SARAH KILPATRICK | DATA 512

Estimating Connections
Between Wildfire Smoke Impact
+
Respiratory-Related Mortality
in Fresno, California

Data provided by:
- United States Geological Survey
- Environmental Protection Agency
- California Health and Human Services

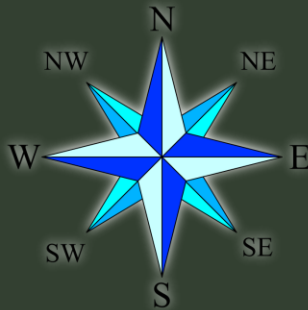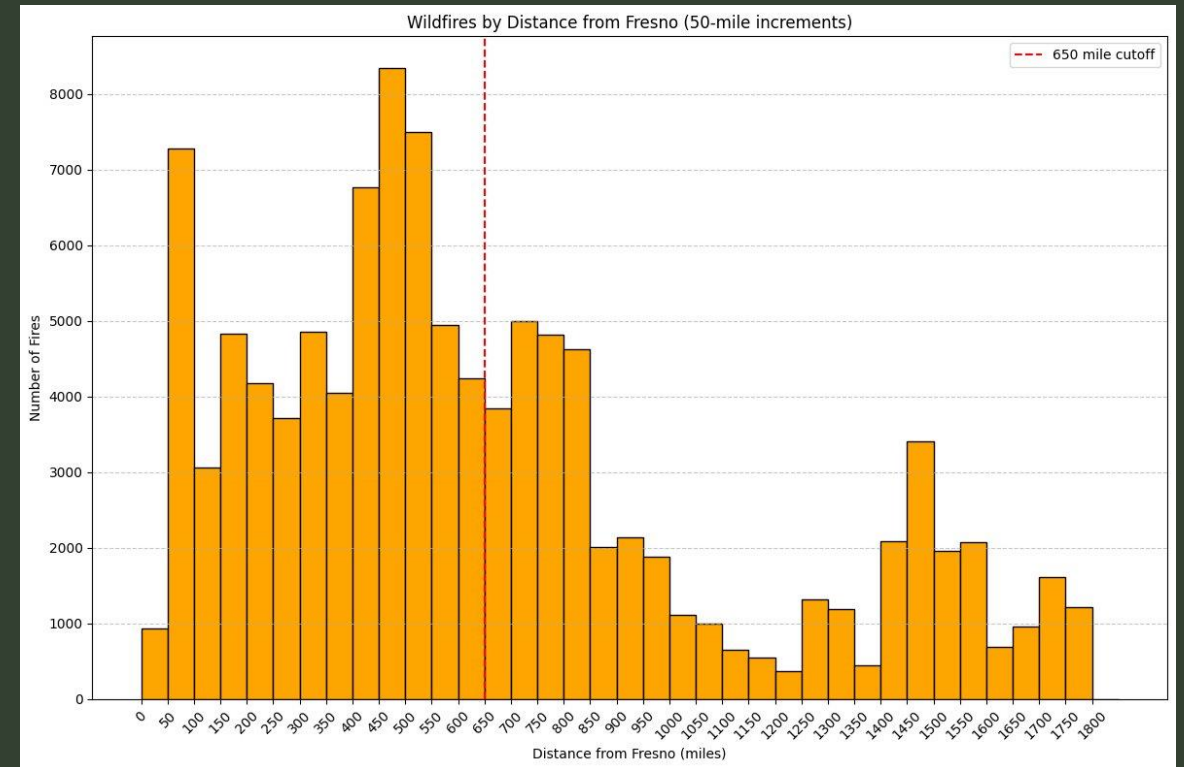# Fresno: Medium-sized city in California Central Valley

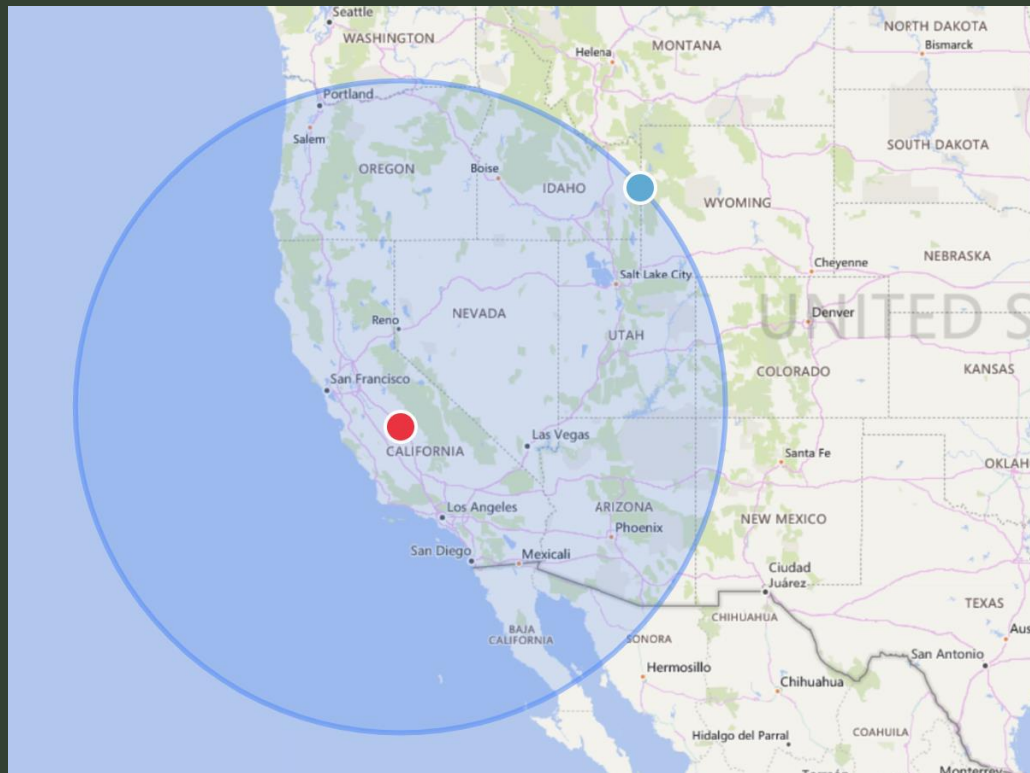- **Flat, agricultural corridor**
  - **North-west prevailing winds**

- **Smoke Estimate:**

$$\frac{\text{GIS\_Acres} \times \text{Cardinal Weight}}{(\text{Distance to Fresno} + 1)^2 / 5}$$

Not at the Doorstep, but Definitely in the Front Yard

650-mile radius around Fresno, CA

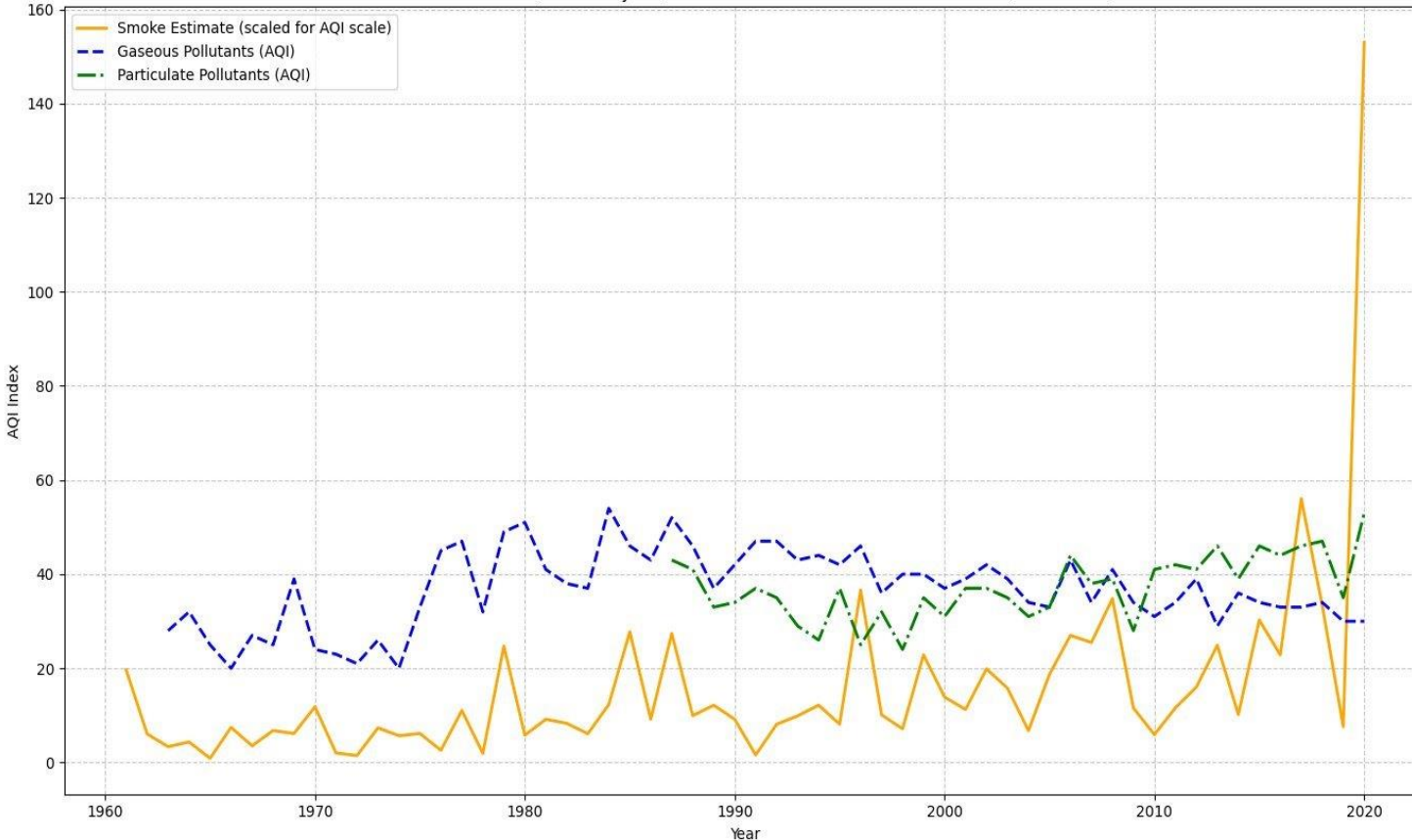**Majority of fires within radius**

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Smoke Estimate Compared to AQI Data

- ## Preliminary Estimate, Averaged Annually
  - Orange – Smoke Estimate
  - Blue – Gaseous Pollutants
  - Green – Particulate Pollutants

Smoke Estimates (Divided by 50) vs. Gaseous and Particulate Pollutants (1961-2020)
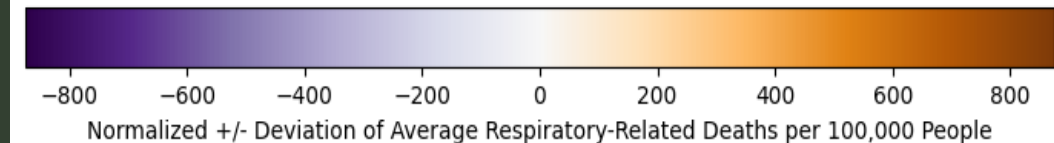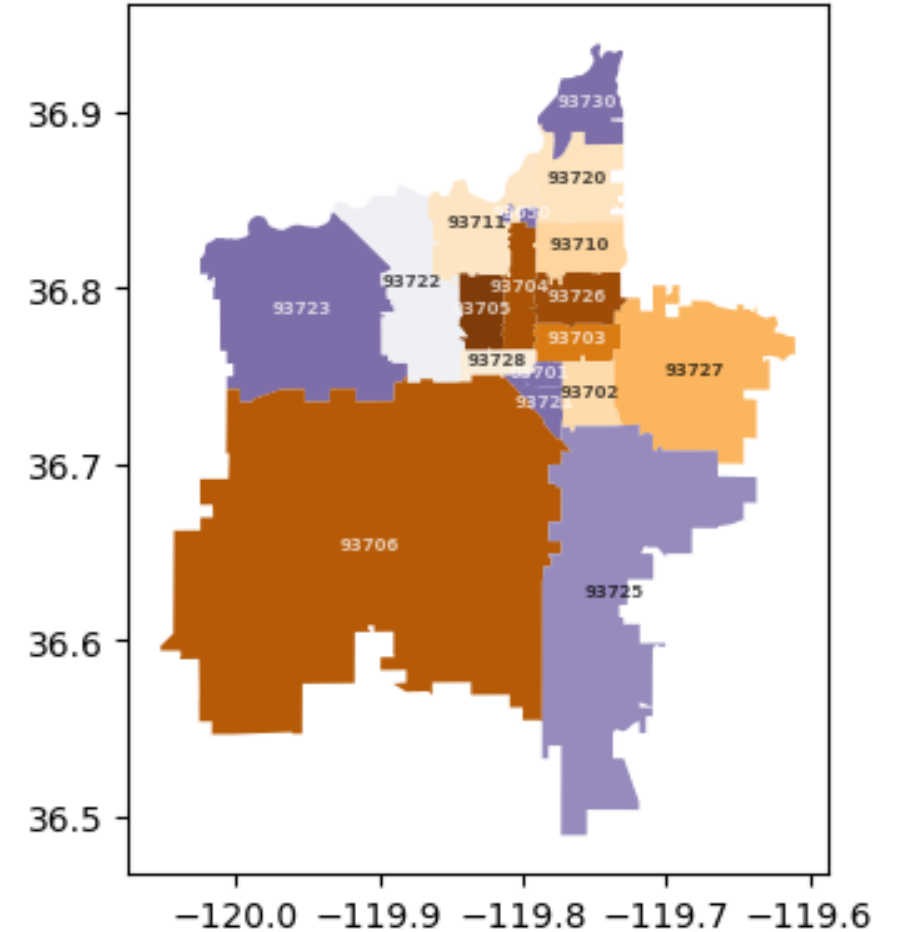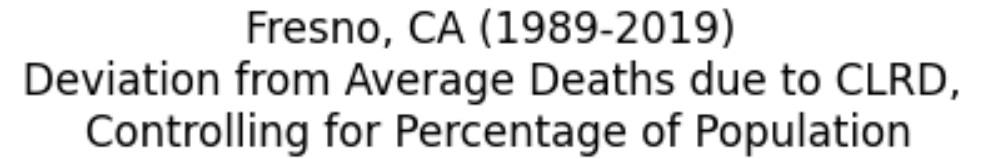
Pollutant Type	Pearson Correlation	Kendall Tau
Gaseous	0.31	0.23
Particulate	0.26	0.03

Low positive association between pollutants and preliminary smoke estimate

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Who's All Here?

- **How To Read:**
  - ***Darkest Orange*** = +CLRD than avg.
  - ***Darkest Purple*** = -CLRD than avg.

- **Limitations:**
  - Controlling for income/occupation

- **Findings:**
  - 10/19 zip codes higher than average

Fresno, CA (1989-2019)
Deviation from Average Deaths due to CLRD,
Controlling for Percentage of Population

Normalized +/- Deviation of Average Respiratory-Related Deaths per 100,000 People

Fresno's Trend in Chronic Lower Respiratory Deaths (CLRD)

Total Deaths by Year (Chronic Lower Respiratory Diseases)
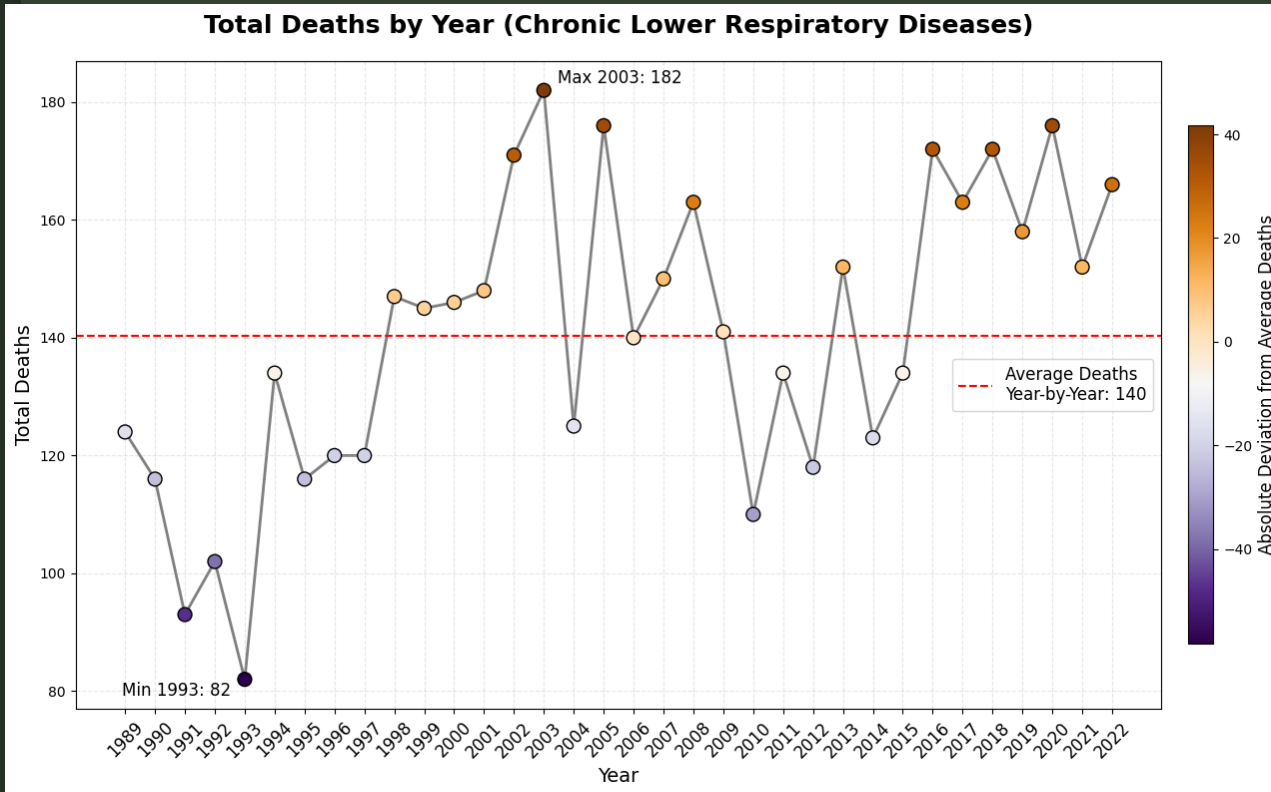
But wait, chronic means LONG TERM, not ACUTE!

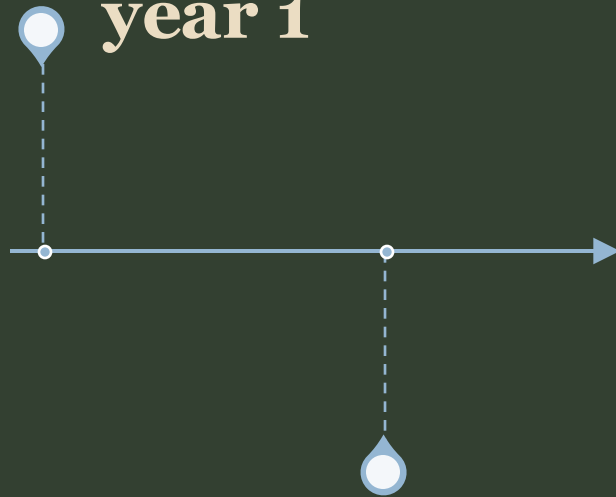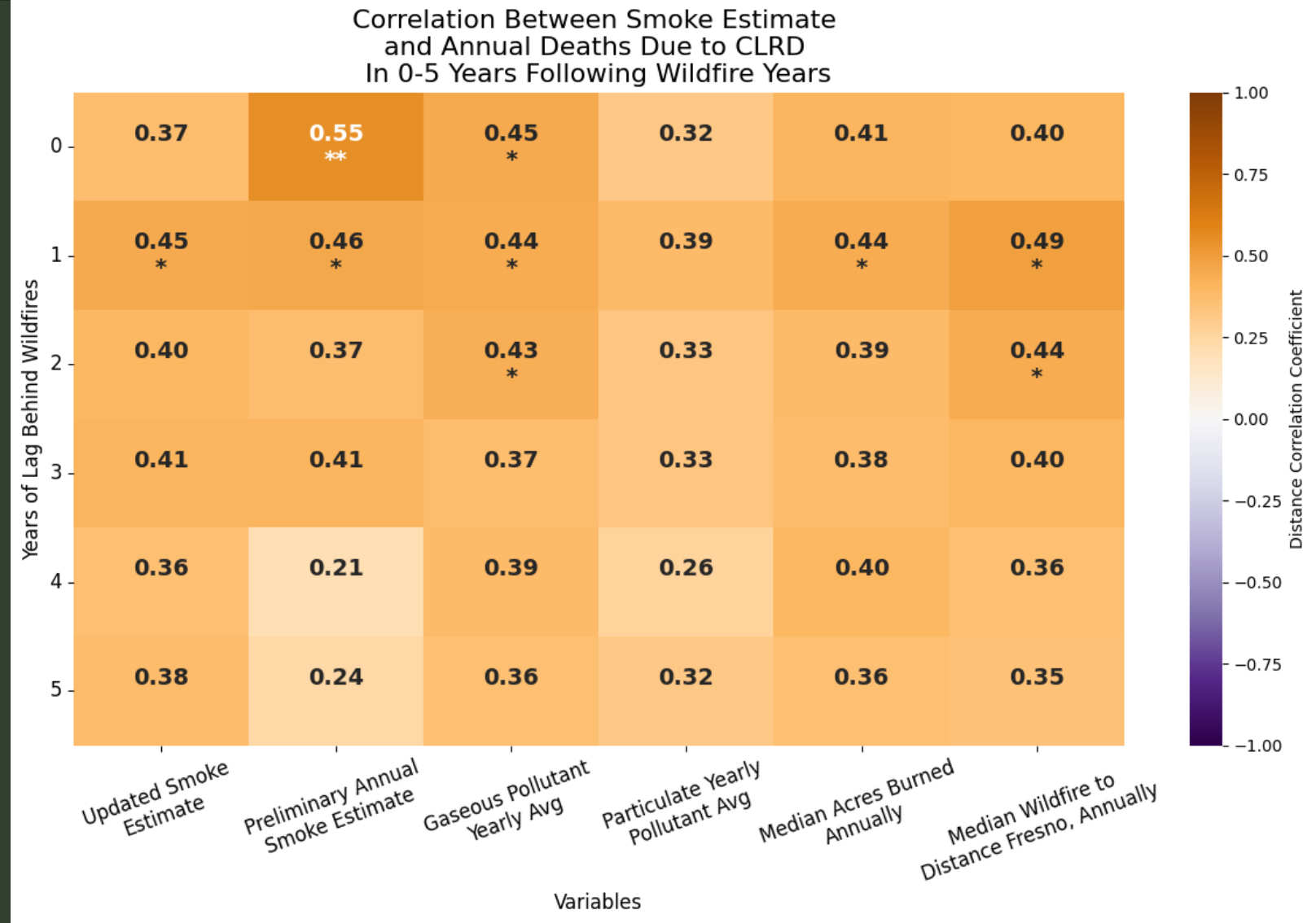Could there be a lag in high-smoke years and high-mortality years?

High smoke prevalence in year 1

High CLRD-caused mortality in year 1+lag

Correlation Between Smoke Estimate
and Annual Deaths Due to CLRD
In 0-5 Years Following Wildfire Years

Years of Lag Behind Wildfires	Updated Smoke Estimate	Preliminary Annual Smoke Estimate	Gaseous Pollutant Yearly Avg	Particulate Yearly Pollutant Avg	Median Acres Burned Annually	Median Wildfire to Distance Fresno, Annually
0	0.37	0.55 **	0.45 *	0.32	0.41	0.40
1	0.45 *	0.46 *	0.44 *	0.39	0.44 *	0.49 *
2	0.40	0.37	0.43 *	0.33	0.39	0.44 *
3	0.41	0.41	0.37	0.33	0.38	0.40
4	0.36	0.21	0.39	0.26	0.40	0.36
5	0.38	0.24	0.36	0.32	0.36	0.35

Variables

Distance Correlation Coefficient

* = p-value < 0.05
** = p-value < 0.01

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Don't Blink!

Final Estimate	Preliminary Estimate
Annual Aggregate, medians	Annual aggregate, averages
Estimates Impact on CLRD Mortality	Estimates Smoke "Prevalence"?
Statistically significant	Not statistically significant
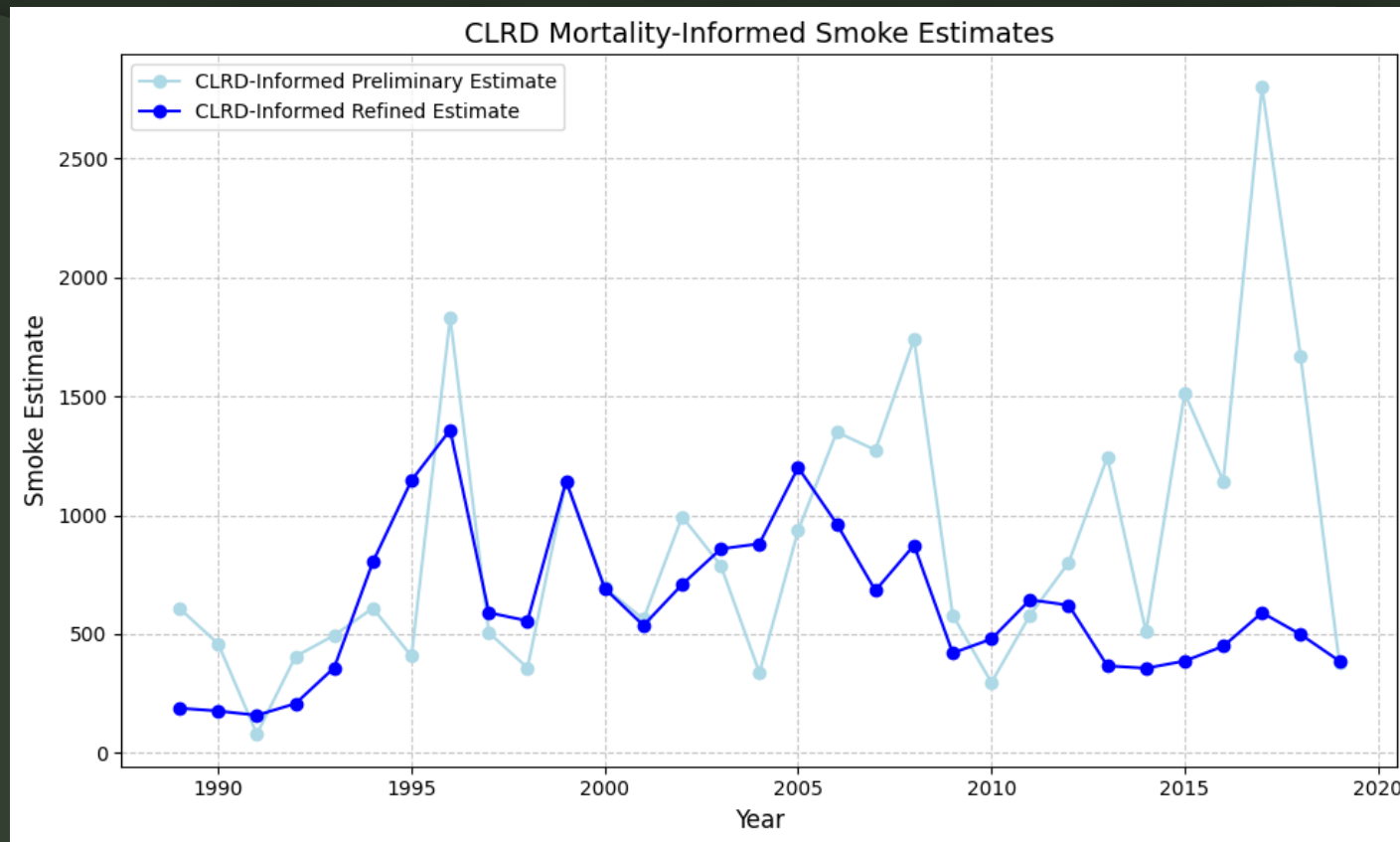
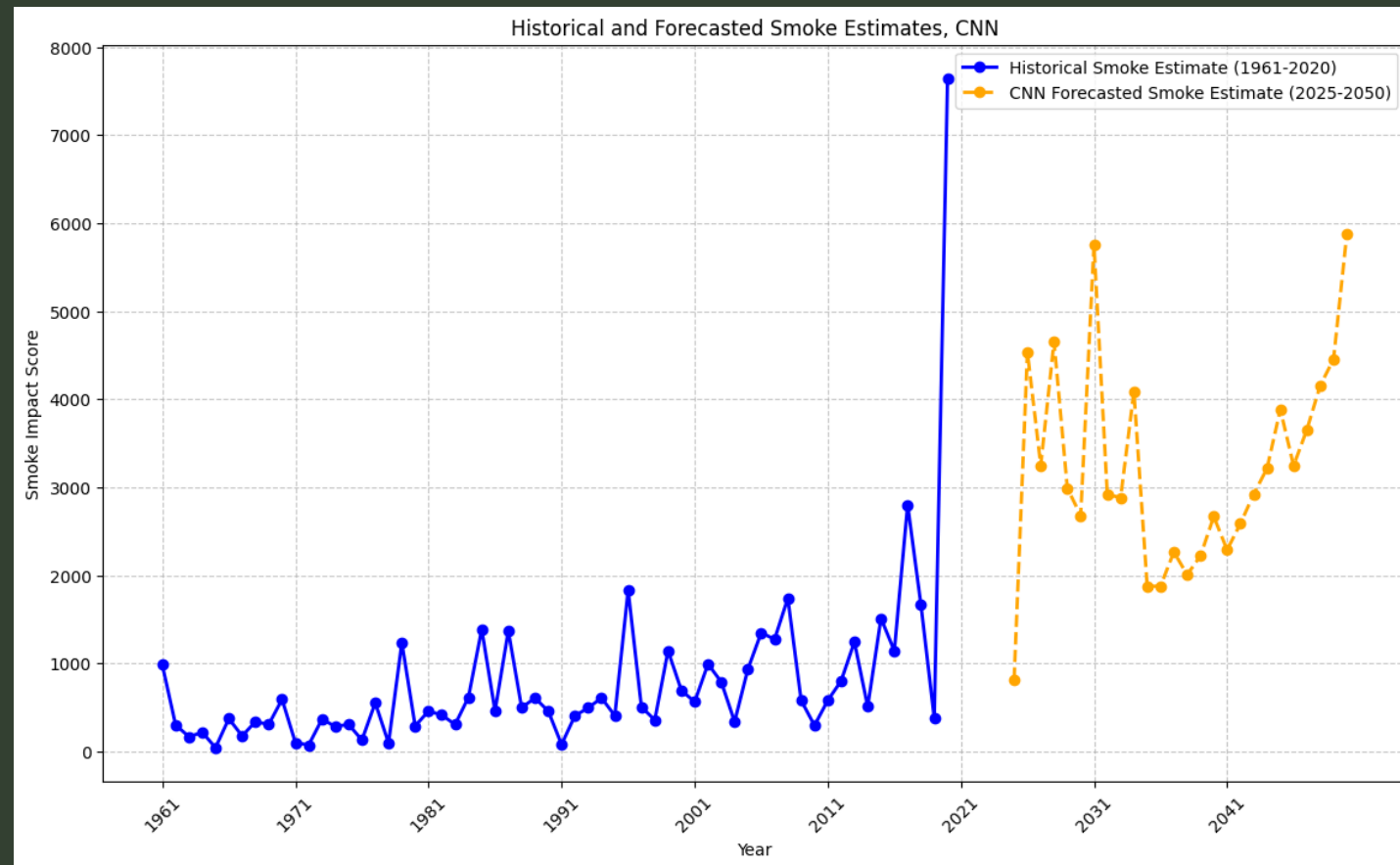

Final Smoke Estimate informed by linkages with mortality due to chronic, low-respiratory diseases (CLRD)

Forecasting for Fresno's Future

- Near-future: high smoke impact variability
- Far-future: increasing effects

Historical and Forecasted Smoke Estimates, CNN

Legend:
- Historical Smoke Estimate (1961-2020)
- CNN Forecasted Smoke Estimate (2025-2050)

Discussion

Stronger statistical signal for mortality 0–12 months after wildfire year in preliminary vs. refined estimates.

Limitations

Pollutants may travel above the atmospheric layer of prevailing winds.

Considerations

Promising links between mortality lag and wildfire smoke prevalence.