Macro- to fine-scale spatial and temporal distributions and dynamics of phytoplankton and their environmental driving forces in a small montane lake in southern California, USA

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ABSTRACT: A wireless network of buoys, two autonomous robotic boats, and an autonomous tethered vertical profiling system were used to characterize phytoplankton dynamics and spatiotemporal changes in chemical and physical forcing factors in a small montane lake (Lake Fulmor, Idyllwild, California). Three deployments each year were conducted in 2005 and 2006 to examine seasonal changes in the structure of the lake and phytoplankton assemblage, as well as fine-scale temporal and spatial variations. The buoys yielded fine-scale temporal patterns of in situ fluorescence and temperature, while the vertical profiling system yielded two-dimensional, cross-sectional profiles of several parameters. The autonomous vehicles provided information on fluorescence and corresponding temperature patterns across the surface of the lake. Average, lake-wide chlorophyll concentrations increased 10- fold seasonally, and strong anoxia developed in the hypolimnion during the summer. The latter process dramatically affected vertical chemical gradients in the 5 m water column of the lake. Small-scale spatial (<1 m) and temporal (minutes) heterogeneity in fluorescence were surprisingly large. These variations were due predominantly to vertical mixing of the phytoplankton assemblage and to phytoplankton vertical migratory behavior. Large peaks in fluorescence at 0.5-m occurred at very short time intervals (minutes) during all deployments, and appeared to be due to upward mixing of deeper dwelling eukaryotic phytoplankton during early-mid-summer, or downward mixing of surface-associated cyanobacteria during late summer.