Using Hyperspectral Imaging to Detect Harmful Algal Blooms

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Introduction

- Algal bloom: a rapid growth of algae in an area
- Caused mainly by eutrophication of nitrogen and phosphorous
- Health concerns: rashes, nausea, organ failure
- Economic Decline: U.S. loses $2 billion per year
- Ecosystems are damaged due to overgrowth and toxins

Hypothesis

- UAV-based hyperspectral remote sensing can be used to detect Harmful Algal Blooms in freshwater.

Methods

Table 1. Specification of Corning microHSI and the Landsat 8 satellite

	Spatial	Spectral	Temporal
Corning microHSI	.01-.15 m	4 nm	On demand
Landsat 8	30 m	~100s nm	16 day revisit time

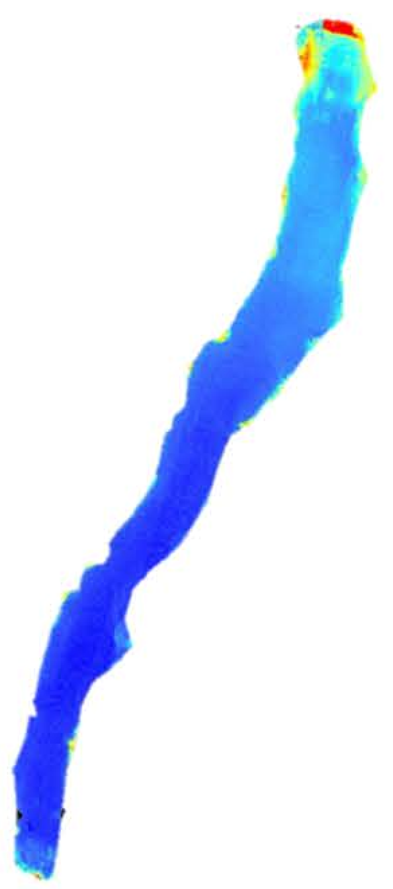


Figure 1. Landsat Image of Canandaigua Lake

- Data was downloaded from the **USGS Earth Explorer**
  - Bands 2, 3, and 4 were added and then a raster calculation was performed in order to **convert reflectance data to both chlorophyll concentration and RGB bands**
  - Darker blue indicates lower Chlorophyll concentration whereas dark red indicates high concentration
- Sampling site chosen: Canandaigua Lake, Canandaigua, NY

Methods

Figure 2. Setting up UAV with Toughbook computer ground control station.

Figure 3. Field set up of calibration cards at launch site.

- Data was acquired with the **Corning microHSI 410 Shark hyperspectral sensor** attached to the **DJI Matrice 600 Pro Hexacopter** along with Kodak and WhiBal calibration cards to collect and calibrate images
- Images were preprocessed with the ArcGIS and referenced using GPS

Results

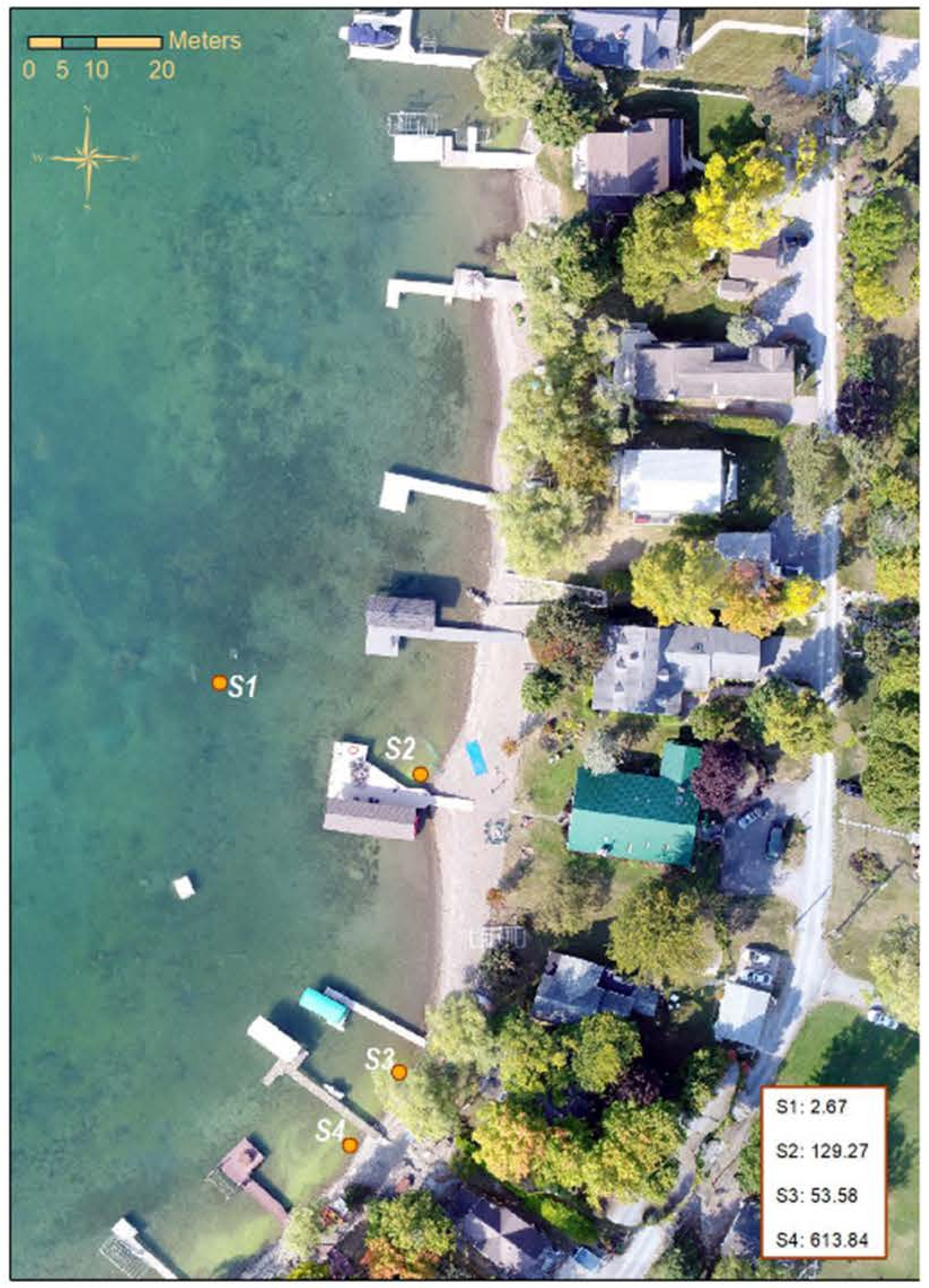


Figure 4. 4 Sampling Points taken along Canandaigua Lake. Microcystin concentrations in μg/L for each sampling point are indicated bottom-right. Image from Phantom 4 Pro 20-megapixel camera.

Results

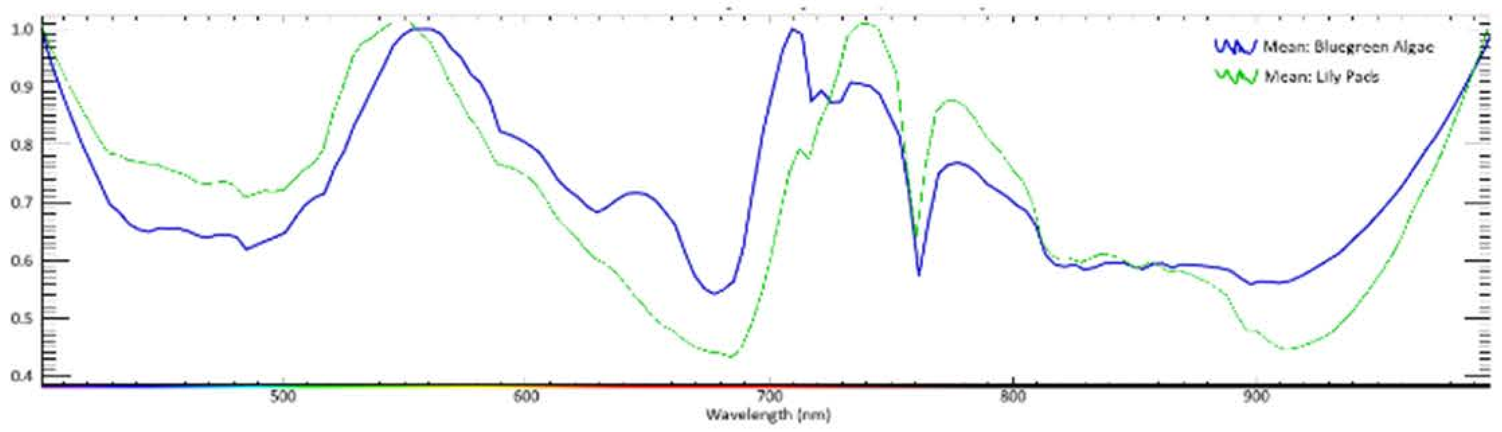
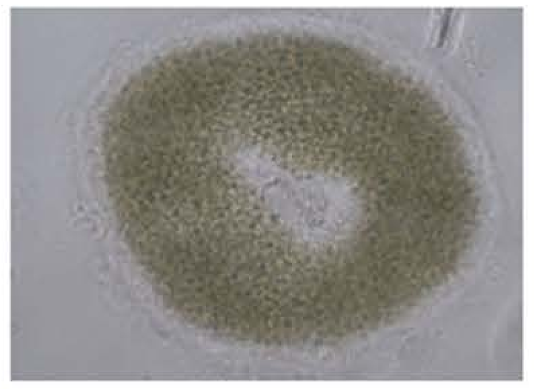


Figure 5. Reflectance spectra of common chlorophyl producing organisms, lily pads and cyanobacteria. Figure indicates distinct spectral peaks of cyanobacteria located at 710 nm.



- The spectral peak in Figure 5. at 710 nm indicative of blue-green cyanobacteria that can produce harmful algal blooms

Figure 6. Cyanobacteria *Microcystis aeruginosa* from Sample 4

Discussion

- Data collected can be used to detect the presence of algal blooms in bodies of water
- Large amounts of data can be quickly collected
- Financial and environmental damage caused by HABs can be mitigated in a cheap and effective way
- Cost effectiveness-relate to other more expensive methods

Future Work

- Additional hyperspectral data collection of the harmful algal blooms
- Create a linear regression model to compare hyperspectral reflectance to cyanobacteria concentration, and therefore the concentration of the harmful algal blooms
- Use a Principal Components Analysis (PCA) to reduce redundancy within the data set to decrease computation complexity

References

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