Something in the Air:

Wildfires and their impact on air quality
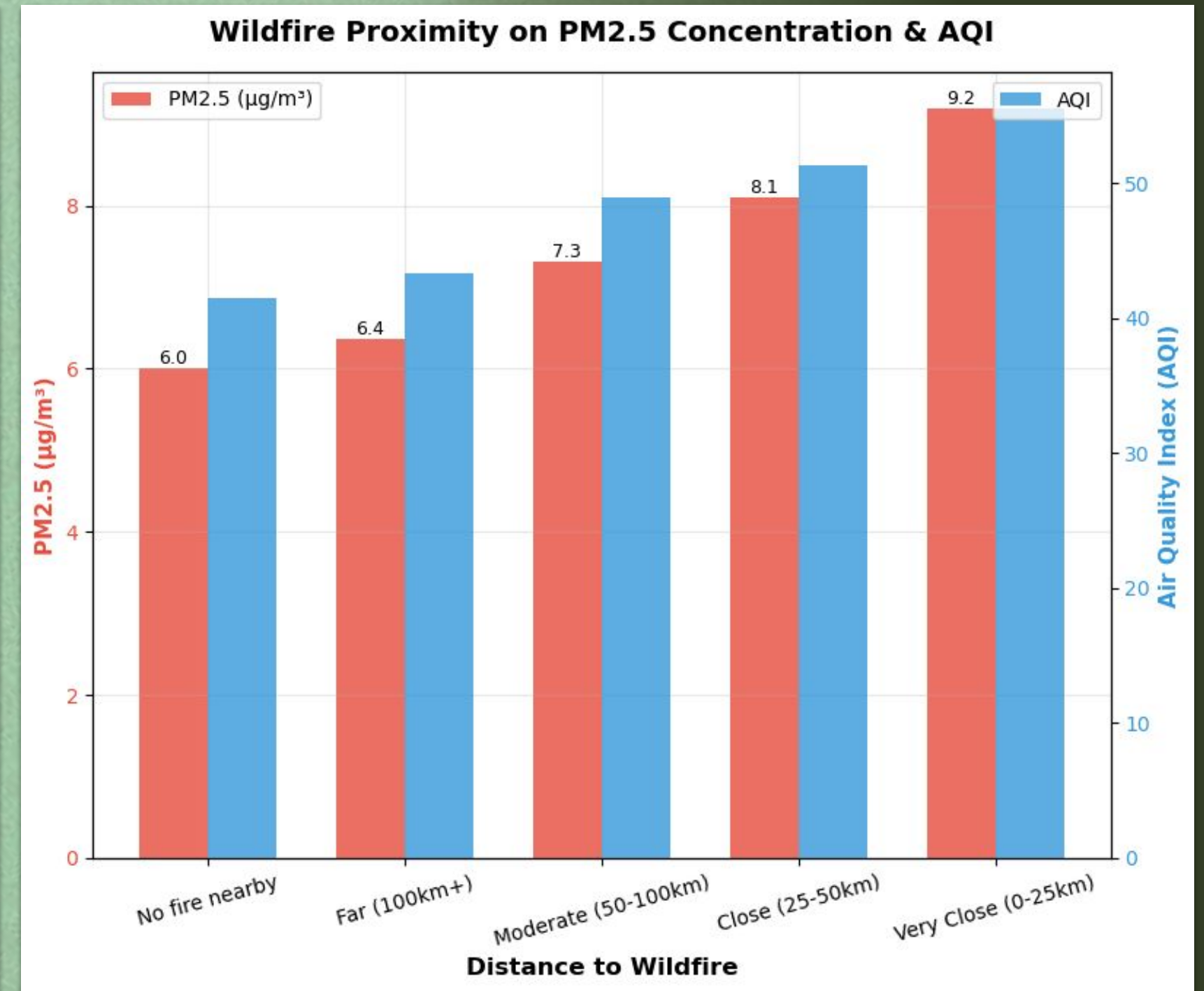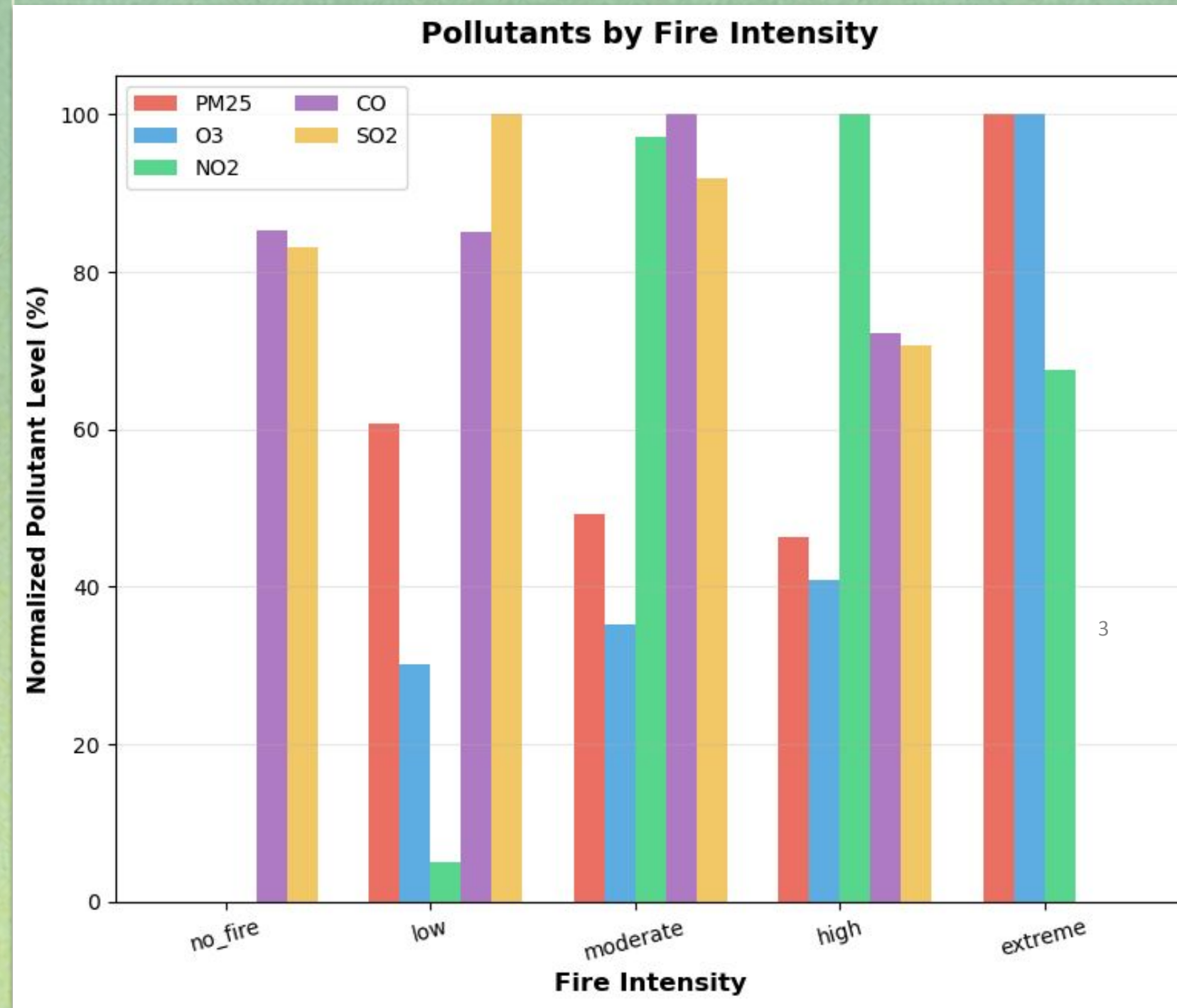
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Data & Variables

- **Sources:** NASA satellite fire detections, EPA air quality monitoring, and Open-Meteo API weather data
- **Dataset**: 20K observations from 75 monitoring sites across 40 states, each row corresponding to a daily observation

- *Target variable:* PM2.5 concentration (µg/m3), i.e., fine particulate matter

- *Air quality measurements:* CO, O3, NO2, SO2, AQI
- *Fire features:* dist to nearest fire, intensity, brightness, fire counts within 50-100 km radius
- *Weather conditions:* temperature, humidity, wind speed, precipitation, evapotranspiration, weather description
- *Temporal factors:* season, month, day of week, wildfire season
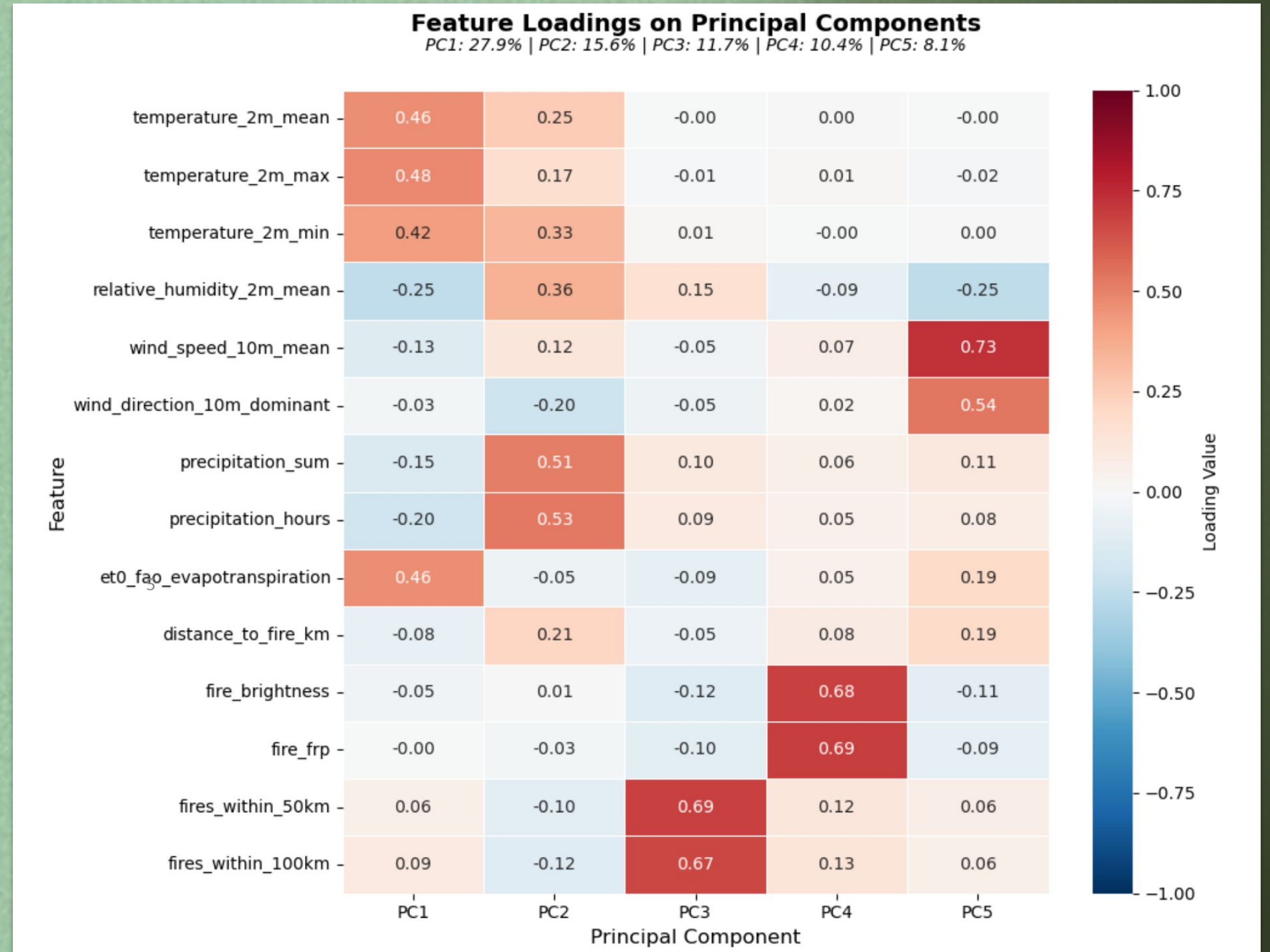
Exploratory Data Visualizations

Research Questions:

How does fire proximity affect PM2.5?

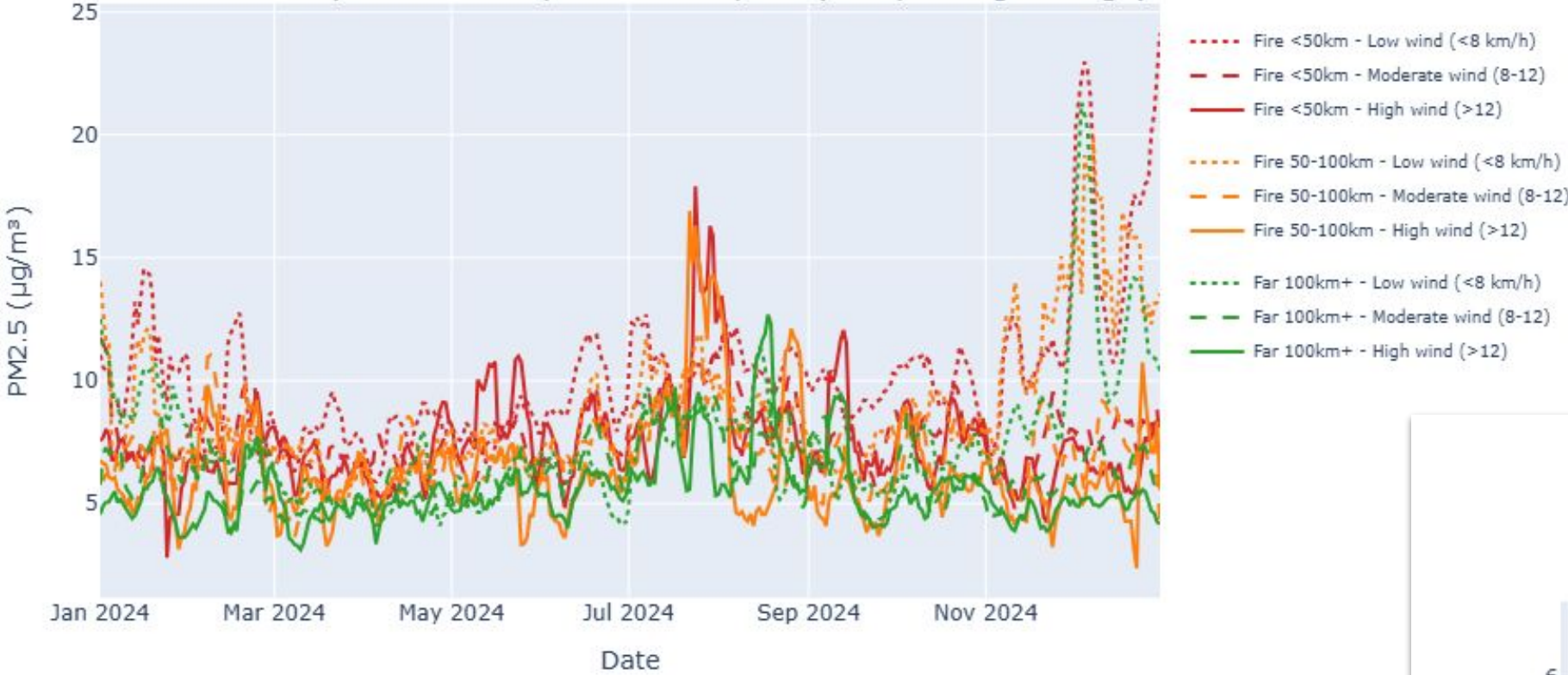Do weather conditions moderate these fire impacts?

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Principal Component Analysis

- First 5 PCAs capture **74% of variability**

- **Natural groupings:**
  - PC1 ~ temperature
  - PC2 ~ rain
  - PC3 ~ fire proximity
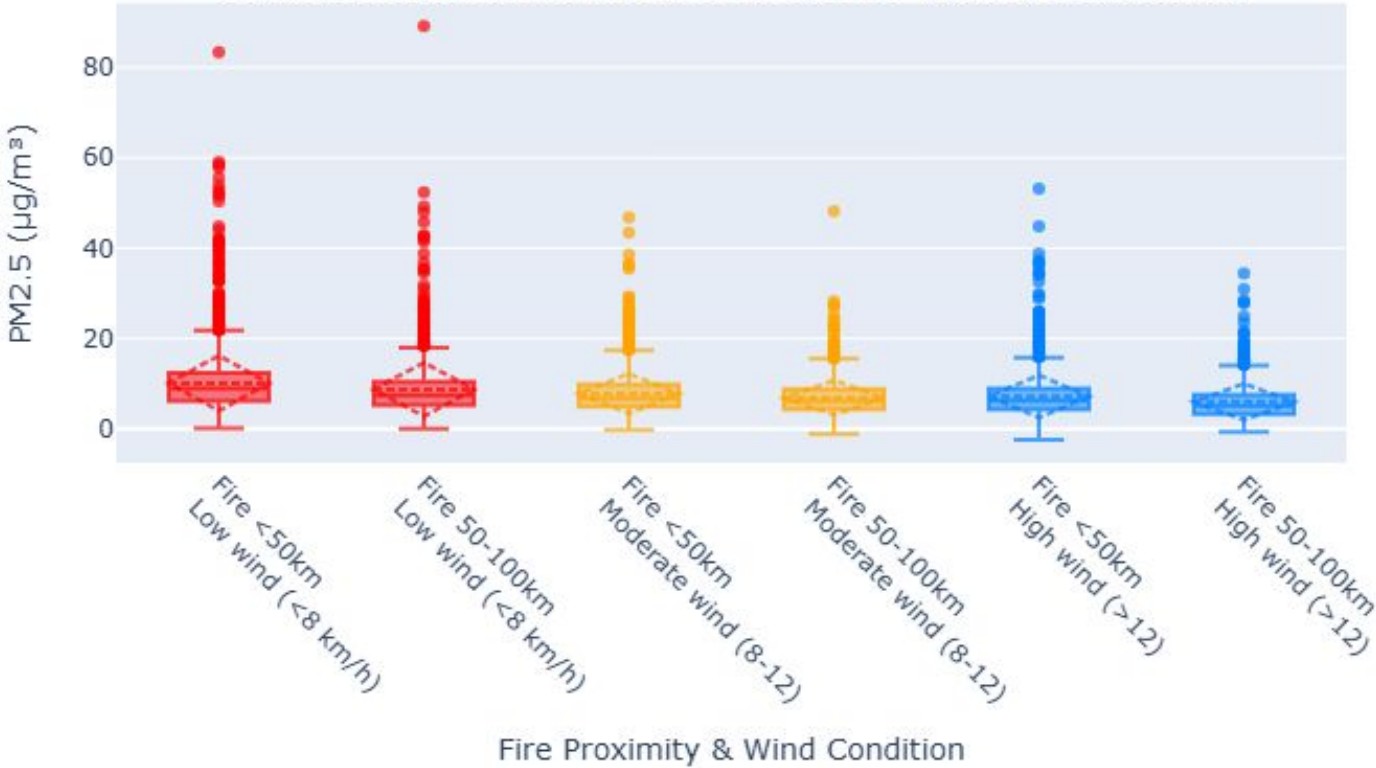 - PC4 ~ fire intensity
  - PC5 ~ wind

Feature Loadings on Principal Components
PC1: 27.9% | PC2: 15.6% | PC3: 11.7% | PC4: 10.4% | PC5: 8.1%

Feature	PC1	PC2	PC3	PC4	PC5
temperature_2m_mean	0.46	0.25	-0.00	0.00	-0.00
temperature_2m_max	0.48	0.17	-0.01	0.01	-0.02
temperature_2m_min	0.42	0.33	0.01	-0.00	0.00
relative_humidity_2m_mean	-0.25	0.36	0.15	-0.09	-0.25
wind_speed_10m_mean	-0.13	0.12	-0.05	0.07	0.73
wind_direction_10m_dominant	-0.03	-0.20	-0.05	0.02	0.54
precipitation_sum	-0.15	0.51	0.10	0.06	0.11
precipitation_hours	-0.20	0.53	0.09	0.05	0.08
et0_fao_evapotranspiration	0.46	-0.05	-0.09	0.05	0.19
distance_to_fire_km	-0.08	0.21	-0.05	0.08	0.19
fire_brightness	-0.05	0.01	-0.12	0.68	-0.11
fire_frp	-0.00	-0.03	-0.10	0.69	-0.09
fires_within_50km	0.06	-0.10	0.69	0.12	0.06
fires_within_100km	0.09	-0.12	0.67	0.13	0.06

Principal Component

Time Series Analysis

High wind speeds 👍

Low humidity 👍

Conclusions for Stakeholders

- **Environment:** Encourage action by policymakers and individuals
- **Public health**: Issue air quality warnings and mind humid conditions
- **Policy Planning**: Anticipate air quality impacts in advance

- **Prediction challenges despite multi-model approach**
- **However, successful capture of trends and conditions**
- **Actionable insights for protecting environmental and public health**