

# Multi-Day Wildfire Smoke Exposure Thresholds & Distributions for an Oregon Health Impacts Study



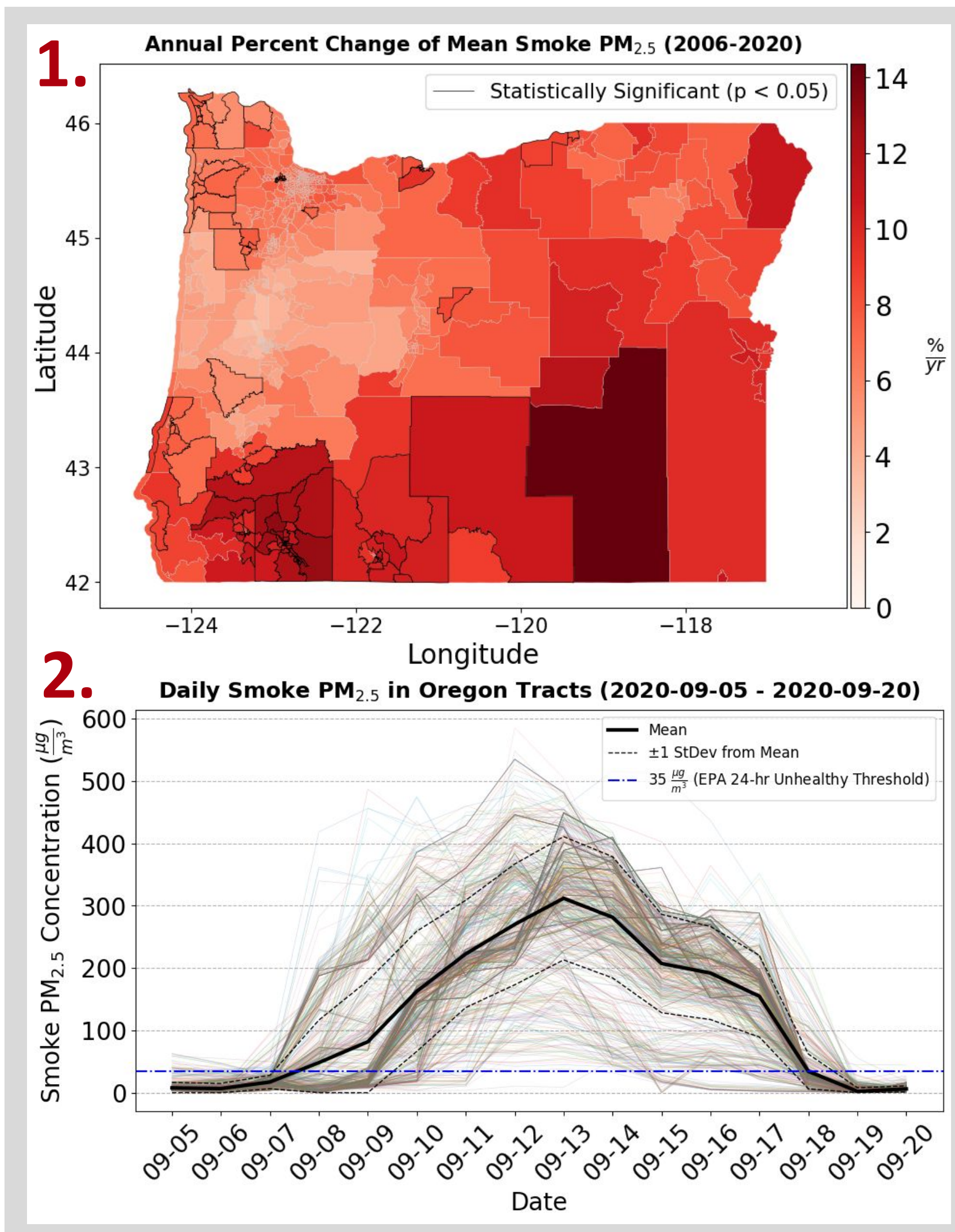
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## Background & Motivation

Wildfire smoke has drastically impacted air quality in Oregon<sup>1</sup>. Recent years saw the **most severe wildfire seasons in modern history**<sup>1</sup>.

Fine particulate matter (PM<sub>2.5</sub>) from wildfire smoke poses significant **respiratory and cardiovascular risks**, among other health impacts<sup>2,3</sup>.



- Few studies have focused on:
- Smoke health impacts on children and different demographic groups<sup>4</sup>
  - **Duration of exposure**<sup>5</sup>

The goal of this project is to **determine thresholds, identify trends, and understand distributions** of Oregon smoke events in preparation for a health impacts case-crossover study.

## Smoke Dataset Information

- **Data:** Daily CONUS census tract-level wildfire-driven smoke PM<sub>2.5</sub> estimates
- **Date Range:** 2006-01-01 → 2020-12-31
- **Focus Area:** 834 Oregon census tracts
- **Source:** Environmental Change and Human Outcomes (ECHO) Lab at Stanford University<sup>6</sup>

## Smoke Event Thresholds & Justification

**Medium Smoke Day: 9-15 µg/m<sup>3</sup>**

**High Smoke Day: 15+ µg/m<sup>3</sup>**

**Event:** One or more consecutive days with smoke PM<sub>2.5</sub> ≥ 9 µg/m<sup>3</sup> in a single census tract

The World Health Organization (WHO) states that 24-hour average exposures should not exceed 15 µg/m<sup>3</sup> more than 3-4 days per year. This value encapsulates all 98th percentile smoke events in Oregon (Table 2).

The values of 9 and 15 µg/m<sup>3</sup> are consistent with a similar case-crossover study conducted in Washington state from 2006-2017<sup>7</sup>:

- 15 µg/m<sup>3</sup> was the 99th percentile of PM<sub>2.5</sub> concentrations during two relatively smoke free years in Washington state
- 9 µg/m<sup>3</sup> was their lower threshold, which is also near the 98th percentile of all days in Oregon between 2012-2020 (Table 1)

**Table 1 - Smoke PM<sub>2.5</sub> (µg/m<sup>3</sup>) percentiles for ALL Oregon census tract days, including days with zero smoke.**

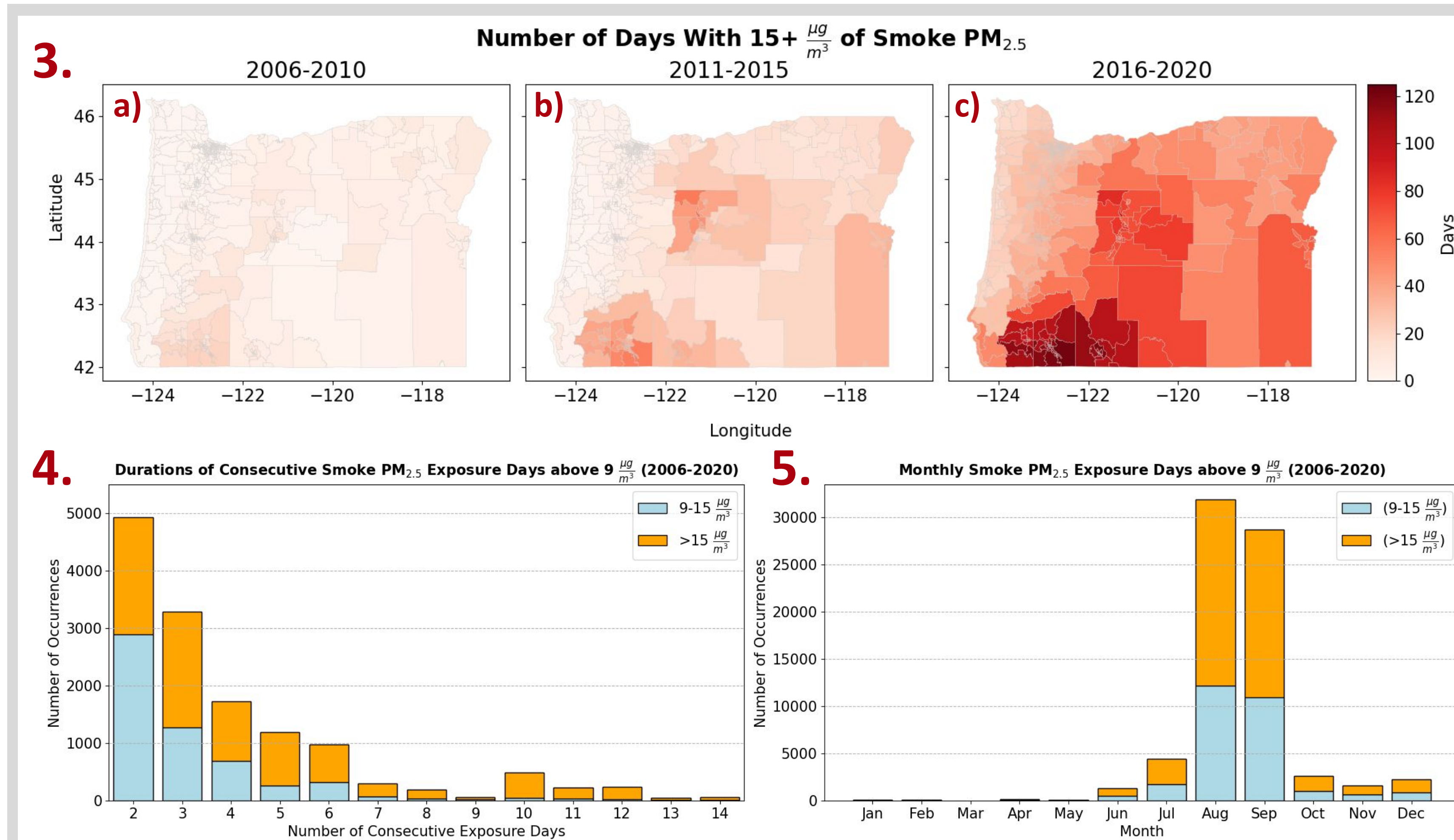
Percentile	2006-2020	2012-2020
95%	3.107	4.154
98%	6.918	9.467
99%	11.425	19.034

**Table 2 - Smoke PM<sub>2.5</sub> (µg/m<sup>3</sup>) percentiles for ONLY Oregon census tract days with smoke.**

Percentile	2006-2020	2012-2020
95%	10.236	12.614
98%	18.405	24.898
99%	33.627	43.616

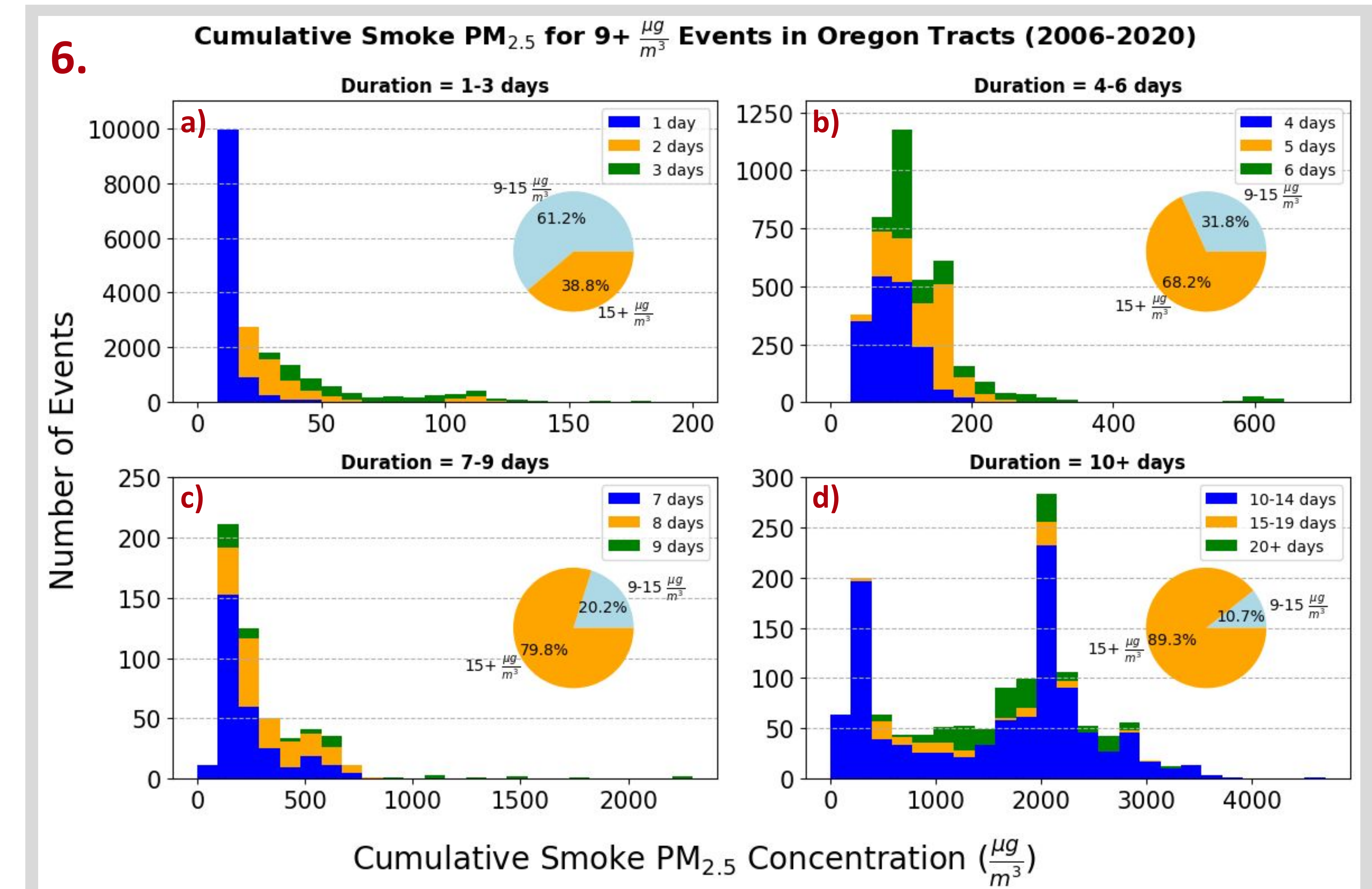
## Trends & Distributions of Smoke Events

- **25,317 total events** were identified between 2006-2020
- Several census tracts experienced **over 60 events and 300 days above 9 µg/m<sup>3</sup>** of smoke PM<sub>2.5</sub> individually, with over 60% of these days also exceeding 15 µg/m<sup>3</sup> and occurring between 2016-2020
- Most event days occurred during **August and September**, but a significant portion also occurred during June-July and October-December



## Distributions of Smoke Event Durations

- In general, long-term events (7+ days) had a **greater fraction of high threshold days** (15+ µg/m<sup>3</sup> of smoke PM<sub>2.5</sub>) than short-term events (e.g. 1-3 days)
- There were over **1300 instances** of consecutive day events lasting at least 10 days within individual census tracts, where the longest event lasted **40 days**
- Over **900 instances** of consecutive day events exceeding a cumulative smoke PM<sub>2.5</sub> concentration of **1000 µg/m<sup>3</sup>** within individual census tracts were observed



## Ongoing & Future Work

- Health Impacts Case-Crossover Study:**
- **Focus:** Examine the association between the duration and magnitude of exposure to smoke PM<sub>2.5</sub> and risk of hospitalization among different ages and demographic groups
  - **Data:** Oregon patient-level hospitalization records (2012-2022)
  - **Health Impacts Studied:**
    - Respiratory
    - Cardiovascular
    - Pregnancy complications
    - Acute mental health
  - **Meteorological Reanalysis Data:**
    - **Data:** Daily Oregon census-tract level temperature and heat index values
    - **Purpose:** Account for heat-related impacts on smoke days

## Supplemental Information

Additional Oregon smoke PM<sub>2.5</sub> statistics, event analysis, short wildfire case studies, and more:



## References & Acknowledgements

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