Recent results and challenges related to drought prediction.

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MAPP 2012 - 2013 Webinar Series
Drought Prediction

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CLIMATE PROGRAM OFFICE
Advancing scientific understanding of climate, improving society's ability to plan and respond

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The drought forecasting challenges: large, complicated and many

Three challenges where we could spend an hour discussing each:

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2. What do we know about the sources of hydrologic predictability, and are there limits? What is the impact of initial soil moisture conditions versus precipitation forecast skill in determining hydrologic predictive skill?

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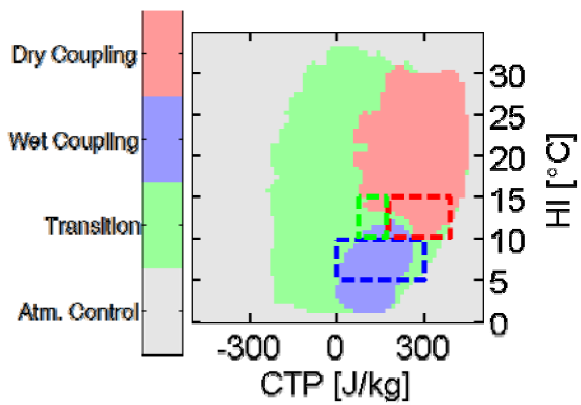
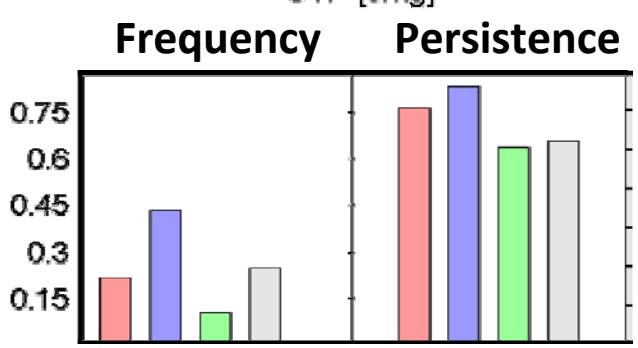
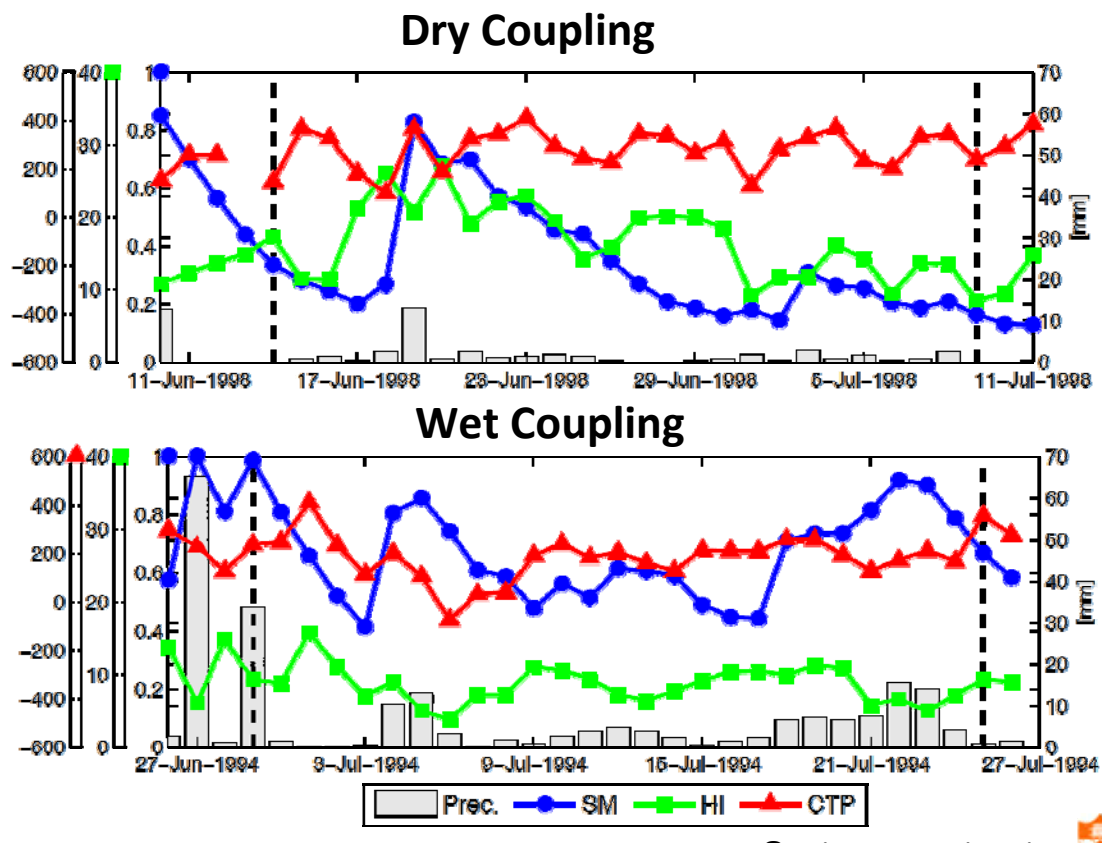
Temporal variability of land-atmospheric coupling

- **What is the temporal variability of land atmosphere interactions and what role does it play in hydrologic extremes of drought and wet conditions?**
- Develop new classification of land atmosphere coupling for drought:

  $CDI=(N_{DC}-N_{WC})/(N_{DC}+N_{WC})$
- The Classified CTP-HI space is then used to generate a time series of coupling







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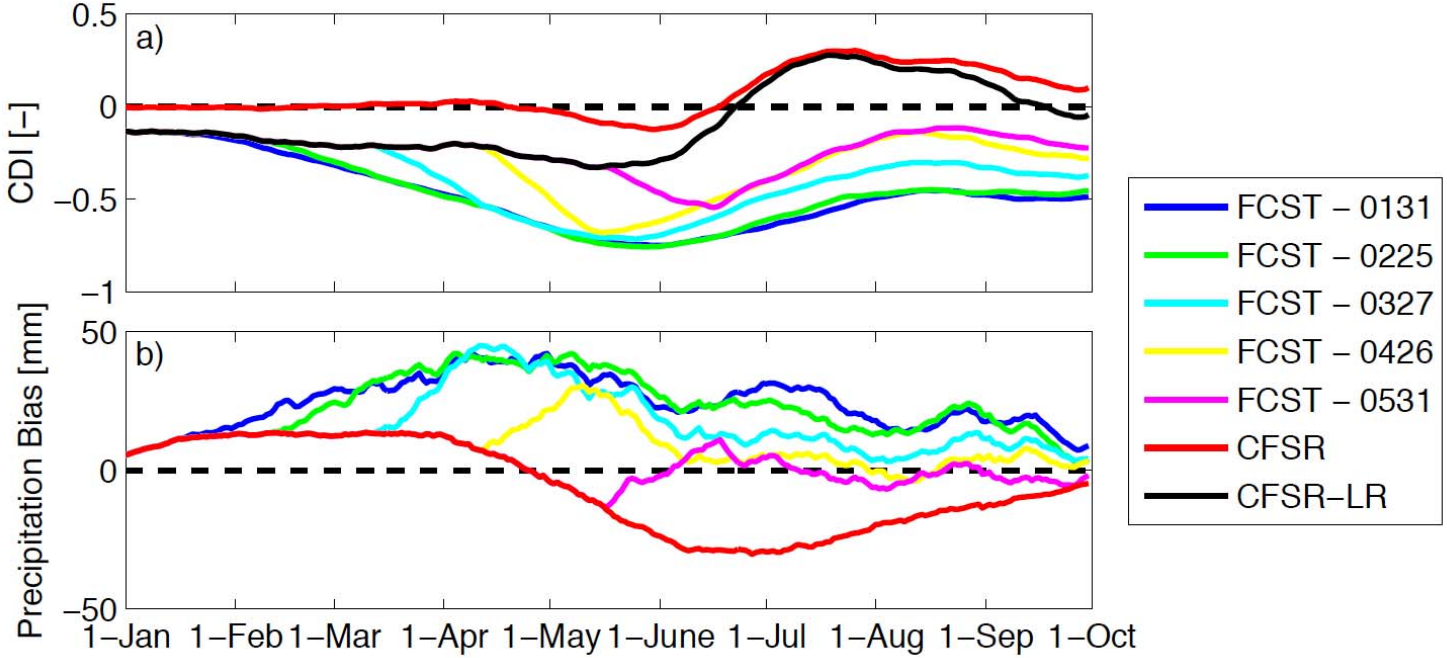
CFSv2 fails hold dry coupling in the CDI resulting in a wet precipitation bias relative the CFSR.



	R	P	E	Q	ΔS_{1-3}	ΔS_4
$GP_{Reanalysis}$	23	245	265	16	–52	–7
$GP_{Forecast}$	–1	319	422	22	–21	–103
$SE_{Reanalysis}$	200	684	469	33	2	–20
$SE_{Forecast}$	0	478	469	73	–9	–55

CFSR and CFSRR have a different terrestrial hydrologic climatology over the 28 year .
GP: Great plains
SE: Southeast

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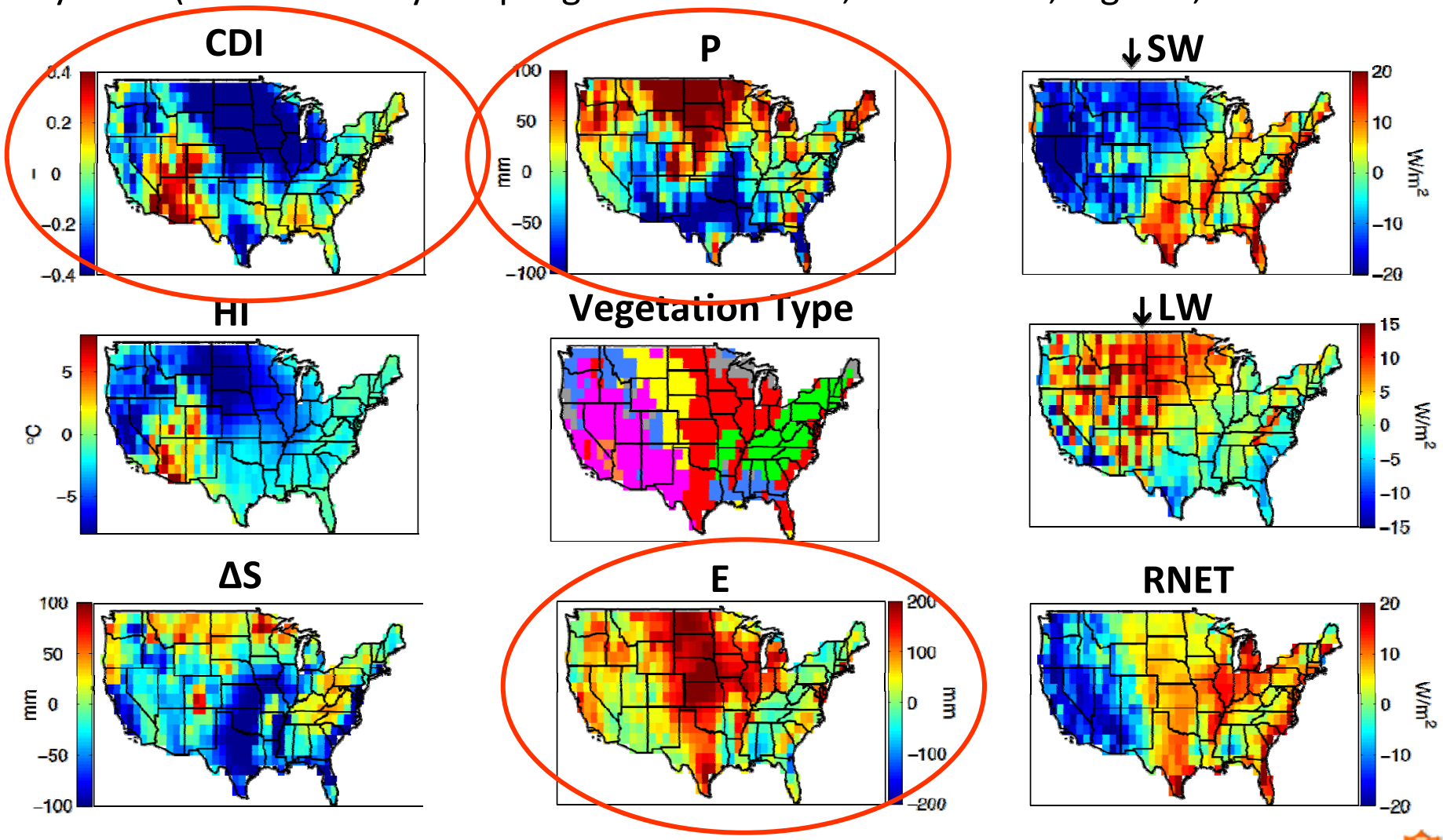
Comparisons between CFSR and CFSRR shows a summer time seasonal forecast divergence.

- Difference (Forecast – 0531-Reanalysis) Average Summer (June – Sep) for 28 years. (CFSRR low dry coupling in northern GP; biased wet; high ET; etc.



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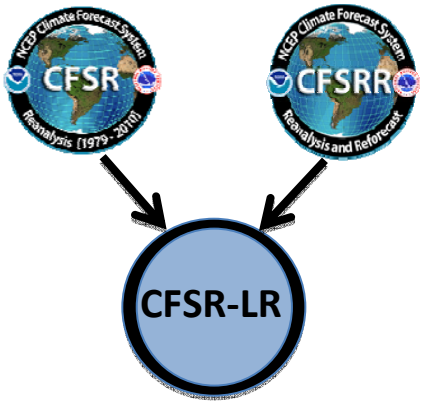
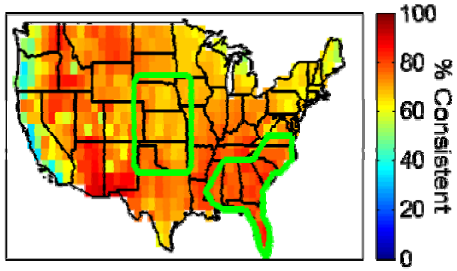
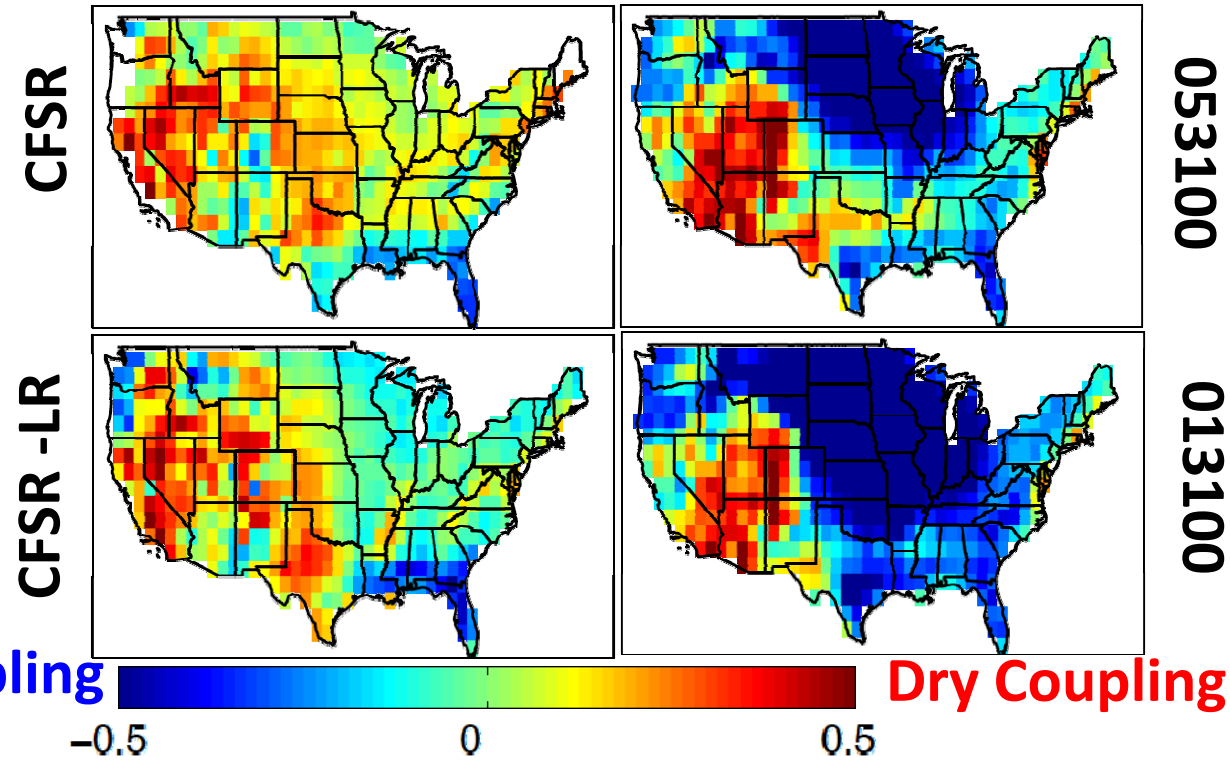
CFSv2 summertime seasonal forecast breakdown…a challenge to fix it.

- **How does the coupling in the forecast models differ from the reanalysis?**
- Use the NCEP Climate forecast system (CFSR- CFSRR) 1982-2009





Average Summer (June – Sep) CDI for 28 years



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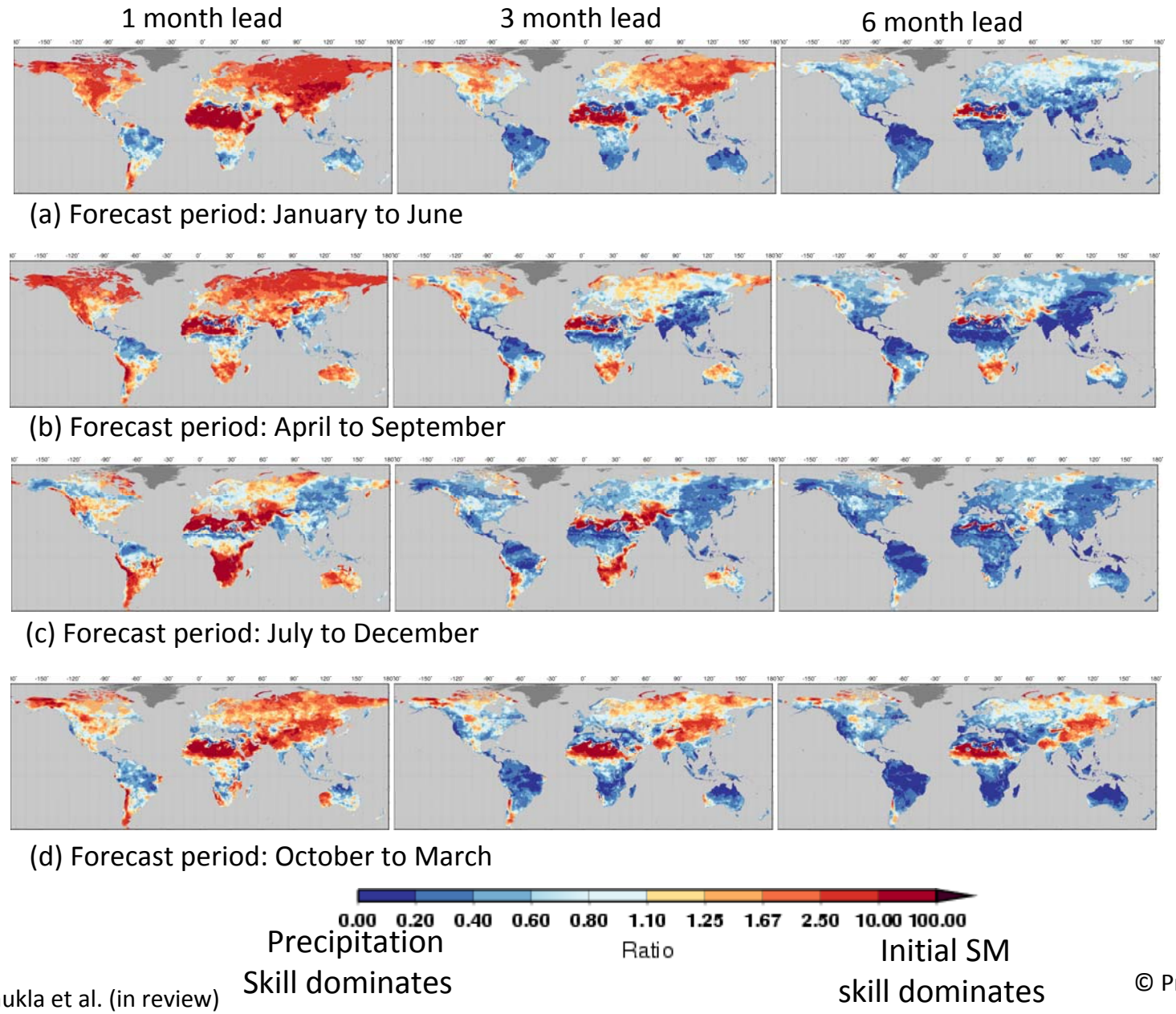
Initial soil moisture (and snow) conditions dominate precipitation forecasts as a source predictability in hydrological seasonal forecasts.



From Shukla et al. (in review)

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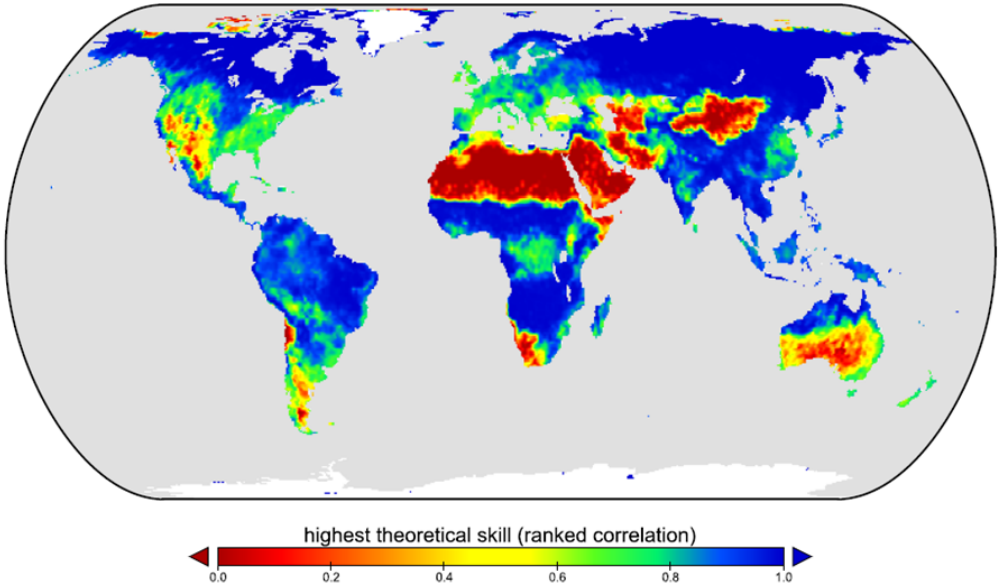
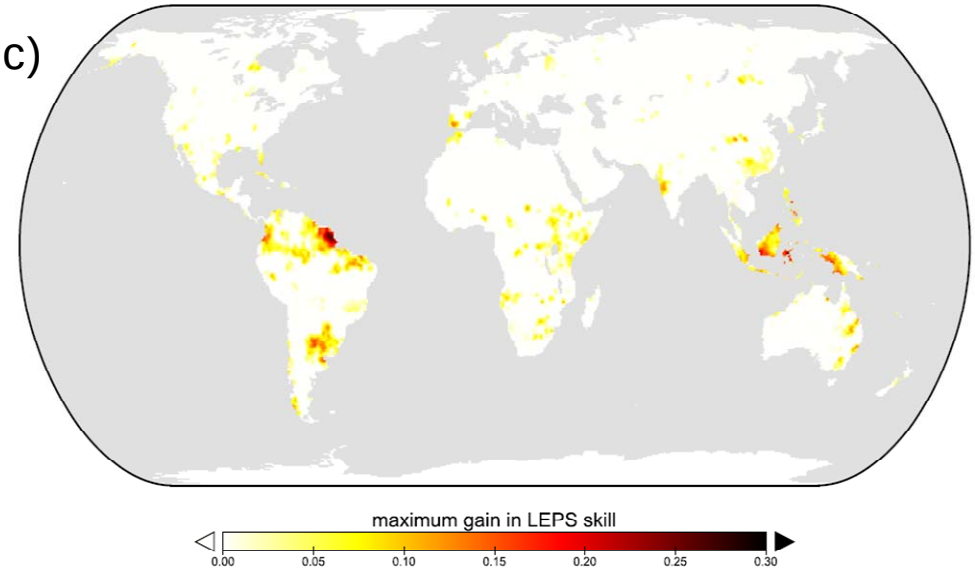
To what extent do climate anomalies provide information useful to improving seasonal hydrological prediction? Apparently very little.



The maximum theoretical forecast skill for runoff (ranked correlation coefficient among the six forecast periods)

c)



Contribution of climate indices to theoretical skill, calculated as the difference between the mean ranked correlation coefficient for the case with and without ensemble sampling based on climate indices, respectively.

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Integrating drought monitoring and seasonal hydrological forecasting to assess drought recovery risks

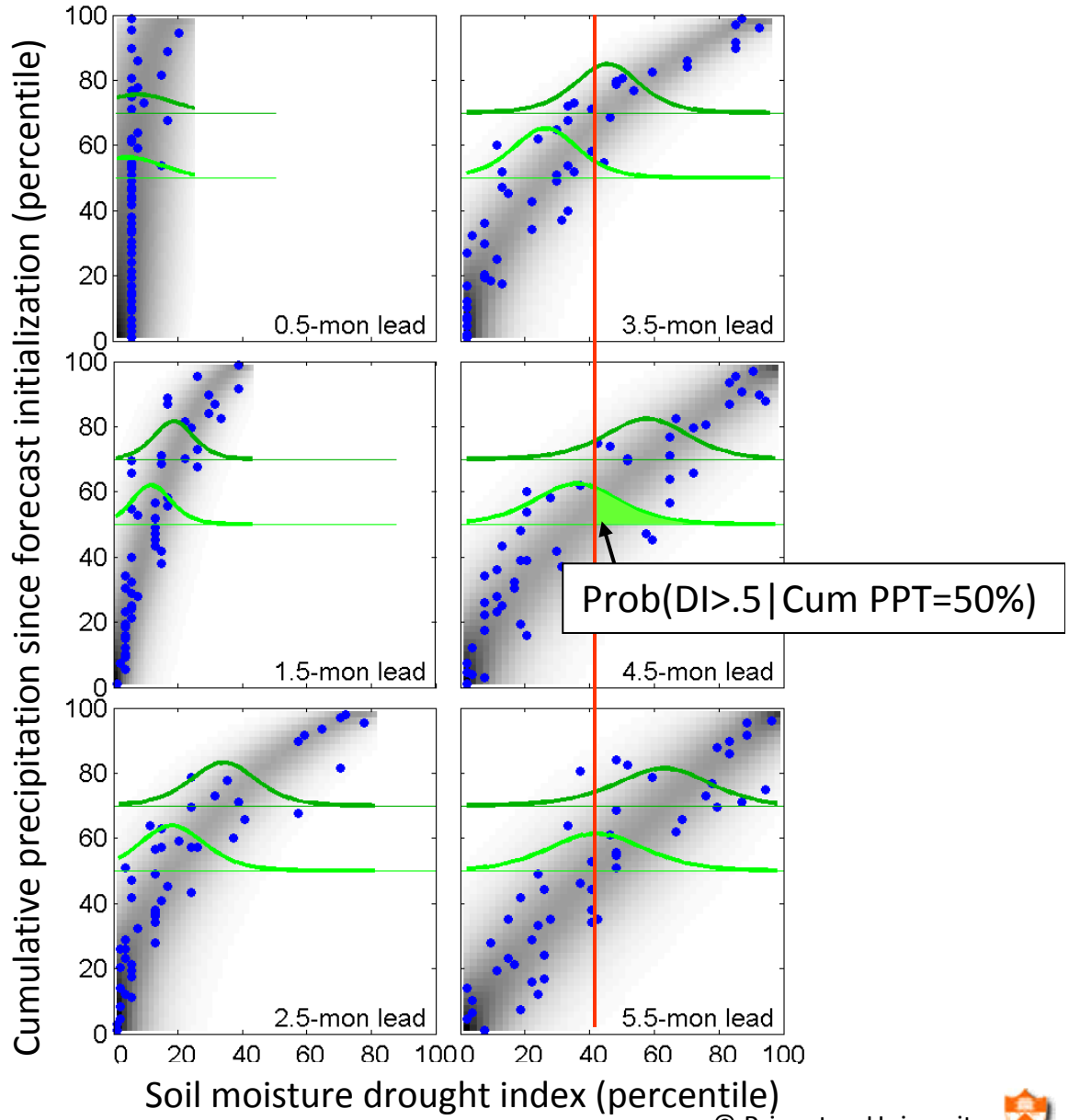
ESP (50 years) was used to project drought recovery using initial soil moisture conditions from our drought monitor (http:hydrology.princeton.edu/forecast/current.php)

The ensemble of the joint distribution of predicted Soil Moisture Drought Index and Cumulative Precipitation since Feb (forecast initialization) was fit using Copula statistics.

<u>EXAMPLE ON THE RIGHT</u>

1/8° area centered at (100°W, 40°N) in Iowa

Conditional PDF: 50% and 70% cumulative Precipitation



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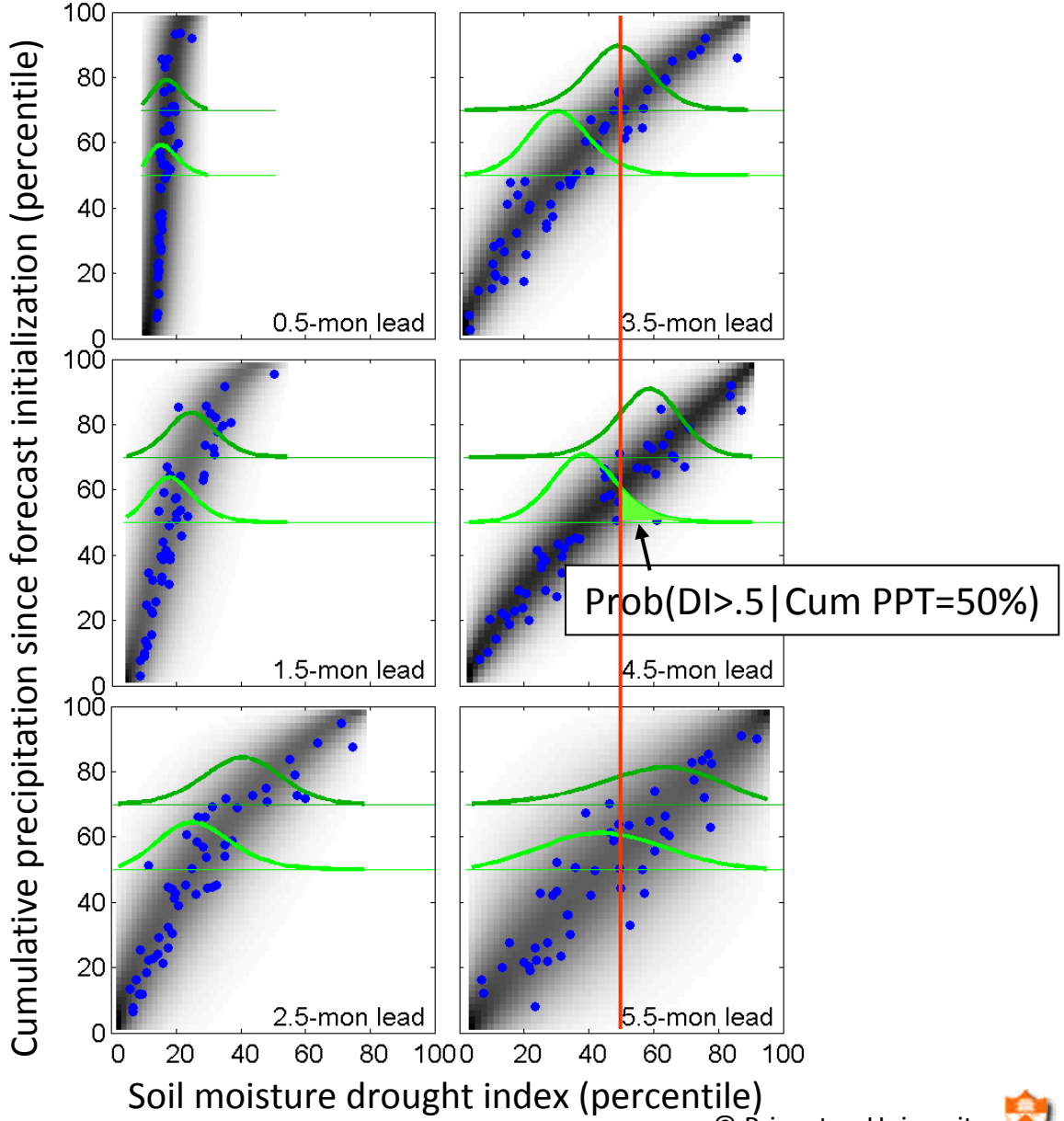
<u>EXAMPLE ON THE RIGHT</u>

4° area centered at (100oW, 40oN) in Iowa

Conditional PDF: 50% and 70% cumulative Precipitation



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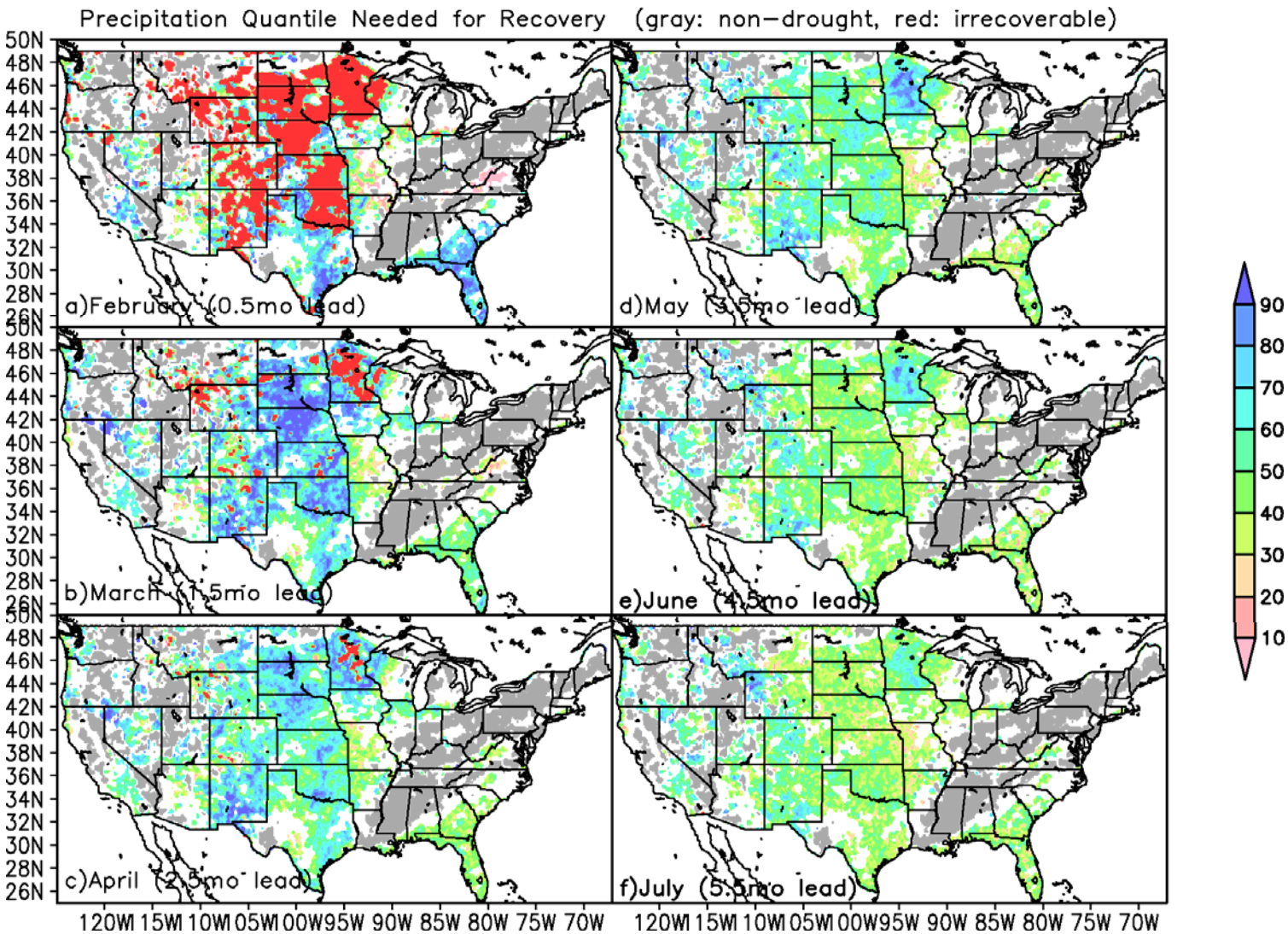
Average precipitation quantile for soil moisture drought index to exceed 0.3



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