Two New Sensors Available for Variable Fluorescence and Fluorometric Characterization

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Beta testing conducted by: **Dr. Raphael Kudela of the University of California at Santa Cruz**

INTRODUCTION

Turner Designs, Inc has developed an *in situ* variable fluorescence system that can be used to determine the quantum efficiency of phytoplankton in both oligotrophic and mesotrophic environments. The PhytoFlash is distinct from other 'active' fluorometers on the market in that it is the first patented solid-state instrument capable of variable fluorescence measurements on natural concentrations of phytoplankton. The solid-state platform allows for a much wider range of uses due to the small size, power efficiency, more stable components, and lower price point.

The variable fluorescence measurement is being used in an ever-growing list of applications, such as;

- *In situ* measurement of phytoplankton photosynthetic parameters
- Indicator of nutrient status of planktonic algae
- Detection of the onset of algae blooms
- Accurate measurement of algal biomass and monitoring algal community changes
- Measurement of non-photochemical quenching (laboratory mode)

SPECIFICATIONS

Optical Specifications

Excitation Filter	<500 nm
Emission Filter	680AF80 nm
LED wavelength	460nm
Minimum Detection Limit	0.15 µg/l

Electronic Specifications

Sampling Rate	0.2 Hz
Saturating LED	200-10,000 ms
Data Format	RS-232

Physical Dimensions

Length	12 inches (30.5 cm)
Width	3 inches (7.6 cm)
Weight (in air)	2.95 lbs (1.34 kg)
Sample Volume	5.36 ml

Photosynthetic Parameters

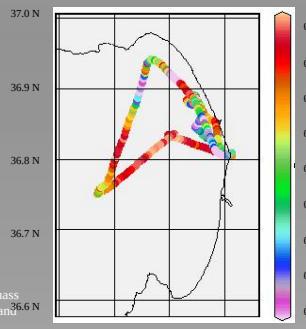
Fo	Minimum fluorescence	**Fv/Fm (yield)**	Maximum quantum yield of photochemistry in PSII
Fm	Maximum fluorescence	**Blank**	Calculated blank value used in calibration
Fv	Variable fluorescence (Fm-Fo)	**Response Curves**	Available during laboratory mode

UNDERWAY MAPPING OF YIELD (Fv/Fm) DURING A REDTIDE OFF THE COAST OF CALIFORNIA

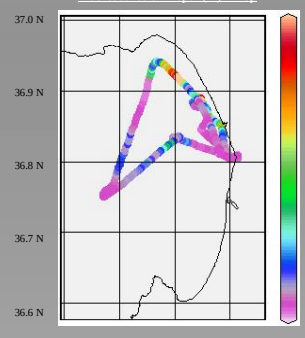
Data was collected during a cruise in Monterey Bay in September 2006 as a large red tide (>250 µg Chl) event was occurring. The yield data was collected by a PhytoFlash active fluorometer during tows. The PhytoFlash was collecting data as it was in line with the underway sampling system.

Monterey Bay, California USA

Yield on Depth (m) = Top



Fluorescence on Depth (m) = Top



The underway data show that higher yields were concentrated in the center of the Bay. Higher biomass concentrations mostly occurred along the coast. The bloom was dominated by the dinoflagellate *Akashiwo sanguinea*.

Preliminary conclusions suggest that the highest biomass (fluorescence) was not necessarily the highest Yield, and that the low biomass waters were "healthy" (Fv/Fm >0.6).

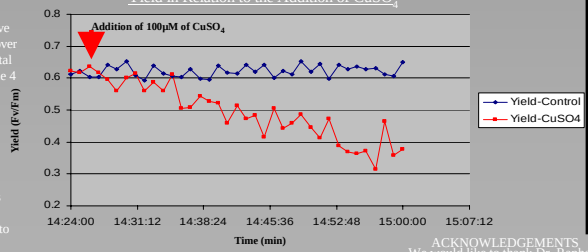
HOW YIELD (Fv/Fm) CHANGES WHEN A SYSTEM IS IMPACTED

Copper sulfate ($CuSO_4$) was used to inhibit photosynthesis in a green alga (*Dunaliella)* culture to demonstrate how yield is affected by "impacted" systems. Yield was evaluated using the PhytoFlash active fluorometer. Yield measurements were taken at 1-minute intervals over a 50-minute period for two sub-samples, a control and an experimental sample. 100 µM $CuSO_4$ was added to the experimental sample at the 4 minute mark.

Results

Yields ranged from 0.588-0.648 for the control sample over 50-minutes displaying natural variability. At approximately 16-minutes after the addition of $CuSO_4$ yields begin to deviate from the natural range of variability. At the end of the experiment (50-minutes) yields dropped significantly to 0.216 for the $CuSO_4$ sample and the control remained above 0.600. The PhytoFlash active fluorometer was able to detect a negative impact in the system that was affecting photosynthetic efficiency.

Yield in Relation to the Addition of $CuSO_4$



Beta testing conducted by: **Dr. Bruce Hargreaves of Lehigh University**

INTRODUCTION

The submersible C6 Multi-Sensor Platform was designed for extended or short-term deployments. Each C6 comes with a factory installed temperature and pressure sensor and a depth rating of 600 meters. The C6 Windows™ based user interface allows for intuitive calibration, data logging, and data management capabilities.

The submersible battery pack and mechanical wiper allows for extended deployments greater than 85 days. Existing Cyclops-7 users can easily integrate existing Cyclops-7 sensors into the C6 Multi-Sensor Platform. The C6 provides individual automatic gain control, calibration, digital data reporting and datalogging.

SPECIFICATIONS

Optical Sensors

- Chlorophyll *a in vivo*
- Blue Green Algae – Phycocyanin
- Blue Green Algae – Phycoerythrin
- Rhodamine Dye
- Fluorescein Dye
- Turbidity CDOM
- Optical Brighteners
- Oil
- Custom

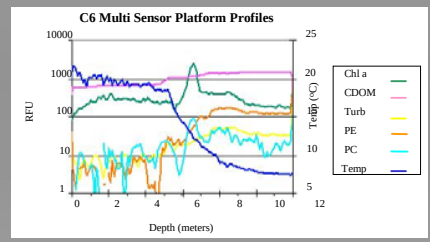
Electronic Specifications

Sampling Rate	1 second
External Power	8-20 VDC
Output	Digital Signal
Interface	RS-232

Physical Dimensions

Length with Sensors Attached	13.3 inches (33.8 cm)
Diameter	4.0 inches (10.2 cm)
Weight (in air)	6.0 lbs (2.74 kg)
Depth Rating	600 meters

PROFILES IN LAKE LACAWAC & CRATER LAKE



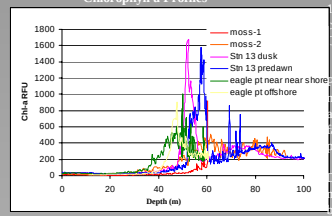
C6 Multi Sensor profiles were recorded in Lake Lacawac on September 22nd, 2007.

There appears to be some phycoerythrin signal in the hypoxic zone associated with the sharp Chlorophyll-a peak. There is also a deeper broad peak of phycoerythrin -rich anoxic phytoplankton, associated with high turbidity consistent with small size, that may also have some Chlorophyll -a type fluorescence. It is also possible the the latter is phaeophytin degraded from upper water column Chlorophyll -a.

C6 mounted to a profiler in Crater Lake, Oregon

Data will be posted on the Turner Designs website.

Chlorophyll a Profiles

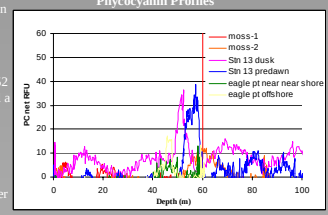


100 meter C6 Multi Sensor profiles (down casts) were recorded in Crater Lake, Oregon during July 19, 2007.

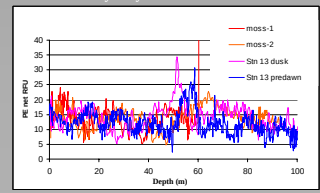
Preliminary results show a PC signal at 52 meters that also appeared for Chlorophyll a and turbidity. PE and PC peaks match fairly well suggesting a niche for picocyanobacteria or cryptophytes.

Data not shown records low CDOM measurements at all depths but was higher below thephotic zone

Phycocyanin Profiles



Phycoerythrin Profiles



TURNER DESIGNS

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