

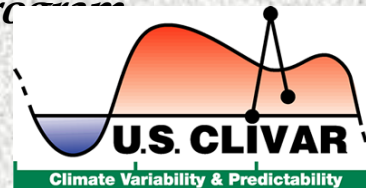
CLIVAR Activities and Linkages to OCB

*Presentation for the OCB Meeting
July 2010*

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U.S. Climate Variability and Predictability



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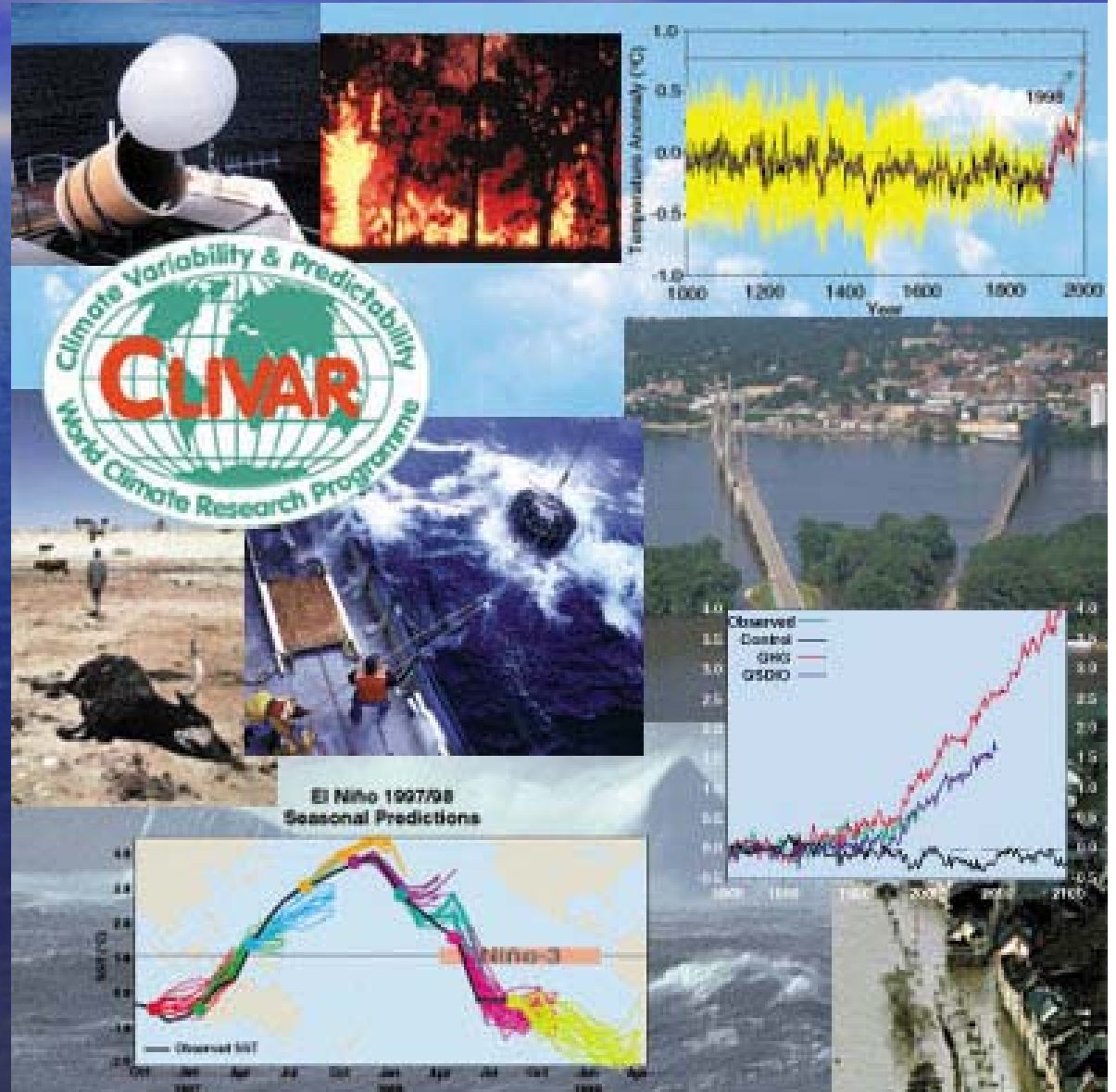


CLIVAR (Climate Variability and Predictability)

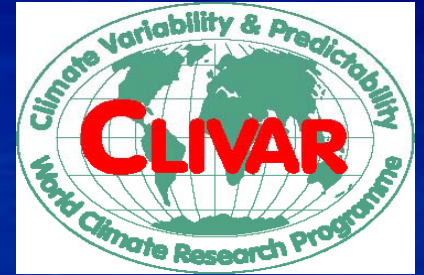
CLIVAR is an multidisciplinary research effort within the World Climate Research Programme (WCRP) focusing on the variability & predictability of the slowly varying components of the climate system.

CLIVAR coordinates activities in support of its mission to observe, simulate and predict Earth's climate system, with focus on ocean-atmosphere interactions, enabling better understanding of climate variability, predictability and change, to the benefit of society and the environment in which we live.

<http://www.clivar.org>



CLIVAR Imperatives 2010-2014

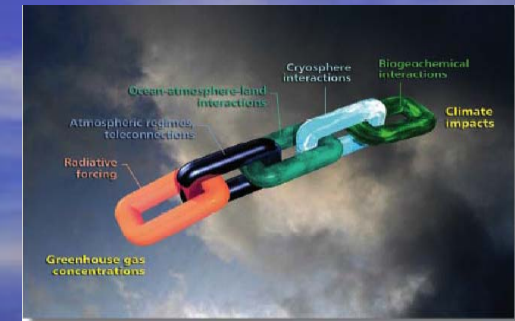


- Anthropogenic Climate Change
- Decadal Variability, Predictability and Prediction
- Intraseasonal and Seasonal Predictability and Prediction
- Improved Atmosphere and Ocean Components of Earth System Models
- Data Synthesis and Analysis
- Ocean Observing System
- Capacity Building

Some areas of CLIVAR Activities

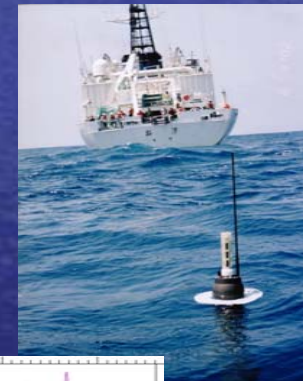
➤ Modeling

- ✓ Exploring concepts related to seamless prediction paradigm
- ✓ Improving (ocean) models
- ✓ Climate change experiments in support of AR5



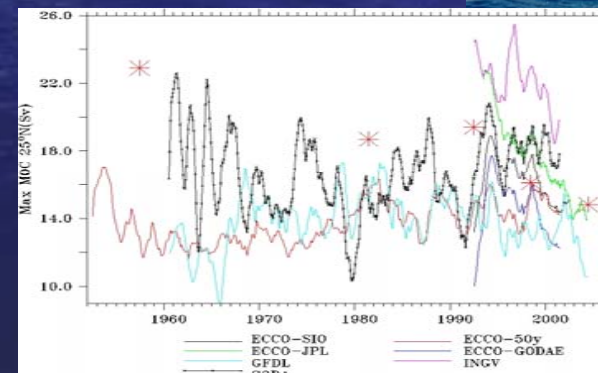
➤ Observations

- ✓ Sustained ocean observations and monitoring
- ✓ Process studies
- ✓ Improved historical data



➤ Analysis products

- ✓ Ocean data assimilation
- ✓ Reanalysis



➤ Empirical Studies

- ✓ Understanding of the coupled climate system



CLIVAR Organization



Scientific Steering Group

Crosscutting (global) Panels

Observations & Data

CLIVAR Synthesis & Observations Panel*

PAGES/CLIVAR Working Group

CC/CLIVAR Expert Team on Climate Change Detection (A2)

Modelling

Working Group on Seasonal to Interannual Prediction

JSC/CLIVAR Working Group on Coupled Modelling

WGCM/CLIVAR Working Group on Ocean Model Development

Regional or PRA¹ related Panels

Asian-Australian Monsoon Panel (G2)

Variability of the American Monsoon Systems (VAMOS) (G3)

Variability of the African Climate System Panel (G4)

Atlantic Implementation Panel (D1-D3)

A. Koertzing (Carbon Rep.)

Pacific Implementation Panel (G1 & D4)

D. Feely (Carbon Rep.)

Southern Ocean Implementation Panel (D5)

Nikki Lovenduskihas

CLIVAR/MOC Indian Ocean Implementation Panel

Raleigh Hood

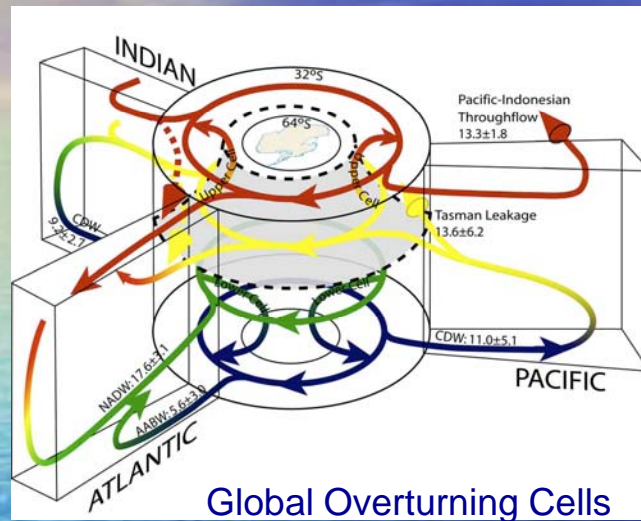
¹ Principal Research Areas

*to be established

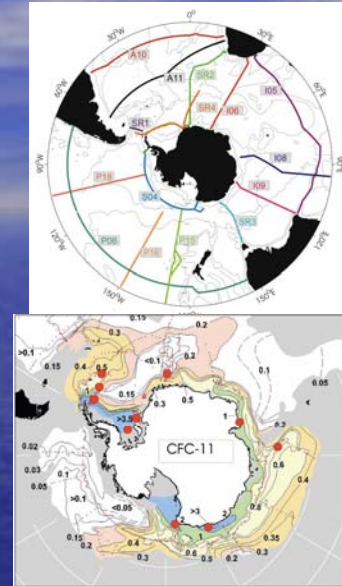
International CLIVAR Project Office

© ICPO, 2003

Southern Ocean Implementation Panel



Plans for a Southern Ocean Observing System (SOOS) underway



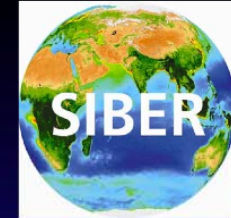
Panel goals include enhancing interaction between the meteorology, oceanography, cryosphere, **biogeochemistry** and paleoclimate communities with an interest in the climate variability of the Southern Ocean region.

Relevant questions include:

- What is ocean carbon cycle response to historical climate change (e.g. Southern Annual Mode)?
- Role of winds and ocean surface fluxes (physical carbon pump)? Modeling and prediction challenges (including eddy effects, mixing, etc)?

Indian Ocean Panel... jointly developing:
S I B E R : Sustained Indian Ocean Biogeochemistry and Ecosystem Research

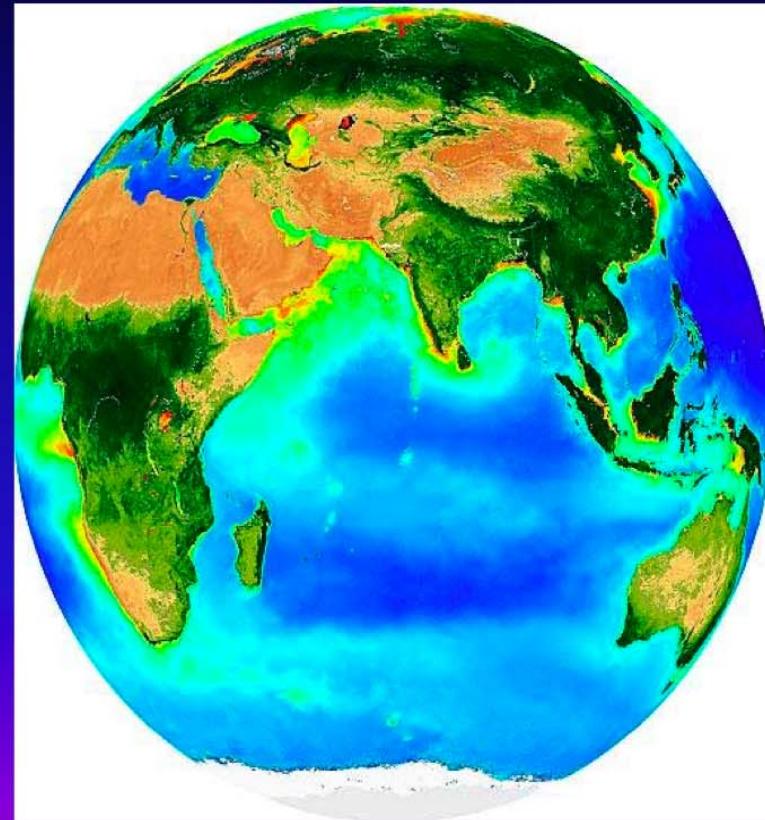
SIBER Science Plan and Implementation Strategy:



Long term goal of SIBER is to improve our understanding of the role of the Indian Ocean in global biogeochemical cycles and the interaction between these cycles and marine ecosystem dynamics.

This understanding will be required in order to:

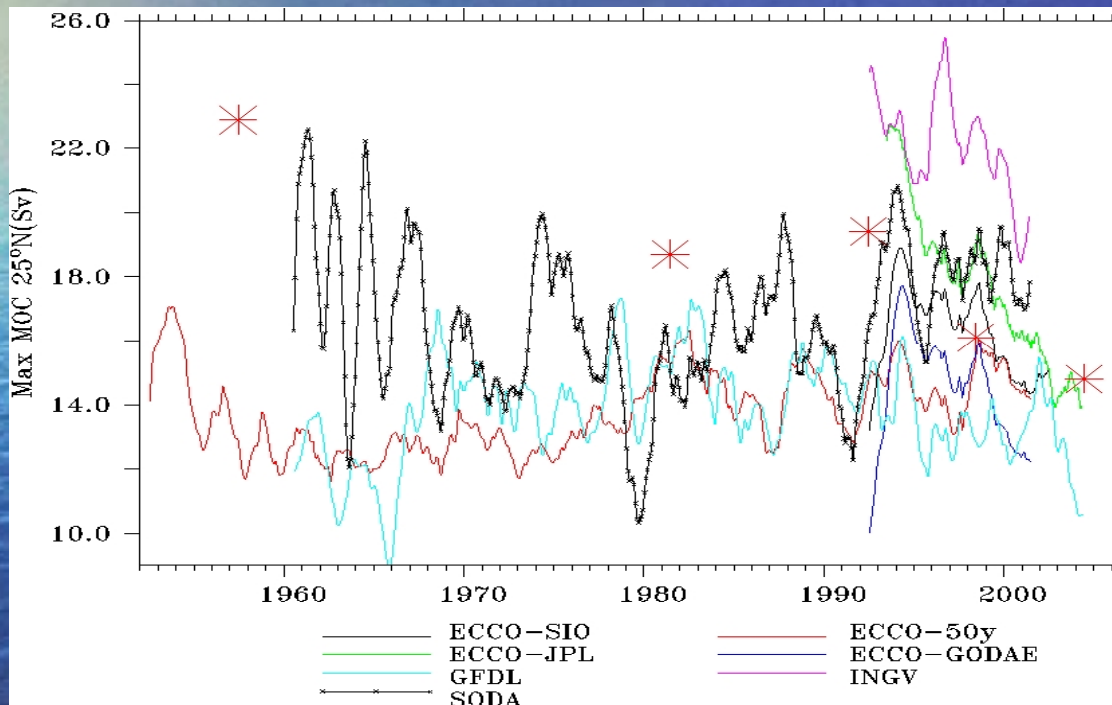
- Predict the impacts of climate change, eutrophication and harvesting on the global oceans and the Earth System.
- It is fundamental to policy makers in the development of management strategies for the Indian Ocean.



SeaWiFS biosphere image of the Indian Ocean region showing land vegetation and marine surface phytoplankton concentrations for boreal summer/austral winter. From <http://oceancolor.gsfc.nasa.gov/SeaWiFS>.

Ocean Reanalyses

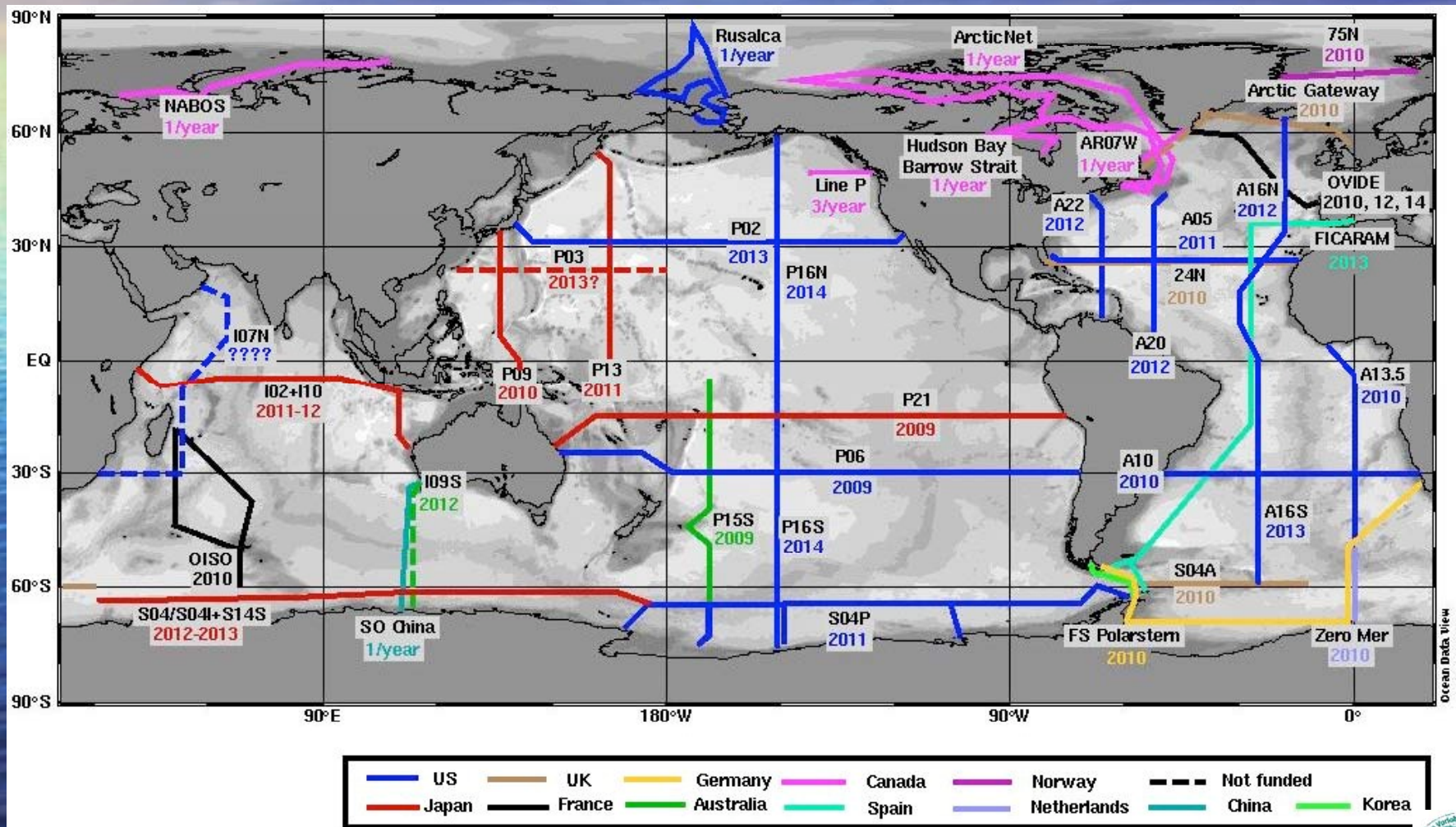
- CLIVAR is taking lead in coordinating global and basin ocean reanalyses for climate



Comparison of 8 different ocean analyses (lines) plus observed (*'s) estimates of Atlantic overturning strength

- Ties between ocean reanalyses and carbon program?

US CLIVAR Initiated CLIVAR-Carbon Deep Ocean Hydrography Observations



Ocean Data View

GO-SHIP

Future



Global Ocean Ship-based Hydrographic Investigations Program

- **Overarching Goal:** Develop sustained global network of repeat hydrography sections to become part of the global ocean and climate observing networks
- GO-SHIP goals:
 - develop formal international agreements, including an internationally-agreed strategy and implementation plan
 - advocate for national contributions to this strategy and participation in the global program,
 - provide a central forum for communication and coordination, and
 - develop syntheses of hydrographic data, in partnership with national, regional, and global research programs.

<http://www.go-ship.org/>



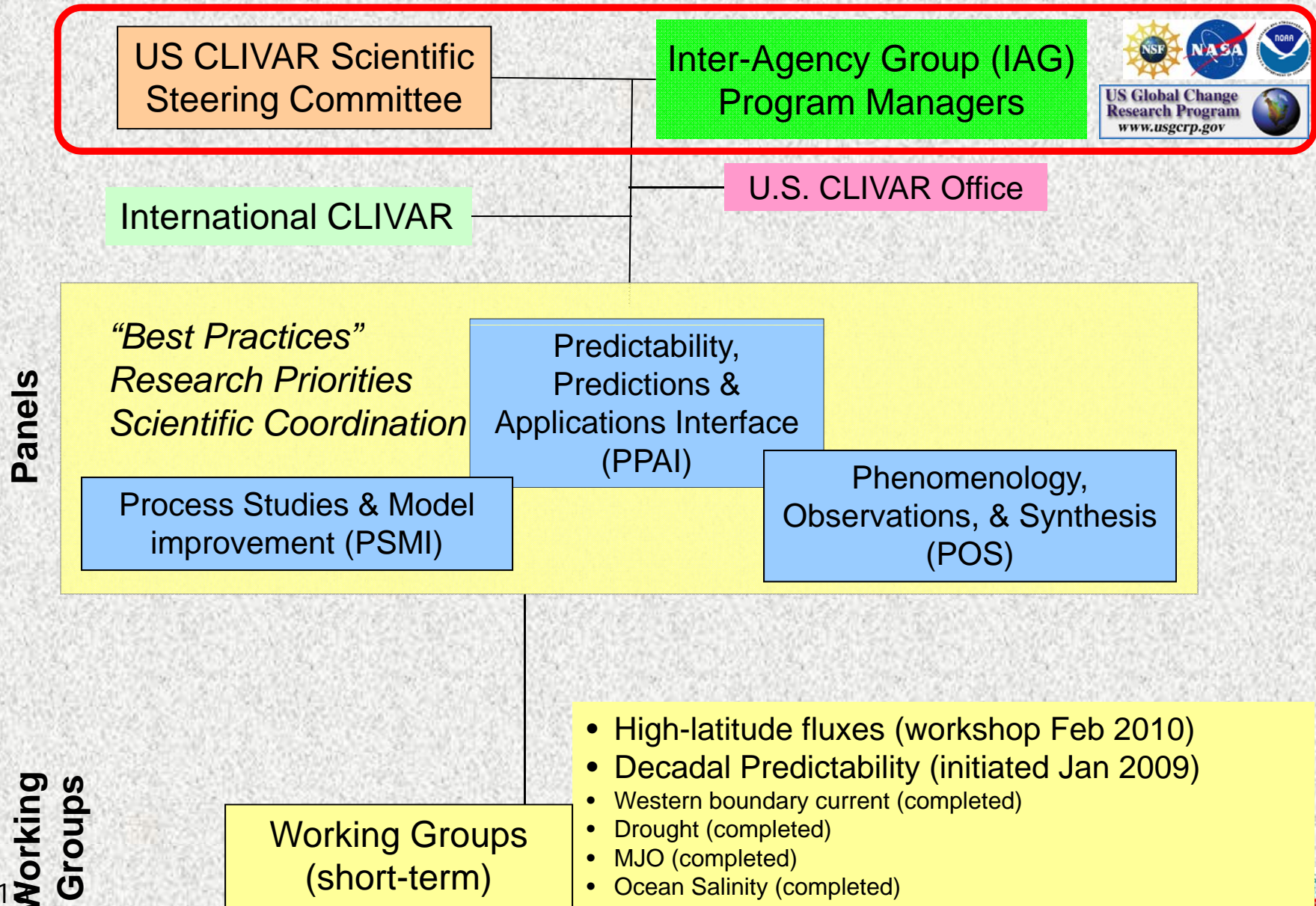
Mechanisms for Increased Int'l Coordination

- International CLIVAR basin Panels (each has a carbon representative, e.g. Koertzinger, Raleigh Hood, Feely)...
 - Opportunity to coordinate across disciplines. Successes correlate to active participation of carbon scientists and joint programs (e.g. SIBER).
 - Encourage IOCCP and OCB to recognize and support such interactions.
- New initiatives: e.g. GO-SHIP, Oceanobs09 follow-on are great opportunities for coordinating observations...would welcome more truly joint initiatives

Aims of US CLIVAR

- Coordinate and Implement CLIVAR in the US
 - Coordination and leadership of **US scientific community** addressing CLIVAR objectives
 - Coordination of **programmatic community** - inter- and intra-agency programs
 - Coordinate **US and Int'l CLIVAR** activities

U.S. CLIVAR Organization



U.S. CLIVAR

Current foci for US CLIVAR:

I Extremes (Drought)

II Decadal Variability/Predictions

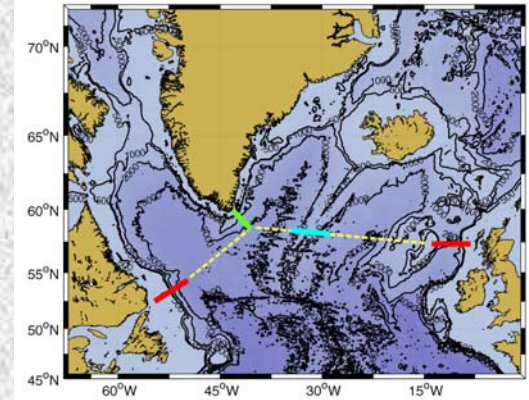
New scientific areas that should be addressed jointly with other programs:

- polar changes (focus in 2010),
- **carbon cycle**
- ecosystems, & coastal changes

US CLIVAR Sample Activities

- Process Studies/Model Improvement
 - Model improvement: **CPTs** (4 established in 2010 – 1 focuses on diapycnal ocean mixing) – embedded in US climate modeling centers
 - Process Studies
 - Best practices and scientific assessment: CLIMODE, VOCALS, DIMES, IASCLIP, DYNAMO, etc (increasingly multidisciplinary)
- Predictability/Predictions & Applications Interface
 - Earth system modeling/prediction links to marine ecosystems. NCAR Summer Colloquium (Aug 2-14, 2009)
 - Post-Doc program: increase pool of scientists qualified to transfer climate knowledge to decision-frameworks & tools
- Phenomenology, Observations, & Synthesis
 - **Reanalyses/Integrated Earth System Analyses** (IESA) Workshop, Fall 2010

A new AMOC initiative: Overturning in the Subpolar North Atlantic Program - OSNAP



Goal: To quantify the large-scale, low-frequency, full water-column net fluxes of mass, heat and fresh water associated with the meridional overturning circulation in the subpolar North Atlantic.

Interdisciplinary linkage: Primary linkage is with biogeochemistry and ocean biology in order to answer:

1. What are the mechanisms controlling CO₂ uptake in the subpolar North Atlantic and how do they vary on seasonal and interannual time scales?
2. What are the spatial and temporal patterns of primary productivity in the North Atlantic on seasonal and interannual time scales?

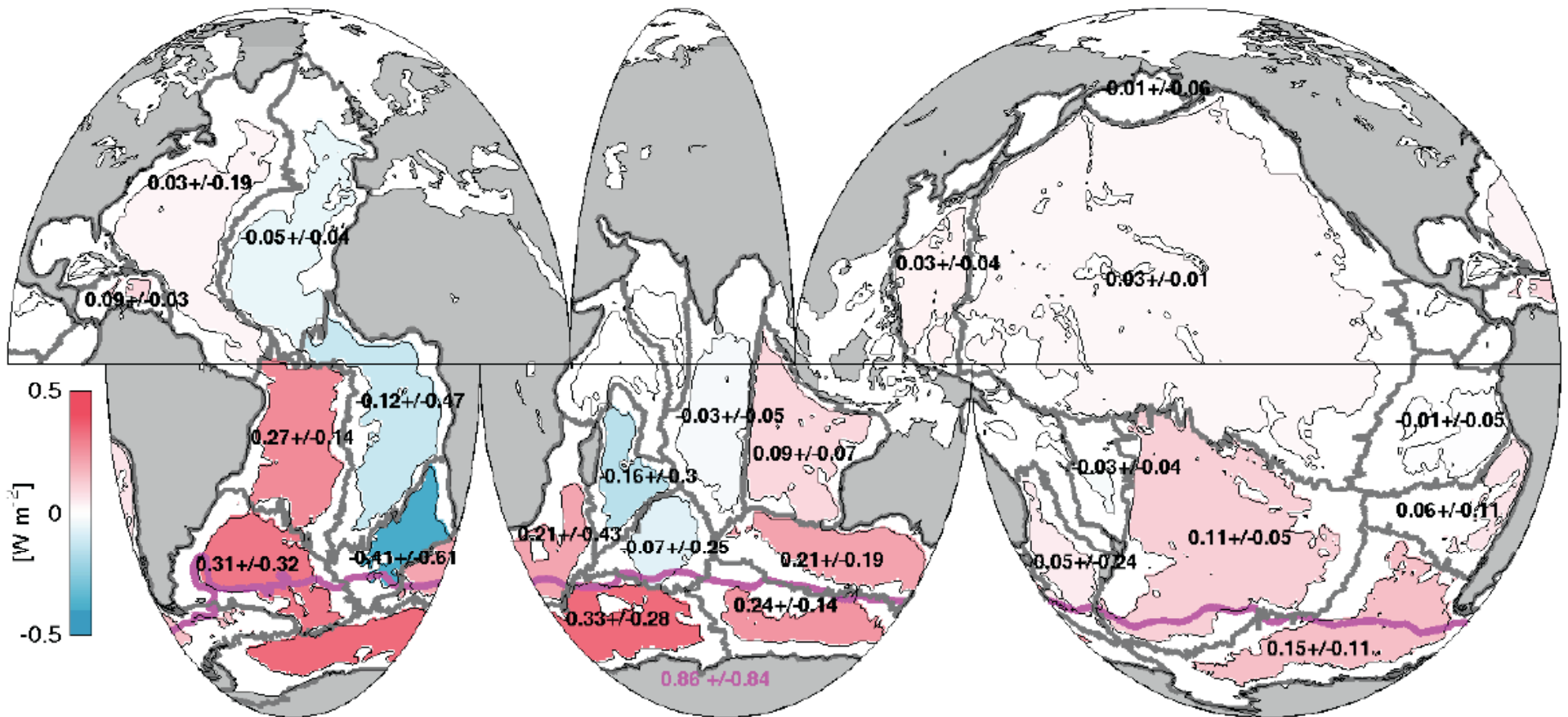
Participants at OSNAP planning workshop in April 2010: Emanuel Boss (U. Maine), Galen McKinley (U. Wisconsin), Mary Jane Perry (U. Maine) and Cisco Werner (Rutgers)

US Atlantic Meridional Overturning
Circulation (AMOC) - Atlanticmoc.org



Antarctic Bottom Water Warming Between the 1990s and the 2000s

Purkey and Johnson, 2010



Mean local heat fluxes through 4000m implied by abyssal warming below 4000m from the 1990s to the 2000s within each of the 24 sampled basins indicated by black numbers and color (see key), as well as 95% confidence intervals.

Heat and Carbon Uptake in the Southern Ocean...A New Working Group*??

Aims: Synthesize current capabilities; motivate and identify needed improvements in coupled climate models to improve estimates of ocean heat and carbon uptake in the southern ocean region

Potential activities:

- Develop critical diagnostics for Southern Ocean heat and carbon uptake taking advantage of the latest observations and analyses - particularly the new deep ocean observations and analysis
- Use these diagnostics to assess the performance of the AR5 models in the Southern Ocean.
- Publish a synthesis of the model/data intercomparison and critical diagnostics in time to be included in AR5 assessment.
- Identify needed improvements in coupled climate models for the Southern Ocean region

* Informal focused limited-lifetime group of PIs that leverage existing research activities and abilities. They are provided staffing, telecons, meetings, and potential community workshop over a ~2 yr life time.

Pathways and Mechanisms for increasing CLIVAR-Carbon coordination

- IWG's, SSC/SSGs, and existing infrastructures (e.g. CLIVAR and carbon project offices)
 - E.g. better coordination of ocean process research and experiments (e.g. ocean mixing, air-sea fluxes, etc)
- Joint sessions between annual meeting of US CLIVAR and OCB (July 2011)
- Jointly supported limited-lifetime Working Groups

WCRP Open Science Conference

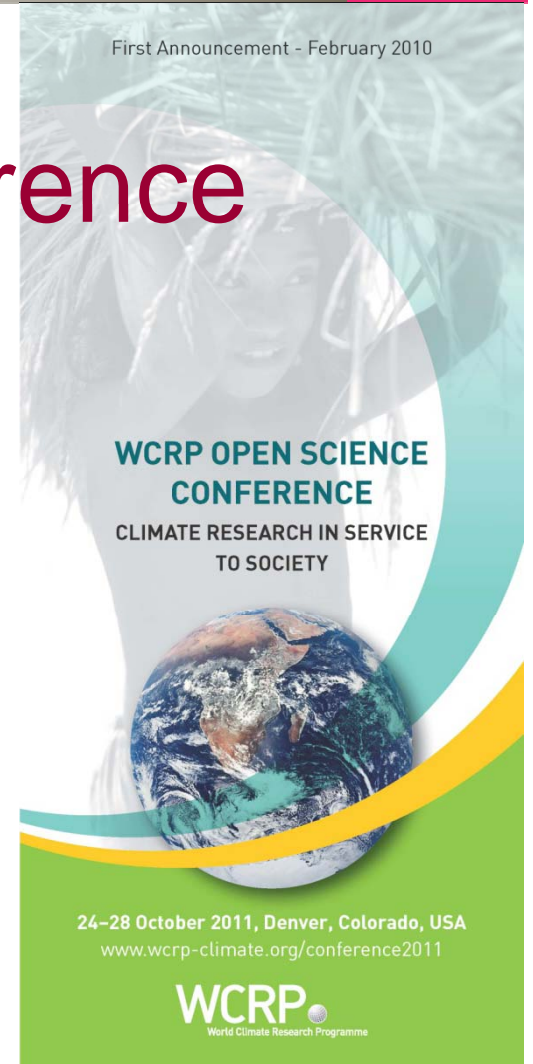
24-28 October 2011

Denver, Colorado, USA

www.wcrp-climate.org/conference2011

Promoting, Facilitating and Coordinating
Climate Research in Service to Society

David Legler
OCB Meeting
July 2010



int



ICSU
International Council for Science





Name	Expertise
OceanObs'09 www.oceanobs09.net	Ocean information for society: sustaining the benefits, realizing the potential
	21-25 September 2009 - Venice, Italy

Integrated Framework for Sustained Ocean Observations task team (IFSOC-TT)
 OceanObs'09 calls upon the nations for a completion of the initial ocean observing system by 2015. The working group that will, in

Must be sufficient to meet society's needs for useful hindcasts, nowcasts and forecasts of marine variability (including physical, biogeochemical, ecosystems and living marine resources), weather, seasonal to decadal climate variability, sustainable management of living marine resources, and assessment of longer term trends.

Dave	
Candy	
Vicki	
Albert Fischer	secretariat
John Gunn*	Biology
Julie Hall	Biology
Eric Lindstrom*	Satellites
Yukio Masumoto	Physical oceanography
David Meldrum	Meteorology/Physical/observing systems
Mike Meredith	Polar regions
Pedro Monteiro	Carbon fluxes
José Mulbert	Biology/coastal

forward the next decade integrating feasible new biogeochemical, ecosystem, and physical observations while sustaining present observations, and considering how best to take advantage of existing structures.

Sylvie Pouliquen	Real-time data systems
Carolin Richter	Climate observations
Sun Song	Marine ecosystems
Mike Tanner	Climate / GEOSS
Martin Visbeck	Physical oceanography/climate research
Stan Wilson	Satellites

Take away messages

- International coordination between ocean carbon and CLIVAR is mostly through personal initiative via CLIVAR basin panels.
Support of international Carbon programs and their interactions with CLIVAR helpful.
- Development of global ocean observing systems (e.g. Argo, hydrography) that address physical AND carbon-related measurements is being fostered by various groups (e.g. OOPC).
Need to continue support of ocean observing systems for climate and carbon. Efforts to jointly develop/enhance regional networks (e.g. OSnap) should be continued.
- What are scientific areas of future potential (US) coordination? modeling, prediction, field experiments (and other elements of process-related research)? *While CLIVAR and US Carbon programs have full scientific agendas (and never enough \$\$), are there some scientific challenges that will motivate the programs to work together... what are these? Respective roles? Coordination? Opening the door....*



Global Change Programs with Ocean Focus



Physical

Geological

Biogeochemistry

Ecology

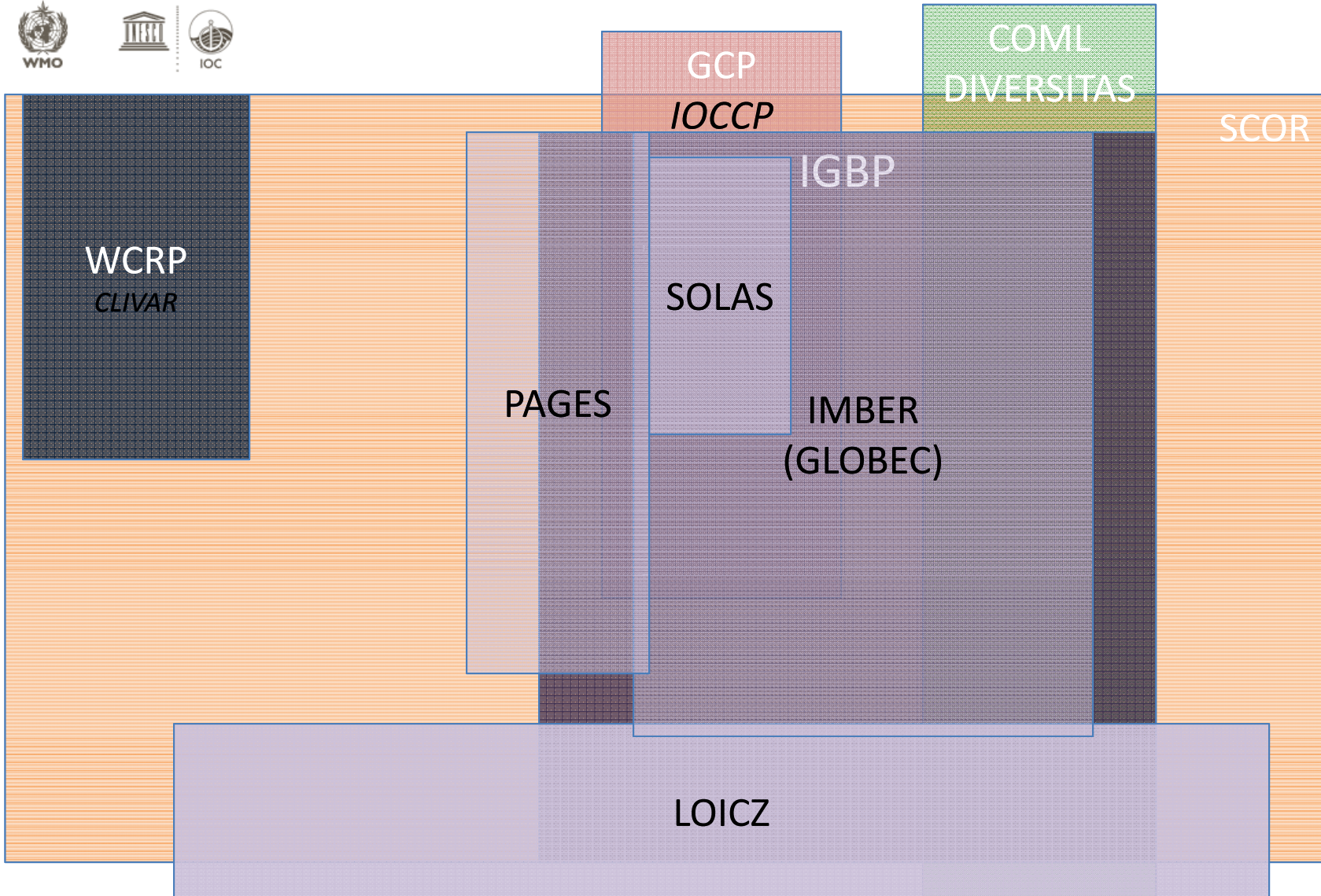
Society



Open Ocean

Margins

Coastal



Cross-cutting activity: AMOC



- US Atlantic Meridional Overturning Circulation (AMOC) - [Atlantimoc.org](http://atlantimoc.org)
 - How should we observe/monitor AMOC? How is it changing? Predictability? Role in abrupt climate change? Impacts on climate, sea level, ecosystems, etc
 - Goals:
 - Design and implementation of an AMOC monitoring system...trans-basin focus
 - Assessment of AMOC's role in global climate
 - AMOC predictability
 - Funding of 38+ research projects from NSF, NOAA, NASA, and DOE
 - **Impacts of AMOC variability on carbon transport and storage**