Shorter Time Scale Session

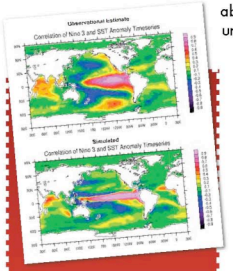
An Advertisement

US CLIVAR Process Study & Model Improvement Panel

Climate Model Improvement with the use of process studies

U.S. CLIVAR - CLIMATE VARIABILITY AND PREDICTABILITY

The mission of the U.S. CLIVAR's Process Study and Model Improvement panel is to reduce the simulation uncertainties in general circulation models used for climate variability prediction and climate change projection through an improved understanding and representation of the physical processes governing climate and its variations.

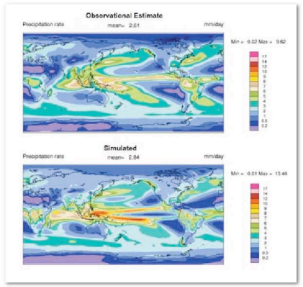


The observed and simulated correlation between an El Nino Southern Oscillation (ENSO) index (Nino 3) and Sea Surface Temperature. Accurately simulating the observed structure and period of ENSO phenomena using global models remains a significant modeling challenge.

Systematic Biases in Climate Models

Established examples of systematic biases include: representation of stratocumulus clouds, the eastern ocean boundary sea surface temperature, a double ITCZ, weak tropical variability, storm track placement and variations, and mid-latitude air-sea interaction. The biases and errors shown in the simulations to the left and below exist in many climate models.

The simulated precipitation (right) exhibits several of the systematic biases listed above. These biases result from complex and subtle nonlinear interactions and feedbacks in the atmosphere and ocean systems. Diagnosing and understanding these processes is an essential part of the model development and improvement.



"BEST PRACTICES" for PROCESS STUDIES

The U.S. CLIVAR Process Study and Model Improvement Panel have established a set of "best practices" for current and future process studies to follow:

1. Entrain modelers during the early planning stages of process studies;
2. Encourage broad use of the data gathered as a result of the process study;
3. Create synthesis data sets that can be used as benchmarks for assessing and validating climate models.

Activities and Opportunities for Involvement

CLIVAR has a rich history in facilitating Climate Process Teams and process studies, and working groups that bring together observationalists, modelers and theoreticians to examine physical processes in the climate system.

The first three CPTs were - 1) Low-Latitude Cloud Feedbacks on Climate Sensitivity (http://www.atmos.washington.edu/~breth/CPT-clouds.html) whose goal is to increase our understanding of tropical and subtropical cloud feedbacks on climate sensitivity, and reduce the large uncertainty in GCM simulations of these feedbacks; 2) Ocean Eddy Mixed-Layer Interactions (http://www.cpt-emilie.org) whose goal is to foster our understanding of the effect of transient eddy motions in the upper ocean and to develop parameterizations of these effects for IPCC-class climate models; and 3) Gravity Current Entrainment (http://www.cpt-gce.org) which aims to to better represent dense gravity currents in ocean climate models.

In addition to improving understanding of key processes, the process studies (shown below) are designed to leave a continuing legacy for the overall climate observational record.

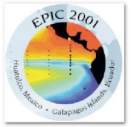
Leadership

Meghan Cronin, NOAA Pacific Marine Environmental Lab
Jim Hack, National Center for Atmospheric Research
Raffaele Ferrari, Massachusetts Institute of Technology
Dick Johnson, Colorado State University
Terry Joyce, Woods Hole Oceanographic Inst.
Bill Large, National Center for Atmospheric Research
Sonya Legg, NOAA Geophysical Fluid Dynamics Lab
Hua Lu Pan, NOAA - NCEP
Paul Schopf, George Mason University
Ken Sperber, Lawrence Livermore Lab
Shang-Ping Xie, University of Hawaii

For additional information: www.usclivar.org

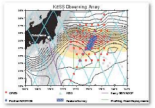
Field Campaigns:
The North American Monsoon Experiment (NAME) which is examining the predictability of warm season precipitation over North America; (www.eol.ucar.edu/projects/name)

and the Eastern Pacific Investigation of Climate processes on the coupled atmosphere-ocean system (EPIC) - designed to observe and understand the ocean-atmosphere processes responsible for the structure and evolution of the large-scale atmospheric heating gradients in the equatorial and northeastern Pacific



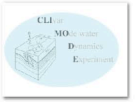
portions of the cold tongue/ITCZ complex. (www.eol.ucar.edu/projects/epic/)

Current process studies include the Kuroshio Extension System Study (KESS) which looks to



understand the processes that govern the variability of and the interactions between the Kuroshio Extension and its recirculation gyre; (www.po.gso.uri.edu/dynamics/KESS/);

CLIVAR MOde Water Dynamic Experiment (CLIMODE) which is examining is examining



the dynamics of the "18°C" subtropical mode water of the North Atlantic Ocean. (www.climode.org)

U.S. CLIVAR
Climate Variability & Predictability

http://www.usclivar.org/Organization/PSMIpanel.html

Questions for the Rappateurs

- What are the outstanding challenges/errors
- Have the root causes been identified
- What are the most glaring deficiencies and the implications
- Are there any emerging research themes
  - Do they warrant new ad-hoc working groups?
- Examples of how errors translate across time scales

Questions for the Rappateurs

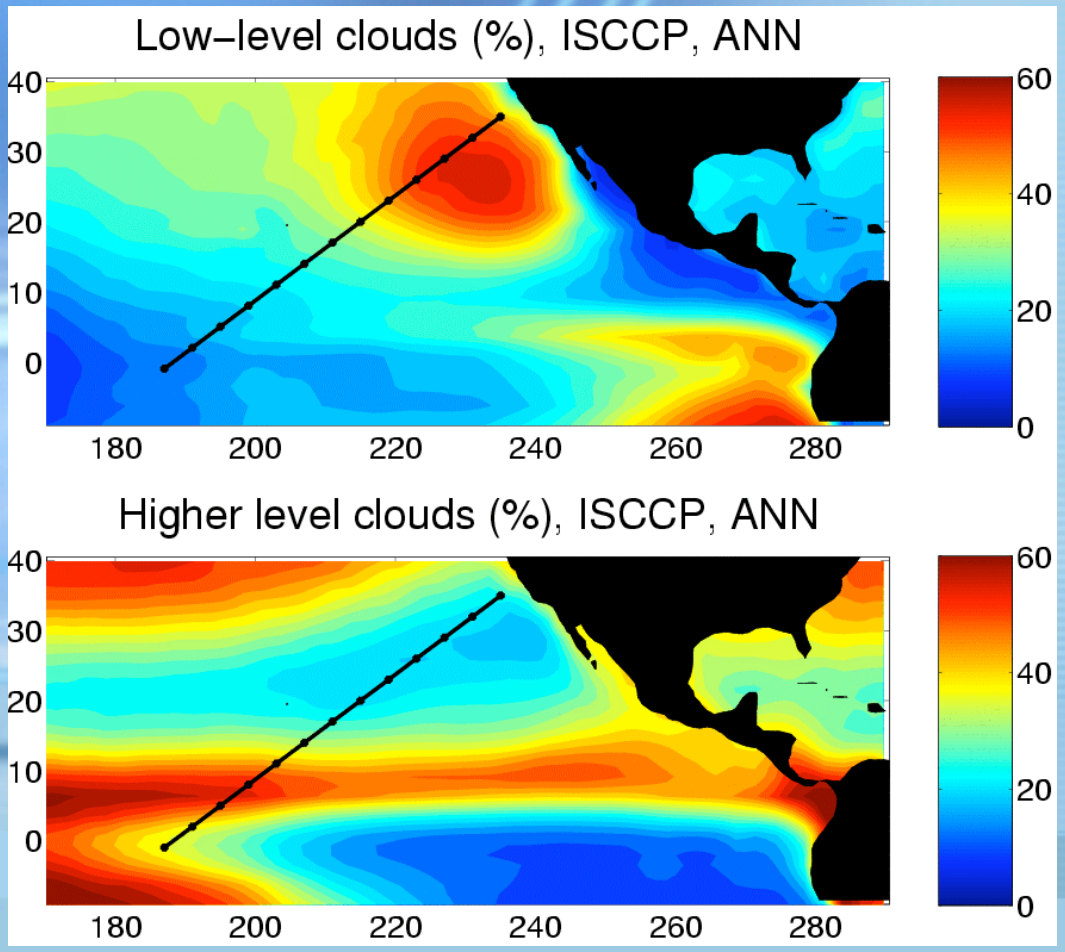
- Are there any emerging research themes
  - *Evaluation of climate models on deterministic time scales*

Short Time Scale

- Evidence of short timescale simulation improvements
  - e.g., improvements in forecast skill scores
  - e.g., systematic reduction of tropical cyclone track error
- Many examples of NWP testing of climate models
  - examples of "seamless" approach to global modeling
  - ability to test process formulation as well as role of resolution
  - illustrates value of a data assimilation component for climate
  - opportunities for evaluating the quality of analysis systems
    - e.g., transplant experiments
  - powerful approach when coupled with observational data

From Hannay et al.

- Pacific Cross-section: ***several cloud regimes***
  stratocumulus, shallow cumulus, deep convection…



EUROCS project
JJA 1998

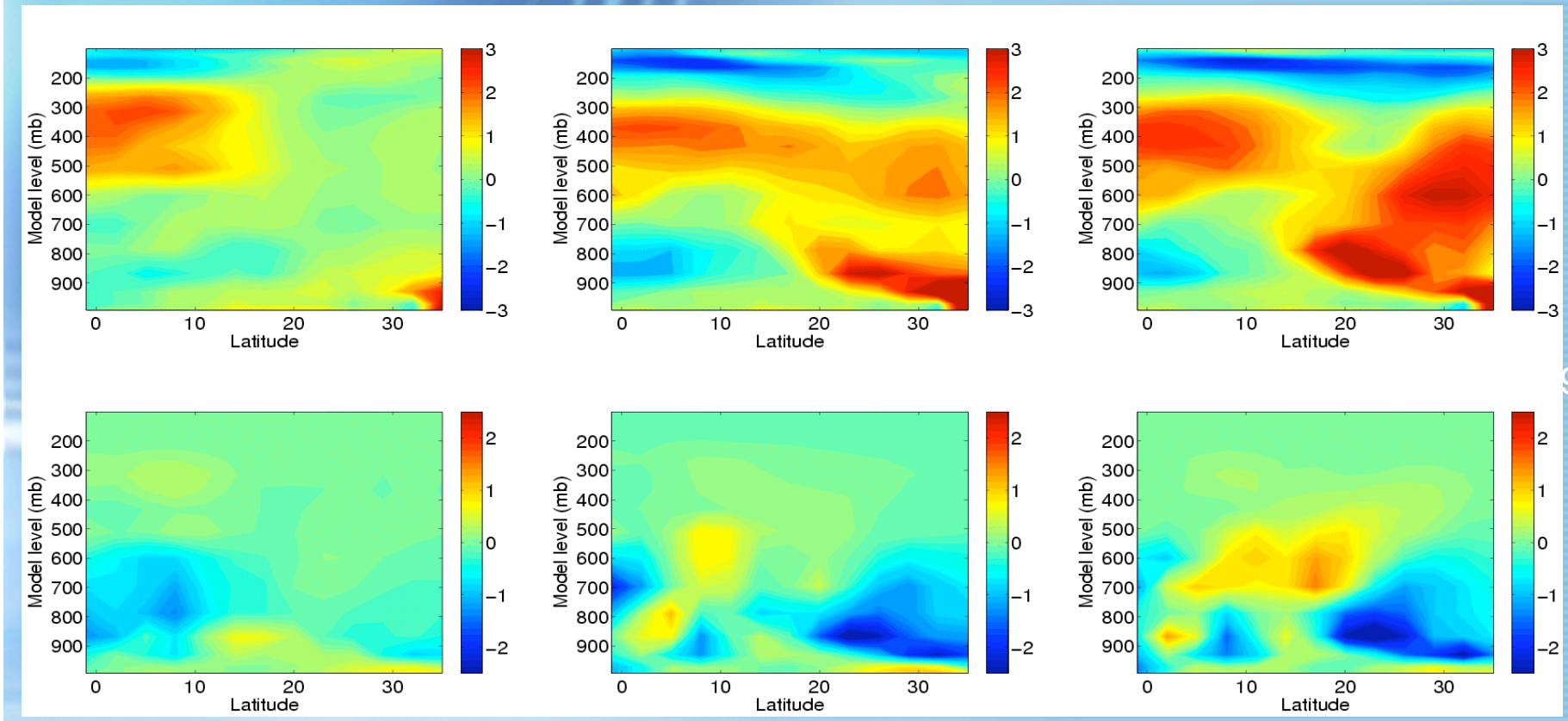
GCSS intercomparison
JJA 1998/2003

Observations
ISCCP data
SSM/I product
TOVS atmosphere
GPCP precipitation
AIRS data

Reanalyses
NCEP/ERA40

Forecast errors and climate errors: Control-ERA40

Forecast T error (K), day 1 | Forecast T error (K), day 5 | Climate T error (K), JJA1998



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- Cloud regimes => range of error structures
- Climate bias appears very quickly in CAM
- Climate error ~ Forecast error at day 5

NWP Evaluation of Climate Models

- Demonstrated technique for improving climate model formulation
  - provides valuable connection to observational data
- Illustrates importance of a data assimilation component for climate models
- Unique configuration for evaluation of diurnal cycle, a principal mode of climate variability