An International Global Drought Information System Workshop: Next Steps

Pasadena, CA, USA, 11-13 December 2014

There is currently no global, authoritative, and consistent information on drought that is easily accessible to all users, including such information as our understanding of the physical mechanisms and predictability of drought, real time assessments of on-going drought, and predictions. As part of an on-going effort to address this problem (building in particular on the outcomes of two previous workshops), we are requesting support for an international workshop focusing on the necessary next steps (including the identification of research gaps) for moving forward with an experimental global drought information system (GDIS). In particular, a key goal of this workshop is to develop a concrete implementation plan towards realizing practical continental scale pilots that will mesh with actual users (such as the food security community).

JET PROPULSION LABORATORY CENTER FOR CLIMATE SCIENCES

NASA

MAPP Modeling, Analysis, Predictions, and Projections

NIDIS

Earth System Science

European Commission

WCRP World Climate Research Programme

GEO GROUP ON EARTH OBSERVATIONS

WMO

US CLIVAR

Thanks to our local hosts:

Graeme Stephens
Amber Jenkins
Martha Farfan
Debra Shimoda

Other logistical Support:

Sam Benedict
Anna Pirani
Isabel Hall
Roberta Boscola

Global Drought Information System

Siegfried Schubert (GMAO/NASA),
Doug Cripe (GEO), Mike Hayes (NDMC), Kingtse Mo (NOAA/CPC),
Will Pozzi,(GEO), Roger Pulwarty (NIDIS),
Sonia Seneviratne (ETH), Kerstin Stahl (Univ Freiburg),
Robert Stefanski (WMO), Ron Stewart (Univ Manitoba),
Juergen Vogt (JRC), Eric Wood (Princeton)

and the DIG Community

GDIS/GHP Meeting
Pasadena, CA
12/10/2014

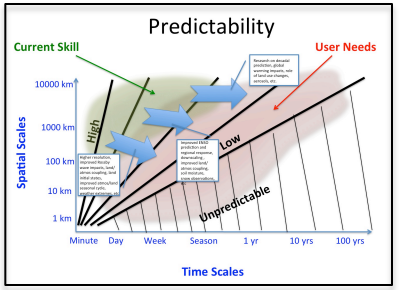
The WCRP Drought Interest Group (DIG)

(Founding members: D. Legler, S. Schubert, R. Stewart, H. Cattle, P. van Oevelen, V. Detemmerman, R. Lawford, R. Mechoso, C. Jakob, and A. Pirani)

The DIG was formed in 2008 as part of the WCRP Extremes crosscutting activity to *" identify and leverage current drought research activities within WCRP in order to assess the gaps in drought research and coordinate drought research at an international level with the goal of advancing the predictive understanding of extremes. "*

A WCRP White Paper " *Drought predictability and Prediction in a Changing Climate: Assessing Current Capabilities, User Requirements and Research Priorities*"
http://www.clivar.org/organization/extremes/resources/dig

2011 workshop in Barcelona: recommendation to develop a global drought information system (GDIS):
http://drought.wcrp-climate.org/workshop/ICPO_161_WCRP_Report.pdf



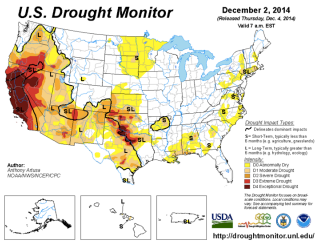
2012 workshop in Frascati: advance the Barcelona recommendations including Special Collection of JCLIM on drought world-wide:

http://www.clivar.org/sites/default/files/documents/GDIS_Report_final.pdf

Goals

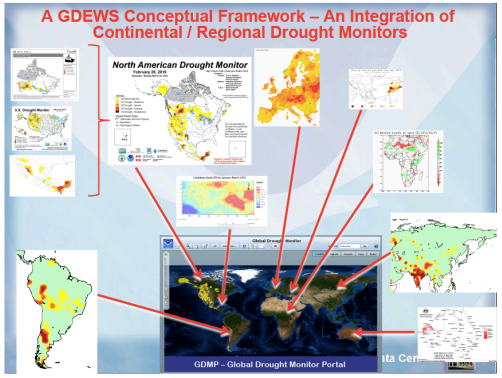
- Advance understanding of drought mechanisms and predictability
- Advance regional climate information and decision support
- Develop a global real time monitoring and prediction system

Is the Science and Available Drought Information Consistent with/Meeting User Needs?



Real Time Drought Monitoring and Prediction

GDEWS Proposal: 2007 GEO Ministerial Summit



NIDIS/ NCDC: R. Heim and M. Brewer

Local/regional scales

User needs/expectations for drought information

Global scales

Advancing Drought Science

Global Drought Information System - Drought Characterization, Occurrence, Driving Mechanisms, and Predictability Worldwide (GDIS Worldwide)

Ronald Stewart, University of Manitoba
Siegfried Schubert, NASA Goddard Space Flight Center
Organizers

Description

This special collection of the *Journal of Climate* is devoted to our understanding of drought throughout the world. The idea for this collection came about as a recommendation of a 2012 international workshop on the development of a Global Drought Information System (GDIS) sponsored by WCRP and various partner organizations (ESA-ESRIN, NASA, NIDIS, NSF, GEO, USCLIVAR, and NOAA). The collection is an important step in the development of a GDIS, providing a comprehensive overview of the state of our understanding of drought, as well as recent research advances. Individual papers solicited for this collection focus on specific large regions/continents that collectively encompass most of the world. Specific aspects of drought that are considered include its overall characterization and metrics, key physical mechanisms and drivers, impacts, trends, and predictability. A synthesis paper attempts to organize the many facets of drought throughout the world into a global view as well as to provide an overall assessment of high priority drought research challenges.

SPECIAL
GDIS Drought Worldwide
COLLECTION

JCLIM Special Collection On Drought Worldwide

Collection Organizers: Ronald Stewart and Siegfried Schubert

Focus: Drought Characterization, Occurrence, Driving Mechanisms and Predictability Worldwide

Seager, Richard, Martin Hoerling, 2014: Atmosphere and Ocean Origins of **North American Droughts.** *J. Climate*, **27**, 4581–4606. doi: http://dx.doi.org/10.1175/JCLI-D-13-00329.1

Cai, Wenju, Ariaan Purich, Tim Cowan, Peter van Rensch, Evan Weller, 2014: Did Climate Change–Induced Rainfall Trends Contribute to the **Australian Millennium Drought**?. *J. Climate*, **27**, 3145–3168. doi: http://dx.doi.org/10.1175/JCLI-D-13-00322.1

Schubert, Siegfried D., Hailan Wang, Randal D. Koster, Max J. Suarez, Pavel Ya. Groisman, 2014: **Northern Eurasian Heat Waves and Droughts**. *J. Climate*, **27**, 3169–3207. doi: http://dx.doi.org/10.1175/JCLI-D-13-00360.1

Müller, O.V., E.H. Berbery , D. Alcaraz-Segura, M.B. Ek, 2014: Regional model simulations of the 2008 **drought in southern South America** using a consistent set of land surface properties. J. Climate, 27(17): 6754-6778. e-View doi: http://dx.doi.org/10.1175/JCLI-D-13-00463.1

Lyon, B., 2013: Seasonal **Drought in East Africa** and its Recent Increase During the March-May Long Rains, Under review.

Maria Belen Rodriguez-Fonseca, Elsa Mohino, C. Roberto Mechoso, Cyril Caminade, Marco Gaetani, J. Garcia-Serrano, Michela Biasutti, Edward K. Vizy, Kerry Cook, Yonkang Xue, Bernard Fontaine, Irene Polo, Teresa Losada, Juergen Bader, Francisco J. Doblas-Reyes, Lisa Goddard, Serge Janicot, A. Arribas, Leonard Druyan, William Lau, Andrew Colman, David P. Rowell, Fred Kucharski, and Aurore Voldoire, 2014: Climate Variability and Predictability of **West African Droughts**. Under Review.

Barlow, M., B. Zaitchik, S. Paz, E. Black, J. Evans, A. Hoell, 2013**: Drought in the Middle East and Southwest Asia**. J. Climate. Under review.

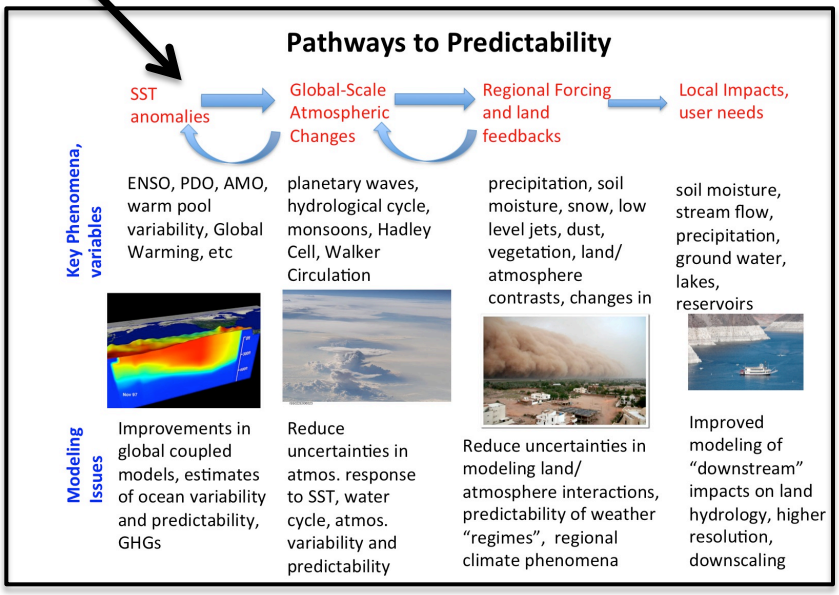
Zhang, L. and T. Zhou, 2014: **Droughts over East Asia**: A Review. J. Climate. Under review.

Krishna Kumar Kanikicharla, Ashwini Kulkarni, Sivanand Pai and Sumant Nigam, 2014: **Monsoon droughts in India**, J. Climate, under review.

Sonia I. Seneveratne, Lukas Gudmundsson, Henny van Lanen, Kerstin Stahl, Lena Tallaksen, Stefan Brönnimann, Peter Greve, Bart van den Hurk, Valerie Masson-Delmotte, Boris Orlowsky, Siegfried Schubert, Irmi Seidl, Adriaan J. Teuling, Robert Vautard, 2014: **European Drought,** J. Climate, to be submitted**.**

Schubert, S., R. Stewart, H. Wang, et al., 2014: **Global Drought: A Synthesis of Current Understanding,** J. Climate, to be submitted to GDIS Special Collection

Large Scale Drivers of Drought



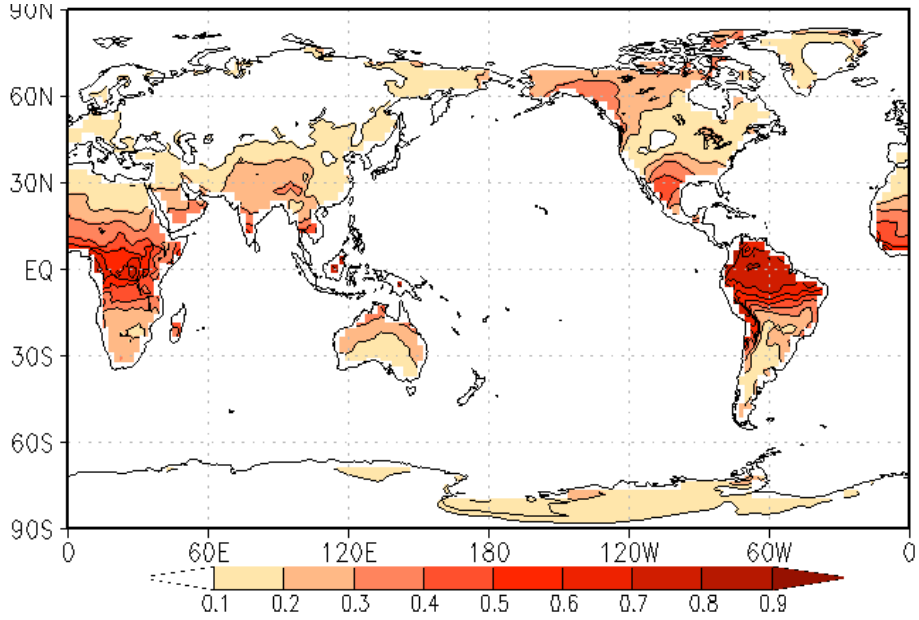
- *use AGCM simulations to quantify SST response*
- *are our models giving realistic answers?*

(GEOS-5, CCM3, CAM4, GFS, and ECHAM5: 1979-2011)

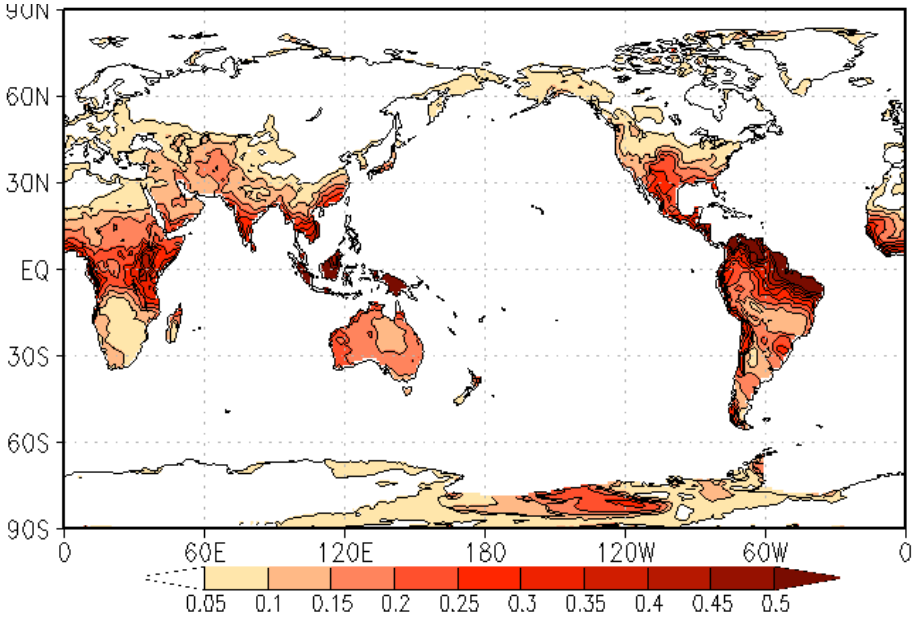
Can we predict drought on interannual time scales?

SST Forced Variance / Total Variance

T2m



Precip

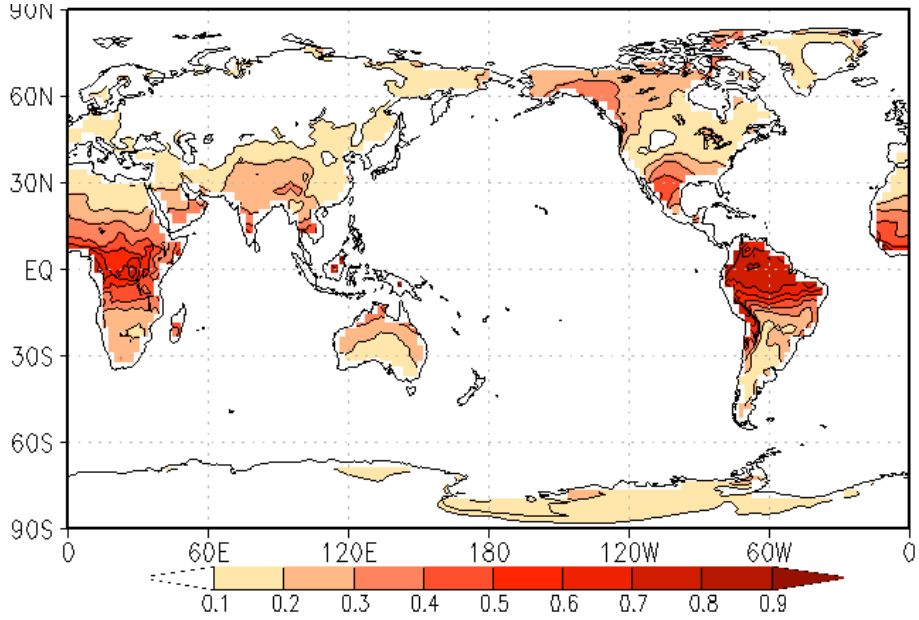


Multi-model Consensus based on GEOS-5, CCM3, CAM4, GFS, and ECHAM5
(Annual means for 1979-2011)

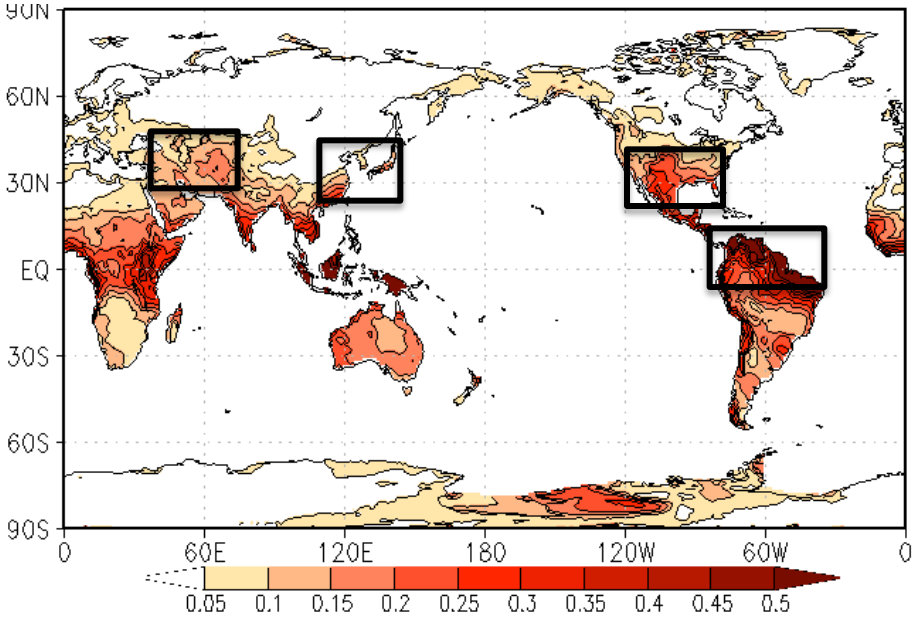
Are these results realistic?

SST Forced Variance / Total Variance

T2m



Precip

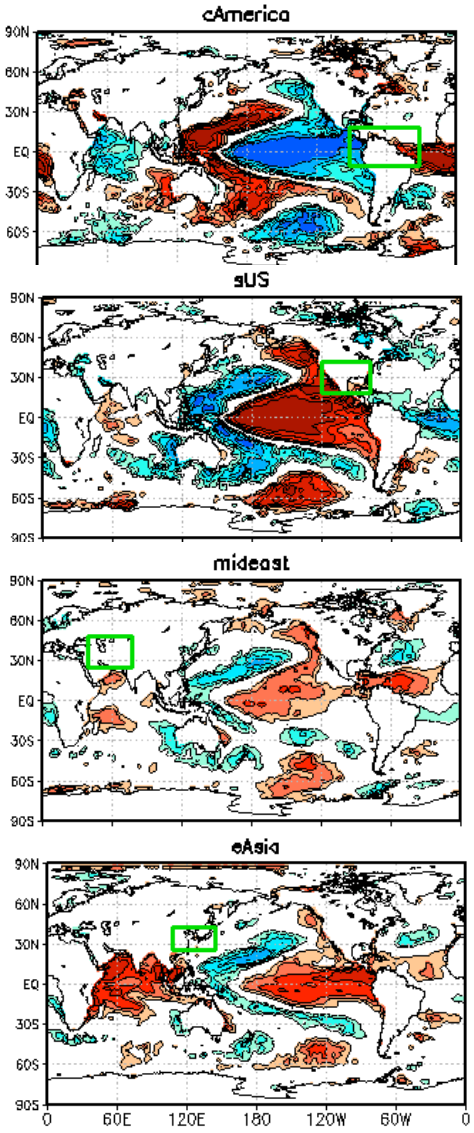


Multi-model Consensus based on GEOS-5, CCM3, CAM4, GFS, and ECHAM5
(Annual means for 1979-2011)

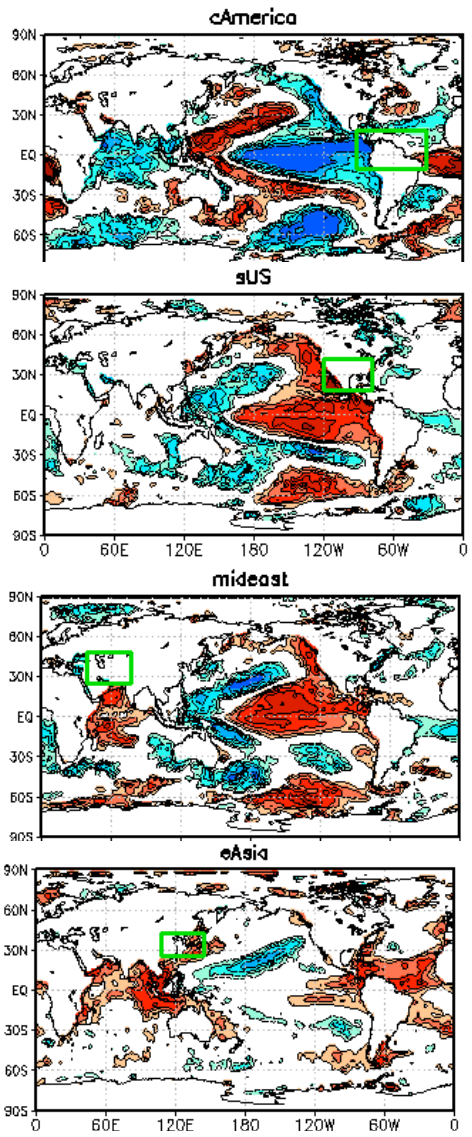
Correlations of Precipitation with SST for Selected Regions

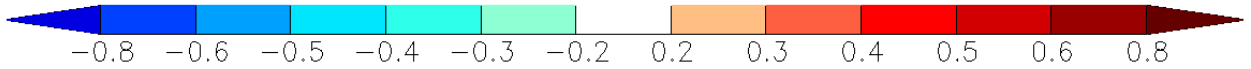
(Annual Means 1979-2011)

5 Model Ensemble Means



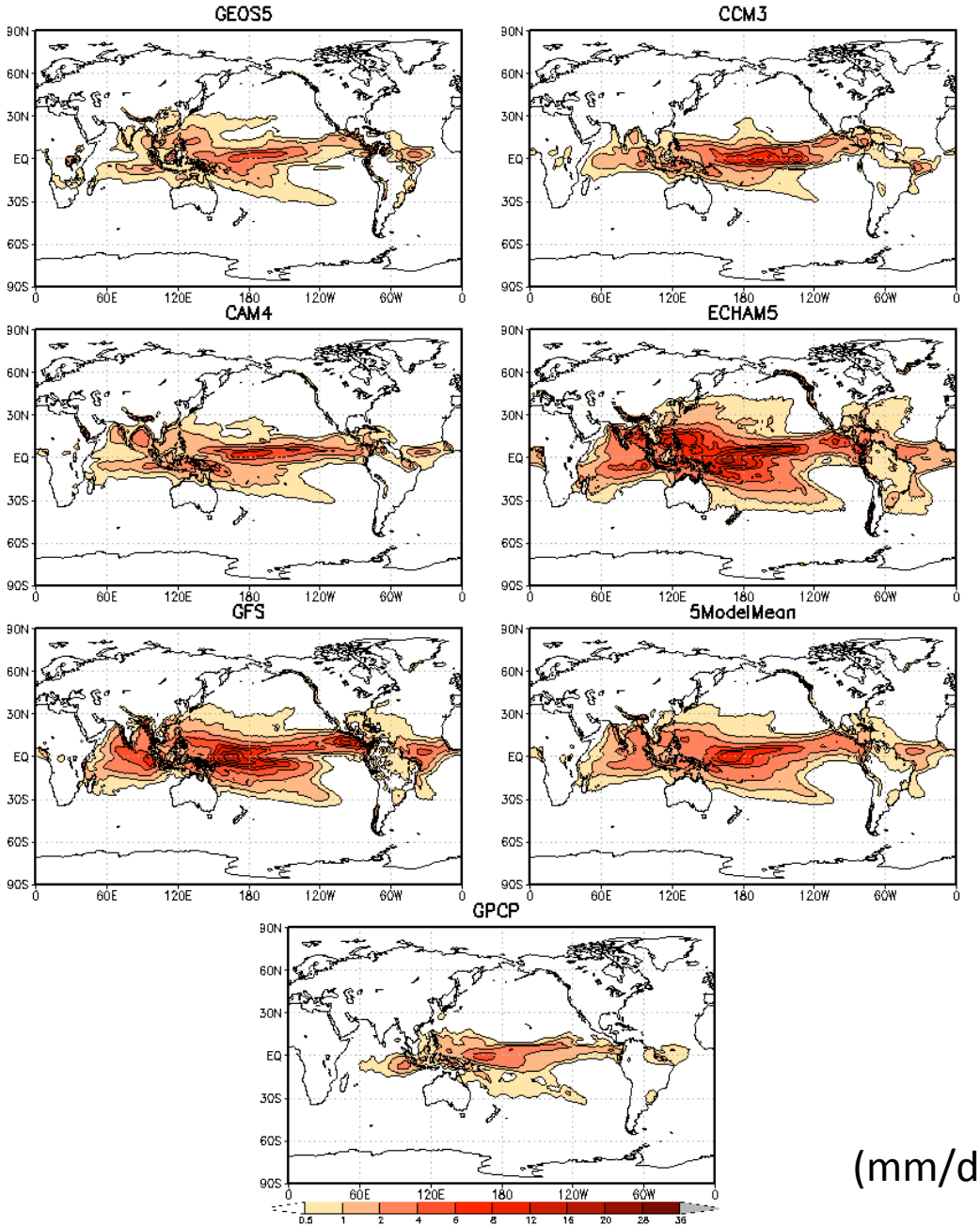
GPCP Observations





Spatial patterns of the responses appear to be very realistic

Precipitation Total Variance (Annual 1979-2011)

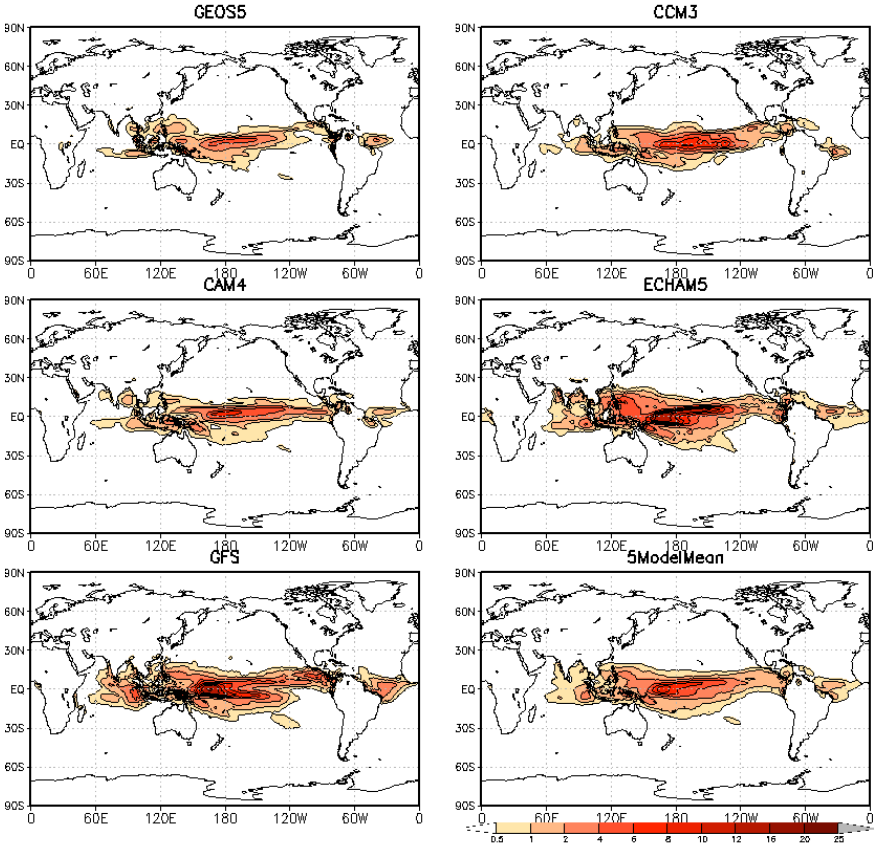


Substantial disagreement among models and observations

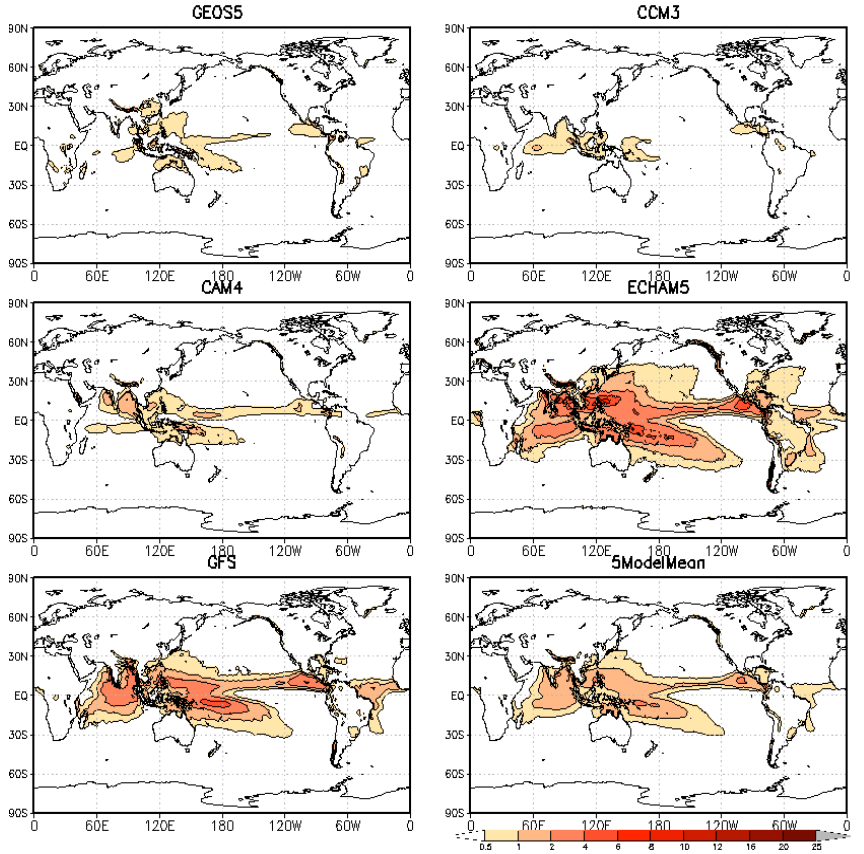
$(mm/d)^2$

Precipitation Variance (Annual 1979-2011)

SST-Forced



Internal



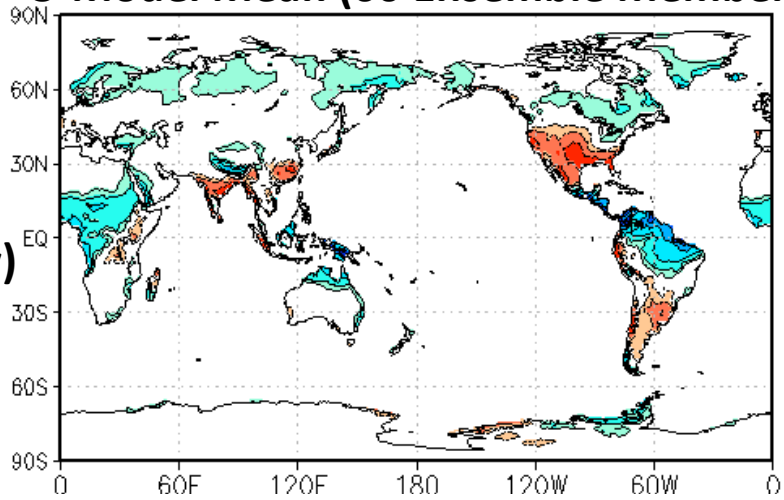
$(mm/d)^2$

Decadal Changes

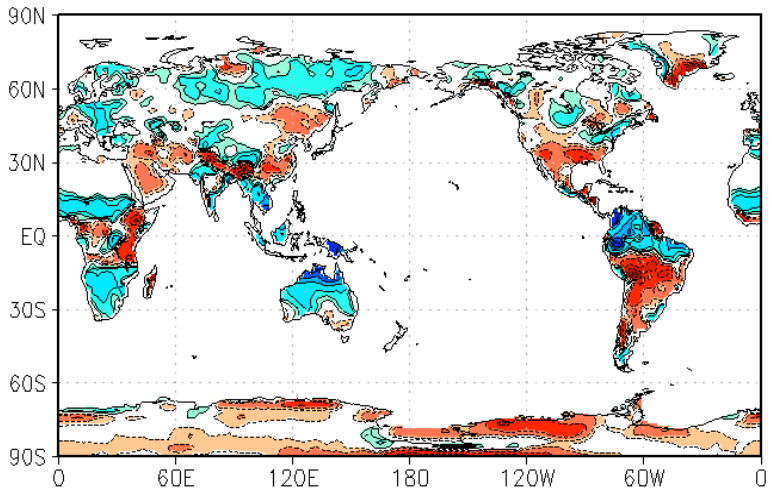
1998-2011 minus 1979-1993 (Annual Mean)

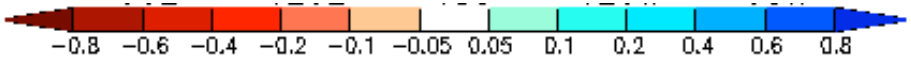
Precip (mm/day)

5-Model Mean (60 Ensemble Members)



GPCP

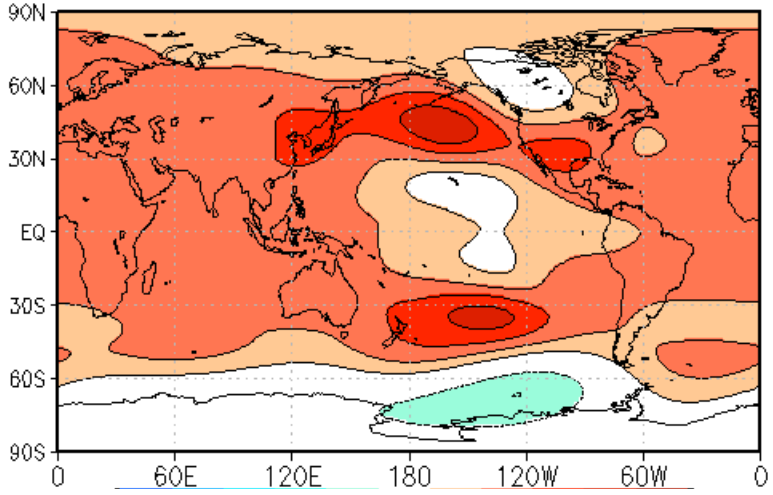




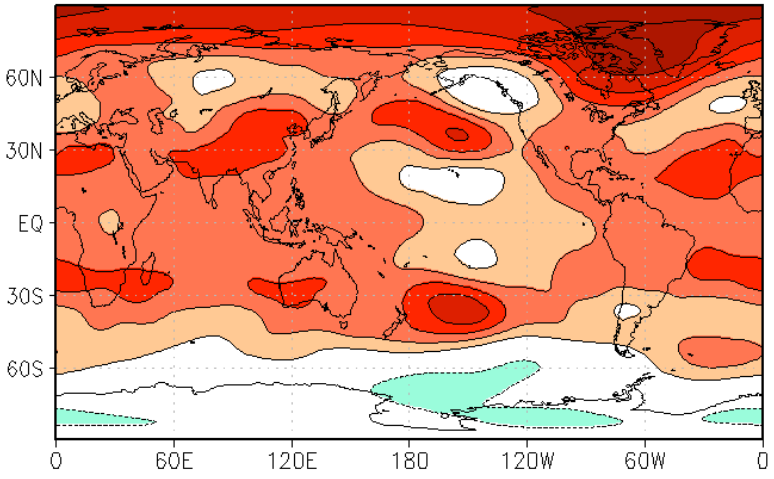
mm/day

200mb Z (m)

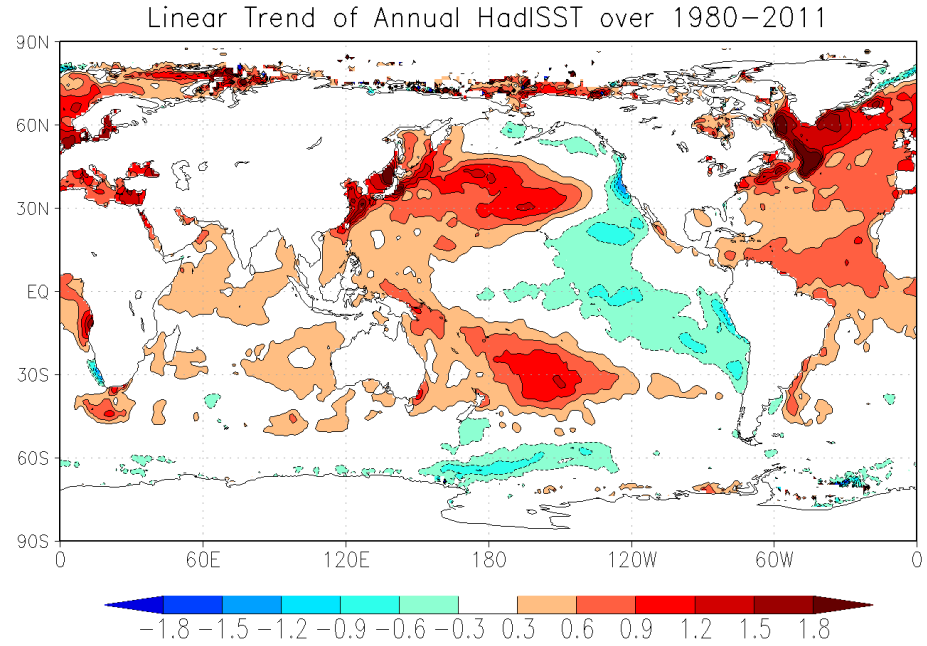
5-Model Mean (60 Ensemble Members)



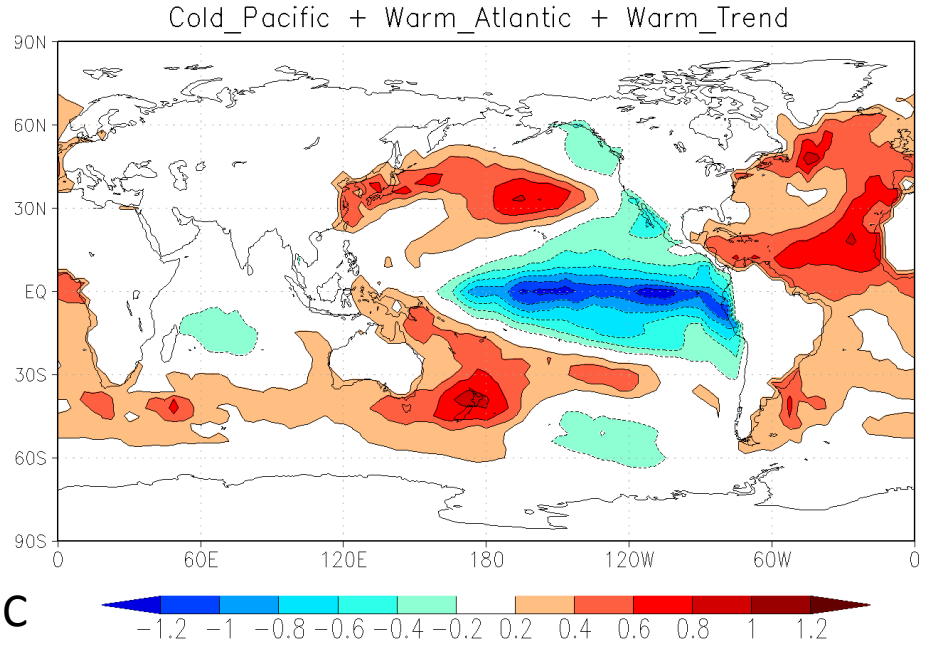
MERRA

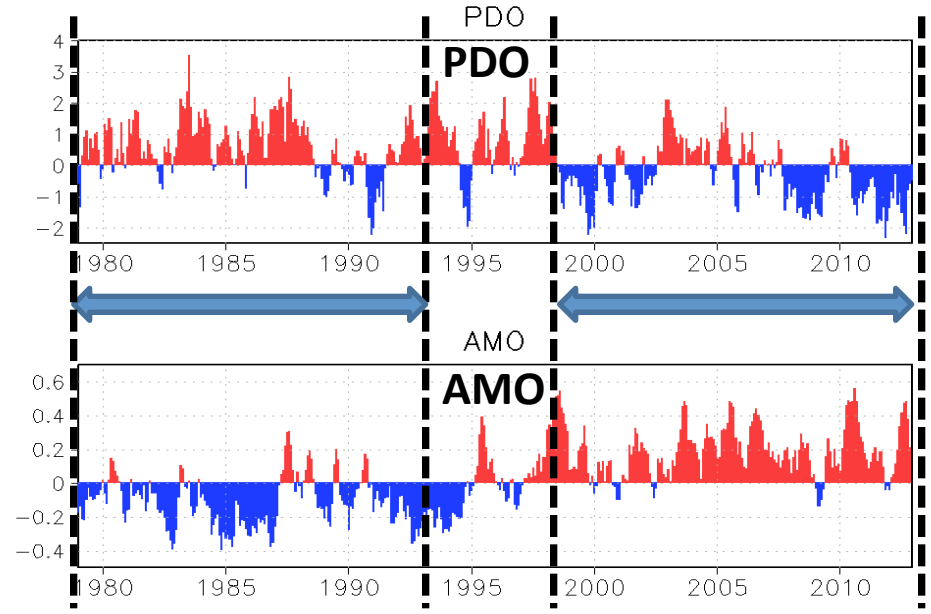


Observed Trend in SST (1980-2011)

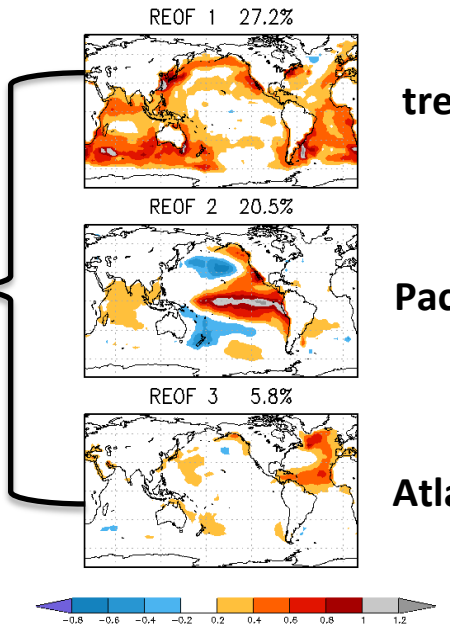


Idealized SST (ColdPac+WarmAtl+Warmtrend)



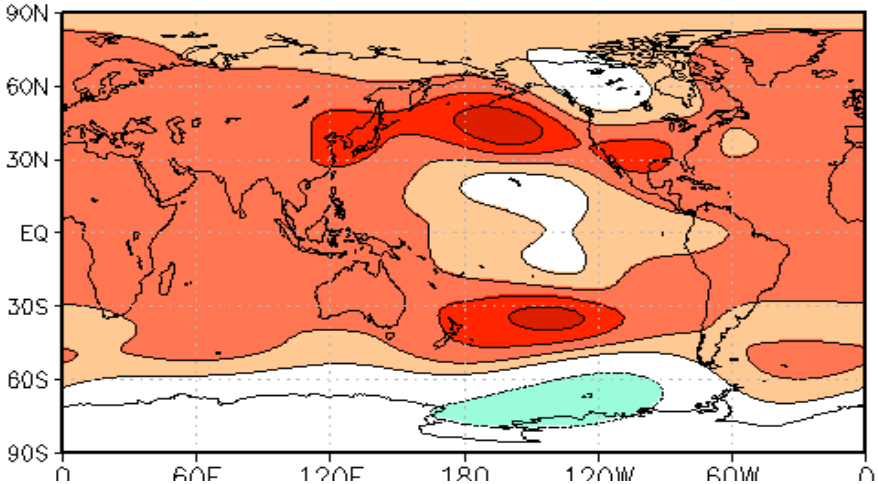


Above SST field is constructed from these three leading SST REOFs



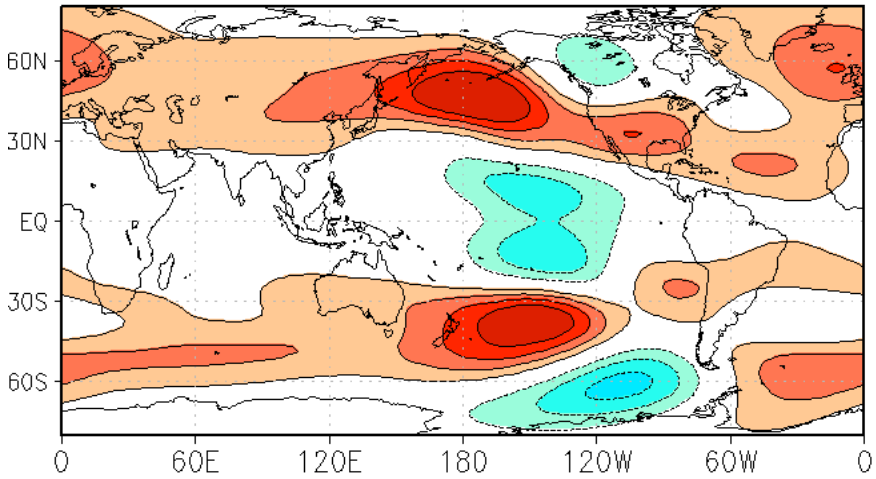
Z200mb (1998-2011 minus 1979-1993)

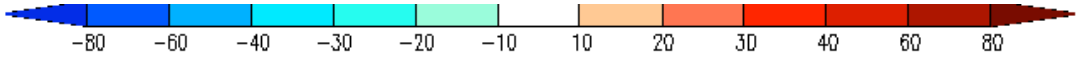
(60-member ensemble mean GEOS-5, CCM3, GFS, CAM4 and ECHAM5)



z200mb response to idealized SST

(CCM3, GEOS-5, GFS, and GFDL)

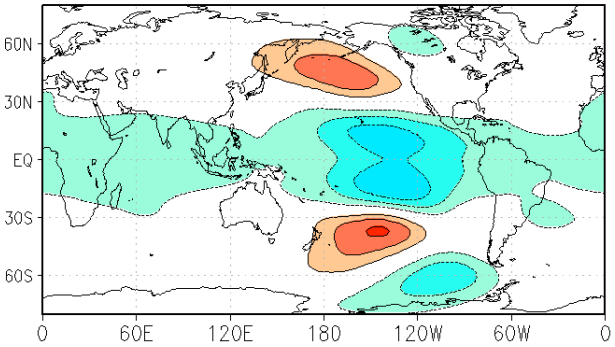




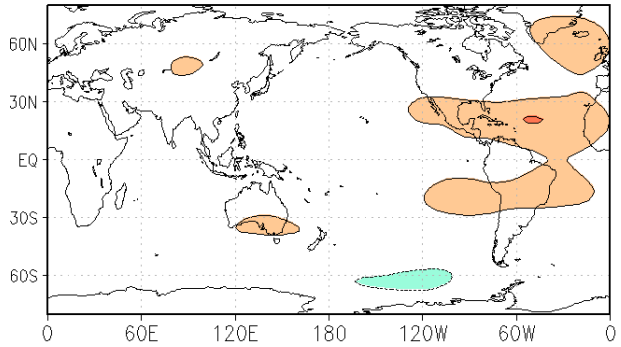
Components of z200mb Response to Idealized SST

(CCM3, GEOS-5, GFS, and GFDL)

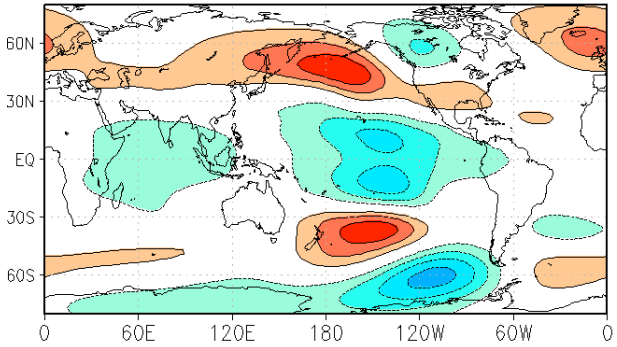
Cold Pacific



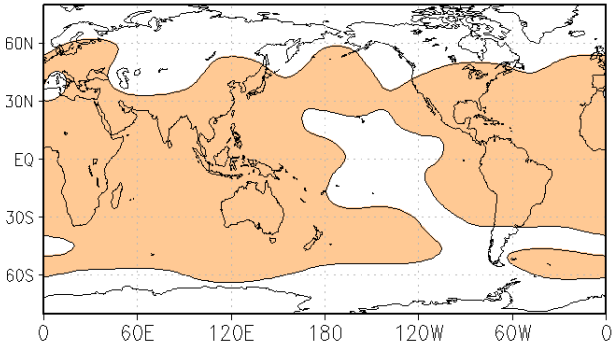
Warm Atlantic



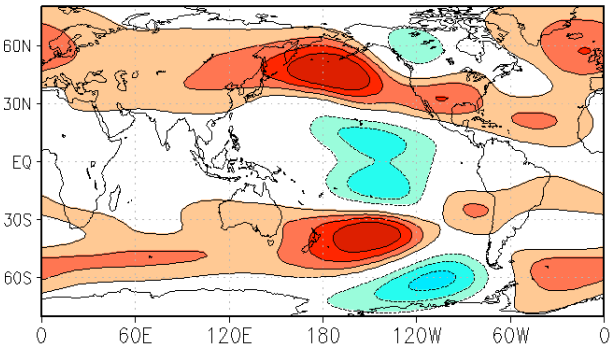
Cold Pacific+Warm Atlantic



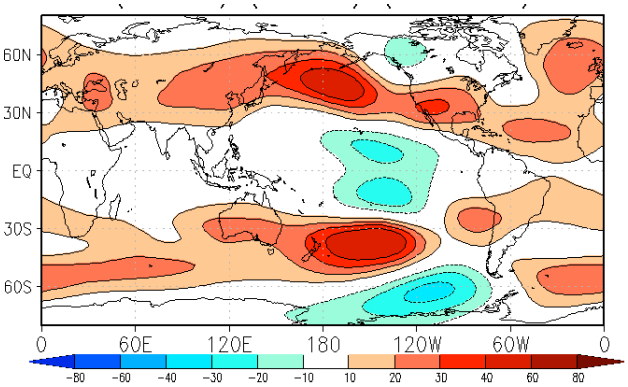
Warm Trend



Cold Pacific+Warm Atlantic + warm Trend



Sum of Components



Drought forecast challenge: improving estimates of predictability and forecast uncertainty at all time scales (key goal: reliable forecasts of precipitation)

Address deficiencies at interfaces:

-*atmosphere/ocean*
    -models disagree on strength of forcing by SST
    -models disagree on internal atmospheric variability
-*atmosphere/land* (uncertainties in local and non-local feedbacks)

Address deficiencies in scale interactions/linkages

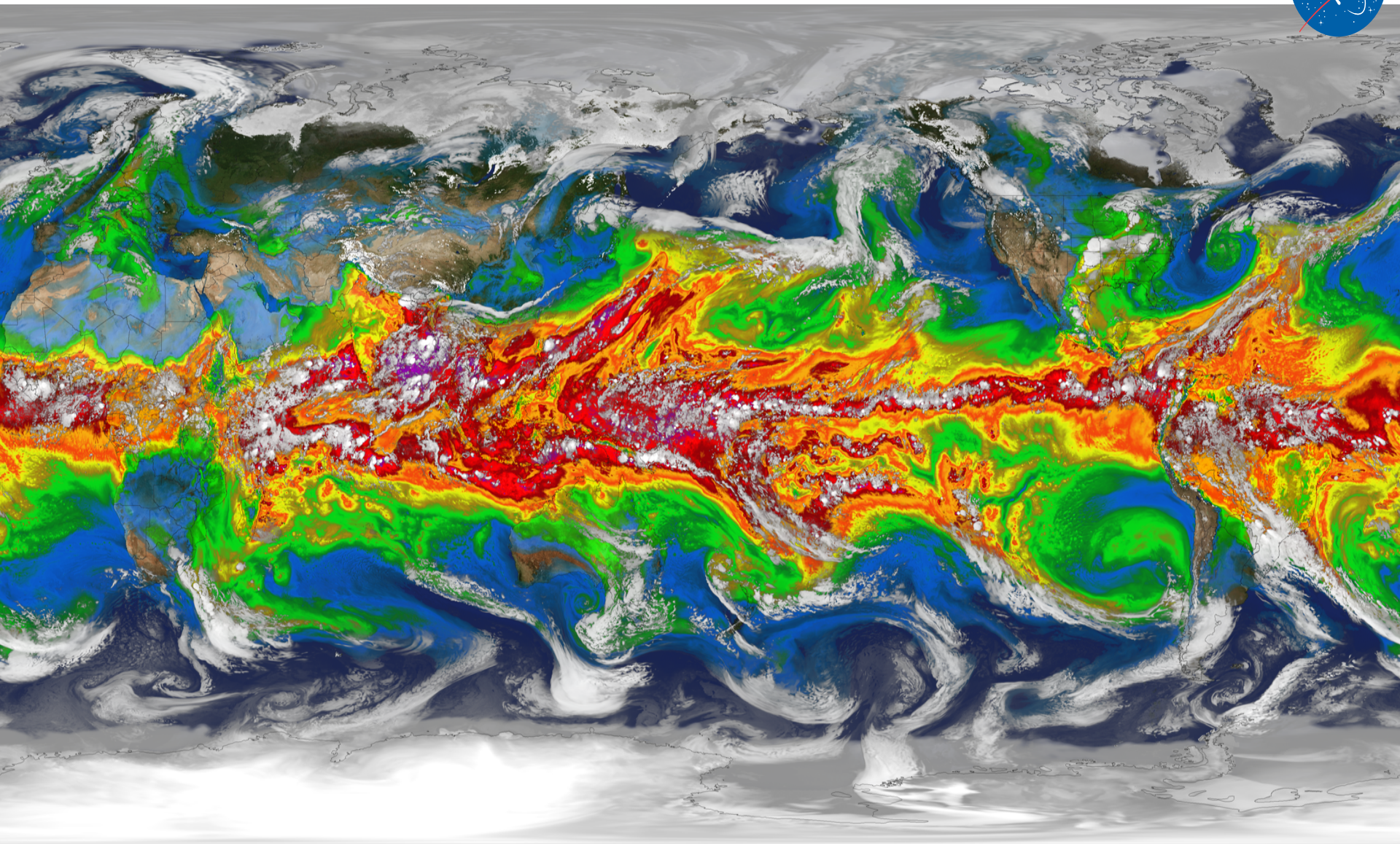
- *subseasonal to seasonal* (e,g. MJO impact on ENSO, Rossby waves/heat waves)
- *seasonal to decadal* (e.g., ENSO and PDO interaction)
- *decadal to centennial* (e.g., PDO and climate change: relative impacts on drought)
- *weather and climate* (e.g., impact of weather on drought) – *resolving weather in global climate models**

Improve initial conditions for forecasts

- improved estimates of atmosphere, land and ocean states
- understanding what matters for prediction

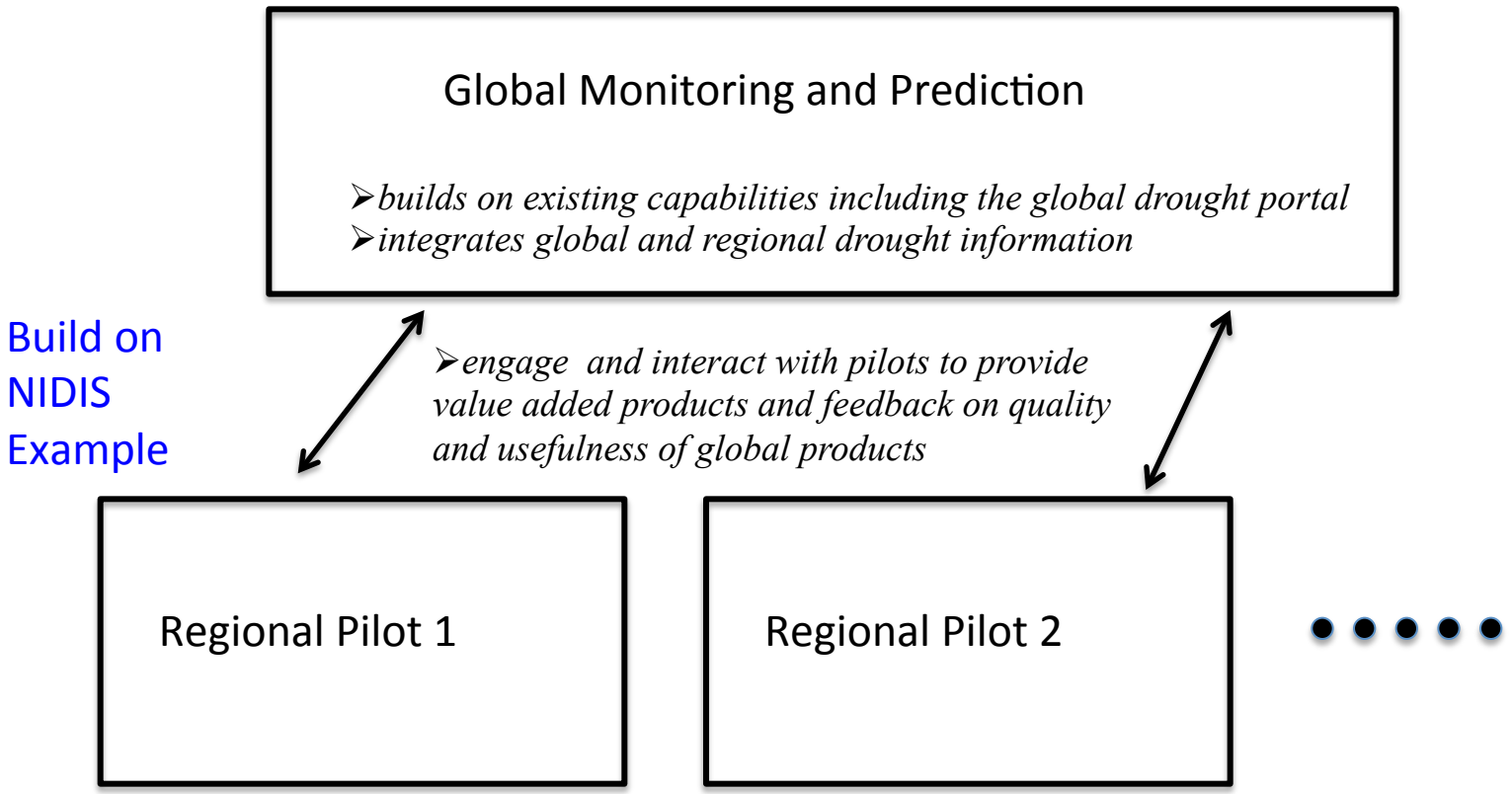
*Gelaro, R., and Co-authors, 2014: Evaluation of the 7-km GEOS-5 Nature Run . Tech. Rep. Ser. on Global Modeling and Data Assimilation, Vol. XX, NASA/TM-2014-104606, 286 pp.

Deep Convective Clouds and Water Vapor in the 7km GEOS-5 Nature Run



Develop a Global Real Time Monitoring and Prediction System

A limited Duration (2 year) Demonstration



Afternoon talks – background for Pilot Studies

- European drought monitoring and prediction – Juergen Vogt (30 minutes including discussion)
- US Drought monitoring and prediction – Kingtse Mo (30 minutes including discussion)
- Drought monitoring and prediction in Latin America – Will Pozzi (30 minutes including discussion)
- Drought monitoring and prediction in Africa – Justin Sheffield (30 minutes including discussion)

Outline of Workshop Agenda

- **Thursday- Dec 11**
- **09:00am** Links to NIDIS and other efforts
- **09:30am** Droughts in different regions of the globe (a scientific assessment, GDIS JCLIM)
- **03:00pm** Special Topics (Research challenges/gaps): discussion/short talks)
- **05:30pm** Synthesis and next steps for drought science
-
- **Friday – Dec 12**

  Regional Needs and Capabilities: Possible contributions to/returns from GDIS
- **09:00am** South America
- **10:30am** Africa
- **11:30am** Other Strategic Partners (China, Australia, South-Eastern Europe)
- **1:30-3:30** Afternoon Breakout Sessions
- **3:30-6:30** Plenary to discuss outcome of breakout sessions (needs/capabilities) and global providers (short talks on global capabilities)

Outline of Workshop Agenda-continued

- **Friday- Dec 13**

- ***GDIS Regional Pilots: The Way Forward***
- **08:30am** Outline of proposal for a GDIS pilot
- **09:30am** Users and expectations
- **11:00am** Review datasets available in real time
- **12:30pm** How to link datasets (Drought Portal)
- **01:30pm** Discussion – Institutional commitments and roles

- **03:30pm** Wrap-up

  Action items

  Present a plan for pilots

  Plans for addressing research gaps