

CLIVAR: CLIMATE & OCEAN

variability, predictability and change

WCRP Core Project on the
Ocean-Atmosphere System

US CLIVAR SUMMIT 2017

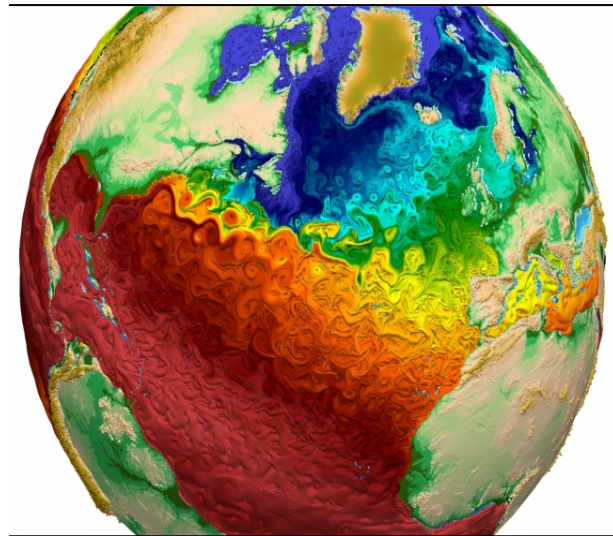
Detlef Stammer & Annalisa Bracco (SSG co-chairs)



CLIVAR: CLIMATE & OCEAN

variability, predictability and change

- Describe and understand the dynamics of the coupled ocean-atmosphere system,
- Identify processes responsible for climate variability, change and predictability,
- Develop - through the collection and analysis of observations - and apply models of the coupled climate system.

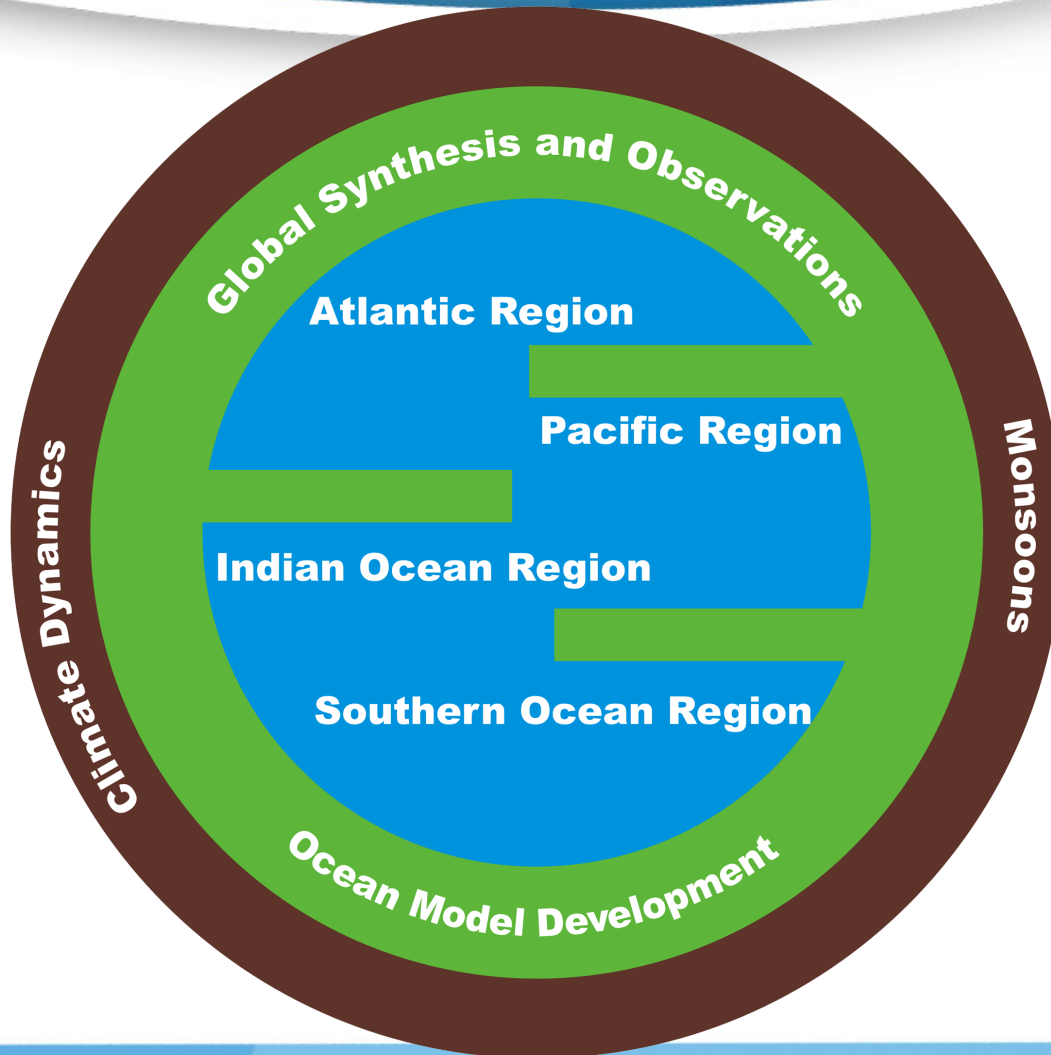


Credit: Los Alamos National Laboratory

How CLIVAR works

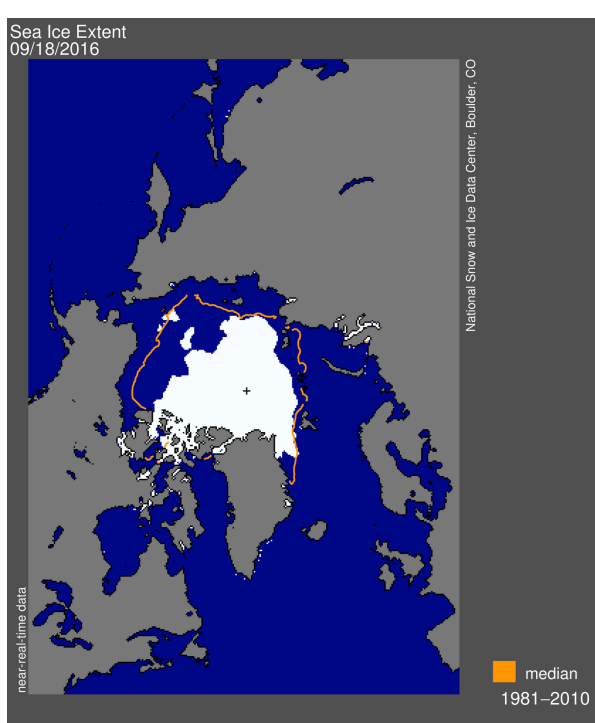
CLIVAR Panels

CLIVAR Panels



Proposed New CLIC/CLIVAR panel: **NORP**

- ✓ Approved by CLIVAR and CLIC Steering Committees (2/16/17)



An International Panel to
Coordinate and Facilitate
Activities on the Role of the
Northern Oceans in the context
of the Global Climate System
from a Coupled Ocean-Air-Ice
Perspective

Research Foci

Research Foci (RF): launched in 2015; focused limited-lifetime initiatives (5 years or less); topics of high priority in the climate research community that would benefit from enhanced international coordination.

- **Decadal Climate Variability & Predictability**
- **Planetary Heat Balance & Ocean Heat Storage (with GEWEX participation)**
- **ENSO in a Changing Climate**
- **Eastern Boundary Upwelling Systems**
- **Regional Sea Level Change & Coastal Impacts (with CliC, is a GC)**



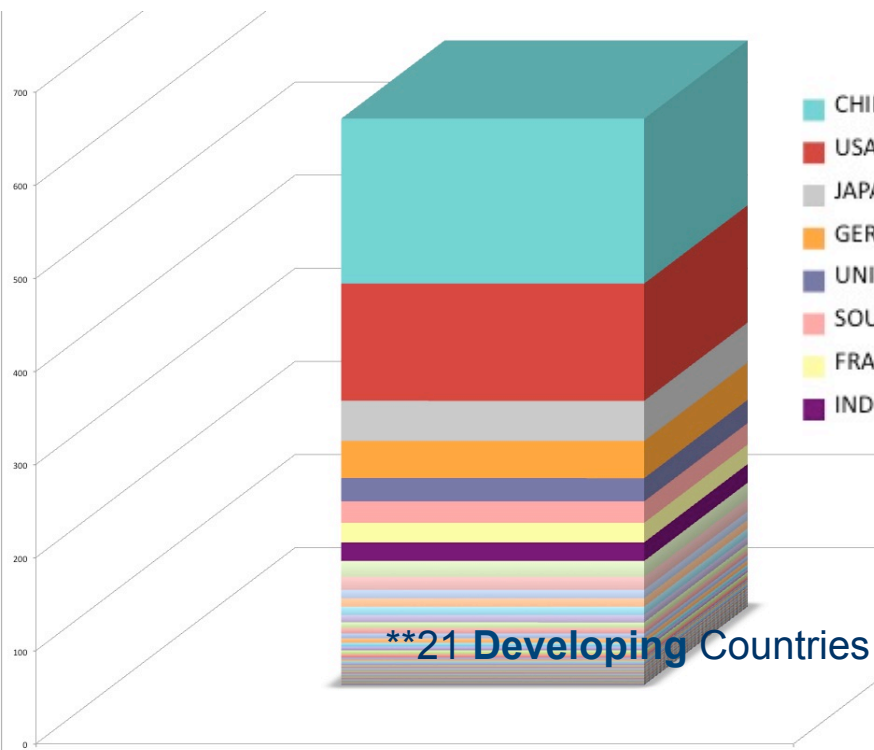
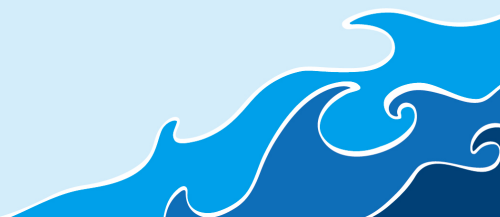
- **CLIVAR was established 20 years ago** as one of the core-projects of the World Climate Research Programme, building on WOCE and TOGA,
- The CLIVAR legacy includes the
 - **implementation and development of major multinational observing networks** in all the ocean basins;
 - development of **ocean and climate re-analyses**, bridging observations and modeling through data assimilation
 - development of **ocean-climate models, initialized decadal climate predictions building on o&c reanalyses.**



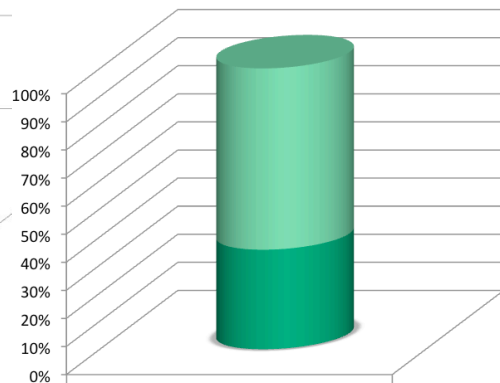
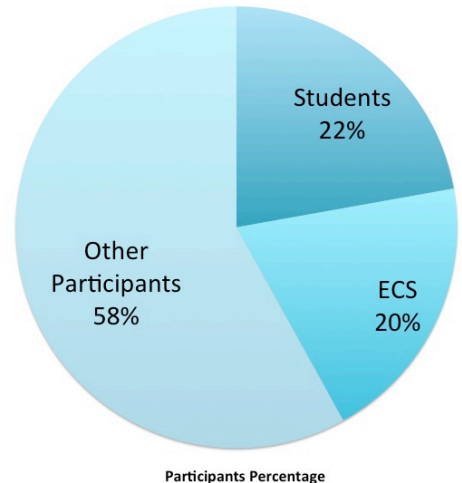


CLIVAR

Open Science Conference
Qingdao, 2016



- CHINA 177 PARTICIPANTS
- USA 126 PARTICIPANTS
- JAPAN 43 PARTICIPANTS
- GERMANY 40 PARTICIPANTS
- UNITED KINGDOM 25 PARTICIPANTS
- SOUTH KOREA 23 PARTICIPANTS
- FRANCE 21 PARTICIPANTS
- INDIA 20 PARTICIPANTS



608 Participants from 47 Countries

General reflection

- Great enthusiasm and community engagement for CLIVAR and WCRP research
- Large number of unsolved problems that are scientifically challenging and have global societal impacts

Point of pride: Early Career Scientists Symposium

- Hosted by FIO: 18, 23-24 Sept
- Unique opportunity for young scientists to interact and exchange ideas with their peers and senior scientists.
- Designed by and for the CLIVAR ECS community, jointly with YESS



Opportunities at the OSC

- Career development workshops
- Mentoring



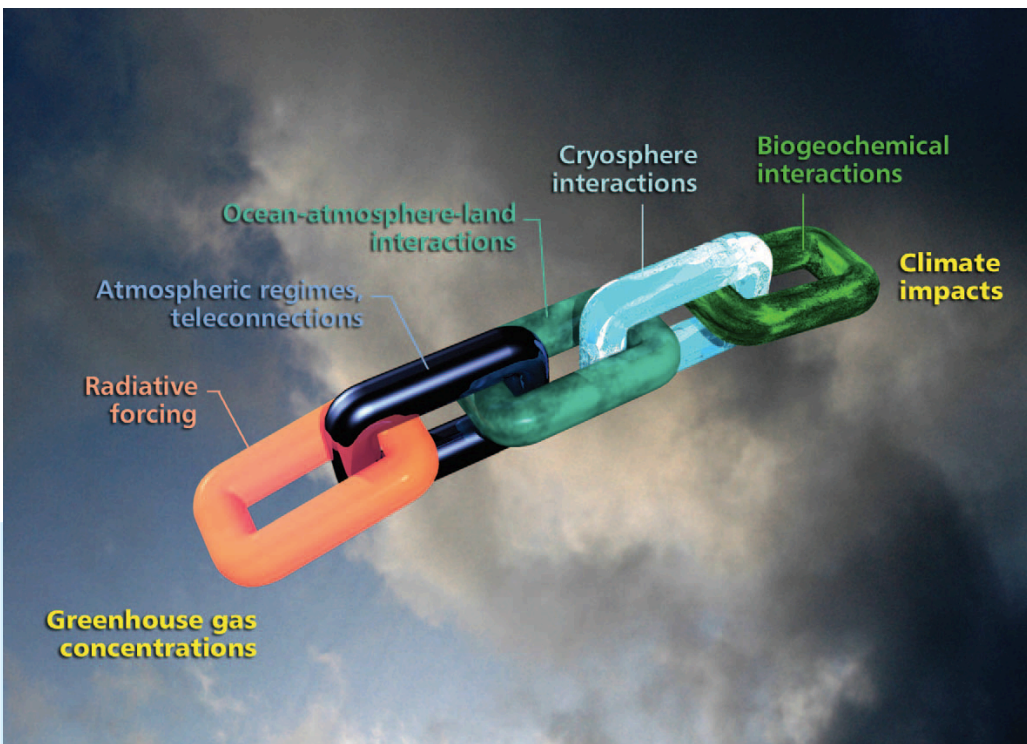
Where are we going: CLIVAR Future

Overarching goal: ***Building a society resilient to environmental changes***

- What is needed (I):
 - Expanding on a climate risk concept (uncertainty)
 - Providing **regional climate information and seamless predictions across timescales**

Where we are going: CLIVAR Future

- What is needed (II):
 - Understanding mechanisms and consequences of climate variability and change, globally and **regionally**



Palmer et al., BAMS 2008

Where we are going: CLIVAR Future

- What is needed (III):
 - Establishing a multi-scale approach in space and time to climate science, and to mitigation/adaptation
 - Increase awareness (what is settled, what is not yet understood, and why we still **NEED** fundamental climate science after COP21)

OSC Output

- EOS summary
- Nature Climate Change article (in preparation)
- ECS point of view paper accepted in the new NPJ Climate and Atmospheric Science
- CLIVAR Exchanges with contributions from ECS poster winners

Climate and Ocean Science Builds for the Future

Second WCRP/CLIVAR Open Science Conference: Charting the Course for Climate and Ocean Research; Qingdao, China, 18–25 September 2016



No. 71 February 2017



CLIVAR Exchanges

CLIVAR Open Science Conference Award Winners

New CLIVAR Science Plan

Long term objectives:

- Identify ocean and coupled **climate processes** that are critical for global and regional climate variability and change
- Identify temporal and spatial scales of **climate predictability**
- Quantify constraints on **climate sensitivity**, air-sea exchange and Earth's energy budget / ocean heat content
- Quantify **regional impacts** of climate change in **sea level, cryosphere and water cycle**
- Quantify past/present/future **ocean role in CO₂ and heat uptake** and links between **climate and ocean ecosystems**

To be released at the end of 2017

Science Plan

Structure

1.1 The WCRP mission (WCRP just underwent its own review)

1.2 CLIVAR's role within WCRP

2. SCIENCE GOALS

3. Chapter 3. Organizational Structure and Implementation

4. Chapter 4. International Coordination as Enabling Capabilities

5. Chapter 5. Coordination and Cooperation

Science Goals

- Determine mechanisms of climate variability, climate change and climate sensitivity
- Quantify fundamental processes that need to be properly represented in climate models
- Identify and monitor the ocean's role in climate variability, predictability and change (i.e. answer the question how predictable is the climate on different time and space scales?)
- Integrate climate research across disciplinary borders

CLIVAR Enabling Capabilities

International cooperation is critical to grow the infrastructure that underpins all CLIVAR science:

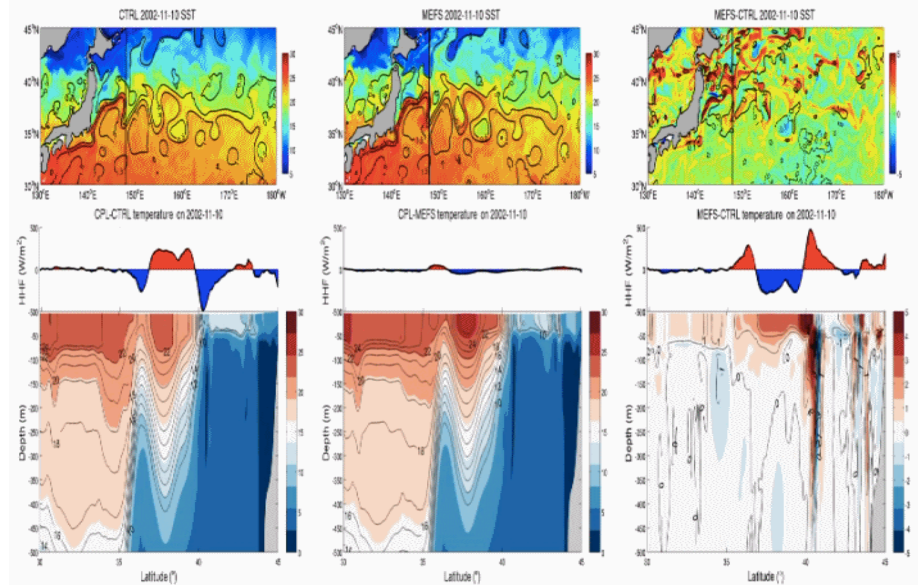
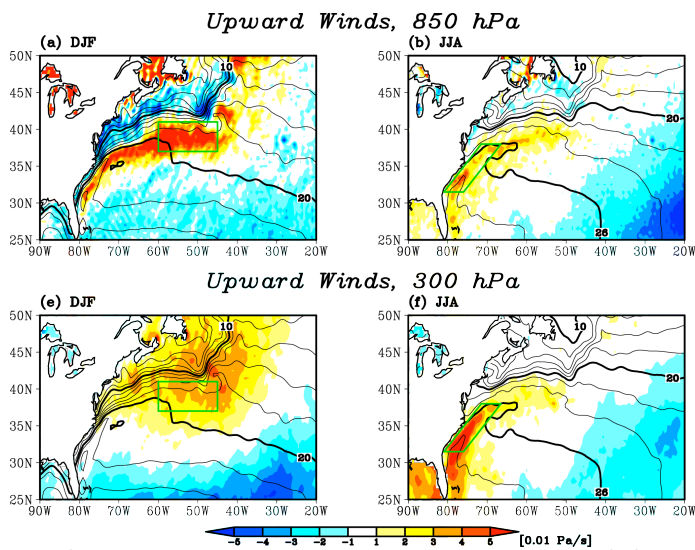
- Climate and Ocean Process and Sustained Observations
- Global, Regionally Enhanced and Process Models
- Ocean Data, Synthesis and Assessment
- Capacity Development and Knowledge Exchange

CLIMATE PROCESSES

Climate Dynamics Panel

Key Themes

- Storm tracks, jet streams and weather systems
- Tropical-extratropical interactions
- Coupled atmosphere-ocean feedbacks



Mesoscale eddy role in air-sea interactions
Ma et al., Scientific Reports, 2015

CLIMATE PROCESSES

RF ENSO in a changing climate

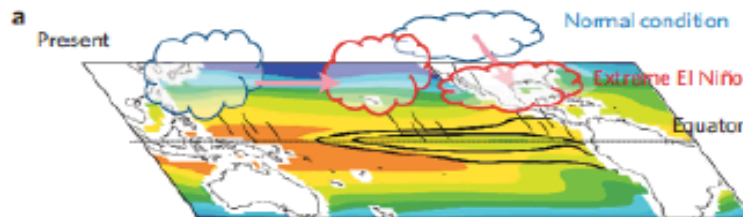
nature
climate change

LETTERS

PUBLISHED ONLINE: 19 JANUARY 2014 | DOI: 10.1038/NCLIMATE2100

Increasing frequency of extreme El Niño events due to greenhouse warming

Wenju Cai^{1,2*}, Simon Borlace¹, Matthieu Lengaigne³, Peter van Rensch¹, Mat Collins⁴, Gabriel Vecchi⁵, Axel Timmermann⁶, Agus Santoso⁷, Michael J. McPhaden⁸, Lixin Wu², Matthew H. England⁷, Guojian Wang^{1,2}, Eric Guilyardi^{3,9} and Fei-Fei Jin¹⁰



Need for:

- TPOS-type observations
- Continued/enhanced record
- Enhanced obs of Equatorial currents
- Equatorial atmospheric data

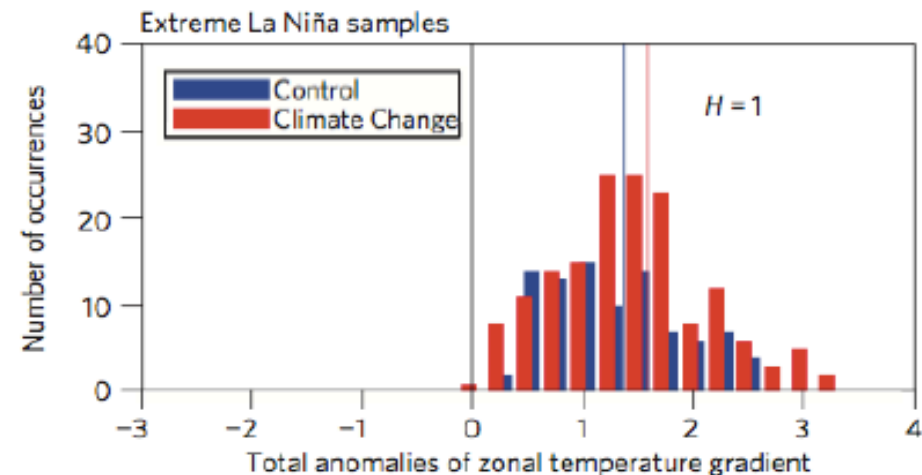
LETTERS

PUBLISHED ONLINE: 26 JANUARY 2015 | DOI: 10.1038/NCLIMATE2492

nature
climate change

Increased frequency of extreme La Niña events under greenhouse warming

Wenju Cai^{1,2*}, Guojian Wang^{1,2}, Agus Santoso³, Michael J. McPhaden⁴, Lixin Wu², Fei-Fei Jin⁵, Axel Timmermann⁶, Mat Collins⁷, Gabriel Vecchi⁸, Matthieu Lengaigne⁹, Matthew H. England³, Dietmar Dommenget¹⁰, Ken Takahashi¹¹ and Eric Guilyardi^{9,12}



CLIMATE PROCESSES

Ocean Model Development Panel

- Coordinate Ocean-Ice Reference experiments
 - Evaluation, understanding, and improvement of ocean models
 - Investigation of mechanisms for seasonal, interannual, and decadal variability
 - Evaluation of robustness of physical mechanisms across models
 - Complements data assimilation / state estimation
 - bridges observations and modelling
 - ocean initial conditions for climate (decadal) prediction simulations.

Decadal Climate Variability and Predictability

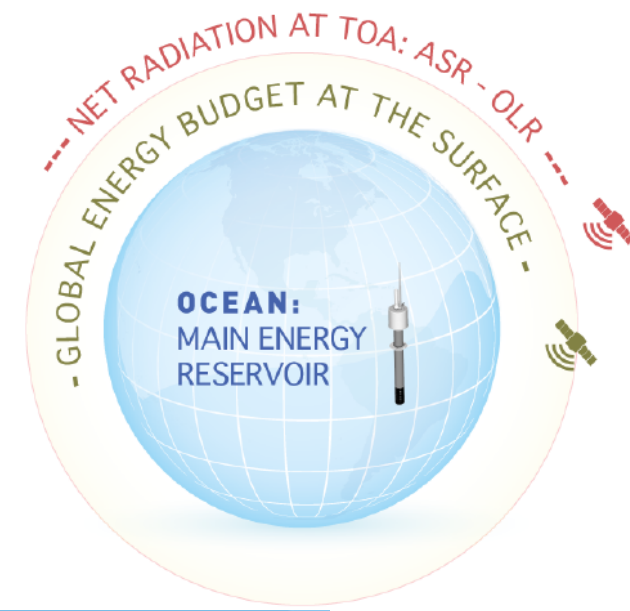
DCVP RF

- Two focus areas:
 - **Atlantic Decadal Climate Variability and Predictability:** variations of ocean circulation systems (AMOC, gyres), related SST (AMV/AMO extratropical and tropical) and atmospheric (NAO/AO, blocking) variability; their interactions with land areas and other ocean basins.
 - **Pacific Decadal Climate Variability and Predictability:** decadal tropical SST variability (IPO); links to North Pacific ocean circulation and SST
- CLIVAR and WCRP are already engaged in observational, analysis and modeling research on these subjects.
- DCVP RF will draw on these activities but focusing on **process understanding**

CLIMATE SENSITIVITY RF CONCEPT-HEAT

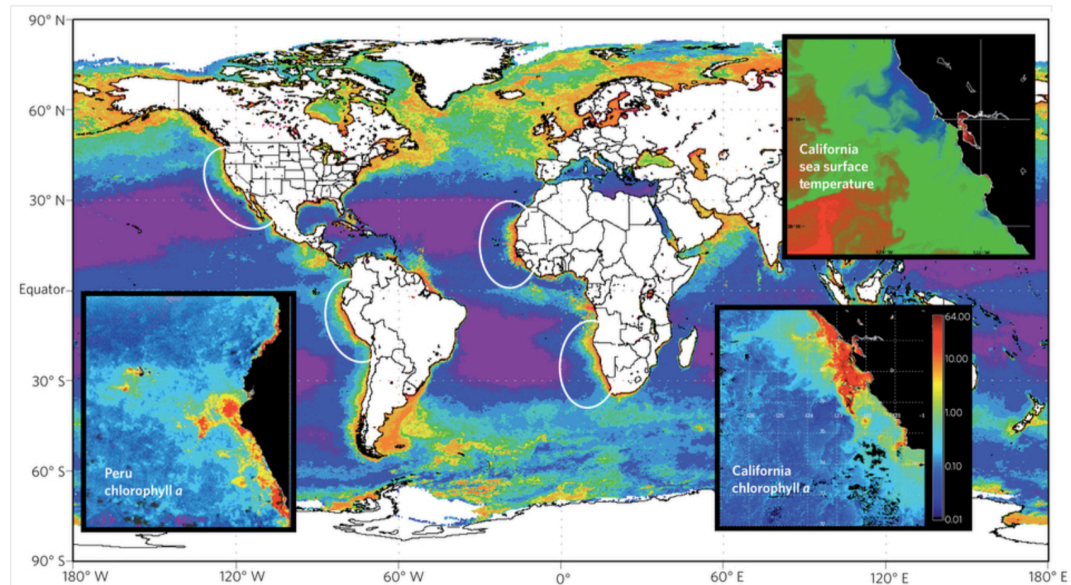
Consistency between planetary energy balance and ocean heat storage

- **K. von Schuckmann, K. Trenberth; joint with GEWEX**
- **Bringing together different climate research communities** concerned with the energy flows in the Earth's System to advance on the **understanding of the uncertainties through budget constraints**:
 - **Atmospheric radiation**
 - **Ocean Heat Content**
 - **Earth's surface fluxes (when, where, how much)**
 - **Climate variability and change**
 - **Data assimilation & operational services**
 - **Climate projection**
 - **Sea level**



REGIONAL IMPACTS / CO₂ and HEAT UPTAKE RF on Eastern Boundary Upwelling Systems

- Identifying key **physical processes, similarities and differences** between EBUS
- Improving **model representation** of EBUS.
- **Examining biogeochemical interactions** and role in carbon and nutrient cycling
- **Understanding future variability**



In collaboration with IMBER and SOLAS

Contribution to IndOOS review

- **IORP/SIBER/IRF/IOGOOS**
- **30 January to 1 February, 2017, Perth, Australia**
- **24 presentations, 40 participants**

Indian Ocean Observing System (IndOOS) mission statement

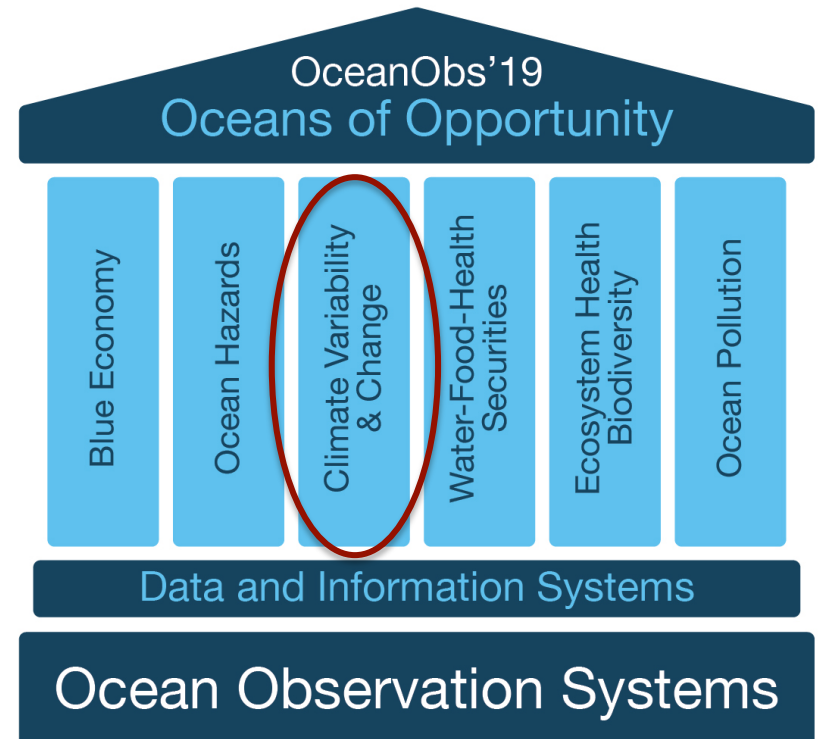
The goal of IndOOS is to provide sustained high-quality oceanographic and marine meteorological measurements to support knowledge based decision-making through improved scientific understanding, weather and climate forecasts, and environmental assessments for the benefit of society.

+ Terms of Reference for IndOOS review

+ Outline of IndOOS Review paper with several CLIVAR members contributing

OceanObs'19

Exploratory activities for potential CLIVAR involvement in the organization of OceanObs'19, especially in the area of Climate Variability & Change



Dissemination

- ✓ Town halls: AGU Fall Meeting, Ocean sciences
- ✓ Session at major conferences
- ✓ Themed workshops
- ✓ Training Schools (ICTP and FIO/China every other year on the horizon)
- ✓ Exchanges

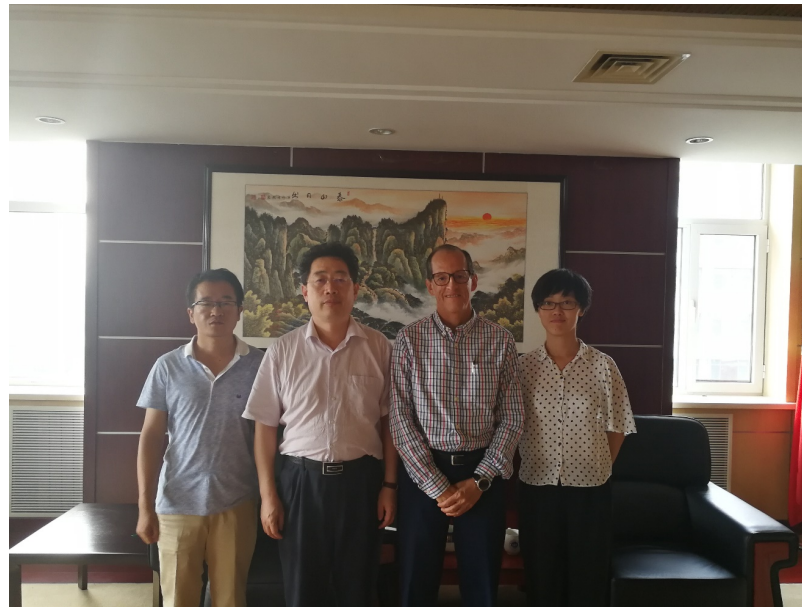
Recent CLIVAR capacity development activities

2016:

- CLIVAR-ICTP Advanced School on Earth System Modelling, IITM, Pune, India, July 2016
- ECSS, Qingdao, China, September 2016
- ICGPO summer intern from Kenya, August 2016

Planned CLIVAR capacity development activities for 2018

Planning of Training Opportunities for Early Career Scientists



Representatives of the First Institute of Oceanography (FIO), UNESCO/IOC Regional Training and Research Center on Ocean Dynamics and Climate (ODC), and the International CLIVAR Project Office (ICPO) are in final stages of discussion towards establishing a biannual CLIVAR-IOC/ODC Joint Summer School, beginning in the summer of 2018 for Early career Scientists from around the world.



IV International Conference on El Niño Southern Oscillation: ENSO in a warmer Climate

16-18 October 2018. Guayaquil, Ecuador



Contact us:

enso2018@clivar.org

Visit us at:

[http://
www.ensoconference2018.org/](http://www.ensoconference2018.org/)

GOAL OF THE CONFERENCE: To review the progress on the science of ENSO and its “flavors” and distinct precursors, and examine how the different oceanic and atmospheric processes that drive ENSO and impact its predictability would vary in a warming world.

6 plenary sessions: i) ENSO observations, including paleodata and analysis of recent events; ii) ENSO dynamics; iii) ENSO and other modes of climate variability; iv) Modeling and prediction; v) Impacts and regional processes; vi) Climate information and sustainable development and future of climate and ocean science.

A special issue of the *“International Journal of Climatology”* is planned

We expect 300 participants from around the world

ICPO News

- New ICPO director: We are very happy to welcome Dr. Jose Luis Santos Davila and wish to thank Dr. Nico Caltabiano for all his work and help during the transition

Challenges

- Sustained funding for the program activities (on ok trajectory)
- Recent changes at WCRP that have delayed action (now set)

Thank you