USING TURNER DESIGNS' C3 SUBMERSIBLE OR PHYTOFLASH ACTIVE FLUOROMETERS FOR *IN VIVO* MONITORING OF ALGAL FLUORESCENCE

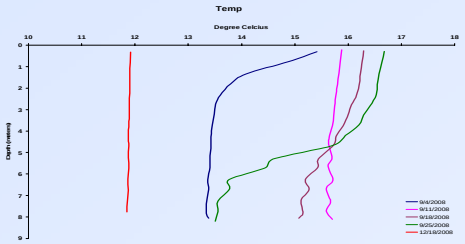
by Lawrence Younan
Application Scientist, Turner Designs

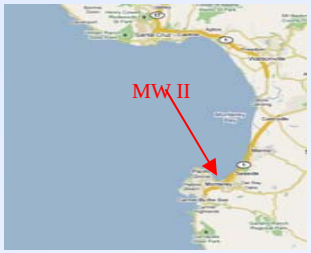
Introduction

Sampling efficiency is important for monitoring protocols that are set up to predict algal blooms. Too much time is often wasted on techniques such as cell counting, either manual or automated. Turner Designs' C3 Submersible Fluorometer is an *in situ* fluorometer that can be configured with up to 3 different pigment-specific optical sensors for rapid *in vivo* detection of different algal groups within an aquatic system. A huge benefit to using the C3 for *in vivo* studies is that it is a self-maintained unit with features such as large internal memory, wiper brush, and battery pack. Its ability to be integrated into larger multi-parameter systems or CTD's add to its versatility.

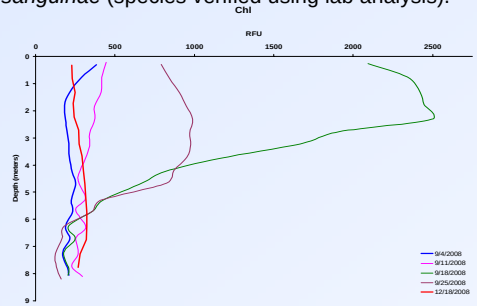
Profiling

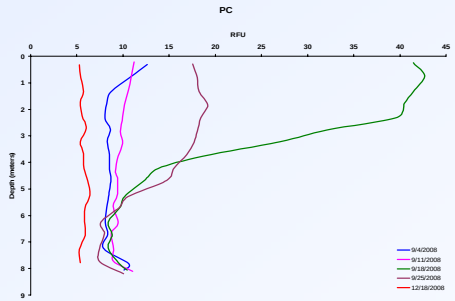
The C3 Submersible Fluorometer can be used for profiling to collect data in an effort to monitor algal activity throughout the water column over time. A C3 configured with 3 sensors (Chlorophyll, Phycocyanin, Turbidity) was used to collect profiling data from Monterey Bay, Ca. Three profiles were made, each profile 45-60 minutes time, to a depth of 8 meters.





A sharp 2 meter thermocline was observed in the 9/4/2008 profile. The gradual breakdown of this thermocline, possibly due to increased tidal mixing or movement of water masses, may have contributed to the increased fluorescence signal from chlorophyll, which was observed on 9/18/09. This increased chlorophyll fluorescence signal was a result of a dinoflagellate bloom, *Akashiwo sanguinae* (species verified using lab analysis).

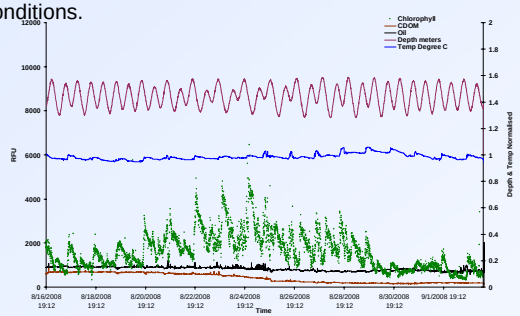




Phycocyanin fluorescence was simultaneously measured for all 5 profiles taken (above, right). The December profile displayed a chlorophyll fluorescence signal similar to the profile taken at the beginning of September. However, phycocyanin fluorescence had decreased indicating little or no phycocyanin containing algae, possibly cyanobacteria or cryptophytes, present in the algal community for the month of December. These data show that the C3, equipped with pigment specific sensors, can be used to characterize different algal groups and monitor their abundances over time in mixed algal communities.

In Vivo Monitoring

Data below were taken from a C3 Submersible Fluorometer that was deployed for one month in San Francisco Bay. Equipped with a wiper brush, battery pack, pressure sensor, and 3 optical sensors (Chlorophyll, CDOM, Oil), the C3 logged data continuously at 5 second intervals and recorded a small algal bloom (corroborated by CICORE data) even under heavy biofouled conditions.



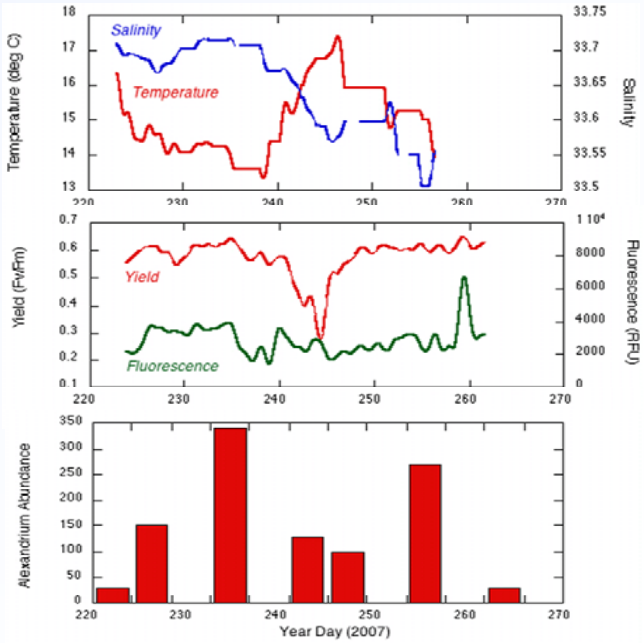
Red PhytoFlash: Determining Physiological State of Algae

Data collected from *in vivo* monitoring events provides information on changes in fluorescence, so researchers are left guessing, for the most part, at what might have caused, for example the change in algal abundance. Turner Designs has developed an *in vivo* fluorometer that is 10x more sensitive to prokaryotic algae (Cyanobacteria), but can be used for monitoring chlorophyll fluorescence and provide information on the physiological state of either prokaryotic or eukaryotic algae.

The PhytoFlash was installed in 2 meter water depth at a wharf in Santa Cruz, Ca and sampled at 1 minute intervals.

Fluorescence was continuously monitored and although no change in fluorescence was observed from year day 240-250, during the shift in temperature and salinity there was a coincidental spike in Urea concentrations (data not shown) and a drop in yield. The drop in yield is indicative of stressed algal cells. *A. cantenella* abundance significantly decreased during this period along with the production of saxitoxins (data not shown).

The yield parameter is a good indication of how the physiological state of algae may be affected by changes in biological, physical, or chemical parameters, which may directly correlate to a change in abundance.



Acknowledgments: Turner Designs thanks Dr. G. J. Smith of Moss Landing Marine Laboratories, California and Dr. R. Kudela of University of California Santa Cruz for their support and efforts.