Global Marine Carbon and Biogeochemistry Observing Capacity and Data Products

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Scientific Steering Group

http://www.ioccp.org/

2 Co-chairs
10 SSG Experts
2 Project Office Staff

Co-chairs

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Project Office

M. Telszewski (Director)
A. Palacz (Officer)

Project Office hosted by the
Institute of Oceanology of Polish Academy of Sciences

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Richard Sanders (Norway)

Maribel García-Ibáñez (Spain)

Adrienne Sutton (USA)

Keyhong Park (Rep. Korea)

Kim Currie (New Zealnd)

Sana Ben Ismail (Tunisia)

Véronique Garçon (France)

Dariia Atamanchuk (Canada)

Steve Jones (Norway)

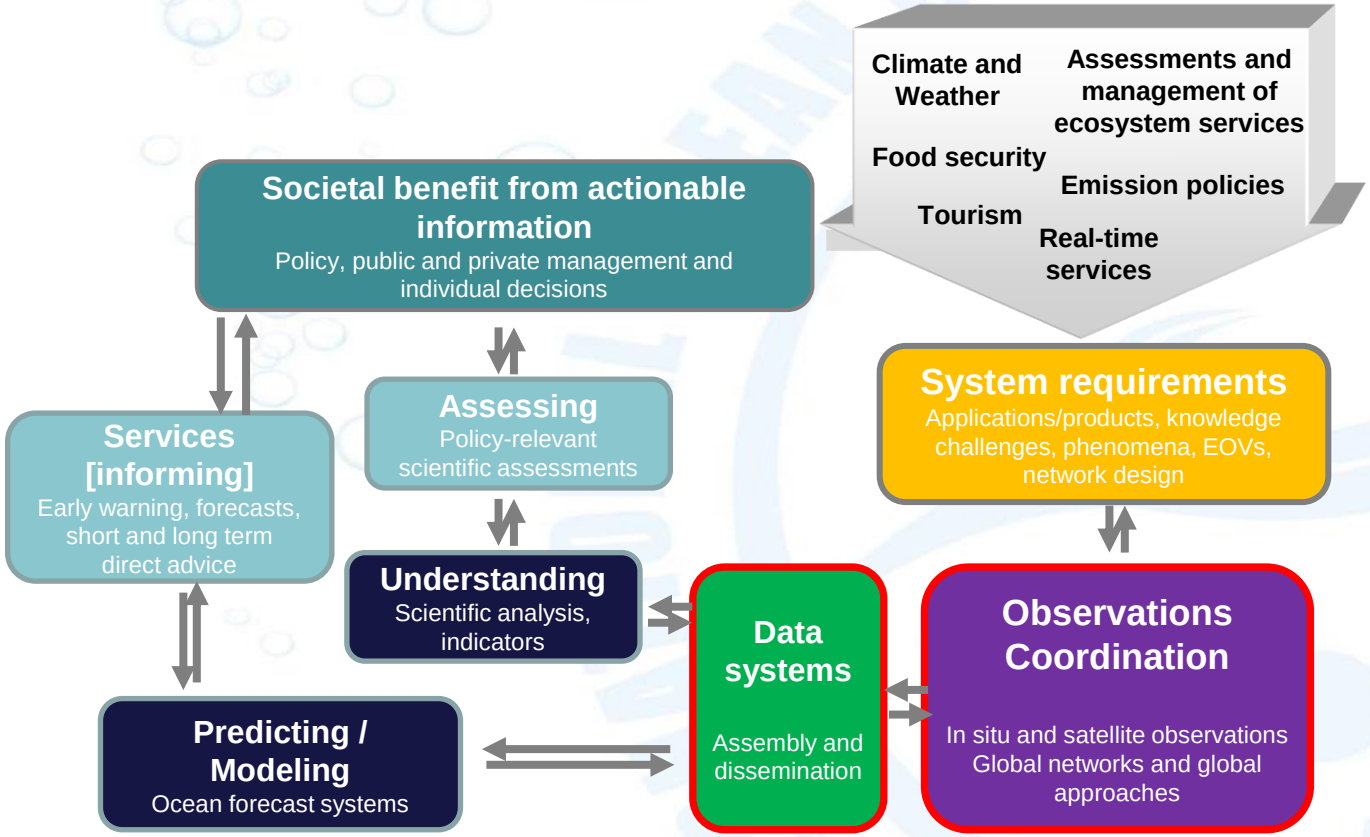
3 PI's applied

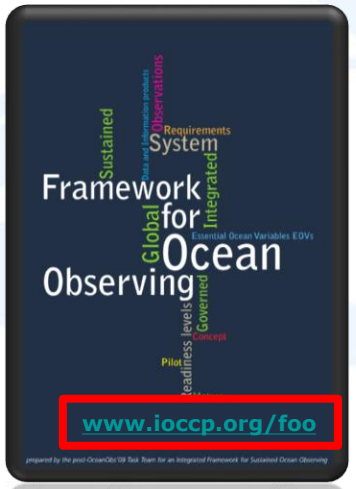
Emmanuel Boss (USA)

Fei Chai (China)

IOCCP Terms of Reference

Facilitate a dialogue with stakeholders to implement a scientifically and economically effective, fit-for-purpose observing system for ocean carbon and biogeochemistry.





Biogeochemistry Panel

IOCCP Terms of Reference

Develop and maintain a set of specifications, implementation goals, and progress metrics for Essential Ocean Variables for ocean carbon and biogeochemistry parameters for GOOS and corresponding Essential Climate Variables for the Global Climate Observing System (GCOS).

EOVs
Biogeochemistry

- Oxygen
- Nutrients
- Inorganic Carbon
- Transient Tracers
- Particulate Matter
- Nitrous Oxide
- Stable Carbon Isotopes
- Dissolved Organic Carbon
- Ocean Colour

GOOS Biogeochemistry Panel

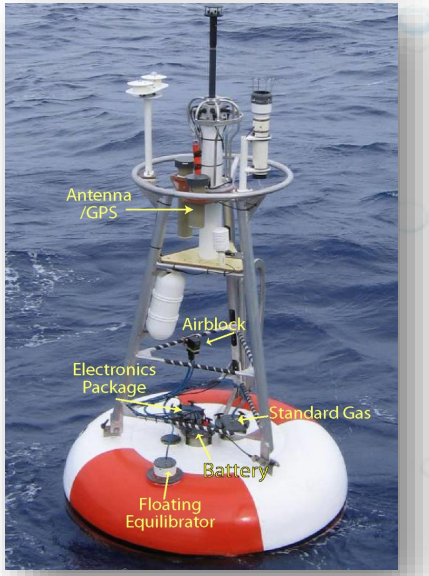
soconet

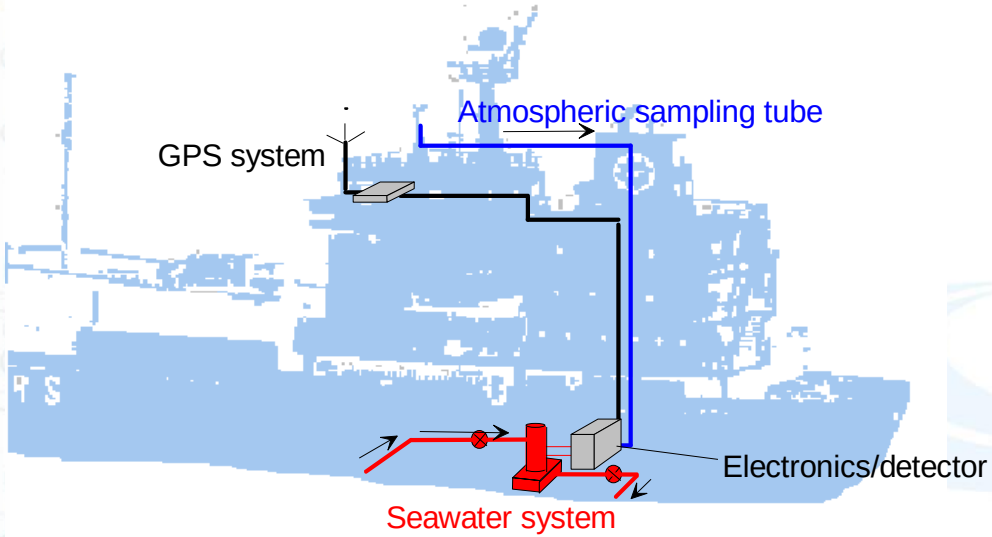
• SURFACE OCEAN CO_2 OBSERVING NETWORK •

Observing network mission, design, and community of practice

FAIR data principles that feed into SOCAT and other products and facilitate data assimilation and model assessment

Best practices and interoperability





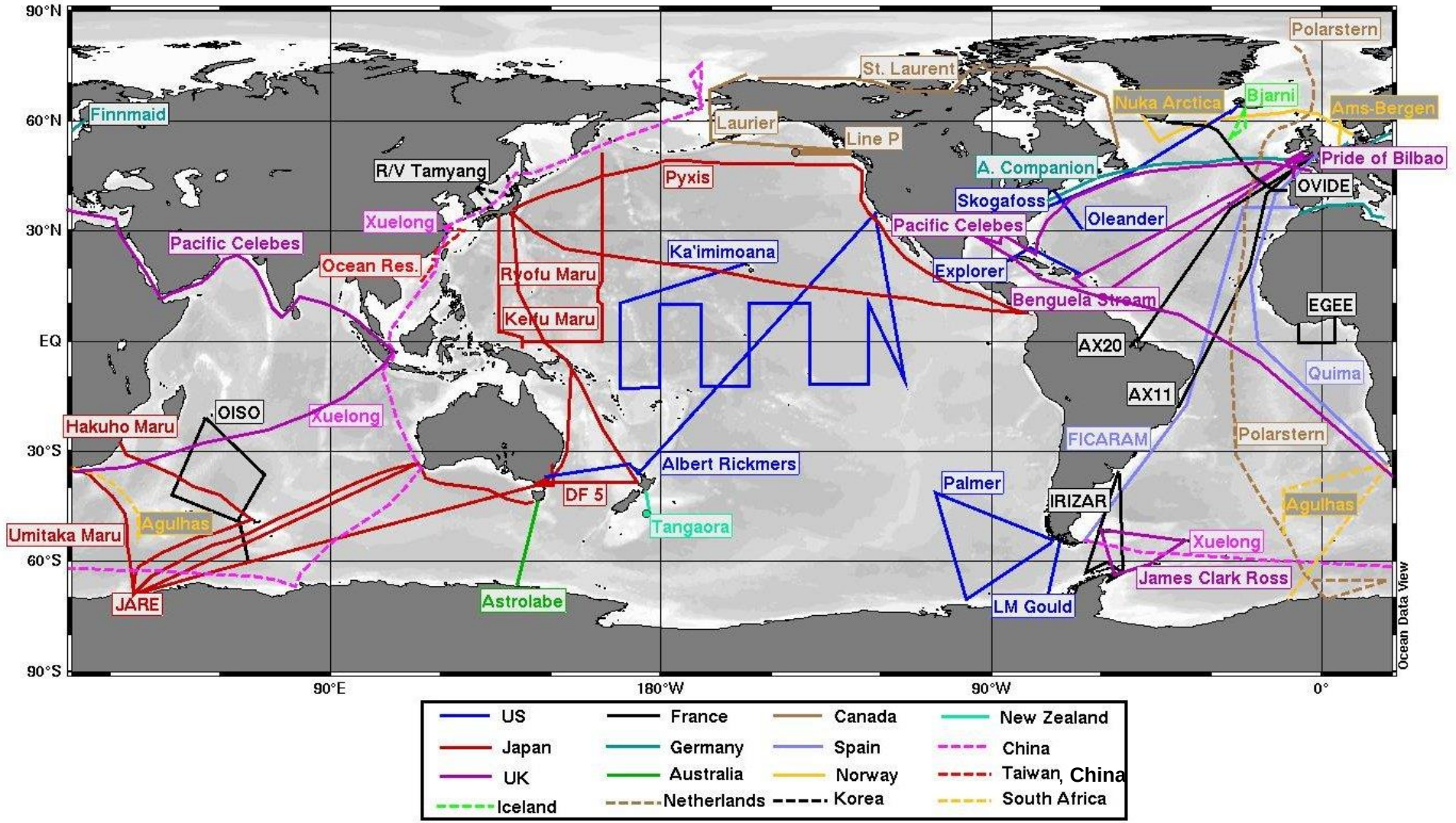
SOCONET:

- **Surface ocean CO_2 measurements** from moving and fixed platforms (With other parameters in concept and pilot phase pH, TA, DIC);
- **Atmospheric CO_2** from some data originators (discussions with GAW);
- Checked sea surface temperature and salinity as well as other BGC parameters (oxygen, nutrients)

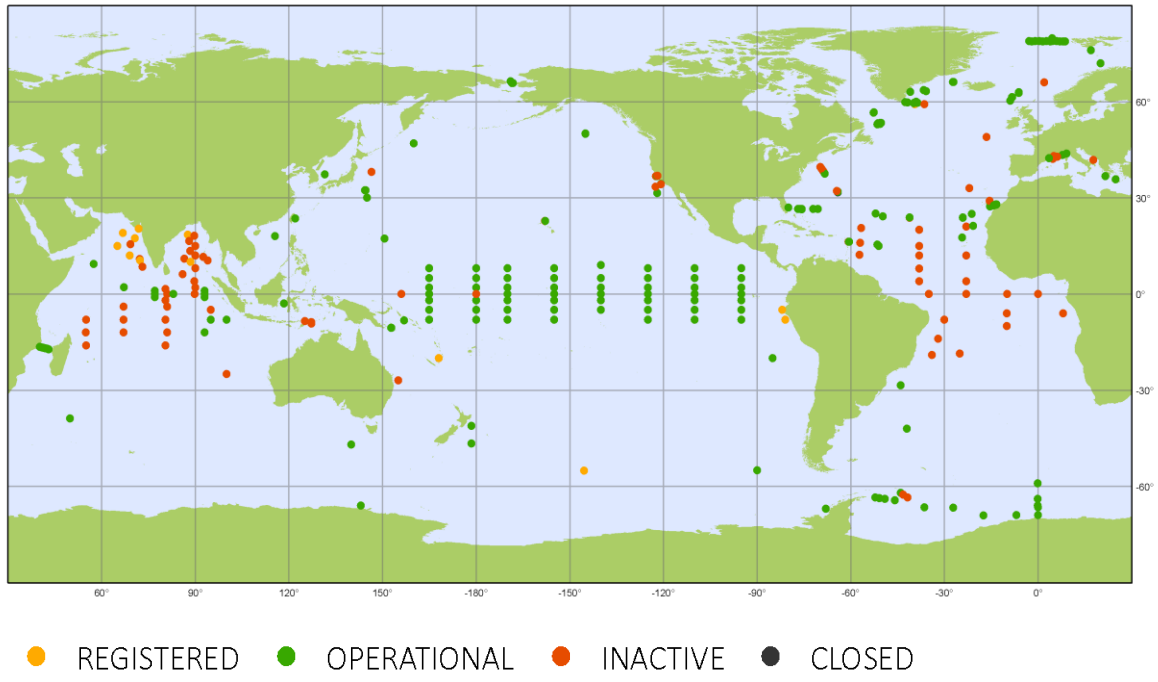
COP26

The operational activities are particularly important for our US partners (NOAA) given the COP26 commitment to support a globally "operational" Surface Ocean CO_2 Reference Network.

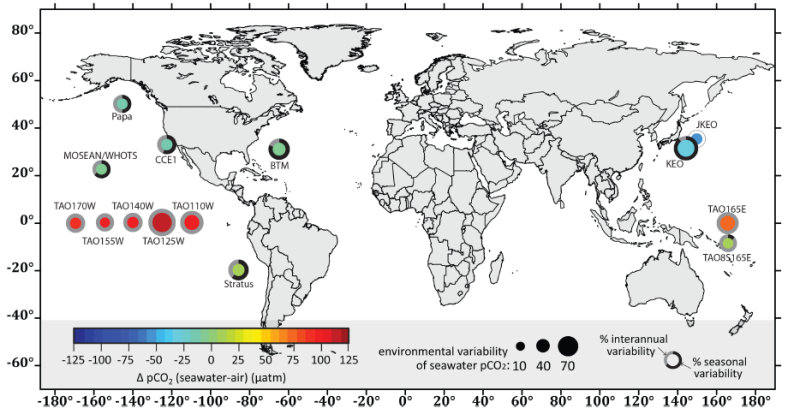
CO_2 observations in collaboration with commercial partners

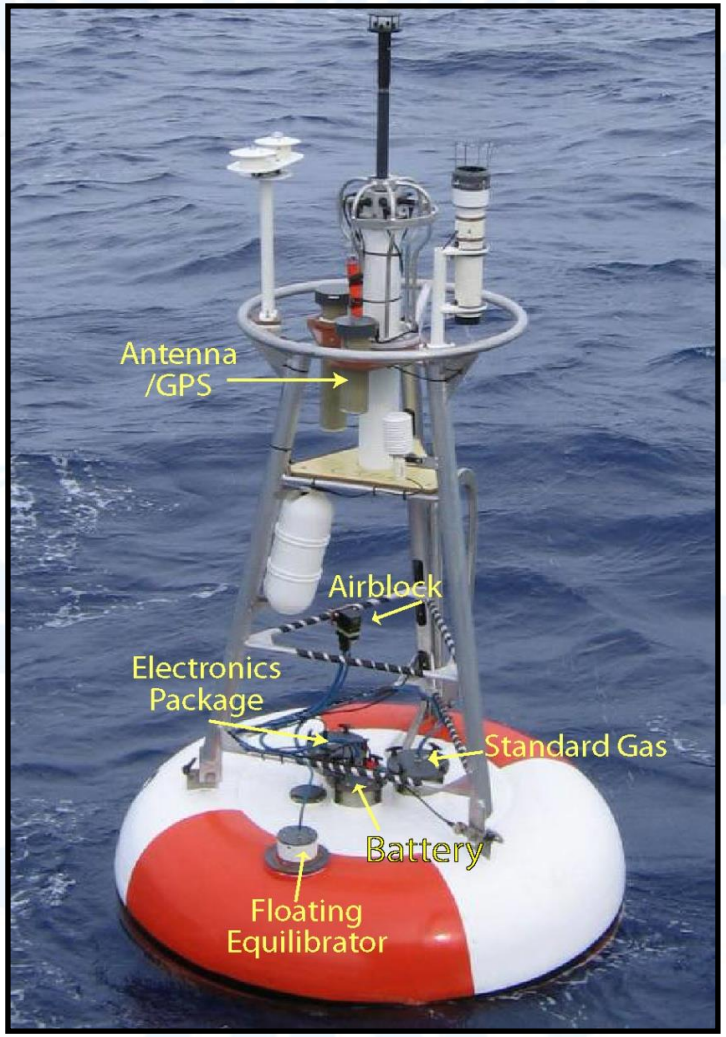


Biogeochemical Time Series



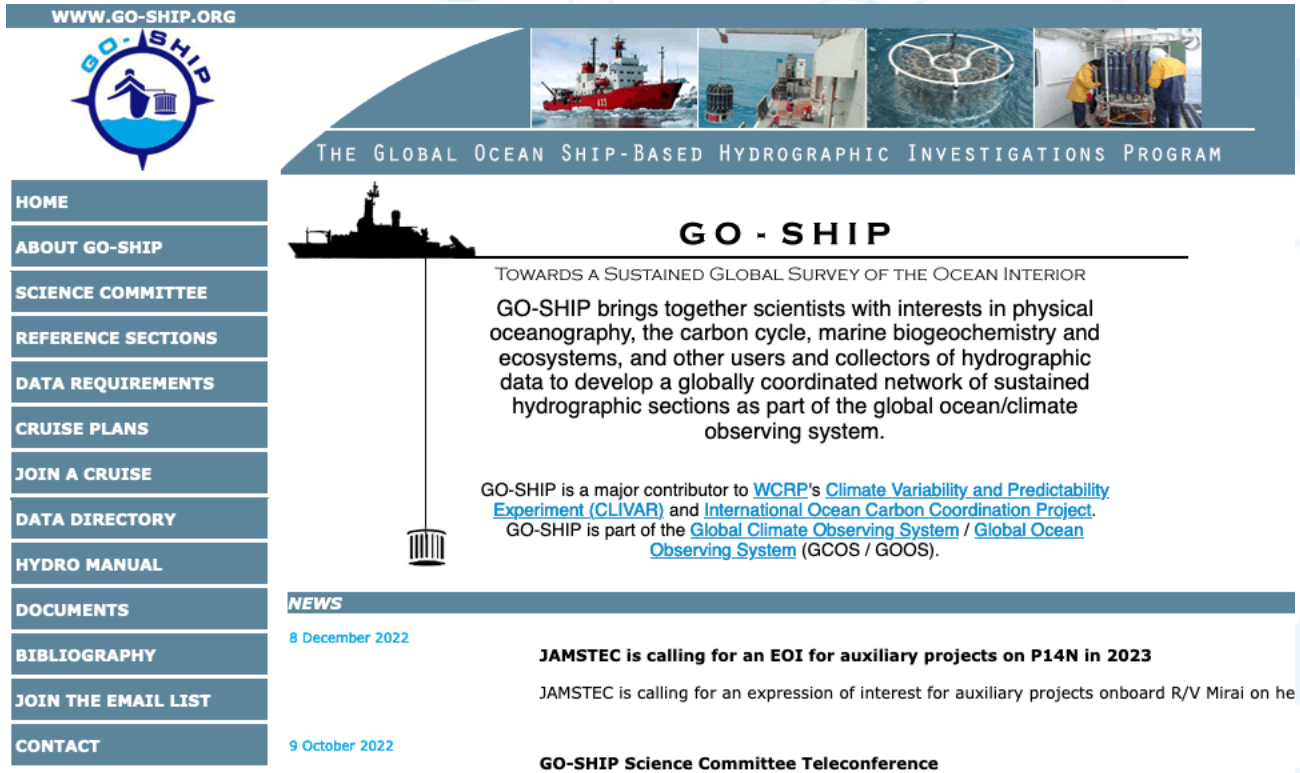
OceanSITES





MapCO$_2$ system

Decadal Repeat Hydrography - http://www.go-ship.org/



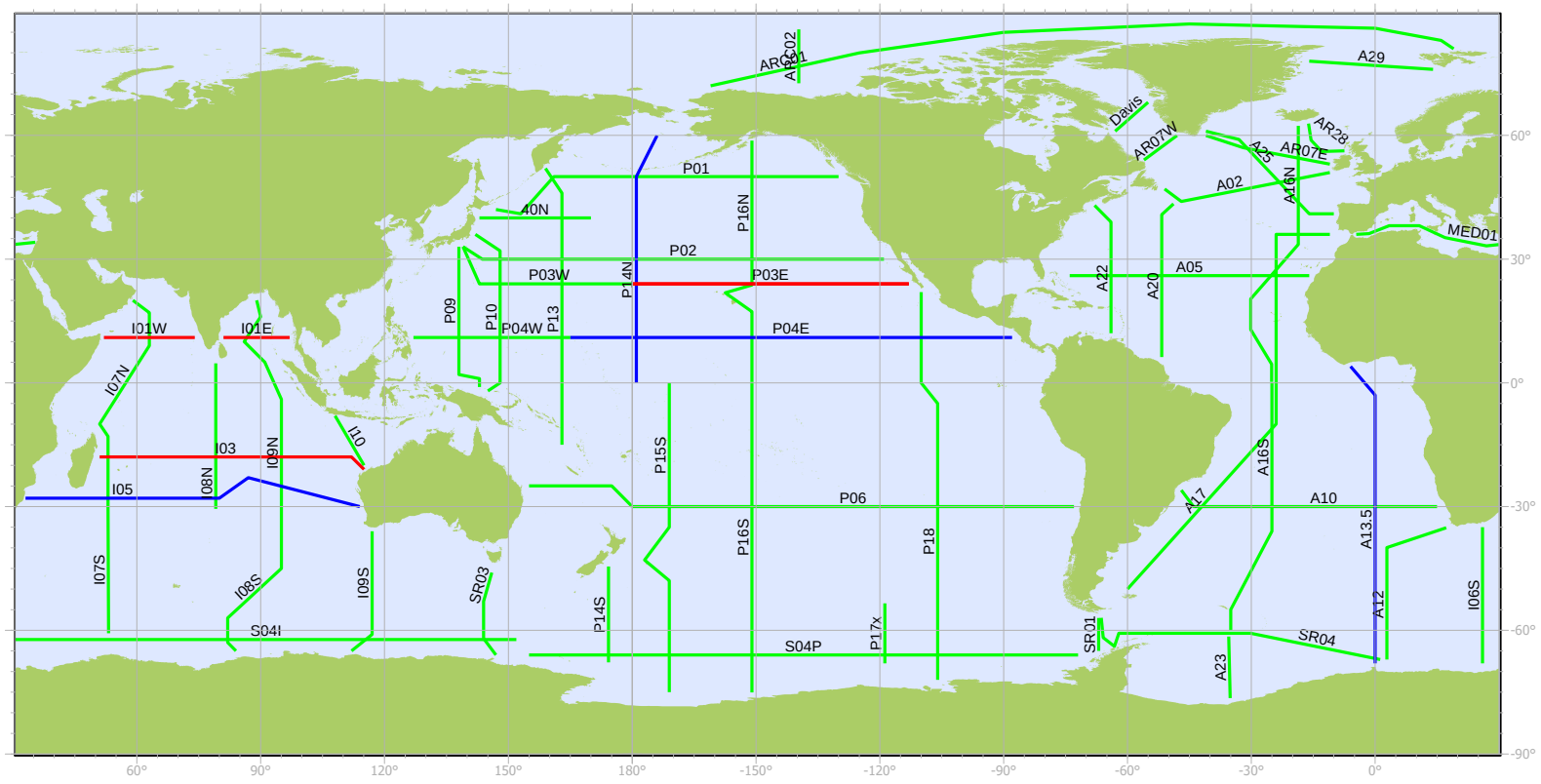
GO-SHIP provides approximately decadal resolution of the changes in inventories of heat, freshwater, carbon, oxygen, nutrients and transient tracers, covering the ocean basins from coast to coast and full depth (top to bottom), with global measurements of the highest required accuracy to detect these changes.

The GO-SHIP principal scientific objectives are:

(1) understanding and documenting the large-scale ocean water property distributions, their changes, and drivers of those changes, and

(2) addressing questions of a future ocean that will increase in dissolved inorganic carbon, become more acidified and more stratified, and experience changes in circulation and ventilation processes due to global warming and altered water cycle.

Decadal Repeat Hydrography - http://www.go-ship.org/



GO-SHIP | Status of 2012-2023 Survey (55 Core Lines) | April 2023

completed (47) | funded (4) | not planned yet (5)
at sea (0) | planned (0)

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Projection: Plate Carree (-150,0000)

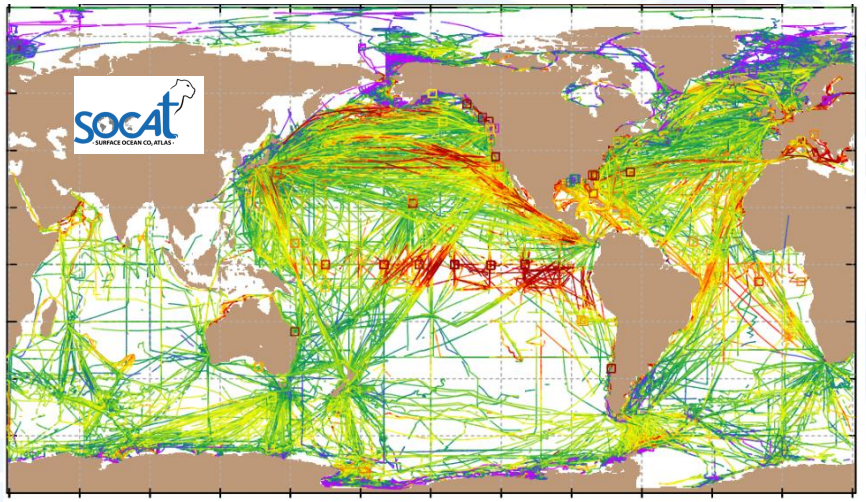
www.socat.info

Ocean carbon synthesis products

www.glodap.info

Surface Ocean CO_2 Atlas (SOCAT)

- *In situ,* surface ocean CO_2 measurements
- 33 million CO_2 values (1957-2020)

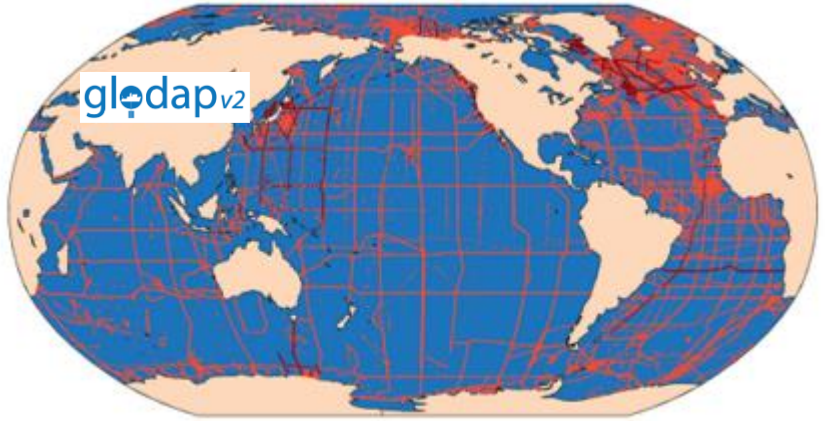


Global Data Analysis Project (GLODAP)

- Interior ocean carbon and other observations
- 946 cruises (1972-2019)

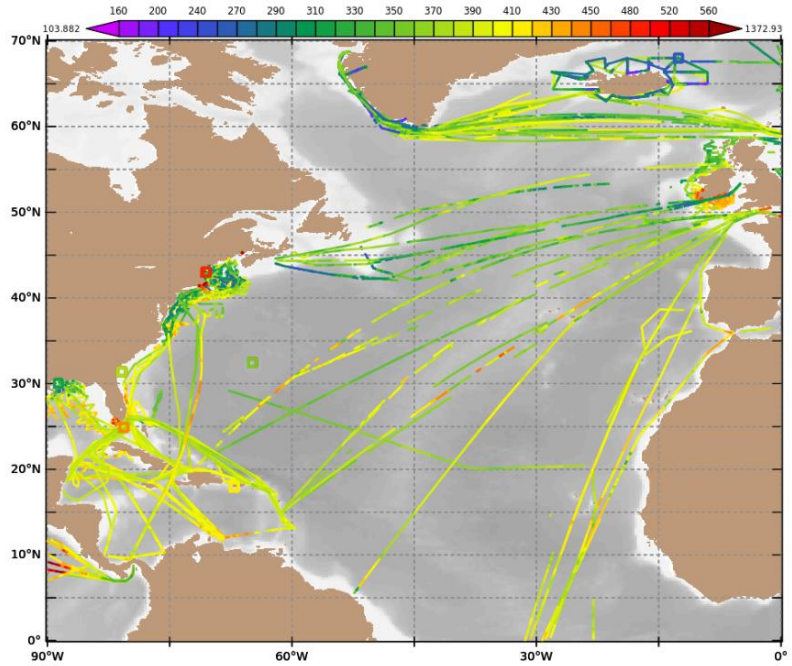
SOCAT and GLODAP

- Quality-controlled synthesis products of ocean carbon measurements for the global oceans
- Standardized procedures
- (Bi-)Annual public releases
- Used in >500 scientific publications and reports
- **Community-led, volunteer, fragile, short-term funding**

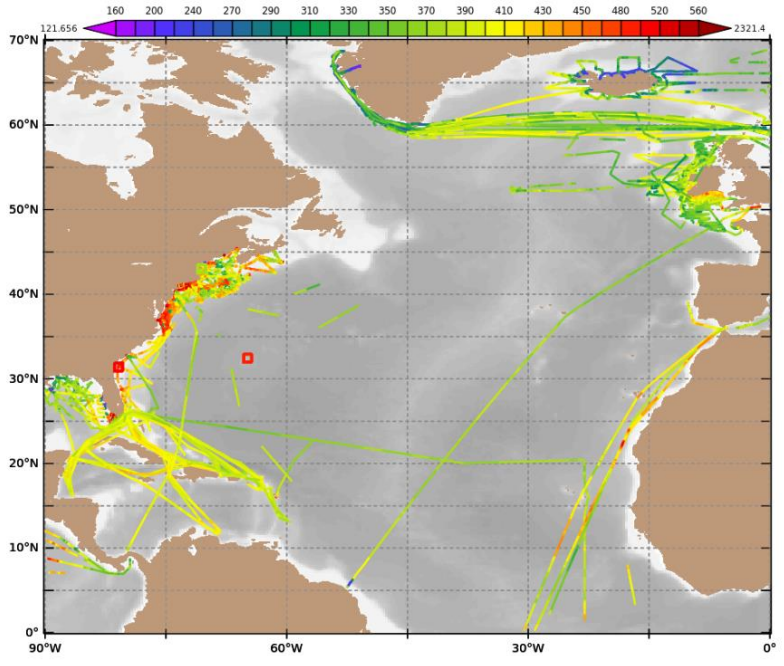


pCO_2 data from surface observations

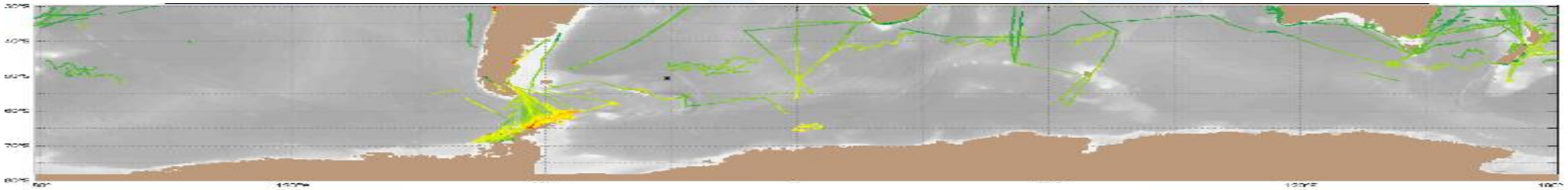
It’s actually sparse, and subject to funding short-termism



North Atlantic 2017

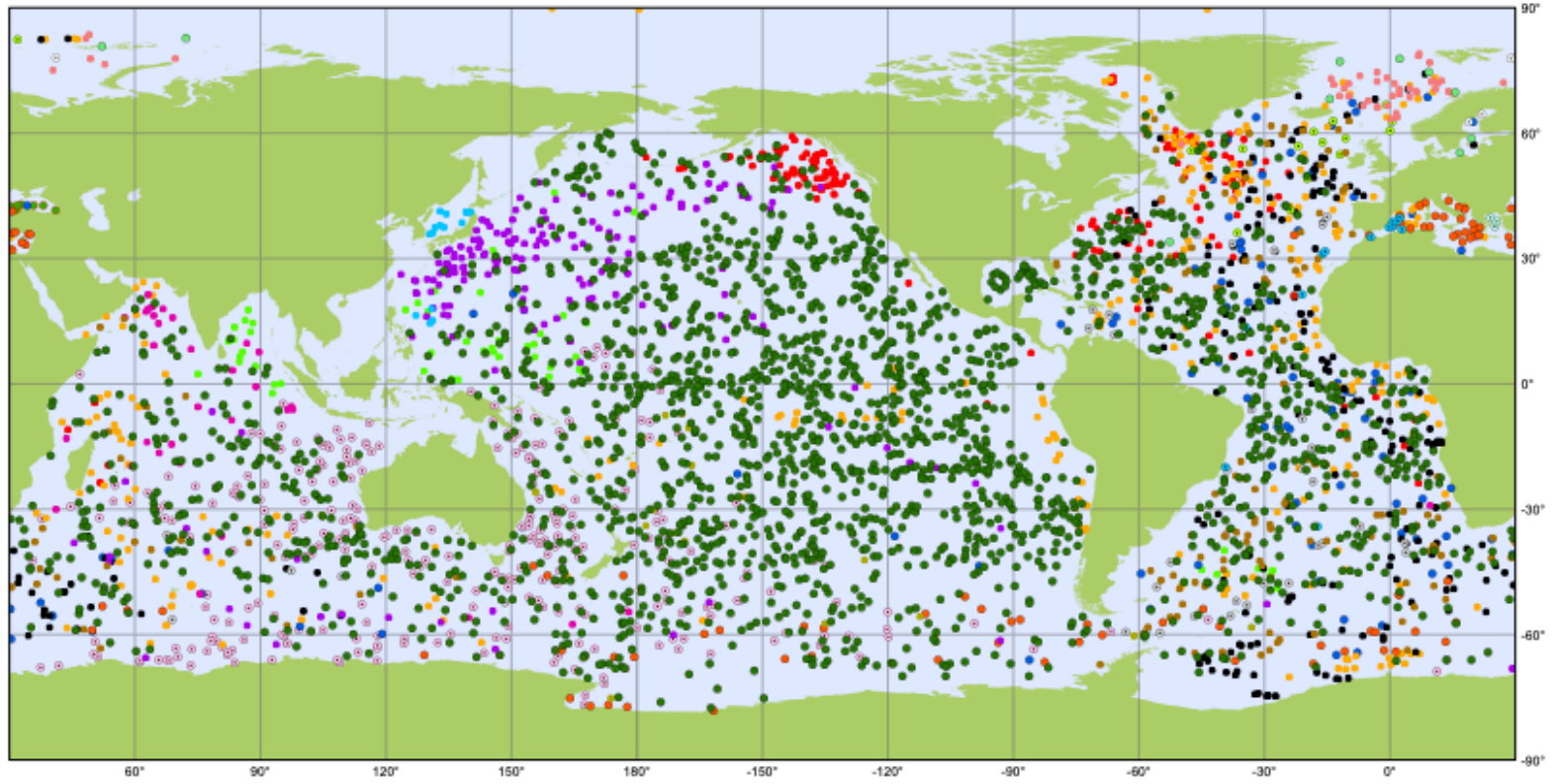


North Atlantic 2018



All Southern Ocean winter data 2000-2018

Profiling floats help filling the gaps



Argo

National contributions - 3921 operational floats

Latest location of operational floats (data distributed within the last 30 days)

March 2023

AUSTRALIA (307)	FINLAND (6)	IRELAND (16)	NEW ZEALAND (16)	SPAIN (14)
BULGARIA (8)	FRANCE (305)	ITALY (90)	NORWAY (45)	UK (149)
CANADA (152)	GERMANY (223)	JAPAN (182)	PERU (1)	USA (2154)
CHINA (58)	GREECE (4)	MOROCCO (1)	POLAND (10)	
EUROPE (91)	INDIA (35)	NETHERLANDS (39)	KOREA, REPUBLIC OF (15)	

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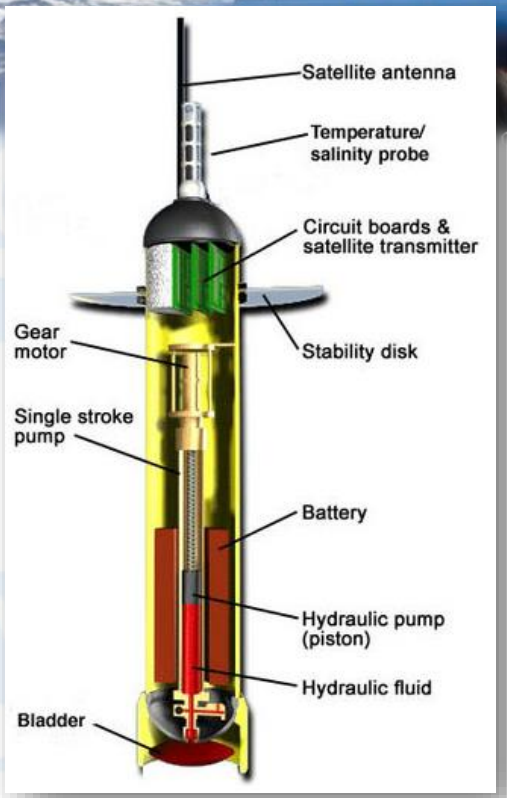
Projection: Plate Carree (-150,0000)



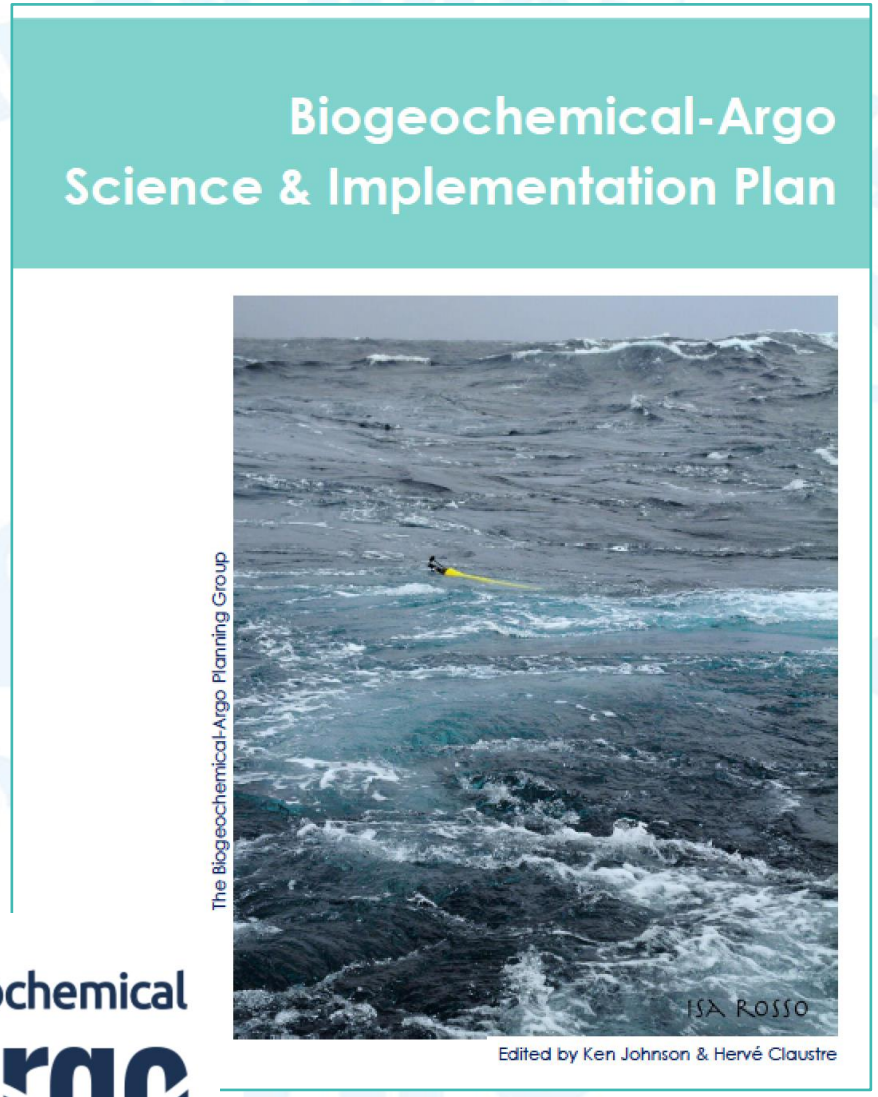
Biogeochemical floats - http://biogeochemical-argo.org

Research topics

- Carbon uptake
- OMZs and nitrate cycling
- Acidification
- Biological carbon pump
- Phytoplankton communities

Management topics

- Living marine resources
- Carbon budget verification

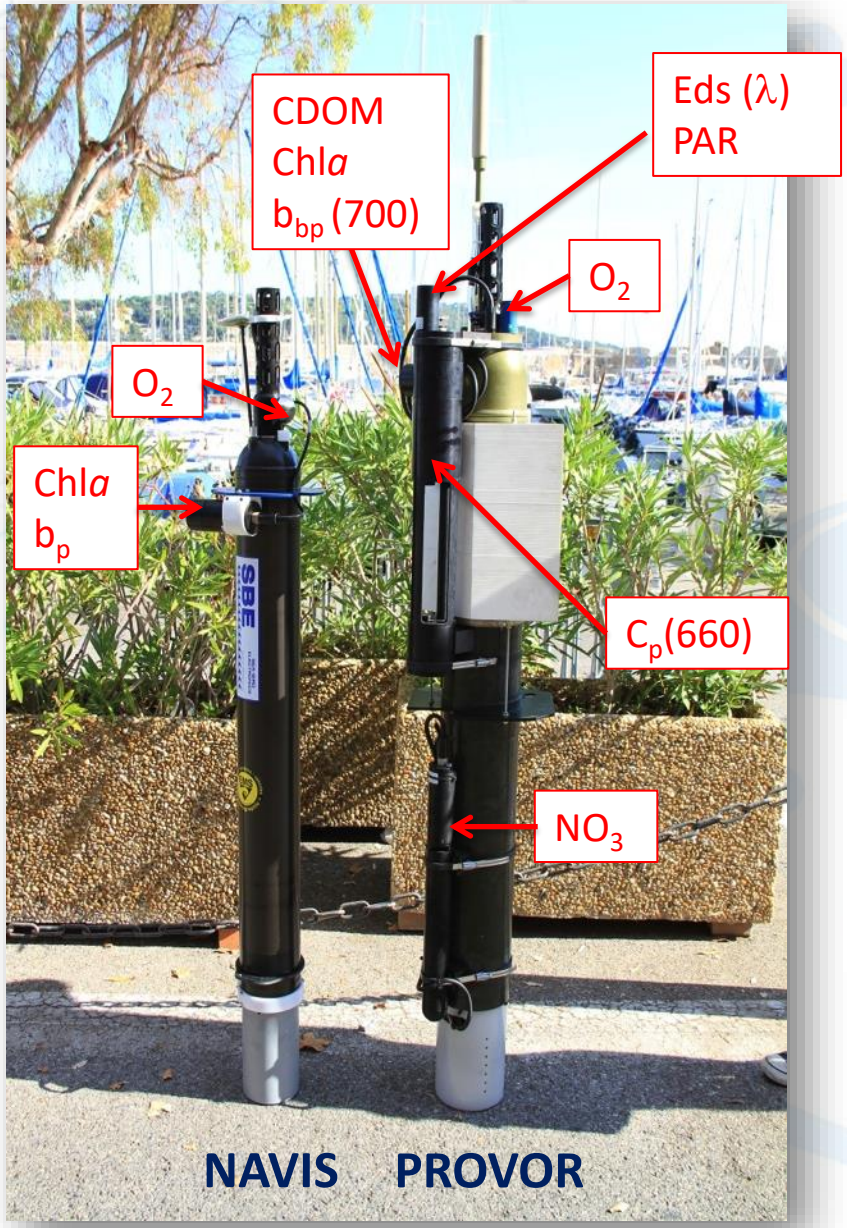


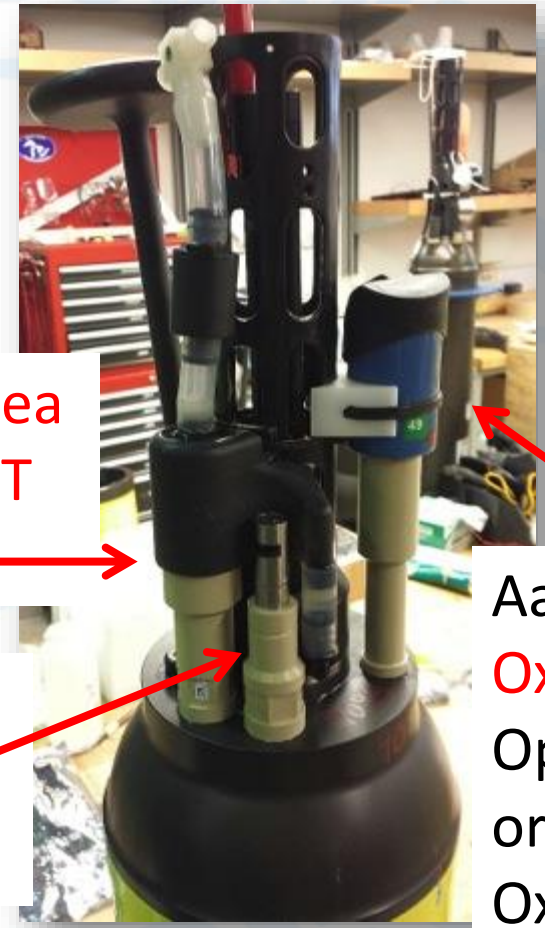
biogeochemical Argo

Complexity in biogeochemistry

Core Variables:

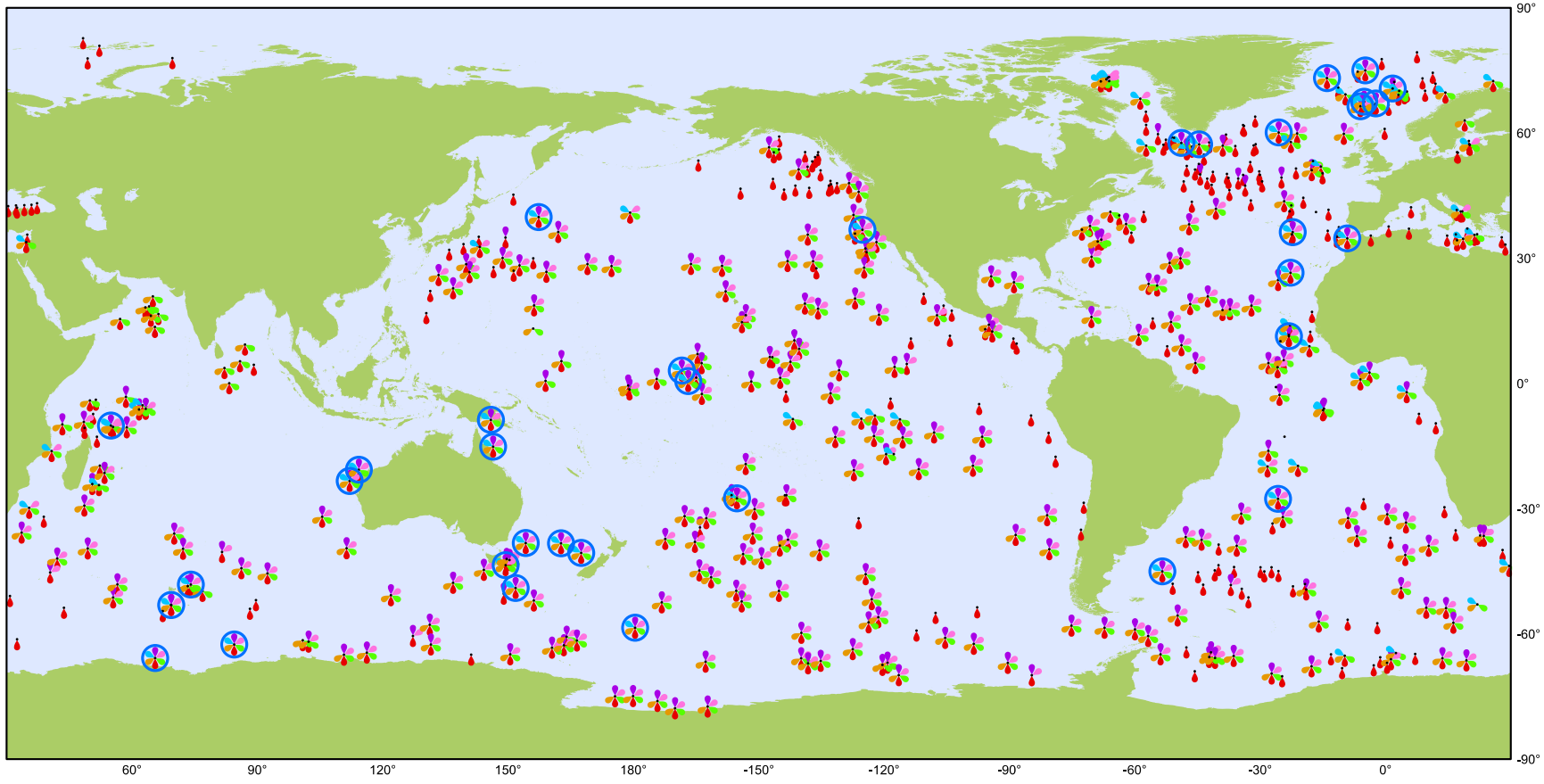
- O_2
- NO_3
- pH
- Chl*a*
- Suspended particles
- Downwelling irradiance





APEX head

Floats need biogeochemical sensors



Biogeochemical Argo

Sensor Types

Latest location of operational floats (data distributed within the last 30 days)

April 2023

biogeochemical Argo

- Operational Floats (524)
- Suspended particles (313)
- Downwelling irradiance (81)
- pH (268)
- Nitrate (252)
- Chlorophyll a (313)
- Oxygen (516)
- Full BGC Floats (35)

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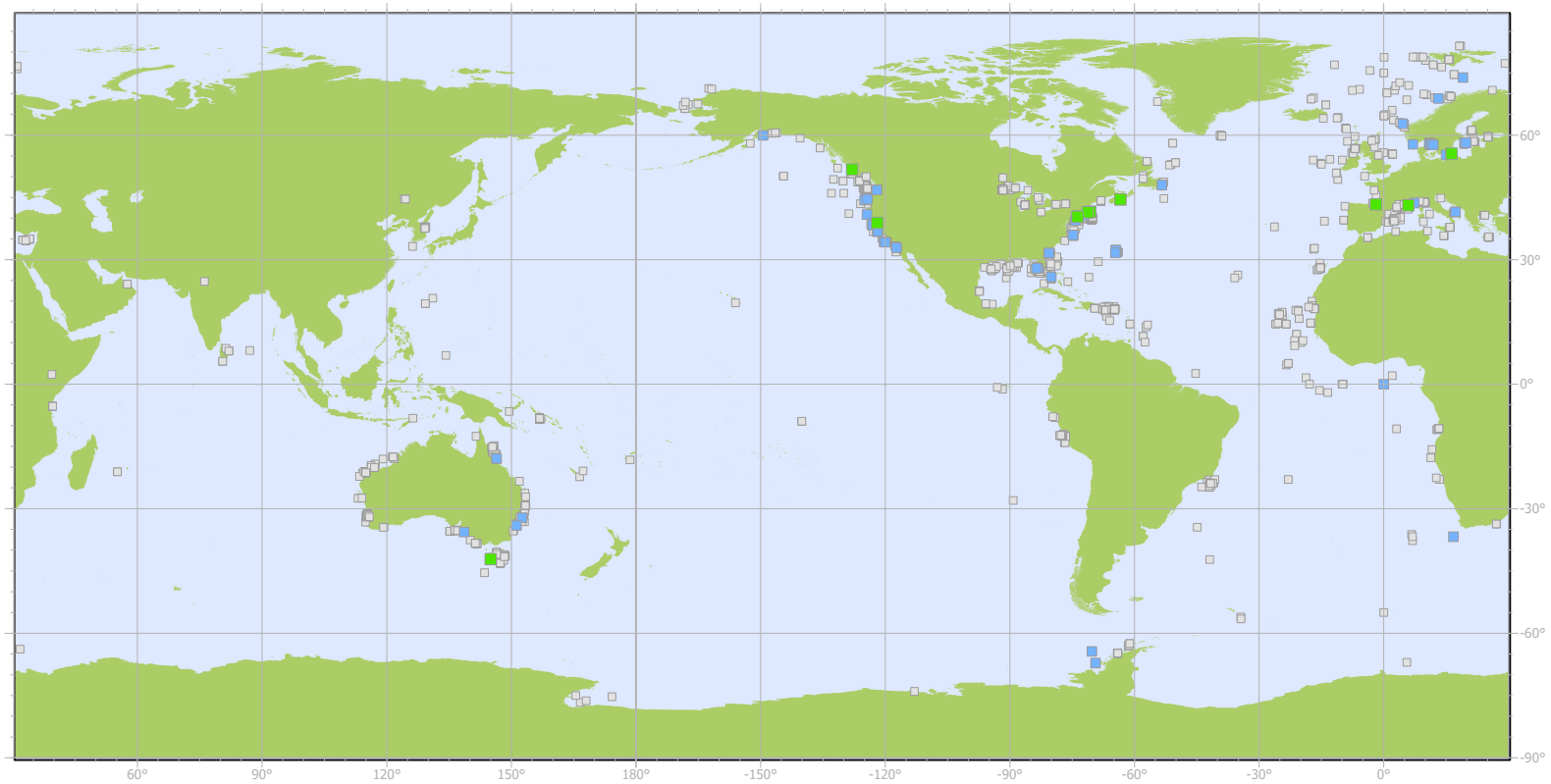
Projection: Plate Carree (-150,0000)

Ocean gliders help filling the gaps



OceanGliders

OceanGliders Deployments

Deployment location of all glider missions

April 2023

Historical deployments of the OceanGliders program (2239)

Deployments of the year (75)

Deployments of the month (12)

Ocean Gliders

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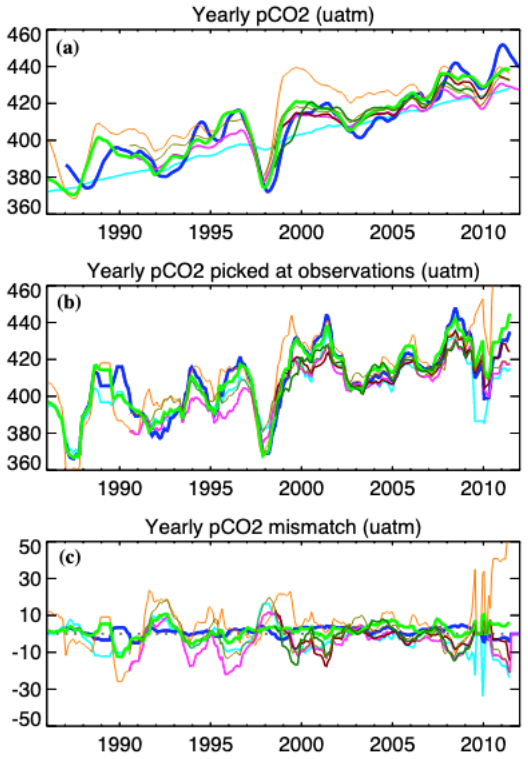
Projection: Plate Carree (-150,0000)

Ocean Gliders

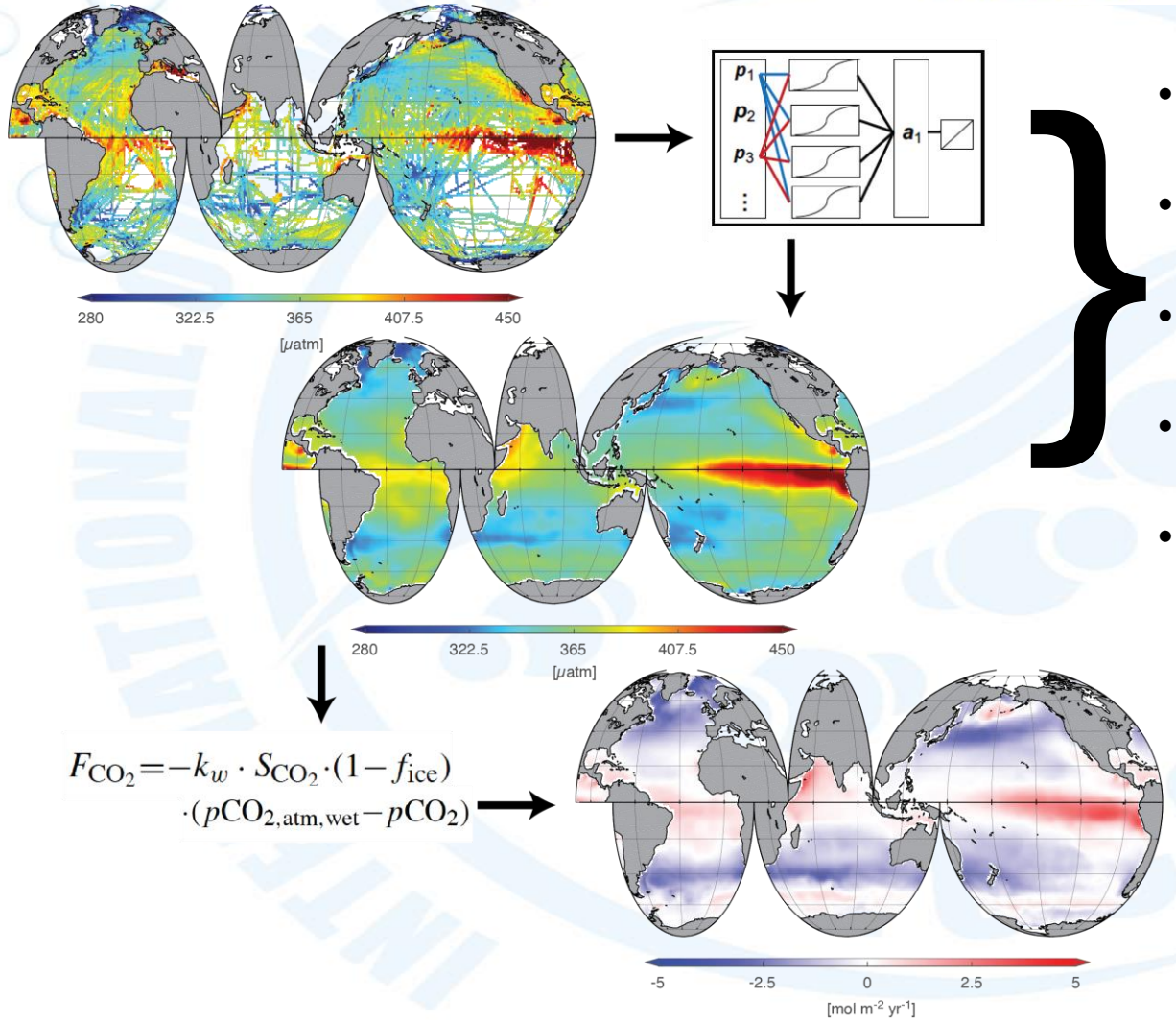
https://www.oceangliders.org/

OceanGliders

Surface ocean carbon mapped fields



Comparison of selected mapping methods over selected region



- Regression models
- Neural networks
- Mixed layer scheme
- Model-informed regression
- …

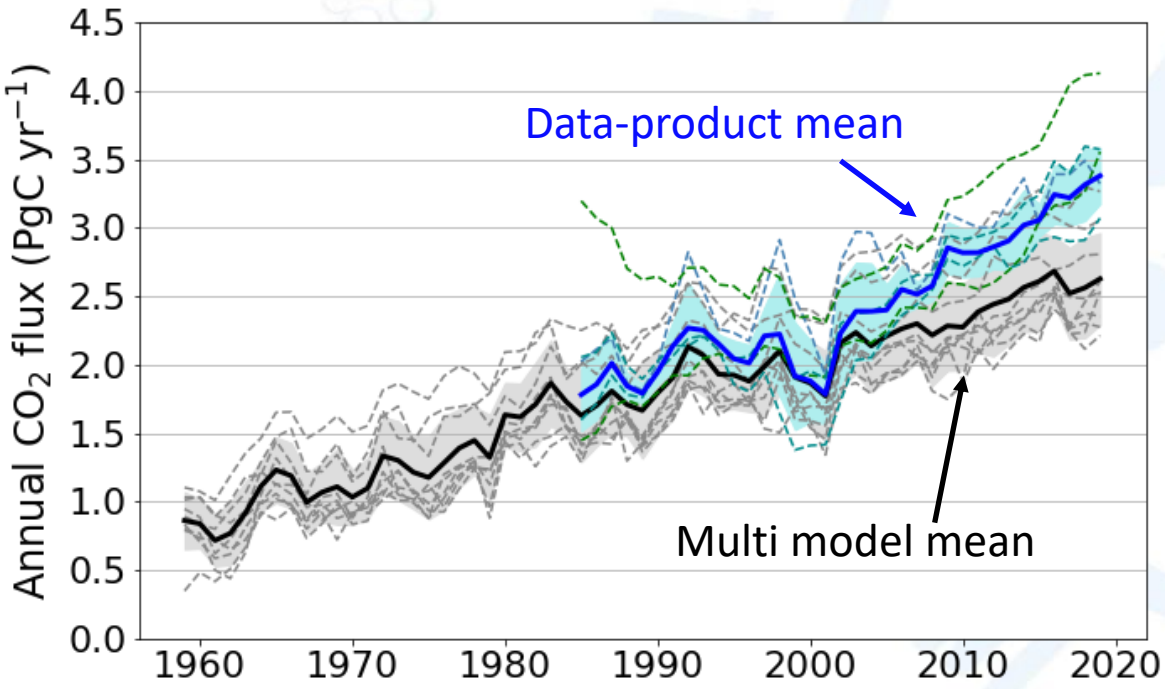
Global Carbon Budget

GLOBAL CARBON PROJECT

Global Carbon Project:

- Combining and synthesizing information on CO_2 emissions and sinks
- Around 40 (ocean) co-authors contributing ocean CO_2 observations, data-products and models
- Based on best scientific knowledge by being rooted deeply in the scientific community

How much CO_2 goes into the ocean each year



Estimated from a suite of **global ocean biogeochemical models**

➡ robust to estimate the **global** ocean **mean** sink and anthropogenic trends

Compared to **data-products** (statistical mapping of pCO_2 observations; 98% gap-filling)

➡ key strength: assess interannual and multi-year **variability**

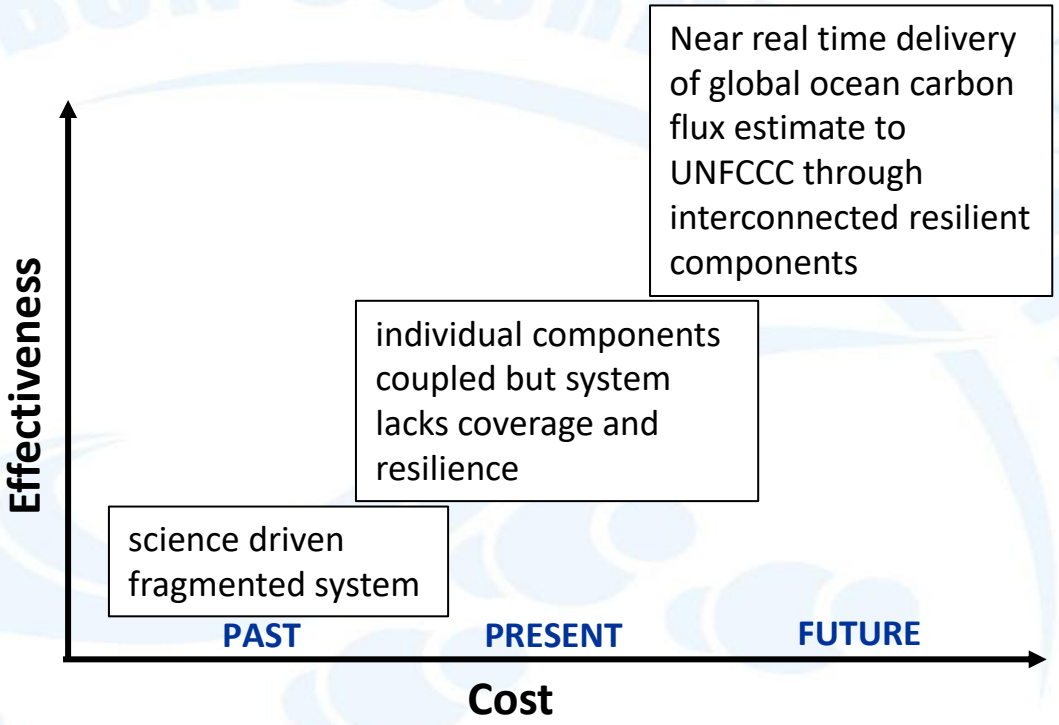
Current challenge: Operationalizing the value chain of Surface Ocean Carbon Observations

- We have all the components of the value chain and when they occasionally work together, they have a demonstrated ability to estimate surface ocean CO_2 uptake to very high precision in near real time.

- Much of the system is supported by short term research funding rather than longer term operational funding (similar to Met obs.), which is rather counterproductive at the time of the climate emergency when we most need to know ocean carbon uptake in near-real time for a wide variety of purposes.

- Significant data gaps are appearing and key parts of the chain operate on a best endeavours basis – we are sliding back down the curve, just when we need to be climbing it.

- We are in a process of describing a fully operational Ocean Carbon Observing System capable of operationally delivering ocean carbon flux information. Strategy will include a tailored investment in suport of this operation.



Effectiveness of operational value chain

- fit-for-purpose design
- speed of delivery
- operational links between components
- system resilience

Requirement to rapidly and operationally link ocean carbon data through to policy makers and minimize mitigation/ adaptation costs

WORLD METEOROLOGICAL ORGANIZATION

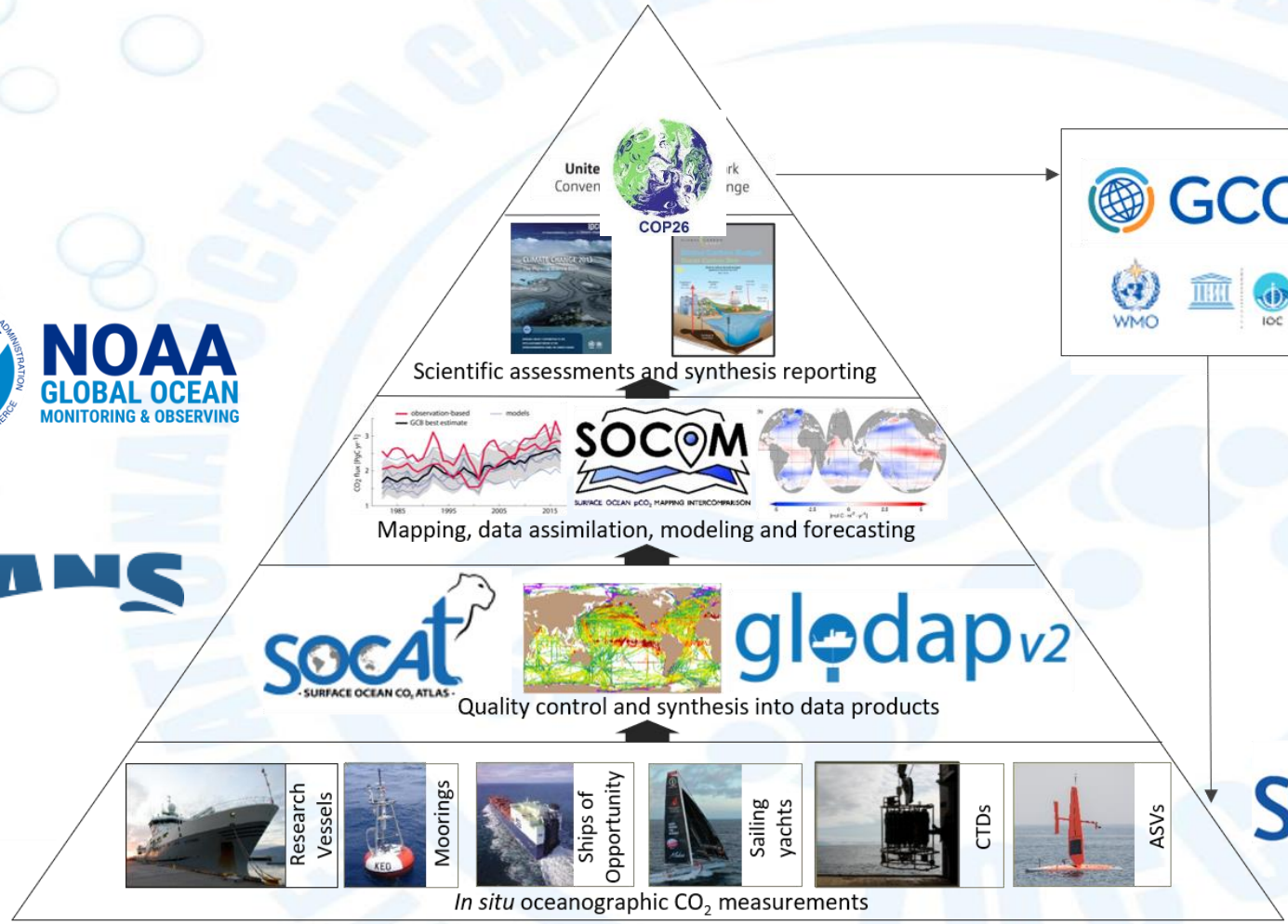
G7 FUTURE OF THE SEAS & OCEANS INITIATIVE

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT IOCCP

NOAA GLOBAL OCEAN MONITORING & OBSERVING

ICOS Ocean Thematic Centre

JPI OCEANS



GCOS GOOS

WMO IOC International Science Council UN environment

SOCONET SURFACE OCEAN CO2 OBSERVING NETWORK

International Council for Science
SCOR
Scientific Committee on Oceanic Research

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT
IOCCP

The Global Ocean Observing System
GOOS
Biogeochemistry Panel

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

A communication and coordination service for marine biogeochemistry

www.ioccp.org ***@ioccp_org***

Thank You!

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The Global Ocean Observing System
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