

From Research to Operations: Transitioning NOAA's Lake Erie Harmful Algal Bloom Forecast System

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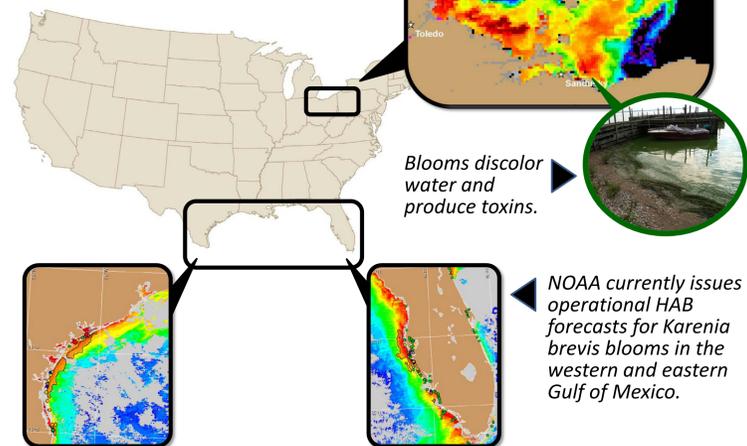
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INTRODUCTION

NOAA's Harmful Algal Bloom Operational Forecast System (HAB-OFS) currently operates in the eastern and western Gulf of Mexico. A key priority for the program is to leverage NOAA's research to operations process to systematically transition to operations scientifically mature HAB forecasts in regions of the country where there is an identified user need and an operational framework can be supported. While in the demonstration phase, the Lake Erie HAB forecast has proven its utility. Over the next two years, NOAA will be transitioning the Lake Erie HAB forecast to operations. An initial operating capability will be established in the HAB-OFS' operational infrastructure by the 2016 bloom season. Once operational, the forecasts will be assessed and continued improvements will be made based on the operational needs identified by the assessments and emerging scientific research. In addition, the lessons learned from the Lake Erie transition will be used to streamline the process for future HAB forecasts presently in development.

NOAA is planning to transition Lake Erie HAB forecasts to operations. Forecasts are issued for recurrent cyanobacterial blooms.



APPROACHING THE TRANSITION

Technical Readiness Levels (TRLs)

- Used by NOAA as a systematic method of assessing the maturity of research & development projects throughout their progression from research to demonstration to operations.
- Based on Mankins (1995) and codified in NOAA Administrative Order 216-115.

Lake Erie HAB Forecast System

- The initial research and development phases (TRLs 1-5) have already been completed by NOAA's National Centers for Coastal Ocean Science (NCCOS).
- NCCOS has issued demonstration bulletins since 2009 (TRL 6-7).
- NCCOS is ready to transition its demonstration forecasts to an operational center.
- As the system is transitioned to operations at NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), it will move from TRL 7 through TRL 9.

TRL 7. System Demo in Operational Environment or Relevant End-to-End Environment (Present to Sep 2016)

Transfer System from Research Environment to Operational Environment

- Stand up hardware/software in operational environment
- NCCOS will train CO-OPS staff



Parallel Testing of Operational and Research Environments

- NCCOS will continue to issue Lake Erie HAB bulletins in the research environment and disseminate them to the public.
- CO-OPS will use the operational infrastructure to create test Lake Erie HAB bulletins.

Assessment

- NCCOS and CO-OPS versions will be assessed throughout the season.
- Statistically compare performance of two versions and compile results
- Address issues causing differences, if necessary

TRL 6. System Demo in Research Environment: Current Lake Erie HAB Bulletin

Purpose

- Bloom response and mitigation

Audience

- Public water suppliers
- Public health officials
- Natural resource managers
- Researchers
- Commercial and recreational interests in the area (i.e. boaters, fishermen, swimmers)

Provides Observations and Forecasts

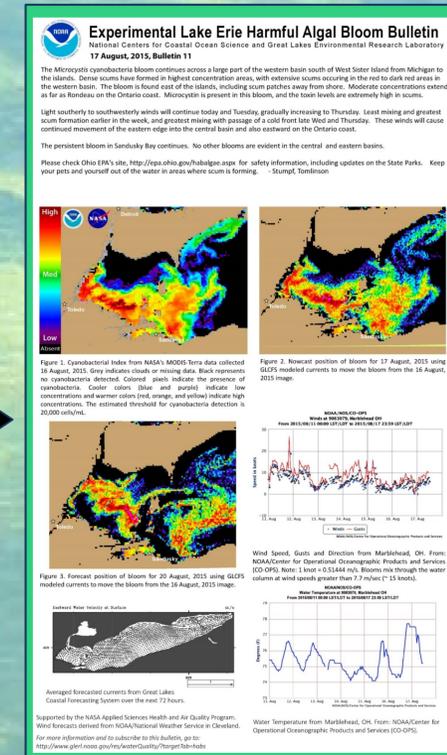
- Current and forecasted bloom distribution
- Observations of bloom toxicity and cell counts from NOAA's Great Lakes Environmental Research Laboratory (GLERL)
- Potential for vertical mixing or scum formation
- Predictions of bloom decline

Dissemination

- NCCOS prepares 2x weekly bulletins
- Provided to subscribers via email
- For more information: http://www.glerl.noaa.gov/res/HABs_and_Hypoxia/



Water near Lake Erie water supply intake.



Example of the Demonstration version of the Lake Erie HAB bulletin that the Operational version will be based on.

NOAA'S DEFINITION OF OPERATIONS

"Sustained, systematic, reliable, and robust mission activities with an institutional commitment to deliver specified products and services".

| Criteria for Transition | Justification for Transitioning Lake Erie HAB Forecast System |
|--|---|
| State of the Science | Procedures for remote detection and forecasting have been developed, tested, and demonstrated (Wynne et al. 2013). |
| User Demand & Economic Value | <ul style="list-style-type: none"> Blooms of cyanobacteria are a recurring problem in Lake Erie Dominant bloom forming species, <i>Microcystis aeruginosa</i>, produces microcystin, a toxin poisonous to humans, livestock and pets. Once microcystins have contaminated the source water used for drinking water, removal is costly for public water suppliers. Early warning of microcystins allows for cost-effective mitigation. |
| Benefits of Operations | <ul style="list-style-type: none"> NOAA demonstration system is used to respond to and mitigate the impacts of cyanobacterial blooms. Operational system will meet user requirements for routine and reliable forecast products that are systematic and sustainable. |
| Operationally Available Infrastructure & Personnel | <ul style="list-style-type: none"> Components and data are either already available or an operational path has been determined. Experienced HAB-OFS analysts currently responsible for the Gulf of Mexico forecast products will be trained to operate in Lake Erie. Resources for sustained data collection, forecast creation, product assessment, and technical support exist. |

TRL 8. System Completed and "Mission Qualified" in Test and Demonstration (Oct 2016)

System Validated and Verified through Testing

- Achieved when assessment results of parallel testing phase indicate CO-OPS was successfully able to generate forecasts and Lake Erie HAB bulletins in their operational environment.
- Documentation of the process completed.

TRL 9. "Mission Proven" in Successful Operations (Jun to Oct 2017)

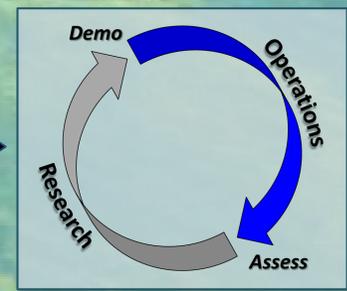
Operational Lake Erie HAB Forecast System

- Operational hardware/software fully integrated.
- Technical support in place.
- Products generated in operational environment.

NEXT STEPS (Oct 2017 and beyond)

Operations to Research Loop

- Operational product performance will be assessed routinely.
- Assessments guide ongoing research to improve the system.
- New research will be transitioned that addresses user requirements and/or the needs identified in the assessment.
- Future components that are transitioned to operations will follow a similar process from TRLs 1-9.



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