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Hyperspectral remote sensing of water quality: a rapid assessment tool for mapping blue-green algae in inland water

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Remote sensing, using both air- and space-borne platforms, has provided new ways to assess biological activity in the world's oceans, specifically mapping chlorophyll a for monitoring productivity. More recently, with advances in both the spatial and spectral resolution of sensors, remote sensing methods have been extended to more optically complex inland waters including shallow lakes and reservoirs, where high concentrations of suspended material, dissolved organic matter, and yellow substances affect the irradiance signal.

These remote sensing techniques, which utilize the known optical properties of substances found in the water column, can be applied to assess the abundance of nuisance algal blooms. Potentially harmful blooms of blue-green algae are occurring at increasing rates in the Indiana lakes and reservoirs that receive recreational use and are part of the drinking water supply network. These blooms have led to aesthetic degradation of water resources and have been known to produce toxins, which can have serious adverse human health effects. Though strains of blue-green algae seen in the Indiana lakes have been documented as toxin producers, the conditions in which they produce toxins are highly variable, causing health officials to close lakes without fully understanding the level of toxicity. Current methods for detecting blooms are costly and time consuming, delaying management decisions. Ongoing work to document reservoir conditions, distribution of algae, and level of toxin production is necessary.

Remote sensing, using blue-green algal pigments (chlorophyll a and phycocyanin), can provide a rapid assessment of the spatial distribution and relative concentration of blue-green algae and can inform sampling campaigns and ultimately management decisions. Coupled with physical and chemical data from lakes, remote sensing can help in understanding bloom formation and toxin production potential. The use of remote sensing can provide an efficient method for tracking blue-green bloom occurrence over time relative to long-term management strategies. Semi-empirical remote sensing algorithms applied to two Indianapolis reservoirs have proven robust in predicting phycocyanin concentration with a root mean square error of 24.61 pbb ($n=48$, $p<0.0001$) and have been successfully used to aid drinking water managers in the targeted application of algaecide treatment to maximize benefit. Algorithm transferability needs to be analyzed further through application to additional test lakes in Indiana and continued collection of spectra on the current reservoir data set.

This presentation will provide an overview of hyperspectral remote sensing as it is applied to water quality. A discussion of the applicability of remote sensing tools for reservoir management with a focus on blue-green algal assessment will be provided.