

# The role of fixed-point deep ocean observatories in a global observing system

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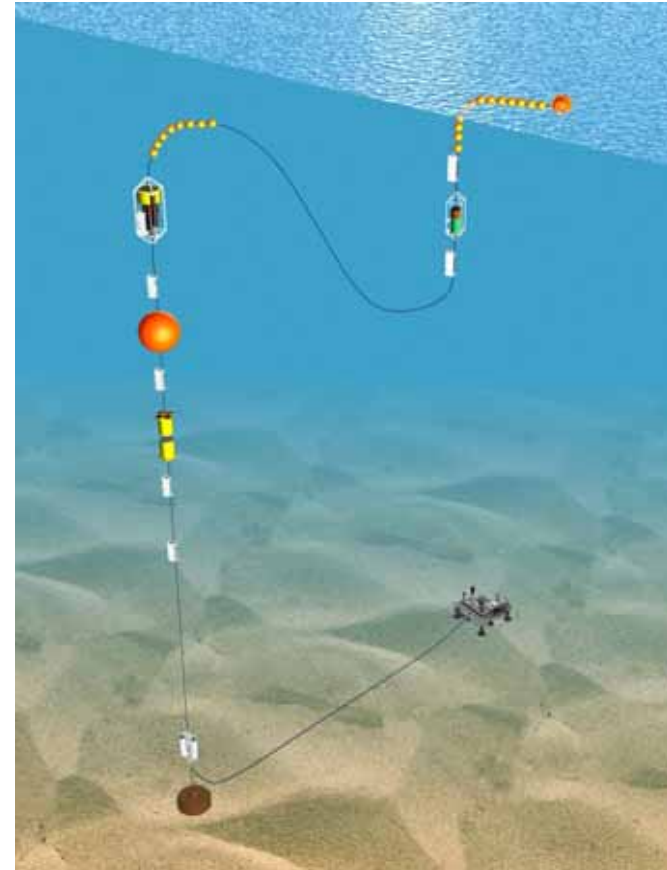


**National Oceanography  
Centre, Southampton**

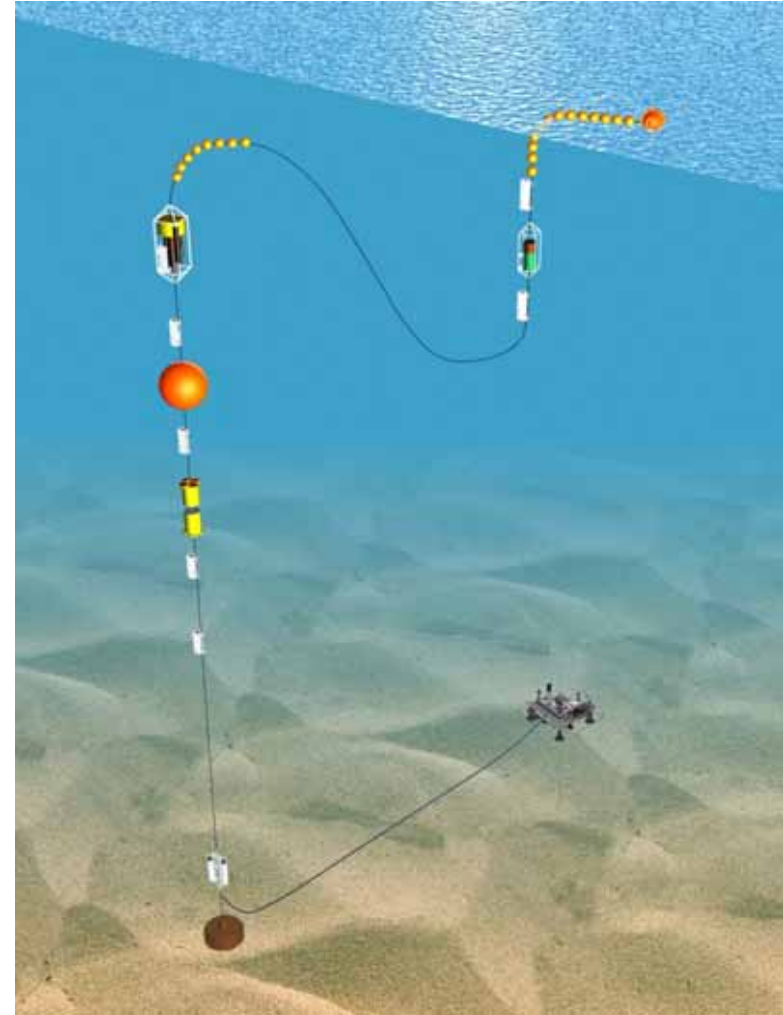
UNIVERSITY OF SOUTHAMPTON AND  
NATURAL ENVIRONMENT RESEARCH COUNCIL

# Global Observing System

1. Satellite remote sensing
2. Ships (a) Research vessels  
(b) Voluntary Observing Ships
3. Drifters, gliders and buoys
4. Eulerian (fixed-point) observatories  
(a) Shelf seas  
\*(b) Open ocean



Why are fixed-point deep ocean observatories important and relevant for a global ocean observing system?



# Unique contributions/strengths of fixed time-series

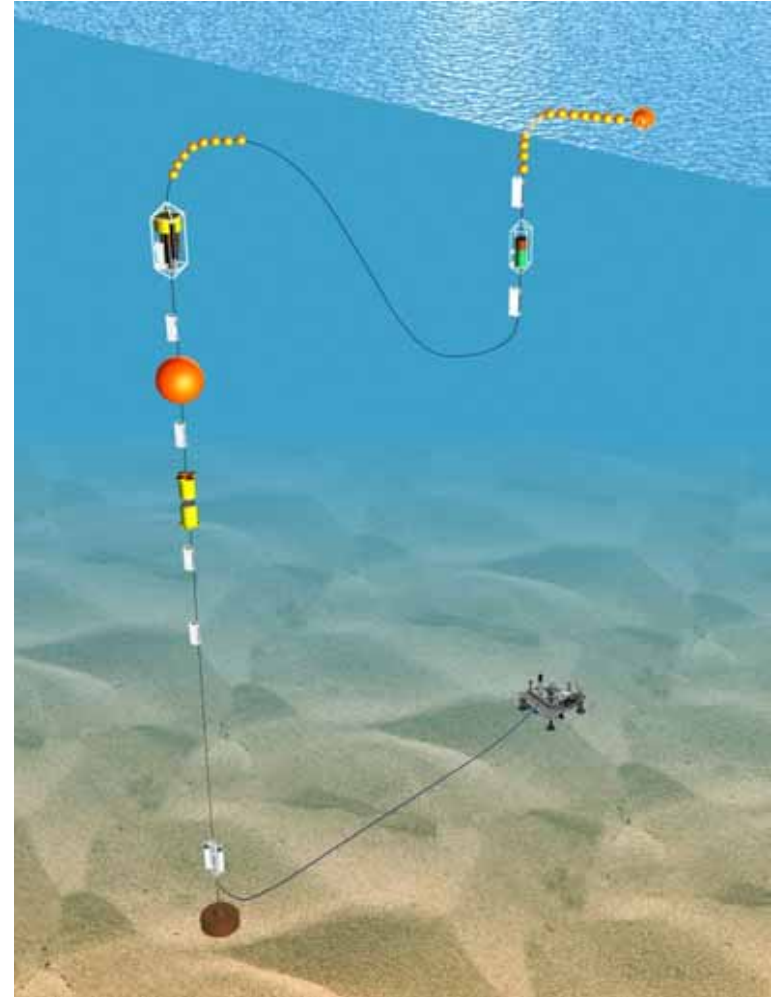
## Sustained, high frequency, *in situ* time-series

- Short-term variation and ecosystem dynamics
- Capture episodic events
- Long-term change and climatic trends

# Multidisciplinary science: Vertical coverage

- Temperature
- Salinity
- Nutrients
- Chl-a
- CO<sub>2</sub>
- Particle flux
- Currents

Real-Time Telemetry



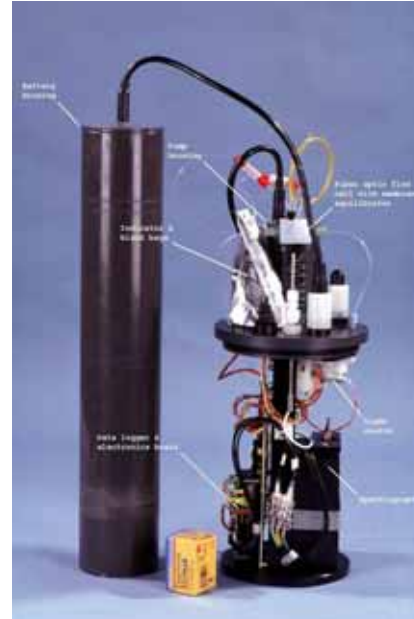
# Observatory sensors



Fluorescence



Nutrients



CO<sub>2</sub>



CTD



Downward particle flux



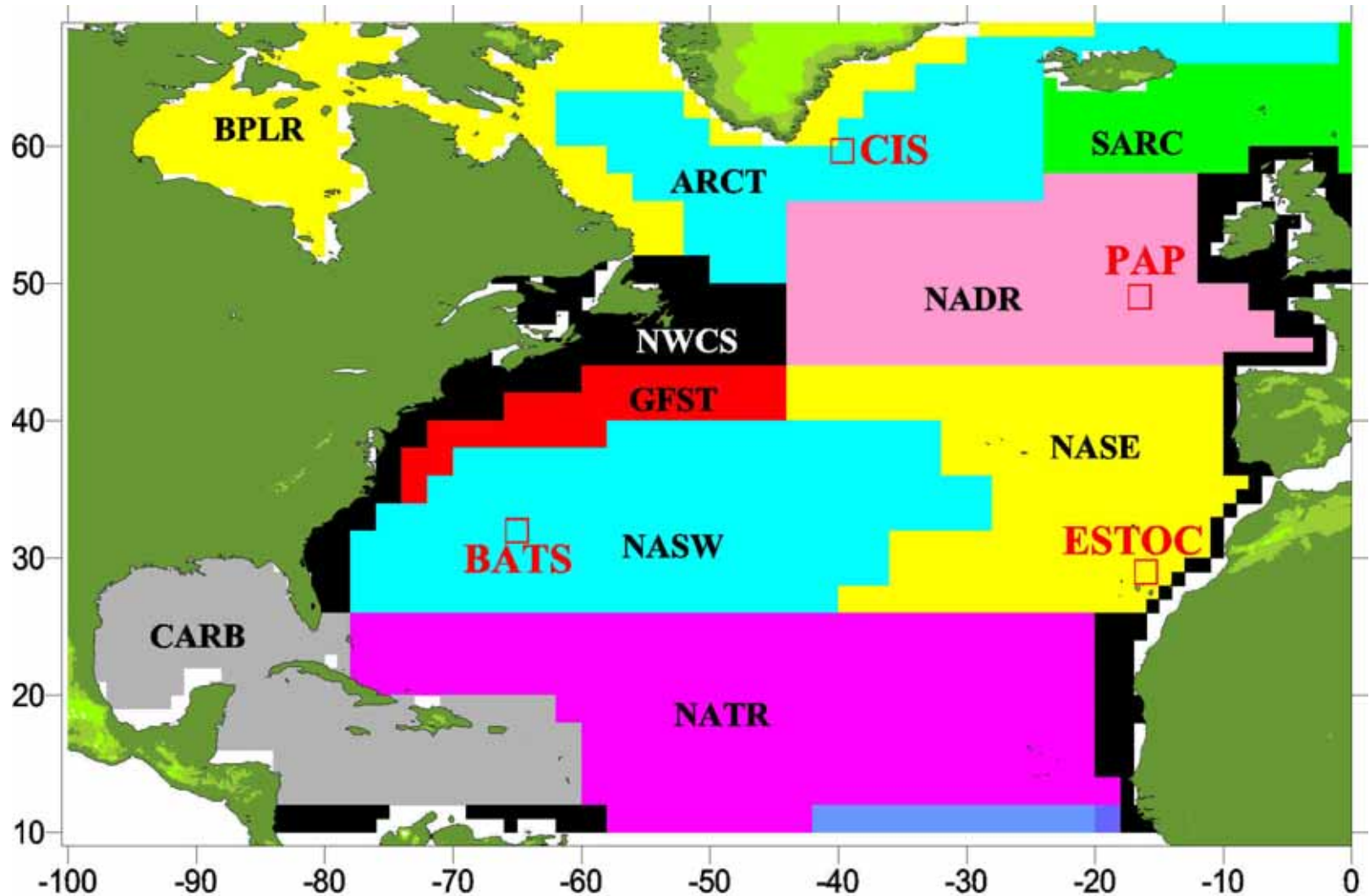
Water  
currents

PROVEN SENTINEL PERFORMANCE—IN DEEP WATER

# Unique contributions/strengths of fixed time-series

- **Mature technology:** Fixed autonomous platform in remote/harsh environments (e.g. high latitude open ocean, strong currents, hydrothermal vents)
- **Durability and Inexpensive:** Prolonged measurements at high sampling rate without cables required

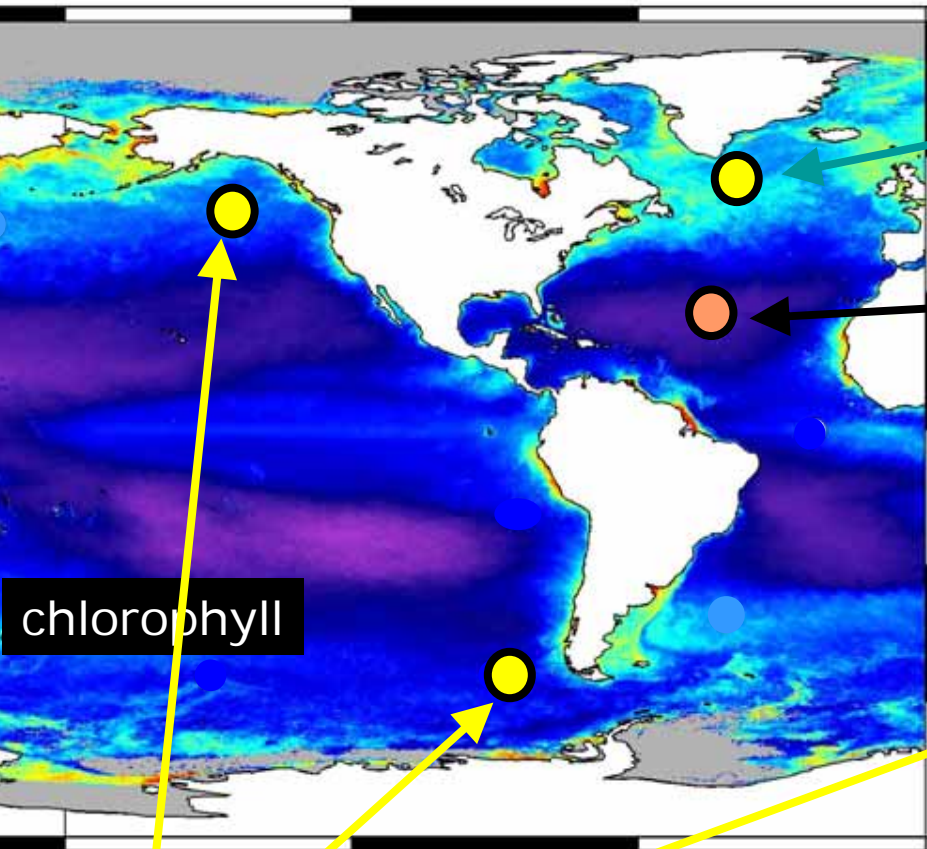
# Key locations: Models for open ocean processes



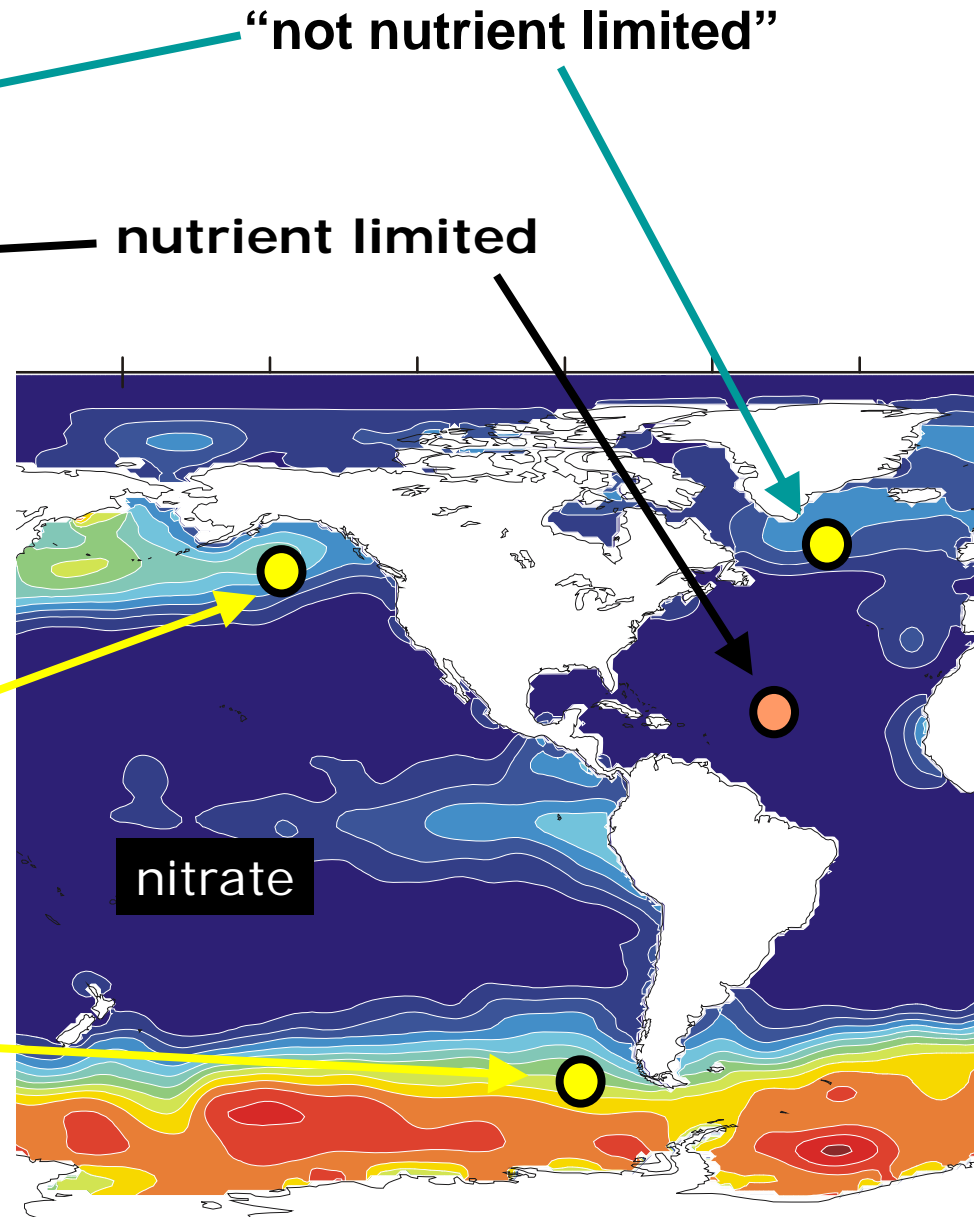


# Ocean productivity: contrasting regimes

(response to climate variability)



**Nutrient-rich but  
(iron) limited**

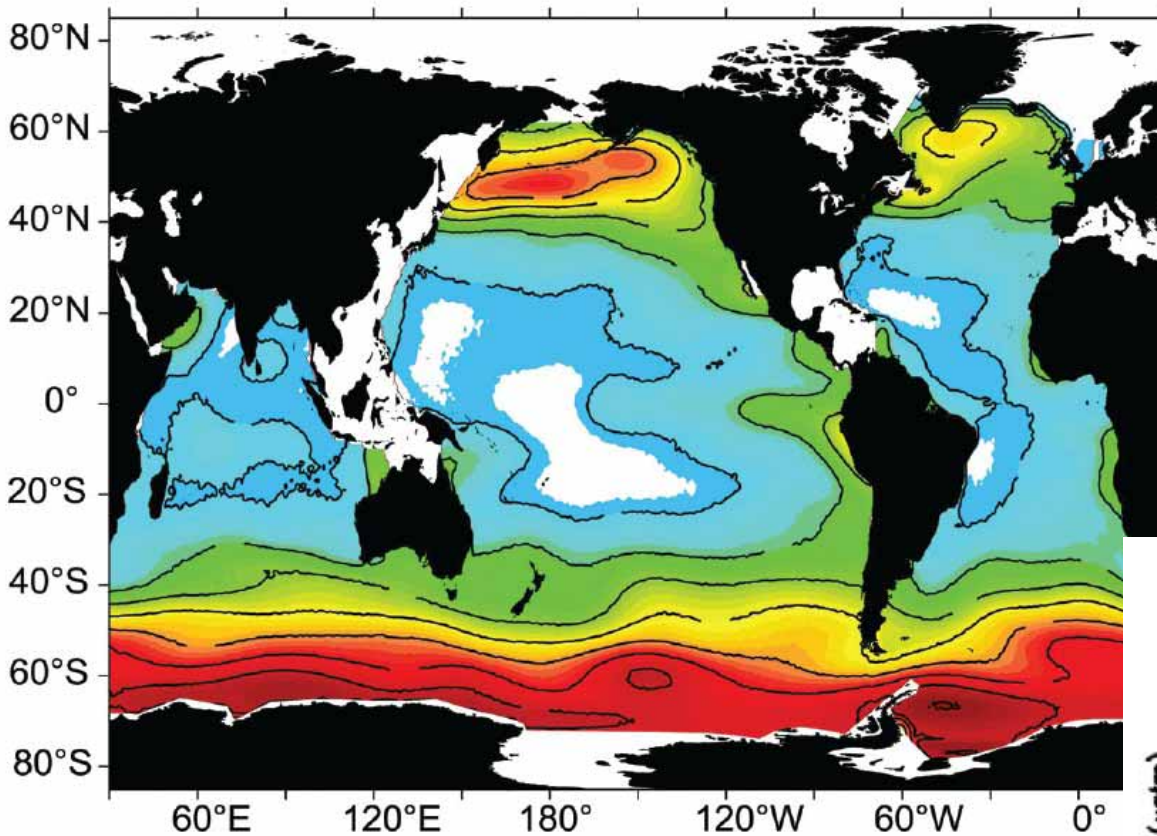


**"not nutrient limited"**

**nutrient limited**

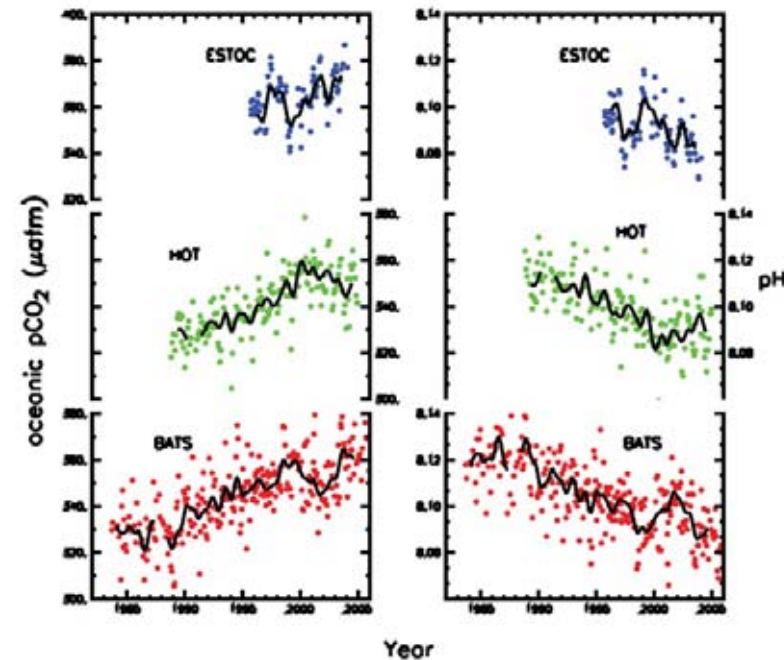
**nitrate**

# global carbon cycle processes and acidification



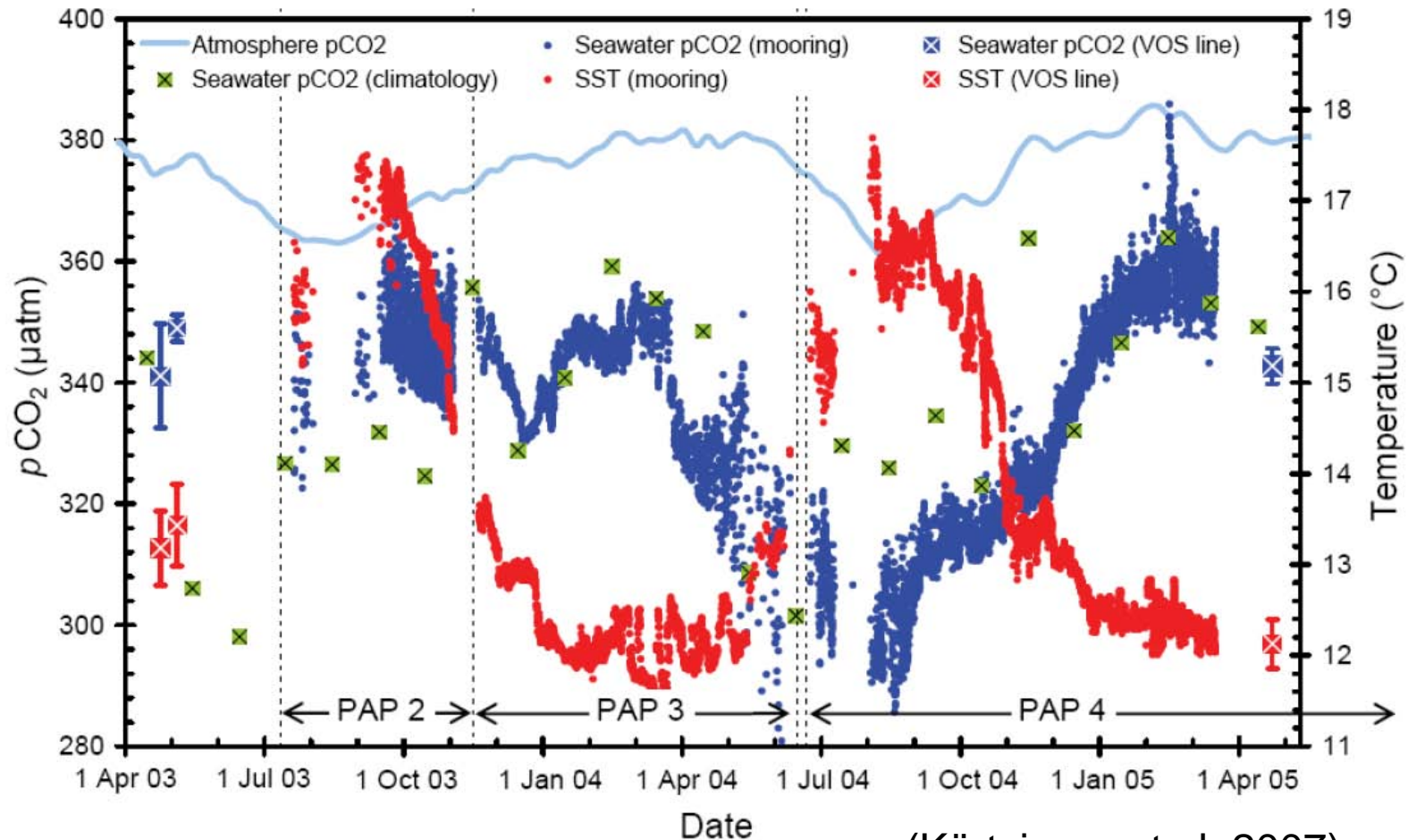
A sustained multidisciplinary presence in these regimes will allow us to observe and understand the processes

It is already happening...



# Ocean time-series data: NE Atlantic

## pCO<sub>2</sub>: Ocean as a perennial C sink in the NE Atlantic (PAP site)



(Körtzinger et al. 2007)

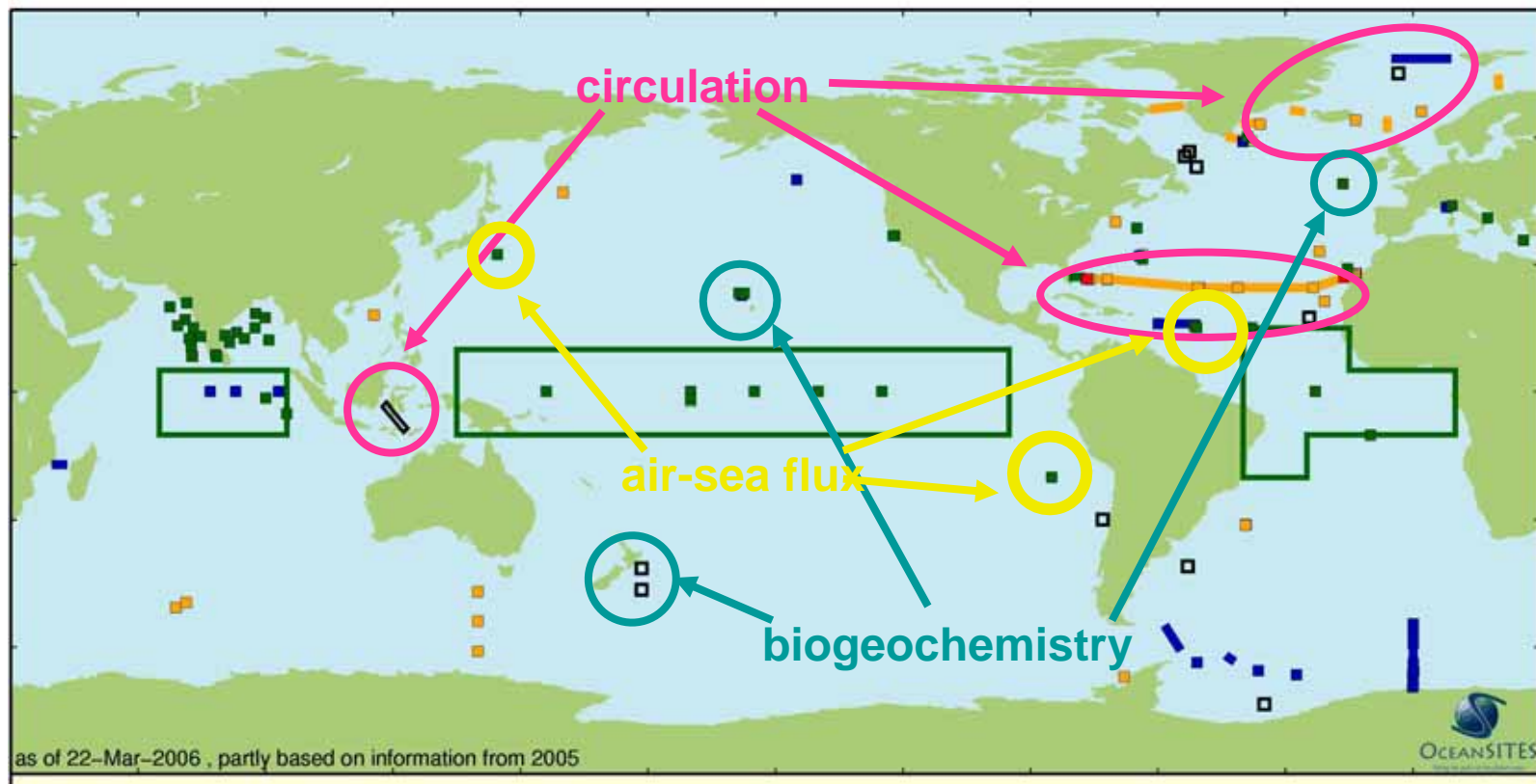
Existing status and current global coverage of fixed-point deep ocean observatories

# OceanSITES: A global network of fixed-point reference sites



- collect sustained timeseries of atmospheric, physical, biogeochemical, or ecosystem variables
- mooring or ship-board (min. monthly) (and cable or glider observations)
- Data philosophy: Share data freely and in real-time

OceanSITES is an official component of the global ocean observing system, part of the IOC/WMO coordination body JCOMM, and a pilot project of the Data Buoy Coordination Panel (DBCP).



Courtesy Uwe Send, SCRIPPS Institution of Oceanography

## **Core sites and set of sensors for global impact (to be decided)**

### **Data on global ocean timeseries indicators will be available e.g.**

- pH
- assembled heat and freshwater content timeseries
- eddy energy timeseries

### **Products will be developed and provided to a variety of users e.g.**

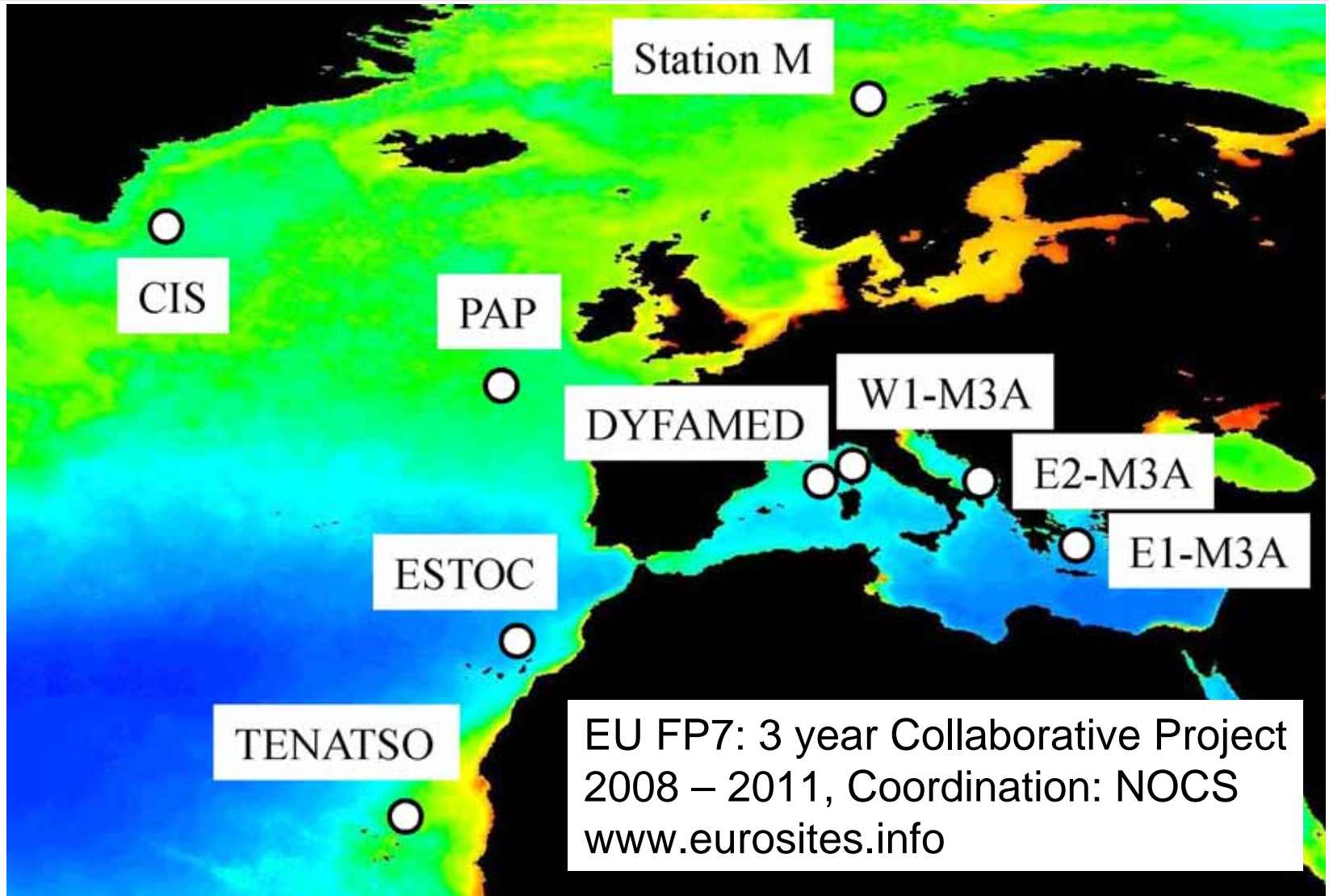
- air-sea flux data for model validation
- 15m currents for validation of drifter and satellite current products
- sea surface salinities for remote sensing validation
- wave data (surface moorings) for wave products/validation
- column integrated chlorophyll estimates (remote sensing/model validation)



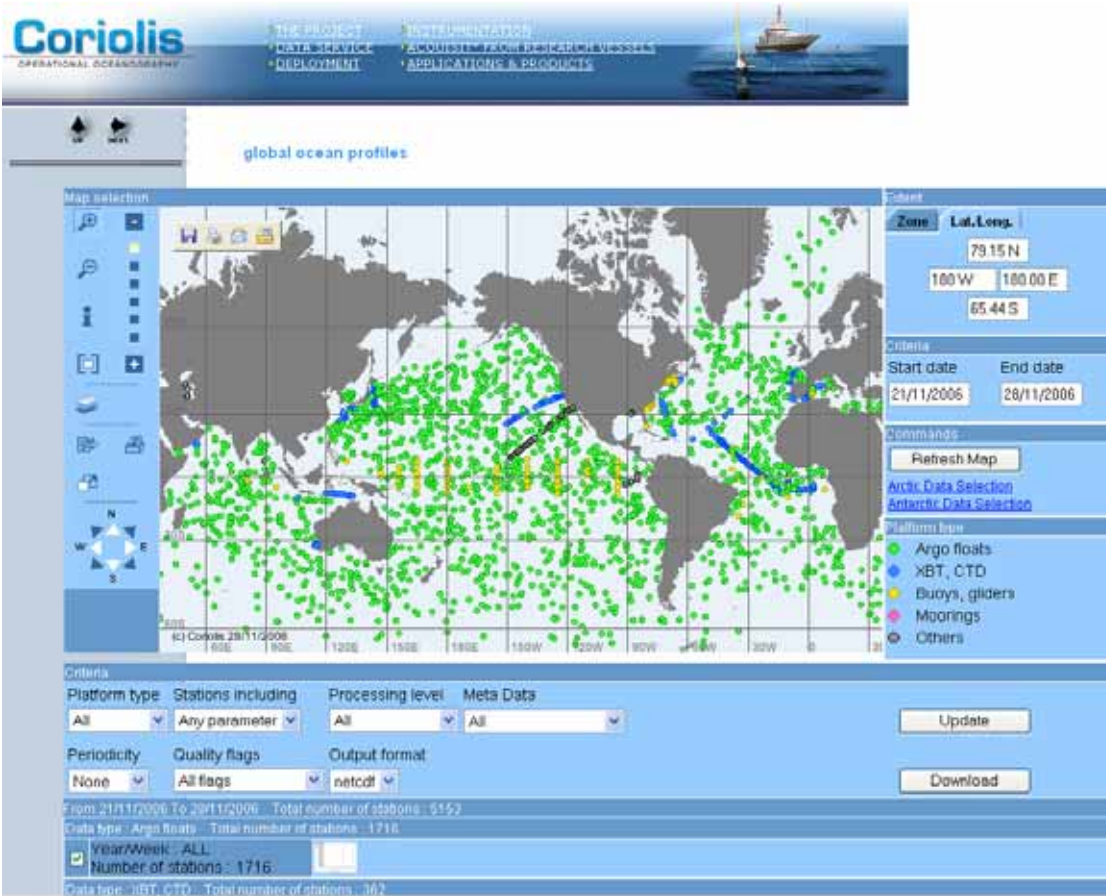
# EuroSITES

European Ocean  
Observatory Network

Integrate and enhance 9 existing  
deep ocean (>1000 m) observatories



# Integrated Data management



-Regional DAC's  
-Global GDAC

Real-time  
Open access  
QC data (data/metadata)  
Interchangeable formats

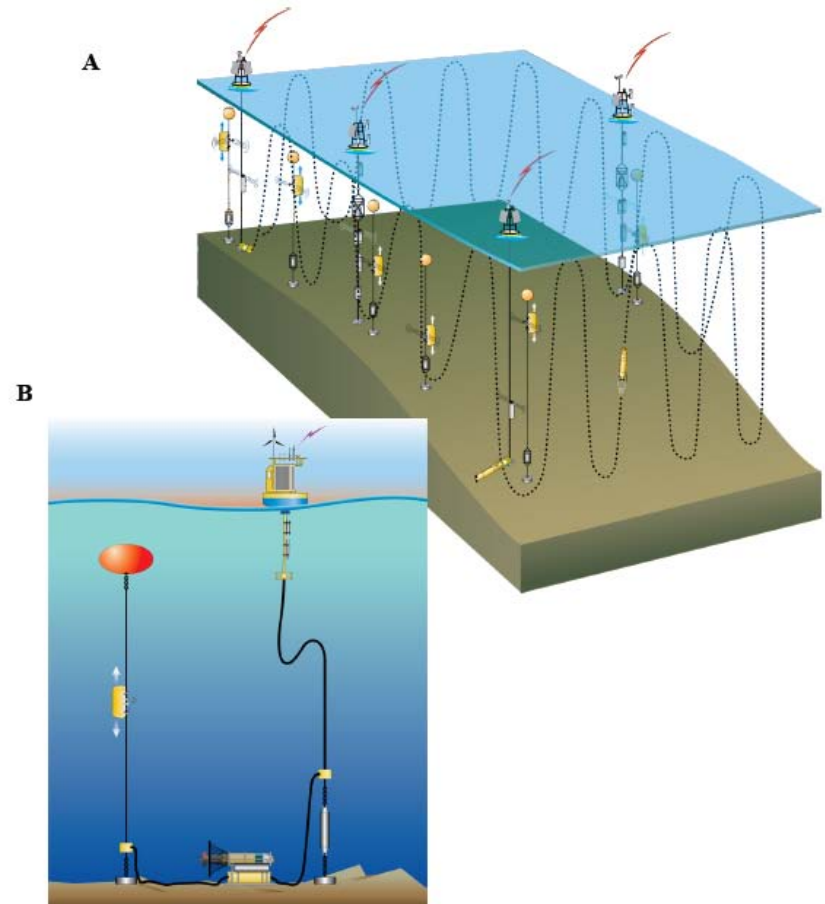
SEADATANET  
INSPIRE Directive  
MyOcean



# The future role of fixed-point observatories in a global observing system

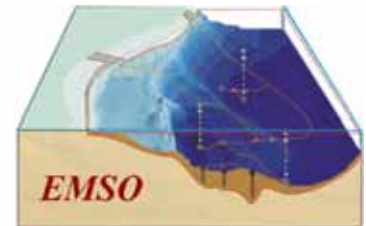
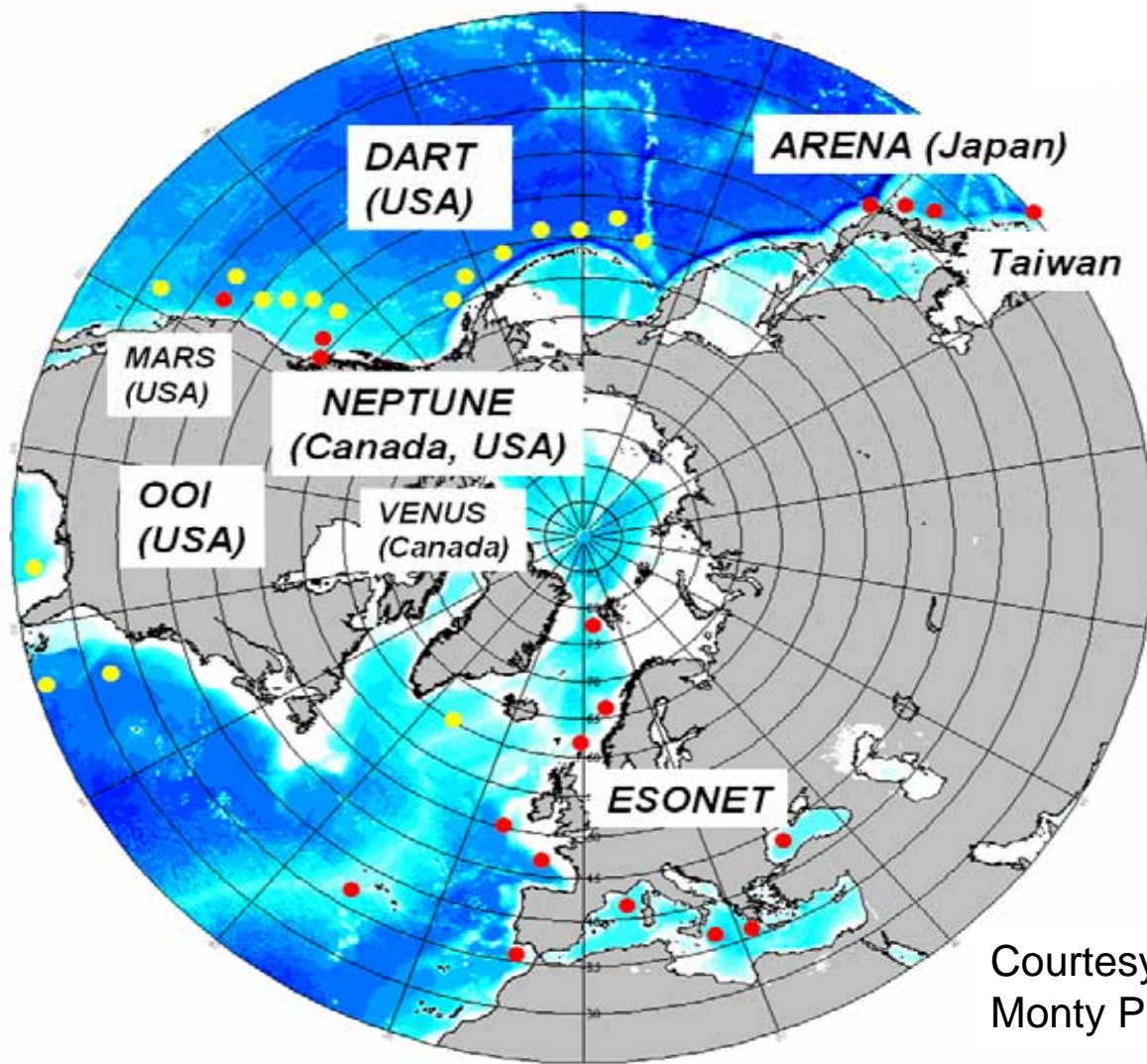
# Integration and Technological advancement

- Integrated science:  
Atmosphere to ocean interior,  
seafloor and subseafloor
- Regional multi-node
- Fixed and mobile assets:  
Temporal and Spatial context
- New Technology  
Sensors, Power, Telemetry
- Interactivity: Adaptive sampling



Pioneer Array: OOI

# Current Seafloor Initiatives

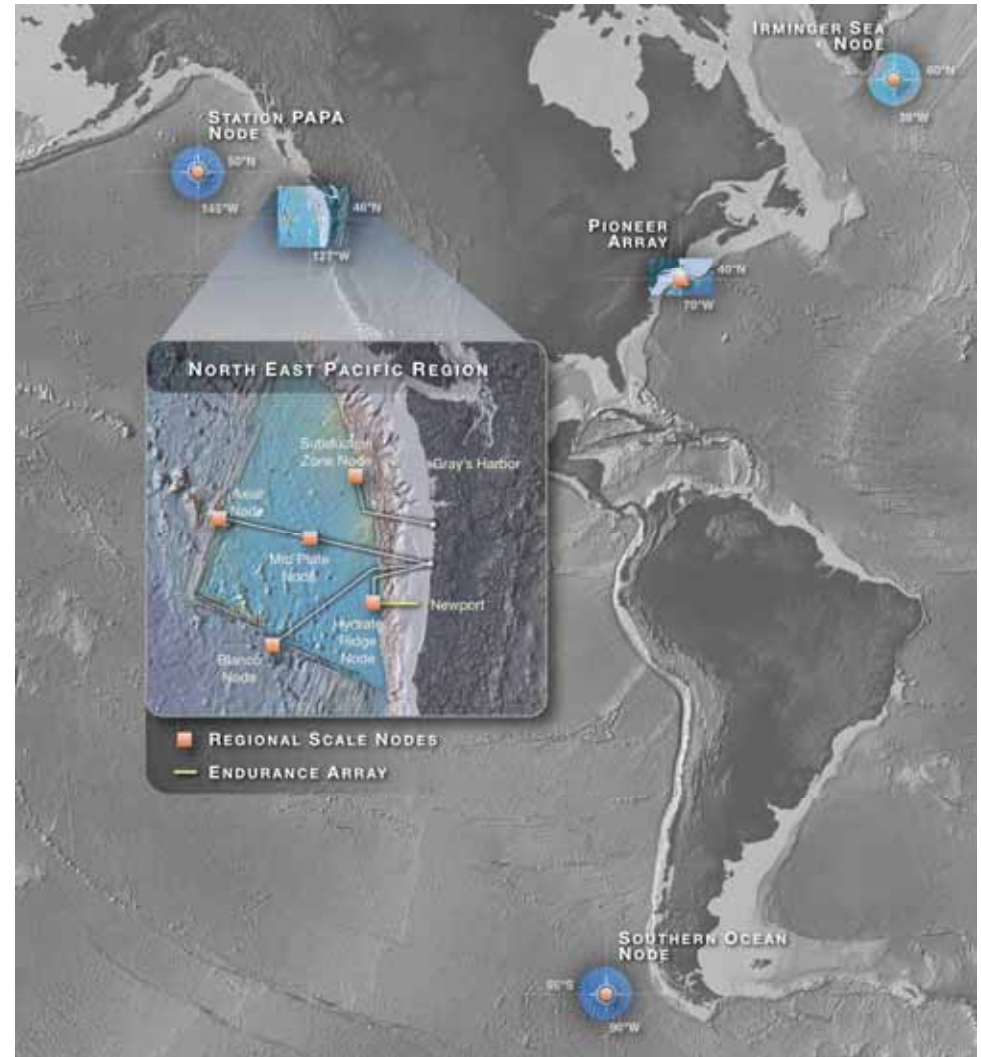


Courtesy:  
Monty Priede UNIABN, UK



# Ocean Observatories Initiative (OOI)

- NE Pacific,
- The coastal boundary current regions,
- The high latitude of the Atlantic and Pacific

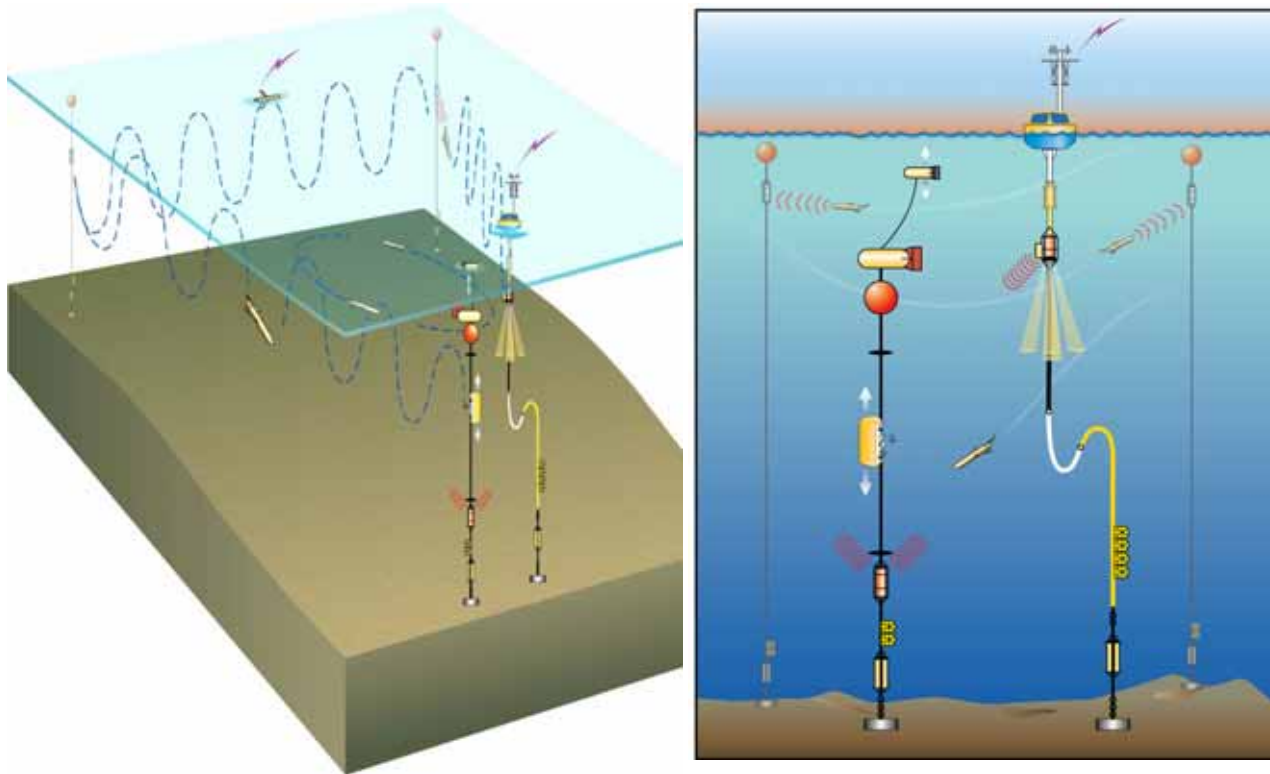


Courtesy of:

Dr. Holly Given, Director OOI

# The North Atlantic

## The Irminger Sea Global Node at 60°N, 39°W



Fixed and mobile assets to resolve mesoscale processes:  
collaboration with CIS European Time Series Site

# Emerging Sensor Technology

# Problems e.g. Biofouling



Instrument frame prior to  
Deployment in NE Atlantic



After 12 months at 45m depth  
NE Atlantic

# Emerging sensor technology

Need more Biological and chemical sensor development to measure variables currently not sampled long-term:

- Deep oxygen consumption
- pH
- Deep Zooplankton sampling
- Osmosamplers
- Genomics (e.g. DNA chips, field genomics for diversity and function studies)



# Emerging technology: *In situ* Oxygen Consumption

Sensor: *In situ* Oxygen Dynamics Auto-sampler: IODA6000

Testbed: ANTARES site, Ligurian Sea, Mediterranean

Direct measurements of O<sub>2</sub> consumption in the mesopelagic and bathypelagic: Efficiency of the biological pump



LMGEM, Marseille, France  
(Christian Tamburini, Anne Robert,  
Dominique Lefèvre)

CPPM, Marseille, France  
(P. Payre, M. Billault, S. Beurthey & K. Arnaud)

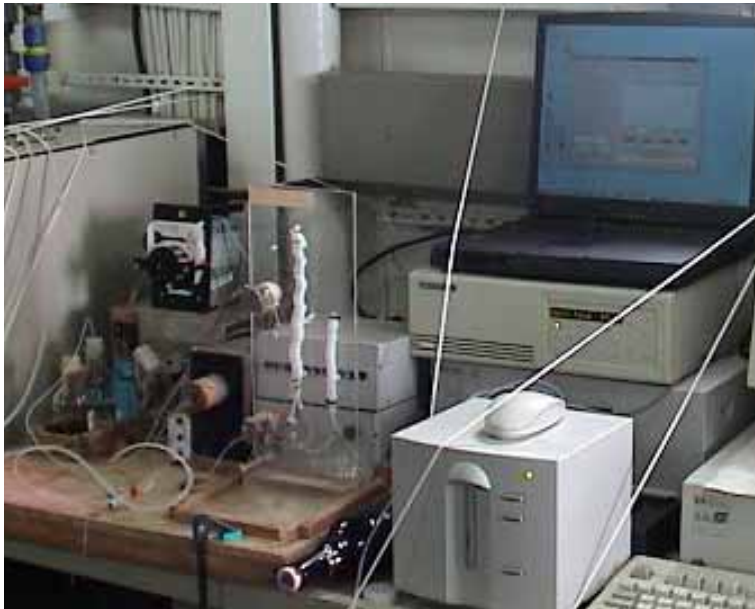


# Emerging technology: Ocean Acidity

Sensor: Adapted pH Spectrophotometric sensor

Testbed: ESTOC site (29°10'N, 15°30'W)

Autonomous sampler for long-term pH measurements at high precision and accuracy



ULPGC, Spain  
Melchor González Dávila  
J. Magdalena Santana-Casiano



Thank you