

# Long-term Trends in Fine Particulate Matter: Case Study of the Southeast Pennsylvania Region (2004-2022)

Jesse Zhong (NOAA), Shobha Kondragunta (NOAA/NESDIS/STAR), Amy K. Huff (NOAA/IMSG)

### Introduction

- Fine particulate matter ( $PM_{25}$ ; particles  $<2.5 \mu m$  in diameter) is one of six critera pollutants regulated by the US Environmental Protection Agency (EPA) under the Clean Air Act and is a key indicator of air quality
- PM<sub>25</sub> is hazardous to human health because it can penetrate deep into the lungs and enter the bloodstream, increasing the risk of heart disease, lung cancer, and troubled breathing
- SE PA encompasses Bucks, Chester, Delaware, Montgomery, and Philadelphia Counties, including the city of Philadelphia
- Area is representative of studying air quality trends, as SE PA lies downwind of air-polluting power plants in the Ohio River Valley and northern mid-Atlantic states

### **Experimental Methods**

- Analyzed fully validated 1-hour average  $PM_{25}$  concentrations (for the FEMs) and 24-hour average PM2.5 concentrations (for the FRMs) for each day, 2004-2022, downloaded from US EPA's Air Quality System
- Created line/bar graphs highlighting trends within individual seasons, on a month-to-month basis, as well as in "extreme" days  $(PM_{25} \text{ levels} \ge 35 \,\mu\text{g/m}^3)$

### Figures



Figure 1: General decline in PM<sub>2.5</sub> concentrations from 2004-2018, with plateauing from 2018-2022.

### PM<sub>2.5</sub> Summer Seasonal Averages (2004-22)



Summer Season (Jun, Jul, Aug)





Figure 5: Southeast Pennsylvania region



Figure 2: Significant 117% increase in Code Green days from 2004-2018. Slight decrease at end of observational period.



Figure 4: Side-to-side comparison reveals how PM<sub>2.5</sub> concentrations in summer 2015 were consistently lower than summer 2005.



Figure 6: A significant decrease in unhealthy "extreme" days, with sharpest drop off in 2009.

PM<sub>2.5</sub> Concentration Summer 2005 vs. 2015

## **Results and Conclusions**

- winter
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### References

We thank Sean Nolan of the Pennsylvania **Department of Environmental Protection for** providing the  $PM_{25}$  data from AQS.





• Study reveals a gradual decline in PM<sub>2.5</sub> concentrations in the last two decades for the mid-Atlantic region and therefore a general improvement in air quality

However, PM<sub>25</sub> concentrations have

stabilized in recent years and seem to have settled on a new norm

 Decline was most prominent in the summer months, less so in the spring and fall

months, and virtually non-existent in the

### Summer decrease attributed to

reduction in sulfate, historically a major component of PM<sub>2,5</sub>, which peaks during warm and humid conditions Decline in sulfate concentrations was expected since most power plants that burn coal, the main emitter of sulfur dioxide (SO2) (the chemical precursor of sulfate), have transitioned to natural gas usage in recent years to meet federal regulations and enhance cost efficiency

• Improvement in air quality does not necessarily mean reduced health risks recent extreme events, such as the wildfireinduced smoke affecting New England in summer 2023, prove that residents still need to anticipate air pollution caused by rare meteorological conditions.