

FinalProject

2023-12-05

Final Project: An Analysis of Warming Temperatures

The Data:

I used data from a number of sources. The main data set was published on GitHub by the Washington Post, and it contains the year, a two digit fips code denoting the state, the average annual temperature in Fahrenheit, and the average annual temperature in Celcius. The GitHub site also includes several other data files containing different variables, and can be found at <https://github.com/washingtonpost/data-2C-beyond-the-limit-usa>.

The next data set contains information on deaths from pneumonia and Influenza, with the variables including the state, the age group, the season, the corresponding year and week, number of deaths from flu, number of deaths from pneumonia, deaths from both, the total deaths, and percentage of deaths from pneumonia and influenza. This file can be found at https://healthdata.gov/dataset/Deaths-from-Pneumonia-and-Influenza-P-I-and-all-deaths-3pyb/about_data.

The third data set talks about airborne particulate matter, or PM for short. It includes the variables: year, state, county, and a measure of the annual average concentration. I added made this into 1 full dataset, but each year can be separately downloaded at <https://ephtracking.cdc.gov/qrd/87>.

The fourth main data set provides data from 1895 to 2019 on the Standardized Precipitation Index, or SPI. On top of the year column and the spi, the data file also contains a county fips number, a state fips number, and the month. https://data.cdc.gov/Environmental-Health-Toxicology/Standardized-Precipitation-Index-1895-2016/xbk2-5i4e/about_data.

Additionally, I used a file that contained the names of states and their fips code, as well as the data set provided during the semester with the latitude and longitude of the state centers. The former can be found here: <https://gist.github.com/dantonoriega/bf1acd2290e15b91e6710b6fd3be0a53>.

The Questions:

With this data, I set out to answer three questions.

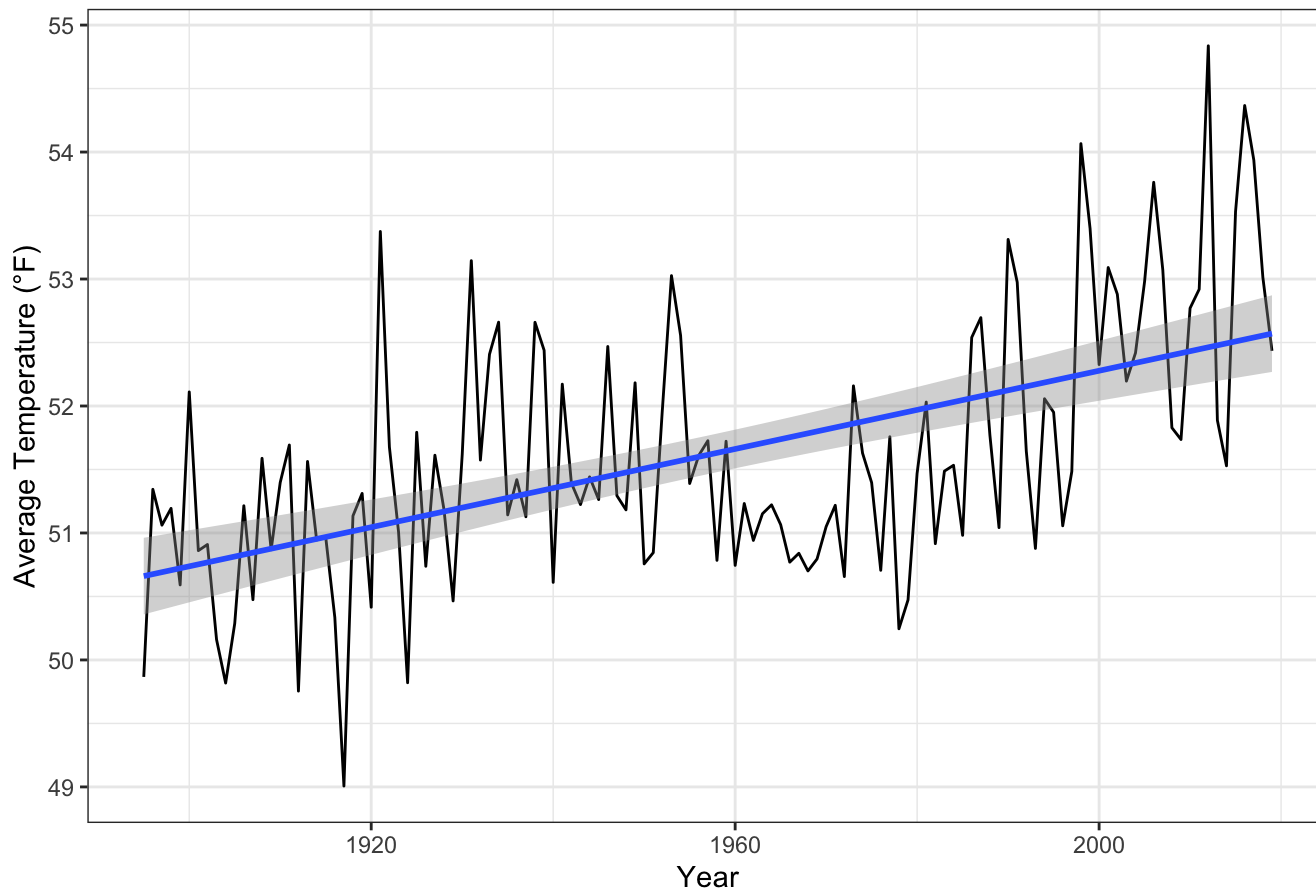
- 1.) Are rising temperatures associated with a decrease in deaths from pneumonia and influenza?
- 2.) Are changing temperatures correlated with the concentration of fine particulate matter?
- 3.) Are changing temperatures correlated with changing precipitation?

Are rising temperatures associated with a decrease

in deaths from pneumonia and influenza?

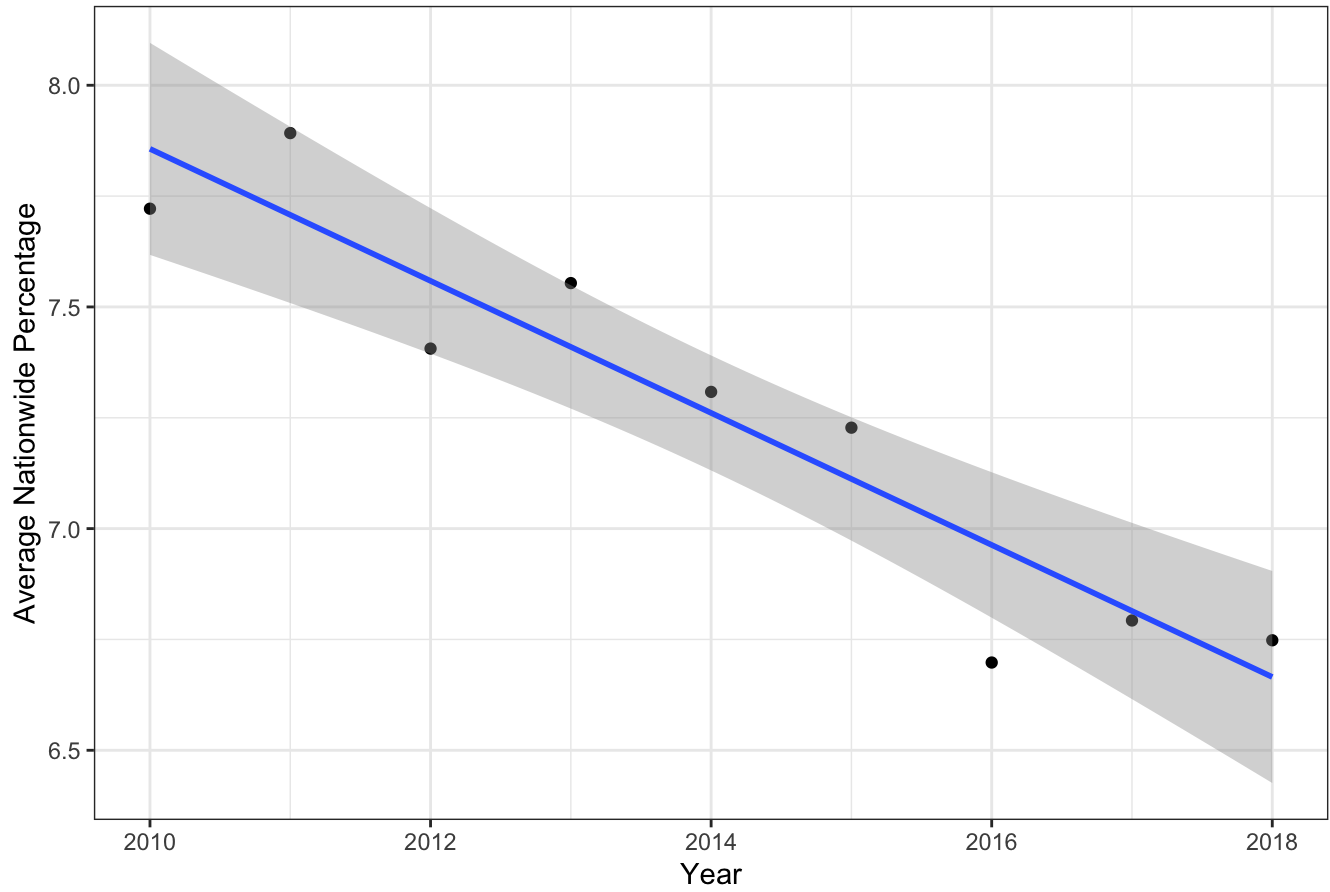
First, I had to prove that temperatures are actually rising.

Average Temperature Statewide by Year



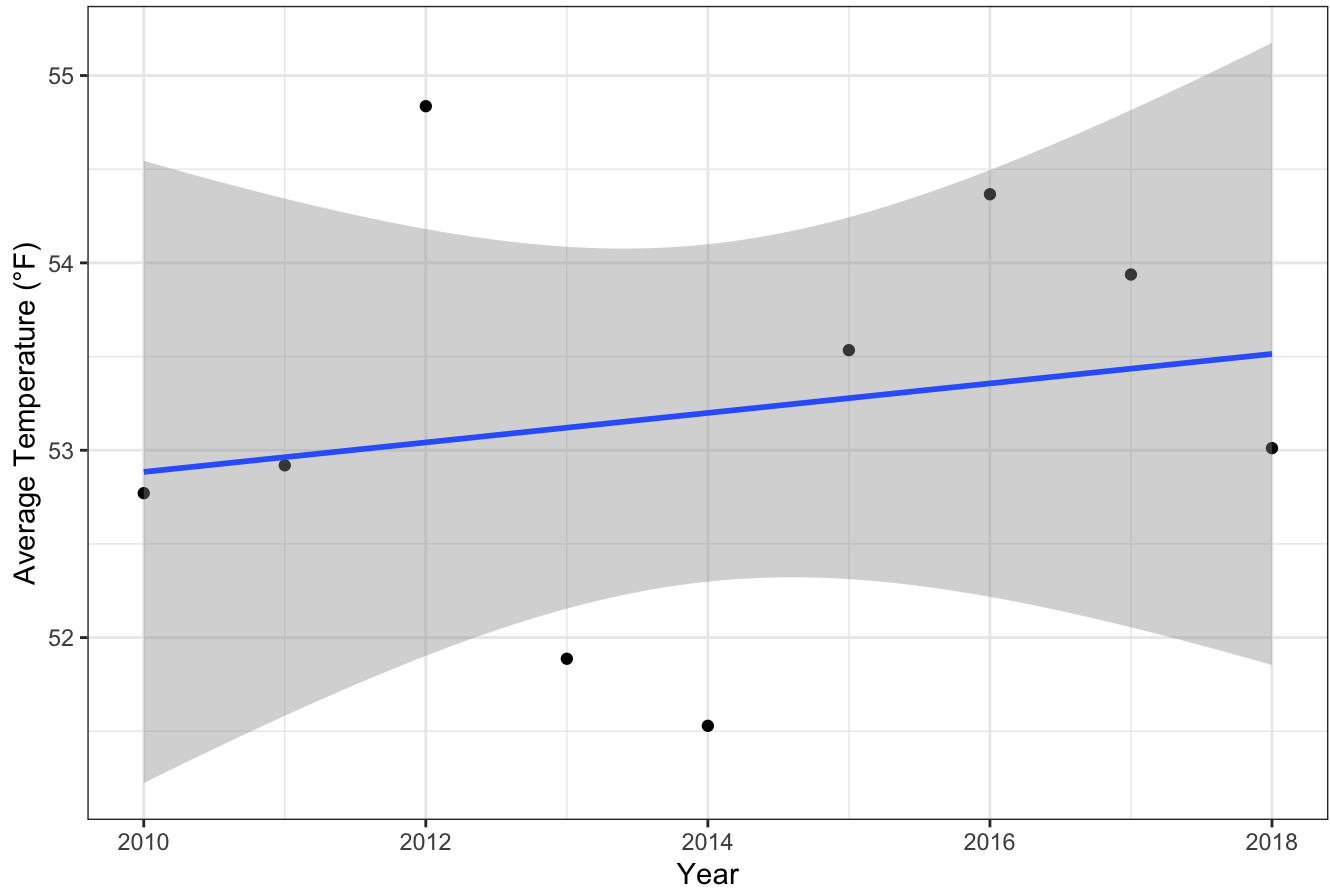
The graph shows a significant increase in temperature. The next step was to replicate the graph with the data showing the percentage of deaths each year due to pneumonia and influenza.

Percentage of Deaths from Pneumonia and Flu by Year



This significant decrease is exactly what I was hoping to see! Unfortunately, the pneumonia and influenza data is over a lot shorter period of time, so I wanted to check if the temperature data is significantly increasing over the same time period.

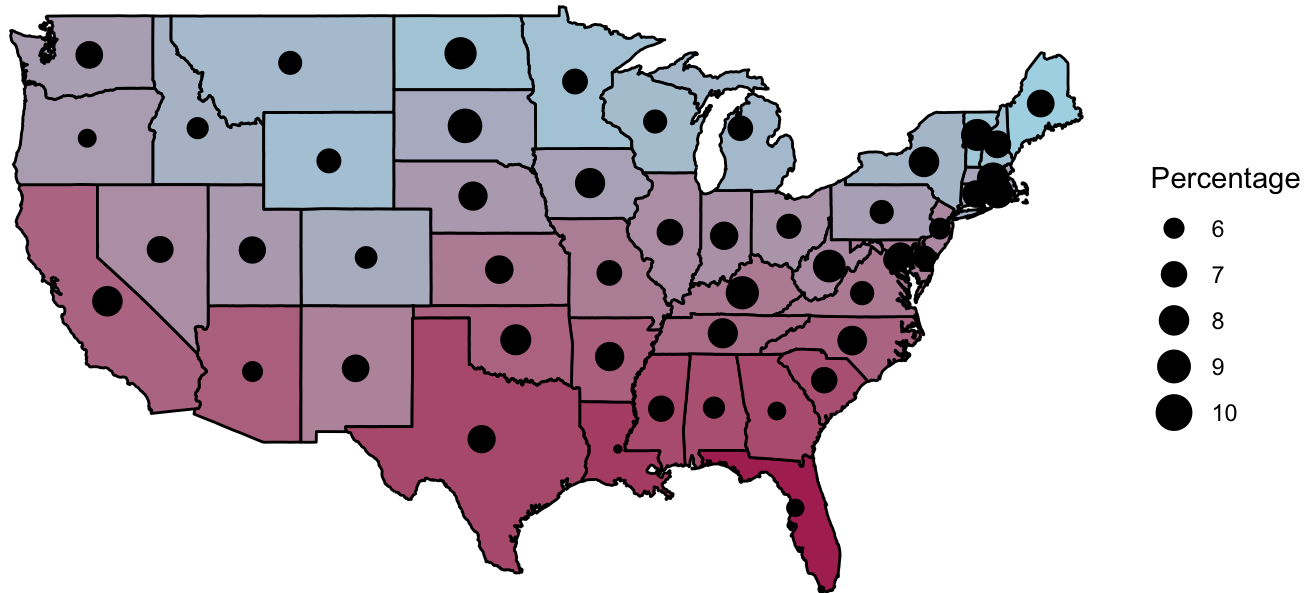
Average Temperature Statewide on Overlapping Years



The graph shows that, while the temperature is increasing, the error on it tells us that it's not a significant increase and that more analysis is needed. The next thing I wanted to test was if warmer states suffer less from pneumonia and influenza than colder states.

Average Temperature and Percent of Deaths in 2015

Dot size indicates the percentage of deaths due to pneumonia and influenza that year.



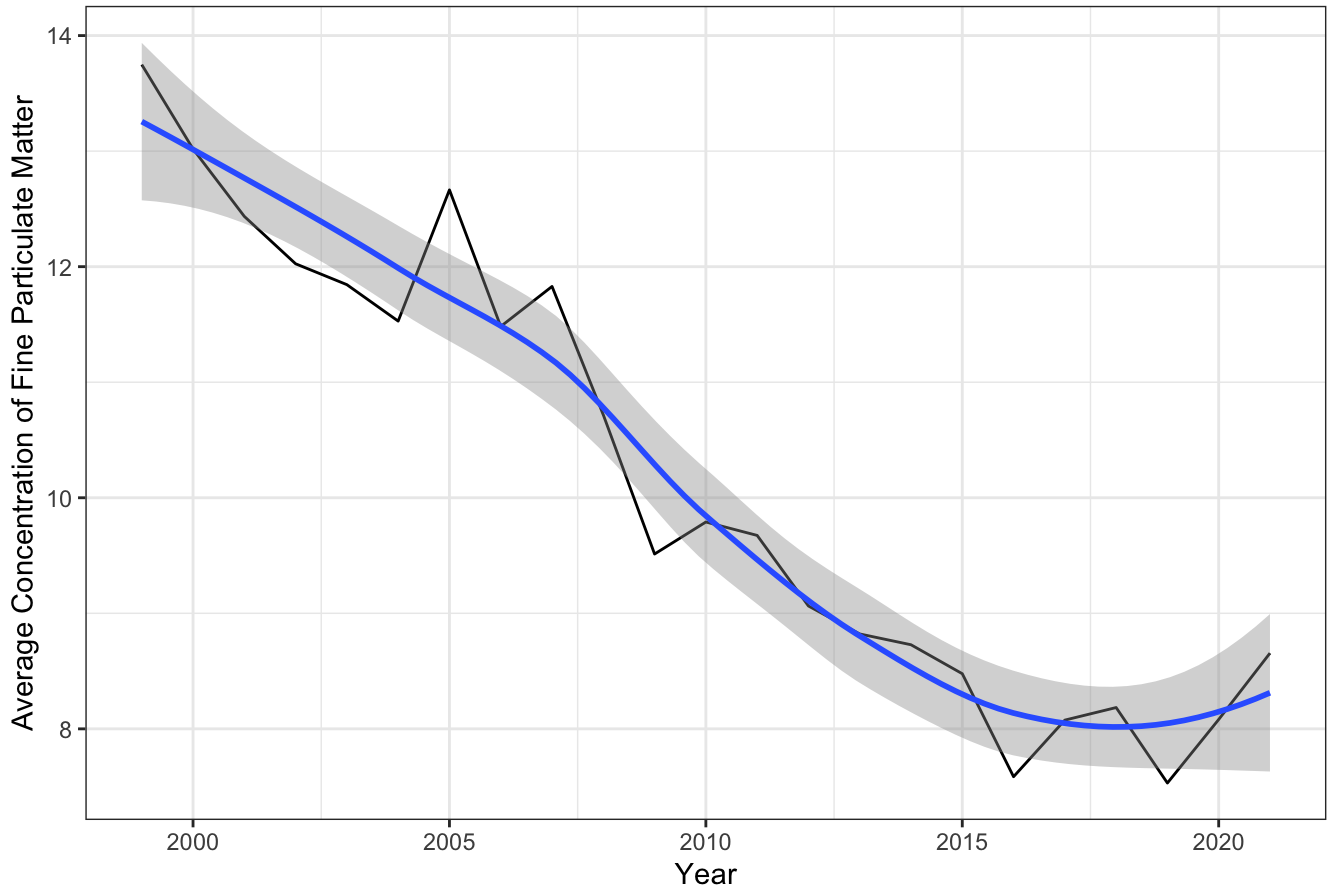
This graph doesn't appear to show a clear trend between warmer regions and lower percentages.

Are changing temperatures correlated with the concentration of fine particulate matter?

Airborne particulate matter (PM) can be defined as a mixture of chemical pollutants of many types. The data set I'm using contains information on particles that are 2.5 micrometers and smaller, which can be inhaled and deposited on interior surfaces of the lung. These deposits can cause tissue damage and inflammation.

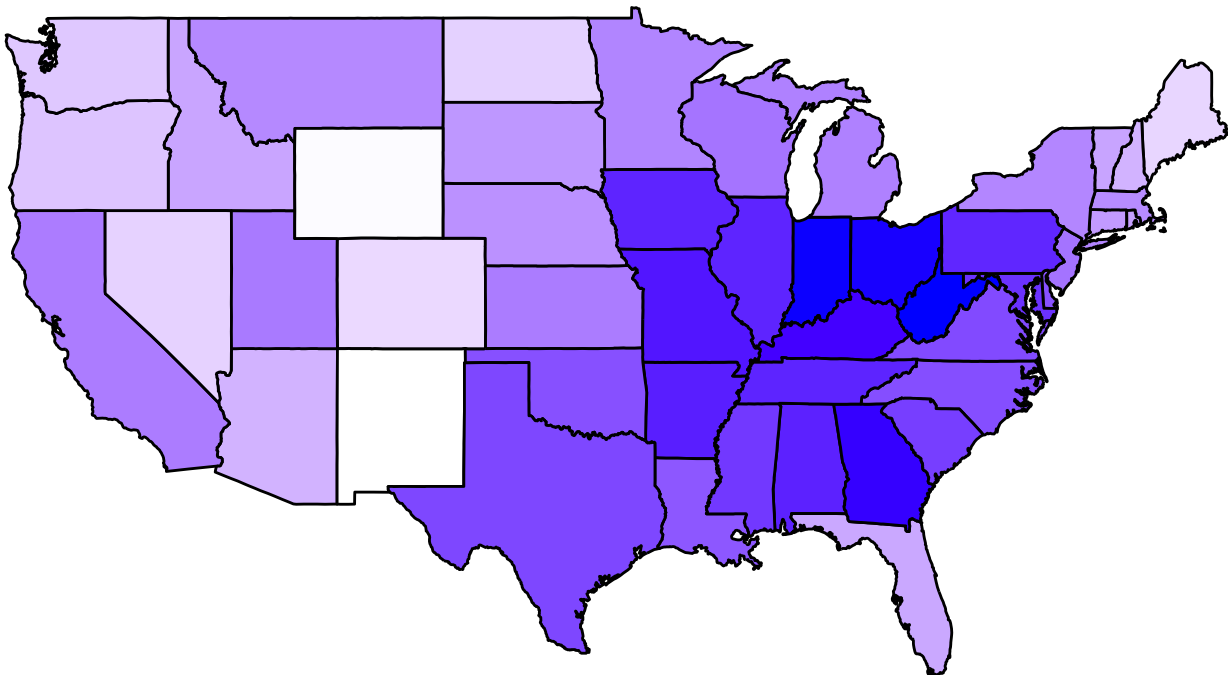
If climate change is blamed on pollution, this should show an increase in particulate matter to match increases in temperature.

Average Concentration of Particulate Matter Decreasing Over Time



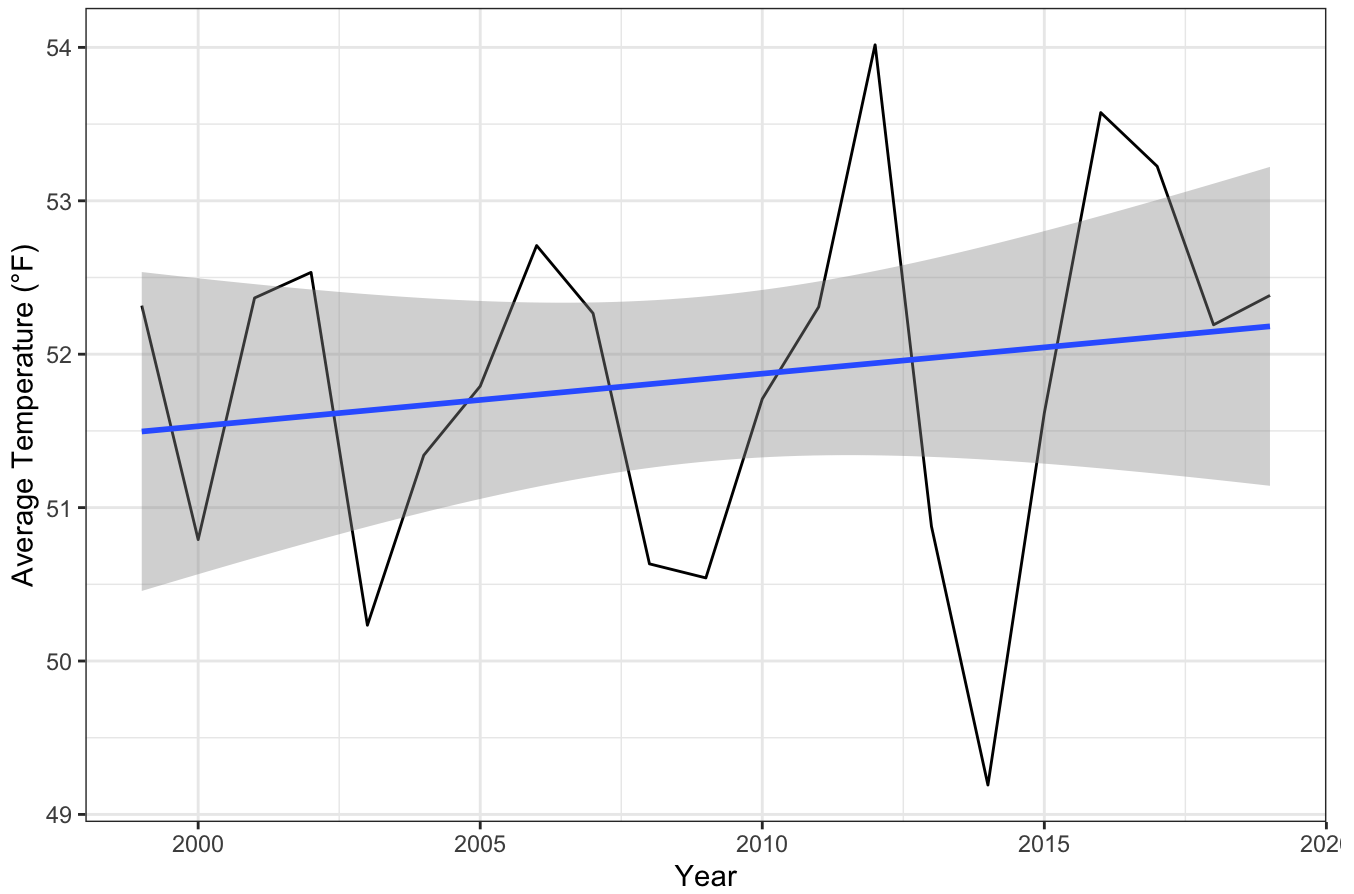
Midwest Suffers From Highest PM Concentrations

Fine Particulate Matter Concentration by State in 2015

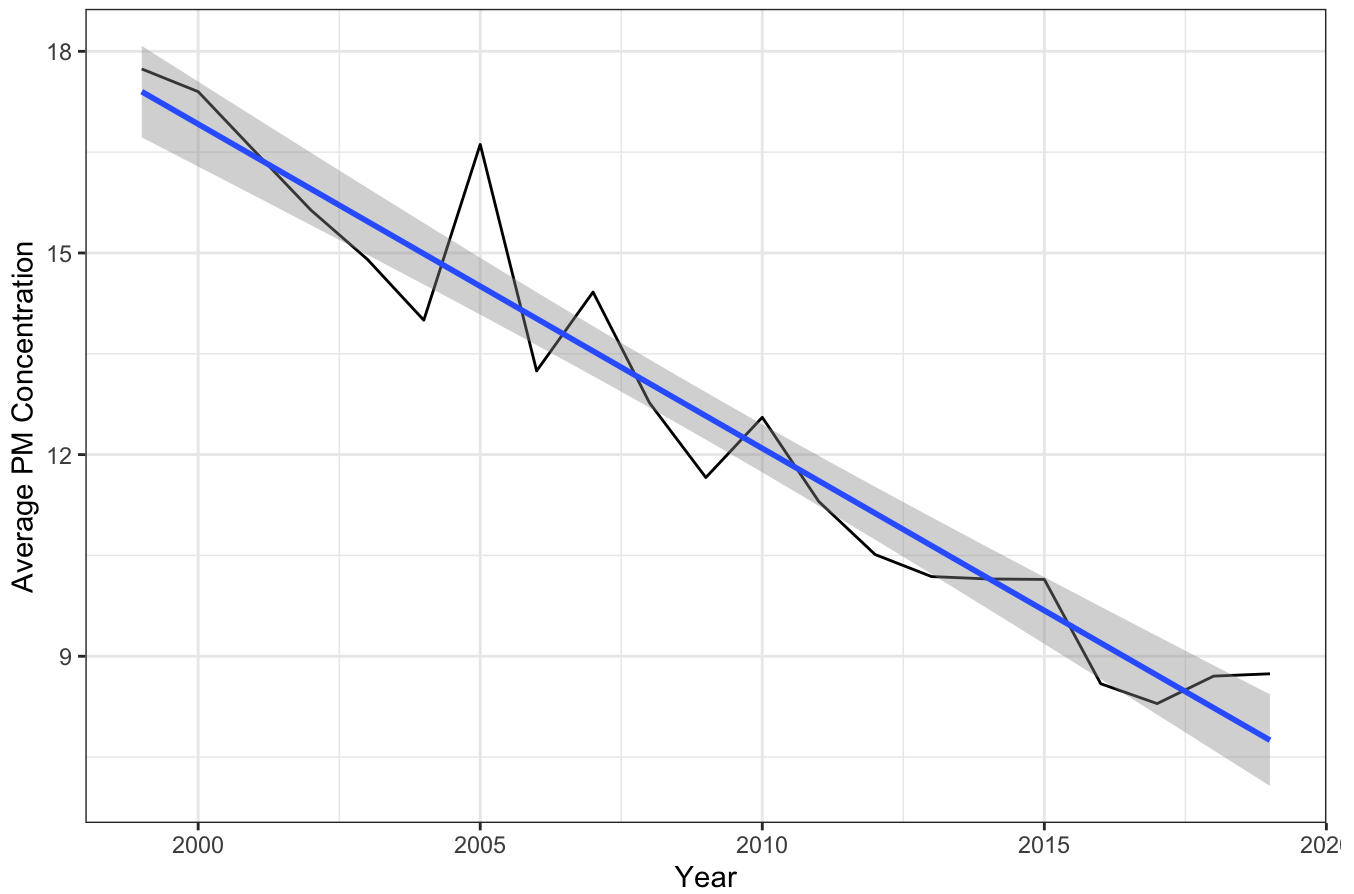


Over the whole nation, the concentration of fine particulate matter is going down. This didn't fit with my expected, so I wanted to pick out one state with a high pm concentration and California because it has a large forest and is somewhat liberal. I chose Ohio.

Ohio Temperatures Slightly Rising

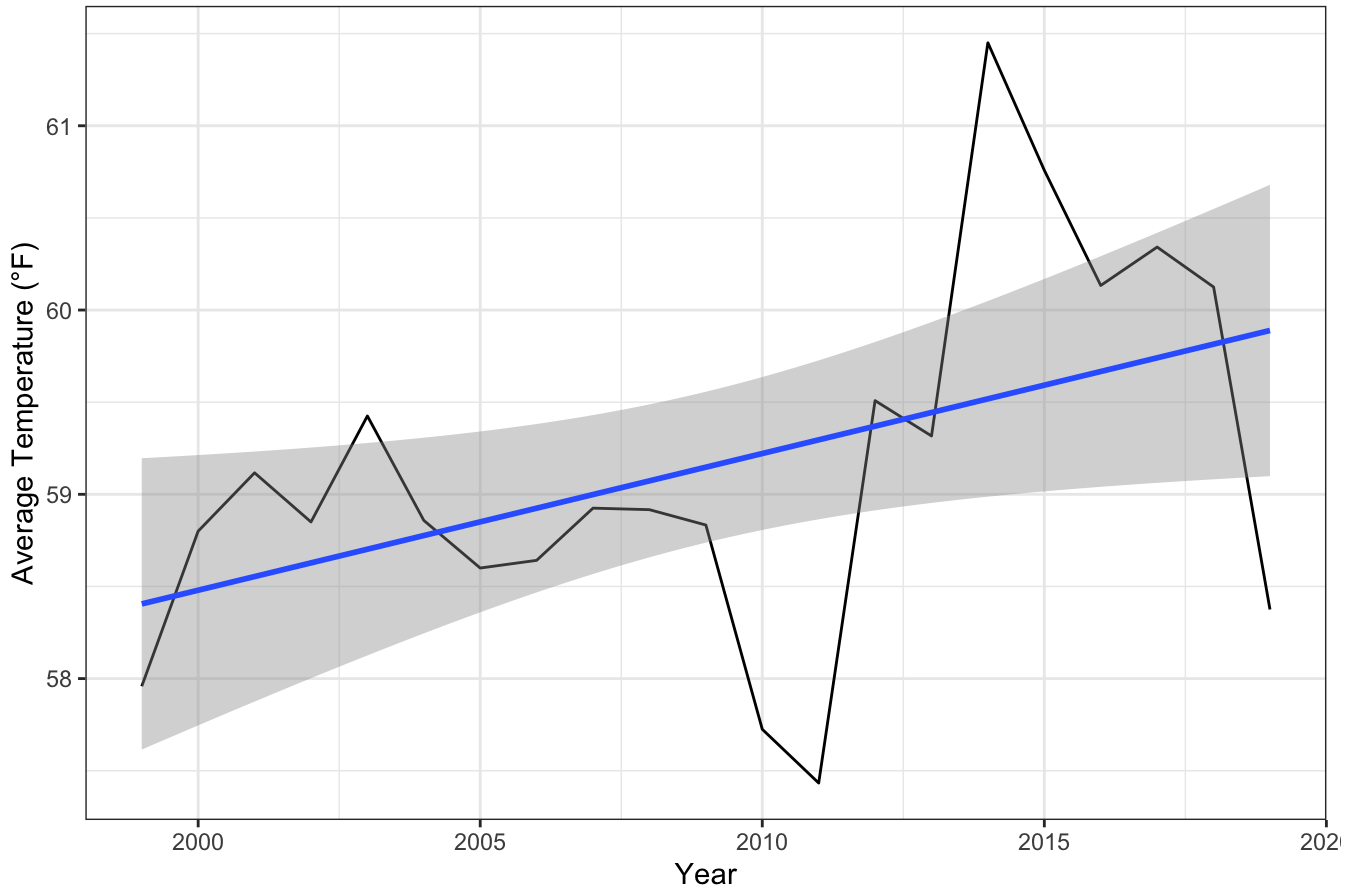


Ohio Particulate Matter Sharply Decreasing

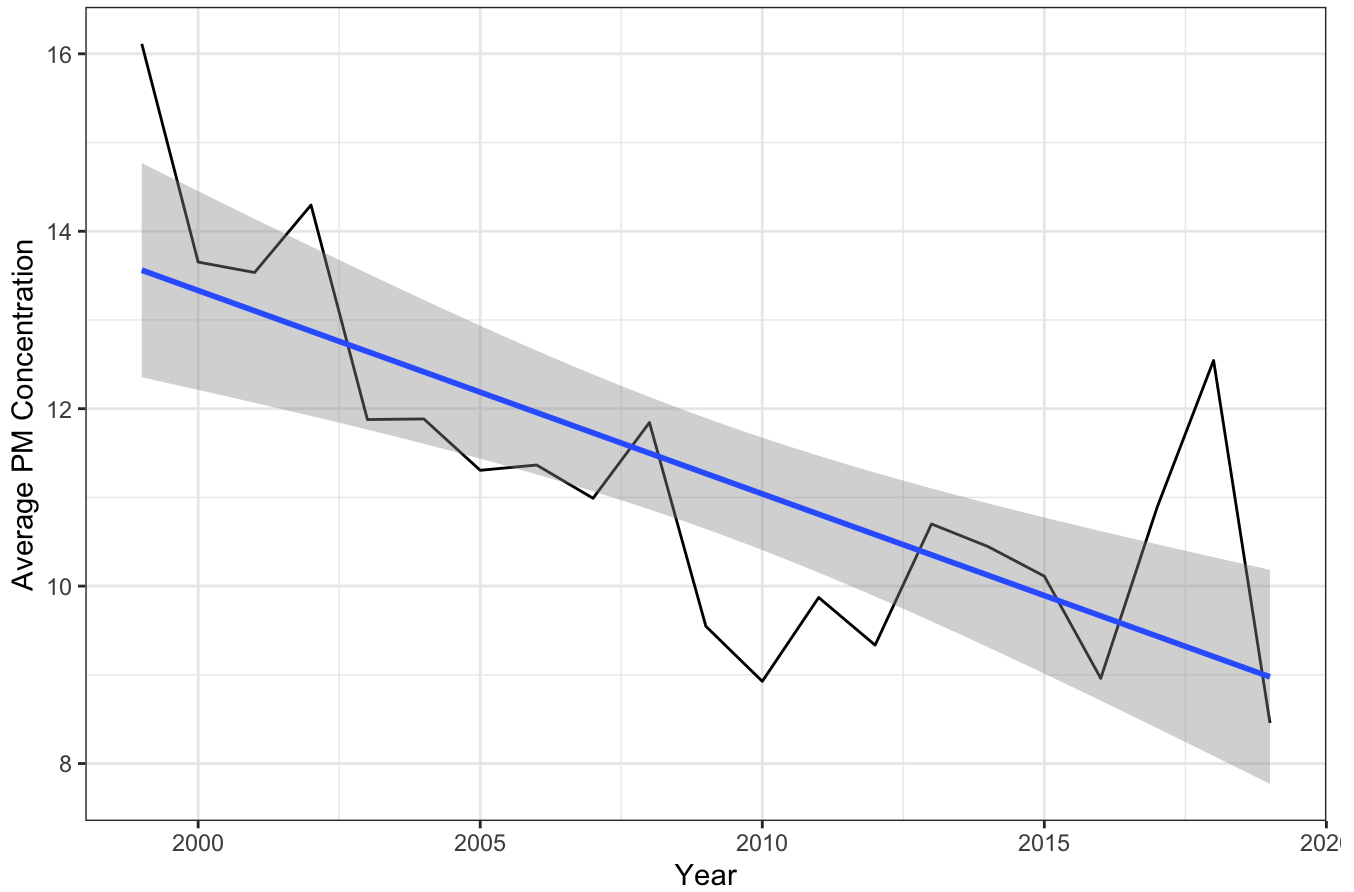


Ohio seems to show the same correlation that the national data showed, so now I'm moving to California for another instance.

California Average Temperatures on The Rise



Fine Particulate Matter Decreasing in California

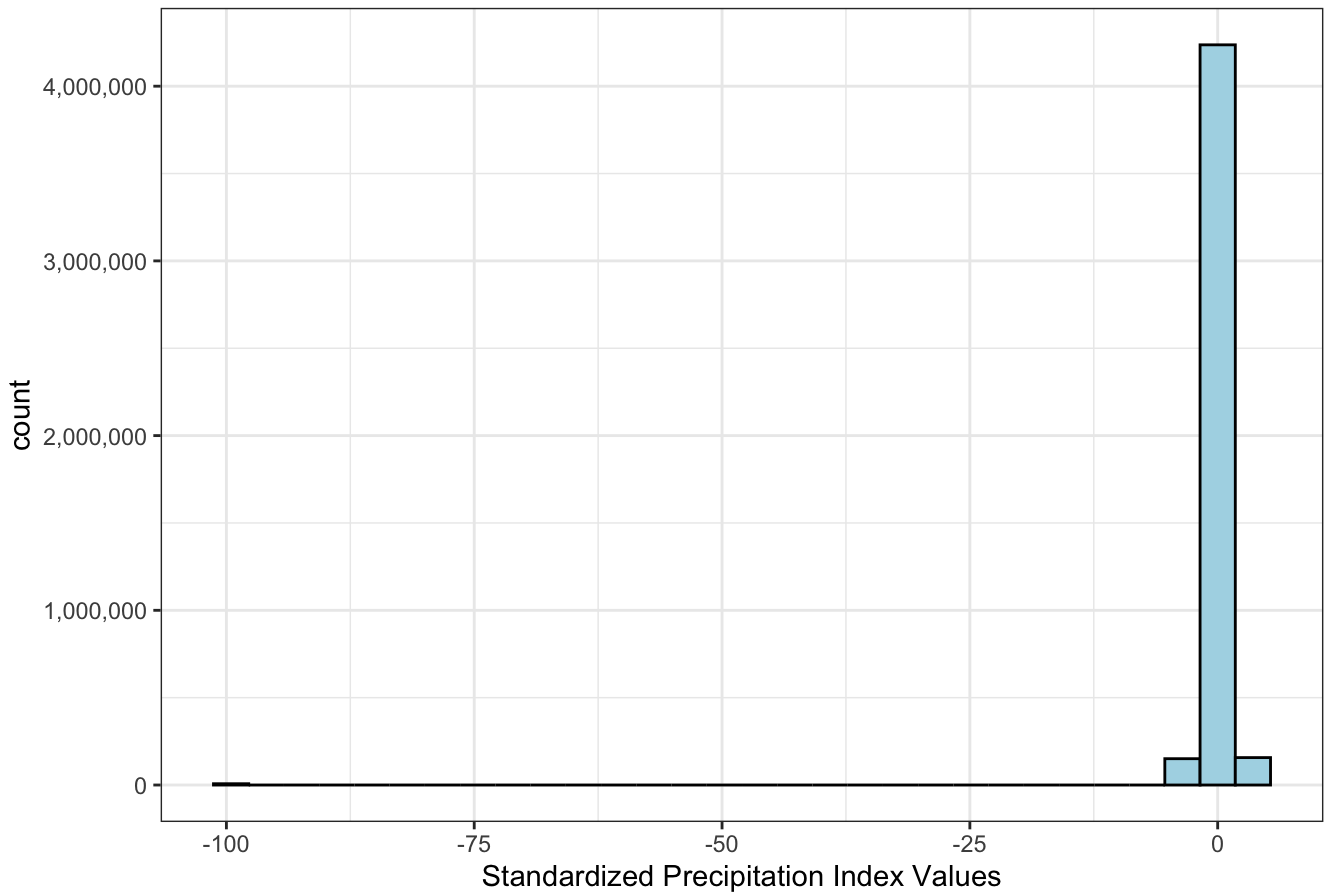


Since all the data seems to corroborate that particulate matter concentration is decreasing over time, I can't confirm it as a cause of global warming. They could have a negative correlation, or not be correlated at all.

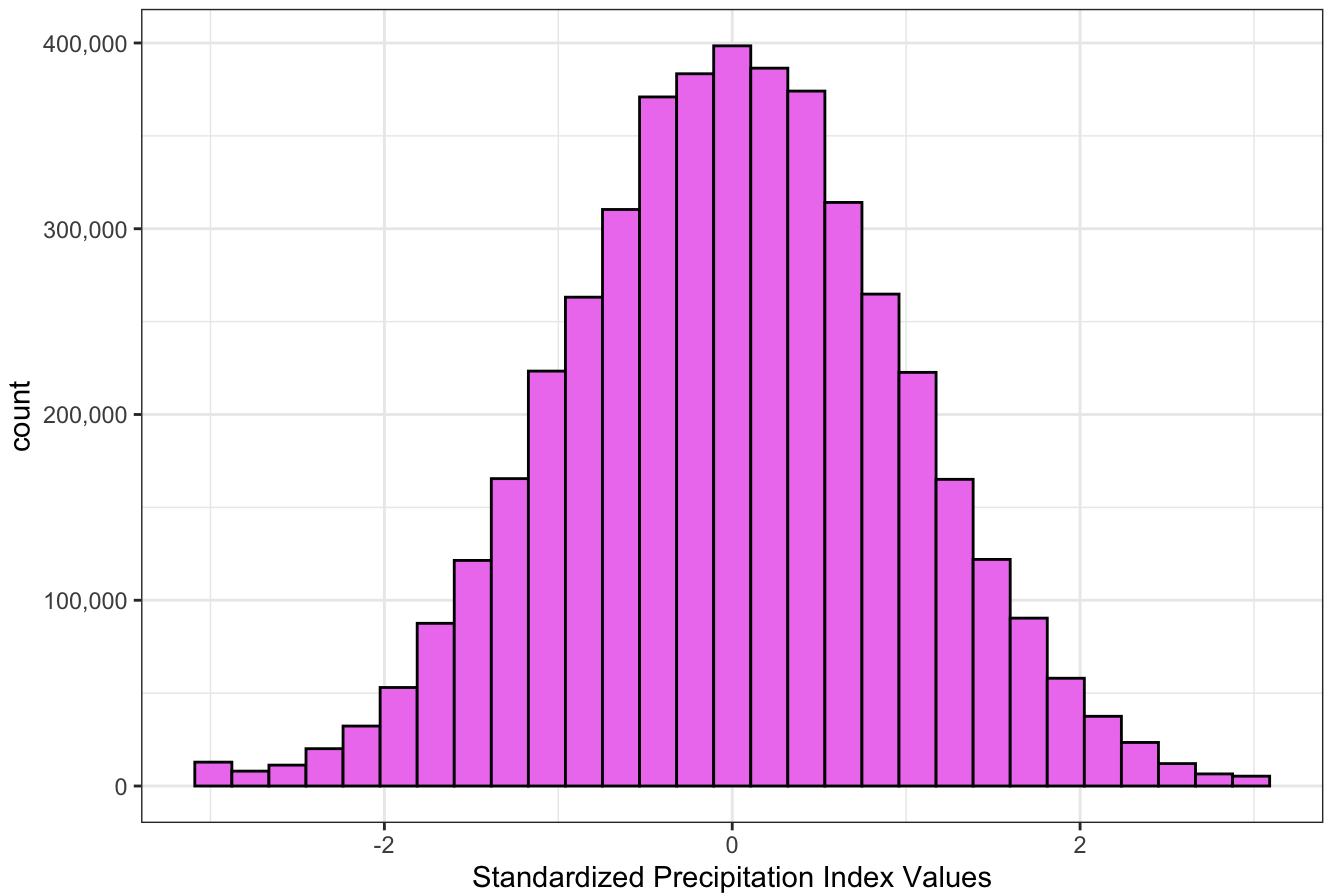
Are changing temperatures correlated with changing precipitation?

I didn't have an expected outcome for this one since I wasn't sure how higher temperatures would impact the water cycle. Right away, I noticed something weird with the data set. The standardized precipitation index measures the difference between the value and the average. Most of the values were between 3 and negative 3, but a notable amount were around negative 100. I decided to take them out since they were so extreme, and the distribution normalized.

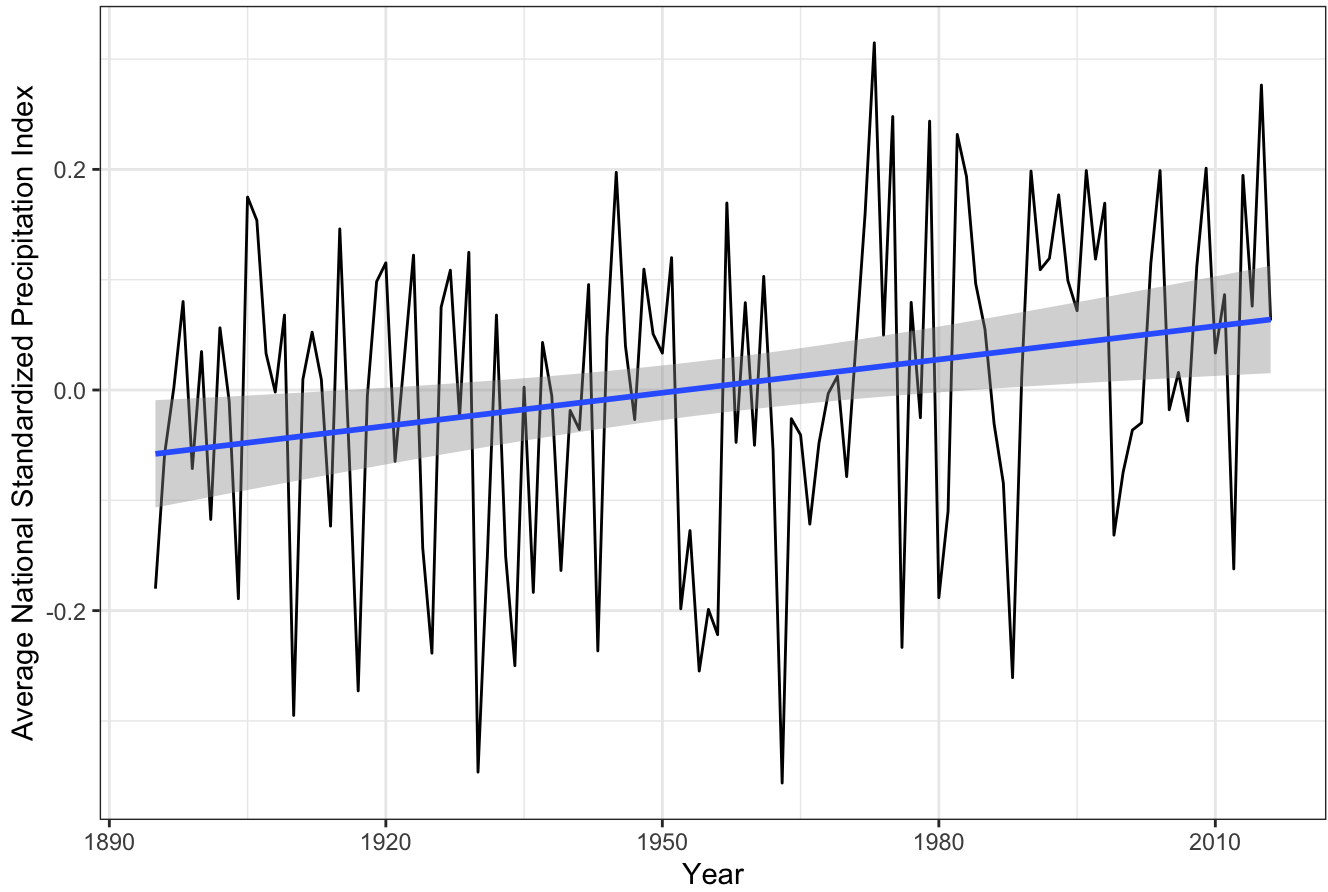
Distribution of SPI values



New Distribution of SPI values

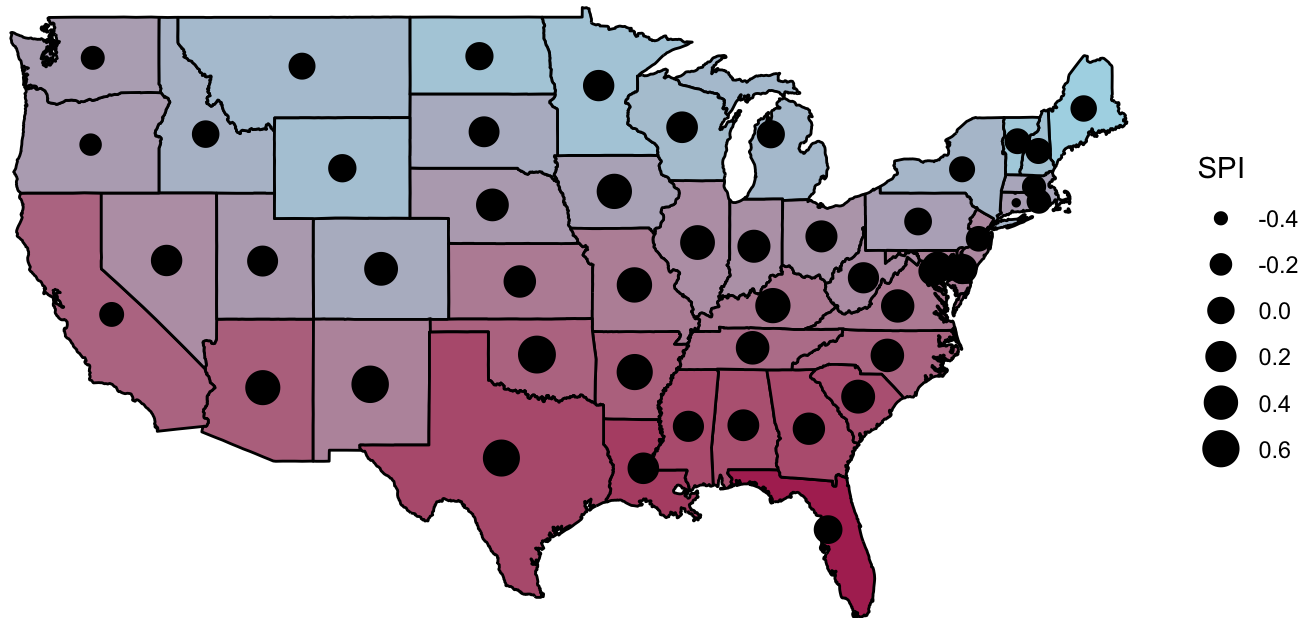


Precipitation Significantly Increasing Over the Years



This final plot appears to show a correlation between temperatures rising and precipitation increasing, but I wanted to see if that was true regionally as well.

Average Temperature and Standardized Precipitation Index in 2015



This graph doesn't seem to show any strong correlations between precipitation levels and temperature, but it sure is pretty.

Conclusions:

I set out to answer 3 questions about climate change's correlation with other variables. First, I investigated if rising temperatures were correlated with percentages of death due to pneumonia and influenza, and found that while there was a small correlation, more investigation was needed to support the theory. Next, I investigated if rising temperatures were correlated with an increase in airborne fine particulate matter, since air pollution is supposed to contribute to climate change. However, we found that if temperatures and particulate matter have any correlation, is a small negative correlation. The third thing I investigated was if rising temperatures were correlated with precipitation. Both temperatures and precipitation are on the rise since 1895, implying a positive correlation.