Strategy and Evolution of CLIVAR

Towards a Science Agenda and Implementation Strategy

Martin Visbeck and Jim Hurrell

Co-Chairs, International CLIVAR SSG

International CLIVAR Project Office

Catherine Beswick
Interim Director

Nico Caltabiano

Carlos Ereño

Anna Pirani

Xiaohui Tang

Bob Molinari
(Retired)

Valery Detemmerman
WCRP JPS

Outline

CLIVAR: Progress and Achievements

- Current Research Challenges
- Current Imperatives
- WCRP Cross Cuts / GEWEX interactions

Strategy and Evolution

- Major research foci for the next 5 years
- How they relate to WCRP Grand Challenges
- Implementation

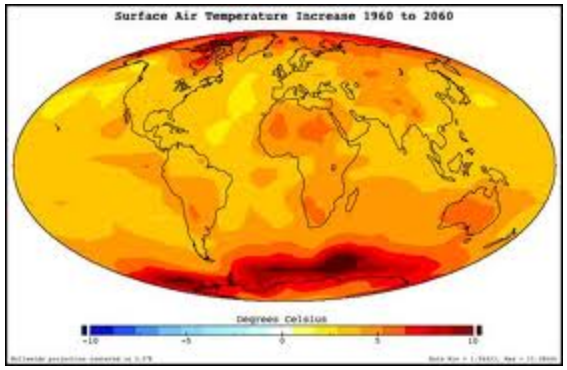
CLIVAR ICPO

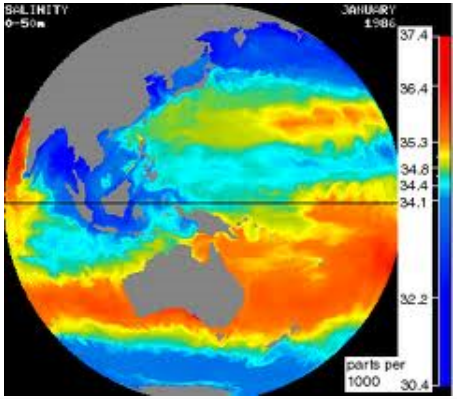
Conclusions and Issues for JSC Consideration

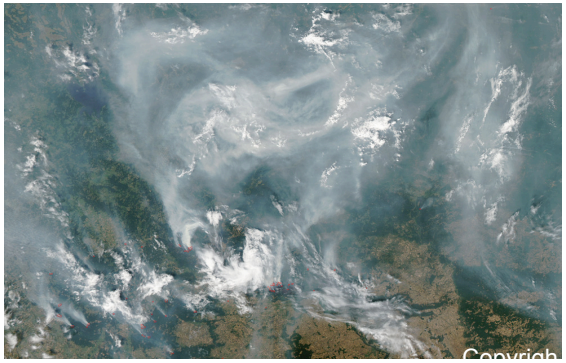
CLIVAR (Climate Variability and Predictability)

Mission

To observe, simulate and predict changes in Earth's climate system with a **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.







CLIVAR Objectives

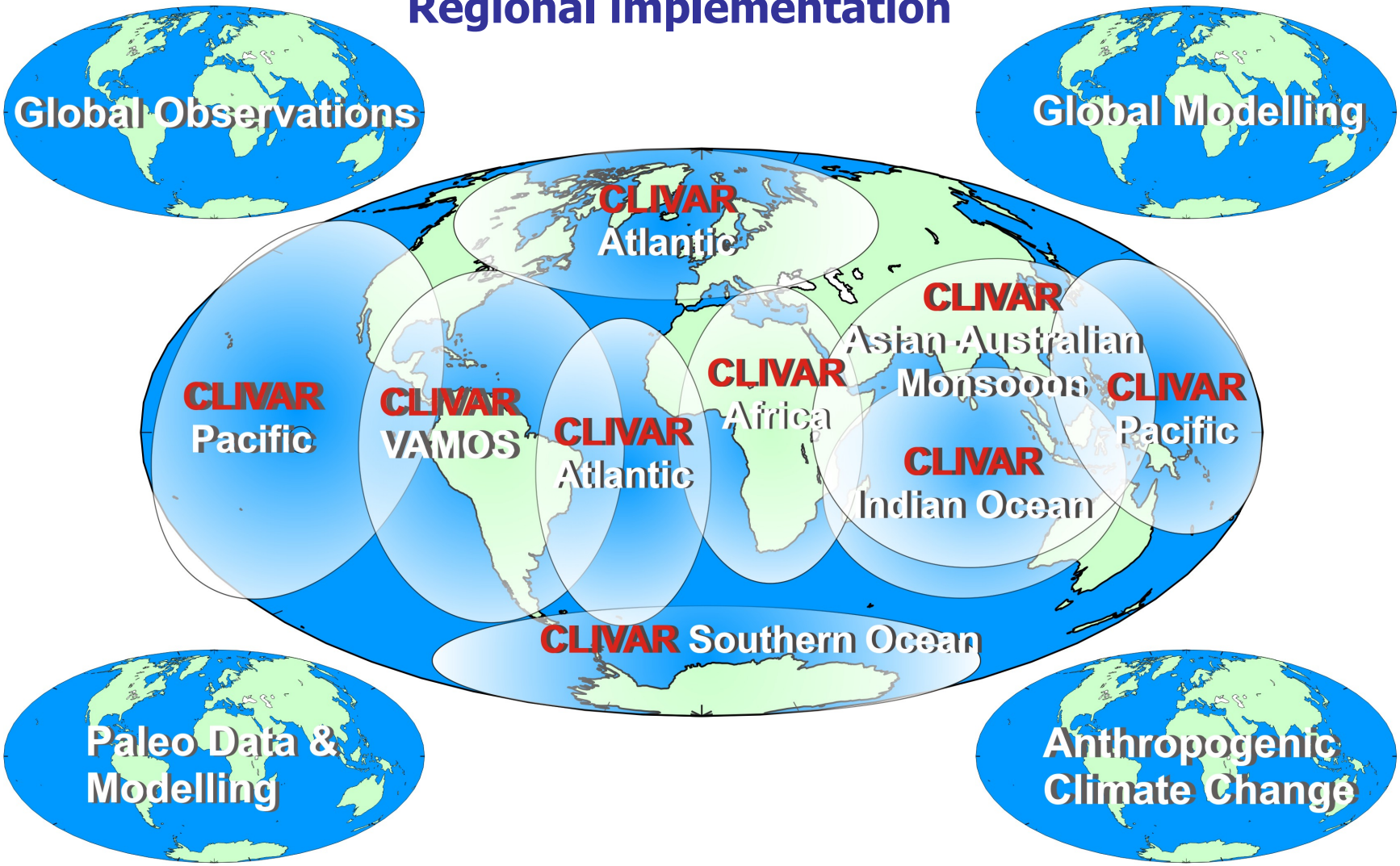
- Understand the causes of climate variability on intra-seasonal to centennial time-scales through observations, analysis, and modeling

- Improve predictions of climate variability and change associated with both internal and external processes

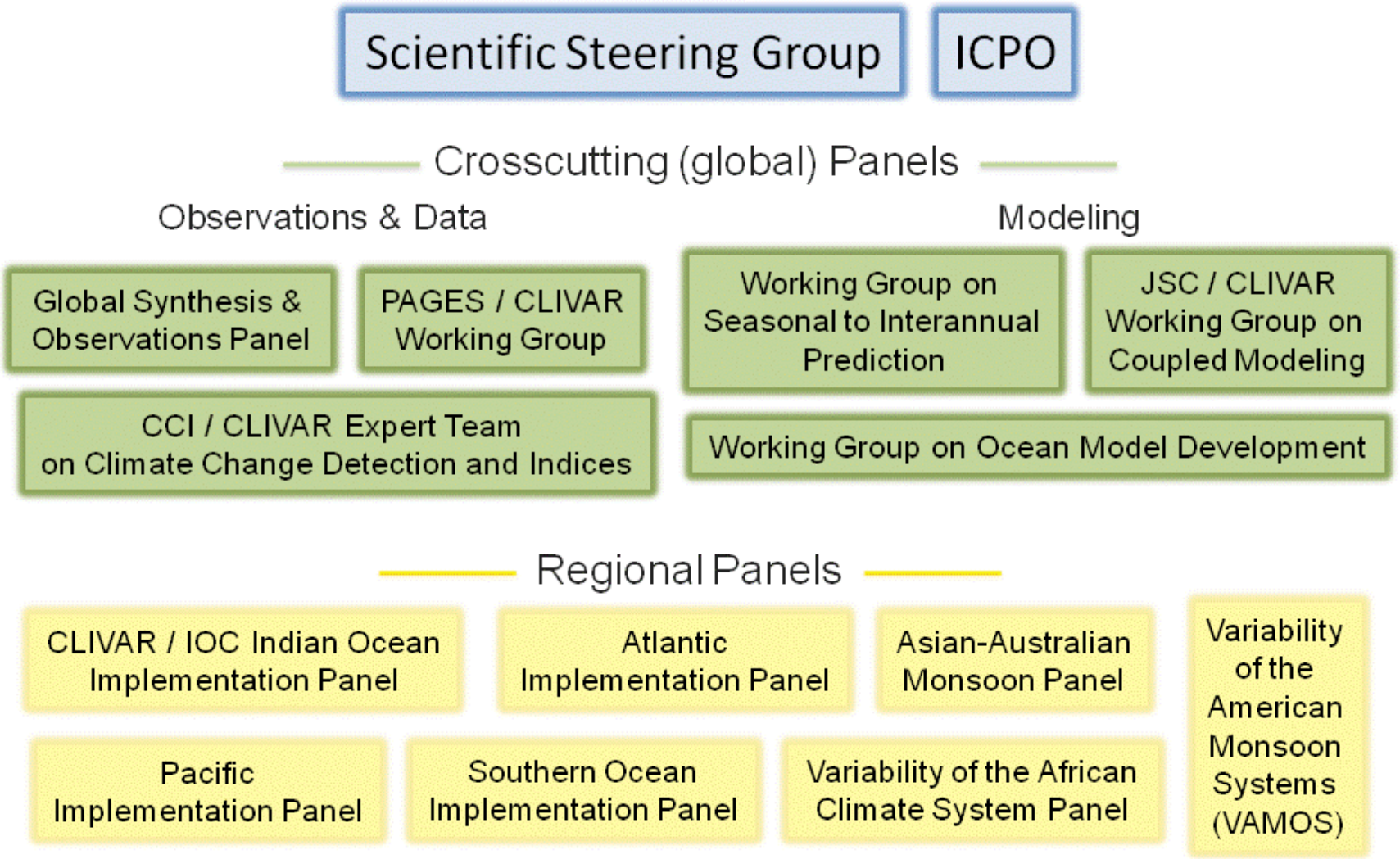
- Extend observational climate record through assembly of quality-controlled paleoclimatic and instrumental data sets

CLIVAR – A Global View

Regional implementation



CLIVAR Organization
(Historical)



Highlights and Plans from Panels

Martin Visbeck and Jim Hurrell
Co-Chairs, CLIVAR SSG

CLIVAR Research Challenges and Imperatives

- Top priorities of CLIVAR panels and working groups
- Developed and evolve around several criteria;
  - ✓ scientific importance;
  - ✓ opportunity to make considerable progress;
  - ✓ benefit from international coordination
- Research Challenges and Imperatives map across:
  - ✓ CLIVAR panels and working groups
  - ✓ WCRP and other international research programs
- Therefore, they have helped inform ongoing discussion on future evolution of WCRP

CLIVAR Research Challenges and Imperatives:

Selected Highlights and Progress

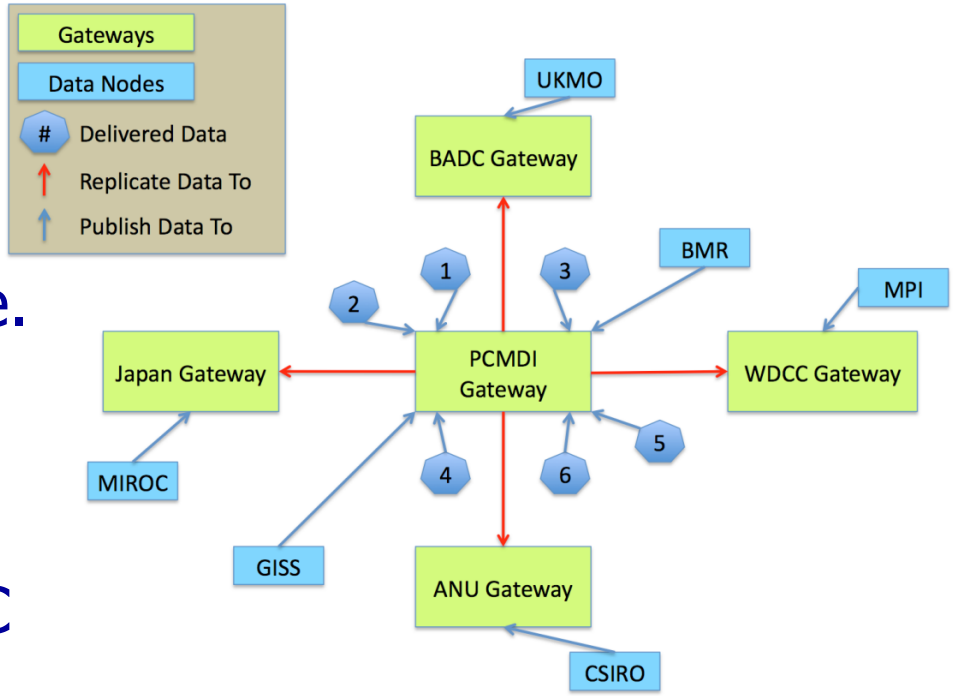
CLIVAR Research Challenges

- Anthropogenic Climate Change
- Intra-to-Seasonal Variability, Predictability and Prediction
- Decadal Variability, Predictability and Prediction
- Improved Atmosphere and Ocean Components of ESMs
- Data Synthesis and Analysis
- Ocean Observing System
- Education and Capacity Development

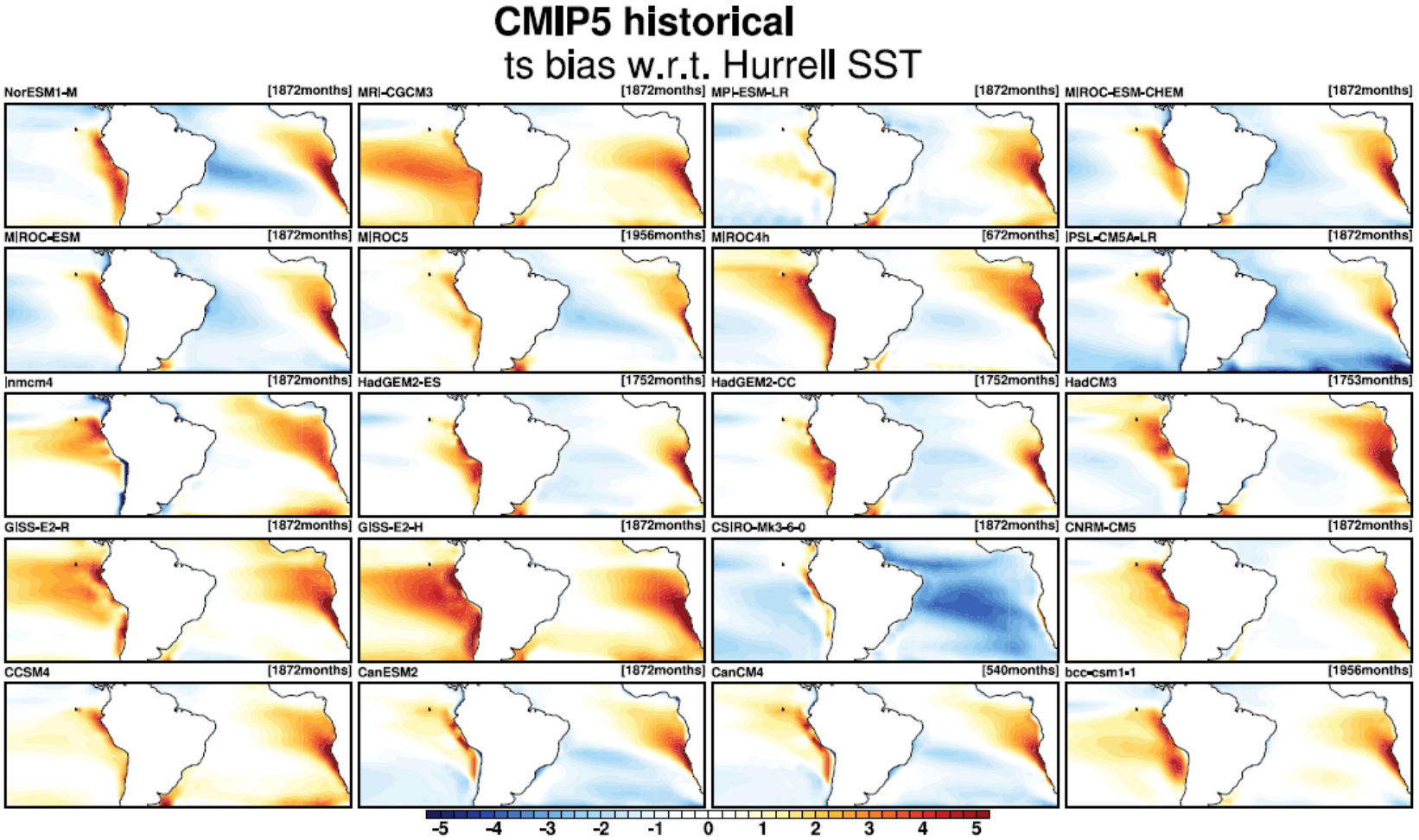
Anthropogenic Climate Change

CMIP5 – Unprecedented International Coordination

- More than 20 participating modeling groups → 40+ models
- 2.3Pbytes of model output expected → ~100 times greater than CMIP3
- Data being served by federated centers around the world and will appear to be a single PCMDI archive.
- Archive available to analysts now …
- CMIP5 session at WCRP OSC
- Analysis workshop March 2012 (Hawaii)



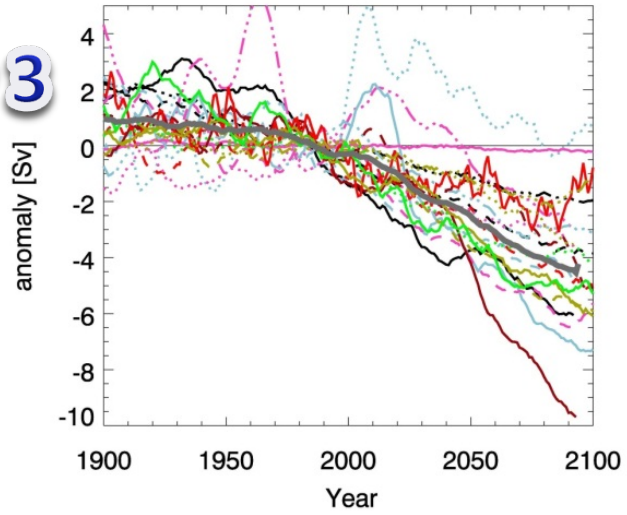
CMIP5 Model comparisons:
Tropical SST bias still significant



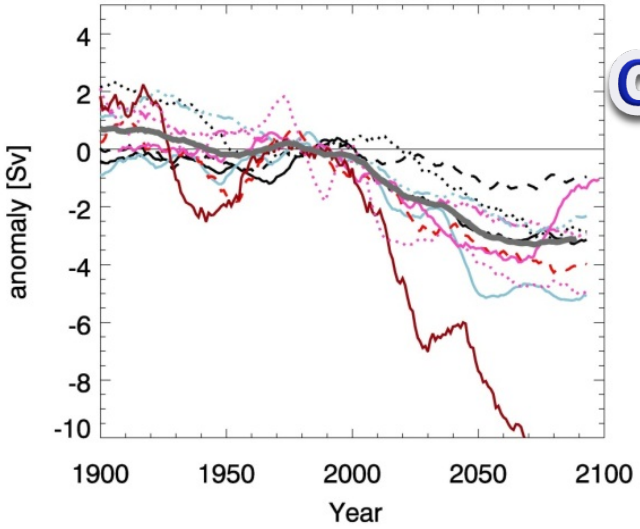
Medeiros, UCAR (pers. com.)

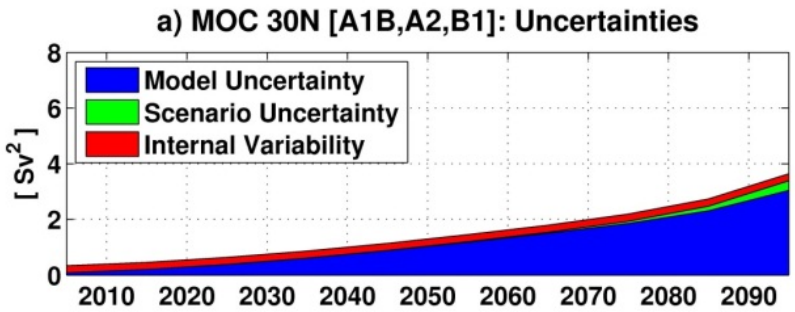
Atlantic Implementation Panel:
Prediction of Atlantic Meridional Circulation

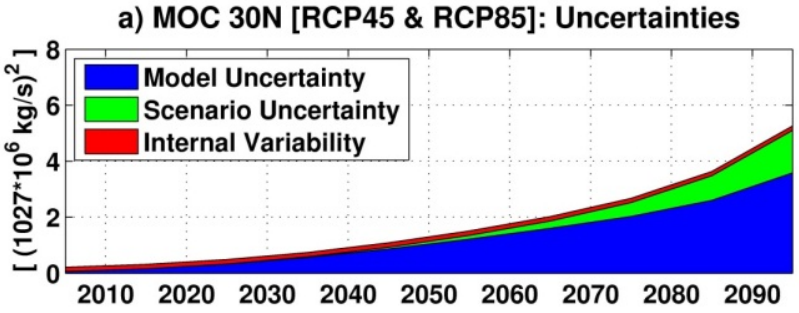
CMIP 3



CMIP 5







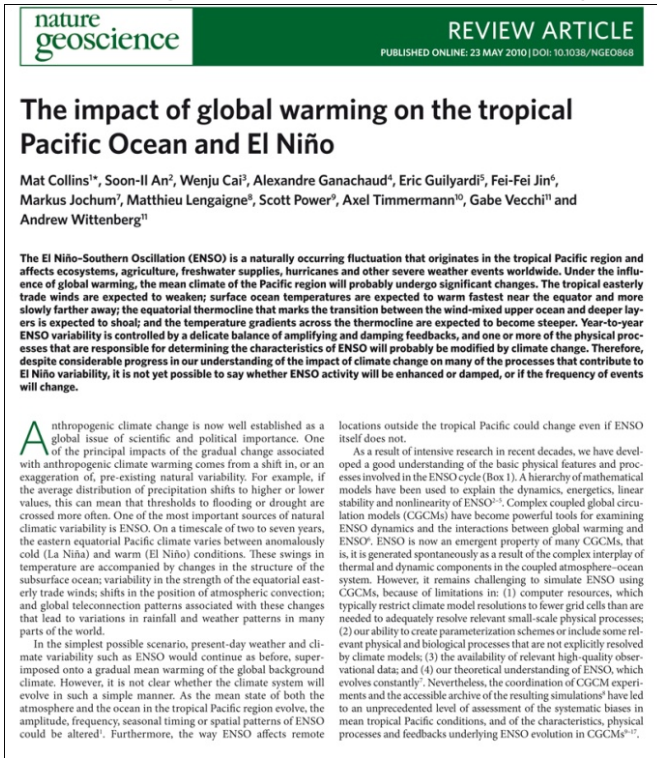
Martin, GEOMAR (pers. com.)

Anthropogenic Climate Change

- Promote analysis of CMIP5 (e.g., small grants program)
- Explore regional change through regional CLIVAR panels

CLIVAR Pacific Panel

Projected 21st century changes in amplitude of ENSO variability (CMIP3)



nature geoscience

REVIEW ARTICLE

PUBLISHED ONLINE: 23 MAY 2010 | DOI: 10.1038/NGEO868

The impact of global warming on the tropical Pacific Ocean and El Niño

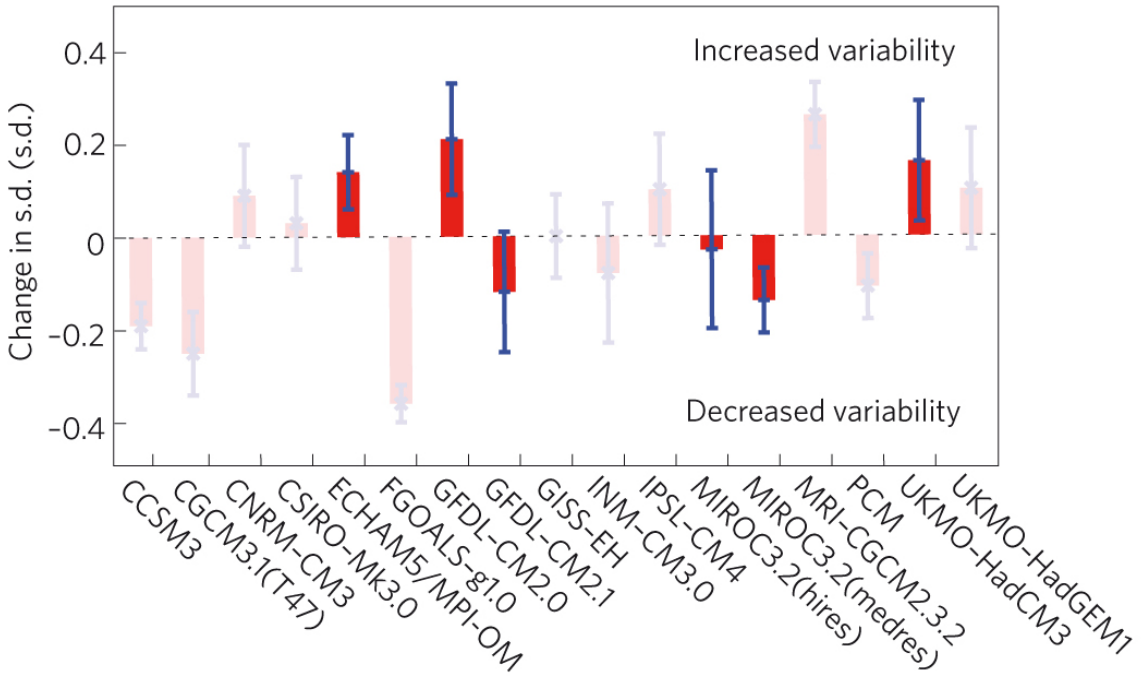
Mat Collins[1]*, Soon-Il An[2], Wenju Cai[3], Alexandre Ganachaud[4], Eric Guilyardi[5], Fei-Fei Jin[6], Markus Jochum[7], Matthieu Lengaigne[8], Scott Power[9], Axel Timmermann[10], Gabe Vecchi[11] and Andrew Wittenberg[11]

The El Niño–Southern Oscillation (ENSO) is a naturally occurring fluctuation that originates in the tropical Pacific region and affects ecosystems, agriculture, freshwater supplies, hurricanes and other severe weather events worldwide. Under the influence of global warming, the mean climate of the Pacific region will probably undergo significant changes. The tropical easterly trade winds are expected to weaken; surface ocean temperatures are expected to warm fastest near the equator and more slowly farther away; the equatorial thermocline that marks the transition between the wind-mixed upper ocean and deeper layers is expected to shoal; and the temperature gradients across the thermocline are expected to become steeper. Year-to-year ENSO variability is controlled by a delicate balance of amplifying and damping feedbacks, and one or more of the physical processes that are responsible for determining the characteristics of ENSO will probably be modified by climate change. Therefore, despite considerable progress in our understanding of the impact of climate change on many of the processes that contribute to El Niño variability, it is not yet possible to say whether ENSO activity will be enhanced or damped, or if the frequency of events will change.

Anthropogenic climate change is now well established as a global issue of scientific and political importance. One of the principal impacts of the gradual change associated with anthropogenic climate warming comes from a shift in, or an exaggeration of, pre-existing natural variability. For example, if the average distribution of precipitation shifts to higher or lower values, this can mean that thresholds to flooding or drought are crossed more often. One of the most important sources of natural climatic variability is ENSO. On a timescale of two to seven years, the eastern equatorial Pacific climate varies between anomalously cold (La Niña) and warm (El Niño) conditions. These swings in temperature are accompanied by changes in the structure of the subsurface ocean; variability in the strength of the equatorial easterly trade winds; shifts in the position of atmospheric convection; and global teleconnection patterns associated with these changes that lead to variations in rainfall and weather patterns in many parts of the world.

In the simplest possible scenario, present-day weather and climate variability such as ENSO would continue as before, superimposed onto a gradual mean warming of the global background climate. However, it is not clear whether the climate system will evolve in such a simple manner. As the mean state of both the atmosphere and the ocean in the tropical Pacific region evolve, the amplitude, frequency, seasonal timing or spatial patterns of ENSO could be altered[1]. Furthermore, the way ENSO affects remote locations outside the tropical Pacific could change even if ENSO itself does not.

As a result of intensive research in recent decades, we have developed a good understanding of the basic physical features and processes involved in the ENSO cycle (Box 1). A hierarchy of mathematical models have been used to explain the dynamics, energetics, linear stability and nonlinearity of ENSO[2,3]. Complex coupled global circulation models (CGCMs) have become powerful tools for examining ENSO dynamics and the interactions between global warming and ENSO[4]. ENSO is now an emergent property of many CGCMs, that is, it is generated spontaneously as a result of the complex interplay of thermal and dynamic components in the coupled atmosphere–ocean system. However, it remains challenging to simulate ENSO using CGCMs, because of limitations in: (1) computer resources, which typically restrict climate model resolutions to fewer grid cells than are needed to adequately resolve relevant small-scale physical processes; (2) our ability to create parameterization schemes or include some relevant physical and biological processes that are not explicitly resolved by climate models; (3) the availability of relevant high-quality observational data; and (4) our theoretical understanding of ENSO, which evolves constantly[5]. Nevertheless, the coordination of CGCM experiments and the accessible archive of the resulting simulations[6] have led to an unprecedented level of assessment of the systematic biases in mean tropical Pacific conditions, and of the characteristics, physical processes and feedbacks underlying ENSO evolution in CGCMs[6–17].



Collins et al., 2010: *Nature Goesciences*

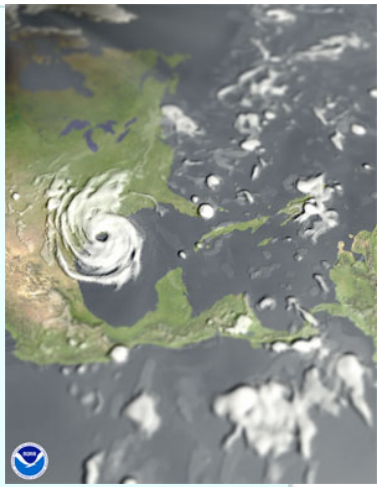
"…despite considerable progress in our understanding of the impact of climate change on many of the processes that contribute to El Niño variability, it is not yet possible to say whether ENSO activity will be enhanced or damped, or if the frequency of events will change"

Anthropogenic Climate Change

Hurricanes Working Group

Chairs: Gabe Vecchi (GFDL), Suzana Camargo (LDEO/Columbia U) and Kevin Walsh (U Melbourne, Australia)

To coordinate efforts to produce a set of model experiments designed to improve understanding of the variability of tropical cyclone formation in climate models (Potential for synergy with WGCM and Atlantic Panel)



Scientific Objectives:

- Improve understanding of interannual variability and trends in tropical cyclone activity from the beginning of the 20th century to the present.
- Quantify changes in the characteristics of tropical cyclones under a warming climate.

The WG is coordinating a set of GCM experiments with 12 models using a common set of forcings to evaluate model response to varying SST configurations

Next tasks:

- Preparing paper for submission this summer to *BAMS* focusing on Tier 1 experiments, describing models participating
- Preparing between eight and twelve focused analyses articles for submission to *J. Climate Special Issue*
- Planning community workshop to be held winter/spring 2013

CLIVAR Research Challenges

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- Decadal Variability, Predictability and Prediction
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Climate-system Historical Forecast Project

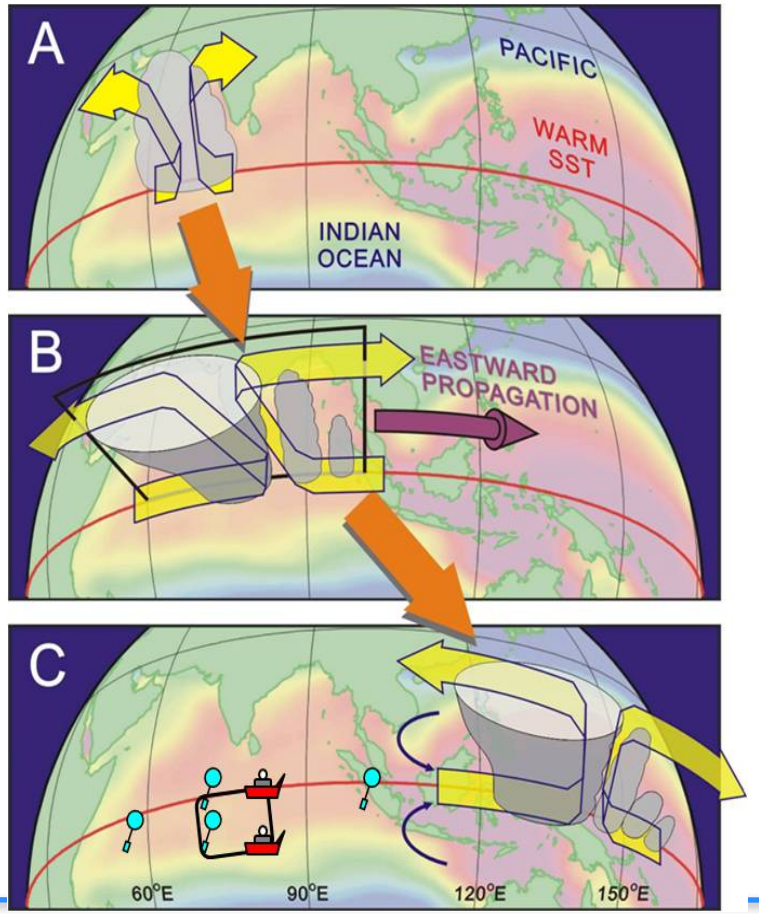
- **Best Possible Observationally Based Initialization of all the Components of Climate System**
  - Building links across core WCRP projects
  - Establishing links to WWRP TIGGE (1-90 day predictions)

Seasonal and CMIP5 hindcast simulations ***CLIVAR Regional Panels to Lead Application Interface for Seasonal Prediction Skill Assessment***	**Sea-Ice HFP** ***To explore seasonal predictability associated with sea ice***
Stratosphere-resolving HFP experiment (StratHFP) ***High and low top models will be used to quantify improvements in actual predictability by initializing and resolving the stratosphere in seasonal forecast systems***	**Global Land-Atmosphere Coupling Experiment (GLACE-2):** ***To determine prediction skill associated with accurate initialization of land surface states***

CINDY2011 (Cooperative Indian Ocean exp. on ISV in 2011) and **DYNAMO*** (Dynamics of the MJO)

Goal: to collect in-situ observations to advance our understanding of MJO initiation process and to improve MJO prediction and simulation

Endorsed and **Supported** by IOP and AAMP through the provision of high resolution forecasts and analyses from available forecast centers. AAMP and YOTC are also promoting coordinated numerical experimentation for CINDY-DYNAMO, making use of the full range of modeling abilities.



Period:
October 2011 – January 2012

Main Location:
In and around central equatorial Indian Ocean

Strong International Participation
Japan, USA, India, France, UK, Seychelles, China, Australia, and others

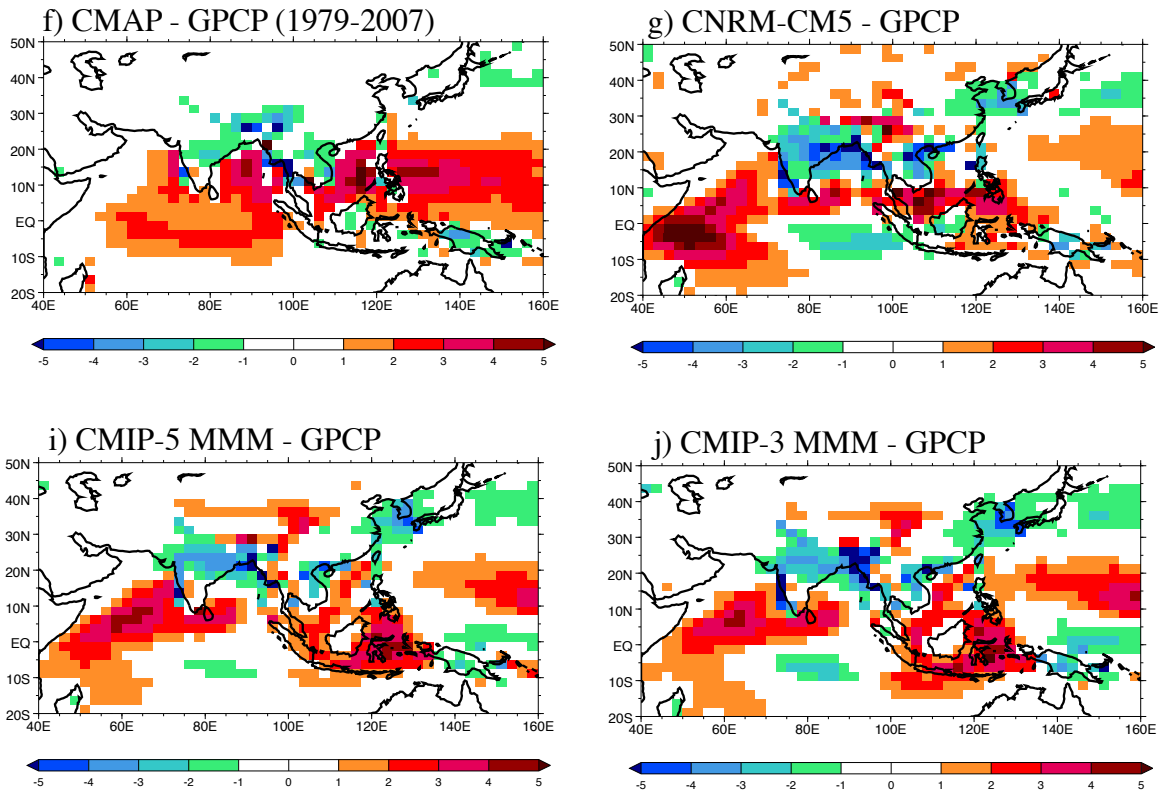
*DYNAMO is a US program and its field campaign is US component of CINDY2011.

AAMP Monsoon Diagnostics/Metrics Task Team

Boreal Summer Asian Monsoon Model Uncertainty

JJAS Climatological precipitation rate error

- **Model error largely consistent with observational uncertainty**
- **Systematic model error similar between CMIP-5 and CMIP-3**
- **For total precipitation CMIP5 MMM has larger pattern correlation and lower RMSE than the CMIP-3 MMM compared to GPCP**



CLIVAR Imperatives

- Anthropogenic Climate Change
- Intra-to-Seasonal Variability, Predictability and Prediction
- Decadal Variability, Predictability and Prediction
- Improved Atmosphere and Ocean Components of ESMs
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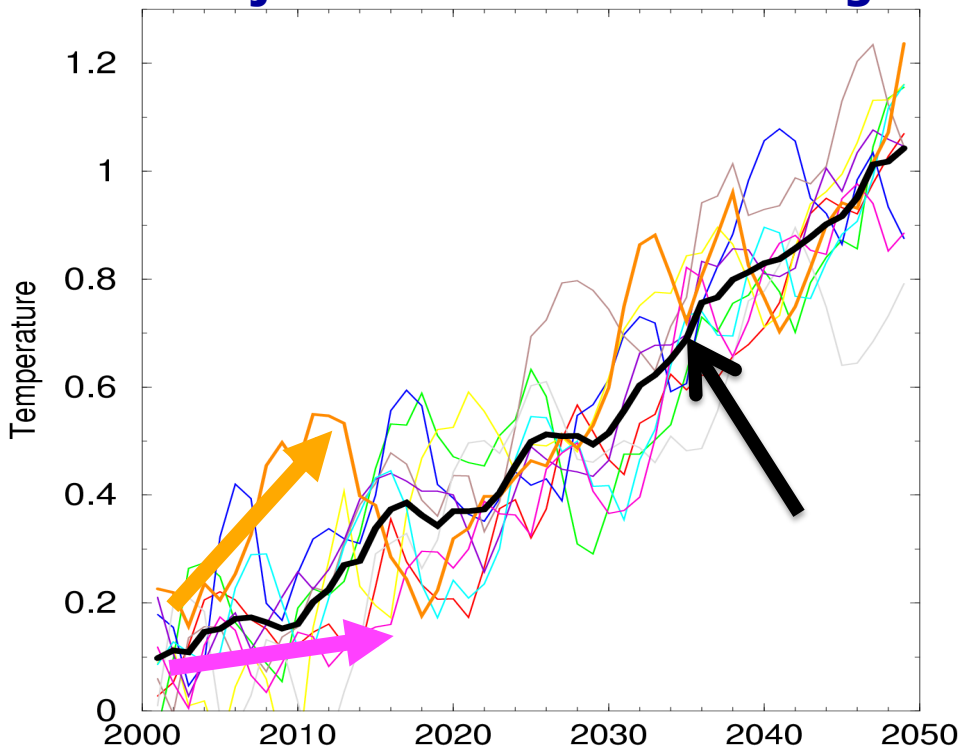
Decadal Prediction: pan-CLIVAR effort

- Clear evidence of decadal variability in ocean and atmosphere, but to what extent is it predictable?
- What are the sources of predictability and the processes that give rise to decadal variability?

Projected Atlantic SST Change

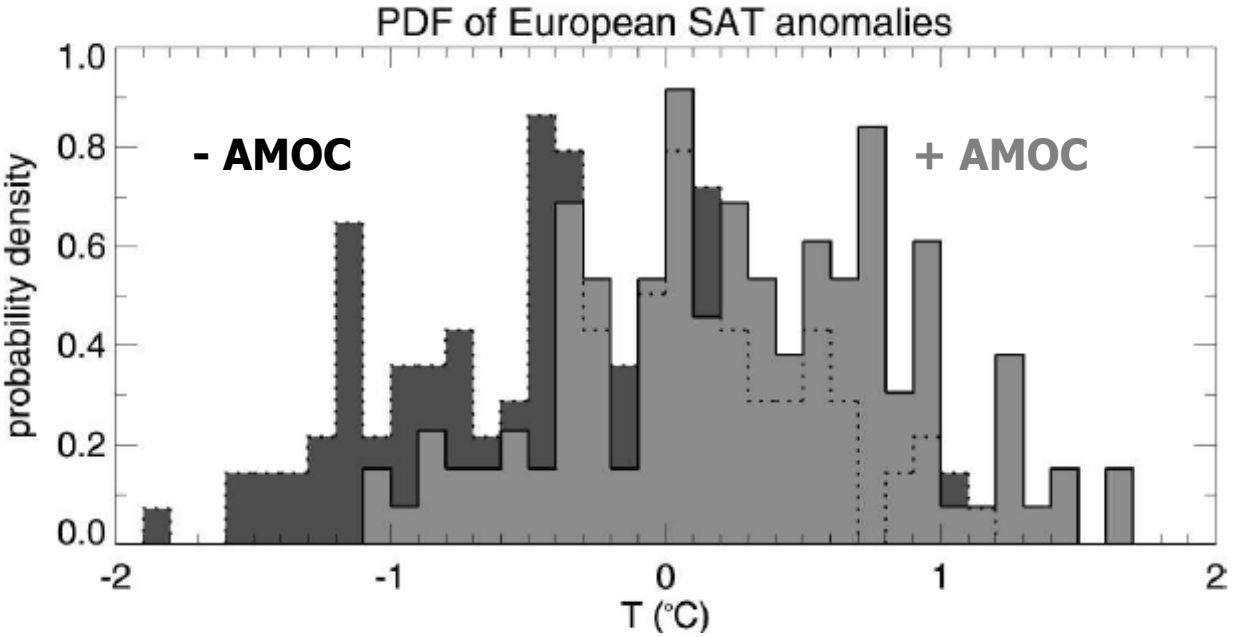


Decadal Variations:

- ✓ **Forced by External Processes**
- ✓ **Generated by Internal Processes**
- ✓ **Interactions of Forced and Natural Variability**

Decadal Prediction: pan-CLIVAR effort

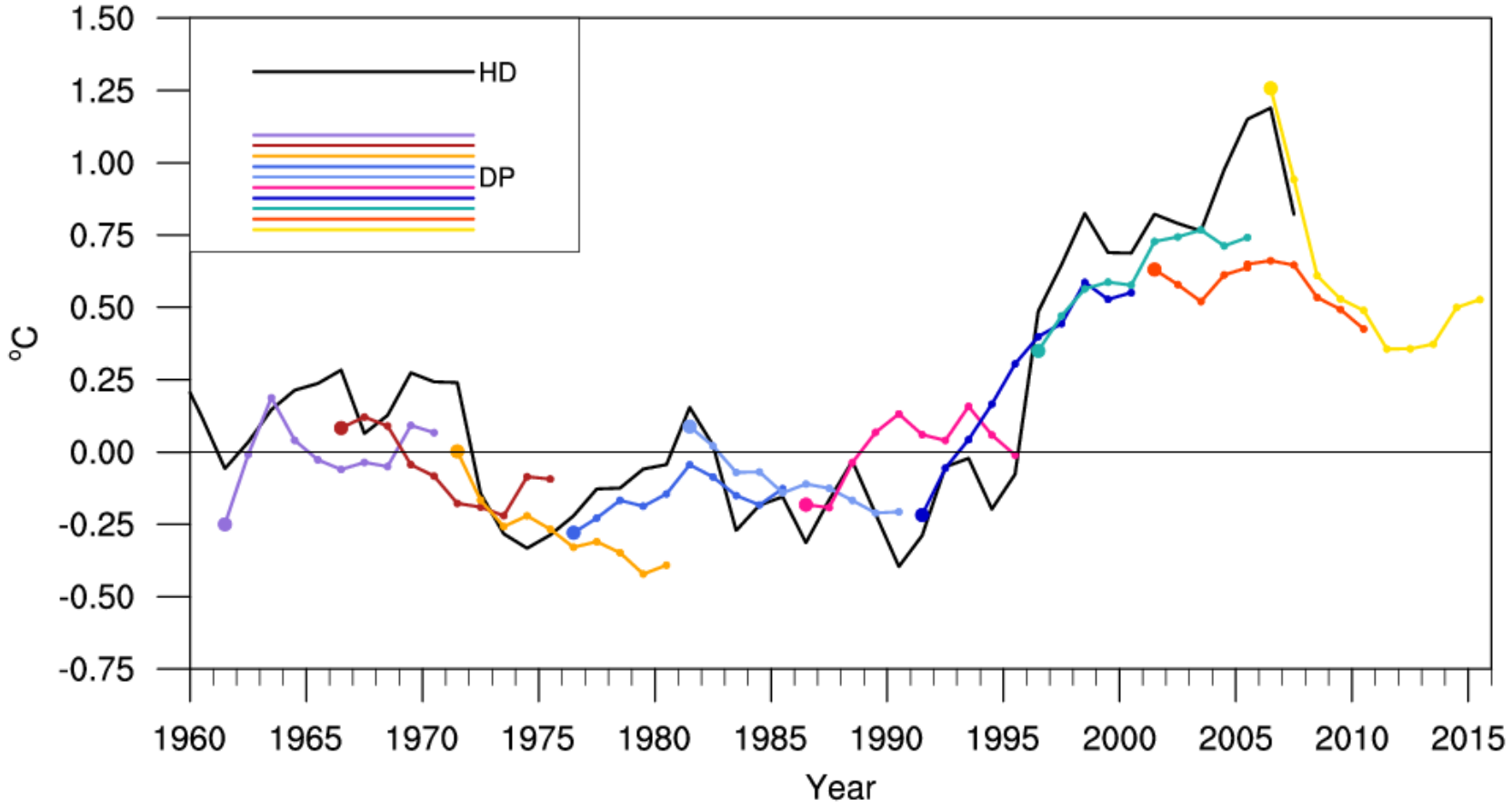
- Clear evidence of decadal variability in ocean and atmosphere, but to what extent is it predictable?
- What are the sources of predictability and the processes that give rise to decadal variability?
- Does oceanic variability have atmospheric relevance?



Decadal Prediction: early results

DRIFT – BIAS CORRECTION

Case Study: North Atlantic Subpolar Gyre Heat Content



HD/DP correlations: 0.94 (1-5 yr lead); 0.94 (6-10 yr lead) (99% confidence)

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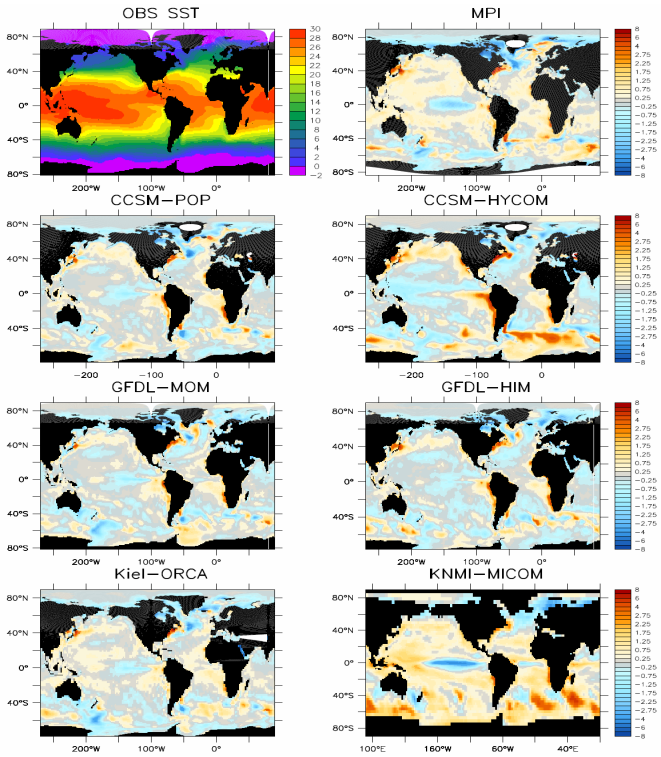
Evaluation of Ocean Models

WGOMD: Coordinated Ocean-ice Reference Experiments (CORE)

http://www.clivar.org/organization/wgomd/core/core.php



CORE: Benchmark simulations for global ocean-ice models with detailed protocols, facilitating solution comparisons from different models

CORE-I Results: 500-yr repeating annual cycle
(Griffies et al. 2009, *Ocean Modeling*)

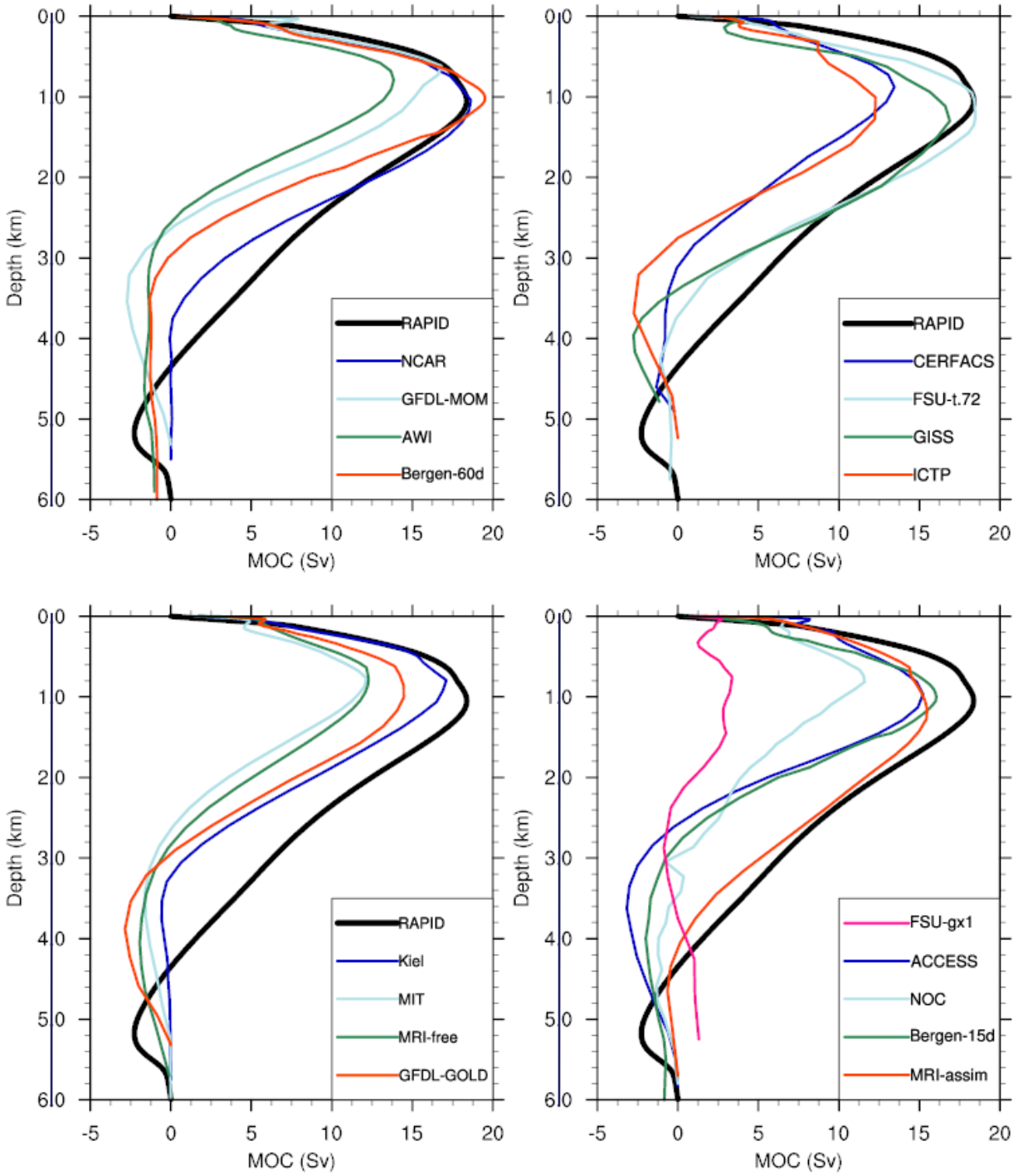
CORE-II: Interannually-varying forcing (1948-2007)

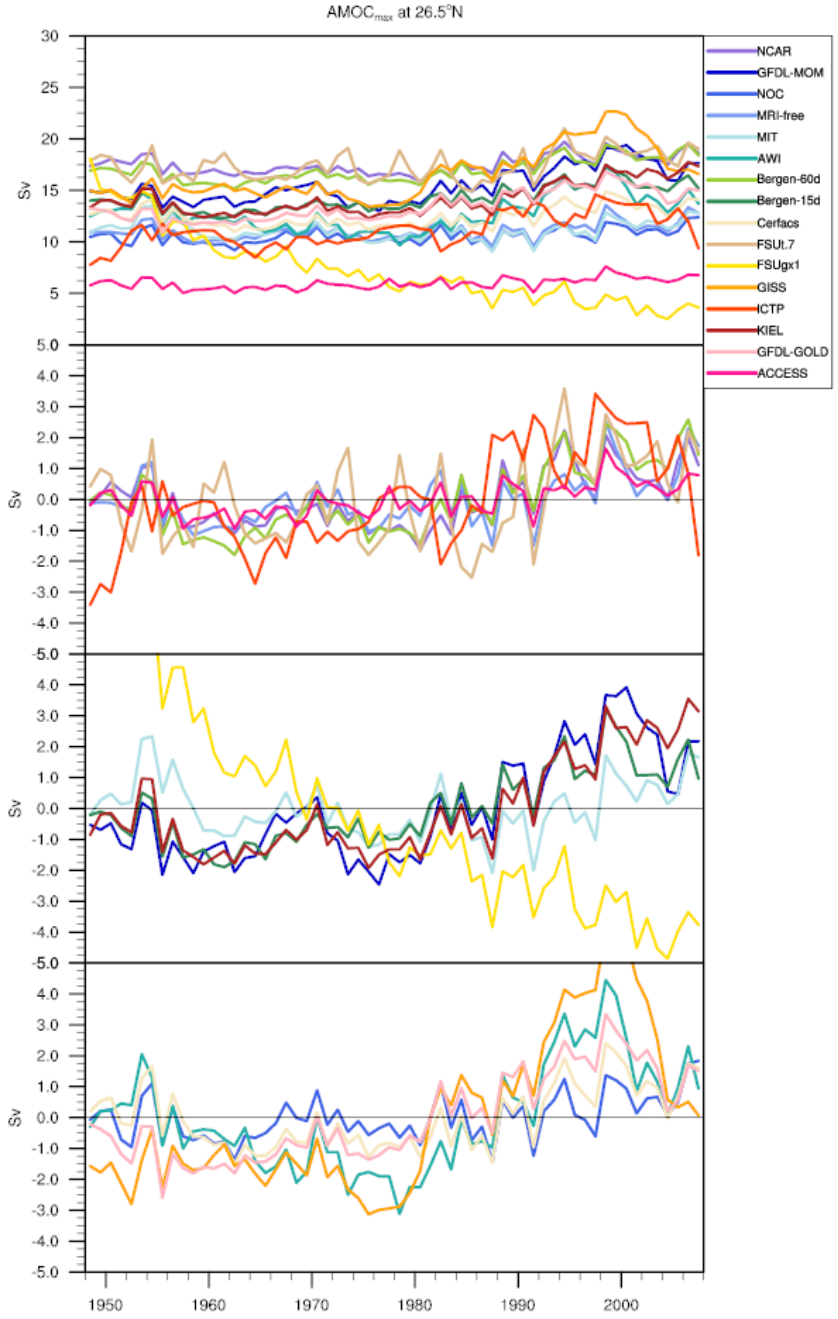
- ✓ evaluation, understanding, and improvement of the ocean component in CMIP5 models
- ✓ investigation of mechanisms for interannual to decadal variability, e.g., AMOC;
- ✓ evaluation of robustness of mechanisms across models;
- ✓ providing initial conditions for decadal predictability studies;
- ✓ CORE-II synthesis papers in time for evaluation and inclusion in AR5.

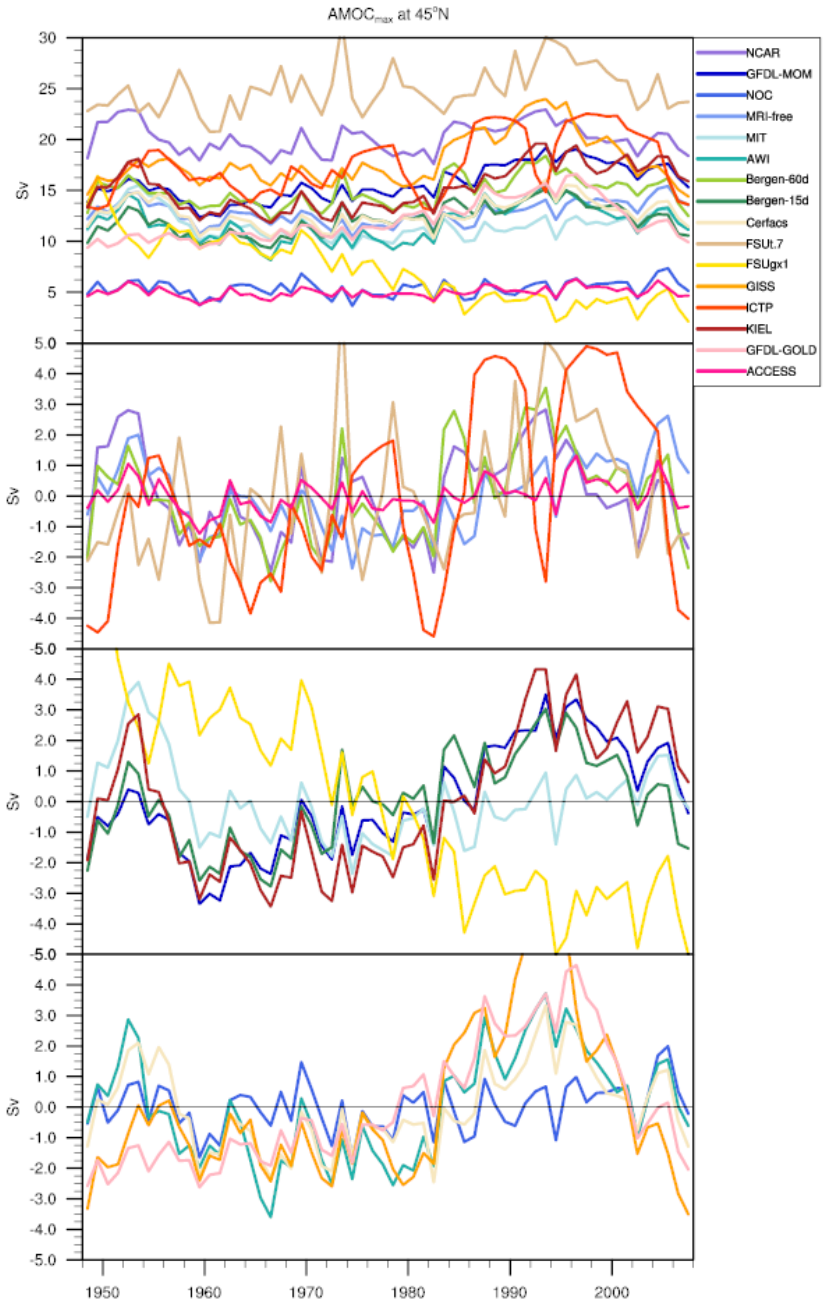
CORE: Web-based repository to facilitate access and analysis

http://www.clivar.org/organization/wgomd/reos/reos.php

Model AMOC comparisons with the RAPID data at 26.5°N




AMOC$_{max}$ at 26.5°N
Sv
NCAR
GFDL-MOM
NOC
MRI-free
MIT
AWI
Bergen-60d
Bergen-15d
Cerfacs
FSUt.7
FSUgx1
GISS
ICTP
KIEL
GFDL-GOLD
ACCESS
1950
1960
1970
1980
1990
2000


AMOC$_{max}$ at 45°N
Sv
NCAR
GFDL-MOM
NOC
MRI-free
MIT
AWI
Bergen-60d
Bergen-15d
Cerfacs
FSUt.7
FSUgx1
GISS
ICTP
KIEL
GFDL-GOLD
ACCESS
1950
1960
1970
1980
1990
2000

Improved Atmosphere and Ocean Models

AIP/VAMOS Joint targeted workshop

Workshop on Coupled Ocean-Atmosphere-Land Processes in the Tropical Atlantic

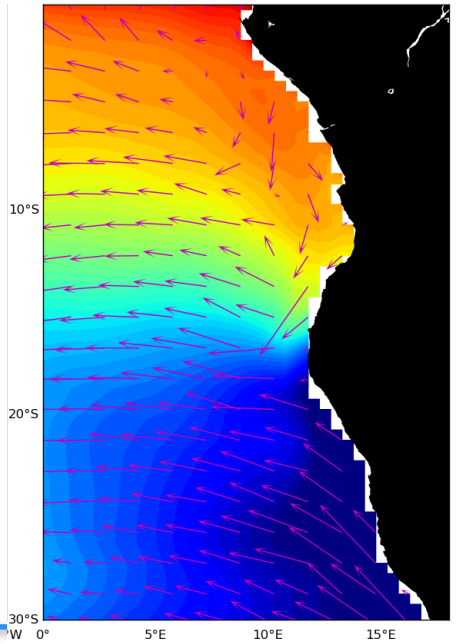
23-25 March 2011, Miami, FL, USA

- Large tropical Atlantic biases are present in the current generation of seasonal and longer-term prediction systems
- These biases lead to large model uncertainties as to the future evolution of the tropical Atlantic climate and limit prediction skill

Meeting Objectives

- Develop a coherent synthesis of knowledge on Atlantic biases and their causes;
- Articulate an effective way forward;
- Identify an international network of interested, active researchers, groups, funding agencies; and
- Determine geographical focus

Outcome: high enthusiasm, working group formed



Improved Atmosphere and Ocean Models

US-CLIVAR Climate Process Teams (CPTs)

- Teams of observational scientists, diagnostic scientists, process modelers, coupled modelers, data assimilation systems developers, focused on quantifying and reducing uncertainties associated with key processes
- Objective is to speed the improvement of coupled models by:
  - Transferring theoretical and process-model understanding into improved treatment of processes in climate models;
  - Sharpening our understanding of how particular physical processes impact the climate system;
  - Identifying sustained observational requirements required by climate models for these parameterizations; and
  - Identifying additional process studies necessary to reduce uncertainties associated with important climate model processes/parameterizations.
    - Ocean Boundary Mixing, Cloud Parameterizations, Sea Ice/Ocean Mixing
    - Internal-Wave Driven Mixing in Ocean Models, Ocean Mixing Processes Associated with Sea Ice, Stratocumulus to Cumulus Transition

CLIVAR Imperatives

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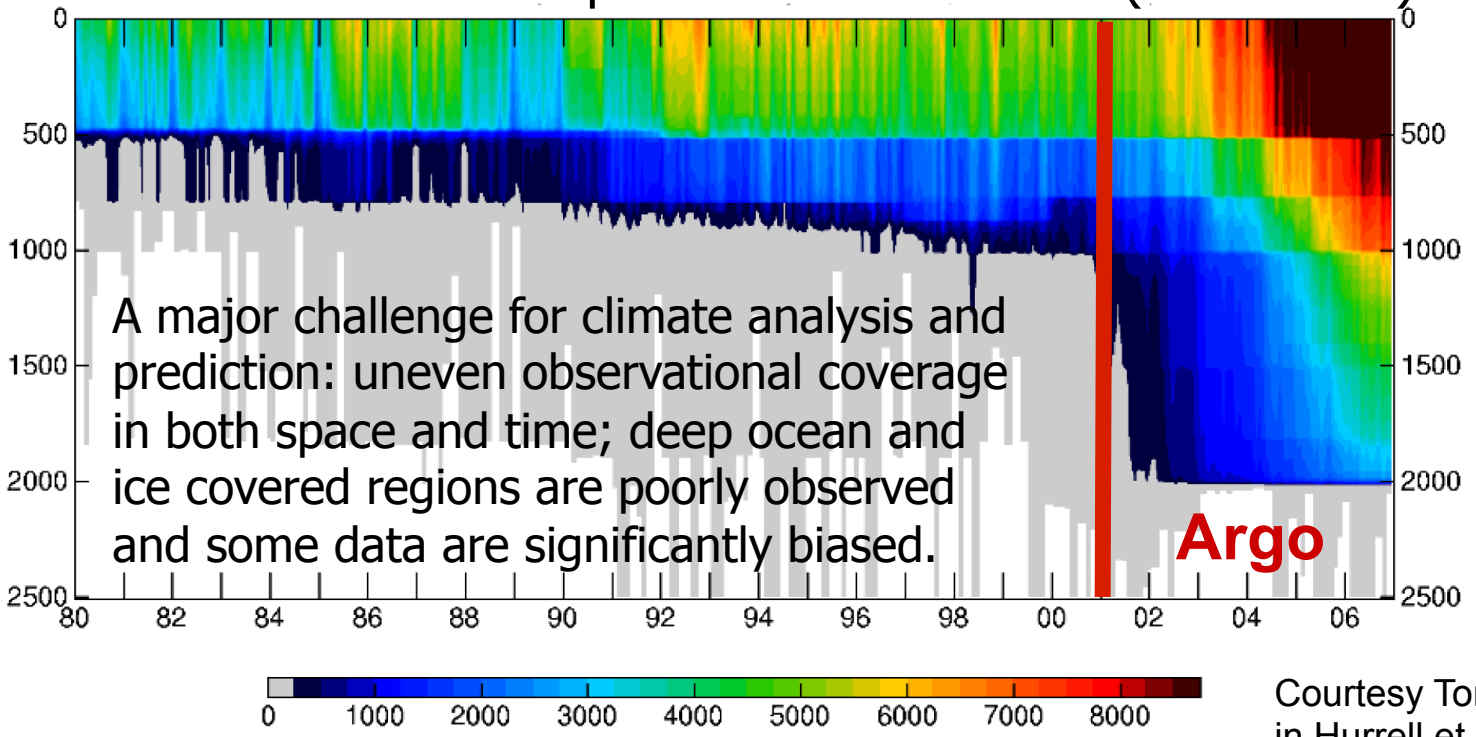
Data Synthesis and Analysis

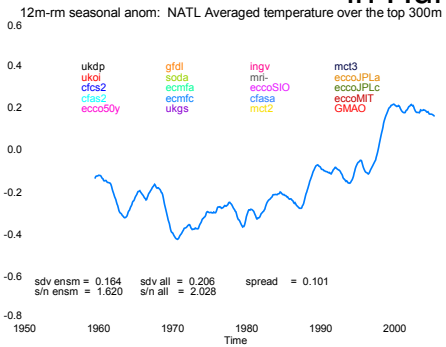
Global Number of Temperature Observations (1980-2006)



Courtesy Tony Rosati in Hurrell et al. (2010)

GSOP: Ocean Synthesis Evaluation Workshops

- Inter-comparison of products from multiple groups
- Evaluation of product quality and skill
- Identification of system strengths and weaknesses
- Definition of standards for assessment



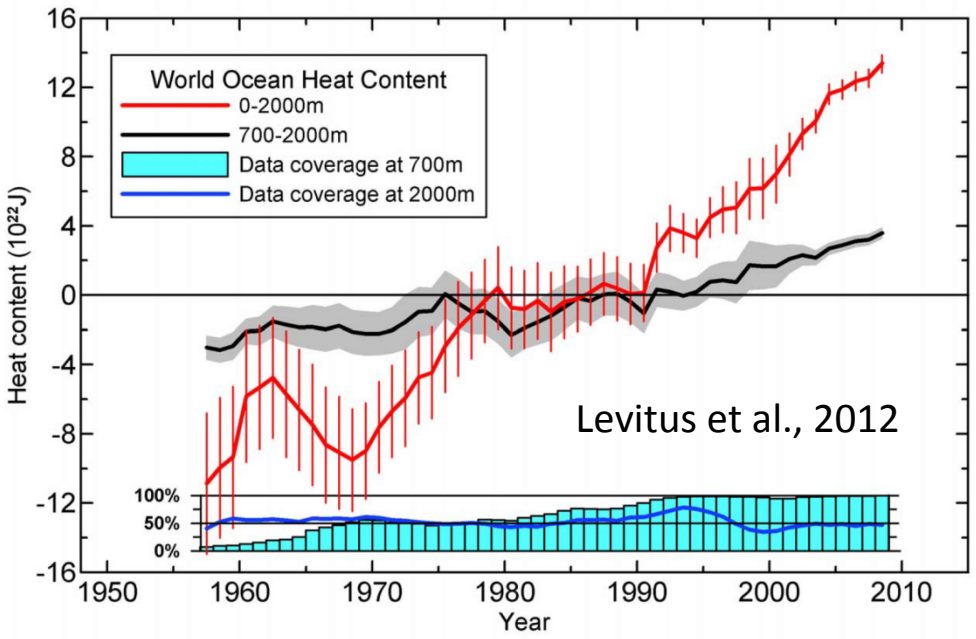
N. Atlantic T (0-300 m)

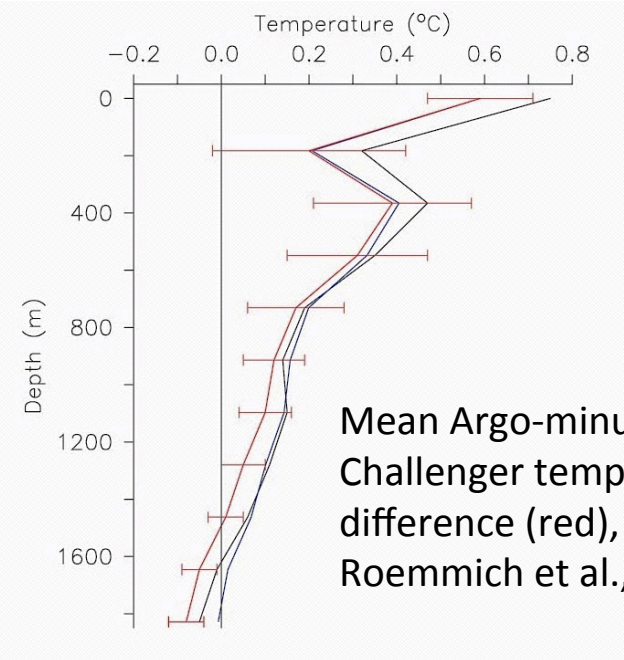
Data Synthesis and Analysis

ARGO ocean observations

Since 1998, 1080 research papers have used Argo data. Argo contributes to a broad range of climate-related basic research, including global change, in addition to operational and education applications.

Recent analyses of global ocean heat content include improved estimates for the recent half century (Levitus et al., *GRL*, 2012), and estimated warming for the 135-year interval between the Challenger Expedition and Argo (Roemmich et al., *Nature Climate Change*, 2012).





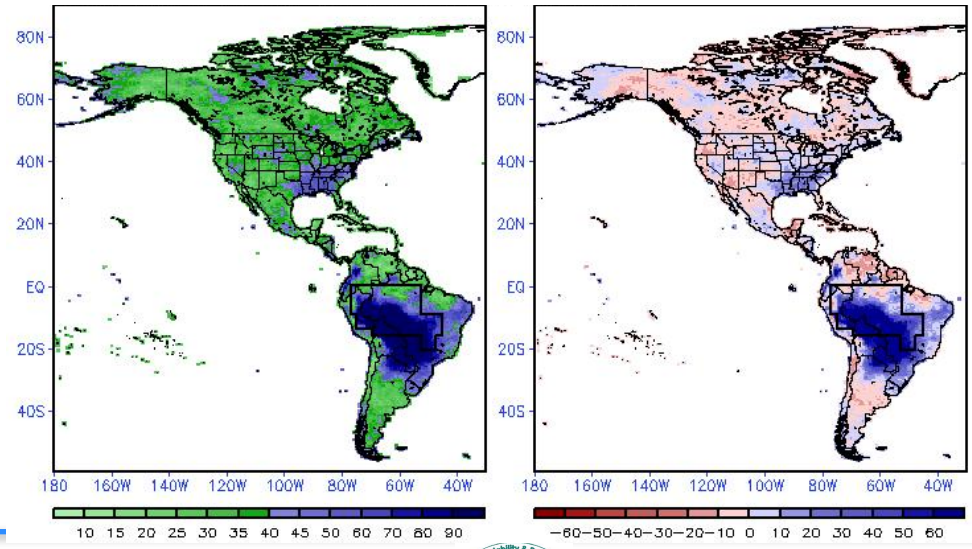
Mean Argo-minus-Challenger temperature difference (red), from Roemmich et al., 2012)

VAMOS Extremes Working Group:

Atlas of Extremes over the Americas

http://gmao.gsfc.nasa.gov/research/subseasonal/atlas/Extremes.html

- On-line atlas of temperature and precipitation extremes, using ETCCDI indices both observational gridded data and reanalysis products
- WG also evaluating model simulations (e.g., CMIP5, regional downscaling, seasonal hindcasts, ultra-high resolution global runs, etc.)
- And WG is formulating and coordinating new model simulations to help shed light on the mechanisms and predictability of extremes.



2009 (MERRA)

Number of extreme rain days (> 90th percentile)

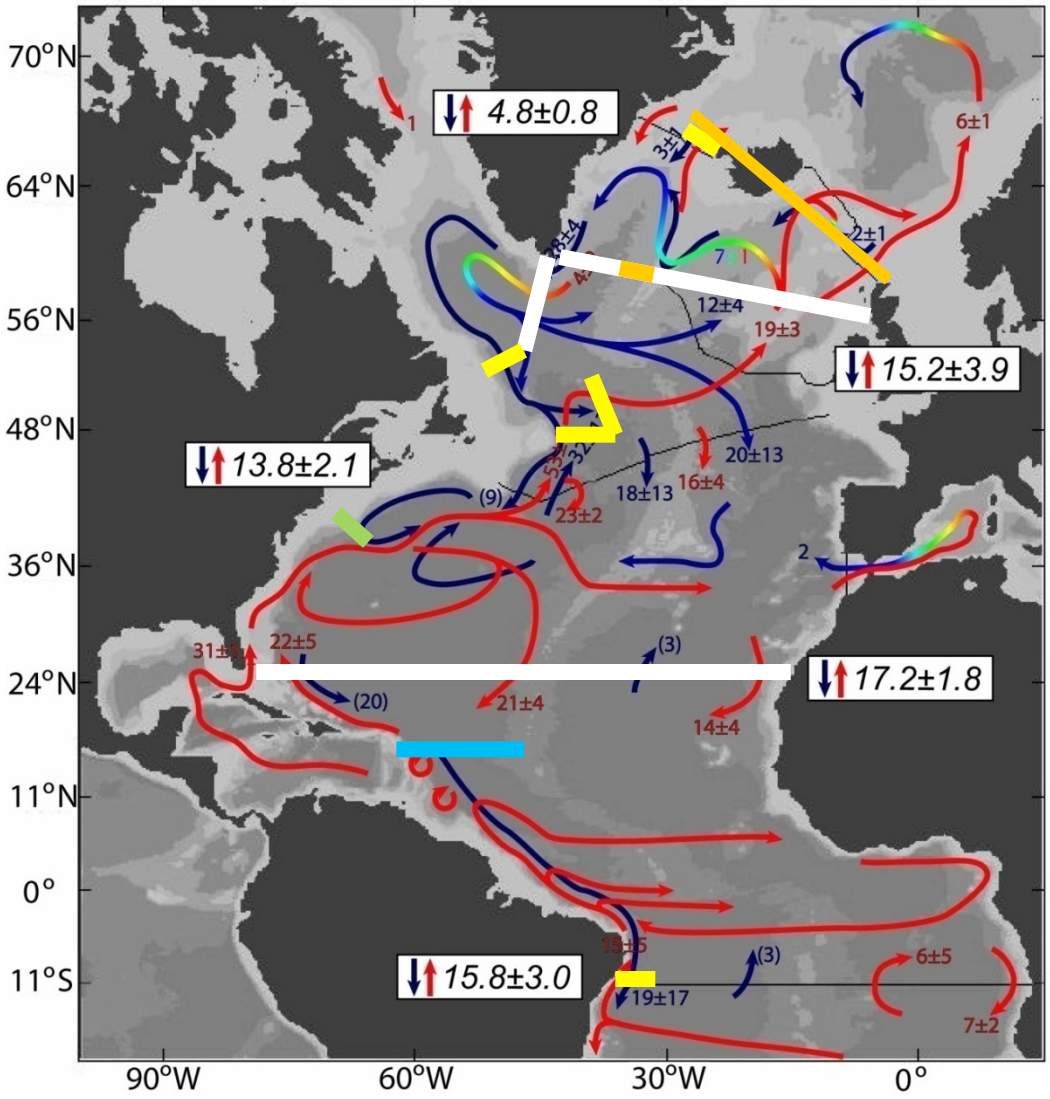
Total (left) and Anomaly (right)

CLIVAR Imperatives

- Anthropogenic Climate Change
- Intra-to-Seasonal Variability, Predictability and Prediction
- Decadal Variability, Predictability and Prediction
- Improved Atmosphere and Ocean Components of ESMs
- Data Synthesis and Analysis
- Ocean Observing System
- Education and Capacity Development

AMOC Observing System

International Coordination of Integrated Observing Networks



AMOC observing system including trans-basin, overflow & western boundary current observations.

RAPID/MOCHA (-2015, NERC Climate Theme Action 2-page proposal for the continuation of the array from 2015-2022)

EU-NACLIM (2013-2016)

German RACE (2013-2015, possible 2nd phase -2018)

WHOI Line W at 40°N

US MOVE at 16°N

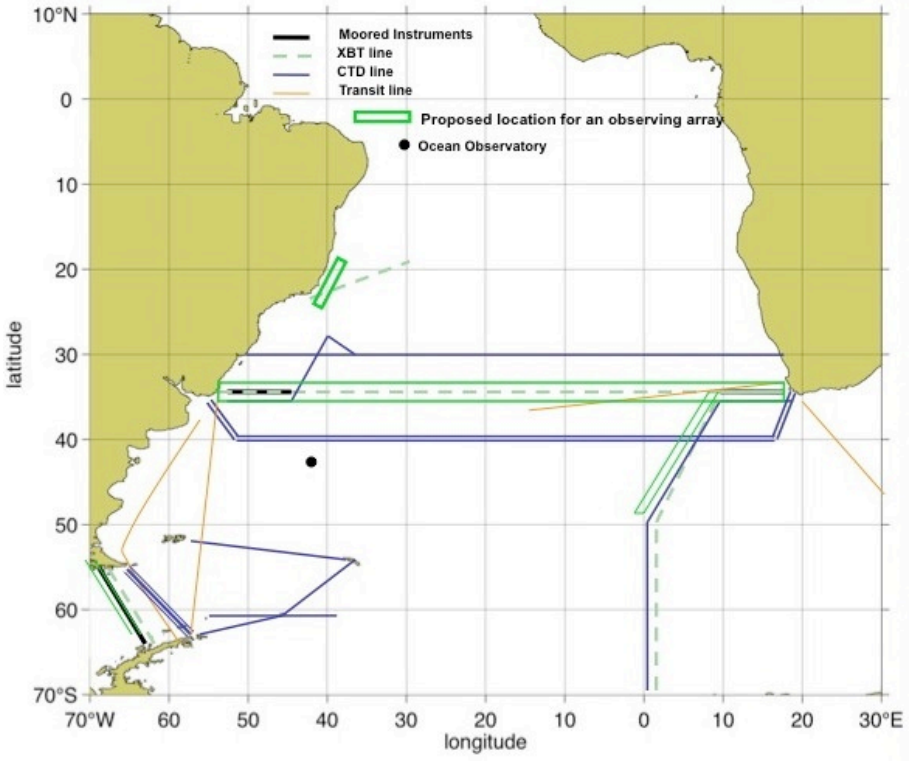
OSNAP (US, UK, Canada, Germany, Netherlands)

SAMOC: South Atlantic Meridional Overturning Circulation

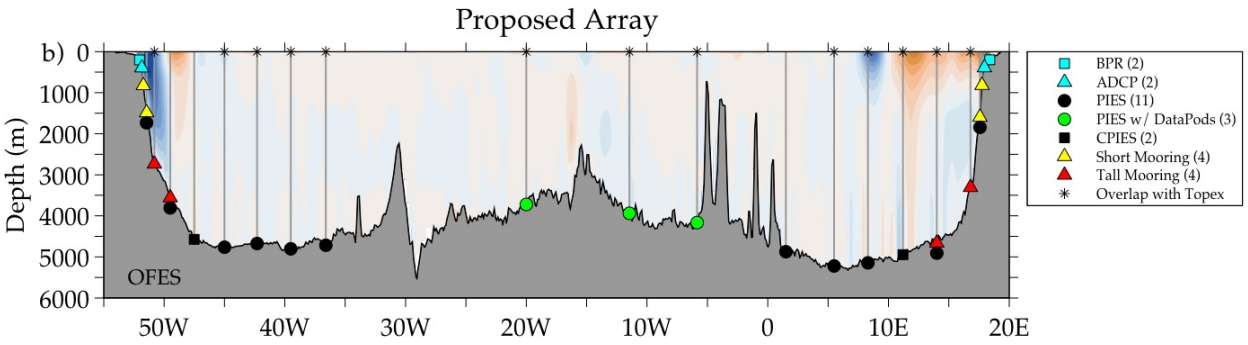
The main objectives of SAMOC are to measure the strength and variability of the MOC as well as the meridional heat and fresh- water transport in the South Atlantic, all of which are crucial to improving our understanding of climate system variability.

Several components of SAMOC have been funded through national agencies

SAMOC has been endorsed by the CLIVAR SSG in May 2012



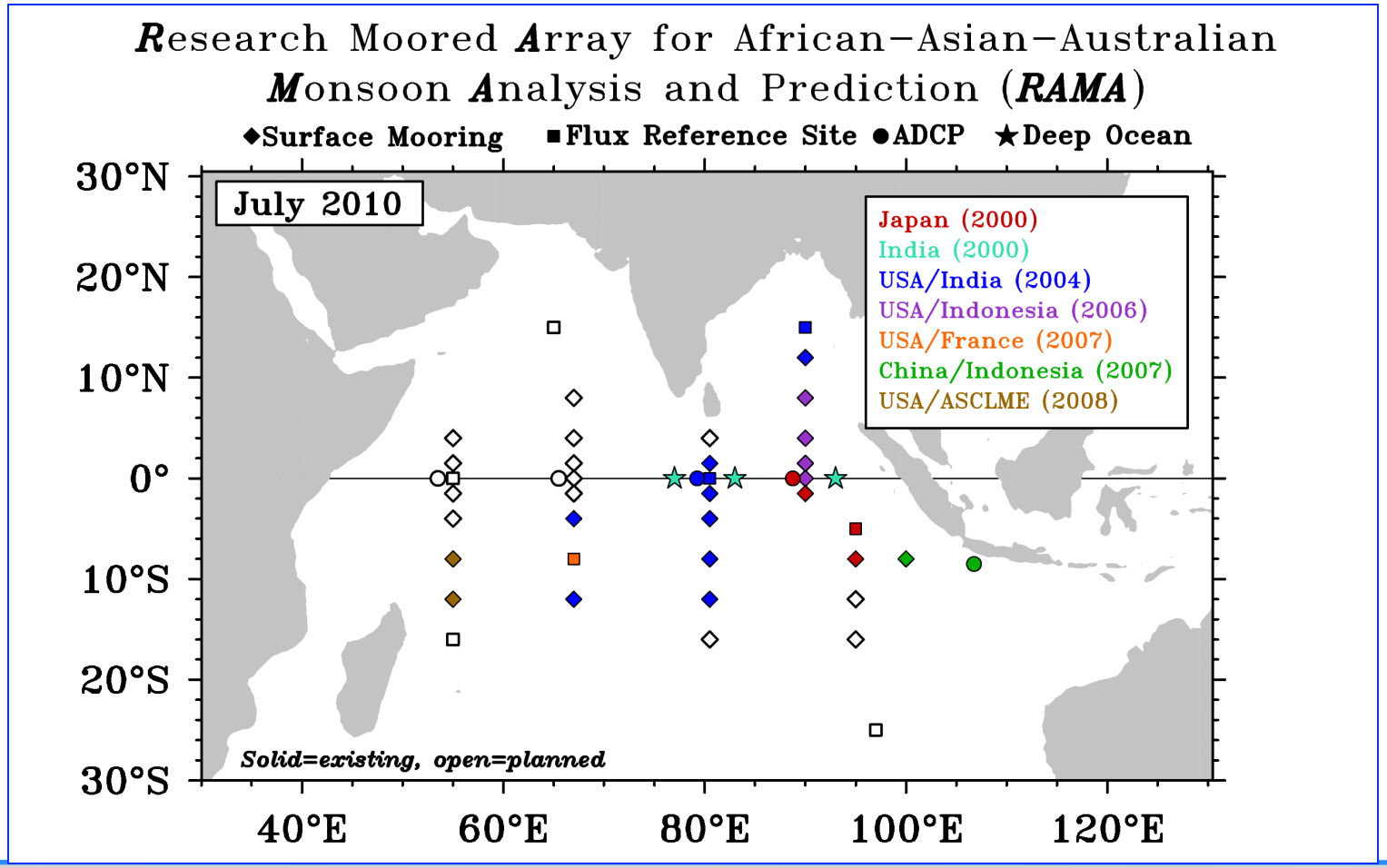
The proposed array along 35°S consists of bottom pressure gauges (cyan squares), upward-looking ADCPs, mid-depth and deep moorings with full water-column T, S, p and discrete current measurements**, PIES (black circles), PIES-with datapods (green circles), and CPIES (black squares). Color contours are of 27-year mean OFES meridional velocity along 34.5°S.**



Ocean Observing System

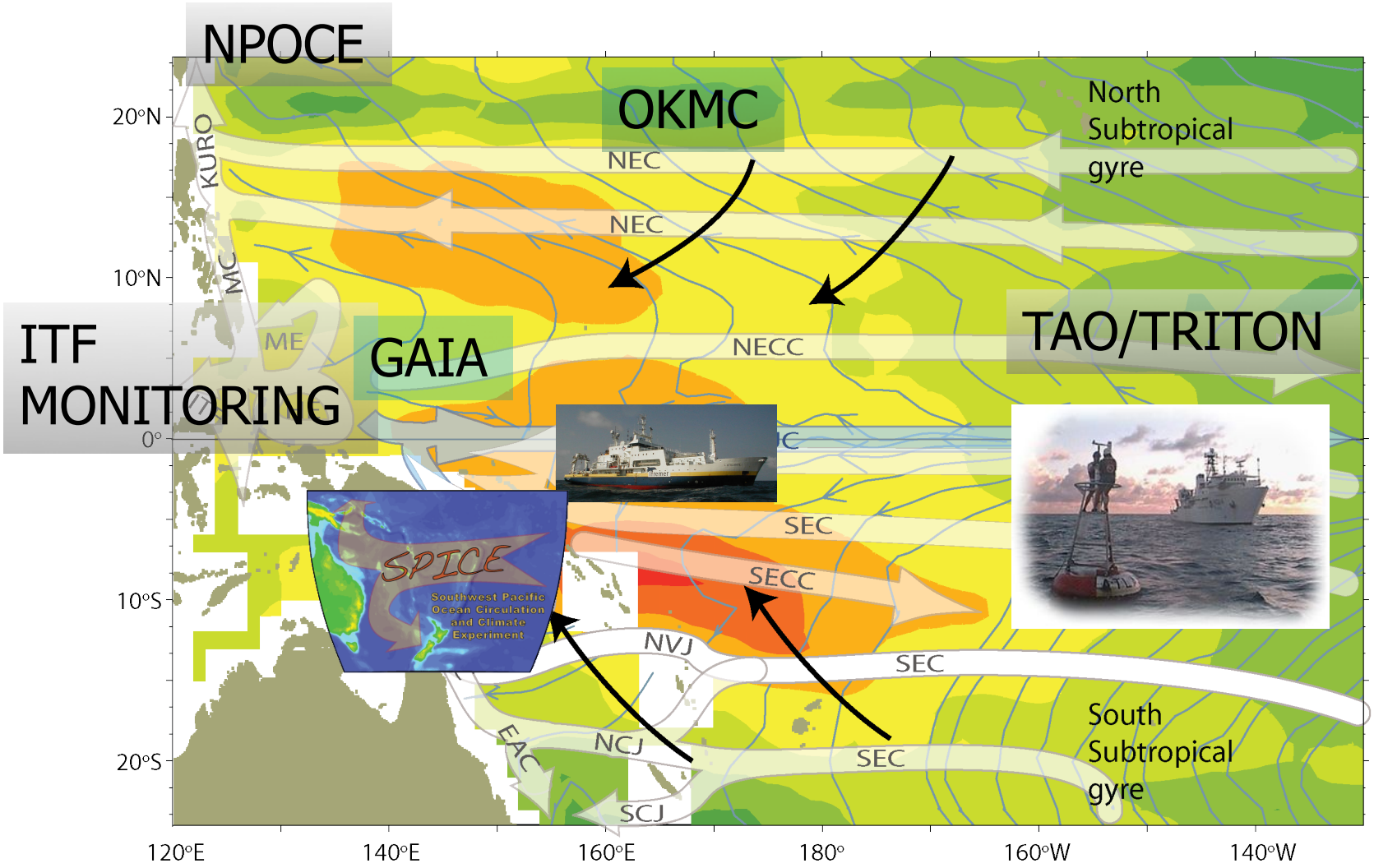
International Coordination of Integrated Observing Networks

RAMA observational network (IOP/GOOS/IOC)



Ocean Observing System

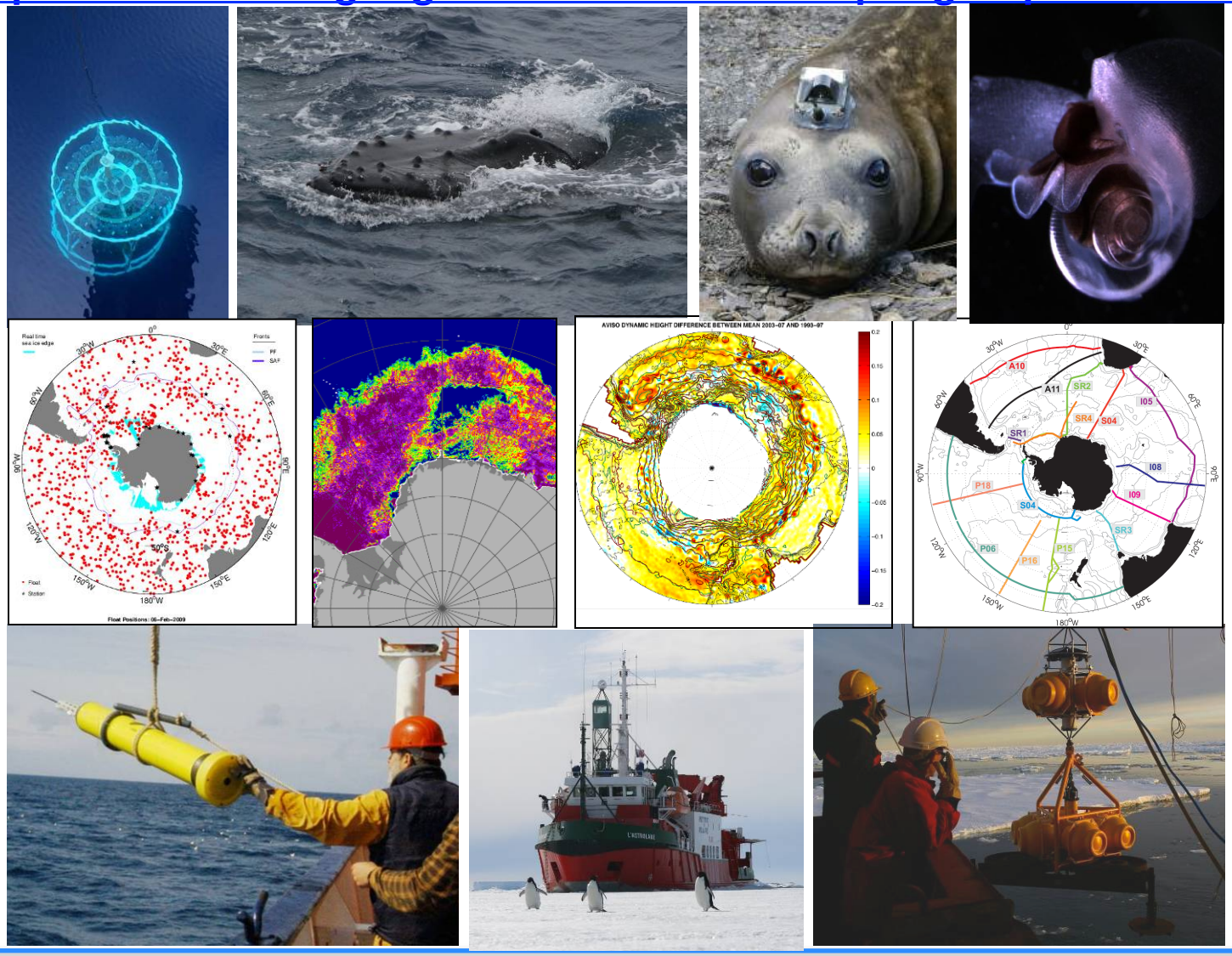
International Coordination of Integrated Observing Networks



The Southern Ocean Observing System:

A Legacy of the International Polar Year

http://www.clivar.org/organization/southern/expertgroup/SOOS.htm



CLIVAR Imperatives

- Anthropogenic Climate Change
- Intra-to-Seasonal Variability, Predictability and Prediction
- Decadal Variability, Predictability and Prediction
- Improved Atmosphere and Ocean Components of ESMs
- Data Synthesis and Analysis
- Ocean Observing System
- Education and Capacity Development

Education and Capacity Development

Working together

GHAfrica Workshop (WMO/World Bank) 02/2011

Central Africa (USA) 04/2007

Mexico (UK) 03/2009

West Indian Ocean (France) 09/2009

Southeast Asia (USA)12/2007

Indonesia, Malaysia, Thailand, Philippines (NL) 12/2009

Recent workshops:

Jan 2011, CIIFEN, Equator, S. America

Feb 2011, ICPAC, Keyna, GH Africa

Dec 2011, Gambia, W. Africa

May 2012, New Caledonia, Pacific Island countries and East Timor

May 2012, Jamaica, Caribbean

CLIVAR supported workshops (Jan-Sep 2012)

Meeting Title	Group	Venue	Dates
10th Meeting of the CLIVAR Working Group on Ocean Model Development (WGOMD)	WGOMD	Venice, Italy	11-13 January 2012
Workshop on Using Paleo-Climate Model/Data Comparisons to Constrain Future Projections	CLIVAR/PAGES Working Group	Honolulu, Hawaii, US	1-3 March 2012
Indonesian Throughflow Workshop	Indian Ocean Panel / Pacific Panel	Jakarta, Indonesia	12-14 March 2012
WCRP Workshop on developing a Global Drought Information System	Drought Interest Group	Frascati, Italy	11-13 April 2012
7th Pacific Panel Meeting	Pacific Panel	Noumea, New Caledonia, France	28-29 April 2012
Capacity building workshop on Data Rescue & Climate Change Indices: a contribution to the implementation of the GFCS in the Caribbean	ETCCDI	University of West Indies, Mona, Jamaica	7-10 May 2012
VAMOS Workshop on Modeling and Predicting Climate in the Americas	VAMOS	Petropolis, Brazil	4-6 June 2012
15th Session of the CLIVAR VAMOS Panel	VAMOS	Petropolis, Brazil	6-7 June 2012
SSG-19	SSG	La Paz, Mexico	11-14 June 2012
CLIVAR/WCRP Workshop on Decadal and Multi-decadal Variability in Pacific and Indian Ocean	PP - IOP	Qingdao	4 - 7 September, 2012
12th Session of the CLIVAR Atlantic Implementation Panel	AIP	Kiel, Germany	10-11 September 2012
IMBER ClimECO3 Summer School	IMBER	Ankara, Turkey	23-28 July 2012

Outline

CLIVAR: Progress and Achievements

- Current Research Challenges
- Current Imperatives
- WCRP Cross Cuts / GEWEX interactions

Strategy and Evolution

- Major research foci for the next 5 years
- How they relate to WCRP Grand Challenges
- Implementation

CLIVAR ICPO

Conclusions and Issues for JSC Consideration

Interactions with GEWEX

- WCRP changes (mission, name, etc):
- Surface fluxes: e.g. ocean fluxes (meeting Nov 2012)
- Drought: the DIG activity & relation to other extremes
- Extremes: ETCCDI and GEWEX activities (need to unite)
- Monsoons: AAMP, MAHASRI (need to unite)
- Africa: VACS, as well as potential LVB RHP but also AMMA, for example (need one WCRP African effort)
- South America: VAMOS, LPB, and continuation (split?)

Interactions with GEWEX

WCRP changes: GEWEX concerns

- We can be an umbrella/haven/base for panels, but we are not going to force it!
- We can do things jointly, but experience suggests a primary lead project office (Is the activity more ocean or land oriented?)
- With CLIVAR: all land-atmosphere stuff should be joint, incl. monsoons, maybe extremes, and we should avoid duplication (much easier said than done)

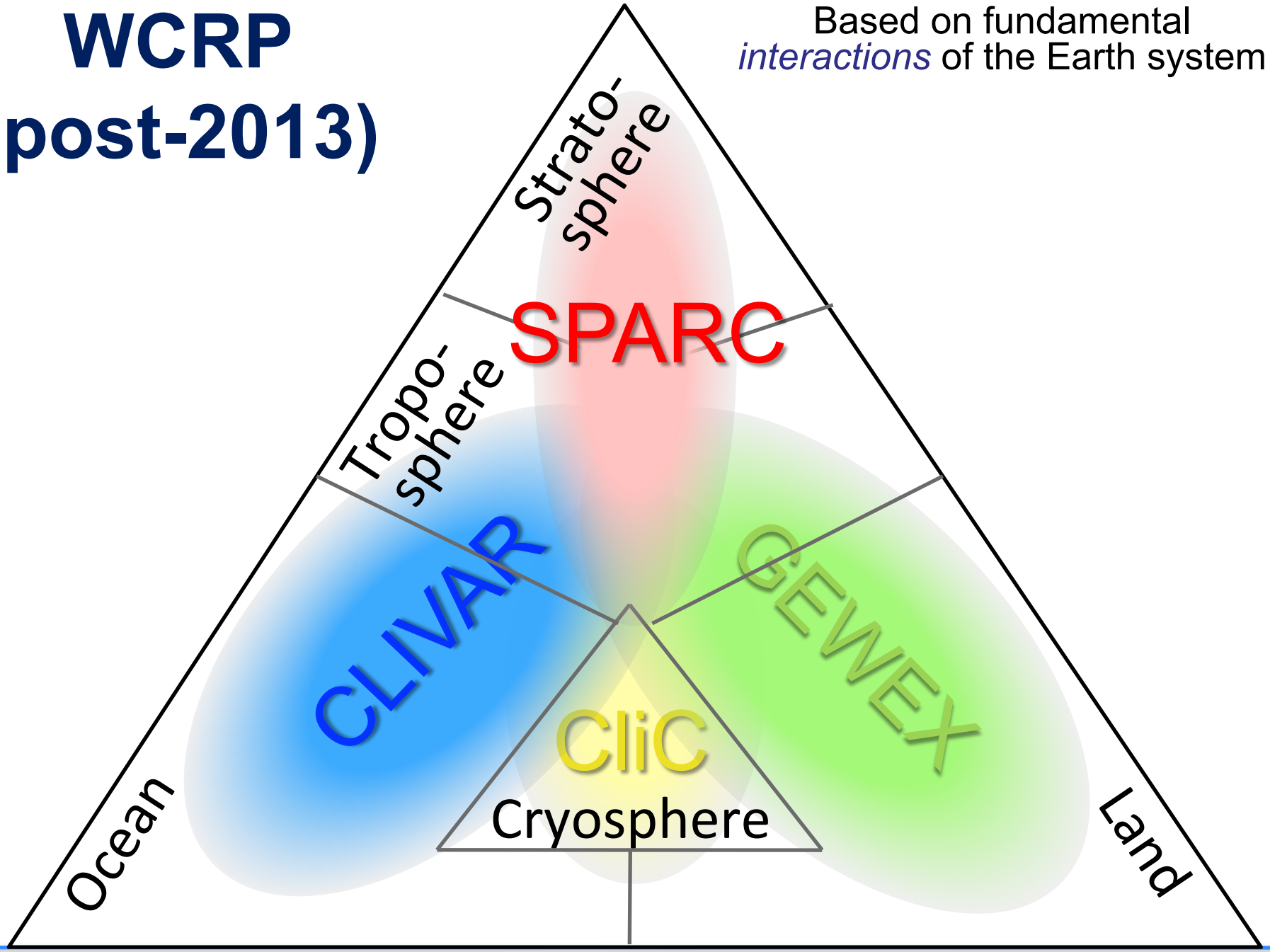
Strategy and Evolution of CLIVAR

Towards a Science Agenda and Implementation Strategy

Martin Visbeck and Jim Hurrell
Co-Chairs, CLIVAR SSG

WCRP (post-2013)

Based on fundamental *interactions* of the Earth system



JSC Guidance to CLIVAR
Considered at SSG-19

Overall:

JSC would like to encourage a fresh look*, independent of prior panel names or structure* … developing a research agenda that addresses … the grand challenges and imperatives of CLIVAR [and its stakeholders, as well as] the overall WCRP future plan and priorities.

CLIVAR should re-examine its project substructure at SSG-19, including whether *elements of CLIVAR may have a better home elsewhere in WCRP*, and address the issue of a name change

JSC Guidance to CLIVAR
Considered at SSG-19

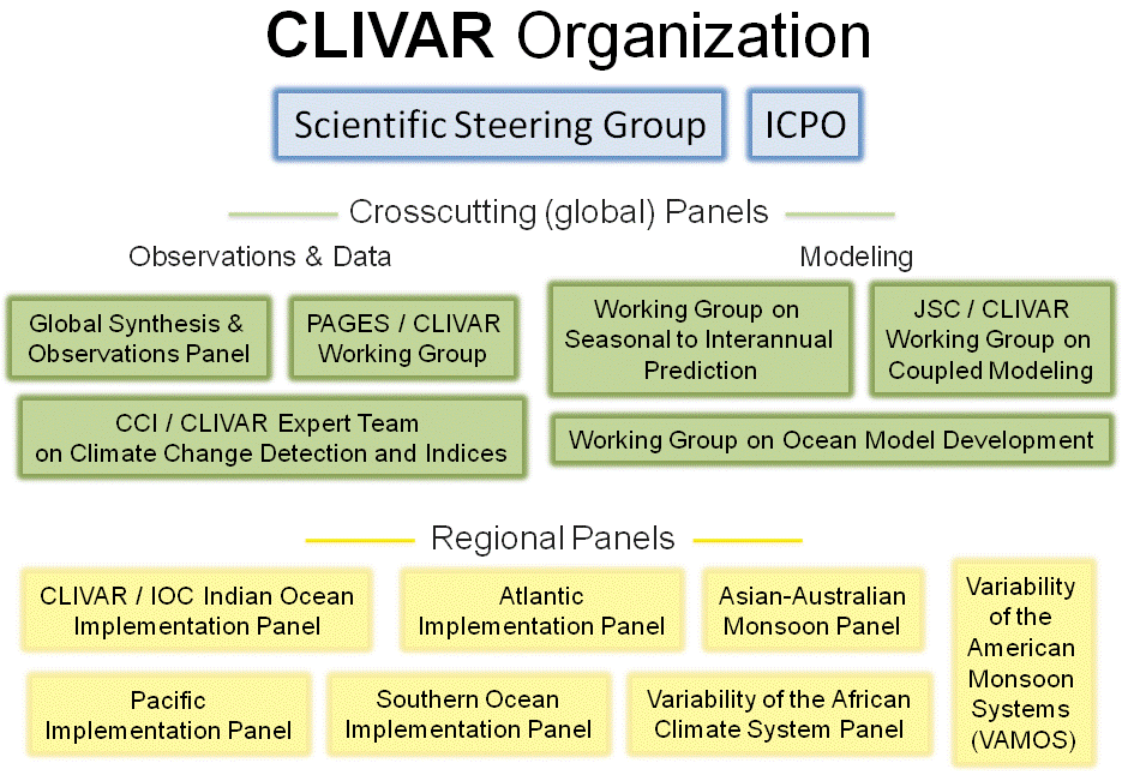
VACS and VAMOS:

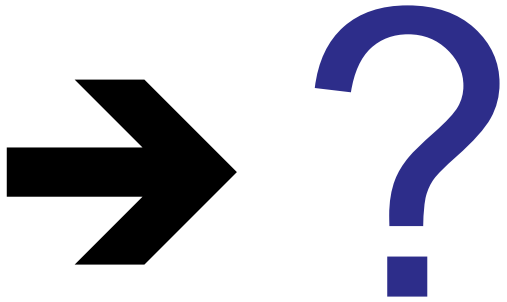
- JSC agreed to request … VACS and VAMOS panels to work with their constituencies to develop a list of research priorities and activities for their respective regions for post 2013

- JSC envisions great opportunities for cooperation and partnership between CLIVAR and GEWEX for both the VACS and VAMOS, or any subsequent activity they may transition to in the future.

WCRP Evolution

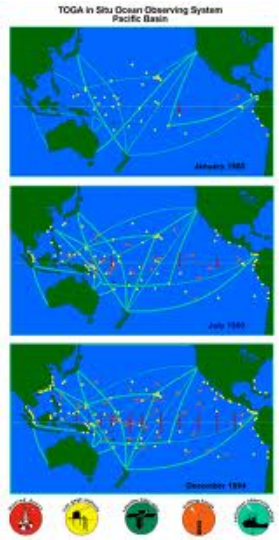
What does it mean for CLIVAR?





CLIVAR Research and Imperatives

- Anthropogenic Climate Change
- Intra-to-Seasonal Variability, Predictability and Prediction
- Decadal Variability, Predictability and Prediction
- Improved Atmosphere and Ocean Components of ESMs
- Data Synthesis and Analysis
- Ocean Observing System
- Capacity Building



All Must Remain WCRP Priorities

WCRP Evolution

What does it mean for CLIVAR?

Default Structure

CLIVAR Organization

Scientific Steering Group | ICPO

Crosscutting (global) Panels

Observations & Data

- Global Synthesis & Observations Panel
- PAGES / CLIVAR Working Group
- CCI / CLIVAR Expert Team on Climate Change Detection and Indices

Modeling

- Working Group on Seasonal to Interannual Prediction
- JSC / CLIVAR Working Group on Coupled Modeling
- Working Group on Ocean Model Development

Regional Panels

- CLIVAR / IOC Indian Ocean Implementation Panel
- Atlantic Implementation Panel
- Asian-Australian Monsoon Panel
- Pacific Implementation Panel
- Southern Ocean Implementation Panel
- Variability of the African Climate System Panel
- Variability of the American Monsoon Systems (VAMOS)

current CLIVAR Organization

Scientific Steering Group | ICPO

Crosscutting (global) Panels

Observations & Data

- Global Synthesis & Observations Panel
- ? Working Group (WCRP)
- CCI / CLIVAR Expert Team on Climate Change Detection and Indices (GEWEX WCRP)

Modeling

- ✓ Seasonal to Interannual Prediction (WCRP)
- ✓ Working Group on Coupled Modeling (WCRP)
- Working Group on Ocean Model Development

Regional Panels

- CLIVAR / IOC Indian Ocean Implementation Panel
- Atlantic Implementation Panel
- Asian-Australian Monsoon Panel
- Pacific Implementation Panel
- Southern Ocean Implementation Panel
- Variability of the African Climate System Panel (GEWEX WCRP)
- Variability of the American Monsoon Systems (VAMOS)

future CLIVAR Organization

Scientific Steering Group | ICPO

WCRP JSC-33

CLIVAR SSG-19 Planning Process

Some Guiding Questions:

- What research challenges and capabilities should be the focus of an ocean-atmosphere project?
- If it is time to "downsize" CLIVAR where do broader activities fit into the restructured WCRP?
- Is it time to change the name of CLIVAR?

Goal: to begin to construct the "new" CLIVAR around ocean-atmosphere research challenges/capabilities

CLIVAR SSG-19 Planning Process

What should the new CLIVAR be?

Towards the new CLIVAR science agenda and implementation strategy

What's in a name?

Should CLIVAR become

CLI**M**AR?

Climate processes, variability, predictability and trends interacting with the marine realm

CLIVAR Planning Process

Timeline

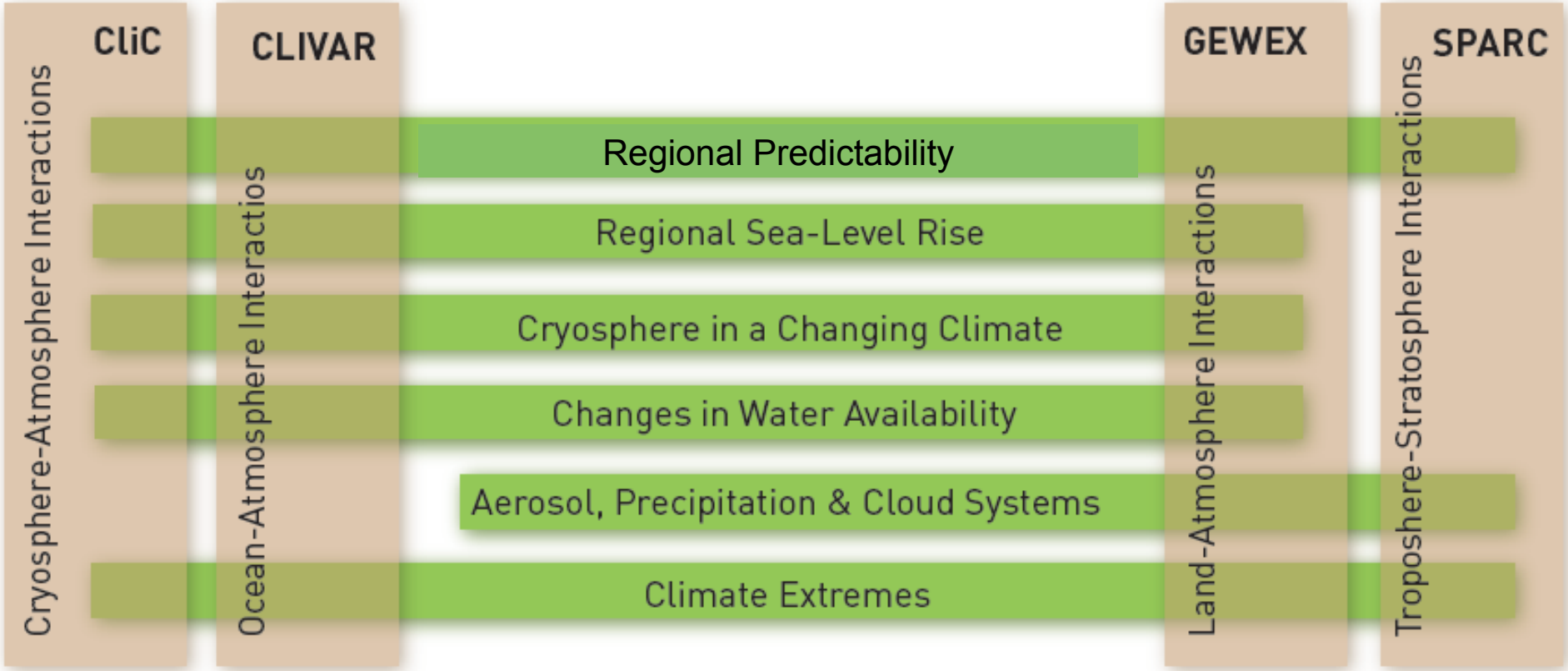
- SSG-19 (11-14 June 2012)
  - Update on WCRP evolution and charge to CLIVAR
  - Develop first draft science agenda and implementation strategy
  - Discuss and debate
- JSC-33 (17-20 July 2012)
  - Consultation with other core projects and JSC
- Debrief from JSC-33 (late July/early August)
  - Teleconference(s) with Panel/WG Co-Chairs & SSG
- Leading to SSG-20 (June 2013, Kiel Germany)
  - Develop Research Challenge position papers
  - Panel and WG discussions of implementation framework
  - Refine and put plans in place for 2014 transition

CLIMAR Research Challenges

- What should they be?
  - How do they relate to existing CLIVAR Research Challenges/Imperatives
  - Preliminary discussion at SSG-18; panel input and good discussions at CLIVAR SSG-19
  - Further community input at Ocean Sciences (Feb 2012, Salt Lake City)
  - US CLIVAR and other National Themes

- WCRP Grand Challenges and the role for CLIMAR

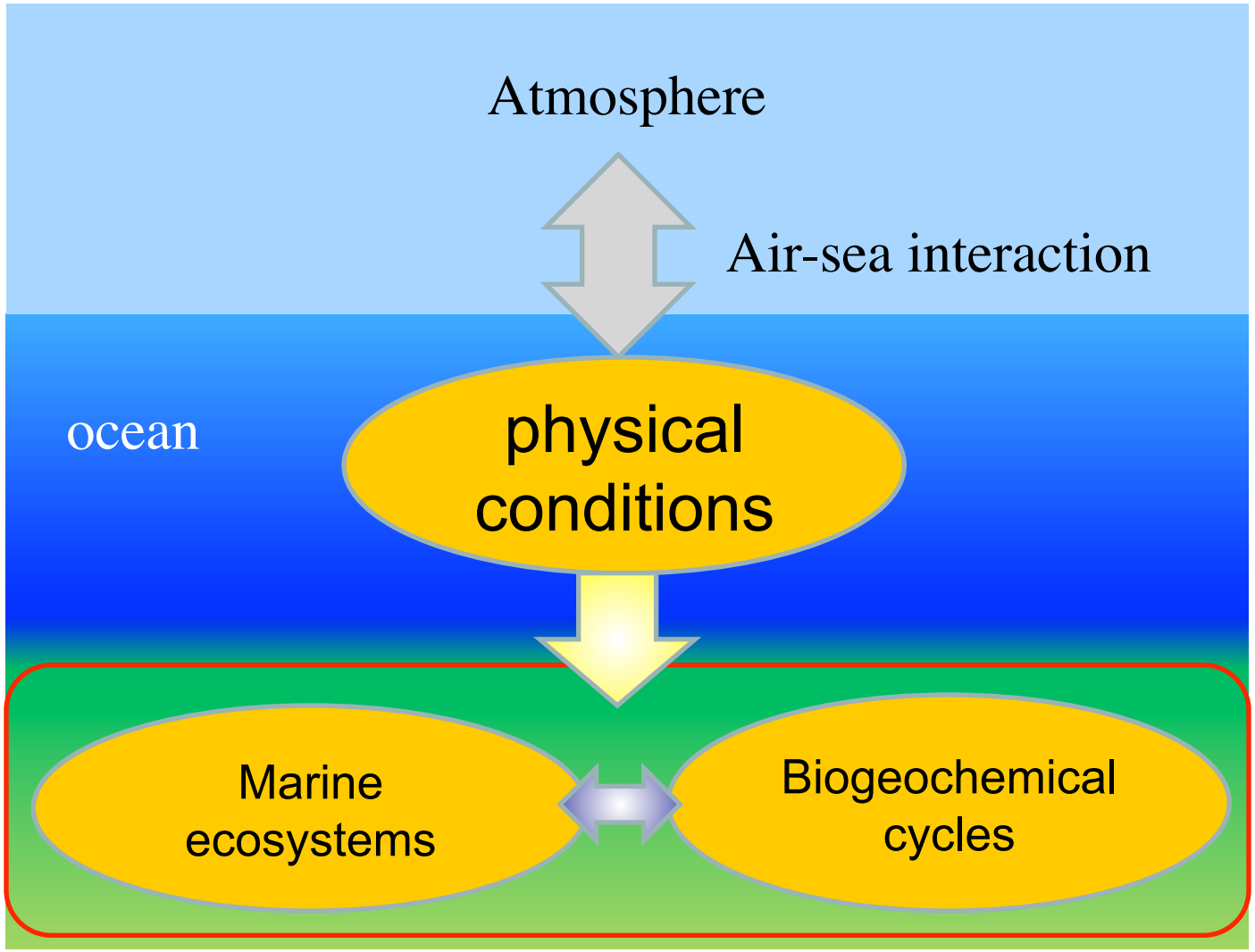
WCRP Grand Challenges



CLIMAR Research Challenges

- Intraseasonal, seasonal and interannual variability and predictability of monsoon systems
- Decadal variability and predictability of ocean and climate variability

Two directions of importance of climate variability in conjunction with the physical ocean



CLIMAR Research Challenges

- Intraseasonal, seasonal and interannual variability and predictability of monsoon systems
- Decadal variability and predictability of ocean and climate variability
- Trends, nonlinearities and extreme events
- Marine biophysical interactions and dynamics of upwelling systems
- Dynamics of regional sea level variability
- …

Some Examples …

- Intraseasonal, seasonal and interannual variability and predictability of monsoon systems

- Decadal variability and predictability of ocean and climate variability

- Dynamics of regional sea level variability

Variability and Predictability of Monsoon Systems

CONTEXT:

Improved monsoon predictions are necessary to meet the pressure of adjusting to short-term and long-term variations of the global monsoon. Seasonal prediction has a long history, but still not much skill. Intraseasonal (ISO) predictions are perhaps more important, but we have yet to deliver a real-time ISO forecast system. On the longer-term, decadal and interdecadal variations may mask anthropogenic signals.

QUESTION:

- What are the physical mechanisms responsible for modulating predictability of the global monsoon on subseasonal to interdecadal time scales?

Variability and Predictability of Monsoon Systems

Key CLIMAR Science Challenges:

- What is the relative role of the oceans and land in contributing to predictability as a function of time scale?
- What is the role of the oceans for interannual to interdecadal variability, especially related to ENSO and its teleconnections?
- What is the role of aerosols for monsoon variability, predictability, and change?

- Communication challenges
  - Communicating forecast/projection products and their uncertainties for the range applications that span the relevant time scales.
  - Communicating the assessment of skill in terms of historical performance.

Decadal Variability and Predictability

CONTEXT:

Decadal-scale variability may dominate anthropogenic trends regionally on the timescale of planning and adaptation investments. Many across the range of scientific and development communities are thus seeking decadal-scale climate information to guide decisions for the future.

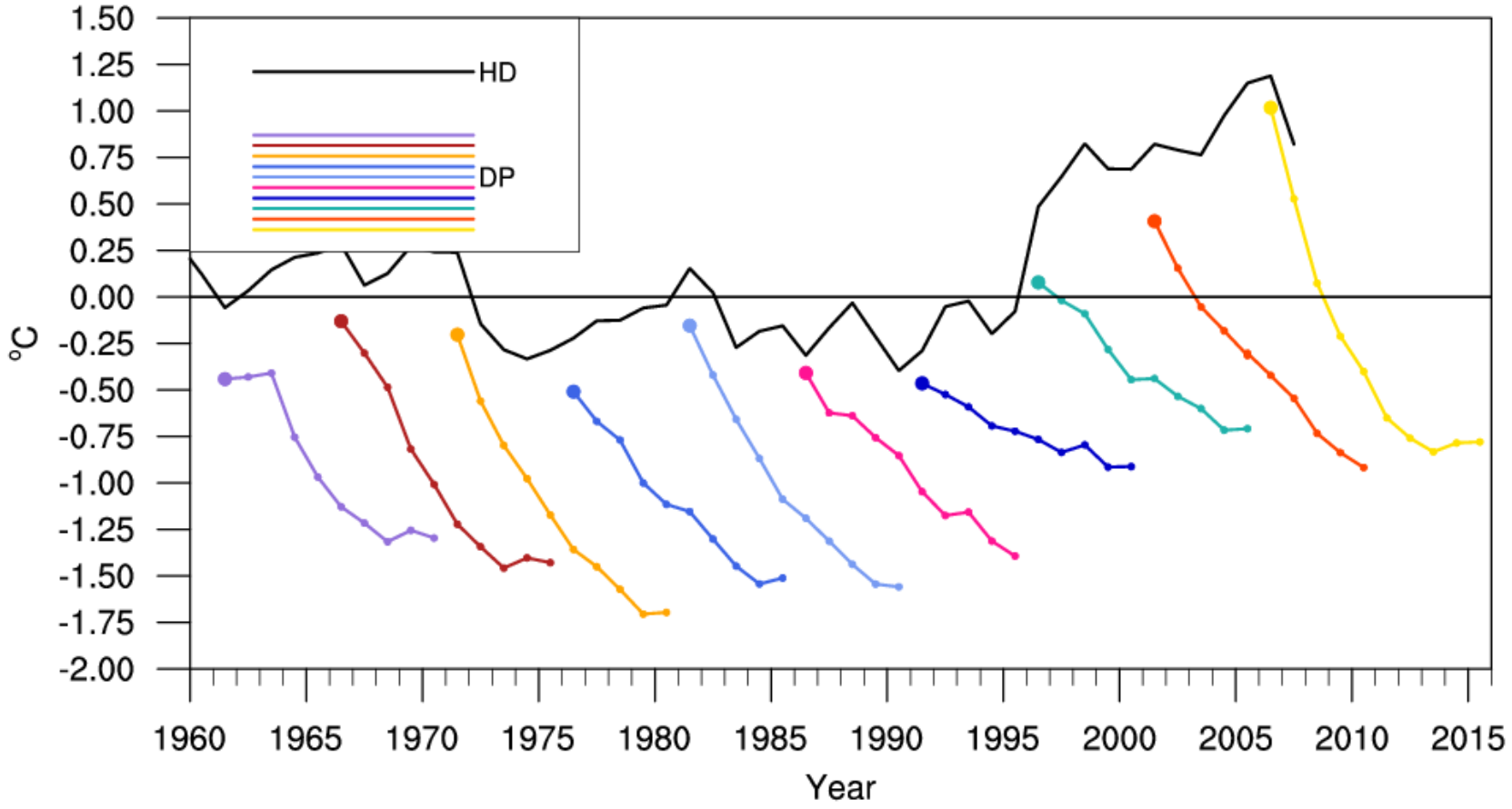
QUESTION:

- What are the physical mechanisms responsible for low frequency variability and can they be exploited for decadal climate prediction?

Decadal Prediction: early results

DRIFT – BIAS CORRECTION

Case Study: North Atlantic Subpolar Gyre Heat Content

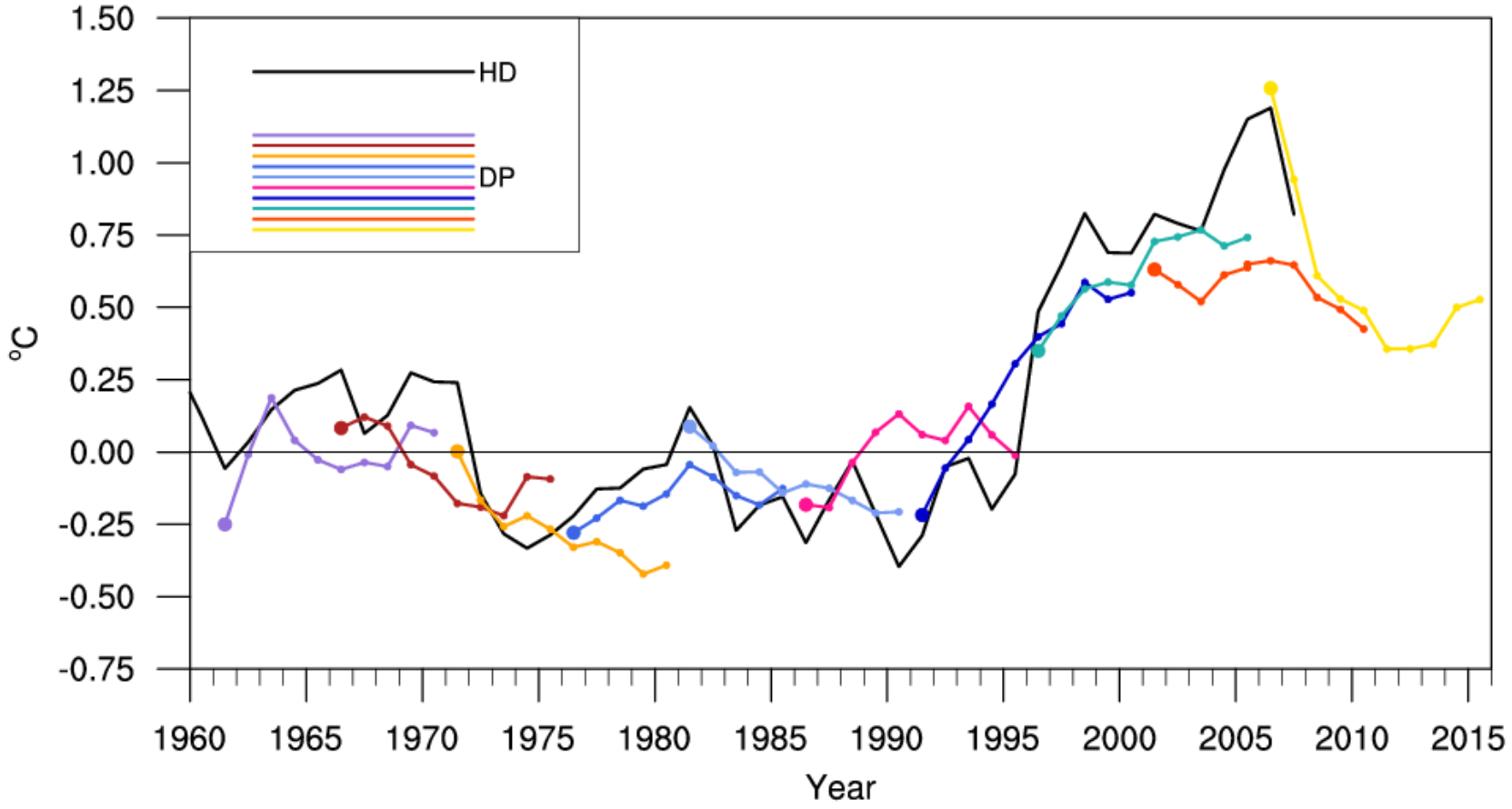


HD/DP correlations: 0.94 (1-5 yr lead); 0.94 (6-10 yr lead) (99% confidence)

Decadal Prediction: early results

DRIFT – BIAS CORRECTION

Case Study: North Atlantic Subpolar Gyre Heat Content



HD/DP correlations: 0.94 (1-5 yr lead); 0.94 (6-10 yr lead) (99% confidence)

Decadal Variability and Predictability

Key CLIMAR Science Challenges:

- What are the processes that give rise to decadal variability and which of these are sources of predictability?
- Does oceanic variability have atmospheric relevance outside the tropics? If so, what are the processes and timescales?
- Do we have the proper tools to realize the predictability?
  - Adequacy of Ocean Observing System
  - Advanced Models, Assimilation, Initialization, Prediction and Verification Techniques

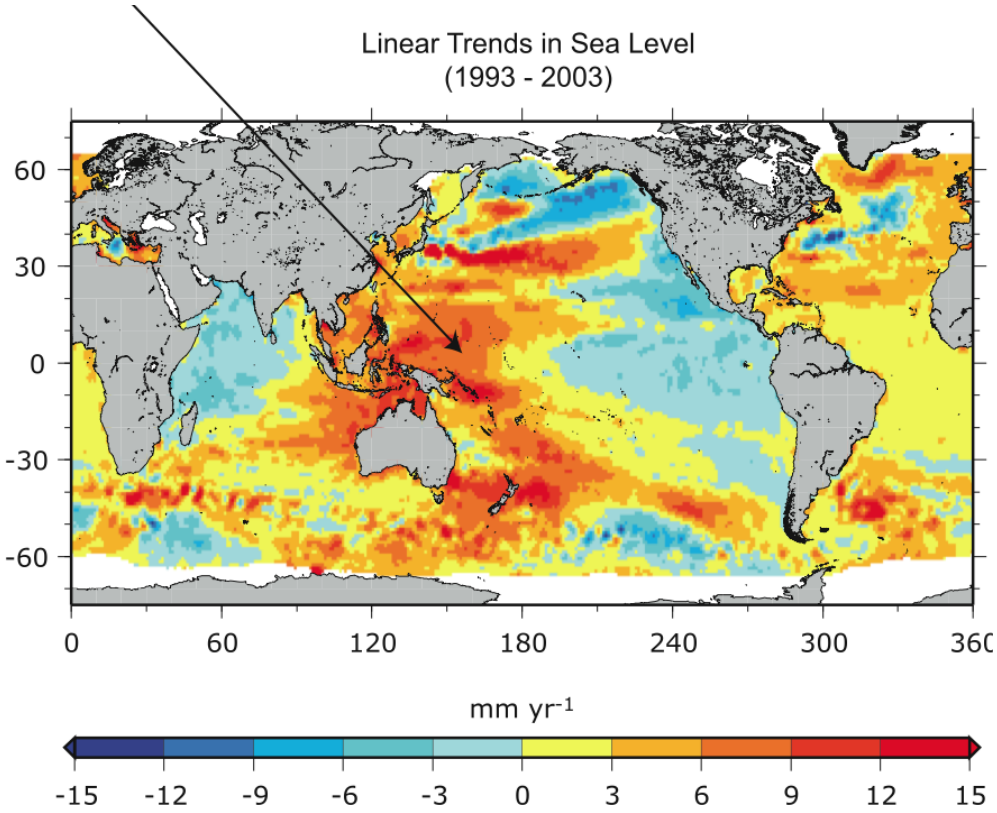
- Communication challenges
  - Typically, seasonal predictions are more relevant to management decisions whereas decadal predictions could be useful to planning decisions.
  - Tempering expectations: clear communication of what information can (and cannot) be provided, and with what degree of accuracy or probabilistic reliability.

Regional Sealevel Variability

CONTEXT:

Changes in regional sea level are significantly different from the global mean rise.

The spatial patterns of change are highly non-uniform, with regions of both sea level rise and sea level fall over decadal time spans.



While adiabatic ocean dynamics (wind forcing) appears to dominate on interannual-decadal time scales, other factors (thermohaline circulation, geoid) may become relevant on longer time scales.

Regional Sealevel Variability

Question:

- While satellite altimetry allows an accurate mapping of changes since 1993, there is little quantitative knowledge of multi-decadal time scales: What was the spatial pattern of change during the last 50 or 100 years and what factors governed the regional changes over multi-decadal periods?

Regional Sealevel Variability

Key CLIMAR Science Challenges:

- Can model-data synthesis methods be advanced such that multi-decadal ocean reanalysis (hinddcast) products become sufficiently?
- Will it be possible to advance regional climate projections (e.g., of regional wind stress changes, or changes in the thermohaline circulation) to enable robust projections of regional sea level changes?

•Communication challenges

- Decadal to multi-decadal predictions are most relevant to planning decisions.
- Tempering expectations: clear communication about the degree of accuracy or probabilistic reliability of regional sea level projections.

CLIMAR Research Challenges & Capabilities

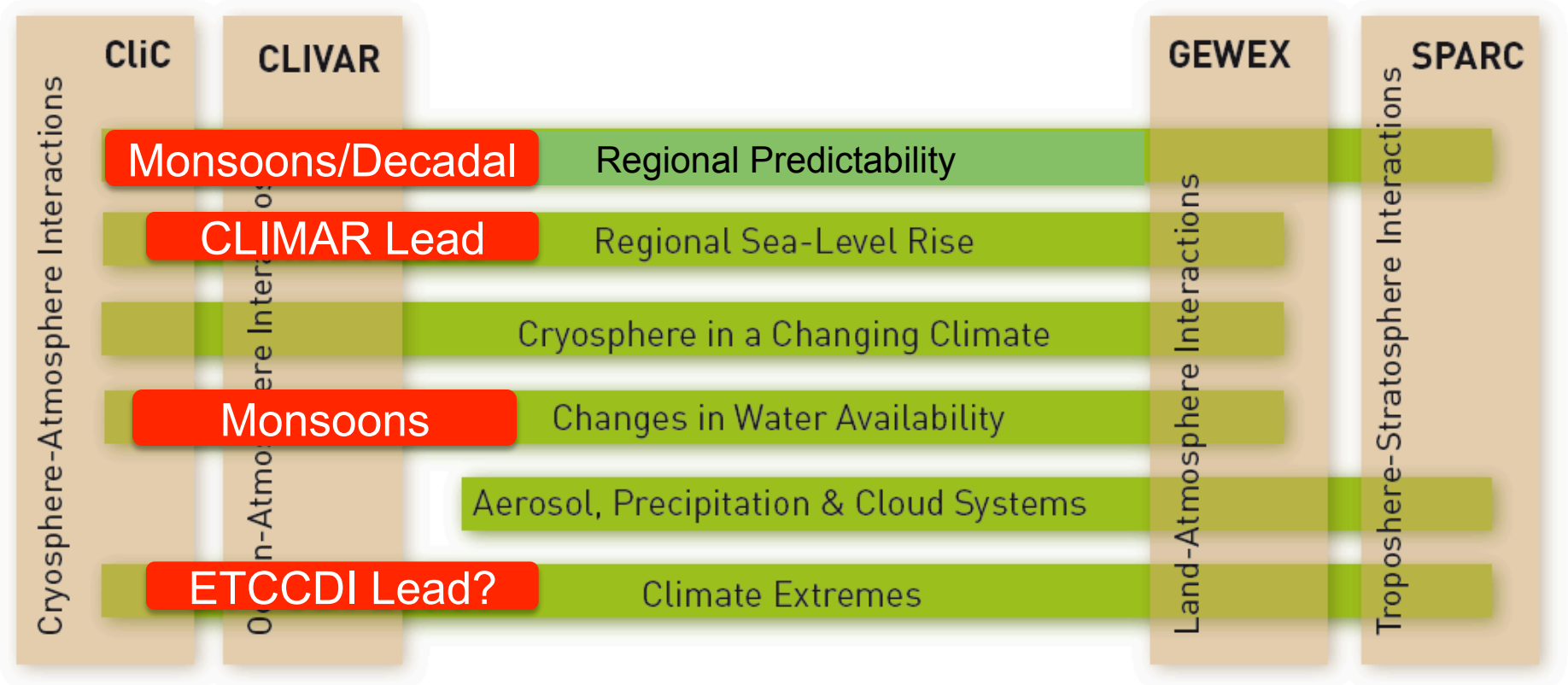
Research Challenges

- I-S-I variability and predictability of monsoon systems
- Decadal variability and predictability of ocean and climate variability
- Trends, nonlinearities and extreme events
- Marine biophysical interactions and dynamics of upwelling systems
- Dynamics of regional sea level variability
- …

Capabilities (Imperatives on global and regional scales)

- Improving ocean system models
- Improving ocean observing systems
- Ocean data, synthesis and information systems
- Knowledge transfer and stakeholder feedback
- Education, capacity building and outreach

WCRP proposed Grand Challenges



Draft Implementation Framework

CLIMAR+ research challenge panels (odd year)

CLIMAR implementation panel (even year)

	I-S-I Monsoons	Decadal Variability	Seal Level Regional	Upwelling Ecology	Extremes Trends	…
Atlantic	X	X	X	X	X	
Pacific	X	X	X	X	X	
Indian	X	X	X	X	X	
Southern		X	X	X	X	
Model	X	X	X	X	X	
Data	X	X	X	X	X	
Transfer	X	X	X	X	X	
GEWEX	X	X			X	
SPARC	X	X			X	
CLIC		X	X		X	
WGSIP	X	X		X	X	
WGCM	X	X	X	X	X	
IMBER		X		X		

Outline

CLIVAR: Progress and Achievements

- Current Research Challenges
- Current Imperatives
- WCRP Cross Cuts / GEWEX interactions

Strategy and Evolution

- Major research foci for the next 5 years
- How they relate to WCRP Grand Challenges
- Implementation

CLIVAR ICPO

Conclusions and Issues for JSC Consideration

ICPO Director Vacancy

- Advertised widely early May 2012
- Closing date was 14th June 2012
- Selection process ongoing

Conclusions and Issues for JSC Consideration

New CLIVAR / CLIMAR

- VACS/VAMOS and the WCRP Regional Panel
- Panel structure change
- WCRP grand challenges / interest to lead some
-

JSC Guidance to CLIVAR
Considered at SSG-19

VACS and VAMOS:

- JSC agreed to request … VACS and VAMOS panels to work with their constituencies to develop a list of research priorities and activities for their respective regions for post 2013

- JSC envisions great opportunities for cooperation and partnership between CLIVAR and GEWEX for both the VACS and VAMOS, or any subsequent activity they may transition to in the future.

VACS Activities and Planning

Strengthening the network of African climate scientists

- CLIVAR Exchanges Special Issue (8/12) – introducing ongoing, major international research projects across Africa
- VACS Newsletter – sharing new results, emerging scientist news and profiles, events and opportunities
- VACS database of climate scientists in Africa – searchable by topic and geographical area of study
- Review papers to identify the science priorities for climate science in Africa

Proposal: **State of the African Climate System Conference (Sept 13)** to narrow the gap between African decision-makers and climate science researchers, towards the production of actionable climate research ($30K for WCRP)

VAMOS Activities and Planning

New Mission and Research Challenges: 5+ year plan

- Integrate across regional projects to characterize, simulate and predict the complete annual cycle of American monsoons
- Conduct coordinated global modeling experiments to identify principal sources of error in simulations of the American monsoons
- Coordinate targeted, but migrating Intensive Observing Campaigns, to document and quantify 'missing' elements
- Leverage existing progress in paleo-climate research
- Provide needed guidance to regional 'downscaling' activities
  - No CORDEX domain properly configured for North American Monsoon
  - Joint VAMOX/CORDEX workshop in planning stages (sometime in 2013)

Planning: Develop a climate research program for 'Latin America' which has more emphasis on climate services and stakeholder input

- Scoping workshop in spring 2013: researchers and stakeholders

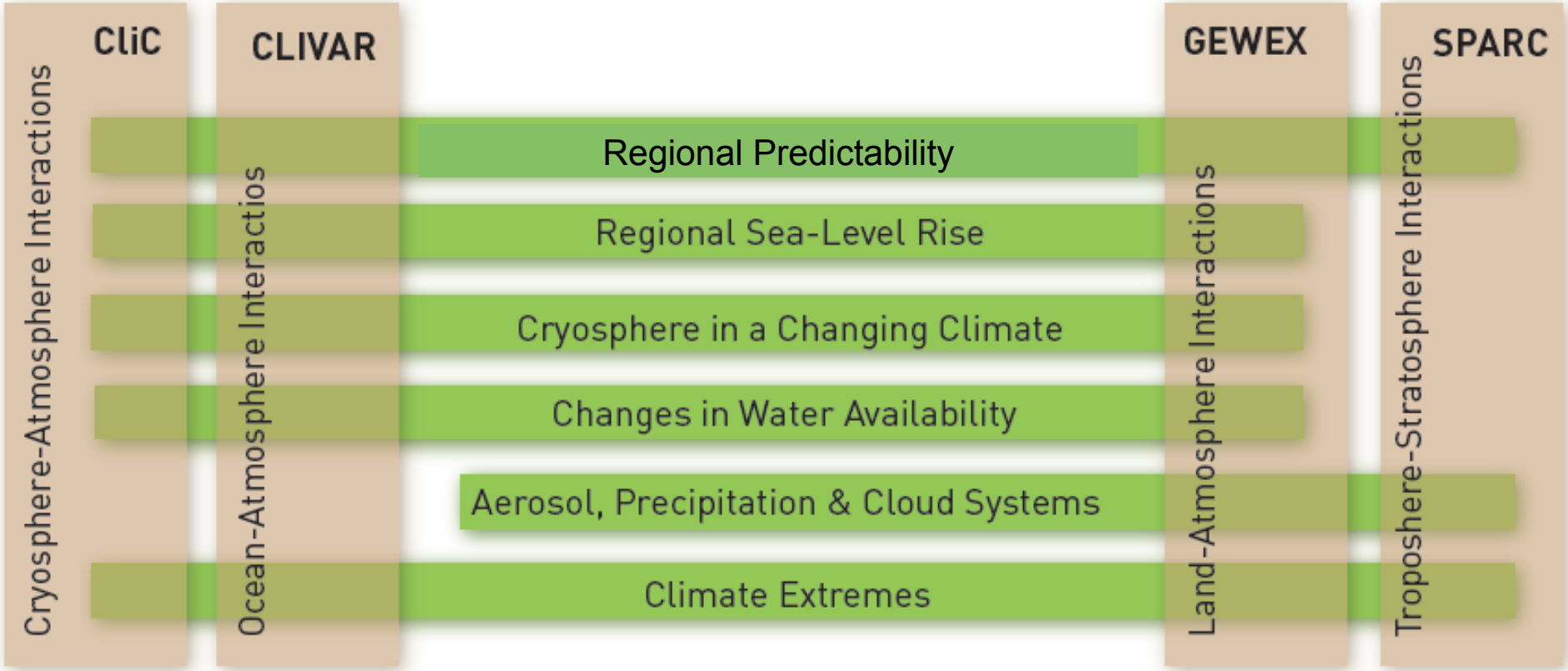
VACS/VAMOS and new WCRP Structure

VACS: Panel members suggest VACS should be renamed **African Climate Panel (ACP).** Also propose ACP would report to CLIVAR recognizing, however, that a strong interaction with GEWEX is necessary for the accomplishment of the science priorities.

VAMOS: Panel members suggest VAMOS has been and should remain a **WCRP cross-cut program**, having only "lived" in CLIVAR. To enable optimal linkages to relevant WCRP programs (e.g., CLIVAR, GEWEX, WGSIP, WGCM) VAMOS views itself needing to be outside of existing programs.

Need JSC advice on how to proceed as to the 'home' of the new ACP and S. America group (how about Asia?)

WCRP Grand Challenges



WCRP/CLIMAR Research Challenges

- Intraseasonal, seasonal and interannual variability and predictability of monsoon systems
  Lead the WCRP Grand Challenge 'regional predictability'
  Part of the WCRP Grand Challenge 'water'
- Decadal variability and predictability of ocean and climate variability
  Lead the WCRP Grand Challenge 'regional predictability'
- Trends, nonlinearities and extreme events
  Lead the WCRP Grand Challenge 'extreme events'
- Marine biophysical interactions and dynamics of upwelling systems
- Dynamics of regional sea level variability
  Lead the WCRP Grand Challenge 'regional sea level'

Evolution of CLIMAR Panel Structure

Matrix advise to the SSG on implementation issues.

- regional/ technical implementation

- science issue implementation

CLIMAR+ research challenge panels (odd year)

CLIMAR implementation panel (even year)

	I-S-I Monsoons	Decadal Variability	Seal Level Regional	Upwelling Ecology	Extremes Trends	...
Atlantic	X	X	X	X	X	
Pacific	X	X	X	X	X	
Indian	X	X	X	X	X	
Southern		X	X	X	X	
Model	X	X	X	X	X	
Data	X	X	X	X	X	
Transfer	X	X	X	X	X	
GEWEX	X	X			X	
SPARC	X	X			X	
CLIC		X	X		X	
WGSIP	X	X		X	X	
WGCM	X	X	X	X	X	
IMBER		X		X		

Need JSC advice on this fundamentally different management of the CLIMAR portfolio with impact on WCRP partners

CLIVAR SSG Membership Process

New, expanded effort to broaden applicant pool.
Requests for nominations through:

- Existing networks (Panels, Working Groups)
- All CLIVAR mailing lists
- Calls in CLIVAR Exchanges (Feb 2012)
- Calls in CLIVAR Bulletins (Feb and March 2012)

Results

- 15 nominations in 2012, complete with bios, CVs, and agreement to serve if selected
- Debated at SSG-19; memo to JSC shortly thereafter with recommendations