Can forest management improve public health outcomes? A case study from Tahoe Central Sierra Initiative

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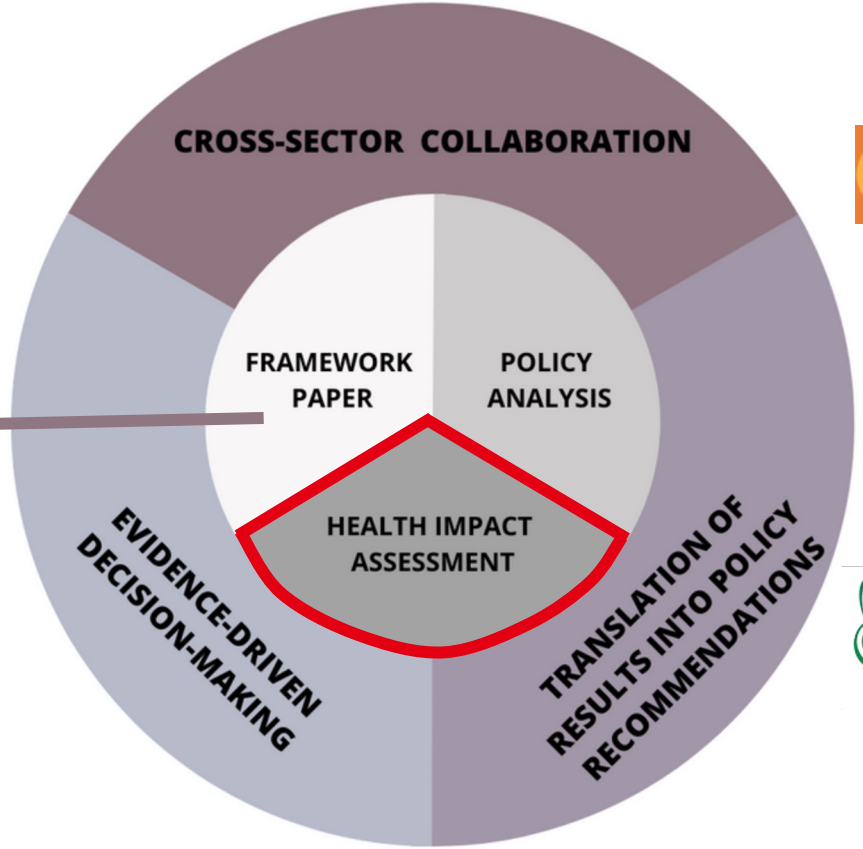
Science for Nature and People Partnership



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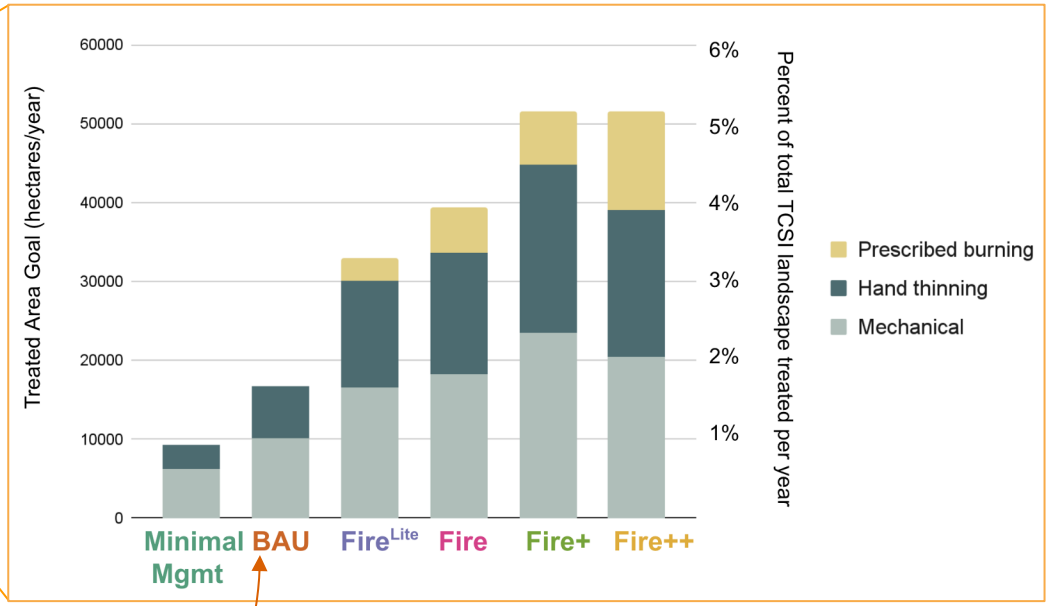
Science for Nature and People PARTNERSHIP

The Nature Conservancy

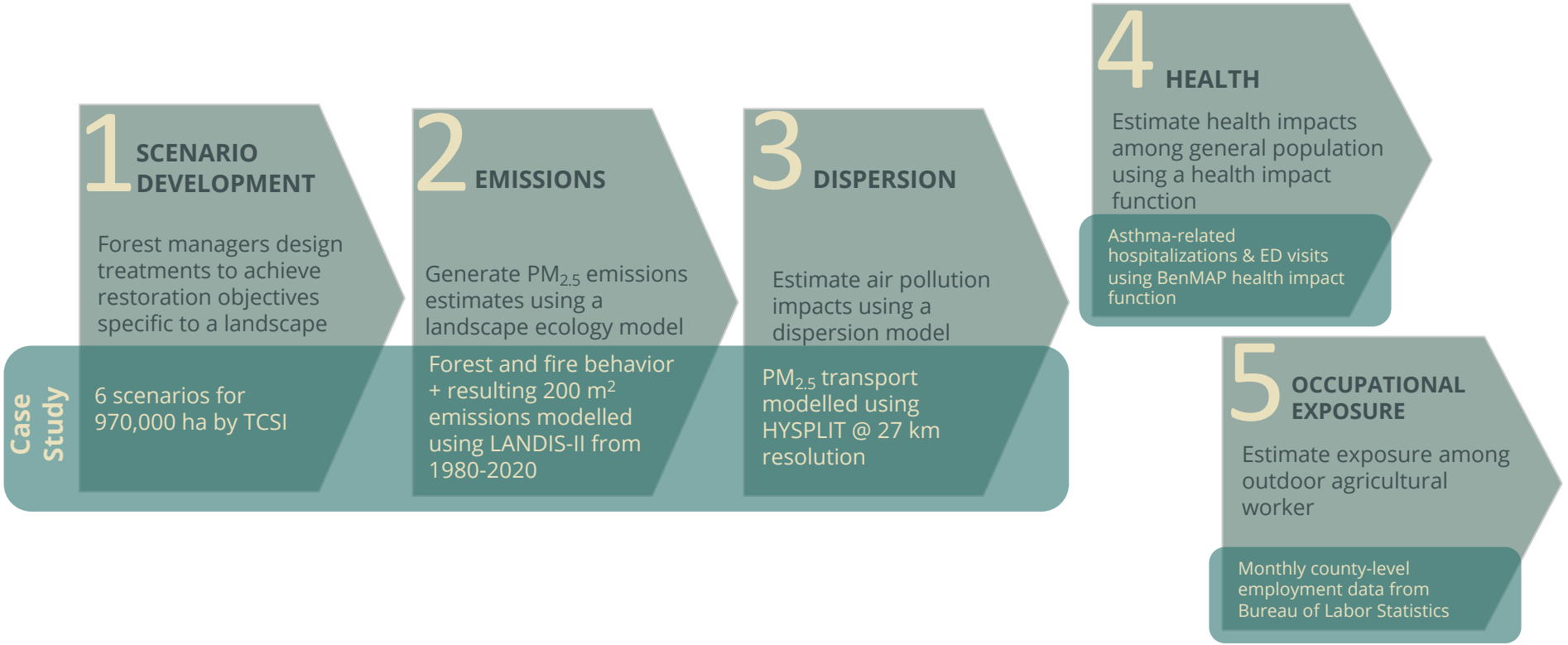
Wildlife Conservation Society

NCEAS
National Center for Ecological Analysis and Synthesis

Forest management scenarios designed for TCSI



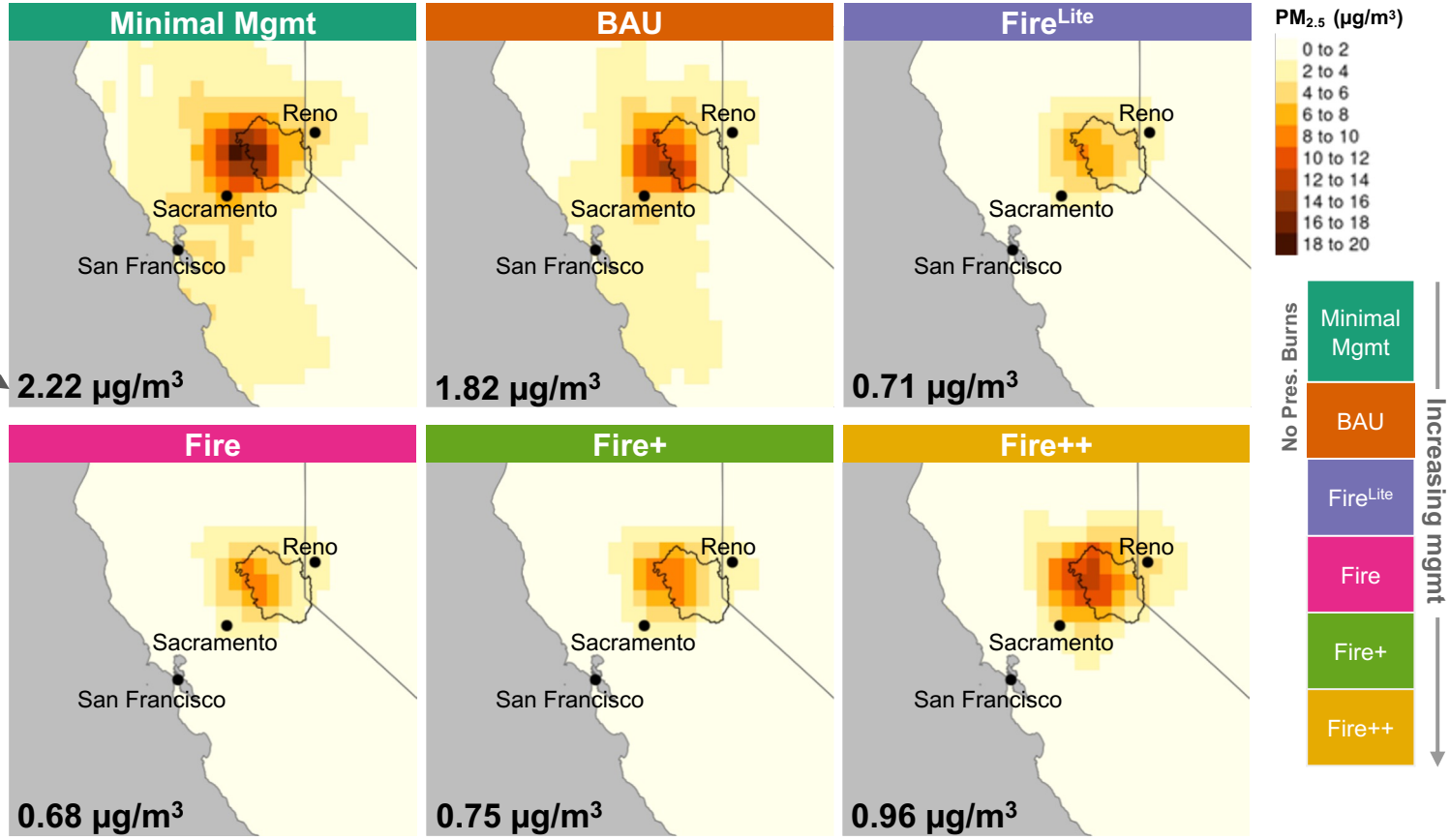
Framework for linking methods across forest management, air quality, and public health analysis



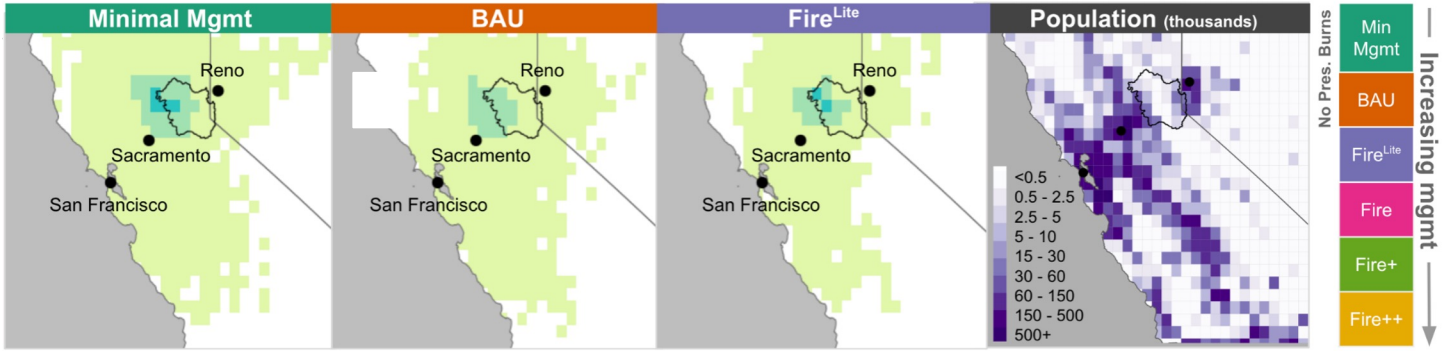
Time frame: 1981-2020

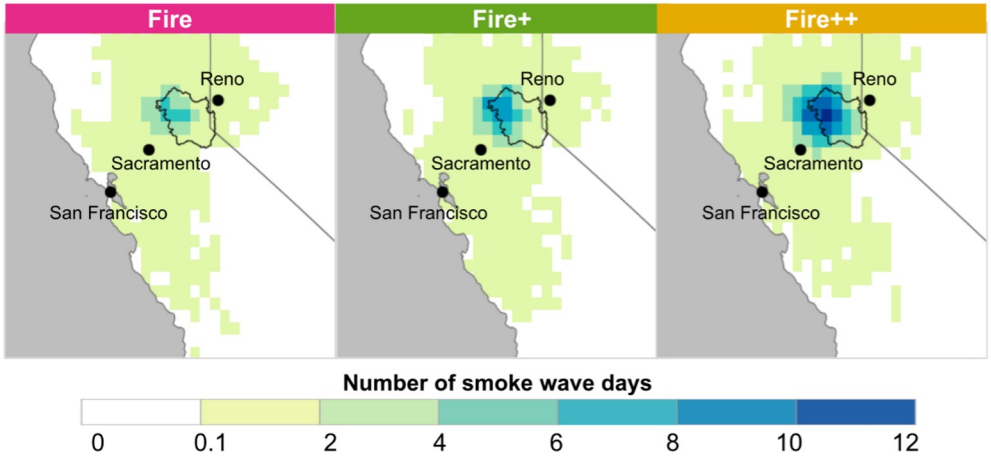
40-year average total smoke dispersion patterns for each scenario

Population-weighted 40-year average total smoke $PM_{2.5}$ concentrations

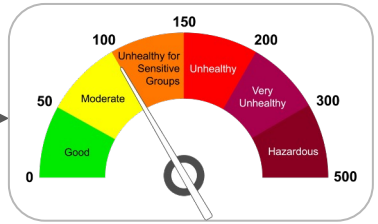


Scenario impacts on smoke waves





Smoke wave = at least 2 consecutive days with $PM_{2.5}$ from smoke > 12 µg/m3 (EPA AQI cutoff between 'Good' and 'Moderate')



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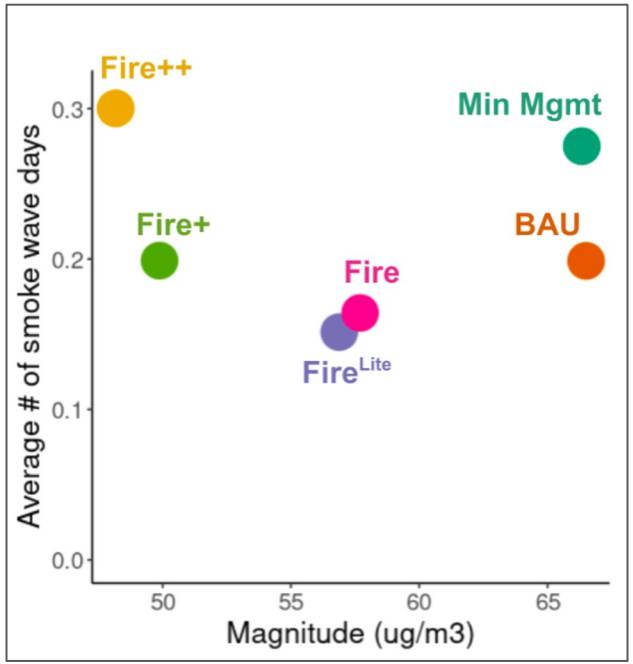

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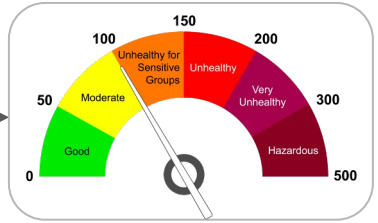


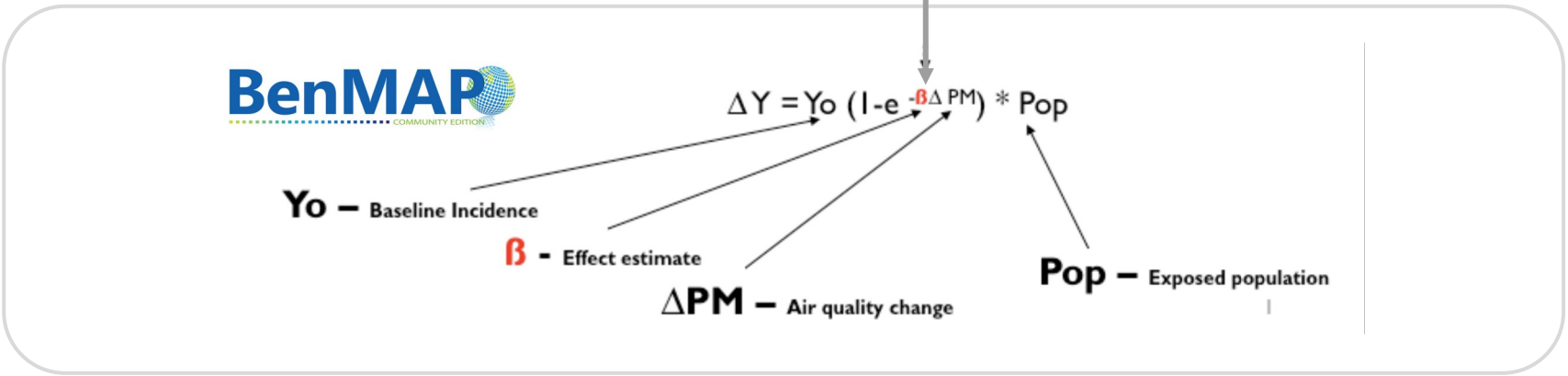
Estimating asthma impacts

Relative risk (RR) = ratio of the probability of disease if exposed versus the probability disease if unexposed

Why asthma?

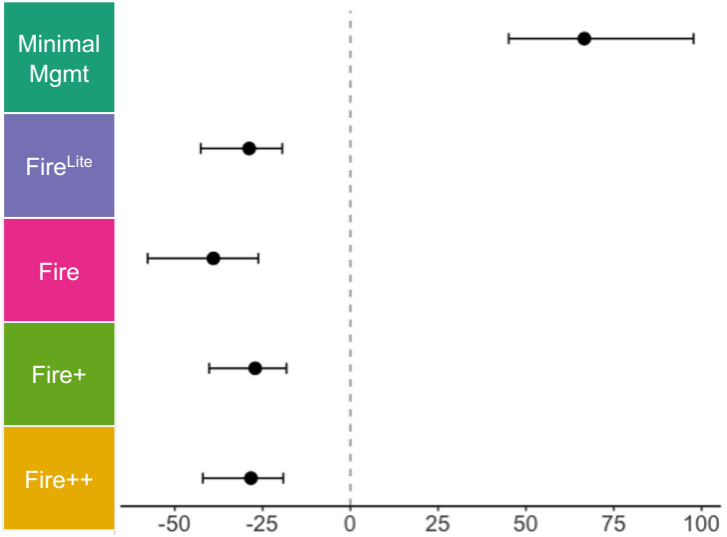
Most consistent results across wildfire smoke epidemiological studies (i.e. across geographies and populations)

Asthma RRs: Borchers-Arriagada et al. 2019 (per 10 ug/m^3 increase in $PM_{2.5}$)	
Hospitalizations (8 studies)	**1.07** (95% CI: 1.04, 1.09)
Emergency Dept (ED) Visits (6 studies)	**1.06** (95% CI: 1.02, 1.09)

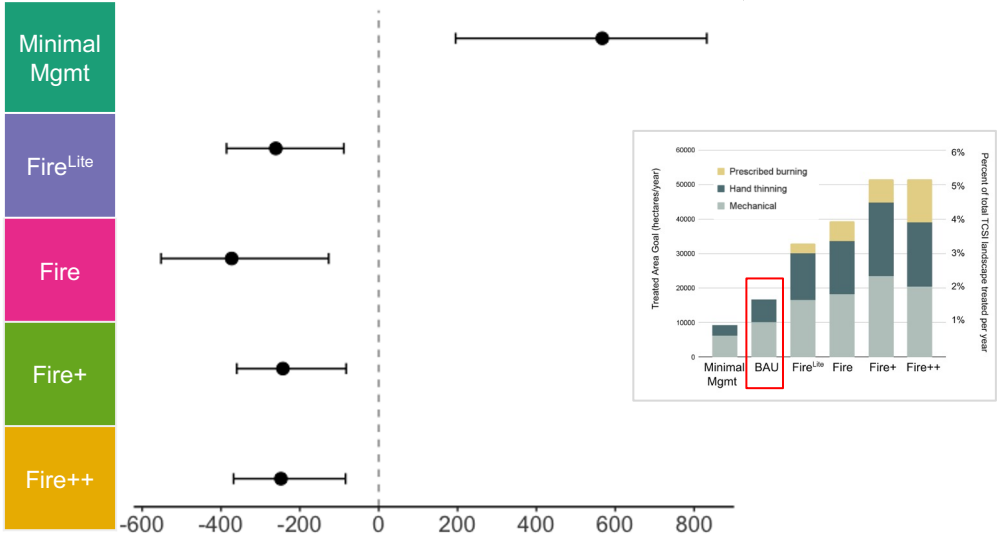


Statewide asthma impacts

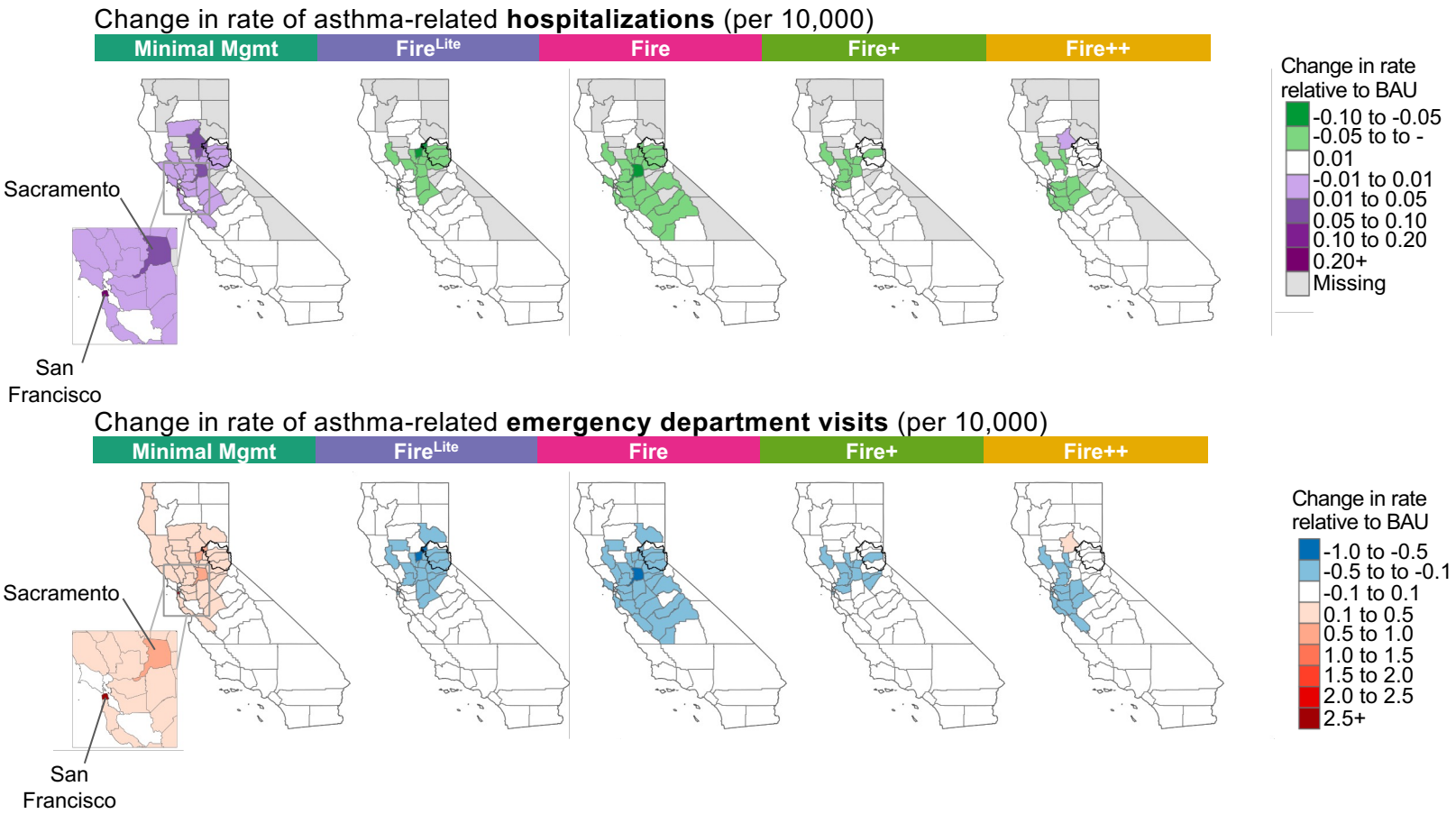
Difference from BAU in statewide annual asthma-related **hospitalizations**



Difference from BAU in statewide annual asthma-related **emergency department visits**



Where are these changes happening?



California's agricultural industry

- Employs >400,000 workers per year (CA EDD 2023)
- Provides >75% of the fruits and nuts and >33% of the vegetables consumed across the U.S. (CDFA 2023)
- Top crop commodities: grapes, almonds, strawberries, pistachios, lettuce, tomatoes, walnuts, rice CDFA 2023)
- Generated approximately $22.5 billion in 2021 (CDFA 2023)

Employment data

Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) 2018-2020

NAICS Codes:

111: Crop Production

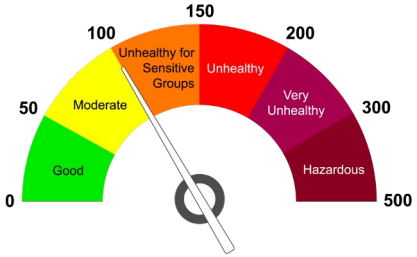
1151: Support Activities for Crop Production

California's smoke rule for outdoor workers (Section 5141.1)

Goal: To protect outdoor workers exposed to smoke from wildfires*

*applies to emissions from fires on 'wildlands', which includes prescribed fire

State of California
Department of
Industrial Relations
EST. 1927



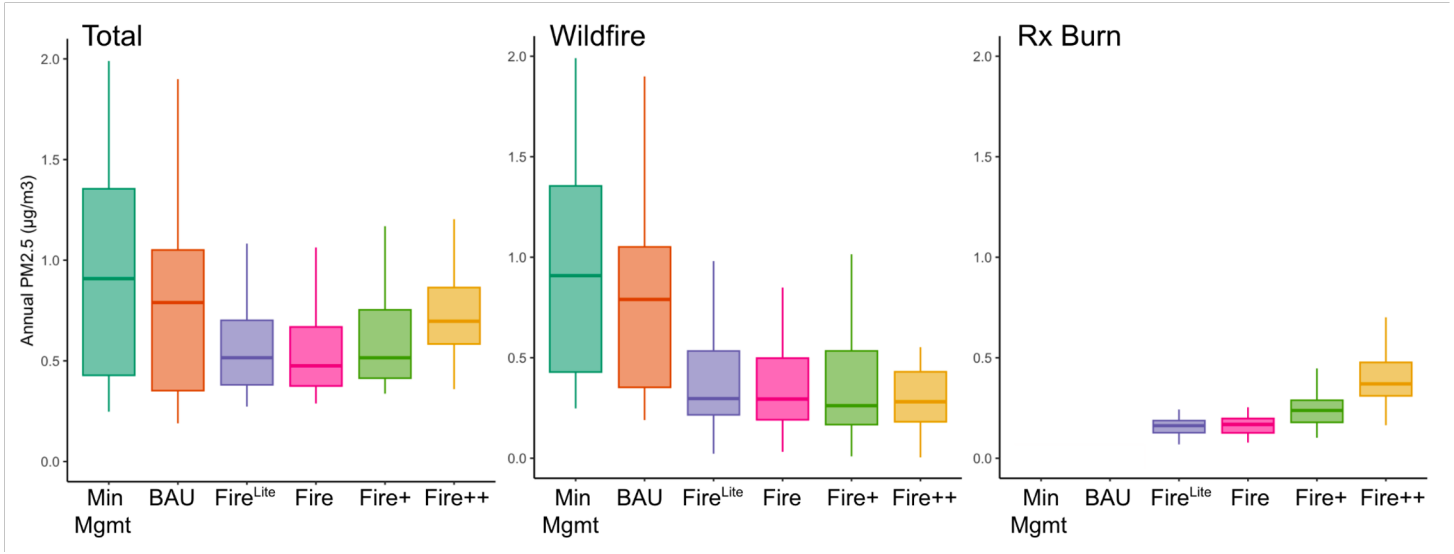
AQI 151 ($PM_{2.5}$ > 55.5 ug/m^3)

1. **Engineering Controls**: providing enclosed buildings, structures, or vehicles where the air is filtered
2. **Administrative Controls**: relocating work to a location where the current AQI for PM2.5 is lower, changing work schedules, reducing work intensity, or providing additional rest periods.
3. **Respiratory Protective Equipment**: Provide a sufficient number of respirators for voluntary use

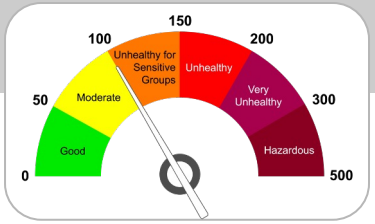
AQI 500 ($PM_{2.5}$ > 500.4 ug/m^3)

1. **Respiratory Protective Equipment**: respirator use is required.

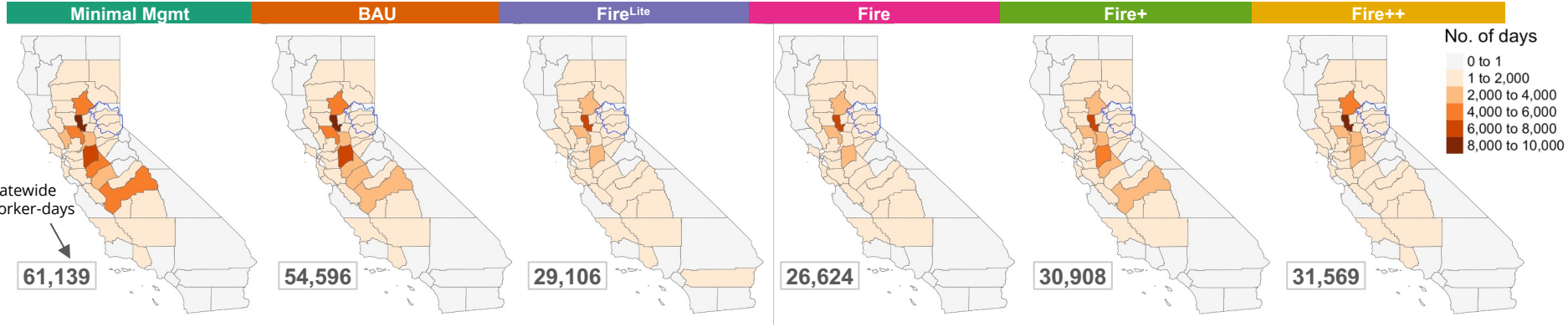
Annual employment-weighted average $PM_{2.5}$ concentrations by fire type



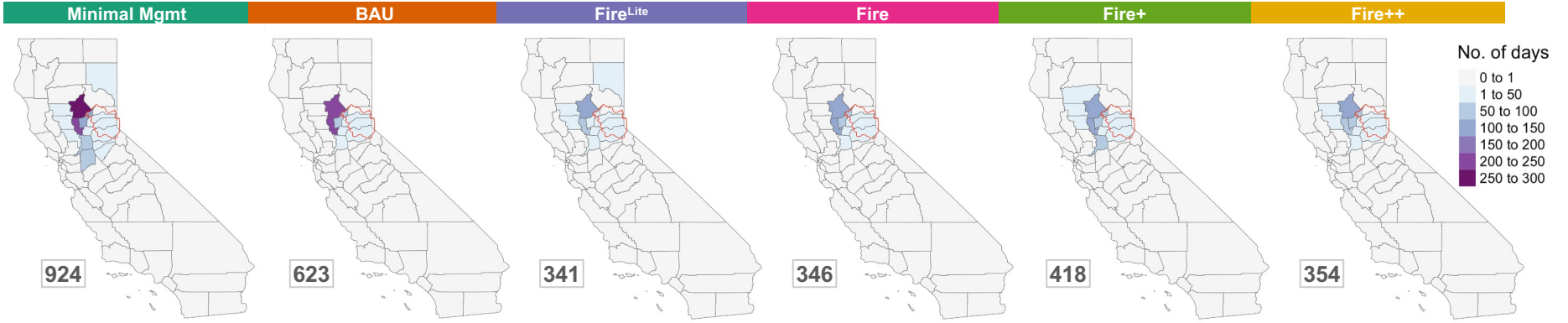
Impacted worker-days under Section 5141.1 at the county level



Average number of worker-days per year that exceed the **AQI 151 threshold**



Average number of worker-days per year that exceed the **AQI 500 threshold**



Takeaways

- Moderate amounts of Rx burning can contribute to exposure reduction and health co-benefits
- Greater amounts of Rx burning may reduce the magnitude of those benefits

- How can this information be useful for **practitioners**?
  - Inform decision making about ongoing and future management plans
  - Identify areas for **collaboration** with local public and occupational health agencies

What's next?

Western Fire & Forest Resilience Collaborative

1 SCENARIO DEVELOPMENT

Forest managers design treatments to achieve restoration objectives specific to a landscape

2 EMISSIONS

Generate $PM_{2.5}$ emissions estimates using a landscape ecology model

3 DISPERSION

Estimate air pollution impacts using a dispersion model

4 HEALTH

Estimate health impacts among general population using a health impact function

Thank you!

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