

CLIVAR-ICTP Workshop on Decadal Climate Variability and Predictability: Challenges and Opportunity

Workshop Objectives and the CLIVAR DCVP RF

International Center for Theoretical Physics (ICTP)
Trieste, Italy 16-20 November 2015

Decadal Climate Variability

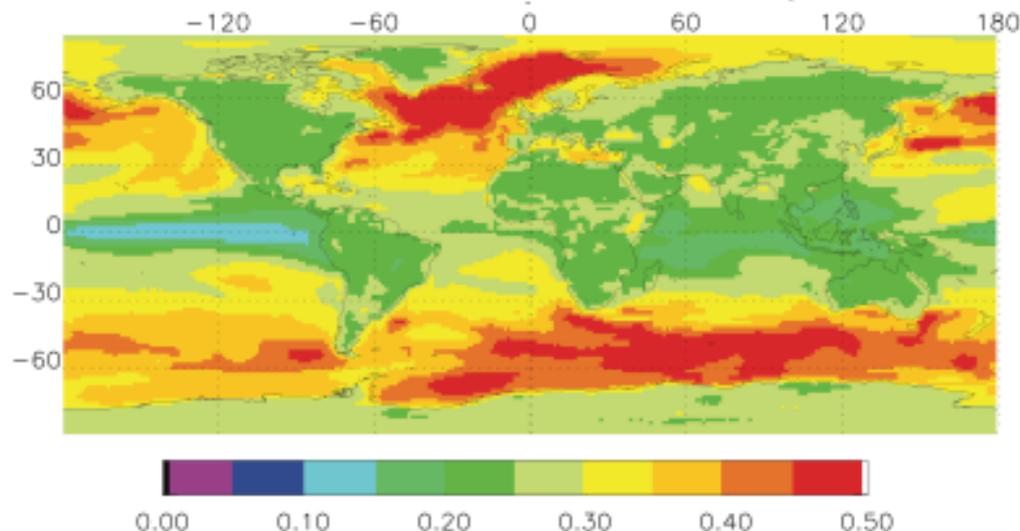
impacts on humans and the environment

The core issue: The global and regional-scale expressions of the interaction between multi-year natural climate variations and anthropogenic climate change:

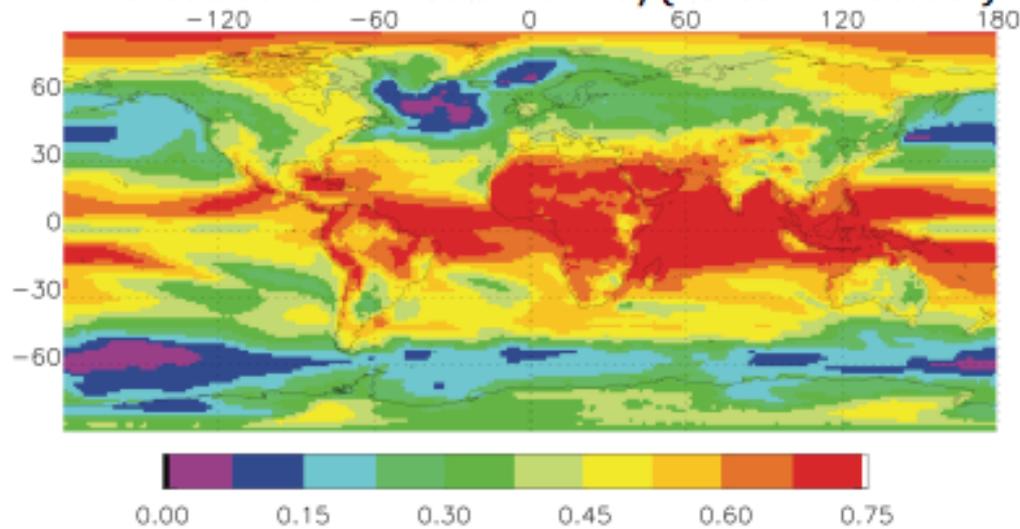
- Sahel droughts of 1970s & 1980s [AMOC/AMV + ENSO + Indian Ocean SSTs + anthropogenic aerosols]
- Decadal variations in Atlantic TC activity [AMOC/AMV + ENSO + GHGs]
- 1960's-1990's Mediterranean drying trend [NAO trend + AMV]
- Southwest US multi-year droughts [PDV + AMOC/AMV + GHGs]
- Recent 'hiatus' – In the Pacific the east is cooling not warming and the trades are intensifying [IPO/PDO (ocean heat uptake) + external forcing (stratospheric WV + volcanic aerosols + solar variability)]
- Recent California drought [multi-year natural variability superimposed on a warming trend].

Internal Decadal vs. Forced Variability

Internal Variance Ratio for Ts: Decadal/Total



Forced Variance Ratio: Forced/(Forced + Decadal)



- The North Atlantic, North Pacific, and the Southern Oceans are regions of high internal decadal and longer time scale variability.
- Decadal and longer time scale variability is relatively weak over land.
- Externally forced variance to total variance ratio is low in regions of high decadal internal variability

Why DCVP research now?

- New instrumental observations (particularly of the ocean and from space & recent advanced in modeling and in reanalysis.
- CMIP5 experiments in initialized decadal prediction (and plans for continuation under CMIP6) indicate areas of success and frustration pointing at the need for more work on physical understanding.
- The surprising “hiatus” and increase in damaging climate extremes invoke societal need for near-term knowledge for planning & preparedness.
- Reconstructions of past climate variability from high-resolution single and multiple proxies provide new information on forced and free decadal variability during the pre-industrial era.
- CMIP 5 simulations of the climate of last millennium: a study of the climate response to external forcing from solar variability, volcanic forcing, and changes in land use and contrast this response with the response to anthropogenic GHG emissions and aerosols.

CLIVAR Scientific Steering Group

Core Panels

Ocean Model Development Panel

Global Synthesis and Observations Panel

Climate Dynamics Panel

Atlantic Region Panel

Pacific Region Panel

CLIVAR/IOC-GOOS Indian Ocean Region Panel

CLIVAR/CLIC/SCAR Southern Ocean Region Panel

CLIVAR/GEWEX Monsoons Panel

Research Foci

Decadal climate variability and predictability

Biophysical interactions and dynamics of upwelling systems

Regional sea level change and coastal impacts

ENSO in a changing climate

Planetary heat balance & ocean heat storage

CLIVAR DCVP Objectives

- CLIVAR DCVP seeks to characterize the multi-year to multi-decadal variability of the climate system in response to internal processes and natural and anthropogenic forcing as well as their interaction
- to determine and understand the phenomena, their governing mechanisms, and impacts through diagnostic analysis and modeling
- to assess and subsequently harness the predictability of decadal climate variability for societal benefit.

DCVP RF

To advance CLIVAR DCVP objectives the Project sought to identify a limited number of research objectives that will be:

- Relevant & tractable and will benefit from international collaboration.
- Cuts across other CLIVAR panels agenda and timely (preferably is already in consideration or implementation).
- Leads to widely appealing, actionable research activity resolvable within a finite time (~5 years) and yielding broad scientific and societal benefit.

Community discussion yielded the following two foci that were endorsed by the SSG and are being developed further by the DCVP WG:

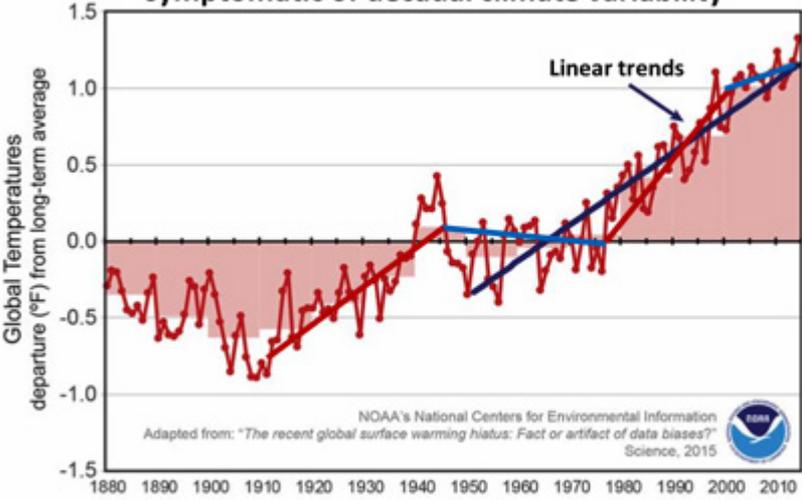
1. The decadal modulations – slowdowns and accelerations – of the long-term anthropogenic warming trend
2. The role of volcanic eruptions in decadal climate variability and their impact on decadal climate prediction

Hiatus expressions: global mean vs. the spatial pattern

a

Latitude

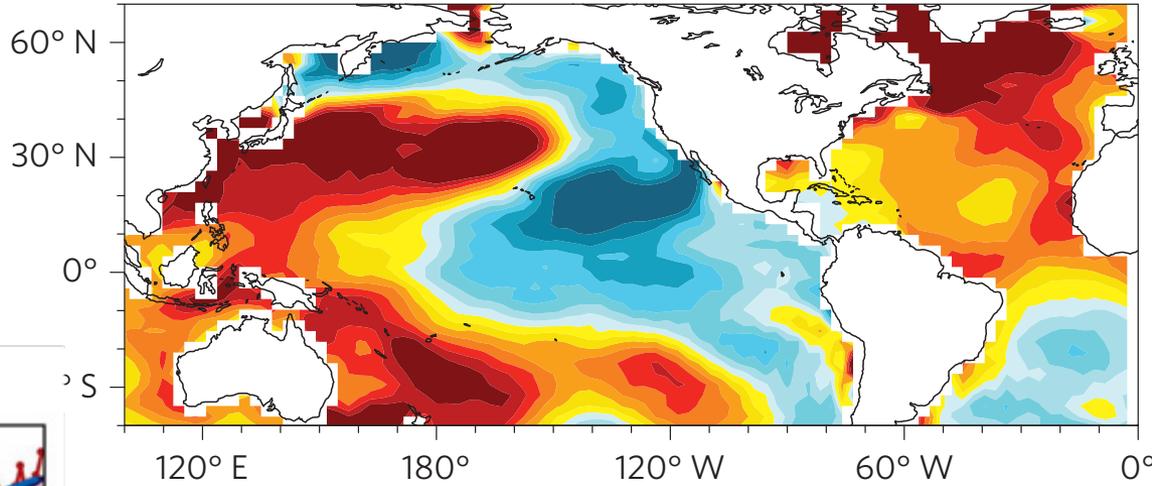
Recent slow down in global warming is symptomatic of decadal climate variability



Karl et al. (2015)

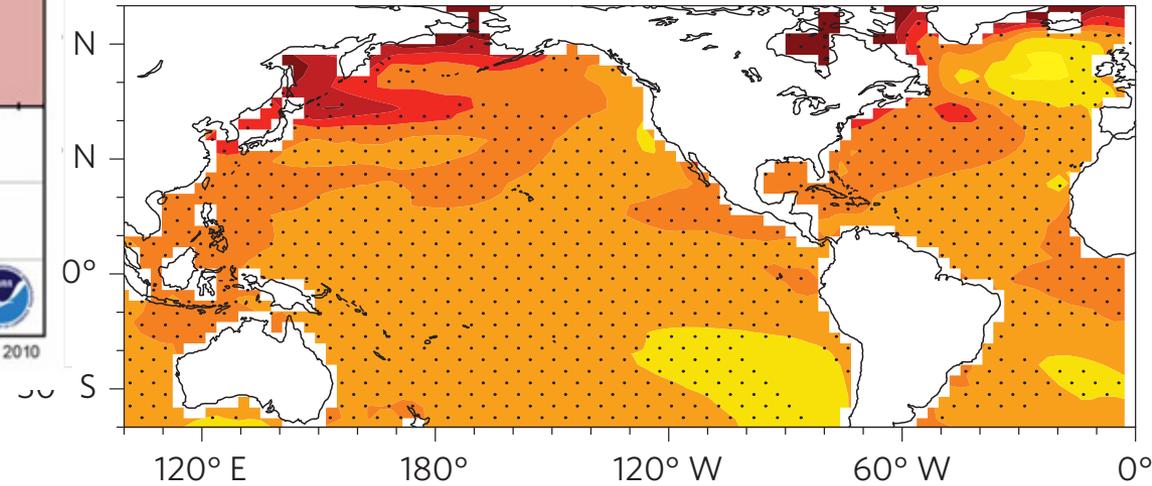
TAS 1998–2002 minus 1981–1995

Reanalysis



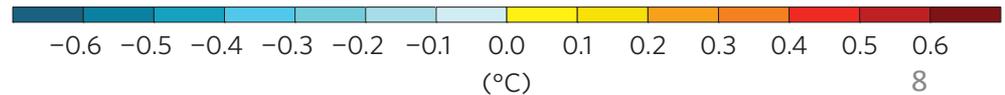
Uninitialized

Longitude



Meehl et al. (2014)

Longitude

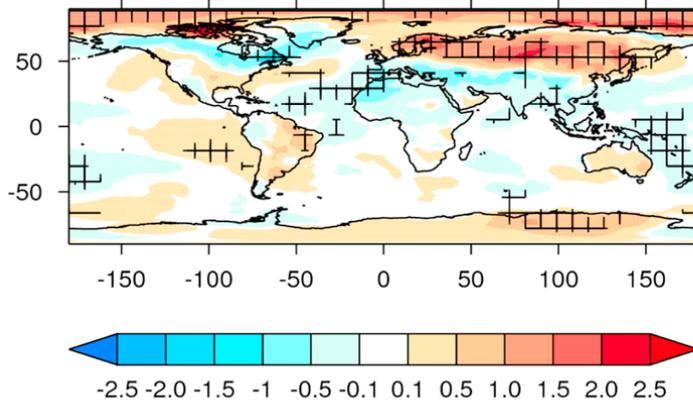


Dynamical response to volcanic eruptions:

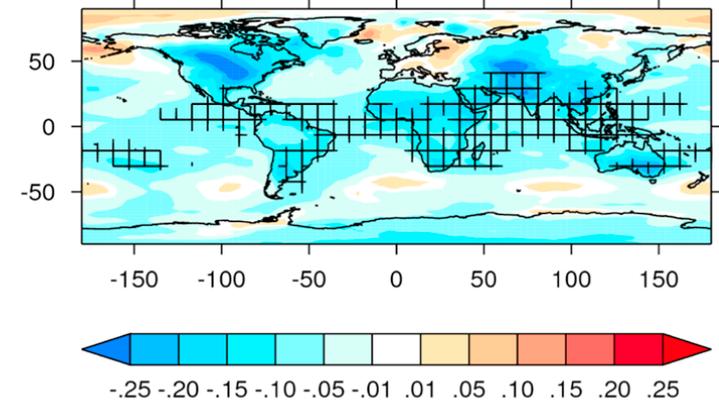
Large inter-model & model-obs. disagreements

Dynamical response averaged over first to large VEs, two winters after 20c volcanic eruptions. Top: Ts, bottom SLP. Note difference in color scale extent for obs. and models.

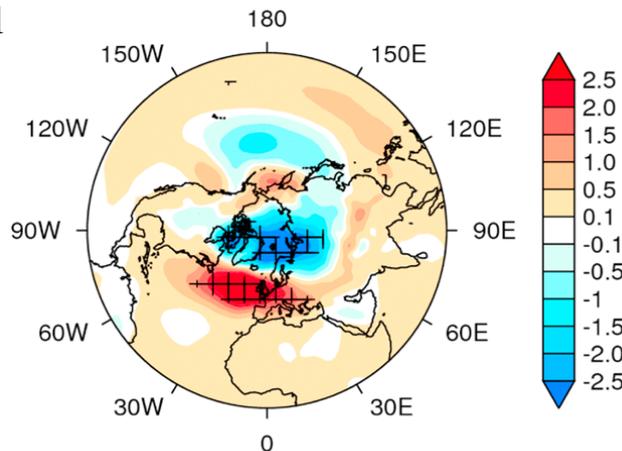
a) 20CRv2



b) MM-CMIP5



c) 20CRv2



d) MM-CMIP5

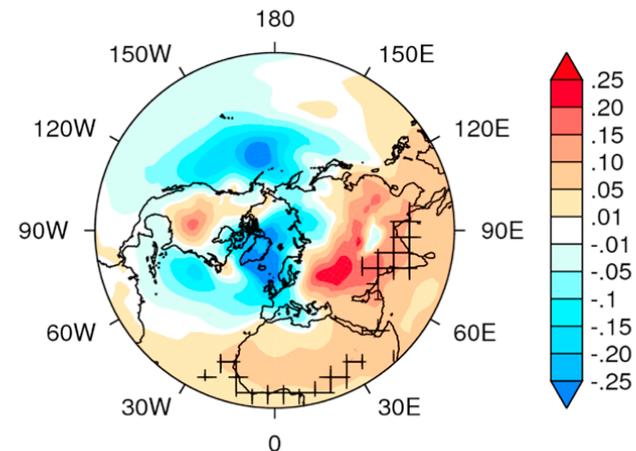


Figure from Driscoll et al. (2012),

DCVP RF Working Group

Title	Institute	Role	Year	Country
Cassou, Christophe	CERFACS Climate Modelling and Global Change	Co-Chair		France
Kushnir, Yochanan	LDEO Columbia University	Co-Chair		USA
Amy Solomon	NOAA/ESRL	Member		USA
Davide Zanchettin	Univeristy of Venice	Member		Italy
Alicia Karspeck	NCAR	Member		USA
Danabasoglu,Gokhan	NCAR, Climate and Global Dynamics Laboratory	Member		USA
Doblas-Reyes, Francisco	Institut Català de Ciències del Clima, SpainInstitut Català de Ciències del Clima	Member		Spain
Hawkins, Ed	University of Reading	Member		UK
Heimbach, Patrick	The University of Texas at Austin; Institute for Computational Engineering and Science (ICES); Jackson School for Geosciences (JSG), Institute for Geophysics (UTIG)	Member		USA
Von Schuckman, Karina	Mediterranean Institute of Oceanography, University of Toulon	Member		France
Masahide, Kimoto	Atmosphere and Ocean Research Institute, University of Tokyo	Member		Japan
Msadek, Rym	NOAA GFDL and UCAR	Member		USA
Mueller, Wolfgang	Max Planck Institute for Meterology	Member		Germany
Power, Scott	Bureau of Meteorology	Member		Australia
Zhou, Tianjun	LASG, Institute of Atmospheric Physics, Chinese Academy of Science	Member		China

DCVP RF Activities

- Work with the WCRP/WGSIP Decadal Climate Prediction Project (DCPP) to establish protocols for CMIP6 decadal prediction activities. In particular:
 - Pacemaker experiments for understanding mechanisms of climate shifts, internal modes of variability and predictability
 - Perturbation experiments on the impact of volcanoes on predictability and predictions
- Prepare the DCVP chapter in the new CLIVAR Science Plan; organize and convene a DCVP session in the CLIVAR Open Science Conference.
- Assist in organizing the ICTP/CLIVAR International Workshop on Decadal Climate Variability and Predictability: Challenge and Opportunity, to be held on 16-20 November 2015, Trieste, Italy.

- *Update the CLIVAR DCVP science agenda and propose an implementation plan that lays out the path for rapid progress on the most pressing research objectives.*

CLIVAR-ICTP Workshop Objectives

- Report on the outcomes of recent research on DCVP and discuss and share ideas inspired by these results
- Identify the obstacles to progress in DCVP science and related pressing scientific issues, particularly those that require international attention and would benefit from enhanced international coordination
- Identify existing and emerging opportunities for making rapid progress on these issues
- Suggest new activities or initiatives that can foster such progress