New Technologies and Their Roles in Advancing Biogeochemical Science during the JGOFS Era

(With a Glimpse of Future Technologies)

Tommy Dickey

University of California, Santa Barbara

A Sea of Change: JGOFS Accomplishments and the Future of Ocean Biogeochemistry

Final Open Science Conference

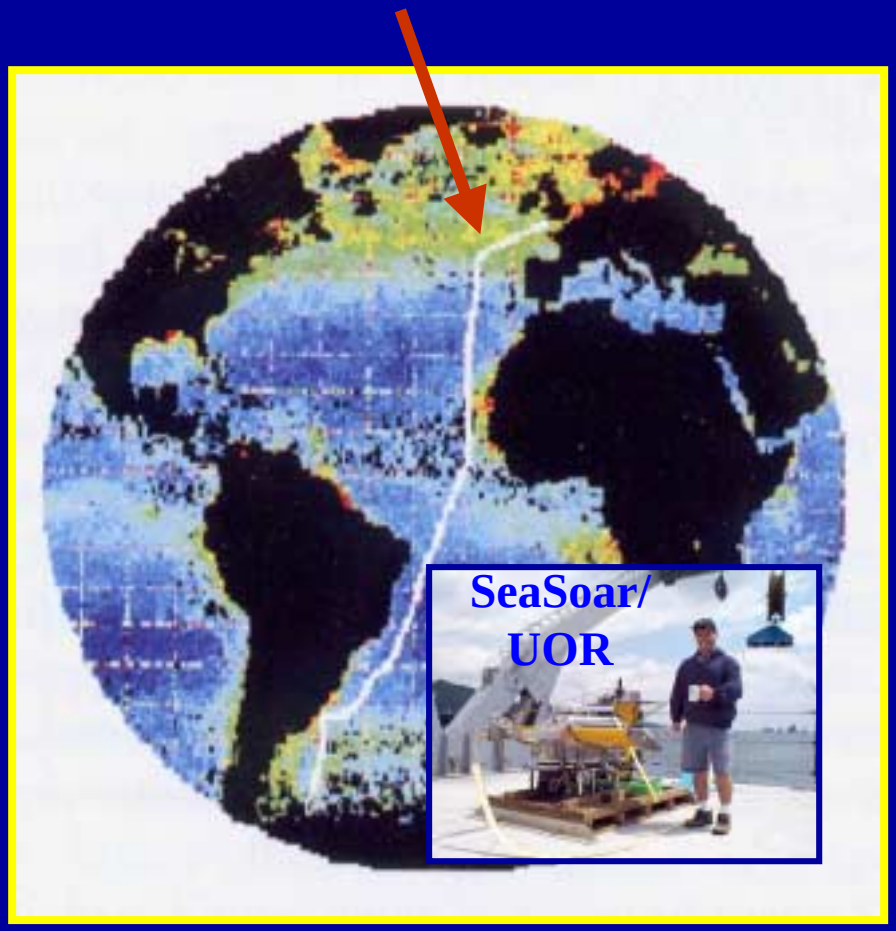
Washington, DC

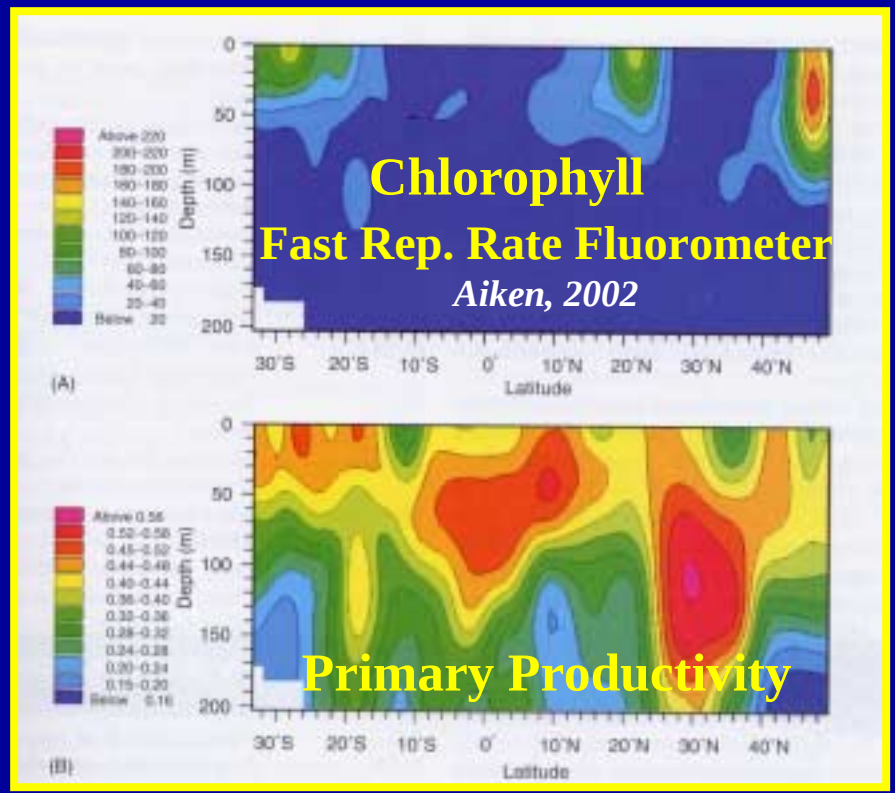
May 5-8, 2003

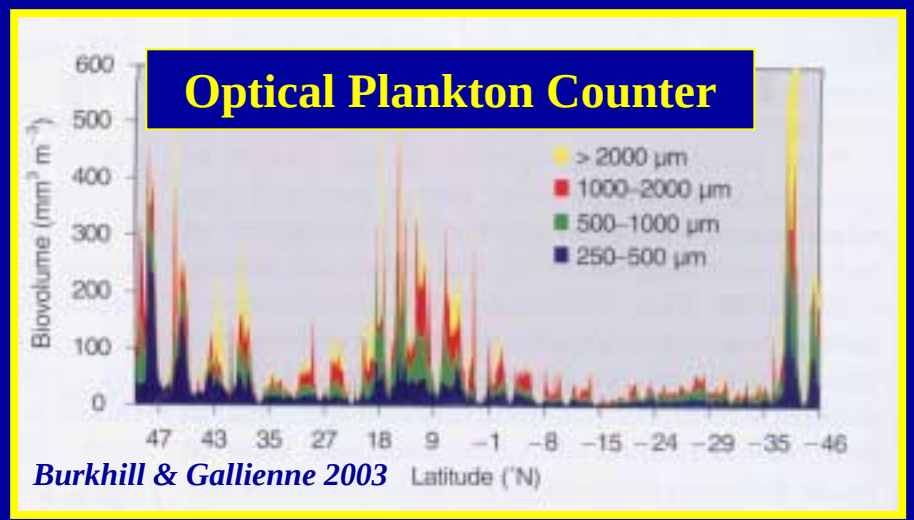
Spatial Variability

Example:

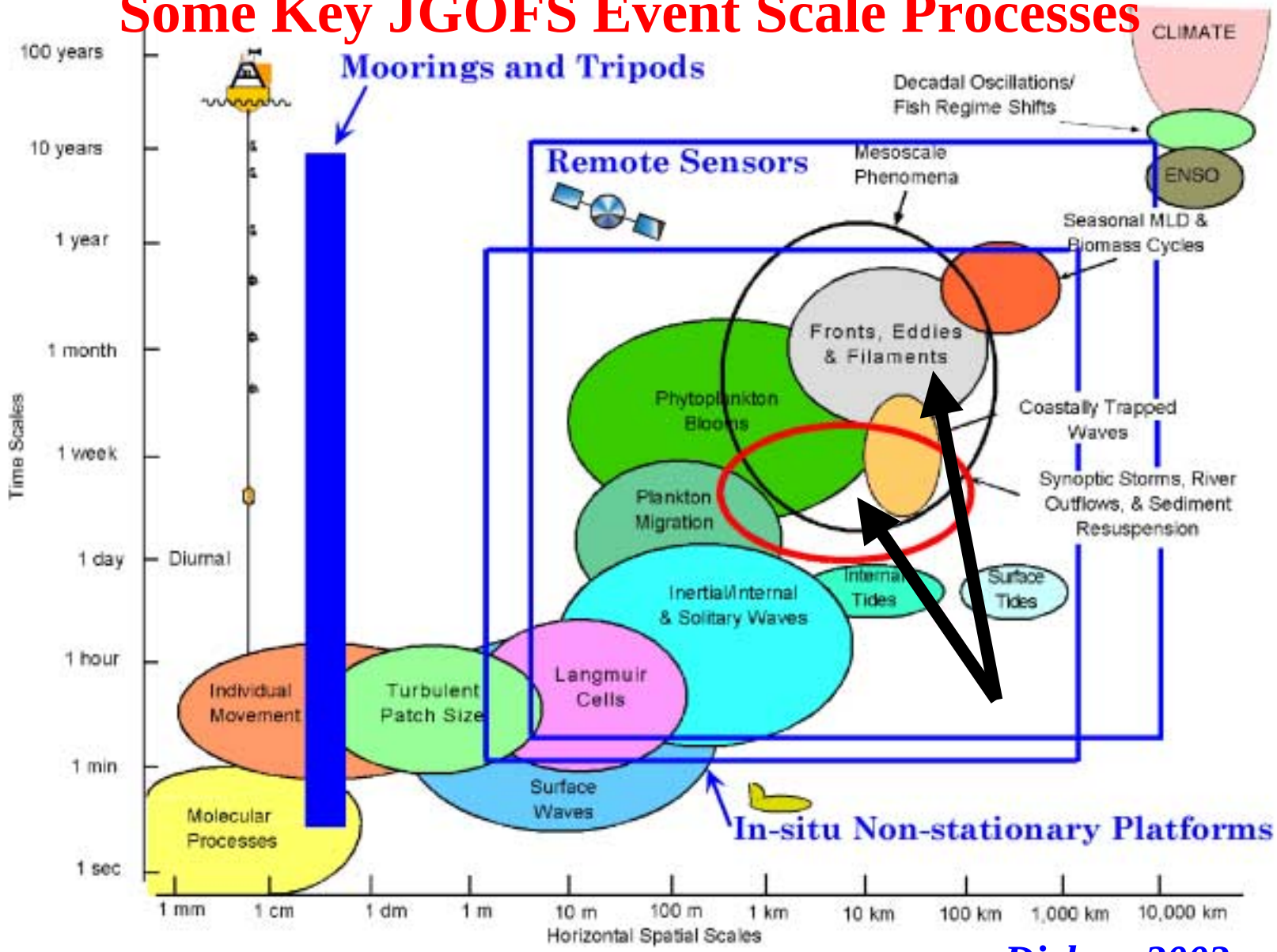
Atlantic Meridional Transect







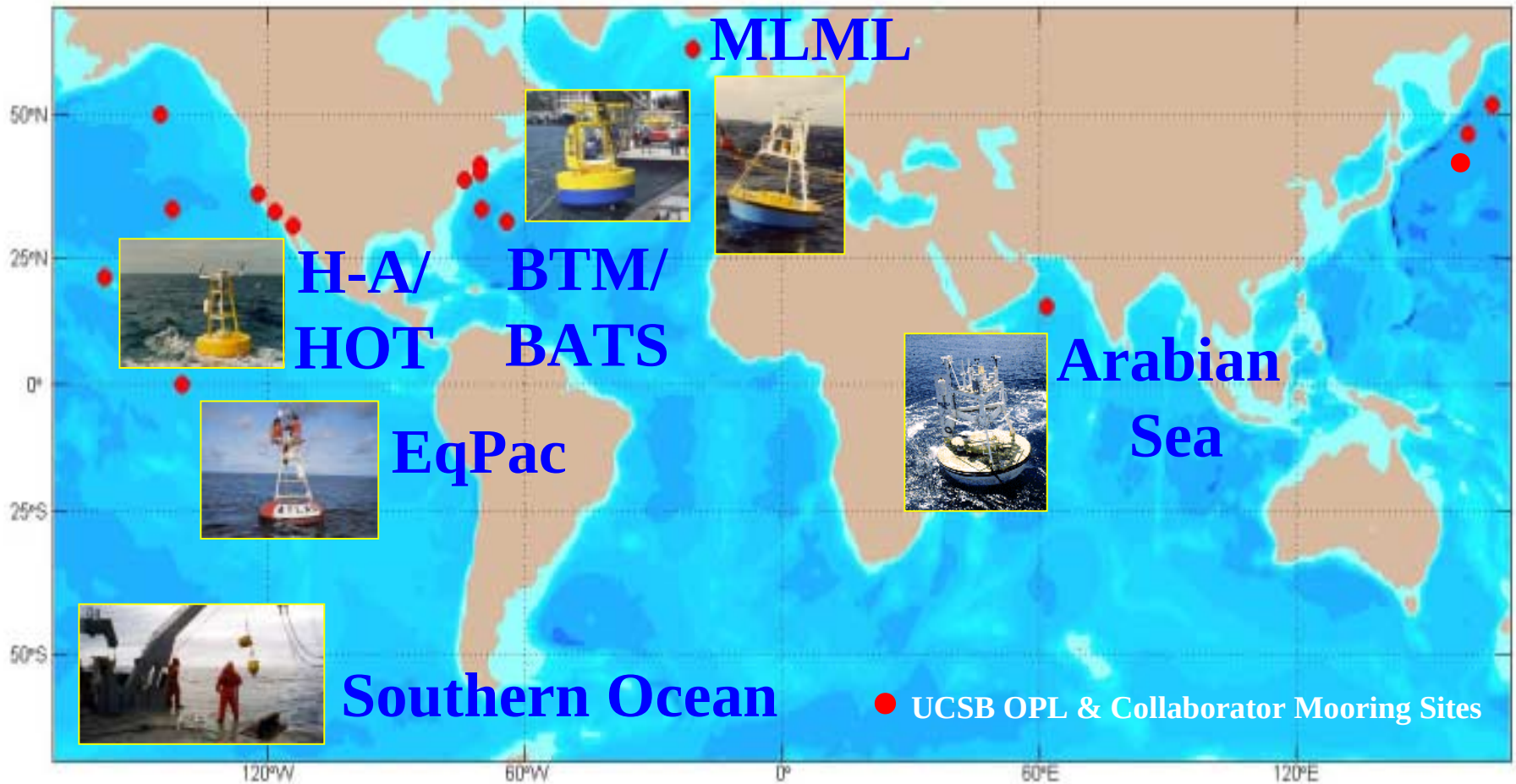
Some Key JGOFS Event Scale Processes



Dickey, 2002

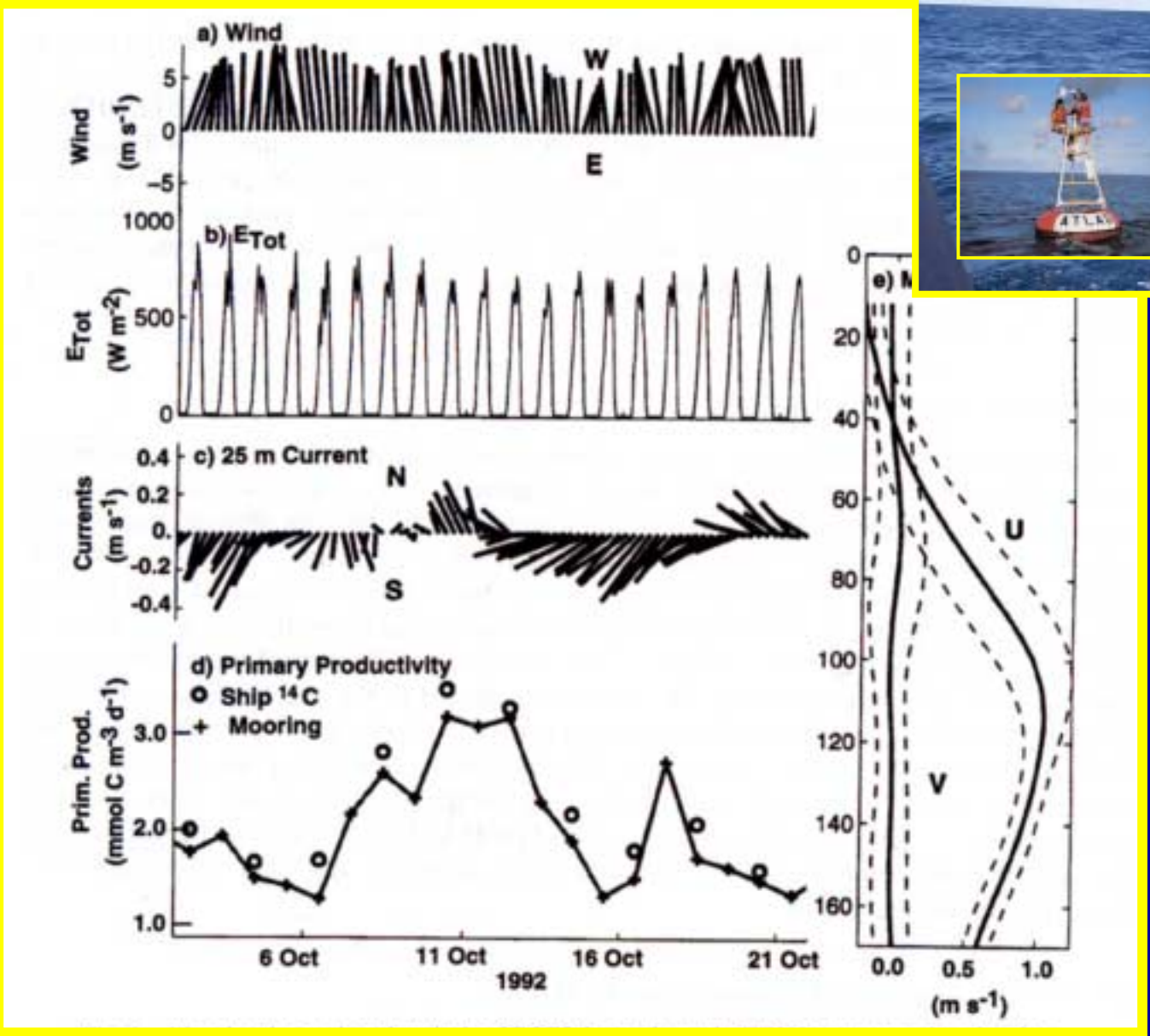
JGOFS Biogeochemical Mooring Study Sites

High Frequency, Long-term Time Series



JGOFS Equatorial Pacific

Passage of Tropical Instability Wave (TIW)



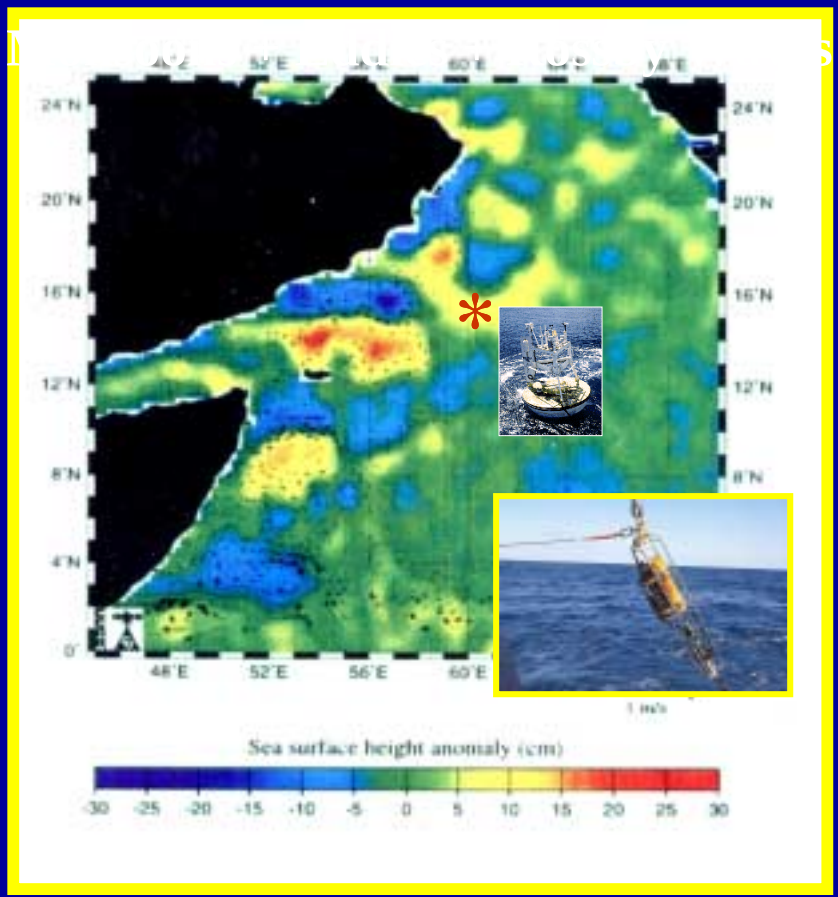
Processes:

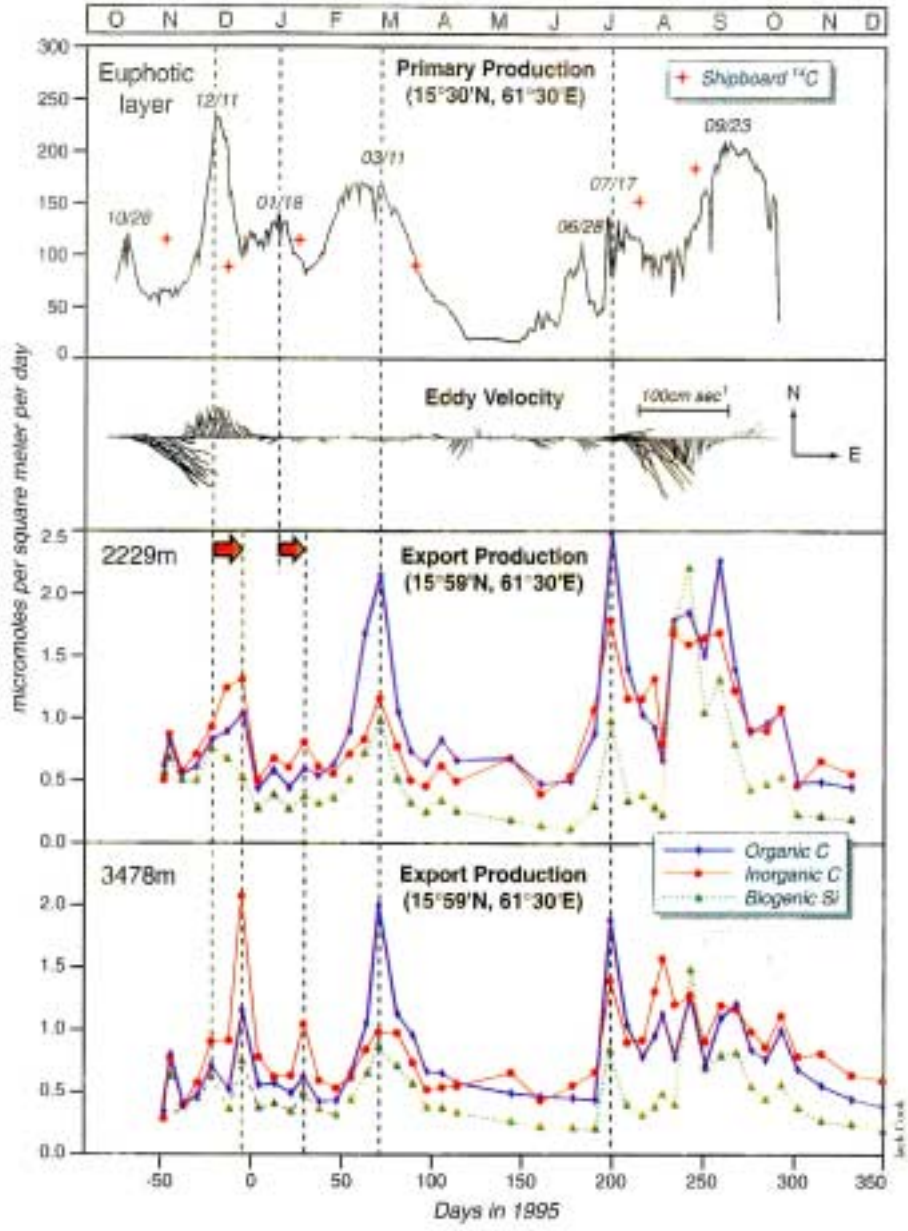
+ ENSO – 2 phases
+ Kelvin Waves
+ TIWs
+ Diel

Foley et al., 1998

JGOFS Arabian Sea Mooring Array

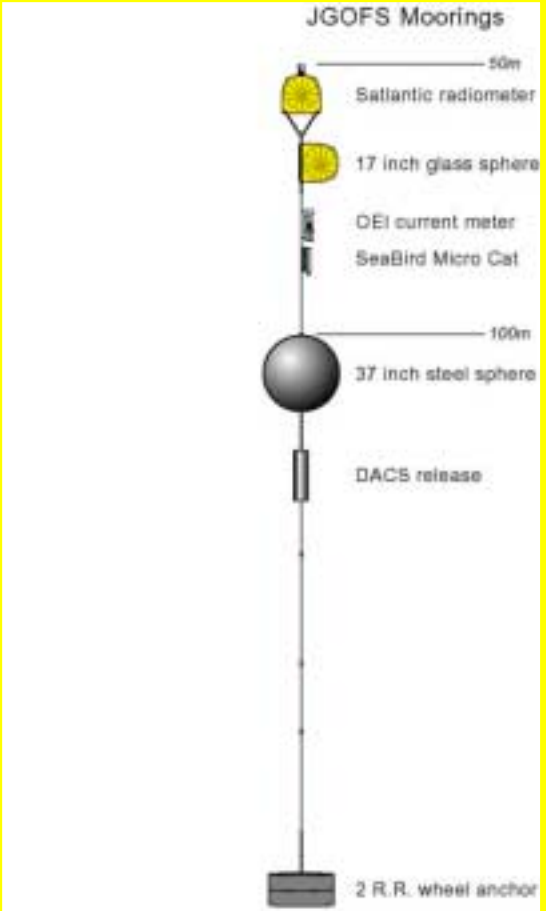
Monsoons & Eddies



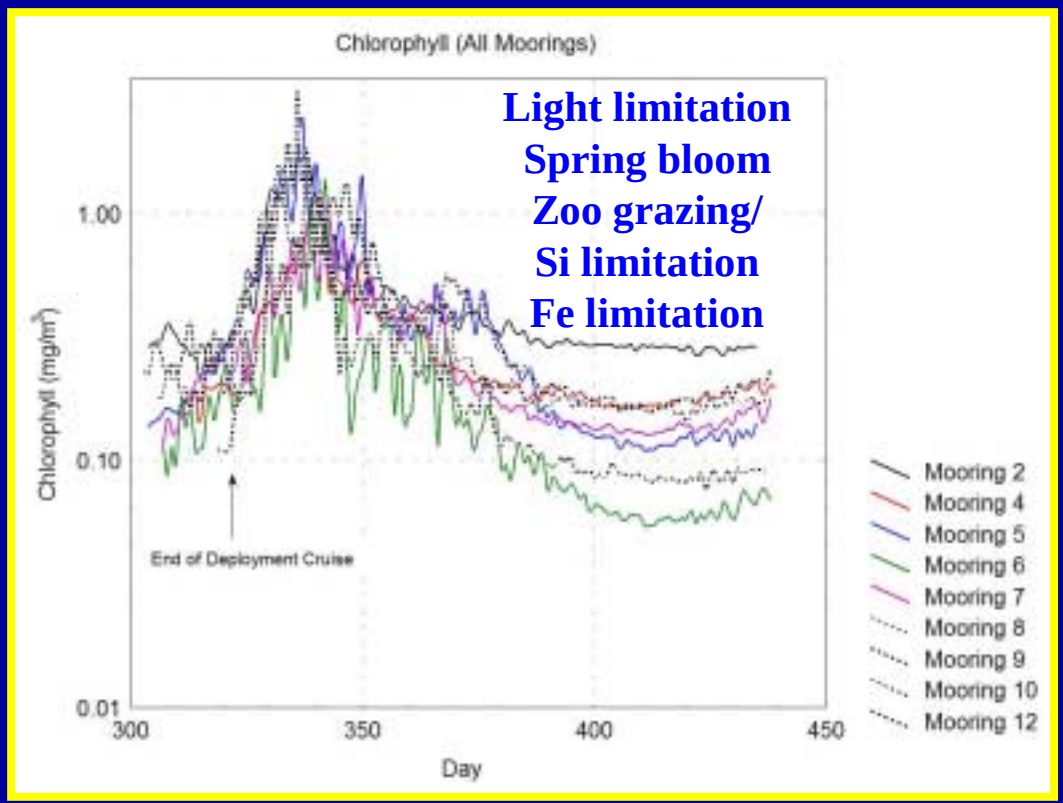


Honjo et al., Weller et al., Marra, et al. and Dickey et al.

JGOFS
Southern Ocean
12-Mooring Array
Spring Bloom & Fronts

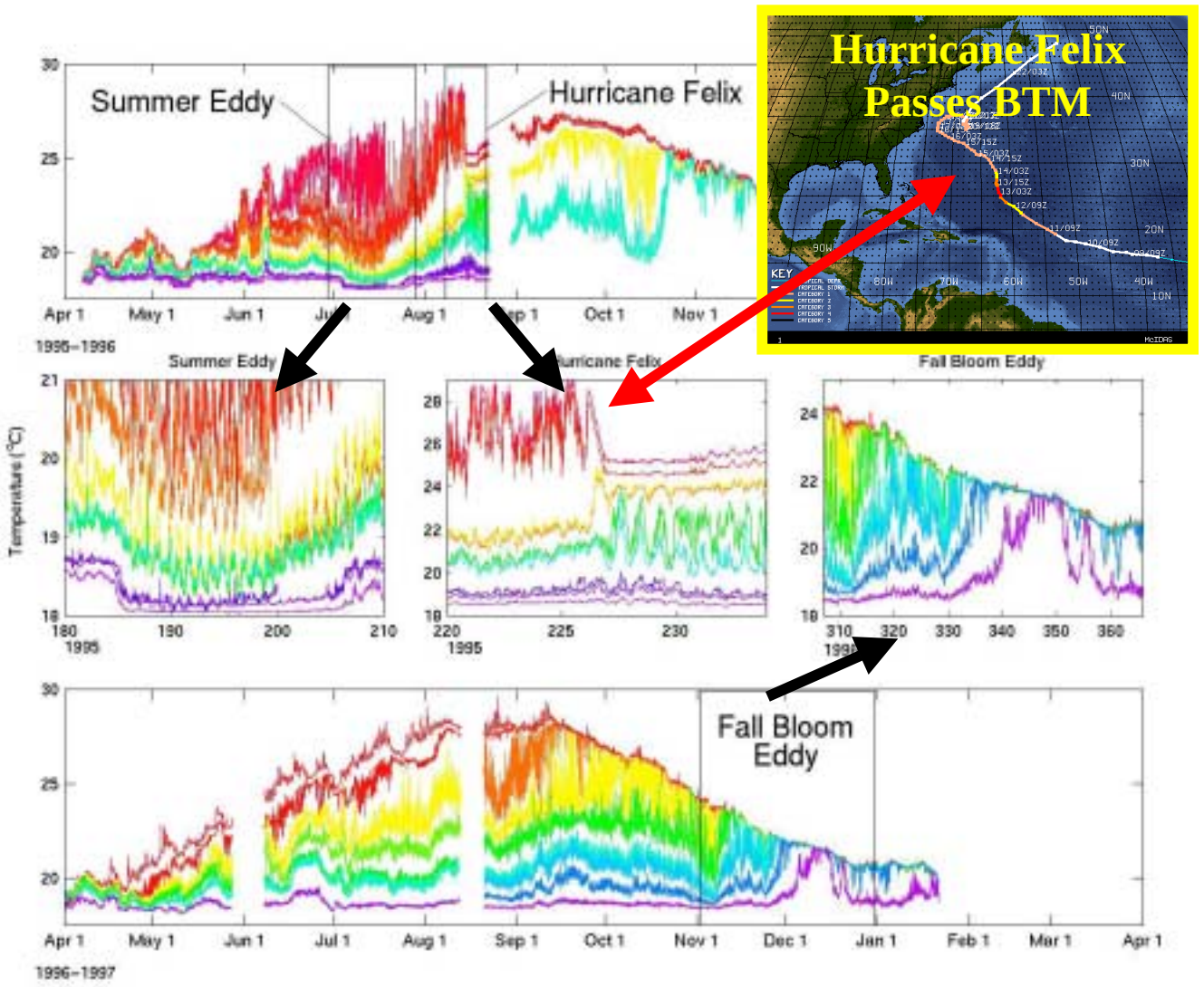


Abbott et al., 2000



Roles of Episodic Events?

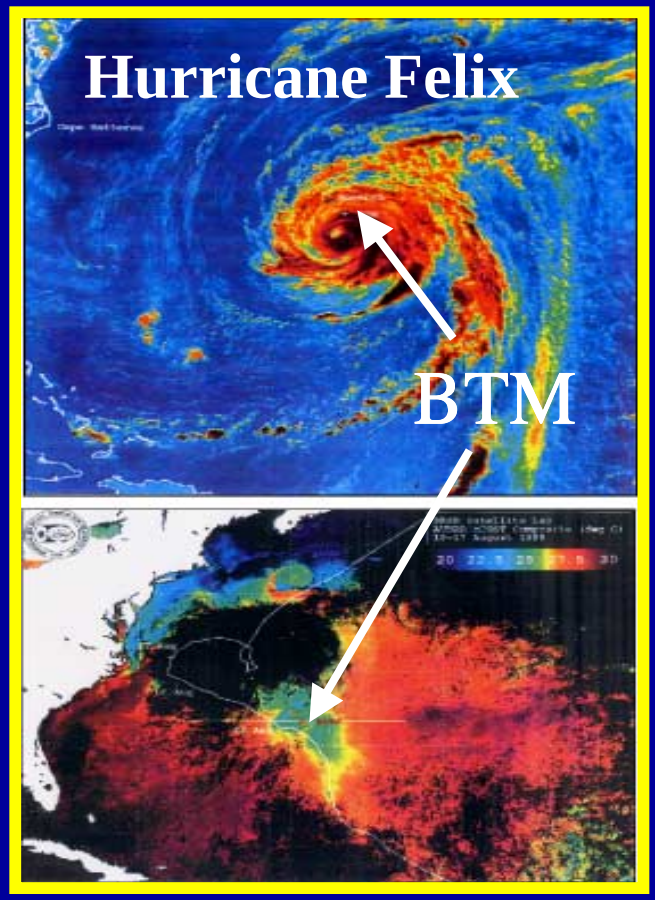
Eddy and Hurricane Passages at BTM/BATS Site



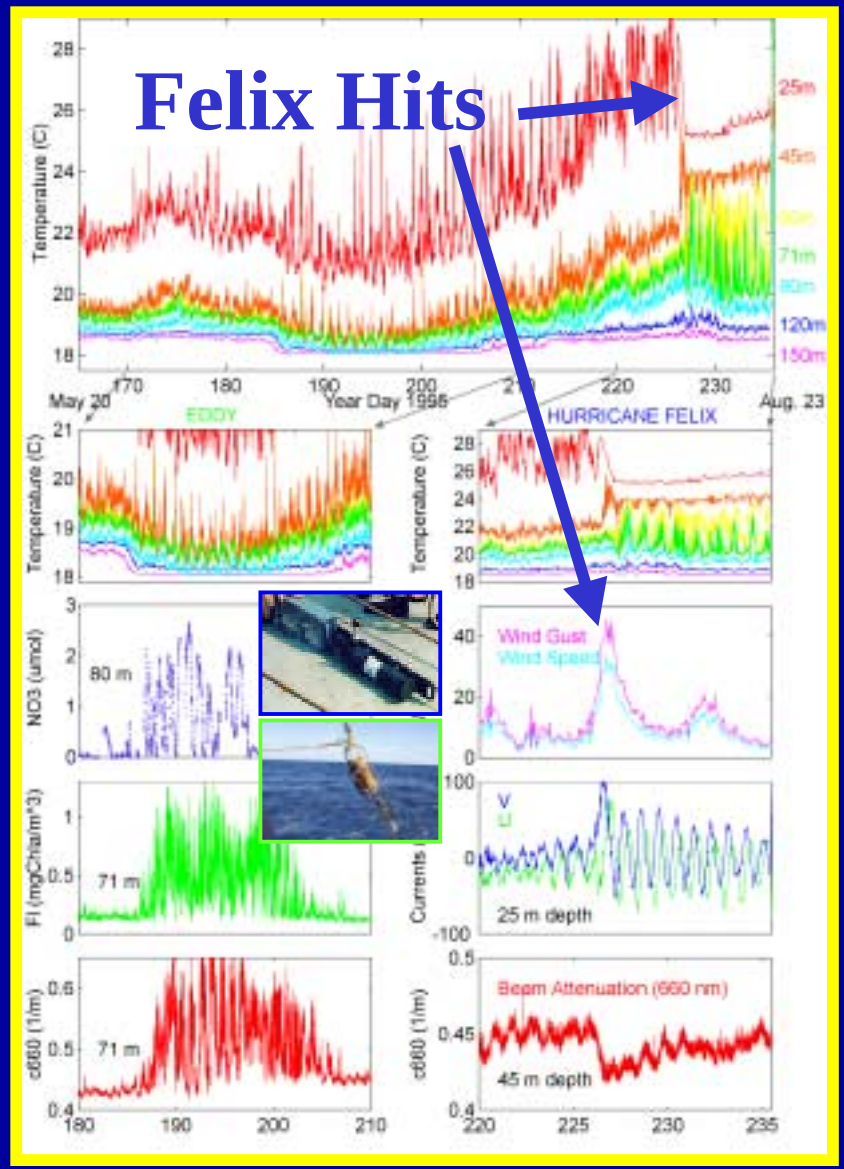
Dickey et al., 1998a,b, 2001; McNeil et al., 1999, Conte et al., 2003; Zedler et al., 2003

Events at the JGOFS BTM/BATS Site

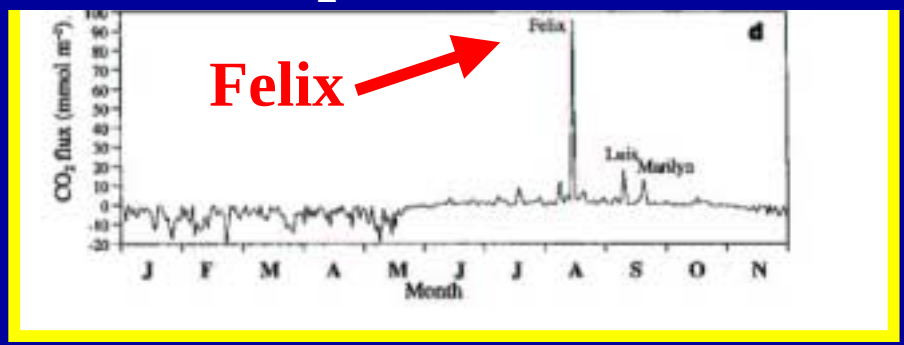
Effects: pCO_2, PP, Biol. Pump?



Eddy



CO_2 Efflux



Dickey et al., 1998a,b, 2001a; McGillicuddy et al., 1998, McNeil et al., 1999, Bates et al., 2000

Nitrate Injections at JGOFS H-A/HOT Site

HALE ALOHA HOT MOORING
Nitrate OsmoAnalyzers at 180m & 120m

180m depth

120m depth

Nitrate (µM)

Temp (°C)

Time (GMT)

5/8/99
6/27/99
8/16/99
10/5/99
11/24/99

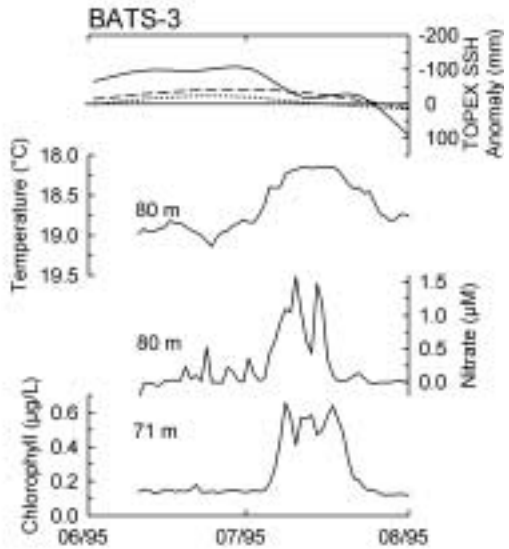
180m Osmo Nitrate
180m Bottle Data
120m Osmo Nitrate
120m Bottle Data
180m Temp
120m Temp

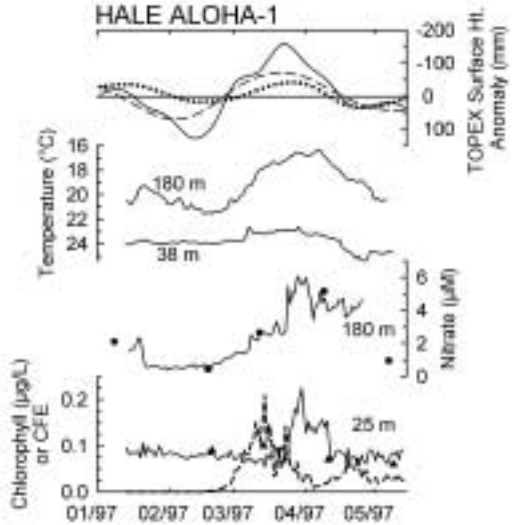
Osmoanalyzer, Hans Jannasch

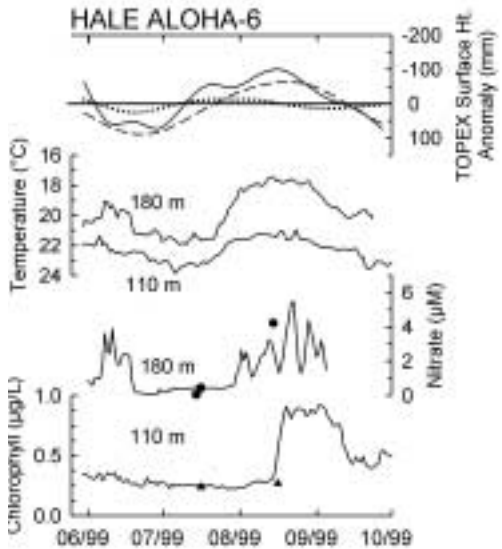
Data provided by Hans Jannasch and Ken Johnson; see paper by Letelier et al., 2000

Eddy and Rossby Wave Passages at BTM/BATS and H-A/HOT Sites

2nd Baroclinic Eddy 1st Baroclinic Eddy-Rossby Wave Rossby Wave

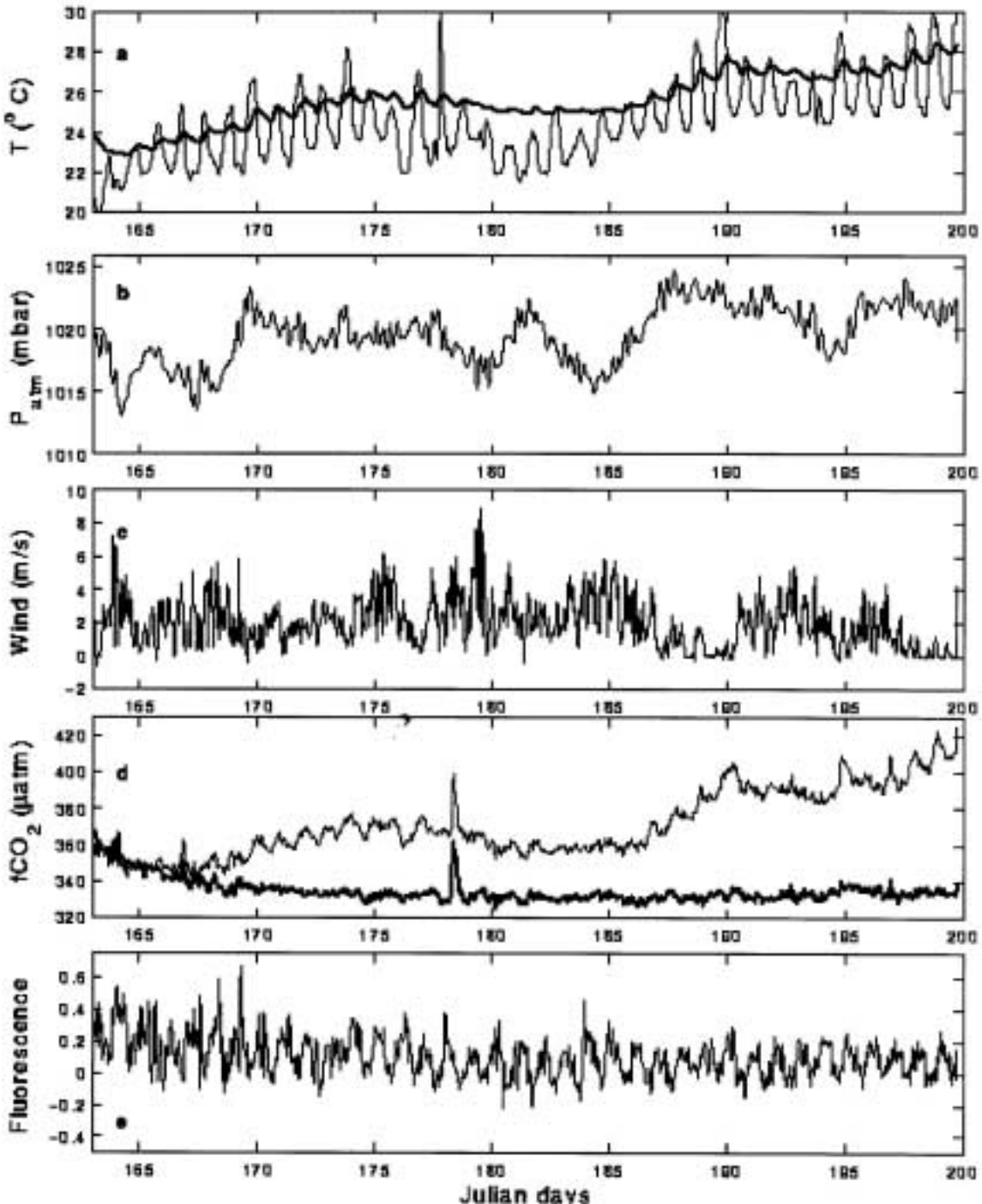




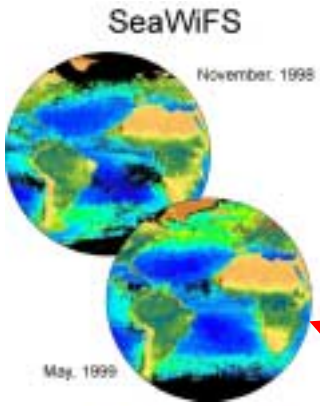


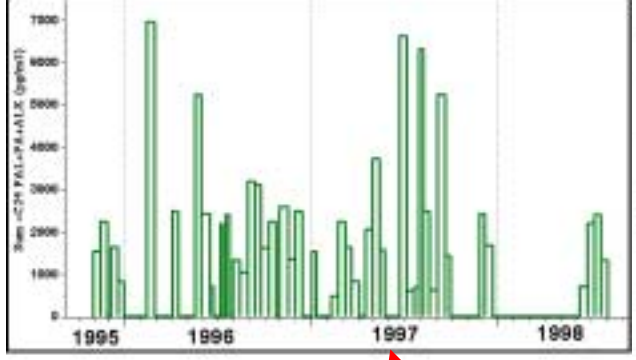
Sakamoto et al., 2003

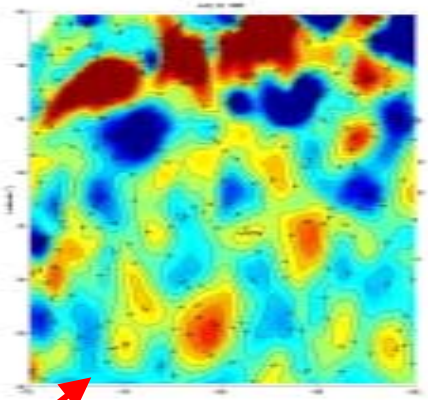
CARIOCA Buoy/Drifter and BTM Time Series

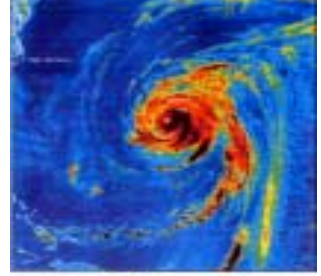


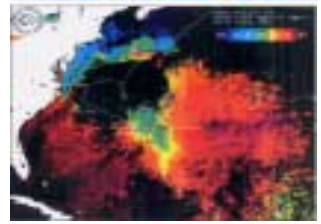
Argo floats also capable of interdiscipl. measurements

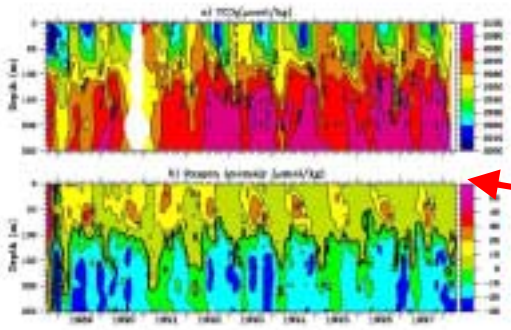

SeaWiFS
November, 1998
May, 1999

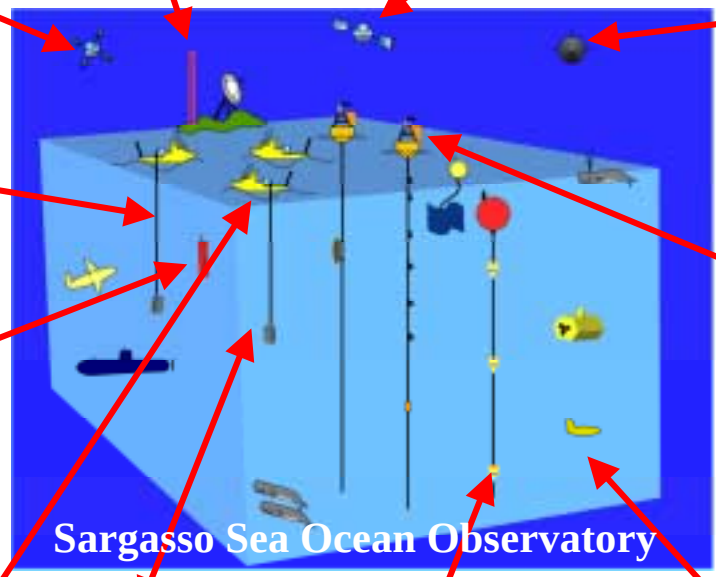

1995
1996
1997
1998

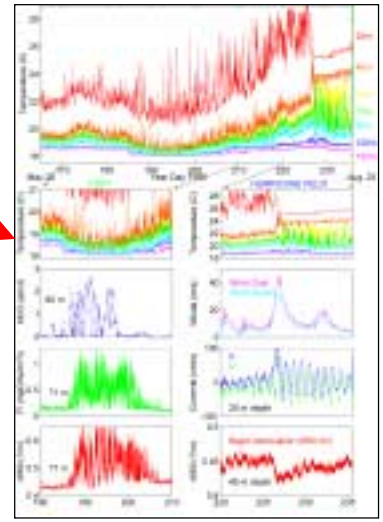


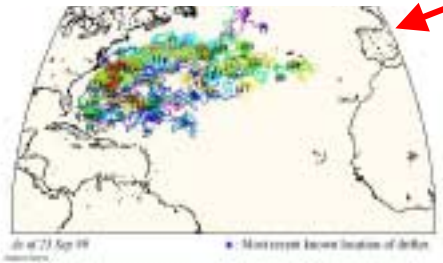


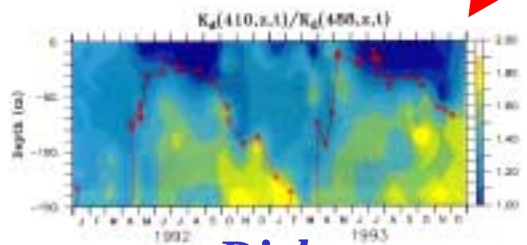




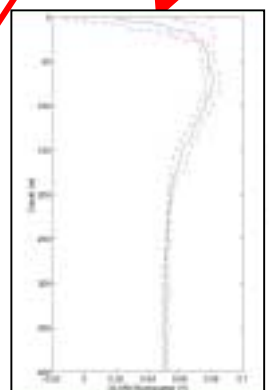

Sargasso Sea Ocean Observatory

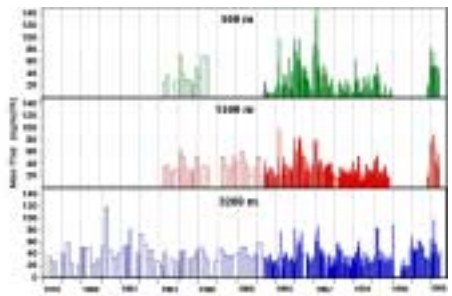


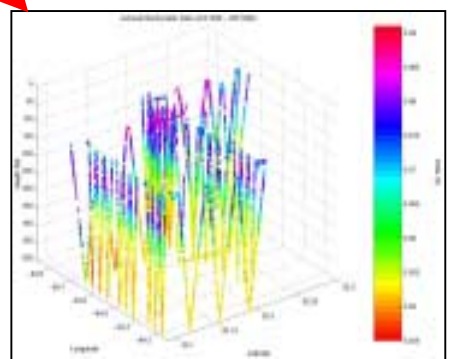



$K_d(410,z,t)/K_d(488,z,t)$
1992
1993

Dickey







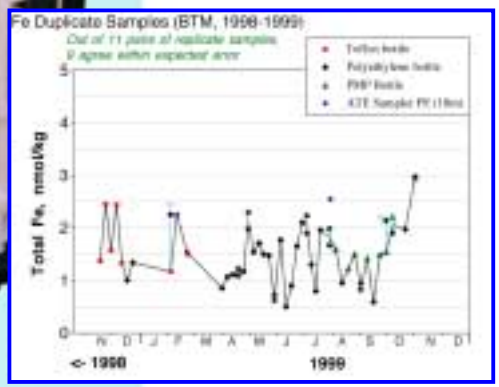
MITESS Iron Time Series from BTM

Ed Boyle

MITESS:

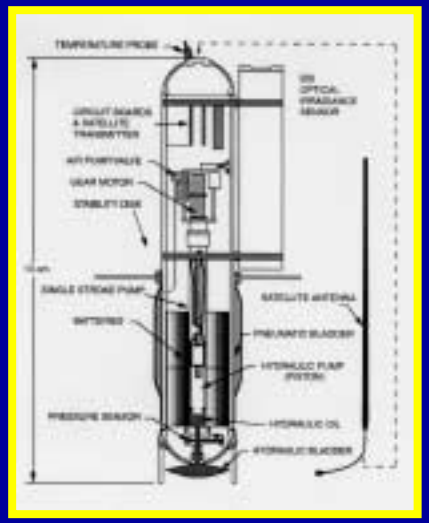
Moored In-situ Trace Element Serial Sampler

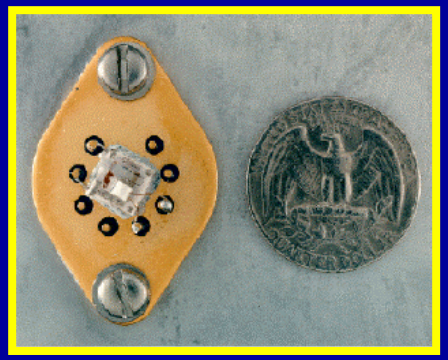
- Collects uncontaminated water samples under programmed control
- Deployable on Moorings for >6 months
- Can be used by anyone to collect deep-sea trace metal profiles

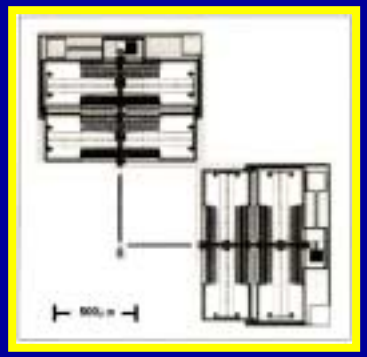


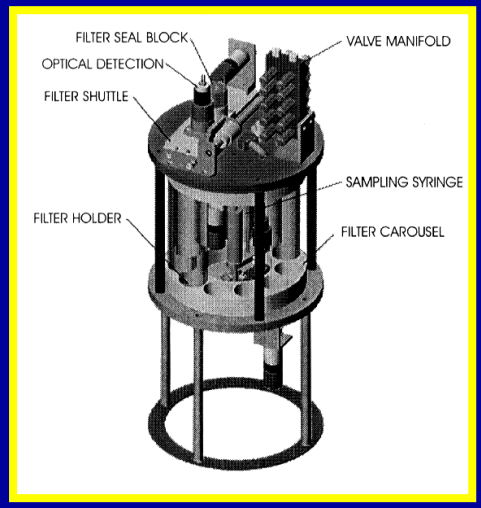
TS-SID for ^{14}C Prim. Prod. Measurements

Craig Taylor

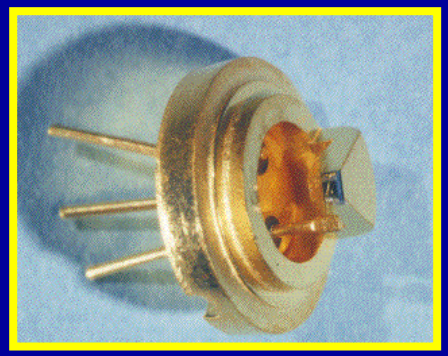


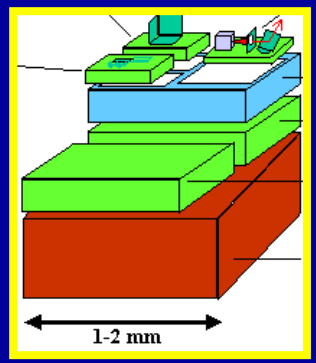




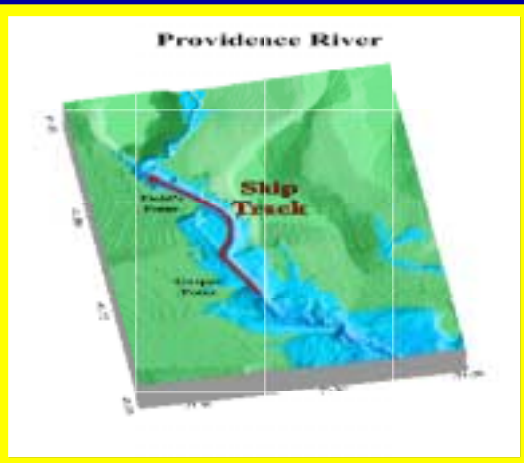


A Glimpse of Future Technologies





Chemical Plume Mapping with an Undulating Towed Vehicle



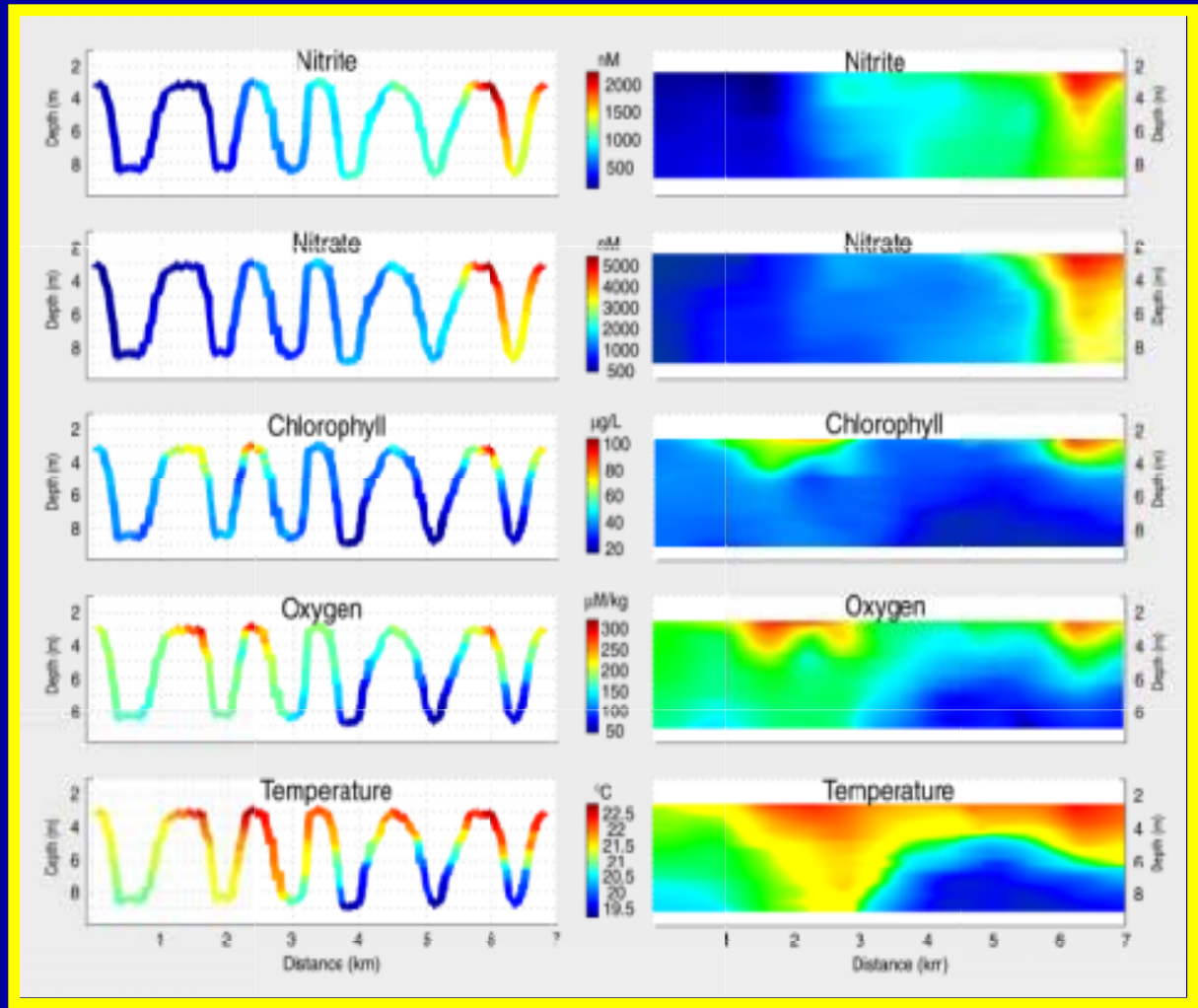


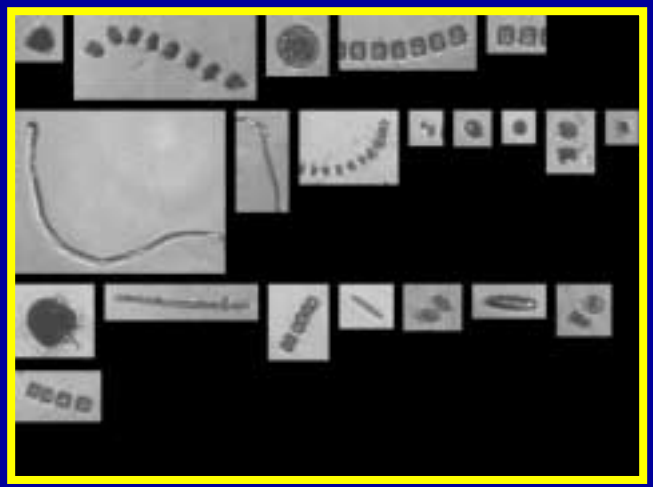
Figure provided by Al Hanson

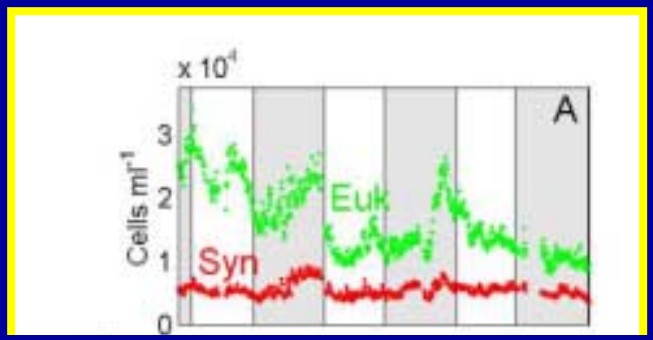
Spectral Elemental Analysis System

In Situ Mass Spectrometer

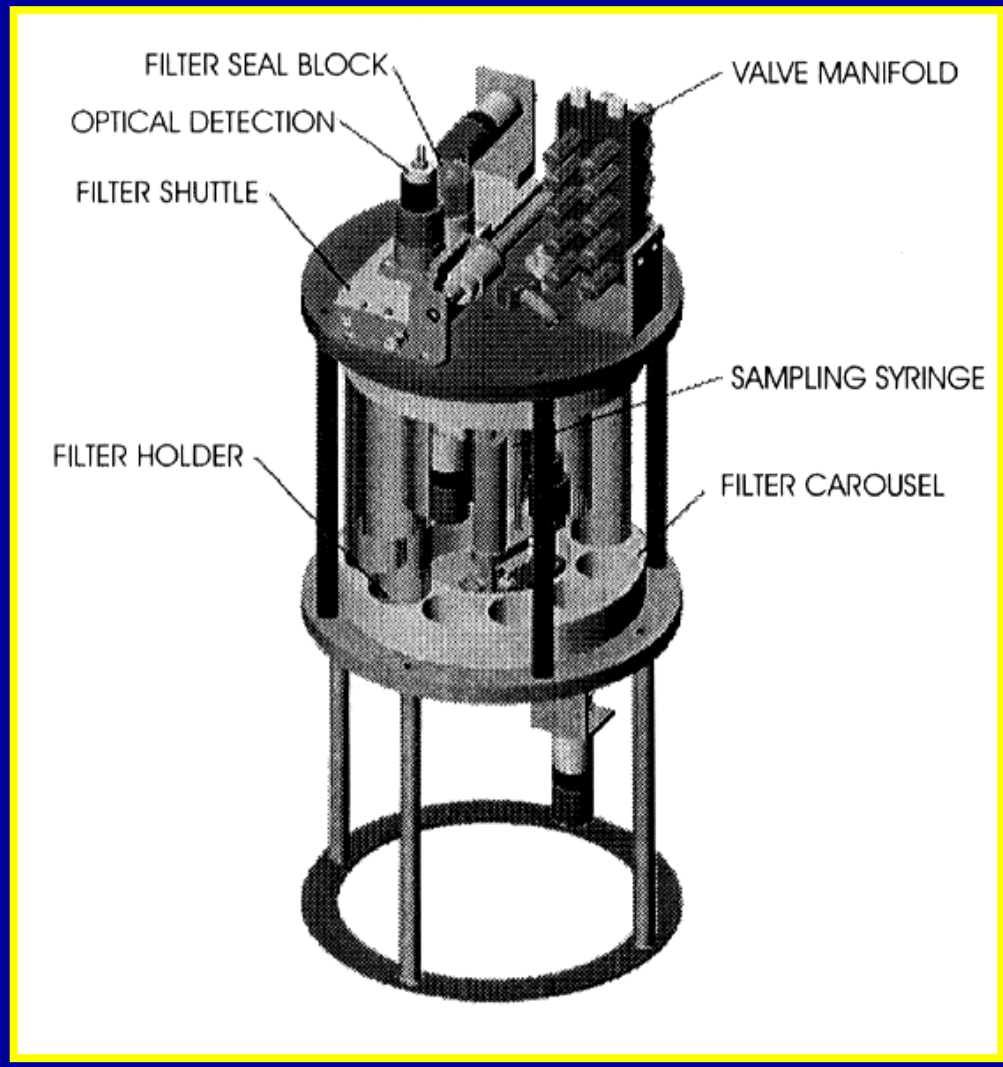
Bob Byrne, USF

Moored Flow Cytometer (left)
DNA System (below)



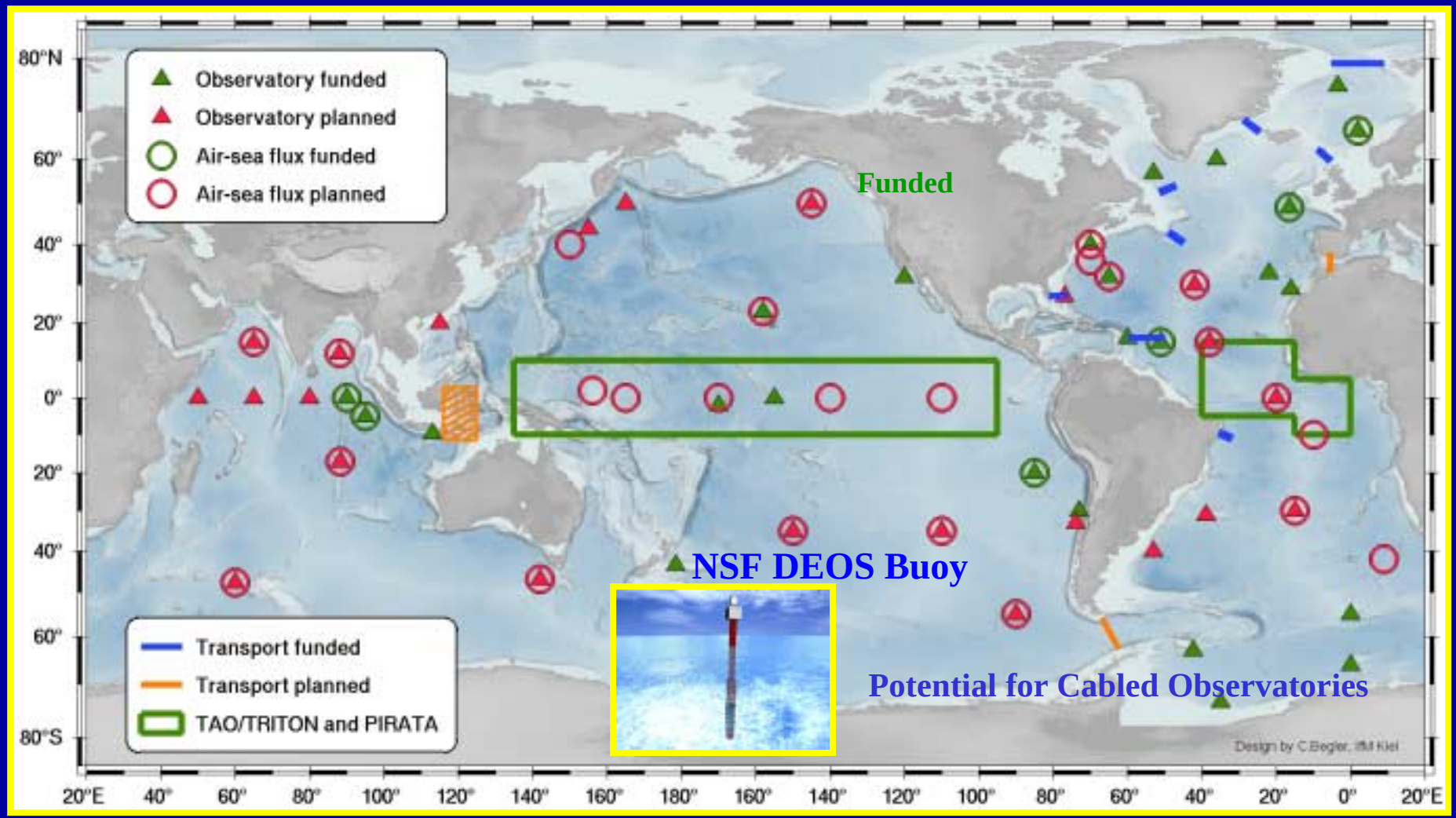


Rob Olson et al.



Chris Scholin

Global Map of Existing and Planned Time Series Observatories



Note: Biogeochemical Measurement Sites: 30 planned; ~10 in operation now

Ocean Observing Panel for Climate Global Eulerian Observatories (GEO)/Time Series Science Team

DEOS Observatory

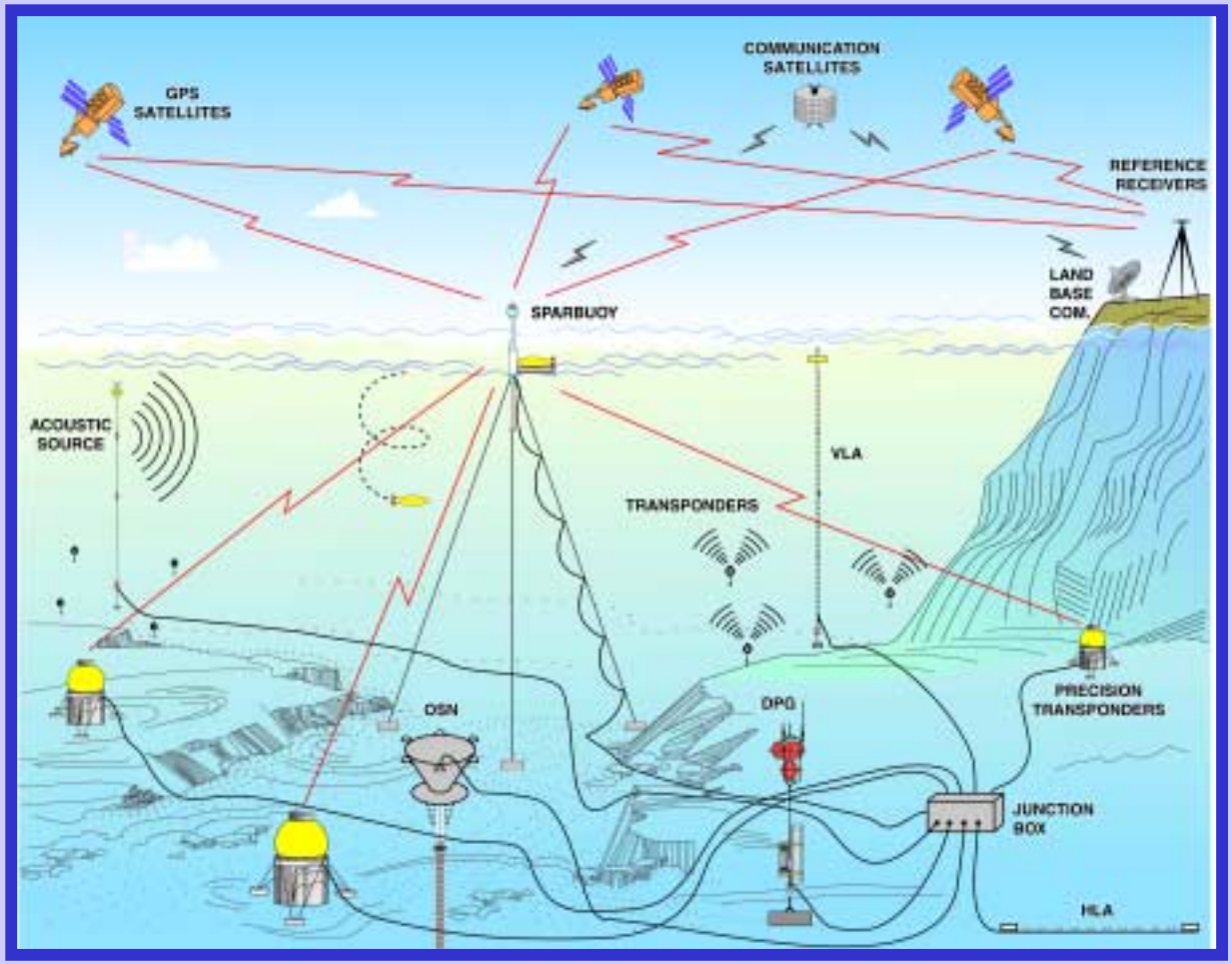


Figure provided by John Orcutt

AUVs and gliders with interdisciplinary sensors

Summary of JGOFS Advances Enabled Via Technologies

- **Measurements of seasonal, interannual, and "long-term" biogeochemical (BGC) and ecosystem variability (HOT/BATS): e.g., carbon, new organisms, …**

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- Instrumentation making possible Fe-enrich. studies

Selected Recent Relevant References:

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Dickey, T., 2002, Instrumentation and new technologies, Oceans 2020: Science for Future Needs, Ch. 9, J.G. Field, G. Hempl, and C.P. Summerhayes (Eds.), Island Press, Washington, DC, 211-259.

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Website: www.opl.ucsb.edu

For further information, websurf @
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email :
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