

Uncovering the relationship between drought indices and rangeland production

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USDA United States Department of Agriculture
Climate Hubs
<http://www.usda.gov/climatehubs>

Why?

- National grazing allotment evaluation

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- Production assessment in support of public land grazing management



Impetus:

evaluating drought resiliency: How is our management working?

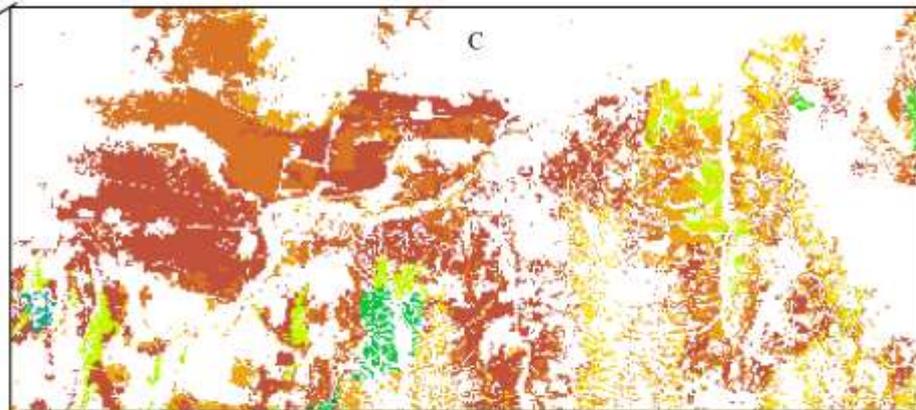
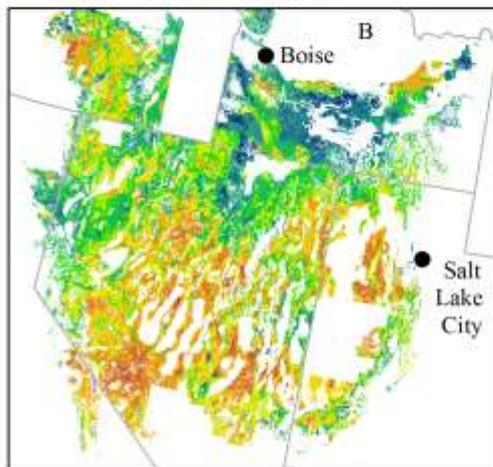
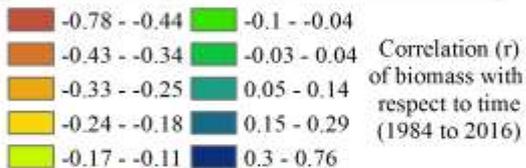
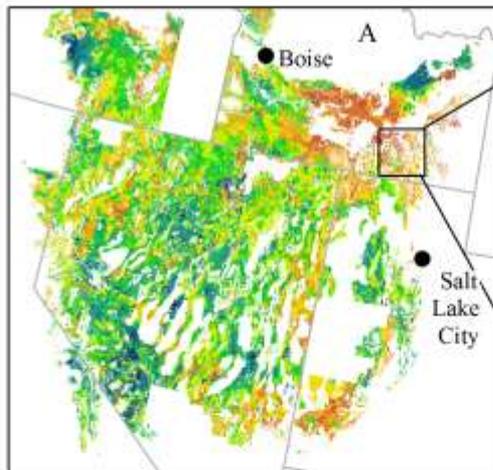
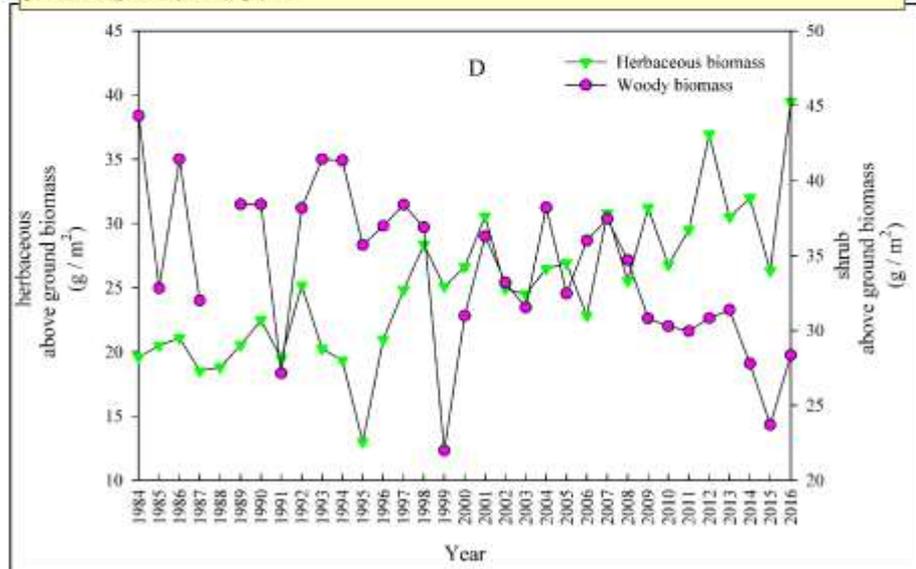
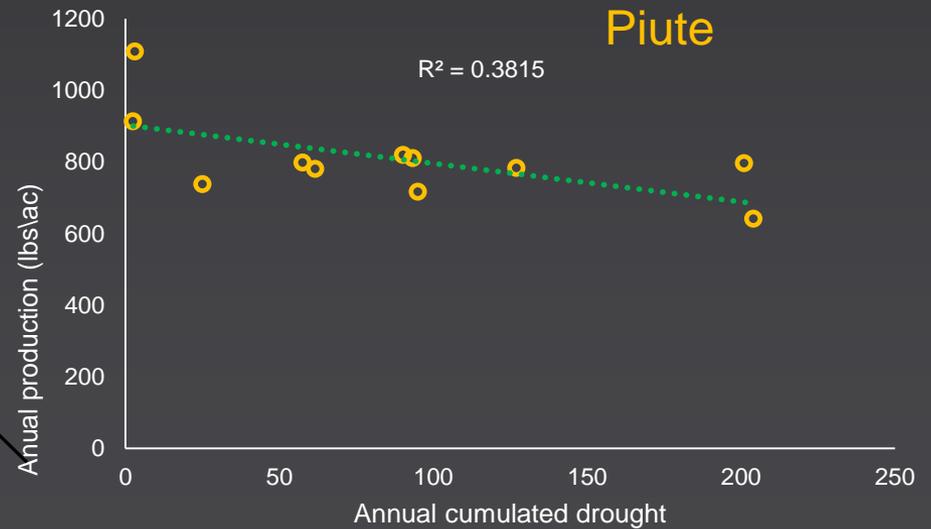
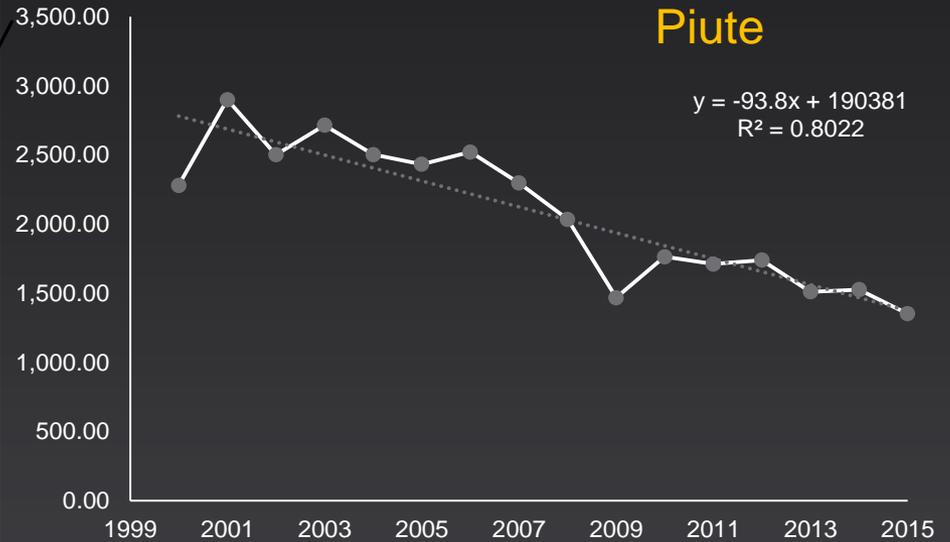
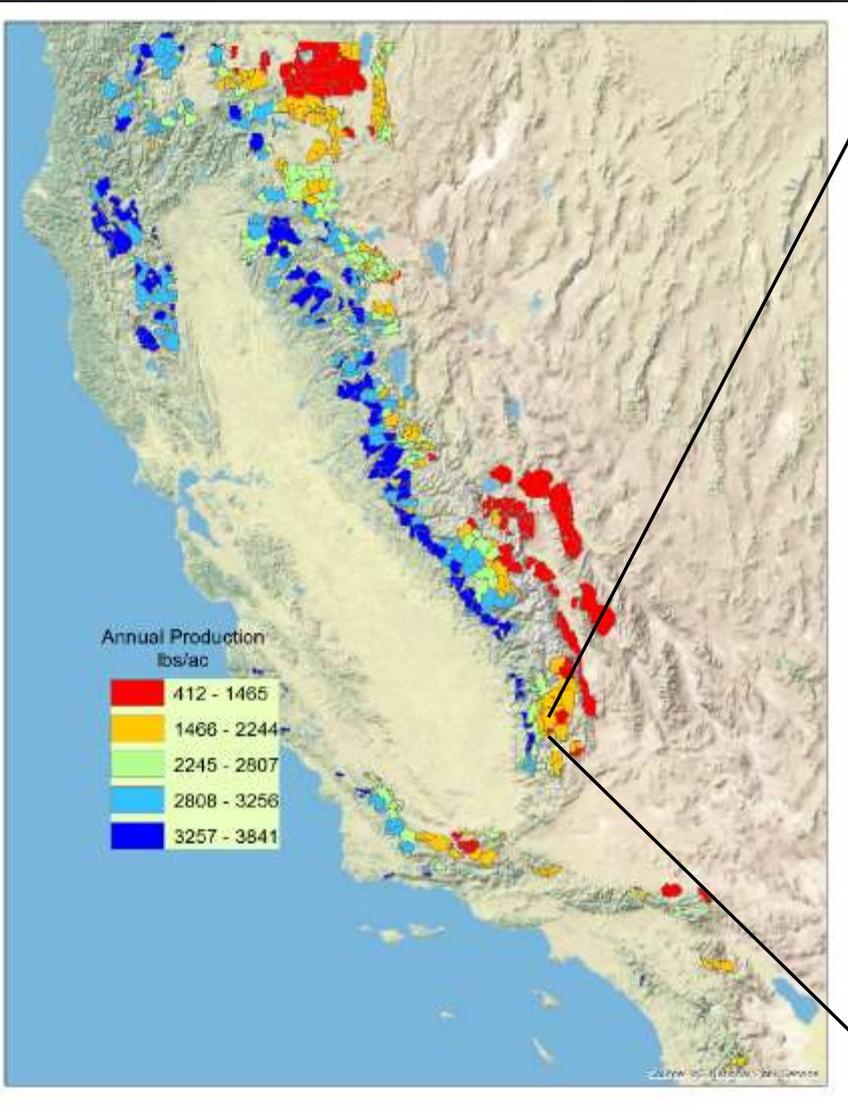


Figure 2 Panels. Trend of shrub biomass (A) and herbaceous biomass (B) on the Upland Gravelly Loam (Bonneville Big Sagebrush) Ecological Site. Panel C shows the significant decline of shrubs on this Ecological Site. This site occupies about 30,000 ha in the study area and is representative of other sites where shrub biomass has been steadily decreasing while being replace by increases in herbaceous production (as shown in Panel 4), often invasive annual grasses, especially cheatgrass.



Impetus:

evaluating drought resiliency: How is our management working?



Why?

- National grazing allotment evaluation
- Production assessment in support of public land grazing management
- These issues caused us to investigate various drought monitors



Relations with annual production

The Study

- 1) What vegetation types exhibit the highest correlation between drought monitors and annual production?

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- 3) What lag times exhibit the highest correlation between rangeland production and drought monitors?

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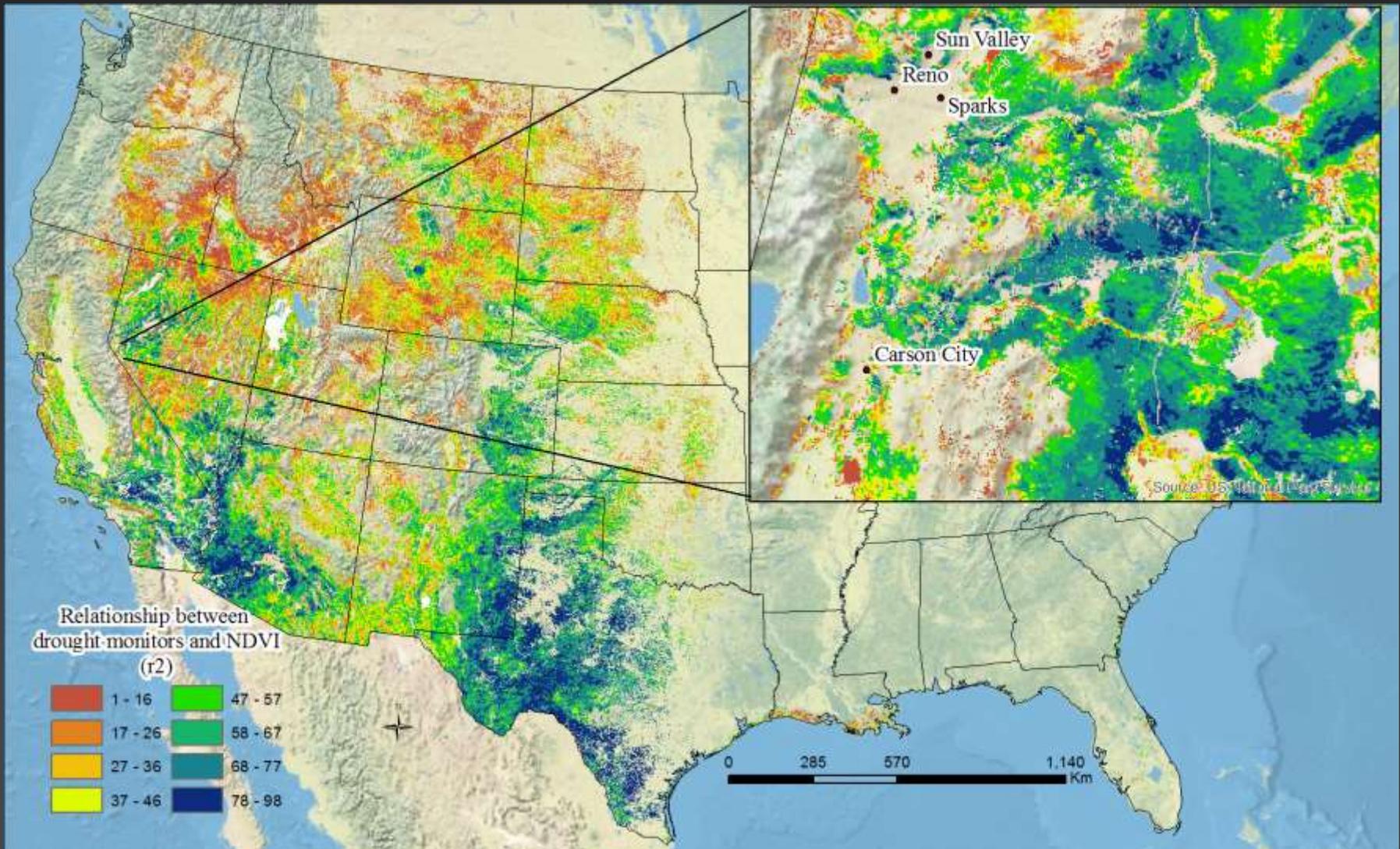
- 1) What vegetation types exhibit the highest correlation between drought monitors and annual production?
- 2) What monitor exhibits the highest correlation with rangeland production?
- 3) What lag times exhibit the highest correlation between rangeland production and drought monitors?
- 4) What vegetative and regional characteristics enable high correlations between rangeland production and drought monitors

The Study

- Palmer Drought Severity Index (**PDSI**)
- Self calibrated Palmer Drought Severity Index (**PDSI_{sc}**)
- US Drought Monitor (**USDM**)
- Evaporative Demand Drought Index (**EDDI**)
- Standardized Precipitation Evaporation Index 6 (**SPEI₆**)
- Standardized Precipitation Evaporation Index 12 (**SPEI₁₂**)

Results

What vegetation types exhibit the highest correlation between drought monitors and annual production?



Results

What vegetation types exhibit the highest correlation between drought monitors and annual production?

EVT	SAF SRM	Mean max
Tamaulipan Mixed Deciduous Thornscrub	Mesquite-Ganjeno-Acacia	80
Tamaulipan Mesquite Upland Scrub	Mesquite-Ganjeno-Acacia	79
Tamaulipan Savanna Grassland	Mesquite-Ganjeno-Acacia	78
Tamaulipan Calcareous Thornscrub	Mesquite-Ganjeno-Acacia	77
South Texas Sand Sheet Grassland	Mesquite-Live Oak-Seacoast Bluestem	77
Chihuahuan Succulent Desert Scrub	Sideoats Grama-Sumac-Juniper	70
Edwards Plateau Limestone Shrubland	Juniper-Oak	70
Edwards Plateau Limestone Savanna and Woodland	Juniper-Oak	70
Western Great Plains Mesquite Woodland and Shrubland	Mesquite	69
Quercus havardii Shrubland Alliance	Sand Shinnery Oak	69
Chihuahuan Mixed Desert and Thornscrub	Creosotebush-Tarbrush	67
Sonoran Paloverde-Mixed Cacti Desert Scrub	Palo Verde-Cactus	66
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	Creosotebush-Bursage	65
North American Warm Desert Sparsely Vegetated Systems	Sparsely Vegetated	65
Apacherian-Chihuahuan Mesquite Upland Scrub	Mesquite	65
Sonoran Mid-Elevation Desert Scrub	Creosotebush-Bursage	62
Chihuahuan-Sonoran Desert Bottomland and Swale Grassland	Alkali Sacaton-Tobosa Grass	61
Colorado Plateau Blackbrush-Mormon-tea Shrubland	Blackbush	61
North American Warm Desert Riparian Systems	Riparian Woodland	61
Western Great Plains Shortgrass Prairie	Blue Grama-Buffalograss	59

Results

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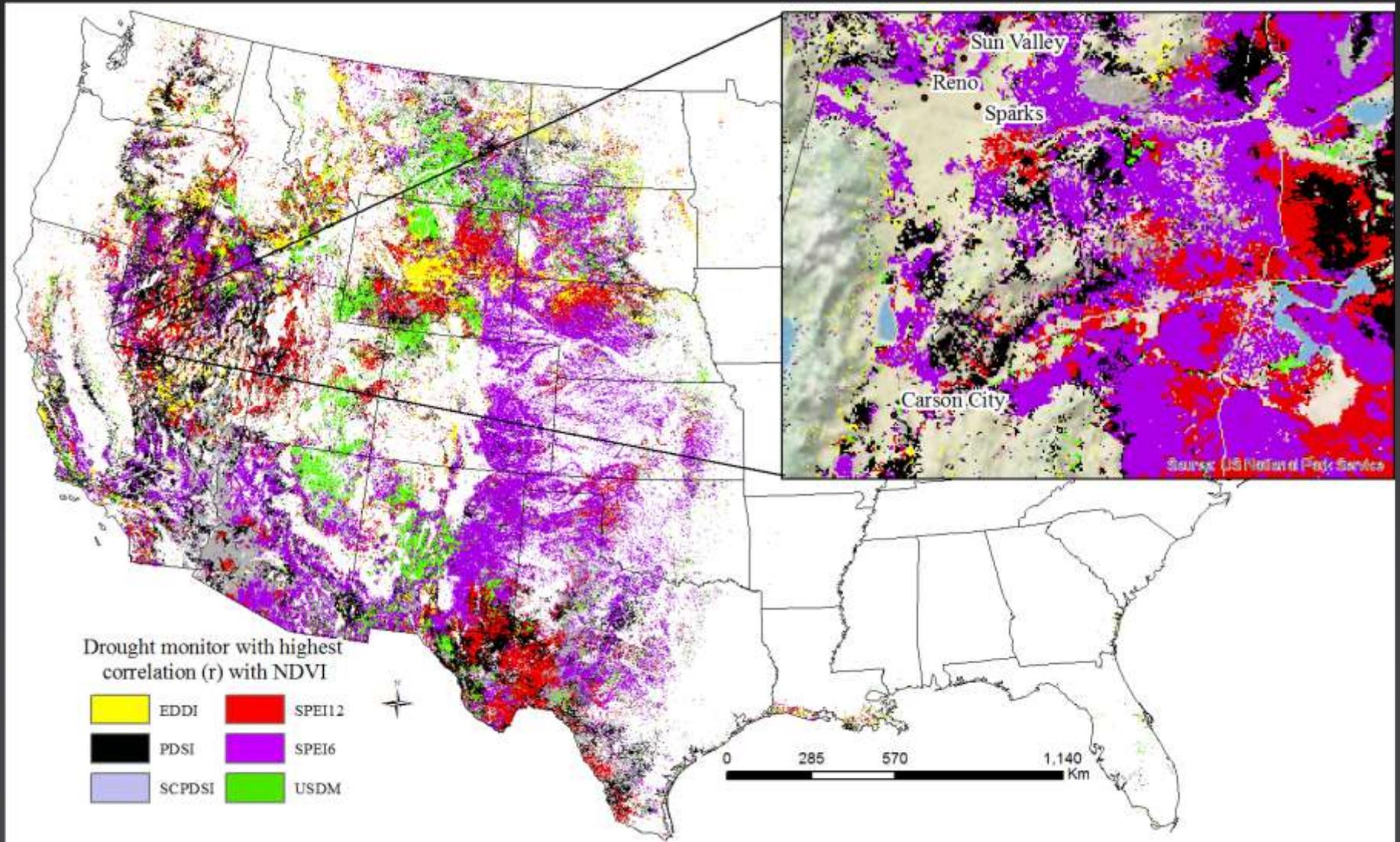
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Something in common?

C4 Dominance

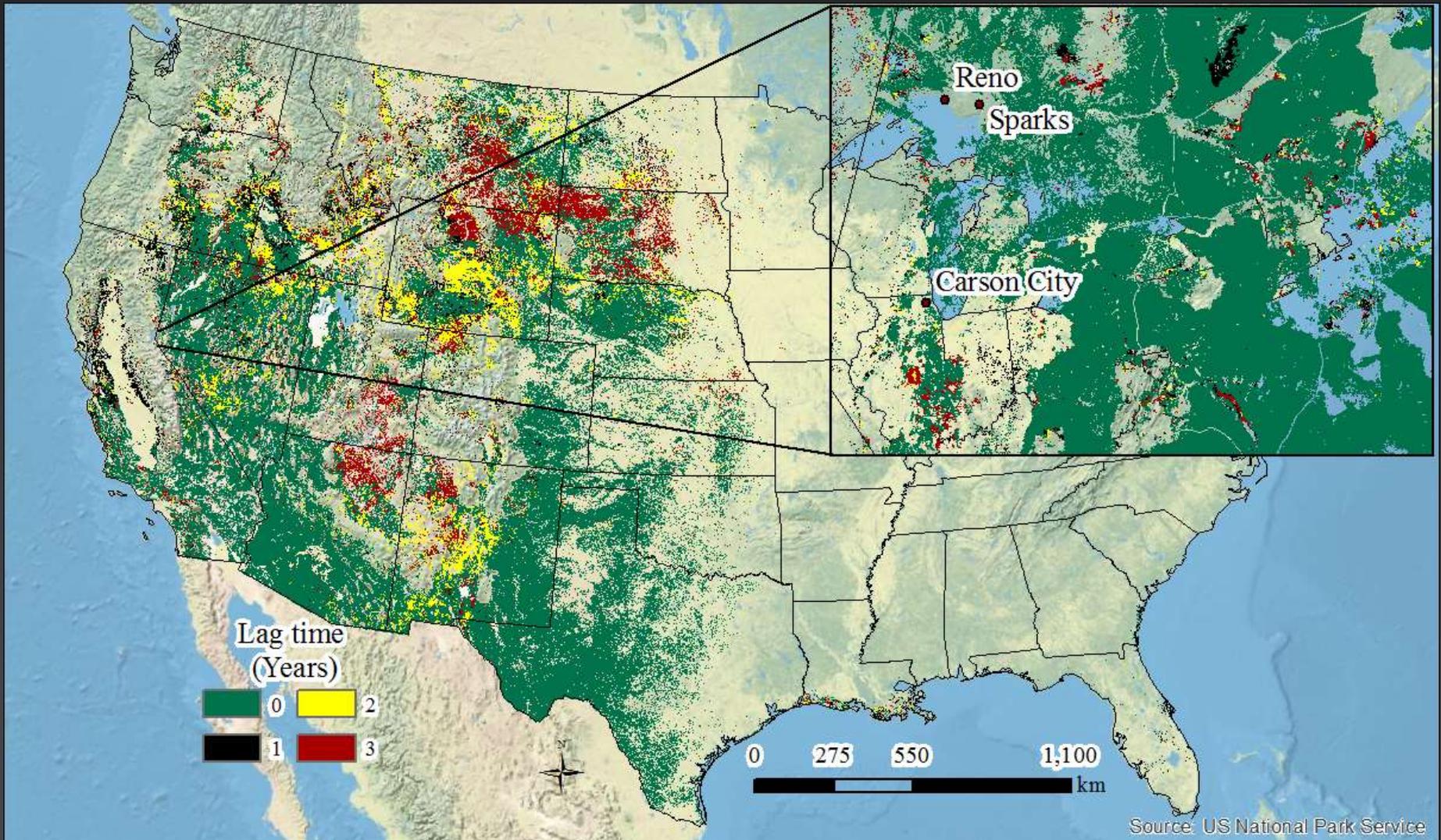
Results

What monitor exhibits the highest correlation with rangeland production?

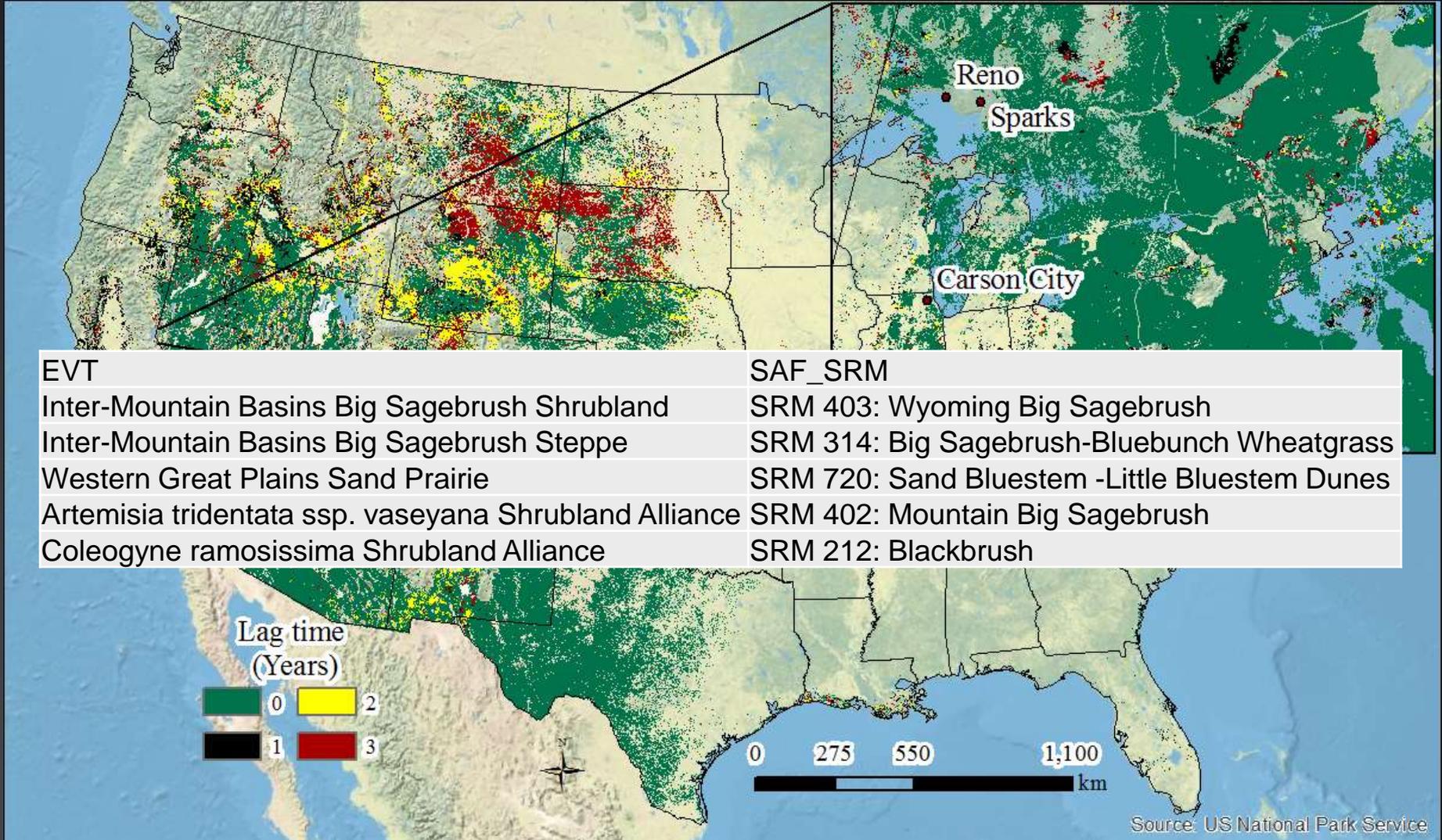


Results

What lag times exhibit the highest correlation between rangeland production and drought monitors?



Wrapup



Results

Lag 2 or 3



Results

Lag 2 or 3



Results

Lag 0



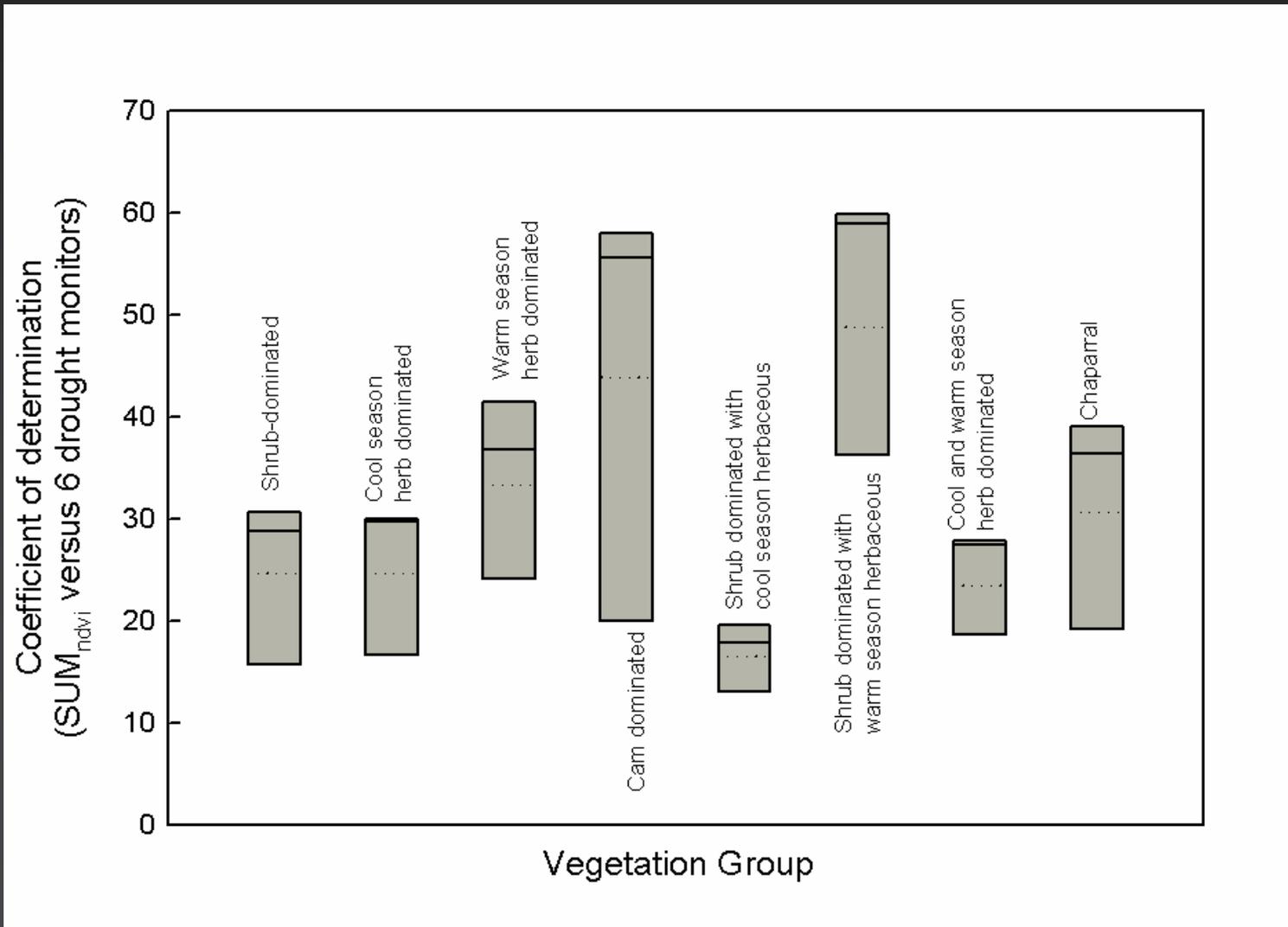
Results

Lag 0



Results

What vegetative and regional characteristics enable high correlations between rangeland production and drought monitors?



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Correlation Analysis: what drives monitor correlation with production?

Indicator	Slope (parameter estimate)	Significance
PPT (AMJ)		N/A
PPT (JAS)		N/A
PPT (JFM)	-0.00337	0.0025
PPT (OND)		N/A
TMAX (AMJ)	0.07569	0.0002
TMAX (JAS)	-0.04734	0.0013
TMAX (JFM)		N/A
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Results

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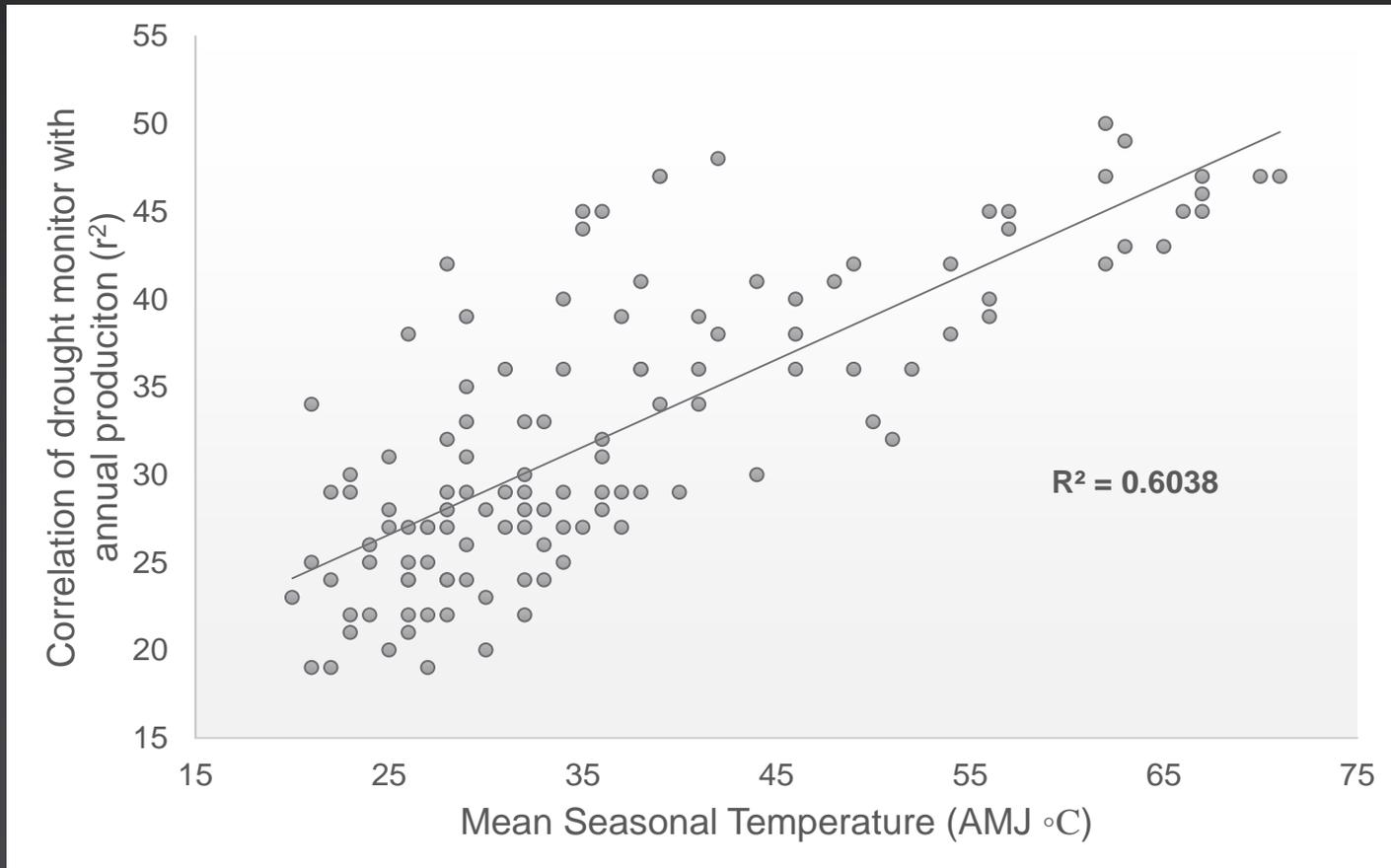
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Correlation Analysis: what drives monitor correlation with production?



Main Caveats

- We only focused on drought as indicator of production
- Annual time scales to not make sense everywhere
- There are timing issues

WRAPUP

- SPEI(s) is best indicator of production
- High CV of NPP increases effectiveness
- Lags are very important, especially in shrubs
- Warmer regions exhibit greater correlations
- C4 influences monitor as does growing season
- Next Steps:
 - *Teaming with USGS + DRI*
 - *Intra-season dynamics*
 - *Other drought monitors*

Thank you
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