The spatial dynamics of vertical migration by Microcystis aeruginosa in a eutrophic shallow lake: A case study using high spatial resolution time-series airborne remote sensing

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Limnol. Oceanogr., 53(6), 2008, 2391-2406 | DOI: 10.4319/lo.2008.53.6.2391

ABSTRACT: Time-series airborne remote sensing was used to monitor diurnal changes in the spatial distribution of a bloom of the potentially toxic cyanobacterium *Microcystis aeruginosa* in the shallow eutrophic waters of Barton Broad, United Kingdom. High spatial resolution images from the Compact Airborne Spectrographic Imager (CASI-2) were acquired over Barton Broad on 29 August 2005 at 09:30 h, 12:00 h, and 16:00 h Greenwich mean time. Semiempirical water-leaving radiance algorithms were derived for the quantification of chlorophyll *a* (R^2 = 0.96) and C-phycocyanin (R^2 = 0.95) and applied to the CASI-2 imagery to generate dynamic, spatially resolving maps of the *M. aeruginosa* bloom. The development of the bloom may have been fostered by a combination of the recent improvements in the ambient light environment of Barton Broad, allied to the acute depletion of bioavailable nutrient pools, and stable hydrodynamic conditions. The vertical distribution of *M. aeruginosa* was highly transient; buoyant colonies formed early morning and late afternoon near-surface aggregations across the lake during periods of nonturbulent mixing (wind speed <4 m s^{-1}). However, the extent of these near-surface aggregations was highly spatially variable, and nearshore morphometry appeared to be crucial in creating localized regions of nonturbulent water in which pronounced and persistent near-surface aggregations were observed. The formation of these near-surface scums would have been vital in alleviating light starvation in the turbid waters of Barton Broad. The calm water refuges in which persistent near-surface accumulations occurred may have been an important factor in determining the persistence of the bloom.

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