Seasonal and Hourly Variability of Particulate Matter 2.5 in Denver

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Project Overview

Particulate matter (PM) 2.5 contributes to air pollution, acid rain, and health issues such as cardiovascular respiratory diseases. It is important to study how PM 2.5 concentrations vary across Denver to gauge its impact on health and environment. Here we perform an exploratory analysis to better understand spatial and temporal variability of PM 2.5 across the Denver area. We identify when peak concentrations occur and theorize that they are due to wildfires.

Air Quality Sensor Data

- We use data from Purple Air, a sensor network that records hyper-local PM 2.5 concentrations every 10 minutes.
- We select 10 sensors from Longmont to South Denver with data from 2019-2021 to represent the Denver metro area.

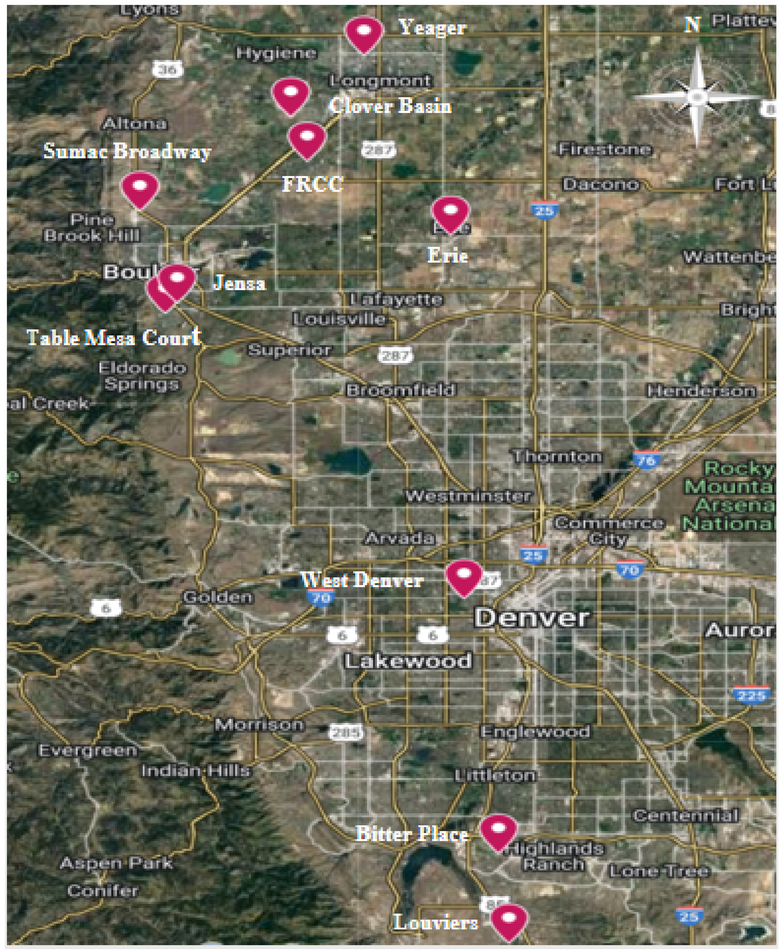

Figure 1: Map of selected Purple Air sensors.

Exploratory Data Analysis

As a case study, we show hourly medians from the West Denver sensor. This analysis highlights seasonal and hourly variability.

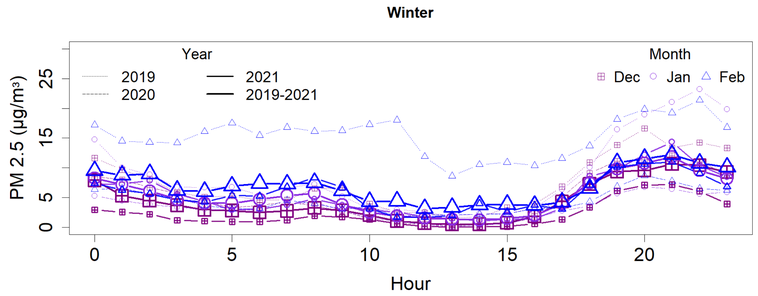

Figure 2: Hourly medians of West Denver PM 2.5 concentrations during winter.

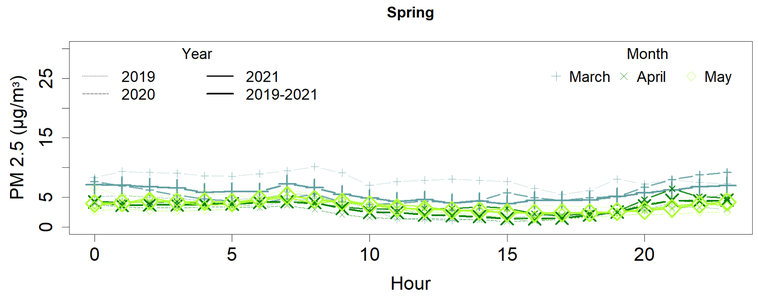

Figure 3: Hourly medians of West Denver PM 2.5 concentrations during spring.

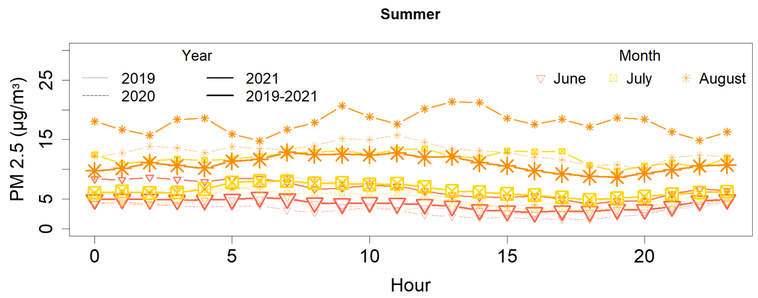

Figure 4: Hourly medians of West Denver PM 2.5 concentrations during summer.

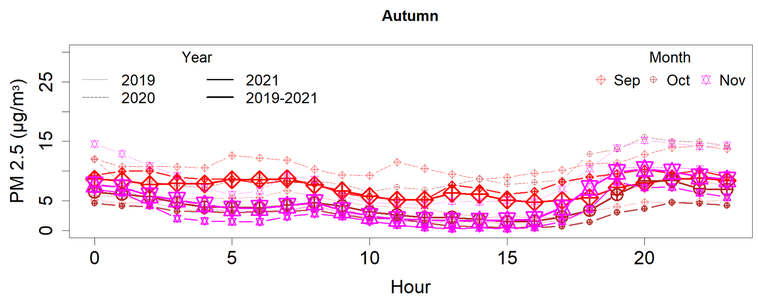

Figure 5: Hourly medians of West Denver PM 2.5 concentrations during autumn.

Exploratory Data Analysis (Continued)

The Yeager sensor in Longmont has a slightly different trend during winter than the West Denver sensor. This is potentially due to differences in local PM 2.5 sources.

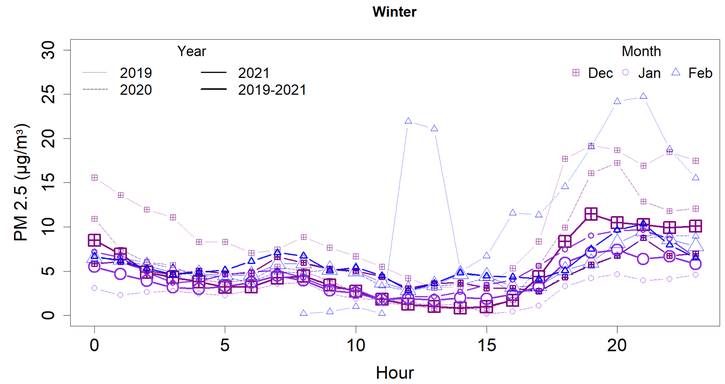

Figure 6: Hourly medians of Yeager PM 2.5 concentrations during winter.

Finally, we show monthly boxplots using all data from 2019-2021 for all 10 sensors. All sensors have elevated concentrations during the summer, likely due to wildfires.

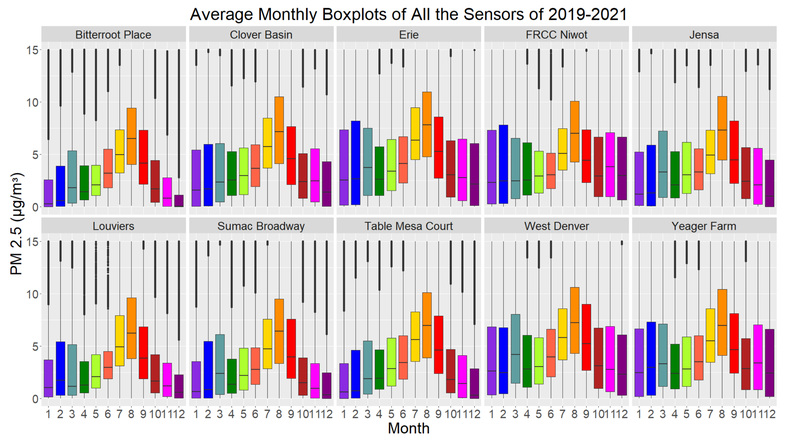

Figure 7: PM 2.5 monthly boxplots using data from 2019-2021.

Conclusion

- All sensors record elevated concentrations of PM 2.5 in the summer, which is likely a result of wildfires.
- Some sensors see differences trends in PM 2.5 for certain months, potentially due to the impact of local emission sources such as industrial facilities, population density, and forest coverage.
- Next we will use multiple linear regression to analyze the impact of wildfires on PM 2.5 concentrations during summer.