

ONGOING CHANGES IN THE U.S. TORNADO ACTIVITY & LINKAGE TO CLIMATE INDICES

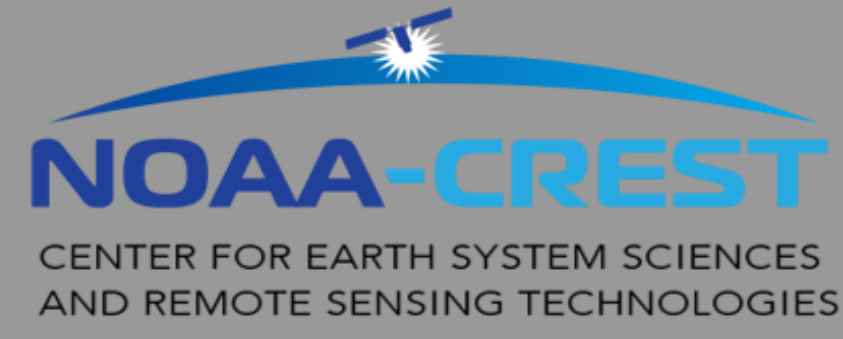
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OVERVIEW

Over the last two decades, the U.S. experienced an average of 1,239 tornadoes per year. The amount of destruction that severe thunderstorms, hail, and winds that accompany a tornado create an average of 5.4 billion dollars losses and hundred of deaths and injuries.

Evidence suggests that El Niño 3.4 Southern Oscillation and the Southern Oscillation Index activity has an impact on spring tornado activity in U.S. as the conditions created by this climate phenomenon shape the way that jet streams flow over the U.S. A better forecasting of tornadoes and tornadoes related events could offer better civil readiness and minimize these losses.

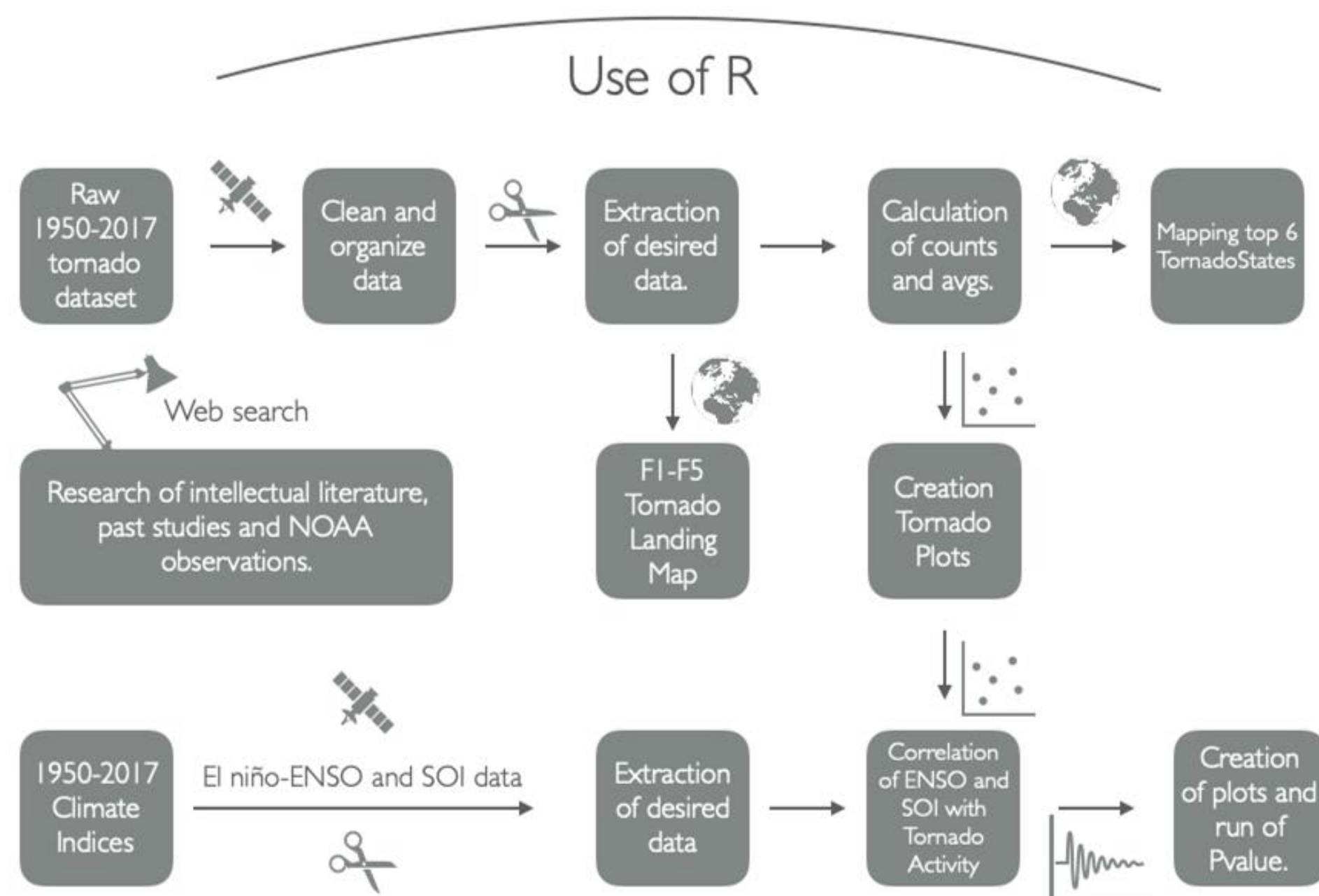
The study investigated changes in US tornado records and correlated tornado activity to regional climate activity such as ENSO-El Niño 3.4 and ENSO-SOI contributions to annual U.S. tornado frequency.

OBJECTIVES

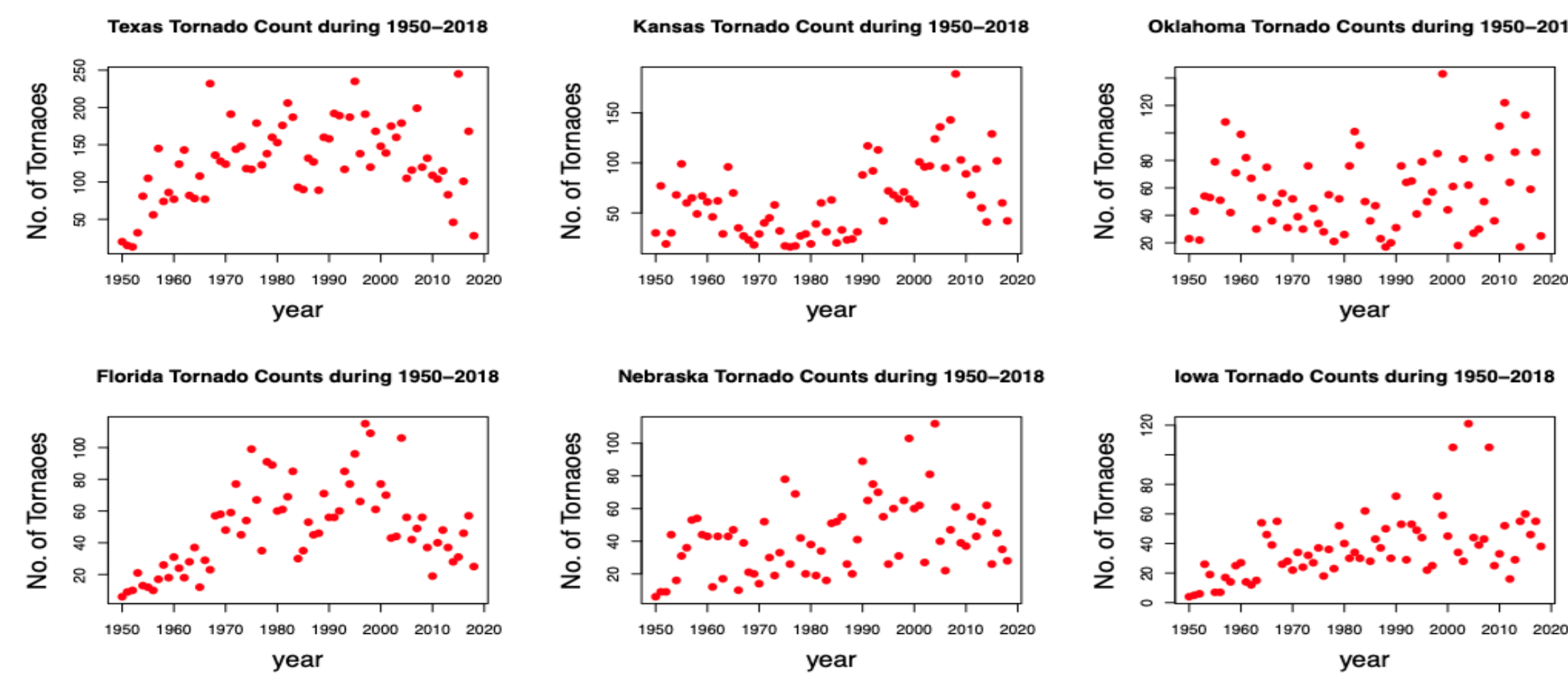
- Compile tornado records, calculate statistics, and visualize the data
- Investigate changes in tornado frequency between 1950 and 2018
- Determine where different categories of tornado F1-F5 occur
- Explore possible correlations between annual tornado activity and regional climate indices (ENSO-El Niño and ENSO-SOI)

METHODS

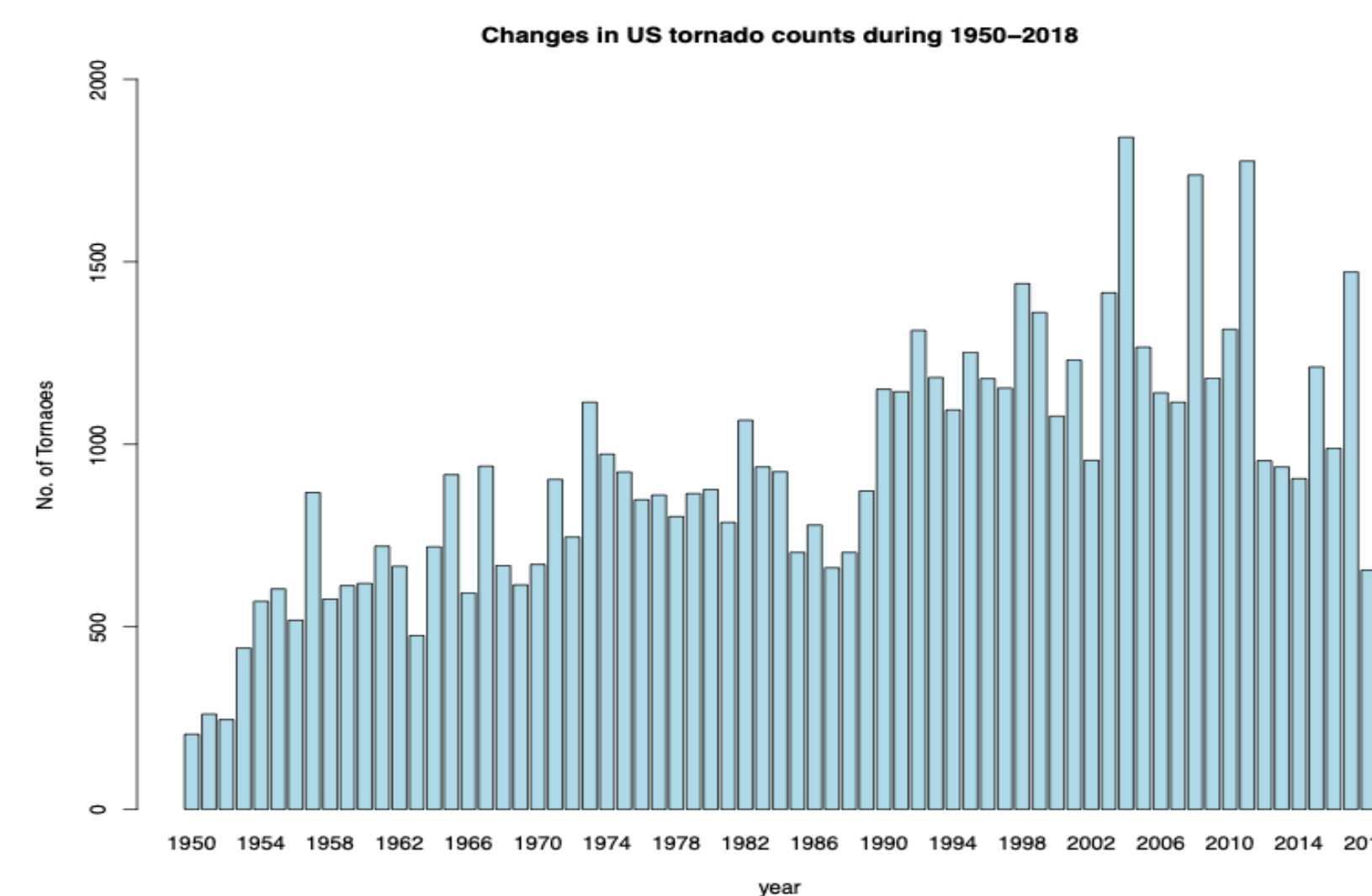
- Historical tornado records were obtained from US Storm Prediction Center (SPC). The entire record over the period 1950-2017 is available online at <https://www.spc.noaa.gov>.
- The time series of ENSO-El Niño 3.4 and ENSO-SOI were collected from Royal Netherlands Meteorological Institute's climate explorer.
- We first did some exploratory analysis to visualize data and find tornado-prone regions.
- We applied `cor.test` in R to examine the correlation between ENSO-El Niño 3.4, ENSO-SOI and tornado frequency for each U.S. state. The p-value of less than 0.1 was considered to report significant association for each climate index.



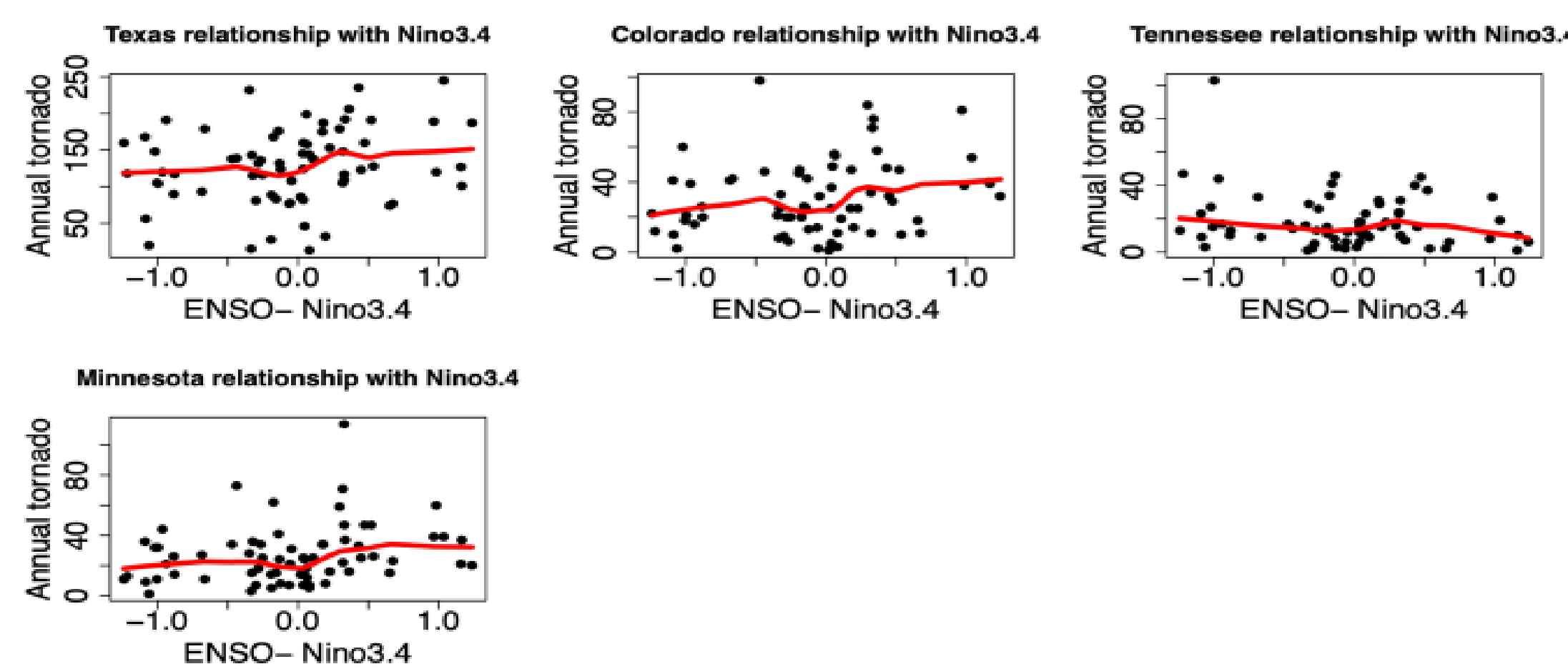
RESULTS



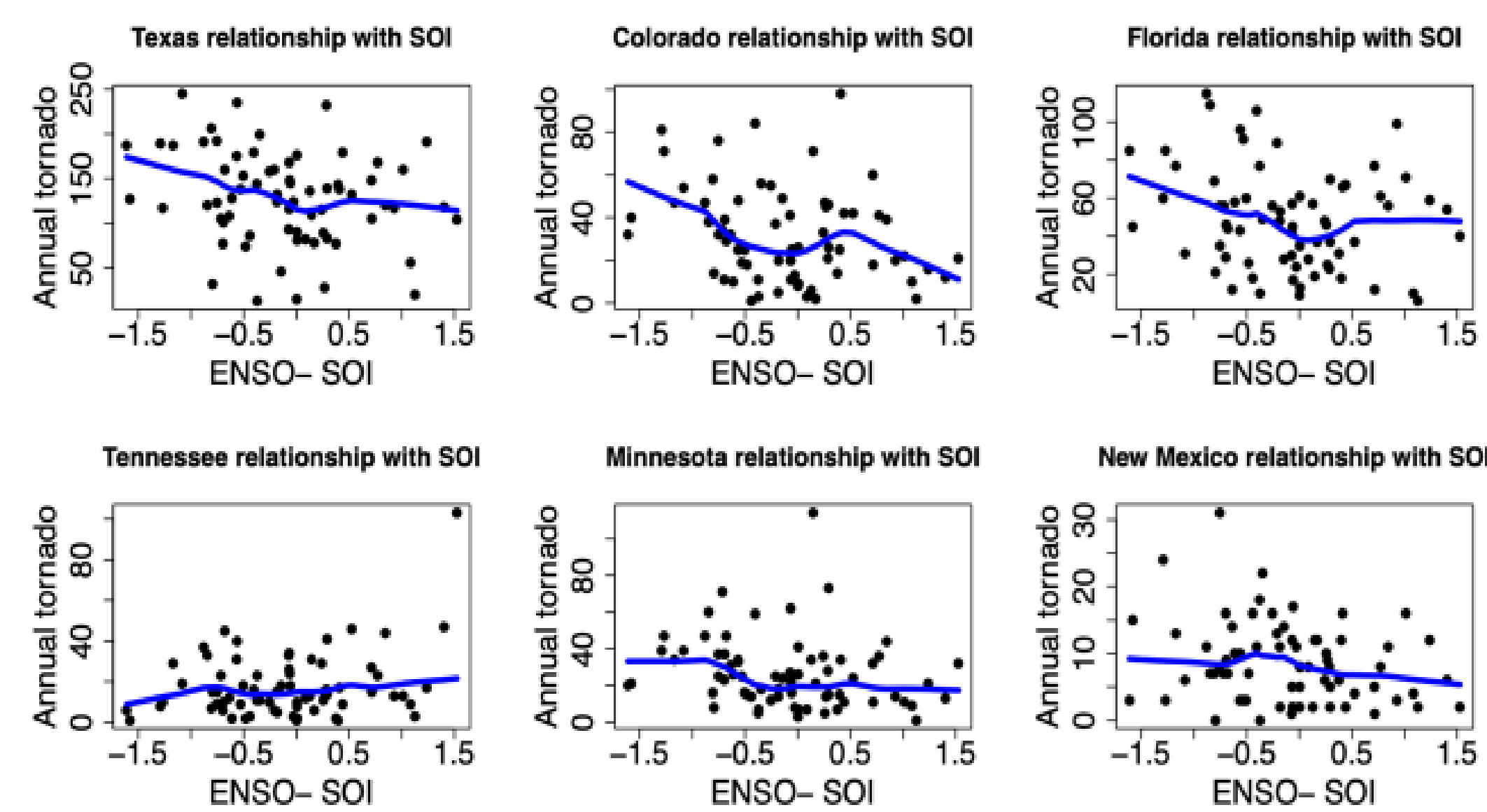
TOP 6 STATES WITH MOST RECORDED TORNADOES
Texas, Kansas, Oklahoma, Florida, Nebraska and Iowa



U.S. TOTAL YEARLY COUNTS

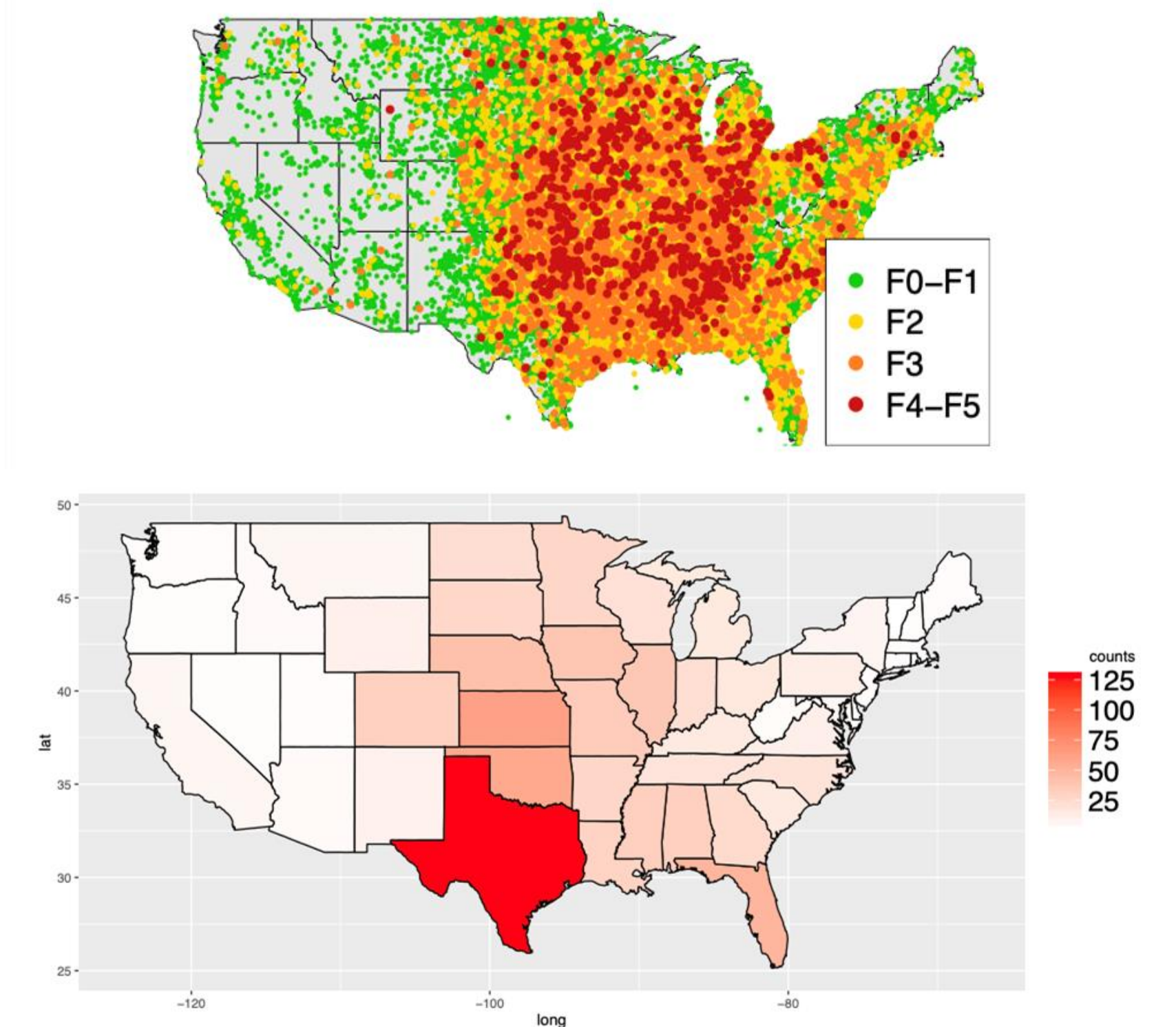


ENSO-EL NIÑO 3.4 AND TORNADO FREQUENCY CORRELATION



ENSO-SOI AND TORNADO FREQUENCY CORRELATION

TORNADO LANDINGS During 1950-2018



- The states with the most tornado landings are Texas, Kansas, Oklahoma, Florida, Nebraska, and Iowa.
- The average annual number of tornadoes is 1,253
- Notable correlation between ENSO-SOI and tornado frequency in: Texas, Colorado, Florida, Tennessee, Minnesota and New Mexico.
- Notable Correlation between ENSO-El Niño 3.4 and tornado frequency in: Texas, Colorado, Tennessee and Minnesota.
- Tornado counts noteworthy rising in the southeastern regions.
- Severe Tornado activity (F3,F4,F5) is most likely in the southern, south-central, and south-east U.S. regions.

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