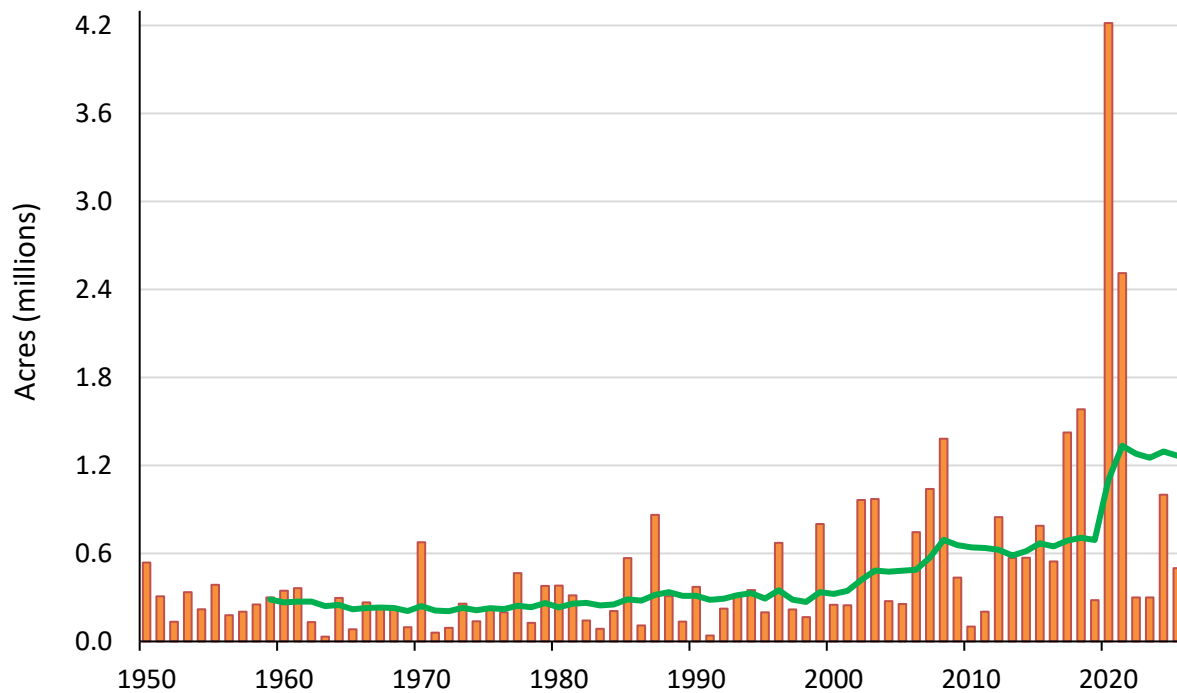


4.1 Wildfires

Wildfires now burn more acreage, and large fires are occurring more often, fueled by dry conditions, high winds, and dense vegetation. Fast-moving wildfires have left entire neighborhoods in ruins, and the increasing extent of high-severity wildfire damage to natural landscapes limits recovery. Although fire is an essential and often beneficial component of California's ecosystems, the undesirable impacts from modern wildfires challenge people and ecosystems to adapt to each increasingly dangerous fire season.

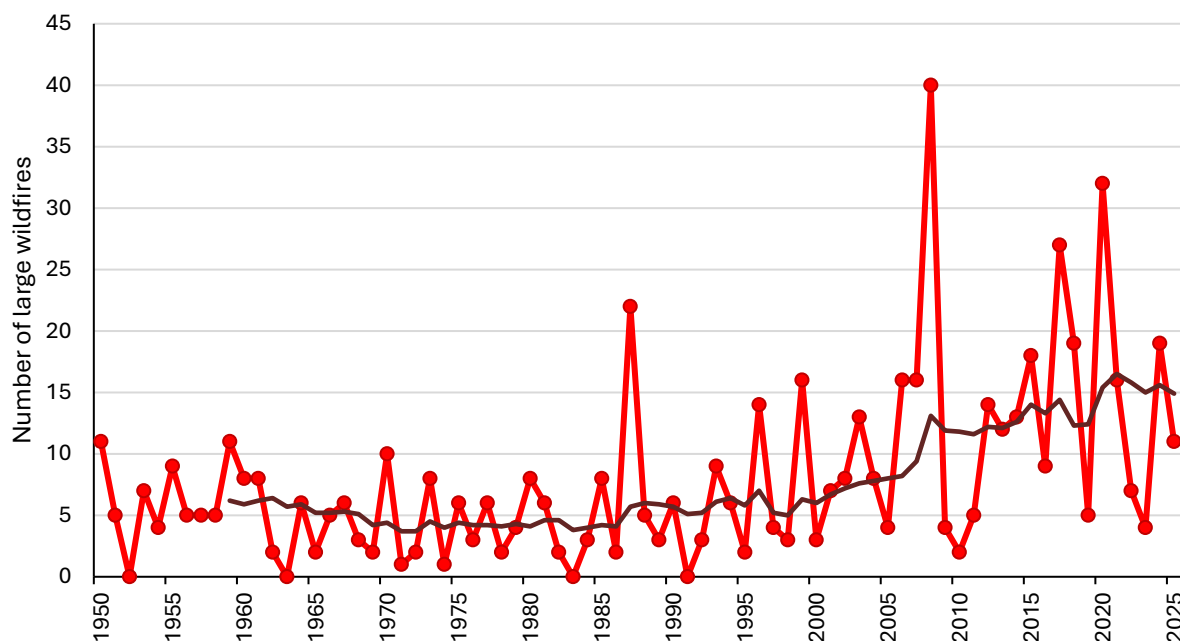
Figure 4.1.1. Statewide Annual Acres Burned.



The graph shows annual number of acres burned in California from 1950 to 2025. Source: CAL FIRE (2026a)



Figure 4.1.2. Statewide Number of Large Wildfires.



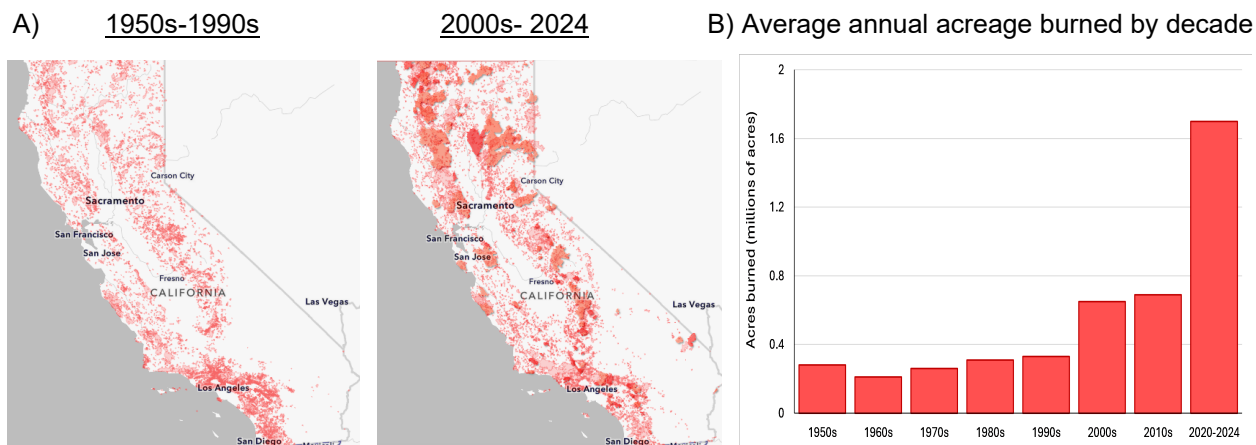
The graph shows the number of large wildfires larger than 10,000 acres from 1950 to 2025 (the dark line represents the 10-year running average). Source: CAL FIRE (2026a)

What does the indicator show?

Figure 4.1.1 shows the number of acres burned by wildfires each year. The total annual area burned since 1950 ranged from a low of 32,000 acres in 1963 to a record high of 4.2 million acres in 2020 – more than 4 percent of the state's roughly 100 million acres of land. 2021 was the second highest year in acreage burned by a wide margin: wildfires consumed about 2.6 million acres, compared to about 1.6 million in 2018, the third highest year. 2024 ranks seventh highest. In addition, large wildfires are becoming increasingly common: the total area burned by wildfires and the number of large fires (over 10,000 acres) in California has risen substantially (**Figure 4.1.2**). The average (mean) area burned each year in the last two full decades (2000s and 2010s) is at least double the acreage of earlier decades (**Figure 4.1.3**).



Figure 4.1.3. Areas Burned in California.



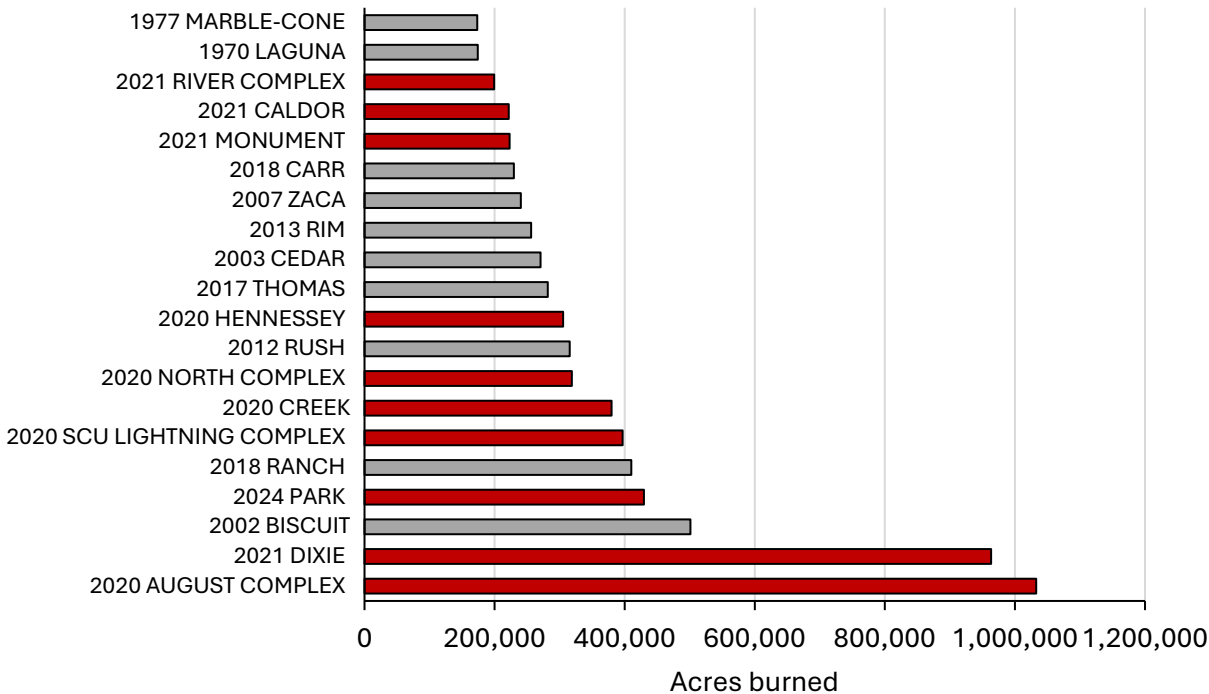
The maps above show areas burned in 1950s-1990s (A) and in 2000s-2024 (B). The graph shows the average annual acreage burned by decade.

Source: CAL FIRE (2025)

From 1950 through 1999, about 0.3 million acres burned on average each year. From 2000 to 2019, about 0.7 million acres burned on average each year. From 2020 to 2024, about 1.7 million acres burned on average each year (more than double the annual average from 2000 to 2019). In addition, until the 2010s, the largest fires occurred in Southern California. In the past several years, most of the largest fires have occurred in the north, including the August Complex fires in 2020 (in Mendocino, Humboldt, Trinity Tehama, Glenn, Lake and Colusa Counties) and the Dixie Fire in 2021 (in Butte, Plumas, Lassen, Shasta and Tehama counties), which surpassed previous fire size records with all but two of the largest wildfires have occurred since 2000 (**Figure 4.1.4**), including nine that burned in 2020 and 2021 (CAL FIRE, 2025). The increasing prevalence of very large fires (>10,000 acres) in California and across the West has led some researchers and agencies to describe the US as entering an era of “mega-fires” or, when also considering recent large-scale tree mortality events, an era of “mega-disturbances” (CAL FIRE, 2018; also see the *Forest Tree Mortality* chapter and *Changes in Forests and Woodland Composition* chapter).



Figure 4.1.4. Top Twenty California Fires, by Size, Since 1950.

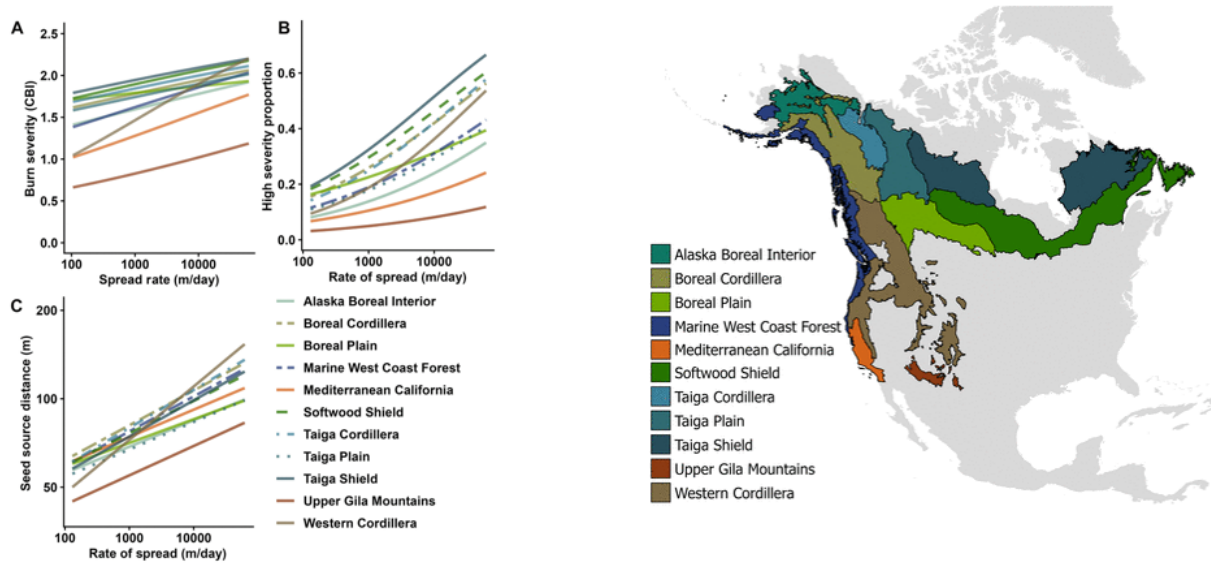


Red bars denote fires that occurred in 2020 through 2024. Source: CAL FIRE (2025)

In addition to increasing acreage burned and increasing numbers of large wildfires, the speed at which a fire burns is an important metric relevant to the impacts of wildfires. A study of 3,499 wildfires occurring between 2012 and 2023 in conifer-dominated forests of Canada and the western United States found that the fastest fires burned outsized areas and had more severe ecological impacts (Figure 4.1.5; Coop et al., 2026). As described in more detail in “*What factors influence this indicator?*”, evidence suggests that a changing climate, combined with land-use patterns, is creating conditions that favor faster-moving, larger, and more severe wildfires across the state and may have significant ecological impacts. Further research on wildfire spread rates in California could provide valuable insights into how climate change is influencing fire behavior. This need is underscored by the fact that 16 of the 20 most destructive wildfires in the state’s recorded history, as measured by structural damage and human mortality, occurred after 2010 (CAL FIRE, 2026b).

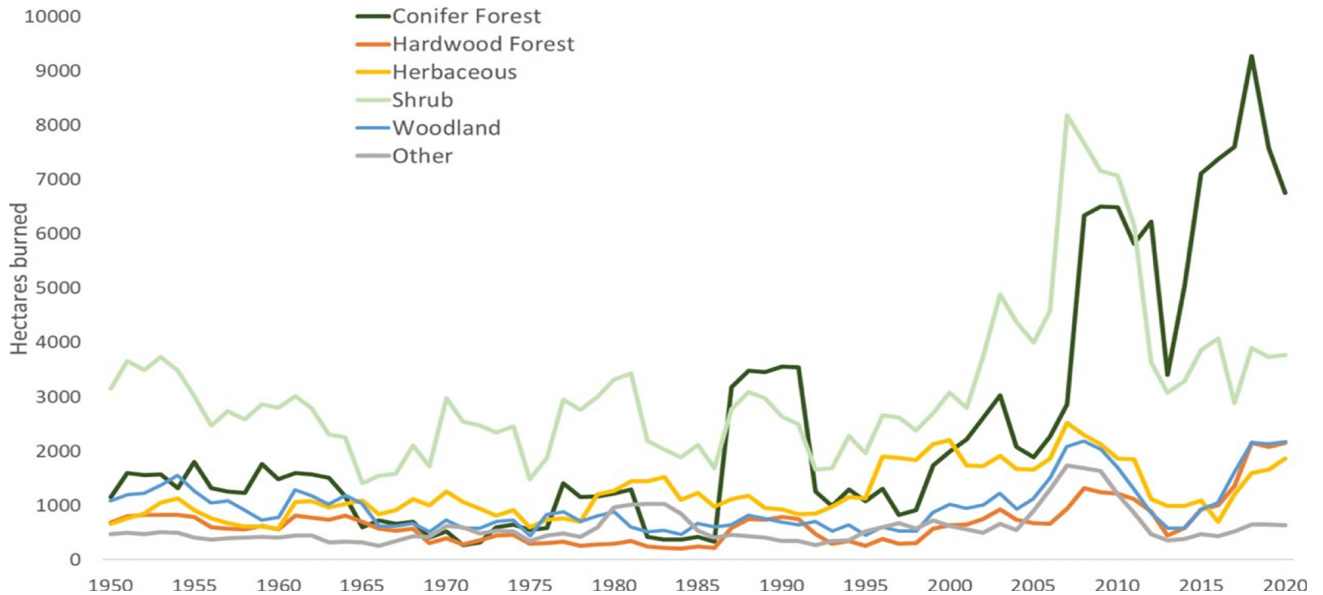


Figure 4.1.5. Rate of Spread of Wildfires in Conifer-Dominated Forests of Western United States and Canada and Ecological Impacts.



The increasing speed of wildfires is directly proportional to A) burn severity, B) the proportion of area burned at high severity, and C) the distance from live tree seed sources. The map on the right shows the ecoregions studied. Source: Adapted from Coop et al. (2026)



Figure 4.1.6. Area Burned by Vegetation Type.

The graph above shows area burned in California from 1950 to 2020 in hectares (1 hectare equals 2.47 acres). Area burned is smoothed over a five-year window for five vegetation types: coniferous forest; hardwood forest; woodland (consisting of hardwood and coniferous woodland); shrub; herbaceous vegetation; and “other,” which includes lower flammability and partially vegetated areas. Source: Schwartz and Syphard (2021)

Why is this indicator important?

Wildfires are a natural part of California's landscape and play an important role in shaping the state's ecosystems. More beneficial fire is needed to restore ecosystem structure and function. At the same time, wildfires can pose serious risks to public health, safety, property, and infrastructure. In the worst instances they take a heavy toll on individuals and communities across the state—causing the loss of lives, homes, livelihoods, and cherished places—and beyond in terms of smoke-related health impacts and negative economic impacts.

"It was nuclear winter. It was like Armageddon. It looked like the end of the world."

- San Diego city firefighter Mitch Mendler, on southern California wildfires in 2007

(Reported by the Associated Press)



Large, high-severity wildfires threaten California’s diverse ecosystems. While many of these ecosystems—and iconic species like giant sequoias and redwoods—are adapted to fire, the scale, frequency, or intensity of recent wildfires (such as the CZU Complex Fire that devastated the Big Basin Redwoods State Park ([Figure 4.1.7](#)) are unprecedented. Severe wildfires can transform forests into shrubland or grassland, diminishing soil health, water quality, wildlife habitat, and carbon storage (CAL FIRE, 2018). They degrade soils, increase erosion and flood risk (Oakley, 2021; Neary et al., 2008), and kill wildlife that might otherwise evade smaller fires (CAL FIRE, 2018).

Figure 4.1.7. Coastal Redwood Regrowth.



The CZU Complex Fire severely damaged ancient coastal redwoods of Big Basin Redwoods State Park in 2020, burning even upper branches despite fire-resistant bark (Potter, 2023). The redwoods mobilized old carbohydrate stores to resprout a few months after (sprouts formed a ring around the burned tree in the photo above), but it is uncertain whether they can fully recover or withstand future extreme fires (Peltier et al., 2023). Photo credit: Lissy Enright/US Forest Service



Severe wildfires also can disrupt aquatic ecosystems by altering streamflow, increasing sediment, and introducing pollutants like ash, fire retardants, and heavy metals—threatening species such as Chinook salmon (Alizadeh et al., 2021; Neary et al., 2008). Runoff from burned areas can carry such contaminants to the ocean, harming marine ecosystems for years (OPC, 2026). At the same time, wildfire smoke can provide a benefit to cold-water adapted species like Chinook salmon by reducing solar radiation and cooling air temperatures, which in turn cools freshwater temperatures (David et al., 2018; also see the *Chinook Salmon Abundance* chapter for the complex ways in which wildfires impact Chinook salmon populations in California).

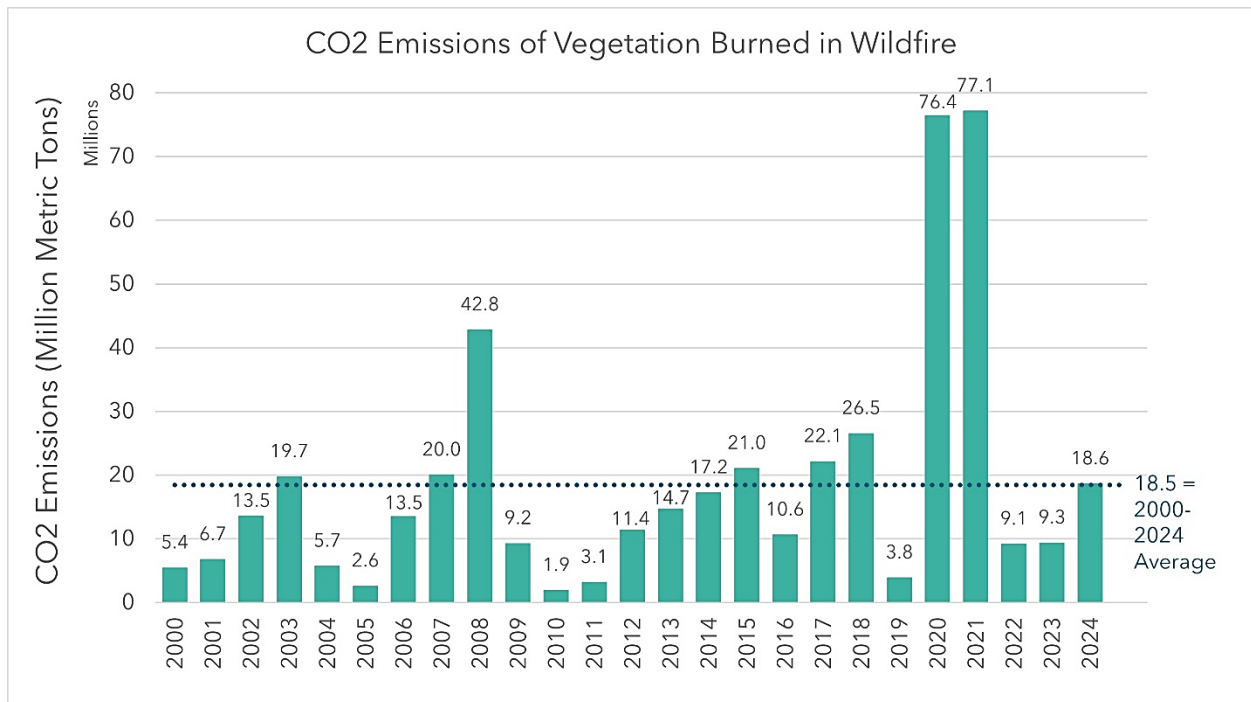
Smoke and toxic gases released by wildfires can impact the health of wildlife and ecosystems. Adverse health impacts of wildfire smoke have been reported to contribute to changes in behavior, movement and vocalization in a vast assemblage of terrestrial and aquatic mammals (primates, marsupials, bats, etc.), birds (raptors, woodpeckers, etc.), insects (butterflies, beetles, etc.) and reptiles (lizards, snakes, etc.) (Sanderfoot et al., 2021). Smoke is known to damage the lungs of birds and increase their susceptibility to respiratory infection. Wildfires have increasingly coincided with fall bird migration, where low visibility caused by smoke can disrupt the navigation for migratory species and create difficulties in finding food sources (Overton et al., 2021; Sanderfoot and Holloway, 2017; see the *Migratory Bird Arrivals* chapter and the *Spring Flight of California Central Valley Butterflies* chapter for other ways that climate change is impacting these species). Wildfire smoke can also negatively impact watersheds, where deposition of smoke and ash in streams can result in dramatic increases in nutrient concentrations and fluctuations of pH, potentially harming aquatic organisms (David et al., 2018).

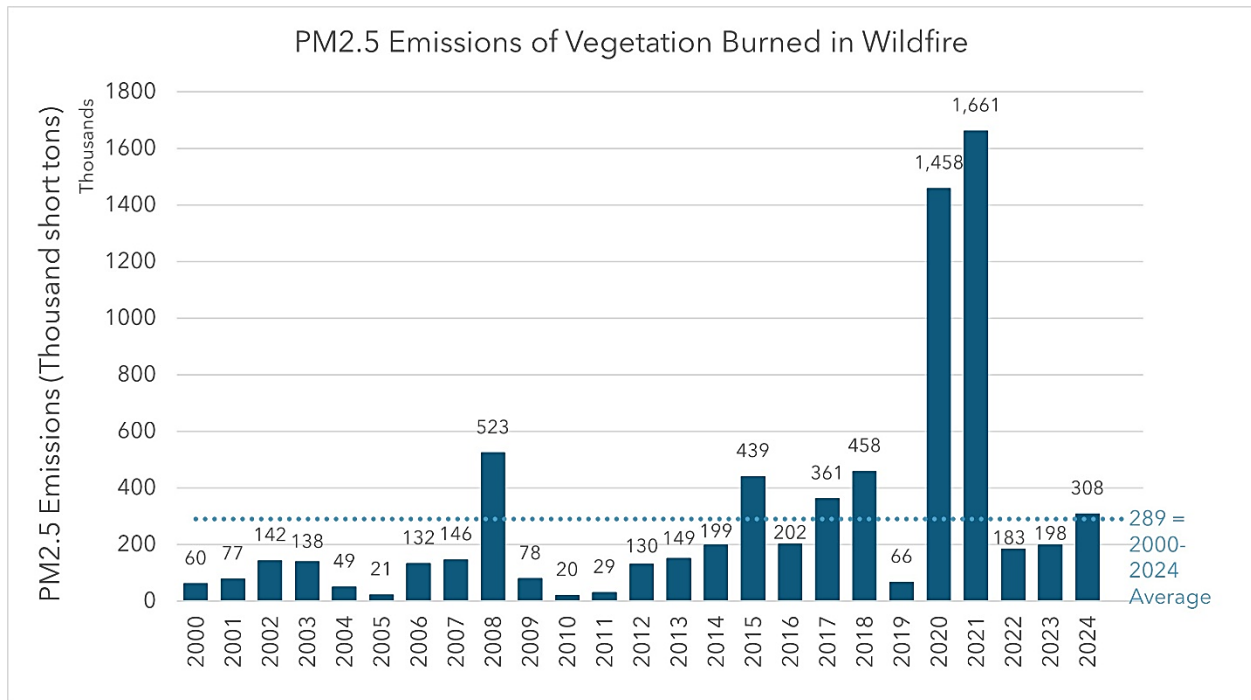
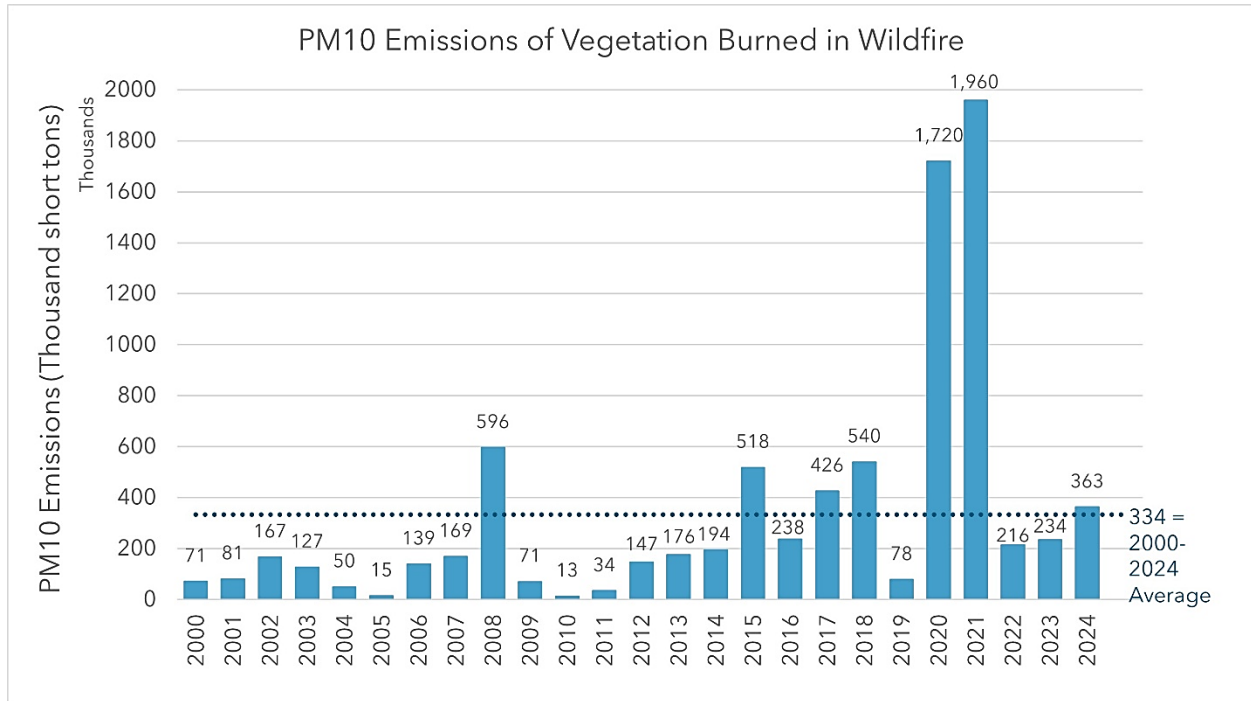
Wildfires have severe impacts on public health, primarily through exposure to wildfire smoke, which is often transported to local and regional population centers and can worsen air quality across the state. When human-made structures burn (as increasingly occur in the wildland-urban interface (WUI), communities are also exposed to diverse



and largely uncharacterized air toxins from building materials and household products. The chemical composition of WUI fire smoke — which may include combustion products of plastics, synthetic polymers, treated wood, paints, coatings, insulation, and electronics — can differ substantially from vegetation-only wildfire smoke, meaning PM (2.5) mass alone does not fully characterize the health hazard in structure-fire events. Wildfire also releases carbon dioxide (CO₂) and other greenhouse gases that contribute to climate change, though quantifying the net contribution is complex given that fire is part of the terrestrial carbon cycle and can bolster carbon sequestration in healthy fire regimes. **Figure 4.1.8** shows CO₂ and particulate matter (PM_{2.5}) emissions from California wildfires since 2004; 2020 and 2021 represent the two highest years on record. For a detailed assessment of wildfire smoke trends and health impacts, see the *Wildfire Smoke* chapter. Hazardous chemicals from fires can be both emitted into the air and deposited in the surrounding soil (Cornwall, 2025). Long after air emissions from the wildfires dissipate, potential exposure to deposited ash, soot, and debris in and around the burn areas, particularly during periods of high winds, may still occur.

Figure 4.1.8 Annual Wildfire CO₂, PM₁₀, and PM_{2.5} Emissions.





Source: CARB (2026)

Larger and more severe wildfires are increasingly affecting people across all racial and socioeconomic groups in California (Yadav et al., 2023). Specific demographics especially vulnerable to wildfire impacts include older adults and children, as well as



people with disabilities. These individuals often face greater health risks and barriers to evacuation, protection, and recovery during wildfire events.

Historically marginalized populations also face systemic barriers that make it more difficult for them to access and participate in federal wildfire prevention programs. Certain racial and ethnic groups may also be more vulnerable to wildfire impacts. For example, the January 2025 Los Angeles wildfires, the worst in the city's history, exposed stark racial disparities in their impacts. Nearly half of Black homes in Altadena were destroyed or majorly damaged by the Eaton Fire, versus 37% of non-Black homes (Ong et al., 2025; [Figure 4.1.9](#)). While Latino neighborhoods were less directly affected by the fires, they faced greater health risks from wildfire smoke due to co-occurring pollution burdens (Pech et al., 2025).

Figure 4.1.9. Burned homes in Altadena from the Eaton Fire.



In January 2025, the Eaton Fire in Los Angeles County severely affected Altadena, a historically Black, middle-class community, where 61% of the community's Black households fell within the fire perimeter compared to 50% of non-Black households. This photo shows at least three burned-down homes and charred trees in Altadena from the Eaton Fire. Source: Ong et al.



(2025). Photo credit: Mayra Beltran/Los Angeles County.

Lower-income communities experience wildfires more frequently and with greater impact (Hino and Field, 2023; Masri et al., 2021). In addition, rural and low-income residents - especially older adults and people who live in isolated areas - often have limited capacity to protect their homes and are more likely to experience property loss during large, hard-to-contain fires (CAL FIRE, 2018; Syphard, 2012).

Access to adequate housing can offer protection from wildfire smoke, yet fire-prone communities increasingly face housing challenges. Wildfires reduce available housing stock, drive up prices, and create uncertainty around where new housing should be built. These pressures limit access to affordable, safe housing, particularly for already vulnerable populations—and increase the risks faced by those living in wildfire-prone areas (Lappe & Vargo, 2022). Low-income communities are also being pushed to the WUI and wildfire-prone areas because of limited affordable housing closer to cities.

Notably, wildfires are also a serious threat to California's tribal nations. Wildfires on or near native lands threaten the health, safety, and economy of those tribes, culturally important species, medicinal plants, traditional foods, and cultural sites (Jantarasami et al., 2018). More information specific to each tribe is presented in the *Impacts on Tribes* section. For example, the number of acres burned annually in the Eastern Sierra within a hundred miles of the Bishop Paiute Tribe's Reservation has increased by approximately 500% from 1950 to 2025 (Bishop Paiute Tribe, 2026). The number of wildfires per year has also been increasing since 1950, impacting the Bishop Paiute Tribe and others in the region. Although a historically fire-adapted system, large high-severity wildfires in this region threaten many species, alter the habitat, and disrupt ecosystem dynamics. Post-fire, shallow-rooted invasive plants are outcompeting slow-growing native plants in the Owens Valley, further contributing to future fire risk due to their flammability and weakening the soil (Big Pine, 2026).

The Pala Band of Mission Indians in the Palomar range of southern California has likewise noted ecological as well as social and cultural impacts from increasing wildfire frequency and severity (Pala Band of Mission Indians, 2026). They have observed fire-driven conversion from native woody shrublands to more flammable, invasive annual



grasses, increased soil erosion, siltation and channelization of surface water, which contributed to the severity of floods that impact the Tribe during the rainy season. Along with the downstream effects of flooding and habitat loss, wildfires have caused significant economic and cultural losses for the Tribe and continue to threaten their sacred sites and lifeways.

In terms of dollars, the Palisades and Eaton Fires of 2025 inflicted more damage than the five previous fire seasons combined (NOAA, 2025a). During several days in early January, LA County—with a population approaching 10 million people—was encircled by fire. The fires killed at least 29 people, destroyed at least 16,251 structures, and caused “between \$76 billion and \$131 billion” in capital losses and property damages. LA County’s gross domestic product (GDP) is expected to contract by 0.48%, or \$4.6 billion (Li, 2025).

In recent years, wildfires have deterred visitors from popular destinations like California’s wine country and the Sierra Nevada (Bauman et al., 2020; Wilson et al., 2020). Smoke, poor air quality, and reduced visibility can create a sense of fear, force people indoors, and lead to travel restrictions to support firefighting efforts—all of which contribute to canceled plans and reduced tourism revenue. These disruptions also impact local workers, particularly those in outdoor service roles, who may face reduced hours and unpredictable conditions on smoky days.

Additionally, wildfire smoke can affect local energy production. Reduced solar output due to smoke and haze can place added stress on the power grid, with downstream effects for businesses and households alike (Gilletly et al., 2023).

What factors influence this indicator?

Changes to historical fire regimes

Before Euro-American settlement, 4.5 to 12 million acres burned annually in California through lightning strikes and intentional burns by Native Americans to steward the land (Stephens et al., 2007). These low-intensity fires reduced small trees and underbrush (which otherwise serve as fuel for larger fires), supported native species, and enhanced ecosystem resilience. Tribes like the Karuk and Amah Mutsun use fire to protect cultural and ecological resources (Amah Mutsun, 2022; Karuk, 2026). This natural fire regime



was disrupted by the depopulation of Native communities and over a century of fire suppression, leading to fuel buildup in forests (Taylor et al., 2016). Today's catastrophic burns are partly due to strict fire suppression dating back to 1910, which excluded tribal knowledge. Today, there is clear consensus among fire ecologists that dry, western pine forests depend on frequent, low severity fires to reduce fuels and maintain the open, park-like conditions with low tree density that these ecosystems evolved under. Without these fires, tree density increases, with smaller trees and heavy surface fuel loads enabling understory fires to spread into tree canopies that cause high severity fires. After decades of fire suppression, California forests have become significantly denser and prone to larger, high severity fires (Hagmann et al., 2021; Scharffenberger, 2021).

Tribal cultural burns differ from prescribed fire in that they are smaller in scale, timed to seasonal and ecological cues, and based on thousands of years of traditional knowledge. The small, patchy scale of cultural burns likely prevents heavy smoke from being delivered to large populations (Long et al., 2021). Prescribed fire (controlled burns) are intentionally managed fires conducted by trained forest and land management agencies, nonprofits, or private landowners or contractors under strict permitting and regulatory practices, potentially leading to more frequent but lower-intensity smoke exposures (Rosenberg et al., 2024). Prescribed burns offer a significant overall reduction in smoke emissions and health impacts compared to wildfire, even when factoring smoke from the prescribed fires (Kelp et al., 2025; US EPA, 2021c). Wildfires can produce up to 20 times more PM_{2.5} per unit area burned than prescribed fires, and even in aggressive prescribed burning scenarios smoke levels only surpassed baseline smoke levels in 4% of California zip codes (Kramer et al., 2023). Areas in California which had been recently treated with prescribed fire and then burned during the 2020 wildfire season had 14% lower smoke emissions than adjacent, untreated areas. Prescribed burns were less effective at reducing smoke impacts in areas near human populations (Kelp et al., 2025).



Tribal Connection 4.1.1

A Big Pine Paiute Tribal member comments on the longstanding relationship between California Native American tribes and fire, and the current context: *“I want to note that while tribal leadership is increasingly being asked by state, local, and federal agencies how they can support and incorporate traditional fire practices, the reality is far more complex. From an indigenous perspective, the conditions we now face—the result of decades of fire suppression, ecological disruption, and land mismanagement—have pushed the landscape into a state that traditional practices were never meant to navigate alone. Cultural burning was never intended to act as crisis response or large-scale wildfire suppression. It was a preventative practice, rooted in the rhythm of the seasons, the relationship to the environment we were actively living in, and the long-term care of a landscape we'd been inhabiting from the start of our people's history. Now, many areas are so overgrown or overtaken by invasive species that cultural burning is no longer viable without first undergoing major ecological reset—often through the very wildfires we seek to prevent. Paradoxically, it sometimes takes a catastrophic event to clear the ground enough for traditional methods to become possible again, though by that point the damage is already done. This is not a failure of indigenous knowledge, but a reflection of just how far the land has been pushed beyond its natural systems of balance”* (Big Pine, 2026.)

Ignition sources and development patterns

Humans are the leading cause of wildfires in the US, with over 8,000 human-caused fires in California alone in 2024 (NIFC, 2025). Population growth and land use changes—such as housing expansion into wildland areas—have increased ignition sources and fuel availability (Li et al., 2021; Mass et al., 2019; Syphard, 2012). The expansion of electrical infrastructure (much of it vulnerable to strong winds) has further raised wildfire hazard (Mass et al., 2019). From 2013 to 2024, nearly 55,000 buildings were completely or partially damaged by wildfire in California, and 86% of these structures were in areas where development occurred on or near wildland areas (Bar et al., 2026).



Climate change

The size, severity, onset, and duration of wildfires are greatly influenced by climate change. Anthropogenic warming is estimated to have enhanced the frequency of extreme daily wildfire growth in California (whether wildfire area burned reached 10,000 acres or more in a day) by 25% on average, relative to pre-industrial conditions. For some fires, there was almost no change, and for other fires, the enhancement has been as much as 461% (Brown et al., 2023). The area burned by high-severity fires from 1985 to 2017 in western US forests showed an eightfold increase, corresponding with warmer and drier fire seasons (Parks and Abatzoglou, 2020). A recent study shows that anthropogenic warming (warming caused by human activity) significantly influences the onset of wildfire seasons in California (Madakumbura et al., 2025). Warmer spring and summer temperatures, reduced snowpack and earlier spring snowmelt have been associated with increased wildfire activity in western US forests beginning in the mid-1980s: more frequent large wildfires, longer wildfire durations, and longer wildfire seasons (Westerling et al., 2006; Westerling, 2016; Williams et al., 2019). Climate change contributed an estimated 33 to 82% of total burned area of wildfires in the western US from 1992 to 2020 (Feng et al., 2025).

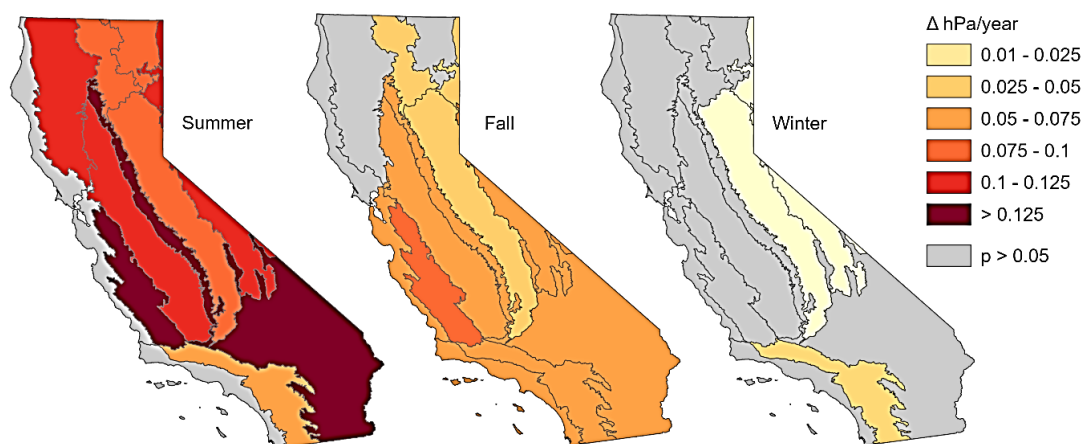
Lightning-initiated wildfires have driven most of the recent increase in large wildfires in the forests of western US, including California (Li et al., 2020; NIFC, 2022). The relative importance of lightning versus human ignitions varies by ecosystem type, geographic region, fire-size threshold, and season with human ignitions remaining the leading overall cause of California wildfires (NIFC, 2025), while lightning plays a larger role in forest fire occurrence in certain regions and years. Lightning activity is sensitive to surface air temperature changes (Price, 2013). The atmosphere over the Northern Hemisphere has become increasingly unstable due to increased moisture content and warmer air temperature which may result in more lightning activity in the future (Chen and Dai, 2023). The number of days that the western US may experience cloud-to-ground lightning (a type of lightning caused by a discharge between opposite charges in the cloud and on the ground) could increase by the mid-21st century, driven by rises in moisture and atmospheric instability (Kalashnikov et al., 2025). Lightning can amplify climate-related impacts by igniting wildfires, which release greenhouse gases



through smoke, and by producing nitrogen oxides that lead to the production of tropospheric ozone, a potent greenhouse gas (Schumann and Huntrieser, 2007). At the same time, a large portion of global warming is due to positive feedback from increasing upper tropospheric water vapor influenced by global thunderstorm activity (Price, 2023)

Climate change-linked increases in temperature and in vapor pressure deficit (VPD) have significantly enhanced fuel aridity over the past several decades, creating a more conducive fire environment (Abatzoglou and Williams, 2016). VPD is a measure of atmospheric demand for water, i.e., the difference between the amount of water vapor in the air and the maximum amount that could exist in the vapor phase at that temperature. As summertime temperatures increased by approximately 1.4°C in California since the early 1970s, VPD has likewise increased (Williams et al., 2019; **Figure 4.1.10**). The warming-driven increase in VPD has been found to be the strongest climatic driver of wildfires in the summer and of increased wildfire activity across the Sierra Nevada (Chen et al., 2021).

Figure 4.1.10. Vapor Pressure Deficit (1984 to 2022).



The maps above show seasonal changes in vapor pressure deficit by ecoregion across California. Changes are expressed as rates of change over time, with gray shading indicating areas where trends were not statistically significant.

Source: CAL FIRE

High-precipitation years boost vegetation growth, which then dries out the following spring or summer under warm, dry conditions (Keeley and Syphard, 2017). Over the



past four decades, warm fall temperatures and declining precipitation have driven a rise in fire-favorable weather conditions across California (Goss et al., 2020). California is also experiencing "hotter droughts" – droughts that are intensified by unusually warm temperatures leading to reduced snowpack and streamflow, dry soils, and widespread tree mortality. These conditions heighten the risk of fast-spreading, high-severity wildfires that are ecologically damaging and costly to control (Crockett and Westerling, 2017). The 2012–2016 drought significantly reshaped forests in the central and southern Sierra Nevada, with tree mortality drastically increasing the amount of large woody fuels (Stephens et al., 2018). These studies represent an important step toward overall accountability of the impacts of climate change. The current state of knowledge and results strongly support action to mitigate the impacts of climate change, alongside proactive land management practices that enhance the resilience of forested landscapes to wildfire.

Higher-altitude forests are partly buffered against the effects of warming by the availability of moisture from climatologically colder and wetter conditions. Deep snowpacks and abundant spring runoff provide moisture to soil and vegetation, reducing the overall flammability of these forests by limiting the window when fuels are receptive to ignition and fire spread. However, fire is increasing disproportionately at high-elevation forests in the Sierra Nevada and, more broadly, the western United States (Alizadeh et al., 2021; Schwartz et al., 2015).

In California's seasonal and ephemeral snowpacks, which provide key water supplies throughout the state, a trend of increasing wildfire activity has been observed since 2001, peaking in 2020 and 2021 (Hatchett et al. 2023). This trend of increasing wildfire activity across major snow zones throughout California can strain the state's current water management system. Wildfire leads to earlier snowmelt due to increased exposure of snow to solar radiation by removing the canopy and by reducing the snowpack's albedo (ability to reflect sunlight) by the deposition of black carbon (Koshkin et al. 2022). Changes to spring runoff patterns requires adjustments in water storage and flood strategies, as much of the state's flood protection and water supply infrastructure was designed and optimized for historical conditions (see the *Snowmelt Runoff* chapter). Changes in fire management (such as reduced fire suppression at high



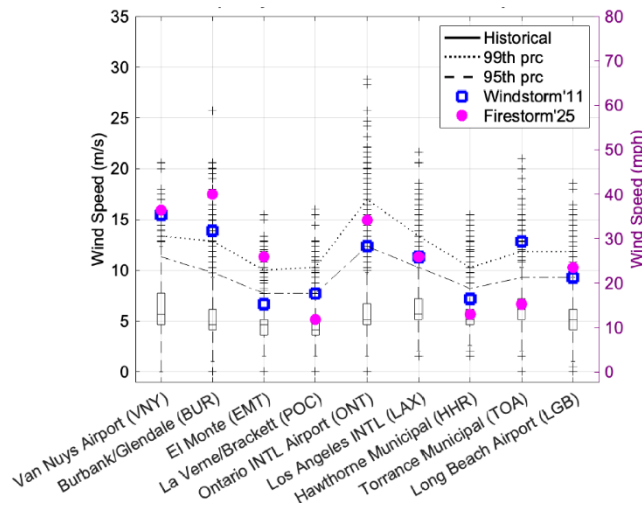
elevations), climate (including warming temperatures, especially at night, and earlier snowpack melt), fuels (resulting from increasing tree densities), and ignitions (from both lightning and human-caused sources) are recognized as factors influencing the trend. These factors are not mutually exclusive and may have synergistic effects.

Wind-driven wildfires

Large wildfires in California are often associated with strong wind, especially fast-moving downslope winds such as the Santa Ana winds (in Southern California) and Diablo winds (in Northern California) (Abatzoglou et al., 2021). In Southern California, Santa Ana fires, which occur mostly in September through December, spread three times faster than non-Santa Ana fires and occurred closer to urban areas (Jin et al., 2015). Santa Ana winds played a critical role in the magnitude of both the Palisades Fire and the Eaton Fire (Woolcott, 2025), just as they have in many of southern California's largest and most destructive fires (Gershunov et al., 2021). A trifecta of fire-conducive climate conditions set the stage for the 2025 fires: back-to-back wet winters that boosted herbaceous vegetation, the third driest start to the wet season, and an extremely strong and dry Santa Ana wind event ([Figure 4.1.11](#) and [Figure 4.1.12](#); Guirguis et al., 2025). The evidence presented primarily addresses whether climate change has increased the frequency or severity of conditions conducive to fire, such as those in January 2025. Whether climate change made the specific January 2025 wind event more likely or intense is a separate attribution question. The 2018 Camp and Woolsey Fires occurred during periods of extreme fire weather that coincided with strong offshore winds. As the start of California's rainy season has steadily shifted later (Luković et al., 2021; Swain, 2021), wildfire risk has increased due to the overlap of dry fuels and fire-promoting winds in late autumn. In a study of 70 years of atmospheric conditions over California and the Northern Pacific, Guirguis et al. (2023) found conditions favoring hot Santa Ana winds to be increasing in frequency, a trend that is expected to continue in a warming climate.



Figure 4.1.11. Observed Wind Speeds in Los Angeles County.

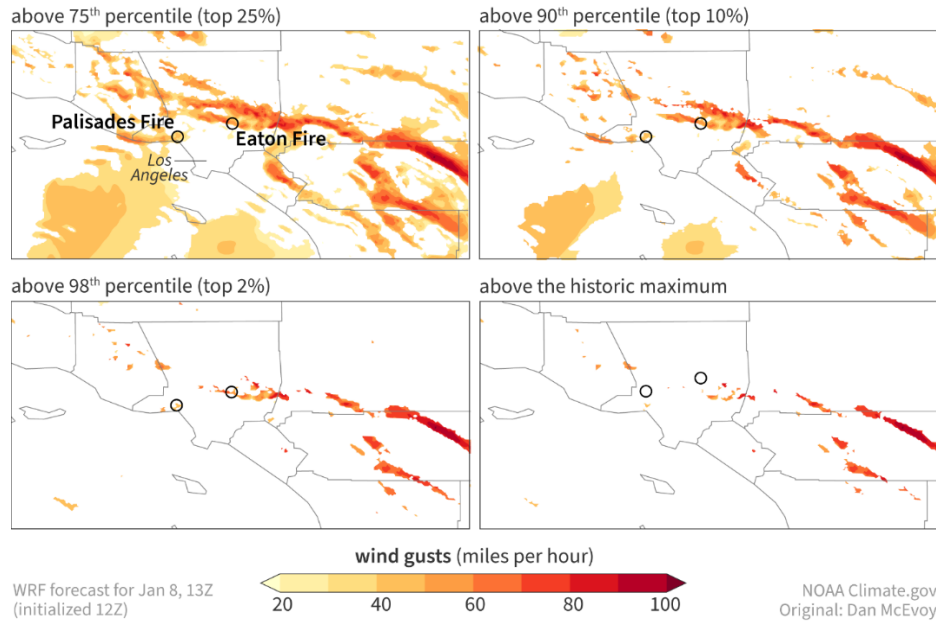


Daily peak sustained wind speeds at weather stations across Los Angeles County during the December 1, 2011 (Windstorm'11) and January 7, 2025 (Firestorm'25) events. Both events exceeded the local 95th percentiles at most weather stations.

Source: Guirguis et al. (2025)



Figure 4.1.12. Forecast Wind Gusts in the Los Angeles Mountains.



Maps show forecasted wind gusts above the 75th percentile (top left), more limited areas above the 90th (top right), and above the 98th over the Palisades and Eaton fires (bottom left) on January 8, 2025. Some gusts were forecasted to exceed historic maximums (bottom right).

Source: NOAA (2025b), adapted from Dan McEvoy.

Similarly, catastrophic wildfires in Northern California, including the series of “Wine Country” fires in Napa and Sonoma Counties in October 2017 and the 2018 Camp Fire in Butte County, were driven by downslope Diablo winds (Smith et al., 2018). These fires burned through both forested and non-forested landscapes of shrubs, grasses, and oak woodlands (Keeley and Syphard, 2019), many of which had not experienced fire in over 50 years.

In 2020, following a heatwave and amidst severe drought and extremely dry fuels, elevated moisture from a developing Pacific tropical storm moved northwards across California in mid-August, leading to a widespread dry lightning outbreak that ignited hundreds of fires (Hatchett et al., 2024). With suppression resources limited due to both high national resource commitment (US Department of Interior, 2020), and COVID-



related impacts on resource availability (Wells et al., 2024), many of these large complexes (e.g., the August Complex, the North Complex, the SCU, LNU, and CZU Complexes) contributed to the record burned area during 2020 as well as substantial structure losses.

Technical considerations

Data characteristics

Data on statewide annual acres burned (**Figure 4.1.1**) were downloaded from a fire perimeter database spanning 1950-2025 made publicly available online through CAL FIRE. CAL FIRE works with the USDA Forest Service (USFS) Region 5, the Bureau of Land Management (BLM), and the National Park Service (NPS) to track fires on public and private lands throughout California. The data for the period 1950 to 2001 include USFS wildland fires 10 acres and greater, and CAL FIRE fires 300 acres and greater, with data for smaller fires and other jurisdictions included when available. In 2002, standard practice additionally included BLM and NPS fires of 10 acres and greater, as well as CAL FIRE timber fires of 10 acres and greater, brush fires of 50 acres and greater, grass fires of 300 acres and greater, wildland fires destroying three or more structures, and wildland fires causing \$300,000 or more in damage. Further details are available at the [CAL FIRE fire perimeters webpage](#).

Strengths and limitations of the data

The CAL FIRE database represents the most comprehensive digital record of wildfires in California. However, some fires may be missing for a variety of reasons (e.g., lost historical records, and/or inadequate documentation). The containment date for many of the fires is missing, but a large majority of the fires have alarm dates, which reasonably approximates the ignition time. In addition, although every attempt is made to remove duplicate fires, some duplicates may still exist. In addition, overgeneralization may occur, such as unburned islands within old, large fires may be classified as burned.



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