Effect of light exposure and nutrients on buoyancy of *Microcystis* colonies

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Introduction

Understanding the vertical distribution of *Microcystis* is important for improving satellite-derived 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

Figure 1. Method flows of sample collection, sample incubation and data measurements.

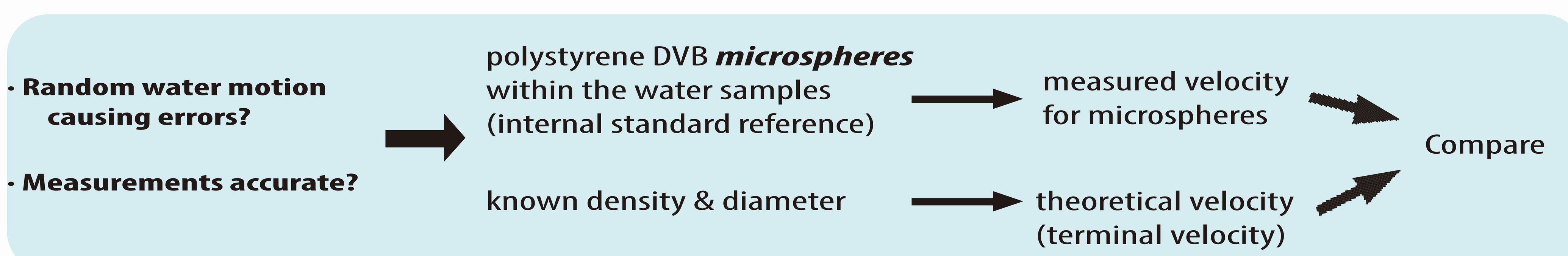
Videographic recording system: a *camera system* and a *software system*.

Camera System:
- temperature-controlled room
- stationary table, 3D 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

Software System:
- Contemplas Templo - collecting videos of *Microcystis* movements
- Contemplas Vicon Motus - measuring the buoyant velocities

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.

2. Method Verification



Results & Discussions

1. Method Verification

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

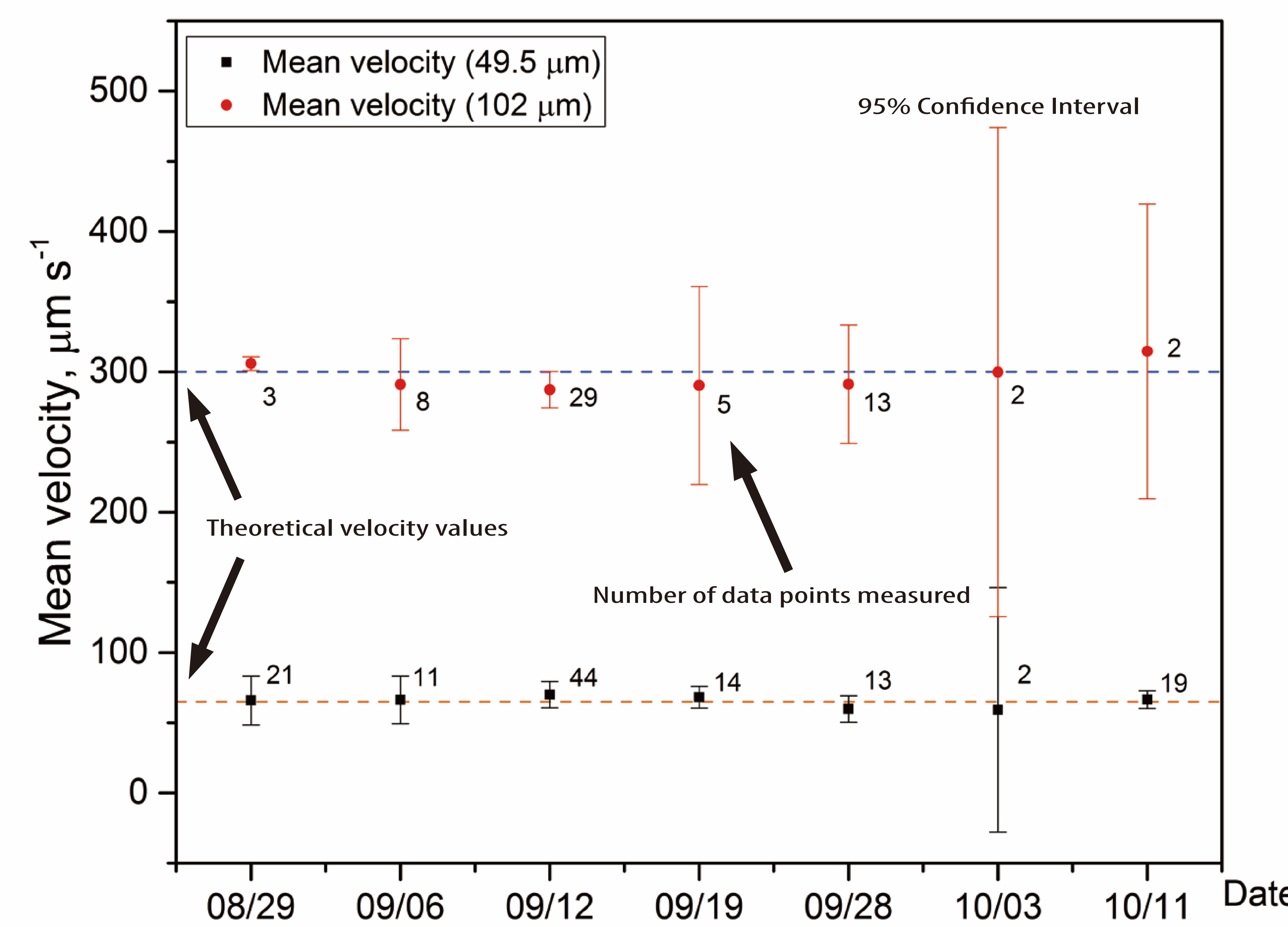


Figure 2. Mean velocity of microspheres for each size on each sampling day throughout the bloom season.

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).

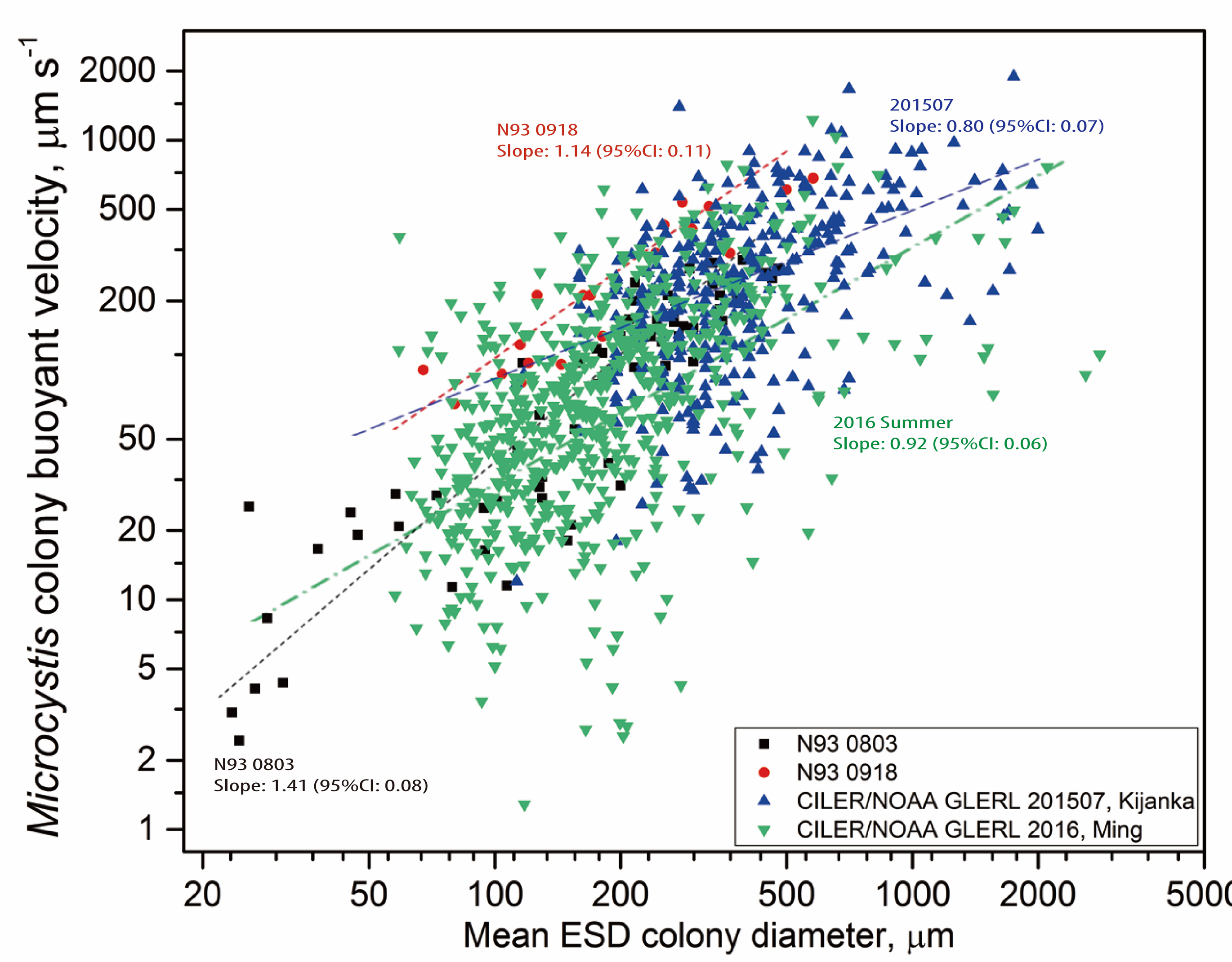


Figure 3. *Microcystis* buoyant velocity vs. colony size for data comparison. Only floating colonies are shown in this figure.

3. Velocity & Light Exposure

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

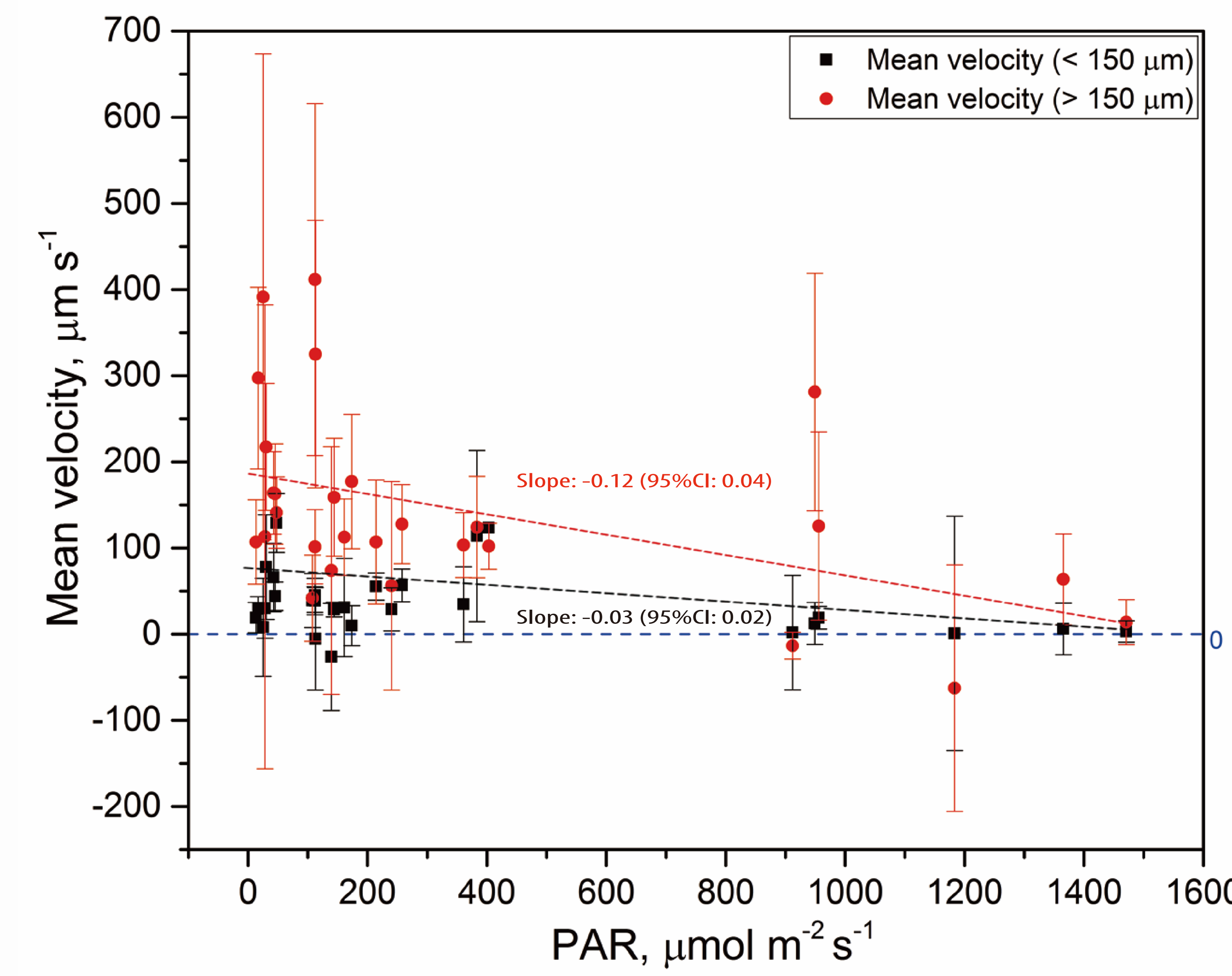


Figure 4. Mean velocity versus PAR for two colony size classes.

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/long 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 abundancy conditions.

References:

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