

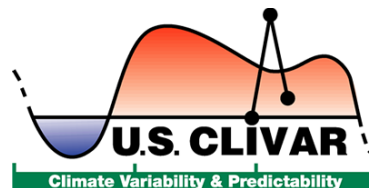
US CLIVAR Report

US CLIVAR science activities, initiatives, future strategy

Martin Hoerling, Chair, US CLIVAR SSC

U.S. Climate Variability and Predictability Program

www.usclivar.org



Messages

- US CLIVAR moving ahead on *decadal variability* and *extremes* themes. Climate of *polar regions* is a third core theme, and will be explored at July 2010 Summit. Carbon cycle and ecosystem opportunities will be explored over the next year.
- 4 new Climate Process Teams (CPTs) to begin in 2010. Coordinating a new call for CMIP5 analysis proposals (including those addressing decadal diagnostics)
- FY11 small grants program for analyzing reanalysis products
- Several refereed publications from Panels and Working Groups
- Atlantic MOC activity has grown significantly (now 38 projects), gained some momentum, and is now providing interesting results.
- Panel members have been actively engaged in numerous workshops and conferences
- Good interagency cooperation continues.
- New round of strategic planning in USGCRP??? Opportunity?

US CLIVAR Activities Update

Process Studies/Model Improvement

- *4 new CPTs to begin in 2010: Ocean Boundary Mixing, Cloud Parameterizations (2), Sea Ice/Ocean Mixing*
- Program for CMIP5 model analyses is under development
- Process Studies
 - DYNAMO (under review), IASCLIP (planning stage), CLIMODE, VOCALS, DIMES, etc
 - Ocean salinity budget campaign (SPURS)

Predictability/Predictions & Applications Interface

- *Decadal Predictability Working Group*
- FY11 small grants program for comparing various reanalysis (CFSR, MEERA, ESRL)
- *Post-Doc program (PACE): increase pool of scientists qualified to transfer climate knowledge to decision-frameworks & tools*

Phenomenology, Observations, & Synthesis

- High-latitude surface fluxes Working Group
- Contributed many papers to the Oceanobs'09 Conference
- *Reanalysis/Integrated Earth System Analysis (IESA) Workshop, November 2010*

US CLIVAR Panel and Working Group Publications, 2009-2010

- Cronin, M.F., S. Legg, and P. Zuidema, 2009: CLIMATE RESEARCH: Best Practices For **Process Studies**. *Bull. Amer. Meteor. Soc.*, **90**, 917–918.
- CLIVAR Madden–Julian Oscillation Working Group, 2009: **MJO** Simulation Diagnostics. *J. Climate*, **22**, 3006–3030.
- Kim D, Sperber K, Stern W, Waliser D, Kang IS, et al., 2009: Application of **MJO** Simulation Diagnostics to Climate Models. *Journal of Climate*, **22**, 6413–6436
- Schubert, S., +32 co-authors, 2009: A U.S. CLIVAR Project to Assess and Compare the Responses of Global Climate Models to **Drought**-Related SST Forcing Patterns: Overview and Results. *J. Climate*, **22**, 5251–5272.
- Kelly, K.A., R.J. Small, R.M. Samelson, B. Qiu, T.M. Joyce, Y-O. Kwon, M.F. Cronin, 2010: **Western Boundary Currents** and Frontal Air-Sea Interaction: Gulf Stream and Kuroshio Extension, *J. Climate*, in press.
- Kwon, Y-O., M. A. Alexander, N.A. Bond, C. Frankignoul, H. Nakamura, B. Qiu, L. Thompson, 2010: Role of **Gulf Stream**, Kuroshio-Oyashio and Their Extensions in Large-Scale Atmosphere-Ocean Interaction : A Review, *J. Climate*, in press.
- Gottschalck, +12 co-authors, 2010: A Framework for Assessing Operational Model **MJO** Forecasts: A Project of the CLIVAR Madden-Julian Oscillation Working Group. *Bull. Amer. Met. Soc.*, In press.
- Bourassa, M., S. Gille, +13 co-authors, 2010: **High-Latitude Ocean and Sea Ice Surface Fluxes**: Requirements and Challenges for Climate Research, *Bull. Amer. Meteor. Soc.*, submitted.
- US CLIVAR Decadal Predictability Working Group, 2010: Distinguishing the roles of natural and anthropogenically forced **decadal climate variability**: Implications for prediction, *Bull. Amer. Meteor. Soc.*, submitted.

Distinguishing the Roles of Natural and Anthropogenically Forced Decadal Climate Variability: Implications for Prediction

US CLIVAR Decadal Predictability Working Group

Amy Solomon*, Lisa Goddard, Arun Kumar, James Carton, Clara Deser, Ichiro Fukumori, Arthur Greene, Gabriele Hegerl, Ben Kirtman, Yochanan Kushnir, Matthew Newman, Doug Smith, Dan Vimont, Tom Delworth, Jerry Meehl, and Timothy Stockdale

Bulletin of the American Meteorological Society

Submitted November 2009, in revision

Capsule: In decadal forecasts, the magnitude of natural decadal variations may rival that of anthropogenically forced climate change on regional scales.

To assess these forecasts, it is necessary to identify what processes contribute to the skill of a decadal prediction and how to distinguish between natural and externally forced variations.

PACE Fellowship Awards

The goal of this program is to train climate researchers to transform their knowledge into solutions and tools for the decision/risk management community.

2010 Fellowships



KRISTEN GUIRGUIS

- *Research Topic:* Extreme heat event characterization and morbidity/mortality prevention
- *PhD Institution:* Duke University, Hydrology and Fluid Dynamics
- *Host Partners:* Alexander Gershunov, Scripps Institution of Oceanography and Helene Margolis, California Department of Public Health
- *Appointment:* 2010 - 2012



ROBERTO MERA

- *Research Topic:* Adaptation to climate change through land use planning
- *PhD Institution:* North Carolina State University, Marine, Earth & Atmospheric Sciences
- *Host Partners:* Phil Mote, Oregon Climate Change Research Institute and Jeff Weber, Oregon Department of Land Conservation & Development
- *Appointment:* 2010 - 2012

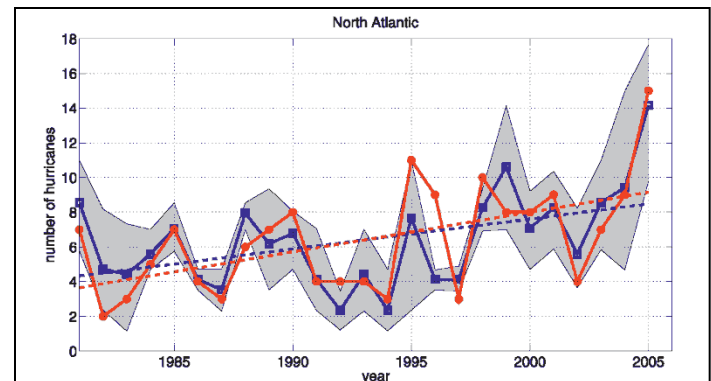
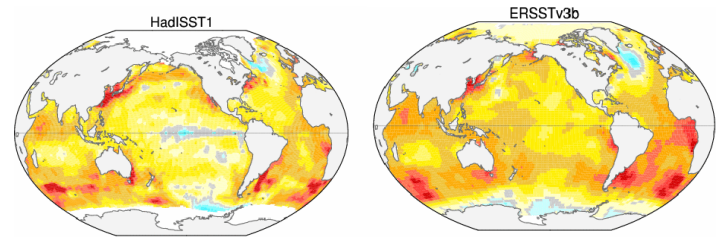
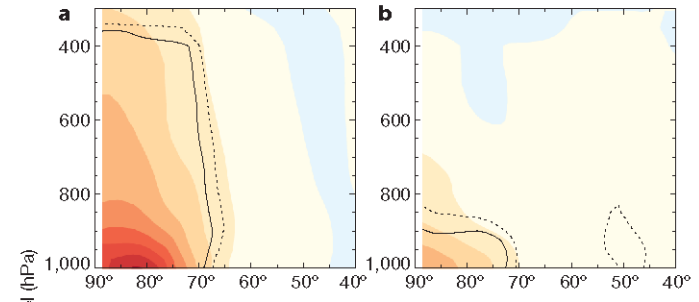


ERIN TOWLER

- *Research Topic:* Tools to quantify risks resulting from climate change in the Northern Rockies
- *PhD Institution:* University of Colorado, Water Resource Engineering
- *Host Partners:* Jim Hurrell, National Center for Atmospheric Research and DeWayne Cecil, United States Geological Society, Climate Response Center
- *Appointment:* 2010 - 2012

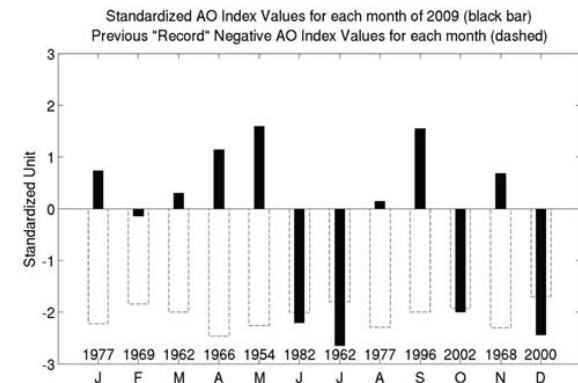
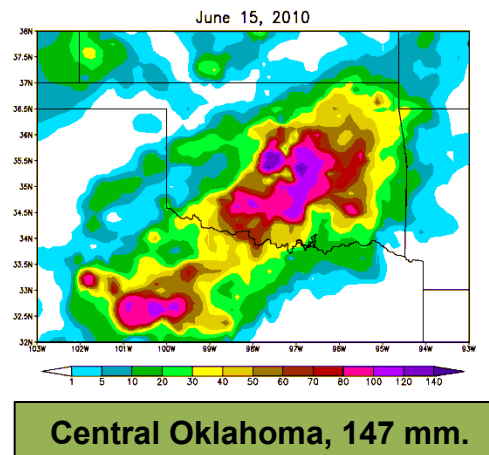
Toward Developing a Predictive Understanding of Climate: Advances in Understanding

- **Role of sea ice in high latitude temperature amplification (Screen and Simmonds, 2010; Bekryaev et al., 2010)**
- **Uncertainty in SST trends in tropical eastern Pacific (Deser et al., 2010)**
- **Seasonal prediction/predictability of hurricanes and relation to SSTs (Zhao et al., 2009; Larow et al. 2010)**



Toward Developing a Predictive Understanding of Climate: Emerging Issues

- Causes and understanding of recent climate extremes (e.g., high rainfall events; AO in 2009/2010)
- Role of sea ice in climate variability (e.g., role of ice-albedo feedback; attribution of decline in sea ice to various causes, e.g., circulation, ocean heat transport, greenhouse gas)
- Assessing reliability of decadal predictions from CMIP5 experiments



Evaluation of Reanalyses – Developing an Integrated Earth System Analysis (IESA) Capability

November 1-3, 2010

Sheraton Hotel, Baltimore, Maryland (Inner Harbor)

Sponsors: NOAA, NASA, NSF, and U.S. CLIVAR

Workshop Objectives

- ° *Assess strengths and limitations of the new recent U.S. reanalyses and suggest where improvements of reanalysis products can be made*
- ° *Develop definitions and identify goals of U.S. efforts leading to the forthcoming generation of integrated Earth system analyses (IESA)*
- ° *Develop diagnostics to quantitatively assess needed improvements in IESA products*
- ° *Demonstrate applications of reanalyses in climate and weather that would further highlight needed improvements in reanalysis products*

U.S. Atlantic Meridional Overturning Circulation (AMOC)

- Increase in number of projects (currently 38)
 - observations, modeling, OSEs, assimilation, processes, etc
- Recent N. Atlantic sub-polar gyre obs workshop
 - Identify motivation and design of a N Atlantic subpolar gyre obs system for large-scale, low-freq, full water column net fluxes of mass, heat, freshwater associated with AMOC
 - AMOC, THOR, plus carbon and biological communities
- S. Atlantic obs “array” workshop (SAMOC) – Rio, mid-May
- Third AMOC Science Team workshop June 2010 (Miami)
- Joint RAPID-AMOC Science meeting July 2011 (Bristol)



AMOC Program Vision: Working with interagency and international partners an objectively based design will be established for the sustained ocean observing system required for such an early warning system and the economic and social benefits to be derived from this estimated.

Immediate Plans: Raise visibility of AMOC within agencies and the community, articulate successes, identify program priorities and needs for the next several year, and increase coordination with international community to address these needs.

US CLIVAR Science Priorities and Challenges

° Decadal Variability

I. Science Questions

- * What processes give rise to decadal variations in societally relevant environmental attributes (e.g., precipitation, storms, surface temperature, sea level, ecosystem services)?
- * What is the predictability of decadal climate variations, what processes contribute to this predictability, what are the skill contributions (if any) from internal conditions versus externally forced conditions?

II. Overarching Challenges

- * Attribution: Distinguishing internal variability from anthropogenic change signals.
- * Mitigation: Global climate sensitivity to greenhouse gas emissions.

US CLIVAR Science Priorities and Challenges

° **Extremes** (*for discussion*)

I. Science Questions

- * What are the physical processes responsible for extremes, and what is the capability of current models to simulate the statistical properties of extreme climate events?
- * What are the return periods for climate events of high societal and ecosystem relevance, and are these periods changing?

II. Overarching Challenges

- * Attribution: Linking local extremes to global climate variability and change.
- * Monitoring: High quality climate observing systems, reconstructions of past climates/extreme events.

US CLIVAR Science Priorities and Challenges

° Polar Climate (*for discussion*)

I. Science Questions

- * What processes affect sea ice conditions, and what is the impact of polar climate change (e.g., sea ice loss) on global and lower-latitude climates? What are the large-scale polar/subpolar/subtropical interactions and processes involved in affecting these changes?
- * What is the role of oceans in ice shelf stability?

II. Overarching Challenges

- * Attribution: Distinguish natural variability from anthropogenic forcing in polar regions.
- * Monitoring: Ocean currents and ocean transports in polar regions, ocean-sea ice-atmosphere fluxes, surface energy balance.

News from Washington

...Got Services?

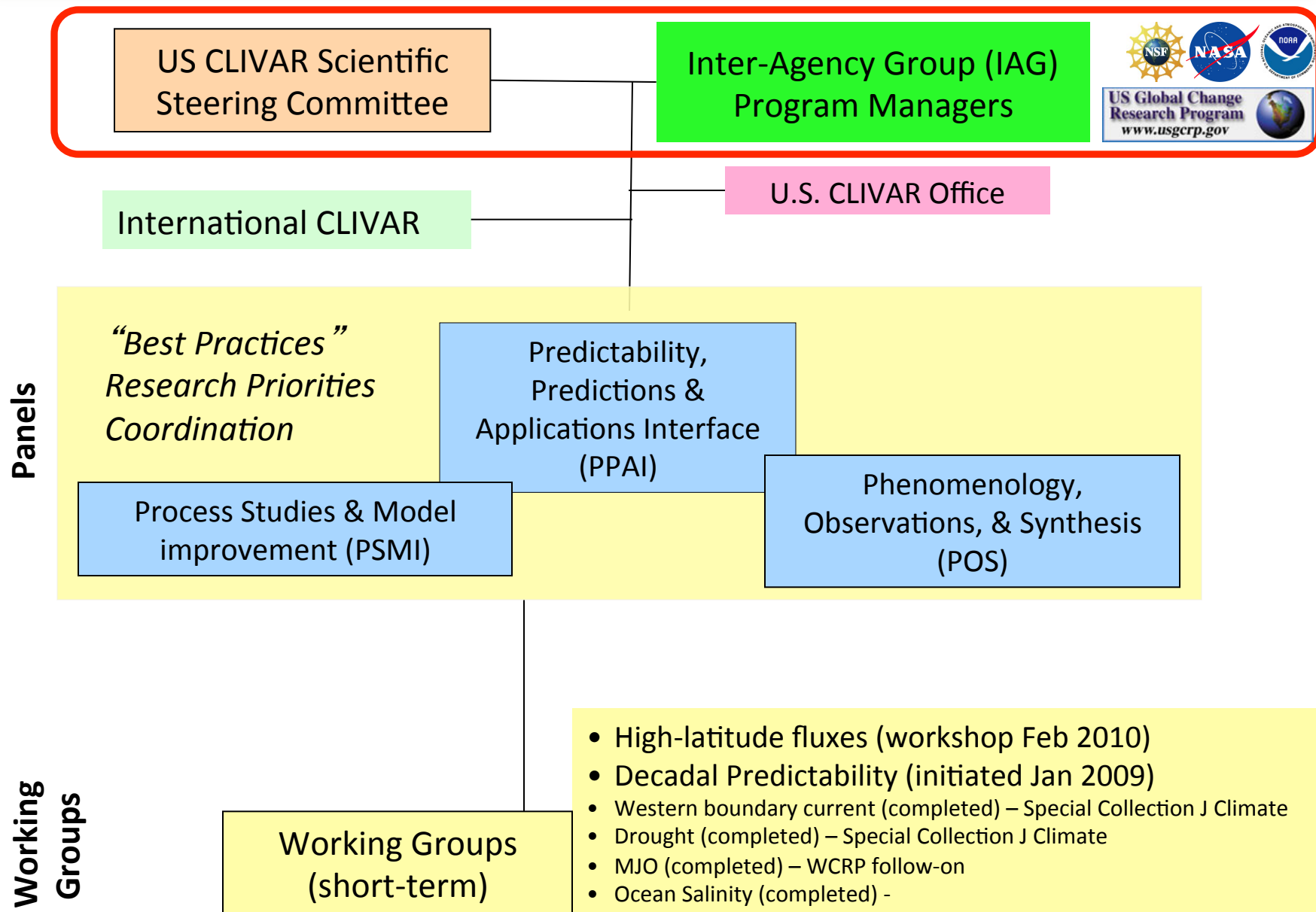
- NOAA climate research reorganized into 4-part program: Earth System Science; Obs/Monitoring; Modeling, Analysis, Predictions, projections (MAPP); Climate-Societal Interaction
- NSF released large-valued climate research initiatives on decadal/earth system modeling; water sustainability and climate; ocean acidification; and biodiversity.
- NSF Ocean Observatories Initiative - 25-yr pledge of support.
- NASA preparing for launch of Aquarius (salinity/soil moisture)
- A new US national assessment underway...
- Initial discussions underway towards developing a new USGCRP Strategic Plan...likely to have significant focus on applications and services (e.g. assessments, impacts, adaptation, decision-making, etc)
 - *Unclear at this time what US CLIVAR's role would be*

2010 Summit Overview and Goals

- Exploring the Polar and Extremes themes – what are the relevant challenges, gaps, and opportunities? and what activities might US CLIVAR encourage and coordinate to address these themes?
 - Input for a brief research vision/strategy document to guide community efforts?
 - New working groups?
- The ongoing research challenges of climate variability and change still remain
 - Panel recommendations for new working groups, funding gaps, community activities, etc

Extra Slide

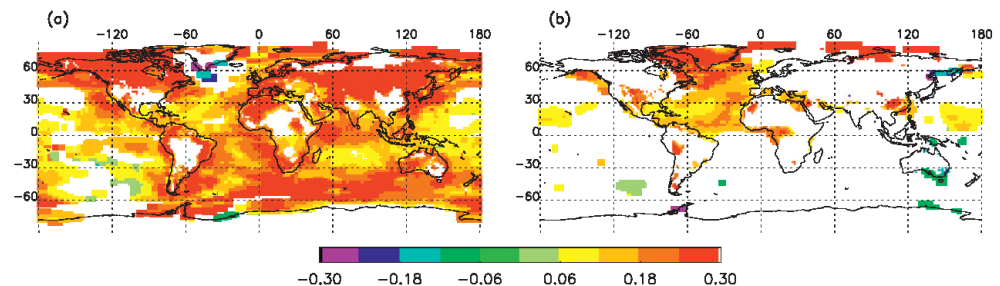
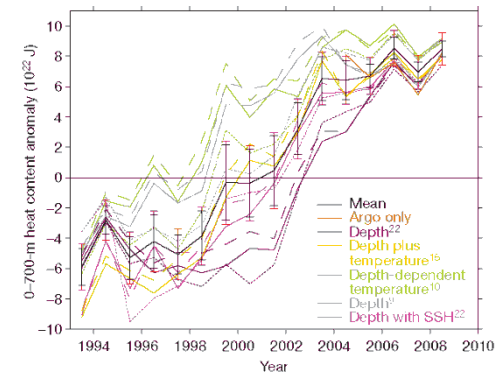
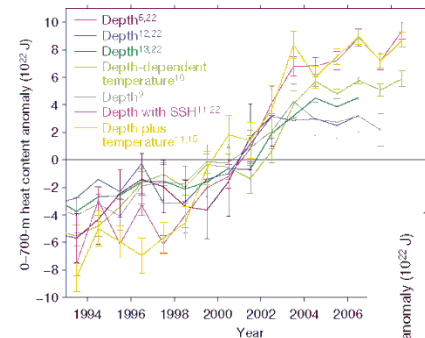
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PPAI Slides

Toward Developing a Predictive Understanding of Climate: Advances in Understanding

- **Resolving discrepancies in the upper ocean heat content (Lyman et al. 2010)**
- **Analysis of natural and forced decadal variability (Ting et al., 2009; Branstator and Teng, 2010)**



Toward Developing a Predictive Understanding of Climate: PPAI Related Activities

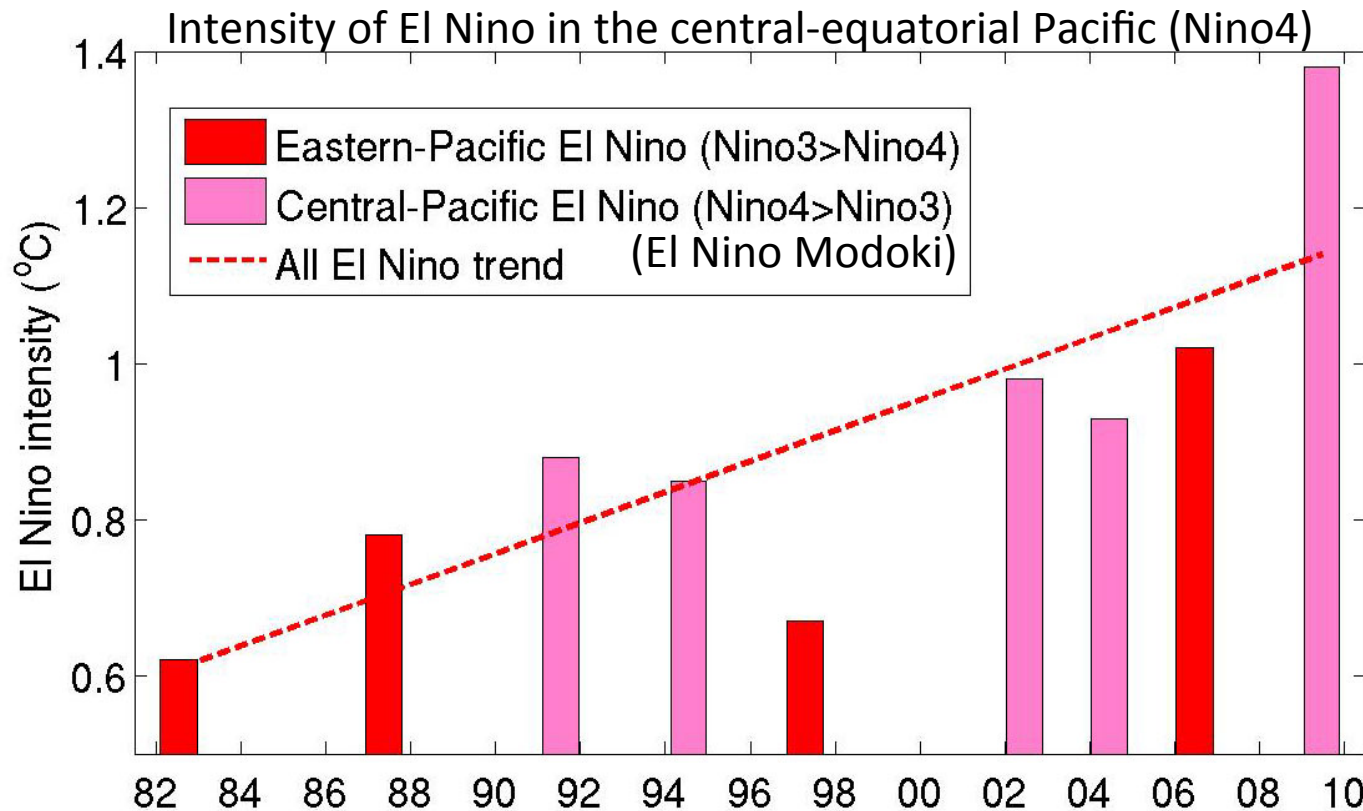
- Drought Working Group – J. Climate Special Issue papers
- Decadal Predictability Working Group – 1st Paper submitted to BAMS
- 3rd Class for PACE (Postdocs Applying Climate Expertise Fellowship Program)
- NRC study on the predictability seasonal and intraseasonal time scales (to be released in next couple of months)
- Contributions to development of reanalysis workshop, 1-3 November, 2010, Baltimore
- International Group on Attribution of Climate Related Events
- FY11 small grants program for comparing various reanalysis (CFSR, MEERA, ESRL)
- Organizing workshop on “Biogeochemical impacts of climate and land-use changes on marine Ecosystems” (ICTP, November 2009)
- Participation in the CLIVAR/WGSIP
- Attribution of Climate Events (ACE) workshops

Toward Developing a Predictive Understanding of Climate: Emerging Data Sets

- Various US reanalysis data sets (CFSR, MEERA, ESRL)
- CMIP5 – Initialized Decadal Predictions (~ late 2010/early 2011)
- CMIP5 – Climate change scenario runs

PSMI Slides

Increasing Intensity of El Nino in the central-equatorial Pacific (CP) (Lee & McPhaden 2010, GRL)



- CP-El Nino events have occurred more frequently in recent decades (Kao & Yu 2009, Kug et al. 2009).
- These events may occur more frequently under projected global warming scenarios (Yeh et al. 2009).
- CP- and EP-El Nino events have different climate impacts (Weng et al. 2009, Kim et al. 2009).
- El Nino intensity in the CP region has nearly doubled in the past three decades, causing an apparent increase of Pacific warm-pool SST; important implications to climate.

Highlights of POS-related Research & Activities

Record warming in the South Pacific & western Antarctica associated with the 2009-10 El Nino (Lee et al. 2010, GRL)

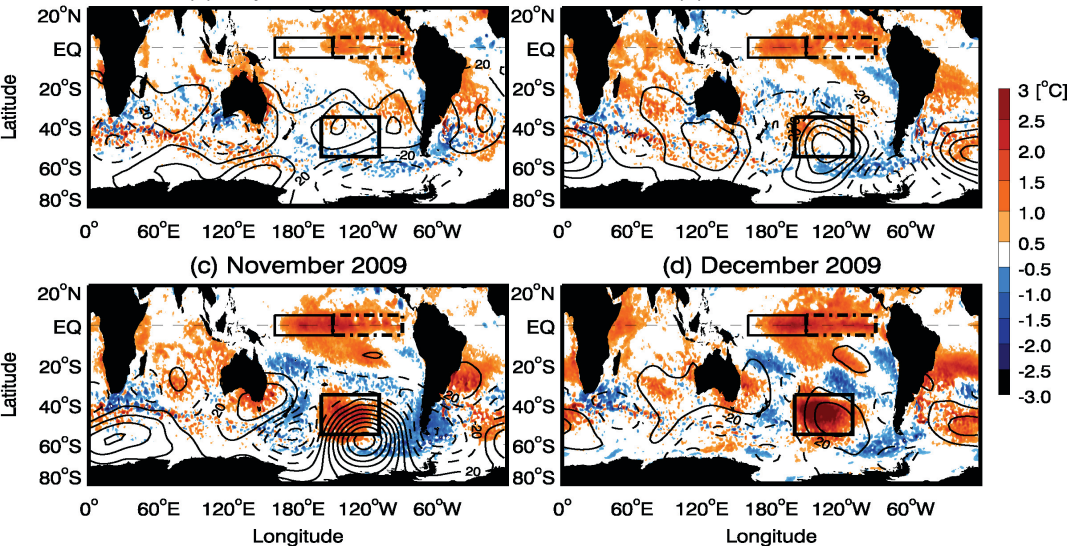
SSTA anomaly & 500-hPa geopotential height anomaly

(a) September 2009

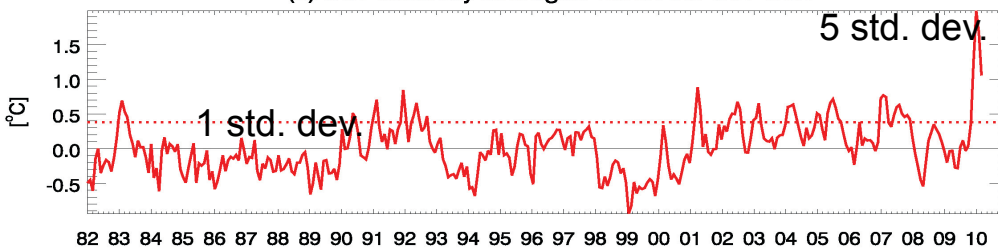
(b) October 2009

(c) November 2009

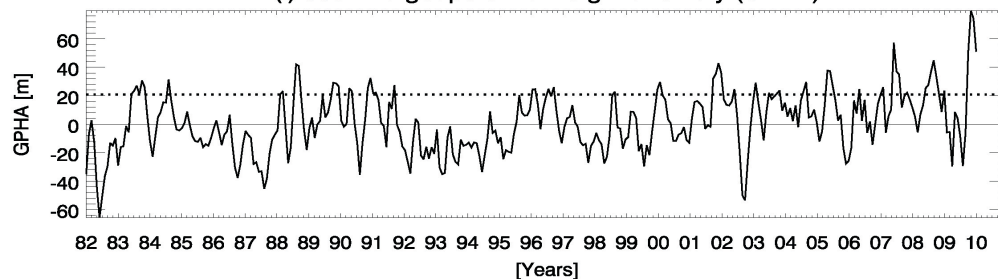
(d) December 2009



(e) SST anomaly averaged within the SCP box



(f) 500-hPa geopotential height anomaly (GPHA)



- Record mixed-layer warming in South-central Pacific (SCP) & W. Antarctica during 2009-10 austral spring-summer.
- Associated with an extreme & persistent anticyclone.
- Related wind changes caused the oceanic warming: comparable roles of heat flux & ocean dynamics.
- Southern Annular Mode did not play a major role.
- The 2009-10 El Nino appeared to have fueled the South Pacific warming.
- Extreme events like this may adversely affect the Antarctic environment, esp. if they become more frequent & intense in the future associated with Central-Pacific El Nino (previous slide).

Workshops that involved POS in 2009-2010

- OceanObs' 09, Venice, Italy, Sept. 2009. Several community whitepapers.
- “The Eighth Workshop on Decadal Climate Variability Decadal Climate Predictability and Prediction: Where Are We?”, St. Michaels, MD, Oct. 2009. BAMS article.
- US AMOC Science Team meeting, Miami, FL, June 2010.
- Joint International CLIVAR Indian-Ocean Panel, IOGOOS, and SIBER meeting, July 2010, Perth, Australia.
- WGOMD-GSOP Workshop: “Decadal Variability, Predictability and Prediction: Understanding the role of the Ocean”, Boulder, CO., Sept. 2009.
- GODAE OceanView Scientific Steering Team meeting, Tokyo, Japan, Oct. 2010.
- Integrated Earth System Analysis workshop, Baltimore, MD, Nov. 2010.