

# Utilization of Dynamic Seasonal Climate Predictions for Drought Monitoring and Prediction Activities at NCEP/CPC

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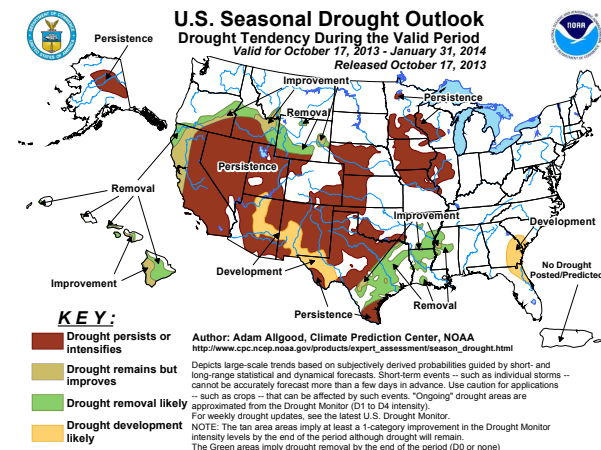
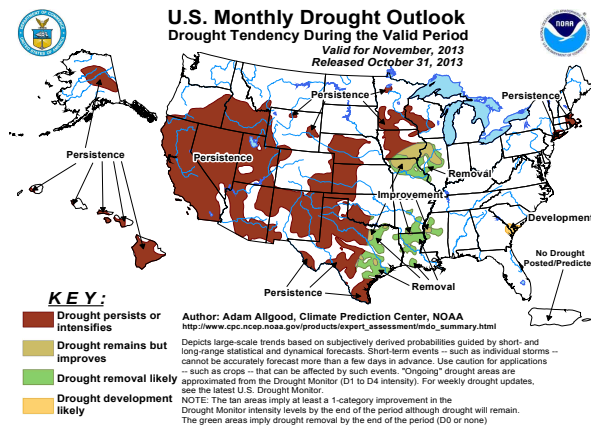
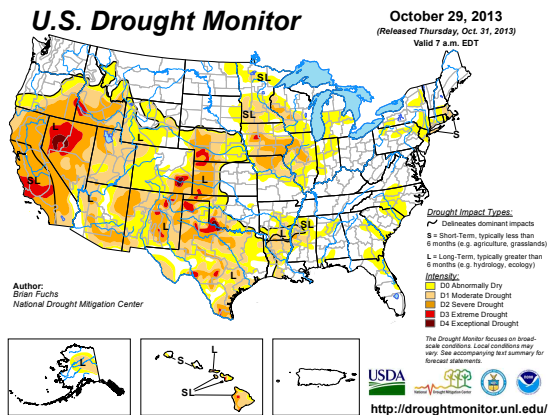
# Outline

- CPC Drought Monitor and Outlooks
- NCEP NMME System
- NMME-Based SPI Prediction
- Summary

# CPC Drought Monitor and Outlooks

[www.cpc.ncep.noaa.gov/products/Drought](http://www.cpc.ncep.noaa.gov/products/Drought)

- Drought Monitor issued weekly – in partnership with USDA and Drought Mitigation Center, Univ. of Nebraska
- Monthly and Seasonal Drought Outlooks issued once a month



# Input Data for Drought Monitor and Outlooks

- Observed and predicted precipitation and surface temperature
- Soil moisture and runoff from NCEP Land Data Assimilation System (NLDAS)
- Drought Indices:
  - Standardized Precipitation Index (SPI)
  - Palmer Drought Severity Indices (PDSI)
  - Soil Moisture Percentile from NLDAS
  - Standardized Runoff Index from NLDAS
- For Outlooks: Predicted SPI and other indices from CFS, NMME, UW VIC, NASA Mozaic, Princeton ESP and NCEP ESP

# North American Multi-Model Ensemble (NMME) System for Seasonal Climate Prediction

- Initiated in 2010 as part of NOAA Climate Test Bed Project
- 6 coupled GCMs currently participating – NCEP CFsv2, Canadian CMC1 and CMC2, GFDL CM2.2, NASA GEOS5 and NCAR CCSM3.0
- Multi-member ensemble predictions for both hindcast suite (1982-2010) and real-time forecasts.
- Initial conditions around the 1<sup>st</sup> of each month, forecast data transferred to NCEP by the 7<sup>th</sup>.



## Hindcast Configuration

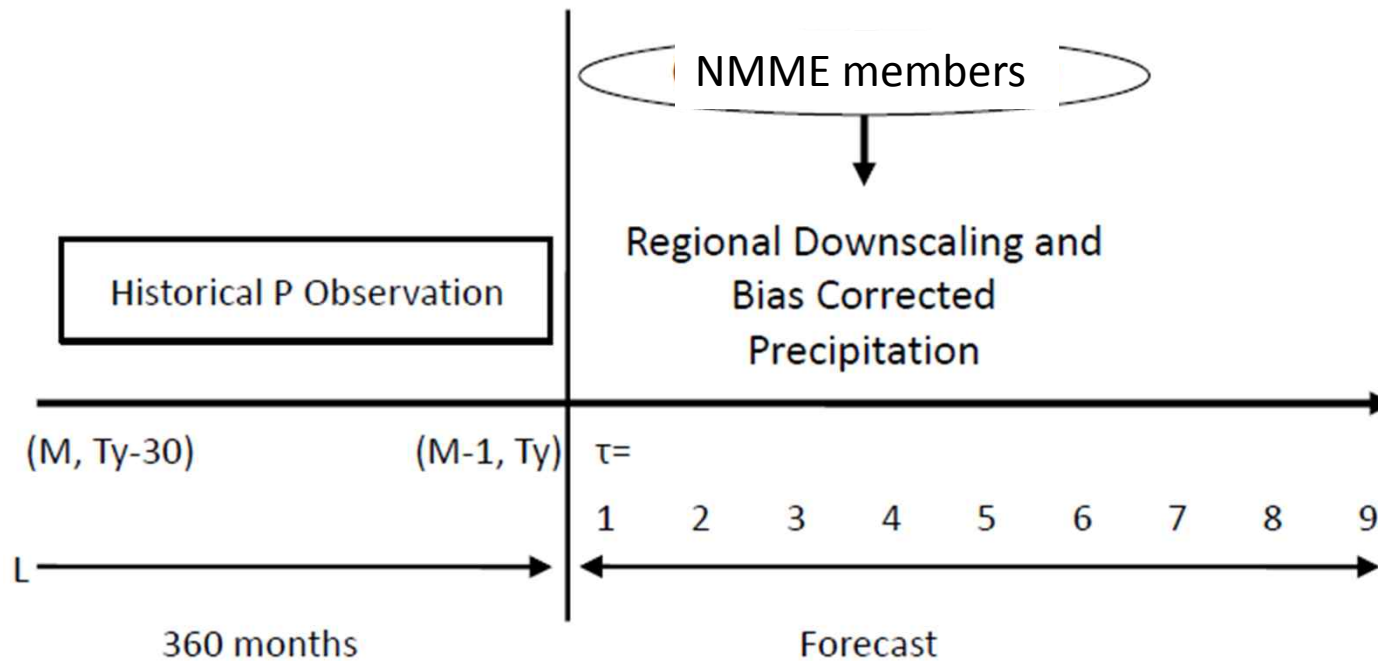
							Model resident Resolutions			
	Start months available NOW		Period	Members	Arrangement of Members	Lead (months)	Atmosphere	Ocean	Reference	
NCEP-CFSv2	12		1982-2010	24(28)	4 members (0,6,12,18Z) every 5th day	0-9	T126L64	MOM4 L40 0.25 deg Eq	Saha et al 2010	NCEP-CFSv2
GFDL-CM2.1	12		1982-2010	10	All 1st of the month 0Z	0-11	2x2.5deg L24	MOM4 L50 0.30 deg Eq	Delworth et al 2006	GFDL-CM2.1
CMC1-CanCM3	12		1981-2010	10	All 1st of the month 0Z	0-11	CanAM3 T63L31	CanOM4 L40 0.94 deg Eq	Merryfield et al 2012	CMC1
CMC2-CanCM4	12		1981-2010	10	All 1st of the month 0Z	0-11	CanAM4 T63L35	CanOM4 L40 0.94 deg Eq	Merryfield et al 2012	CMC2
NCAR-CCSM3.0	12		1982-2010	6	All 1st of the month**	0-11	T85L26	POP L40 0.3 deg Eq	Kirtman and Min 2009	NCAR-CCSM3.0
NASA	12		1981-2010	6	1 member every 5th day as CFSv2	0-9	1x1.25deg L72	MOM4 L40 1/4 deg at Eq	Rienecker et al 2008	NASA

# NMME-Based SPI Prediction

- To develop a global Standardized Precipitation Index prediction of global drought in support of the Global Drought Information System (GDIS)
- Evaluate the SPI predictions based on the NMME hindcast suite
- Work toward near real time operation at CPC to support the global hazards outlook and the African Desk activities
- Challenges of real time operation

# SPI Prediction with the NMME System

## Forecast Procedure



SPI3 at lead-1 has 2 months P analysis  
and one month predicted P

Yoon et al. (2012),  
JHM

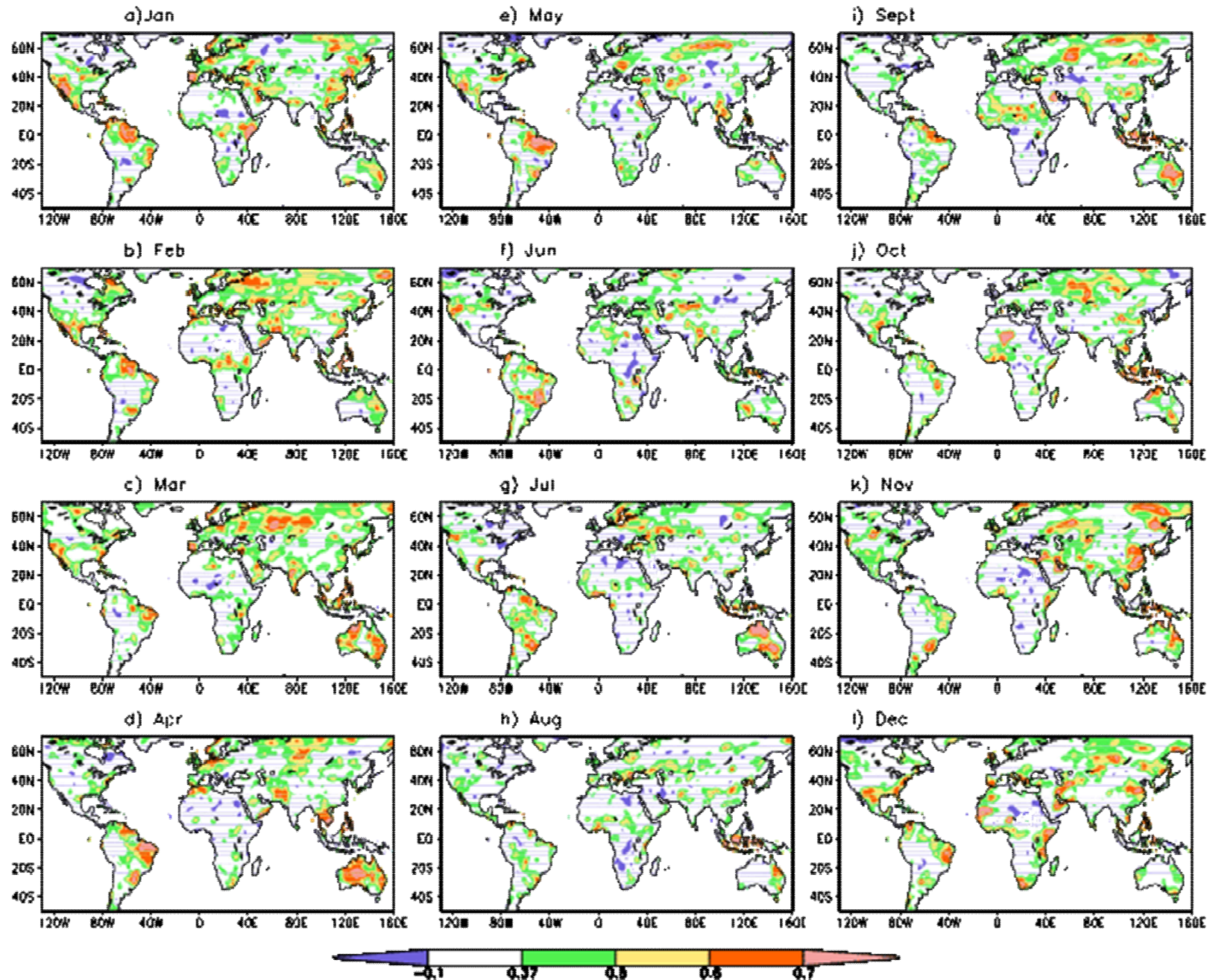
# procedures

For each model , each lead time and a given target year

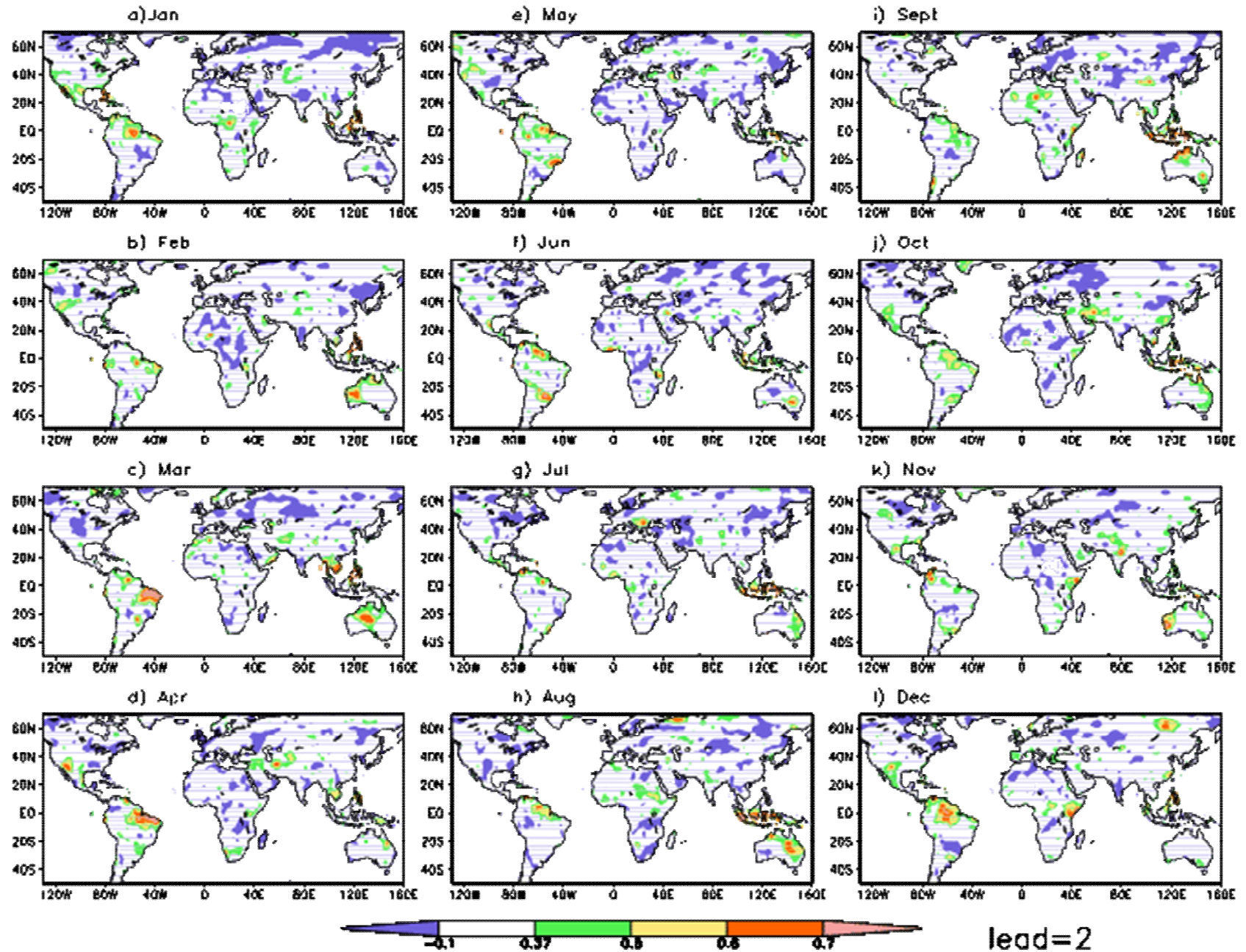
- Obtain the ensemble mean
- Correct the model mean with hindcasts except the target year
- Append the ensemble mean error corrected P to the P analysis to calculate SPI
- NMME Ensemble mean of SPI prediction
- P analysis Chen et al.(2002) CPC 50-yr P analysis based on the station data from 1950-present
- P analysis GPCC 1950-2010 better quality control, but not real time operation

Chen, M., P. Xie, J. E. Janowiak, and P. A. Arkin, Global Land Precipitation: A 50-yr Monthly Analysis Based on Gauge Observations, 2002, J. Hydrometeor., 3, 249-266.

# NMME Precip. Fcst Corr. Score; 1-month lead



# NMME Precip. Fcst Corr. Score; 2-month lead

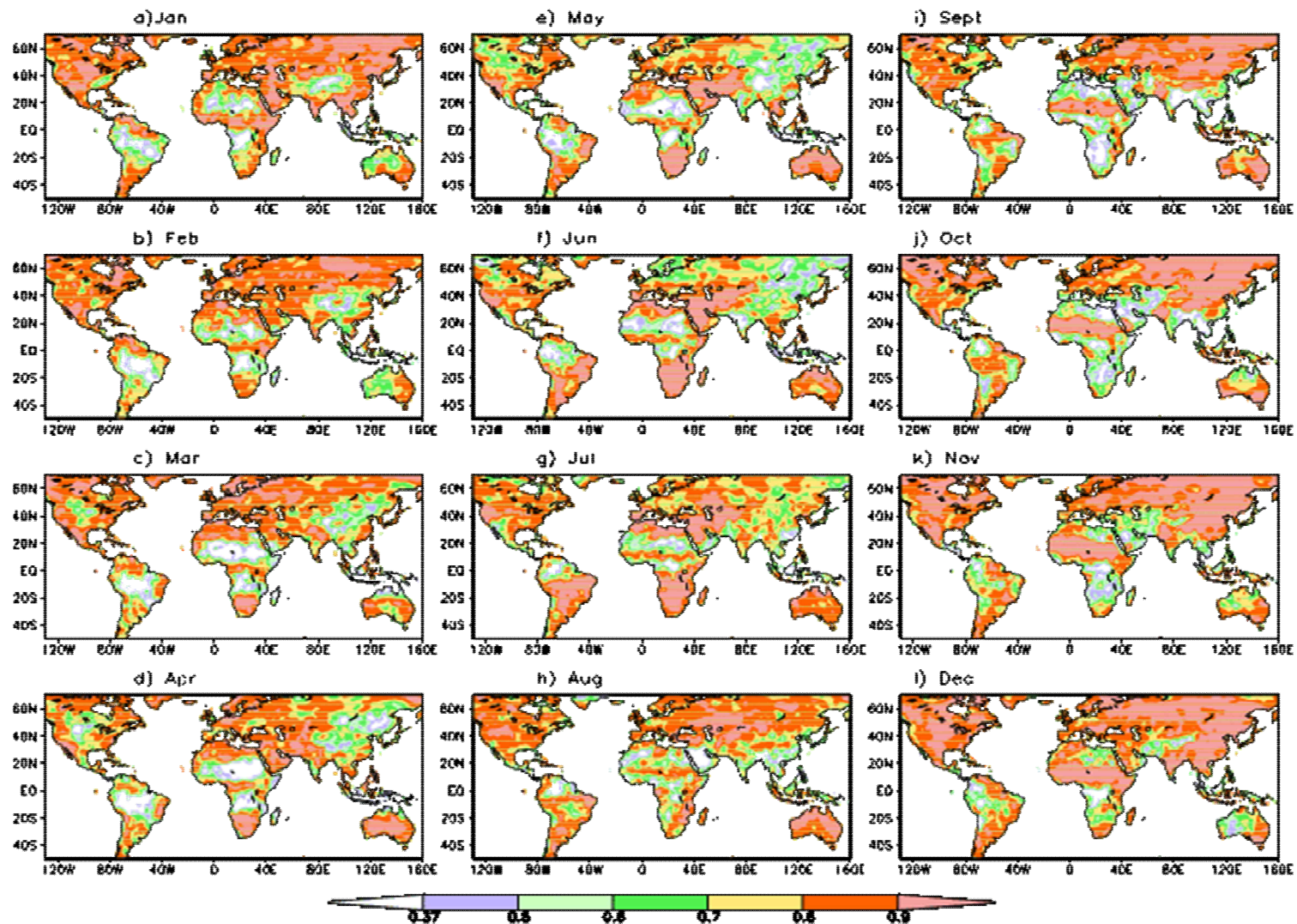


# Precip. fcsts from NMME ensemble

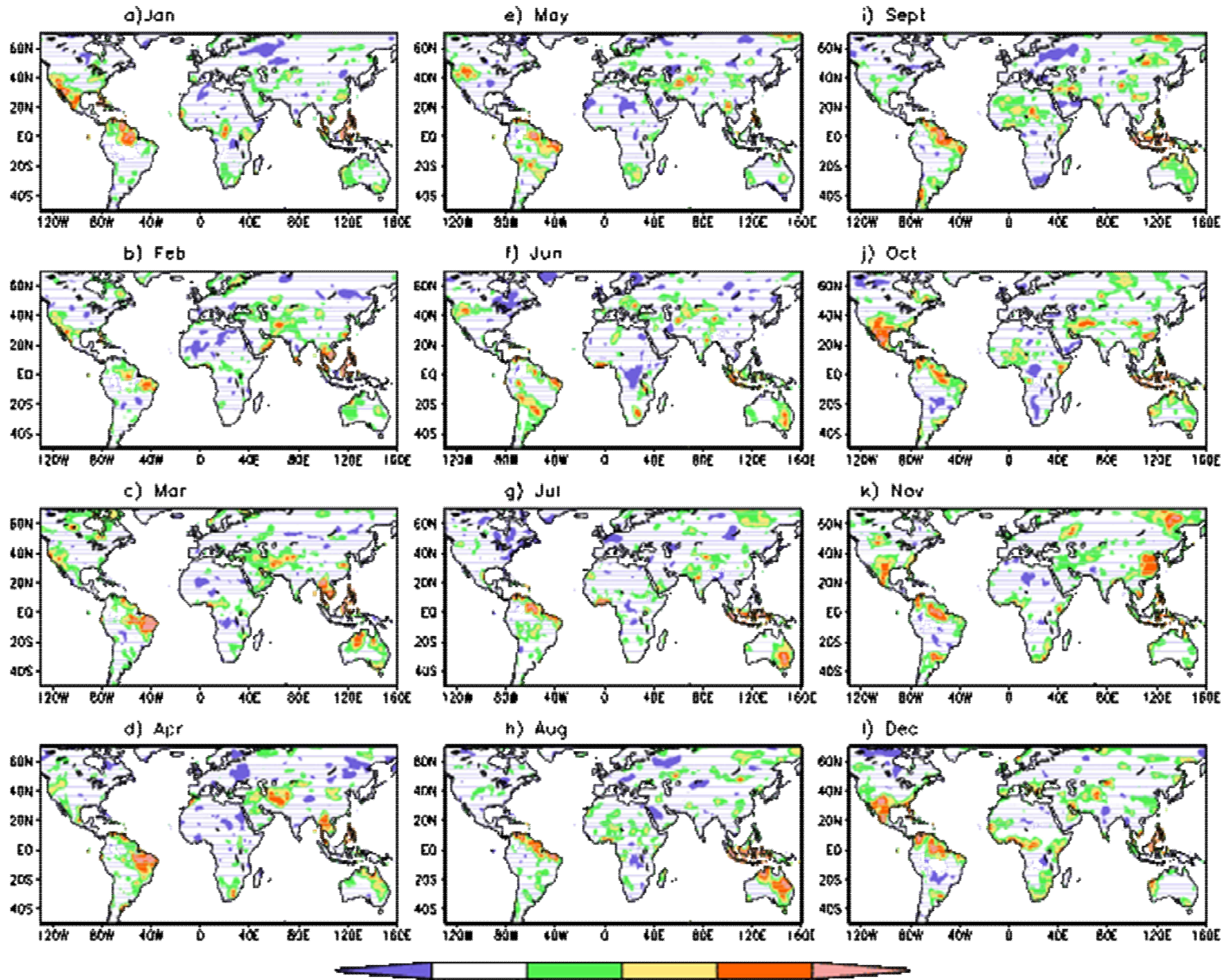
- P fcsts for Lead-1 have high skill over the following areas:
  - The cold season: U.S. western region, Northeastern Brazil, Europe winter and Australia
- Less skillful during NH summer: In particular over the monsoon regions such as India, SE Asia and North America
- Low level of skill over Africa
- P forecast skill drops quickly and at 2-month lead, there are negative correlations over most places

# SPI3 Corr. Score; 1-month lead

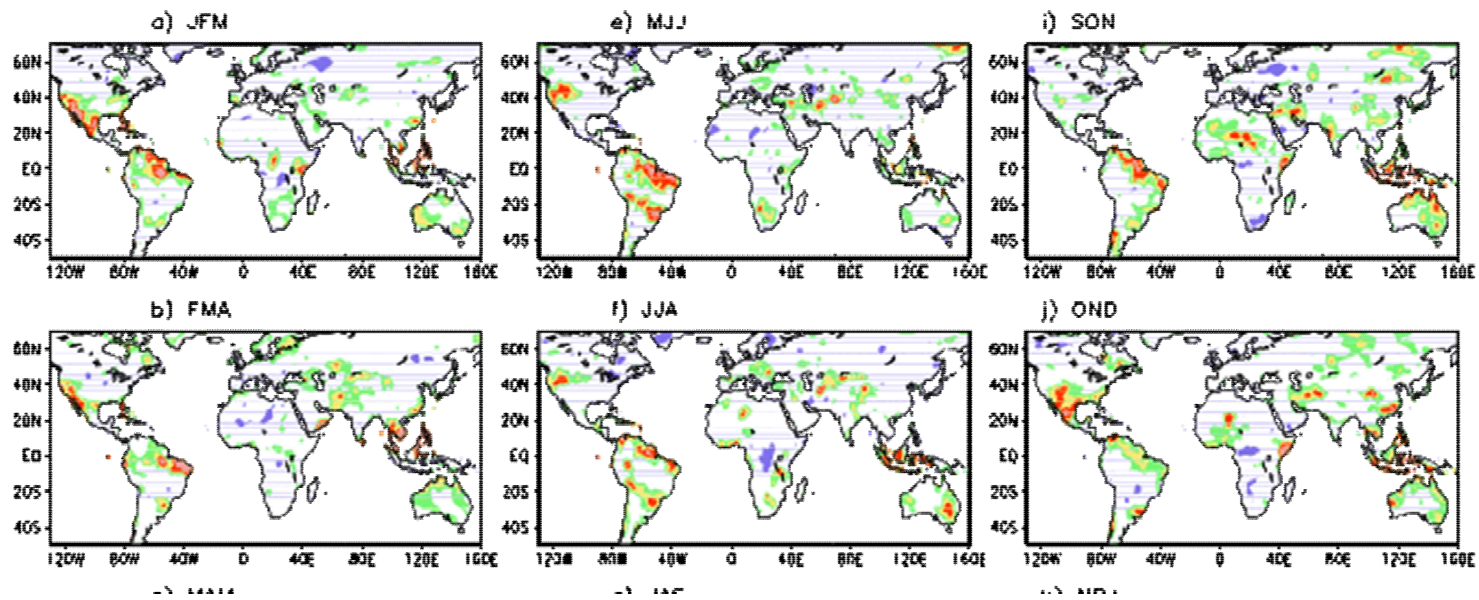
High skill contribution from obs



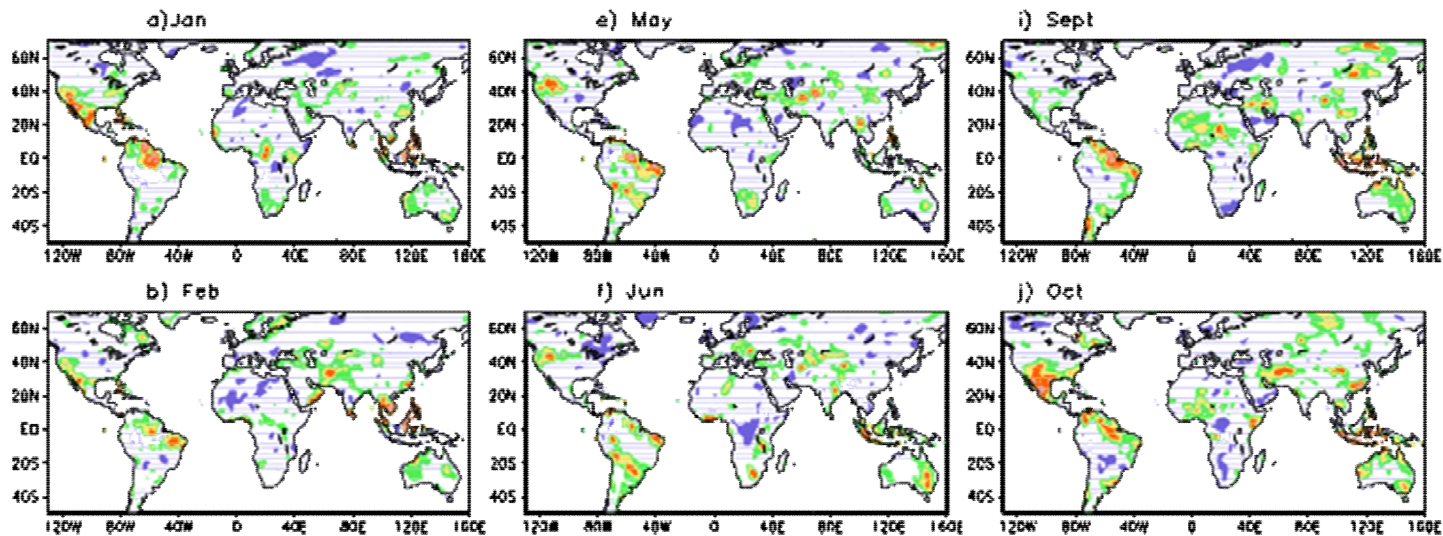
# SPI3 Corr. Score; 3-month lead



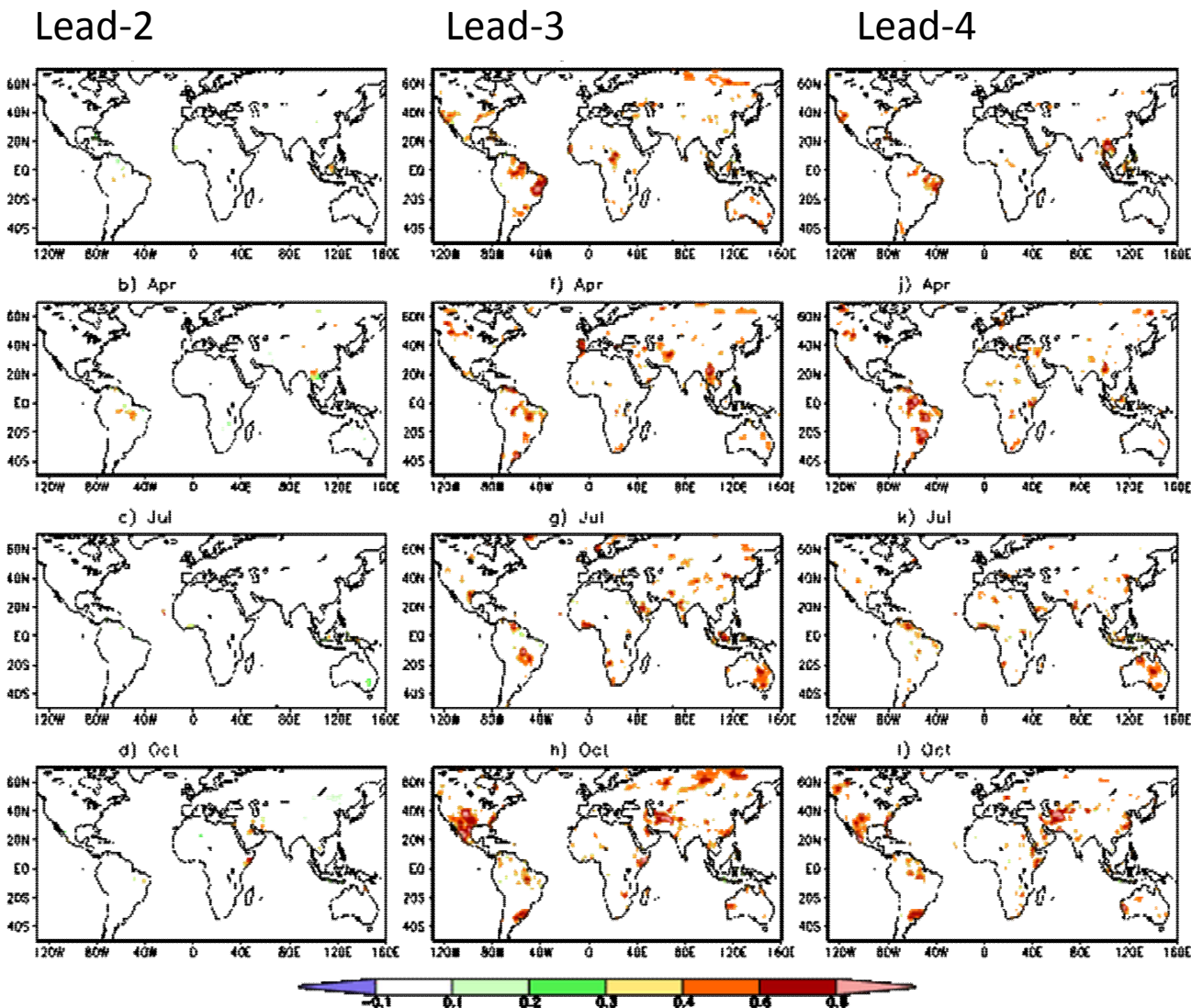
## Seasonal mean Precip Score; 1-month lead



## SPI3 score; 3-month lead



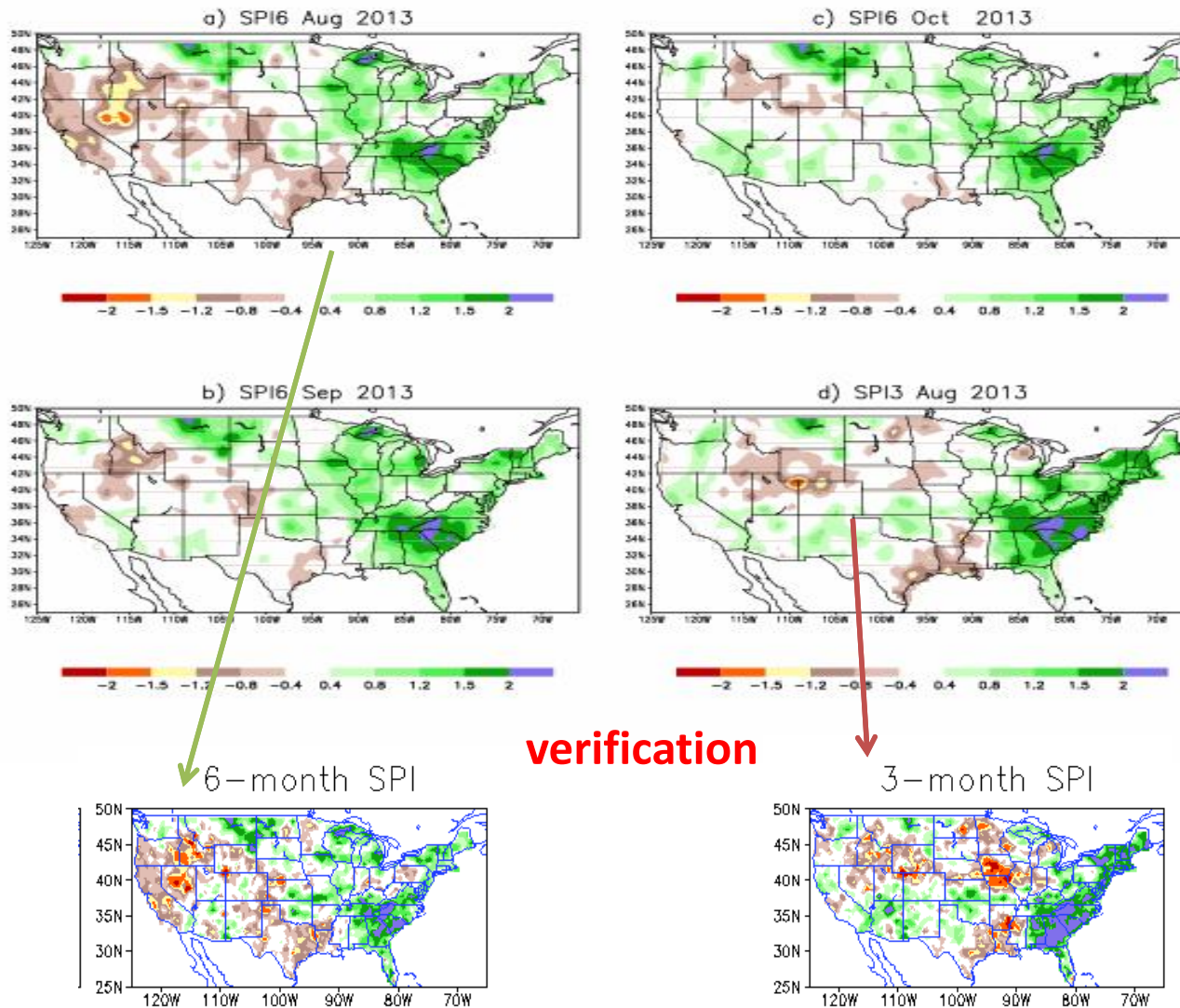
# SPI3 Corr. Score difference: NMME - Persistence



- Difference starts to appear after lead-3 (no obs)
- They are located over the U.S. and south America, Australia where the fcst skill is high
- For areas with unskillful P fcsts make no difference

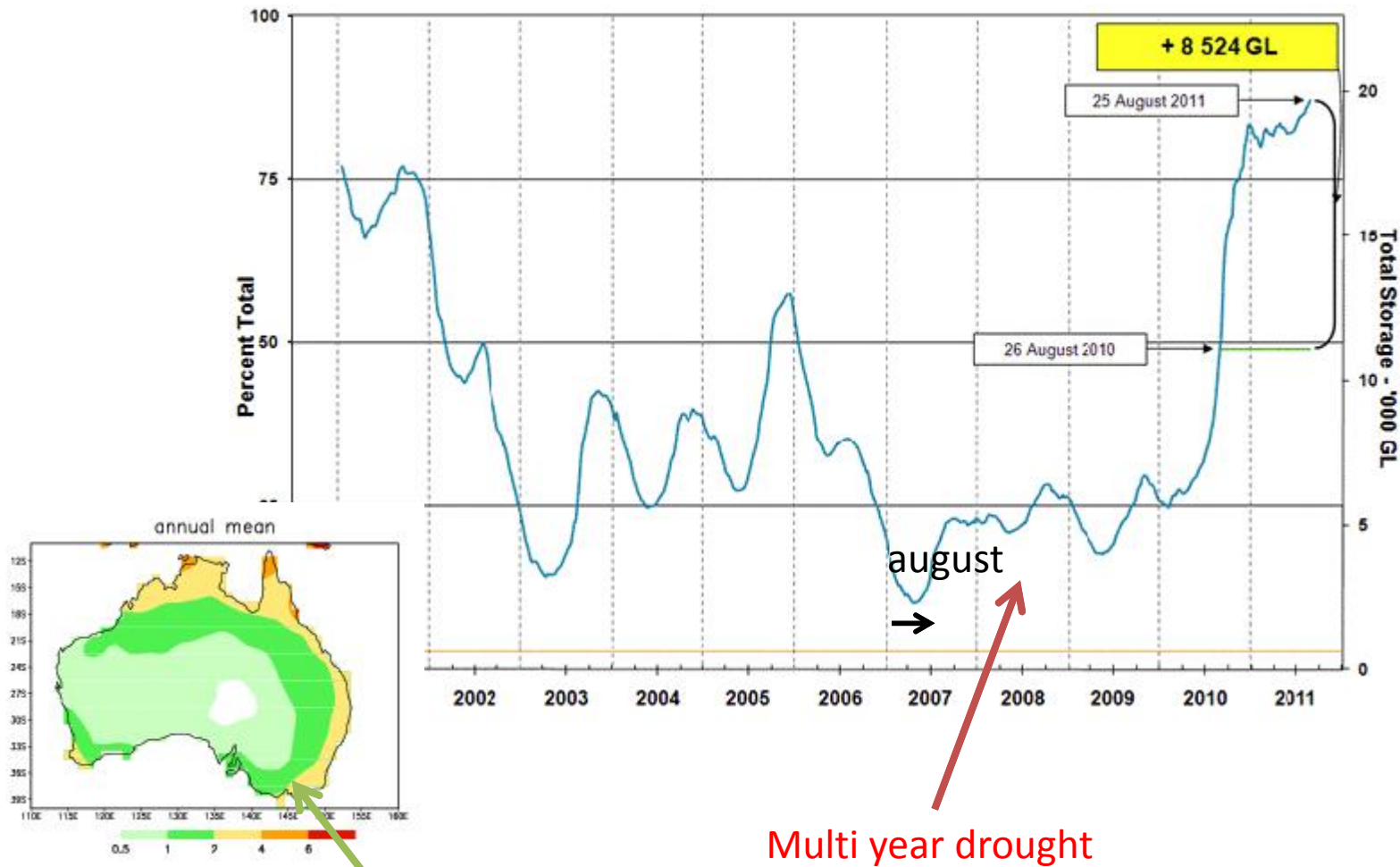
# Real time SPI prediction in operation since Jan 2013

Example: 201308



# Impact of Precipitation Analysis on SPI Prediction

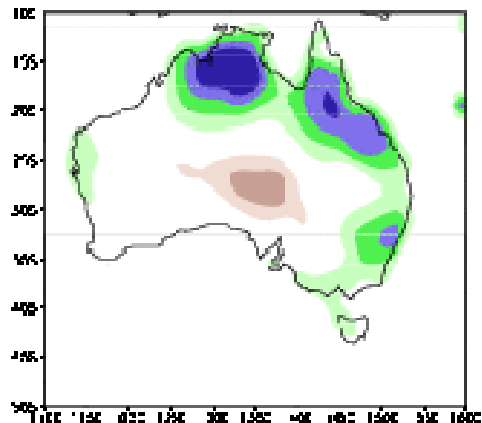
# Water storage in the Murray Darling Basin (Australia) from BMRC



Murray Darling basin (dry area with weak annual cycle)

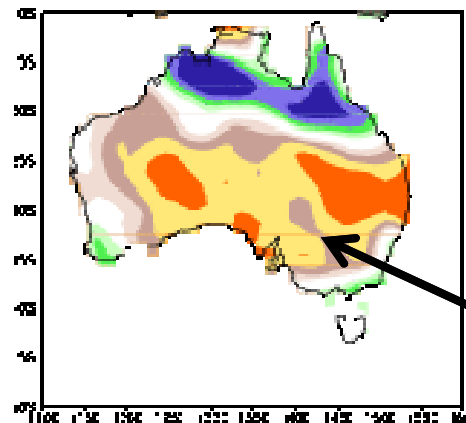
# SPI3 prediction for Australia; August 2006

CPC Analysis



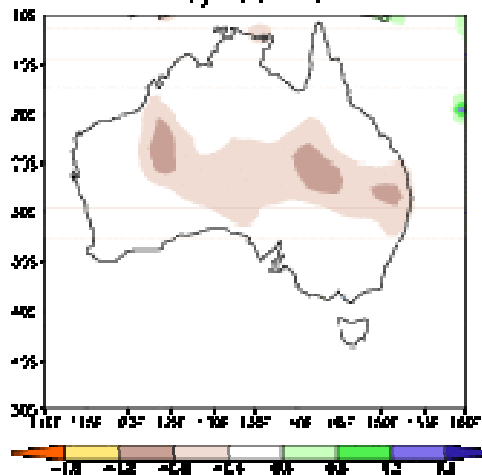
Lead -1

GPCC



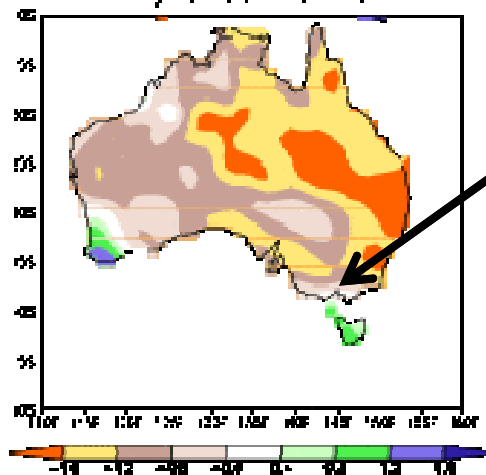
GPCC captures the drought

b) lead-3



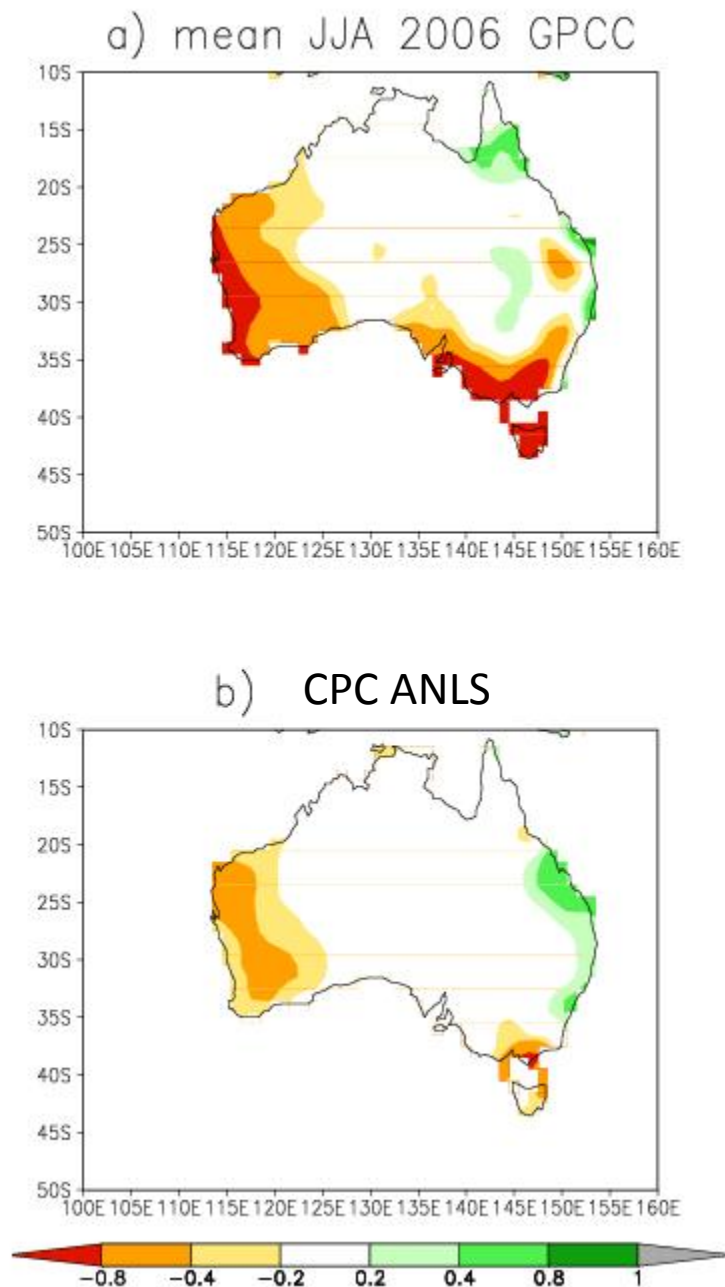
Lead-3

d) GPCC lead-3



## Seasonal mean P anomaly for JJA 2006

The GPCC data better captures  
the Australian drought in JJA  
2006 due to better analysis  
procedure and quality control.



# Summary

- Errors in the SPI prediction come from:
  - A) P forecasts -- the skill of P forecasts drops sharply after 1 month. Even at lead-1, the predictions can not capture the variability of monsoon rainfall
  - B) P analysis-- because the observations influence the SPI at lead-1, we need to have reliable analysis in real time.
  - C) A minimum of 30-yr analysis data needed to get stable SPI computations. (e. g. to get 1982 SPI predictions, analysis from 1952 is needed)
- P analyses after 1980 are better with satellite-based observations.
- Currently testing with P analysis after 1980 and compare to the SPI from the GPCC analysis. Decision to be made how to proceed for the real time operation