# Predictability of Subseasonal Extreme Precipitation Events in the United States

Melanie Schroers, Dr. Elinor Martin

School of Meteorology, University of Oklahoma

Motivation

- S2S prediction of climate extremes is needed for disaster mitigation.
- Flooding is costliest of all natural disasters (Miller et al. 2008)
- Most studies focus on precipitation on the <u>daily</u> timescale and show increasing daily precipitation.
  - (Karl & Knight, 1998; Kunkel et al., 1999; Groisman et al., 2012 seen to right).
- Yet, planning for these events would ideally happen at a longer timeframe than current daily forecasts.


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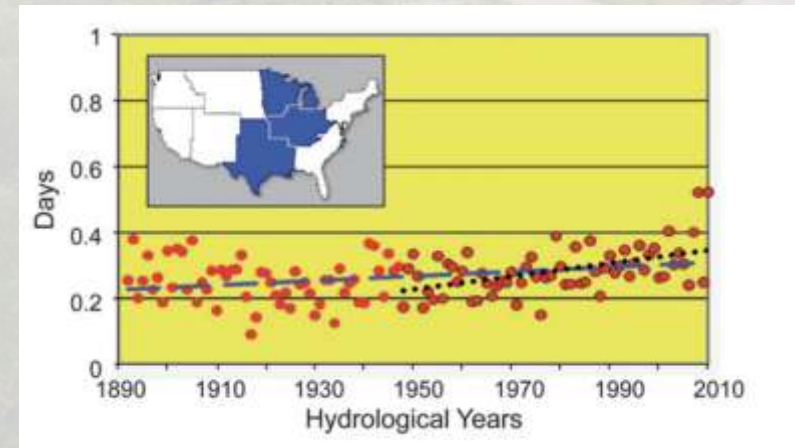
Defining our extreme events

Using a 14 day sliding window from Jan 1, 1981 to Dec 31, 2018:

1. Total area of rainfall exceeding PRISM 95th percentile of 14 day precipitation must be above the area threshold

2. Area-averaged precipitation must exceed 10 mm/day for 5 (or 3 for MW) of the total 14 day sliding window

3. The heaviest rainfall day and the surrounding two days must not exceed 50% of the event precipitation

4. If events are overlapping, the event with the higher rainfall totals is chosen as the event

PRISM 95th Percentile of 14 day Precipitation (1981-2010)

	WC	MW	NP	SP	SE	GL	NE
Area Threshold (km²)	200,000	200,000	200,000	200,000	300,000	300,000	200,000
Event Count	51	50	17	57	46	54	38
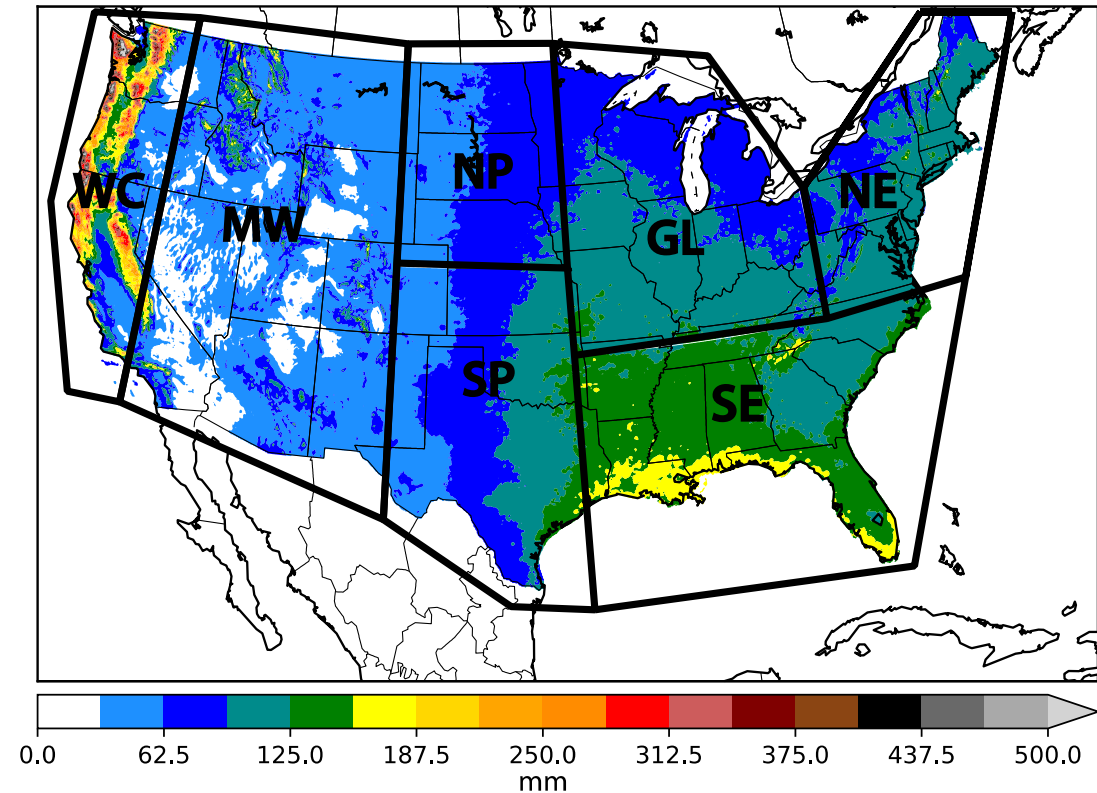
When are the S2S events happening?
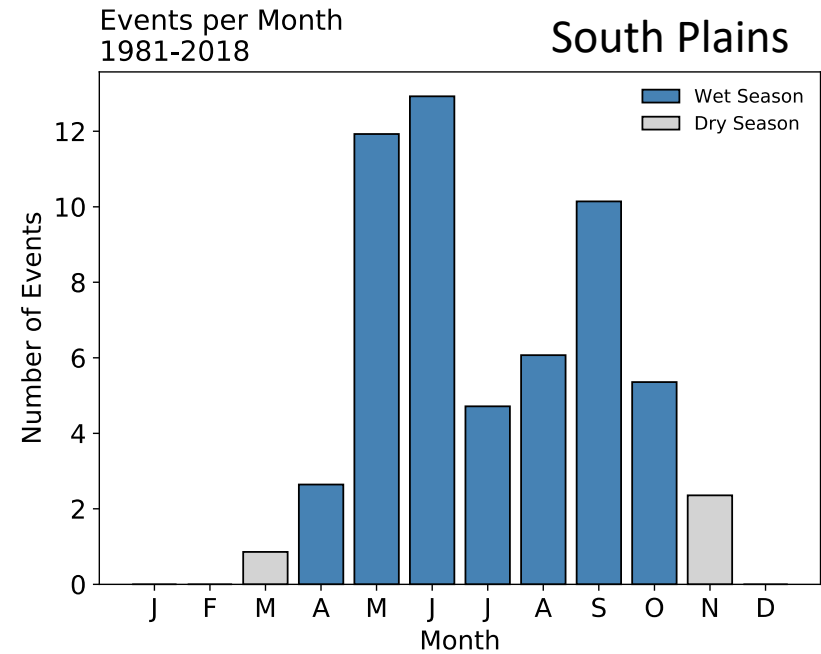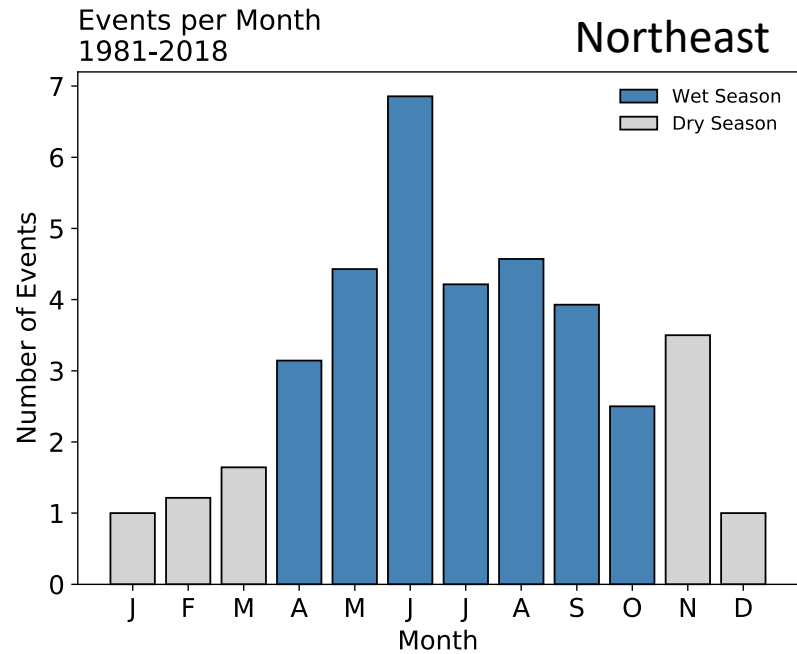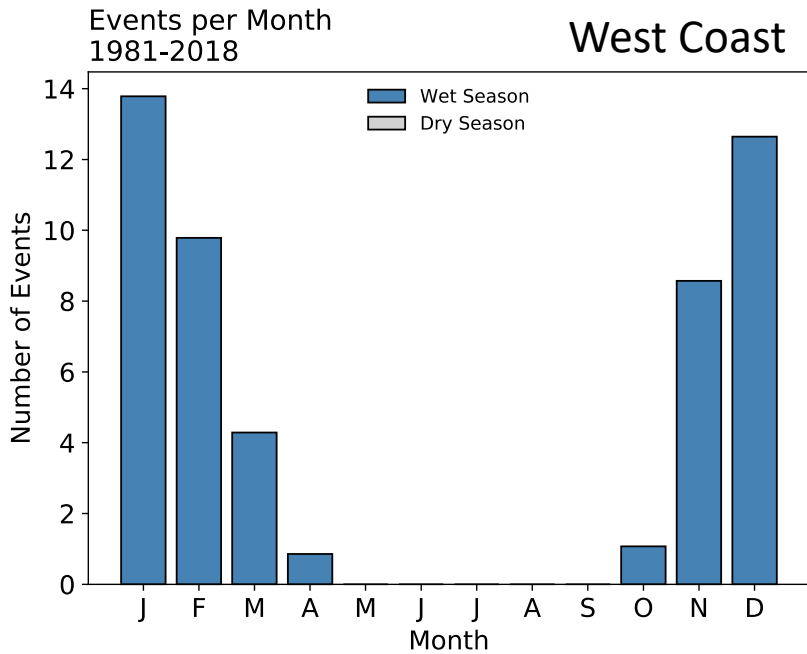
- Most events happen within typical wet season
- Exceptions are NE and SE, where it has been shown precipitation can occur all year round

Principal Component Analysis

Input:

- All event days (N_{events} x 14 days)
- 500 hPa Geopotential Height Standardized Anomalies from ERA5
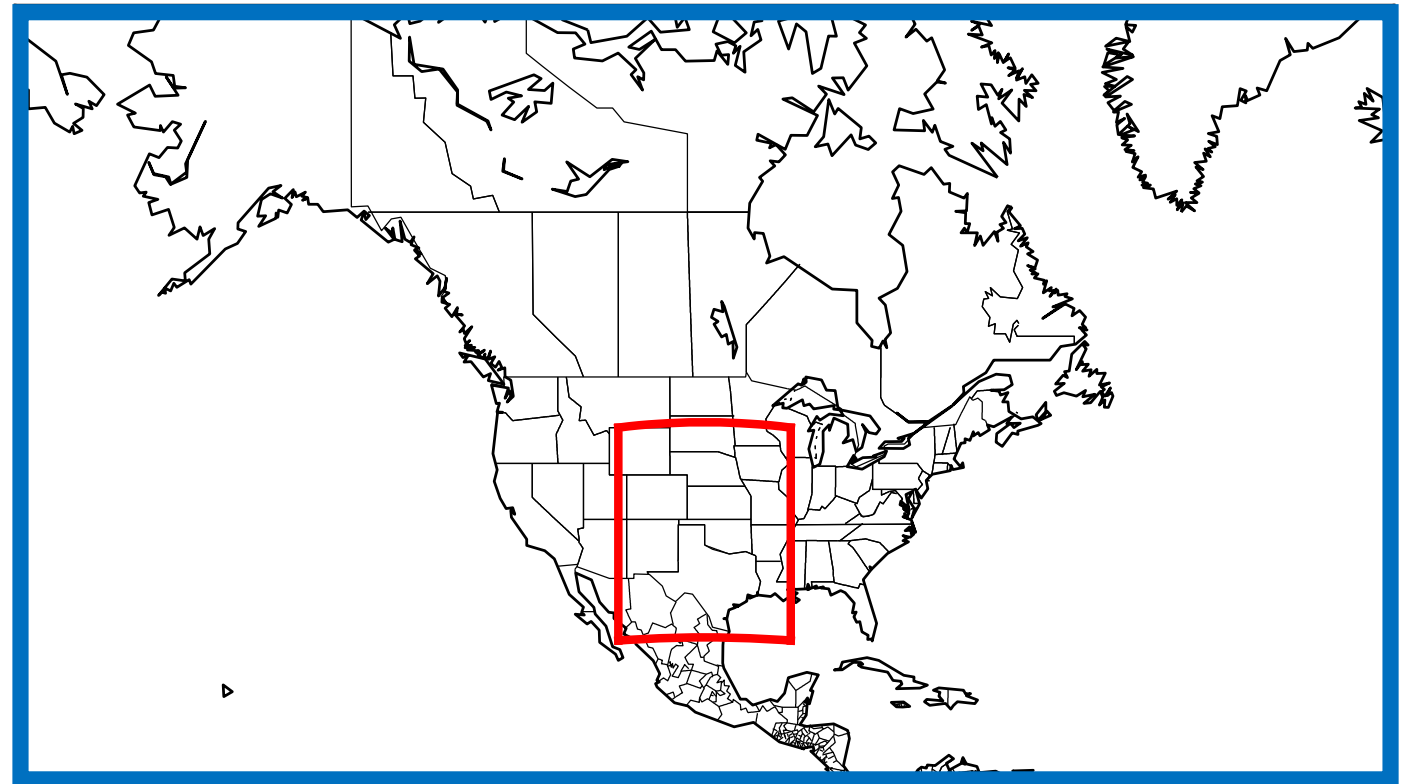- Only Region of Interest

Output:

- Regression of variables of Full Map onto standardized PCs

Techniques:

- Promax Rotation
  - preferred when there is a high correlation between grid points

Region Used for Southern Plains PCA
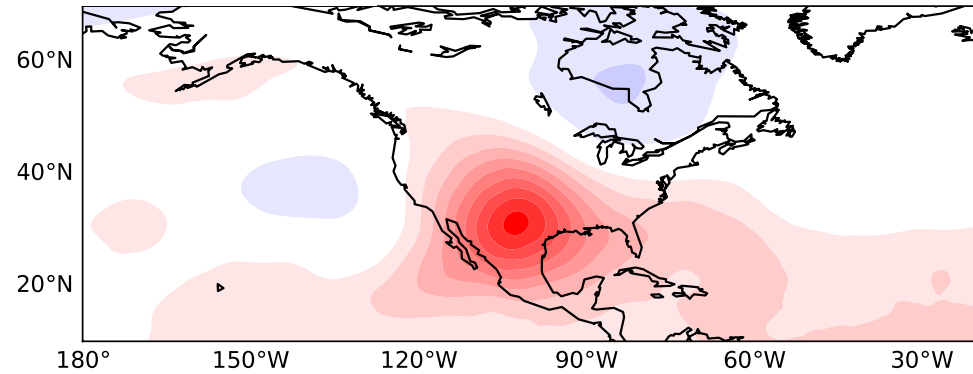
Can heights alone give us common synoptic setups of our events?

Congruence Coefficient
$$r_c = \frac{\sum X_{pattern} Y_{daily}}{\sqrt{\sum X_{pattern}^2 \sum Y_{daily}^2}}$$

Standardized 500hPa Geopotential Height Anomalies
South Plains

EOF 1 (50.66%)

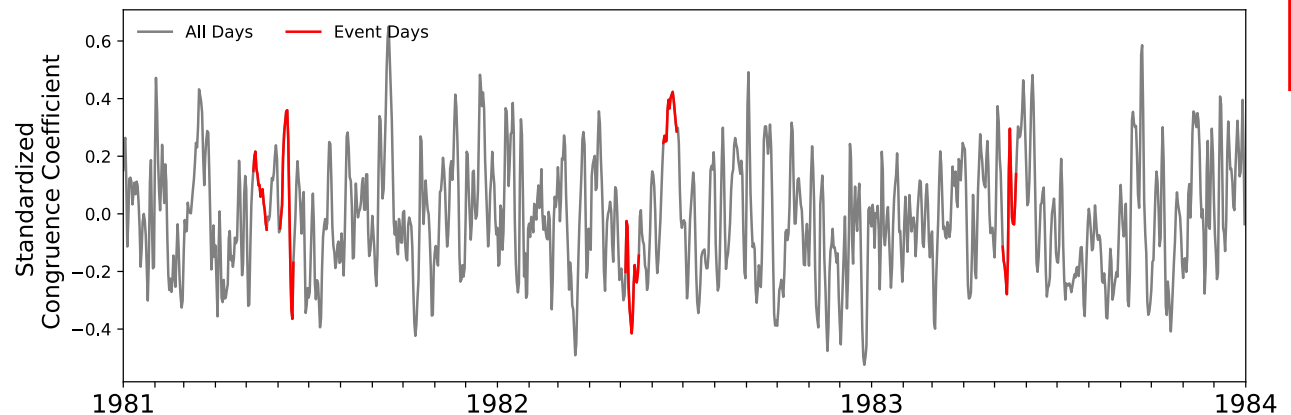EOF 2 (17.9%)

Standardized Anomaly
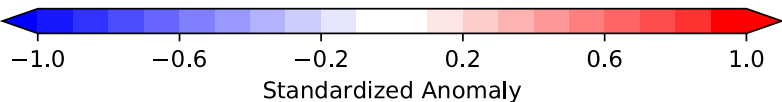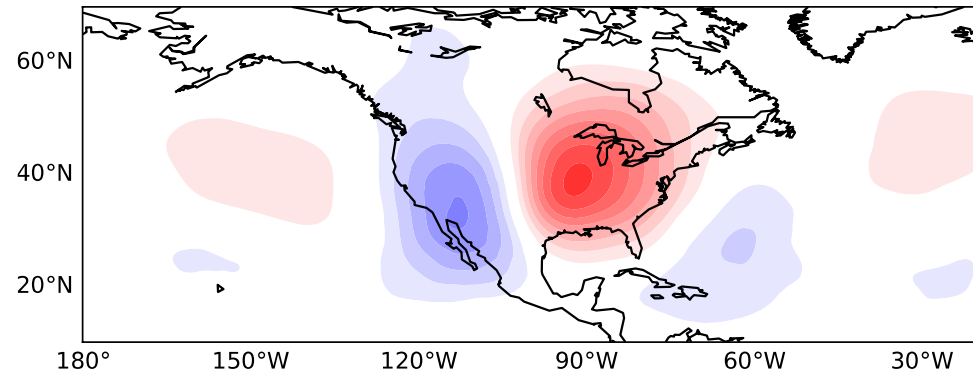
Comparing all days to EOF pattern

No strong signals of event days
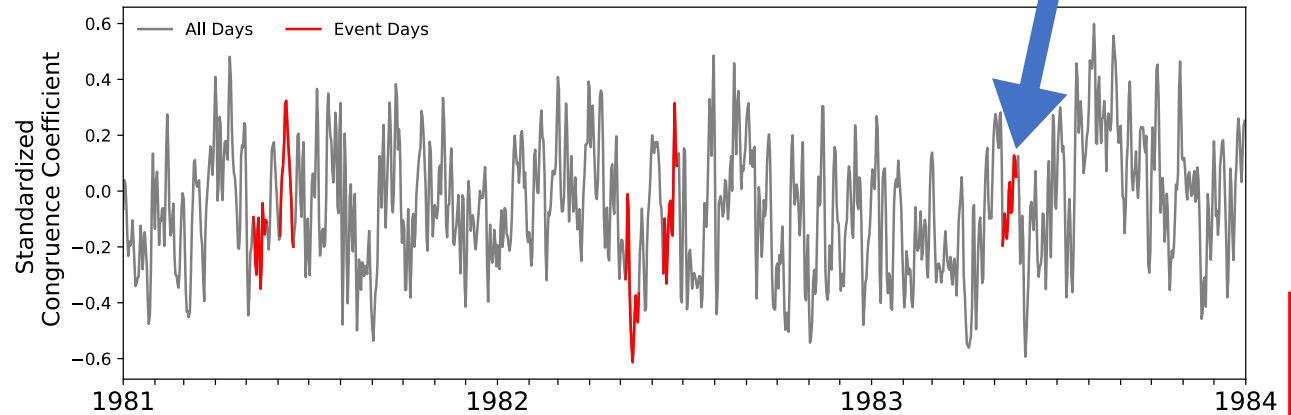
Simple Answer: No

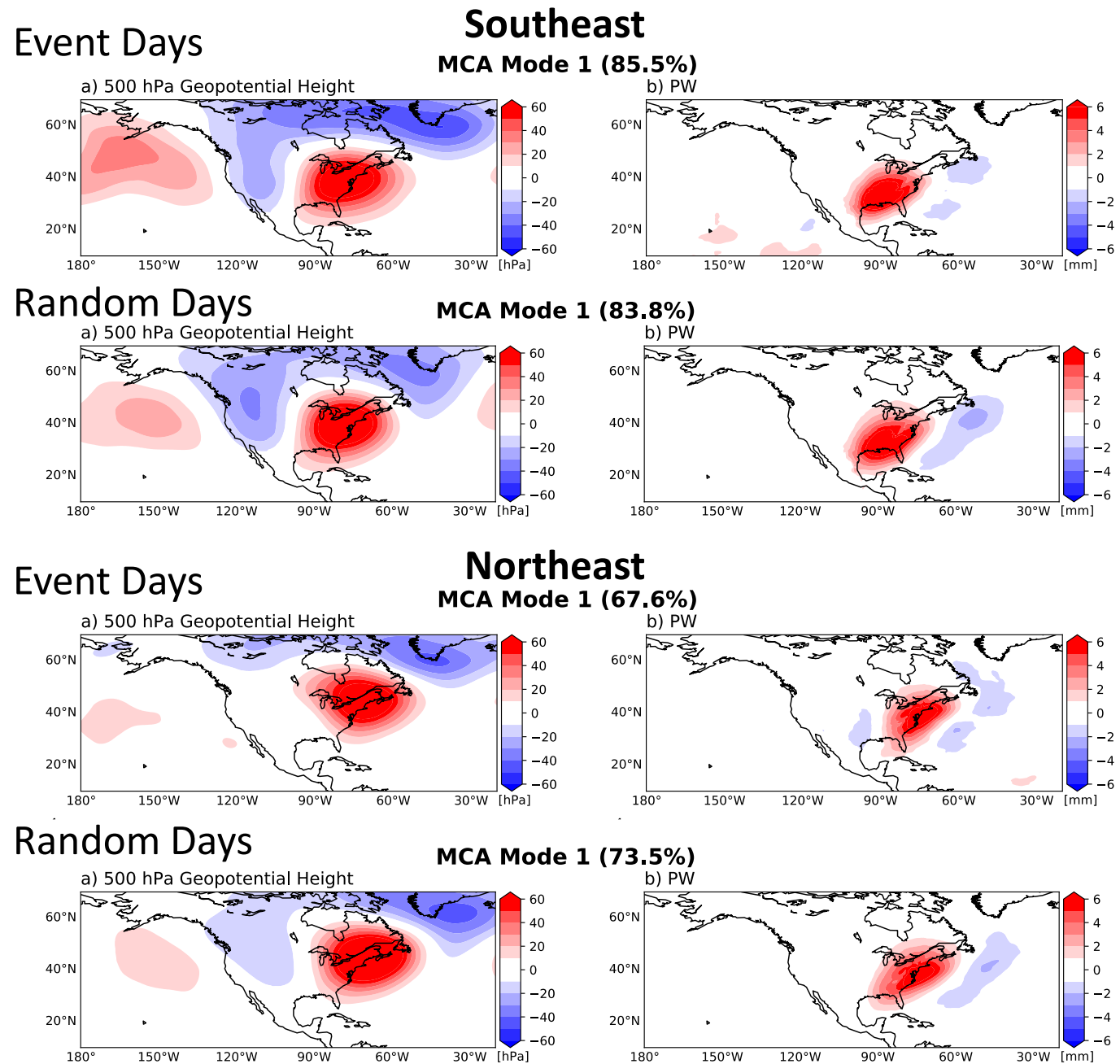# Coupled Patterns of Heights and Precipitable Water

Maximum Covariance Analysis used to find coupled pattern.

Conducted on:
- Extreme Event days
- Random Days

Found:
- The same patterns are seen in both our event days and random days which is indicative of non-useful patterns for predictability.

Southeast

Event Days — MCA Mode 1 (85.5%)

Random Days — MCA Mode 1 (83.8%)

Northeast

Event Days — MCA Mode 1 (67.6%)

Random Days — MCA Mode 1 (73.5%)

Conclusions

- See a trough/ridge pattern that may explain precipitation in EOFs

- Heights alone are not a good predictor

- Coupled patterns with height and precipitable water do not give unique patterns for event days

- Not Shown:
  - Different EOF patterns produce different precipitation spatial distributions within the regions

Future Work

- Continue moving forward with predictability

- Look at IVT, Soil moisture, Temperature advection, Climate modes etc.

- Goal:
  - Create predictive model for S2S extreme precipitation.

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Contact info: maschroers@ou.edu