Monitoring and Forecasting Cyanobacterial Blooms for Public Health Protection and Response

NASA - Decision Support through Earth Science Research Results NNH08ZDA001N-Decisions



Team

NOAA/NOS Center for Coastal Monitoring and Assessment: Rick Stumpf, Tim Wynne, Shelly Tomlinson Overall project coordination, satellite remote sensing for detection of cyanobacteria, forecast system development, overseeing the transition of research capabilities into operations and skill assessment

Center of Excellence for Great Lakes and Human Health: Sonia Joseph *Will lead the education and outreach component in the Great Lakes*

NOAA Great Lakes Environmental Research Lab : Juli Dyble-Bressie Evaluate the ecological models for detection and forecasts and assist in field data collection

Florida Department of Health: Andrew Reich Will lead user interaction in Florida and develop plans that integrate the forecasts into response systems, and aid in identifying appropriate products

Center for Disease Control and Prevention: Lorraine Backer To incorporate products into the HAB Illness Surveillance System (HABISS) to make them available to the user community

Metrics

Metric	Measures		
Total forecasts	# of states	# of water bodies	<pre># forecasts (climatologic/ seasonal/ nowcasts)</pre>
Use of forecasts (HABISS)	# of states receiving forecasts	# of states contributing data	# of products
Data access	<pre># states contributing data</pre>	# sites with data	# complete data records in HABISS
Response plans	<pre># of response plans using forecasts</pre>	% of products used	# changes in response
Skill	Assessibility of forecasts	% accuracy	% increase in accuracy during project
Outreach/ education	# of states trained	# of agencies	# of individuals
Reliability	% of products created each season	% products assessed each year	% of users engaged each year

NOAA Coastal Ocean Science



Plans for FY 2010

An operational nowcast/forecast system will be in place for Florida and Lake Erie Regional climatology will be done for Florida and Lake Erie Field validation of spectral products Great Lakes and Florida user workshop to discuss the usefulness and possible improvements of forecasts

Plans for FY 2010 continued

Establish GIS links to HABISS Test automated HABISS broadcast to managers



Aquatic Toxins Program



Surveillance Research Education Public Health Protection Strategies



NOAA Coastal Ocean Science

Public Health Protect and Promote Safety and Health of People





NOAA Coastal Ocean Science

To Whom It Concerns,

We live on Catawba Island and when we came home yesterday, the shoreline around our house smelled and the water was bright green and thick like pea soup. I've attached a photo of this phenomena as it's almost impossible to believe. Obviously we stayed out of the water. But this has us greatly concerned.

Can you please supply us with some sort of explanation, if you have one yet?



NOAA Coastal Ocean Science

The share a company



Goals of Proposal

Help managers with public health and safety

Reduce cost of impact

Educate the public

Reduce impacts to the public

Establish as an operational capability





NOAA Coastal Ocean Science



2007 HAB Stakeholder Workshops

Identify HAB monitoring methods Assess stakeholder needs and existing knowledge Work with end users to develop useful tools and technologies



Toledo HAB workshop, NOAA GLERL



Components to a forecast

- Create the HAB field
 - Identify a HAB
 - Locate the HAB: area and concentration
- Model the HAB field
 - Obtain currents



MODIS 31Aug09 (NASA Rapidfire)

(probably modeled) from HAB field to present

- Obtain forecasted currents
- nowcast to today and forecast out 2-4 days (limit of forecast)
 Interpret the fields (past, nowcast, and forecast)
- Share information
 - Inform Public Health & environmental managers
 - Guide field sampling

Rule-Based Model



NOAA Coastal Ocean Science



Bloom Vs No-Bloom



NOAA Coastal Ocean Science

MERIS and MODIS Detection Products September 11, 2008



MERIS Cyano Index

MODIS Cyano Index



NOAA Coastal Ocean Science

Scum detection with MODIS





NOAA Coastal Ocean Science

MODIS Images in Florida

Rhos 865

NIR/Red



NOAA Coastal Ocean Science

Bulletin for Managers, distributed by CEGLHH



EXPERIMENTAL Lake Erie Harmful Algal Bloom Bulletin 4 September 2008 National Ocean Service Great Lakes Environmental Research Laboratory Last bulletin:

Conditions: A *Microcystis aeruginosa* bloom has been identified in western Lake Erie from the Maumee River mouth eastward, along the south shore.

Analysis: A *Microcystis aeruginosa* bloom was identified on August 26, 2008 through the use of MERIS imagery. The bloom was confirmed through sampling on August 28, 2008 and extends from the Maumee Bay eastward and along the southern shore of western Lake Erie. Concentrations range from very high to low, with the greatest concentration at the Maumee Bay in the far SW corner of the basin (41.7919N, -83.3925W) along the southern shoreline almost to the Bass Islands (41.6602N, -83.0780W). Satellite chlorophyll levels have exceeded 40 ug/L. A cyanobacteria bloom is also present in Sandusky Bay, however the majority of the bloom was primarily comprised of *Planktothrix spp.* and some *Anabaena spp. M. aeruginosa, Anabaena spp.* and *Planktothrix spp.* are known to produce toxins. Strong winds and thunderstorms are expected through Friday, which may cause the bloom to disperse, become mixed within the water column or possibly concentrate along the southern shore of Lake Erie. Further sampling is recommended.



Imagery shows the spectral shape at 681 nm from September 2, 2008, where colored pixels indicate the likelihood of *Microcystis* (with red being most likely). *Microcystis* concentration sampling data from August 28, 2008 are shown as red circles (very high), orange circles (high), yellow circles (medium) green circles (low) and blue circles (very low) and purple circles (not present).

-Tomlinson, Wynne

Wind conditions from South Bass Island, OH



Please note:

1. MERIS Imagery was distributed by the NOAA Coastwatch Program and provided by the European Space Agency

2. Cell counts were collected by the Great Lakes Environmental Research Laboratory

3. The wind data is available throught the National Data Buoy Center

Lake Erie: Strong northeasterly winds (10-20 knots) are expected through tonight, and are expected to shift southwesterly on Friday. Northwesterly winds of 5-15 knots are expected Saturday and Sunday, with a decrease in storm activity.

NOAA Coastal Ocean Science

Great Lakes Coastal Forecasting System provides nowcast and forecast of currents



NOAA Coastal Ocean Science

Components of Forecasting Blooms

- Particle Trajectory using GNOME
 - (General NOAA Operational Modeling Environment) to move the blooms (surface only at this time).
- Merges particle field with current field



NOAA Coastal Ocean Science





Concentration estimated from satellite converted to particles



Particles are combined in GNOME with currents



Particles modeled, and reformed to concentration



NOAA Coastal Ocean Science

Images will need to be interpreted with winds based on Wynne et al.



NOAA Coastal Ocean Science







NOAA Coastal Ocean Science





Experimental Lake Erie Harmful Algal Bloom Bulletin 2009-003 06 August 2009 National Ocean Service Great Lakes Environmental Research Laboratory Last bulletin: 30 July 2009



Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from August 05, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. Bloom (with red being the highest concentration). *Microcystis* spp. abundance data from August 03 shown as white squares (very high), circles (high), diamonds (medium), triangles (low), + (very low) and X (not present). Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* spp.



Figure 2. Nowcast position of *Microcystis* spp. bloom for August 06 using GLCFS modeled currents to move the bloom from the August 05 image. Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* spp. Conditions: A Microcystis spp. bloom has been identified in Maumee Bay and the adjacent waters to the northeast. The bloom may be visible from the shore, or the near shore areas outside of Maumee Bay, to the east where concentrations are relatively high. A mixed bloom is also present in Sandusky Bay. Moderate taste and odor issues have been observed and may continue in Sandusky Bay as a result of the bloom.

Analysis: The Microcystis spp. bloom in the western basin of Lake Erie continues to increase in both area and concentration. The bloom in Sandusky Bay is a mixed bloom, primarily dominated by *Planktothrix* spp. Wind stress is expected to be low for the next several days, and will most likely intensify the bloom. The bloom is forecasted to be transported to the east over the next three days. The feature present around the South Bass Islands has not been confirmed as *Microcystis*, sampling is recommended.

-Wynne, Tomlinson



Figure 3. Forecast position of *Microcystis* spp. for August 09 using GLCFS modeled currents to move the bloom from August 05 image. Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* spp.

Please poter

- MERIS imagery was distributed by the NOAA CoastWatch Program and provided by the European Space Agency

- The wind data is available through the National Data Buoy Center and the National Weather Service

- Modeled currents were provided through the Great Lakes Coastal Forecasting System



NOAA Coastal Ocean Science

⁻ Cell counts were collected by the Orest Lakes Environmental Research Laboratory



Experimental Lake Erie Harmful Algal Bloom Bulletin 2009-004 13 August 2009 National Ocean Service Great Lakes Environmental Research Laboratory Last bulletin: 06 August 2009



Figure 1. MERIS image from the European Space Agency. Imagery shows the spectral shape at 681 nm from August 11, where colored pixels indicate the likelihood of the last known position of the *Microcystis* spp. Bloom (with red being the highest concentration). *Microcystis* spp. abundance data from August 11 shown as white squares (very high), circles (high), diamonds (medium), triangles (low), + (very low) and X (not present). Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* spp.



Figure 2. Nowcast position of *Microcystis* upp. bloom for August 13 using GLCFS modeled currents to move the bloom from the August 11 image. Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* upp.

Conditions: A Microcystis spp. bloom has been identified in Maumee Bay and the adjacent waters to the northeast. The bloom may be visible from the shore, or near shore areas outside of Maumee Bay. A mixed cyanobacterial bloom is also present in Sandusky Bay. Moderate taste and odor issues have been observed and may continue to persist as a result of the bloom.

Analysis: The Microcystis spp. bloom in Western Lake Erie continues to persist and increase in both area and concentration. The bloom in Sandusky Bay is a mixed bloom dominated by *Planktothrix* spp. Wind stress is expected to be low for the next several days, which may intensify the bloom. The bloom is forecasted to remain relatively stationary, with a tendency to drift slightly to the NE. The feature present around the South Bass Islands has been identified as having very low concentrations of *Microcystis*. The feature has spread in area since last week's bulletin and may continue to spread. It should be noted that clouds covered Maumee Bay (gray pixels in the observed imagery). As a result of these clouds, the nowcast and forecast show no (or very little) concentration in Maumee Bay.

-Wynne, Dyble, Meredith



Figure 3. Forecast position of *Microcystis* spp. for August 16 using GLCFS modeled currents to move the bloom from August 11 image. Please note: Colored pixels in Sandusky Bay are due to a mixed bloom dominated by *Planktothrix* spp.

Please note:

- MERIS imagery was distributed by the NOAA CoastWatch Program and provided by the European Space Agency

The wind data is available through the National Data Buoy Center and the National Weather Service
 Modeled currents were provided through the Oreat Lakes Coastal Forecasting System

Modeled currents were provided through the Oreat Lakes Coastal Forecasting System



NOAA Coastal Ocean Science

⁻ Cell counts were collected by the Great Lakes Environmental Research Laboratory