

C3 Submersible Fluorometer



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Outline

- Introduction to Turner Designs
- Why we developed the C3
 - Hardware Configuration
 - Software Overview
- Applications
- Performance Data
- Hands on

Turner Designs History

- Established over 30 years ago by George Turner
- Focused on the development of filter fluorometers for field and laboratory use
- Became a leader in filter fluorometers with a reputation for building rugged, reliable, stable instruments
- As fluorescence measurements gained popularity the company expanded into multiple markets
 - Environmental
 - Industrial
 - Hydrocarbons
 - BioTech
 - OEMs

Turner Designs Today

- Dedicated to Environmental Customers
 - Strong OEM business in Industrial Process Control applications
- Located in Sunnyvale, CA
 - In 20,000 sq ft (1,860 sq meters) facility
- Committed to quality
 - ISO 9001 Certified
- Number 1 supplier of filter fluorometers in the world
 - Customers in >50 countries
- Product innovations over the years
 - World standard field fluorometer
 - Handheld fluorometer
 - Solid secondary standard
 - All solid-state active fluorometer (patents issued)

Turner Designs' Strengths

- Our business is:
 - Developing fluorescence solutions for environmental and industrial applications
- Our products are:
 - High quality
 - Accurate and repeatable
 - Reliable
 - Easy to use
- Our company provides:
 - On time & accurate deliveries
 - Excellent customer support and service

Product Portfolio



Why Develop the C3 Submersible?

- Offer a submersible fluorometer that incorporates 1, 2 or 3 optics
- Create a versatile fluorometer for coastal, open ocean, and freshwater communities
- Provide a fluorometer which is user-friendly and easy to deploy
- Replace the SCUFA

C3 Submersible Fluorometer

How does C3 Compare to SCUFA?

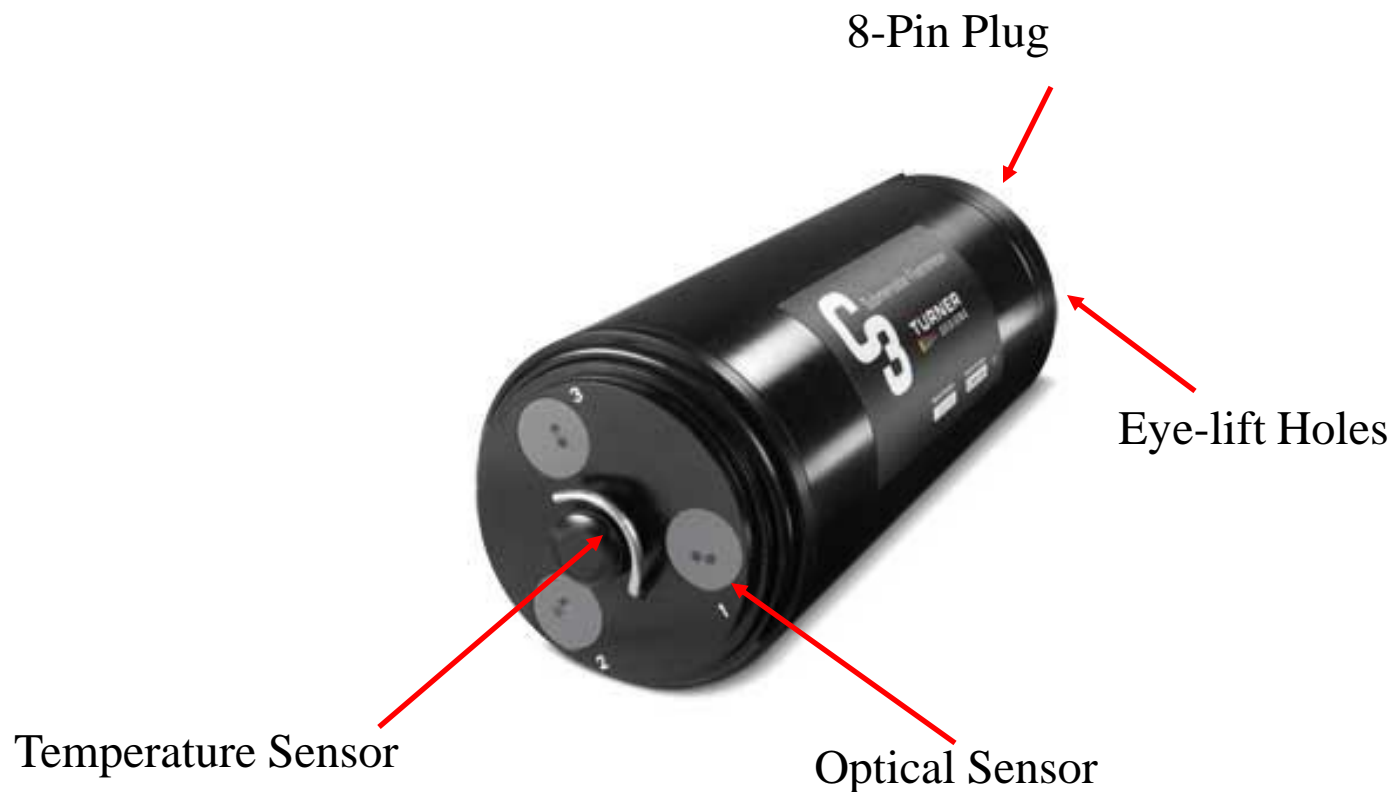
FEATURE	C3 Submersible Fluorometer	SCUFA
Applications (Optical Kits)	1, 2 or 3	1 + turbidity
Memory (data points)	480,000	8640
Resolution	16 Bit	12 Bit
Temperature Compensation	X	X
Material	Delrin	Delrin/Stainless Steel
Wiper Motor	X	
Pressure Sensor	X	
Battery Bracket	X	
Multiple Calibrations	X	
Shade Cap	X	
Flow Cap	X	X
Solid Standard	X	X
Digital Data Output	X	X
Analog Data Output		X

C3 Submersible Fluorometer

Features and Benefits

Feature	Benefit
Flexible	Select 1, 2, or 3 optical sensors to be installed 9 defined optical kits or request a custom kit
Versatile	Operate in the self-contained mode, used during discrete sampling, or integrate into a 3 rd party system
Mechanical Wiper/Delrin housing	Minimize bio-fouling and corrosion during extended deployments
Large internal data-logging capacity	Over 480,000 data points at 1 second logging intervals
Extended battery life	Lithium-Ion Battery. Able to log @ 15-minute intervals for over 45 days
Integrated Depth and Temperature	No need to add additional sensors <i>*Depth is an optional factory-installed accessory</i>
Secondary Solid Standard	Enables easy verification of calibration and instrument stability
Extender cables	Enable real-time data downloading at depth

Hardware Configuration



Included with the C3 as standard

- Up to 3 factory-installed sensors
- Factory-installed temperature sensor
- C-Soft Software, User's Manual and Quick Start Guide



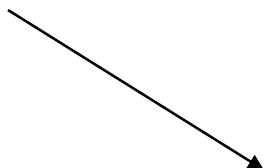
12 V Power Supply



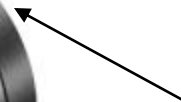
Interface Cable

Factory-Installed Options

Mechanical Wiper



Pressure Sensor



Available Accessories



Submersible Battery Pack
Includes recharger



Battery Bracket



Shade Cap
Weighted Cap Available

Solid Standard Insert

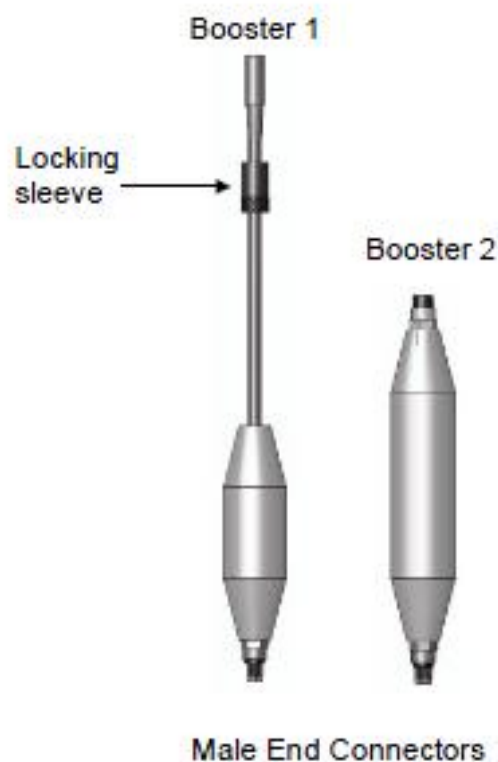


Adjustable Secondary Solid Standard



Flow Cap

Cables and Boosters for Real-Time Data Collection



Standard Cable Lengths Available:

10 meters

25 meters

50 meters

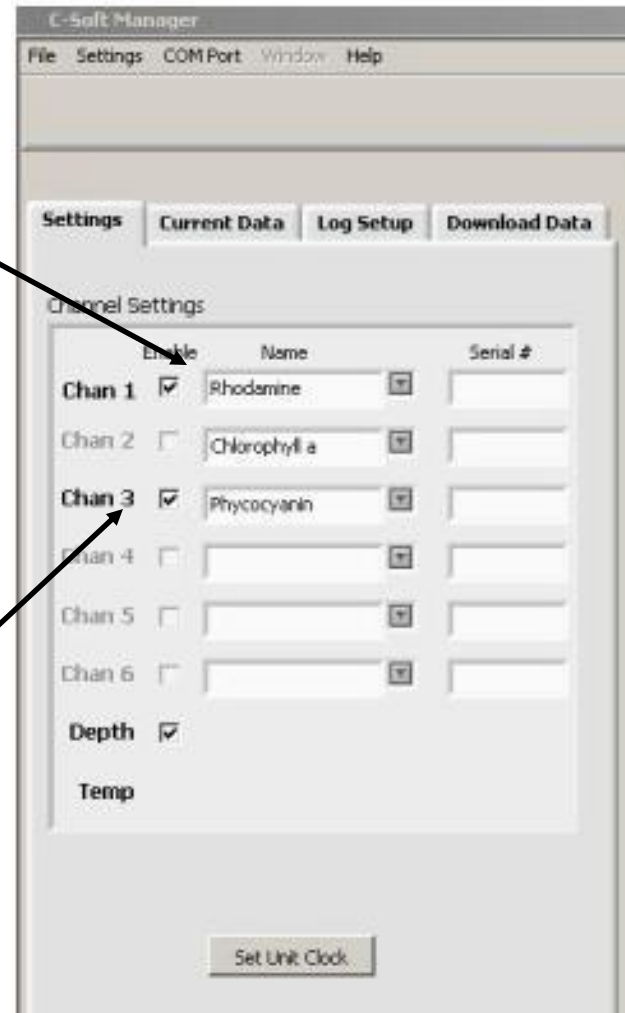
Boosters:

Allow users to read real-time data to depth
Required for depths greater than 10 meters

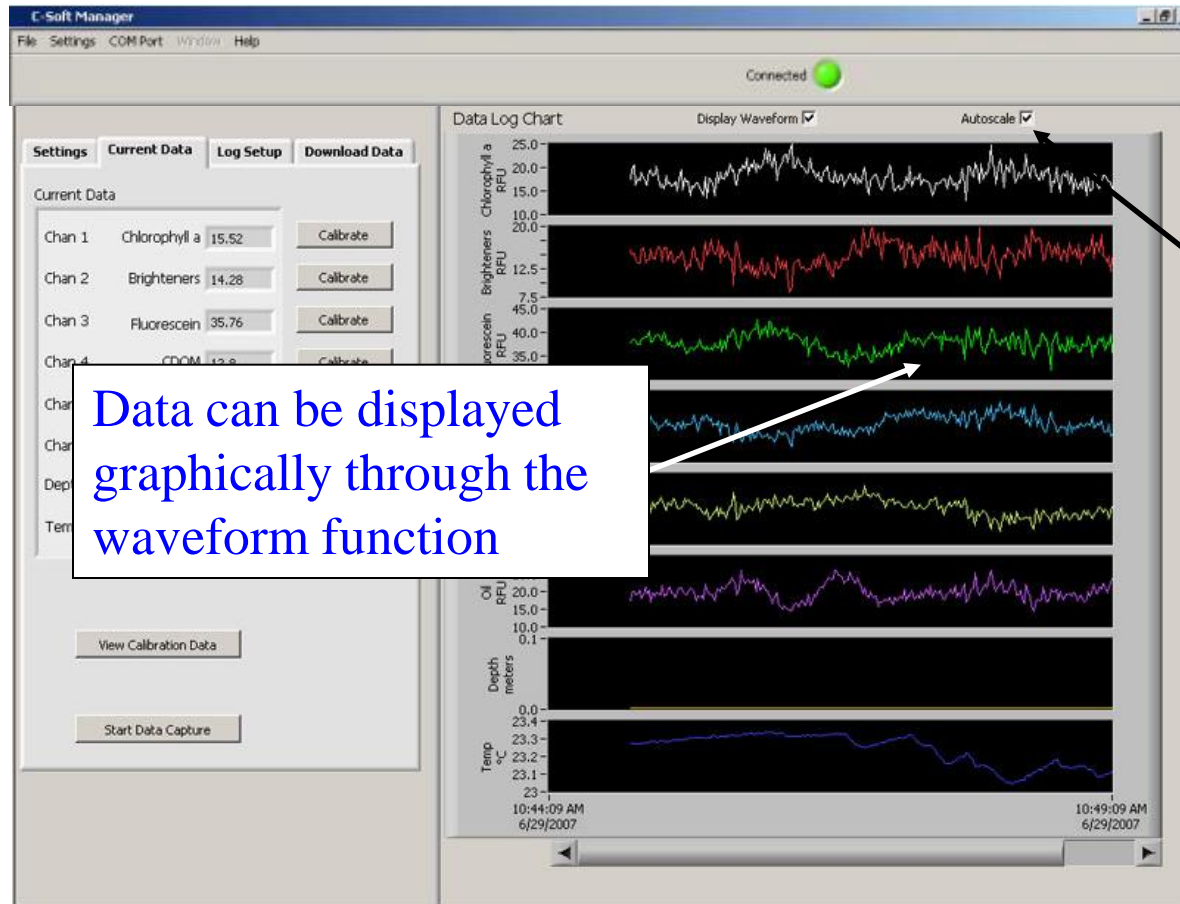
C-Soft Software

Dropdown Applications

Enable or Disable
Sensors



C-Soft Software



Data can be displayed graphically through the waveform function

Auto-Scaling Available

C-Soft Software

C-Soft Manager

Channel Calibration

Unit Label: Chan 1:Rhodamine Current RFU: 83.20

Step 1 Press "Set Blank" to set the blank value to the current RFU.

Blank RFU

x1

x10

x100

Step 2 Enter the value of your standard and select the units of measure.

Standard Value: Units:

Step 3 Press "Set Standard" to set the standard value to the current RFU.

Standard RFU:

Step 4 Optional: Click the temperature compensation box to activate.

Temp Compensation: ☐

Step 5 After calibration is complete press "Save Calibration".

Step by Step
Calibration
Procedure

Select Units from
Dropdown or
Manually Enter

Temperature
Compensation

Operate in Raw
Fluorescence Units
Mode

C-Soft Software

Multiple Files can
be Saved in the C3

Files are Time-
Stamped

Multi-Sensor Platform

Download Log Data...

Total Files 1

Start Date/Time	End Date/Time	Records	Save
02/02/07 16:02	02/02/07 16:06	264	<input checked="" type="checkbox"/>
		0	<input type="checkbox"/>
		0	<input type="checkbox"/>
		0	<input type="checkbox"/>
		0	<input type="checkbox"/>
		0	<input type="checkbox"/>
		0	<input type="checkbox"/>

Save Files Cancel

Save Files to Any
Location on Computer
in csv. format

Applications

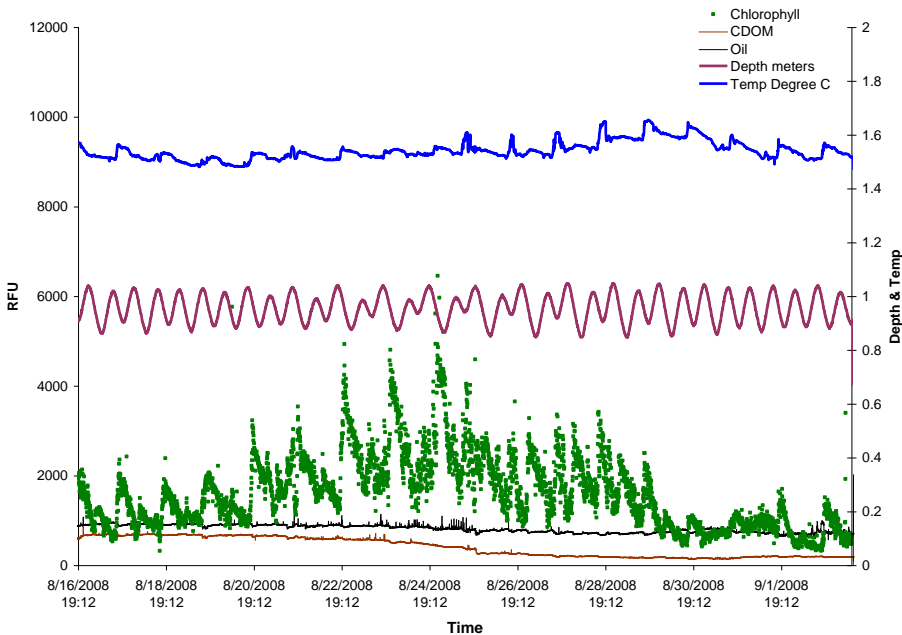
Application Specifications

	<u>Minimum Detection Limit</u>	<u>Dynamic Range</u>
Chl <i>a in vivo</i>	0.025 ug/L	0-300 ug/L
Phycoerythrin	150 cells/ml	0-150,000 cells/ml
Marine Cyanobacteria		
Phycocyanin	150 cells/ml	0-150,000 cells/ml
Freshwater Cyanobacteria		
Rhodamine Dye	0.01 ppb	0-500 ppb
Fluorescein Dye	0.01 ppb	0-500 ppb
Turbidity	0.05 NTU	0-3000 NTU
Oil, Crude	0.1 ppm	0-1,000 ppm
CDOM	0.2 ppb QS	0-1,000 ppb QS
Optical Brighteners	0.002 ppb QS	0-10,000 ppb QS

Performance Data

C3 Submersible Fluorometer

San Francisco Bay

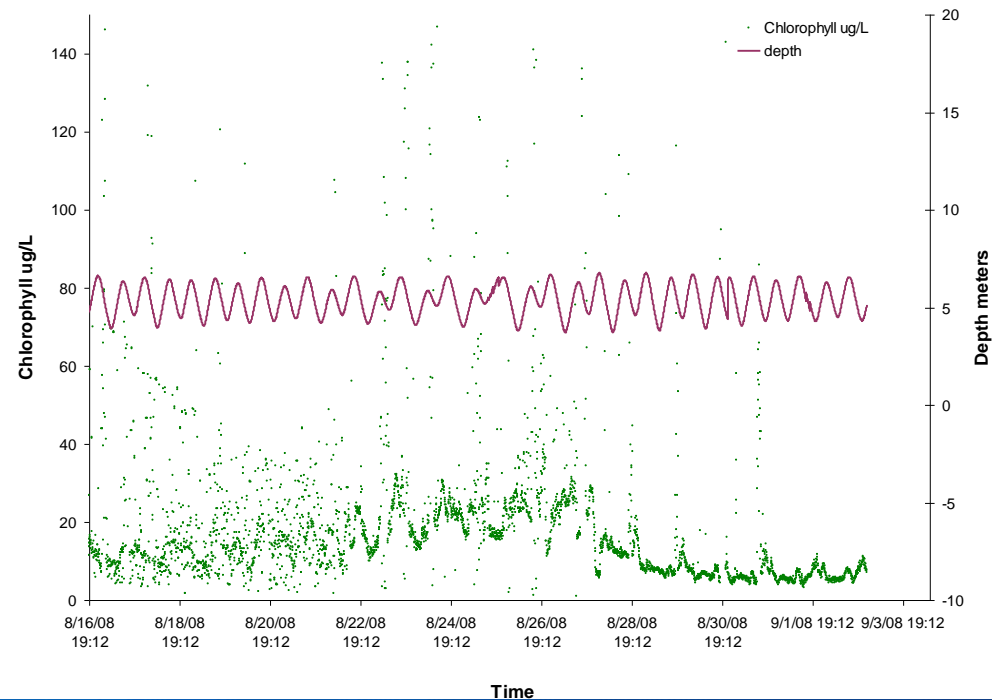


Data taken with C3 Submersible Fluorometer suspended from the side of a pier

Data taken at 5 minute intervals

Data from CICORE archived data sets

Data taken at 6 minute intervals



C3 Submersible Fluorometer

**Wiper enables continued use even under
severe biofouling conditions**

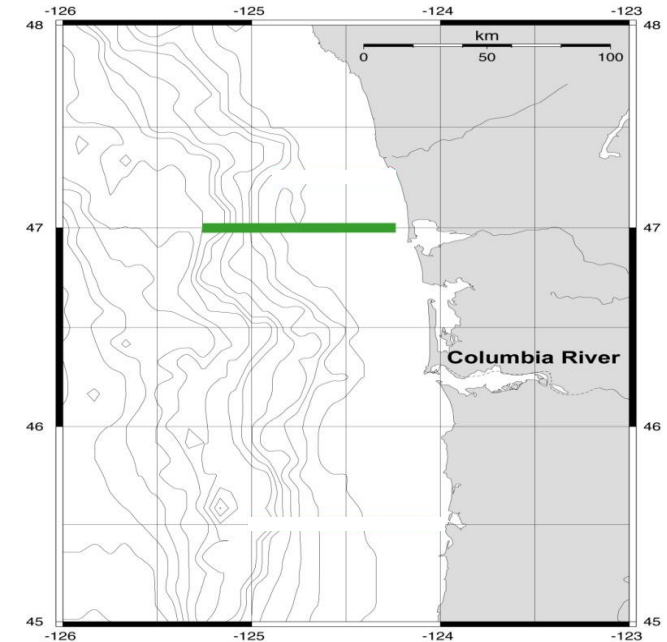
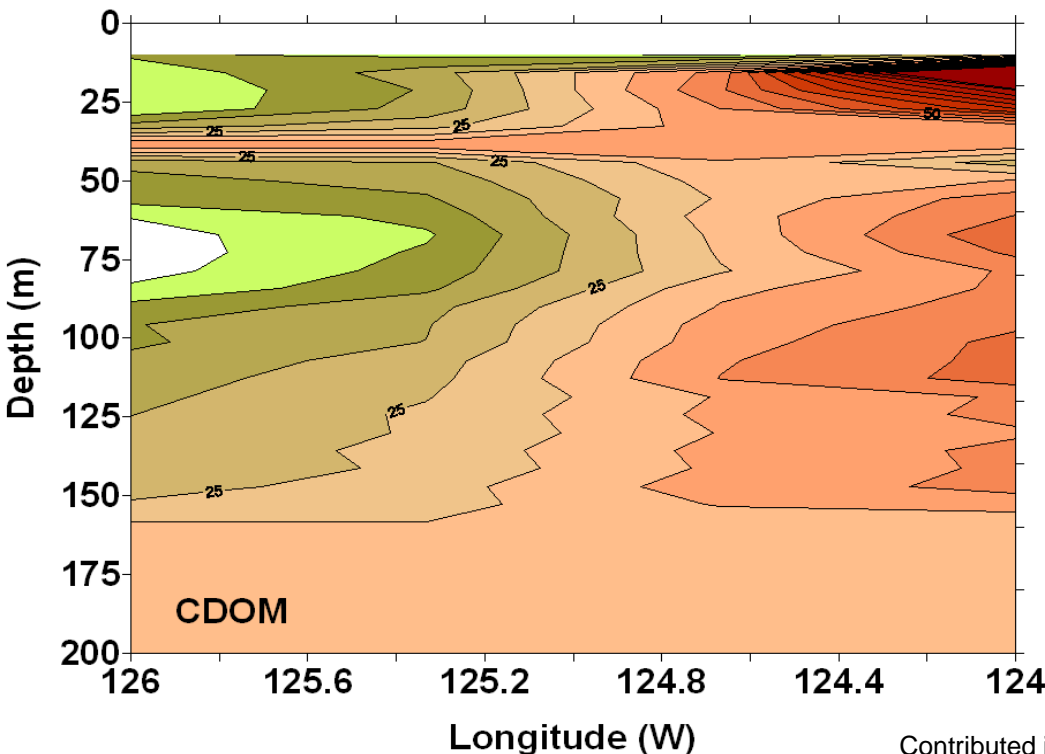


C3 Submersible Fluorometer

Data collected from 1 sampling line off the coast of WA on June 5, 2008

No upwelling at time of sampling

Vertical and horizontal profiles show affects from high river input



Upper right hand corner indicates high CDOM input from the river flow

Depth profile shows CDOM concentrations are higher nearshore and lower offshore as might be expected for this type of system

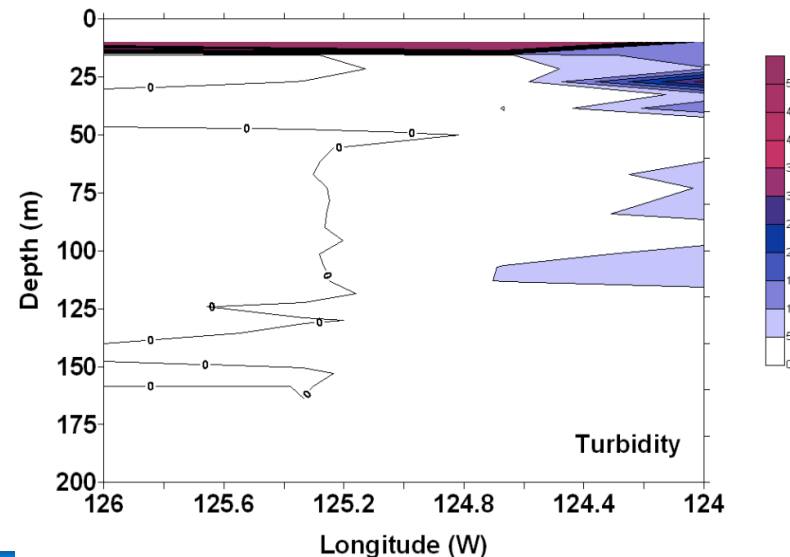
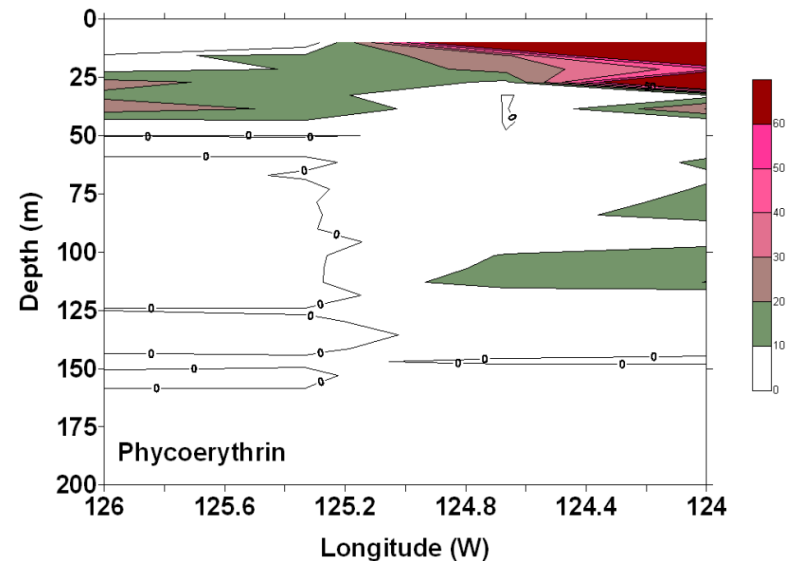
C3 Submersible Fluorometer

Phycoerythrin (PE) showing a near surface PE layer that is clearly distinguished from the turbidity layer detected at 10-12 meters depth

PE is an accessory pigment typically found in marine cyanobacteria and nanoflagellates such as Cryptomonads

It isn't uncommon to find these organisms in systems that contain higher CDOM concentrations

C3 detection of these separate layers may indicate formation of a niche community in this system



Lake Lacawac (NE Pennsylvania)

Depth: 13m max; Summer stratification: Mix layer 2-3m

[Chl-a]: 5ug/L (mixed layer)

[DOC]: 5 mg/L

Dissolved O₂: anoxia develops from bottom reaching 9m by June

Water source: precipitation & runoff from small watershed (50% of border is sphagnum bog; watershed protected from development)



C3 Submersible Fluorometer

Vertical profile data taken June 28th, 2008

Data binned at 0.25 meters

C3 configured with Chl, CDOM, Turbidity

C6 configured with Chl, PC, PE

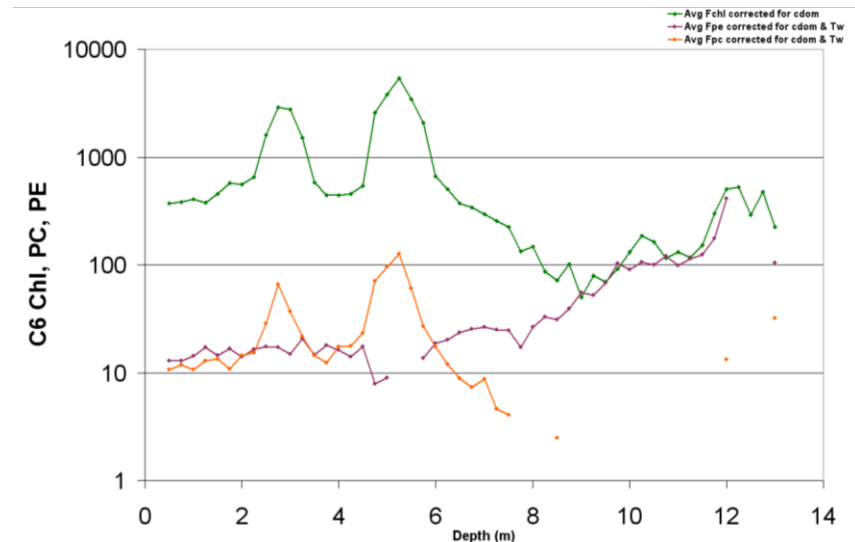
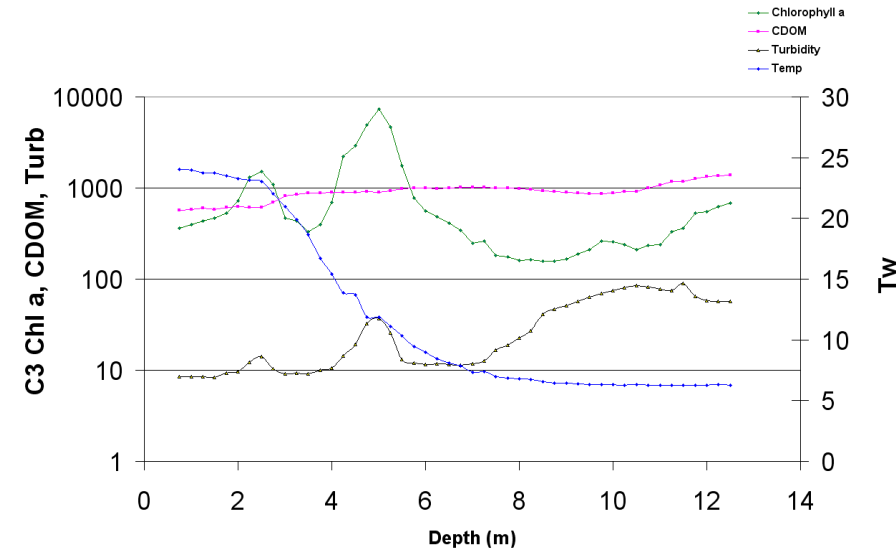
C3 data indicate uniform CDOM distribution through the water column to depth (13 meters)

C3 data show reduction of Chl *a* with increase in Turbidity which could mean an abundance of smaller cells

C6 data show a mix of eukaryotic algae and cyanobacteria (PC containing) within the mixed layer near surface water

At the 9meter anoxic layer both instruments detect a chlorophyll minimum

C3 and C6 can be used to easily survey water columns for determining phytoplankton abundances, distribution, changes in community, or other phenomena

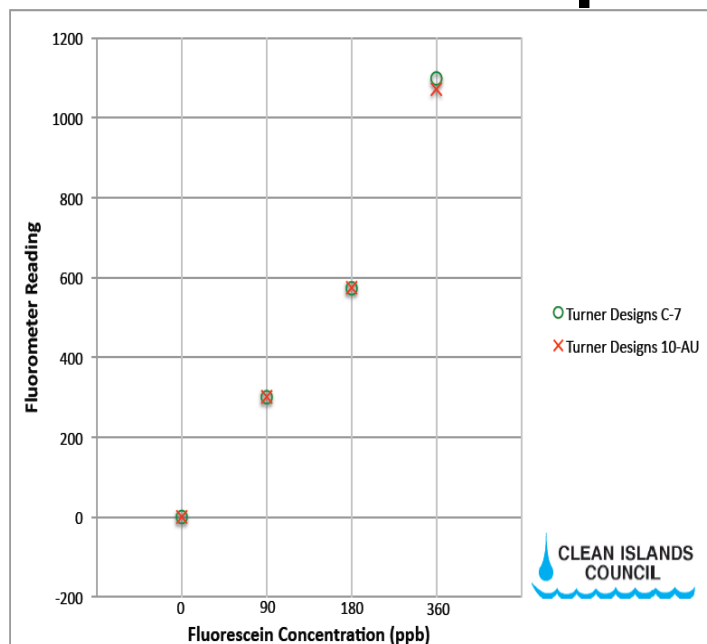


Oil Spill Response

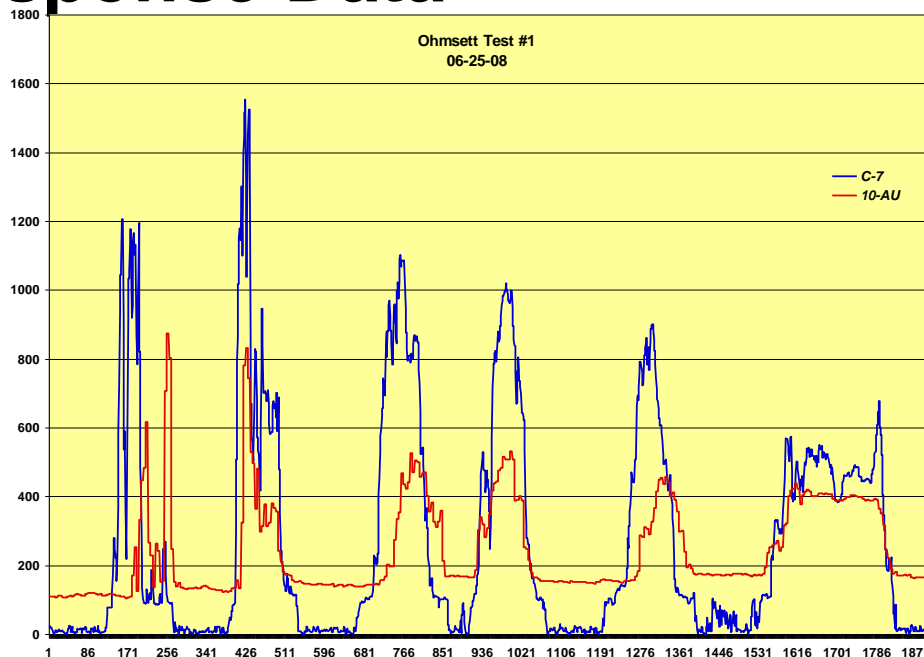


- Special Monitoring of Applied Response Technologies (SMART) is a cooperatively designed monitoring program.
- SMART protocol uses small, efficient teams of trained personnel with rugged and easy to use field instruments.
- Hydrocarbon concentrations are monitored using fluorescence for reaction to the addition of dispersants and the use of burning techniques.
- The C3 is under evaluation for integration into this system

Oil Spill Response Data



Lab results



Field results

- Initial testing was done using the Cyclops-7 Fluorometer
- Data from the C-7 was compared with data from the Strike Team's 10-AU
- Correlation was made between the instruments' measurements illustrating the potential for in-situ fluorometry within the SMART protocol

More Information

Turner Designs' website has a wealth of information:
www.turnerdesigns.com

The screenshot shows the Turner Designs website homepage. At the top is the Turner Designs logo with the tagline "Reliable Instruments for an Unreliable World". Below the logo is a navigation bar with buttons for "Support", "Applications", "Products", and "Contact Us". A secondary navigation bar includes links for "Case Studies", "Knowledge Database", "How to Buy", "Instrument Donation", and "Newsletter". A green banner below this reads "OPTICAL INSTRUMENTS TO MEASURE THE PROPERTIES OF WATER FOR ENVIRONMENTAL AND INDUSTRIAL APPLICATIONS". The main content area is divided into two columns. The left column, titled "Environmental", features a circular image of a lake and text describing their complete line of fluorometers for environmental use, with a "Learn More >>" link. The right column, titled "Industrial & OEM", features a circular image of an industrial tank and text describing their fluorescence sensors for industrial and OEM use, also with a "Learn More >>" link. Below the "Environmental" section is a "What's New" section with a link to "View Our Full Blog" and text about the "Optical Brighteners Module" now available for the "Trilogy Laboratory Fluorometer". It describes how Optical Brighteners (OBAs) or Fluorescent Whitening Agents (FWAs) are added to laundry soaps and detergents, and how laundry wastewater is a major contributor of brighteners to wastewater systems, with a "Learn More>>" link. To the right of the "What's New" section are four buttons: "Products", "Applications", "Support", and "About Us", each with a small icon and a right-pointing arrow. At the bottom is a footer bar with links for "Why Buy From Us", "Search", "About Us", "Job Opportunities", "Contact Us", and "Tradeshows We Are Attending". Below the footer bar is contact information: "Toll Free: 877.316.8049 | Phone: 408.749.0994 | Fax: 408.749.0998 | ©2008 Turner Designs, Inc. GSA Contract # GS 24F 1107B".

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We offer the most complete line of fluorometers for environmental applications in the world. Turner Designs provides a knowledgeable support staff to meet your fluorescence, absorbance and turbidity requirements. [Learn More >>](#)

Industrial & OEM
Our fluorometer product line includes fluorescence sensors specifically designed for Industrial and OEM use, comprising handheld units, on-line monitoring units, submersible sensors and others. [Learn More >>](#)

What's New
[View Our Full Blog](#)
Optical Brighteners Module now available for Trilogy Laboratory Fluorometer
Optical Brighteners (OBAs) or Fluorescent Whitening Agents (FWAs) are added to products such as laundry soaps, detergents, and cleaning agents. Laundry wastewater is the largest contributor of brighteners to wastewater systems. [Learn More>>](#)

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