PHYTOFLASH ACTIVE FLUOROMETER: NEW PERFORMANCE DATA

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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 algal blooms
- Accurate measurement of algal biomass and monitoring algal community changes
- Measurement of non-photochemical quenching (laboratory mode)
- Ballast water monitoring

PHYTOFLASH SPECIFICATIONS

Optical Specifications

Excitation Filter	475nm
Emission Filter	640-715nm
Minimum Detection Limit	0.15 µg/l

Physical Dimensions

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

Electronic Specifications

Sampling Rate	0.2 Hz
Saturating LED duration (default)	200-10,000 ms, 200ms
Data Format	RS-232 and Analog

PhytoFlash 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 fluroescence (Fm-Fo)**	**Response Curves**	**Available during laboratory mode**

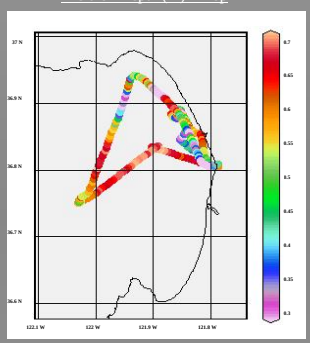
UNDERWAY MAPPING OF YIELD (Fv/Fm) DURING A REDTIDE OFF THE COAST OF CALIFORNIA

Data was collected during a cruise in Monterey Bay in September 2006 as a large red tide (>250 µg chlorophyll *a*) was occurring. Yield data was collected using a PhytoFlash active fluorometer while in line with the underway sampling system.

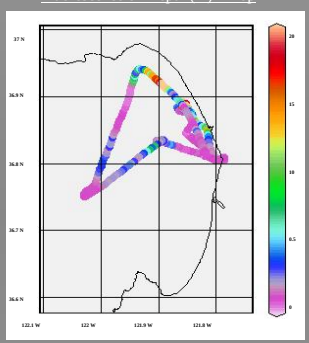
Monterey Bay, California USA

The underway data show that higher yields were concentrated in the center of the Bay. Higher biomass was observed mainly 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).

Yield on Depth (m) = Top



Fluorescence on Depth (m) = Top



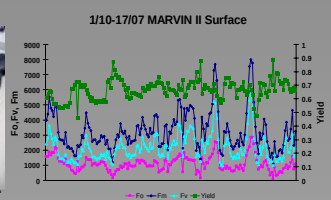
Data courtesy of Dr. Raphael Kudela, University of California at Santa Cruz

PHYTOFLASH INTEGRATION WITH WATER QUALITY MONITORING PLATFORMS

Harmful Algal Blooms (HABs) are triggered by a wide range of biological and physical variables such as nutrients, light availability, temperature, salinity and flow rates. Increased efforts in developing HAB monitoring programs have led to the enhancement of platforms designed to continuously monitor water-quality parameters. The PhytoFlash active fluorometer has been integrated with various multi-parameter systems to collect physiological data such as the photosynthetic efficiency (yield) of phytoplankton cells, effective biological data used to evaluate the occurrences HABs.

MARVIN II

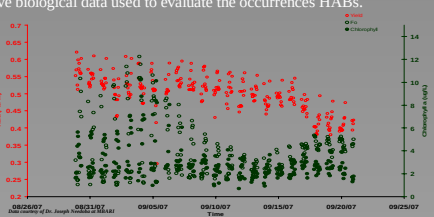
Fluorometer integrated with MARVIN II. Photo and data courtesy of Dr. Merrie Beth Neely at Fish and Wildlife Research Institute



MARVIN (MERHAB[Monitoring and Event Response for HABs] Autonomous Research Vessel *In-Situ*) was designed by programmers and scientists from AMJ Environmental, a subsidiary of YSI Inc. The PhytoFlash was integrated with the MARVIN during a 7-day deployment in the Caloosahatchee River, Florida. Preliminary results indicate baseline fluorescence, Fo (pink), was concurrent with MARVIN chlorophyll data showing no large fluctuations in algal biomass. The average yield (green) of 0.65 indicates a healthy population.

LOBO L01 BUOY *www.mbari.org/lobo*

The Land/Ocean Biogeochemical Observatory (LOBO) L01 Mooring was developed by scientists at MBARI using commercial and in house technology to deploy oceanographic instrumentation for monitoring or tracking environmental parameters. The PhytoFlash was fixed to the mooring and deployed near the mouth of Elkhorn Slough located in Monterey Bay, California in September 2007.



Data courtesy of Dr. Joseph Needoba at MBARI

Graphed data show LOBO measurements taken for 22 days during 12 hour dark periods. Increasing Fo and Yield values recorded prior to 9/5/07 may have indicated the onset of a bloom. On 9/5/07 a small bloom occurred resulting in 10µg/L, measured by the LOBO. Chl *a*, Fo, and Yield started to decrease after the event. Chl *a* continuted to decrease for the remainder of the sampling period. Increased Fo and decreased Yield values towards the end of the sampling period may be indicative of a stressed algal population.

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

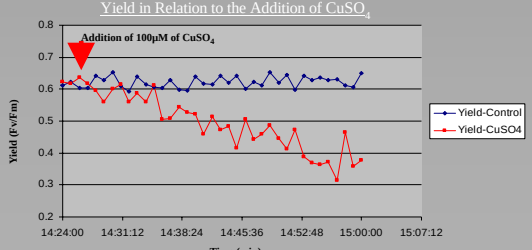
Design

Copper sulfate ($CuSO_4$) was used to inhibit photosynthesis in a green alga (*Dunaliella)* 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 $CuSO_4$



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