NAME modeling and Diagnostic Activities

Kingtse Mo

Climate Prediction Center,

NCEP/NWS/NOAA

7th VAMOS Meeting , Guayaquil, Ecuador

IMPROVE warm season prediction

- ***Improve understanding and prediction of the life cycle of the North American monsoon system and its variability.***
  - ***warm season convective processes in complex terrain; (Tier 1)***
  - ***intraseasonal variability of the monsoon;(Tier 2)***
  - ***the response of warm season atmospheric circulation and precipitation patterns to slowly varying, potentially predictable oceanic and continental surface conditions (Tier 3)***

Best use the NAME data

- Understand the dynamical processes related to NAME and warm season precipitation regimes over North America
  ----- Diagnostic studies
- Data Assimilation
  -----Real time monitoring based on both GFS and EDAS
  ------Verify model forecasts

---- Data impact studies both global and regional

Improve modeling the physical processes related to the NAME

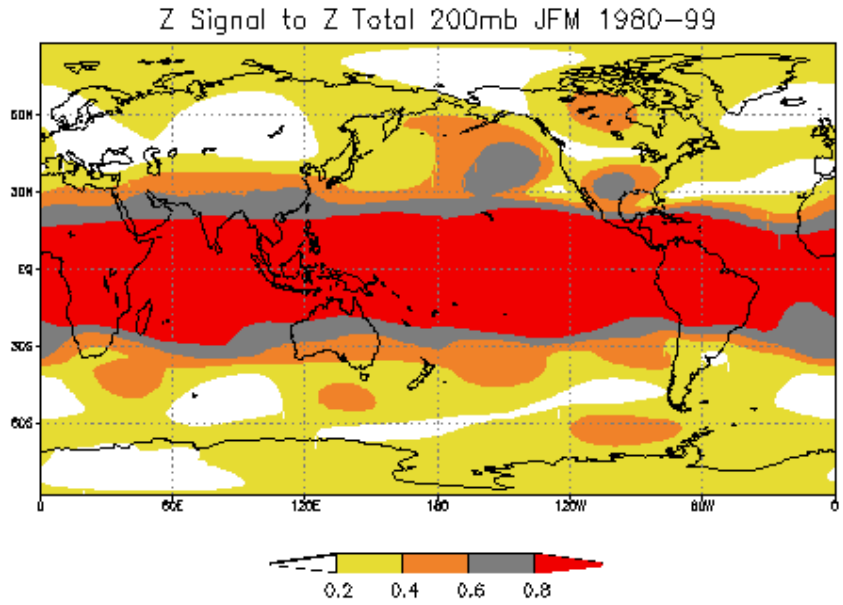
Signal/Total (Z200)

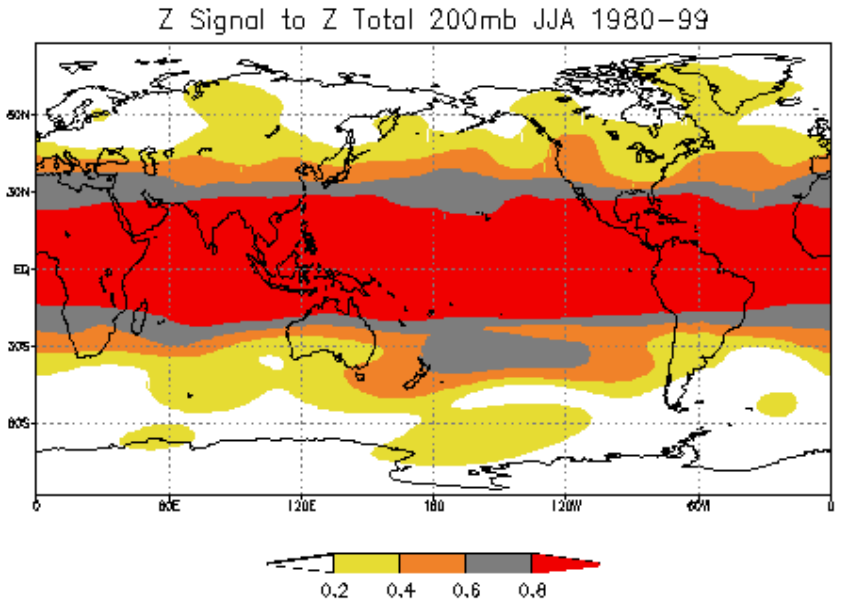
Winter (DJF)

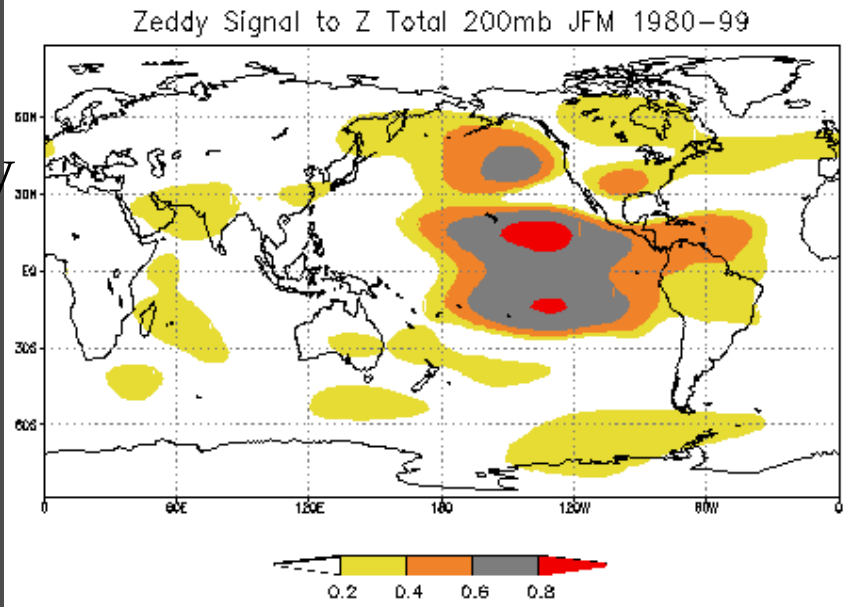
Summer (JJA)

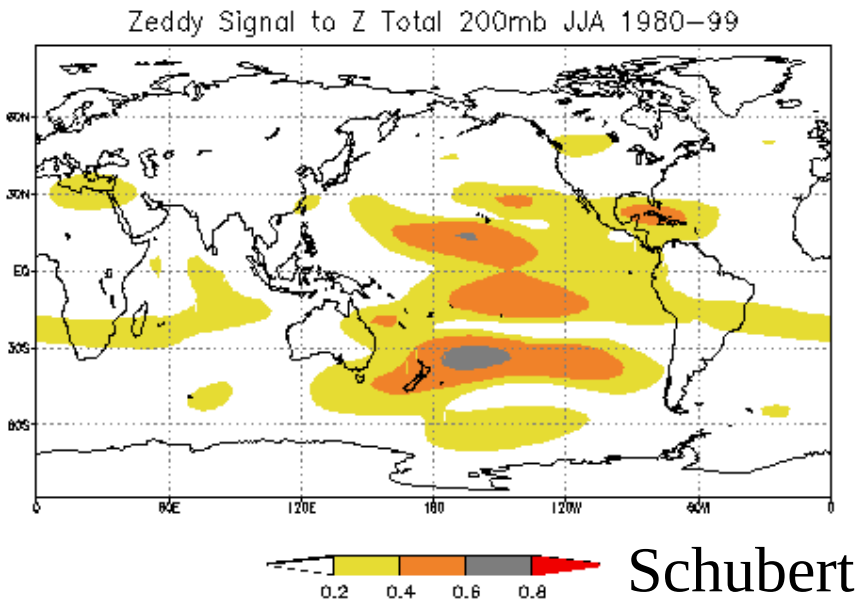
Full

Eddy









Schubert

Prediction Issues

- Summer season
- Stronger zonally-symmetric response to SST: more subtle interactions with orography, land, etc
- Models do poorly in such warm season global/regional interactions
- Getting “local/regional” processes right and their interactions with global scale is critical to improving predictions

Siegfried Schubert 2004

Global modeling issues

- Model resolution
- Physical processes: Convection in complex terrain,
- Predictability

Think globally, act locally

Global modeling issues

- Resolution issues
  - Need to resolve key phenomena
  - Application specific (e.g. regional impacts, extreme events)
  - Computational issues: need for long runs, large ensembles

What is the resolution needed for warm precipitation prediction?

Schmit and Mullen (1996): finer than T107

NCEP seasonal prediction:T62

Can we improve Fcsts using downscaling ?

(Leung 2003, Mo et al. 2001)

Experiments

- Models: with observed SSTs
- A) T126L28 GFS Model (approx 80 km)
- B) T62 GFS model (approx 200 km)
- C) T62 with RSM80 downscaling

➢ Comparison between (a) and (b) shows the impact of horizontal resolution

➢ Comparison between (b) and (c) shows the impact of downscaling.

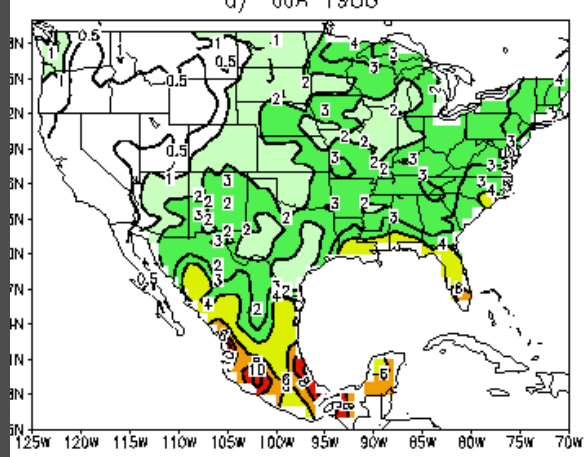
➢ Comparison between (a) to c) shows whether downscaling is a good strategy. If (c) has the similar skill as (a), then c) is easier and less expansive to perform

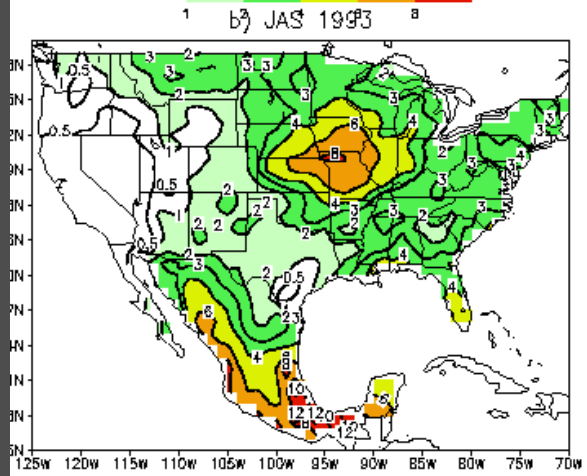
Observed Precip

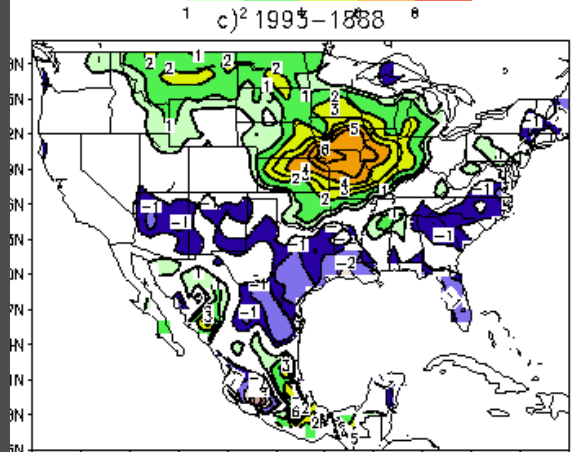
1988 JJA

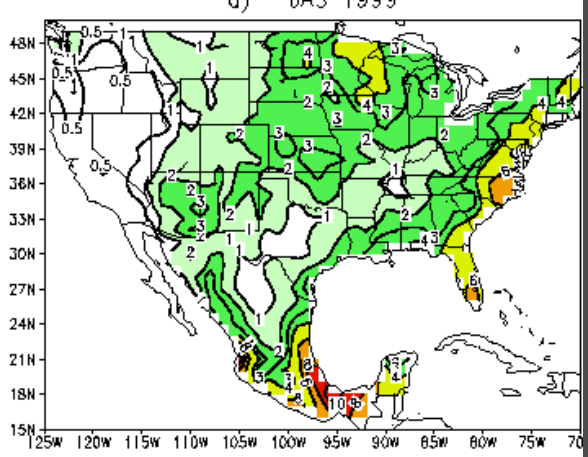
1993 JAS

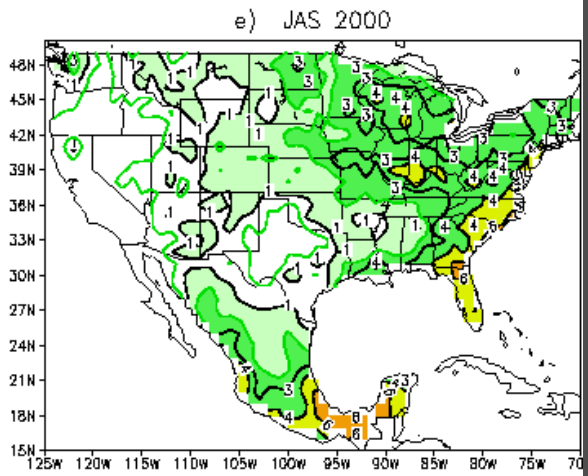
Diff 1993-1988

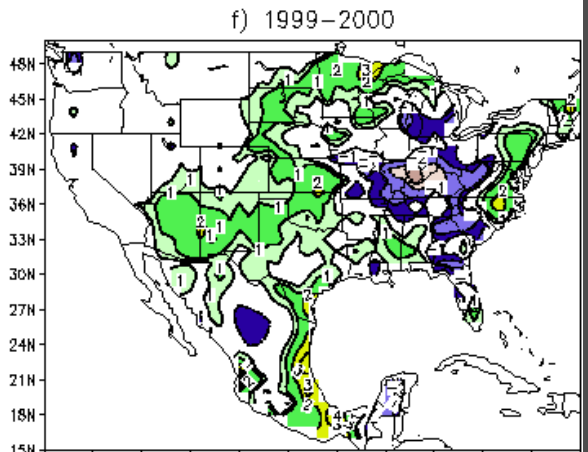












1999JAS

2000JAS

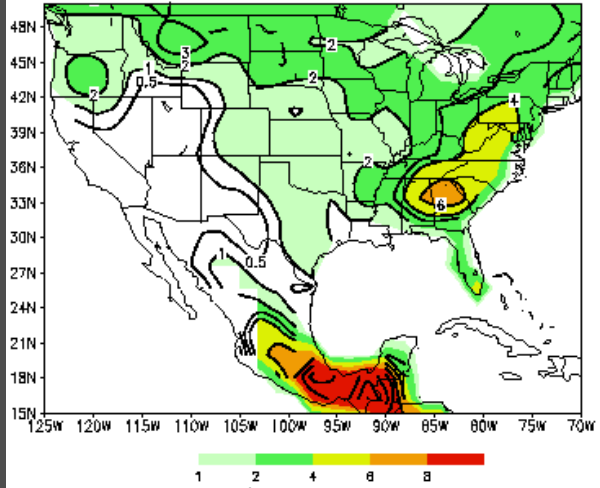
Diff 1999-2000

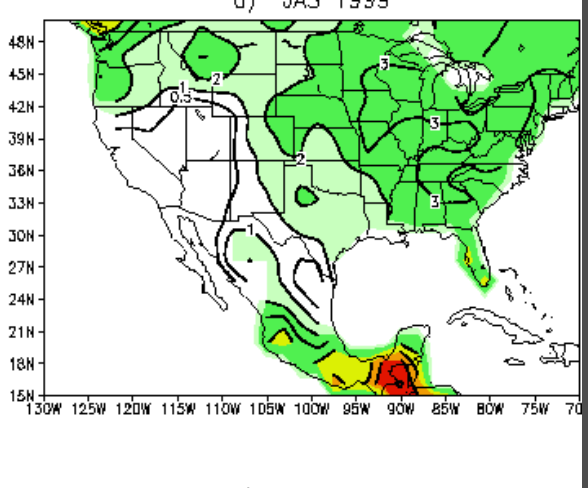
T62 EM
Precip simu

1988JJA

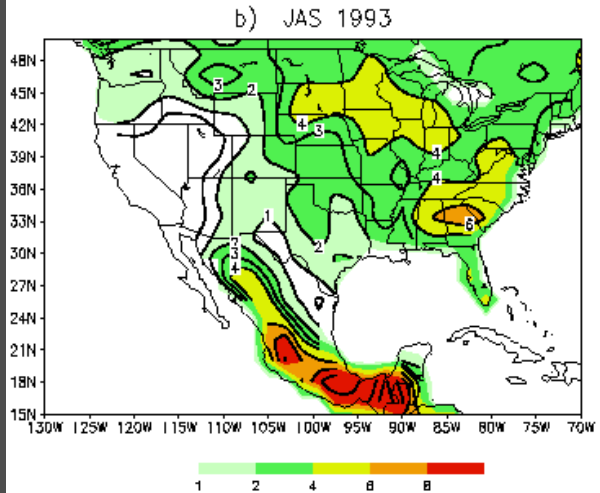
1993JAS

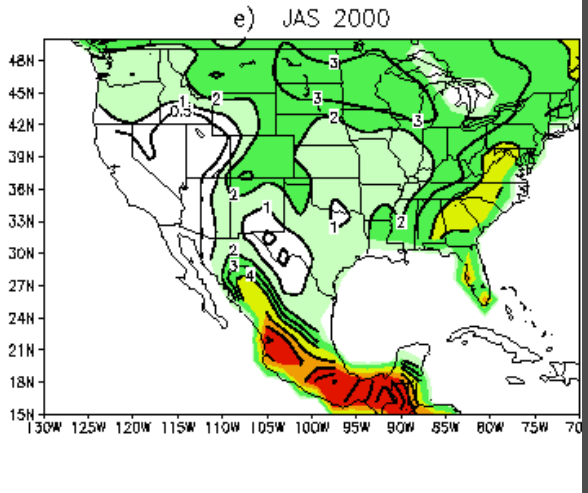
Diff
1993-1988



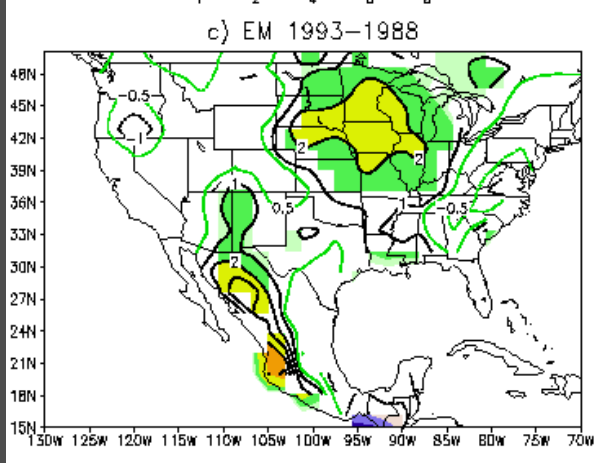


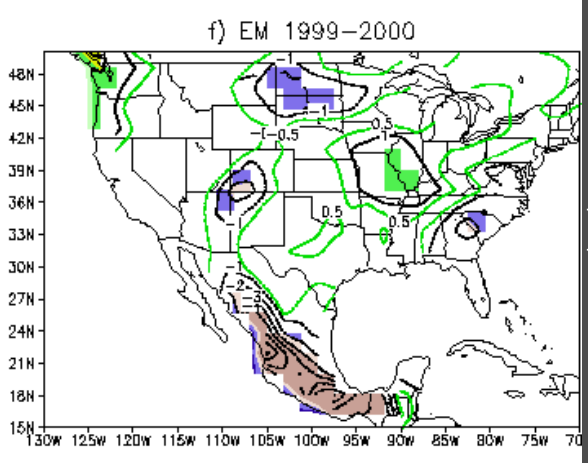
1999 JAS





2000JAS





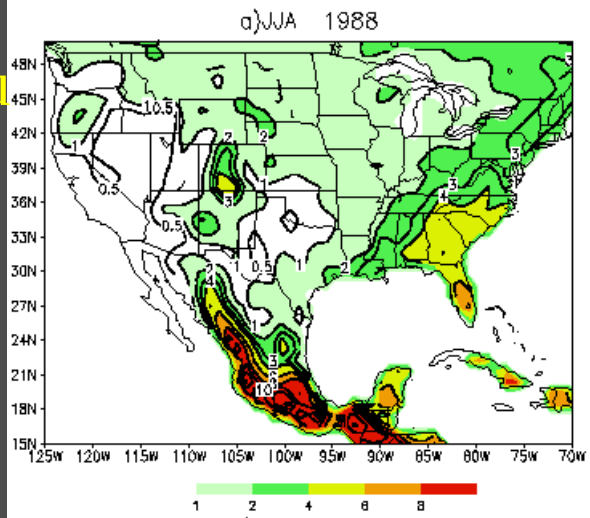
Diff
1999-2000

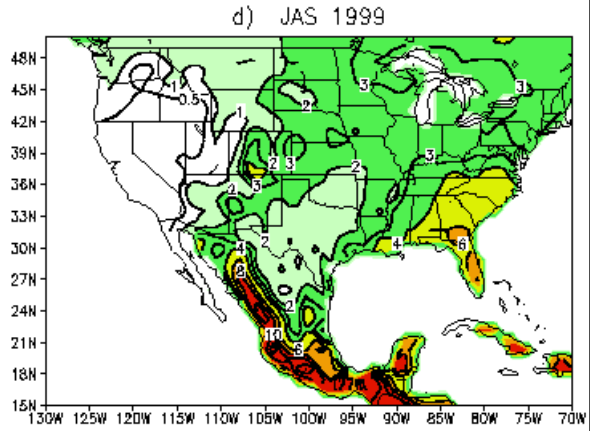
T126L28
Precip simu

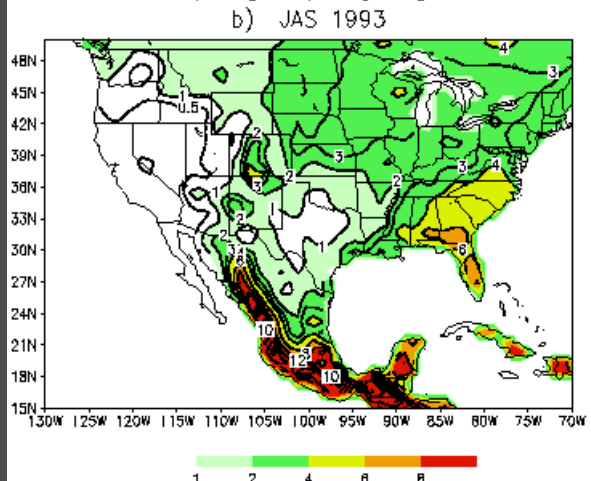
1988JJA

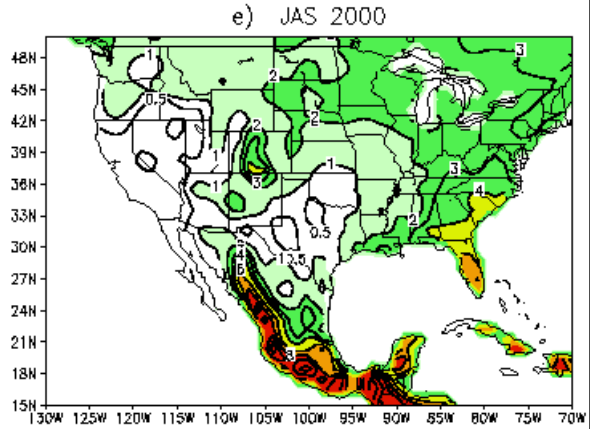
1993JAS

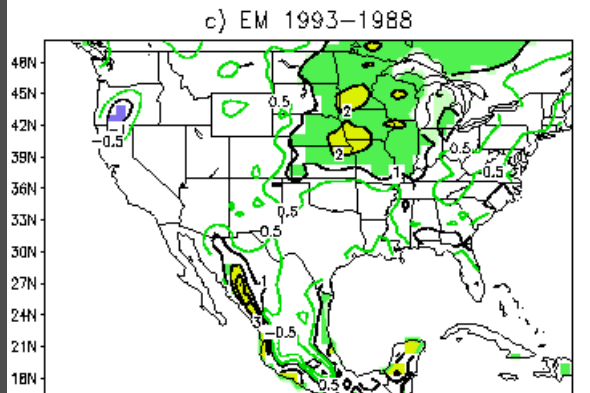
Diff
1993-1988

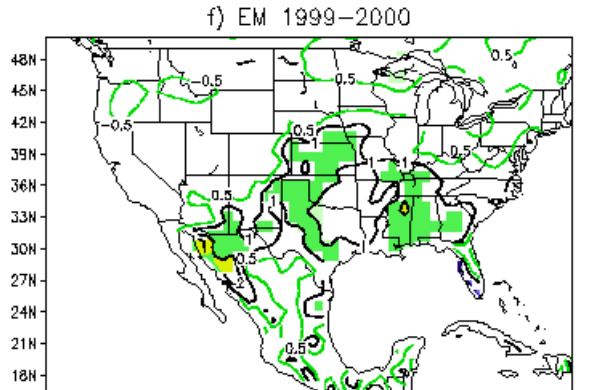








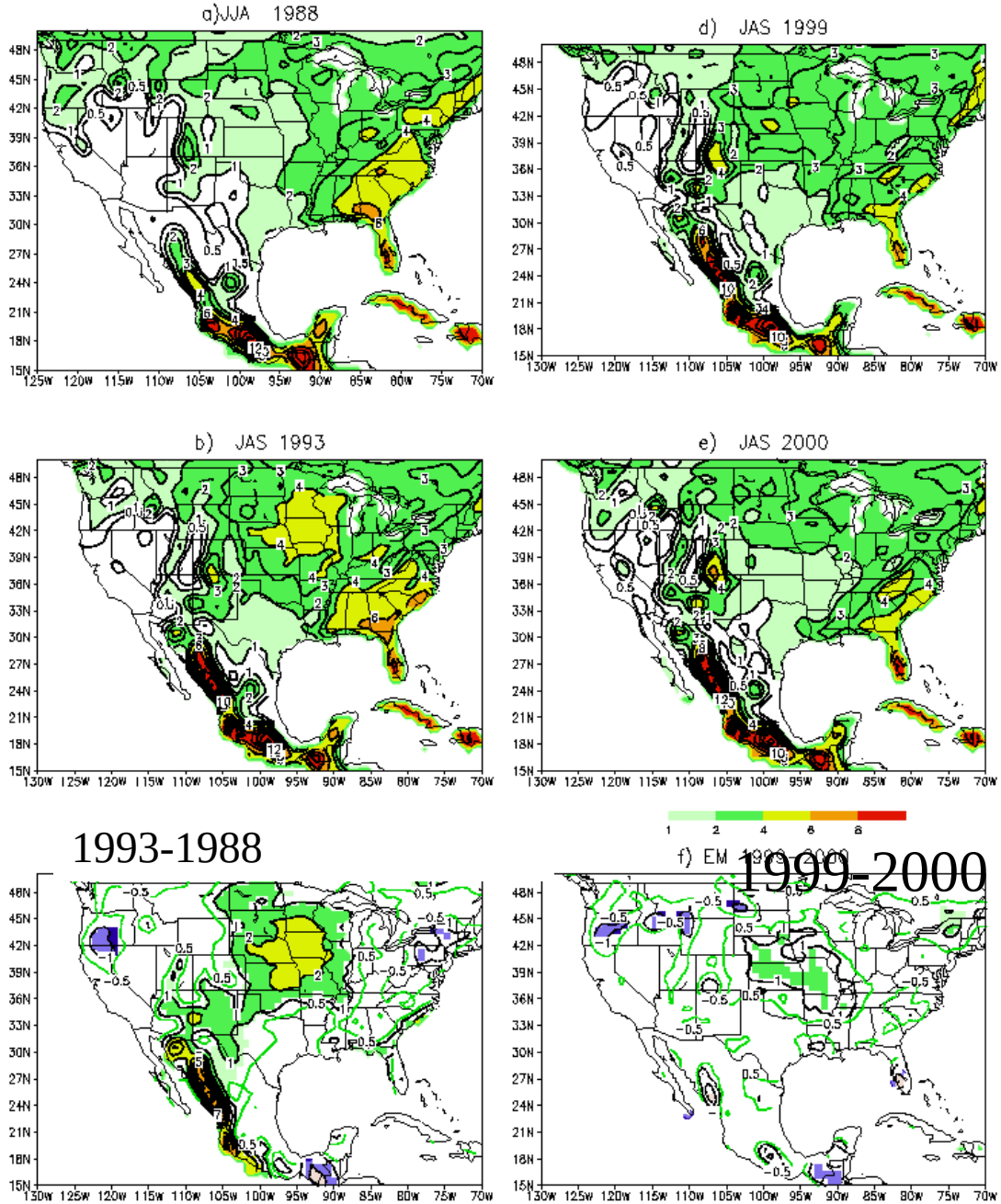




1999JAS

2000JAS

Diff
1999-2000



RSM80/T62 EM Precip

Overall improvement over

The SW and northwestern

Mexico,

The RSM does not overcome the T62 errors

to fcst the differences between two summers

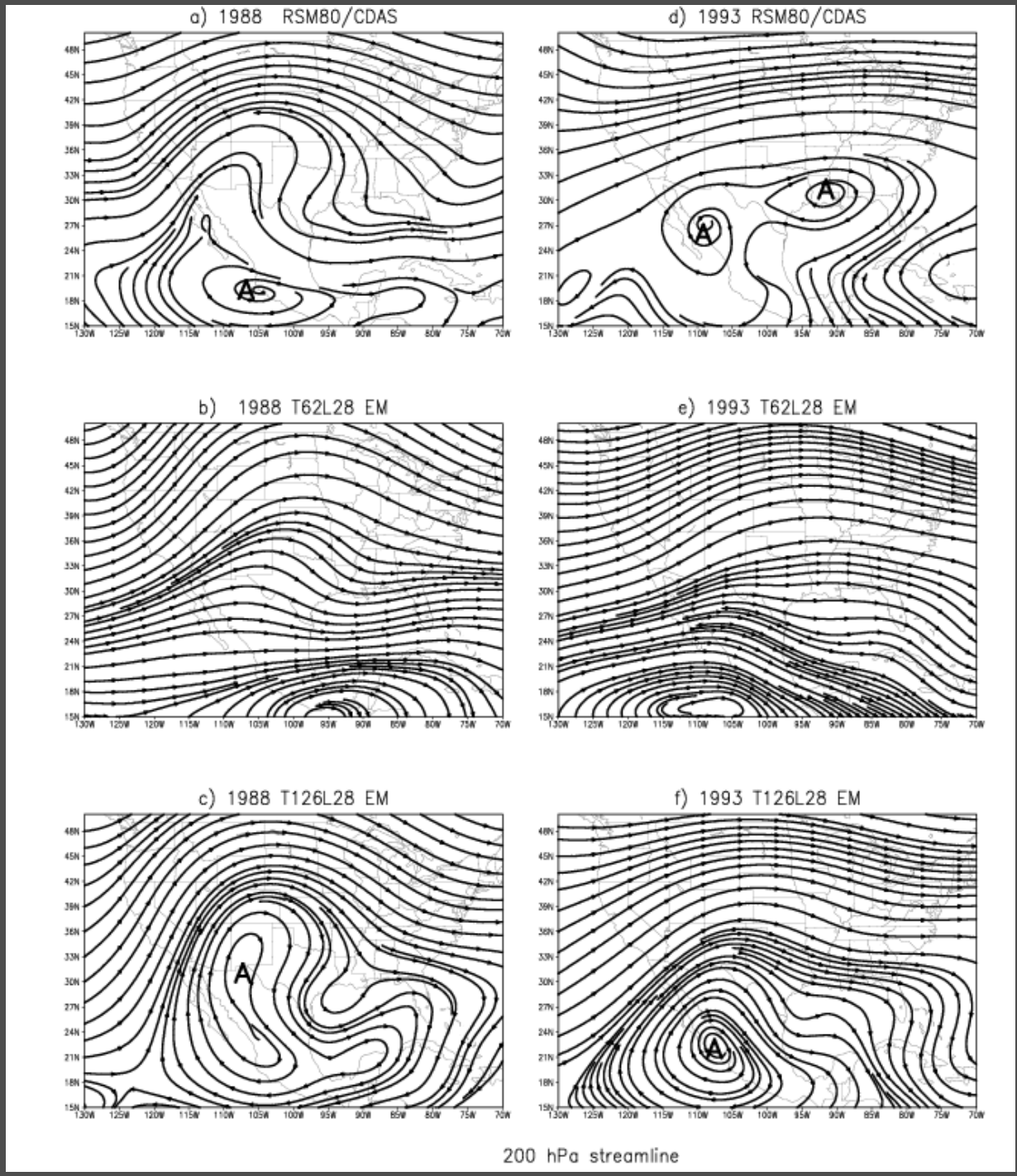
200hPa streamline

1988→

CDAS

T62 EM

T126EM



←1993

CDAS

T62 EM

T126EM

Resolution

- Resolution T126 or higher is needed to fcst P over the monsoon region.
- T62 does not recognize the GOC, no moisture surges and no LLJ→ dryer P fcsts→ Less E→ cooler T→ positive Z850
- The complicate nonlinear feedback → no mean error correction can help
- RSM can improve overall P fcsts, but not overcome errors in T62 global fcsts to capture rainfall variability

Global & regional modeling issues

- Physics issues
  - Limitations of convection parameterizations, but intimately linked to surface interactions, atmospheric boundary layer, clouds, etc.
  - Schemes largely untested at high resolution
  - Diurnal cycle

With the observations from NAME, we will have better understanding on the structure and evolution of monsoon rainfall and related circulation.

- Climate PROCESS team and NAMAP2

(Dave Gutzler next presentation)

An Assessment and Analysis of the Warm Season Diurnal Cycle over the Continental US/N. Mexico in Global AGCM'S

Siegfried Schubert, Max Suarez, Myong-In Lee -NASA/GSFC
Isaac Held-GFDL
Arun Kumar, Hyun-Kyung Kim, Wayne Higgins – NCEP/CPC

OBJECTIVES

1) Assess / analyze the diurnal cycle in three different AGCMs (NASA, NCEP and GFDL),

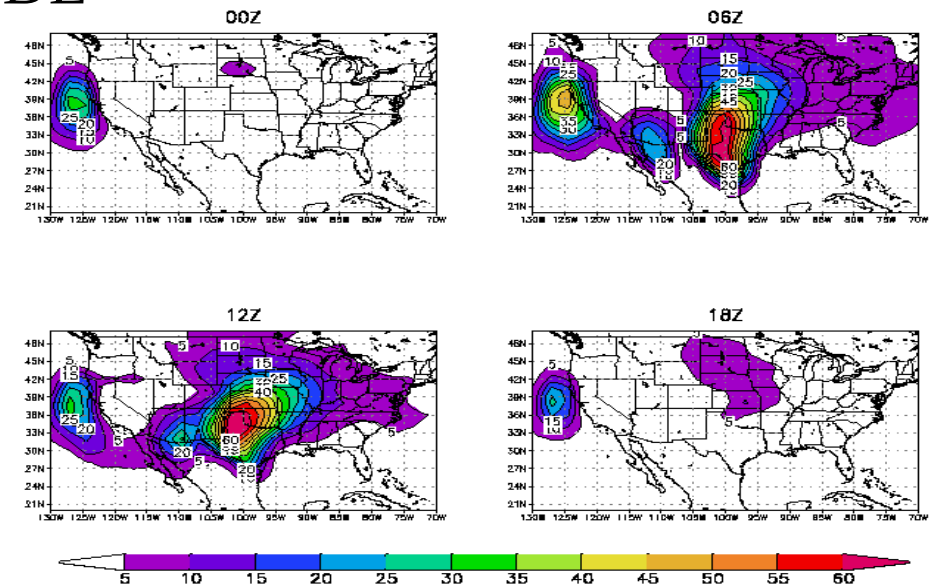
2) Improve understanding of the important physical processes that drive the diurnal cycle,

3) Provide guidance for the development of physical parameterizations aimed at improving the simulation of the warm season hydrological cycle over the US / N. Mexico

http://janus.gsfc.nasa.gov/~milee/diurnal

GFDL

a



NASA

b

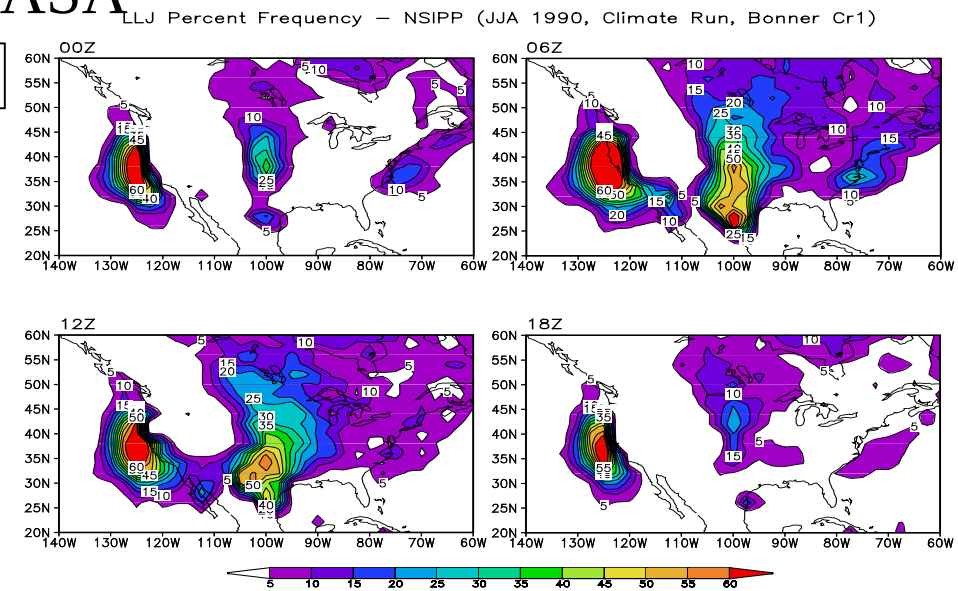


Figure 2: Percent frequency of the occurrence of low-level jets

Percent frequency of LLJs

Bonner criteria

CSST runs 5 warm seasons (May-Sep)

Model 2^{o} resolution

Forecast Experiments for NAME

NAME Seasonal Climate Prediction

Forecasts

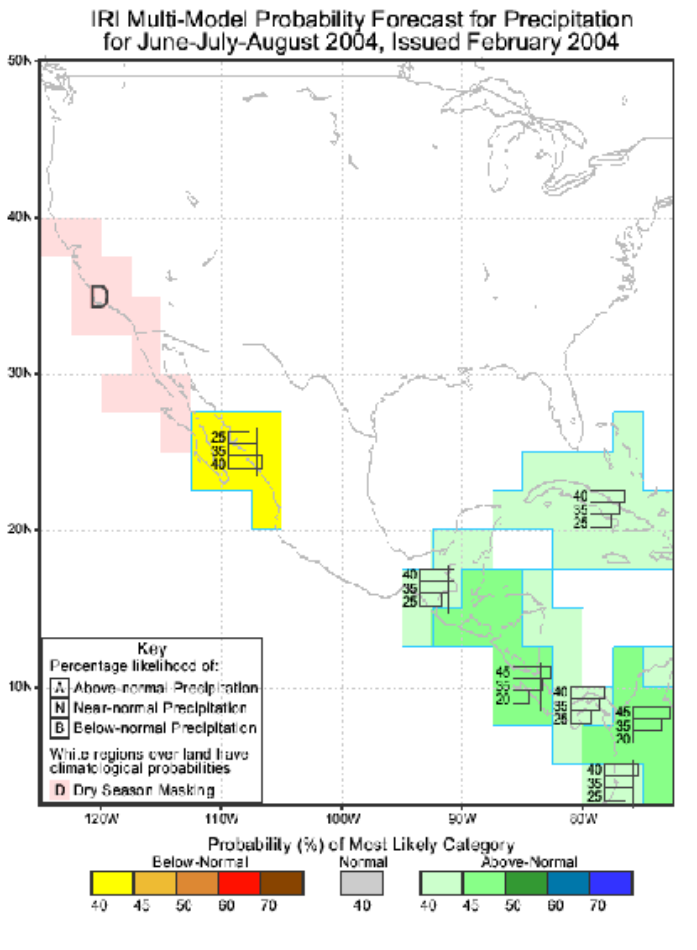
- IRI Forecast for NAME
- NCEP/CPC Seasonal Outlook

- Niño 3.4 SST Forecast
  - CDC
  - CPC
  - IRI

- GCM Forecast
  - IRI MM Temp, MM Prcp
  - NCEP Fcst
  - NSIPP Fcst
  - Scripps: Temp/Prcp, SST

- Statistical Forecast
  - CDC: Fcst, Briefing
  - Optimal Climate Normal
  - Soil Moist Mon & Pred
  - Soil Moist Const Analog: Mon, Sea, Skill, IC, Soil F
  - SST Const Analog: 500mb, Temp, Prec, SST
  - Composites: AO/ENSO, ENSO

Fcst from IRI



Contact: Jae.schemm@noaa.gov

III. Prediction and Global-Scale Linkages

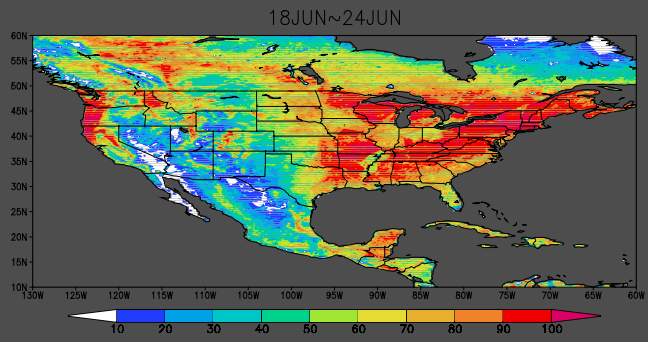
Once we have a reliable model: we can study prediction issues

- ***determine the predictability and prediction skill over the NAMS region associated with the leading patterns of climate variability;***
- ***determine the predictability and prediction skill associated with anomalous land surface conditions in the NAME region (e.g. soil moisture)***
- ***assess the relative influences of local and remote SST's***
- ***Enhance local climate prediction using regional models***

Vegetation Fraction climatology (1986-1999)

(NESDIS AVHRR)

Week1 Jun18



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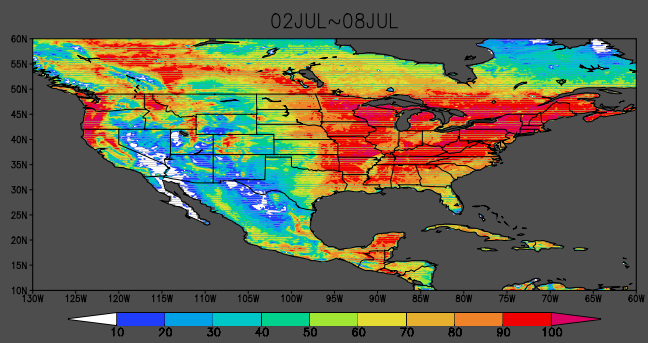

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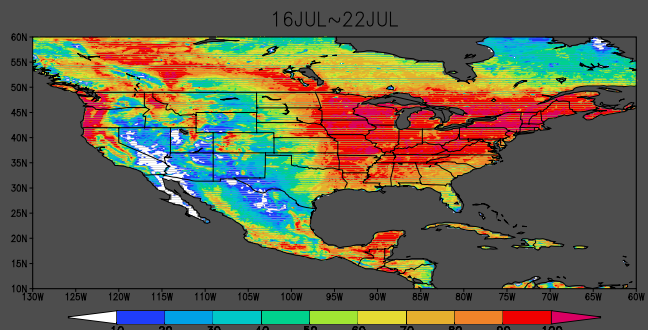

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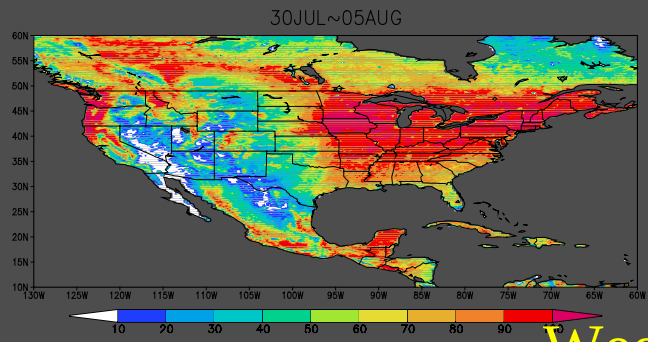

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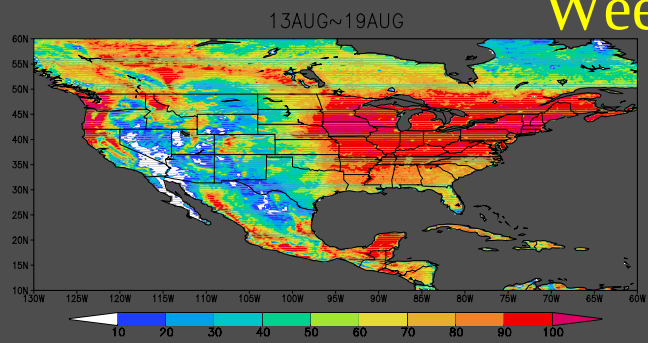
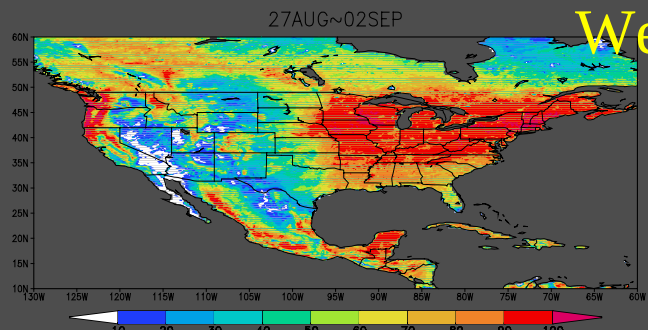


Week 11



Milestones

- Benchmark and assessment of global and regional model performance (2004) (NAMAP1,NAMAP2, Fcst Exp)
- Evaluate impact of the data from the NAME campaign on operational data assimilation and forecasts (2005)
- Simulate the monsoon onset to within a week of accuracy (2006)
- Simulate diurnal cycle of onserved precip to within 20% of a monthly means (2007)
-

WARM SEASON PRECIPITATION MILESTONES IN NOAA/OGP 5-YR PLAN

- **Conduct intensive NAME field observation campaign in northwest Mexico, southwest US, and Gulf of California (04)**
- **Implement new high-resolution North American climate analysis system at NCEP (04)**
- **Assess impact of NAME observations on (NCEP) operational analysis products (05)**
- **Evaluate impact of changes in model parameterization schemes (06)**
- **Measure improvements in model simulations of monsoon onset and variability (07)**
- **Implement recommended changes to NCEP operational climate prediction systems to bring monsoon forecasts online (08)**