Effect of light exposure and nutrients on buoyancy of Microcystis colonies

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Understanding the vertical distribution of Microcystis is important for improving satellite-determined estimates of bloom biomass and for predicting the transport of blooms. Initialized from satellite imagery, the HAB Tracker forecast model predicts the transport and vertical distribution of harmful algal blooms (HABs) in Lake Erie over a five-day period. By focusing on buoyant velocity, we can learn more about the driven factors of Microcystis vertical distributions, and use the results to further improve current HAB Tracker forecast Model.

Objectives

In this study, we used an improved videographic system to measure Microcystis velocity and then developed statistical relationships between Microcystis velocity, colony size, light exposure and nutrients.

Methods

1. Experimental Setup and Microcystis Velocity & Size Measurements

- Water Samples from Lake Erie
- Nutrient Analysis (POC, PON, POP)
- Outdoor Incubation

2. Method Verification

- Random water motion causing errors?
- Measurements accurate?

- Video recording system: a camera system and a software system.

Camera System:
- Temperature-controlled room
- Stationary table, 10 positioning frame
- Shadowgraph optics system
- NIR laser (710 nm), Basler digital video camera (mNIR)
- Quartz prism vessel containing Microcystis samples
- Larger, outer container - the thermal water jacket
- Colony Size - equivalent spherical diameter (ESD): calculated by converting the projected area of a Microcystis colony image to a diameter of a circle of equivalent area.

3. Results & Discussions

1. Method Verification

The mean velocities of two microspheres (49.5 µm and 102 µm) on each sampling day (Figure 2) verified that the Microcystis velocity measurements were accurate.

2. Velocity & Colony Size

Microcystis velocity and colony size were significantly and positively correlated, indicated by the slopes that were significantly different from zero on a log-log plot (Figure 3).

3. Velocity & Light Exposure

Mean velocity of Microcystis and light exposure (PAR) were significantly and negatively correlated, indicated by negative slopes in Figure 4.

4. Velocity & Nutrients

Nutrient analysis showed no deficiency of nitrogen (N) or phosphorous (P) throughout the bloom season in Lake Erie, and we found no significant relationship between buoyant velocity and nutrients if the nutrients are abundant.

Conclusions

Our study has found that strong/light exposure can make Microcystis less buoyant, while large colony size contributes to more buoyant colonies. As for the nutrient effects, we did not observe nutrient deficiency during the bloom season, or the relationship between N:P molar ratios and velocity under nutrient abundance conditions.

References: