Influence of ENSO on Tornado and Hail Environment and Seasonal Severe Weather Predictability

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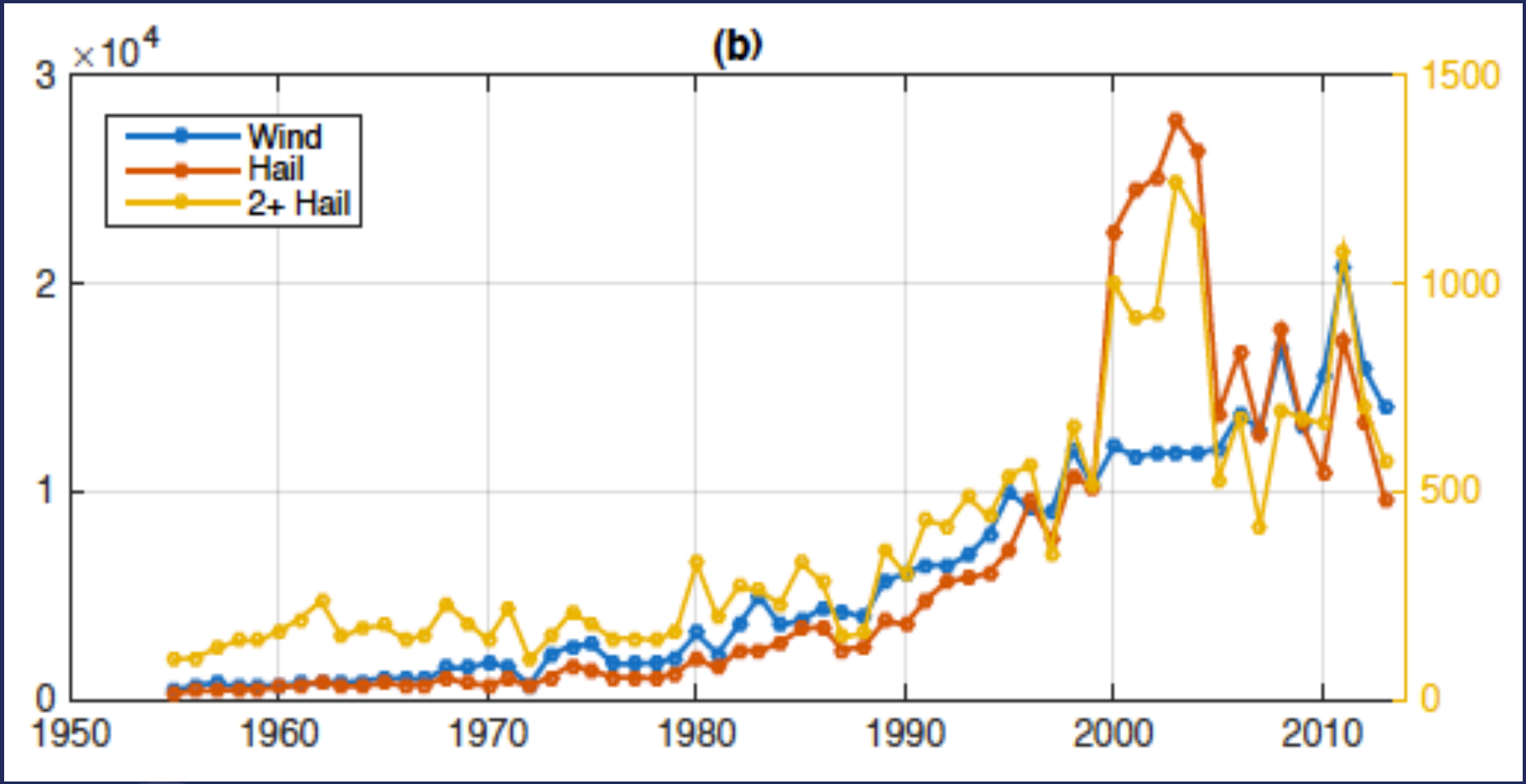
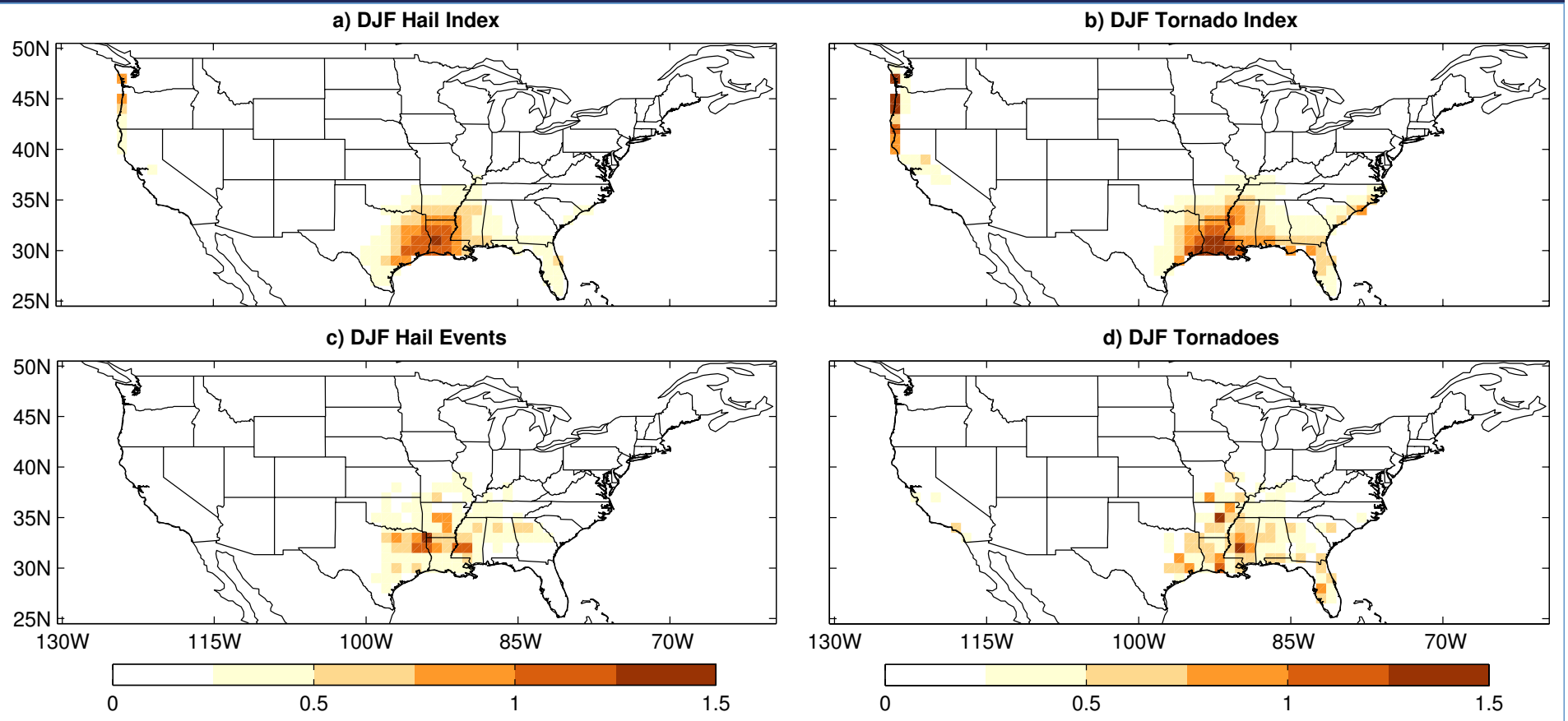
That Small Trend in Reported Hail



Tippett et al. 2015 (CCCR)

DJF Climatology of Hail/Tornadoes (Obs. & Index)



Mean DJF Climatology for Hail and Tornado Index, Tornadoes and Hail Events for the period 1979-2012

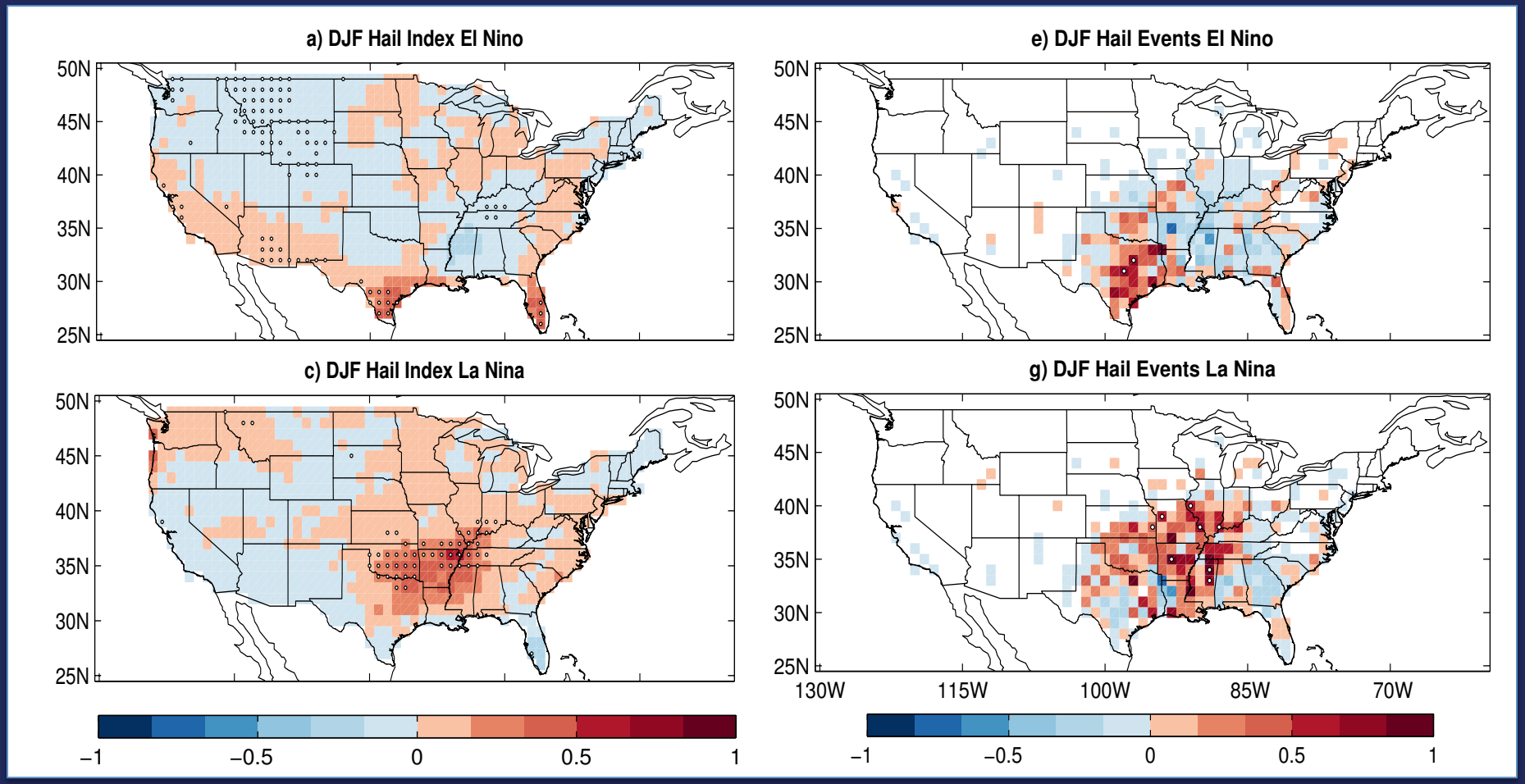
Allen et al. 2015 (Nature Geoscience)

Performance – Correlations Index as Compared to Obs.

		U.S.	Sth	SE	NE	CEN
MAM						
Full	Tornado	**0.71 (0.64)**	**0.58 (0.55)**	**0.43 (0.57)**	**0.65 (0.37)**	**0.77 (0.69)**
1996-2012	Tornado	**0.72 (0.53)**	**0.53 (0.45)**	**0.43 (0.42)**	**0.68 (0.46)**	**0.76 (0.69)**
Full	Hail	**0.58 (0.43)**	**0.49 (0.45)**	**0.39 (0.37)**	**0.72 (0.46)**	**0.79 (0.70)**
1996-2012	Hail	**0.59 (0.26)**	**0.58 (0.47)**	**0.65 (0.58)**	**0.71 (0.72)**	**0.79 (0.74)**
DJF						
Full	Tornado	**0.57 (0.48)**	**0.49 (0.40)**	**0.41 (0.40)**	0.15 (0.17)	**0.65 (0.67)**
1995-2011	Tornado	**0.59 (0.59)**	**0.50 (0.44)**	**0.45 (0.42)**	0.10 (0.22)	**0.70 (0.74)**
Full	Hail	**0.65 (0.61)**	**0.60 (0.59)**	**0.52 (0.64)**	**0.38 (0.43)**	**0.67 (0.47)**
1995-2011	Hail	**0.93 (0.94)**	**0.79 (0.82)**	**0.49 (0.61)**	0.29 **(0.36)**	**0.81 (0.72)**

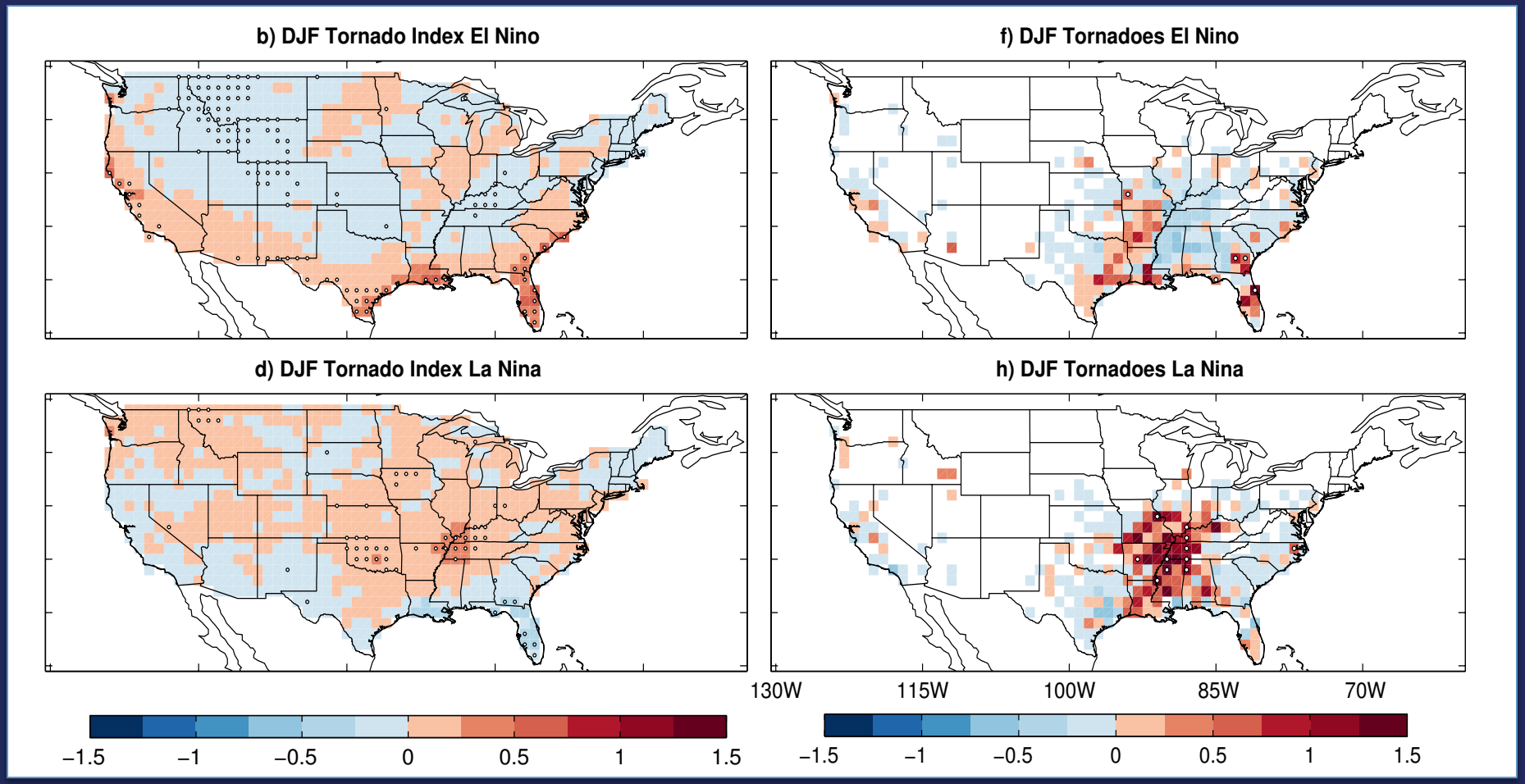
Pearson and (Rank) correlations between the Respective Indices and Obs. For listed periods (Full is 1979-2012).

Modulation of Hail by ENSO Signal - DJF



Composites of El Niño and La Niña DJFs based on 7 and 6 year composites respectively selected using ONI ±1 . Stippling is for Monte Carlo derived significance at the two-tailed 95% level – Confirms Obs. to be shown by Ashton Robinson.

Modulation of Tornadoes by ENSO Signal - DJF



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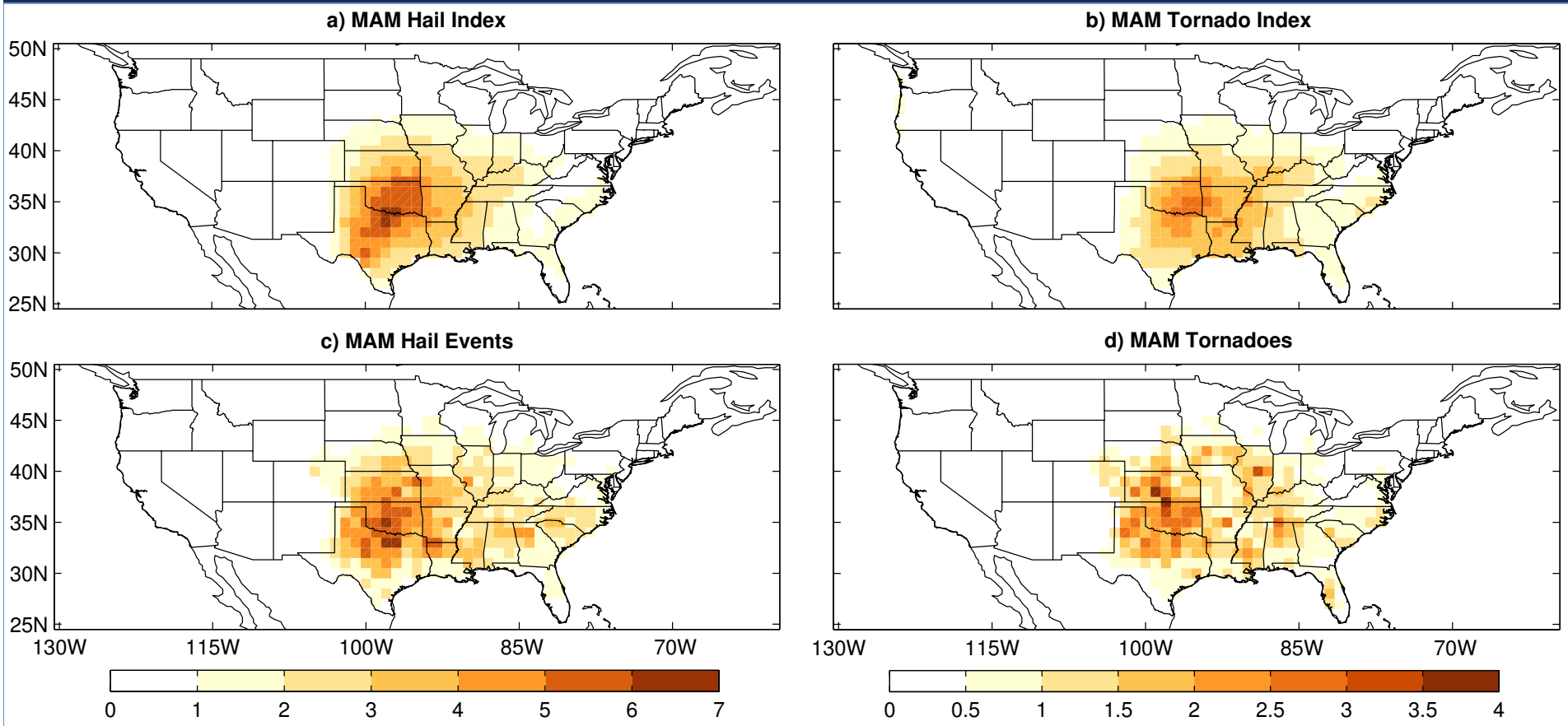
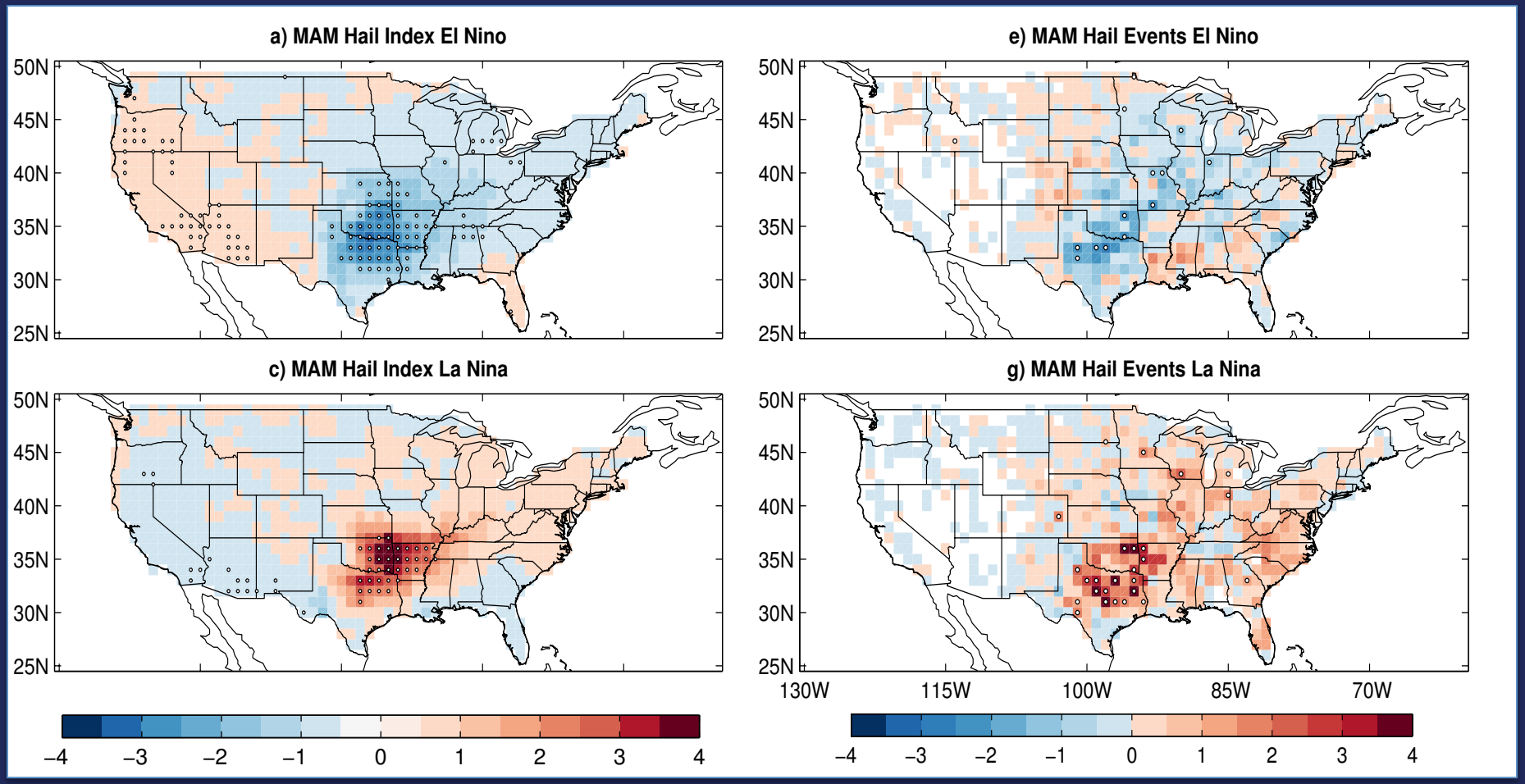
MAM Climatology of Hail/Tornadoes (Obs. & Index)



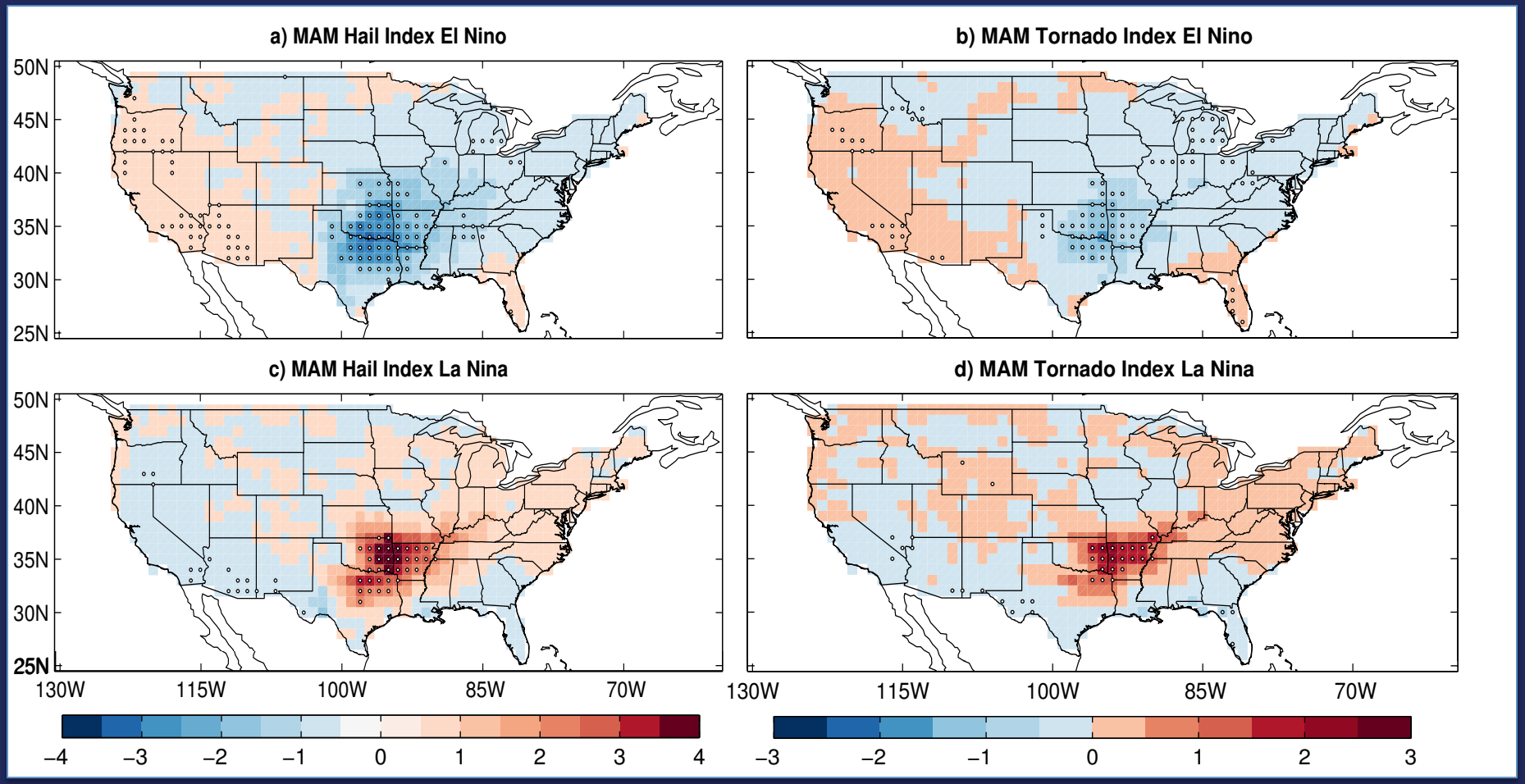
Mean MAM Climatology for Hail and Tornado Index, Tornadoes and Hail Events for the period 1979-2012

Modulation of Hail by ENSO Teleconnection - MAM



Composites of El Niño and La Niña MAMs based on 7 and 6 year composites respectively selected using ONI ±0.5 . Stippling is for Monte Carlo derived significance at the two-tailed 95% level.

Modulation of Hail by ENSO Teleconnection - MAM



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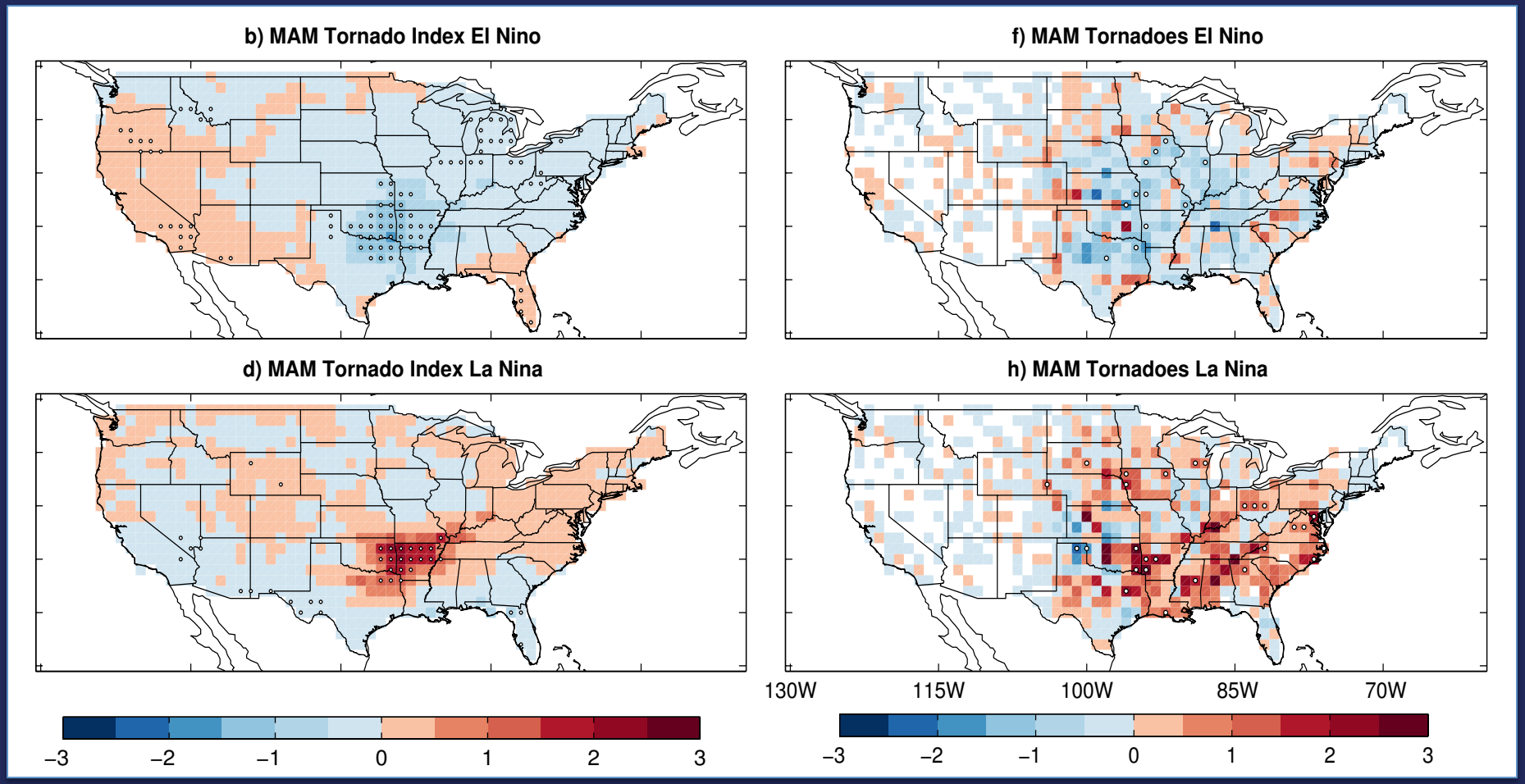
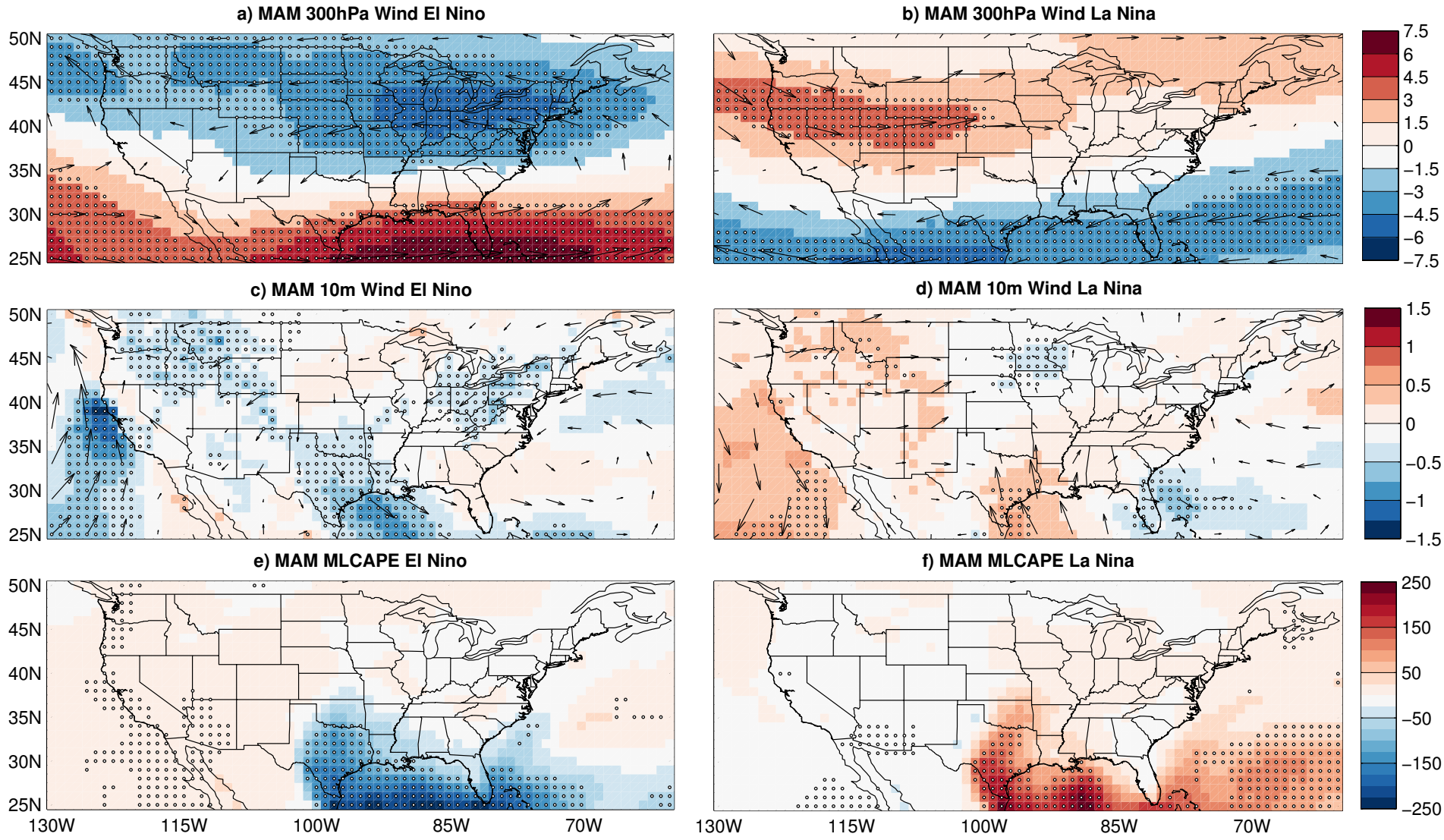
Modulation of Tornadoes by ENSO Signal - MAM



Composites of El Niño and La Niña MAMs based on 7 and 6 year composites respectively selected using ONI ±0.5 . Stippling is for Monte Carlo derived significance at the two-tailed 95% level.

ENSO Teleconnection MAM – Synoptic and Environment



MAM Composites of Environmental variables for El Niño and La Nina

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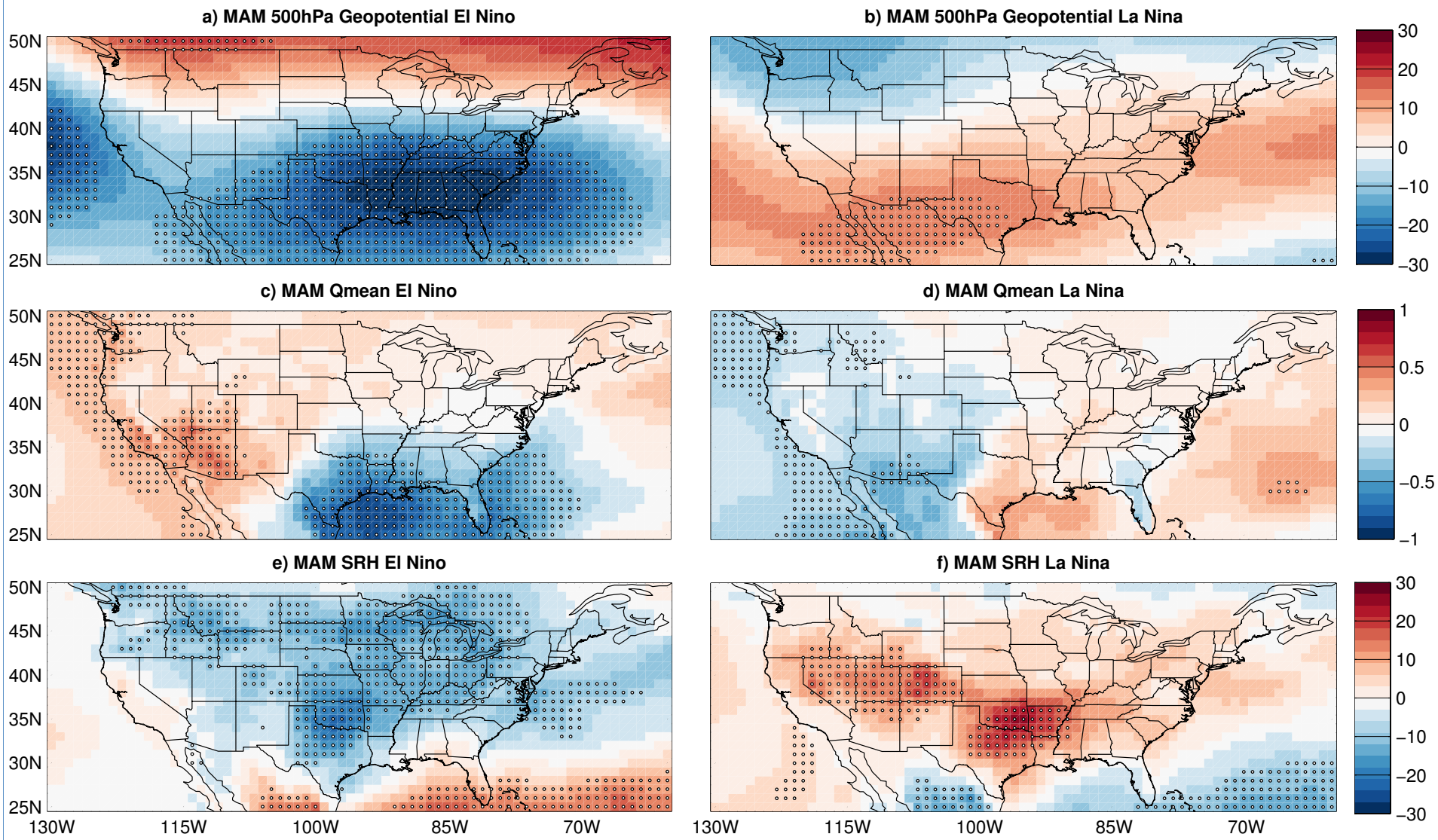
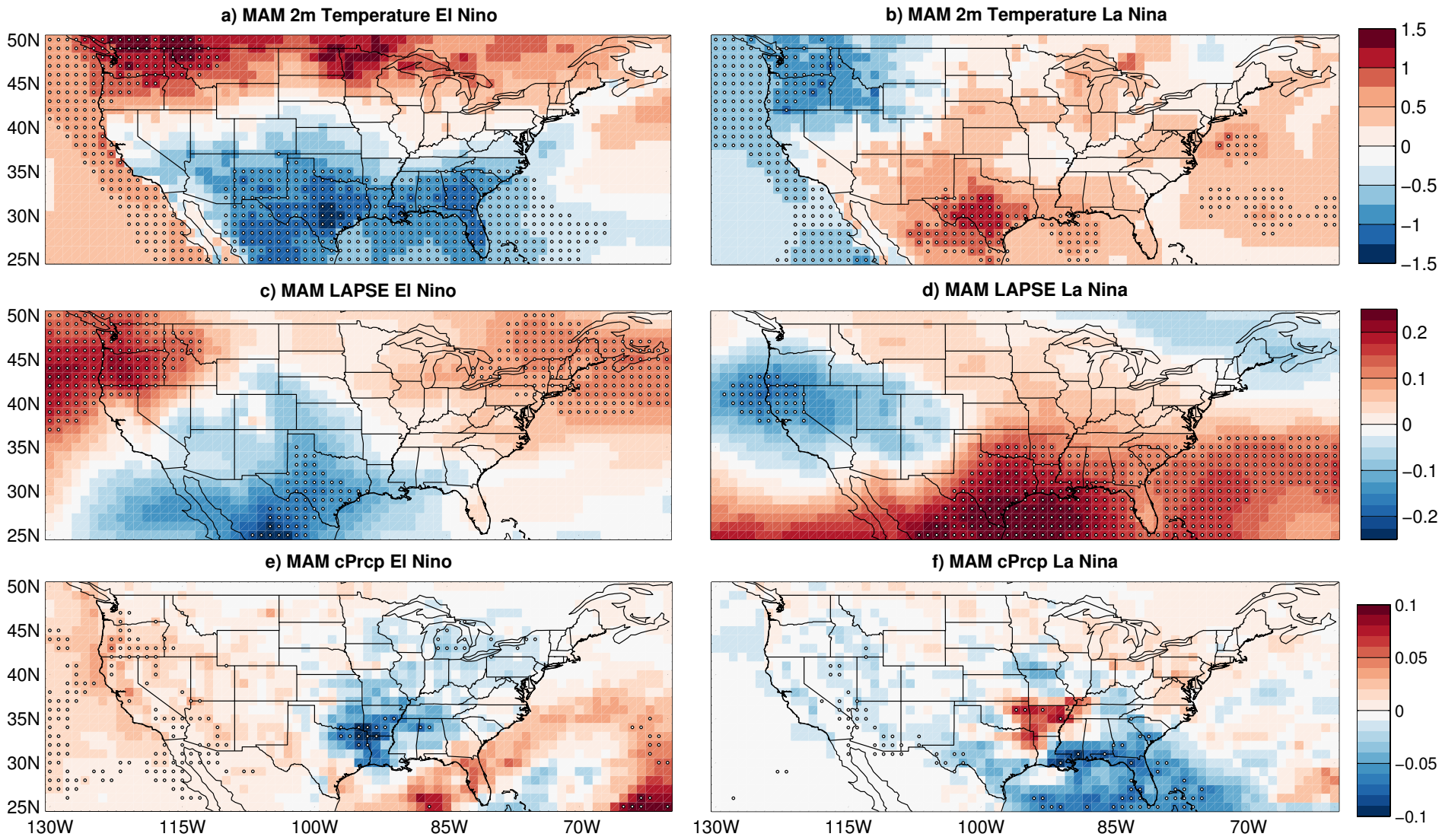
ENSO Teleconnection MAM – Synoptic and Environment



MAM Composites of Environmental variables for El Niño and La Niña

ENSO Teleconnection MAM – Synoptic and Environment



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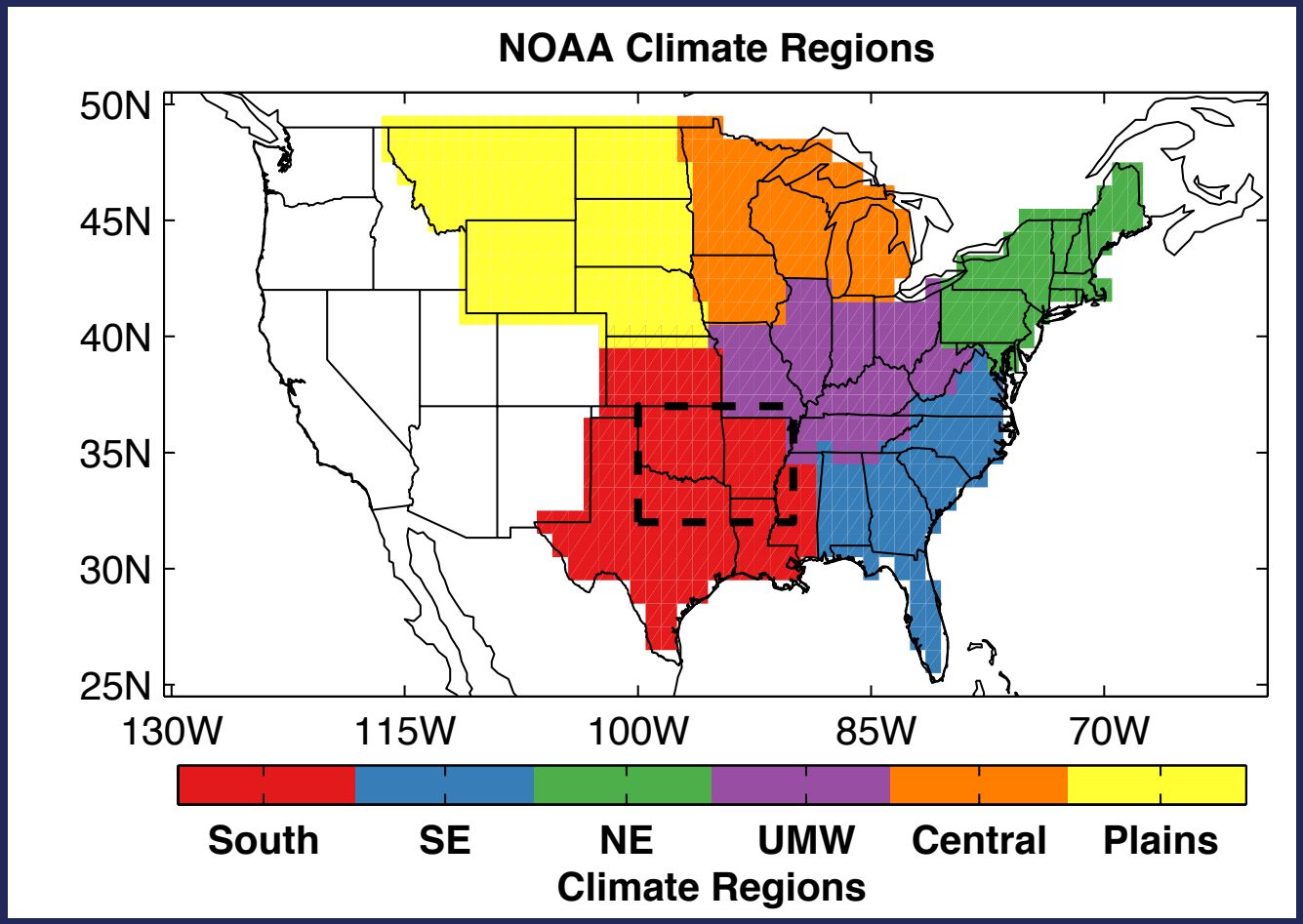
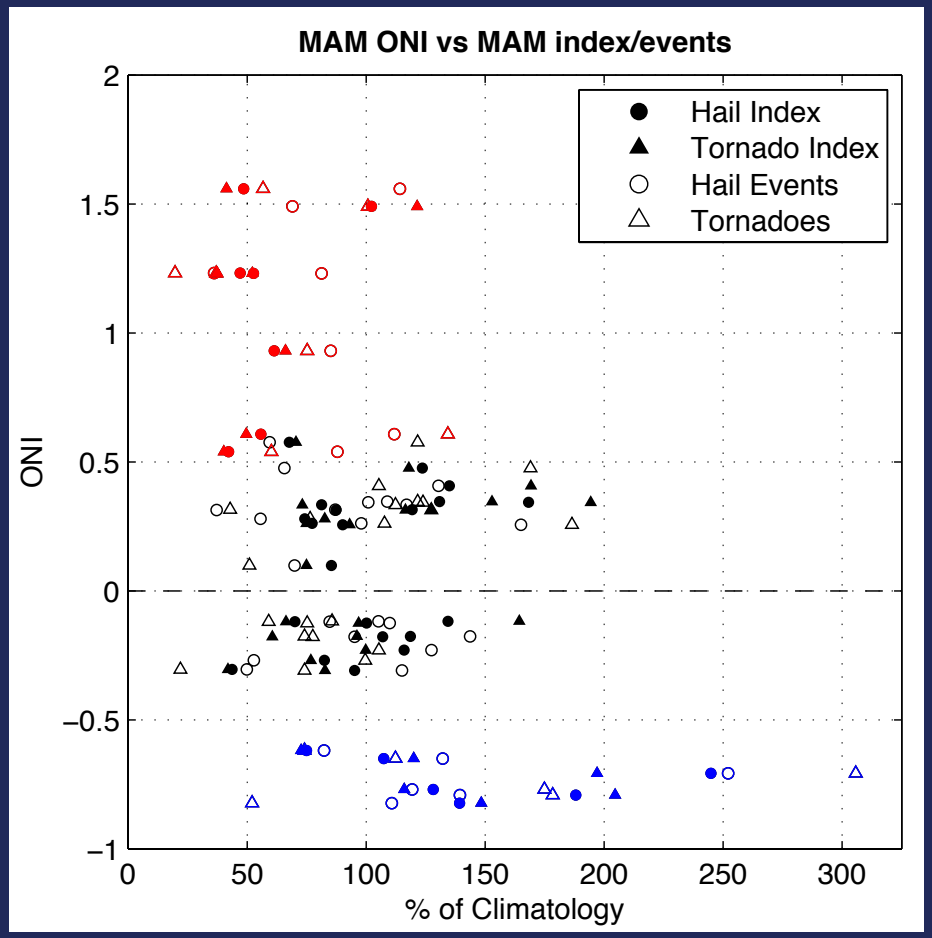
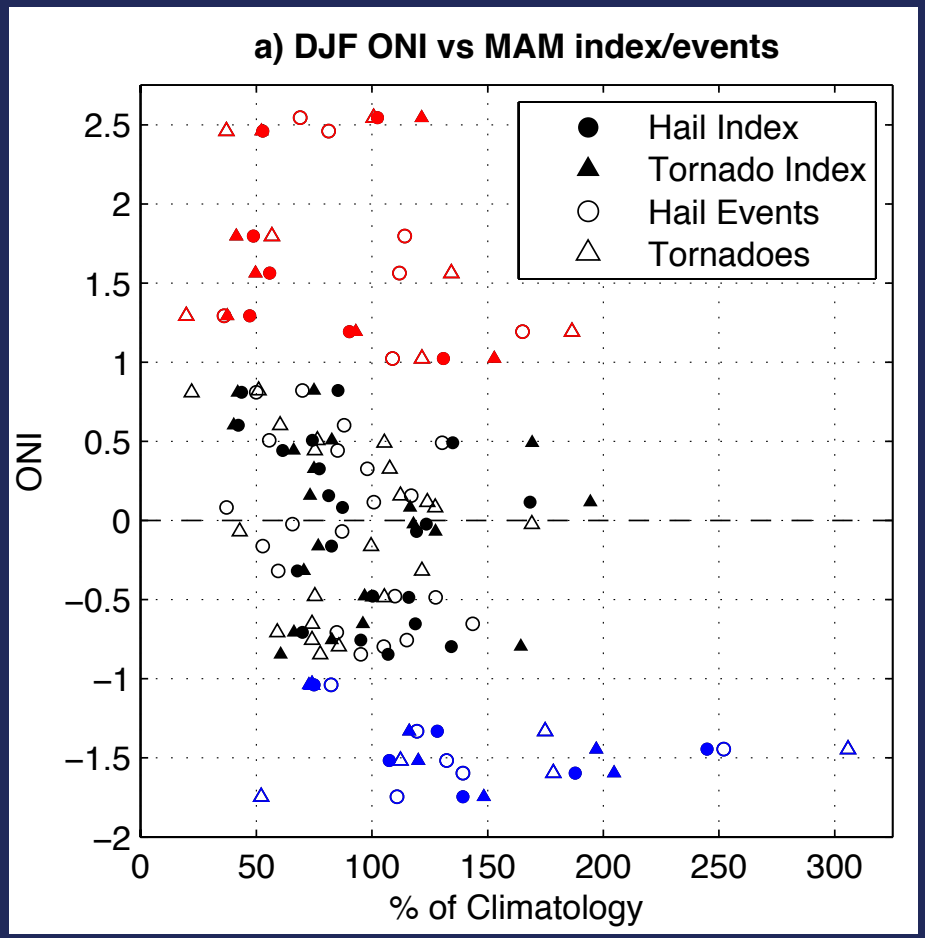
ENSO Signal – Seasonal Predictability: DJF forecasting MAM



Define a box around area with most noticeable signal bounded by 100-90W and 31-36N.

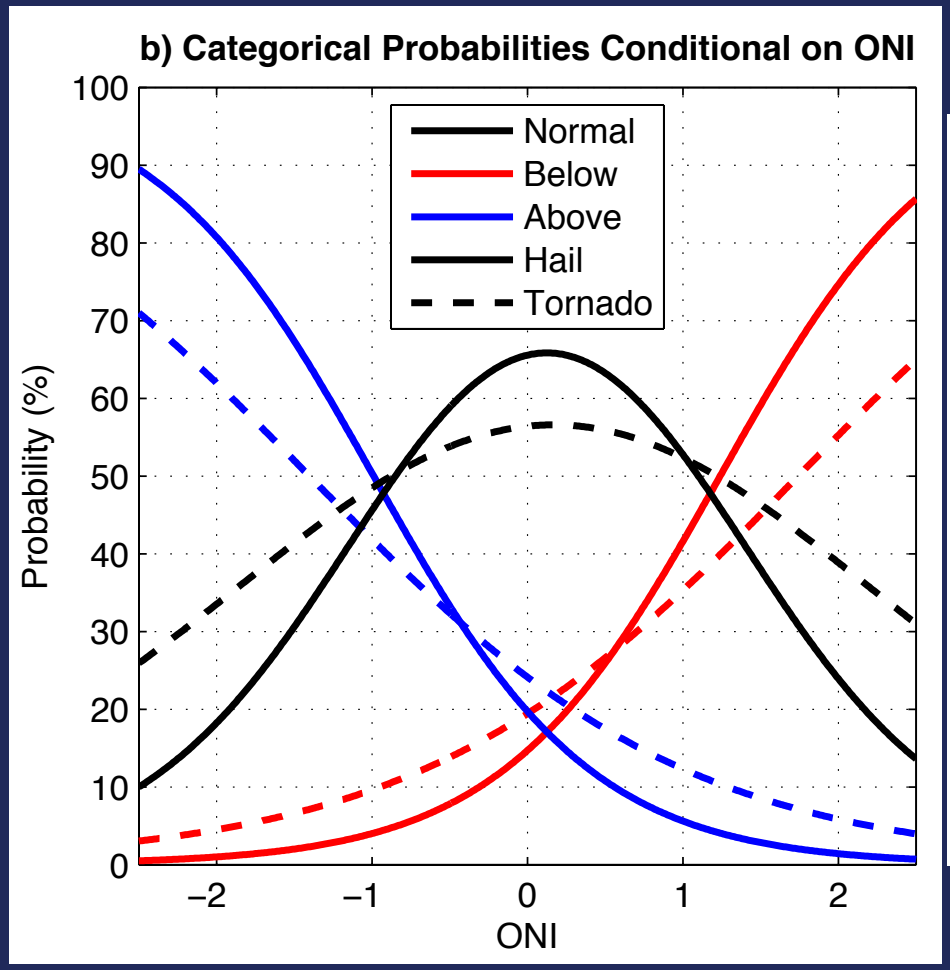
ENSO Signal – Seasonal Predictability: DJF forecasting MAM

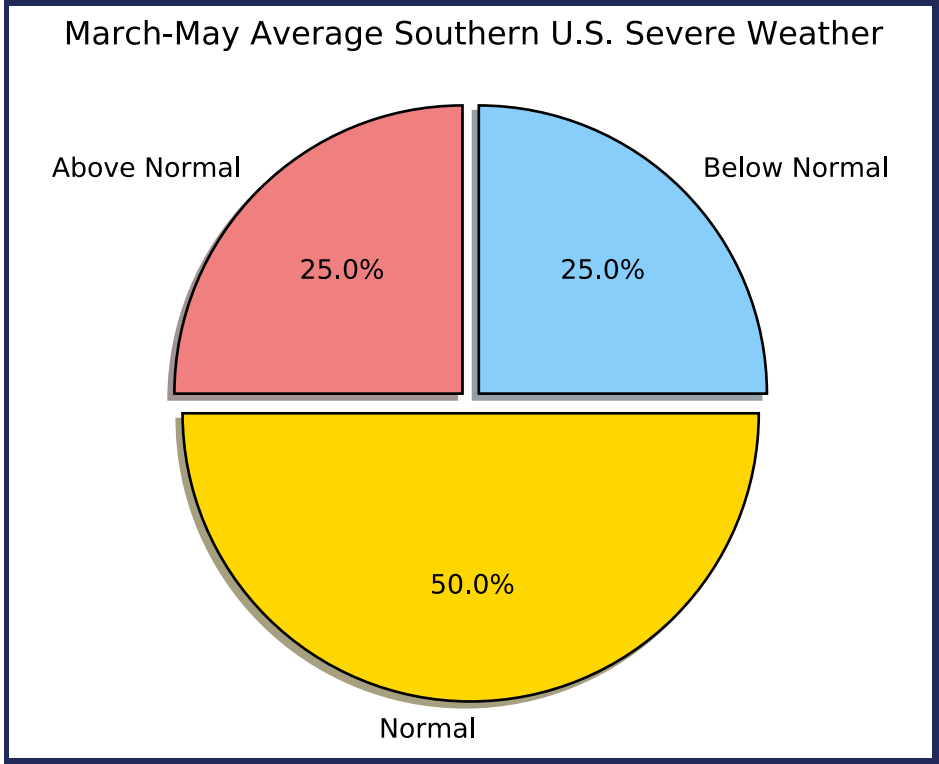




Scatter of box (bounded by 100-90W and 31-36N) total index for hail and observed hail events against seasonal ONI for a) MAM ONI b) Preceding DJF ONI. Shapes are as indicated in the legend. Red shapes correspond to the 7 El Niño seasons and blue icons correspond to the 6 La Niña seasons used in the composite respectively.

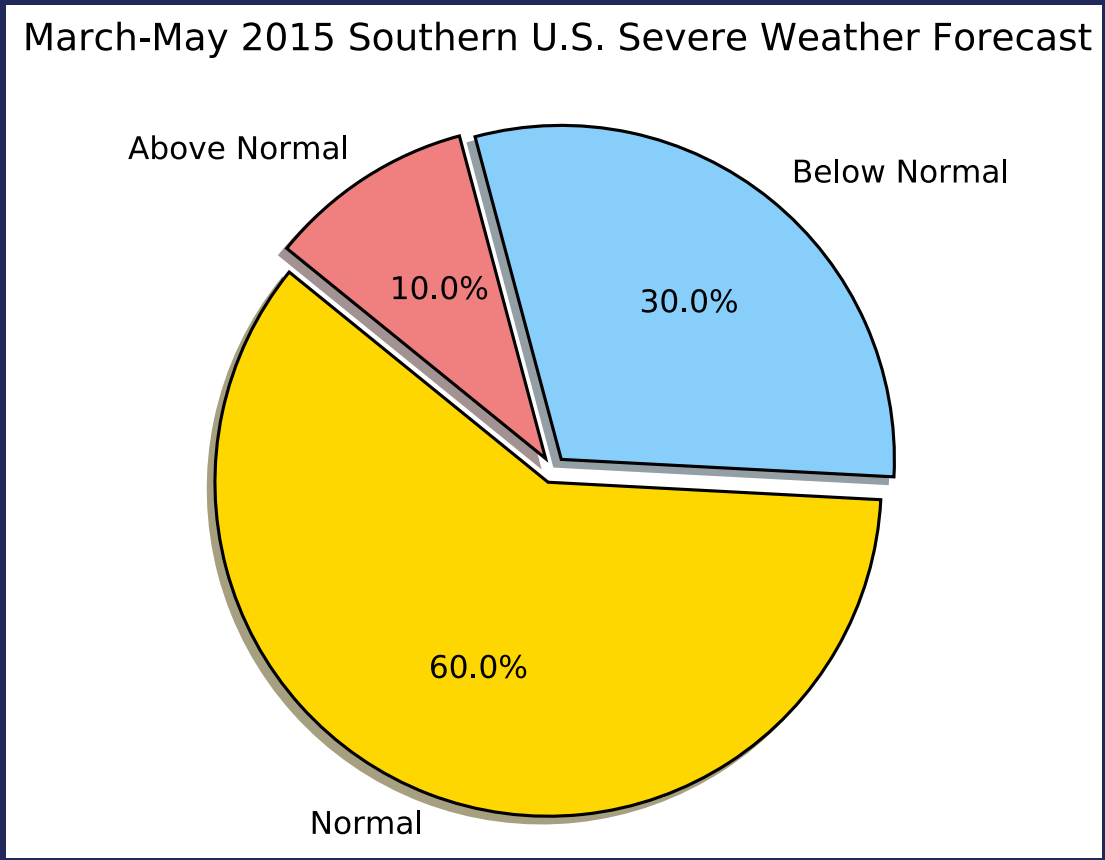
ENSO Signal – Seasonal Predictability: DJF forecasting MAM





Extended Logistic Regression for MAM tornado and hail index probability conditional on the ONI state of the prior DJF for the defined area – Note these aren't your ordinary terciles (25%/50%/25%)

ENSO Signal – Seasonal Predictability: DJF forecasting MAM



Probabilistic forecast of severe weather occurrence based on DJF ONI data for the 2015 spring severe weather season.

Conclusions

- **There is a statistically significant relationship between ENSO frequency of springtime tornado and hail environments, and confirmation for DJF.**

- **Tornado observations, especially restricting to high end events, are a poor way to consider relationships with the climate system in contrast to environmental proxies.**

- **A significant modification of the environmental conditions continues into MAM, with significant negative anomalies in El Niño (25-50%), and an eastward shift and increased frequency in La Niña (20-150%).**

- **These results provide legitimate spring seasonal predictability (3+ months) for moderate to strong ENSO signals using DJF ONI.**

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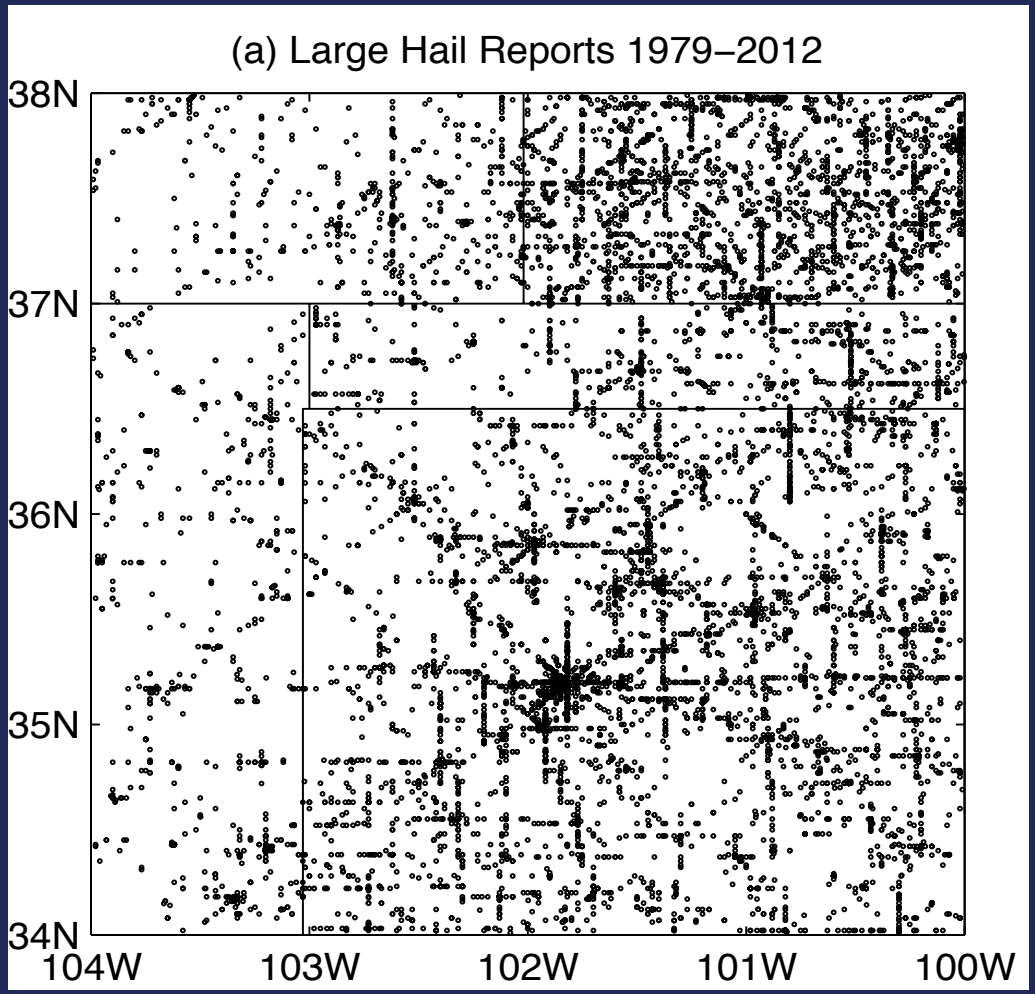
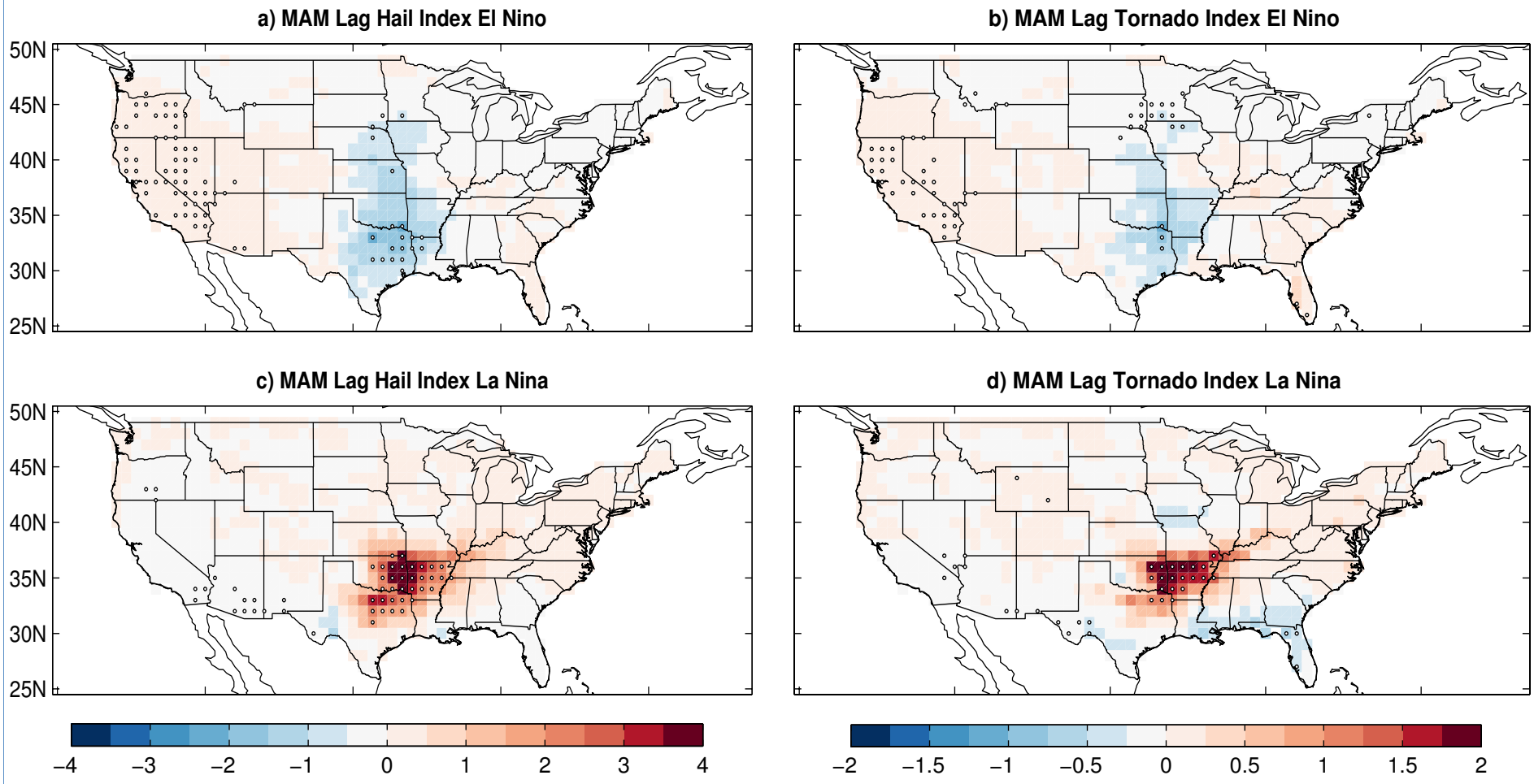
You Can't Just Bias Correct For Population



Point reports for hail greater than one inch 1979-2012 for the TX Panhandle.

ENSO Signal – MAM based on DJF ENSO Signal



MAM anomaly composites El Niño/La Niña based on DJF Oceanic Niño Index greater than of +-1.