Factors Contributing to the Extreme Texas Rains of Spring 2015

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Factors associated with extreme May 2015 rains in Texas, Oklahoma, and New Mexico, are analyzed. Historical data and climate simulations identify a characteristic global atmosphere and ocean pattern. Event return period is estimated.

I. Observations

Extreme Rains in May 2015

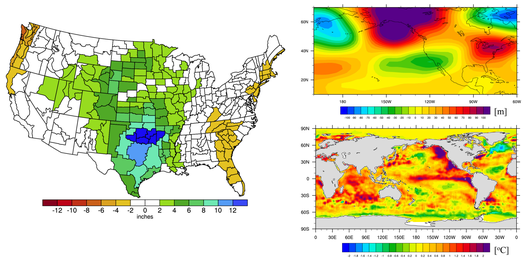

Figure 1: May 2015 NOAA/NCDC Climate Division precipitation anomalies, 20th Century Reanalysis 500mb Z anomalies, Hadley-NOAA/OI SST anomalies.

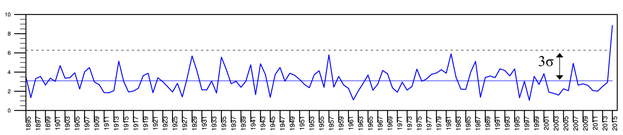

Figure 2: Time series of TX NM OK area-averaged observational precipitation for Mays [inches].

Characteristic Circulation/SSTs for Extreme Wet Mays

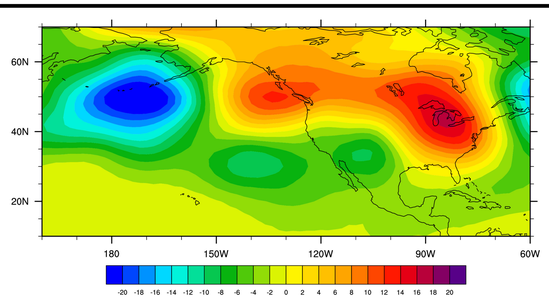

Figure 3: 20th Century Reanalysis 500mb Z anomalies in wettest May quintile [m].

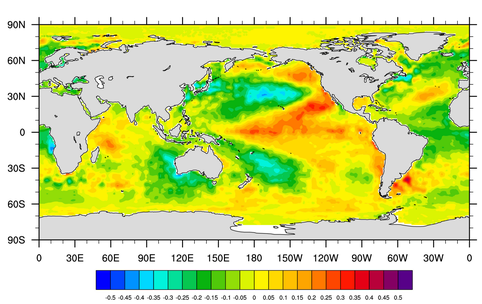

Figure 4: Hadley-NOAA/OI SST anomalies in wettest May quintile [°C].

II. Model Analysis

Simulation of Extreme May Rains

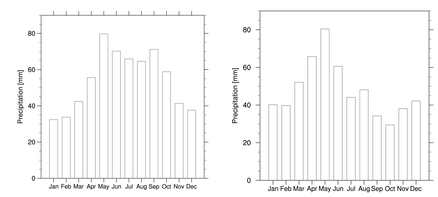

Figure 5: Climatologies of TX NM OK precipitation for obs and 17 AMIP historical GFDL runs (1870-2015).

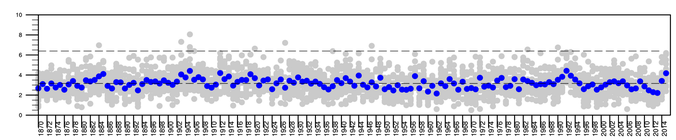

Figure 6: Time series of TX NM OK area-averaged GFDL model precipitation for Mays [inches].

Characteristic Circulation/SSTs for Extreme Wet Mays

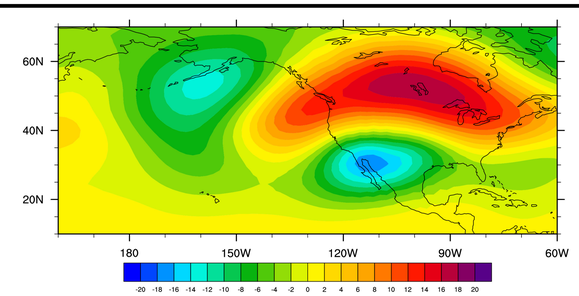

Figure 7: GFDL model 500mb Z anomalies in wettest May quintile [m].

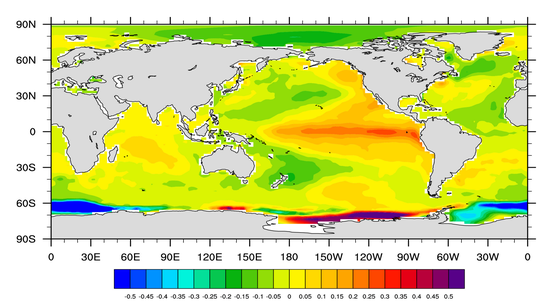

Figure 8: GFDL model SST anomalies in wettest May quintile [°C].

III. Return Period for May 2015 rains

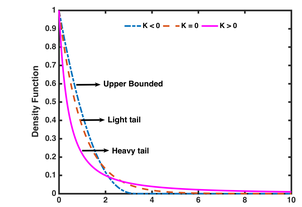

Figure 9: Illustrative example of density functions for Generalized Pareto Distribution (GPD) showing 3 types of extreme tail behavior, as indicated by different shape parameters.

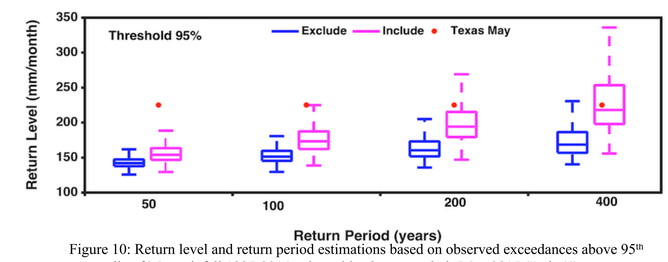

Figure 10: Return level and return period estimations based on observed exceedances above 95th percentile of May rainfall 1895-2014, where blue boxes exclude May 2015 ("prior"), magenta boxes include May 2015 ("posterior"), red dots are May 2015 observation.

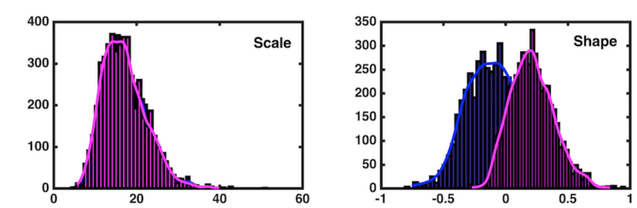

Figure 11: Estimated distribution of scale (left) and shape (right) parameters for prior and posterior cases.

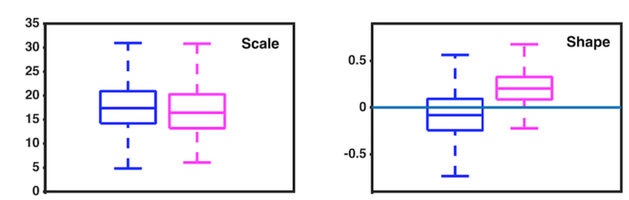

Figure 12: Boxplots of corresponding estimated distributions of scale (left) and shape (right) parameters show the median, the 25th and 75th percentiles, for prior and posterior cases.

Conclusions:

- El Niño conditions favor wet Mays over TX, OK, NM.
- Large-scale atmospheric circulation is key driver.
- The May 2015 rains likely a 200 to 400-year event.
- The 2015 event greatly alters expectations for extreme May rains due to change in the GPD shape parameter.