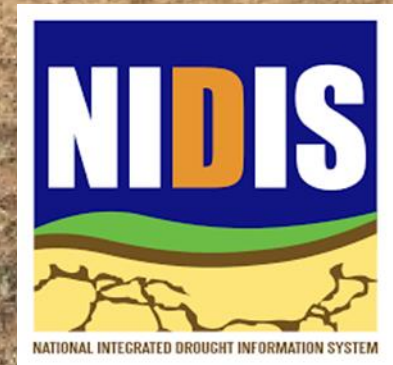


Tracking Seasonal Precipitation's Dependence on Root Zone Soil Moisture Using Regional Reanalysis

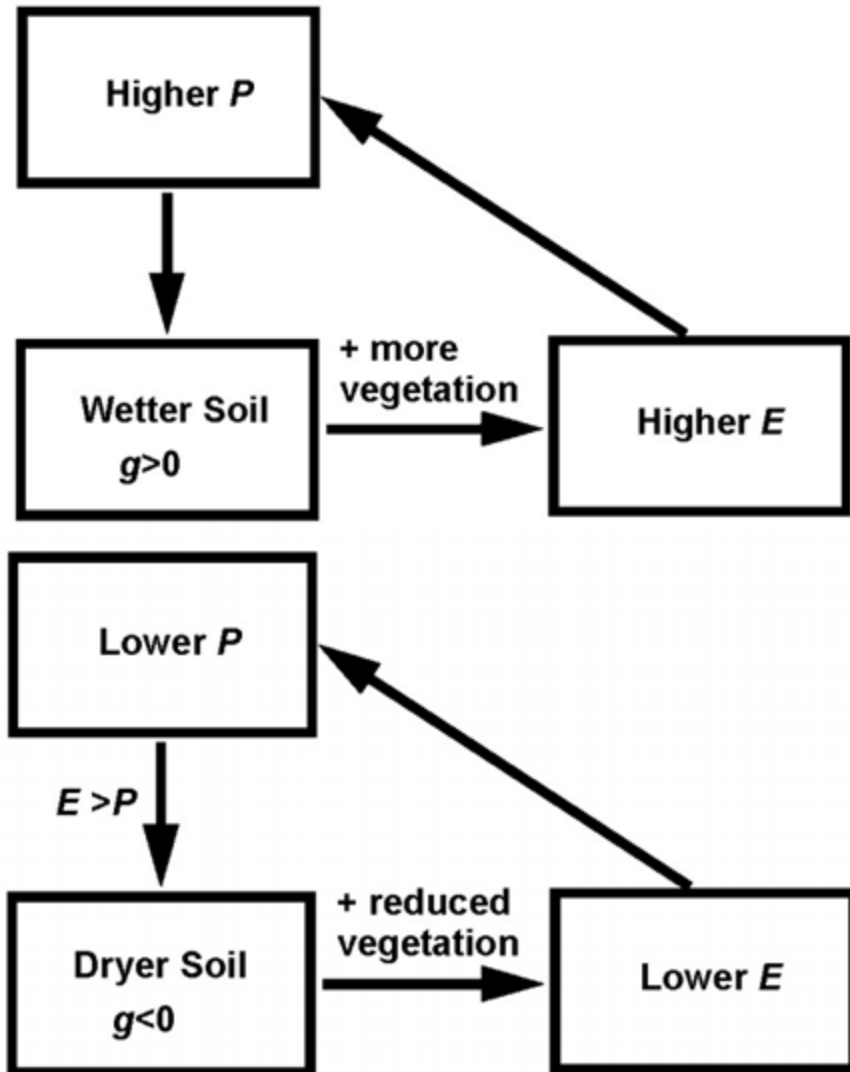
Peter Goble

Russ S. Schumacher and Nolan J.
Doesken

Colorado State University



Background

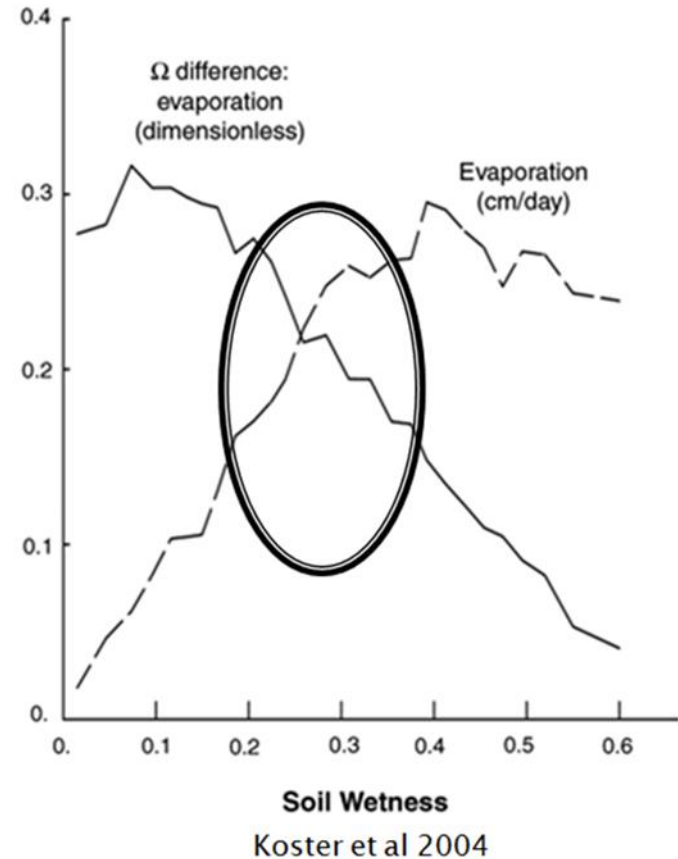
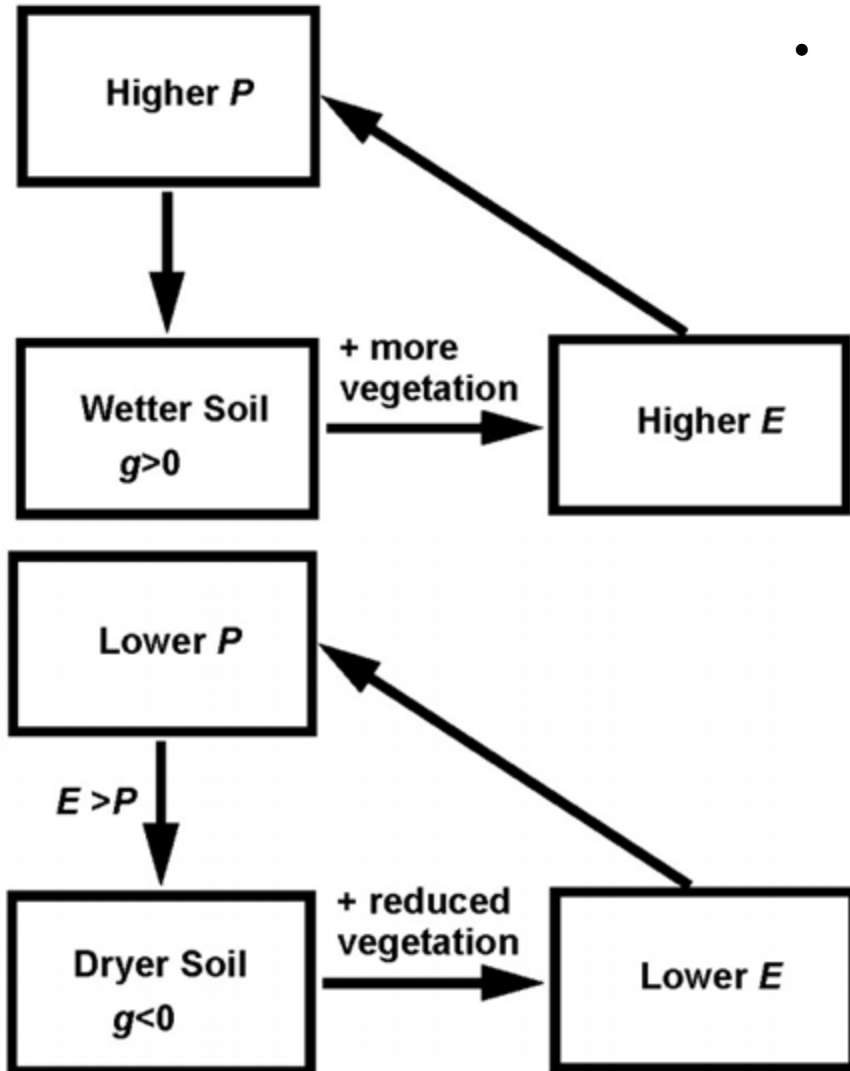


- The atmosphere is chaotic; this makes seasonal forecasting difficult. Soil moisture data is less temporally chaotic, and may offer a partial solution
- If root zone soils are drier (wetter) than usual, it may cause increased subsequent seasonal dryness (wetness) on a seasonal timescale (a positive feedback!)



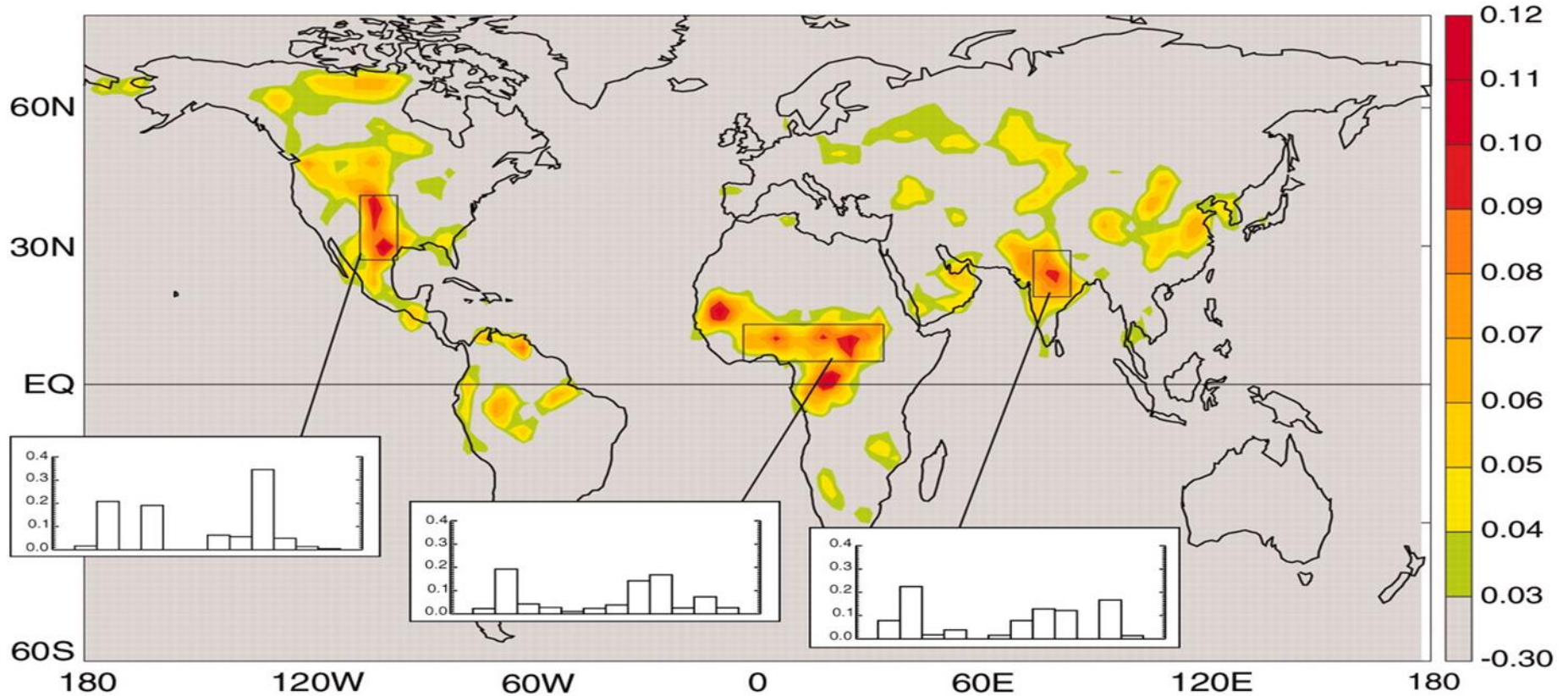
Background

- Transitional zones between “moisture-limited” and “energy limited” evaporation regimes are most vulnerable to these changes



Land-Atmosphere Coupling from GLACE Project

Land-atmosphere coupling strength (JJA), averaged across AGCMs



Koster et al 2004

Coupled modeling experiments show evidence of this relationship, but the spread is large. Can we see this relationship in reanalysis?

Motivation

U.S. Drought Monitor Colorado

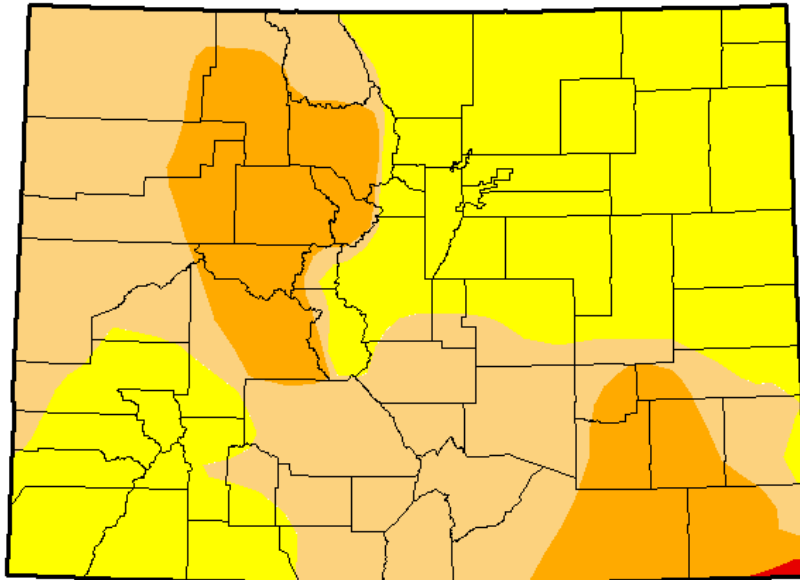
April 3, 2012

(Released Thursday, Apr. 5, 2012)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	55.48	18.50	0.15	0.00
Last Week <i>3/27/2012</i>	2.25	97.75	50.97	9.26	0.15	0.00
3 Months Ago <i>1/3/2012</i>	65.37	34.63	24.98	10.60	0.04	0.00
Start of Calendar Year <i>1/3/2012</i>	65.37	34.63	24.98	10.60	0.04	0.00
Start of Water Year <i>9/27/2011</i>	60.62	39.38	27.69	19.99	7.88	0.56
One Year Ago <i>4/5/2011</i>	40.11	59.89	54.20	41.58	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Brian Fuchs

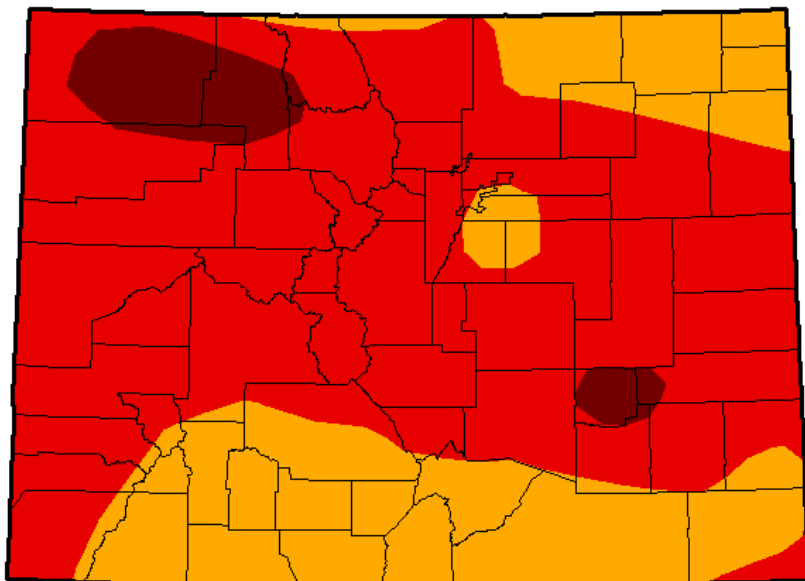
National Drought Mitigation Center



Motivation

U.S. Drought Monitor Colorado

July 3, 2012
(Released Thursday, Jul. 5, 2012)
Valid 7 a.m. EST



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	100.00	100.00	70.69	5.52
Last Week 6/26/2012	0.00	100.00	100.00	97.72	45.83	0.00
3 Months Ago 4/3/2012	0.00	100.00	55.48	18.50	0.15	0.00
Start of Calendar Year 1/3/2012	65.37	34.63	24.98	10.60	0.04	0.00
Start of Water Year 9/27/2011	60.62	39.38	27.69	19.99	7.88	0.56
One Year Ago 7/5/2011	49.31	50.69	34.84	29.02	16.64	1.57

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

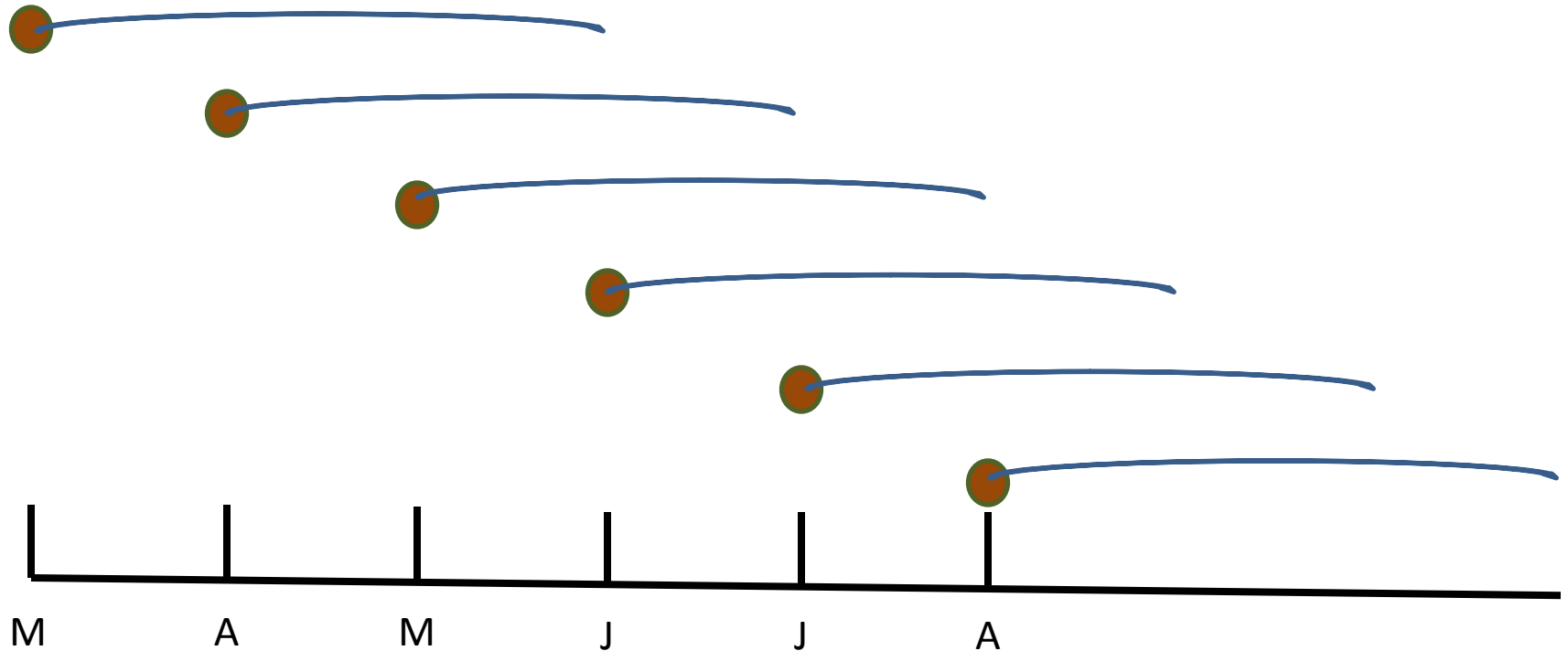


Today's Questions

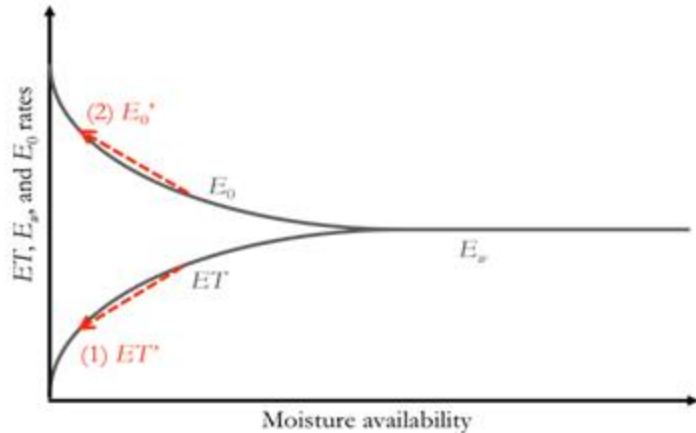
- Do reanalysis data provide supporting evidence that soil moisture levels moderate seasonal precipitation?
- Does the location and intensity of soil moisture correlation (coupling) hot spots change as a function of season?
- How does the relationship between soil moisture and precipitation in the Rockies and Intermountain West compare to that of the south and central Plains?
- Can correlations between modeled soil moisture and precipitation be used to make marginal improvements to seasonal precipitation forecasts?

Methods

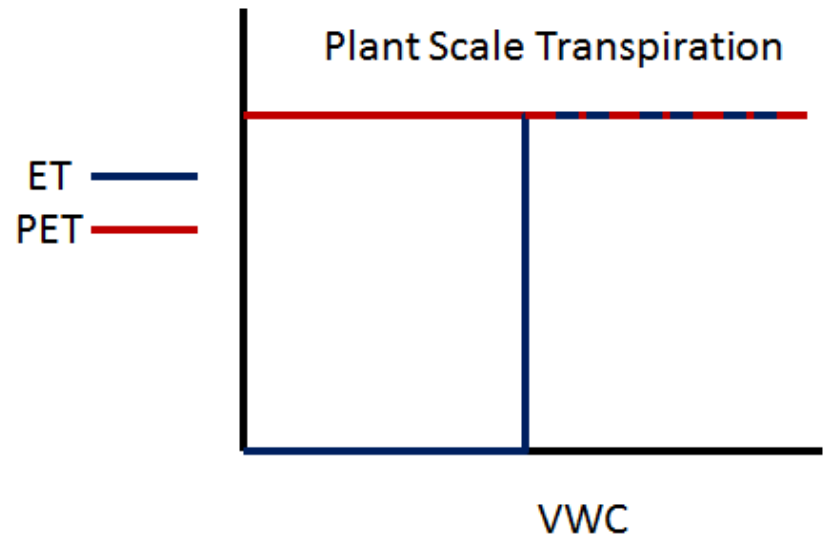
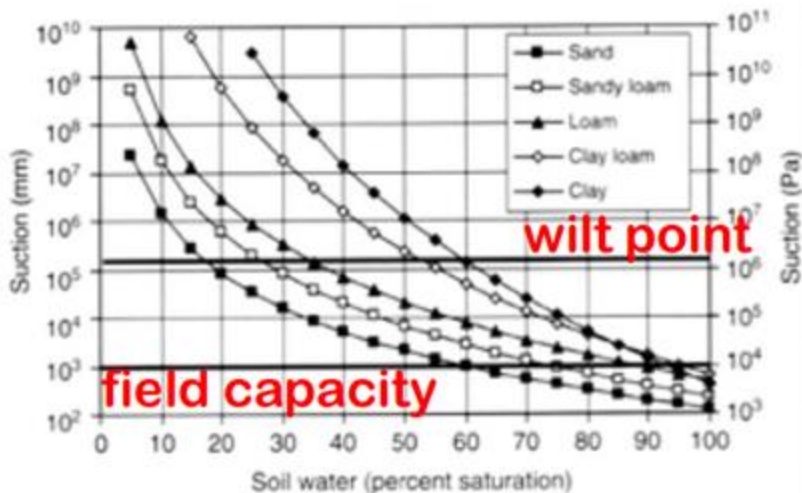
- Find linear correlations between standardized root zone soil moisture and standardized precipitation indices for the subsequent three months
- Data obtained from North American Land Data Assimilation for 1985-2014
- All data standardized



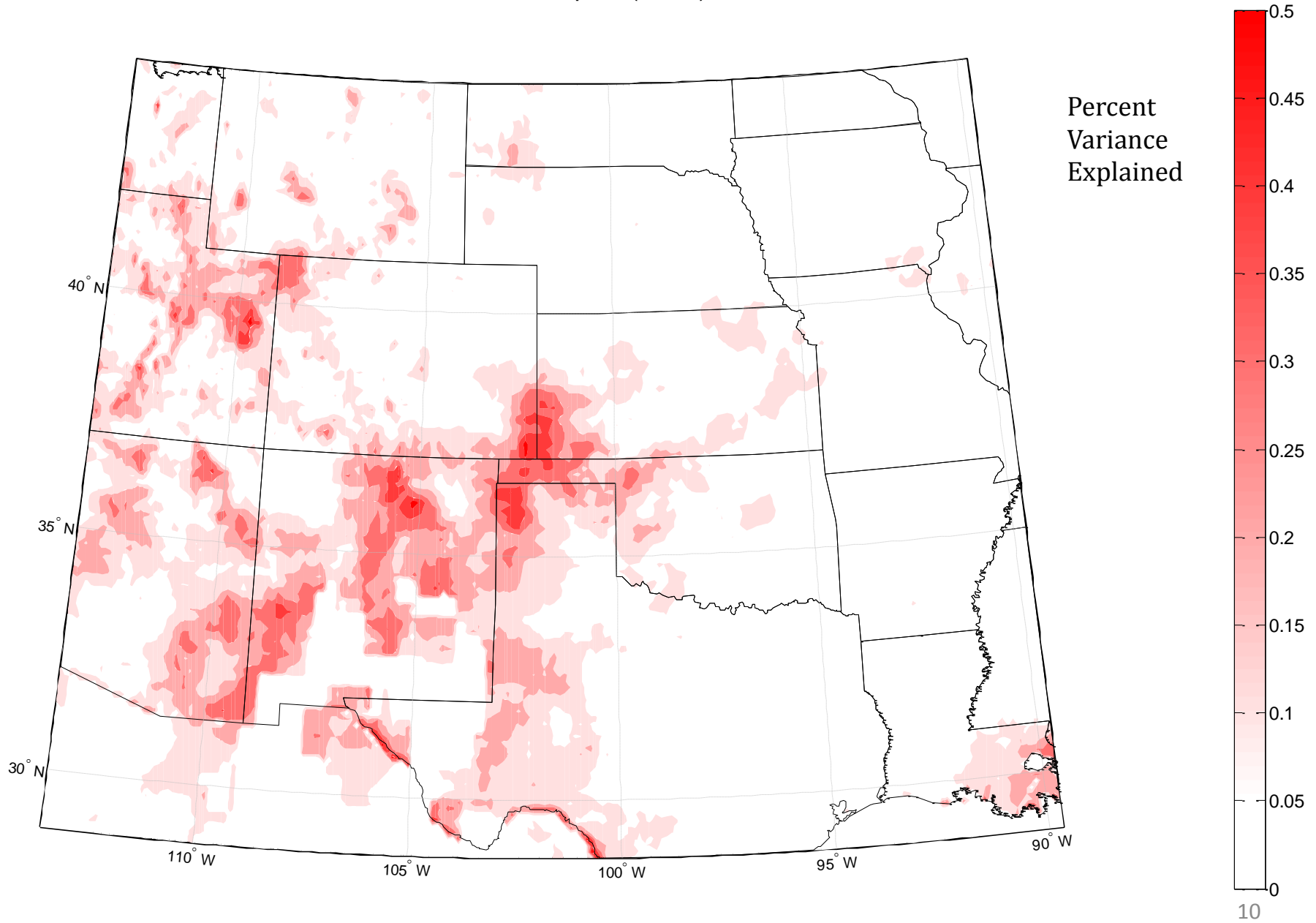
Justification for Linear Approximation



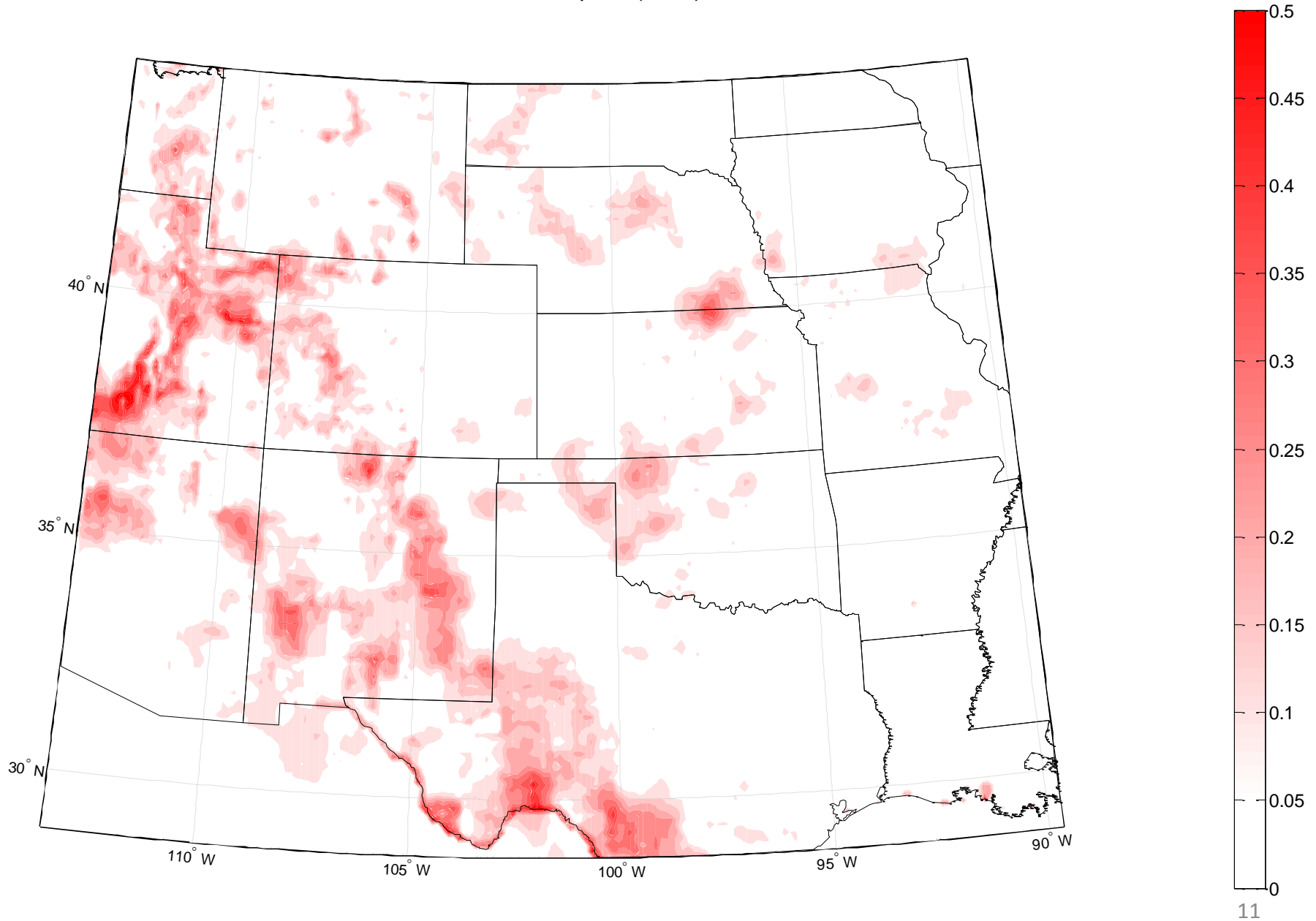
1. First order approximation (sometimes less is more)
2. There exists copious sub-grid scale variability, so may is well keep the analysis simple
3. Anomaly corresponding to wilting not spatially or temporally constant



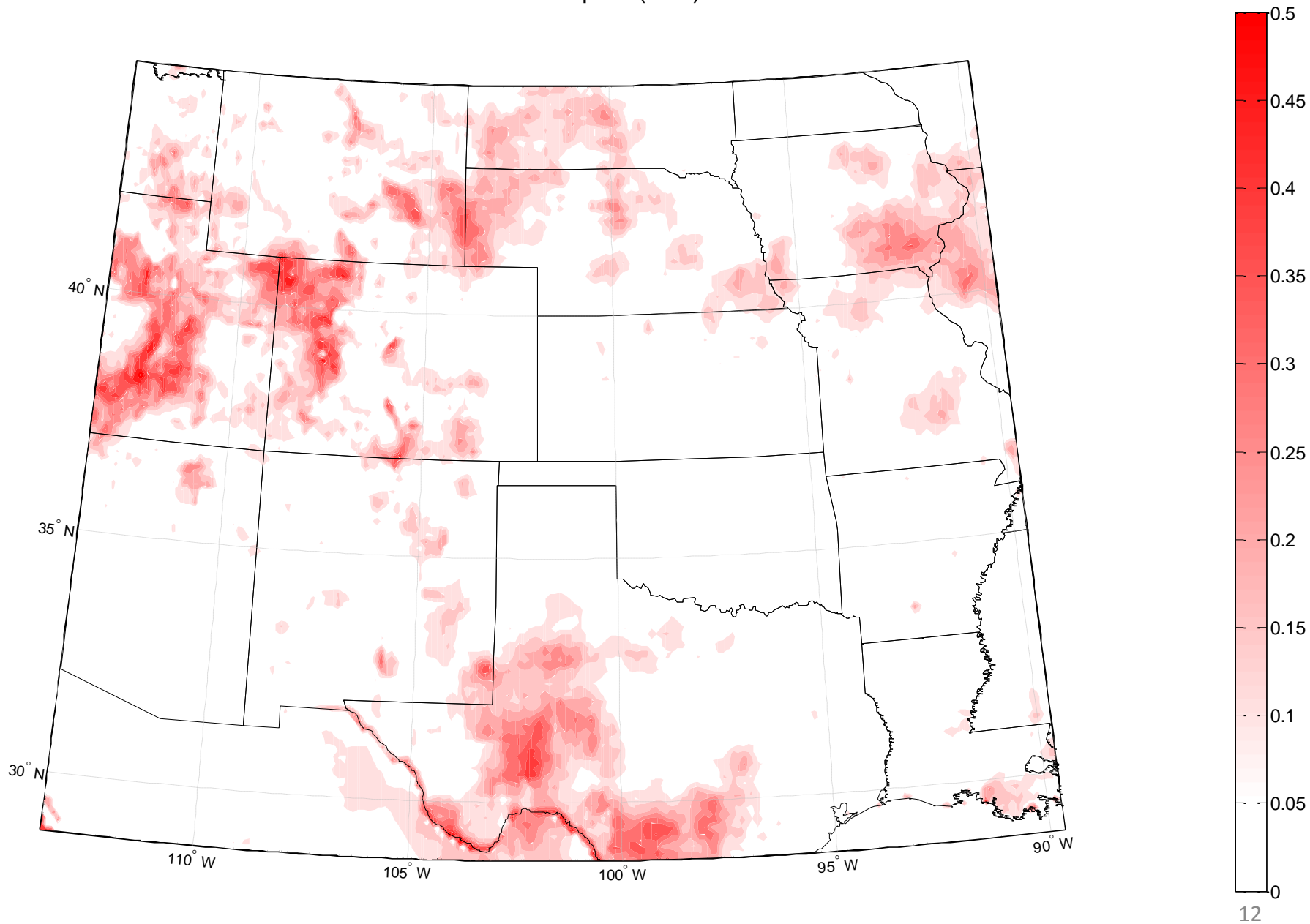
Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (MAM)



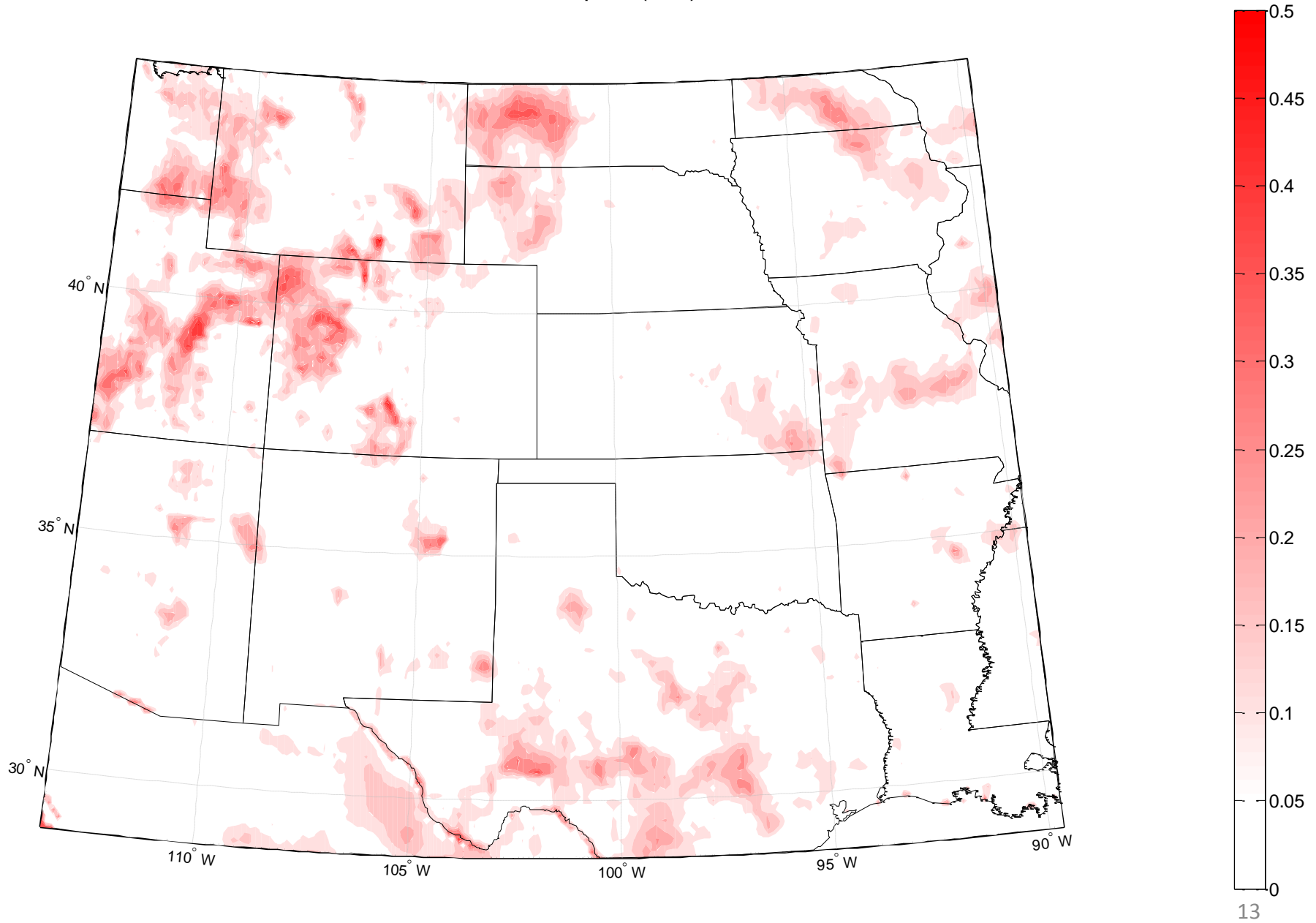
Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (AMJ)



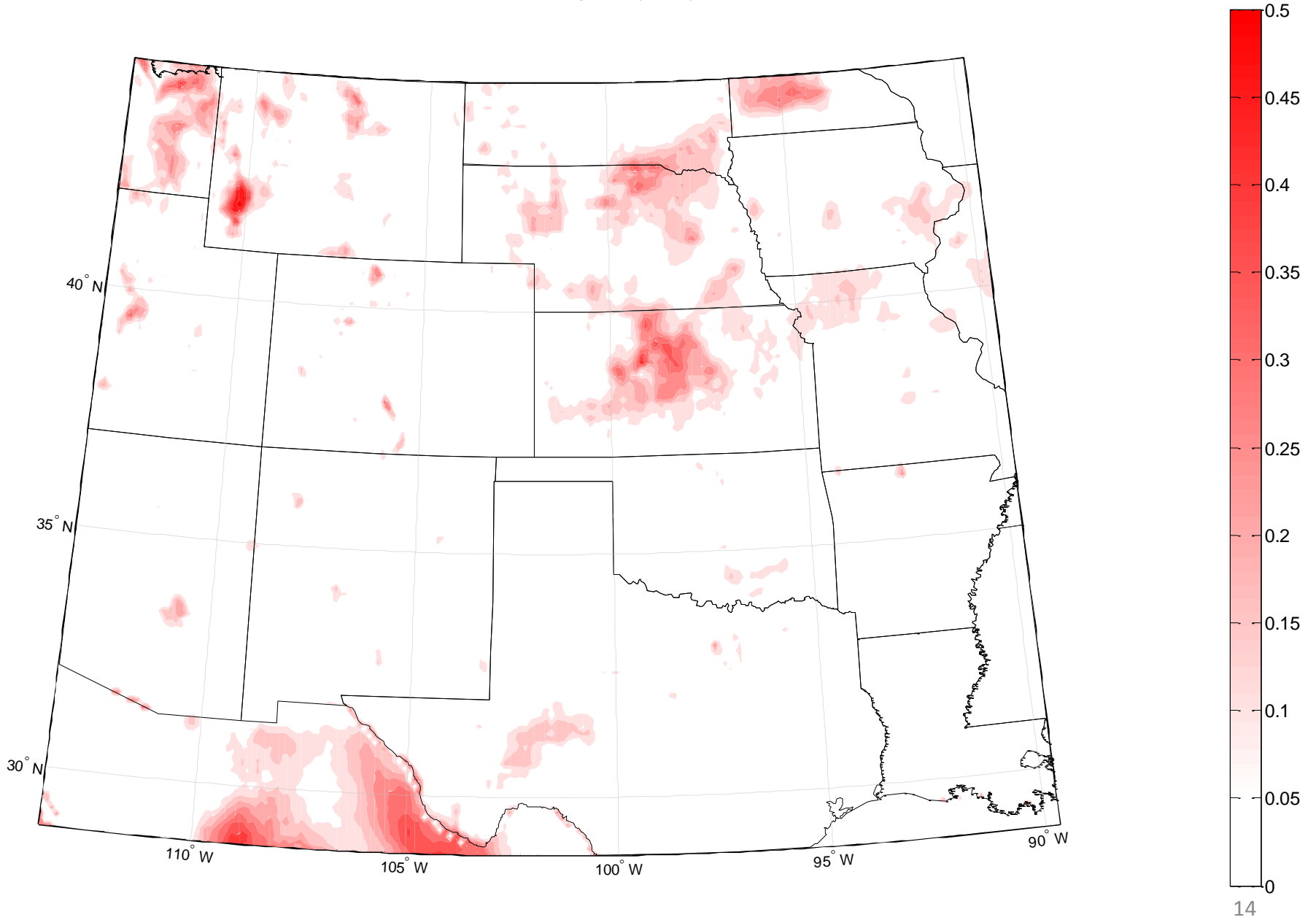
Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (MJJ)



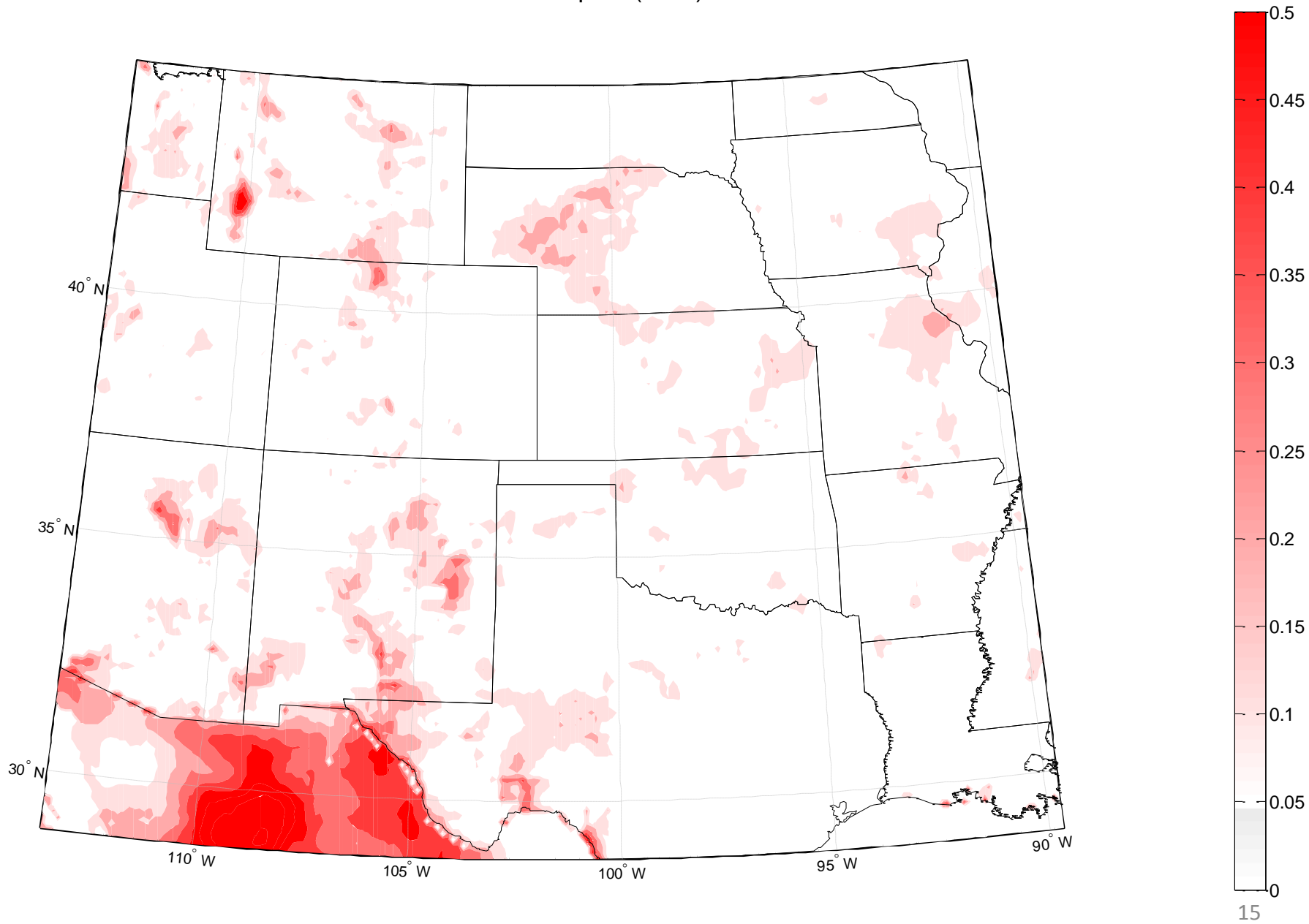
Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (JJA)



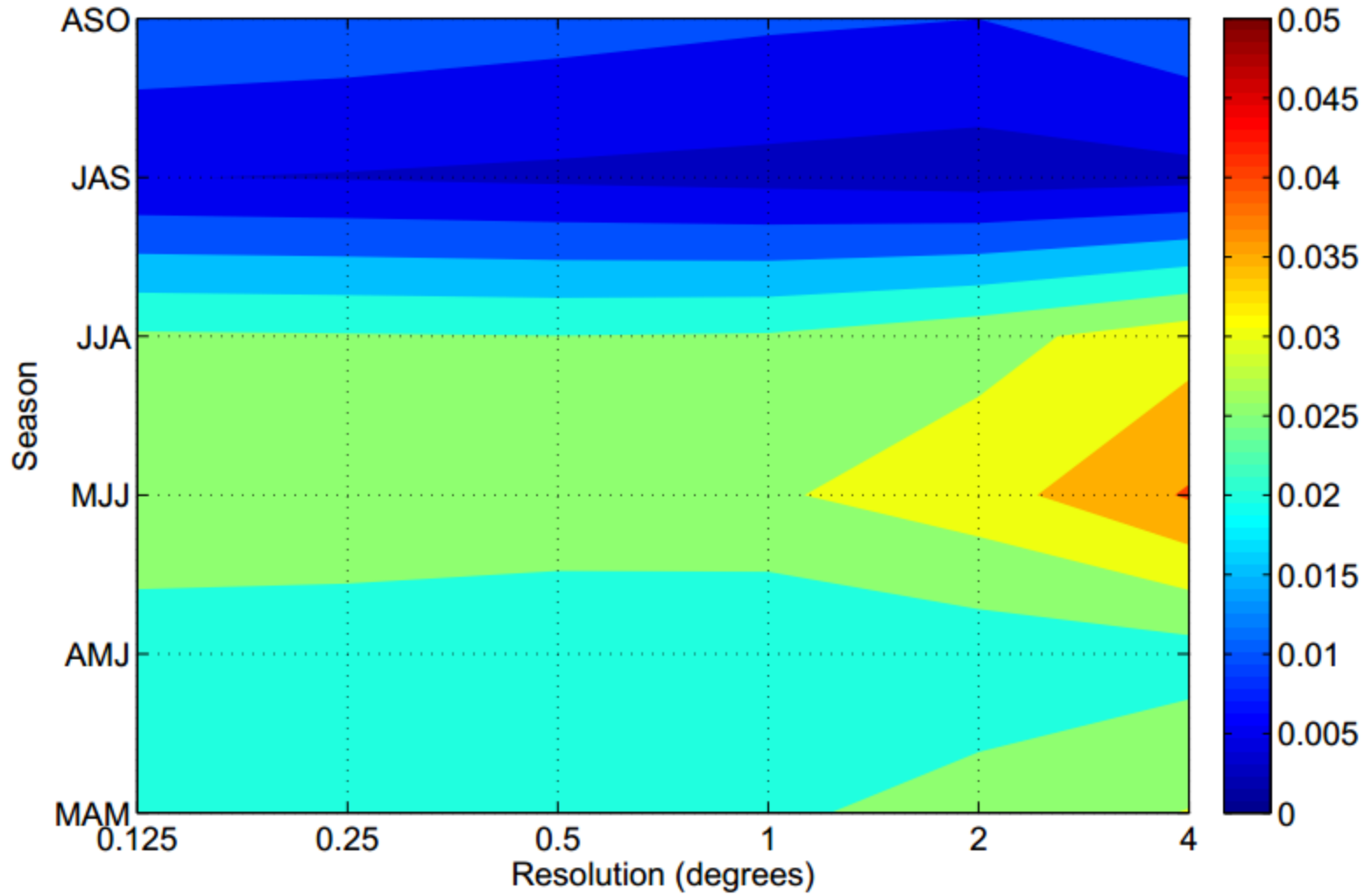
Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (JAS)



Antecedent Soil Moisture/Seasonal Precipitation Correlation Hotspots (ASO)



Domain Average Correlation as a Function of Resolution and Season



Conclusions



- Reanalysis soil and precipitation data reveal a dynamic band of statistically significant positive correlation between root zone soil moisture and subsequent seasonal precipitation
- Winter precipitation (late spring soil moisture) may play an important role in warm season precipitation over the intermountain west
- Correlations in the Central Plains may carry more importance than in the intermountain west because the correlation maximizes at the same time that seasonal precipitation maximizes

Persisting Questions

- How much might soil moisture in a convection source area (ie Rocky Mountains) impact seasonal precipitation elsewhere?
- How is the distribution of soil volumetric water content impacting correlations?
- Are there methods using reanalysis data that would add more value to a seasonal precipitation forecast?

