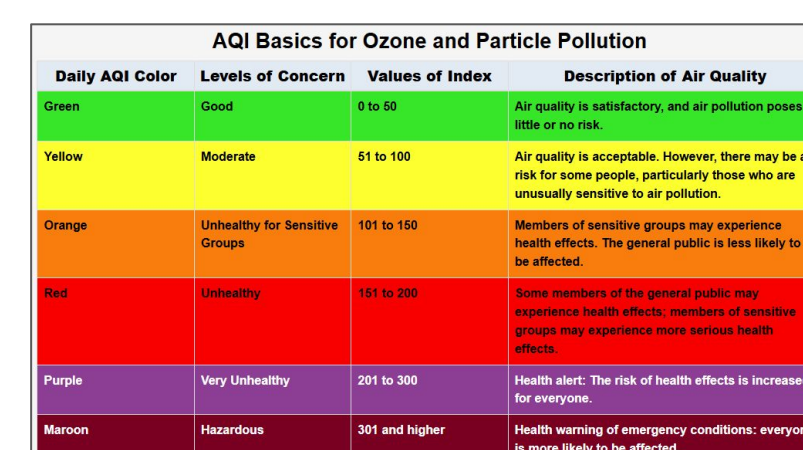


## Introduction

**Question:** To what extent are state and region level changes in air quality from 2010 to 2020 associated with changes in cardiovascular mortality rates (CVD), and how does the strength of the association vary geographically?

- AQI (Air Quality Index) summarizes many pollutant concentrations into one measurement which indicates the level of air quality. The higher the number, the worse the air quality is.

**Figure 1.** AQI values and corresponding description of air quality and risk. From the EPA. (AirNow)



### Hypotheses:

- High AQI will be positively correlated with high CVD mortality, with the strength varying geographically. The correlation will be strongest in the South.
- A larger improvement in air quality from 2010 to 2020 will show a larger reduction in CVD mortality.

## Methods

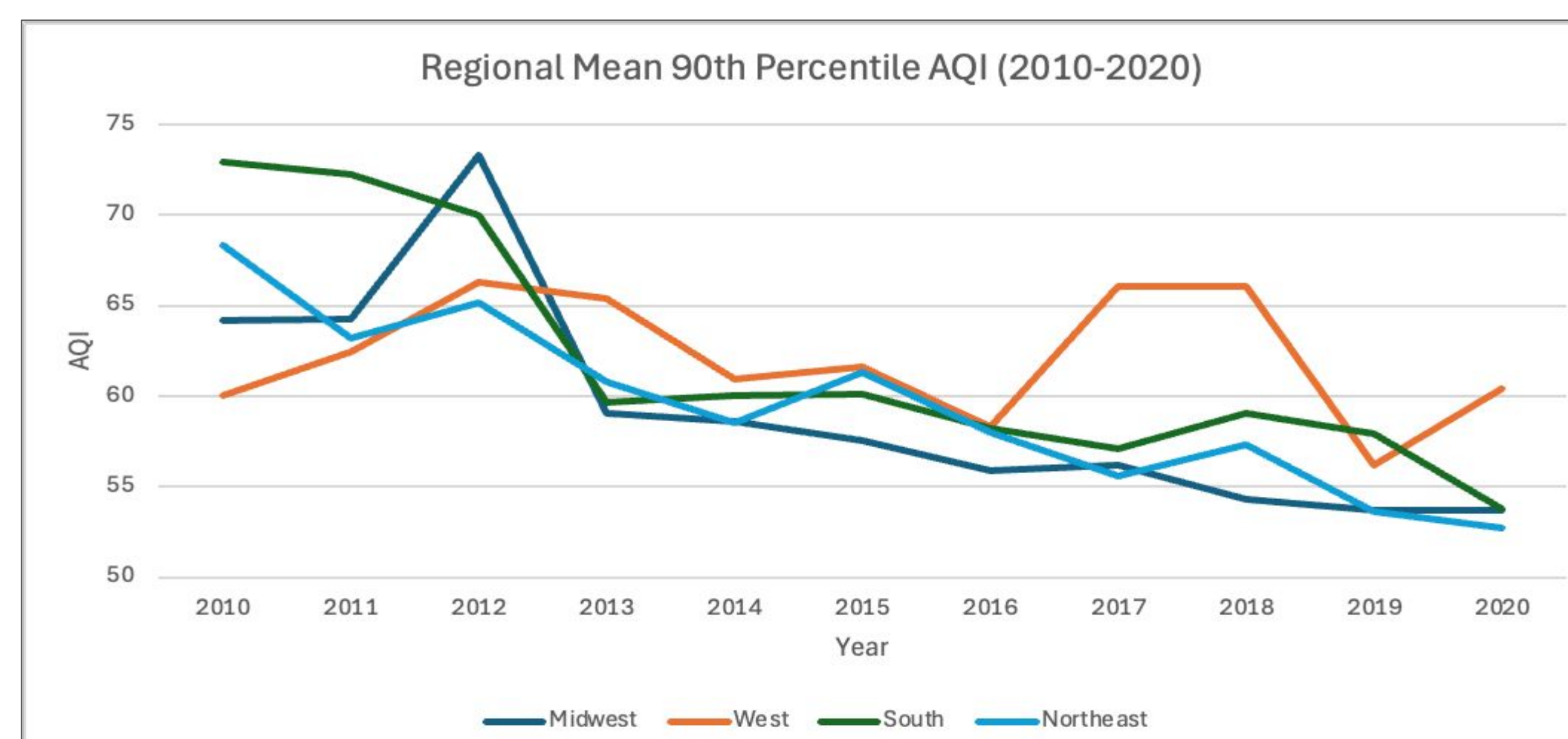
### Data Sources:

- NVSS (National Vital Statistics System) “Cardiovascular Disease Death Rates, Trends, and Excess Death Rates Among US Adults (35+) by County and Age Group 2010-2020”
- EPA Annual AQI by County, compiled for 2010-2020

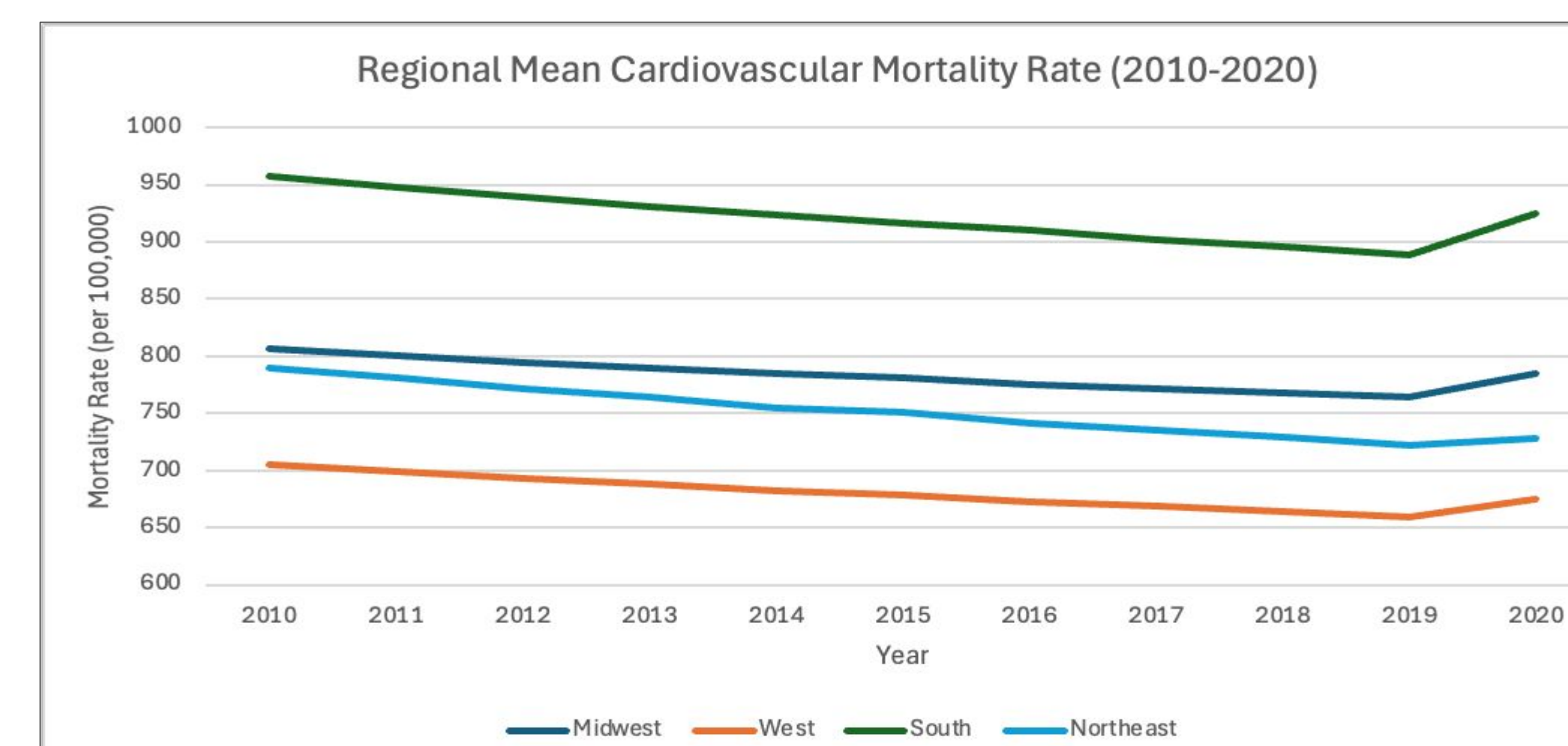
### Data Analysis (using Excel):

- Combined datasets and removed columns and rows with missing or unused values. Kept state, county, year, mortality rate per 100,000, and 90th Percentile AQI.
- Aggregated data to state and region level using Census Bureau regional classifications through averaging values.
- Calculated change (2020-2010 values), and Pearson correlation, and made visualizations.

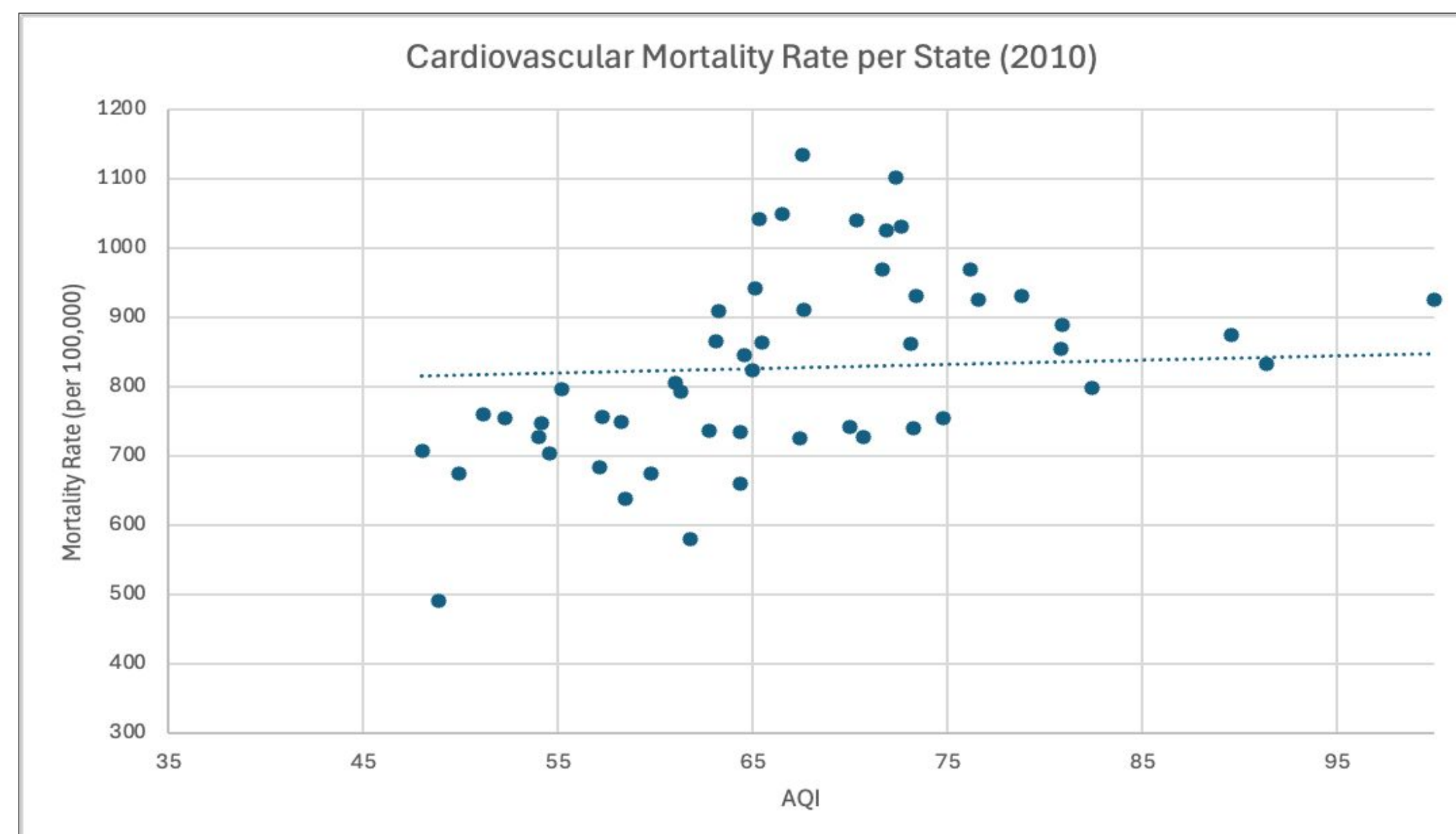
## Results



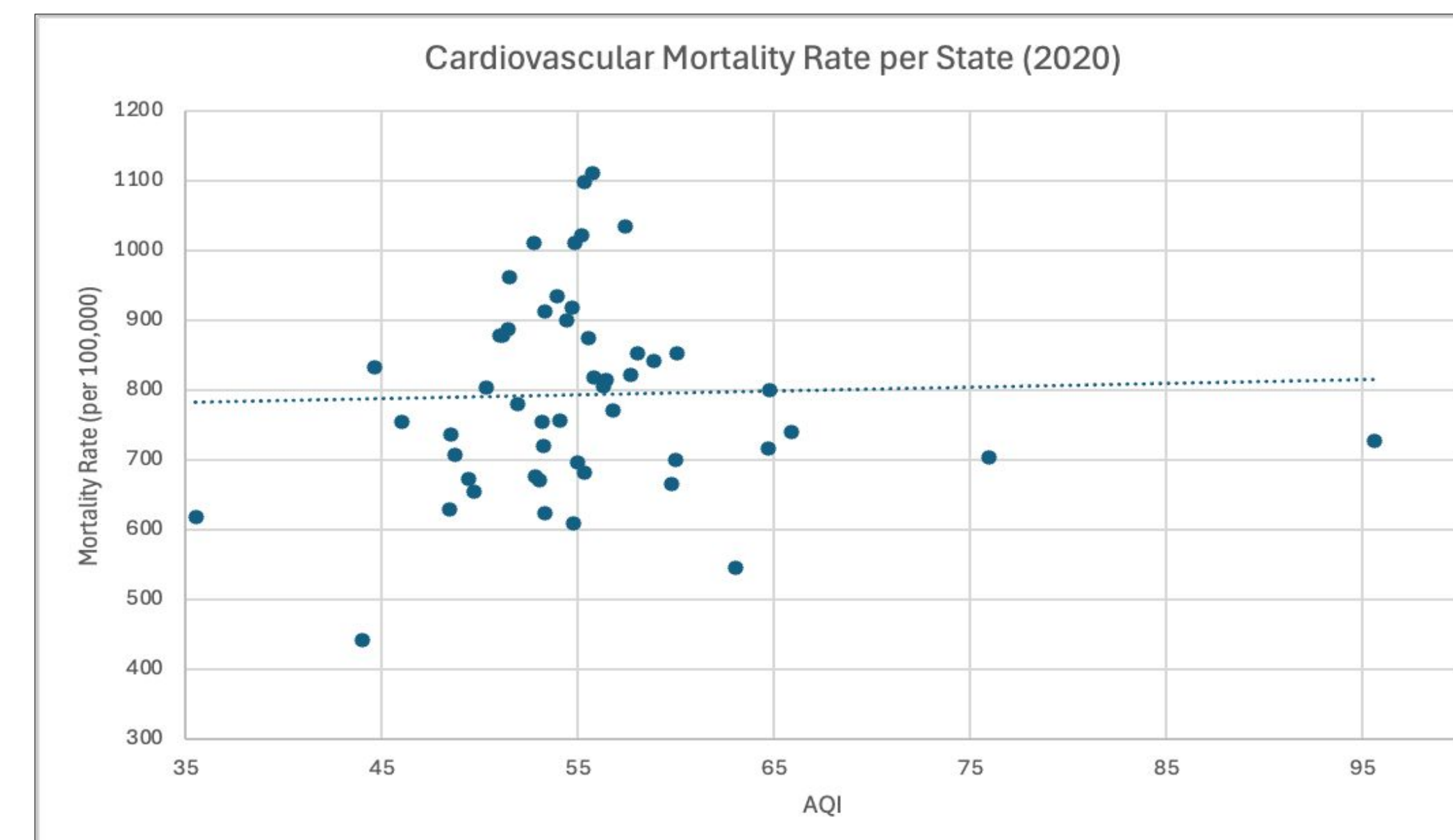
**Figure 2.** Regional trends in 90th Percentile AQI (2010-2020). Most regions show gradual improvement in air quality over time, with the largest decreases in AQI in the South and Northeast. The West shows minimal net change.



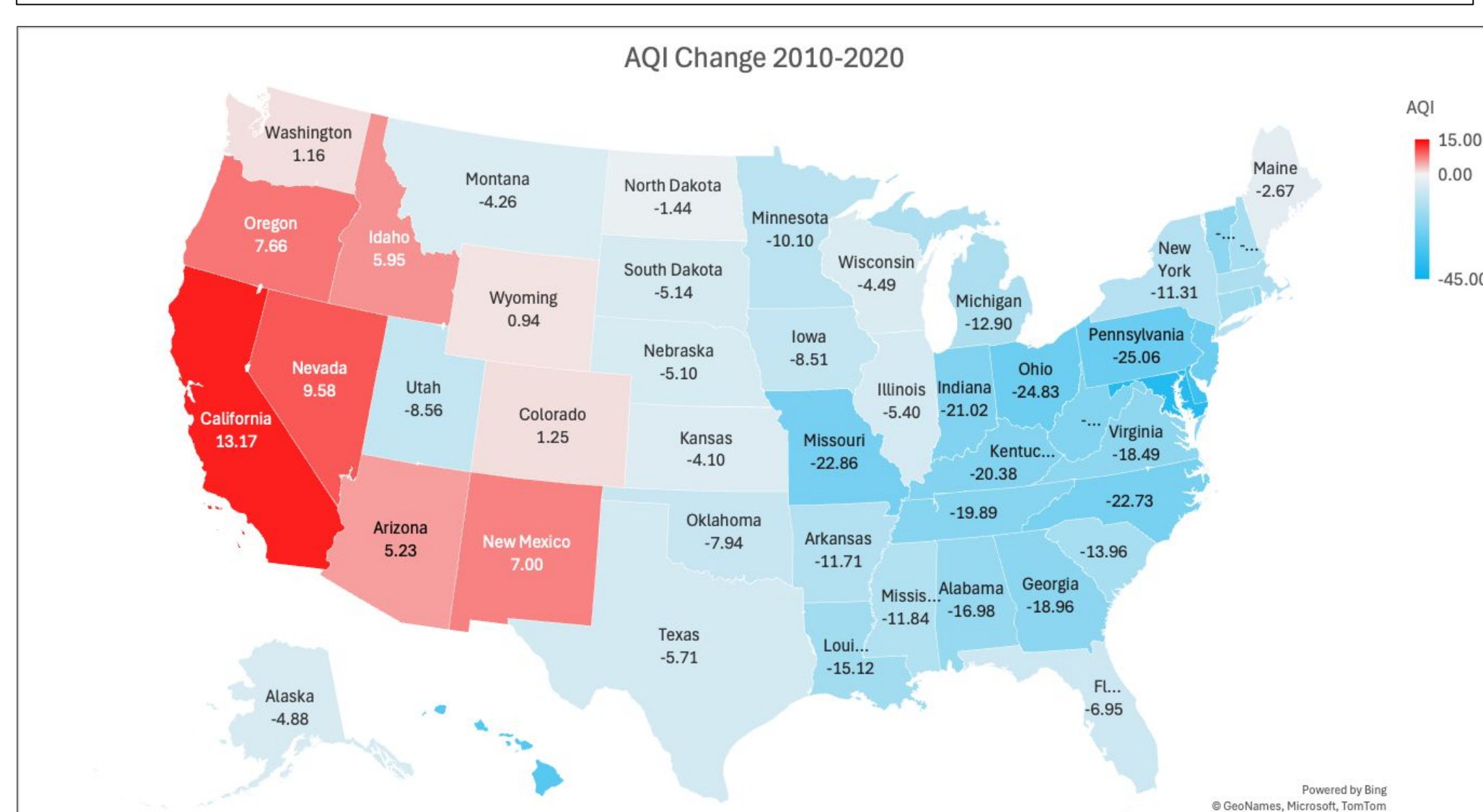
**Figure 3.** Regional CVD mortality rate (per 100,000 adults aged 35-64) from 2010 to 2020. All regions experienced steady declines in cardiovascular mortality with an increase in 2019, with the steepest decrease in the Northeast.



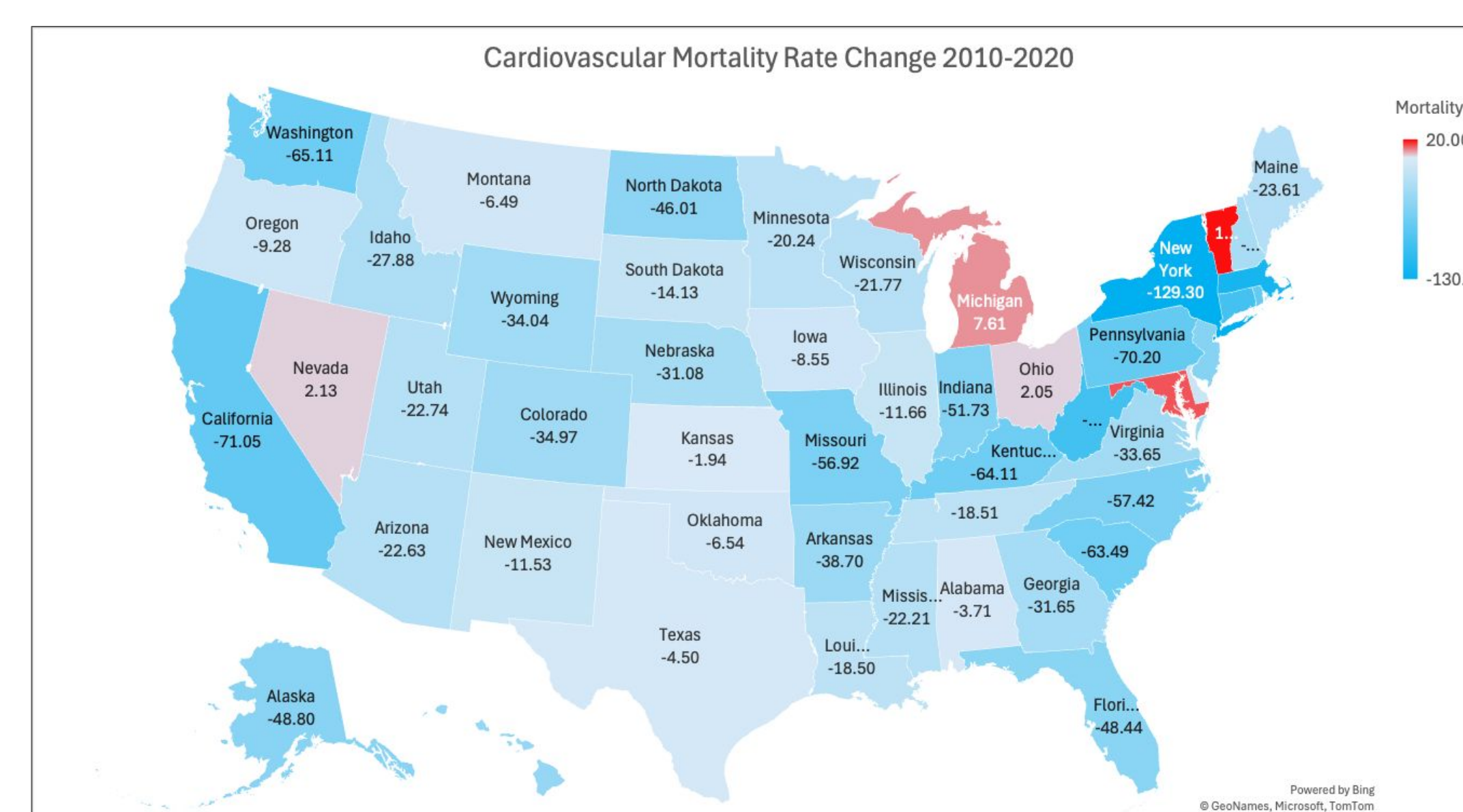
**Figure 4.** Scatterplot of state-level AQI vs. cardiovascular mortality rate in 2010. There is a slight positive trend visible indicating a weak association between high AQI and high mortality.



**Figure 5.** Scatterplot of state-level AQI vs. cardiovascular mortality rate in 2020. The trend remains positive but weak with variation across states.

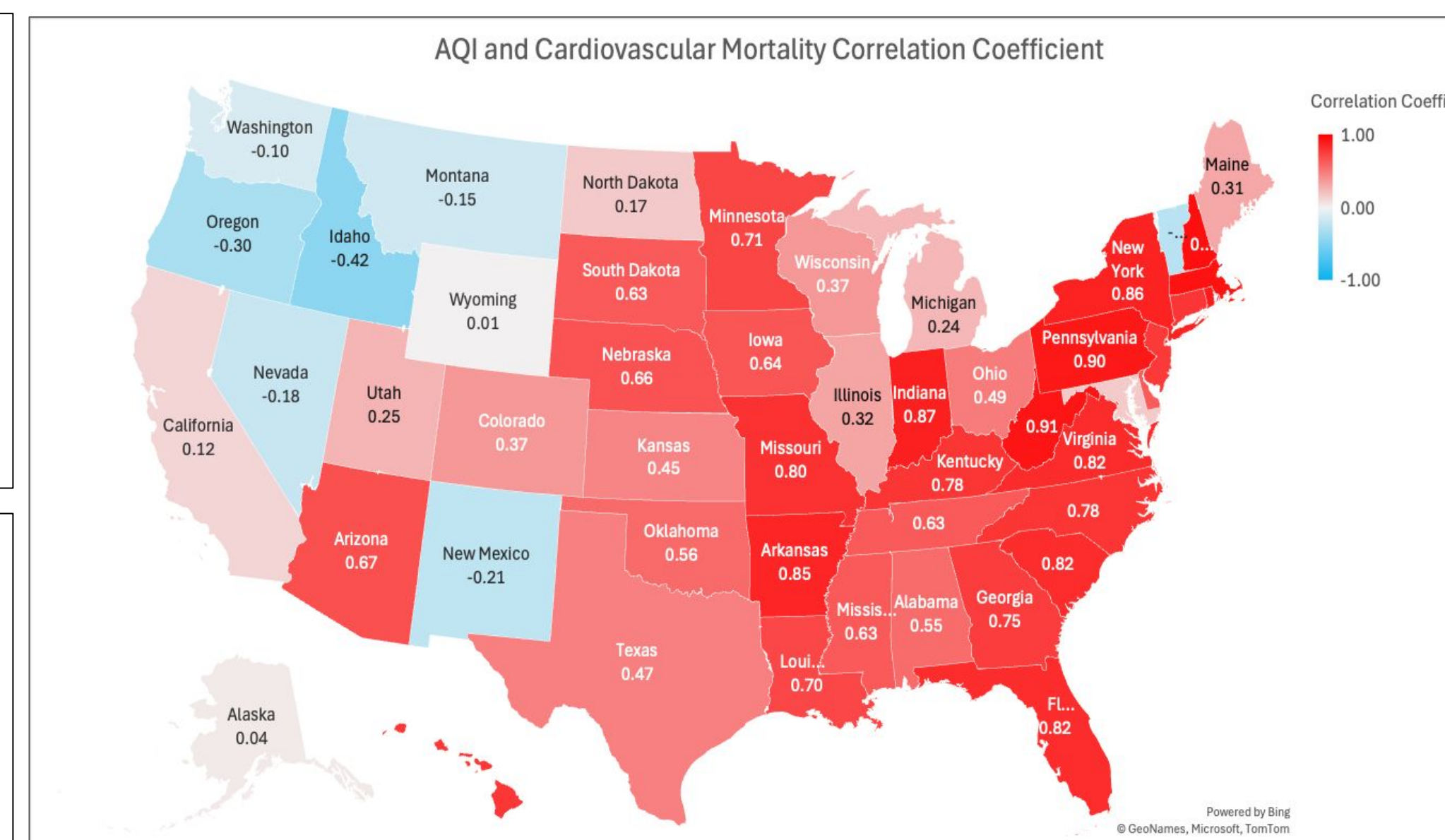


**Figure 6 (above).** Blue shades represent improvements in air quality (decrease in AQI), while red indicates worse air quality. Most states show improvements in air quality except the West.



**Figure 7 (above).** Blue shades represent a decrease in mortality, while red indicates an increase. Most states show a decrease in CVD mortality rates from 2010 to 2020. Larger reductions occur in the Northeast.

- Regional Correlation Strength**
- Midwest: 0.53 (moderate)
  - West: 0.07 (weak)
  - South: 0.68 (strong)
  - Northeast: 0.68 (strong)



**Figure 8 (left).** Red shades indicate a stronger positive correlation while blue indicates a negative correlation between AQI and mortality rate.

## Conclusion

### Overall Trends:

- Air quality generally improved in most states and regions 2010-2020 except the West. CVD mortality declined nationally.

### Association Between AQI & Mortality:

- There is generally a positive relationship between poorer air quality and higher CVD mortality but the strength of the association varies geographically.
- The correlation between AQI and CVD mortality was strongest in the South and Northeast, suggesting that poorer air quality might be more closely tied to cardiovascular risk in these regions.
- Similarly, larger improvements in AQI in those regions also had the larger mortality declines.
- The West shows a very weak correlation indicating little to no association between high AQI and high CVD mortality. One factor may be wildfire pollution which is more prominent in the West.

### State-Level Variation:

- On the state level, there is a slight positive association between AQI and CVD mortality but with significant variability.

### Interpretation & Implications:

- Air pollution does seem to contribute to cardiovascular risk which supports existing evidence. Its influence is not uniform across the U.S however.
- Given the wide variation geographically, there are likely many other factors at play for CVD risk especially in the West.
- Environmental policy, pollution regulation and public health initiatives remain important for reducing CVD risk.

## References

Air Quality System. “Download Files | AirData | US EPA.” n.d. [https://aqs.epa.gov/aqsweb/airdata/download\\_files.html#Annual](https://aqs.epa.gov/aqsweb/airdata/download_files.html#Annual).  
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