Regional Changes in U.S. Warm Season Precipitation Variability

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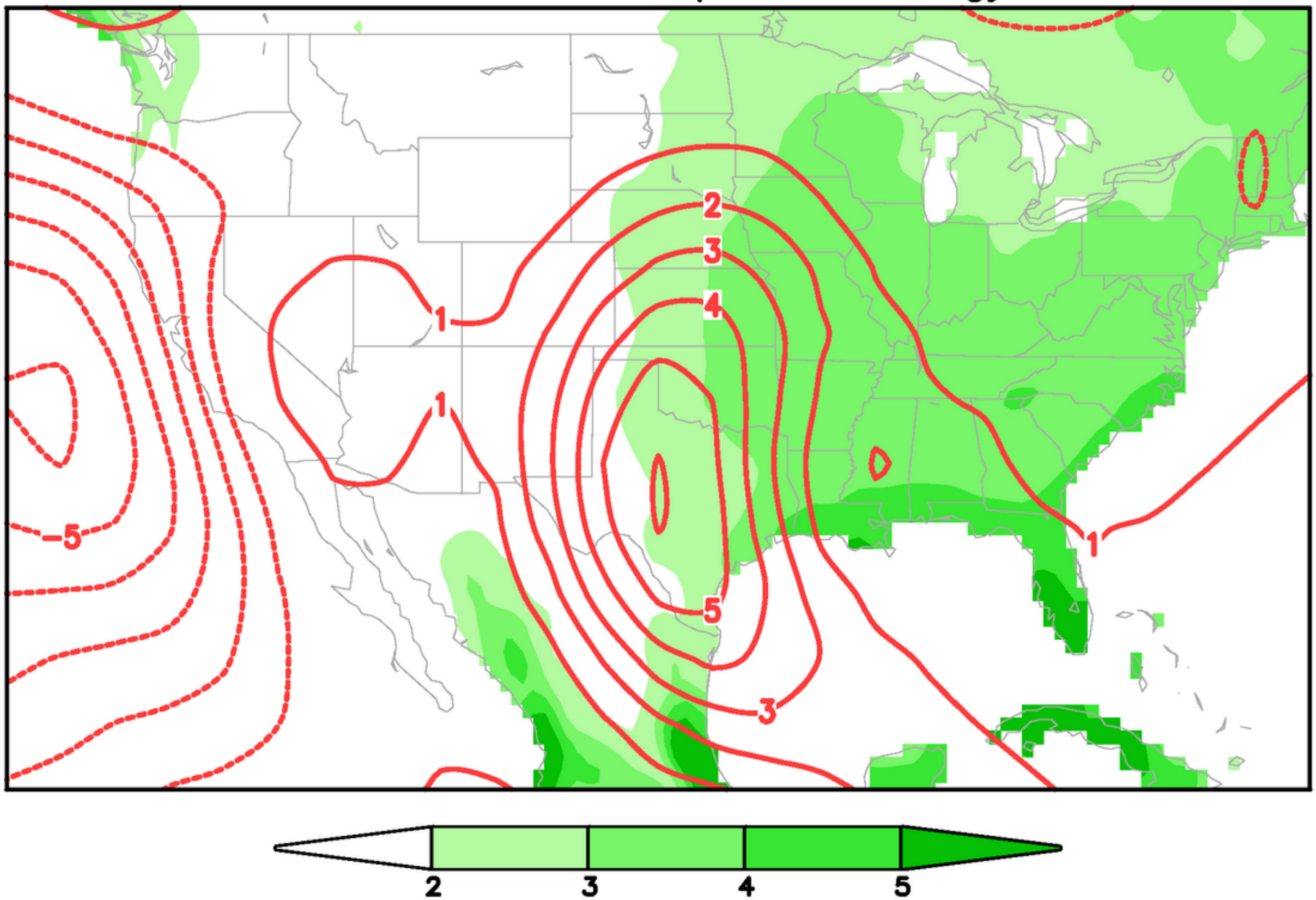
Motivation

- Precipitation extremes (i.e., Drought/Pluvial) are increasing (IPCC, NCA).
- Understanding changes in warm season precipitation variability is important for societal impacts (agriculture, severe weather, central U.S. warming hole).
- North American low-level jet (NALLJ) acts as a scale transfer mechanism focusing the large scale influences into regional climate impacts.
- Recent studies indicate increasing precipitation variability over the SE in JJA. What about other regions and "seasons" and the specific role of NALLJ's?

Data & Analysis Strategy

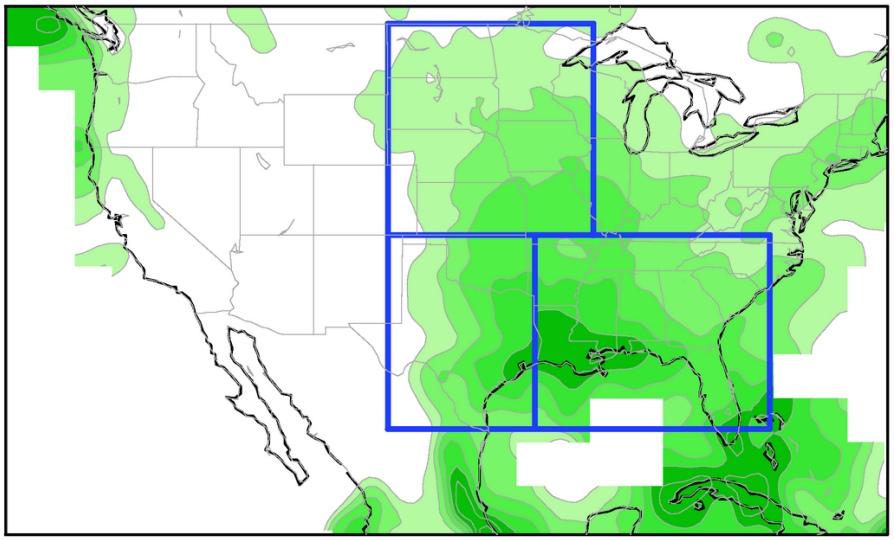
- Precipitation – PREC (Chen et al. 2002)
- Atmospheric Circulation – NCEP/NCAR Reanalysis I. (Kalnay et al. 1996)
- SST – ERSSTv3 (Smith et al. 2008)
- Analysis Strategy:
  - Anomaly Time series
  - EOF/PC Analysis
  - Modal reconstructions
  - Moving Standard Deviations

V850 & Precip Climatology

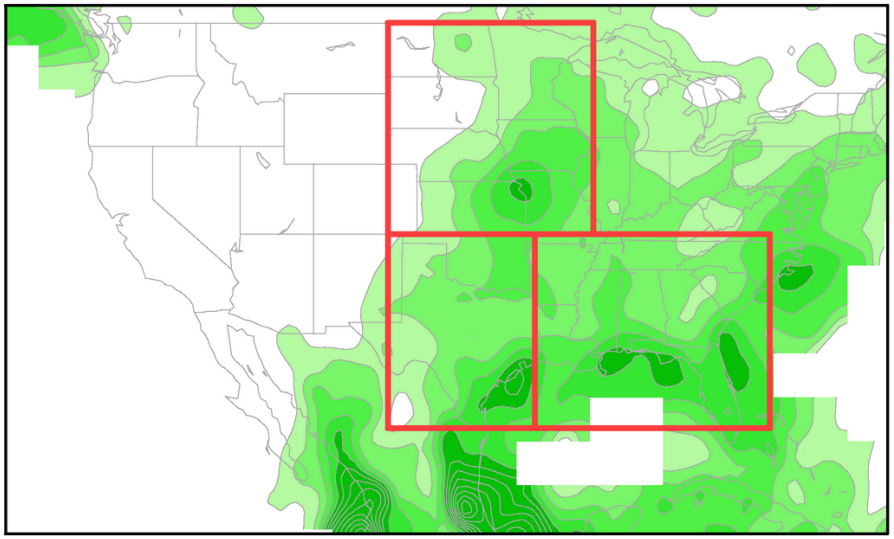


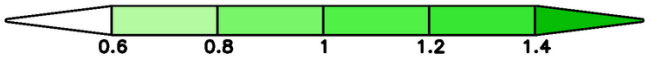
SD of Precipitation 1950-2010

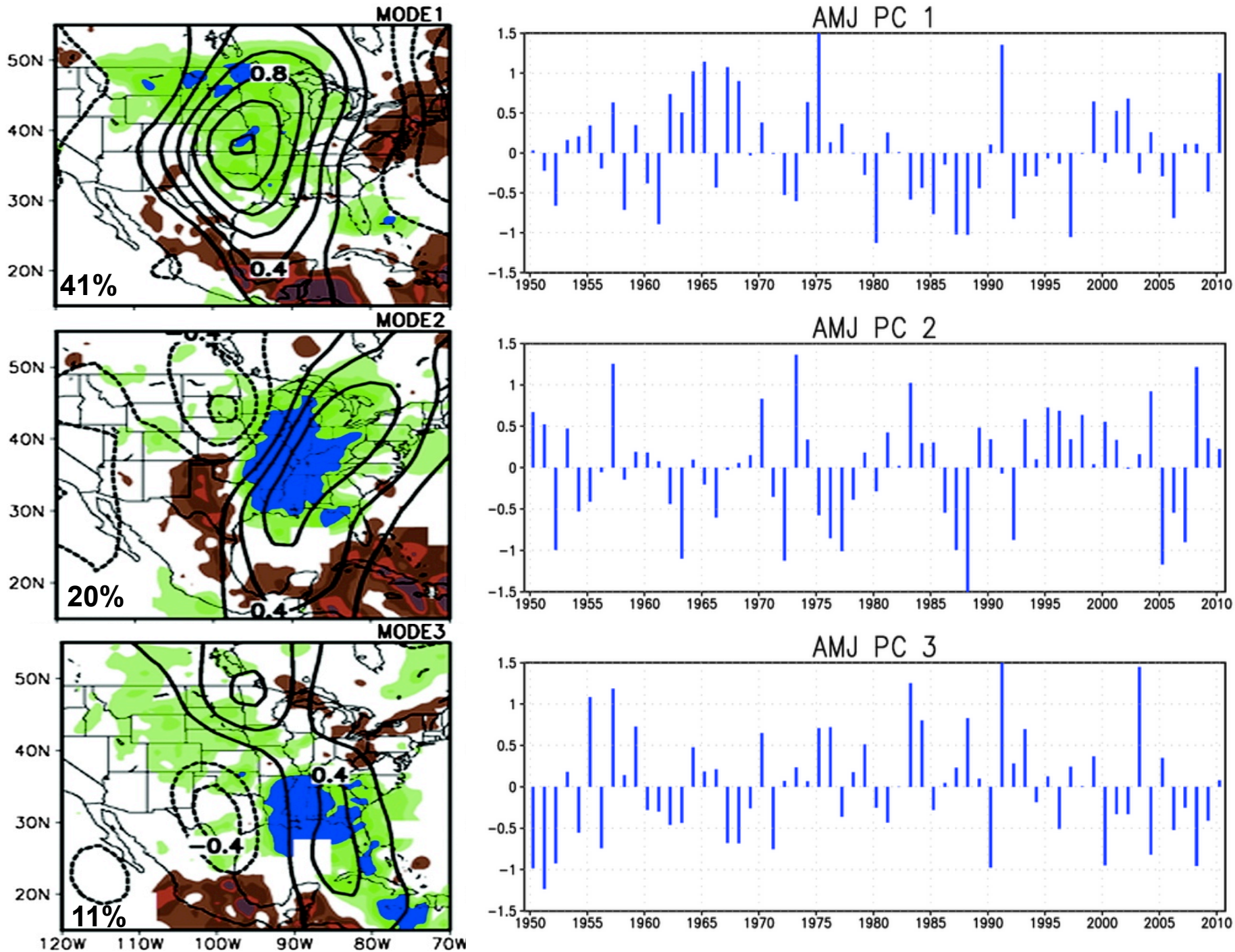
AMJ



JAS

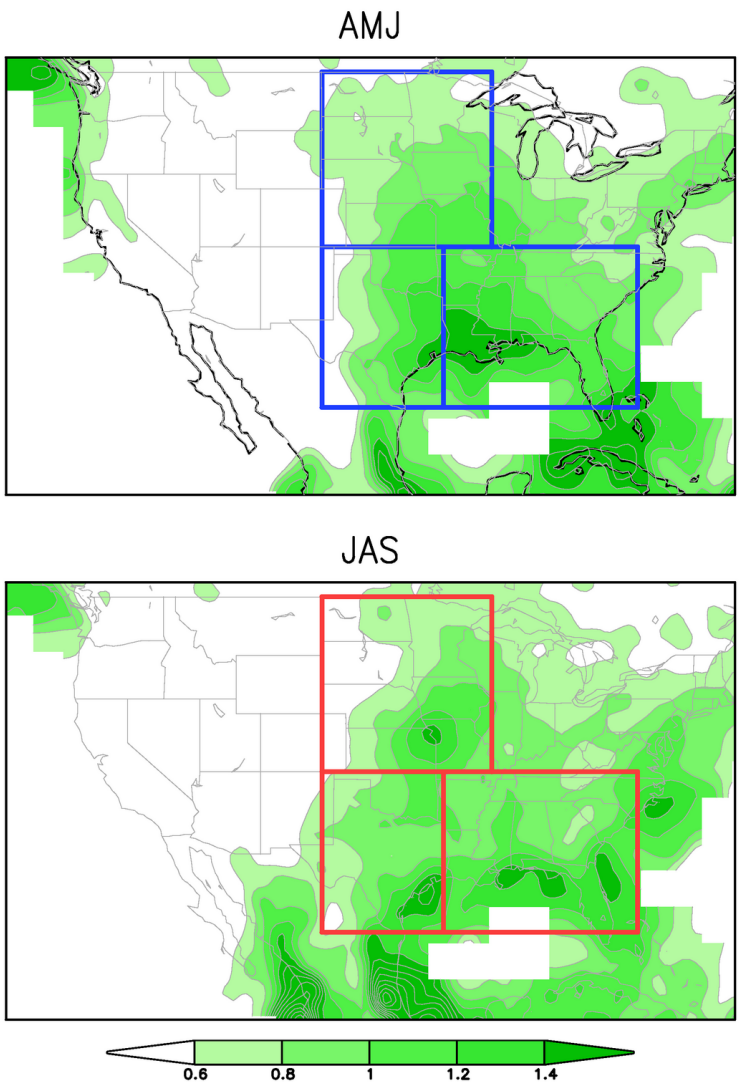


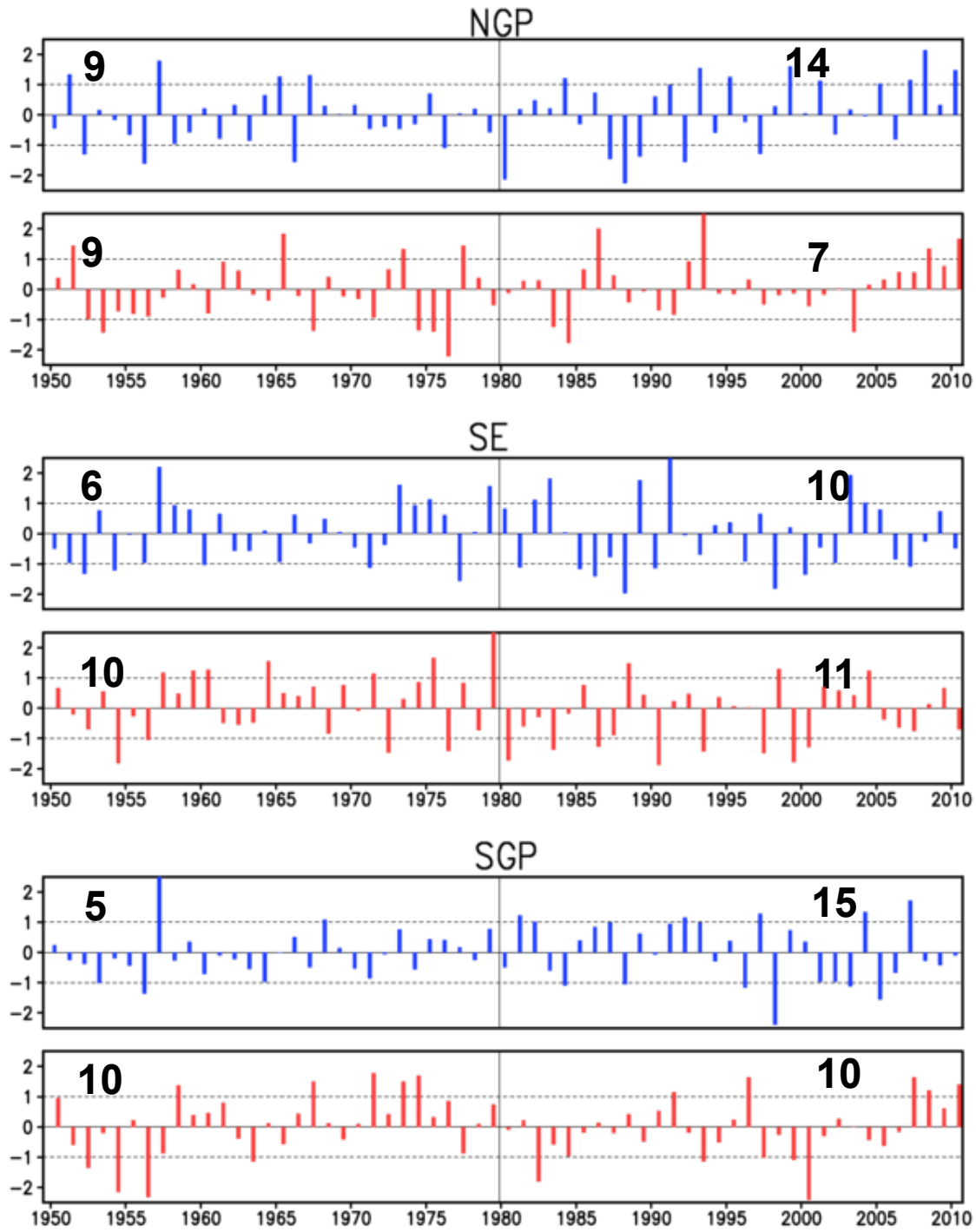



MODE1
0.8
0.4
41%
MODE2
0.4
20%
MODE3
0.4
−0.4
11%
50N
40N
30N
20N
120W
110W
100W
90W
80W
70W
AMJ PC 1
AMJ PC 2
AMJ PC 3
1.5
1
0.5
0
−0.5
−1
−1.5
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

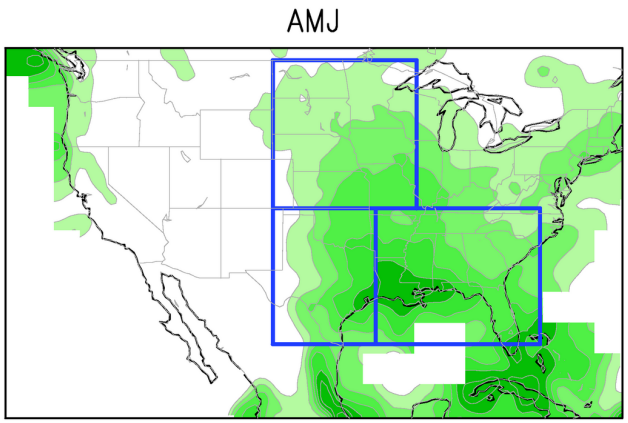
Standardized Precip. Anomalies 1950-2010

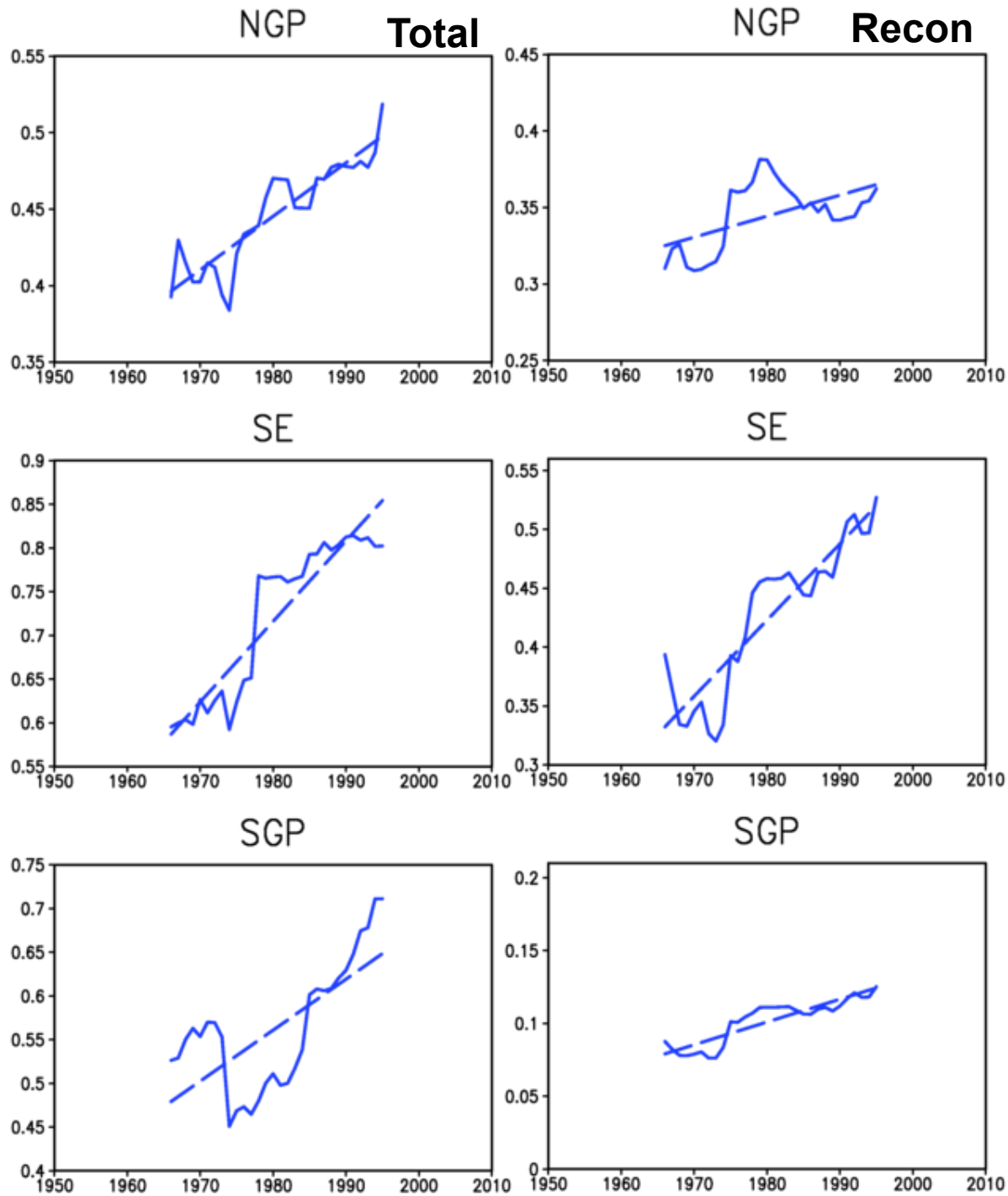
AMJ **JAS**



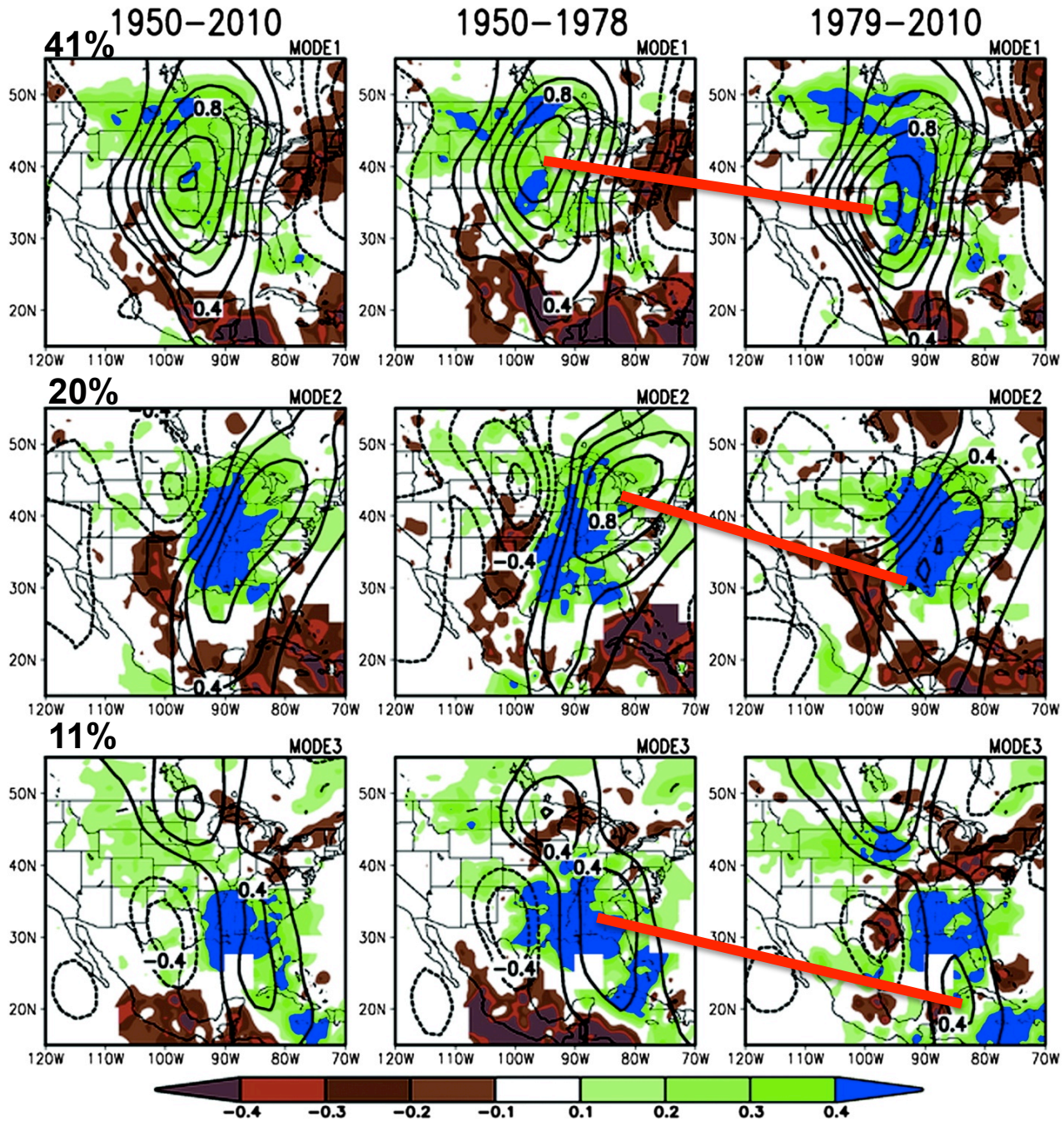


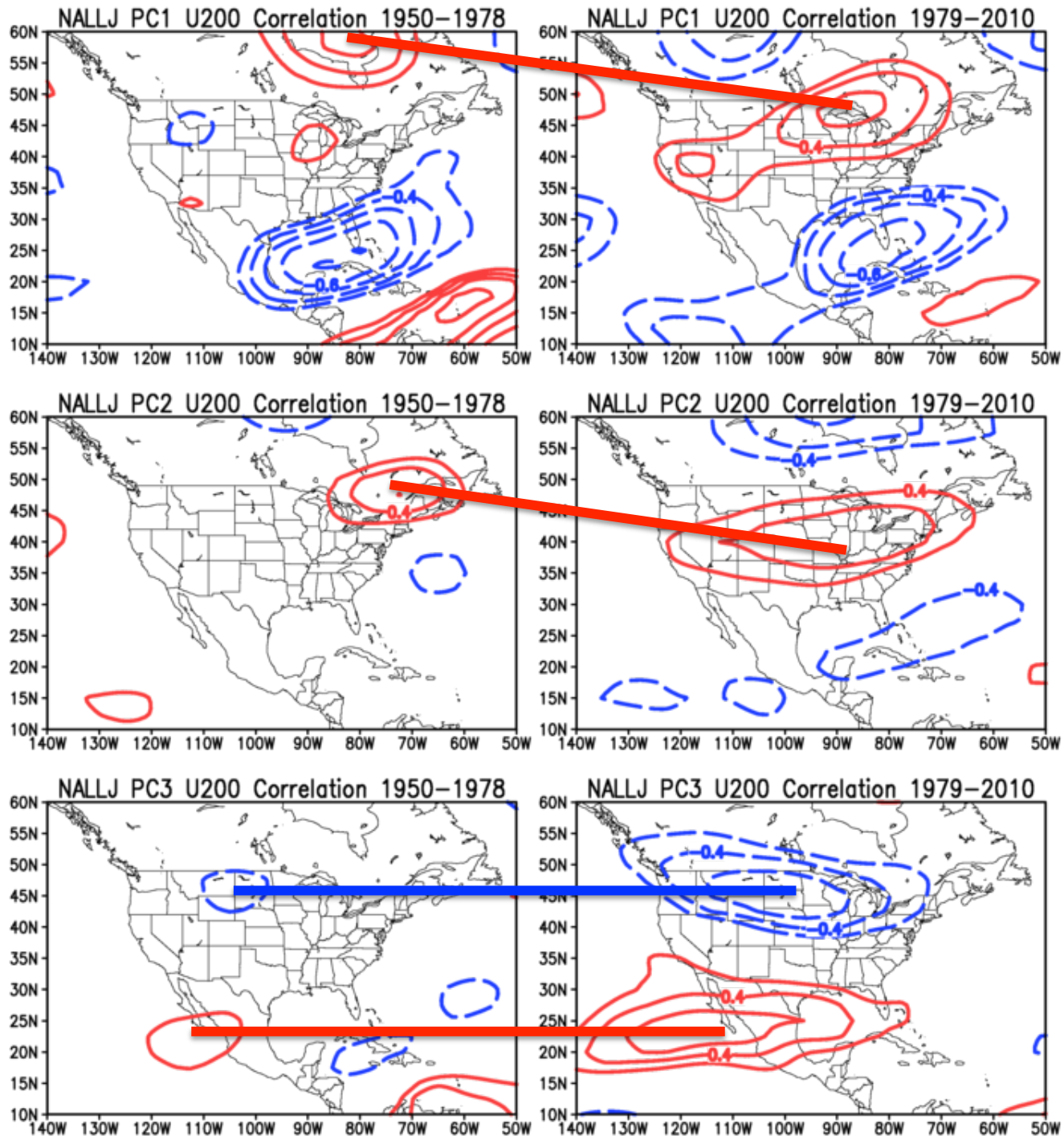
30-year Moving SD Precipitation 1950-2010

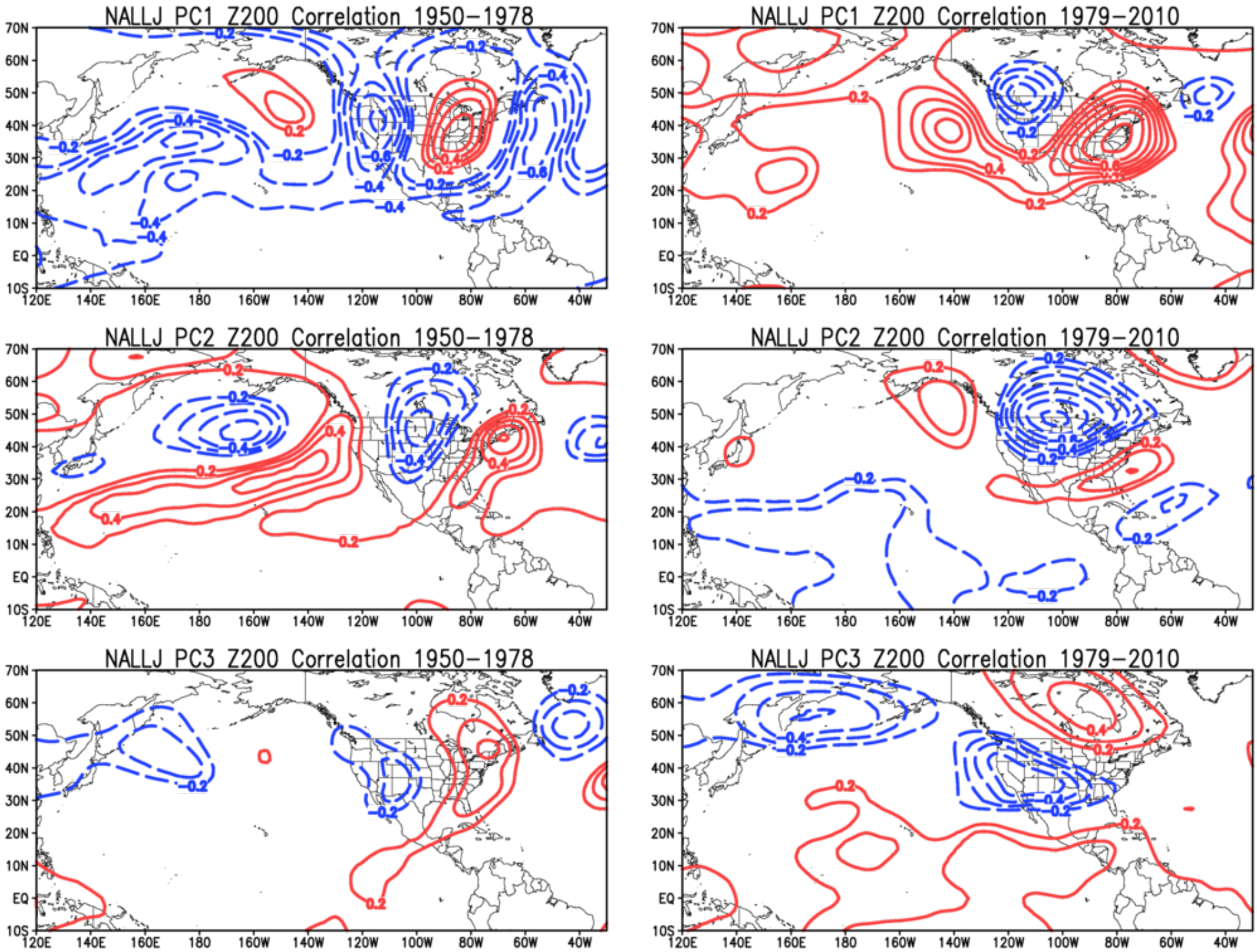


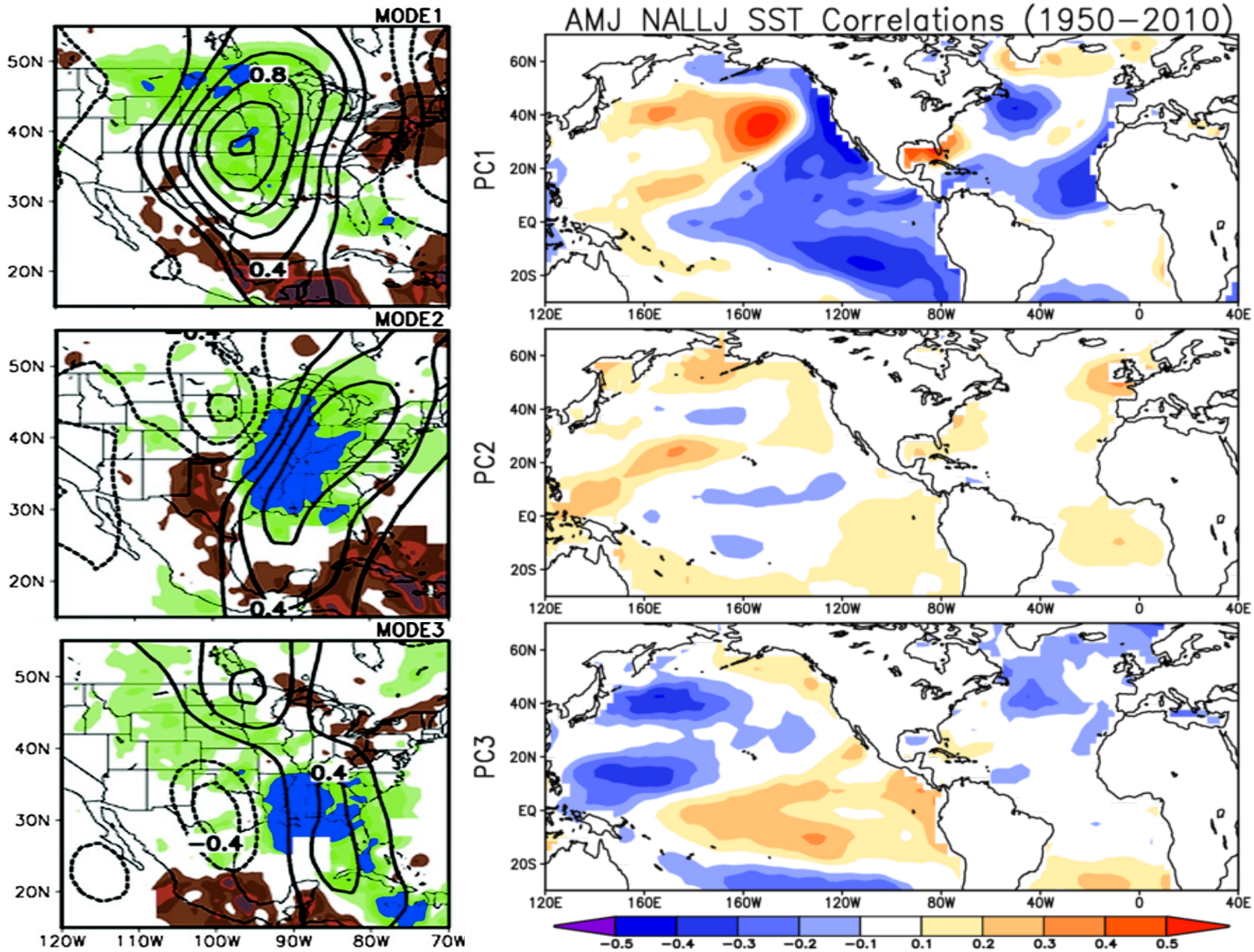


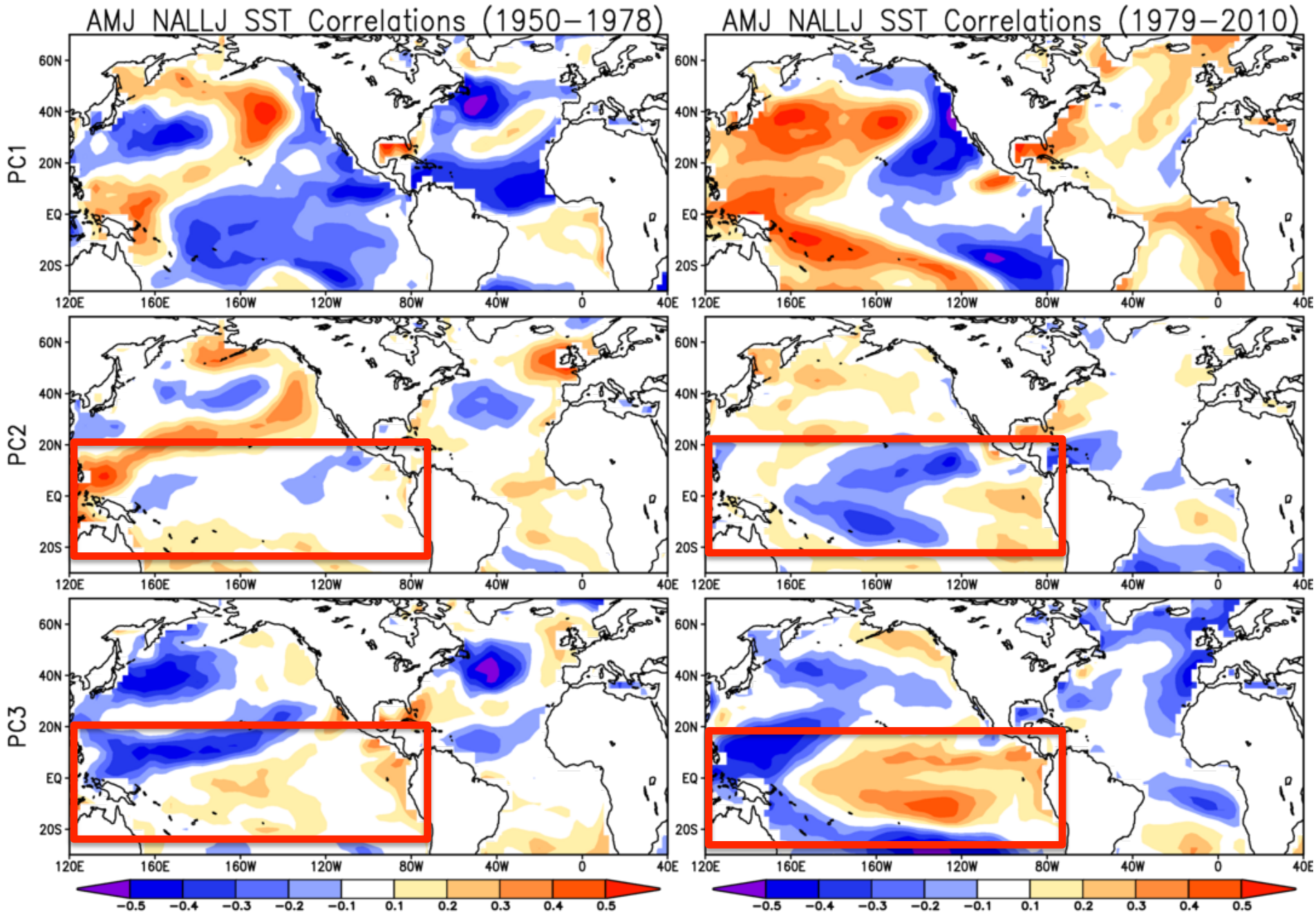
AMJ NALLJ Variability Modes & Precipitation

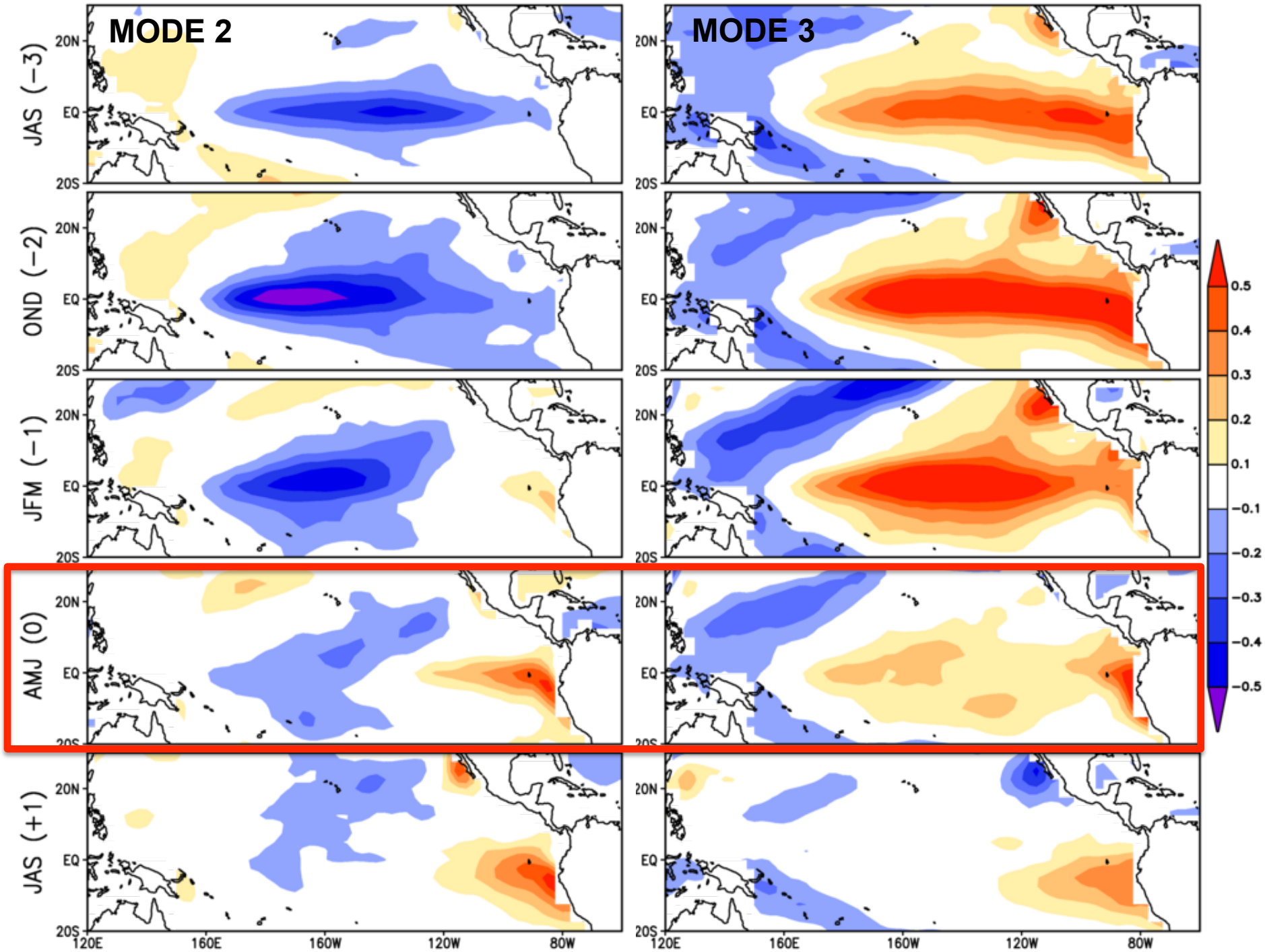


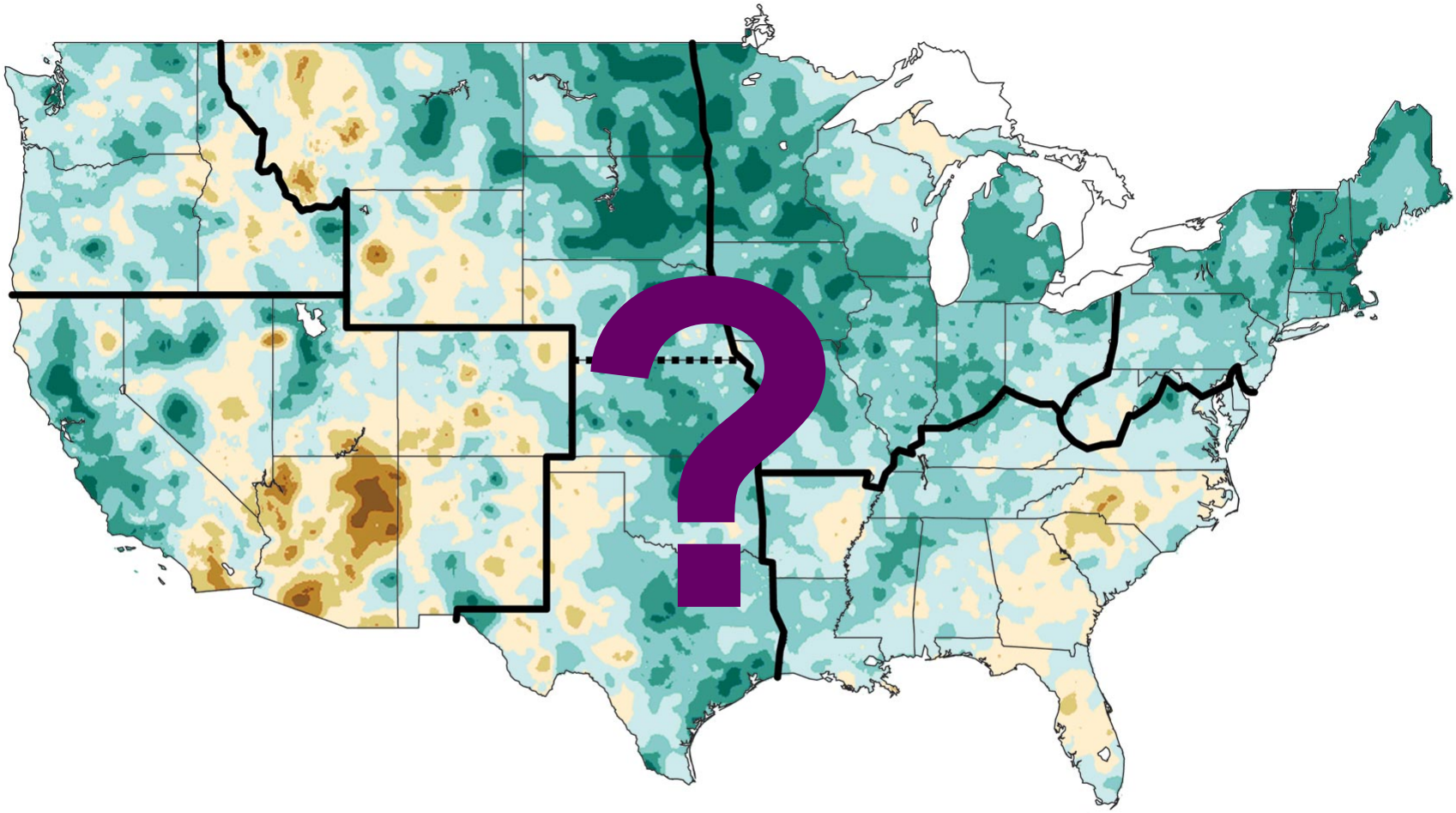

NALLJ PC1 U200 Correlation 1950–1978
NALLJ PC1 U200 Correlation 1979–2010
NALLJ PC2 U200 Correlation 1950–1978
NALLJ PC2 U200 Correlation 1979–2010
NALLJ PC3 U200 Correlation 1950–1978
NALLJ PC3 U200 Correlation 1979–2010
60N 55N 50N 45N 40N 35N 30N 25N 20N 15N 10N
140W 130W 120W 110W 100W 90W 80W 70W 60W 50W
0.4
-0.4
-0.6


NALLJ PC1 Z200 Correlation 1950–1978
NALLJ PC1 Z200 Correlation 1979–2010
NALLJ PC2 Z200 Correlation 1950–1978
NALLJ PC2 Z200 Correlation 1979–2010
NALLJ PC3 Z200 Correlation 1950–1978
NALLJ PC3 Z200 Correlation 1979–2010
70N
60N
50N
40N
30N
20N
10N
EQ
10S
120E
140E
160E
180
160W
140W
120W
100W
80W
60W
40W


MODE1
MODE2
MODE3
0.8
0.4
-0.4
50N
40N
30N
20N
120W
110W
100W
90W
80W
70W
AMJ NALLJ SST Correlations (1950–2010)
PC1
PC2
PC3
60N
40N
20N
EQ
20S
120E
160E
160W
120W
80W
40W
0
40E
-0.5
-0.4
-0.3
-0.2
-0.1
0.1
0.2
0.3
0.4
0.5


AMJ NALLJ SST Correlations (1950–1978)
AMJ NALLJ SST Correlations (1979–2010)
PC1
PC2
PC3
60N
40N
20N
EQ
20S
120E
160E
160W
120W
80W
40W
0
40E
−0.5
−0.4
−0.3
−0.2
−0.1
0.1
0.2
0.3
0.4
0.5


MODE 2
MODE 3
JAS (−3)
OND (−2)
JFM (−1)
AMJ (0)
JAS (+1)
20N
EQ
20S
120E
160E
160W
120W
80W
0.5
0.4
0.3
0.2
0.1
−0.1
−0.2
−0.3
−0.4
−0.5

Discussion

- Increasing springtime precipitation variability over the NGP and SE appear linked to southward shifted NALLJ variations.
- Observed Multi-decadal shifts in NALLJ related Z200 and U200 anomalies are influential.
- A portion of the large scale circulation shifts appear related to intensifying tropical Pacific SST variability in recent decades despite weak contemporaneous correlations.
- *The NALLJ modes have a negligible role in increasing precipitation variability over the SGP region.*