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Randolph, K.[1], Li, L. [2], Tedesco, L.P. [2], Wilson, J. [1], Pascual, D.L. [2] and Moran, D.[3]

[1] IUPUI Department of Geography
[2] IUPUI Department of Earth Science and Center for Earth and Environmental Science
[3] Veolia Water Indianapolis, LLC.

Remote Sensing of Phytoplankton Using Optically Active Pigments, Chlorophyll *a* and Phycocyanin

Nuisance blooms of blue-green algae are seasonally prevalent in Indianapolis' three drinking water reservoirs: Geist, Morse, and Eagle Creek Reservoir. These blooms can lead to aesthetic degradation of drinking water resources (e.g., surface scums on the water and taste and odor in drinking water). Some blue-green algae are able to produce hepatotoxins (e.g., microcystin-LR) and neurotoxins (anatoxin-a), which can lead to adverse human health effects. Current methods for detecting blue-green algae are both costly and time consuming, which can lead to delayed management decisions. However, remote sensing techniques that utilize the optical properties of blue-green algal pigments (chlorophyll *a* and phycocyanin) can meet the need for rapid detection and assessment of blue-green algal distribution. On September 6, 2005, *in-situ* field reflectance spectra were collected at 87 sampling sites on the three Indianapolis reservoirs (~30/reservoir) using ASD Fieldspec (UV/VNIR) and Ocean Optics USB2000 (V/NIR) spectroradiometers. Ground truth samples were taken at each site and analyzed for Chlorophyll *a*, phycocyanin, and other water quality constituents such as turbidity, Secchi depth, conductivity, total dissolved solids (TDS), total suspended solids (TSS), total Kjehldahl nitrogen (TKN), total phosphorus, and organic carbon. Chlorophyll *a* and phycocyanin concentrations were measured flourometrically and spanned a range of 20 to 120 ppb and 2 to 150 ppb, respectively. Previously developed algorithms by Mittenzwey *et al.* (1992), Gitelson *et al.* (1994), Schalles *et al.* (1998), and Simis *et al.* (2005) were applied to field reflectance spectra to predict the phytoplankton pigment concentrations. Algorithm applicability was tested through a least squares regression and residual analysis across all reservoirs and stratified by reservoir. Using data collected by the ASD Feildspec, preliminary results show that, when stratified by reservoir, the Mittenzwey and Gitelson and algorithms yielded high coefficients of determination for estimation of chlorophyll *a* concentrations, 0.802 and 0.797 respectively. Application of the Schalles and Simis algorithms for estimation of phycocyanin concentrations for Morse reservoir resulted in r^2 values of 0.514 and 0.918 respectively. While these algorithms are robust, data will be analyzed to further optimize their applicability to Indianapolis' water reservoirs, thus, providing water quality managers with a survey tool for the rapid delineation and quantification of nuisance phytoplankton.