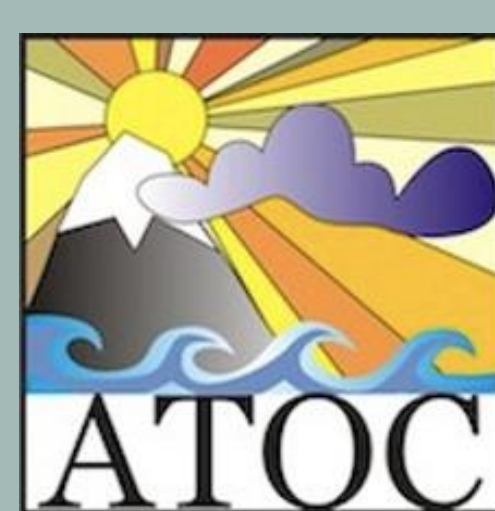




Successful Aging in a Time of Wildfires Field Project

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MOTIVATIONS

Health Risks of Wildfire Smoke

- Wildfire Smoke and PM2.5:** Wildfire smoke contains harmful PM2.5 particles, which pose significant health risks, particularly for older adults with pre-existing respiratory and cardiovascular conditions.
- Growing Wildfire Frequency:** Since 2000, over 1.4 million wildfires have occurred, with increasing frequency and intensity, particularly in California, making it essential to address their health impacts.
- Vulnerable Populations:** Older adults are disproportionately affected due to limited physiological resilience, making it vital to understand and mitigate their exposure to harmful air pollutants.
- Study Regions and Methodology:** The study regions highlighted in the image show the locations of our monitors (yellow boxes) and survey data collection (white boxes). Some sites include both monitors and surveys, providing a comprehensive approach to understanding wildfire smoke exposure.
- Indoor Air Quality's Role:** As most individuals spend significant time indoors, studying indoor air quality is crucial for mitigating exposure to wildfire emissions.
- Addressing Knowledge Gaps:** Limited research exists on the effectiveness of residential buildings in reducing PM2.5 infiltration during wildfire events. This study provides new insights through field measurements and survey data, guiding public health interventions.

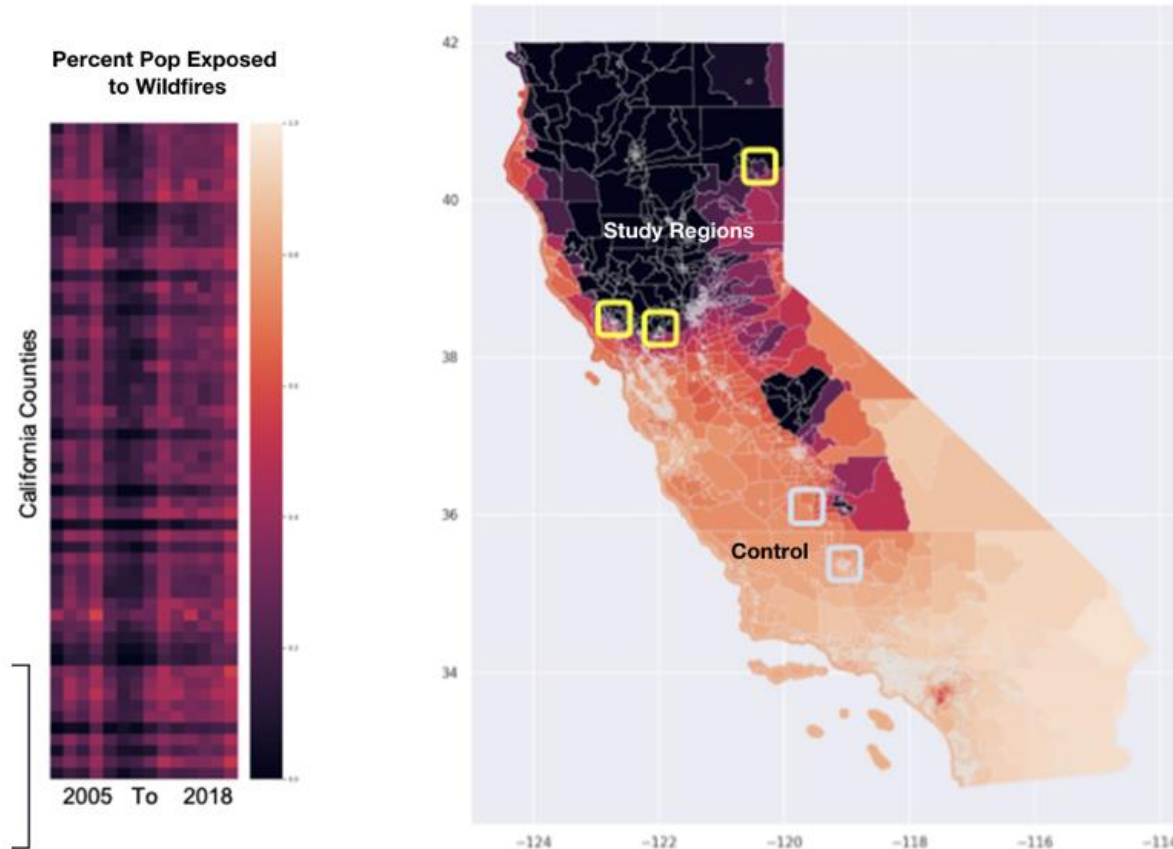


Figure 1: Study regions with air quality monitors (yellow) and survey sites (white)

EXPERIMENTAL DESIGN

- Study Region:**
 - Santa Rosa area in Northern California was selected due to the region's unique meteorological conditions and historical wildfire activity.
 - Previous wildfire events in the region provided a relevant backdrop for understanding current PM2.5 exposure levels.
- Sensor Deployment:**
 - Deployed Purple Air particulate monitors in 25 homes across the region, placed indoors and outdoors, to measure PM2.5 concentrations.
- Meteorological Context:**
 - The nearby Mayacamas Mountains create localized meteorological phenomena, potentially affecting pollutant dispersion and concentration levels, providing a unique setting for studying wildfire smoke dynamics.
- Baseline Study for Broader Application:**
 - This study serves as a pilot to inform future research on aging and wildfires, aimed at expanding to additional regions beyond Santa Rosa.
 - Insights from this initial deployment will guide methodological improvements and scaling to other wildfire-impacted areas.
- Data Collected:**
 - Indoor and outdoor hourly PM2.5 concentrations.
 - Time-resolved measurements will be analyzed to assess trends, exposure patterns, and potential health implications.

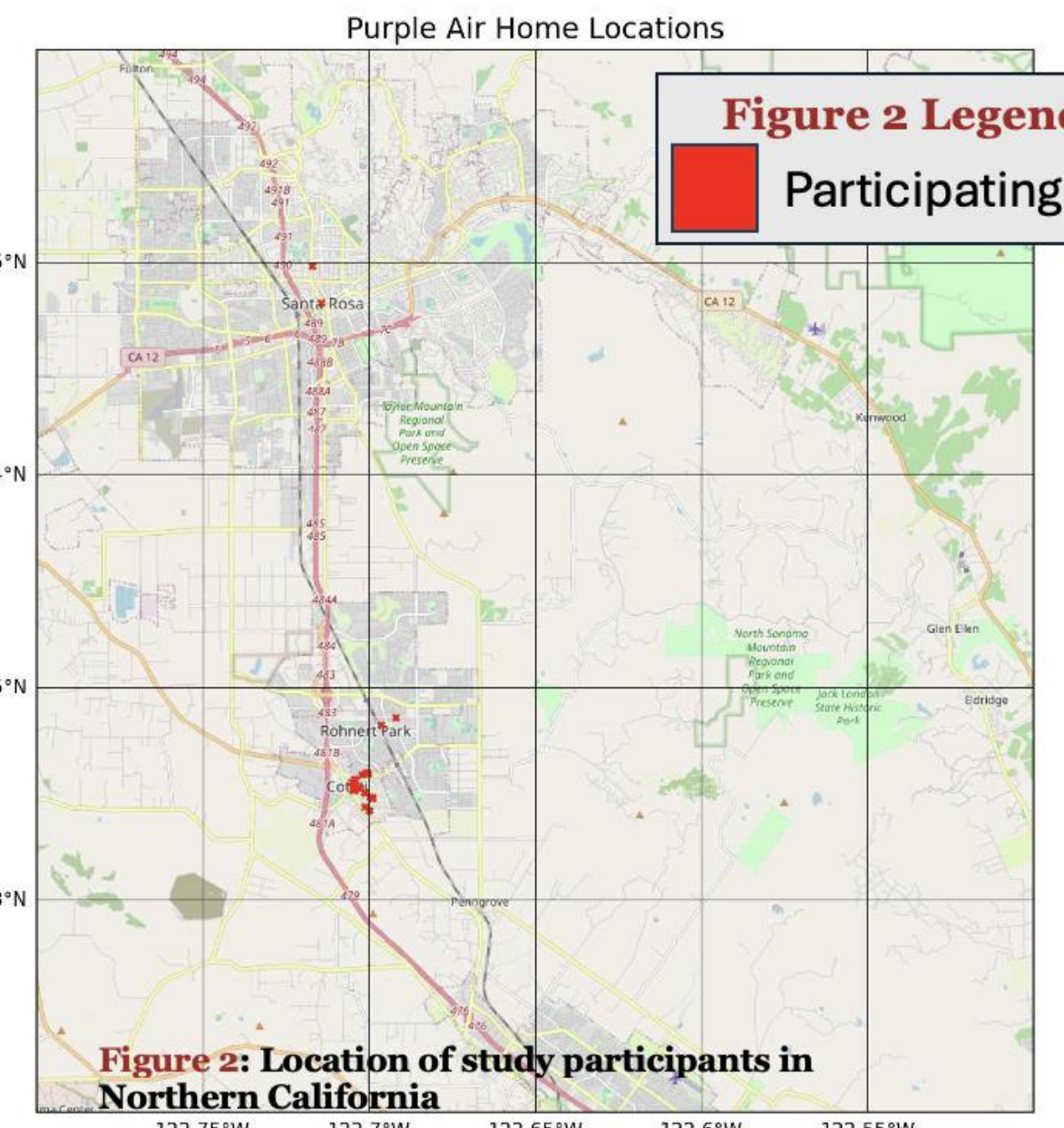


Figure 2: Location of study participants in Northern California

OBJECTIVES

This study aims to evaluate the impact of wildfire smoke on indoor air quality and its potential health implications for older adults in Northern California. By deploying 50 PurpleAir monitors in 25 homes, we measured and compared indoor and outdoor PM2.5 concentrations from June 17th, 2024, until December 30th, 2024. We aim to understand the concentration differences between indoor and outdoor of PM2.5 to understand how to effectively mitigate PM2.5 exposure and to inform strategies for protecting vulnerable populations during wildfire seasons.

Figure 3: Classic PurpleAir PA-II particulate sensor which was placed on the outside of the 25 homes



Figure 4: PurpleAir Zen model particulate sensor which was placed on the inside of the 25 homes



STATISTICAL ANALYSIS

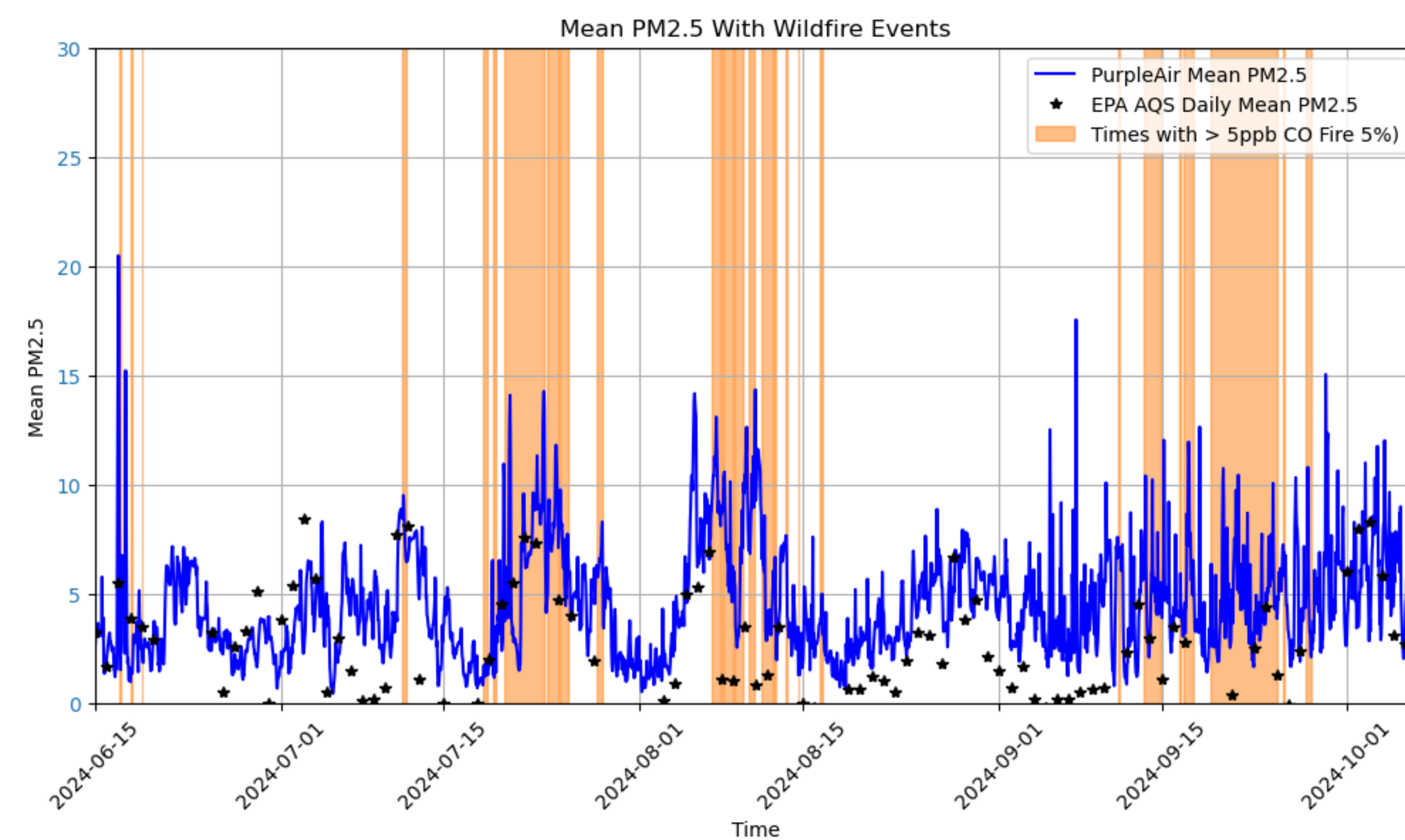


Figure 5: Time series plot showing mean PM2.5 concentrations during wildfire events. The blue line represents the hourly PurpleAir mean PM2.5, while the black stars denote the EPA AQS daily mean PM2.5. Orange-shaded regions highlight times when the WRF-Chem CO-FIRE filter identified CO levels exceeding 5 parts per billion (5 ppb), indicating wildfire-influenced periods. The data spans from mid-June to early October 2024, capturing significant PM2.5 variability associated with wildfire events..

Comparison of PM2.5 Averages

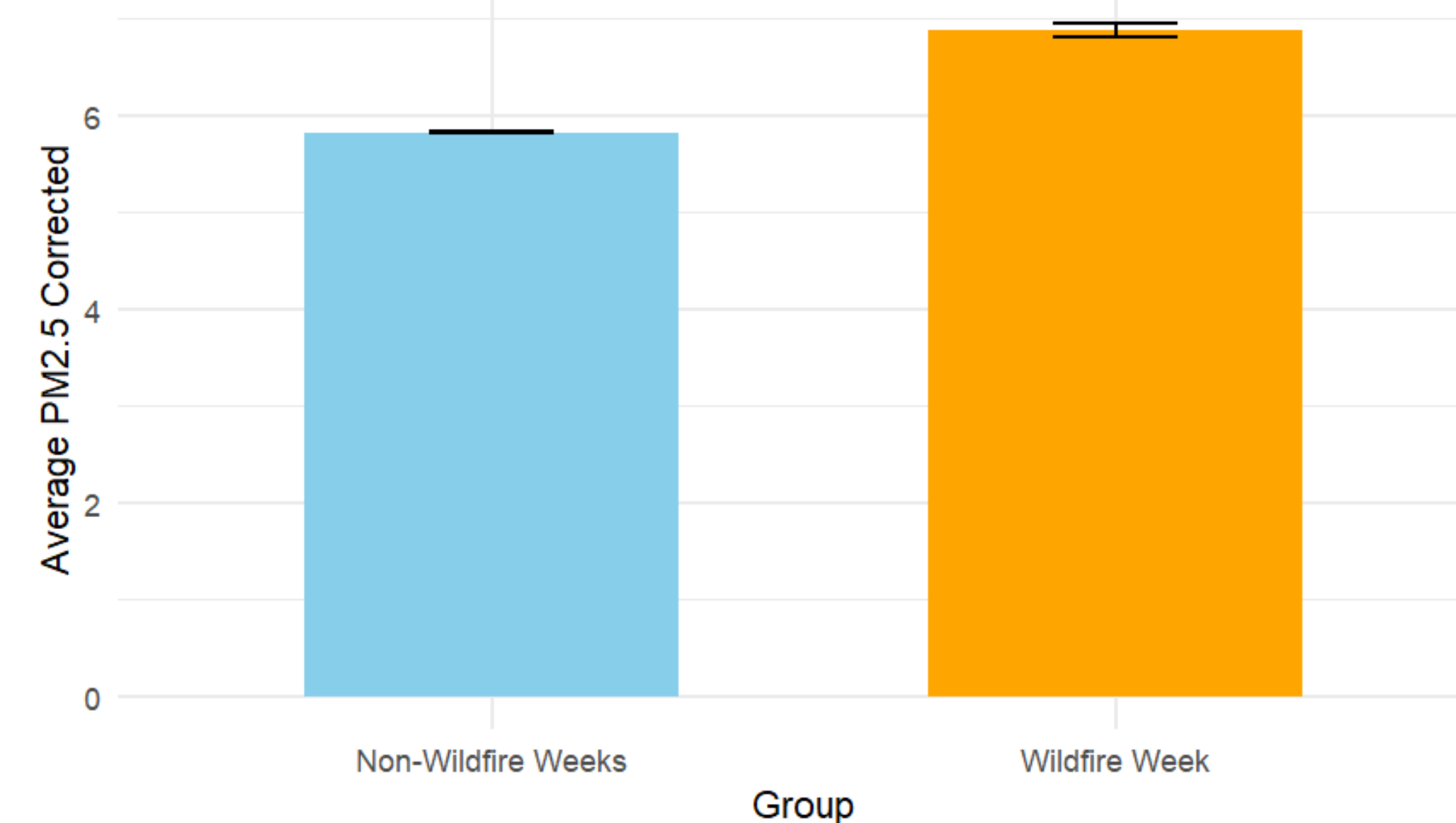


Figure 6: Bar graph showing the mean PM2.5 concentrations for the reference week and the combined data from all other weeks. The orange bar represents the mean PM2.5 concentration during the reference week (6.878 µg/m3). while the blue bar represents the mean PM2.5 concentration for the combined weeks (5.819 µg/m3). Error bars indicate the 95% confidence intervals for the means, highlighting the statistical difference between the two groups as determined by a Welch Two Sample t-test (p<0.001). The t-test suggests significantly higher PM2.5 concentrations during the reference week compared to the combined weeks.

NEXT STEPS

Extended Data Collection:

- Expand the study period to capture a full year's worth of PM2.5 data, enabling seasonal and annual exposure trends analysis.
- Include data collection during high wildfire risk seasons and varying meteorological conditions for comprehensive insights.

In-Depth Statistical Analysis:

- Perform advanced statistical analysis to quantify exposure levels and assess differences between indoor and outdoor PM2.5 concentrations across homes.
- Evaluate the relationship between indoor air quality and home-specific variables (e.g., building characteristics, ventilation practices).

Integration with Meteorological Data:

- Compare PM2.5 concentrations to meteorological events such as temperature inversions, wind patterns, and precipitation to identify correlations with pollutant dispersion.
- Leverage local weather station data and regional atmospheric models to enhance interpretation of the results.

Refinement of Deployment Protocols:

- Use findings from this pilot study to optimize sensor placement strategies and data collection protocols for future deployments in additional regions.
- Consider incorporating other air quality parameters (e.g., CO2, VOCs) to provide a more holistic understanding of indoor environments during wildfires.

Scaling and Broader Application:

- Scale the study to include diverse geographic locations with varying socioeconomic demographics to assess broader exposure trends and disparities.
- Collaborate with public health organizations to inform community-level interventions and protective measures during wildfire events.

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