TURNER DESIGNS
Reliable Instruments for an Unreliable World

C3 Submersible Fluorometer

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C3 Submersible Fluorometer

Outline

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

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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

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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)

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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

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Product Portfolio

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C3 Submersible Fluorometer

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

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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

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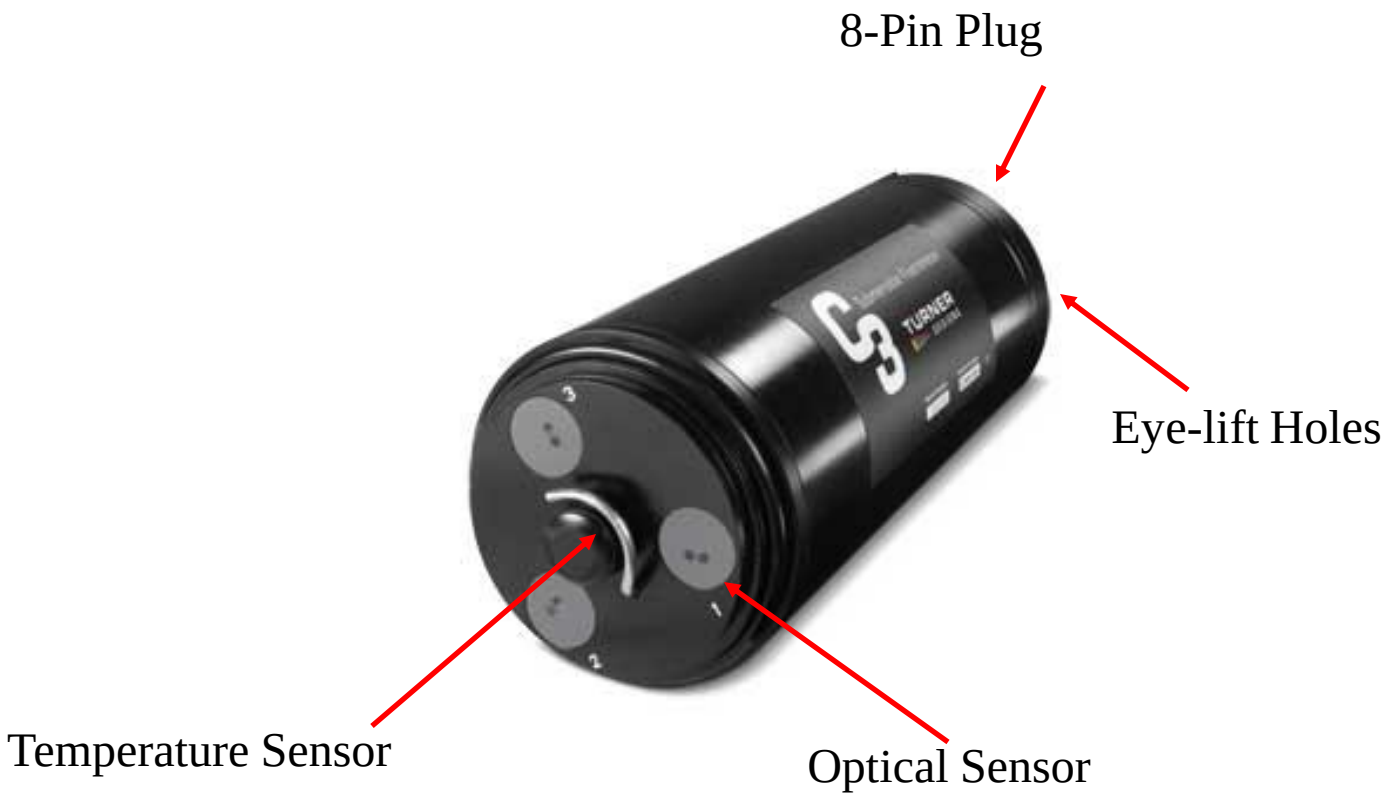
Features and Benefits

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 3rd 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 ****Depth is an optional factory-installed accessory***
Secondary Solid Standard	Enables easy verification of calibration and instrument stability
Extender cables	Enable real-time data downloading at depth

C3 Submersible Fluorometer

Hardware Configuration



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C3 Submersible Fluorometer

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

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Factory-Installed Options

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Available Accessories

Submersible Battery Pack
Includes recharger

Battery Bracket

Shade Cap
Weighted Cap Available

Solid Standard Insert

Flow Cap

Adjustable Secondary Solid Standard

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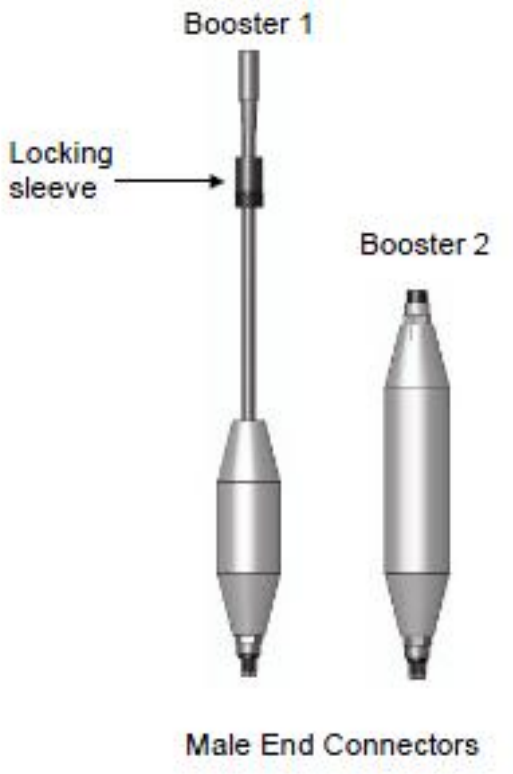
Cables and Boosters for Real-Time Data Collection



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

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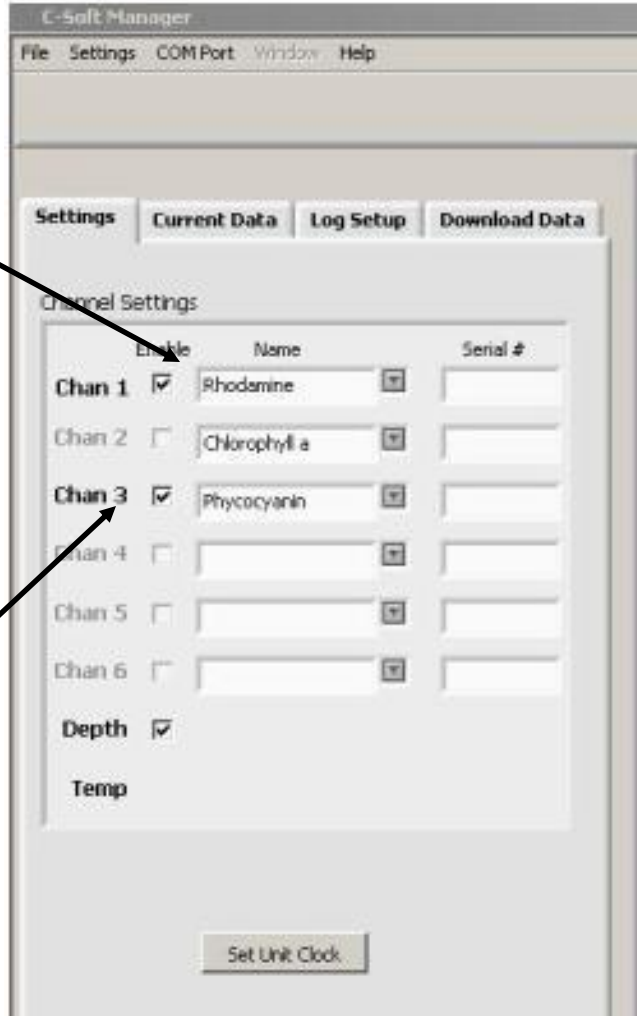
C-Soft Software

Dropdown Applications

Enable or Disable Sensors



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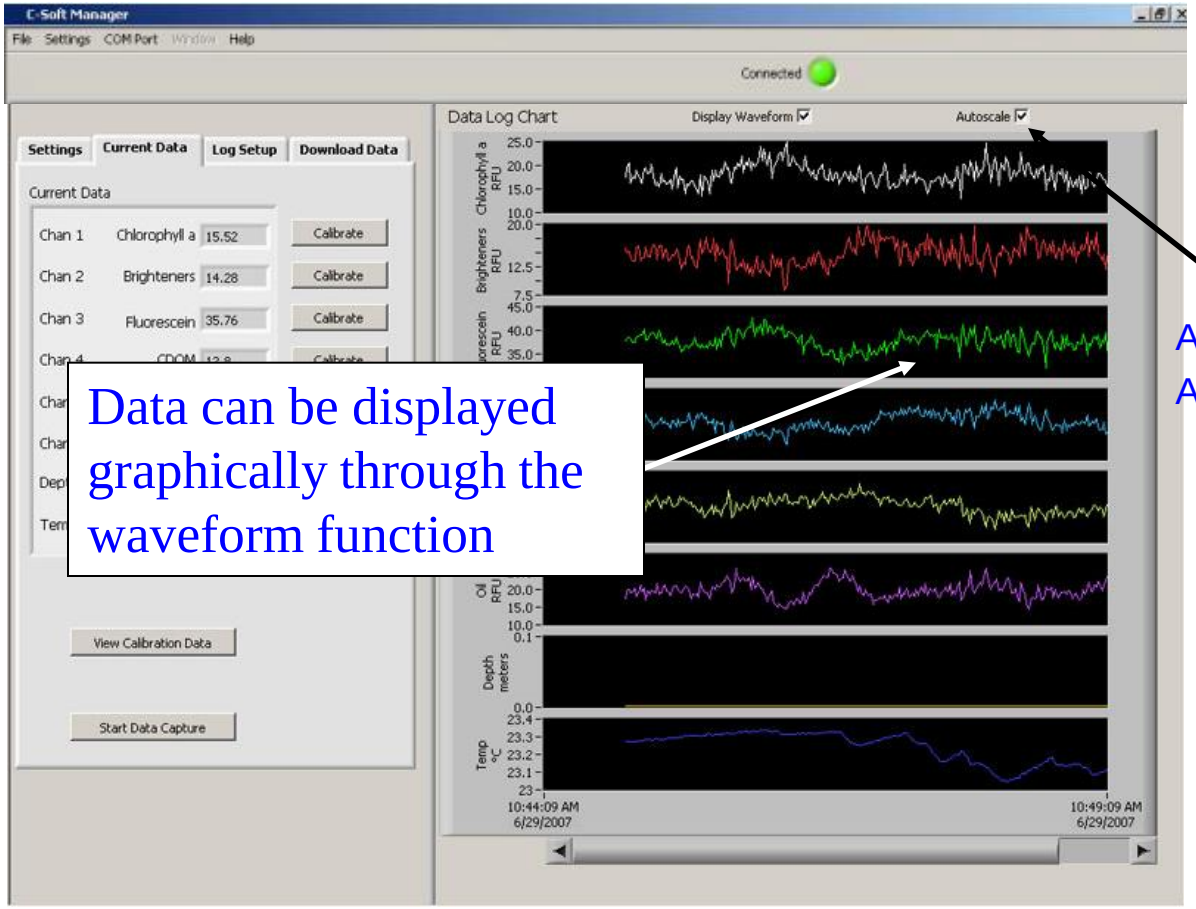
C-Soft Software



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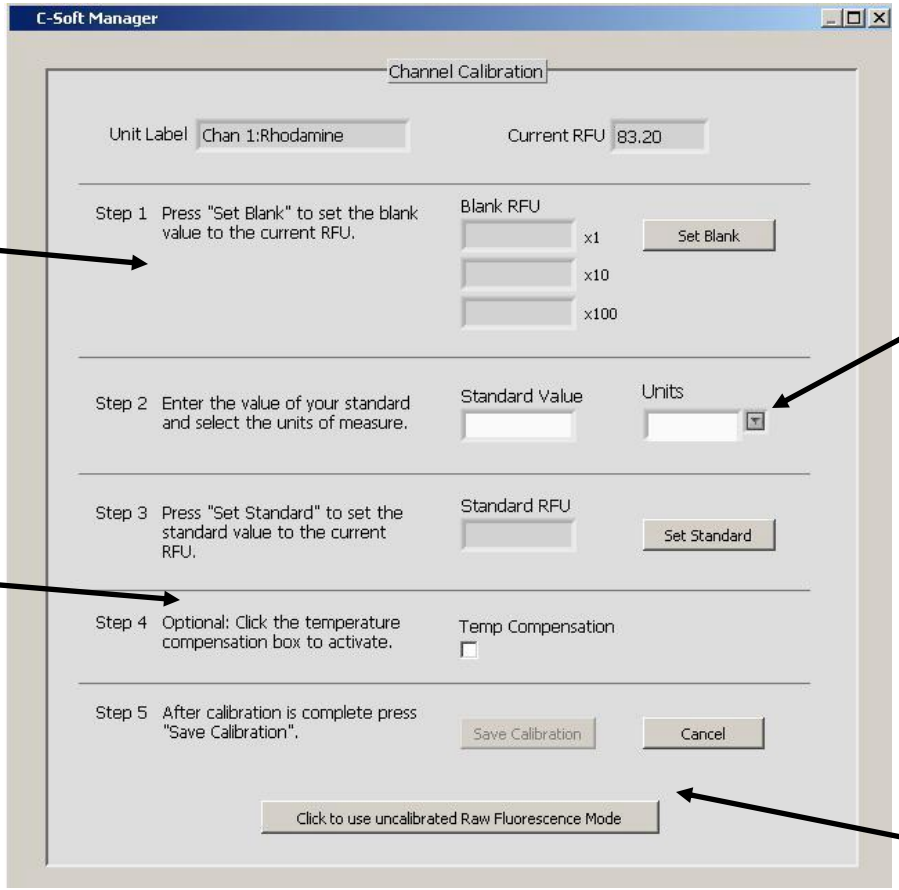
C-Soft Software

Step by Step Calibration Procedure



Select Units from Dropdown or Manually Enter

Temperature Compensation

Operate in Raw Fluorescence Units Mode

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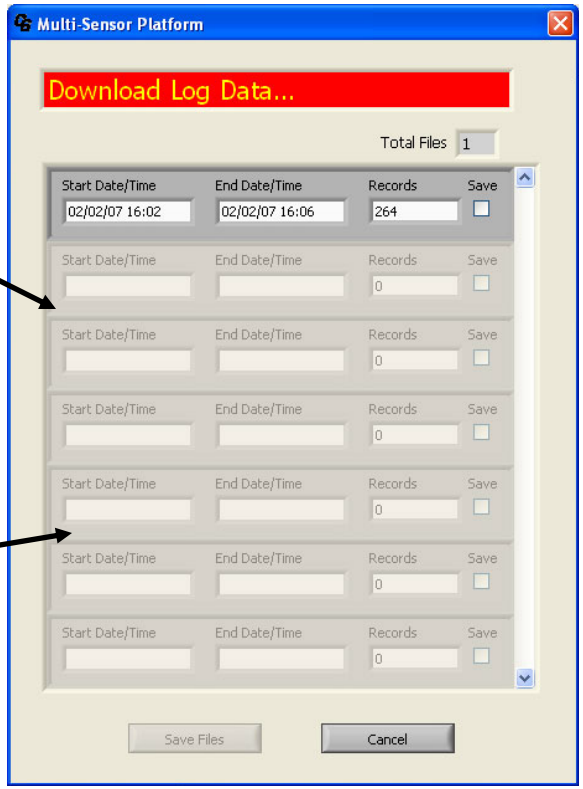
C-Soft Software

Multiple Files can be Saved in the C3

Files are Time-Stamped



Save Files to Any Location on Computer in csv. format

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Applications

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Application Specifications

	Minimum Detection Limit	Dynamic Range
Chl *a in vivo*	0.025 ug/L	0-300 ug/L
Phycoerythrin Marine Cyanobacteria	150 cells/ml	0-150,000 cells/ml
Phycocyanin Freshwater Cyanobacteria	150 cells/ml	0-150,000 cells/ml
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

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Performance Data

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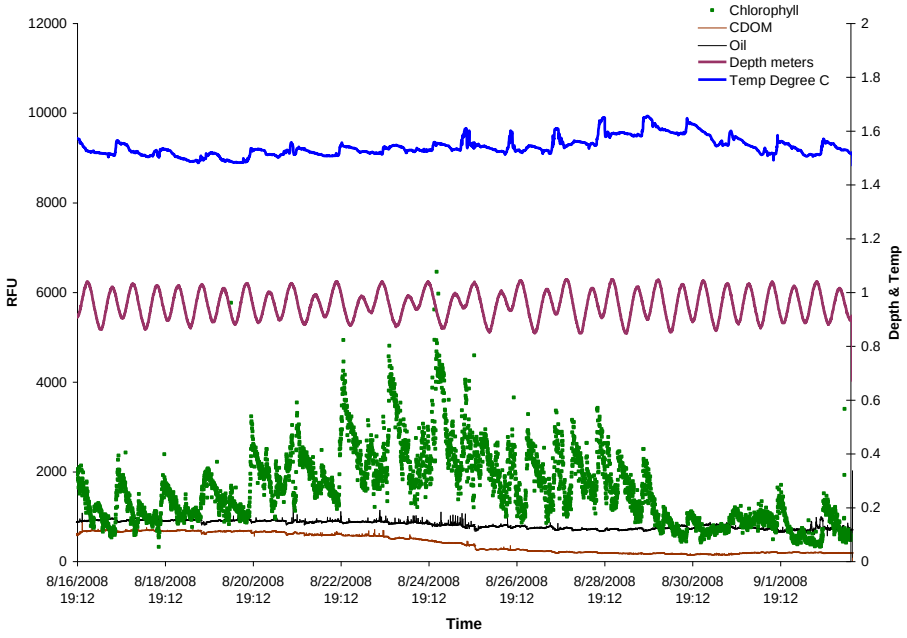


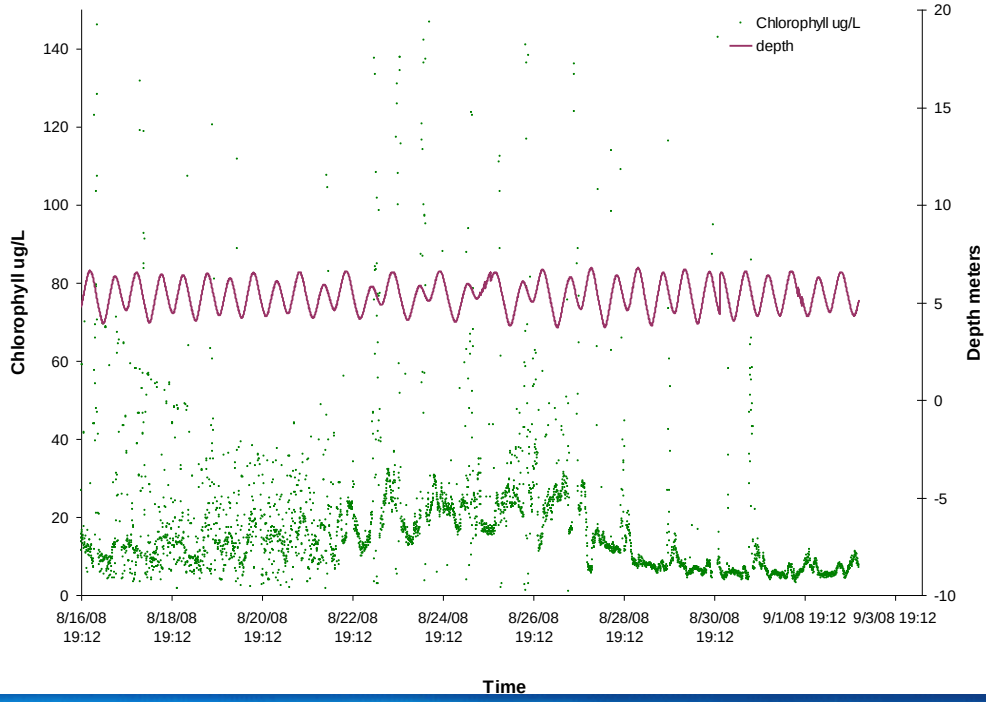
Data taken with C3 Submersible Fluorometer suspended from the side of a pier

Data taken at 5 minute intervals

San Francisco Bay

Data from CICORE archived data sets

Data taken at 6 minute intervals



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Wiper enables continued use even under severe biofouling conditions

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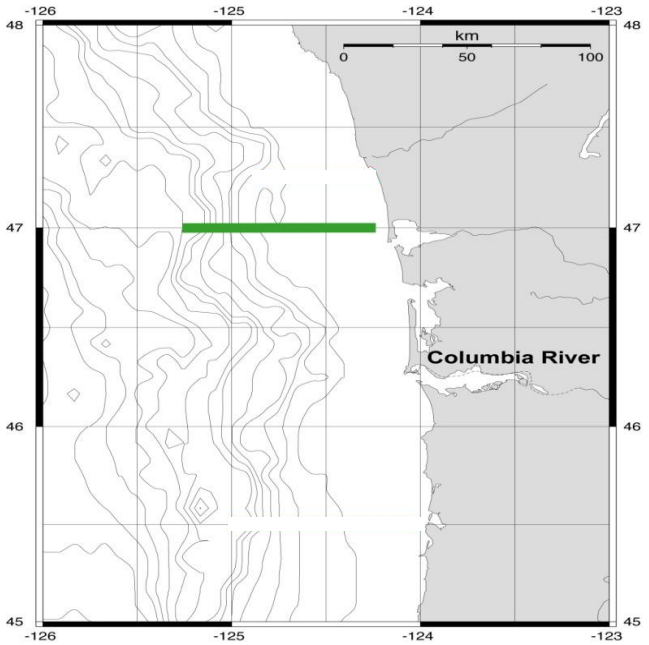
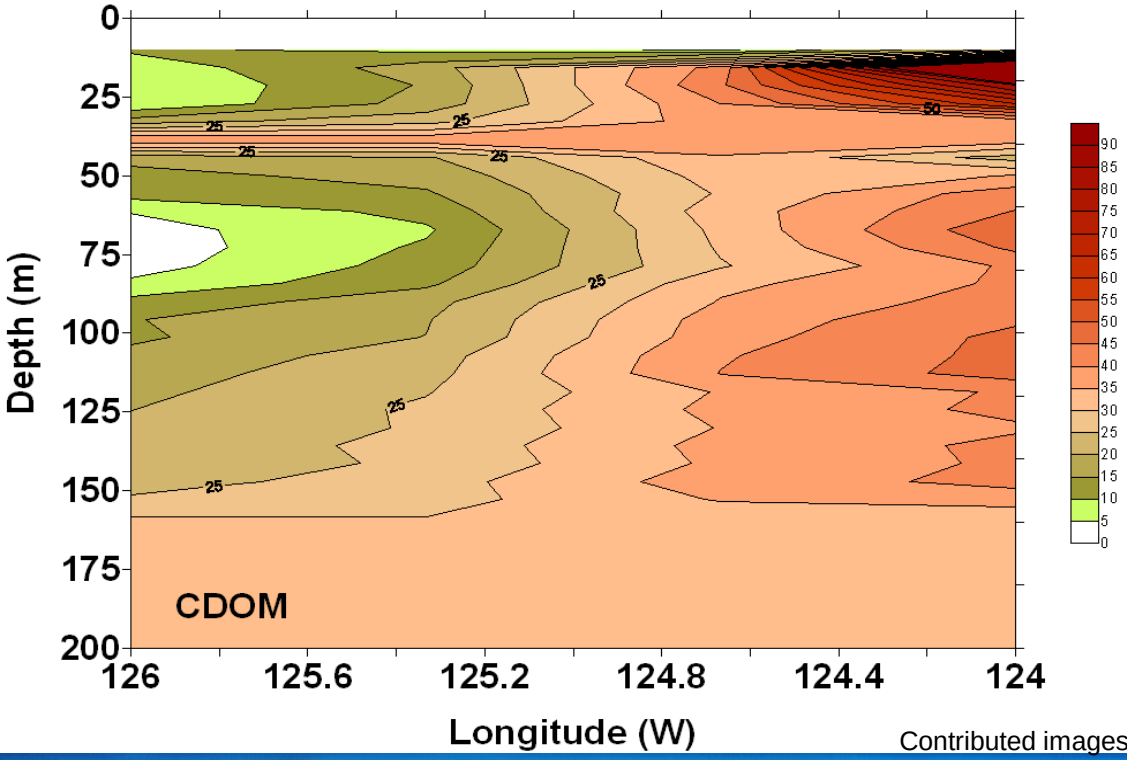
Data collected from 1 sampling line off the coast of WA on June 5, 2008

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

Contributed images and data were provided by Oregon Health Science University

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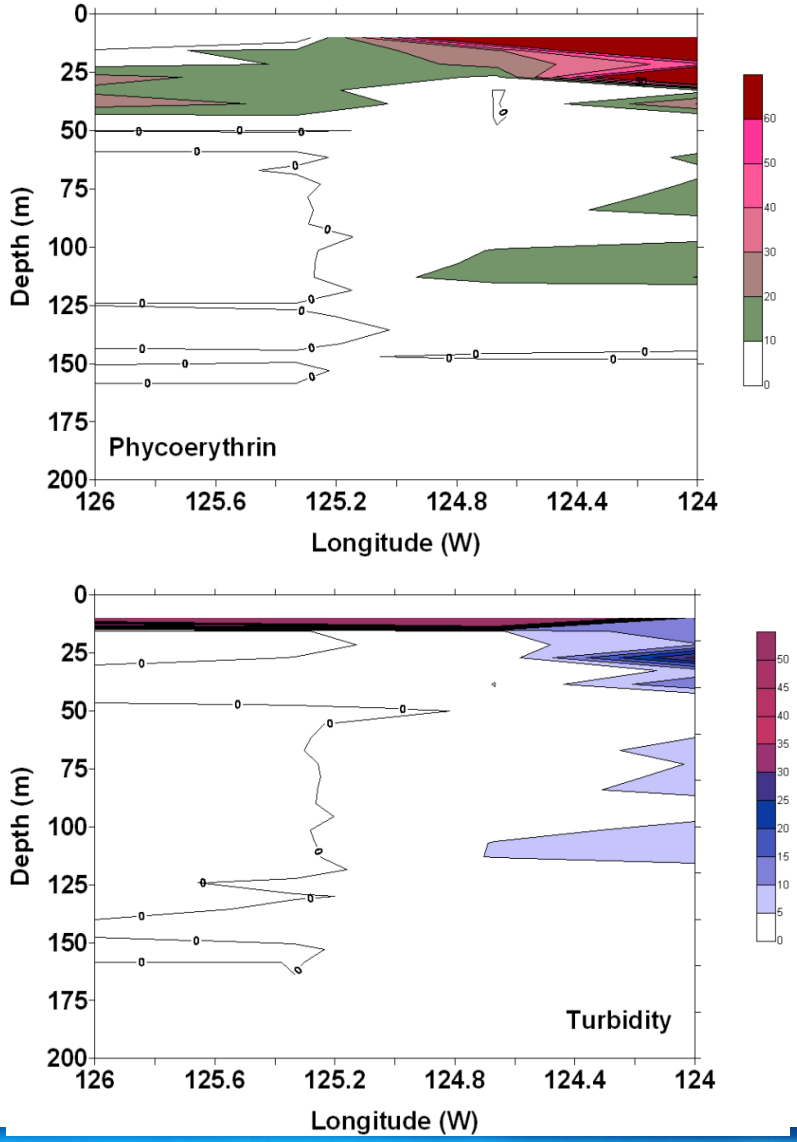
Phycoerythrin (PE) showing a near surface PE layer that is clearly distinguished from the turbidity layer detected at 10-12 meters depth

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



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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)

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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

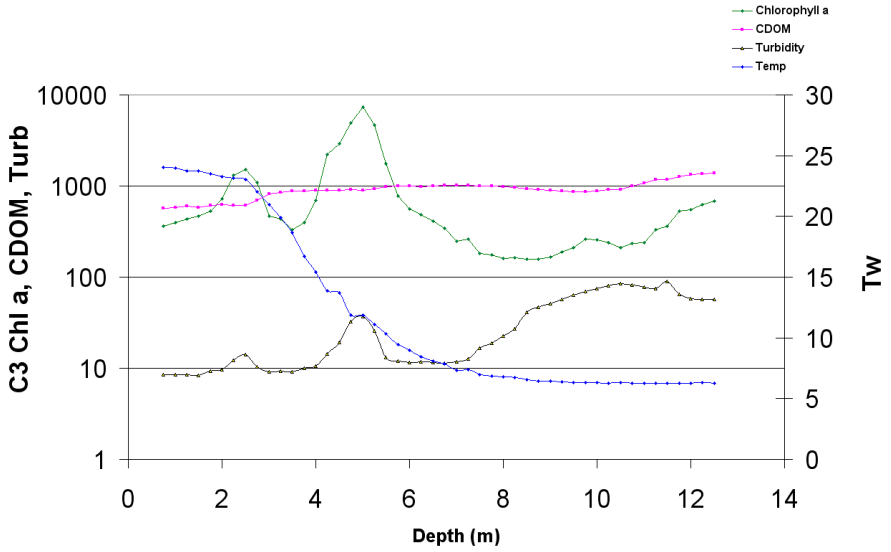
C3 data indicate uniform CDOM distribution through the water column to depth (13 meters)

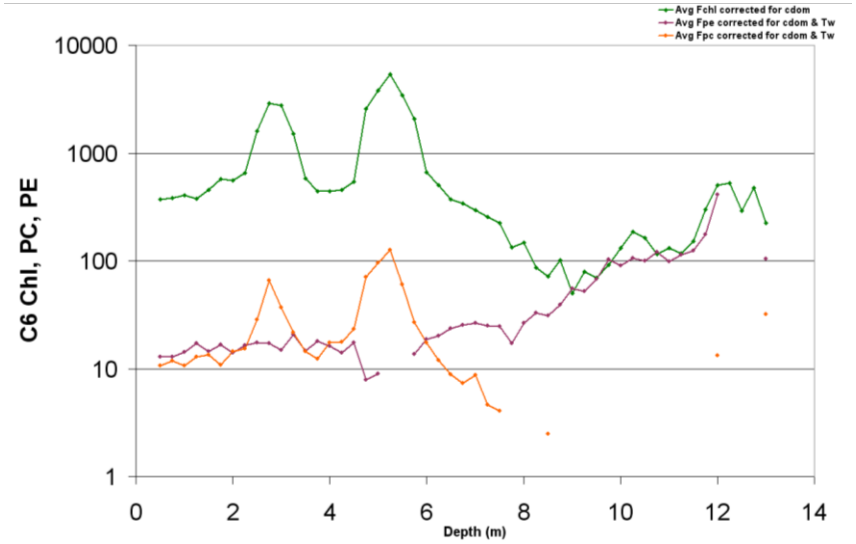
C3 data show reduction of Chl *a* with increase in Turbidity which could mean an abundance of smaller cells

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





Profile data collected from a boat in the self-contained mode.
Dr. Bruce Hargreaves, Lehigh University

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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

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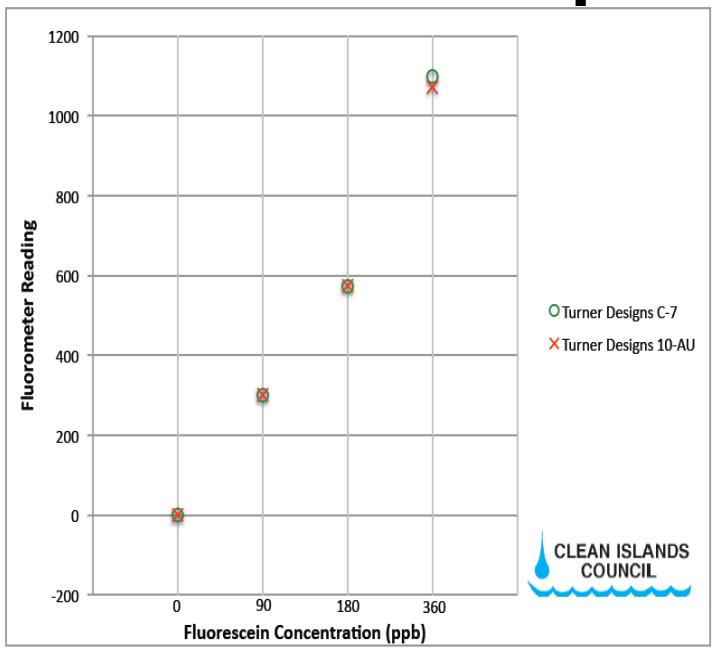
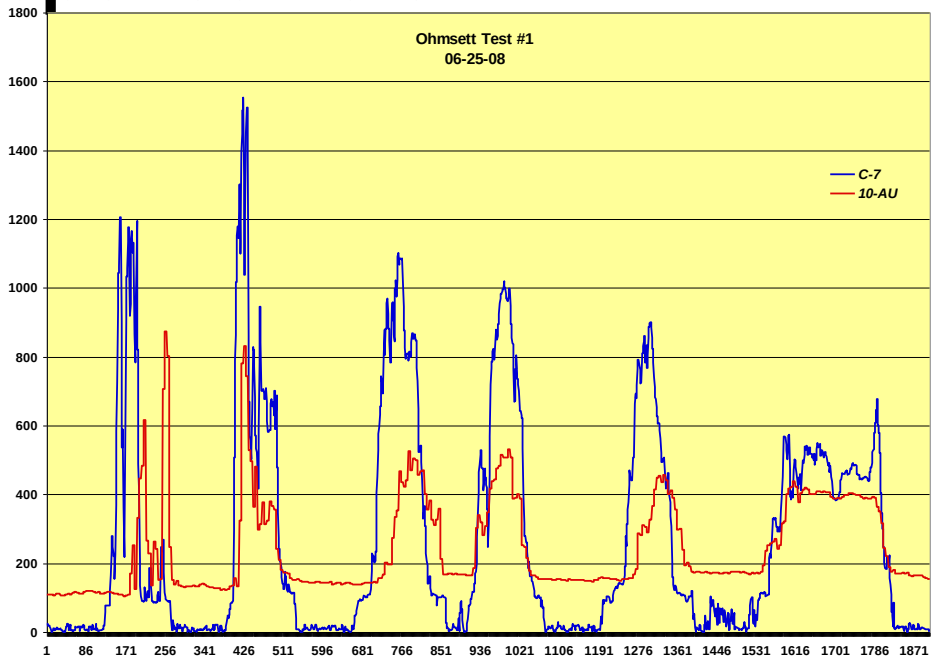
Oil Spill Response Data



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

Information on SMART can be obtained at http://response.restoration.noaa.gov.

Contributed Images and data were provided by the Clean Island Council http://www.cleanislands.com

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More Information

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