CPPA 2008 Report to CEOP
(Climate Prediction Program for the Americas)

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NOAA Climate Program Office

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(presented by Raymond Arritt)

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**

CPPA

PROGRAMS

- Observations and Monitoring
- Climate Research and Modeling
- Climate Services Development

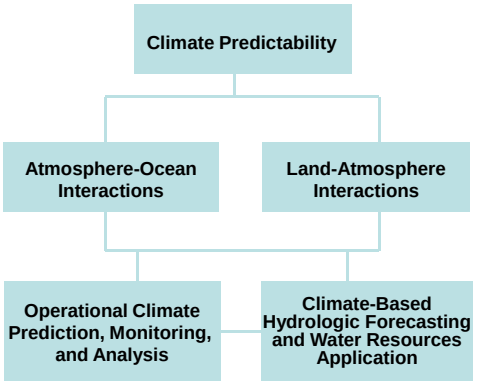
Climate Prediction Program for the Americas (CPPA)

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

CPPA Objectives:

- 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

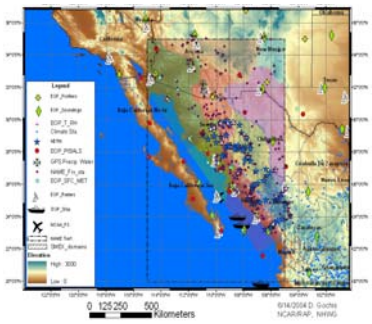
Research Components



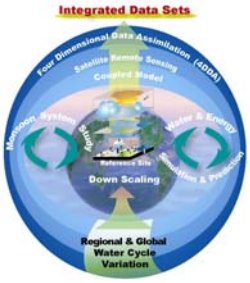
CPPA Contributions to GEWEX-II Objective 1

…. produce consistent research quality data sets…..

- Support research quality climate observing system in North Mexico
- Provide data from 2004 NAME field experiments to research community for process studies, validation for models and satellite estimates



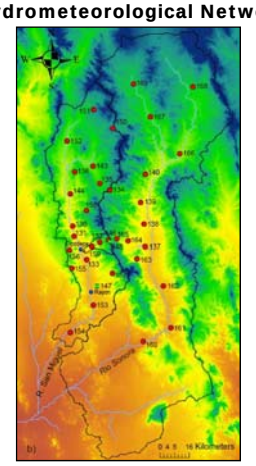
The NAME 2004 Field Campaign



- Support data management for Global CEOP in-situ reference site data
- Provide data in CPPA region (in-situ, remote sensing, and global and regional land and coupled assimilation products) to CEOP

Sonora 2008 NAM Intensive Observations

RIO SONORA
Hydrometeorological Network



(PI: E. Vivoni)

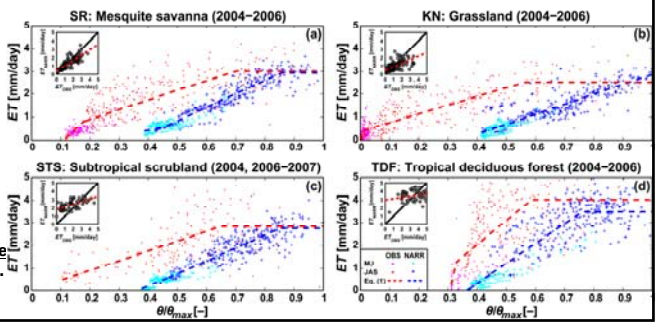
Field Campaign Data Sets Used For:

1. Determining seasonal shifts in the energy and water balance at the point and basin scales (and vegetation controls).
2. Providing forcing and verification data sets for land surface models in the NAM region (Noah and tRIBS models).
3. Developing soil and vegetation parameterizations that can be used in the broader NAM region.
4. Improving seasonal hydrological forecasting and assessing changes in runoff mechanisms through distributed models.

Field Instrumentation:

1. 10 additional rainfall and soil moisture stations (35 total in network).
2. High elevation eddy covariance tower (evapotranspiration).
3. 3 scintillometer transects (sensible heat flux).

Comparison of NARR with Observations of ET-Soil Moisture Relation



CPPA Contributions to GEWEX-II Objective 2

…. Enhance the understanding…. …..

Quantify the roles of SST forcing and land surface in seasonal predictability
- monsoons
- drought and extremes

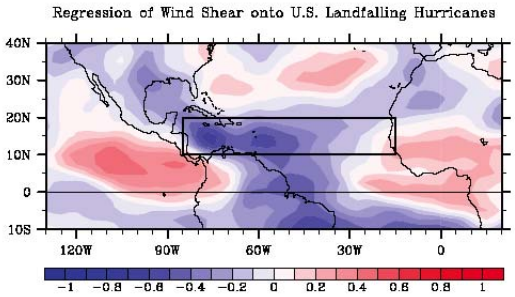
Improve understanding of land surface processes
- soil moisture, snow, vegetation, topography
- two-way (forcing and response)
- example: mountain hydroclimate processes

Water and Energy budget studies in CPPA region

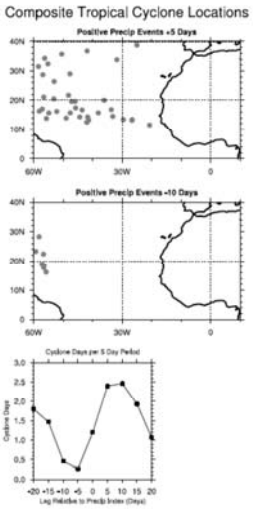
CPPA Extremes Studies

- Impact of intraseasonal variability on the formation of tropical Atlantic Storms.

- Impact of wind shear on U.S. landfalling hurricanes



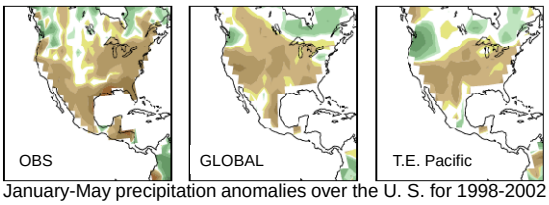
(C.Z. Wang)



(P. Webster)

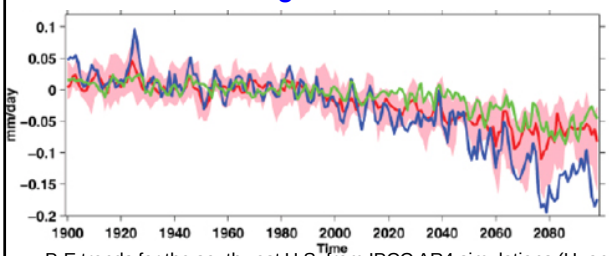
CPPA Drought Predictability Studies

Tropical influences on drought North America



January-May precipitation anomalies over the U. S. for 1998-2002 (Huang and Seager)

Future droughts in the southwest



P-E trends for the southwest U.S. from IPCC AR4 simulations (Huang, Seager)

New FY08 Projects:

- **Roles of SST modes**
- Role of **remote convection**
- Influences of **multi-ocean basins**
- Roles of **vegetation and sub-surface water** and drought impact on phenology;
- Diagnosis of **water budget and moisture sources** during drought
- **Hydrological predictability in the West** under drought conditions

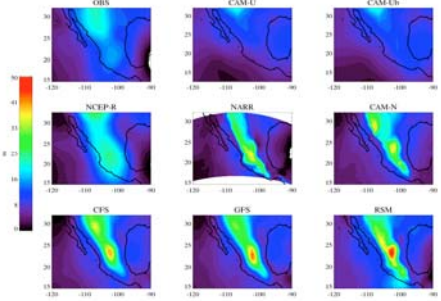
Potential US-Canada collaboration on studies on N. American Drought ?

CPPA Monsoon Process Studies

diurnal variability

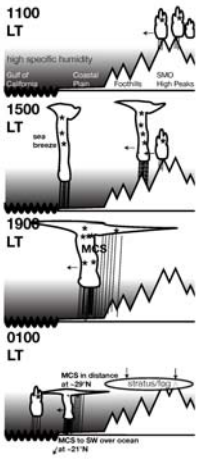
- Diagnoses of observed NAM diurnal variability
- Formulation a conceptual model of diurnal convection
- Role of SST on the diurnal cycle of the NAM and development of ad-hoc datasets
- Model representation of the diurnal cycle of convection: role of the “convection trigger mechanism”

Diurnal difference in 850-500 hPa geopot. thickness



NAMAP2 models, Re-analyses and obs. (Schemm et al.)

Diurnal mechanisms along the SMO



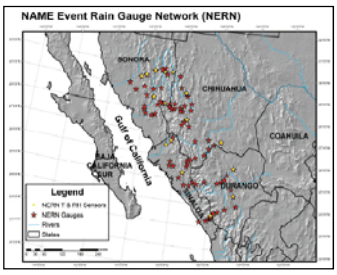
Nesbitt and Gochis

CPPA High-Elevation Studies

- CPPA co-sponsored North American Mountain Hydroclimate Workshop (Oct 07)

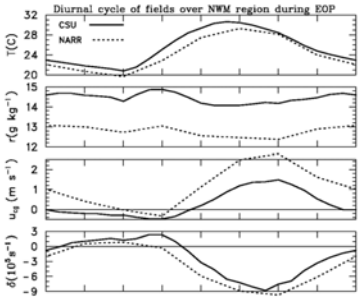
- A. Mariotti (Associate Program Manager) attended CEOP-HE Workshop

- Land surface-climate interaction in cold season and high-elevation is one of CPPA FY09 priorities



NAME rain gauges across mountains

Evaluation of the North American Regional Reanalyses (NARR) over Complex Terrain



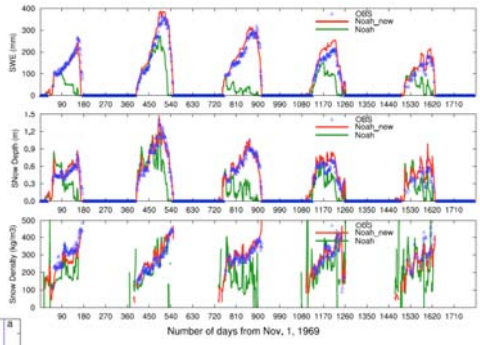
CPPA Contributions to GEWEX-II Objective 3

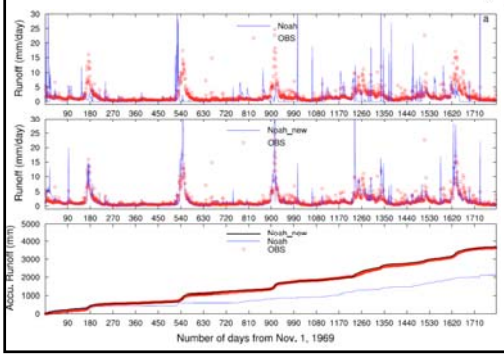
…. Improve the predictive capability …..

- Assess land -surface process simulations in NCEP Global Model using CEOP reference site observations
- Implement Global Land Data Assimilation System (LDAS) for NCEP Climate Prediction System (CFS)
- Participate GMP initiated modeling activities, such as, **GLACE-2**, various model inter-comparison projects
- Model improvement in areas of complex terrain and cold season
- Develop data assimilation methods and systems
- Use of satellite data over land for predictions

Improvements in Snow Modeling

New components in an experimental NOAH set-up:
- a simple groundwater model with a TOPMODEL-based runoff scheme,
- a physically-based 3-layer snow model,
- a frozen soil scheme that produces larger soil permeability.





Improvements 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.

PI: Zong-Liang Yang

A New FY08 CPPA Project:
Multi-RCM Ensemble Downscaling of multi-GCM Seasonal Forecasts

Objective: **Demonstrate the usefulness of multi-model downscaling of global seasonal forecasts for hydrologic applications**.

Contributions to Climate Predictions:

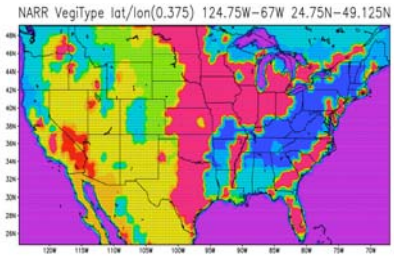
- To examine the role of downscaling in improving GCM prediction skill
- To provide predictions at higher resolution and regional level for hydrologic applications
  - contributing to better climate services
  - comparison of dynamic downscaling and statistical downscaling

Multi-RCM Ensemble Downscaling of multi-GCM Seasonal Forecasts (MRED)

Downscale 25 years of **reforecasts** from new NOAA CFS global seasonal forecast model: T126L64 (~0.95^{o} lat/lon, 105 km)

Will also downscale reforecasts from new NASA seasonal forecast model based on GEOS5 GCM coupled with MOM4 ocean

Regional model resolution 32 km, similar to North American Regional Reanalysis (NARR)

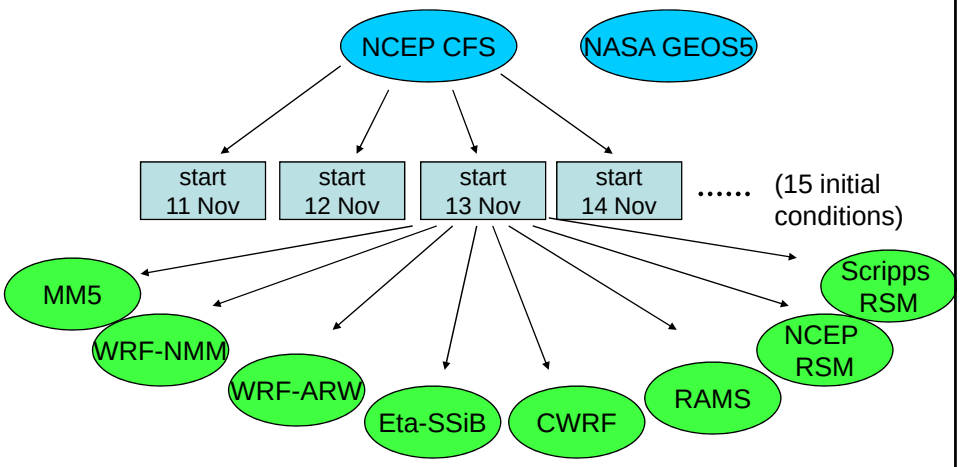


Regional models will be used to create a **multi-model** ensemble with **multiple runs by each model**

- Three versions of WRF
- Two versions of RSM
- MM5
- RAMS
- Eta-SSiB

Each regional model will run 15 ensemble members from each global model

MRED Ensemble



MRED Participants

• Jin Huang, NOAA	Program manager
• Annarita Mariotti, NOAA	Associate program manager
• John Roads (deceased), Scripps	Project originator, lead coordinator
• Raymond Arritt, ISU	Lead coordinator, MM5
• Chris Anderson, ISU	WRF-NMM-ESRL, MM5
• Bill Gutowski, ISU	MM5
• H.-M. Henry Juang, NOAA	CFS forcing, NOAA RSM
• M. Kanamitsu	Scripps RSM, central analysis
• Lai-Yung (Ruby) Leung, PNNL	WRF-ARW
• Xin-Zhong Liang, ISWS	CWRF
• Chungu Lu, NOAA/GSD	WRF-NMM-ESRL
• Lixin Lu, CIRA/CSU	RAMS
• Ken Mitchell, NCEP	CFS forcing, operational transition
• Roger Pielke Sr., Univ. Colorado	RAMS
• Sigfried Schubert, NASA/GSFC	NASA forcing
• Gene Takle, ISU	MM5, applications
• Patrick Tripp, Scripps/UCSD	Central analysis
• Yongkang Xue, UCLA	Eta
• Rongqian Yang, NOAA	CFS forcing

Multi-RCM Ensemble Downscaling of multi-GCM Seasonal Forecasts (MRED)

- **Initial focus is on winter** (1 December – 30 April) to evaluate and compare effects of topographic forcing, snowmelt, and the potential to demonstrate the usefulness of higher resolution, especially for near-surface fields influenced by high resolution orography.
- Winter focus also provides an important link to the **cold season hydrometeorological research** area of CPPA.
- Winter season reflects **ENSO** forcing.
- RCM output will be produced using a **standard output format** using netCDF, based on the format used in IPCC AR4 and adapted by NARCCAP for regional models.

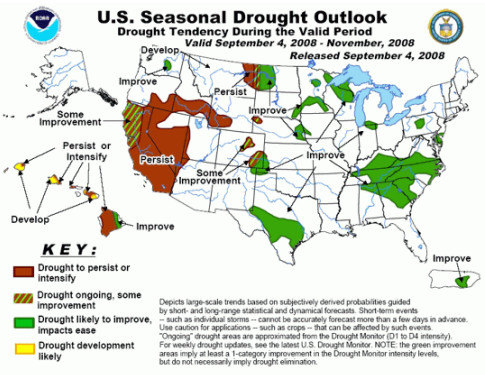
CPPA Contributions to GEWEX-II Objective 4

Undertake joint activities with operational hydro-meteorological services…

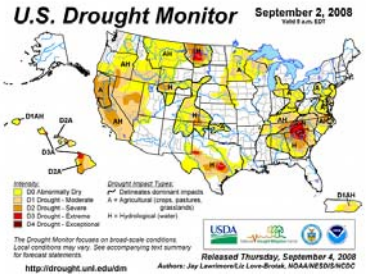
- Transfer the Experimental Western and Eastern Seasonal Hydrologic Prediction Systems to NCEP Operation Platform
- Support HEPEX (Hydrological Ensemble Prediction Experiment)
- Quantify uncertainties in hydrologic forecasts (from climate forecasts, initial boundary condition, model, and predictability studies)
- Downscaling and hydrologic applications of seasonal forecasts
  - contribution to Hydrology Application Project (HAP)
- Continue collaborative activities among the international science community, CPPA researchers, the NWS Office and Hydrologic Development and the NWS River Forecast Centers to improve seasonal hydrologic forecasting techniques.
- Drought monitoring and prediction products (contributing to NIDIS)

Drought Monitor and Outlook

(a) Drought Tendency during Sep-Nov 2008



(b) Current Drought Condition



Contributing CPPA long-term research activities

- Data development and management
- Land Data Assimilation System (LDAS)
- Land surface processes studies and modeling
- Hydrological modeling
- West-wide and East-wide Seasonal Hydrologic Prediction System

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Ending Remarks

- CPPA 2008 PIs will be held in Sept.29-Oct.1,2008
- CPPA FY09 priorities
  - Climate predictability studies
  - Representations of physical processes in climate models
  - Hydrologic and water resource applications
- CPPA is open to inputs from GEWEX/CEOP for future priorities and collaborations with other CEOP colleagues for FY10 and beyond
  - US-Canada joint effort on North American Drought?