Center for Embedded Networked Sensing

Two years of investigations into phytoplankton and ecosystem dynamics in Lake Fulmor, CA using the NAMOS network

Beth Stauffer, Stefanie Moorthi, David Caron, Gaurav Sukhatme, Carl Oberg, Bin Zhang, Amit Dhariwal, Arvind Menezes-Pereira

University of Southern California, Department of Biological Sciences, Computer Science Department

http://robotics.usc.edu/~namos

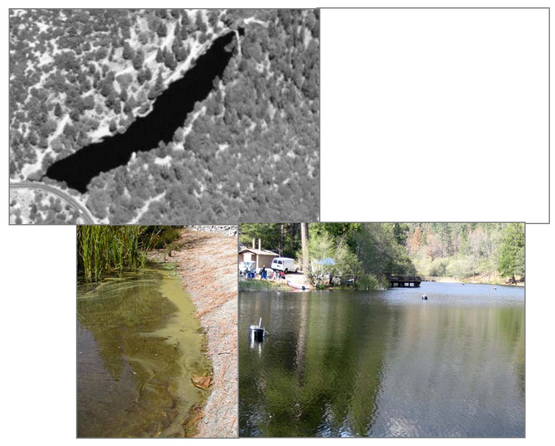
Introduction: Plankton Communities in Aquatic Environments

Phytoplankton communities in lake ecosystems

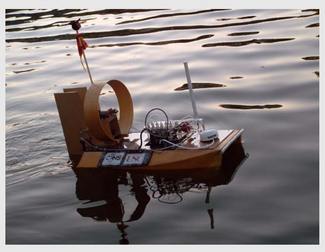
- Communities may be diverse or dominated by one or few species
- The environment that phytoplankton experience is highly dependent on water stratification and flow
  - These parameters are highly variable on both spatial & temporal scales
- Blooms of potentially toxic cyanobacteria & overall eutrophication an important issue for lake ecosystems
- Light extremes & nutrient stress may alter the photosynthetic efficiency of phytoplankton, which is still poorly understood.

Study Site: Lake Fulmor, San Jacinto Mountains, CA

- Subalpine lake, altitude ~5000ft.
- Maximum depth: 6m
- Low flow but relatively strong discrete wind events
- Observed surface scum formation during wind events



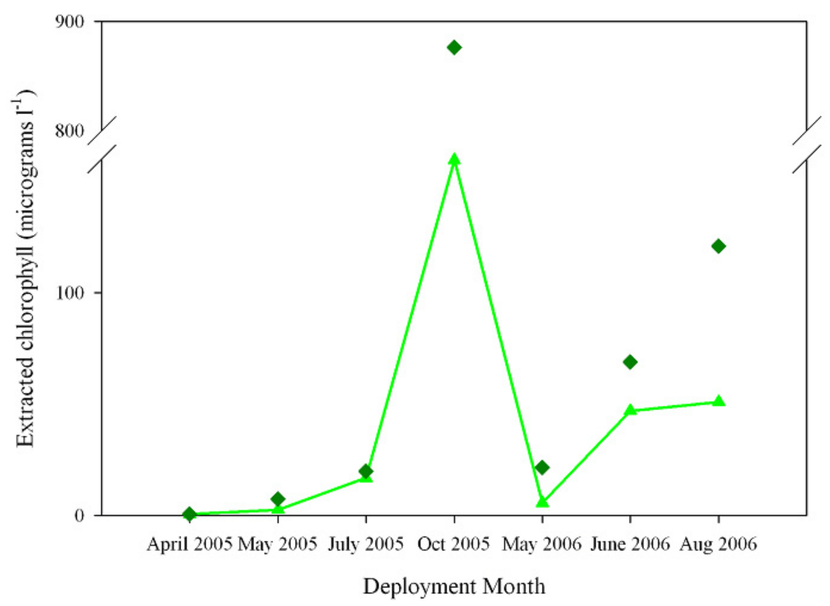
Problem Description: Networked Aquatic Microbial Observing System (NAMOS)



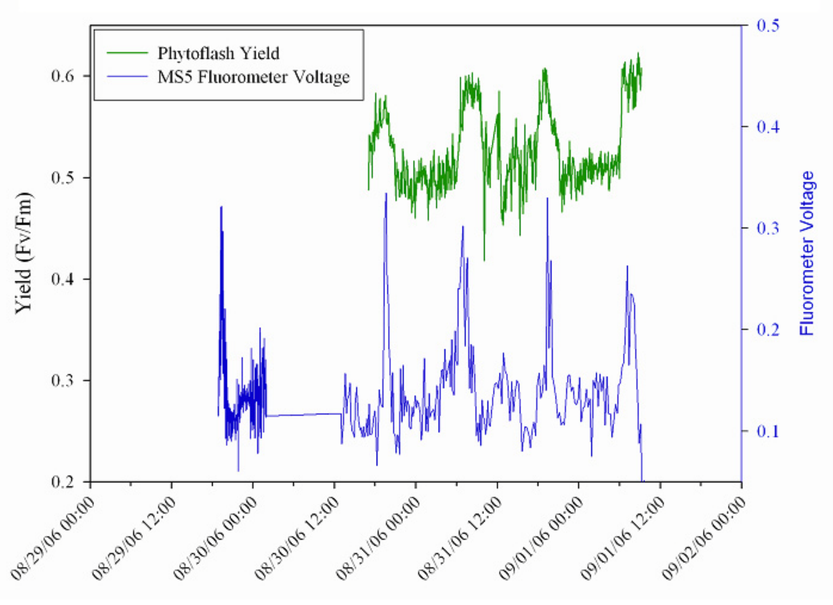
Combined mobile & static components for estimating phytoplankton biomass & water structure

- Temperature sensors provide information on water column stratification
  - surface - 2.5 meters
- Chlorophyll fluorometers estimate phytoplankton biomass near the surface
- Meteorological instrumentation, including wind speed & direction which influence surface water currents & temperature.
- Active fluorometer & NIMS RD provided additional sensor information (pH, DO)
- Discrete samples for nutrients, microscopical analysis, toxin & molecular analyses.

Proposed Solution: Diverse Sensors and Techniques to Characterize a Dynamic Community

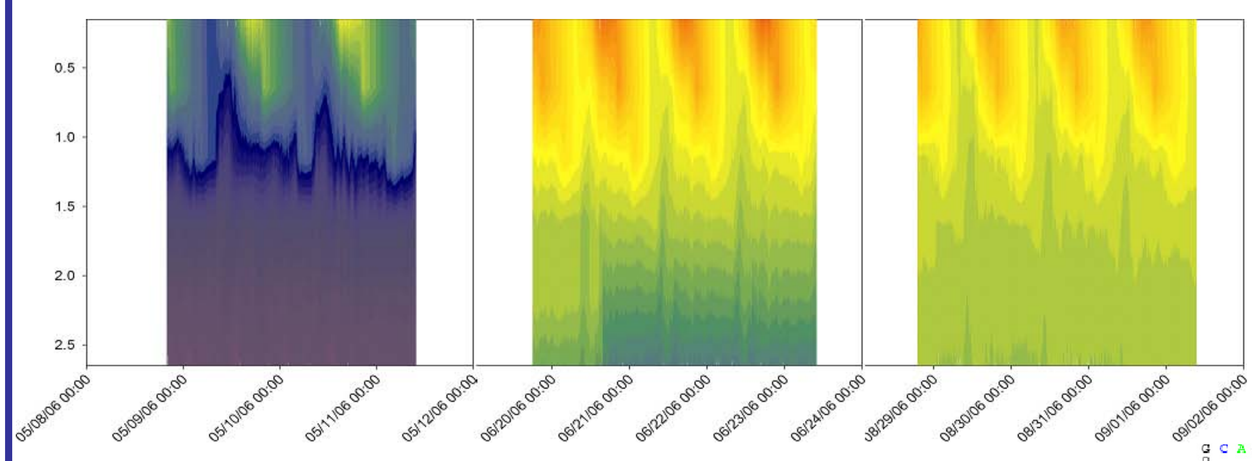


Seasonal increases in average (green line) & maximum (diamonds) chlorophyll *a* concentrations. October 2005 values include samples taken from dense surface scum of cyanobacteria and are exceptionally high.

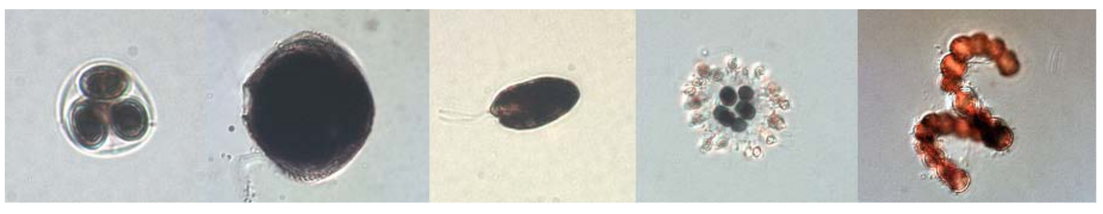


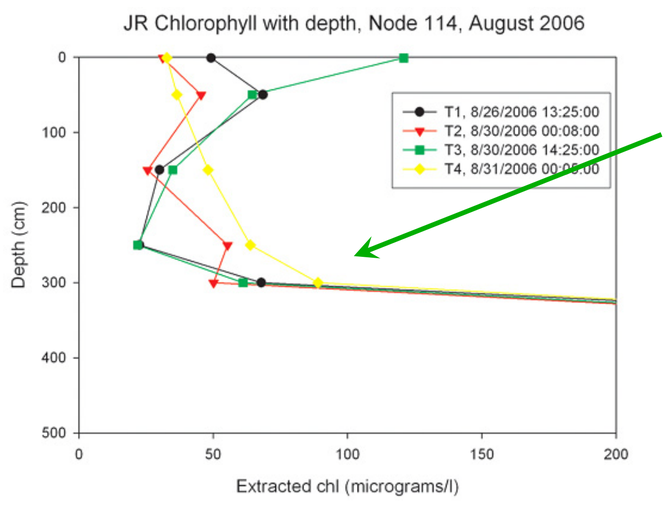
Fluorometer data (blue line) and Phytoflash yield (green line) from August 2006.

- Phytoflash fluorometer (Turner Designs) uses 'active fluorescence' to estimate efficiency of light absorption in photosynthesis.
- Data shows lower efficiency:
  - during night hours, when there is no light for photosynthesis
  - at mid-day, when light is supra-optimal & can cause cellular damage



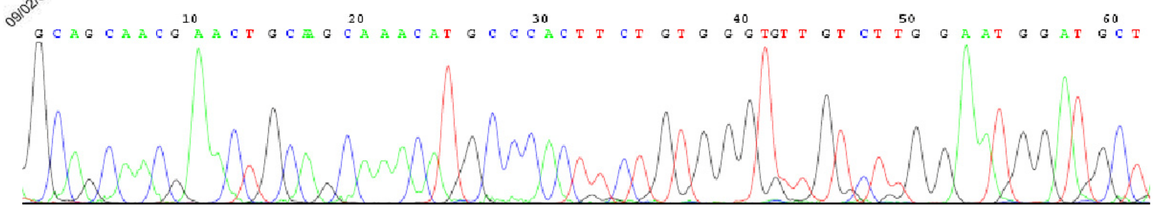
Thermal Stratification increases throughout the 2006 season, with implications for the mixing regime & phytoplankton distribution.





We observed a large chlorophyll peak at 3m depth in August 2006.

- Isolated small green flagellate from samples



We sequenced a portion (~150bp) of the 18S rDNA of the small flagellate, which matched most closely (98%) to *Trachelomonas hispida*, a bottom-dwelling Euglenoid whose ecology is still largely unknown (Reynolds, et al, 2002.