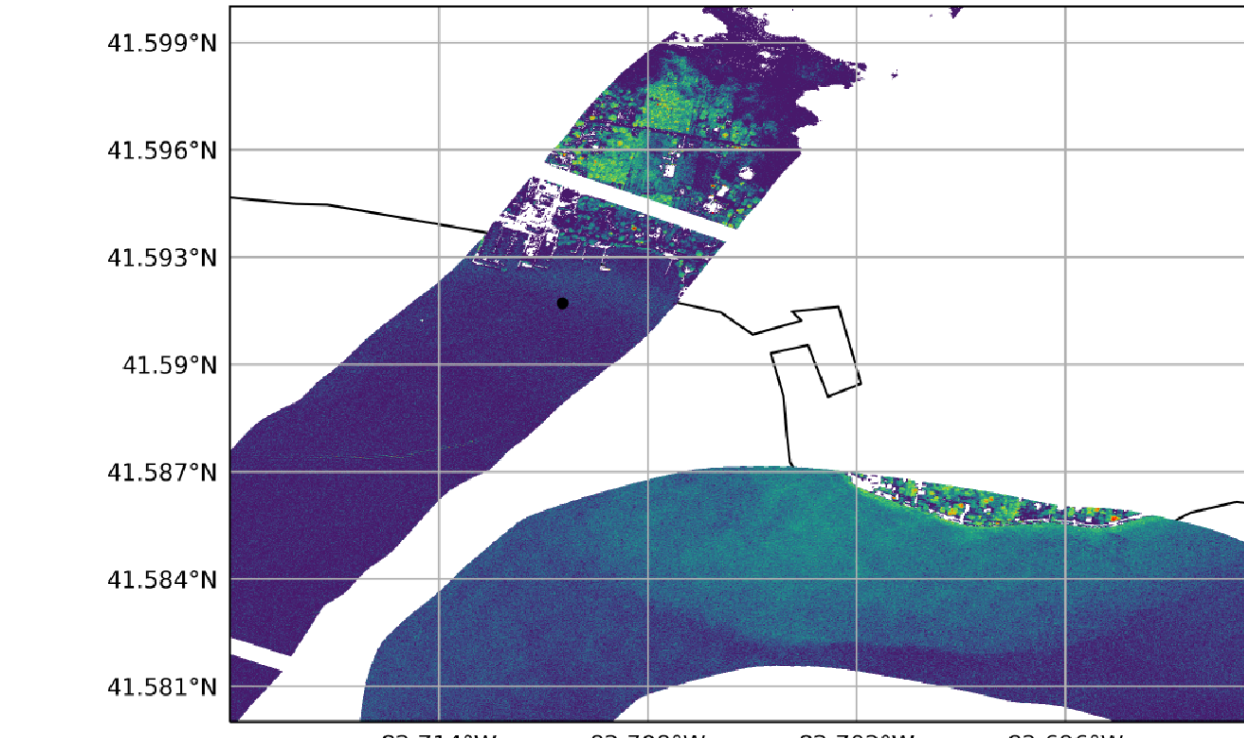
Cyanobacteria Index Images (available in KMZ format and true-color images)

Summary: On 08-19-2019, all locations were moderate to high levels of cyanobacteria except for Kelleys Island and Put-In-Bay. There were some filaments of cyanobacteria around the Put-In-Bay location. Colorbar and color scale are the same as the NOAA NCSS Lake Erie HAB bulletin.

Oregon and Toledo PWS Cyanobacteria Index:

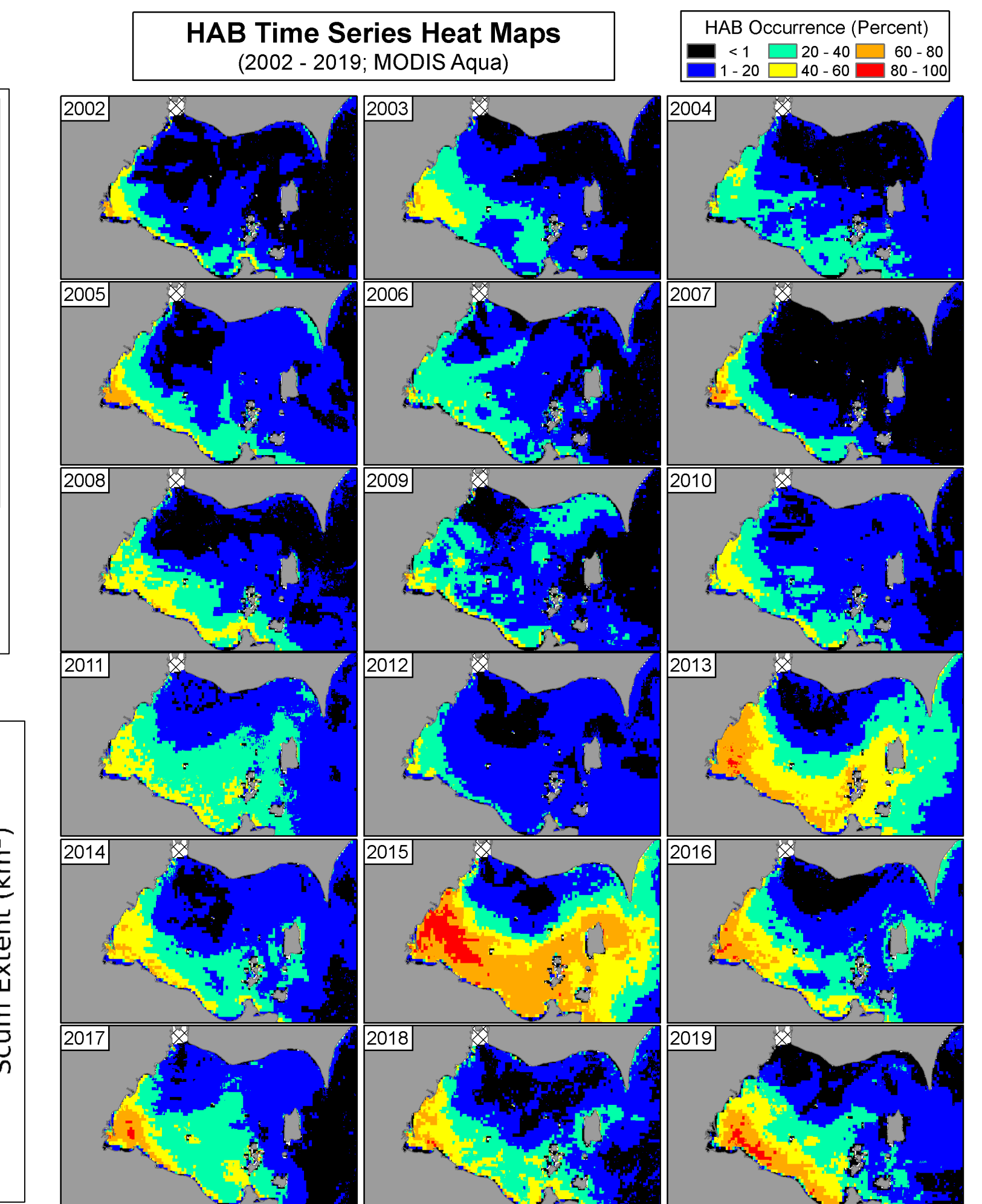
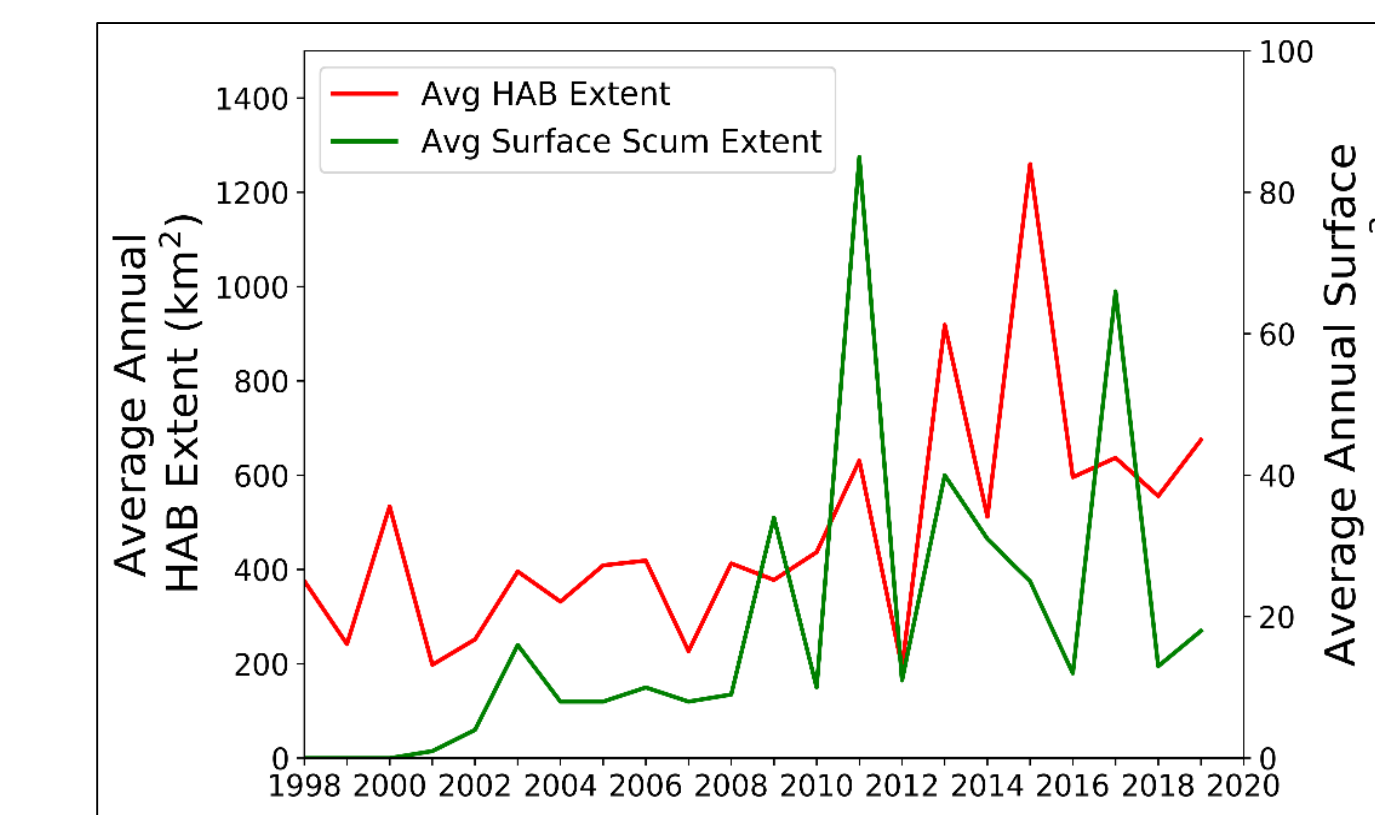
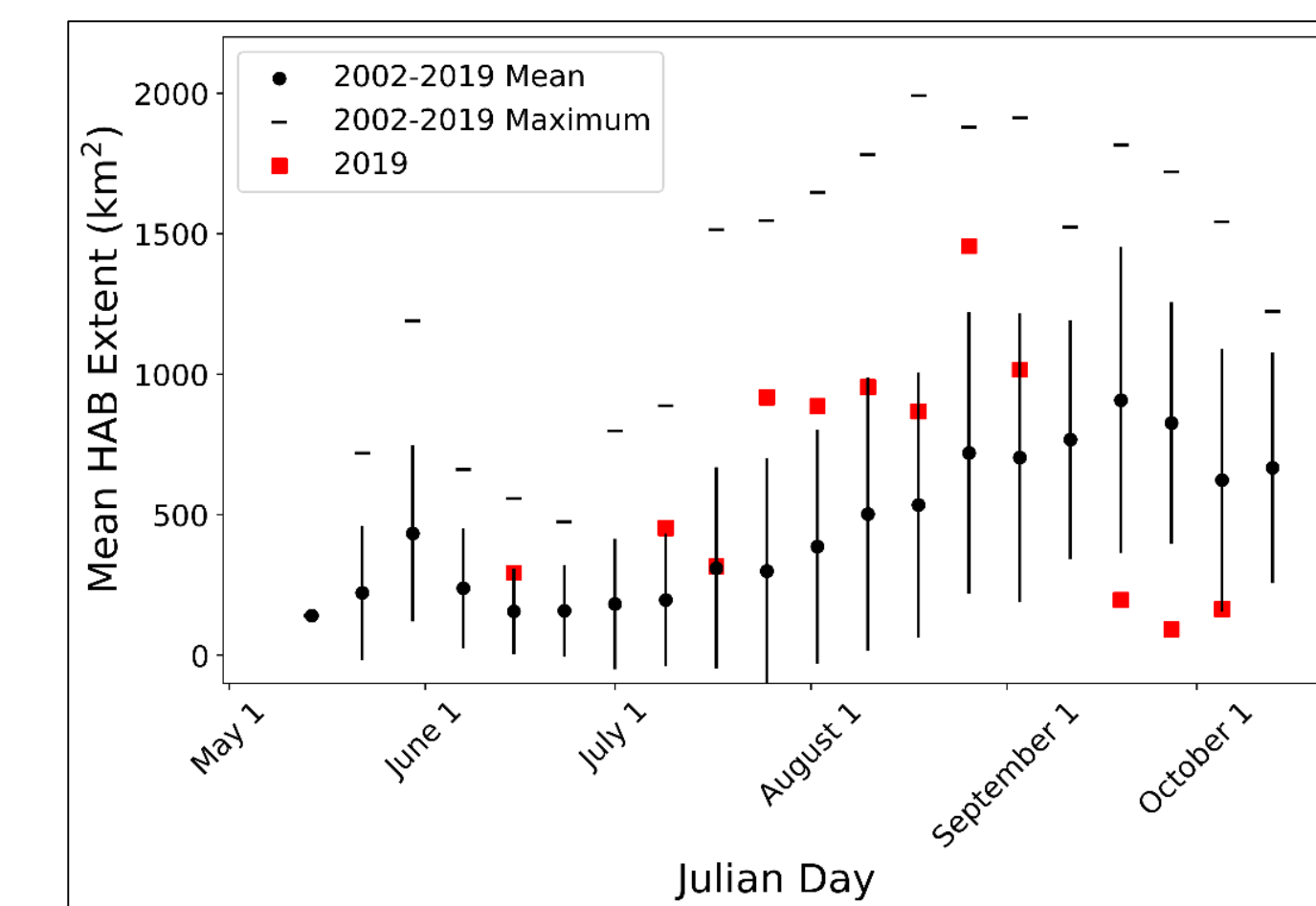


Kelleys Island Village Cyanobacteria Index: (*Disregard CI over land*)



Parameters	Resonon Pika II II	Resonon Pika L
Spectral range	400-900 nm	400-1000 nm
Bands/Channels	240	281
Field of View	17.6 degrees	24.8 degrees

Airborne hyperspectral imaging systems are used to create HAB assessment reports in conditions where satellite observations are unavailable near shore at Lake Erie drinking water intakes.



The Michigan Tech Research Institute western Lake Erie HAB areal extent report NASA MODIS time-series showing that on average, the 2019 HAB in western Lake Erie covered approximately 700 sq km, up from 2018.

Summary

- Decision support for drinking water processing managers is aided by water quality observations displayed on the GLERL HABs and Hypoxia website and the IOOS/GLOS HAB Portal.
- Long-term feedback on the US/Canada 40% phosphorus reduction goal through satellite remote sensing time-series and buoy observations.
- Hyperspectral efforts contribute to NASA PACE algorithm development.
- Funding from GLRI, IOOS/GLOS, and NOAA GLERL base.