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Estimated impacts of forest restoration scenarios on smoke exposures among outdoor agricultural workers in California

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Abstract

As wildfires continue to worsen across western United States, forest managers are increasingly employing prescribed burns as a way to reduce excess fuels and future wildfire risk. While the ecological benefits of these fuel treatments are clear, little is known about the smoke exposure tradeoffs of using prescribed burns to mitigate wildfires, particularly among at-risk populations. Outdoor agricultural workers are a population at increased risk of smoke exposure because of their time spent outside and the physical demands of their work. Here, we assess the smoke exposure impacts among outdoor agricultural workers resulting from the implementation of six forest management scenarios proposed for a landscape in the Central Sierra, California. We leverage emissions estimates from LANDIS-II to model daily $PM_{2.5}$ concentrations with the Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) and link those to agricultural employment data from the Bureau of Labor Statistics. We find a u-shaped result, in that moderate amounts of prescribed burning result in the greatest reduction in total smoke exposure among outdoor agricultural workers, particularly during months of peak agricultural activity due to wildfire-specific smoke reductions. The reduction in total smoke exposure, relative to scenarios with the least amount of management, decreases as more prescribed burning is applied to the landscape due to the contributions of the fuel treatments themselves to overall smoke burden. The results of this analysis may contribute to preparedness efforts aimed at reducing smoke exposures among outdoor agricultural workers, while also informing forest management planning for this specific landscape.

1. Introduction

Since the latter half of the 20th century, wildfires have become more frequent and severe across the western United States (U.S.) due to climate change and post-colonial fire exclusion practices (Littell *et al* 2010, Ryan *et al* 2013, Williams 2013, Dennison *et al* 2014, Abatzoglou and Williams 2016, Westerling 2016, Halofsky *et al* 2020). As a result, outdoor agricultural workers are a population that may be increasingly vulnerable to smoke impacts (Austin *et al* 2021, Marlier *et al* 2022, Jung *et al* 2024, Schollaert *et al* 2023). California's agricultural industry provides over three-quarters of the fruits and nuts and over one third of the vegetables consumed across the U.S., bringing in approximately $22.5 billion in 2021 and employing over 400,000 workers annually (CDFA 2022, CA EDD 2020). A recent study of wildfire smoke exposure among outdoor agricultural workers in California estimated that between 2004–2009, there were 646,000 worker smoke exposure days over the 'Unhealthy for Sensitive Groups' Air Quality Index (AQI) threshold per county (Marlier *et al* 2022). Established by the U.S. Environmental Protection Agency as a tool to communicate air pollution risk exposure to the public, the AQI is a set of six categories based on corresponding ranges of $PM_{2.5}$ concentrations (EPA 2023). The $PM_{2.5}$ concentration threshold for the 'Unhealthy for Sensitive Groups' AQI category is 35.5 $\mu g\ m^{-3}$ (AQI 101). To estimate future smoke impacts, the authors leveraged GEOS-Chem modeled $PM_{2.5}$ data previously generated by Liu *et al* 2016, using emissions estimates from a fire prediction model, which predicts future wildfire burn area based on projected changes in temperature, precipitation, and relative humidity (Yue *et al* 2013, 2014). Based on these estimates, the authors projected the number of worker smoke exposure days to increase by over 190% by 2046 as a result of climate change (Marlier *et al* 2022). Another study in Washington state found that counties with the highest agricultural worker populations experienced the greatest number of days with both elevated heat and air pollution exposures during wildfire season, indicating the potential for hazardous co-exposures during peak crop production periods (Austin *et al* 2021).

Recent surveys of agricultural workers and employers in California have documented varied awareness of air quality issues pertaining to wildfire smoke in the workplace along with limited knowledge of exposure reduction measures, such as the use of masks or respirators, which highlights the need for an increased understanding of smoke exposures in agricultural settings and more targeted exposure reduction efforts (Riden *et al* 2020, Wadsworth *et al* 2022). While few studies have examined the health impacts of wildfire smoke exposure among outdoor agricultural workers, a rich literature has documented the negative links between wildfire smoke exposure and human health outcomes in the general population and subpopulations and provides indications of broadscale impacts. Studies of wildland firefighters have documented an increased risk of short-term declines in lung function and long term elevated risk of hypertension following occupational exposure to wildfire smoke (Groot *et al* 2019, Navarro 2018). Among the general population, wildfire smoke exposure is known to be associated with respiratory-related mortality and morbidities, such as asthma and chronic obstructive pulmonary disease exacerbations, adverse cardiovascular outcomes, mental health outcomes, and birth outcomes, such as low birth weight (Cascio 2018). Relative to the general population, outdoor agricultural workers are likely more vulnerable to the health impacts of wildfire smoke exposure due to more time spent outside during work shifts inhaling ambient air and heavier physical labor demands, which drive increased inhalation rates and higher smoke doses per unit smoke inhaled. Many outdoor agricultural workers are also of lower socioeconomic status, have reduced access to healthcare, and higher rates of preexisting conditions, which are all factors that may increase vulnerability to wildfire smoke exposure impacts (Courville *et al* 2016, Méndez *et al* 2020).

To address occupational exposures to wildfire smoke among outdoor workers, the California Division of Occupational Safety and Health (Cal/OSHA) introduced a wildfire smoke emergency standard in 2019 (CA Section 5141.1). Made permanent in 2021, CA Section 5141.1 requires that employers implement various exposure reduction measures at two AQI thresholds, as determined by the nearest regulatory $PM_{2.5}$ monitor or an approved on-site direct monitoring device (CA DIR 2021). When ambient air pollution levels meet or exceed the lower of the two thresholds—AQI 151 ($PM_{2.5} \geqslant 55.5\ \mu g\ m^3$)—employers are required to implement engineering controls when possible, such as providing an enclosed space with filtered air, administrative controls, such as work schedule changes, and provide NIOSH-approved particulate respirators for voluntary use (CA DIR 2021). At the upper threshold—AQI 500 ($PM_{2.5} \geqslant 500.5\ \mu g\ m^3$)—employers must provide particulate respirators for mandatory use by workers (CA DIR 2021). The rule applies to emissions stemming from fires in 'wildlands', which includes both wildfire and prescribed burns (CA DIR 2021). Marlier *et al* (2022) estimated that 244,000 worker-days per county were impacted by the lower AQI 151 CA Section 5141.1 threshold between 2004–2009, with the number of worker-days more than doubling (767,000 worker-days) by 2046–2051 under future climate change projections. This was the first study to assess wildfire smoke exposures among outdoor agricultural workers in relation to the CA Section 5141.1 thresholds.

Increasing awareness of the adverse human health impacts from wildfire smoke has led to interest in more upstream strategies that address the severity and scale of wildfires. One such example consists of resilience-focused fuel treatment strategies, such as the use of prescribed burns, which are intentionally set fires intended to reduce fuel loads, often implemented outside of peak fire season, when meteorological conditions are conducive for preventing fire spread and undesirable smoke dispersion. Prescribed burns are increasingly being implemented to restore more natural fire regimes and reduce extreme wildfire risk across the western U.S. (Ryan *et al* 2013, Hessburg *et al* 2015, Stephens *et al* 2020). These fuel treatments have the potential to reduce smoke exposures from wildfires, but also contribute to hazardous air pollution themselves (Ravi *et al* 2018, Burke *et al* 2021, D'Evelyn *et al* 2022, Kelp *et al* 2023). Spatiotemporal differences in smoke exposures from wildfires and prescribed burns may have implications for outdoor agricultural workers, approximately 25% of whom are seasonally employed during the growing and harvesting seasons, which often overlap with peak wildfire smoke season (i.e. July–November) (BLS 2022). However, resilience-focused fuel treatments may also reduce total smoke exposures among outdoor workers—therefore addressing occupational health goals in addition to ecological goals (NORA 2018, 2019).

While Marlier *et al* (2022) explored past and future wildfire smoke exposures under climate change among agricultural workers, no previous studies have examined the impacts of management tradeoffs in this population. To address this gap, we compare the smoke exposure impacts of six forest management scenarios, which vary in the scale and pace of management efforts, proposed for a 970,000 hectare landscape in the Central Sierra among crop production and support for crop production workers, with the goal of identifying optimal scenarios for reducing workplace exposures in these specific agricultural sectors (figure 1). The Central Sierras are a fire-prone mountainous region, just east of California's Central Valley, the state's most productive agricultural region (USGS 2023). We leverage modeled estimates of $PM_{2.5}$ concentrations from simulated wildfires and prescribed burns to estimate county-level agricultural worker exposure levels and use those to evaluate the scenarios in the context of CA Section 5141.1.

2. Methods

2.1. Scenarios

Six forest management scenarios were co-developed by management agencies and researchers for a 970,000 hectare landscape called the Tahoe Central Sierra Initiative (TCSI). Each management scenario varies in the amount and rate of hand thinning, mechanical thinning, and prescribed burning applied to the landscape each year (figure 1). The business as usual (BAU) scenario most closely resembles what management currently looks like on the landscape in terms of general management strategy. Prescribed burning is introduced in the middle tier scenarios ($Fire^{Lite}$ and Fire) and increases in the amount applied per year under the upper tier scenarios (Fire+ and Fire++). Additional information about the scenarios can be found in supplementary materials (table S1) (Maxwell *et al* 2022).

2.2. Emissions and dispersion modeling

Simulated emissions from wildfires and prescribed burns under each management scenario were estimated at a 200 × 200 m resolution from 1981–2020 using the LANDIS-II landscape change model with the SCRPPLE fire extension (Scheller *et al* 2007, 2019). LANDIS-II simulates forests as individual species-age cohorts within grid cells that can spatially interact and be impacted across space and time by processes like growth, succession, disturbance, and management, and has been previously validated by Scheller and Mladenoff (2004). We used a combination of meteorological inputs from gridMET (temperature, precipitation, and relative humidity values) the Weather Research and Forecasting (WRF) Advanced Research Weather and Forecasting (ARW) archived 27 km dataset (wind speed and direction) (Scheller *et al* 2007). The BAU scenario was used to calibrate the modeled burn area estimates against the CalFire Fire and Resource Assessment Program perimeter dataset. A more detailed description of the calibration process, along with a figure depicting annual observed burn area relative to modeled burn area estimates for the TCSI are provided in Maxwell *et al* (2022). A figure depicting the number of annual wildfire and prescribed burn events under each scenario is provided in figure S2. While the broader region surrounding the TCSI had been impacted by large wildfires over the past several decades, the largest fire within the TCSI boundary was the King Fire in 2014, approximately 40,000 ha, until the Caldor fire in 2021, which occurred outside of the study period and thus outside of the LANDIS calibration time frame (USFS 2014).

Subsequent downwind wildfires and prescribed burn-specific daily $PM_{2.5}$ concentrations were generated with the Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT), a previously validated air pollution model which estimates particle transport based on meteorology and terrain inputs and does not account for atmospheric chemistry, unlike more complex chemical transport models, such as GEOS-Chem and CMAQ (Draxler 2003, Ngan *et al* 2015, 2019, Stein *et al* 2015, Johnson *et al* 2020). We used simulated emissions estimates from LANDIS-II represented as 200 × 200 m area sources and 27 km meteorological data from the WRF-ARW archived dataset (Stein *et al* 2015, NOAA n.d.). The HYSPLIT gridded wildfire and prescribed burn-specific $PM_{2.5}$ output consists of 24 h averaged concentrations at a 27 km resolution, with the model domain centered at 38° latitude, −120° longitude and spanning 15 degrees in each direction (figure S3). Additional details on the LANDIS-II and HYSPLIT components of this analysis can be found in Schollaert *et al* (2023).

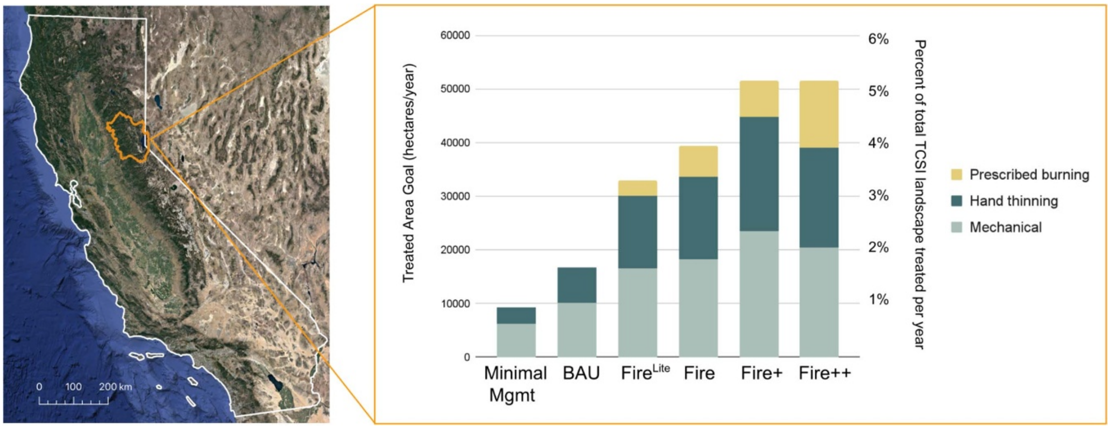

Figure 1. Location of 970 000 hectare Tahoe Central Sierra Initiative landscape (orange) and the distribution of annual treated area goals by treatment type across scenarios. Average annual burn area and emissions estimates under each scenario are provided in figure S1.

2.3. Employment data

Monthly employment data were obtained from the U.S Bureau of Labor Statistics Quarterly Census of Employment and Wages (BLS QCEW) (figure 2). We combined monthly employment counts for 'Crop Production' employment (NAICS 111 Sector Code) and 'Support Activities for Crop Production' employment (NAICS 1151 Sector Code) from 2018–2022. We chose to include these specific subsectors and exclude employment in other agricultural sectors, such as animal husbandry, because of the overlap of the crop growing and harvesting seasons with wildfire season, the spatial proximity of California's Central Valley with the TSCI landscape, and the likelihood of outdoor exposures to workers in these subsectors. For the purposes of this analysis, 'crop production' and 'support activities for crop production' employment will hereby be referred to as 'agricultural employment'. Importantly, the QCEW does not include unpaid family workers, self-employed, or undocumented workers. Additionally, the QCEW provides county-level job counts, not worker counts, and thus does not account for hours worked, individuals with multiple jobs, or where those workers actually reside. Monthly employment counts were averaged across this five year period to represent the most contemporary agricultural worker population.

Figure 2. Average annual crop production and support for crop production employment 2018–2022 per California county. Data are from the United States Bureau of Labor Statistics Quarterly Census of Employment and Wage. Monthly counts were averaged across the year then across the 5 year period.

2.4. Linking employment and smoke concentrations

Daily area average weighted wildfire and prescribed burn $PM_{2.5}$ concentrations were calculated for each county to match the spatial resolution of the BLS QCEW data. Employment-weighted smoke concentrations were calculated using the following equation:

$$eC = \frac{\sum (Pi\, x\, Ci)}{\sum Pi}$$

where eC is the employment-weighted $PM_{2.5}$ concentration, P_i is the employment of a given county (i) from the corresponding month of the daily $PM_{2.5}$ estimate, and C_i is the $PM_{2.5}$ concentration for that county. To evaluate the impact of each of the management scenarios under Section CA 5141.1, employment-days were calculated by multiplying the number of days where total smoke $PM_{2.5}$ (i.e. the sum of wildfire and prescribed burn $PM_{2.5}$) met or exceeded 151 and 500 AQI rule thresholds by employment counts for each county for the corresponding month (based on the 5 year average) when the exceedances occurred (DIR 2021). State-wide impacts were calculated by summing employment-days for each rule threshold across California counties.

3. Results

The distributions of annual average employment-weighted source-specific $PM_{2.5}$ concentrations are shown in figure 3. We estimate that employment-weighted annual average total smoke (i.e. smoke from wildfire and prescribed burns) $PM_{2.5}$ concentrations are greatest under the minimal management (1.66 μg m^{-3}), BAU (1.30 μg m^{-3}), and the Fire++ scenarios (1.30 μg m^{-3}). Employment-weighted annual average total smoke $PM_{2.5}$ concentrations were lowest under the Fire^{Lite} scenario (0.98 μg m^{-3}) and increased as more management is introduced under the Fire (1.07 μg m^{-3}) and Fire+(1.17 μg m^{-3}) scenarios. Under all management scenarios, the annual employment-weighted average $PM_{2.5}$ for prescribed burns are orders of magnitude smaller than those from wildfires.

Wildfires drive peak monthly employment-weighted total smoke $PM_{2.5}$ concentrations in August through November under the minimal management and BAU scenarios (figure 4). Total smoke concentrations for the year are also highest during these months under the scenarios that include prescribed burn use, but the magnitude of the average monthly total smoke concentrations under those scenarios are lower than the lowest management scenarios (figure 4). Importantly, these months of elevated total smoke $PM_{2.5}$ across all scenarios overlap with the peak crop production employment period during the May–October growing and harvesting seasons (figure 4). During the first six months of the year, prescribed burn contributions under the Fire++ scenario drive higher employment-weighted average monthly total smoke exposure levels relative to all other scenarios.

When assessing the impacts of each management scenario under Section 5414.1, the number of state-wide employment-days that reach or exceed the lower AQI 151 threshold are lowest under the Fire^{Lite} (29 106 d), Fire (26 624 d), and Fire+ (30 908 d) scenarios. As more prescribed burning is applied to the landscape under the Fire++ scenario, the number of employment-days that reach or exceed the AQI 151 threshold starts to increase in counties directly west of the TCSI landscape, such as Butte and Sutter counties (figure 5). We see a similar trend for the higher AQI 500 CA Section 5141.1 threshold, but the number of employment-days does not increase as more prescribed burning is applied to the landscape under the upper tier scenarios (Fire+ and Fire++), likely because the magnitude of smoke exposures stemming from prescribed burns are lower relative to those from wildfire (figures 3, 5). The average percent of days per year per county that exceed each rule threshold are provided in figure S5. Importantly, these estimates for impacted employment-days do not additionally account for the contribution of other sources of $PM_{2.5}$ or contributions from fires outside the TCSI landscape. The annual numbers of employment-days impacted by the two Section 5414.1 thresholds for each individual county are provided in table S2.

While the number of employment-days impacted by the lower AQI 151 threshold outnumber those impacted by the upper AQI 500 threshold, the most exceedances for both thresholds under all scenarios occur during the July through November wildfire smoke season (figure 6). The greatest number of exceedances of both rule thresholds occur during the wildfire season in August through October under the minimal management scenario. While exceedances of the lower threshold follow a similar pattern under the BAU scenario, exceedances of the upper threshold under this scenario peak earlier in the season in July - August. While temporal patterns of lower threshold exceedances look similar among the scenarios that include the use of prescribed burning, the timing is more variable at the upper AQI 500 threshold, with a more delayed peak under the Fire^{Lite} scenario in October, relative to the earlier September timing of maximum exceedances under the Fire, Fire+, and Fire++ scenarios (figure 6). State-wide estimates of impacted worker days for each year within the study period are provided in figure S6.

4. Discussion

4.1. Summary of results

Outdoor agricultural workers are a population that are at increased risk of wildfire smoke exposures given the overlap of peak crop production and wildfire seasons, proximity to fire-prone landscapes, and the physically demanding work that contributes to higher respiratory rates and subsequent air pollution doses per unit of exposure. Forest management activities, intended to reduce extreme wildfire risk, may be a useful tool to reduce smoke exposure among this population. Here we demonstrate the utility of a scenario-based approach to evaluate the ability of certain proposed forest management activities planned for the Central Sierra region to reduce smoke exposures among outdoor agricultural workers in California.

We find that implementation of relatively moderate amounts of prescribed burning (i.e. the Fire^{Lite} and Fire scenarios), result in the lowest annual employment-weighted exposure to total smoke. This pattern highlights that the pace and magnitude of fuel treatments applied under these middle tier scenarios are most favorable due to their ability to reduce

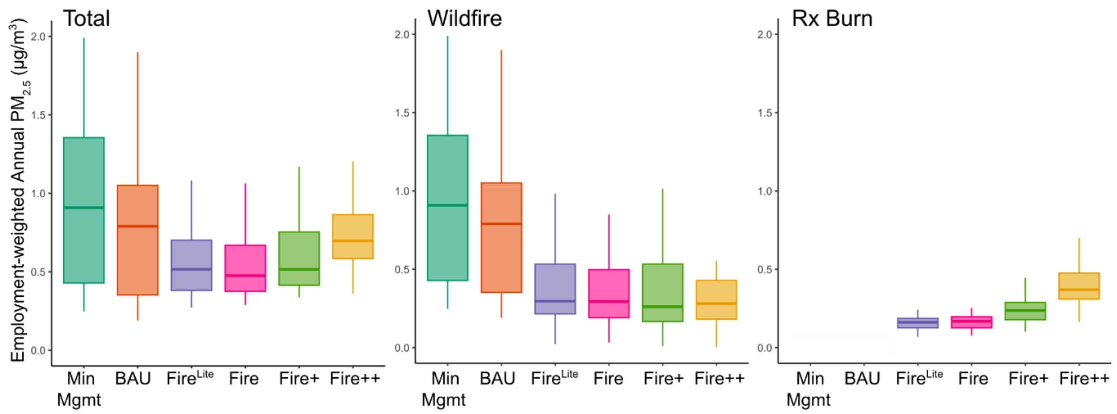

Figure 3. Boxplots of annual employment-weighted average $PM_{2.5}$ concentrations from total smoke, wildfire, and prescribed burns across each scenario.

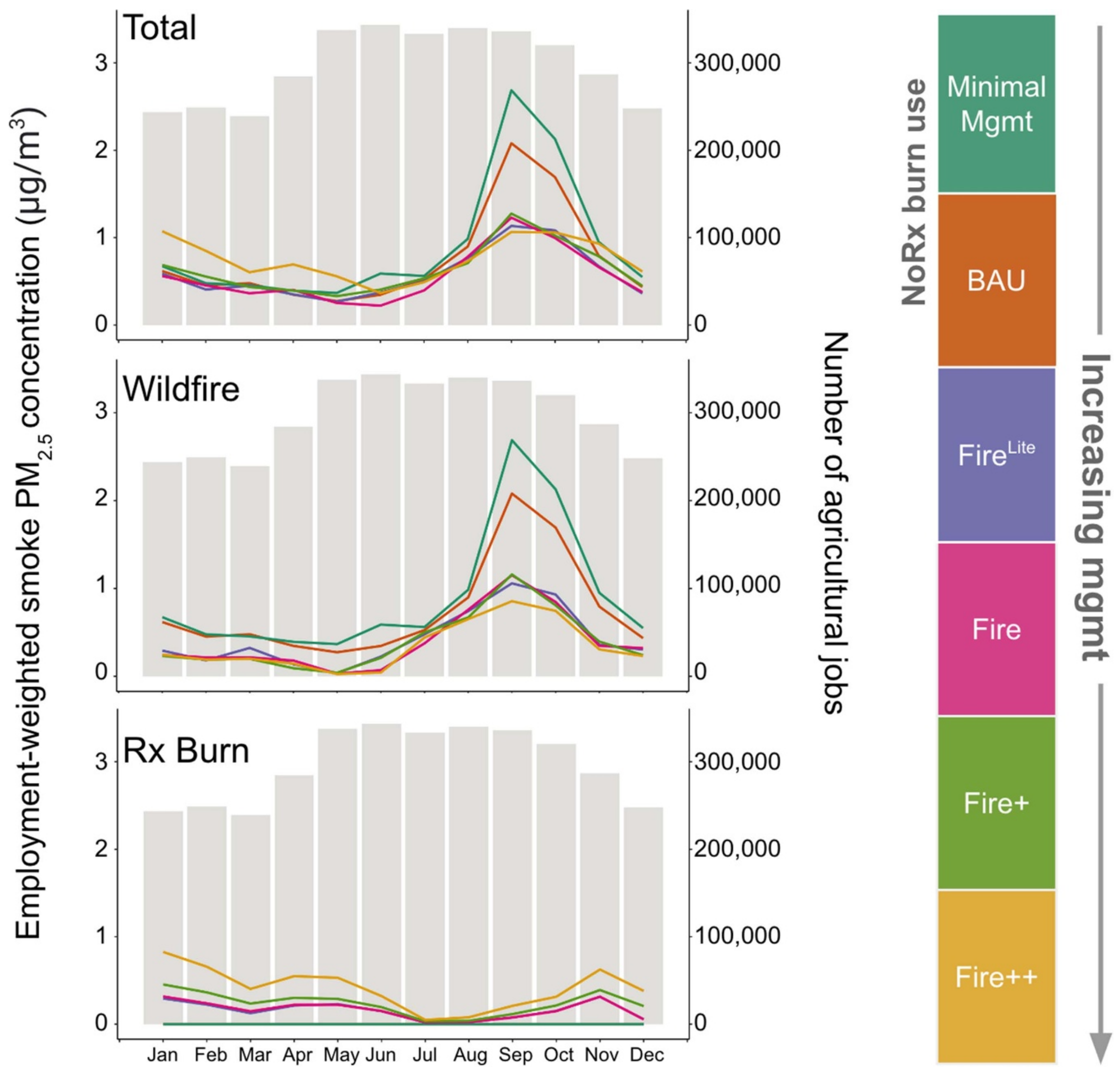

Figure 4. Monthly employment distribution (gray bar) and average monthly employment-weighted total smoke (top), wildfire (middle), and prescribed burn smoke (bottom) concentrations across scenarios.

smoke from wildfires while simultaneously limiting prescribed burn-specific smoke impact among workers. Sub-annually, we see the greatest reduction in smoke exposures among workers in scenarios that use prescribed burning, relative to those that do not, in the months of August through November, when crop production activity is at its peak across the state (figures 4, 6) (USDA 2010, CDFA 2022).

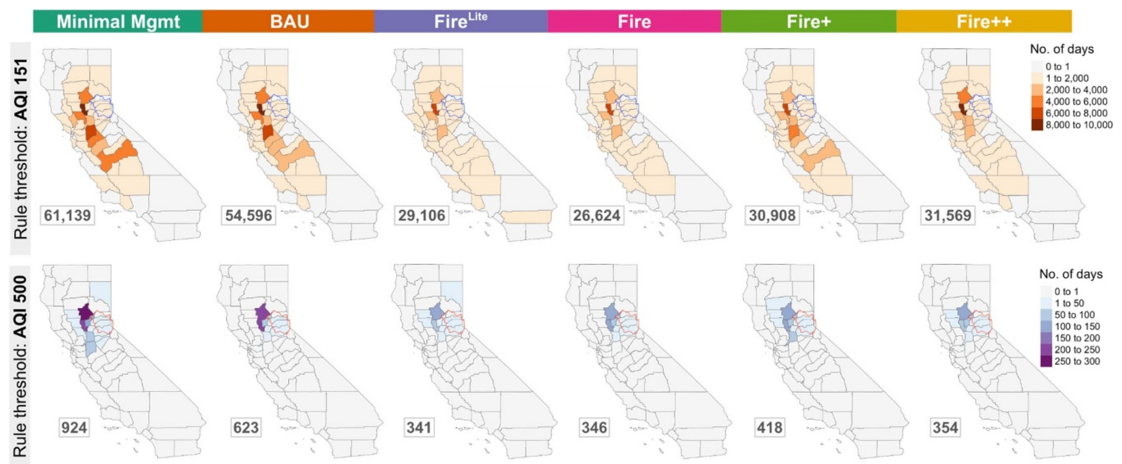

Figure 5. Average number of employment-days per year per county that exceed the AQI 151 (top) and AQI 500 (bottom) thresholds of CA Section 5141.1. The numbers at the bottom left of each map represent the total state-wide number of employment-days per year.

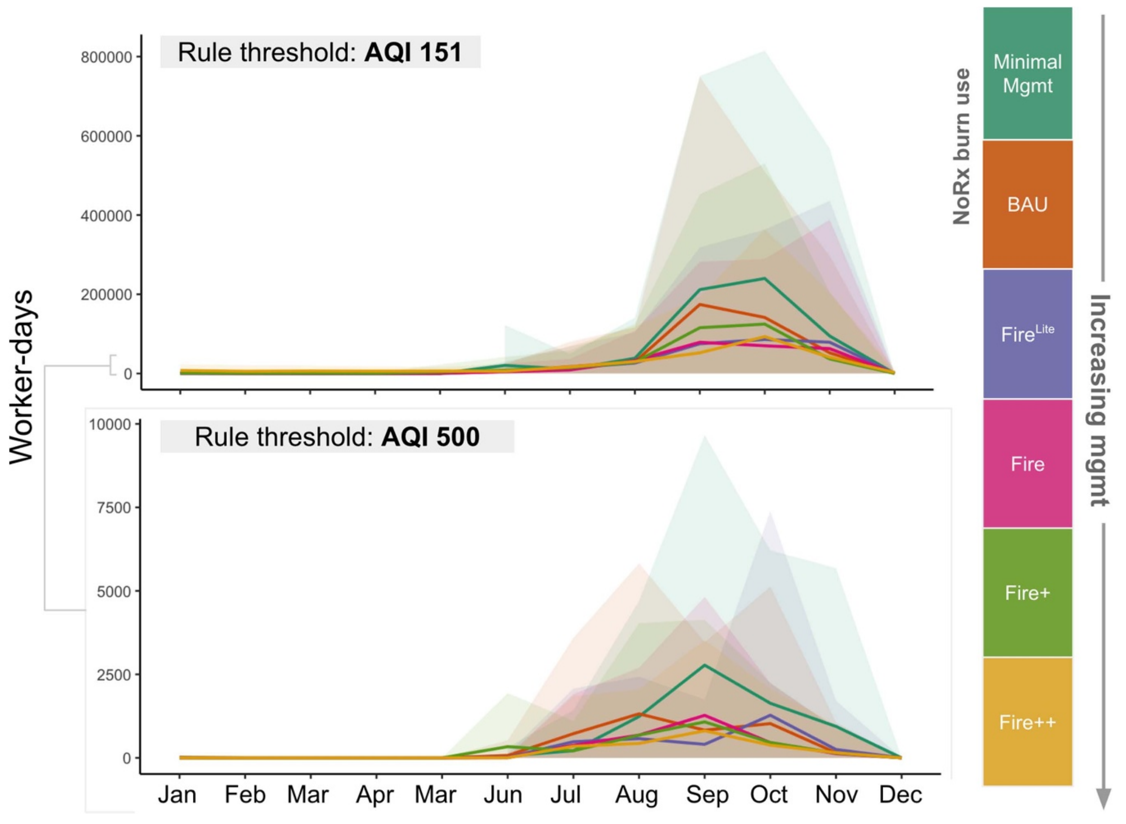

Figure 6. Average monthly state-wide employment-days that exceed the AQI 151 (top) and AQI 500 (bottom) thresholds of CA Section 5141.1. Note the difference in y-axis scale between the top and bottom panels. Shading represents the standard deviation of the monthly estimates.

We also examined the impacts of these proposed scenarios relative to CA Section 5141.1 and found that the minimal management scenario would result in the greatest number of impacted employment-days across the state under the AQI 151 (61,139 employment-days) and AQI 500 thresholds (924 employment-days). The fewest number of employment-days affected under each of the rule thresholds occurred under the two middle tier scenarios, with 29,106 and 26,624 employment-days exceeding the lower threshold and 341 and 346 employment-days exceeding the upper threshold under the Fire^{Lite} and Fire scenarios, respectively. In addition to the potential worker health burdens associated with these exposures, these smoke impacts may have economic implications for employers, for example in terms of respirator costs and reduced productivity (Borgschulte *et al* 2022). While the prescribed burns themselves also contribute to total smoke exposures, particularly under Fire+ and Fire++ scenarios, these fuel treatments are planned events and thus present the opportunity to activate preventive measures and leverage a wider range of the hierarchy of exposure controls to protect workers. For example, employers could proactively establish engineering controls like clean air centers, make administrative work schedule adjustments, or purchase respirators in advance, all which may be less feasible during an unplanned wildfire. While we established that middle tier scenarios can reduce total smoke exposure burden among workers, other scenarios may be more favorable when considering the impacts on factors such as tree mortality, carbon sequestration, and insect outbreaks, as assessed in Maxwell *et al* (2022). Multiobjective decision-making is thus an important step in evaluating these forest management scenarios.

4.2. Strengths and limitations

The primary strength of our analysis stems from our evaluation of spatially and temporally explicit forest management prescriptions designed for a specific landscape, unlike previous studies which have relied on hypothetical high-level representations of prescribed burn increases uniformly applied across large geographic areas (Ravi *et al* 2018, Burke *et al* 2021). Some limitations arise from the use of the BLS QCEW, which provides estimates of the number of jobs within a county but is limited in its representativeness of the true working population in agriculture. The QCEW is estimated to represent about 80% of documented agricultural employment, not accounting for unpaid family workers, self-employed workers, or workers that hold multiple jobs (BLS 2022). The QCEW also does not account for undocumented workers, and given that the U.S. Department of Labor estimates that approximately half of farm workers do not hold legal immigration status, these employment counts are likely an underestimate of the actual agricultural workforce (Castillo and Simnitt 2020). Further, subpopulations, such as undocumented workers, may have elevated risk profiles compared to their counterparts (Castillo *et al* 2021). It is also important to note that other outdoor job sectors beyond NAICS 111 and 1151 are likely to also be impacted by elevated smoke exposures, including other agricultural workers, those who work in construction, outdoor recreation, and transportation, as well as those who work primarily indoors due infiltration of ambient air into indoor environments (Liang *et al* 2021).

Uncertainties in our analyses also stem from aggregating smoke concentrations across county boundaries, which masks spatial variability in $PM_{2.5}$ exposures that may exist within the county, particularly in larger rural counties. Our estimates of worker-day impacts at each of CA Section 5141.1 thresholds do not account for anthropogenic sources of $PM_{2.5}$ or smoke from fires outside of the TCSI landscape, which likely contribute to an underestimation of the number of employment days where smoke exposures exceed the two AQI thresholds across all scenarios. We also do not consider smoke from agricultural burning, which is the practice of burning crop residues before seeding or after the harvest, which likely also contributes to total smoke exposure burdens among agricultural workers. We do not account for exposure misclassification as a result of actions that outdoor workers or employers might take during wildfire smoke events, such as staying home from work, relocation, or altering work schedules; however, studies of risk perception to environmental hazards in agricultural workplaces in California have found limited concern or response pertaining to poor air quality among employers, relative to other environmental hazards (Wadsworth *et al* 2022). Additionally, interviews and focus groups of California agricultural workers have documented limited knowledge of wildfire smoke exposure risk along with a sense of pressure among workers to continue working despite the presence of environmental hazards (Courville *et al* 2016, Riden *et al* 2020). Finally, while we do not characterize the actual dose of $PM_{2.5}$ absorbed and how that may vary relative to the general population due the physical exertion and the elevated respiratory rates of outdoor agricultural workers, we assume constant levels of exertion and respiratory demands among workers across scenarios.

Conclusions

This study provides an evaluation of the potential wildfire smoke reduction and prescribed burn smoke impacts that future forest management activities could have on outdoor agricultural worker populations in California. While this study is specific to a particular region in California, our modeling framework could be applied in other geographies and to other at-risk populations to assess the potential exposure impacts of prescribed fire use in areas where agricultural regions are in close proximity to fire-prone forested lands. Outside of the U.S., our framework can be applied to better understand the downwind exposure impacts resulting from other human-driven biomass burning practices, such as agricultural burning in India or land clearing burns by the palm oil industry in Indonesia. As climate change continues to drive worsening wildfire smoke impacts across the western U.S., and forest management activities ramp up to counteract those impacts, we must better understand the exposure burdens among at-risk populations. Outdoor agricultural workers are a population who are particularly at-risk of wildfire smoke exposures. As forest management planning continues to accelerate across the western U.S., it is crucial that we continue to research and prioritize mitigation strategies that maximize exposure reduction benefits for this at-risk population.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors. Publicly available employment data were accessed via the Bureau for Labor Statistics (www.bls.gov/cew/downloadable-data-files.htm).

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