Simulation of advection and vertical distribution of buoyant cyanobacterial colonies in Lake Erie with a Lagrangian particle model for short-term forecasts of harmful algal blooms

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Short-term forecasts of cyanobacterial harmful algal bloom (CHAB) spatial extent and transport

Cyanobacterial harmful algal blooms (CABs), primarily toxic blooms, are a recurring problem during the summer in western Lake Erie. Short-term forecasts of the spatiotemporal transport of toxics are useful to public water systems, anglers, recreational boaters, and beach users. NOAAs National Centers for Coastal Ocean Science (NCCOS) and NOAA Great Lakes Environmental Research Laboratory have developed an optical tracking model (Microcysts) that uses the latest satellite and model products to predict the spatial extent and transport of Microcystis colonies at the time step necessary for decision making. The model uses optical imagery and satellite-measured colony properties to determine colony properties, including buoyant velocity and turbulent diffusivity. A random walk model (FlowCam) is used to simulate the time step necessary for decision making. By using this approach, the model simulates the transport of Microcystis colonies in near real-time, providing a useful tool for decision makers.

Microcysts colony size distribution and buoyant velocity in Lake Erie

The microcystin-luciferin-globular catastrophe (MLG) assay is a technique used to quantify Microcystis colonies in water samples. The MLG assay is a rapid and sensitive method for detecting Microcystis colonies in water samples, and it is commonly used in the field to monitor the occurrence of Microcystis blooms. The MLG assay is based on the detection of the luciferase enzyme, which is expressed by Microcystis colonies when exposed to luciferin, a substrate that specifically interacts with this enzyme. The assay measures the amount of light produced by the luciferase enzyme, which is proportional to the number of Microcystis colonies in the sample. This method is widely used in the field for monitoring the occurrence of Microcystis blooms, and it is a rapid and sensitive tool for detecting Microcystis colonies in water samples.

Simulating vertical distribution of Microcysts colonies with the Finite Volume Coastal Ocean Model (FVCOM) and a Lagrangian particle tracking model

In late July, a harmful algal bloom (HAB) was observed in Lake Erie. The bloom was characterized by the presence of Microcystis, a cyanobacteria that produces harmful toxins. The bloom was located in the western basin of Lake Erie, where the water is shallow and warm. The bloom was detected using satellite imagery and in-situ observations. The bloom was characterized by the presence of Microcystis colonies, which were observed using a combination of satellite imagery and in-situ observations. The bloom was characterized by the presence of Microcystis colonies, which were observed using a combination of satellite imagery and in-situ observations.

Skill assessment of the CHAB transport forecast model

We assessed the model skill in predicting the location of the HAB using a skill assessment tool, which evaluates the performance of the model compared to the observed data. The skill assessment tool was based on the frequency distribution of the observed and simulated HAB locations. The frequency distribution of the simulated HAB locations was compared to the frequency distribution of the observed HAB locations to evaluate the model skill.

Conclusion

We have developed a model that can simulate the vertical and spatial distribution of buoyant Microcystis colonies in the turbid water column of Lake Erie using a Lagrangian particle tracking model. The model simulates the transport of Microcystis colonies in near real-time, providing a useful tool for decision makers.

References


Figure 7. Vertical profiles of simulated and observed chl-α concentration in Lake Erie.
Figure 8. Comparison of 2D and 3D simulations initialized on August 26, 2011, with observed satellite images.
Figure 9. Comparison of 2D and 3D simulations initialized on August 26, 2011, with observed satellite images.
Figure 10. Error bar chart showing the model skill compared to the observed data.
Figure 11. Particle skill score (PSS) of the model initialized on August 26, 2011.