NOAA Climate Program and CPPA Overview
(Climate Prediction Program for the Americas)

Jin Huang

NOAA Climate Program Office

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NOAA CLIMATE GOAL

Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond


OUTCOMES

- A predictive understanding of the global climate system on time scales of weeks to decades with quantified uncertainties sufficient for making informed and reasoned decisions

- Climate-sensitive sectors and the climate-literate public effectively incorporating NOAA's climate products into their plans and decisions

Monitor the state of the climate

Observations and Monitoring

- Climate System Observations -
  Ocean
  Atmosphere
  Arctic
  Carbon

- Data Management and Information –
  NOAA's Comprehensive Large Array-
  data Stewardship System
  State of the Climate Report
  Climatological Statistics and
  Summaries
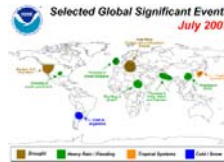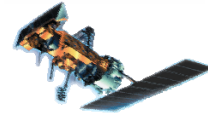
Understand the future state of the climate

Climate Research and Modeling Program

- Understanding Climate Processes –
  NOAA's Research Laboratories,
  Centers, and Cooperative
  Institutes
  Competitive Grants
  Climate dynamics, atmospheric
  composition, carbon cycle

- Earth System Modeling,
  Predictions, and Projections –
  GFDL and NCEP
  Coupled climate models
  Earth system model development

- Analysis and Attribution –
  Reanalysis
  Integrated Earth System Analysis
 Attribution

GFDL MODEL
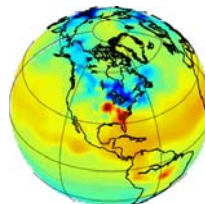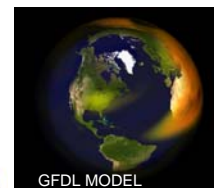
Assess evolving user needs and context

Climate and Societal Interactions

- Assessing Climate, Impacts and Adaptation –
  Global, national, regional, sectoral assessments of vulnerability, impacts and adaptation

- Climate Services Development and Delivery –
  National Integrated Drought Information System (NIDIS)
  Emerging foci on Coasts, Arctic, Fisheries,…
  Regional
  International
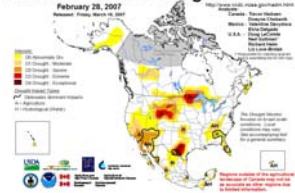
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Updates on NOAA Climate Program

- **Moving towards to National Climate Service**

- **In a process of setting new research themes for FY12-16**

  - Regional scale Information for Understanding and Addressing Climate Variability and Change

  - Climate Information for Risk Management

  - Climate Change, Oceans, Coastal and Great Lakes Ecosystem Interactions

  - National Climate Service Infrastructure

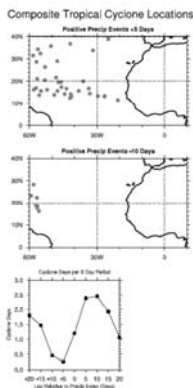# Climate Prediction Program for the Americas (CPPA)

Science Objectives:

- **Mission**: Improve operational intra-seasonal to interannual hydroclimatic predictions for the Americas

- CPPA is one of grant programs in NOAA Climate Program.

- CPPA contributes to CLIVAR (including VAMOS) and GEWEX programs.

- Quantify the sources and limits of **predictability** of climate variations on intra-seasonal to interannual time scale

- Improve **predictive understanding** and model simulations of ocean, atmosphere and land-surface processes, including the ability to quantify uncertainty

- Advance NOAA's **operational** climate forecasts, monitoring, and analysis systems by transferring research to operation

- Develop climate-based **hydrologic forecasting** capabilities for decision support and water resource applications
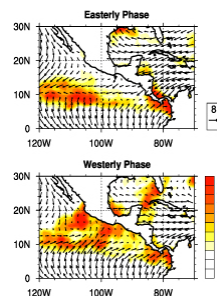

CPPA Major Activities & Accomplishments
Predictability of Climate Phenomena

Extremes

MJO Variability

Monsoons

Diurnal mechanism along the SMO (Nesbitt and Gochis)

Composite of unfiltered wind vectors and precipitation for the easterly and westerly MJO phases (Maloney)
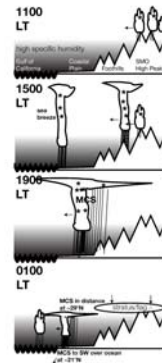
Tropical influences on drought North America (Huang and Seager)

Impact of intraseasonal variability on the formation of tropical Atlantic Storms (P. Webster)

Droughts
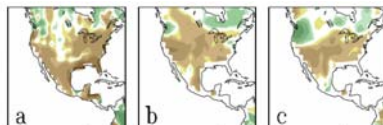
CPPA Major Activities & Accomplishments
Coupled Processes in the East Pacific

Synthesis of Existing Data in the Equatorial East Pacific

Integrating observations and analyses from EPIC 2001 Field Experiment and extended observations in 2003-2007 for a comprehensive picture of cloud and boundary layer processes in the Equatorial East Pacific.

Assessing current model capabilities

PREVOCA project to assess the ability of global and regional models to simulate and predict synoptically-varying clouds, meteorology, ocean circulation and aerosols in Southeast Pacific.
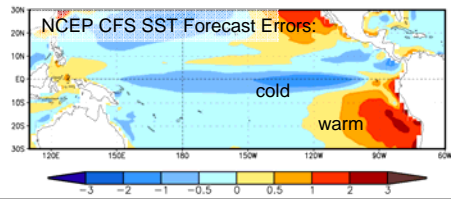
GOAL

Build a comprehensive picture of coupled ocean-atmosphere-land processes in the East Pacific and eliminate systematic errors in coupled GCMs.

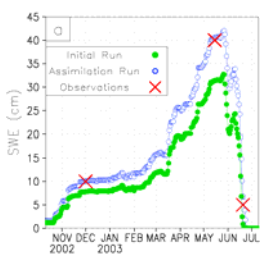**VOCALS-REx 2008 Field Experiment in the**

NOAA Ship Ronald H. Brown
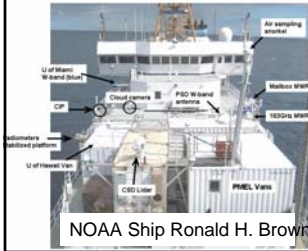
Improving Cloud and SST Biases in NCEP and GFDL Coupled Models

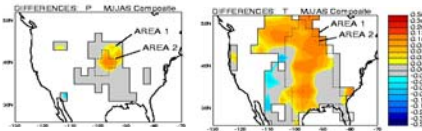NCEP CFS SST Forecast Errors:

cold

warm

CPPA Major Activities & Accomplishments
## Process Studies (Land-Atmosphere Interaction)

A snow evolution modeling system (**SnowModel**) and A Simple Data Assimilation System (**SnowAssim**) (Liston and L. Lu)

GLACE-2: Quantifying the Effects of Land Moisture Initialization on Precipitation Forecasts (R. Koster)


Increase in forecast skill associated with land initialization for monthly precipitation (left) and monthly air temperature (right), as determined from a pilot experiment (the prototype for GLACE-2)
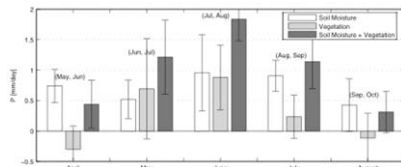
Impact of **Vegetation and Soil Moisture Feedback** on Precipitation (after G. Wang)
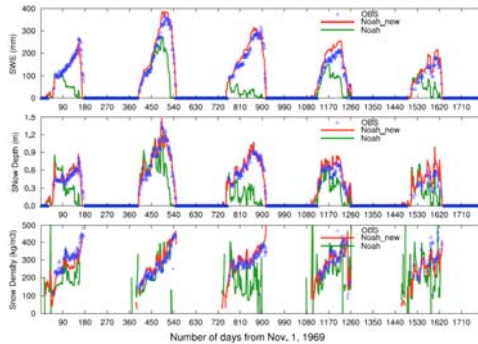
CPPA Major Activities & Accomplishments
Model Development

CFS Errors

Improving Noah Land Model
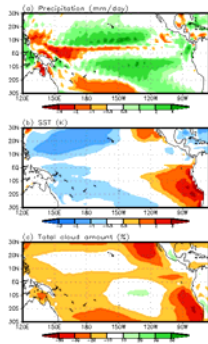
- Diagnoses of tropical biases in CGCMs (Mechoso and H. Pan)

-

- Using VOCALS data to develop and evaluate stratiform cloud parameterizations (L. Donner)

Improvements in snow modelling include:

- snow simulations and the diurnal cycle of the skin temperature of snow, and melting processes.
- runoff and the simulation of soil moisture in winter time. (Z-L Yang, K. Mitchell)

CPPA Major Activities & Accomplishments
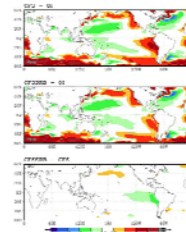## Improving Climate Forecasting

Test impacts of different land models and land initial land states on CFS reforecasts (K. Mitchell)
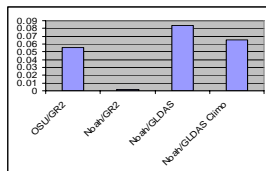
CONUS-average Anomaly Correlation:
CFS JJA ensemble mean precipitation forecasts

Multi-RCM Ensemble Downscaling (MRED) of multi-GCM Seasonal Forecasts (Arritt & others):
-**Objective:** to demonstrate the usefulness of multi-RCM downscaling of global seasonal forecasts
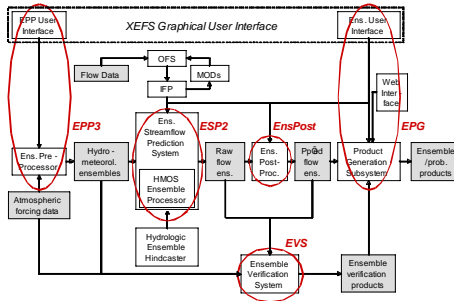- **Central archive accessible for communities**

Investigating the role of radiation and winds in CFS biases (P. Xie and W. Wang)

CPPA Major Activities & Accomplishments
Improving Hydrologic Forecasting

- Development of eXperimental Ensemble Forecast System (XEFS) at NWS/OHD (Restrepo)

- Implemented various components at RFCs

<u>Other funded activities</u>:
- **Snow data assimilations** (Clark and Slator; P. Houser)
- Participate Distributed Model Intercomparison Project (**DMIP-2**)
- **Multi-model data integration and assimilation system** fpr NWSRFS ensemble hydrologic predictions (Toll)
- Development a coupled distributed model with WRF for large **watersheds** (Bras)
- **Regional hydrologic forecasting** model in California (Sorooshian)
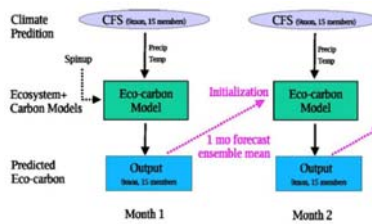

CPPA Major Activities & Accomplishments
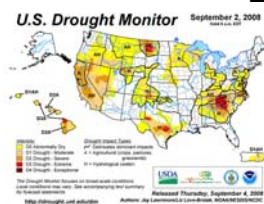### Applications of Climate Predictions

Experimental Seasonal **Hydrologic Prediction System** (Lettenmaier & Wood))
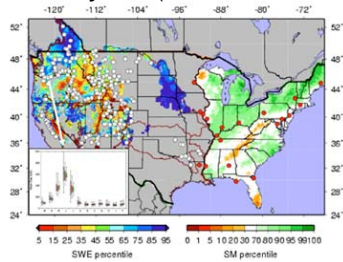
Prototype **Fire Danger** Forecast System (N. Zeng)

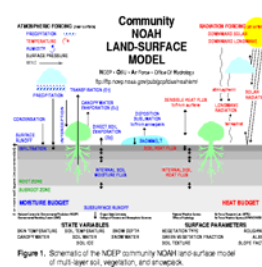### Contributing to Drought Monitoring and
Prediction Products

Mitchell, K. Mo, B.

CPPA Major Activities & Accomplishments
Transitioning Research to Operations

Contributions to NOAA Operations:
-Developed and Implemented of the **land component** in NCEP next generations CFS
- Land Data Assimilation System (LDAS)
- Noah Land Model
- Reducing **tropical biases** in CFS
- Improving **hydrologic forecasting** in NWS/OHD and RFCs
- Global **Monsoon Monitor** at CPC
- **Drought** monitoring and prediction products (contributing to NIDIS)

Figure 1. Schematic of the NCEP community NOAH land-surface model of multi-layer soil, vegetation, and snowpack.

K. Mitchell

Transitioning Mechanisms

- **Core Projects** (NCEP/EMC, OHD&RFCs)
- conduct operation-related research and implementation
- transfer research results from CPPA PIs to NWS operations

.

- **CPPA Synthesis Teams** & **Joint university-NCEP competitive projects**

- **NOAA Climate Test Bed**

CPPA New and Future Activities
Contributing to VAMOS

- **Monsoons:**
  - **Berbery and Mo**: "Monitoring and Prediction of Hydroclimate over Pan America based on the Climate Forecast System Reanalysis and Reforecast Products" (**FY09**)
  - **Future research in FY11 and beyond?**

- **IAS**
  - **6** new projects (**4** in **FY09** and **2** in **FY10**) focusing on predictability in IAS region, and IAS Impact on America's climate
  - **Future?**

- **VOCALS**
  - completed field experiment in **FY08**
  - post-campaign analysis and modeling studies (**FY10**)

- **VAMOS Cross-cutting Themes**
  - Modeling
  - Extremes

- **VAMOS Project Support Office at UCAR**

- **VAMOS Data Management**

Comments/Questions for IASCLIP

- **Justification for a field experiment in IAS region**

  - <u>process study</u>: focused process? scientific hypothesis? improving climate models? involvement of modelers? (example: DYNAMO)

  - <u>enhancing monitoring:</u> importance of IAS region; sustainability issue; use of satellite data
    - Need to engage NOAA Climate Obs. and Monitoring Program

  - <u>applications</u>: impacts of IAS region on extremes (hurricanes)?

- **Timing is a secondary issue**