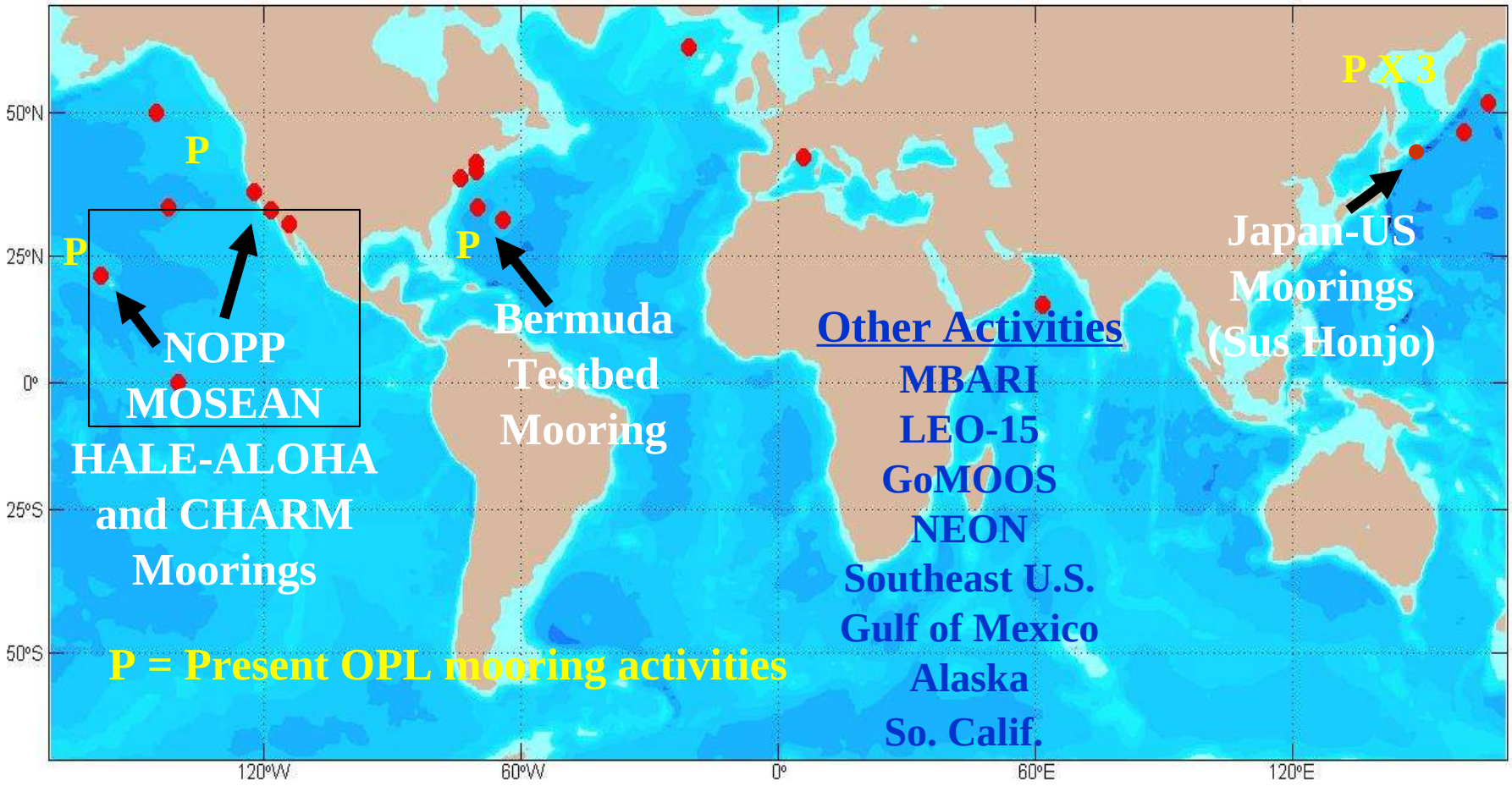
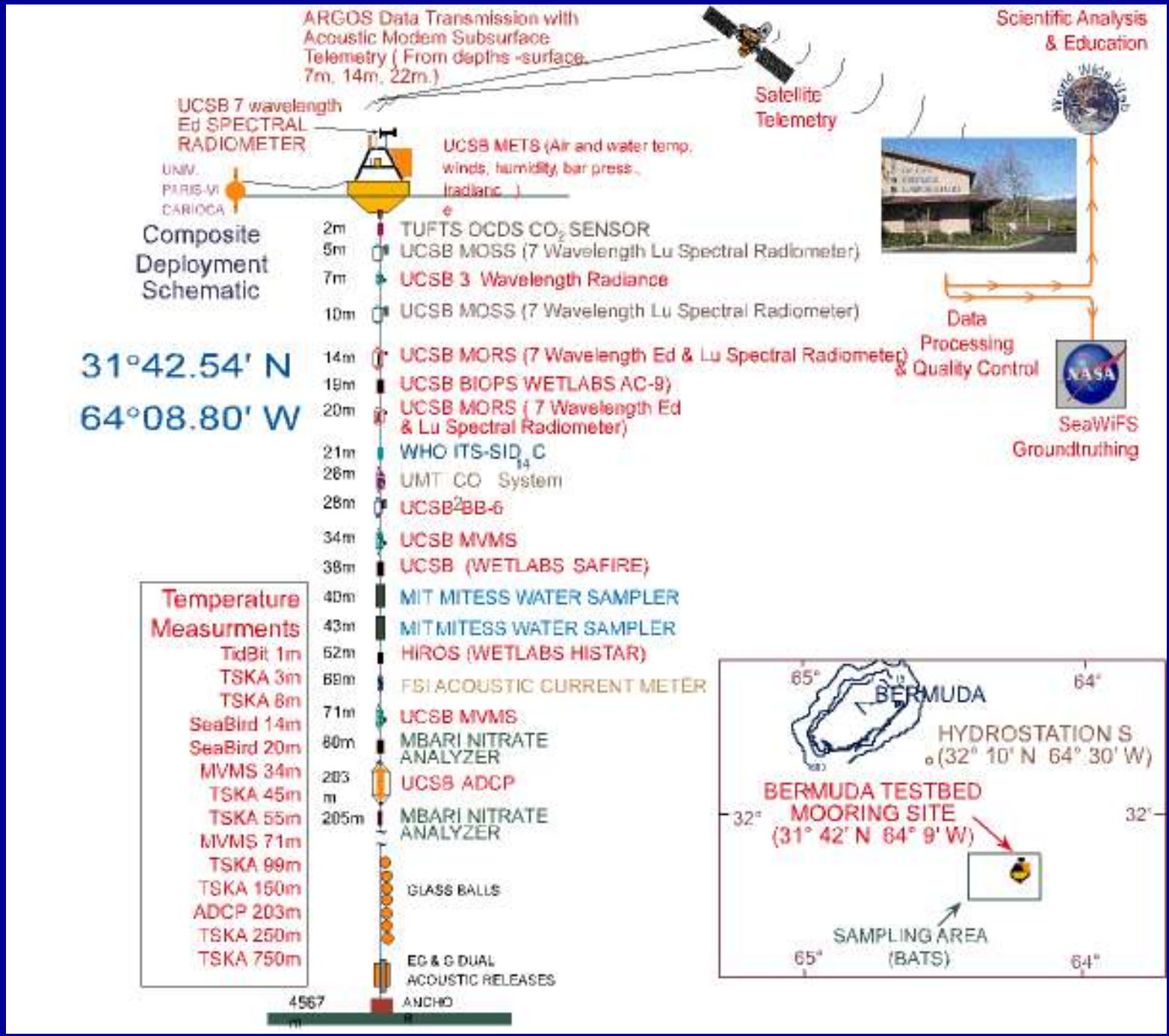
# UCSB Ocean Physics Laboratory
# Interdisciplinary Mooring/AUV Study Sites •




BTM

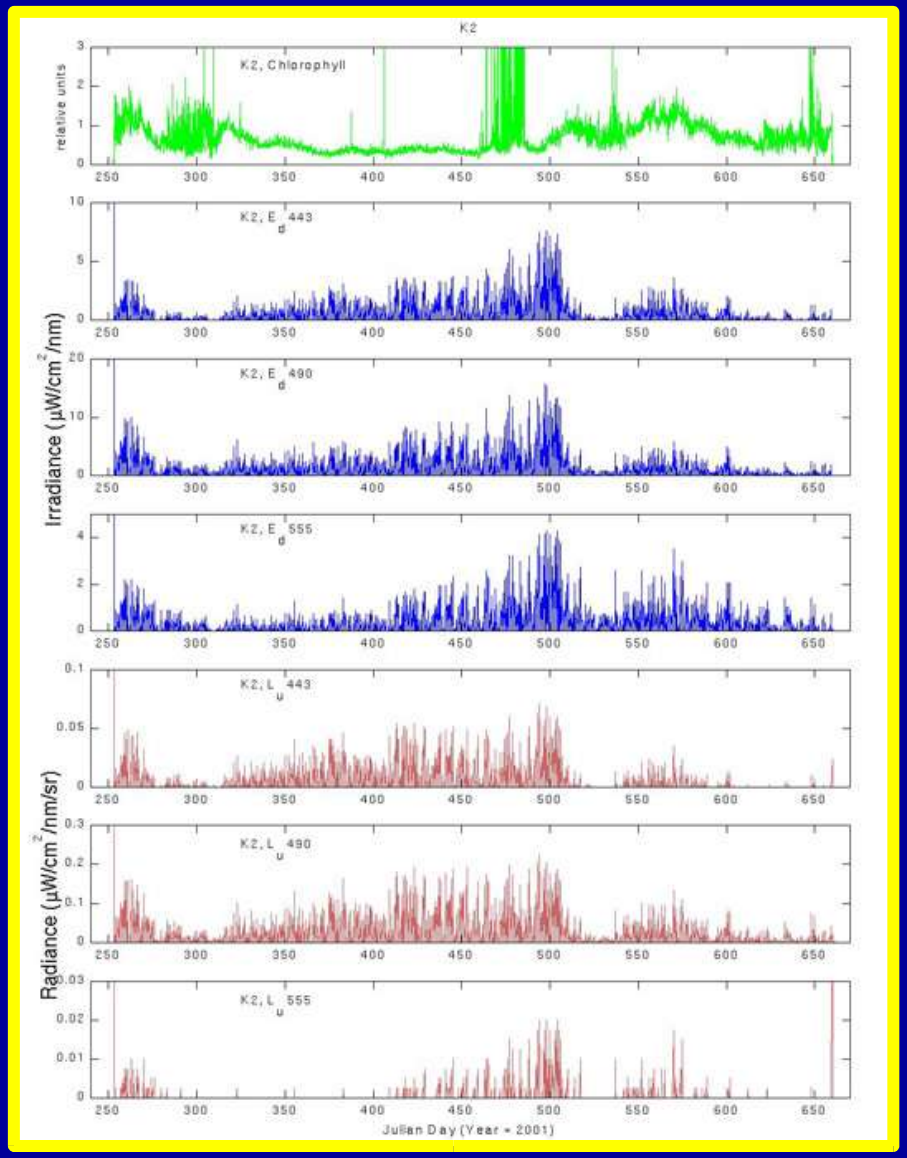

BTM

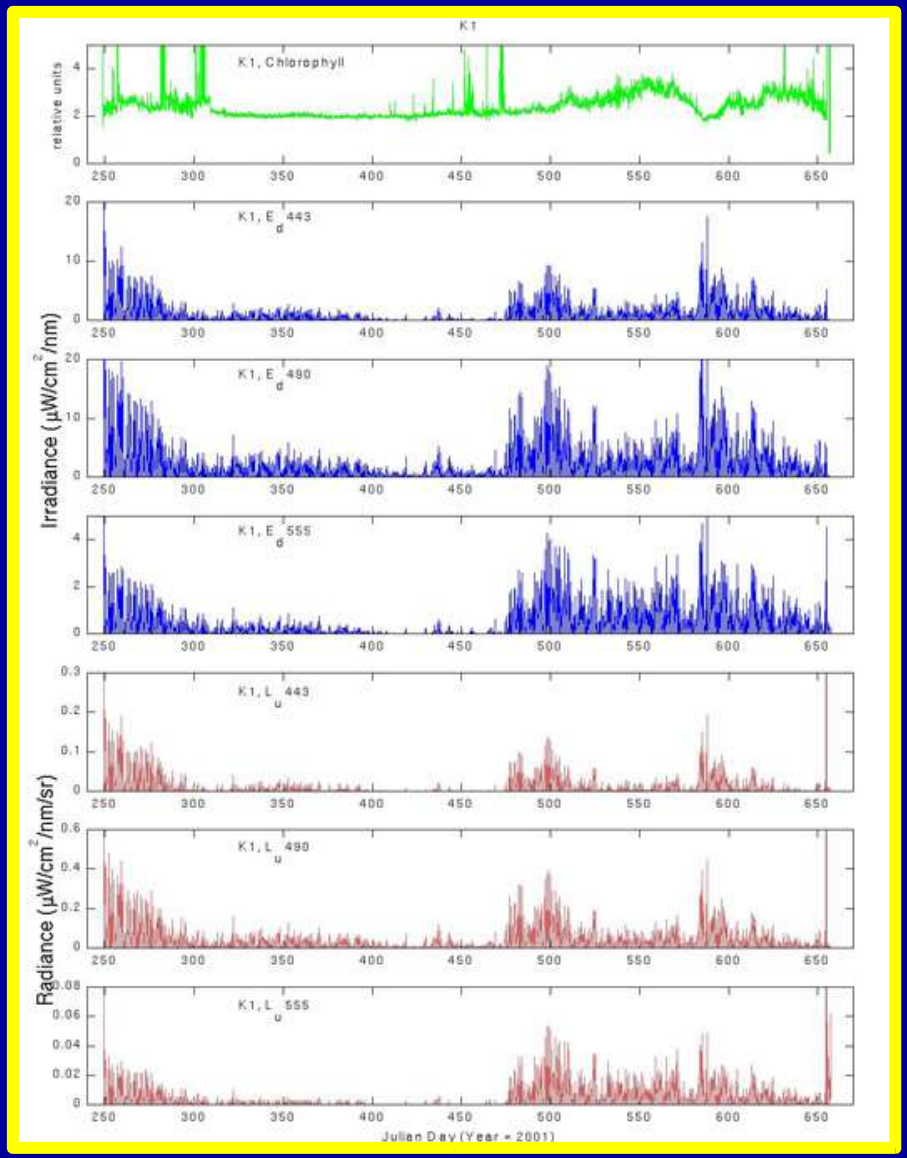

ARGOS Data Transmission with Acoustic Modem Subsurface Telemetry ( From depths -surface, 7m, 14m, 22m.)
Satellite Telemetry
Scientific Analysis & Education
UCSB 7 wavelength Ed SPECTRAL RADIOMETER
UCSB METS (Air and water temp, winds, humidity, bar press., Iradianc )
UNIV. PARIS-VI CARIOCA
Composite Deployment Schematic
31°42.54' N
64°08.80' W
2m TUFTS OCDS $CO_2$ SENSOR
5m UCSB MOSS (7 Wavelength Lu Spectral Radiometer)
7m UCSB 3 Wavelength Radiance
10m UCSB MOSS (7 Wavelength Lu Spectral Radiometer)
14m UCSB MORS (7 Wavelength Ed & Lu Spectral Radiometer)
19m UCSB BIOPS WETLABS AC-9)
20m UCSB MORS ( 7 Wavelength Ed & Lu Spectral Radiometer)
21m WHO ITS-SID 14 C
26m UMT CO System
28m UCSB $^2$BB-6
34m UCSB MVMS
38m UCSB (WETLABS SAFIRE)
40m MIT MITESS WATER SAMPLER
43m MIT MITESS WATER SAMPLER
52m HIROS (WETLABS HISTAR)
69m FSI ACOUSTIC CURRENT METER
71m UCSB MVMS
80m MBARI NITRATE ANALYZER
203 m UCSB ADCP
205m MBARI NITRATE ANALYZER
GLASS BALLS
EG & G DUAL ACOUSTIC RELEASES
4567 m ANCHO R
Data Processing & Quality Control
SeaWiFS Groundtruthing
Temperature Measurments
TidBit 1m
TSKA 3m
TSKA 6m
SeaBird 14m
SeaBird 20m
MVMS 34m
TSKA 45m
TSKA 55m
MVMS 71m
TSKA 99m
TSKA 150m
ADCP 203m
TSKA 250m
TSKA 750m
65°
64°
BERMUDA
HYDROSTATION S
(32° 10' N 64° 30' W)
BERMUDA TESTBED MOORING SITE
(31° 42' N 64° 9' W)
32°
SAMPLING AREA
(BATS)

# O-SCOPE BLOOMS II System: Chlorophyll fluor., VSF, & Spectral $L_u$ & $E_d$

**Casey Moore (WET Labs) , UCSB OPL, and Satlantic**

# Bio-optical Time Series off Japan

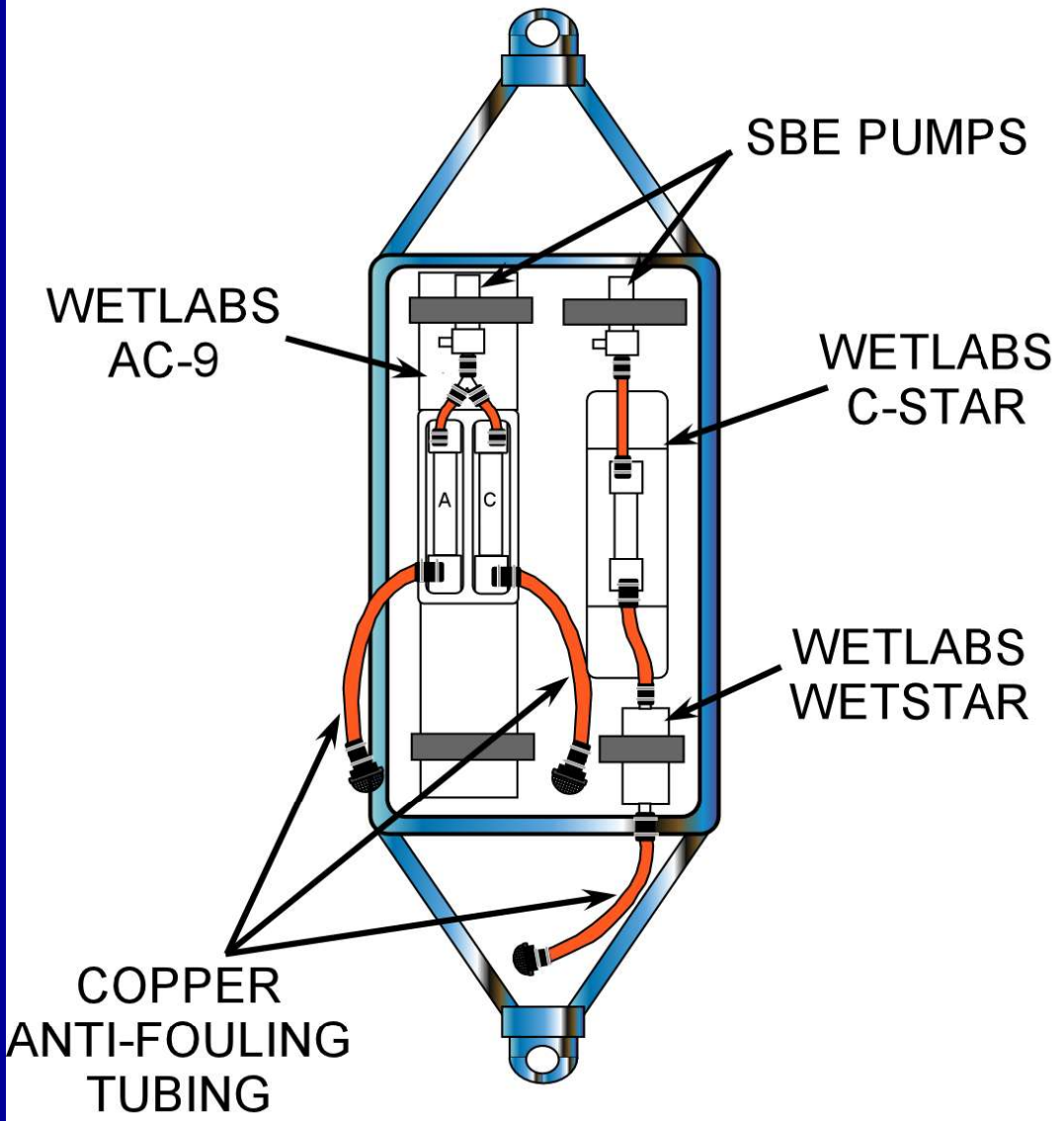



OPL and Japanese Collaborators

# BIOPS system with copper anti-fouling tubing

## BIO-OPTICAL PACKAGE

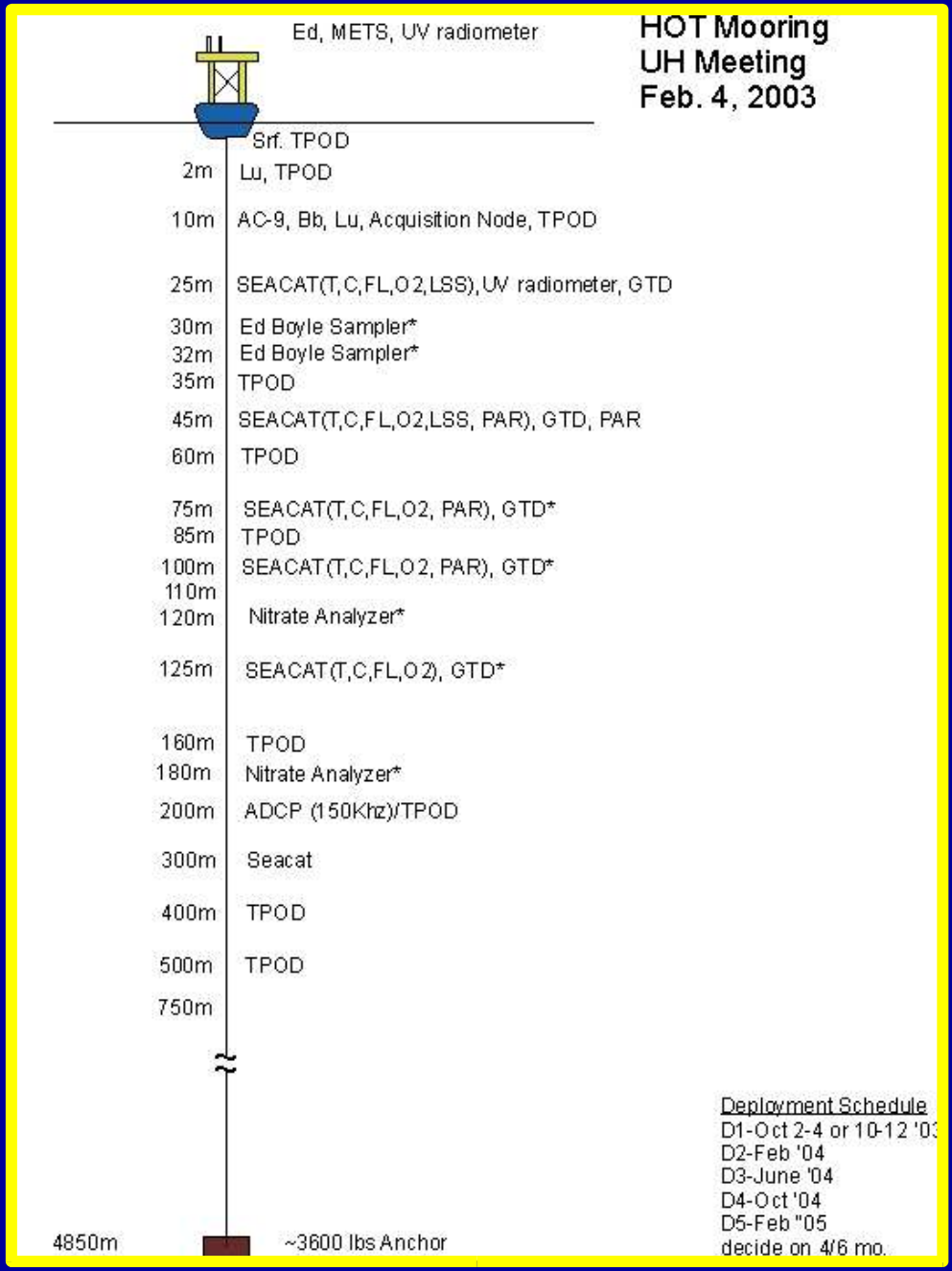



FWS
OPL
5/15/02


# NOPP MOSEAN HALE-ALOHA Mooring

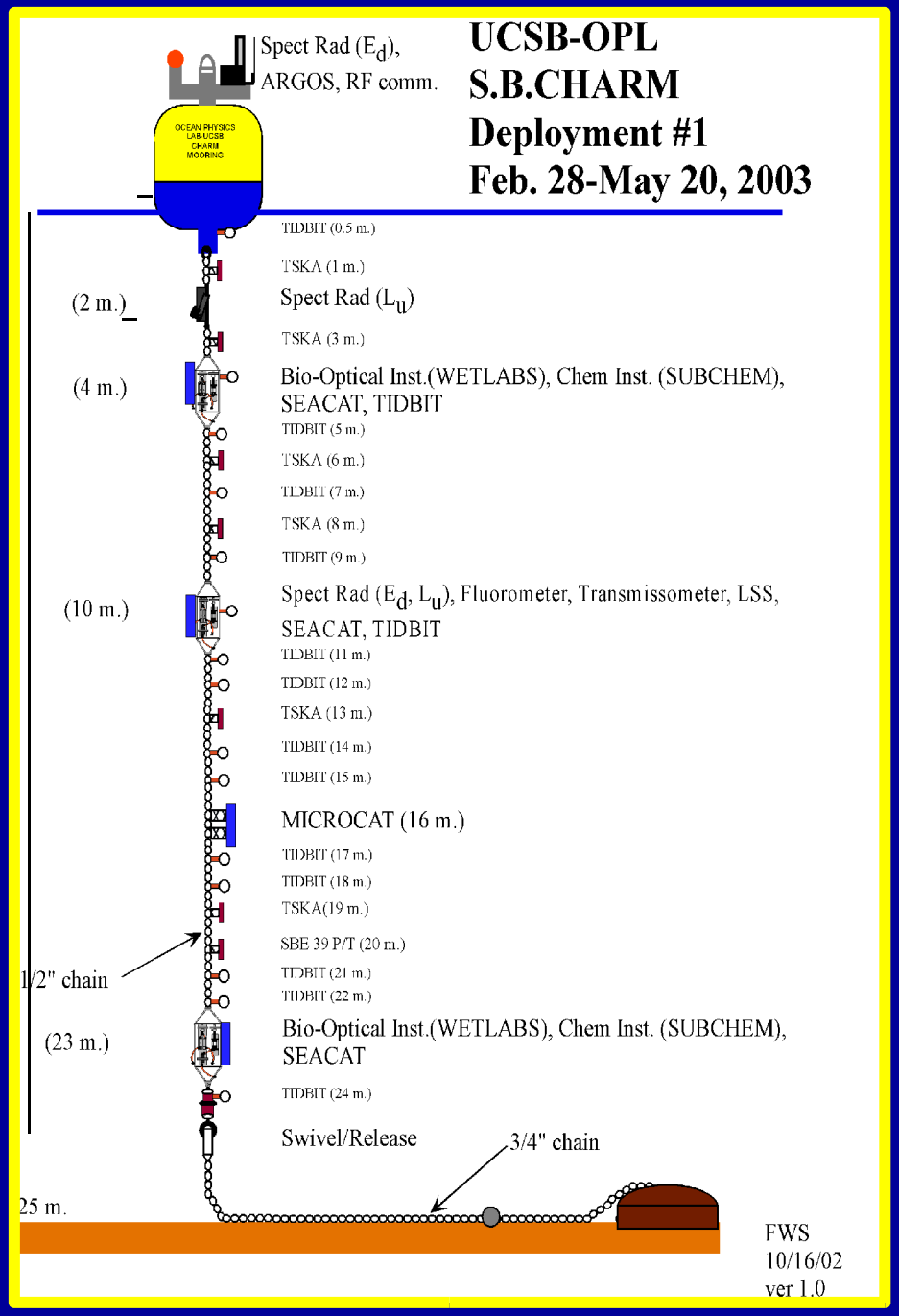
## Begins October 2003

Dickey, Karl, Moore, Hanson

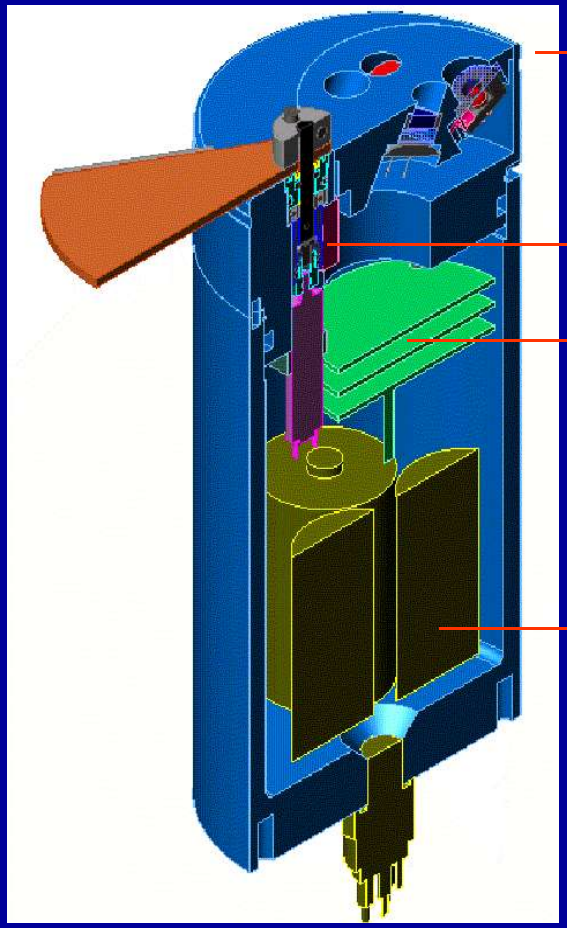


# CHARM ACQUISITION SYSTEM

- RF Telemetry to shore
- On-shore data merge utility
- 2–3 depths – with surface unit connected to near surface instrumentation
- Iridium uplink for H-A?
- Goal - 2 units with telemetry in 2003.



# FL & bb



-Optics

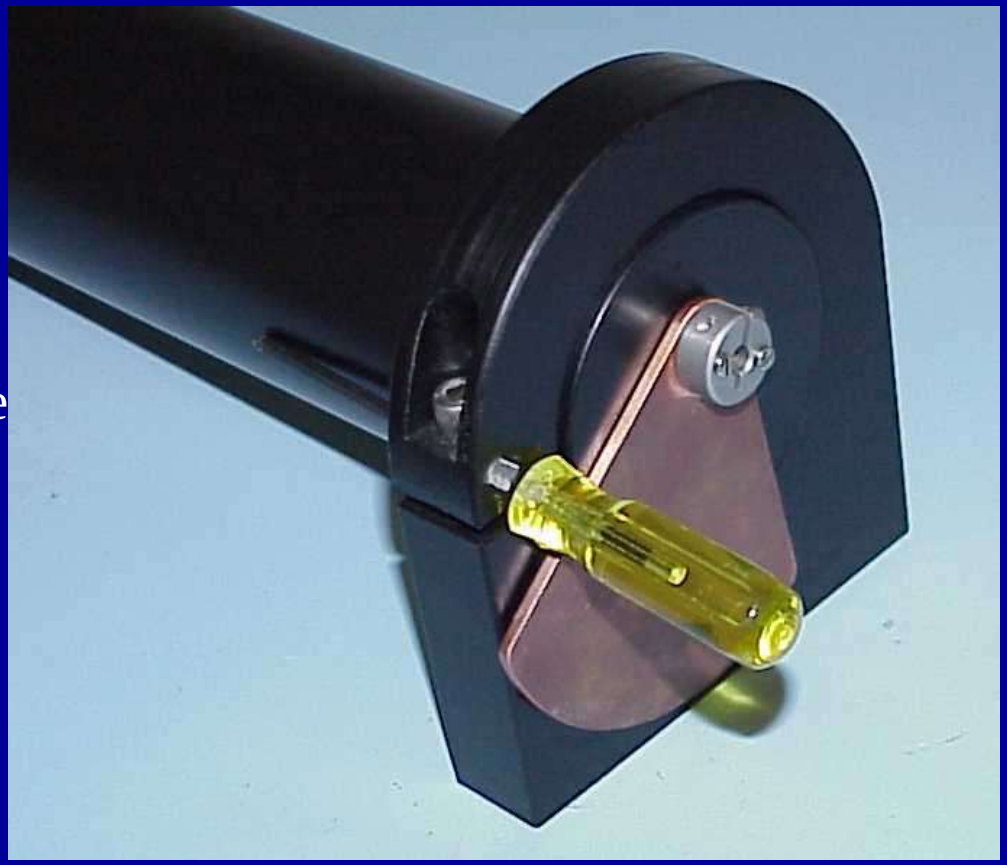
-Shutter assembly

-Electronics

-Batteries

# FL & bb - Status

- New shutter designed and tested;
- Bb3 operational – MOSEAN puck in production;
- FL 3 undergoing 3rd iteration prototyping – spectral interference still a problem;
- Firmware complete;



# Autonomous Nutrient Analyzer for ORCAS IOPC Profiler

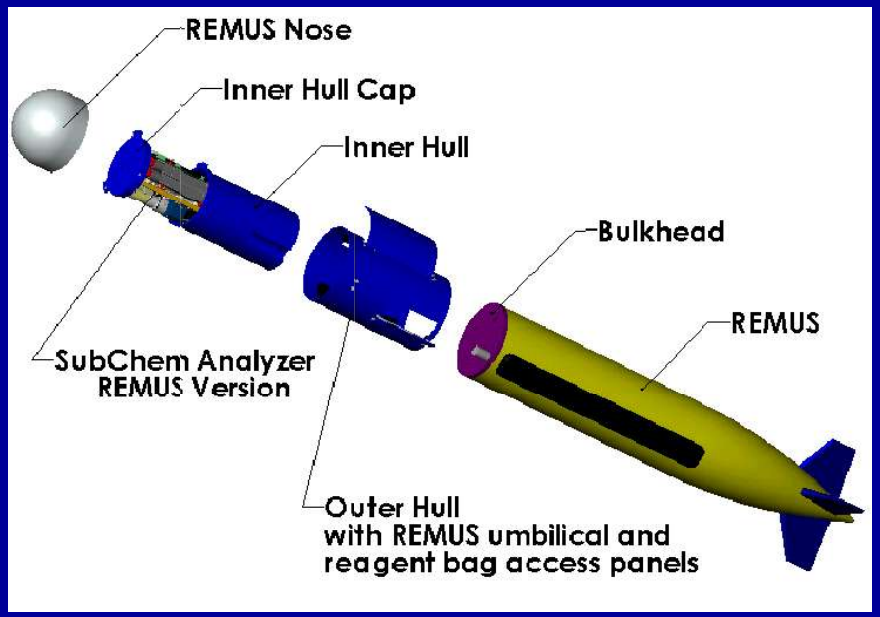
# Short path Spectrophotometer

- Already developed with Subchem
- Nutrient measurements
- Adapting for round boards
- 1-3 channel capability
- Goal delivery of single channel analyzer in 2003
- Ready for delivery to Subchem in April

SubChem Systems, Inc.

Graduate School of Oceanography
UNIVERSITY OF RHODE ISLAND

# REMUS Chemical Analyzer





Status: NUWC Engineering Review May 2002; Field Trials June/July 2002

NAVSEA
NAVAL SEA SYSTEMS COMMAND
Undersea Warfare Center

WET Labs

Woods Hole Oceanographic Institution

# Multi-disciplinary Ocean Systems for Environmental Analysis Systems (MOSEAN)

**PIs: T. Dickey (UCSB), D. Karl (UH), Casey Moore (WETLabs), Al Hanson (SubChem)**

- **Sponsor: National Ocean Partnership Program**
- **Period: 2003-2008**
- **Goals: Develop and test new multi-disciplinary sensors and systems with telemetry: optical, chemical (builds on NOPP O-SCOPE project just completed: Sea Tech.)**
- **Mooring Sites:**

  **Hawaii Ocean Times-series (HOT): HALE-ALOHA (H-A)**

  **Santa Barbara CHAnnel Re-locatable Mooring (CHARM)**

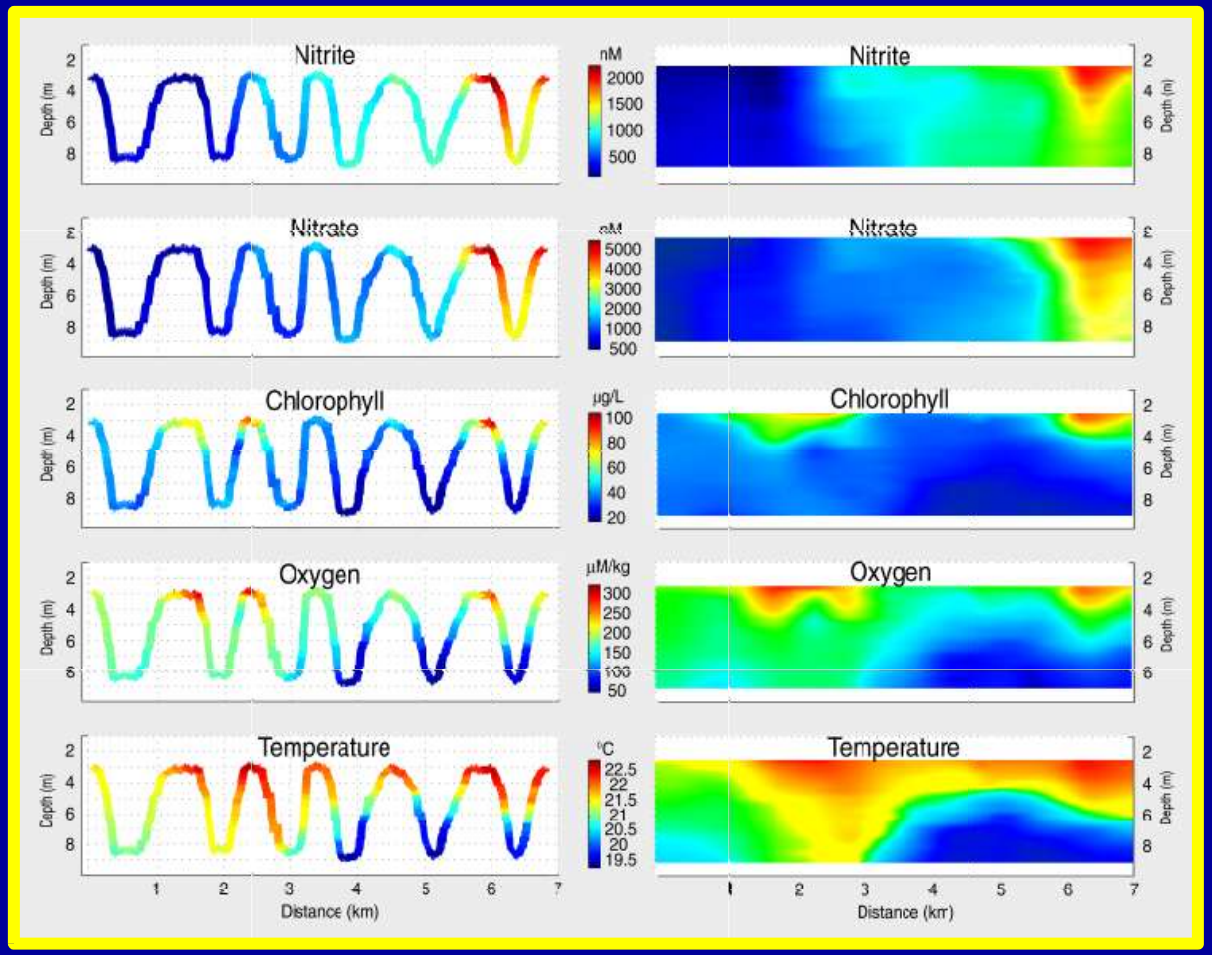
# Submersible Chemical Analyzer


- Real time results
- Fast response
- High resolution profiles
- Multi-chemical capability
- Trace concentrations
- *In situ* calibration
- Accurate determinations

# Chemical Plume Mapping with an Undulating Towed Vehicle

Al Hanson - Subchem





# Shuttered anti-fouling systems

## WETLabs VSF & Fluorometer

## BTM


## UCSB/SATLANTIC spectral radiometer

# Telemetry Types

- Argos: 1200bytes/day no duplex
- Iridium: 2400 bits/sec with duplex
- RF to shore (Free-wave): 115kbits/sec with duplex
- Orbcomm: Between Argos and Iridium in capability?????
- Cables (dedicated and opportunistic where possible (e.g., Hawaii +) O(100's Mbits/sec)??

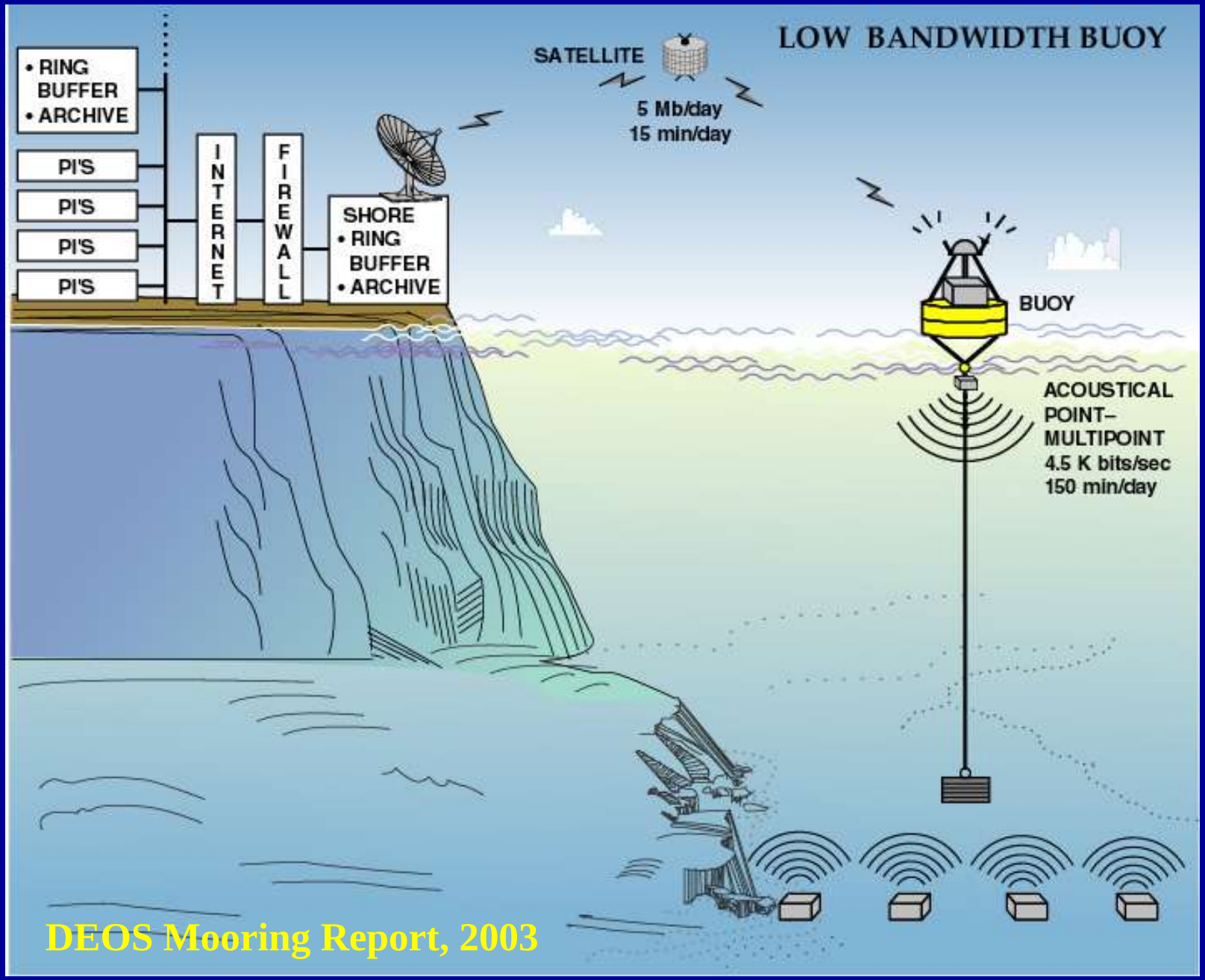
# Mooring/Buoy Types

- Subsurface (i.e., stretch type, Sus Honjo)
- Surface – discus, toroid,
  & spun foam (e.g., new BTM)
- Surface – spar (John Orcutt DEOS plans; Med. MFSTEP, special optical buoys: MOBY, BOUSSOLE)
- Special considerations for profilers

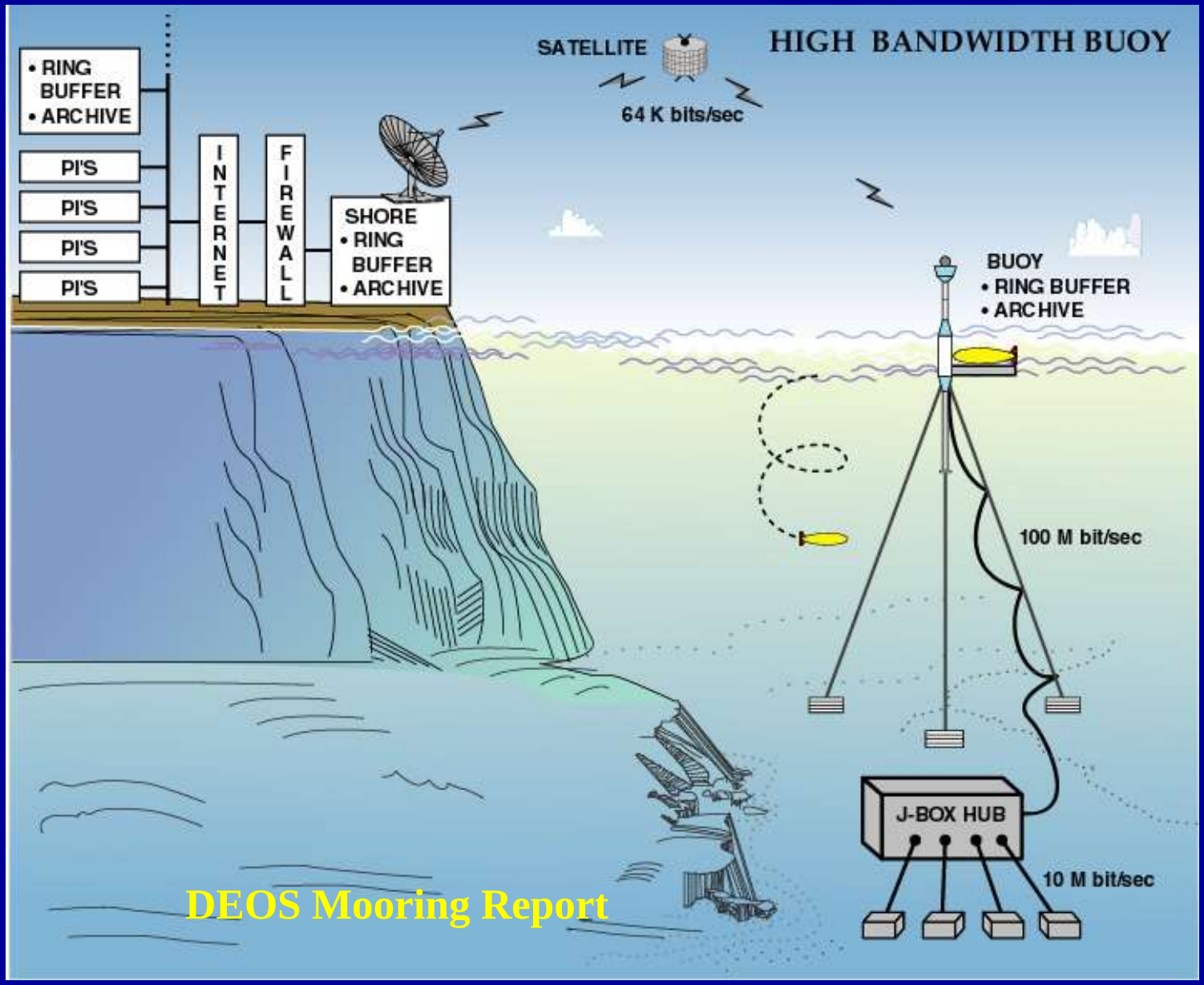
# Some Surface Mooring Types

## (Excerpt from chapter in NASA Report on Optical Moorings and Drifters)

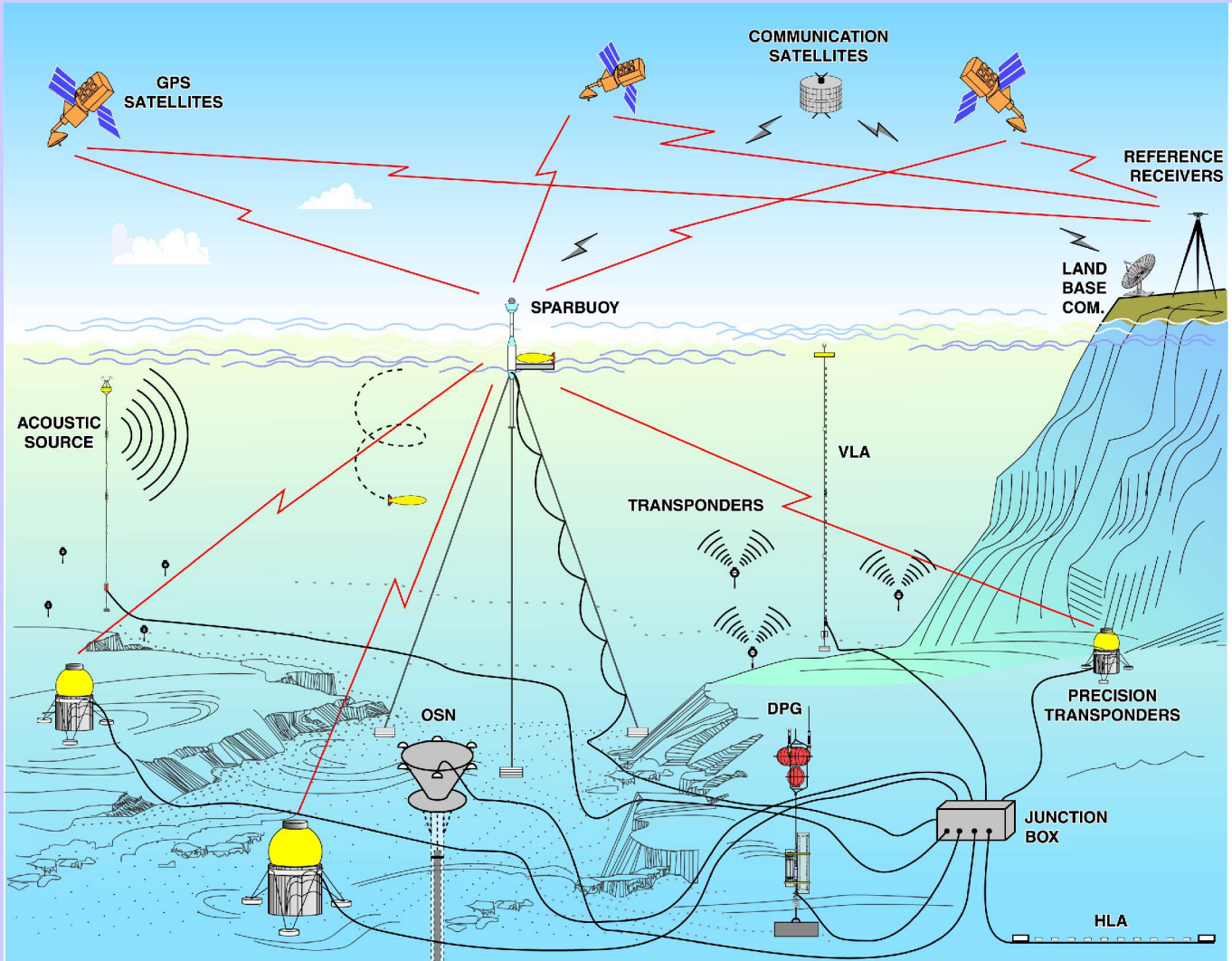
- ***Taut-Wire Surface Moorings*: For the ATLAS systems used in the TAO, TRITON and PIRATA mooring networks, the upper 500 m of the mooring utilizes a jacketed 1.27 cm non-rotating (nilspin). This segment is followed by an eight-strand plaited nylon line (1.9 cm) extending to just above the ocean bottom, where an acoustic release couples it to a ~2000 kg railroad wheel anchor. Taut-line moorings, with a nominal scope of 0.985 (ratio of mooring line length to water depth) are used in water depths greater than 1800 m to ensure that the upper section of the mooring is nearly vertical. More detailed information on the ATLAS taut-wire mooring design is available on-line at (http://www.pmel.noaa.gov/tao).**
- ***Slack-Wire Moorings:* The TAO slack-line moorings have a scope of 1.35, due to either shallow bathymetry, or severe current regimes. In these cases, the upper portion of the mooring is kept close to vertical (but less so than taut-line moorings) by using a reverse catenary design. The reverse catenary design allows the capabilities of being stretched under tension while utilizing traditional catenary concepts through a semi-slack method. Although taut-line moorings maintain subsurface sensor locations at or near desired depths, surface instruments may be subjected to stronger forces from waves and currents. The slack-line moorings provide greater flexibility in the upper water column, which may help reduce these forces.**
- ***Semi-slack/taut Wire Mooring:* MOOS moorings are on 'semi-slack' S shaped tethers with a 1.20% scope. The BTM and HALE-ALOHA platforms have been previously configured as semi-slack moorings with 3-m diameter buoys. However, new configurartions will be in the form of inverse catenary designs, providing less stress forcing of mooring components.**




DEOS Mooring Report, 2003

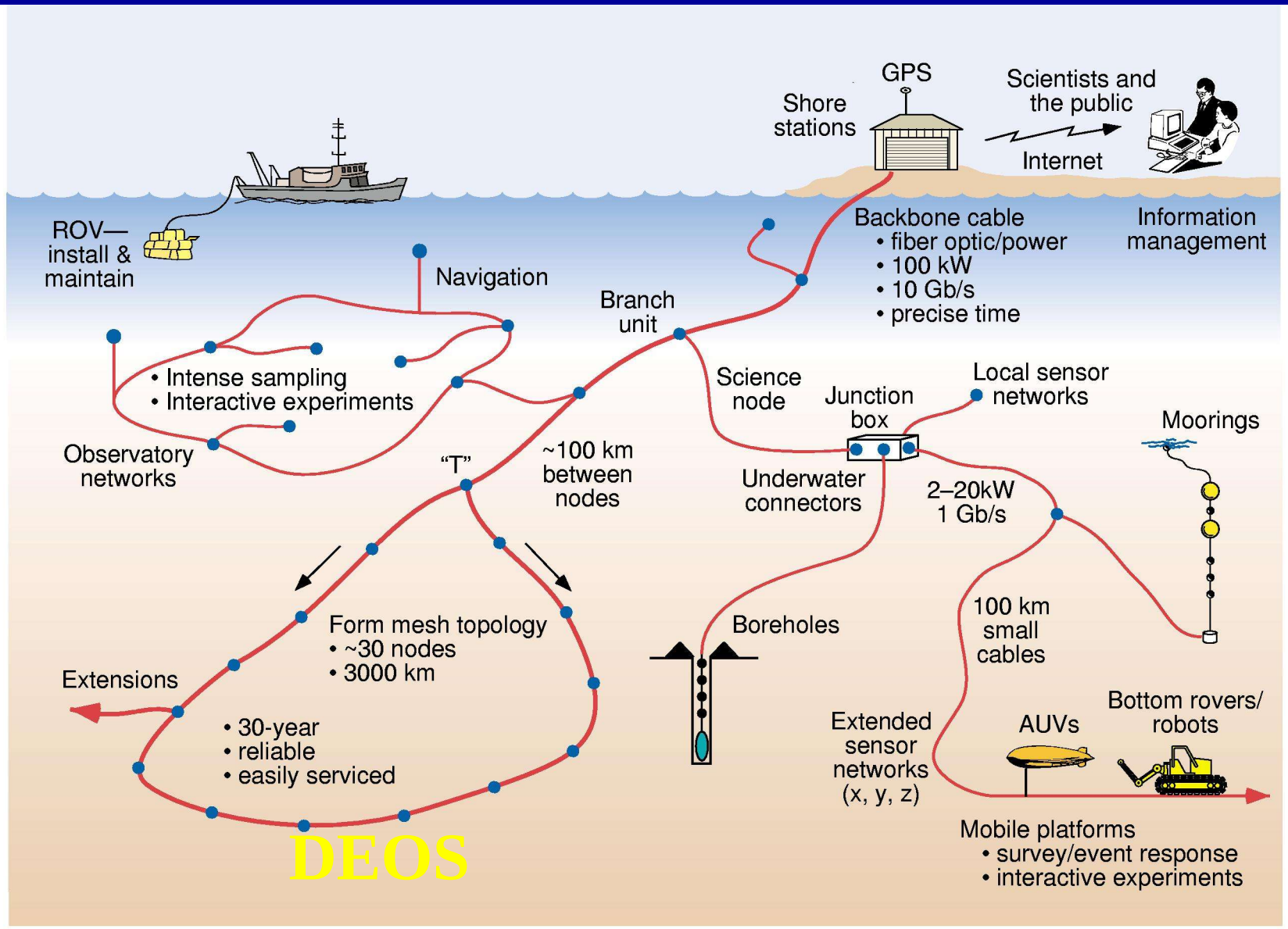

HIGH BANDWIDTH BUOY
SATELLITE
64 K bits/sec
• RING BUFFER
• ARCHIVE
PI'S
PI'S
PI'S
PI'S
INTERNET
FIREWALL
SHORE
• RING BUFFER
• ARCHIVE
BUOY
• RING BUFFER
• ARCHIVE
100 M bit/sec
J-BOX HUB
10 M bit/sec
DEOS Mooring Report

# Observatory

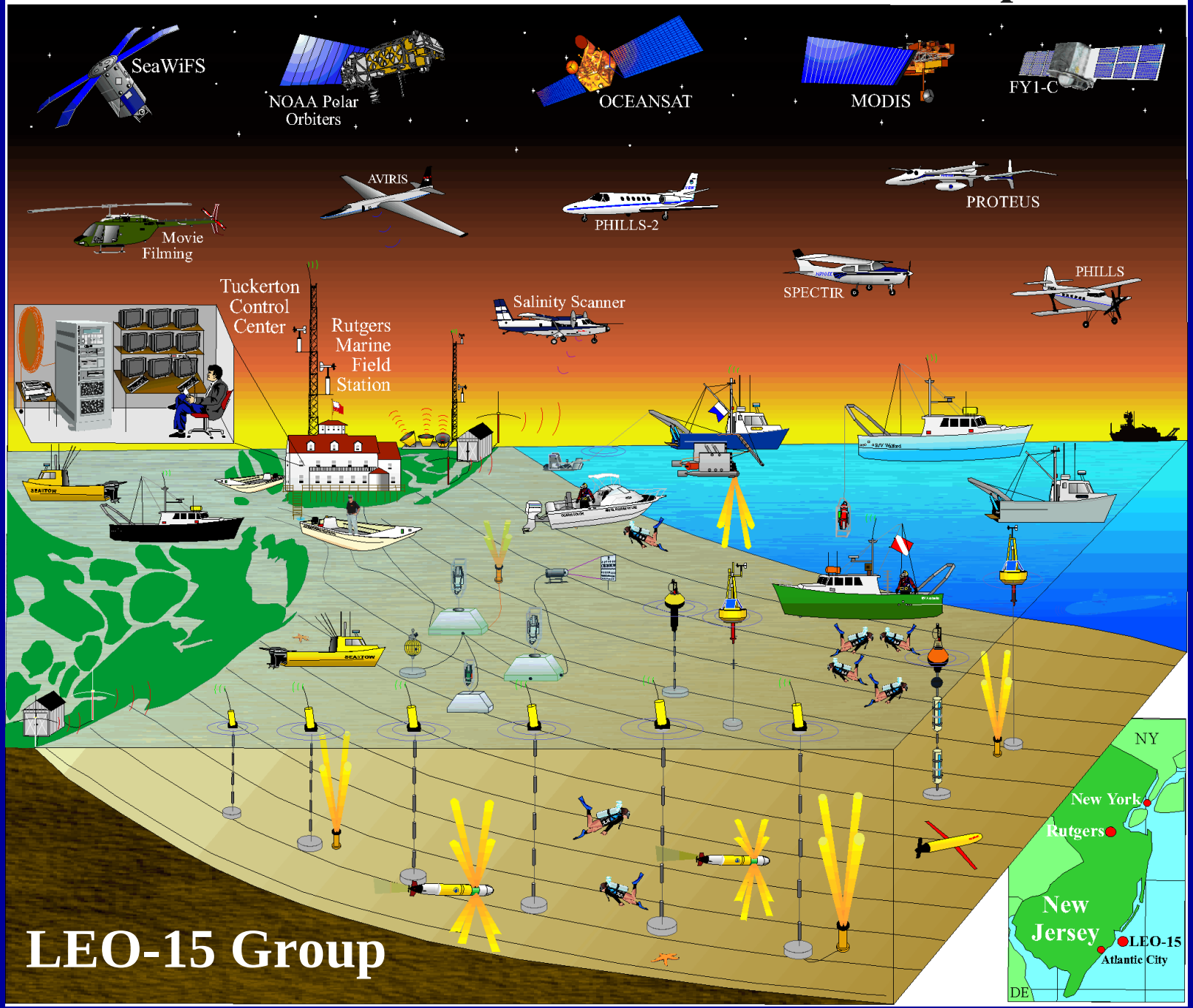



J. Orcutt

# Regional Cabled Ocean Observatory – Essential Elements



# LEO Instrumentation Used for the 2000-2001 Experiment



# END

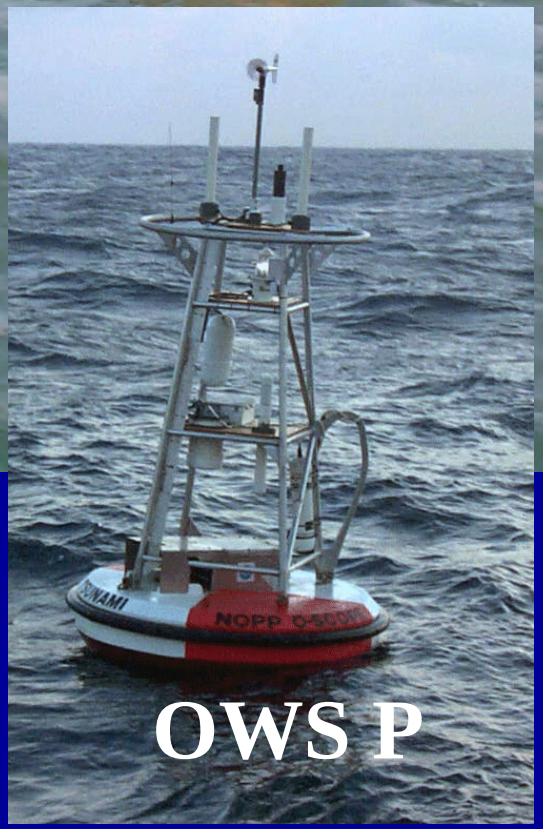
# O-SCOPE & MOSEAN

**Primary Sensors: $pCO_2$, pH, DO, $NO_3$, Spectral Optics**


New Jersey Coast
LEO-15


Bermuda

Monterey Bay

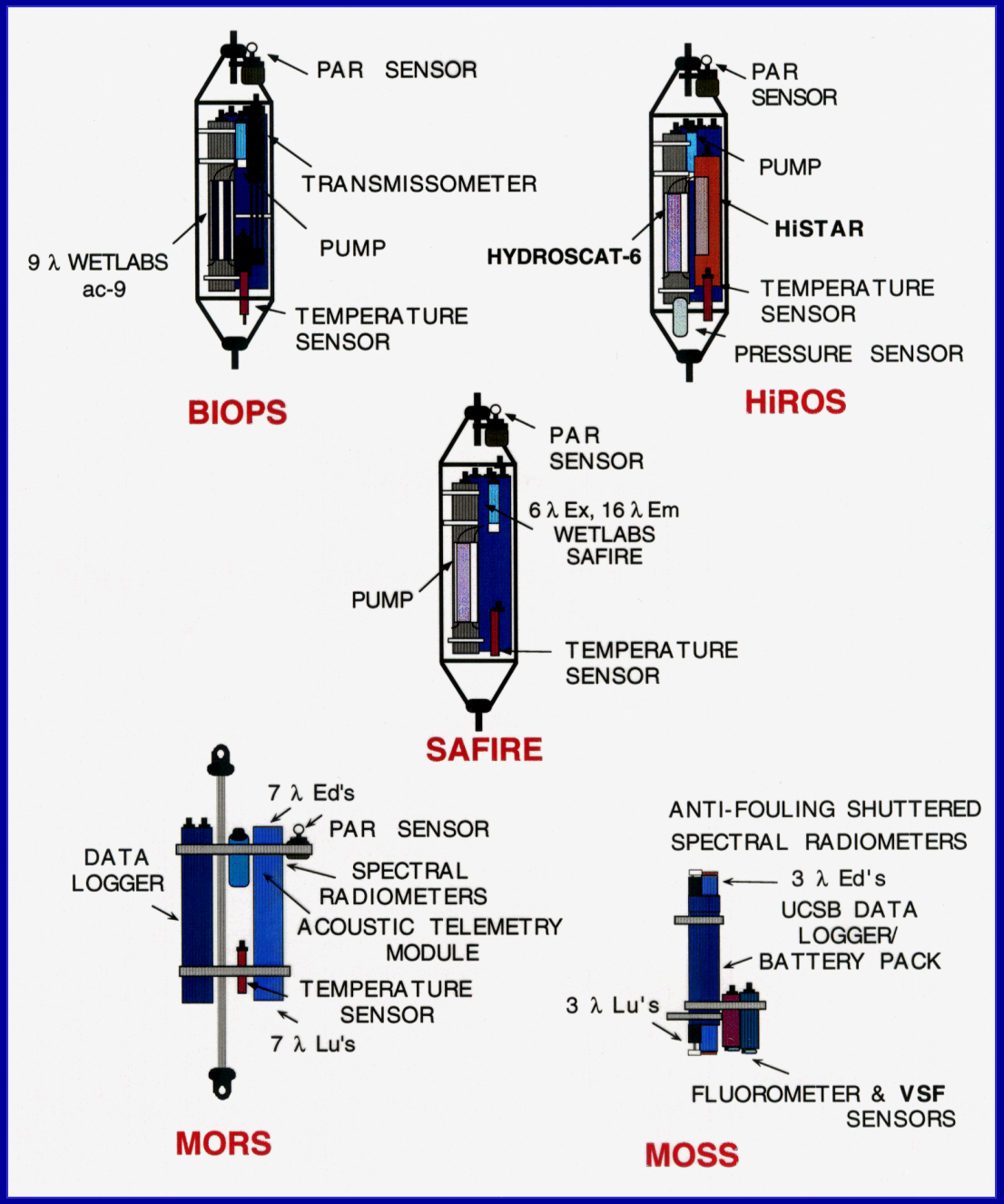


OWS P

**Others:** SO (N. Zeal.), N. Atlantic (UK, Ger.), N. Pacific (Japan, Can., US), Baja (Mex, US) Canada (HAB), Med. (US, EU), Baltic (Ger.), Equat. Pacific, HOT, San. Barbara Chan., + ?

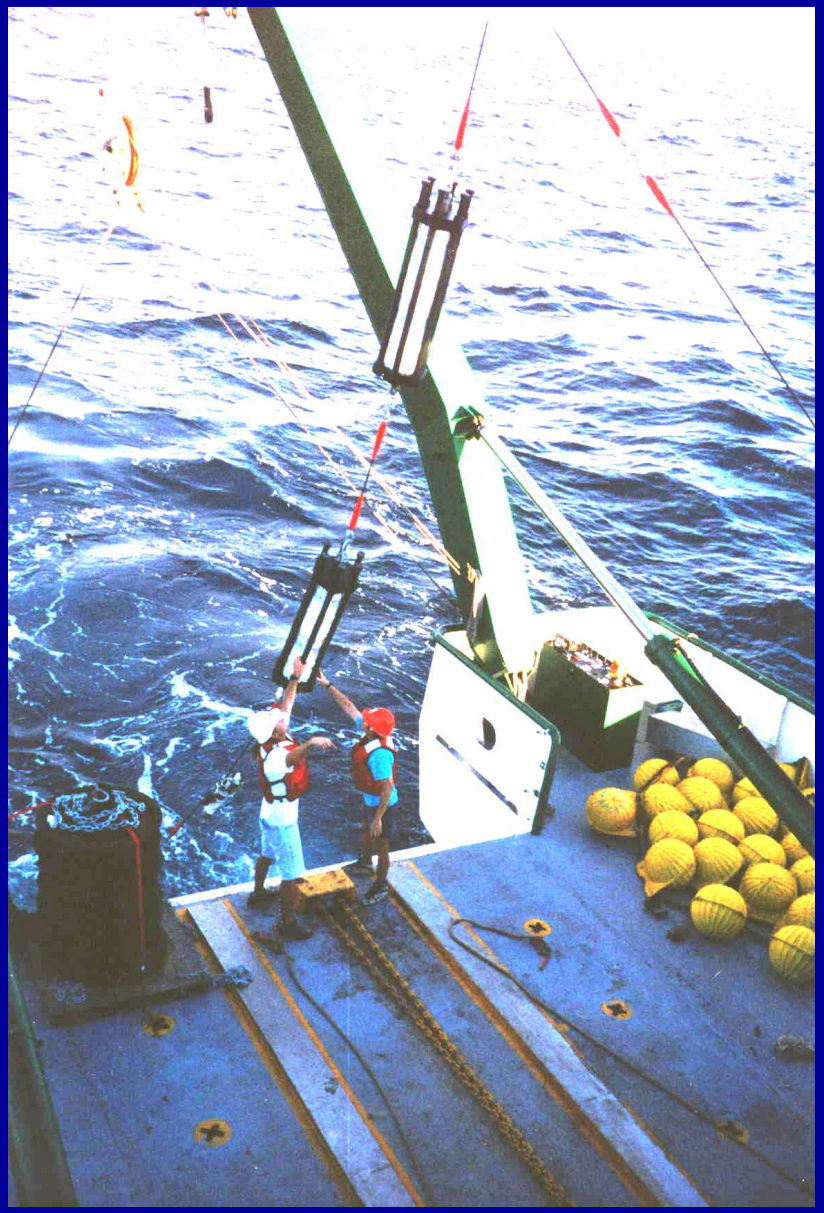
# Spectral Optical Instruments

*UCSB, OPL*



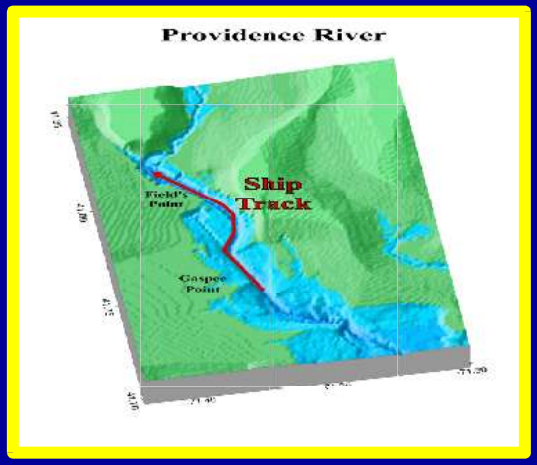

# Dissolved Oxygen Sensors Used by Rik Wanninkhof (AOML) with UCSB Optical Sensors at BTM

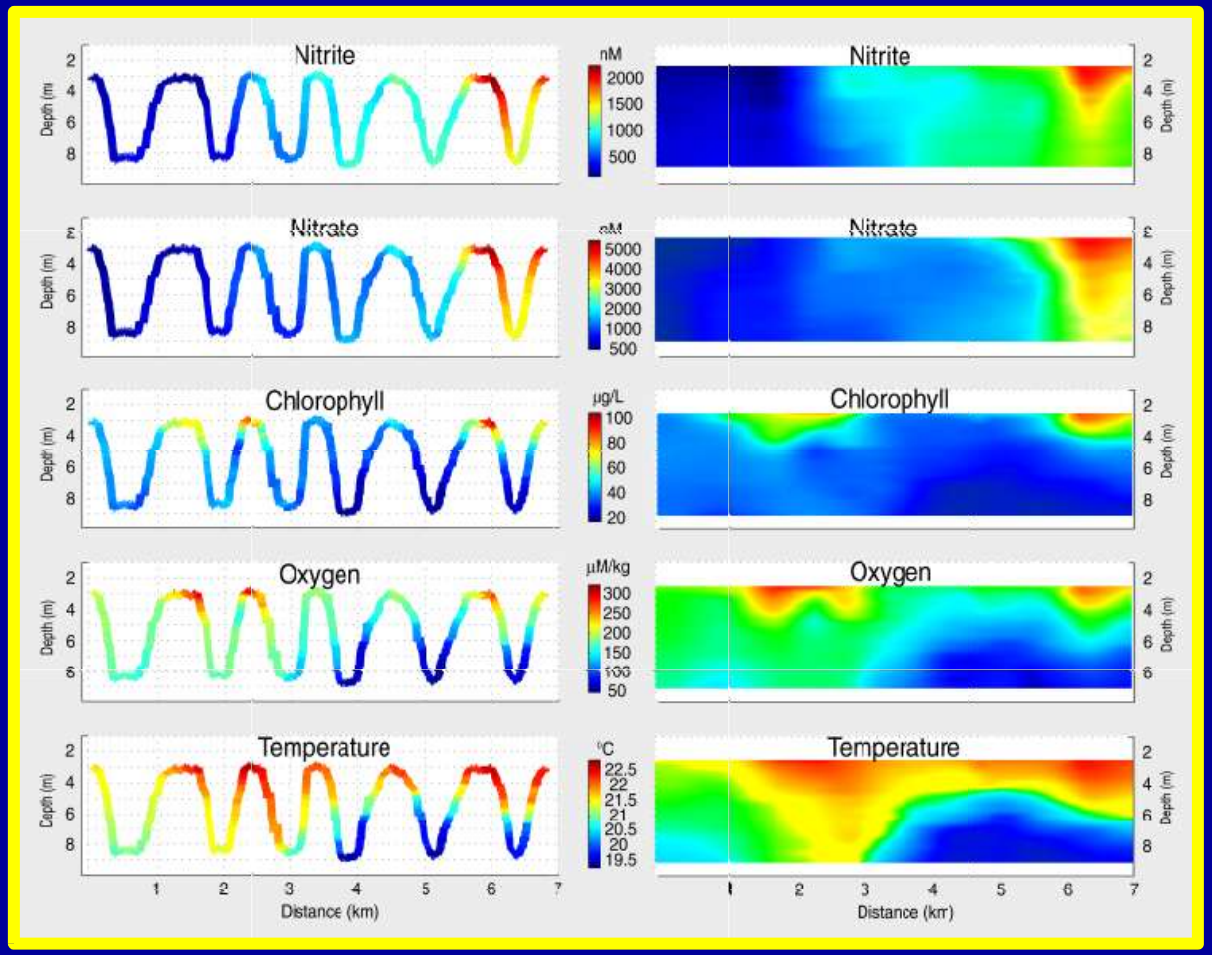
# Trace Element Water Samplers at BTM



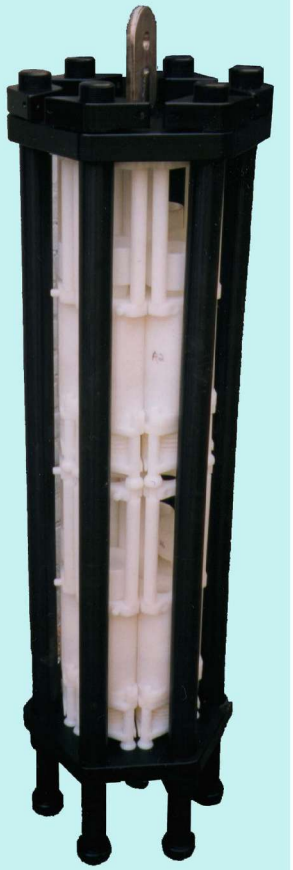
*Ed Boyle, MIT*

# Chemical Plume Mapping with an Undulating Towed Vehicle



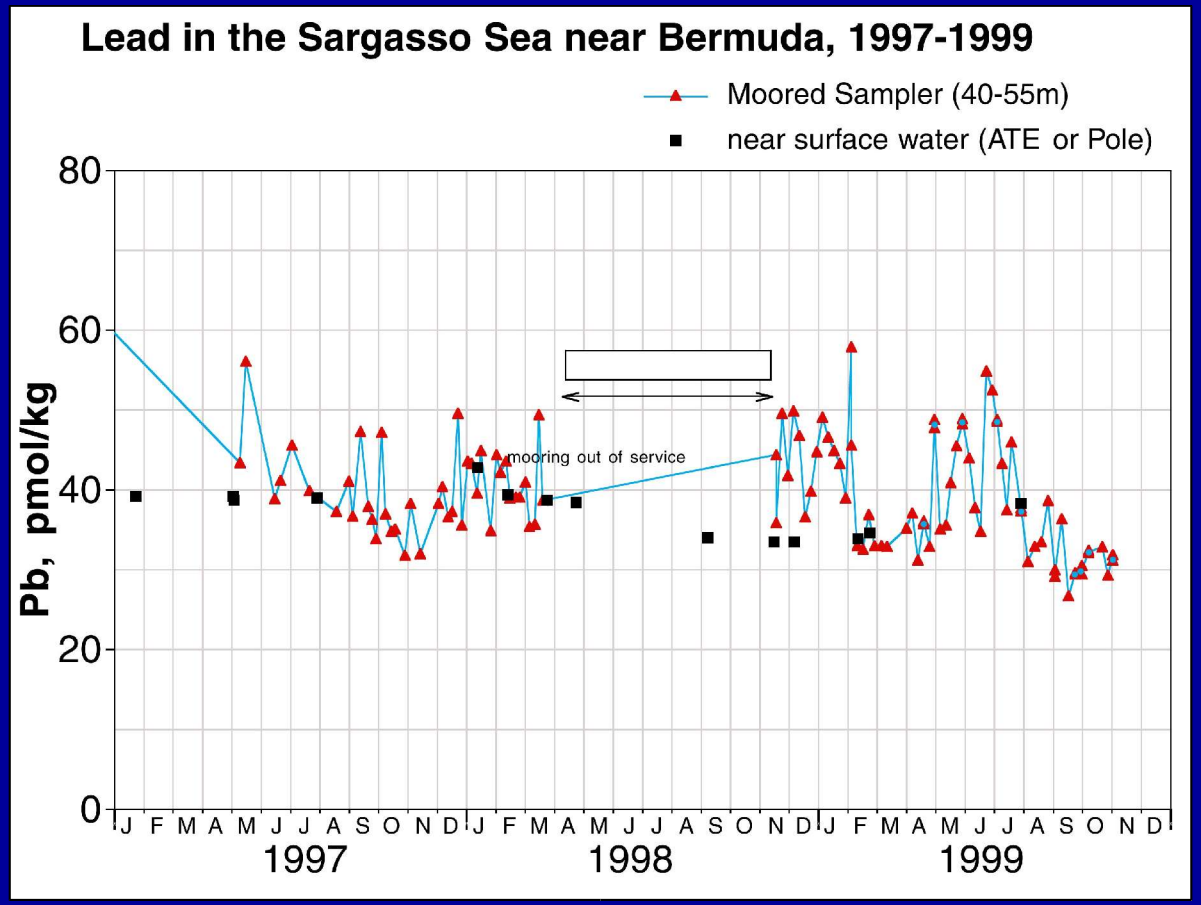
# Moored In-Situ Trace Element Sampler (MITESS)



MITESS:

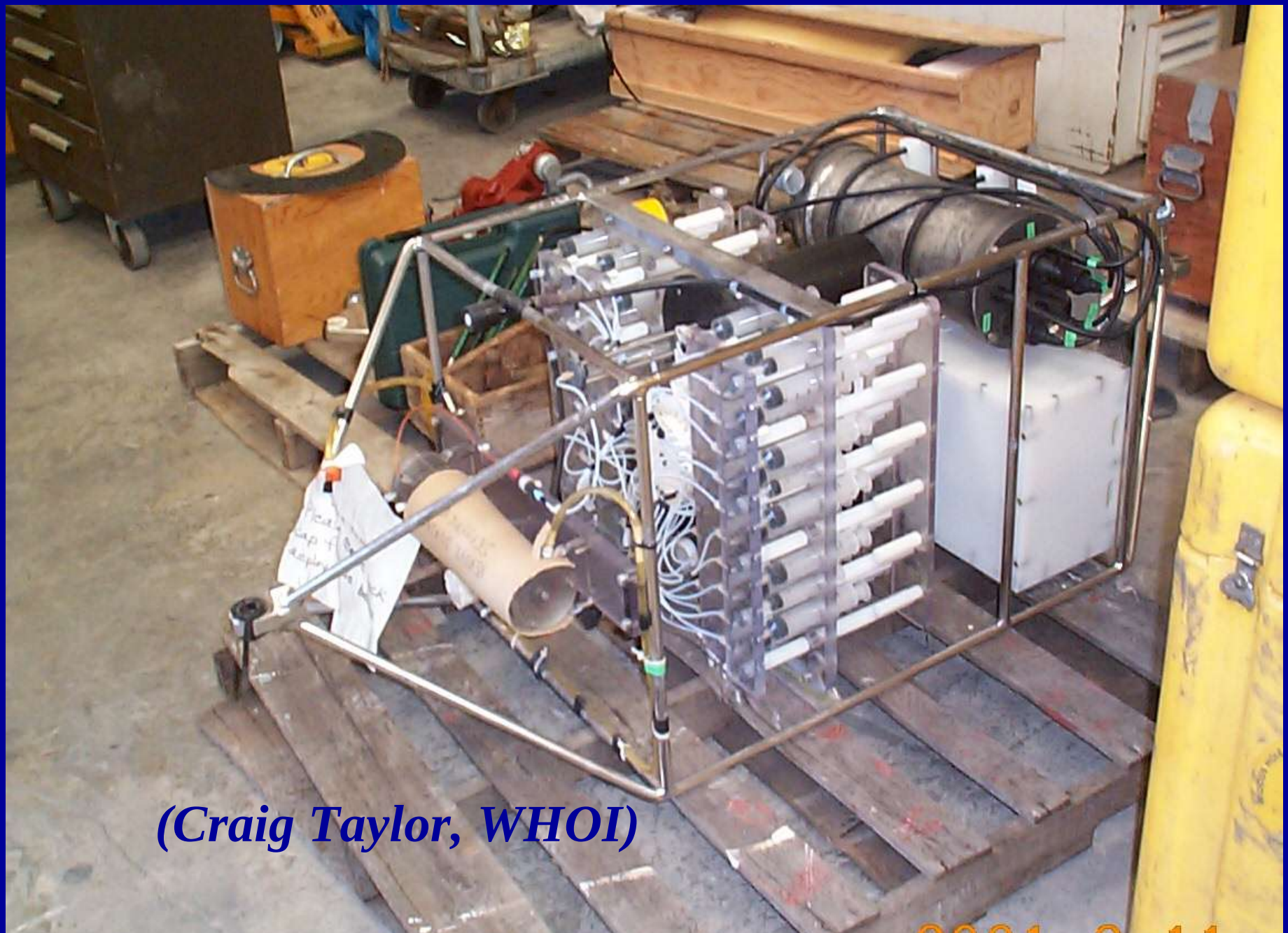
Moored In-situ Trace Element Serial Sampler

- Collects uncontaminated water samples under programmed control
- Deployable on Moorings for >6 months
- Can be used by anyone to collect deep-sea trace metal profiles




*Ed Boyle, MIT*

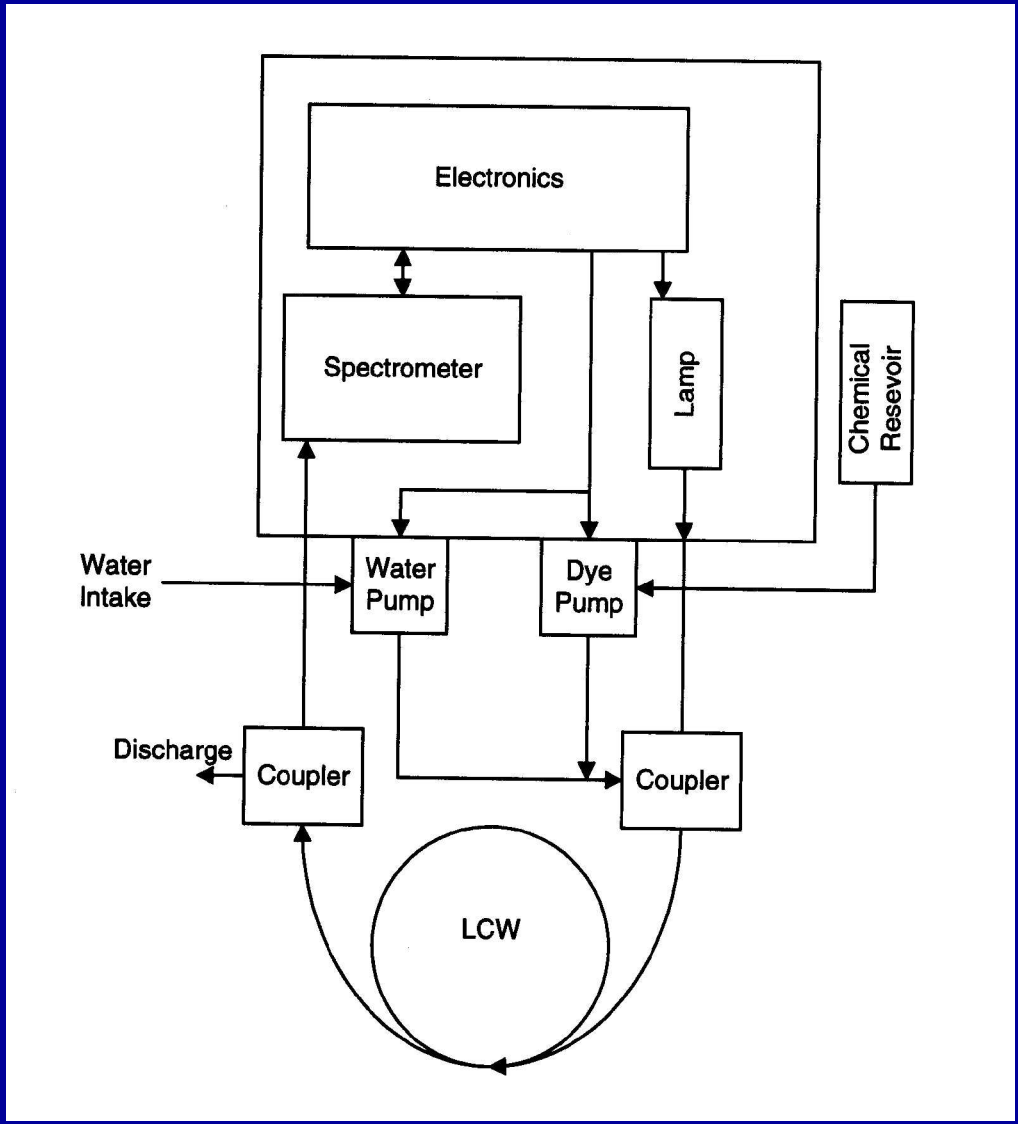
# TS-SID for $^{14}C$ Primary Production Measurements



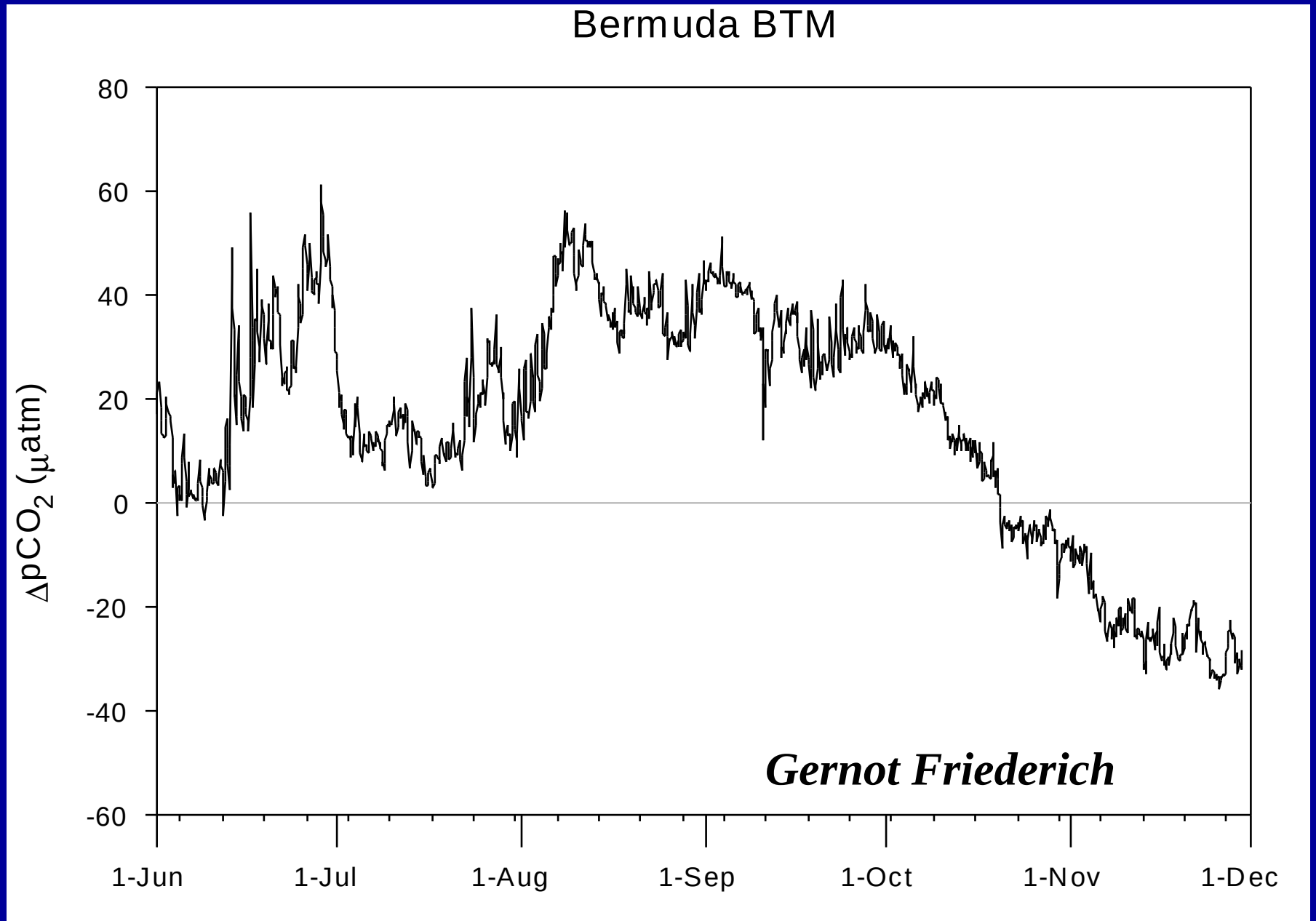
*(Craig Taylor, WHOI)*

# MBARI $\Delta pCO_2$ System:

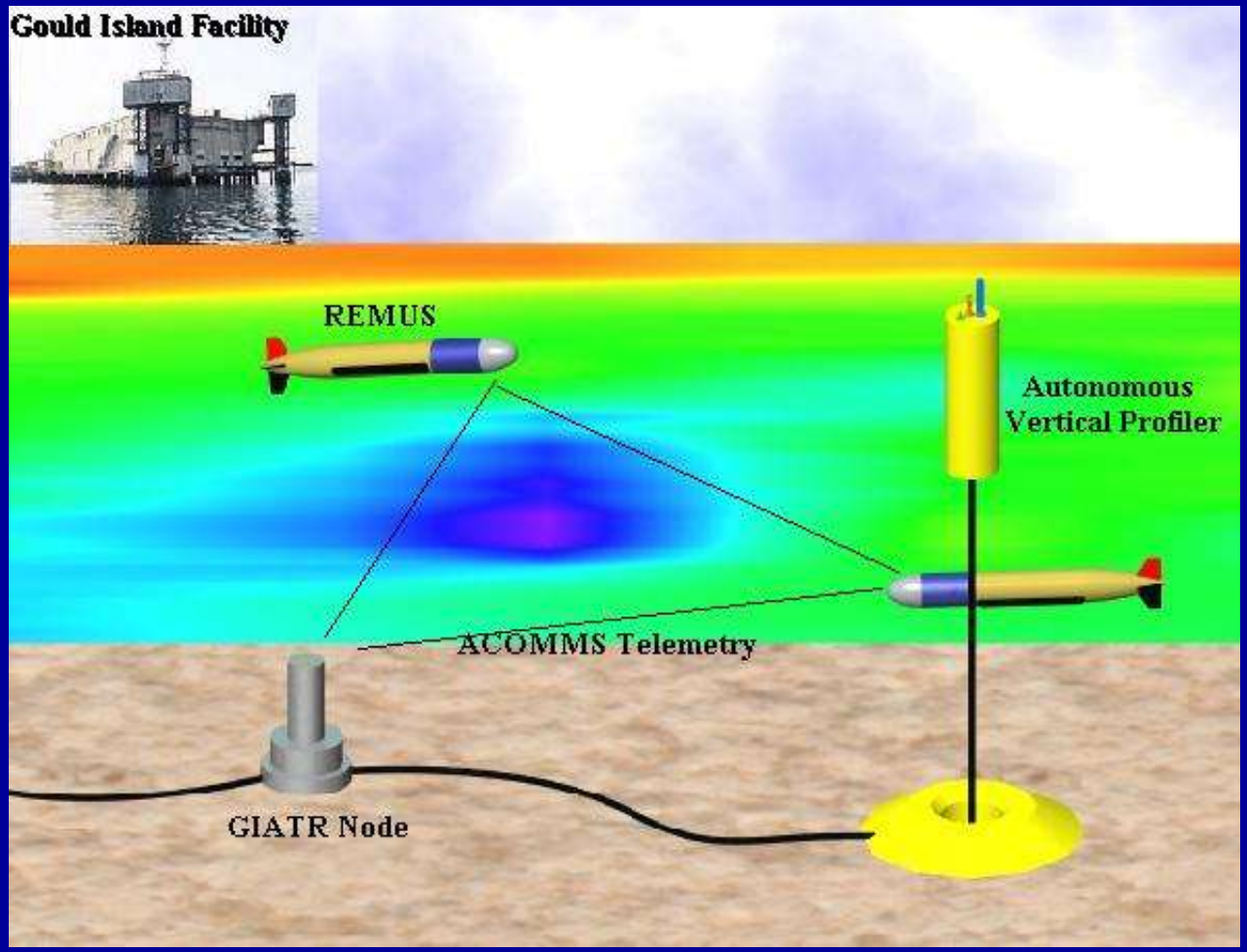
*Gernot Friederich & Francisco Chavez*



# MBARI ΔpCO2 Time Series: June 1 – Dec. 1. 2000



# Chemical Plume Mapping Experiments in the NUWC/NPT Gould Island Acoustic Tracking Range

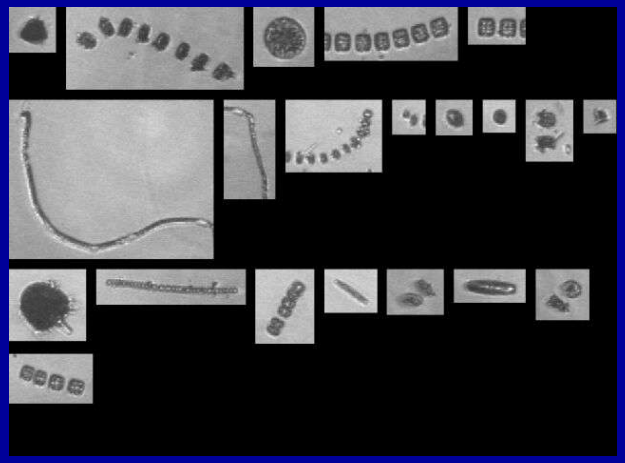



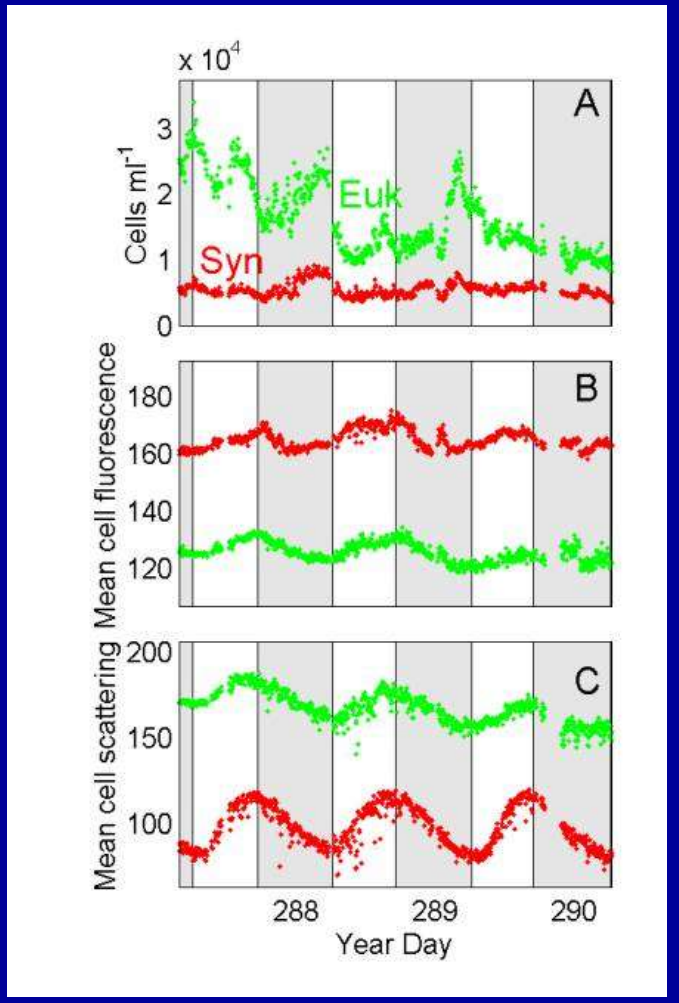

**Environmental Approvals**

SubChem, Al Hanson

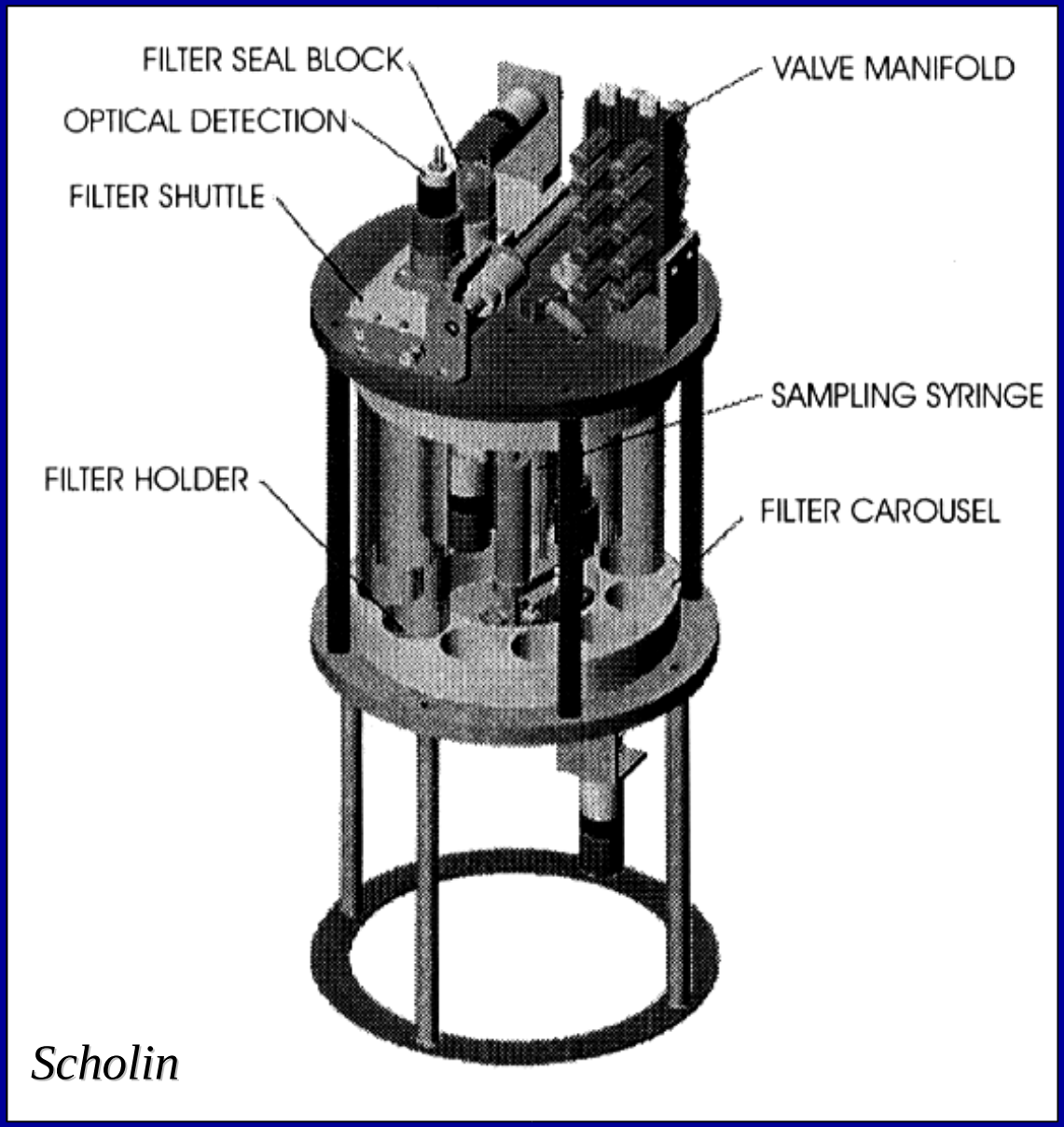
# In Situ Flow Cytometry

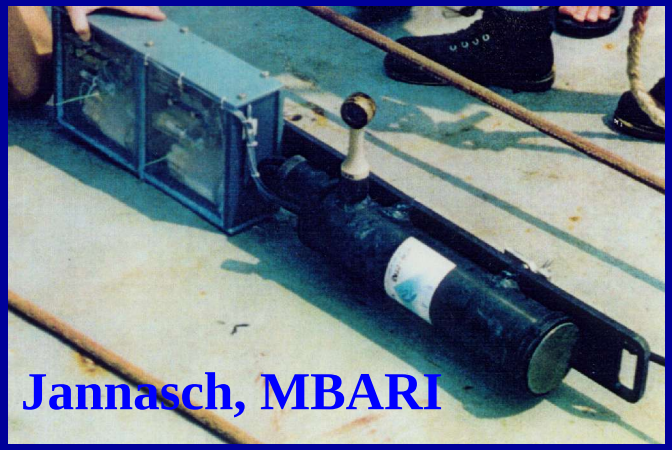
## (*Rob Olson, WHOI, Bigelow*)





# DNA Measurement System






McNeil, 1999; Dickey et al., 2001

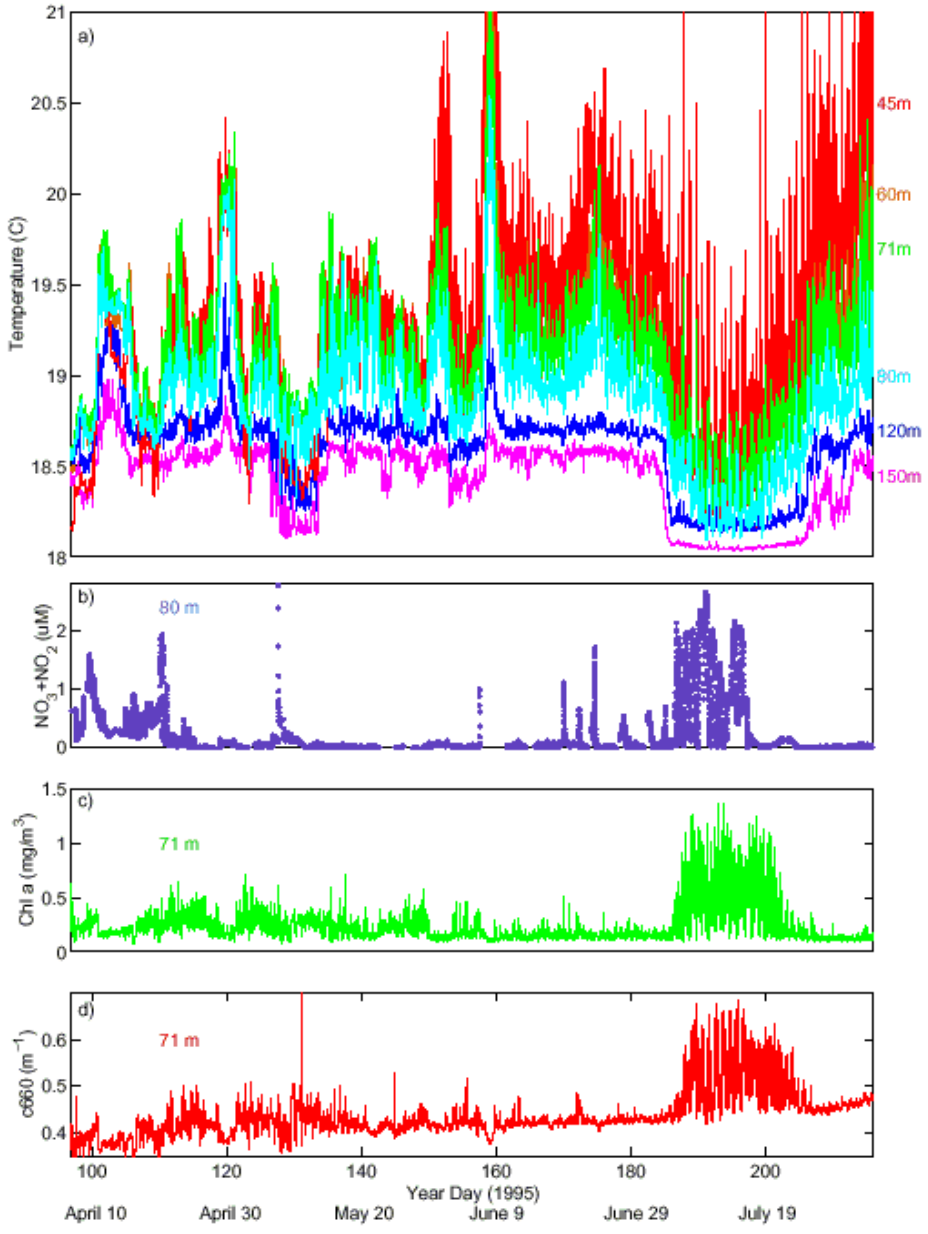
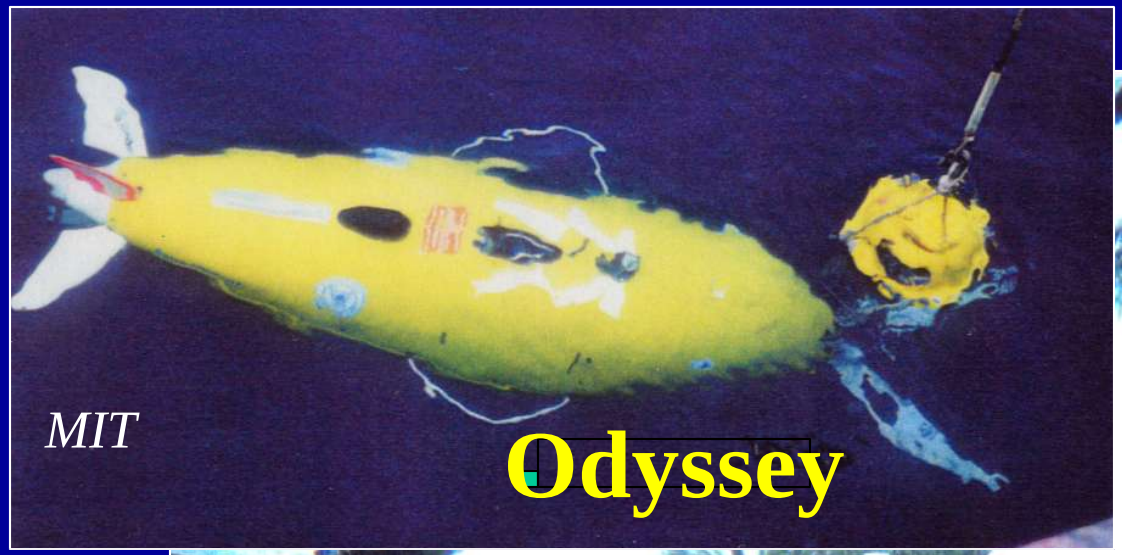



**Figure 7**

# AUV's

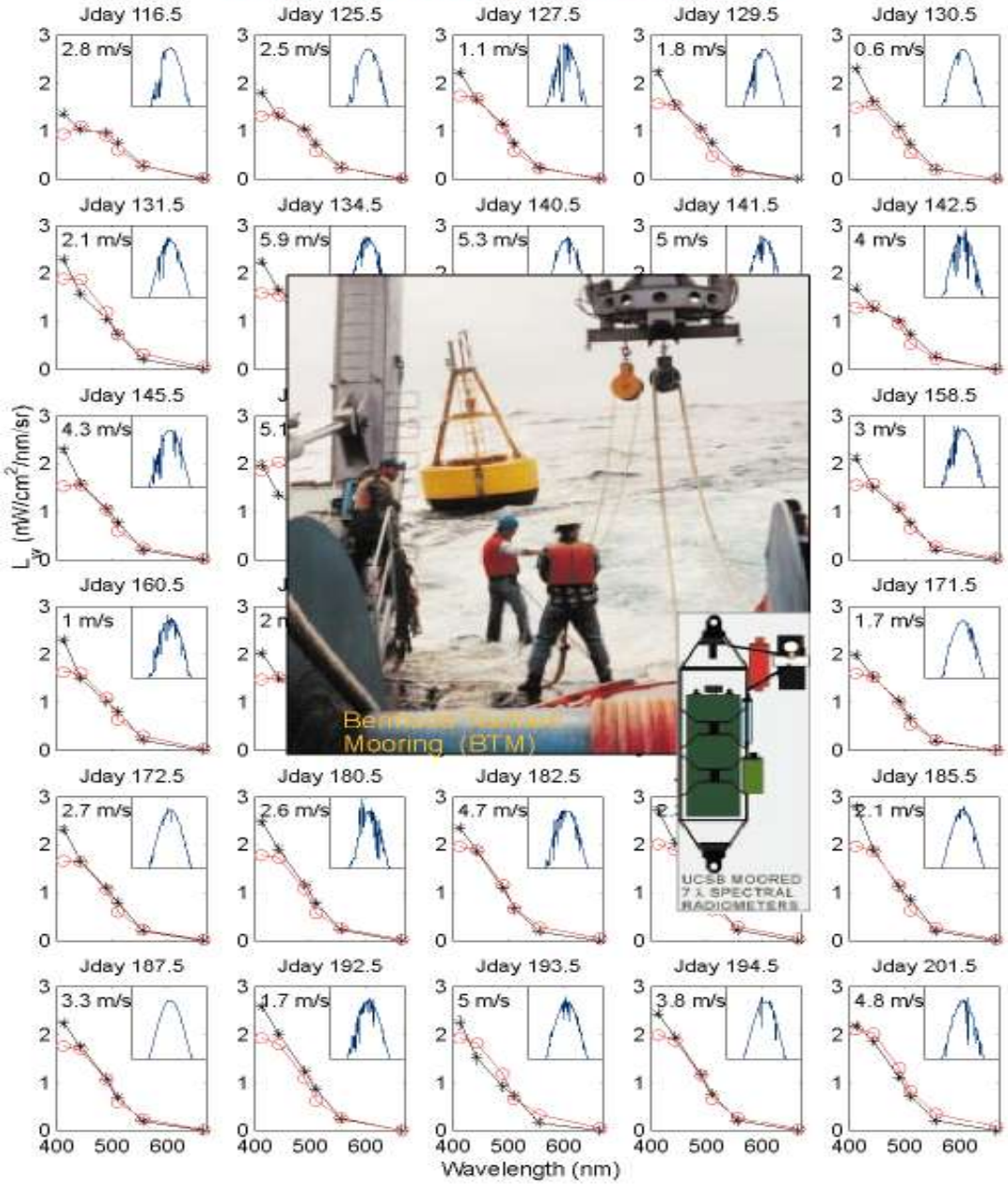


# Bermuda Testbed Mooring: 1994 - present

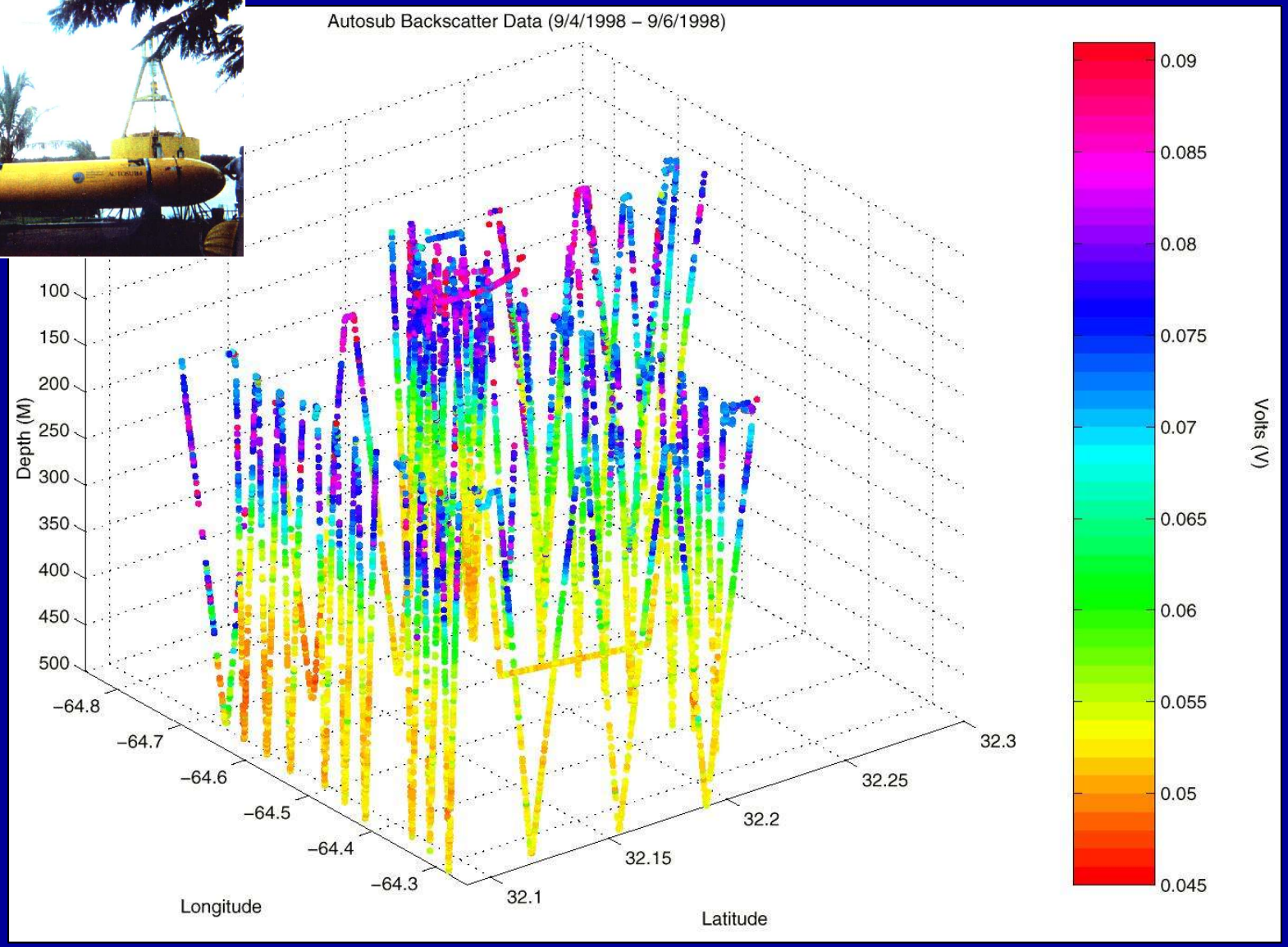

**Earlier BTM Deployment** **New BTM Buoy: September 2002**

*OPL/WHOI*

http://www.opl.ucsb.edu

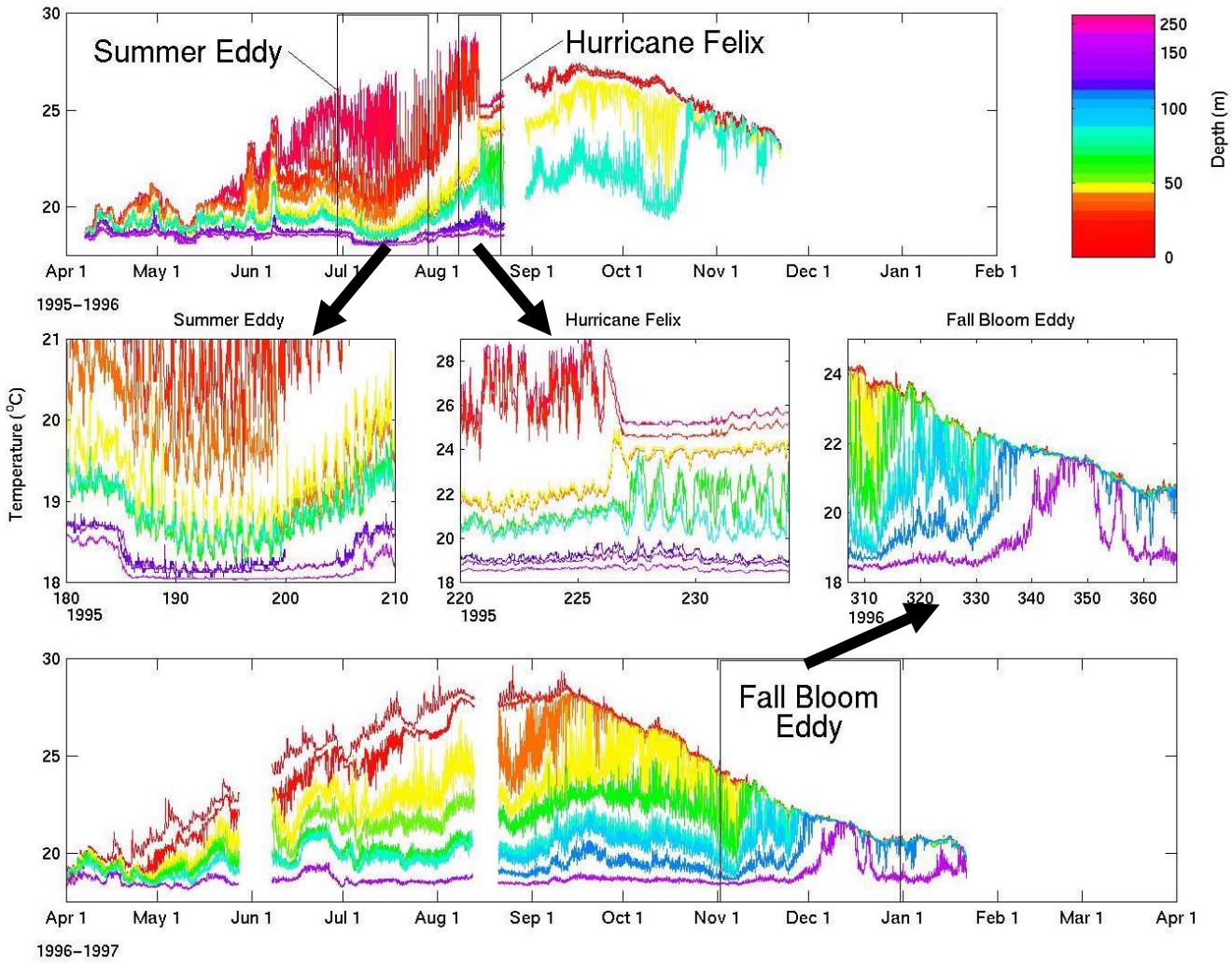


# Autosub: Near Bermuda Testbed Mooring Site

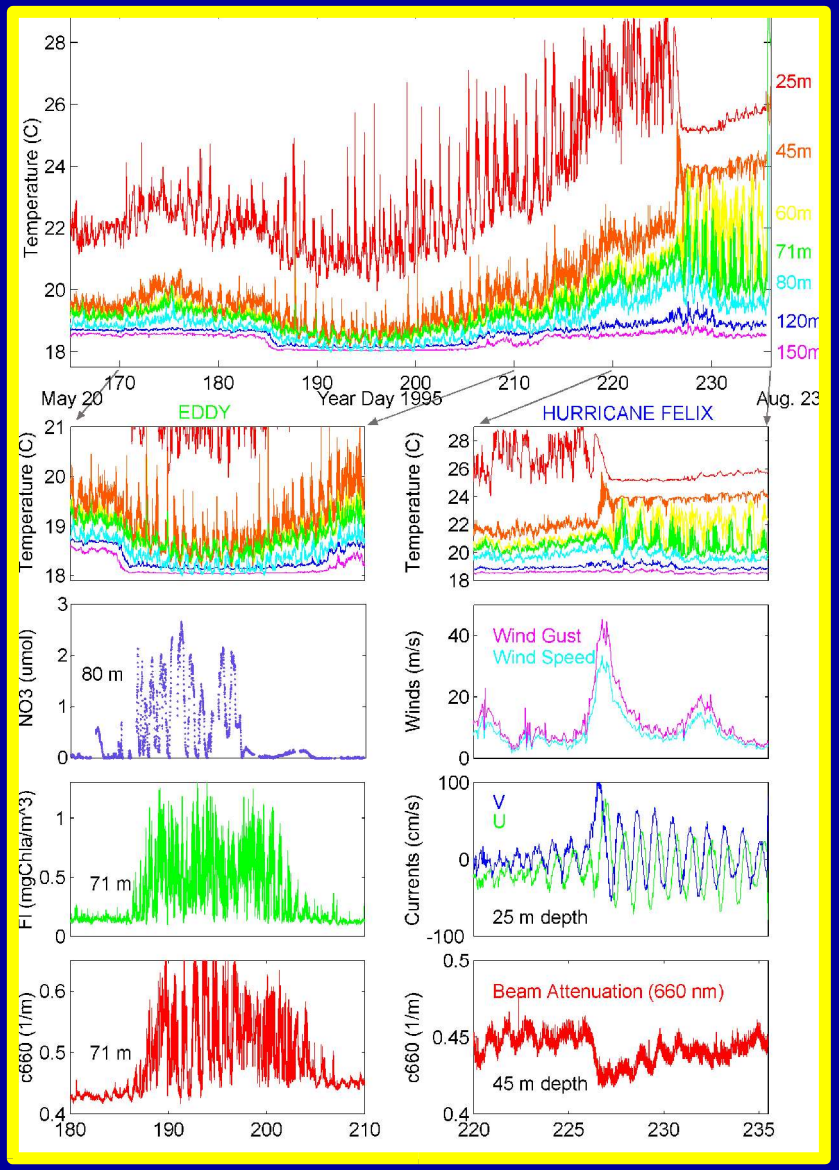


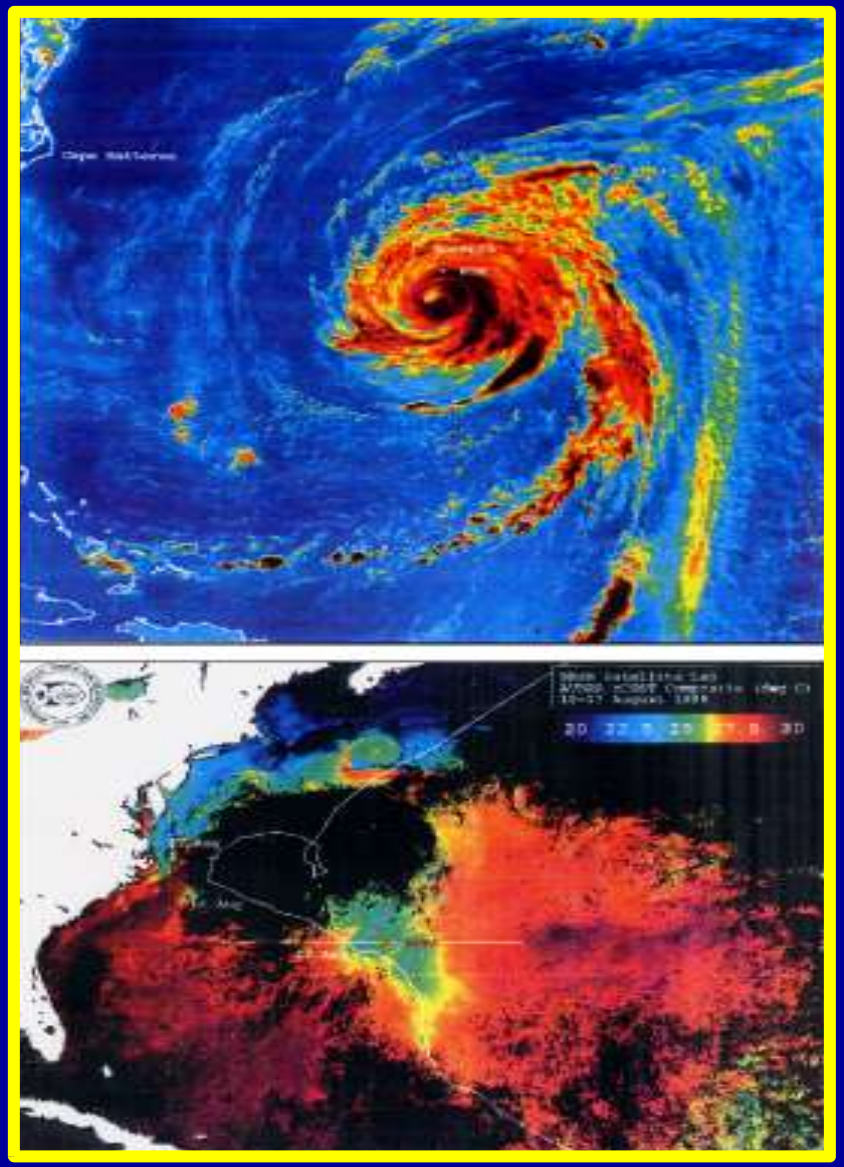

*Griffiths, Knap, and Dickey, 2000*

# Eddy and Hurricane Passages at BTM



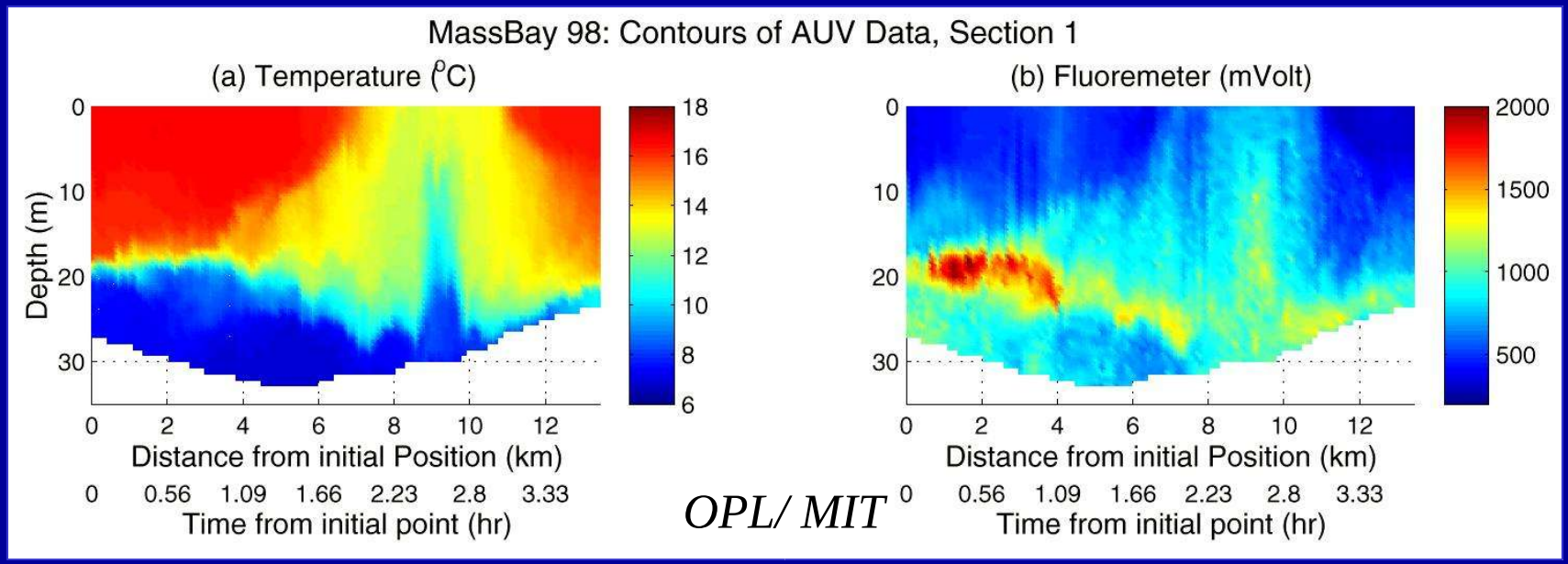
# Events at the Bermuda Testbed Mooring Site



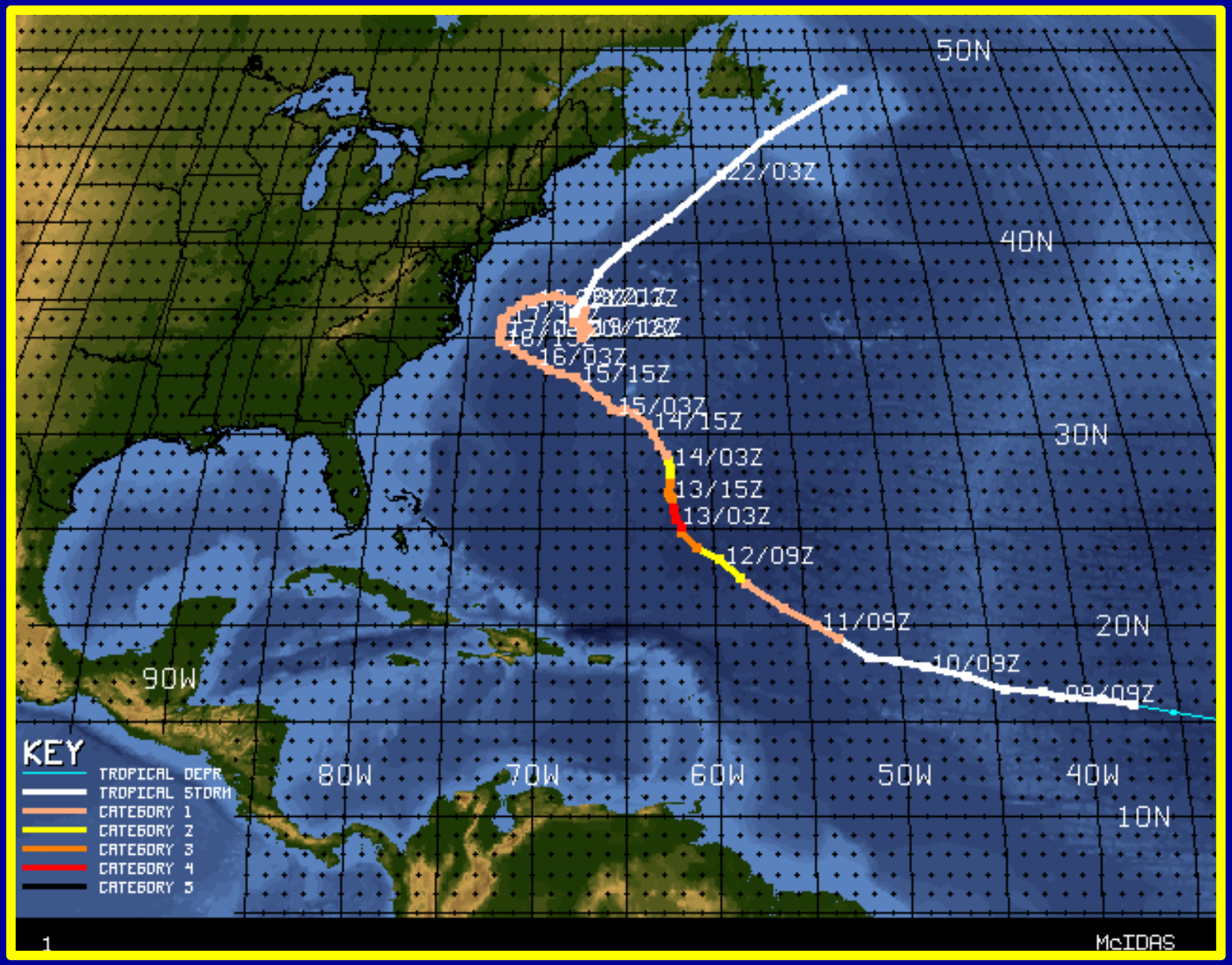



*Dickey et al., 1998a,b, 2001a; McGillicuddy et al., 1998, McNeil et al., 1999*

# Odyssey Observations in Mass. Bay

# Hurricane Felix: August 1995



**For further information, come surfing @**

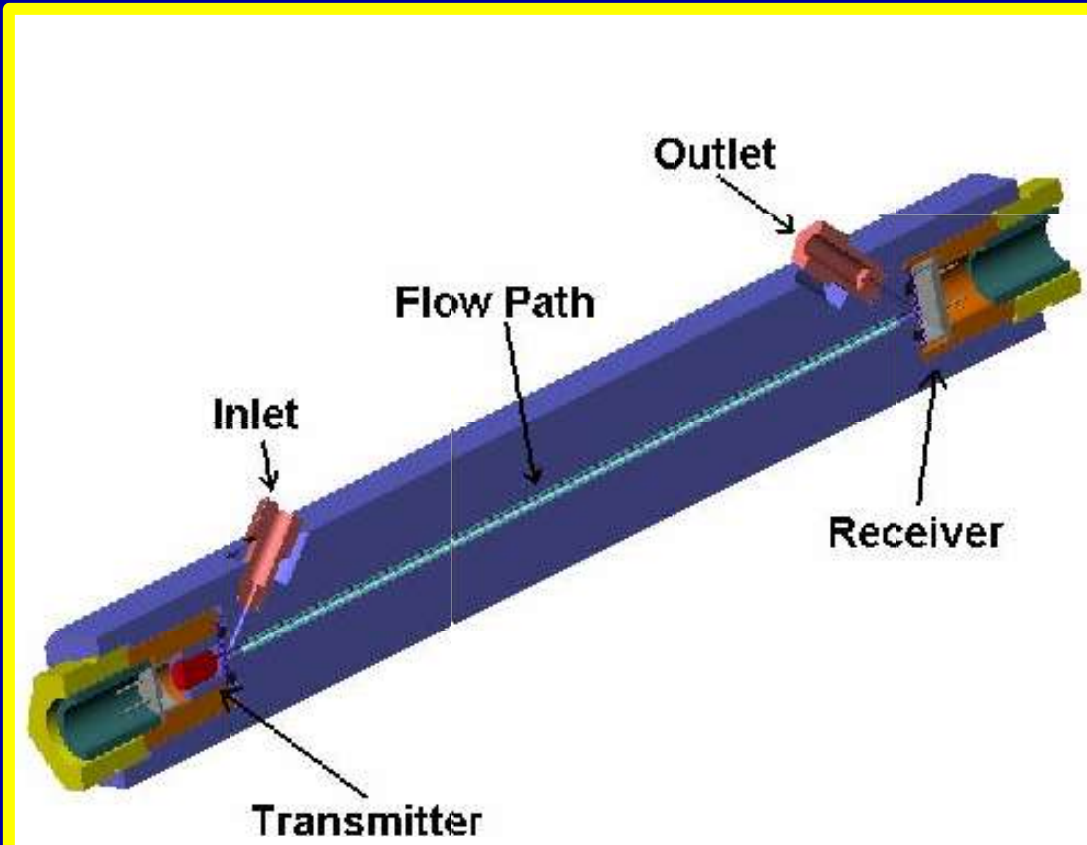
**www.opl.ucsb.edu**

**email :**

**tommy.dickey@opl.ucsb.edu**

# Sensitive Electro-optical Detector

WET Labs
ChemStar



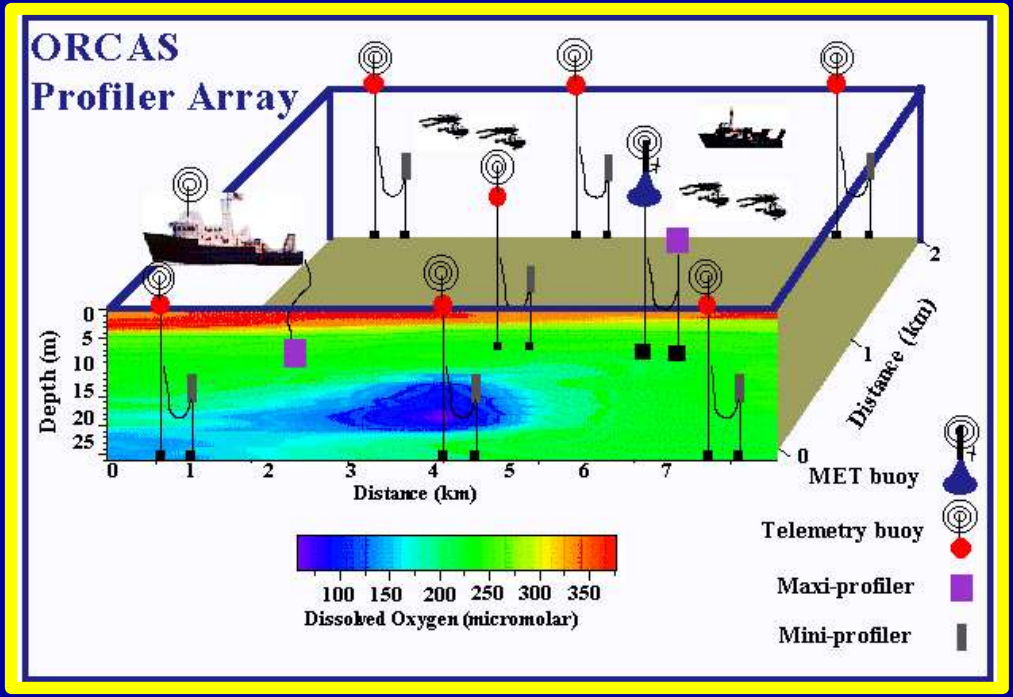
# REMUS Chemical Analyzer

SubChem Systems, Inc.

- Real time data
- Fast response
- High resolution mapping
- Trace concentrations
- *In situ* calibration
- Four channel analyzer
- Multi-chemical capability
  - Present: nutrients, metals,
  - Future: UXO (TNT, RDX etc.)

NAVSEA
NAVAL SEA SYSTEMS COMMAND
Undersea Warfare Center

# Ocean Response Coastal Analysis System
# ORCAS




**Demonstrate the utility of the ORCAS profiling system for 4-D observation of the coastal environmental response to episodic events.**

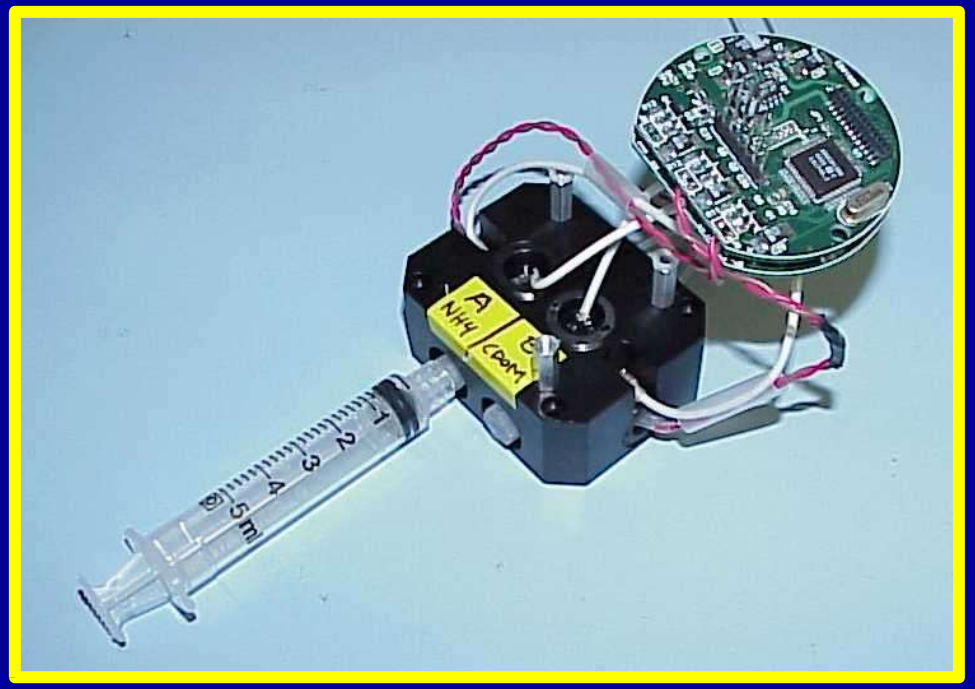
**NAVY - Diver Visibility and Vulnerability**

**EPA - Harmful Algal Blooms**

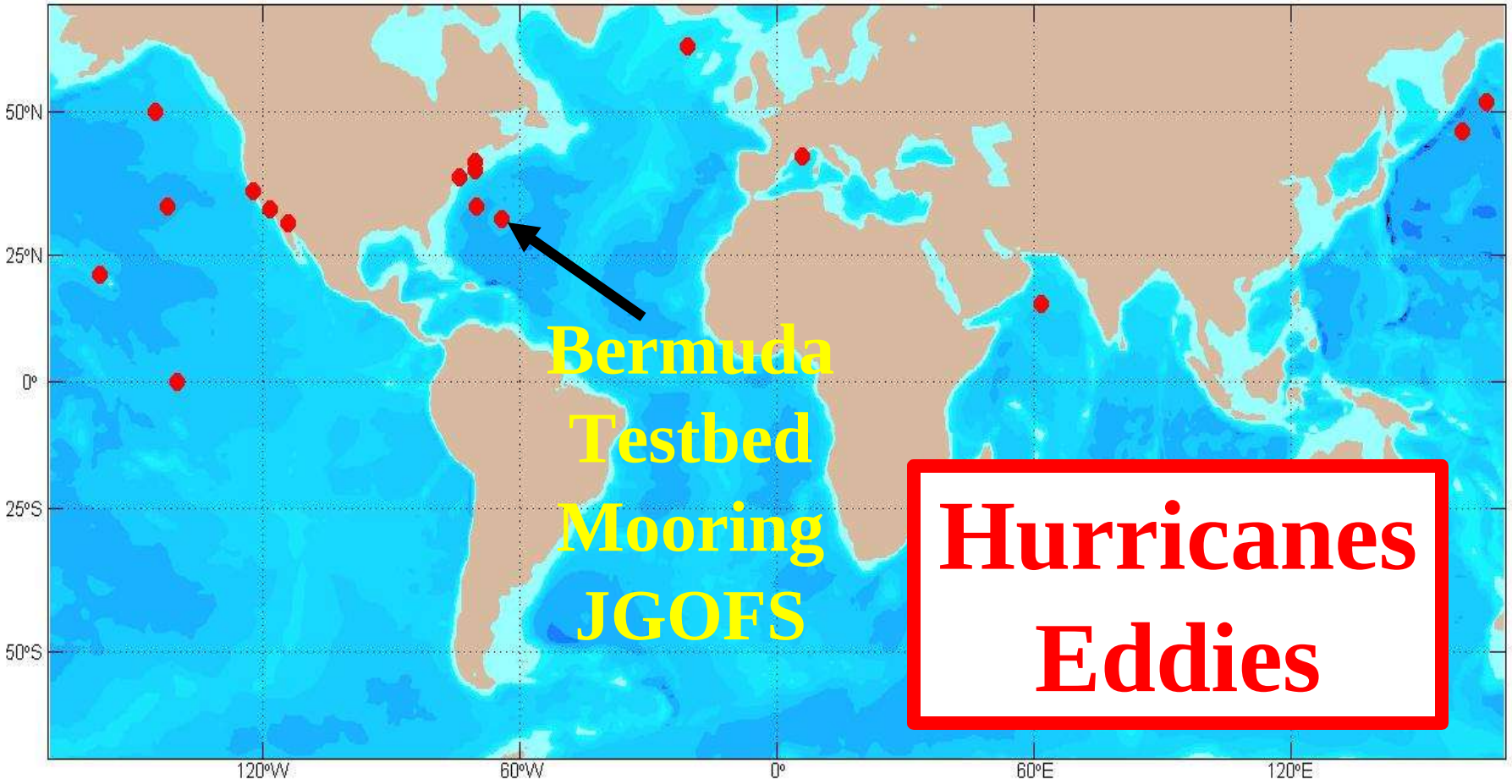
**NOPP Funding: URI-GSO, SubChem, WET Labs, NRL, NAVOCEAN, EPA**

# Fluorometer – Status

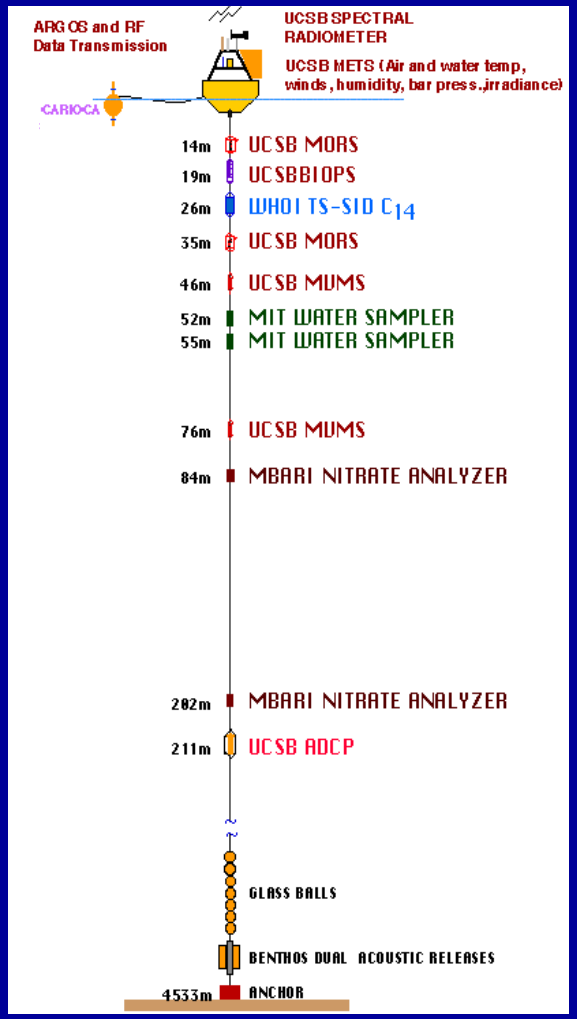
- Optical unit built and tuned for RT operation;
- Designed for NH4 + CDOM
- Ready for reagent delivery package.
- Delivery to Subchem in Feb



# UCSB Ocean Physics Laboratory
# Interdisciplinary Mooring/AUV
# Study Sites



# Bermuda Testbed Mooring Time Series:
# Roles of Events?



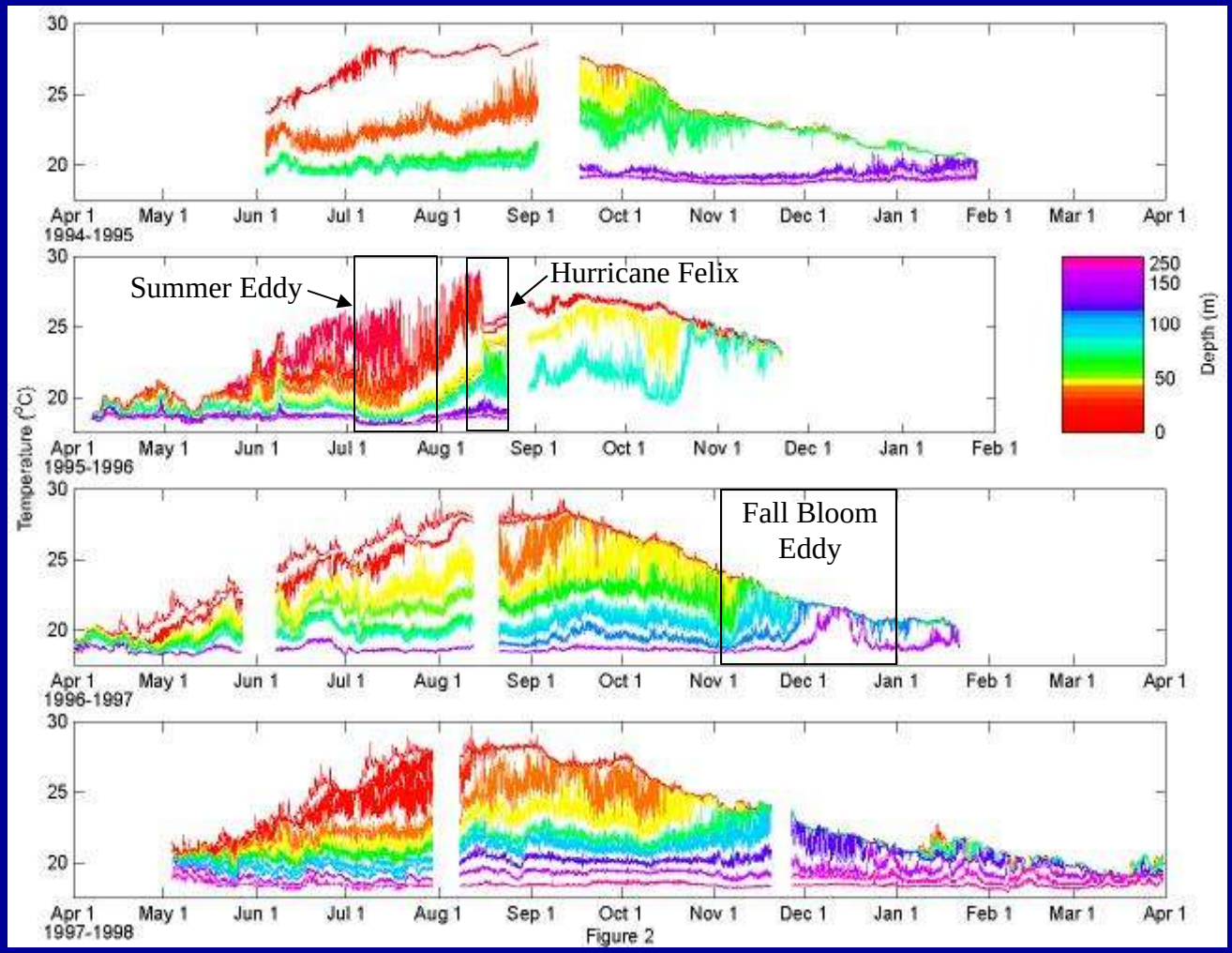
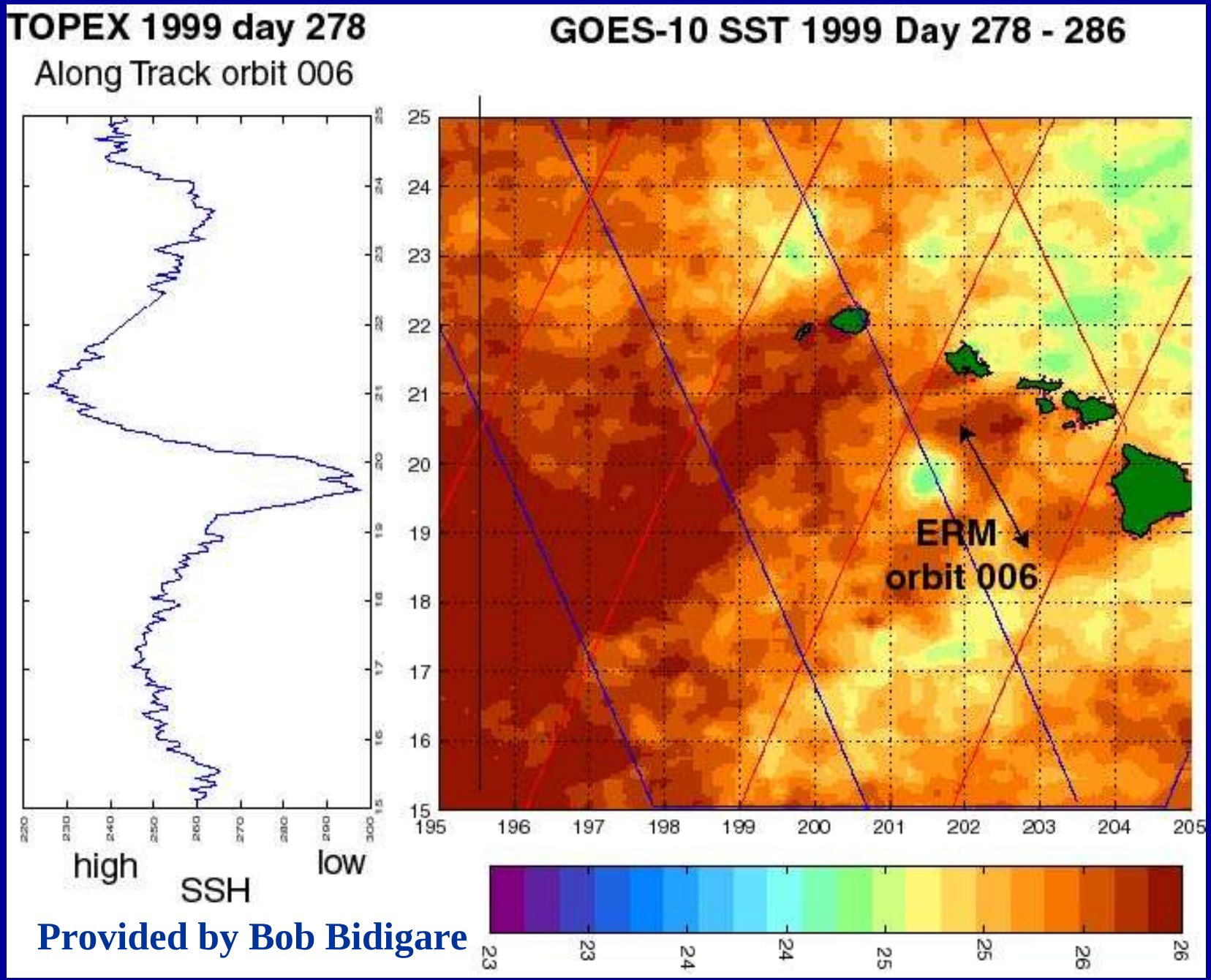




Figure 2

*Dickey et al., 1998a, 2001a*

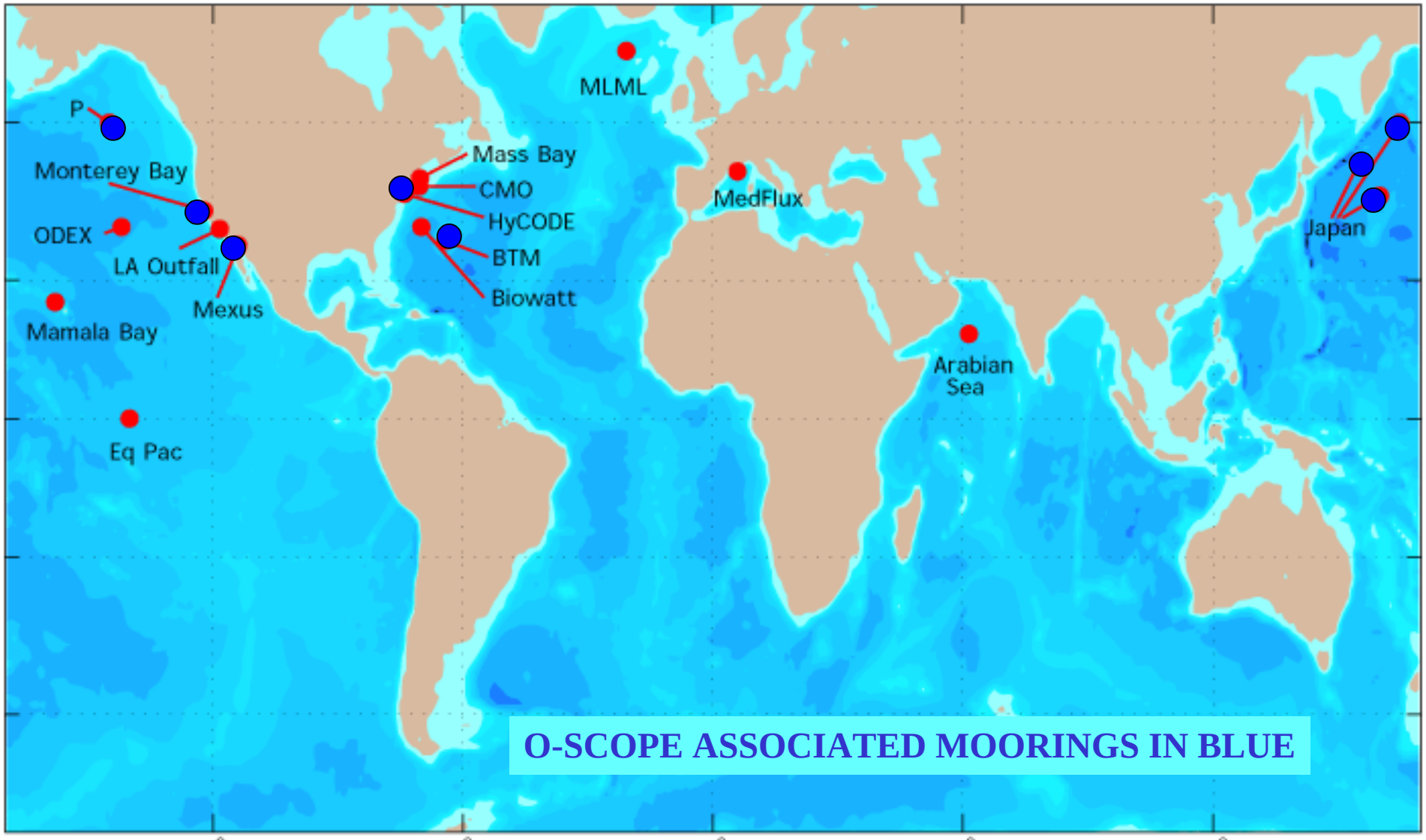

6/20/20

Hans Jannasch



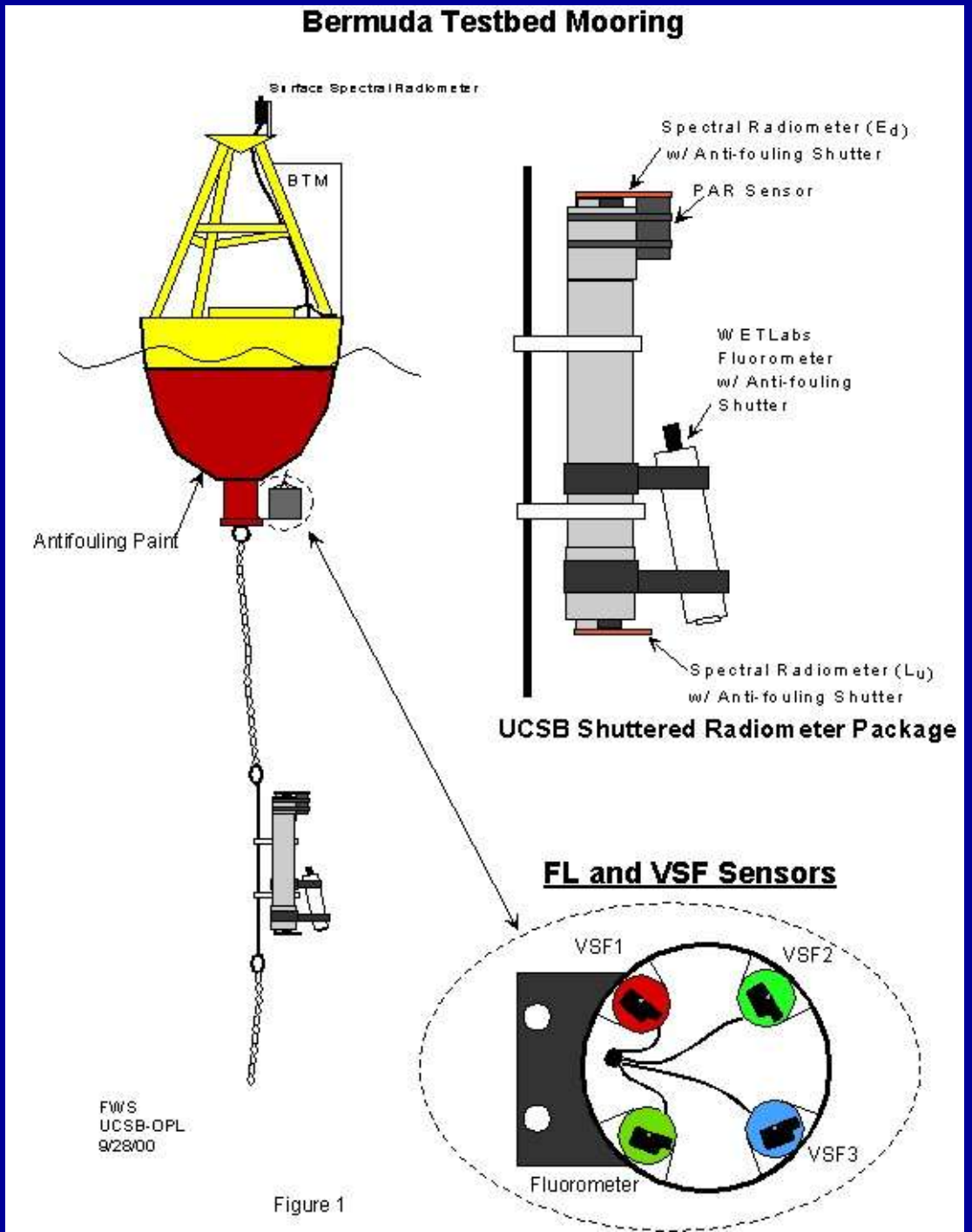

Provided by Bob Bidigare

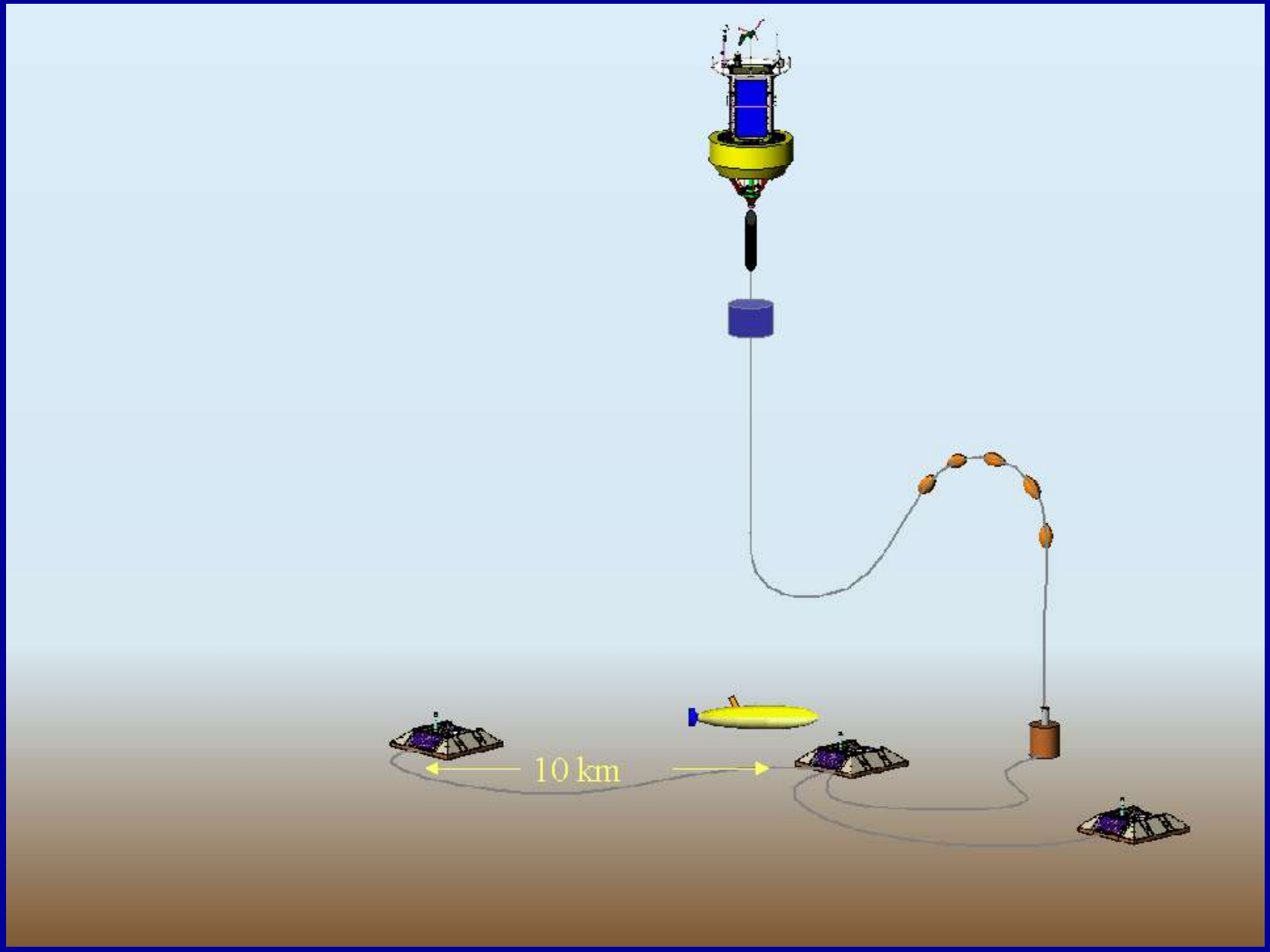
# UCSB Ocean Physics Laboratory Interdisciplinary Mooring/AUV Study Sites




**O-SCOPE ASSOCIATED MOORINGS IN BLUE**

# Bermuda Testbed Mooring Schematic




10 km

# FL-3 & bb-3 (cont)

- Large detection area prevents us from using current shutter design in existing form factor
- Plan to insert present “puck” into larger (3.5”) can.
- Requires new shutter design