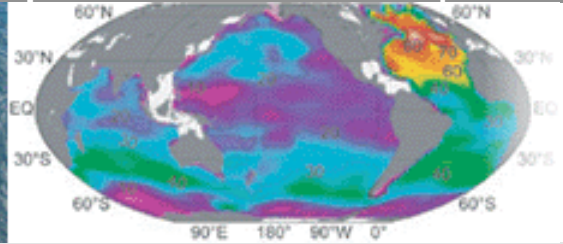
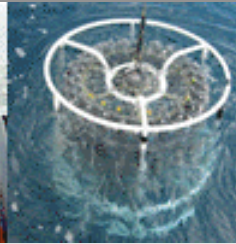


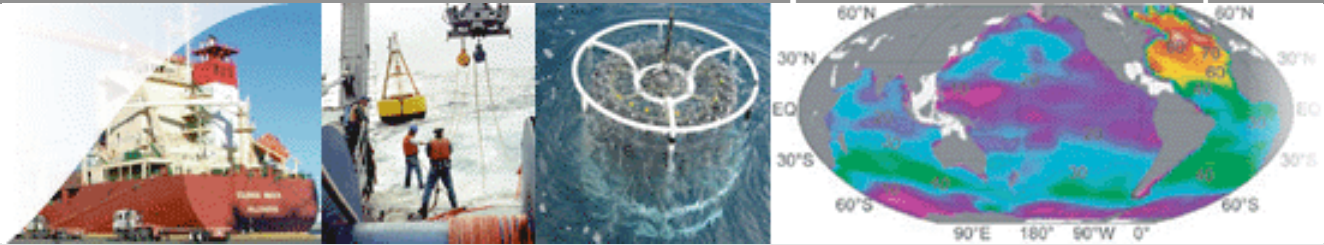
A communication and coordination service for the international ocean carbon community.



International Ocean Carbon Coordination Project

Roger Dargaville, Maria Hood, Chris Sabine, Masao Fukasawa, Bronte Tilkbrook, Nick Bates, Helmuth Thomas, Dorothee Bakker, Cyril Moulin, Cindy Lee, Truls Johannessen and Arne Körtzinger

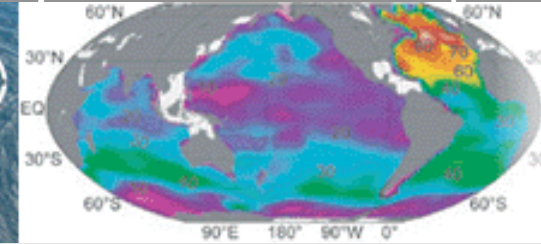
A communication and coordination service for the international ocean carbon community.



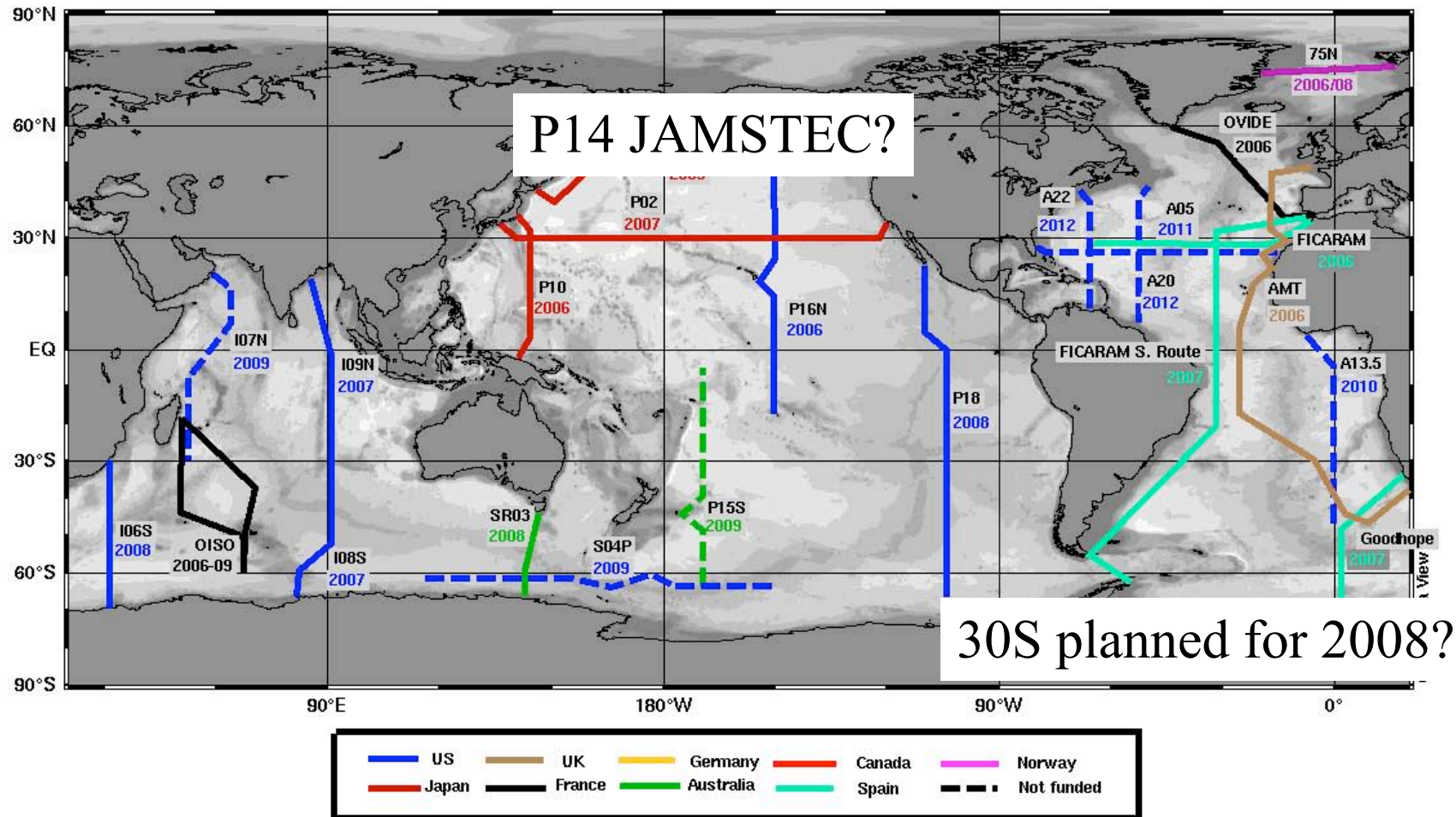
IOCCP activities

- Maintain website and quarterly newsletter
- Observing Programs
 - Repeat Hydrography and Carbon
 - VOS underway pCO₂ network
 - Time series pCO₂ network
 - Ocean Colour
- Pilot Projects
 - Friends of Oxygen on Argo
 - Atmospheric CO₂ on VOS
- Standards and Methods
 - Best Practices Manual
 - Hydrography manual
 - Underway data formats
 - Reference materials
- Sensor inventory
- International Polar Year and Carbon

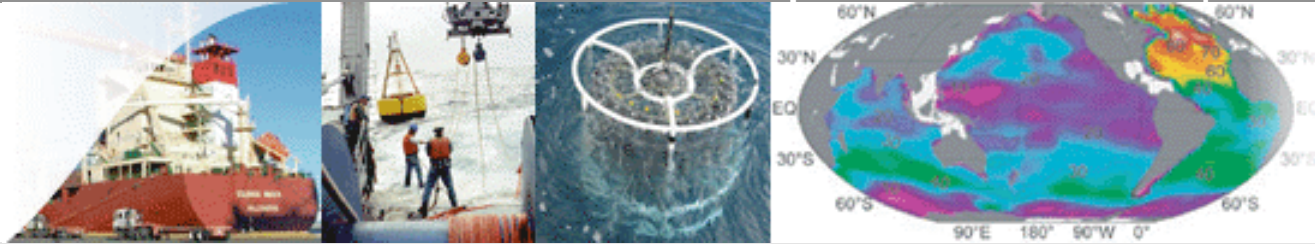
A communication and coordination service for the international ocean carbon community.



Current and planned networks – dashed lines for cruises not yet funded



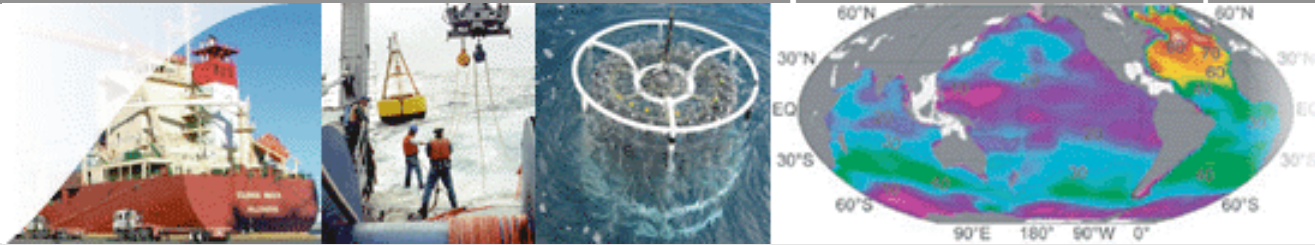
A communication and coordination service for the international ocean carbon community.



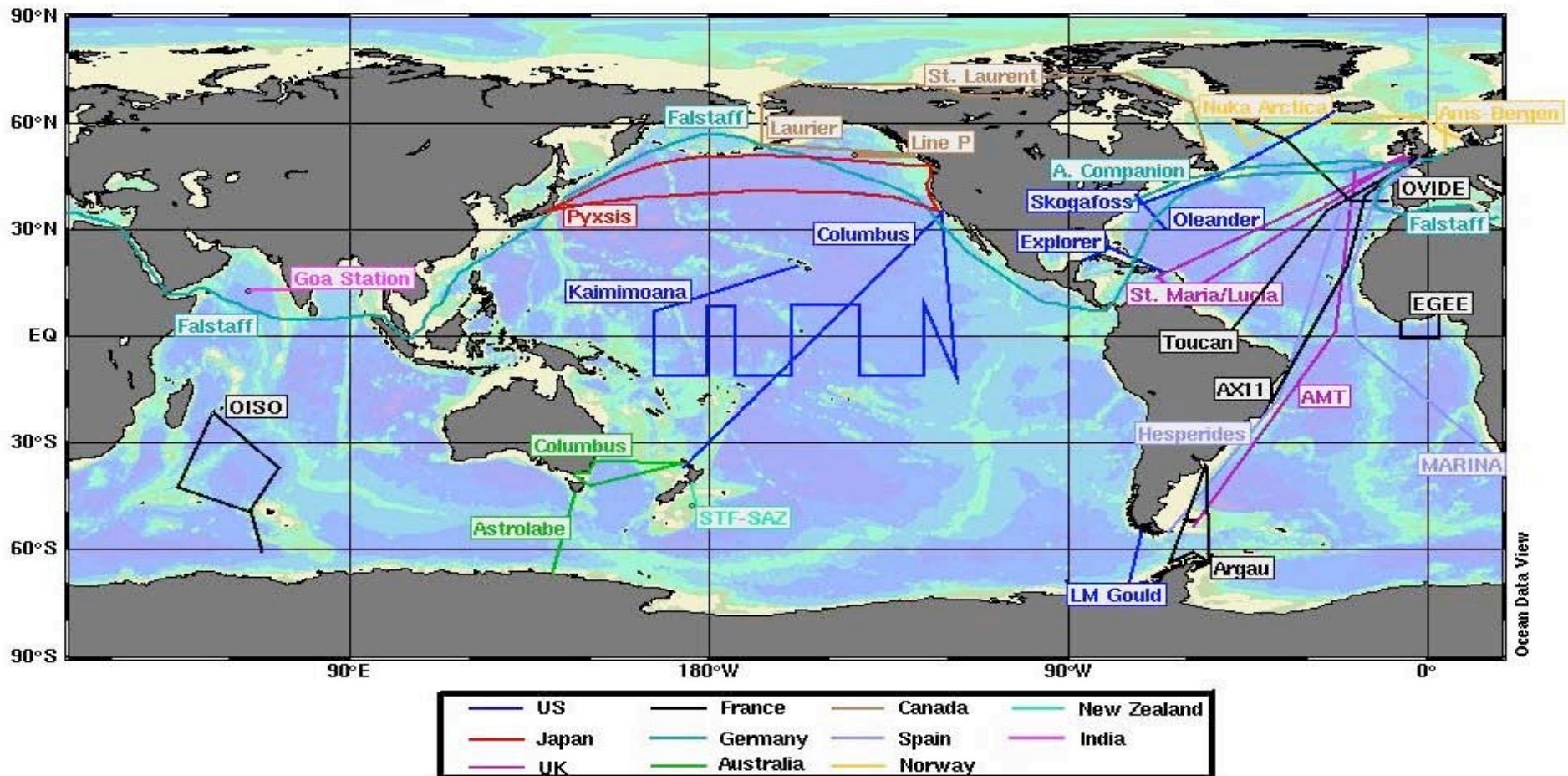
WAVES – web accessible visualization and extraction system

- <http://cdiac3.ornl.gov/waves/>
- CDIAC web based tool for extracting and plotting ocean carbon hydrographical data
- includes total CO₂ & alkalinity, temperature, salinity, oxygen, nutrients, CFCs and carbon isotopes
- 1972 up until the end of 1999
- X-Y plots can be generated instantly,
- Data can be downloaded either to the screen or in netCDF and text formatted files.

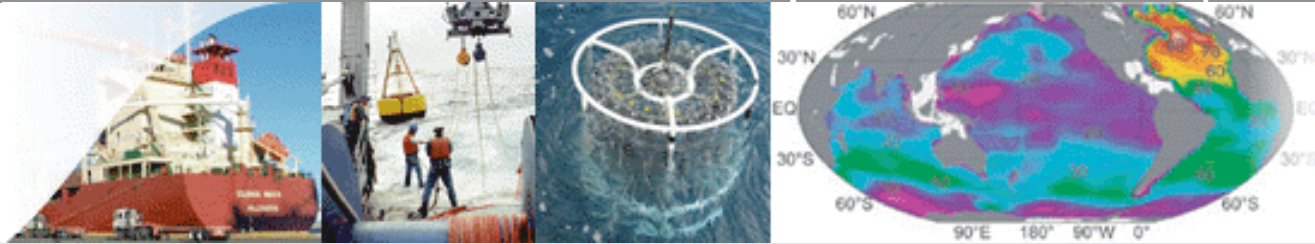
A communication and coordination service for the international ocean carbon community.



Underway pCO2 network



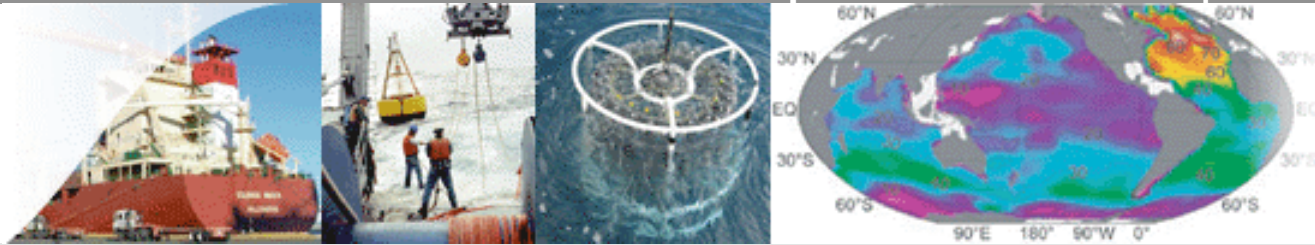
A communication and coordination service for the international ocean carbon community.



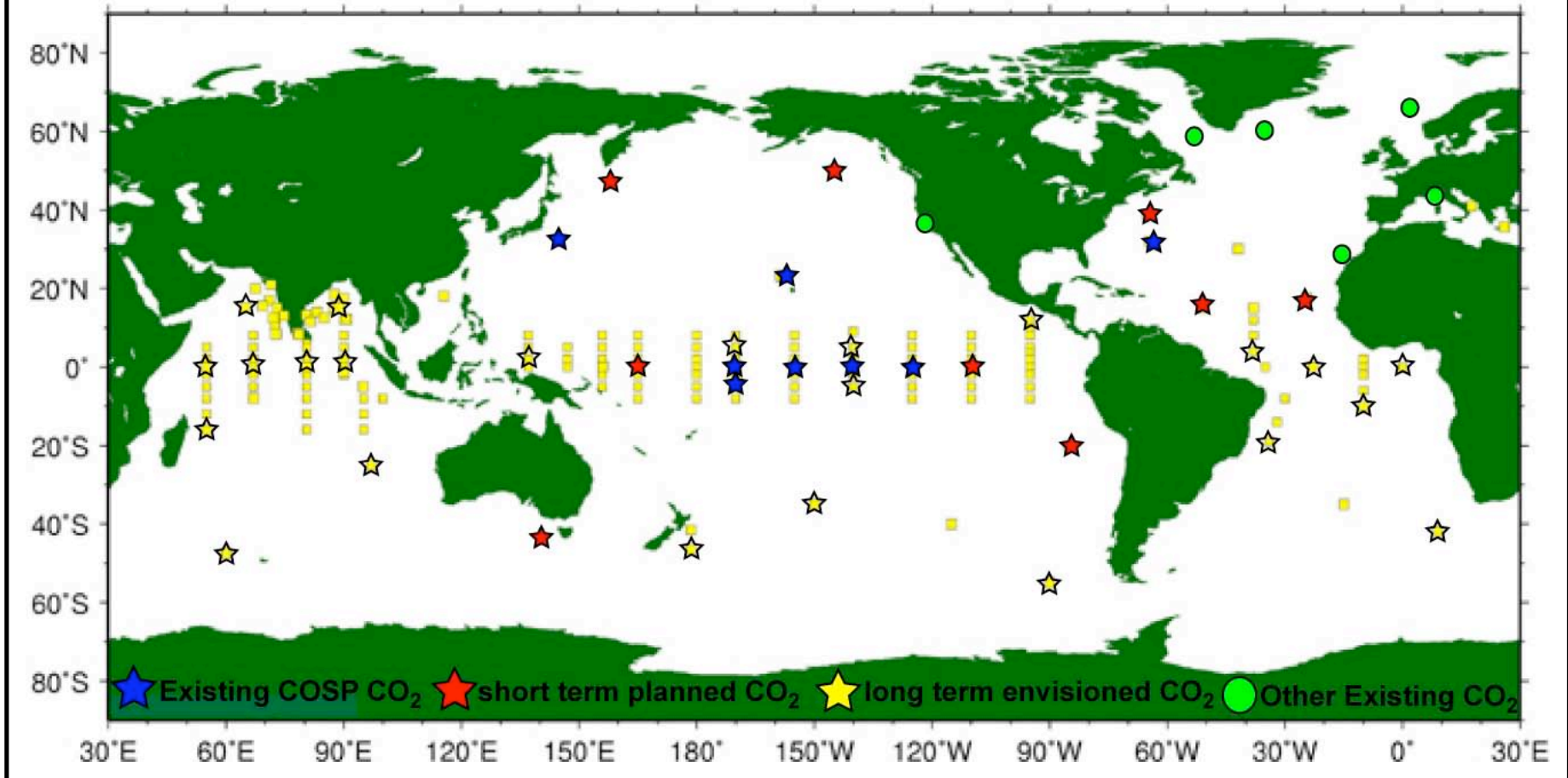
Surface ocean CO₂ workshop

- Paris April 11-13 2007
- Planning for global synthesis of surface carbon (underway pCO₂, time series and moorings)
- Overview
 - What do we know now about ocean carbon?
 - What is the current status of the observing network?
 - Make a plan for future observing networks
 - Make a plan for future synthesis activities
- Structure the meeting by scientific questions

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OceanSITES - meteorological



A communication and coordination service for the international ocean carbon community.

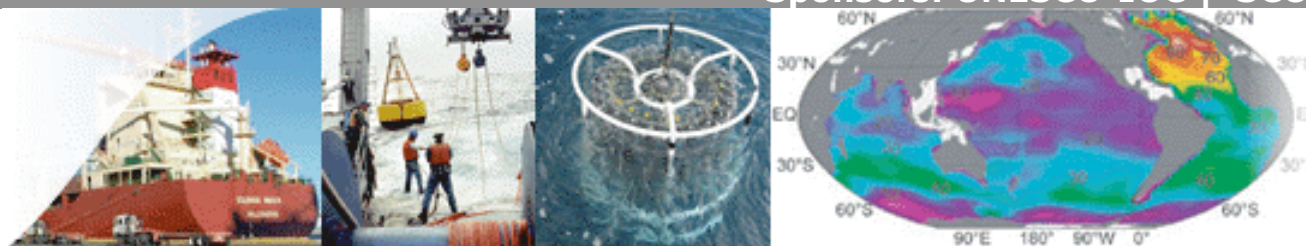
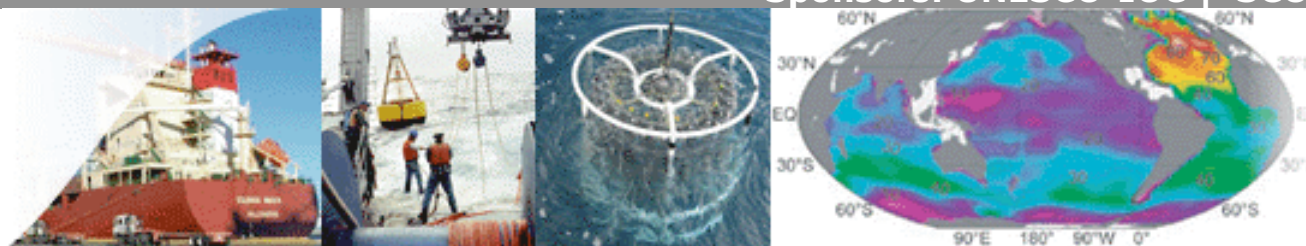


Table of currently active timeseries stations measuring ocean carbon

Region/Station	Position	Dates	Frequency	CO2 Obs	Contact
Stations monitored from ship platforms					
Atlantic					
Norwegian Sea OWS Station M	66° N, 2° E	1992-present	4 / year	Water-column; Surface	T. Johannessen (Norway)
Iminger Sea	60° N, 36° W	1990 - present	3 / year	Water-column; Surface	J. Olafsson (Iceland)
Labrador Sea Station BRAVO	57° N, 53° W	1993 - present	1 / year	Water-column; Surface	P. Jones / K. Azu (Canada)
NW Atlantic Hydrostation S	32° N, 65° W	1983 - present	Monthly	Surface	A. Dickson (USA)
NE Atlantic ESTOC	29° N, 16° W	1994 - present	Monthly	Water-column; Surface	M. Gonzalez/M. (Spain)
NW Atlantic BATS/OFP/BTM (*)	32° N, 65° W	1988-present	Monthly	Water-column; Surface	N. Bates (Bermu)
Pacific					
NE Pacific OSP / Line P	50° N, 145° W	1970's - present	4 / year	Water-column; Surface	C.S. Wong (Can)
NW Pacific HOT (*)	23° N, 158° W				Dore/D. Karl (US)
Mediterranean					
Mediterranean DYFAMED	43° N, 7.9°E	1991-2001; 2003 - present	Seasonal	Water-column; Surface	C. Goyet (France)

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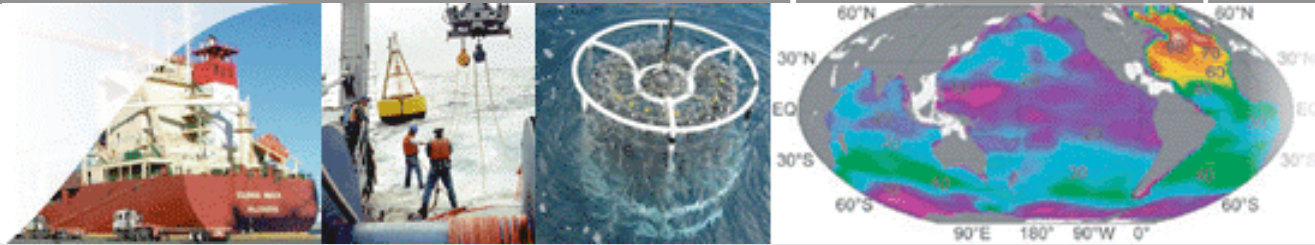
Permanent moorings: open ocean

Atlantic					
NW Atlantic BATS/OFP/BTM	32° N, 65° W	1988 - present	Continuous	Surface	N. Bates (Bernu)
Pacific					
Tropical Pacific TAO / TRITON	0°, 155° W	1997 - present	Continuous	Surface	F. Chavez / C. S (USA)
Tropical Pacific TAO / TRITON	2° S, 170° W	1997 - present	Continuous	Surface	F. Chavez / C. S (USA)
Tropical Pacific TAO / TRITON	0°, 170° W	2005 - present	Continuous	Surface	C. Sabine (USA)
Tropical Pacific TAO / TRITON	0°, 140° W	2003 - present	Continuous	Surface	C. Sabine (USA)
Tropical Pacific TAO / TRITON	0°, 125° W	2003 - present	Continuous	Surface	C. Sabine (USA)
NW Pacific KEO	32° N, 145° E	2006-present	Continuous	Surface	C. Sabine (USA)
NW Pacific HOT	23° N, 158° W	1988 - present	Continuous	Water-column; Surface	D. Karl (USA)

Permanent moorings: coastal

California Current MBARI M1	36.75N 122 W		Continuous	Surface	F. Chavez (USA)
California Current MBARI M2	36.75N 122 W		Continuous	Surface	F. Chavez (USA)
Cape Elizabeth, WA, USA (NDBC 46041)	47.3°N, 124.8°W	Imminent	Continuous	Surface	Sabine (USA)
Grays Reef, Goergia, USA (NDBC 41008)	31.4°N, 80.9°W	Imminent	Continuous	Surface	Sabine (USA)
Kaneohe Bay, Hawaii, USA	21.4°N 157°W	2005-present	Continuous	Surface	Sabine (USA)
Santa Monica Bay, CA, USA	33.9°N, 118.7°N	2006-present	Continuous	Surface	Gruber (USA)
Martha's Vineyard, MA, USA					W. McGillis (USA)

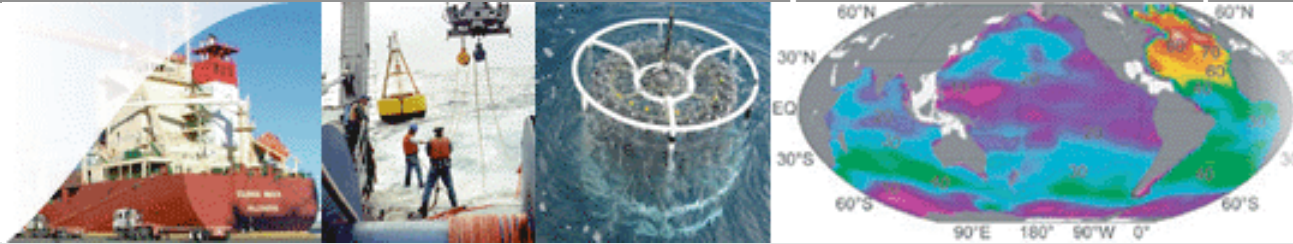
A communication and coordination service for the international ocean carbon community.



Friends of Oxygen on Argo

- Surface ocean O₂ quickly equilibrates with atmospheric O₂
- Once isolated from the surface, depletes with respiration of organic matter
- Both a transport tracer and a biological indicator – component for proxy for DIC
- Potential for O₂ net source to the atmosphere (Joos et al. 2003). Critical for interpretation of O₂/N₂

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Friends of Oxygen on Argo

- 'New' optode technology used dynamic luminescence of luminophores and gas permeable foils
- Nicolas Gruber leading initiative to justify expansion of O₂ measurements on Argo
 - Sensor design, calibration and stability
 - Power usage, communication requirements, additional cost
 - Number of sensors required
 - Interpretation of results

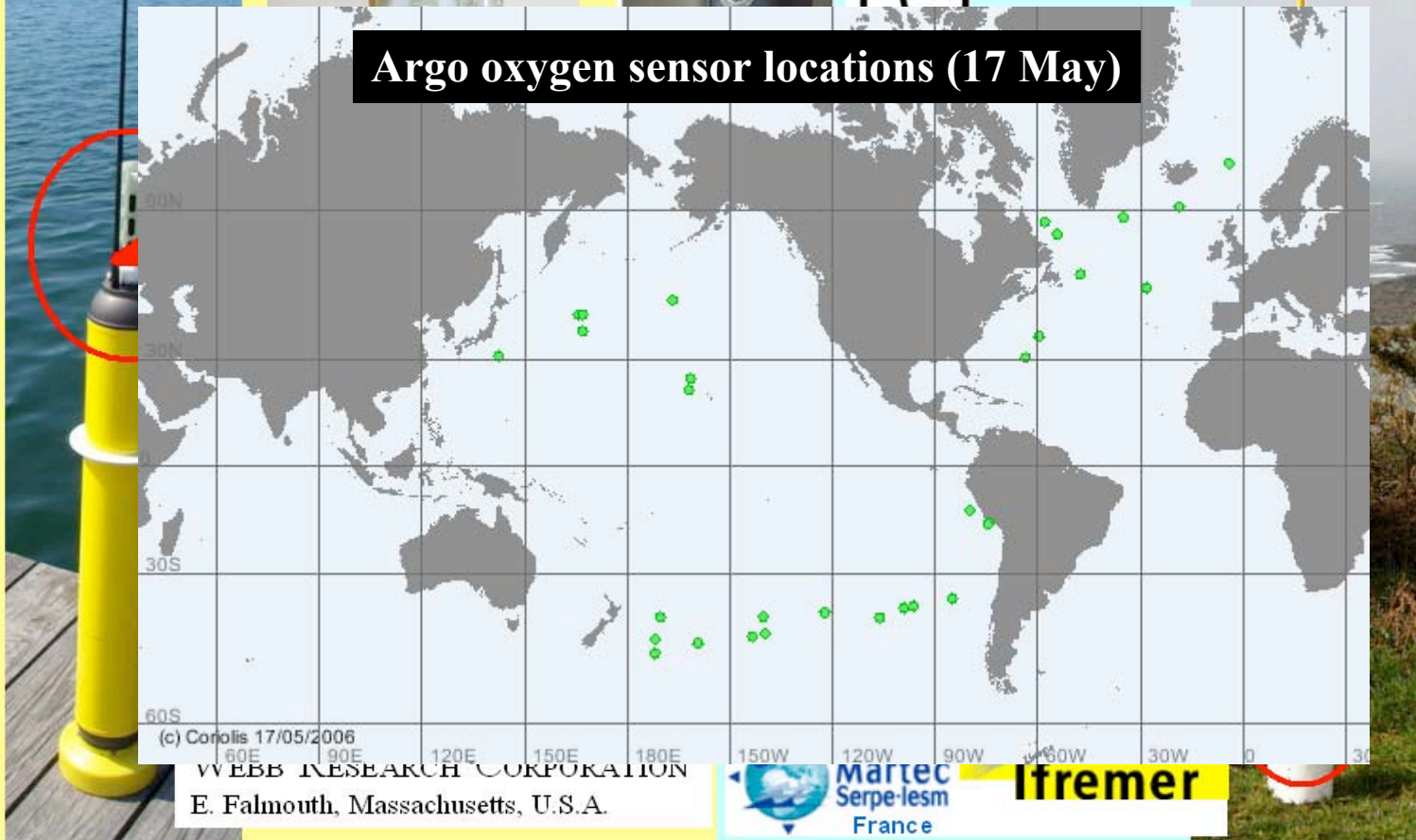
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Aanderaa Instruments
Bergen, Norway

PROVOR

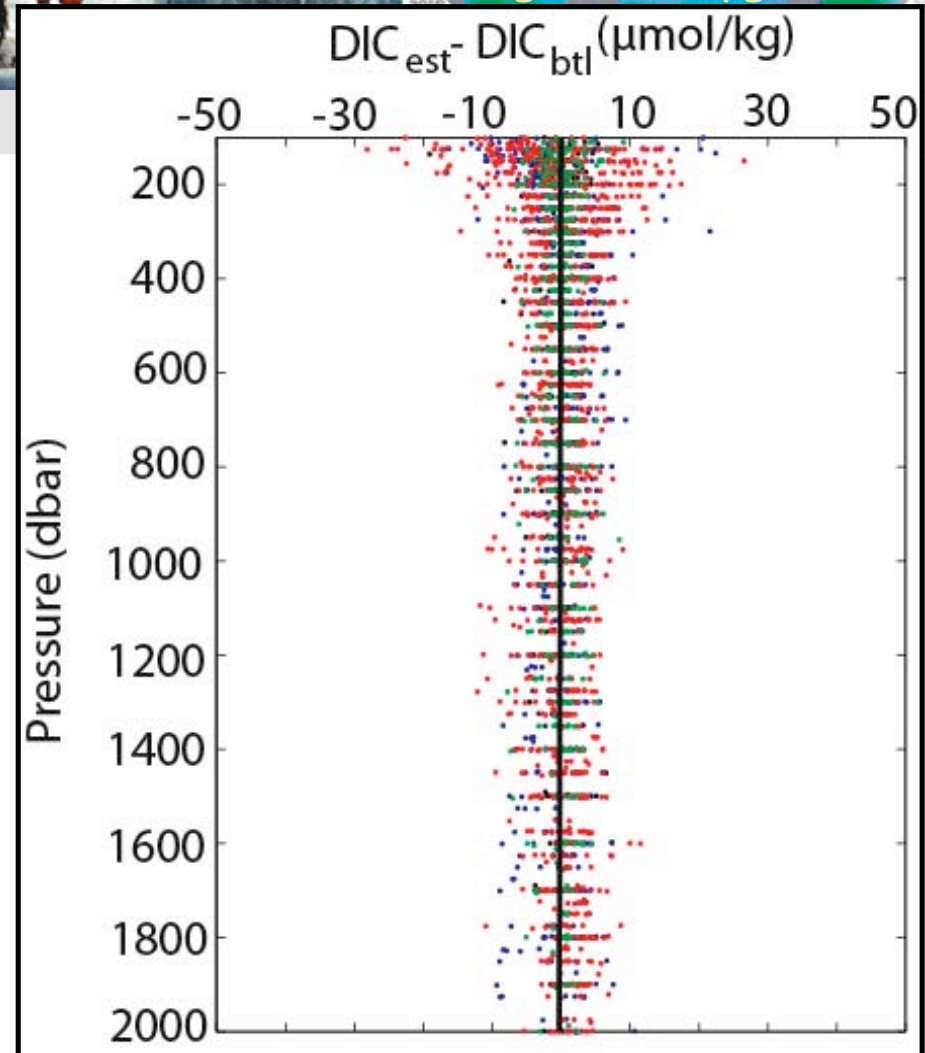
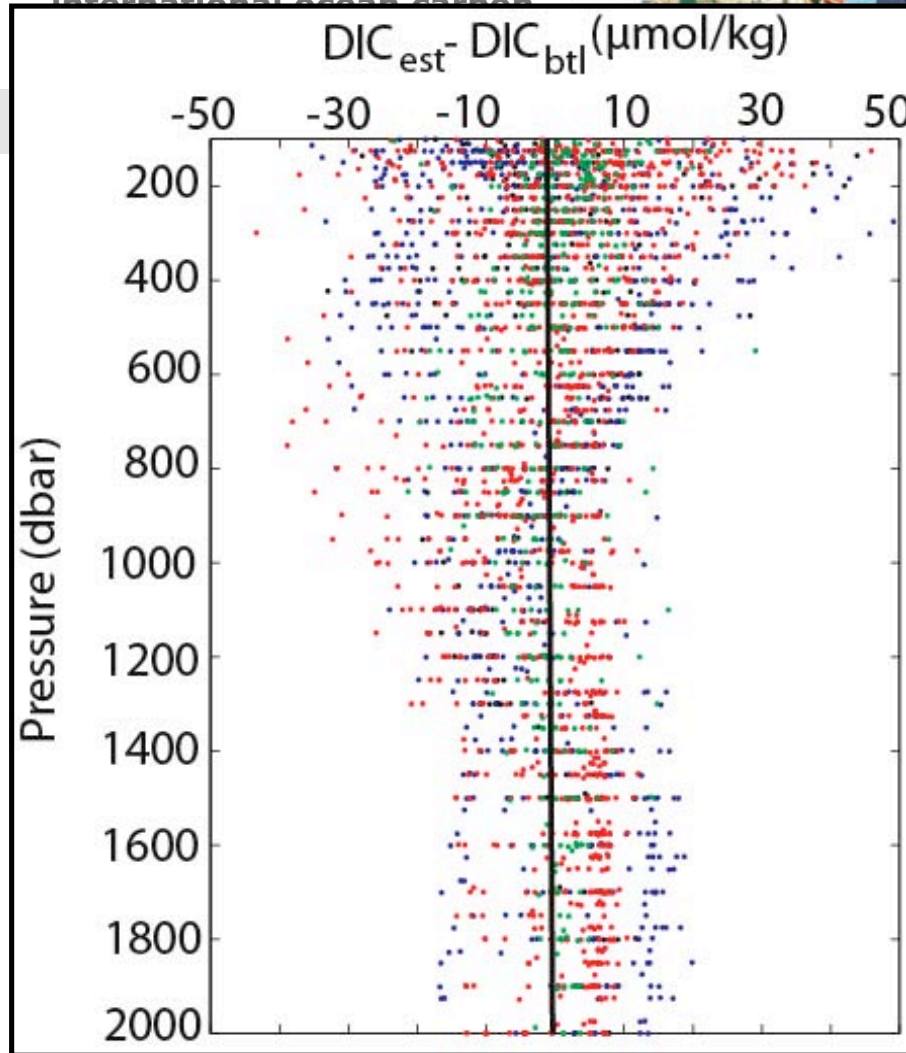
Argo oxygen sensor locations (17 May)



Adding Oxygen Greatly Improves The Fit

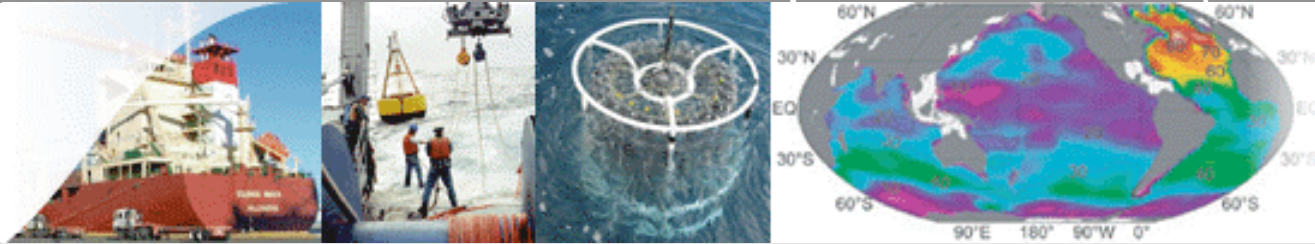
A communication and coordination service for the international ocean carbon
 $Rm\text{se} = 11.4 \mu\text{mol/kg}$ without oxygen

$Rm\text{se} = 3.7 \mu\text{mol/kg}$ with oxygen



Adding oxygen to the global ARGO data base will make these data much more relevant for biogeochemical studies.

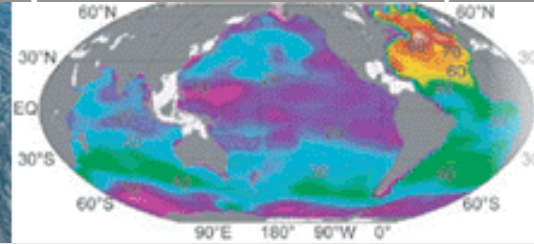
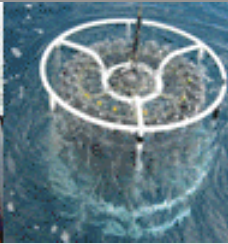
A communication and coordination service for the international ocean carbon community.



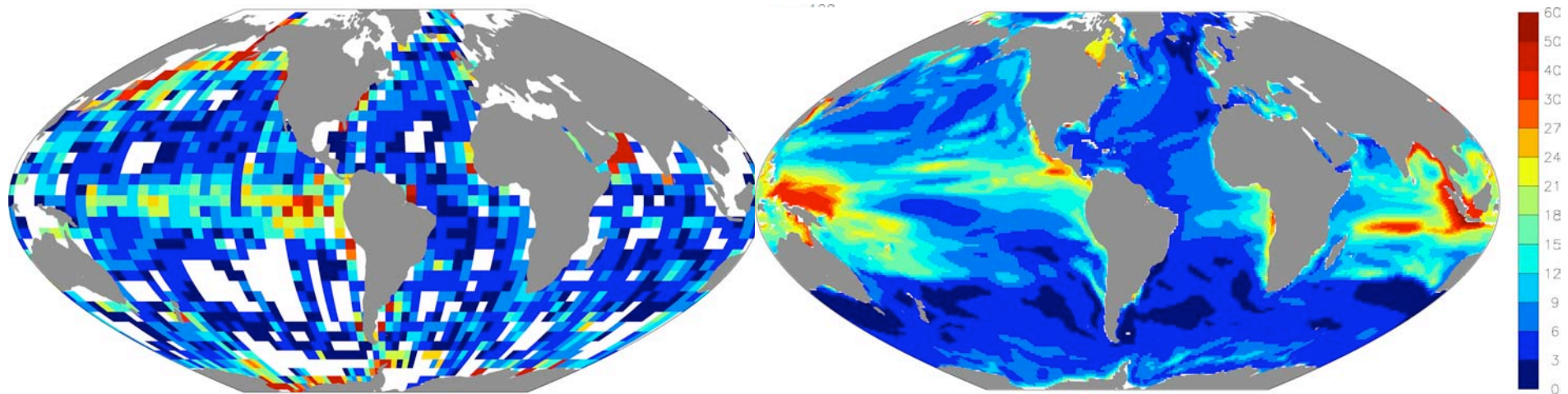
High precision atmospheric CO₂ on VOS pilot project

- Theoretical study to test the utility of adding high precision atmospheric CO₂ to ships do underway pCO₂
- Two main sensors, LoFlo and AIRCOA
- If useful, plan an optimal network
- Use a psuedo data set in a data assimilation framework (Kalman filter)
- Focus the Southern Ocean – least effect from terrestrial sources

A communication and coordination service for the international ocean carbon community.



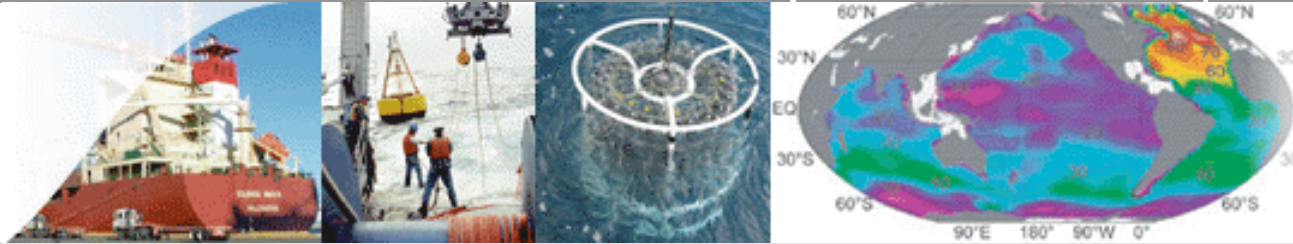
pCO₂ network optimization project



Observed ($>2 \times 10^6$ measurements) and modelled (GFDL earth system model) annual standard deviations

NOAA project lead by Joellen Russell to determine required spatial and temporal resolution for underway pCO₂ observations

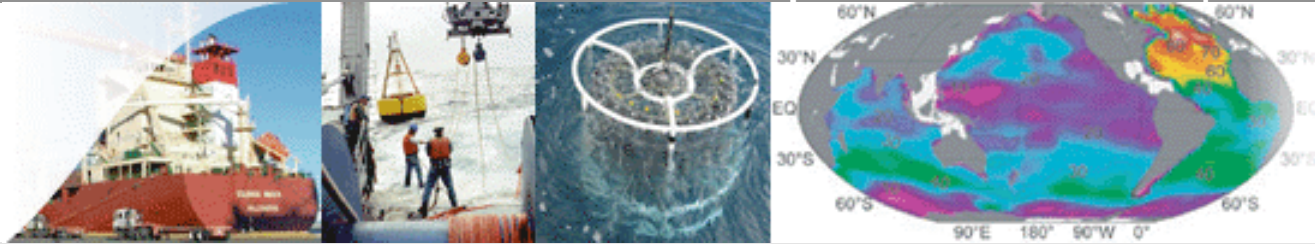
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Biogeochemical Sensor inventory

- OceanSites and the Ocean Research Interactive Observatory Network (ORION) will develop an on-line sensor catalogue
- IOCCP will coordinate input on the carbon related instruments
- IOCCP has expressed interest to host a workshop in Paris in Spring/Summer 2007
- Tommy Dickey going to speak more

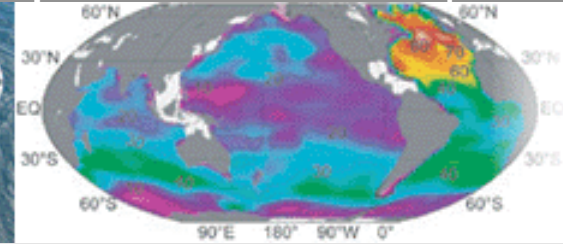
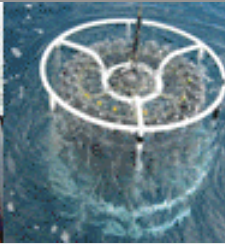
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Proposed data set

- Instrument name
- Company or PI contact
- Variables measured (or calculated)
- Method of measurement (e.g., spectrophotometric, based on optical absorbance of pH indicator solution)
- Stage of development (commercially available, available via contract with lab, available via collaboration, under development, etc.) (if under development: lab tests, field tests (describe), etc.)
- Range, Accuracy, Precision
- Stability over time
- Sampling rate
- Data recording/transmitting
- Depth rating
- Temperature range of operation
- Power supply / requirements, Battery life
- Dimensions, Weight
- Platform possibilities
- Publications

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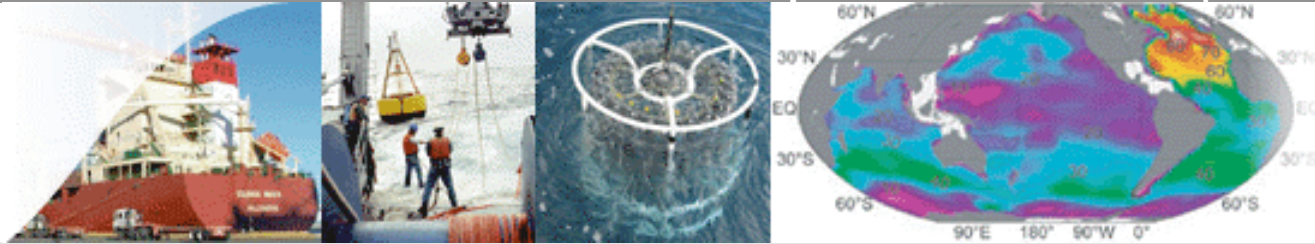


Carbon and the IPY

I. Arctic

- Baffin Bay / Davis Straights Hydrographic Sections
- Barrow Straights Hydrographic Sections
- MERICA program / Hudson Bay
- Joint Western Arctic Climate Study (JWACS)/ Canadian Archipelago
- Study of Environmental Arctic Change (SEARCH)
- International Pan-Arctic Shelf-Basin Exchange Study (SBE)
- Ocean-Atmosphere-Sea Ice-Snowpack (OASIS)
- AR7W Hydrographic Section
- 75N Hydrographic Section
- OWS Mike Hydrographic Program
- Nuke Arctica VOS line
- North Sea VOS line
- St. Laurent and Laurier VOS lines

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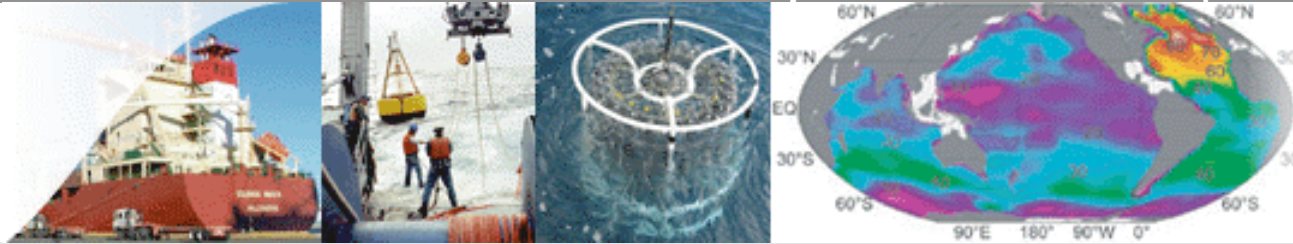


Carbon and the IPY

II. Antarctic

- Post-WOCE Hydrographic Sections (approx. 40 lines)
- OISO Hydrographic Program
- Astrolabe VOS Line
- Drake Passage VOS Line
- CANOPO and Argau Program (hydrography and VOS)
- SCACE Project
- SAZ-SENSE Project
- Synoptic Antarctic Shelf-Slope Interactions Study (SASSI)
- CLIVAR SR3 Line
- Climate of Antarctica and Southern Ocean Program (CASO)

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And...

- Oceans in a high CO₂ world – ocean acidification
- Ocean Vulnerabilities – co-sponsored by Global Carbon Project – possible ‘Virtual’ conference in early 2007
- IGOS-P carbon theme office at UNESCO
- DOIs for datasets – making data more easily available and citable