

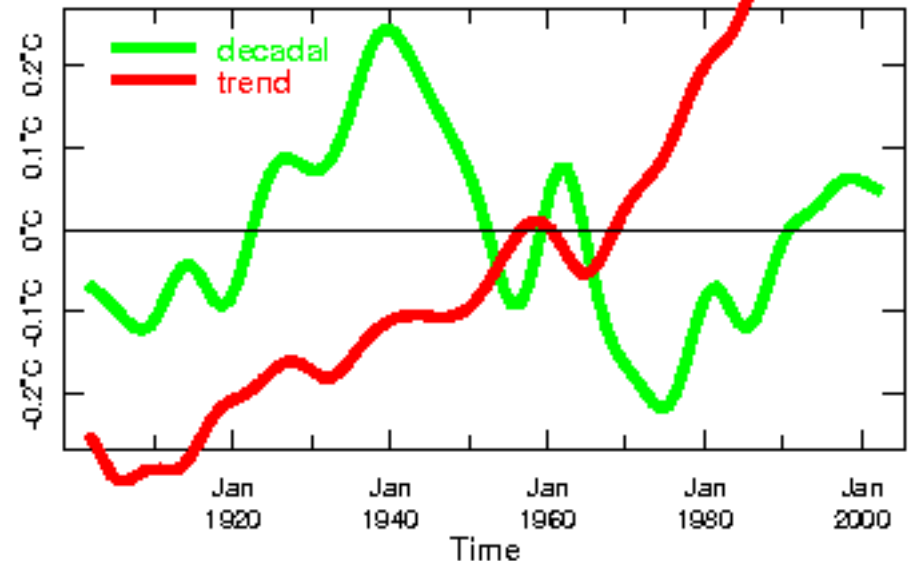
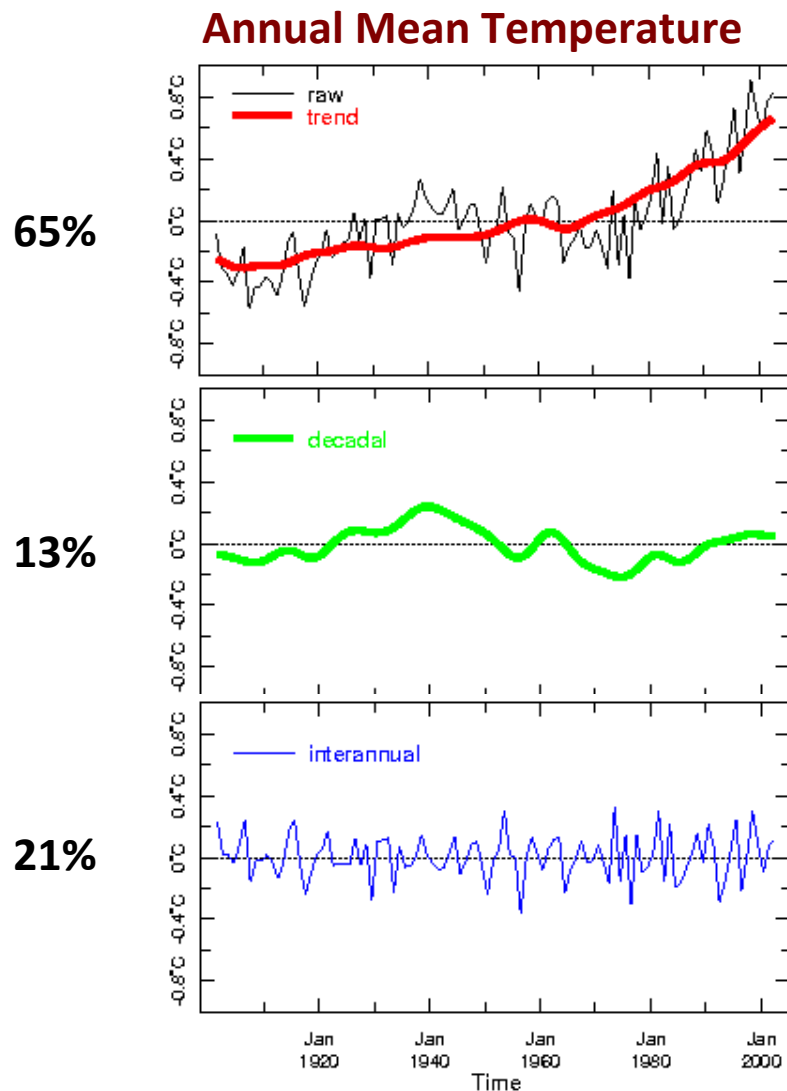
US CLIVAR Decadal Prediction Working Group 2009-2012

Arun Kumar; Lisa Goddard; Amy Solomon
9 July 2013

Membership:

Jim Carton	(University of Maryland)
Tom Delworth	(NOAA/GFDL)
Rim Msadek	(NOAA/GFDL)
Clara Deser	(NCAR)
Ichiro Fukumori	(JPL/NASA)
Lisa Goddard	(IRI/Columbia University)
Ben Kirtman	(University of Miami)
Arun Kumar	(NOAA/CPC)
Yochanan Kushnir	(Columbia University)
Matt Newman	(CIRES/NOAA)
Amy Solomon	(CIRES/NOAA)
Dan Vimont	(University of Wisconsin)
Ex-officio Members	
Arthur Greene	(IRI/Columbia University)
Gabi Hegerl	(University of Edinburgh)
Jerry Meehl	representing WGCM (NCAR)
Doug Smith	(UK Met Office)
Tim Stockdale	representing WGSIP (ECMWF)
George Boer	(CCC)
Rowen Sutton	(U. of Reading)
Ed Hawkins	(U. of Reading)
Ton Fricker	(U. of Exeter)

Climate Variability & Change Globally



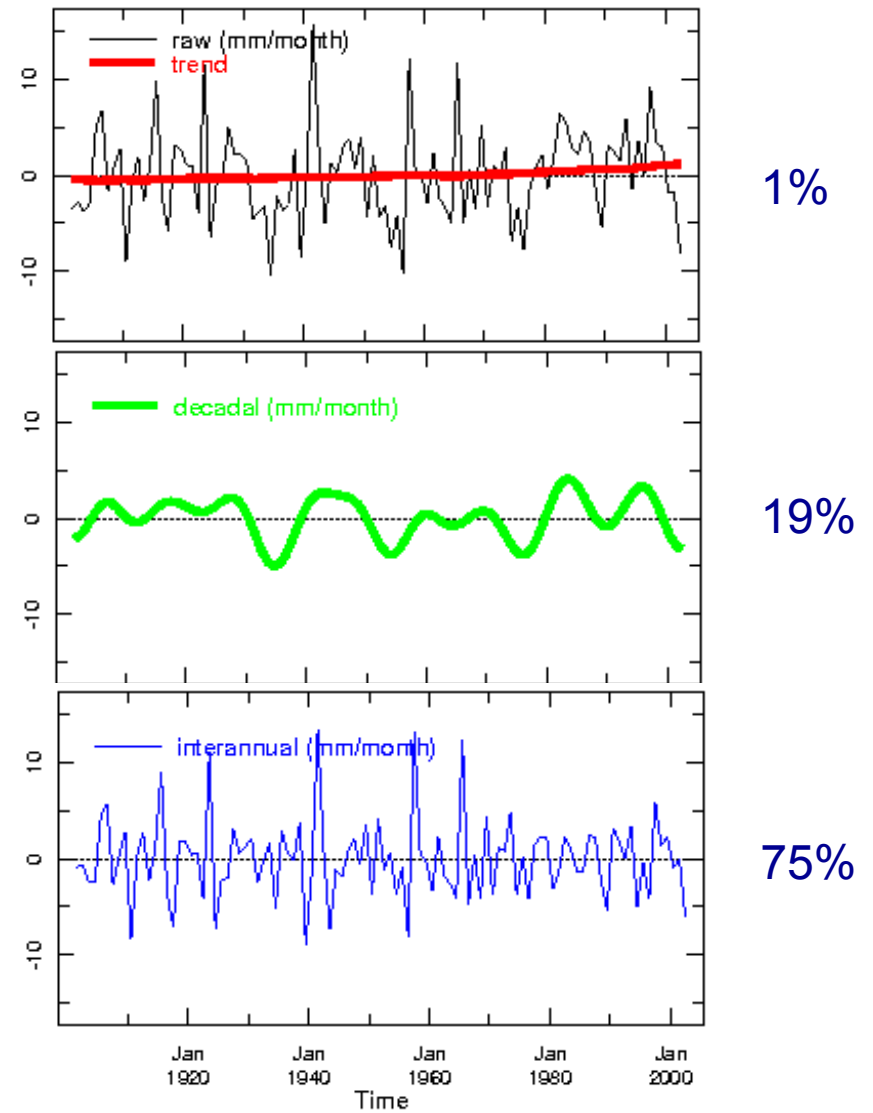
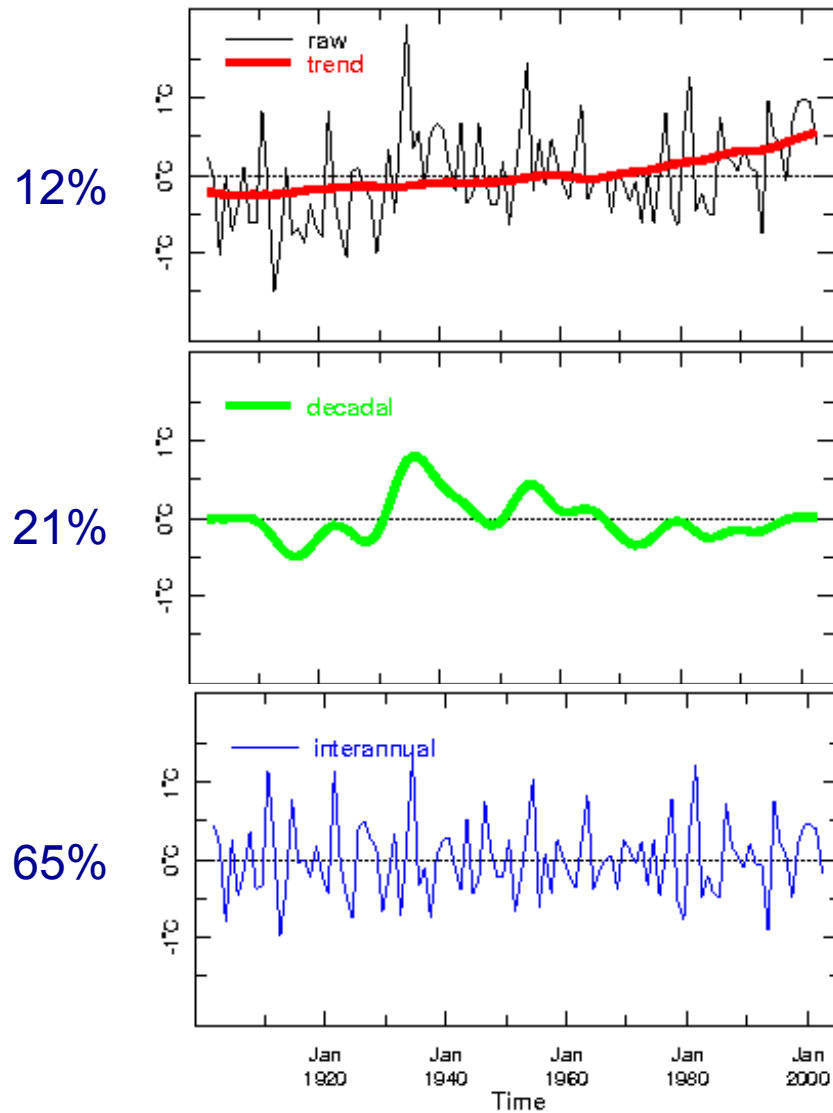
- **There is considerable low-frequency variability (with societal consequences) in the Earth system, and which**
- **Can temporarily *mask* or *enhance* externally forced variability**

http://iridl.ldeo.columbia.edu/maprooms/Global/Time_Scales

Climate Variability & Change in Colorado, USA

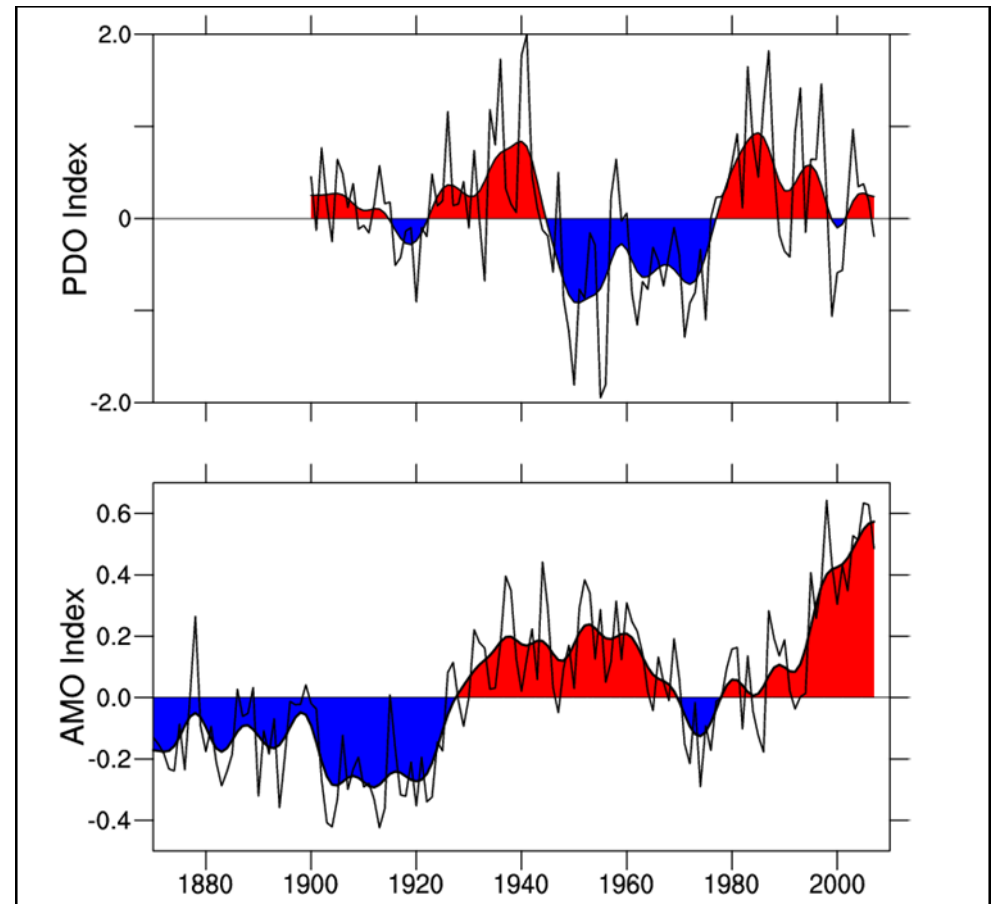
Temperature

Precipitation



Background to the DPWG

Trends superimposed on modes of decadal variability are difficult to discern.



Background to the DPWG

- **To further the understanding of some of the issues related to the (decadal) prediction of the LF natural variability, e.g.,**
 - **what is the decomposition of low-frequency variability into the externally forced and natural components?**
 - **what are the prospects of decadal predictability as an initial value problem?**
 - **how much skill of initialized decadal predictions may improve on other baseline methods? etc.**
- **A Decadal Predictability Working Group (DPWG) was approved in January, 2009, under the US CLIVAR**

Background to the DPWG

- **Objective 1:** Define a framework to distinguish natural variability from anthropogenically forced variability on decadal time scale for the purpose of assessing predictability of decadal-scale climate variations
- **Objective 2:** Develop a set of metrics that can be used to assess and validate initialized decadal climate predictions and simulations

DPWG - Accomplishments

- **First paper related to “objective 1” of the DPWG was published in BAMS 2010**

DISTINGUISHING THE ROLES OF NATURAL AND ANTHROPOGENICALLY FORCED DECADAL CLIMATE VARIABILITY

Implications for Prediction

BY U.S. CLIVAR DECADAL PREDICTABILITY WORKING GROUP: AMY SOLOMON, LISA GODDARD, ARUN KUMAR,
JAMES CARTON, CLARA DESER, ICHIRO FUKUMORI, ARTHUR M. GREENE, GABRIELE HEGERL, BEN KIRTMAN,
YOCHANAN KUSHNIR, MATTHEW NEWMAN, DOUG SMITH, DAN VIMONT, TOM DELWORTH,
GERALD A. MEEHL, AND TIMOTHY STOCKDALE

DPWG - Accomplishments

- **Second paper related to “objective 2” of the DPWG was published in Climate Dynamics 2013 (2012 online)**

Clim Dyn

DOI 10.1007/s00382-012-1481-2

A verification framework for interannual-to-decadal predictions experiments

L. Goddard · A. Kumar · A. Solomon · D. Smith · G. Boer · P. Gonzalez · V. Kharin · W. Merryfield · C. Deser · S. J. Mason · B. P. Kirtman · R. Msadek · R. Sutton · E. Hawkins · T. Fricker · G. Hegerl · C. A. T. Ferro · D. B. Stephenson · G. A. Meehl · T. Stockdale · R. Burgman · A. M. Greene · Y. Kushnir · M. Newman · J. Carton · I. Fukumori · T. Delworth

Received: 10 October 2011 / Accepted: 31 July 2012

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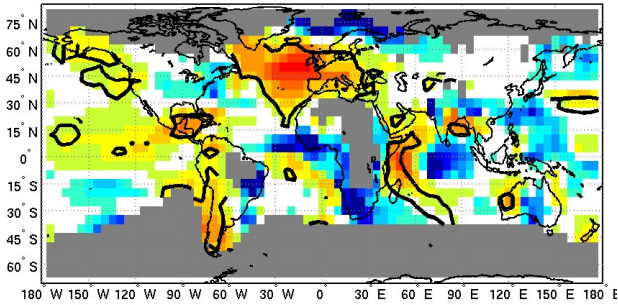
DPWG - Accomplishments

- **2 Manuscripts published – addressing each objective**
- **Establishment of the IRI map room of hindcast skill assessment**
- **Active participation in various workshops related to decadal variability (e.g., WCRP OSC; Aspen; CMIP5 assessment workshop...)**
- **Recommended Call for the small grants program on the analysis of CMIP5 simulations**
- **Participation in the AR5 chapter on short-term prediction of climate**
- **Recommendations to the WCRP/WGCM panel on design and evaluation of decadal prediction runs in CMIP5**
- **Special issue in CLIVAR Variations**

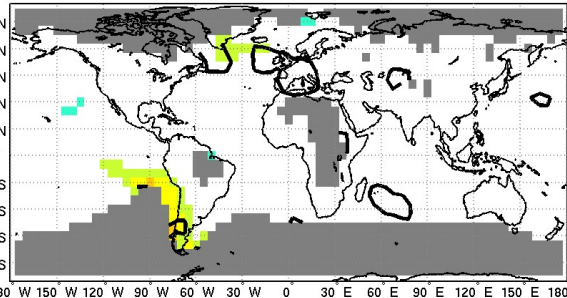
Decadal Predictions: Skill ?

Multi-model Ensemble (12 models: Equal Weighting)

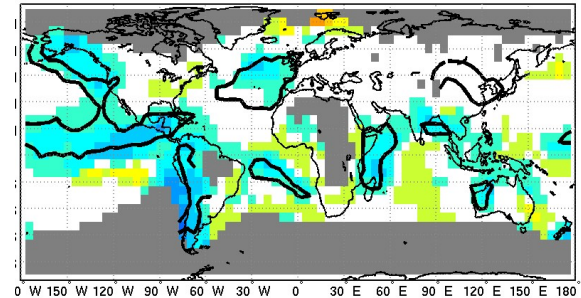
MME temp MSSS: year 2-9 ann
Initialized - Uninitialized



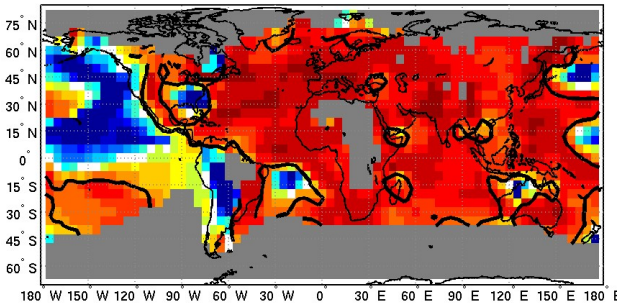
MME temp Correlation: year 2-9 ann
Initialized - Uninitialized



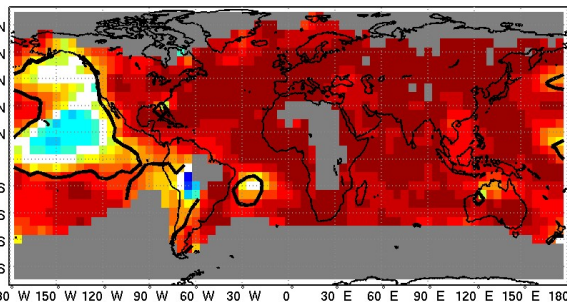
MME temp Conditional Bias: year 2-9 ann
|Initialized| - |Uninitialized|



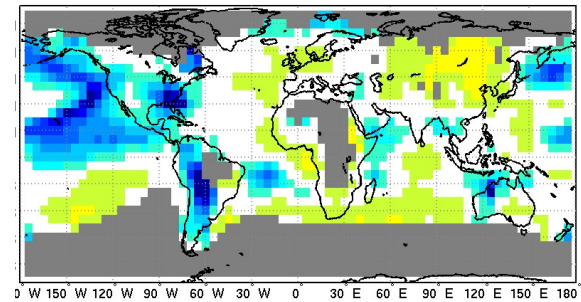
MSSS: Initialized Hindcast



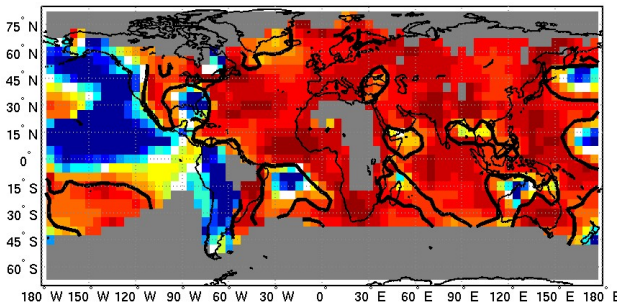
Correlation: Initialized Hindcast



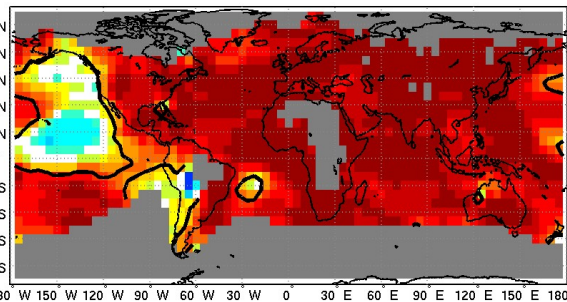
Conditional Bias: Initialized Hindcast



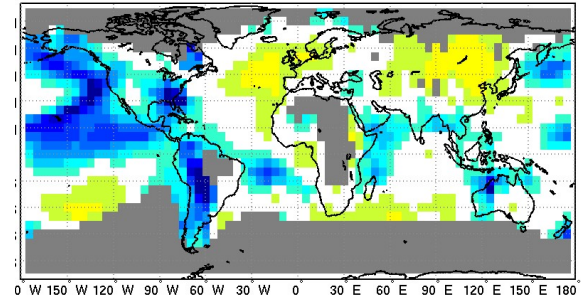
MSSS: Uninitialized Hindcast



Correlation: Uninitialized Hindcast



Conditional Bias: Uninitialized Hindcast



Assessment of Prediction Skill

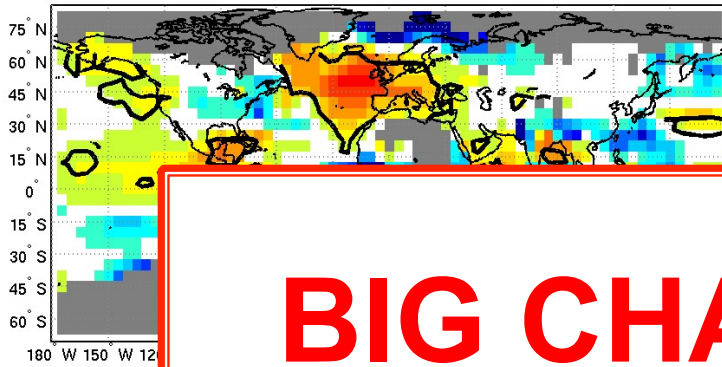
Multi-model Ensemble (12 models: Equal Weighting)

Mean Squared Skill Score

MME temp MSSS: year 2-9 ann
Initialized - Uninitialized

Correlation

MME temp Correlation: year 2-9 ann
Initialized - Uninitialized

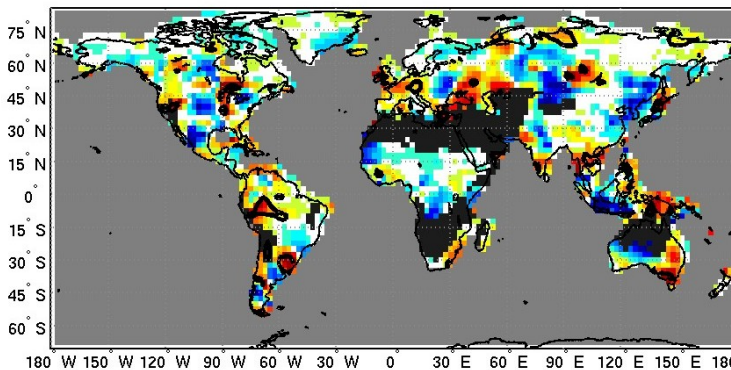
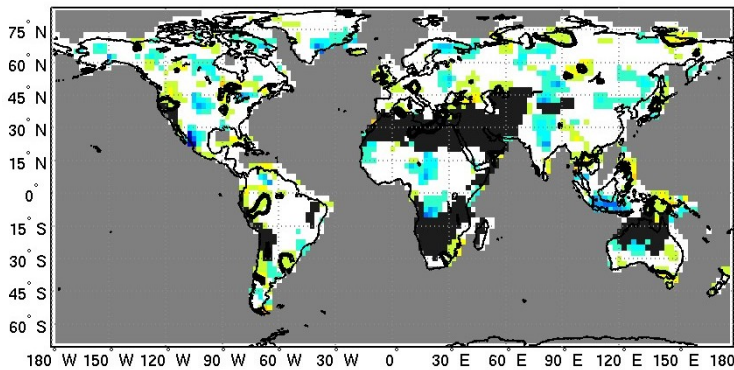


Annual T

BIG CHALLENGE

Initialized - Uninitialized

Initialized - Uninitialized



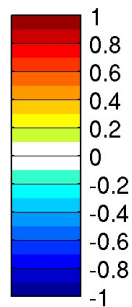
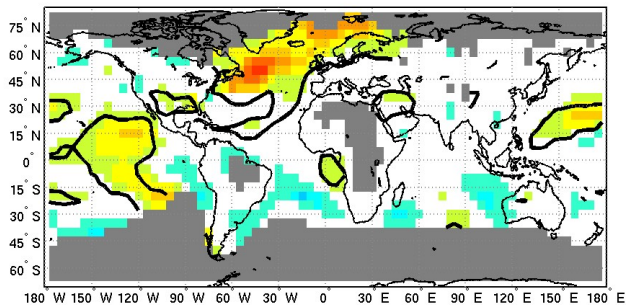
Jul-Aug-Sep P

(based on Goddard et al. 2013, *Climate Dynamics*; See also <http://clivar-dpwg.iri.columbia.edu>)

Assessment of Prediction Skill

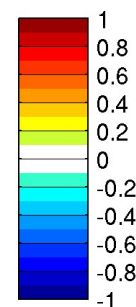
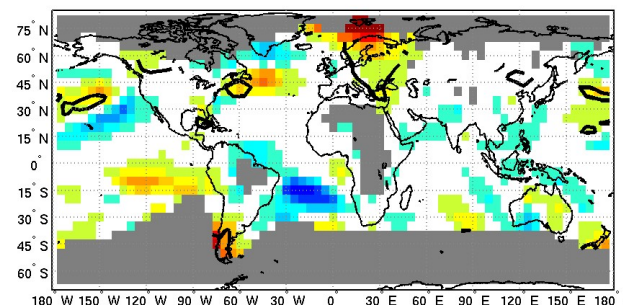
Using ALL start years

DePreSys temp Correlation: year 2-9 ann
Initialized - Uninitialized

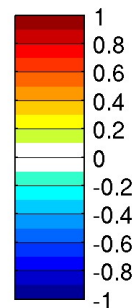
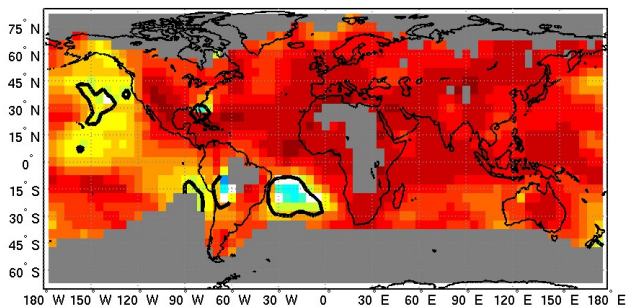


Using Every-5-year starts

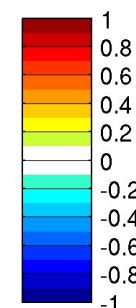
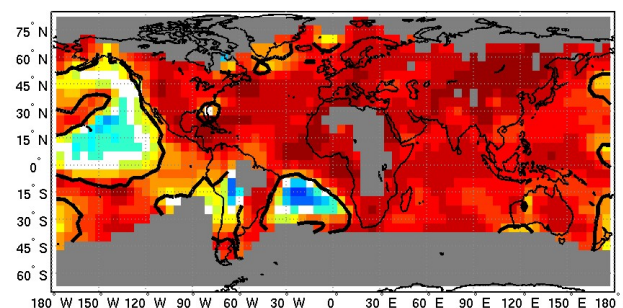
DePreSys temp Correlation: year 2-9 ann
Initialized - Uninitialized



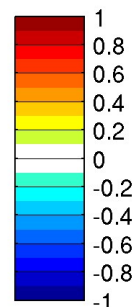
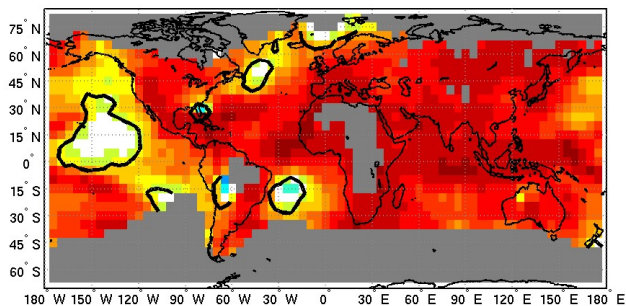
Correlation: Initialized Hindcast



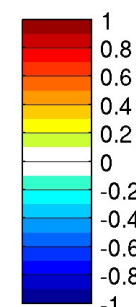
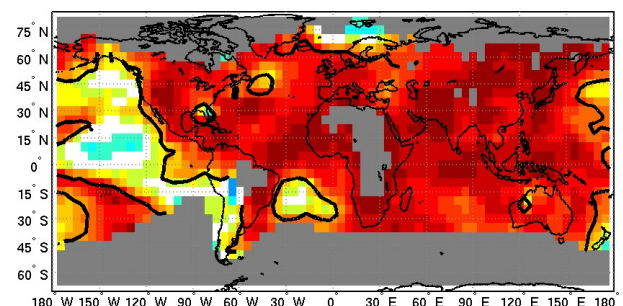
Correlation: Initialized Hindcast



Correlation: Uninitialized Hindcast



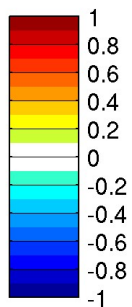
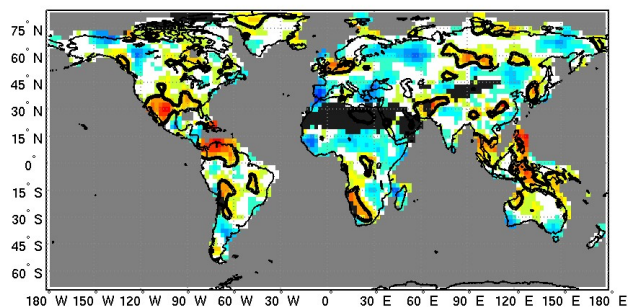
Correlation: Uninitialized Hindcast



Assessment of Prediction Skill

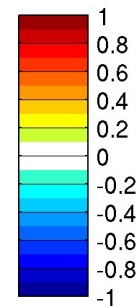
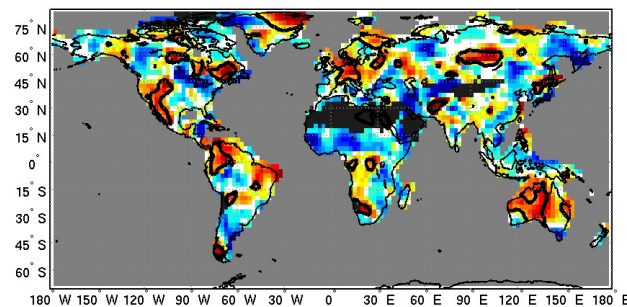
Using ALL start years

DePreSys prcp Correlation: year 2-9 ann
Initialized - Uninitialized

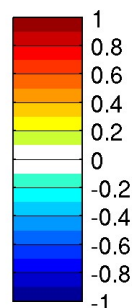
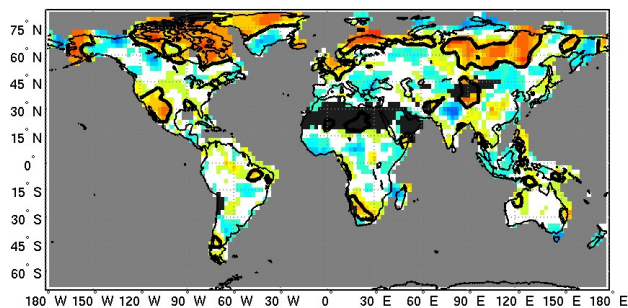


Using Every-5-year starts

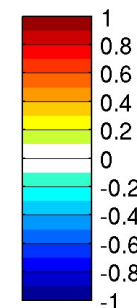
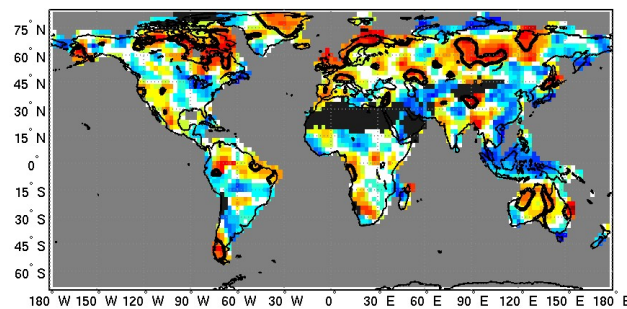
DePreSys prcp Correlation: year 2-9 ann
Initialized - Uninitialized



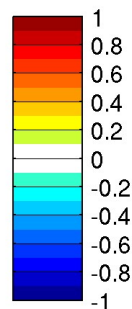
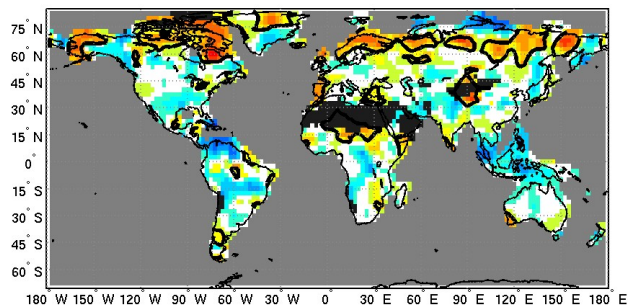
Correlation: Initialized Hindcast



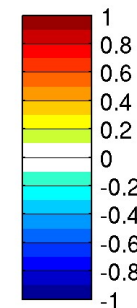
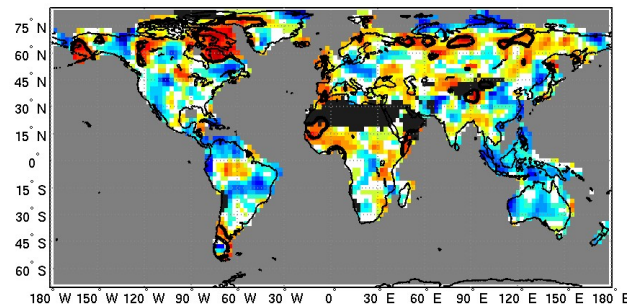
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Correlation: Uninitialized Hindcast



Correlation: Uninitialized Hindcast

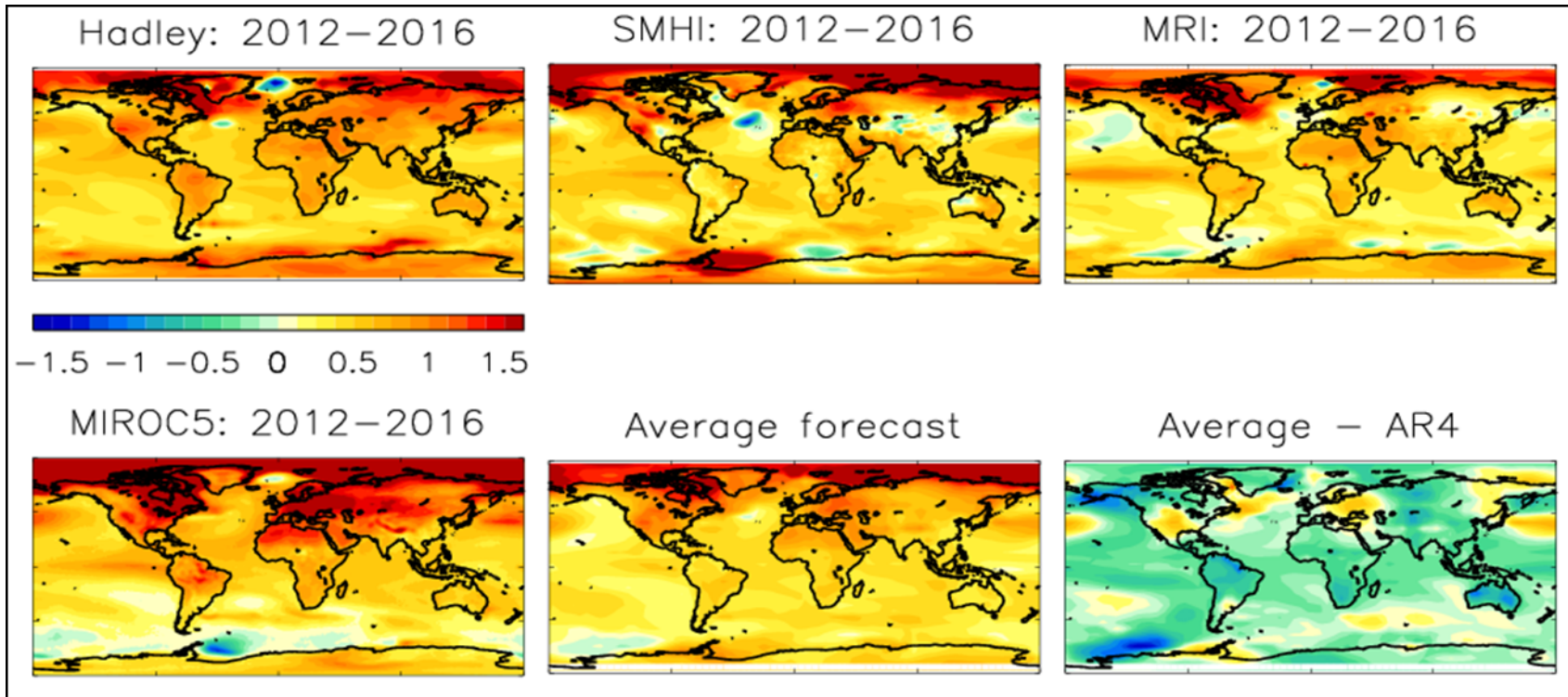


Other Related Activities

- **CMIP5 decadal prediction runs are online**
- **Earth System Grid (ESG) – Data from 16 models**
 - **HadCM3; CanCM4; MRI-CGCM3; MIROC (2);**
 - **IPSL; CNRM; MPI (2); BCC; NCEP; NCAR; GFDL;**
 - **FGOAL; EC-EARTH; GEOS-5**
- **Analysis of skill of decadal predictions using CMIP5 archive**

Experimental Decadal Prediction

- **Experimental real-time ongoing decadal predictions based on once a year exchange of data (organized by Doug Smith)**



Future Evolution of DPWG

- **CMIP-WGCM-WGSIP Decadal Climate Prediction Panel (DCPP)**
 - **Provided recommendations on the submission of decadal runs to the CMIP5**
- **International “Task Force” is developing to map out decadal variability and predictability activities across CLIVAR, linking with US CLIVAR decadal working group and WGCM/WGSIP DCPP**

Decadal Predictions : Some Issues

- **Science issues**
 - **Validating model estimates of decadal predictability**
 - **What are sources of decadal predictability & prediction skill**
- **Technical issues**
 - **Initialization and ensemble generation**
 - **Bias correction**
 - **Ensemble Size vs Number of Predictions**
 - **Verification and evaluations**
 - **Managing expectations**

Meehl et al., 2013: Decadal Climate Prediction: An Update from the Trenches, *BAMS*, *Early On-line Release*.