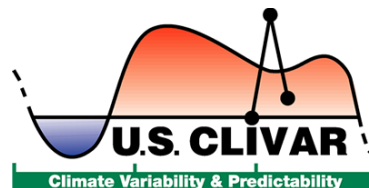


US CLIVAR Briefing for VAMOS Panel Meeting-15

by Rob Wood,
US CLIVAR Science Steering Committee Member

June 6, 2012



Current US CLIVAR Science Goals

- Identifying and understanding the **major patterns of climate variability** on seasonal, decadal and longer time scales and evaluating their predictability
- **Evaluating and improving the models** used for prediction and projection to project climate change due to human activity, including anthropogenically induced changes in atmospheric composition
- Expanding our capacity in short term **(seasonal-to-interannual) climate prediction** and searching for ways to provide **information on decadal variability**
- Better **documenting rapid climate changes and the mechanisms** for these events, and evaluating the **potential for abrupt climate changes** in the future
- Detecting and describing **high impact climate variability and change**

US CLIVAR

Interagency Group

Scientific Steering Committee

Project Office

Panels

Phenomena,
Observations &
Synthesis

Process Study
Model
Improvement

Predictability,
Prediction &
Applications Interface

Working Groups

Salinity
Madden Julian Oscillation
Western Boundary Current
Drought
High Latitude Surface Fluxes
Decadal Predictability
AMOC Science Team

Hurricanes
Greenland Ice Sheet/Ocean Interactions
ENSO Diversity
Eastern Tropical Ocean Synthesis
Extremes
Ocean Carbon Uptake
Southern Ocean

US CLIVAR Program Updates

- US CLIVAR continues to support planning and implementation of US participation in process studies
 - VOCALS – post field synthesis phase
 - AMOC – 60+ projects by four agencies, new observational arrays proposed in S. Atlantic and Subarctic N. Atlantic, PI meeting this August in Boulder, external review of program in 2012
 - DYNAMO – completed six month extended observing period in Indian Ocean in March 2012, successfully captured 2+ MJO events, post-field dataset development and analysis underway
 - SPURS – Field phase in Subtropical Atlantic Gyre to begin with NASA cruise on RV Knorr on 6 September 2012 for 33 days deploying moorings, floats and gliders and conducting surveys
 - IASCLIP - new modeling projects supported by NOAA, (inter)agency briefings this summer
- US CLIVAR moving ahead on themes of *decadal variability*, *climate of polar regions*, *climate extremes*, *tropical predictability*, and *climate and carbon cycle*
 - AMOC Science Team
 - Decadal Predictability Working Group (WG)
 - Greenland Ice Sheet-Ocean Interactions WG
 - Hurricane WG
 - Extremes WG
 - ENSO Diversity WG
 - Eastern Tropical Ocean Synthesis WG
 - Ocean Carbon Uptake in CMIP5 Models WG
 - Southern Ocean Heat and Carbon Uptake WG

Decadal Predictability Working Group

Chairs: Lisa Goddard (Columbia U), Arun Kumar (NOAA/NCEP) and Amy Solomon (U Colorado)

Objectives:

- Define a framework to distinguish natural decadal variability from anthropogenically forced variability and to quantify their relative magnitude.
- Develop a framework for understanding decadal variability through metrics that can be used as a strategy to assess and validate decadal climate predictions simulations.

Published a February 2011 *BAMS* article describing

- existing methodologies to separate decadal natural variability from anthropogenically forced variability,
- the degree to which those efforts have succeeded, and
- the ways in which the methods are limited or challenged by existing data.

DISTINGUISHING THE
ROLES OF NATURAL AND
ANTHROPOGENICALLY FORCED
DECADAL CLIMATE VARIABILITY
Implications for Prediction

BAMS

February 2011

Second paper to *Climate Dynamics* entitled “A Verification Framework for Interannual-to-Decadal Prediction Experiments” provides

- consistent metrics for evaluating forecast quality across predictions systems (as input to AR5 Chapter 11), and
- guidance on the use of model predictions including correction of mean and conditional biases, and
- guidance on how best to approach forecast uncertainty.

Greenland Ice Sheet/Ocean Interactions Working Group

*Chairs: Fiamma Straneo (WHOI), Olga Sergienko (Princeton U) and
Patrick Heimbach (MIT)*

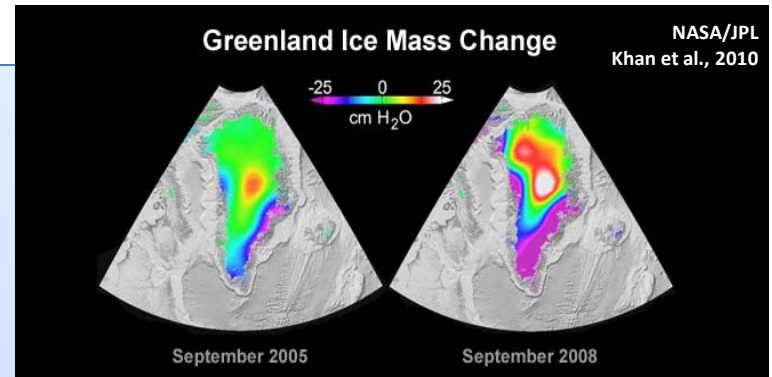
Objectives:

- Foster and promote inter-action between the diverse oceanographic, glaciological, atmospheric, and climate communities interested in glacier/ocean interactions around Greenland.
- Advance understanding of processes and improve their representation in climate models.

Published a White Paper “Challenges to Understand the Dynamic Response of Greenland’s Marine Terminating Glaciers to Oceanic and Atmospheric Forcing”

- presenting a cross-disciplinary synthesis of current state of knowledge on Greenland Ice Sheet mass loss and relevant mechanisms affecting glacial retreat,
- enumerating gaps in understanding of mechanisms linking climate forcings, perturbations at the marine glacier margins, and their dynamic response, and
- recommending approaches to address knowledge gaps, combining monitoring of key systems, process studies targeting specific dynamic regimes and inclusion of dynamics in Earth System Models.

An open international workshop to coordinate interdisciplinary research activities and foster international collaboration is being planned for early 2013 in the US.



US CLIVAR Hurricane 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

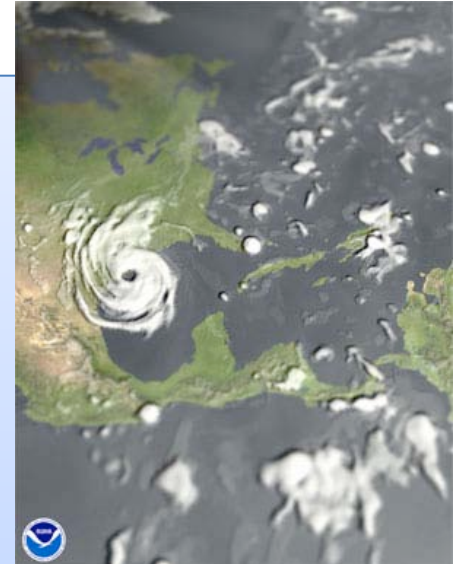
Scientific Objectives:

- 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



US CLIVAR Extremes Working Group

Chairs: Richard Grotjahn (U California-Davis) and Matt Barlow (U Massachusetts-Lowell)

To evaluate whether current climate models produce extremes for the right reasons and whether they can be used for predicting and projecting short-term extremes in temperature and precipitation over North America

Scientific Objectives:

- Assess and synthesize existing knowledge base on the links between Large Scale Circulation Patterns (LSCP) and extremes.
- Identify key questions and knowledge gaps.
- Establish a methodology and research protocols for using the LSCP approach to analyzing extremes in observations and model output.
- Provide a preliminary assessment of the ability of current models to reproduce the correct relationship between extremes and LSCs for North America.

The WG has held two telecons to begin developing two review articles, one for temperature and the other for precipitation extremes, presenting methods for identifying extremes, links between extremes and LSCPs, limitations of data sets, and identification of knowledge gaps.

An open community-wide workshop is being planned for Summer 2013 to establish methodology and research protocols for the LSCP approach.



US CLIVAR ENSO Diversity Working Group

Chairs: Antonietta Capotondi (U Colorado) and Ben Kirtman (U Miami)

To clarify, coordinate and synthesize research devoted to achieve a better understanding of ENSO diversity, including: surface and sub-surface characteristics, tropical-extratropical teleconnections, physical mechanisms, predictability, and relationship with climate change

Scientific Objectives:

- Examine the range of ENSO “flavors” with focus upon longitudinal variations of warming, identify basic surface and subsurface characteristics that are robust among different datasets, assess the existence of possible, and distinct precursors to the different flavors, and create a framework that will allow the community to use these results to better understand how the interplay of different oceanic, atmospheric, and coupled processes drive different ENSO flavors and impact their predictability.
- Examine the performance of the CMIP5 archive in reproducing the best observational estimate of ENSO diversity, and assess its projected changes.

During its first year, the WG is charged with establishing the ability of data sets to reveal a range of ENSO types, and the ability of models to simulate the types revealed. A community workshop is being planned for fall 2012 to review the

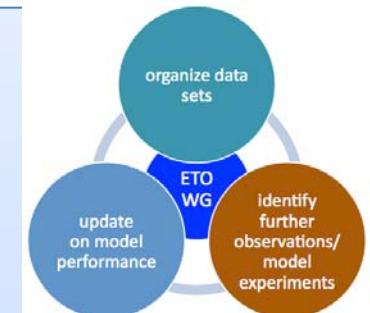
- representation of ENSO diversity in observational data sets,
- model analyses of ENSO diversity and basic characteristics of different ENSO types, and
- extra-tropical influences on ENSO diversity, and remote impacts of different ENSO flavors

US CLIVAR Eastern Tropical Ocean Synthesis Working Group

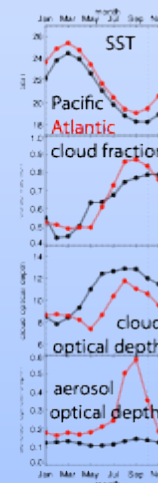
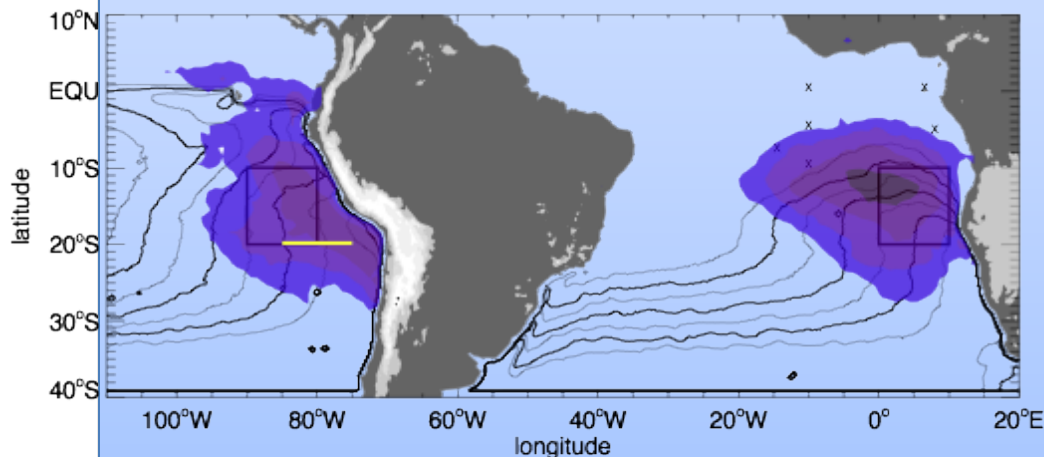
*Chairs: Paquita Zudiema (U Miami), Simon de Szoeke (Oregon State U),
Rob Wood (U Washington), Roberto Mechoso (U California-Los Angeles)*

Scientific Objectives:

- Promote collaboration between observationalists and modelers, and atmospheric scientists and oceanographers, active in the southeast oceanic basins.
- Coordinate a model assessment of surface flux errors for the equatorial Atlantic, mining all available observations.
- Identify recent model improvements and common and persistent model errors, in both CMIP5 and higher-resolution coupled models.
- Provide recommendations of cases for community simulation and evaluation using eddy-permitting ocean models, sharing specified model conditions and output datasets.



The WG is identifying and assembling satellite, buoy and research cruise datasets and assembling plots of readily available CMIP3 and CMIP5 simulations for annual and seasonal-mean values of SST, cloud cover, surface winds, thermocline depth (for a climatological time period beginning ~1950 or 1980? up to 2012 to include modern satellite period at these locations:



- along the Atlantic equator the lines 40° S to 10° N for both EPac and EAtr (near shore; 6.5E intersects with Sao Tome island)
- an E-W line along 18° S
- along the PIRATA line at 11° W
- spatial plot encompassing the Klein & Hartmann domains depicted in the figure to the left.

Two New Working Groups Co-sponsored by US CLIVAR and the Ocean Carbon Biogeochemistry Programs

Ocean Carbon Uptake in CMIP5 Models

*Annalisa Bracco (Georgia Tech); Curtis Deutsch (UCLA);
Taka Ito (Georgia Tech)*

Objectives:

- Foster and promote collaboration between members of the US-CLIVAR and OCB communities and between modelers and theoreticians within each community.
- Advance our understanding of the processes responsible for the oceanic carbon uptake and their representation in climate models.

Tasks:

- Identify common metrics of physical ocean/climate forcing (primarily wind strength, mixed-layer stratification, and ocean mixing).
- Compare metrics in the various models and in the observations for the North Atlantic and the Tropical Pacific.
- Coordinate model evaluation of the climatic influence on CO₂ uptake at different time scales.

Southern Ocean Heat and Carbon Uptake

*Joellen Russell (U Arizona) and
Igor Kamenkovich (U Miami)*

Objectives:

- Improve understanding of the role of mesoscale eddies in the heat and carbon uptake by the Southern Ocean.
- Improve understanding of how the Southern Ocean stratification, circulation and heat and carbon uptake will respond to a changing climate.

Tasks:

- Identify critical observational targets and develop data/model metrics based on the currently available observational data, both physical and tracer, and the assimilative modeling (re)analyses.
- Evaluate and develop our understanding of the importance of mesoscale eddies in the heat and carbon uptake and of the response of the Southern Ocean to a changing climate, using high- resolution numerical studies and theory.

A single open community-wide workshop for both Working Groups will be convened in 2014.

US CLIVAR Science Planning

In January 2012 the US CLIVAR SSC initiated science planning for the 15-year period post 2014.

Draft Mission Statement

US CLIVAR addresses the understanding, modeling, and prediction of climate variability and its impacts on seasonal-to-centennial timescales, with emphasis on the role of the ocean and its interaction with other elements of the Earth system. US CLIVAR serves the climate community through the coordination and facilitation of research on outstanding climate questions.

Draft Science Goals

- 1) Improve understanding of the processes of climate variability and change in the past, present and future.
- 2) Reduce and better quantify uncertainties in the predictions of climate variability and change that derive from general circulation models.
- 3) Improve practices in the development, validation, provision and uses of climate information and forecasts.
- 4) Strengthen connections between the US climate and other Earth science communities with an interest in climate variability (e.g., land surface hydrology, carbon-flux, and ocean-biology communities).

Schedule

- Winter/Spring 2012 - Draft program mission statement and science goals by SSC with input from Panels (completed)
- Summer 2012 – Use Annual US CLIVAR Summit to develop science elements/objectives supporting the science goals
- Fall 2012 – Draft Plan Chapters
- Winter 2013 – Complete Draft
- Spring-Summer 2013 – Invite comment and review by community and National Research Council
- Fall 2013 – Edit based on review comments
- Winter-Spring 2014 – Publish and promote Plan



US CLIVAR Science Planning

Working Outline

Chapter 1. **Introduction** – present state-of-the-science understanding of the climate system variability and predictability

Chapter 2. **History and Context** – summarize the 1990s-2000 science and implementation planning, progress made since those plans were issued, and the overall context in which our new Plan is being developed

Chapter 3. **Fundamental Science Questions** – enumerate and explain overriding questions guiding new research agenda

Chapter 4. **Science Plan Goals** – identify specific goals and achievable objectives for the fifteen-year program period

Chapter 5. **Science Plan Elements** – outline the primary research elements that must be pursued to achieve these goals

Chapter 6. **Interdisciplinary Interaction** – describe cross-disciplinary nature of science questions and identify interdisciplinary science needs

Chapter 7. **Interagency Collaboration** – describe how science goals and objectives support multiple funding agency missions and motivate interagency collaborative sponsorship

Chapter 8. **International Cooperation and Coordination** – describe the international context within which the US program operates, [drawing from the new International CLIVAR Plan](#); enumerate the benefits of fostering cooperation

Chapter 9. **Implementation Approaches** – highlight successful and potential implementation strategies (e.g., climate process teams, limited lifetime working groups) and foreseeable impediments (shift of attention away from fundamental climate research to adaptation and mitigation science)

Chapter 10. **Program Infrastructure** – Identify the critical underpinning infrastructure (e.g., modeling centers, ship/aircraft, routine in-situ and remote sensing observing systems) and describe the program office role