



# Weathering the Weather: Strategies to Reduce Harm to People Living Unsheltered

An Original Research Report for:

**California's Fifth Climate Change Assessment**



CALIFORNIA  
**NATURAL  
RESOURCES**  
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CA Governor's Office of  
**Land Use and  
Climate Innovation**

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# Acknowledgements

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We acknowledge that while this report focuses on strategies to reduce immediate harm during extreme weather events, the most effective and enduring strategy to protect people experiencing homelessness – especially those living unsheltered – is ensuring access to adequate interim housing and permanent, affordable housing. Short-term mitigation measures are essential, but lasting climate resilience requires reducing unsheltered homelessness through sustained investments in housing solutions.

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# About California's Fifth Climate Change Assessment

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California's Climate Change Assessments are the state's scientific foundation for understanding future climate-related vulnerability across California's regions and systems. Senate Bill 1320 (Stern, 2020) requires the State to report the impacts and risks of climate change across California at least every five years, beginning with California's Fifth Climate Change Assessment (Fifth Assessment). Building on decades of climate research and previous Assessments, the Fifth Assessment presents new findings about California's climate future, with a dedicated focus on Tribal partnerships, public engagement, and communities most vulnerable to climate impacts.

The Fifth Assessment's research and tools are designed to fill knowledge gaps about California's climate future, inspire strategic climate actions, and shape planning, investments, and policies at the state, regional, and local scales. Guided by research priorities identified by state, Tribal, and local leaders, community representatives, and subject matter experts, its findings are designed to help illuminate potential climate futures, the challenges they may present, and the opportunities to build resilience through adaptation pathways.

For the full suite of Fifth Assessment research products, please visit: [www.ClimateAssessment.ca.gov](http://www.ClimateAssessment.ca.gov).

## **DISCLAIMER:**

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## **Use of Artificial Intelligence (AI):**

No AI tools were used in the preparation, review, or editing for this report.



# Abstract

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In 2024, an estimated 187,000 Californians experienced homelessness, of which nearly 124,000 were living unsheltered. As climate change increases both the frequency and severity of extreme weather events, people living unsheltered (PLU) face acute and disproportionate risks.

By combining information on where people are currently living unsheltered with projections of extreme heat, we find that state and local officials will need to plan for rapid increases in extreme heat days affecting large numbers of people living unsheltered in the state. For example, in several Continuums of Care (CoCs) where more than 80% of people living unsheltered currently reside, the number of days with a heat index above 100°F (37.8°C) is projected to at least double by the end of the century.

To identify effective strategies to reduce harm to people living unsheltered during extreme heat, flash flooding, and wildfire smoke, we used three methods: 1. A review of 249 articles on unsheltered homelessness and extreme weather; 2. Interviews with 26 staff from relevant agencies and organizations; and 3. Surveys with 47 people living unsheltered in the Los Angeles area who had recently experienced a severe heat wave or wildfire smoke event.

Across these three methods, four central challenges emerged: 1. People living unsheltered are highly exposed and vulnerable to the effects of extreme weather, 2. People living unsheltered lack timely information about hazards, services, or shelters during these weather events, 3. Existing shelters may lack conditions, services, or supports that make them desirable options, and 4. Shelter capacity is often insufficient during these extreme weather events.

We identify strategies to address these challenges and classify 22 of them by their acceptability to people living unsheltered and their implementation plausibility. We then discuss how these strategies can be used to strengthen California's response to extreme weather events for people living unsheltered.

**Keywords:** Continuum of care, homelessness, people living unsheltered, extreme weather, heat, flooding, wildfire, smoke, climate change, surveys, interviews, strategies, risk, communication



# Abbreviations, Acronyms, and Glossary

## Acronyms and Abbreviations

| Acronym or Abbreviation | Definition                                                  |
|-------------------------|-------------------------------------------------------------|
| ADA                     | Americans with Disabilities Act                             |
| CoC                     | Continuum of Care                                           |
| CMIP6                   | Coupled Model Intercomparison Project Phase 6               |
| COVID-19                | Coronavirus Disease of 2019                                 |
| EMT                     | Emergency medical technician                                |
| GCM                     | Global climate model (or general circulation model)         |
| HUD                     | U.S. Department of Housing and Urban Development            |
| IV                      | Intravenous injection                                       |
| LAHSA                   | Los Angeles Homeless Services Authority                     |
| LA LEADS                | Los Angeles Longitudinal Enumeration and Demographic Survey |
| PIT Count               | Point-in-Time Count                                         |
| PLU                     | People living unsheltered                                   |
| SPA                     | Service planning area                                       |
| SSP                     | Shared socioeconomic pathway                                |
| RV                      | Recreational vehicle                                        |



## Glossary

| Term                     | Definition                                                                                                                                                                                                                                                                                                            |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 211                      | A call line service that is designed to connect people to resources such as shelter space.                                                                                                                                                                                                                            |
| Agency level             | Government or quasi-government entity with funding or regulatory authority over service providers.                                                                                                                                                                                                                    |
| American River Parkway   | A river corridor in Sacramento County.                                                                                                                                                                                                                                                                                |
| Antelope Valley          | A region in northern Los Angeles County including Lancaster and Palmdale. This area is considered a mix of developing suburban cities and expansive rural, agricultural, and high-desert areas. It experiences very high temperatures and was the site of survey data collection.                                     |
| Augmented cooling center | A designated, air-conditioned building designed to provide free, temporary relief from extreme heat. When activated, it operates outside of regular business hours.                                                                                                                                                   |
| CA-503                   | The Continuum of Care that includes all of Sacramento County.                                                                                                                                                                                                                                                         |
| CA-600                   | The Continuum of Care that includes all of Los Angeles County sans Long Beach, Pasadena, and Glendale.                                                                                                                                                                                                                |
| Cal-Adapt                | A data platform for California's Fifth Climate Change Assessment data.                                                                                                                                                                                                                                                |
| Chronic homelessness     | A formal definition used by HUD. To qualify as chronically homeless, an individual must have a documented disability (physical, mental and/or substance use disorder) and have experienced homelessness for at least a year (either consecutively or on four or more separate occasions during the past three years). |



| Term                                           | Definition                                                                                                                                                                                                        |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clean air centers                              | A designated facility open to the public that has filtered air.                                                                                                                                                   |
| Climate Normal                                 | An average of the time period from 1991-2020.                                                                                                                                                                     |
| Congregate shelter                             | A shared, temporary residential facility featuring open space sleeping areas, such as gymnasiums, communal bathrooms, and shared dining areas.                                                                    |
| CMIP6                                          | A project that standardizes the uses of and variables for Global Climate Models (GCMs), designed for scientists and policymakers to understand the potential effects of climate change.                           |
| Cooling centers                                | A designated air-conditioned facility designated to provide free, temporary relief from the heat.                                                                                                                 |
| Dangerous for all groups heat threshold        | Maximum daily temperature above a heat index of 100°F (37.8°C).                                                                                                                                                   |
| Dangerous for vulnerable groups heat threshold | Maximum daily temperature above a heat index of 90°F (32.2°C).                                                                                                                                                    |
| EC-Earth3                                      | One of the GCMs in CMIP6 with bias-corrected dynamically downscaled simulations available in Cal-Adapt as part of the Fifth Assessment.                                                                           |
| EC-Earth3-Veg                                  | One of the GCMs in CMIP6 with bias-corrected dynamically downscaled simulations available in Cal-Adapt as part of the Fifth Assessment.                                                                           |
| Emergency shelter                              | A designated facility, stood up during a disaster or emergency, that provides temporary housing for individuals displaced by weather or other events that prevent them from residing where they previously lived. |
| Encampment                                     | An outdoor location not intended for long-term continuous occupancy where people live that is comprised of temporary structures or enclosed places.                                                               |
| End-of-the-Century                             | An average of the time period from 2070 to 2099                                                                                                                                                                   |



| Term                       | Definition                                                                                                                                                                                                                                                               |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extreme heat day           | A day when the maximum heat index exceeds a defined threshold (90°F (32.2°C) or 100°F (37.8°C)).                                                                                                                                                                         |
| Extreme precipitation day  | A day in which the daily precipitation exceeds the hazard-level precipitation                                                                                                                                                                                            |
| Extreme weather event      | Climate-related hazards such as extreme heat, flash flooding, or wildfire smoke                                                                                                                                                                                          |
| First responders           | Emergency personnel such as firefighters, EMTs, and police officers                                                                                                                                                                                                      |
| Flash flooding             | Sudden, high-velocity flooding events                                                                                                                                                                                                                                    |
| Hazard-Level Precipitation | An amount of precipitation exceeding the 99th percentile of historical precipitation for the region considered.                                                                                                                                                          |
| Heat index                 | A measurement, also called the apparent temperature, of what the air feels like when incorporating humidity into pure temperature.                                                                                                                                       |
| Mid-Century                | An average of the time period from 2035 to 2064.                                                                                                                                                                                                                         |
| MIROC6                     | One of the GCMs in CMIP6 with bias-corrected dynamically downscaled simulations available in Cal-Adapt as part of the Fifth Assessment.                                                                                                                                  |
| MPI-ESM1-2-HR              | One of the GCMs in CMIP6 with bias-corrected dynamically downscaled simulations available in Cal-Adapt as part of the Fifth Assessment.                                                                                                                                  |
| Non-congregate shelter     | An emergency or temporary shelter providing private or semi-private accommodation (e.g., hotel/motel rooms).                                                                                                                                                             |
| Outreach worker            | Service provider who engages directly with PLU to provide information, resources, and referrals.                                                                                                                                                                         |
| Policy ecology framework   | An implementation science model that specifies multi-level, interconnected forces, including political and regulatory factors at federal, state, and local government levels as well as within social organizational levels shape the success of policies and practices. |



| Term                     | Definition                                                                                                                                                                                                                   |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prosecutorial discretion | The decision to refrain from enforcing certain laws when specific conditions are met.                                                                                                                                        |
| Respite center           | A designated public facility that provides temporary relief from weather conditions (e.g., cooling centers during heat waves, clean air centers during poor air quality days, and warming centers during cold temperatures). |
| Service provider         | An organization that delivers direct services to people living unsheltered.                                                                                                                                                  |
| Shelter space            | The amount of capacity within a temporary residential facility for housing people experiencing homelessness.                                                                                                                 |
| SSP3-7.0                 | A high emissions scenario described as “Regional Rivalry” with relatively large increases in mean surface temperatures and that assumes few additional climate policies are enacted.                                         |
| TaiESM1                  | One of the GCMs in CMIP6 with bias-corrected dynamically downscaled simulations available in Cal-Adapt as part of the Fifth Assessment.                                                                                      |
| Wildfire smoke           | Particulate matter and gases produced by unplanned or uncontrolled burning of, initially, vegetation.                                                                                                                        |



# Highlights

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- In the coming years, state and local officials in California will have to account for rapid increases in days with extreme heat that affect large numbers of people living unsheltered in the state. For example, in several Continuums of Care where more than 80% of people living unsheltered currently reside, the number of days with a heat index above 100°F (37.8°C) is projected to at least double by the end of the century.
- There are four major challenges associated with addressing the needs of people living unsheltered during instances of extreme heat, flash flooding, and wildfire smoke: 1. People living unsheltered are highly exposed and vulnerable to the effects of extreme weather, 2. People living unsheltered lack timely information about hazards, services, or shelters during these weather events, 3. Existing shelters may lack conditions, services, or supports that make them desirable to people living unsheltered, and 4. Shelter capacity is often insufficient during these extreme weather events.
- We identified over 20 strategies to address these challenges and discuss their advantages and disadvantages.
- We categorized 11 strategies as having (and six as potentially having) high acceptability to people living unsheltered, high plausibility to implement, and a potentially large impact on mitigating the effects of extreme weather events on people living unsheltered in California.



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# 1 Introduction

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## 1.1 Background

As the climate continues to change, California will experience more dangerous and frequent heat waves, flooding from heavy precipitation events, and incidents of toxic wildfire smoke (Thorne et al., 2018). During these events, public health guidance often urges impacted populations to “stay home” or “stay indoors.” For many people living unsheltered (PLU) – that is, on the street, or outside in a tent, makeshift shelter, or vehicle – this is simply not a feasible option. As a result of this and of preexisting conditions, many PLU face severe acute and chronic health consequences from extreme heat, flash flooding, and wildfire smoke events (Legislative Analyst’s Office, 2023). Since California has the largest population of PLU in the nation – an estimated nearly 124,000 (HUD Exchange, 2024b) – the scale of unsheltered homelessness makes climate-change-exacerbated extreme weather a particularly statewide threat.

A recent review of all 58 county Emergency Operations Plans found that almost half did not mention PLU (California Interagency Council on Homelessness, 2024b). Among the plans that did, most did not provide any strategies specifically to protect PLU during extreme weather events.

This represents a critical system gap: without explicit planning, a population exposed to climate hazards remains poorly protected from them.

Given the size of California’s unsheltered population and the accelerating frequency and severity of extreme weather events, it is essential that state and local systems engage in proactive, coordinated planning to reduce risk to PLU. This requires understanding:

1. The expected change in the exposure of PLU to extreme weather events in California over the next century, and
2. Which strategies are most effective and feasible for reducing harm to PLU during these extreme weather events.

This report addresses both questions using a combination of data sources and methodologies, summarized in Table 1.



Table 1. Research Questions and Data Sources

| Research Questions                                                                                                               | Cal-Adapt | Point-in-Time Counts | Literature Review | Practitioner Interviews | Surveys of People Living Unsheltered |
|----------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------|-------------------|-------------------------|--------------------------------------|
| 1. What is the expected change in the exposure of people living unsheltered to extreme weather events in California?             |           |                      |                   |                         |                                      |
| (a). What is the expected change in the frequency and severity of extreme weather events in different parts of California?       |           |                      |                   |                         |                                      |
| (b). What is the geographic overlap of projected extreme weather events and the current residences of people living unsheltered? |           |                      |                   |                         |                                      |



| Research Questions                                                                                                                       | Cal-Adapt | Point-in-Time Counts | Literature Review | Practitioner Interviews | Surveys of People Living Unsheltered |
|------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------|-------------------|-------------------------|--------------------------------------|
| <b>2. What are the most effective and feasible strategies to reduce harm to people living unsheltered during extreme weather events?</b> |           |                      |                   |                         |                                      |
| (a). What are the central challenges to reducing harm to people living unsheltered during extreme weather events?                        |           |                      |                   |                         |                                      |
| (b). How are these challenges experienced by providers and people living unsheltered?                                                    |           |                      |                   |                         |                                      |
| (c). What effective strategies are there to address each challenge?                                                                      |           |                      |                   |                         |                                      |
| (d). What issues arise during implementation of these strategies?                                                                        |           |                      |                   |                         |                                      |
| (e). What barriers do people living unsheltered experience utilizing these strategies?                                                   |           |                      |                   |                         |                                      |
| (f). Which strategies do people living unsheltered prefer?                                                                               |           |                      |                   |                         |                                      |

*Table 1 Note. This table shows the relationship between research questions (rows) and data sources (columns) for this report. The black cells are the primary data source for each research question, the dark gray cells contribute significantly to the research question, and the light gray cells contribute some to the question.*



To estimate the expected change in the frequency and severity of extreme weather events in different locations (research question 1a), we processed projected temperature and precipitation data available as part of California's Fifth Climate Change Assessment (Cal-Adapt data) and compared likely events during a climate normal period, a period during mid-century, and a period at the end of the century. When combined with information on where people are currently living unsheltered from federal mandated Point-in-Time Counts (PIT Counts), which provide an estimate of the number of PLU in a specific community (i.e., Continuum of Care) (HUD Exchange, 2025), we estimated locations where one might expect to see increases in the frequency of adverse events (question 1b).

To identify the major challenges affecting PLU during extreme weather events, we used information gathered from a literature review; interviews with members of the public, non-profit, and volunteer workforce focused either on emergency management or serving PLU, or both; and surveys with PLU in Los Angeles County who had experienced an extreme weather event. Synthesizing the information we gathered from these sources, we identified four challenges to reducing harm that PLU face during extreme weather events:

1. PLU are highly exposed and vulnerable to the effects of extreme weather events;
2. PLU lack timely information about hazards, services, or shelters during these extreme weather events;
3. Existing shelters may lack conditions, services, or supports that make them desirable to PLU; and
4. Shelter capacity is often insufficient during these extreme weather events.

For each of these four challenges, we examine how they are experienced by PLU; what strategies different localities are currently using to address them; the implementation challenges identified by the responsible workforce, the barriers PLU face in accessing and utilizing these strategies; and which strategies PLU prefer – and are therefore more likely to accept.

In the final section of the report, we categorize these strategies by their acceptability to PLU, implementation plausibility, and potential impact.

We note that this analysis does not consider upstream solutions that lie outside the scope of shelters-based responses. While many of the downstream challenges identified here could ultimately be resolved through access to permanent housing, more than 187,000 Californians currently lack stable housing (HUD Exchange, 2024b). As one member of the emergency management workforce observed: "I love the idea that people should be housed. That's a beautiful ideal. But the reality that I experience every day is that that is not a solution." Another public employee shared: "We need a



solution that will work tomorrow because it's going to rain a lot, and there's a bunch of people in our creeks [who are at risk from flooding]. And I don't want to talk about a three-bedroom, two-bedroom house. That's not helping."

## 1.2 Hazards Considered

For this report, we focus on three extreme weather events: extreme heat, flooding from extreme precipitation, and wildfire smoke. We chose these three hazards because they are: (1) all expected to increase in frequency and/or severity due to greenhouse gas emissions-related climate change, especially in California; (2) the primary way to avoid these threats involves staying home, staying inside, or not traveling – strategies that, without shelter, are not an option for PLU; and (3) these are universal threats to all people that will be first (and worst) felt by PLU.

These three hazards are dangerous for all Californians. For example, between 2010 and 2019, an estimated 3,900 people died from extreme heat in California (Phillips et al., 2021) and, during heat waves between 1999 and 2009, unplanned hospitalizations for a range of both physical and mental health conditions increased by as much as seven percent (Guirguis et al., 2014). In 2024, over 140 people died from floods in the US; and in one flash flooding event in Texas in July of 2025, at least 135 people died after a river rose quickly (Statista, 2025; Zhuang et al., 2025). Wildfire smoke, which is widely known to exacerbate conditions such as bronchitis or asthma, can also serve as a vector of infection, carrying pathogenic bacteria and microbes to people's lungs (Kobziar & Thompson, 2020).

Each of these extreme weather events has unique characteristics that drive the types of strategies needed to effectively reduce harm:

- **Extreme heat** can be predicted more than a week in advance (Ogburn & Climatewire, 2013), giving local jurisdictions, emergency managers, and PLU warning. Additionally, the health impacts of extreme heat, though potentially severe, do not occur instantaneously and are preceded by warning signs (Centers for Disease Control and Prevention, 2017).
- **Risk of flash flooding** in California is driven primarily by heavy precipitation events. The risks associated with flash flooding can be exacerbated by recent wildfires (California Department of Water Resources, n.d.). Even if a storm is predicted in an area, flash floods themselves often arrive suddenly and provide immediate threats to life (AccuWeather Staff, 2020).
- **Poor air quality from wildfires**, like extreme heat, has considerable health impacts that do not occur immediately after exposure. Unlike extreme heat, due to difficulties predicting shifting wind patterns and the locations of fires, the specific locations of poor air quality can change suddenly (Stone, 2019). Though some smoke-prediction tools do exist (California Air Resources Board,



2023), thresholds at which entities should mobilize during extreme events are less accepted than for extreme heat and flash flooding (Steinberg et al., 2018) and impacts are fairly unpredictable. This means that determining when to activate emergency responses to wildfire smoke is often difficult.

Table 2 shows the data sources and methodologies applicable to each hazard. Since extreme heat is the most predictable and widespread of the three hazards, and due to ample precedents of extreme heat events, this report covers extreme heat more comprehensively, compared to the other hazards. The gray cells indicate when a hazard is covered by a data source.

**Table 2. Hazards Covered by Data Sources**

| <b>Hazards</b> | <b>Cal-Adapt</b> | <b>Literature Review</b> | <b>Practitioner Interviews</b> | <b>Surveys of People Living Unsheltered</b> |
|----------------|------------------|--------------------------|--------------------------------|---------------------------------------------|
| Extreme Heat   |                  |                          |                                |                                             |
| Flash Flooding |                  |                          |                                |                                             |
| Wildfire Smoke |                  |                          |                                |                                             |

*Table 2 Note. In this report, data sources and the associated methodologies are columns and the three hazards covered are rows. Black cells were included, gray cells were included but provided less comprehensive information than the black cells, and white cells were not included.*

## 1.3 Case Studies

To understand local planning efforts and expected changes, we include case studies (for research question 1) and focus most of our data collection (for research question 2) on Los Angeles and (to a lesser extent) Sacramento. We explore the relevant Continuum of Care (CoC), which is how the U.S. Department of Housing and Urban Development (HUD) organizes its response to homelessness (HUD, 2025). There are 44 CoCs in California. Sacramento County and the Sacramento CoC have the same boundaries, and the homelessness response is led by Sacramento Steps Forward. The Los Angeles CoC, which includes all parts of Los Angeles County except the cities of Glendale, Long Beach, and Pasadena, is led by the Los Angeles Homeless Services Authority (LAHSA).

We chose the Los Angeles CoC because it has the largest concentration of PLU in California (40% of PLU in California were in the Los Angeles CoC in 2024) (HUD Exchange, 2024b) and is among the counties with the worst air quality in the state



(Legislative Analyst's Office, 2023; U.S. Environmental Protection Agency, n.d.). We chose Sacramento County because it also has a large number of PLU (three percent of those in California) and because of the effect of flooding on PLU in that area during the winter of 2023/2024. We also wanted to include major counties in both Northern and Southern California. Since there were no major flooding events in the Sacramento CoC during our study period, we did not conduct any surveys of PLU in that area and, therefore, the case study is less complete than for the Los Angeles CoC. Table 3 shows the geographic scope of each methodology used for this report.

**Table 3. Geography Covered by Each Methodology**

| <b>Hazards</b>  | <b>Cal-Adapt</b> | <b>Literature Review</b> | <b>Practitioner Interviews</b> | <b>Surveys of People Living Unsheltered</b> |
|-----------------|------------------|--------------------------|--------------------------------|---------------------------------------------|
| General         |                  |                          |                                |                                             |
| State           |                  |                          |                                |                                             |
| Los Angeles CoC |                  |                          |                                |                                             |
| Sacramento CoC  |                  |                          |                                |                                             |

*Table 3 Note. The connection between the geographic scope of the analysis (rows) and the methodology (columns). Black cells were the focus of the analysis, dark gray cells were well covered by the analysis, light gray cells were touched on by the methodology, and white cells were not included. The State refers to the State of California, CoC is the Continuum of Care.*

## 1.4 Structure of the Report

This report follows the research questions in Table 1. We address the first question in Section 2, where Cal-Adapt projections are connected with data from Point-in-Time Counts. Section 3 addresses the second question, beginning by describing the three data sources we use to answer it. Then, in that section, we describe each of the four challenges PLU face during extreme weather events, list the strategies that are or could be used to address these challenges, discuss their efficacy, advantages, and disadvantages in different contexts. Section 4 presents a synthesis of strategies by acceptability and implementation plausibility, describes other study implications and limitations, and suggests potential future directions. Appendix A provides more information about research question 1. In Appendix B, we provide more details about the three data sources and methodologies described in Section 3.



## 2 Planning for Changes by Extreme Weather Events for People Living Unsheltered

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By combining outputs from Cal-Adapt data and Point-in-Time Counts, we answer the first research question (“What is the expected change in the exposure of people living unsheltered to extreme weather events in California?”). To do this, we answer the question (1a in Table 1): “What is the expected change in the frequency and severity of extreme weather events in different parts of California?”, and connect these results with where people are currently living unsheltered to understand the intersection of where we expect large increases in extreme weather and where people are living unsheltered (1b in Table 1). The number of people living unsheltered (PLU) in California and where they reside will likely change in the next 75 years and is dependent on numerous political and demographic factors that are outside the scope of this project. We do not attempt to predict the change in the number of PLU in various locations but use the current estimates as an approximation of where PLU will reside in each considered time period. Some figures and tables appear in Appendix A and are denoted as such.

We provide the most robust discussion on extreme heat, as it shows the most consistent pattern across global climate models (GCMs). While we provide a map of the general expected change in extreme precipitation across California in Appendix A, the results differ enough by GCM that we do not answer research question 1b for this hazard. Note that California’s Fourth Climate Change Assessment suggests that atmospheric rivers that affect the state, which have historically been responsible for many of California’s flooding events, are increasing in strength (Bedsworth et al., 2018).

Because the Fifth Assessment’s projected wildfire area and severity data were not finalized in time for this project, we did not investigate the geographic variability in expected changes to wildfire smoke exposure. As the climate changes, we expect that both the severity and frequency of wildfire smoke will increase throughout the state (Thorne et al., 2018) and that a larger area of the state will burn in an average year (an increase of over 75% by the end of the century compared to the mid-to-late 20th century) (Bedsworth et al., 2018).



## 2.1 Methodology

### 2.1.1 Cal-Adapt

Since the extremes of heat or flash flooding are most relevant for planning purposes, we use the five available bias-corrected dynamically downscaled simulations calculated at the 3-km domain from the Cal-Adapt Coupled Model Intercomparison Project Phase 6 (CMIP6) data: EC-Earth3, EC-Earth3-Veg, MIROC6, TaiESM1, MPI-ESM1-2-HR, which are only available for the third Shared Socioeconomic Pathway (SSP3-7.0) (Rahimi, 2023). These GCMs vary in their performance capturing different metrics for California before they are bias corrected; for example, MIROC6 does not capture the sea surface temperatures associated with the El Niño Southern Oscillation and MPI-ESM1-2HR does not capture sea level pressures associated with the Santa Ana Winds as well as the other models (Krantz et al., 2021). SSP3-7.0 is a high emissions scenario described as “Regional Rivalry” with relatively large increases in mean surface temperatures and that assumes few additional climate policies are enacted (Chen et al., 2023).

Following guidance to examine 30-year averages, we report three time periods: the Climate Normal (1991-2020), Mid-Century (2035-2064), and the End-of-the-Century (2070-2099) (Cal-adapt, n.d.-a).

### 2.1.2 Extreme Heat Methodology

We use two maximum daily heat index thresholds: above 90°F (32.2°C) and above 100°F (37.8°C). We chose these thresholds because people at high risk for experiencing the effects of heat (e.g., children, the elderly, those who are pregnant, those with certain chronic illnesses) can begin experiencing heat illnesses at the first threshold of 90°F (32.2°C), and everyone begins experiencing heat illnesses at the second threshold of 100°F (37.8°C) (First Street, n.d.). We describe these two thresholds as dangerous for vulnerable groups and all groups, respectively. While methods to capture the health effects of extreme heat vary, some incorporating acclimatization or the health impacts of high nighttime temperatures, maximum daily temperature and heat index thresholds are a common method (S. Sheridan, 2015; Seneviratne & F. Otto, 2021). The health impacts of different metrics are largely similar for a broad analysis of a community (Anderson, 2009).

Approximately 42% of PLU in California met the criteria for chronic homelessness in 2024, that is experiencing homelessness for a prolonged period of time with a chronic health condition (physical, mental and/or substance use disorder) (HUD Exchange, 2024a). Chronic homelessness serves as a good proxy for those at high risk for sensitivity to heat.

In the first step of the calculation, we determined the annual number of days with a maximum heat index (variable: noaa\_heat\_index\_derived) above 90°F (32.2°C) and above 100°F (37.8°C) in each 3-km grid cell in each CoC by each GCM, across the



three study time periods. Within the 30-year window, we then took the maximum annual number of days above each threshold for each grid cell for each GCM. Since many of the CoCs are large, it is difficult to get one value for an entire CoC. While we want to err on the side of a maximum, we also do not want the absolute maximum for an area, which may be an outlier. Therefore, in the third step, we took the 95th percentile grid cell for each threshold for each CoC for each GCM. This is an imperfect metric, especially for CoCs that are geographically large and meteorologically diverse and where the locations that the majority of PLU may be living are concentrated in one area. When we report a change across time periods, we compare the results within a GCM for each CoC. This methodology is represented graphically in Figure A3.

Note that, even by using the 95th percentile grid cells, there will still be information lost in aggregating to the CoC level. For example, CA-606 (Long Beach), CA-607 (Pasadena), and CA-612 (Glendale) have different values than CA-600 (Los Angeles) despite being very close to or surrounded by CA-600 (see Figure A1). CA-600, which is large, may have areas far from CA-607 or CA-612 that have a higher expected frequency of days above the heat index threshold.

### **2.1.3 Point-in-Time Counts**

Each CoC is required to estimate the number of people experiencing homelessness in its jurisdiction at least every two years (with some exceptions during the COVID-19 pandemic) (HUD Exchange, 2025). CoCs meet this requirement by conducting a Point-in-Time (PIT) Count, a census of people experiencing homelessness on a given night in the winter, usually during the end of January. While the number of PLU on a single night is not equivalent to the average number of PLU over the year or the total number of people who experience unsheltered homelessness annually, the PIT Count is the standard, nationally comparable measure used in the field.

## **2.2 Where in California People Live Unsheltered**

Figure 1 shows the estimated number of PLU in each CoC in California based on the most recent PIT Count in the area, which was conducted in the winter of either 2023 or 2024. Note the logarithmic scale since the Los Angeles CoC has almost 50,000 PLU in its jurisdiction, which is more than six times as many people as in the CoC with the next most PLU within its boundaries. After the Los Angeles CoC (CA-600), the CoCs with the next largest number of estimated PLU in their jurisdictions are both in Northern California: Santa Clara County (CA-500) and Alameda County (CA-502), which have more than 7,400 and 6,300 PLU in them, respectively. Sacramento County (CA-503) is the seventh ranked with more than 3,900 PLU in it. Information on the CoC numbering and on the per capita concentrations of where PLU are located are in Appendix A.

Figure 1. California Map of Where People Live Unsheltered

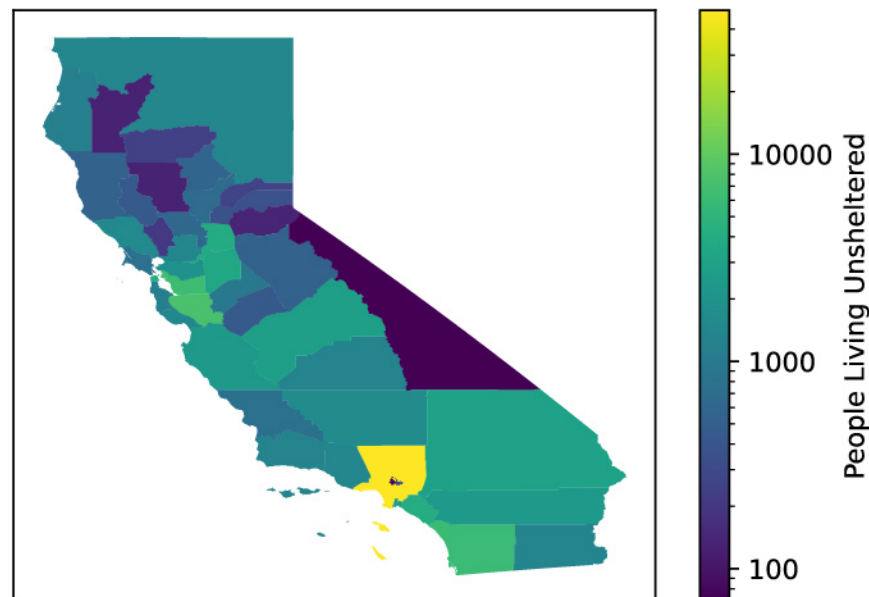


*Figure 1 Note. The number of people living unsheltered in each California Continuum of Care from the 2024 Point-in-Time Count on a log scale from few people (purple) to many (yellow). Data from HUD Exchange (2024b).*

## 2.3 Expected Future Frequency and Severity of Extreme Heat

The absolute number of days a location is above the two heat index thresholds (90°F [32.2°C] and 100°F [37.8°C]) and the change in the number of days between years will matter for anticipating the need for and effectiveness of different risk mitigation strategies. For example, if a jurisdiction always opens emergency shelters when temperatures reach a certain temperature threshold, and that threshold will be met twice as often in twenty years than it will be met today, then funding and other priorities must align with that increase. Without advanced planning, large increases may lead to a jurisdiction accustomed to the status quo being unprepared. Frequent extreme heat means that a jurisdiction may need significant resources.

### 2.3.1 Increases in Extreme Heat Days Across the State (Vulnerable Groups)

Figure 2 shows the estimated annual number of days in each 3-km grid cell that exceeds a heat index of 90°F (32.2°C), which corresponds to our estimate of the expected number of days annually that will be dangerous for vulnerable groups. Every CoC will see an increase in the expected annual number of days that are dangerous for vulnerable groups both between Climate Normal and Mid-Century and between Mid-Century and the End-of-the-Century. Of the 44 CoCs in California,

all but one have an estimated annual number of days with heat indices that are dangerous for vulnerable groups of at least 30 at the End-of-the-Century, though this is only true for 34 of the CoCs during the Climate Normal. More than two-thirds of the CoCs will see dangerous heat for vulnerable groups at least one-third of the year. Four of the CoCs are estimated to see over half the year with heat indices above 90°F (32.2°C) by the End-of-the-Century.

**Figure 2. Extreme Heat Days Dangerous for Vulnerable Groups in Different Timeframes**

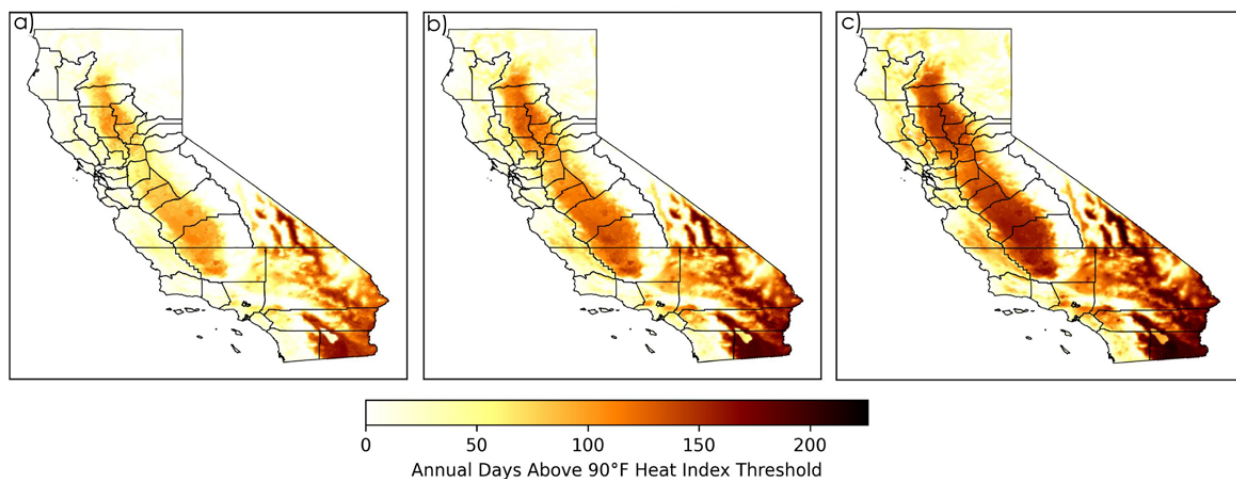


*Figure 2 Note. The expected annual number of days exceeding a heat index threshold of 90°F (32.2°C) in the median GCM in each 3-km grid cell in California during (a) the Climate Normal period, (b) Mid-Century, and (c) the End-of-the-Century colored from white (0 days) to black (226 days). The black outlines correspond to the 44 Continuums of Care in California. Data source: Cal-Adapt CMIP6.*

The Inland Deserts, San Joaquin Valley, and Sacramento Valley regions can expect the most absolute number of extreme heat days dangerous for vulnerable groups increasingly by Mid-Century and the End-of-the-Century. The regions that will see the greatest change in days between the Climate Normal and Mid-Century and, especially, the End-of-the-Century are the North Coast, Sierra Nevada, and the southern part of the Central Coast. Note that one of the reasons a region sees significant change in extreme heat is that, during Climate Normal, they see relatively few extreme heat days.

In Figure 3, this information is presented by CoC. This figure contains abbreviated names; the location of each CoC is shown in Figure A1 and the full name is provided in Table A1, along with the values of the numbers in Figure 3. CoCs that begin with a five are in northern California; those with a six are in southern California.



Figure 3. Estimated Frequency of Dangerous Heat for Vulnerable Groups by CoC

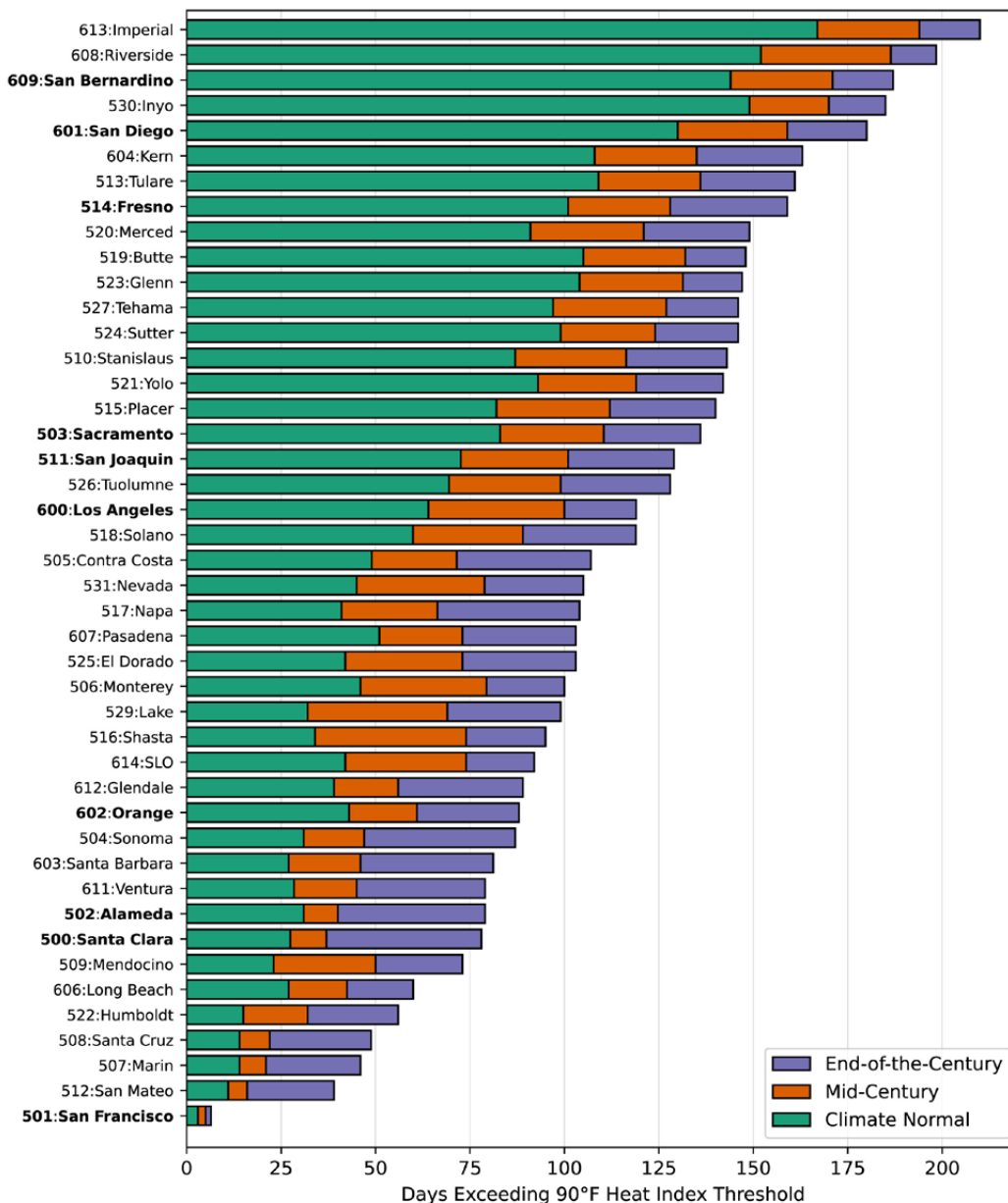


Figure 3 Note. The estimated annual number of days with a heat index that exceeds 90°F (32.2°C) for each Continuum of Care (CoC) during Climate Normal (green), Mid-Century (orange), and the End-of-the-Century (purple). The CoCs, labeled by number and the most populous county in their jurisdiction (or city for Glendale, Long Beach, and Pasadena), are organized in decreasing days above the threshold for End-of-the-Century. The 10 CoCs with the most people living unsheltered according to the 2024 Point-in-Time Count are bolded (data from HUD Exchange, 2024b). The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. Data Source: Cal-Adapt CMIP6.



The three CoCs with the most estimated annual days exceeding the threshold that is dangerous for vulnerable groups (CA-613: Imperial County CoC, CA-608: Riverside City & County CoC, and CA-609: San Bernardino City & County CoC) are all in the top half of the CoCs by number of PLU. By the End-of-the-Century, 96% of the PLU are projected to live in a CoC with at least 30 days a year that are estimated to be dangerous for vulnerable groups (all except for those in CA-501: San Francisco CoC). More than 70% are projected to live in a CoC that exceeds the threshold at least one-third of the year; 6% are projected to live in a CoC that exceeds the threshold for at least half of the year. Almost one-third of the PLU in California currently reside in a CoC where the number of estimated extreme heat days that we classify as dangerous for vulnerable groups will at least double between Climate Normal and the End-of-the-Century (see Figure A4 in Appendix A).

### 2.3.2 Increases in Extreme Heat Days Across the State (All Groups)

There are very few days that were estimated to be dangerous for all groups (above a heat index threshold of 100°F [37.8°C]) during the Climate Normal period, as shown in Figure 4a and Appendix Table A2; 6 of the 44 CoCs were estimated to have zero days annually (containing eight percent of the PLU) and only five were expected to have at least 30 days annually above the threshold (see Figure 5). However, by the End-of-the-Century, 19 of the 44 CoCs (or one-quarter of where PLU reside) are estimated to have at least 30 days above the same threshold.

**Figure 4. Extreme Heat Days Dangerous for All Groups in Different Timeframes**

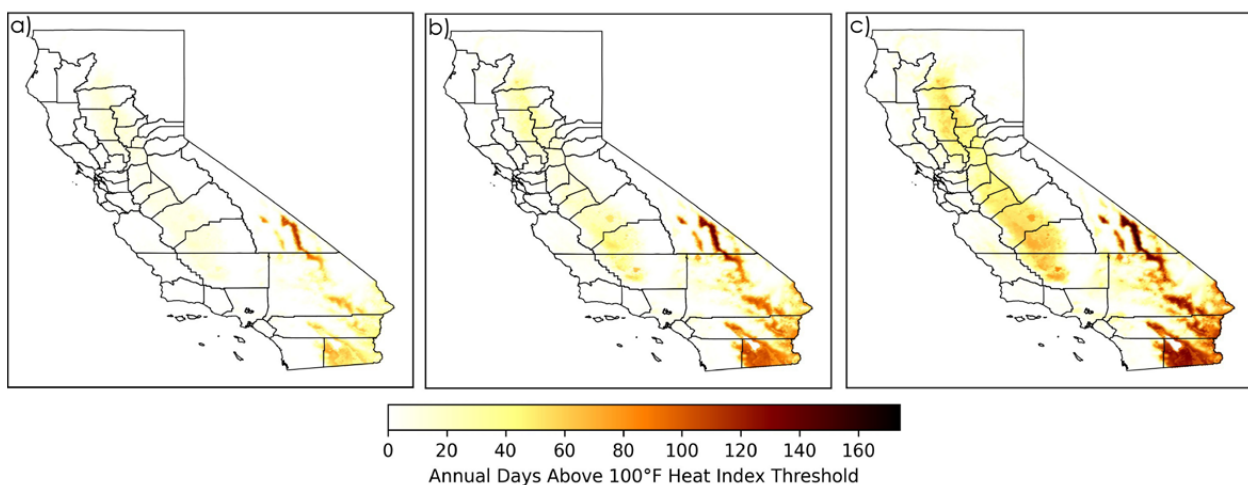


*Figure 4 Note. The expected annual number of days in each 3-km grid cell in California during (a) the Climate Normal period, (b) Mid-Century, and (c) the End-of-the-Century that are estimated to exceed a heat index of 100°F (37.8°C), colored from white (0 days) to black (174 days). The black outlines correspond to the 44 Continuums of Care in California. Data Source: Cal-Adapt CMIP6.*



As with extreme heat dangerous for vulnerable groups, the Inland Deserts, especially, will see a large absolute number of extreme heat days for all groups in both Mid-Century and End-of-the-Century. By End-of-the-Century, the San Joaquin and Sacramento Valleys will also see several heat days above the 100°F (37.8°C) heat index threshold.

**Figure 5. Estimated Frequency of Dangerous Heat for All Groups by CoC**

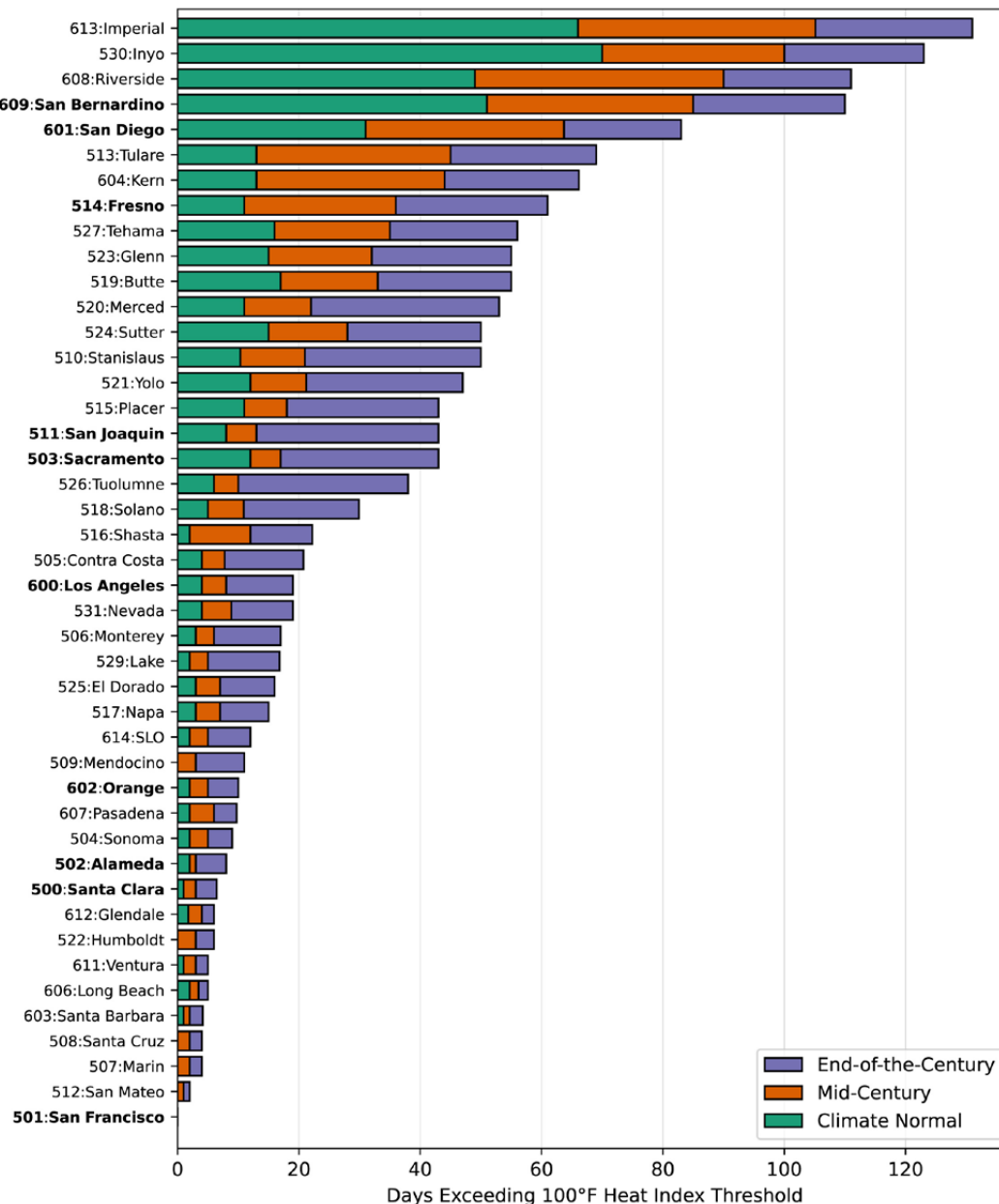


*Figure 5 Note. The estimated annual number of days with a heat index that exceeds 100°F (37.8°C) for each Continuum of Care (CoC) during Climate Normal (green), Mid-Century (orange), and End-of-the-Century (purple). The CoCs, labeled by number*



*and the most populous county in their jurisdiction (or city for Glendale, Long Beach, and Pasadena), are organized in decreasing days above the threshold for End-of-the-Century. The 10 CoCs with the most people living unsheltered according to the 2024 Point-in-Time Count are bolded (data from HUD Exchange, 2024b). Estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. Data Source: Cal-Adapt CMIP6.*

Except for the San Francisco CoC (CA-501), every CoC sees an increase between the Climate Normal and Mid-Century and between Mid-Century and the End-of-the-Century. More than 80% of PLU live in a CoC that will at least double the number of days above the 100°F (37.8°C) heat index threshold between the End-of-the-Century and the Climate Normal; almost 20% live in a CoC that will see at least a tripling in the number of days above the threshold (see Figure A5 in Appendix A). More than 75% of PLU live in a CoC where the increase in the annual number of days dangerous for all groups is greater between the End-of-the-Century and Mid-Century than between Mid-Century and Climate Normal. In other words, there will be a jump in days dangerous for all groups in areas where many PLU reside. If local officials use temperature thresholds to implement risk mitigation strategies (e.g., opening cooling centers), they will likely see rapid increases between Mid-Century and the End-of-the-Century.

Note that only about 30% of PLU are in a CoC that will see this same pattern for the 90°F (32.2°C) threshold (dangerous for vulnerable groups). This differs from the change in the number of days dangerous for all groups because we are reporting days above a threshold. Many areas that see a steady increase in temperature may not see an increase over the higher threshold for many years.

### **2.3.3 Case Studies**

Investigating changes in extreme heat for the Los Angeles City & County CoC (CA-600) and for the Sacramento City & County CoC (CA-503) reveal more granular information about these areas and illustrate the advantages and drawbacks of our method for estimating expected changes to extreme heat throughout California.

#### **2.3.3.1 Los Angeles Continuum of Care**

The 2024 LAHSA's PIT Count estimated that there were 49,509 PLU in the Los Angeles City & County CoC (HUD Exchange, 2024b). Of these, more than 49% likely met the criteria for chronic homelessness, which we use as a proxy for increased sensitivity to heat.

In 2024, LAHSA estimated more than 21,000 cars, vans, RVs, tents, or makeshift shelters with people living in them (LAHSA, 2024a). While some cars, vans, or RVs may have the capabilities to run air conditioning, many do not.

Due to its large geographic size and population, the Los Angeles CoC is divided into eight geographic service planning areas (SPAs). These distinct regions allow for services to target specific needs of the residents in these different areas. SPA 4, which includes the downtown part of the City of Los Angeles, accounts for approximately 26% of PLU in the Los Angeles City and County CoC, followed by SPA 6 (South Los Angeles), with about 18% of PLU, and SPA 2 (the San Fernando Valley) with about 15%, as shown in Figure 6.

**Figure 6. People Living Unsheltered in Los Angeles CoC by Service Planning Area**

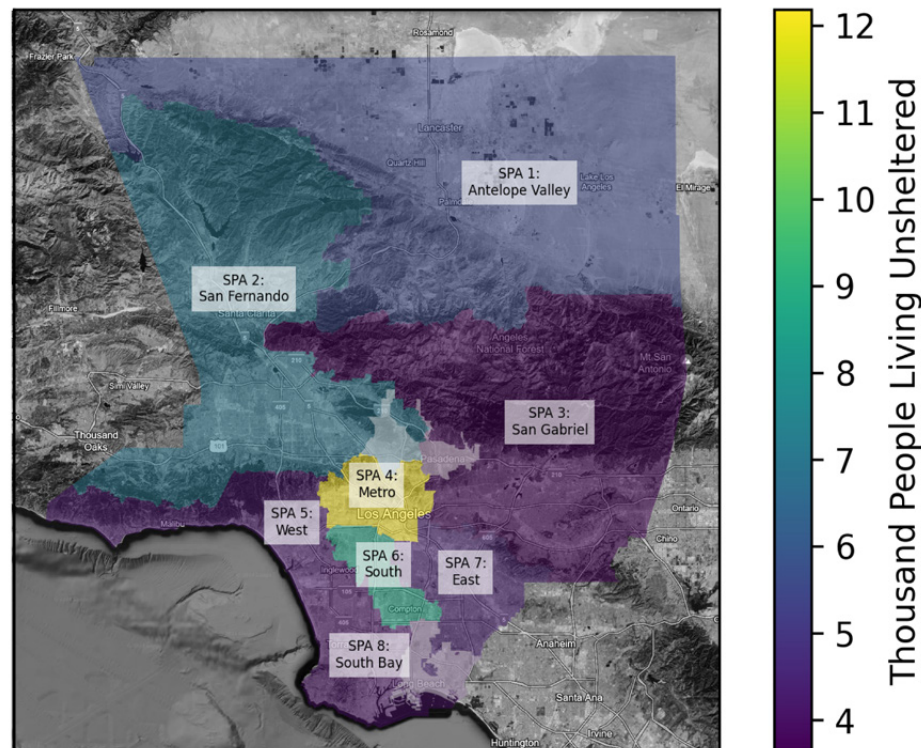


*Figure 6 Note. The number of people living unsheltered in each service planning area (SPA) in the Los Angeles Continuum of Care (CoC) from the 2024 Point-In-Time Count shaded from purple to yellow. The CoCs that are in Los Angeles County but not included in the Los Angeles CoC (Glendale, Long Beach, and Pasadena) are shaded gray. Data source: LAHSA (2024a). Basemap: Google Maps, 2024.*

For all the GCMs, the Los Angeles CoC should expect more extreme heat (at levels dangerous for vulnerable groups and dangerous for all groups) at Mid-Century compared to the Climate Normal period and at the End-of-the-Century compared to Mid-Century. Most of this increase in heat will be concentrated in Antelope Valley, the San Fernando Valley, and the base of the San Gabriel Mountains east of Pasadena, as shown for one of the GCMs in Figure 7. Note that this is consistent for all GCMs run for both heat index thresholds. Of these locations, the San Fernando Valley currently

has a significant number of PLU (about 7,000). At the End-of-the-Century, two of the five GCMs predict that the Los Angeles CoC will see days dangerous for vulnerable groups for more than one-third of the year. One of the GCMs predicts more than 40 days a year that will be dangerous for all groups at the End-of-the-Century.

**Figure 7. Los Angeles Days Dangerous for Vulnerable Groups**

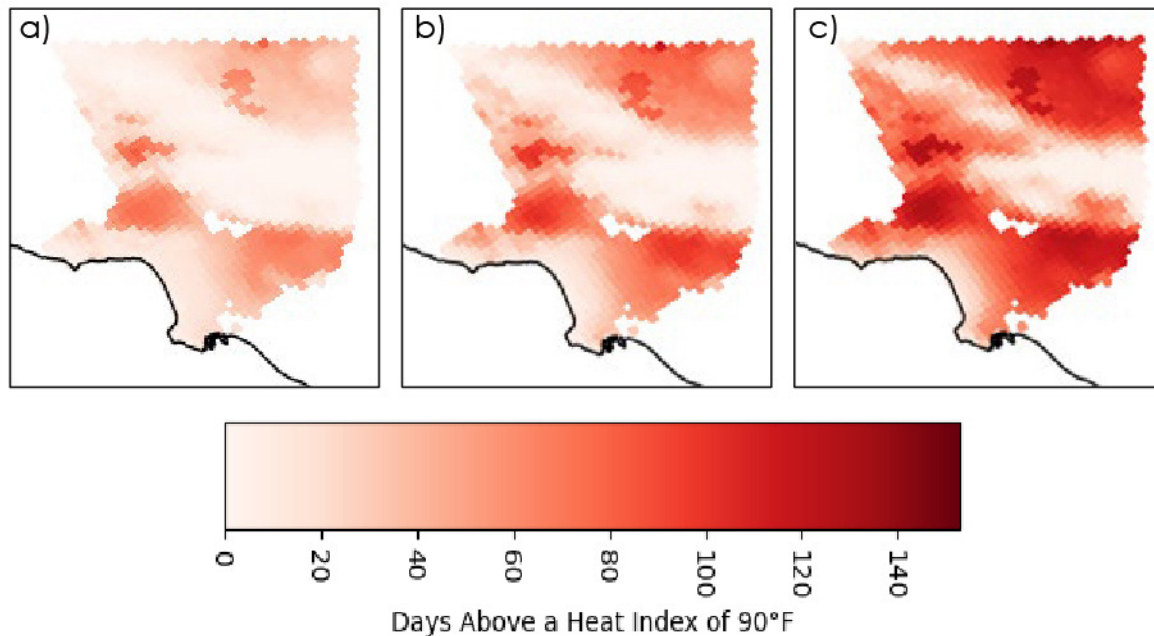


*Figure 7 Note. The number of days annually that will see a heat index above 90°F (32.2°C) for (a) the Climate Normal period, (b) Mid-Century, and (c) the End-of-the-Century. Each 3-km grid cell is colored from white to red. Results in this figure are for the EC-Earth3-Veg GCM for the Los Angeles City & County Continuum of Care (Catalina and San Clemente Islands are not shown). Note that this Continuum of Care excludes Glendale, Long Beach, and Pasadena. Data source: Cal-Adapt CMIP6.*

When looking at the 95th percentile cell in the Los Angeles CoC, for the 90°F (32.2°C) heat index threshold, there is a fairly consistent increase between Climate Normal and Mid-Century and between Mid-Century and the End-of-the-Century. For the 100°F (37.8°C) heat index threshold, however, two of the five GCMs show sharp increases between Mid-Century and the End-of-the-Century (Figure 8).

**Figure 8. Change in Extreme Heat for Los Angeles CoC (>100°F [37.8°C] Heat Index) by Simulation Model**

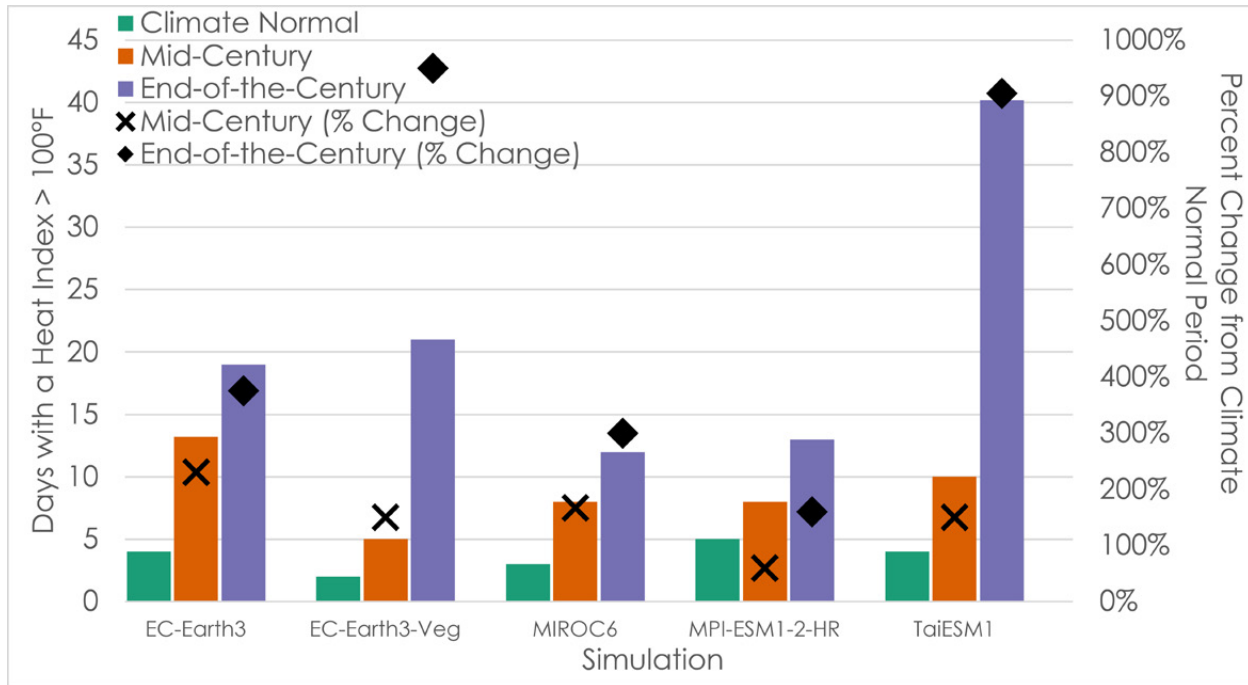


*Figure 8 Note. The 95th percentile grid cell for the Los Angeles Continuum of Care for each of the five GCM simulations showing the annual number of days with a heat index that exceeds 100°F (37.8°C) (left axis) for the Climate Normal (green), Mid-Century (orange), and the End-of-the-Century (purple) time periods and the percent change (right axis) from the Climate Normal for Mid-Century (black Xs) and the End-of-the-Century (black diamonds). Data source: Cal-Adapt CMIP6.*

Figure 7 demonstrates the heterogeneity across the CoC in the estimated number of extreme heat days. This illustrates a challenge for choosing one number for each GCM for each CoC for each timeframe (displayed in Figure 8): the 95th percentile grid cell for the End-of-the-Century is 134 days, while the median grid cell was 71 days and the maximum grid cell estimated 153 days.

### 2.3.3.2 Sacramento Continuum of Care

The 2024 PIT Count for Sacramento County, conducted in late January of that year, estimated 3,944 PLU in its jurisdiction, about 51% of whom were chronically homeless (Baicocchi et al., 2022). As shown in Figure 9, the majority of these people (more than 75%) were in the City of Sacramento, 14% were in unincorporated parts of the county, and the remaining PLU were in the cities of Rancho Cordova, Citrus Heights, Elk Grove, and Folsom. This is a 28% decrease from the last PIT count, which occurred

in late February of 2022. While these numbers were not reported for the 2024 PIT Count, in the 2022 PIT Count, more than 594 people were living along the American River Parkway in “over a dozen” encampments (Baiocchi et al., 2022).

**Figure 9. People Living Unsheltered in Sacramento County**

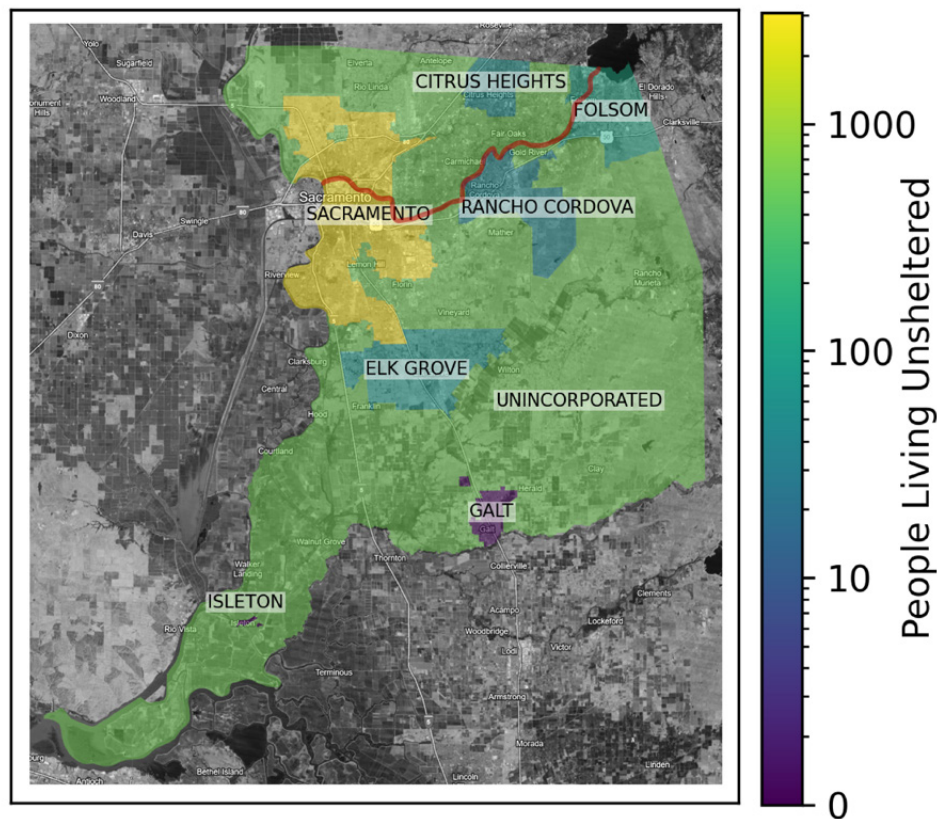


*Figure 9 Note. The number of people living unsheltered in each city in Sacramento County from the 2024 Point-In-Time count shaded from purple to yellow. Isleton and Galt recorded zero people living unsheltered. The red line is the American River Parkway. Data source: Sacramento Steps Forward (2024). Basemap: Google Maps, 2024.*

As with Los Angeles, all the simulations and the two temperature thresholds show consistent locations for increased extreme heat. For Sacramento CoC, these are expected to mostly occur in the northwestern section of the county, which is where Sacramento City is located (Figure 10 shows the results for one simulation for the 90°F (32.2°C) heat index). Sacramento City is also home to the most PLU within the Sacramento CoC.

**Figure 10. Sacramento Days Dangerous for Vulnerable Groups**

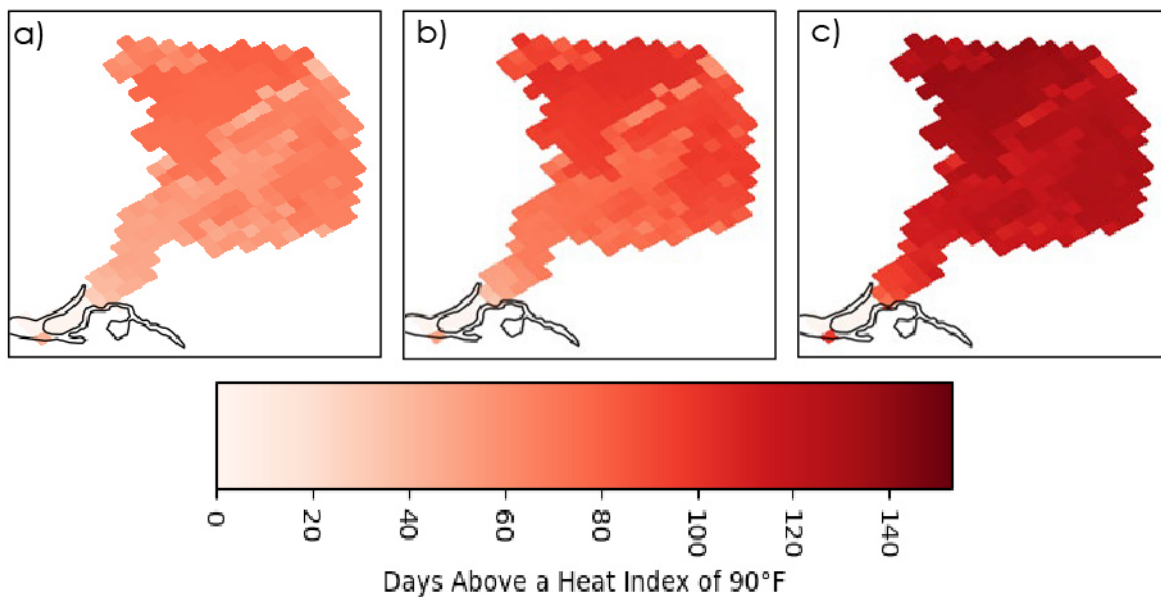


*Figure 10 Note. The number of days annually that will see a heat index above 90°F (32.2°C) for (a) the Climate Normal period, (b) Mid-Century, and (c) the End-of-the-Century. Each 3-km grid cell is colored from white to red. Results in this figure are for the EC-Earth3-Veg GCM for the Sacramento City & County Continuum of Care. Data source: Cal-Adapt CMIP6.*

All five of the simulations indicated a greater increase between Mid-Century and the End-of-the-Century than between Climate Normal and Mid-Century for the 100°F (37.8°C) heat index threshold, which is dangerous for all groups, as shown in Figure 11. In contrast, the 90°F (32.2°C) heat index threshold saw this pattern for only three of the five GCMs. As discussed above (Section 2.3.2), this is because we report the number of days above a threshold and there are areas and days that are not already close to exceeding the 100°F (37.8°C) heat index threshold but are close to the 90°F (32.2°C) threshold.



**Figure 11. Change in Extreme Heat for Sacramento CoC (100°F Heat Index) by Simulation Model**

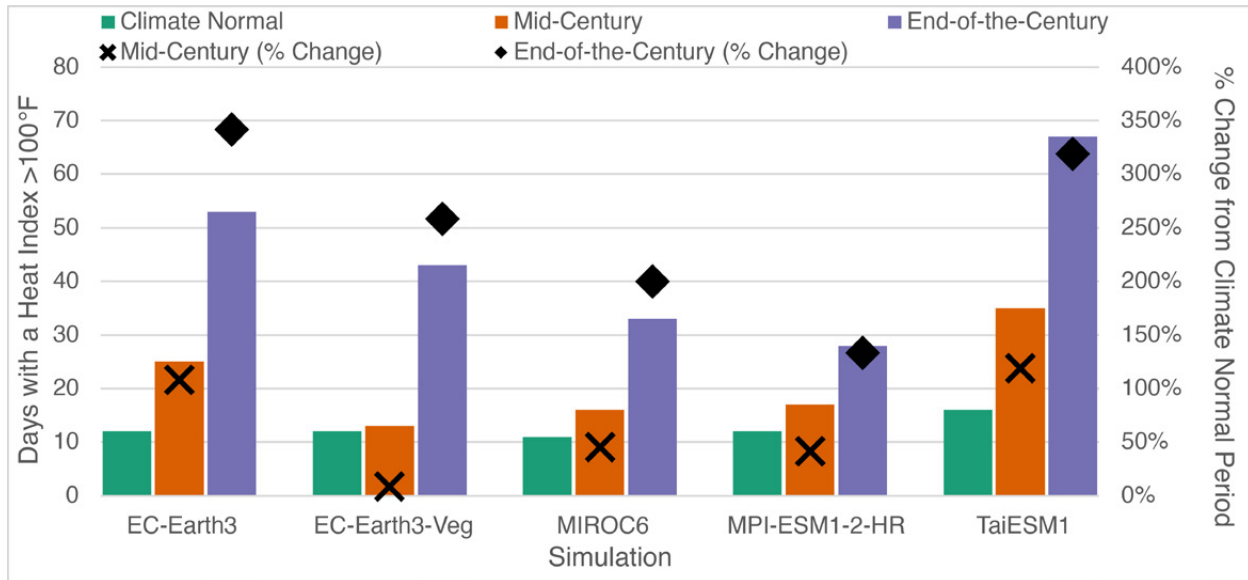


*Figure 11 Note. The 95th percentile grid cell for the Sacramento Continuum of Care for each of the five GCM simulations showing the annual number of days with a heat index that exceeds 100°F (37.8°C) (left axis) for the Climate Normal (green), Mid-Century (orange), and the End-of-the-Century (purple) time periods and the percent change (right axis) from the Climate Normal for Mid-Century (black Xs) and the End-of-the-Century (black diamonds). Data source: Cal-Adapt CMIP6.*



## 3 Challenges and Strategies

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### 3.1 Methods for Challenge and Strategy Identification

To answer our second research question (“What are the most effective and feasible strategies to reduce harm to people living unsheltered during extreme weather events?”), we combine several data sources and methodologies. In this section, we provide a summary of each of these data sources and methodologies. More details on each approach are in Appendix B.

We note that the intersection of unsheltered homelessness and climate preparedness is governed by an evolving landscape of judicial rulings and legislative mandates, so any analysis will necessarily be out of date. At the federal level, *Grants Pass v. Johnson* significantly altered the legal landscape by permitting local jurisdictions to enforce anti-camping ordinances regardless of shelter availability. All interviews and surveys occurred within the eight months following this June 2024 Supreme Court ruling. State policies have also shifted, including a July 2024 Executive Order that directs California agencies to prioritize the removal of encampments that pose immediate health and safety risks – such as in wildfire-prone or flood-vulnerable areas (Exec. Order N-1-24, 2024). However, local counties and municipalities continue to employ a fragmented patchwork of enforcement strategies across the state (Nazarali, 2024). Because local government entities frequently contract these essential services to community-based organizations, a diverse array of policy actors must coordinate across multiple levels of government and have different timelines of policy uptake.

#### 3.1.1 Literature Review

We conducted a broad narrative literature review to identify a comprehensive list of strategies currently used or considered to mitigate risk from extreme weather events to people living unsheltered (PLU) and the features of each of these strategies. While we focus on PLU, much of the literature groups PLU with the broader category of people experiencing homelessness (including people who have access to temporary shelter). When a finding or statistic covers the broader category, we indicate so.

##### 3.1.1.1 Sources and Key Words

To cast a wide net on academic and gray literature related to strategies that mitigate harm to PLU from extreme heat, flash flooding, and wildfire smoke, we searched academic databases (Scopus, Web of Science), emergency management guidance (Homeland Security Digital Database), gray literature (Google Scholar), newspapers in the United States (U.S. Newsstream), and the major newspapers in the two case study locations (The Sacramento Bee and the Los Angeles Times) on February 29,



2024. More information on the databases and keywords used is in Appendix B.1.2. After removing duplicates, we were left with 892 articles. We then filtered these as described in Appendix B.1.3 to 249 relevant and accessible articles.

### **3.1.1.2 Included Hazards, Regions, and Methods**

For each of the 249 articles that were reviewed, we classified them according to the following topics: (a) study region; (b) hazard type(s); and (c) whether risk perception or communication methods were mentioned. We classified articles as covering risk perception if they discussed either the way that PLU made decisions or experienced and interpreted risks from weather events, and we classified them as covering communication methods if they discussed strategies to reach PLU, such as using cellphones or paper flyers. Table 4 shows the distribution of topics covered in the reviewed articles.

**Table 4. Topics Covered in Literature Review**

| <b>Topic</b> | <b>Tags</b>          | <b>Articles</b> | <b>% of Articles</b> |
|--------------|----------------------|-----------------|----------------------|
| Region       | Sacramento County    | 58              | 23%                  |
| Region       | Los Angeles County   | 40              | 16%                  |
| Region       | California State     | 26              | 10%                  |
| Region       | United States        | 218             | 88%                  |
| Region       | International        | 19              | 8%                   |
| Hazard       | Cold                 | 102             | 41%                  |
| Hazard       | Heat                 | 93              | 37%                  |
| Hazard       | Rain or Storms       | 89              | 36%                  |
| Hazard       | Flash Flooding       | 53              | 21%                  |
| Hazard       | Smoke or Air Quality | 21              | 8%                   |
| Hazard       | COVID-19             | 14              | 6%                   |
| Hazard       | Wildfires            | 9               | 4%                   |
| Other        | Communication        | 42              | 17%                  |
| Other        | Risk Perception      | 31              | 12%                  |



*Table 4 Note. The topics covered in the 249 articles reviewed for this report. Those that were tagged with California State include articles that specifically reference the State of California or a location in California that was not in Sacramento or Los Angeles Counties. Those tagged as United States largely focus on the US context or have case studies/data collection within the United States. International articles were those that had primary data collection or case studies outside the United States.*

Sacramento and Los Angeles Counties were mentioned in 23 and 16% of the articles, respectively, primarily because of the inclusion of The Sacramento Bee and the Los Angeles Times. Note that, while many of the articles discussed extreme heat (37%) and a fair number discussed flash flooding (21%), fewer covered poor air quality (8%). This reflects the existing literature because wildfire smoke exacerbated by climate change is a relatively recent phenomenon in many cities. While many of the discussed strategies designed for extreme heat, cold, or flash flooding likely apply to poor air quality from wildfire smoke, more research on specific strategies for mitigating the harm experienced by PLU from wildfire smoke is likely needed. Of the academic articles that did cover strategies for wildfire smoke, more than one-fifth were dissertations.

### **3.1.1.3 Literature Review Advantages and Drawbacks**

Because of the way that the databases were chosen and filtered, some areas are more extensively covered than others. As mentioned above, Sacramento and Los Angeles Counties were overrepresented compared to the rest of the state because we explicitly searched major newspapers in these two regions. Additionally, because of our focus, we may have missed strategies currently being applied elsewhere that could work in California. For example, we did not analyze a major heat wave in 2021 located in the Pacific Northwest, which also has many PLU. This is likely because the Oregonian, the major Portland newspaper, was not included in our source for US newspapers (U.S. Newsstream) after 2018 (ProQuest, n.d.).

Additionally, this review included only information that was publicly available or available from common academic literature databases during our search in February 2024. Since much of the information about local strategies resides in local emergency services departments, we may have missed some of the strategies not covered by newspapers or public documentation. This is one reason why we also conducted interviews with experts and surveys with PLU.

### **3.1.2 Practitioner Interviews**

We conducted 16 practitioner interviews with 26 people working in a variety of settings, including at government agencies focused on emergency management and/or addressing homelessness and serving PLU; local legislators' offices; homeless advocacy organizations; or those who work as service providers, first responders, or



law enforcement. More information on the interview sample is in Appendix B.2. Given our focus on unsheltered adults, we did not include County Offices of Education or Mc-Kinney Vento homeless liaisons in our interview sample, but we recognize that future research should incorporate their viewpoints.

We asked interviewees what strategies their organizations use during or in anticipation of extreme heat, flash flooding from extreme precipitation, and wildfire smoke. Notably, in most interviews, respondents reported that their organizations had no strategies in place to address wildfire smoke.

For each strategy identified, we asked about the decision-making process leading to their implementation during or before the extreme weather event; the challenges associated with implementation; perceptions of each strategy's effectiveness; how information about each strategy is communicated to PLU; and the barriers PLU face in utilizing each of the identified strategies.

### **3.1.3 Surveys of People Living Unsheltered**

We conducted 47 surveys with PLU in locations that recently had either a severe heat wave (Antelope Valley) or a heavy wildfire smoke event (Malibu) about their experiences during and prior to the event. There was not an opportunity to conduct surveys with PLU in areas with recent flash flooding as no flash floods occurred during our study period. For the surveys focused on extreme heat, we surveyed people living in Antelope Valley about the heat wave that occurred in late August to early September 2024. Daytime high temperatures ranged from 100°F to 108°F between August 31 and September 9, 2024, in Lancaster and Palmdale (Timeanddate, n.d.-a, n.d.-b). Our smoke-related surveys were focused on people affected by the Franklin Fire, which started in Malibu, California on December 9, 2024, and was declared contained on December 18, 2024 (CalFIRE, n.d.). The smoke and fire primarily impacted areas in Malibu.

The field staff-administered surveys included questions about exposure and vulnerability to extreme weather events, potential strategies to mitigate harm from these events, preferences and reasons for accepting or not accepting these strategies, and demographic information. More details on the screening and survey methodology and results are included in Appendix B.3.

The average age of the survey respondents was 46 ( $\pm 12$ ) years. Those surveyed about extreme heat tended to be younger than those surveyed about wildfire smoke ( $42 \pm 9$  years for the heat surveys and  $51 \pm 13$  years for the smoke surveys); these demographics match the slightly older population of PLU in Service Planning Area 2 (Westside) compared to Service Planning Area 1 (Antelope Valley) (LAHSA, 2024b, 2024c). About 74% identified as male, 21% as female, and 4% as gender



non-conforming. The age and gender composition of our sample is similar to survey samples of PLU in neighborhoods with high densities of unsheltered homelessness in Los Angeles (Ward et al., 2024).

When asked, 23% of the respondents identified as Hispanic or Latine, though there were more people who identified as Hispanic or Latine in the extreme heat surveys (40%) than in the smoke ones (5%). In Los Angeles County, about half of people are Hispanic, although the rate is higher in Service Planning Area 1 (Antelope Valley), where the heat surveys were conducted (54%), relative to the rate in Service Planning Area 5 (Westside), where the smoke surveys were conducted (17%) (LA County Public Health, 2023). These demographics are also observed in estimates of people experiencing homelessness in the area: 30% of people experiencing homelessness in Antelope Valley are Hispanic relative to 25% in Westside, according to the recent demography survey conducted by the Los Angeles Homeless Services Authority (LAHSA, 2024b, 2024c). While all surveys were conducted in English, 27% of the smoke respondents and 28% of the heat survey respondents reported being able to read flyers in Spanish.

Compared to statewide estimates of the demographics of PLU, people who identified as American Indian/Alaskan Native and those who identified as Native Hawaiian/ Other Pacific Islander were overrepresented (HUD Exchange, 2024a).

Respondents were split between living in a vehicle during or in the week prior to the extreme weather event (32%), living in a tent or makeshift shelter (40%), and sleeping outside (28%), as shown in Figure B4. Most of the respondents reported being unhoused “this time” for at least two years (see Figure B5). We provide more demographic information in Appendix B.3.5.

While this survey effort solicited respondents in a few locations, our sampling method excluded some entire demographics. For example, we did not include individuals under the age of 18, although no one we approached at the sampling locations was a minor or had a minor visibly with them. Unaccompanied youth often hide in more remote, less serviced areas due to safety concerns and to avoid detection, but paradoxically may increase their exposure to environmental hazards and decrease their proximity to shelters (Bender et al., 2015). We also did not ask about family structure or whether respondents had children under their supervision, so cannot report demographics related to families living unsheltered.



## 3.2 Identified Challenges to Reducing Harm and Associated Strategies

From the literature review and drawing on insights from practitioner interviews and surveys with people living unsheltered (PLU), we cataloged strategies for alleviating harm to PLU during extreme weather events and grouped these strategies according to one of the four primary challenges the strategy sought to address. These challenges are listed in order of their proximity to the direct immediate impact of the extreme weather event to the farthest away. More specifically, if shelter space is available, shelters offer appropriate services, and if PLU are aware of these options, then far fewer PLU will remain exposed to hazardous conditions.

Challenges:

1. PLU are highly exposed and vulnerable to the effects of extreme weather events. At the same time, resources and treatments that would reduce this exposure are inaccessible.
2. PLU lack timely information about hazards, services, and shelters during extreme weather events. This is related to ineffective communication between different parts of the emergency response system, service providers, and PLU about what resources are available during extreme weather events.
3. Existing shelters may lack conditions, services, or supports that make them desirable to PLU.
4. Shelter capacity is often insufficient during extreme weather events.

In this section, we discuss each of these four challenges and provide strategies and insights drawn from the literature review, the practitioner interviews, and surveys with PLU. If not included in an accompanying table or figure, we bold each type of strategy. Where relevant, we note which extreme weather events and which actors (e.g., specific agencies or entities) are responsible for implementation of a strategy (Cruden et al., 2023). When identifying actors, we are guided by the policy ecology framework that specifies that social service implementation involves multiple actors operating on different levels: policy, agency, service provider, and individual (or client) level (Raghavan et al., 2008). In this context, service providers are entities responsible for providing direct service to PLU. The agency level refers to entities with funding authority that are typically government or quasi-government organizations.

### 3.2.1 Challenge 1: People Living Unsheltered Are Exposed Directly to Extreme Weather Events and Are Vulnerable to Their Effects

We begin by describing the challenge in general and in the State of California. We also provide results on exposure to extreme weather events and issues of access to resources and services to reduce that exposure from our surveyed populations in Antelope Valley and Malibu.



### **3.2.1.1 Discussion of Challenge**

PLU experience greater exposure to extreme weather events than others because they often live outdoors with limited protection from environmental hazards. Their vulnerability is also heightened by pre-existing health conditions – many of which are worsened by the prolonged exposure that accompanies unsheltered homelessness.

#### ***Exposure and Vulnerability from the Literature***

PLU frequently experience temperatures higher than those faced by housed individuals, including those in homes without air conditioning. In Santa Clara County, research identified a spatial mismatch between enforcement and climate safety; areas where PLU experience fewer displacement orders – and thus greater stability – coincide with urban heat islands and minimal canopy cover (Gabbe et al., 2023). The City of Sacramento, despite a federal court order not to do so, cleared an encampment located in a shaded area near City Hall during a heat wave in 2023 (Clift, 2023d). Whether outdoors with no cover, in a tent or makeshift structure, or in a vehicle, temperatures can be hot; tents or vehicles can be much hotter than their surroundings when ventilation is poor (e.g., car doors and windows are shut or a tent is enclosed, often because of concerns about safety)(Gabbe et al., 2023; Karanja et al., 2023).

Access to drinking water is a critical resource during extreme heat events; without it, extreme heat is more dangerous. Yet, numerous studies show that PLU often lack reliable access to drinking water (Anthonj et al., 2024; Avelar Portillo et al., 2023; Voisinet, 2023).

PLU face elevated risks during flash flooding because many live along riverbanks (Clift, 2023a), the coastline (Serna, 2017), or within flood channels (Littlejohn & Altman, 2017). During flooding events, PLU have required rescue from flood basins (Littlejohn & Altman, 2017), have needed to climb trees to avoid being swept up in the water (Kurhi & Giwargis, 2017), or have drowned (Clift, 2024). PLU may be more vulnerable because of an inability to evacuate quickly, a lack of knowledge about flood risk, insufficient access to transportation, or a hesitance to leave behind belongings (Eisenhardt, 2023). Even PLU in vehicles may be in flood zones or vulnerable to losing this protection from rain; for example, in May of 2023, the City of Sacramento towed a vehicle being used by someone living unsheltered immediately before a large storm (Clift, 2023b).

Living outside increases the severity and duration of exposure to the poor air quality from wildfire smoke events. A study in Salt Lake City found that 89% of people experiencing homelessness reported seeking medical help for conditions that stem from poor air quality, such as exhaustion or nausea, though these issues may have also had other causes (DeMarco et al., 2020). Exposure to wildfire smoke has also



been correlated with emergency room visits by people experiencing homelessness (Schwarz et al., 2024). Additionally, HUD has issued federal-level guidance for communities to prioritize climate-resilient strategies to protect the people experiencing homelessness from wildfire smoke (HUD, 2023).

The risk from poor air quality and from extreme heat increase with both the intensity and duration of exposure (Van Tol et al., 2024). PLU are therefore at higher risk because they are, definitionally, more exposed to weather impacts and exposed for longer periods of time. Existing respiratory or cardiovascular problems, which are common in PLU (Van Tol et al., 2024), can increase vulnerability to both heat and poor air quality. These health conditions may be exacerbated by common experiences among PLU, including previous exposure to extreme heat and poor air quality, sleeping in abandoned buildings, or burning potentially toxic materials to stay warm (Slesnick & Slesnick, 2024).

Other demographic factors can exacerbate risk. For example, young children living unsheltered are more at risk from both wildfire smoke and extreme heat than adults living unsheltered because of their breathing rates and difficulties regulating temperature (Syed et al., 2026). Children also may be less able to swim than adults, increasing the risk from flash flooding. Pregnant individuals living unsheltered may be more likely to suffer adverse pregnancy outcomes, such as preterm births and miscarriages, than those with less exposure (Basilio et al., 2022).

### ***Exposure and Vulnerability from Our Survey Sample***

More than half of our survey respondents reported experiencing at least one challenge with accessing basic resources or managing health issues during extreme weather (see Figure 12). The percentage of respondents citing challenges was higher in the heat sample than the smoke sample, which may reflect the locations where the surveys were conducted or the longer duration of the extreme heat event compared to the wildfire smoke one.

**Figure 12. Reported Challenges by People Living Unsheltered During Extreme Weather**

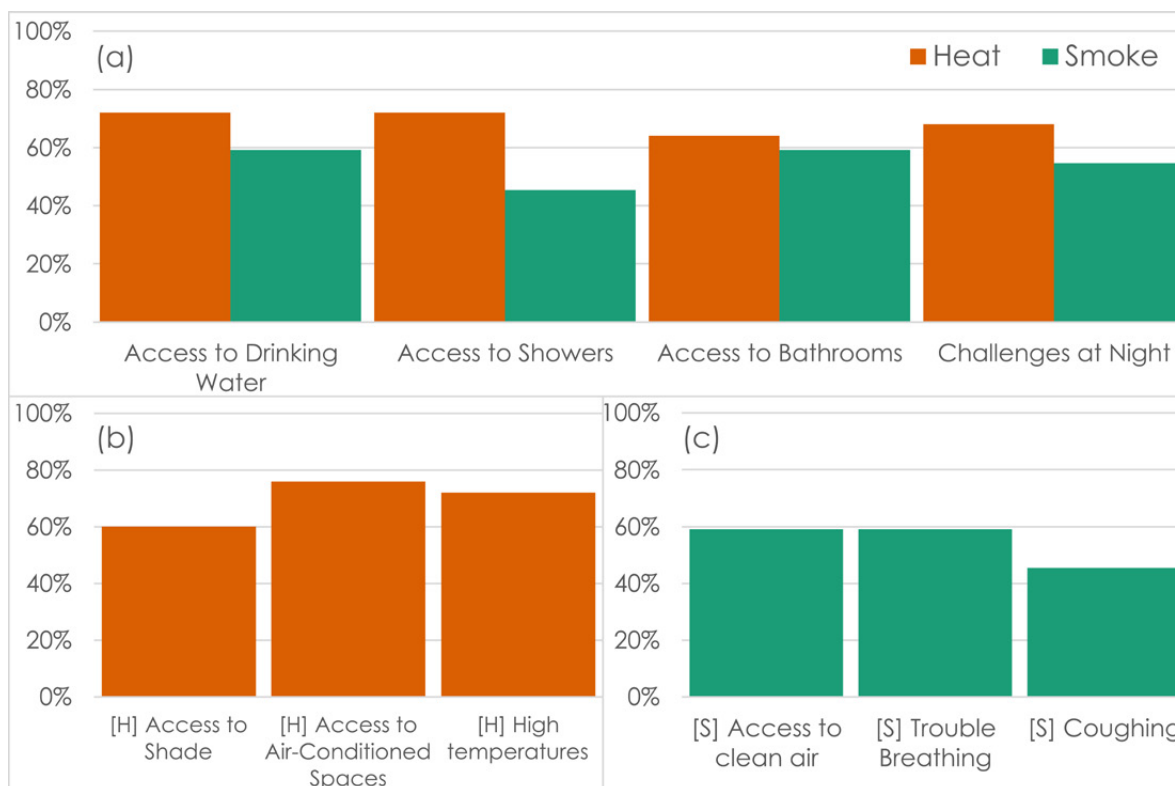


*Figure 12 Note. Percentage of respondents reporting issues during extreme weather events: (a) includes issues reported by both those surveyed about heat and smoke, (b) was asked only of those surveyed about heat, and (c) was asked only of those surveyed about smoke. The issue with “high temperatures,” asked only of those surveyed about heat, indicated the respondent had an issue with higher temperatures in a vehicle, a shelter, or a tent during a hot day since being unsheltered. Data from surveys of people living unsheltered.*

More than a quarter of the respondents living in Antelope Valley reported seeking medical attention for heat stroke, heat exhaustion, or dehydration since becoming unsheltered. For all the cases reported, they sought medical attention on days when temperatures exceeded 100°F (37.8°C). Most of these respondents had sought this medical attention either once or twice a year. In an open-ended survey response, one respondent reported becoming unconscious from heat and, likely, dehydration, on a day when the nearby library (a typical cooling refuge) was closed.

Water access varied by location. In Malibu, 82% of respondents usually considered it “easy” to obtain drinking water, and 95% reported that it typically took less than 30 minutes. However, open-ended responses suggest that water access became more difficult during wildfire smoke events when stores closed or transit services were



disrupted. In Antelope Valley, only 41% reported that obtaining drinking water was “easy,” and just 55% were able to do so within 30 minutes.

Of all the respondents, 49% reported obtaining drinking water from a tap, bathroom, or water fountain (55% among Antelope Valley respondents; 43% among Malibu respondents). About 44% reported purchasing their water (32% Antelope Valley; 57% Malibu), and a smaller group relied on bottled water provided by others (e.g., friends, neighbors, or outreach workers) – a pattern reported exclusively by respondents in Antelope Valley.

Health issues commonly associated with smoke exposure (e.g., difficulty breathing, persistent coughing) were reported more than twice as often by respondents aged 45 and older compared to younger respondents. Individuals sleeping outdoors without any shelter also reported these respiratory problems more than twice as frequently as those staying in tents, makeshift structures, or vehicles.

In open-ended survey responses, PLU exposed to wildfire smoke reported asthma flare-ups, headaches, burning eyes, and the need to repeatedly wipe ash from their faces – all indicators of significant exposure without adequate protective resources.

In addition to increased exposure, forced movement was common during these events. Nearly half of respondents in Antelope Valley reported being compelled to leave their location immediately before or during the heat wave. Of those, 25% left voluntarily – primarily for comfort or safety – and the remainder were prompted by law enforcement, private security, local or state government staff (non-law enforcement), neighbors, or business owners. In Malibu, almost a quarter of respondents reported leaving their location during the wildfire smoke event, all citing personal safety as the reason.

Service providers are often the ones communicating risk about extreme weather hazards, signs of danger to look out for, and how and when to seek medical help. Of those PLU surveyed about extreme heat, only four people (16%) had received information about heat risk or dehydration symptoms since becoming unsheltered in the area. One of these people received this information via a flyer, one in conversation with an outreach worker, and two in conversation with someone else. Of those surveyed about wildfire smoke in Malibu, half had received information about the wildfire risk in the area and 23% about protection from wildfire smoke. The sources for wildfire risk and protection were varied: word-of-mouth, outreach workers, flyers, and firefighters/police officers all contributed predominantly to information about risk. A few people also mentioned that they had received information from the internet, phone alerts, and radio. Prevention information came mostly from outreach workers or word-of-mouth.



### 3.2.1.2 Strategies

#### *Directly Reducing Exposure and Its Effects*

There are many strategies that reduce a PLU's exposure to an extreme weather event or reduce the effect of that exposure. Some of those strategies employed by PLU relevant to extreme heat and wildfire smoke and reported by survey respondents are summarized in Figure 13.

**Figure 13. Protection Strategies People Living Unsheltered Employ During Heat and Smoke Events**

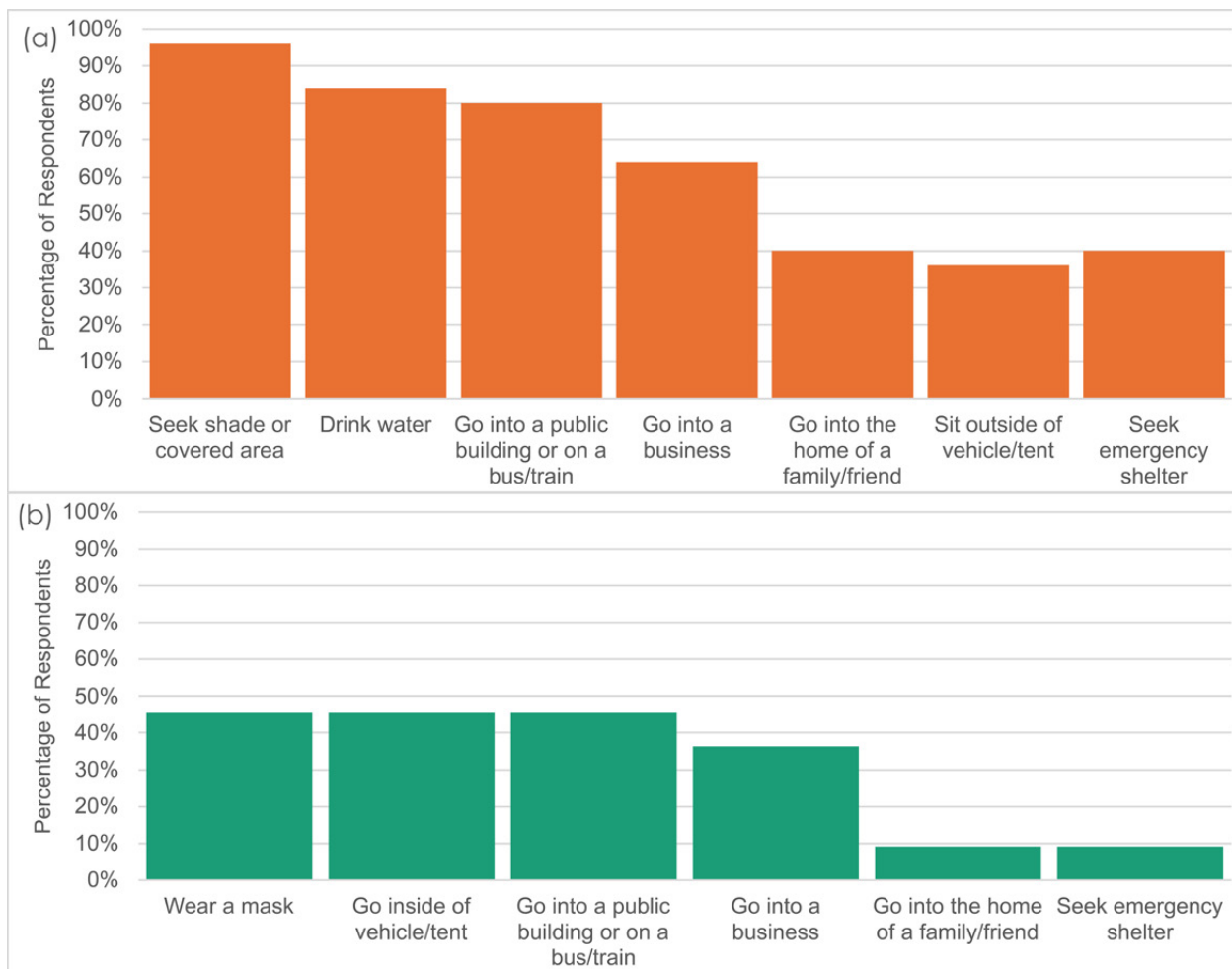


*Figure 13 Note. Strategies survey respondents reported using to protect themselves from (a) extreme heat and (b) wildfire smoke. Data from surveys of people living unsheltered.*

During extreme heat conditions, nearly all respondents reported seeking shade or a covered area and drinking water. Many also sought reliefs by boarding buses or



trains, entering public buildings such as libraries or transit stations, or spending time in private businesses such as restaurants and stores. 40% of respondents in the heat sample reported seeking emergency shelter, compared with less than 10% of those surveyed about wildfire smoke – likely reflecting the sudden onset of smoke events, which often provide little warning or preparation time.

In open-ended responses, PLU described additional adaptations to heat such as **placing cardboard in vehicle windows to block the sun, removing tent rainflies to allow airflow, or limiting movement during the hottest parts of the day.**

Fewer than half of respondents exposed to wildfire smoke reported wearing a mask for protection. However, 68% reported protecting themselves by staying inside a vehicle or tent, seeking emergency shelter, boarding public transit, or entering a public or private building. One person noted that staying inside their vehicle did not fully protect them, saying they “woke up with headaches every morning,” suggesting that the vehicle did not filter smoke as effectively as they believed. In open-ended replies, respondents also described **moving away from heavy smoke: driving, walking, or biking along the coast or toward the ocean.**

Service providers we interviewed mentioned other strategies to reduce exposure, including **organizing transportation to enable family reunification** – i.e., buying tickets for someone who has family or friends elsewhere that are willing to house them. This strategy is very effective at reducing exposure, as long as there is confirmation of a family member or friend who will accept the person traveling.

**Training sessions prior to hazardous conditions** can reduce the effects of exposure for PLU during those events (Edgington, 2009). In particular, we heard about practitioners providing or wanting to provide information about how to detect and prevent heat illnesses and prevent consequences from flash flooding. One interviewee mentioned providing training in benefits offices or other waiting rooms that many PLU already spend time in.

Across strategies, organizations **can incorporate information about vulnerability** to reduce the effects of exposure. For example, one agency opened cooling centers earlier for the first heat wave of the season than they did for other ones because public health officials had told them that the health impacts of the first heat event are worse than subsequent ones.

At the policy level, one strategy to reduce exposure is to implement either **formal policies or to suggest exercising prosecutorial discretion not to clear encampments or move people** from shady areas (during or just prior to extreme heat) or from high ground (during times of heavy precipitation).



### ***Resources to Mitigate Effects of Exposure***

In the paragraphs that follow, we describe the types of resources commonly distributed by service providers, strategies used to deliver them, and the challenges associated with each. In Sections 3.2.3 and 3.2.4, we address the physical spaces that providers operate, and the services offered at those sites.

Providers often offer a wide range of resources before and during extreme weather, including water, ice, sunscreen, cooling fans, and other essential items (Hubert, 2018; Kalofonos et al., 2023; O'Donnell & Chen, 2022). In addition to the strategies identified through the literature review, interviews and surveys revealed additional items that service providers distribute – or that PLU wish were distributed. Table 5 lists all resources cataloged in this study. For the specific resources asked about in the survey, the table shows the share of respondents who received the resource during the hazard or in the week prior, or at any time for items such as first-aid kits or radios. Table 5 includes only resources relevant to the specific hazard (e.g., blankets are not included for extreme heat).

**Table 5. Resources Provided During or Before Hazards**

| <b>Resource</b>          | <b>Relevant Hazard</b> | <b>% Received</b> |
|--------------------------|------------------------|-------------------|
| Water bottles            | H                      | 68%               |
| First-aid kit            | H,F,S                  | 26%               |
| Frozen water bottles/ice | H                      | 20%               |
| Cooling rags             | H                      | 20%               |
| Sunscreen                | H                      | 20%               |
| Masks                    | S                      | 18%               |
| Fresh socks              | H                      | 12%               |
| Food                     | H, F, S                | 12%               |
| Radio                    | H,F,S                  | 4%                |
| Handheld fans            | H                      | 0%                |
| Cellphones               | H,F,S                  | N/A               |
| Device chargers          | H,F,S                  | N/A               |
| Fresh shoes              | H                      | N/A               |
| Toiletries               | H                      | N/A               |



| Resource           | Relevant Hazard | % Received |
|--------------------|-----------------|------------|
| Food benefits card | H,F             | N/A        |
| Ponchos            | F               | N/A        |
| Tents              | F               | N/A        |
| Gas card           | S               | N/A        |
| Safety glasses     | S               | N/A        |

*Table 5 Note. Because we are interested in resources received in anticipation of or during a hazard, the percent received column refers to the portion of respondents who were surveyed about the hazard and received the resource during or in the week prior or (for first-aid kit and radio) who had ever received the resource. The resource "food" was a write-in under the "other" option for the surveys. Resources with an "N/A" in the "% Received" column were not asked about on the survey but came from survey open-ended responses, practitioner interviews, or literature. In the "Relevant Hazard" column, "H" refers to extreme heat, "F" refers to flash flooding, and "S" refers to poor air quality from wildfire smoke.*

Many respondents (68%) had received water during or in anticipation of a heat wave. Though masks are often mentioned to reduce exposure to wildfire smoke, only 18% of those surveyed after an incident of smoke indicated having received one.

To address extreme heat, service providers brought cooling tents or mobile **cooling centers to nearby existing encampments, hosted wound clinics to treat burns from hot surfaces, and administered intravenous injections (IVs)**. The IVs were administered by licensed medical workers on the street or at an encampment in Maricopa County, AZ to people showing signs of exhaustion or severe dehydration (accounted for approximately 20% of PLU the workers encountered). The service providers reported that they found this strategy particularly effective at managing exposure to extreme heat and affordable: the process takes about half an hour and costs around \$4 per person for the IV equipment.

For flash flooding, interviewees from a local government agency relayed that they brought **warming tents to or close to existing encampments and helped people move to higher ground**. Note that one interviewee mentioned how wind, which often occurs along with rain during times of flash flood risk, can knock over trees and makes areas that are protected by trees or shade deceptively dangerous during storms.



When asking people to leave behind a tent to evacuate to shelter or higher ground, one interviewee mentioned the importance of **committing to providing and later following through with replacement tents** so that PLU are less concerned about loss of that resource.

In terms of acquiring and distributing resources, one service provider noted to us that philanthropists are more generous during times of wildfires and rain or cold than during heat waves. The interviewee speculated that this may be because, for people with access to air conditioning, heat waves feel less critically dangerous. This may indicate an issue with relying on donors to provide resources during these events or a need for donor education.

Policymakers could also **fund or build infrastructure that PLU use when shelter or respite centers are not available** such as public water fountains, water parks, public misters, shade structures to address heat, or locations to dry clothes and shoes to address the impacts of flooding.

Agencies and policymakers can **redistribute or provide funding and guidance** for resources, treatments, or trainings that reduce the exposure of PLU as described above.

### **3.2.2 Challenge 2: People Living Unsheltered Lack Timely Information About Hazards, Services, or Shelters During Extreme Weather Events**

Lack of appropriate services and resources for communication between service providers and PLU can prevent PLU from promptly learning about extreme weather events and related services.

#### **3.2.2.1 Discussion of Challenge**

##### ***Communication Mismatch***

Effective communication requires an understanding of how people prefer to receive information and the information sources they have access to. Even if PLU would prefer to receive information through electronic devices, many do not have access to charged phones, a connection to WiFi, or televisions or radios (Neuhaus & Lee, 2017; Ramos, 2023). When materials are printed, some PLU may not understand them due to language or reading barriers (Kurhi & Giwargis, 2017). Word-of-mouth may be an effective communication strategy, but there are not always enough outreach workers to reach everyone living unsheltered (Ramos, 2023). In our interviews, outreach workers indicated they had to triage to reach the people in most danger of a hazard and who most needed assistance during an extreme weather event. Police officers are often sent out to spread information, but PLU do not always trust them because of past negative interactions with law enforcement (Canavan & Ledger, 2004).



In our surveys, we asked about cellphone and internet access as these are potential tools for outreach workers to communicate with PLU. Two-thirds of our respondents reported having a working cellphone. All but one of the cellphone-holders could connect to the internet with it. More than 40% of those with working cellphones reported that it was always charged and turned on and 87% of cellphone-holders kept their device charged at least half the time.

We also asked respondents if they had access to a working radio, computer, or television. One-third of the respondents had access to a working radio and two of the respondents (4%) reported having received a radio at some point since becoming unsheltered in the area. Computers were also accessible (45% had access), but TVs were not (16% had access).

More than 85% of our respondents had engaged with an outreach worker or case manager since becoming unhoused. And more than half of those who had ever engaged with an outreach worker/case manager had done so within the past week, suggesting that the majority of people we surveyed are in regular contact with an outreach worker or case manager that could communicate about potential hazards.

We asked respondents if they had ever ignored warning messages about heat waves or poor air quality and only 13% said they had. When we asked about the specific instance of the hazard, however, 48% of those surveyed about heat and 64% of those surveyed about smoke reported either not knowing about the weather event before it occurred or learning about it by (for wildfire smoke) seeing the fire or smoke in the distance. One respondent described the smoke as “very much a surprise.”

**Friction in Agencies Responsible for Communication to People Living Unsheltered**  
In interviews with service providers and government agencies, we heard that challenges associated with agency collaboration disrupt communication to PLU. Some of this is due to the number of organizations involved: some counties involve many cities or jurisdictions, all of which may have different people or organizations responsible for emergency response and for outreach to PLU.

Agencies with different missions or operating conditions can also lead to friction. For example, outreach teams often partner with law enforcement to reach areas that may be dangerous (e.g., along a riverbank when there may already be some risk of flash flooding). However, as we heard from members of law enforcement, many outreach workers are not comfortable working with them, which can hinder collaborations that could help reach more people. Another cause of friction we heard about occurred when first responders, public health workers, and non-profit service staff made decisions together: there can be a tension between the dual-mandate of the first responders and public health workers (protecting the general community including PLU) and the mandate of many of the non-profit service providers (protecting exclusively PLU). One example of this occurred when providing tents as a resource:



law enforcement discussed how non-profits prefer to give PLU tents to stay safe from, e.g., rain. However, the interviewee mentioned that law enforcement has to also consider rules surrounding ADA accessibility of sidewalks, which may be obstructed by tents. They felt that “You’re either social services and butterflies and unicorns and everything happy or you’re the big bad law enforcement that sweeps everybody down the street.”

Friction between the different organization priorities of staff charged with addressing risk among PLU impede the effort to communicate with PLU about extreme weather and services.

### ***Confusion Around Resources and Services***

Many factors made PLU, those responsible for communicating with them, or those responsible for providing services confused.

One of these factors is unclear jurisdictional boundaries. This can be a problem for the organizations themselves: for example, in Los Angeles, the city may be responsible for housing residents in general, but if someone is having a mental health emergency, then the provision of mental health treatment is under the jurisdiction of the County. Additionally, we heard complaints from a city official about their interaction with someone in charge of managing the waterways, who viewed the people living in the waterways as under the city’s jurisdiction and not theirs when the waterway was not actually within the city’s jurisdiction. Overlapping or unclear jurisdictional boundaries can also cause challenges for communication: for example, nested jurisdictions may have different thresholds to open emergency shelters. This can lead to situations where one shelter opens when another that is nearby – or appears quite similar to those unfamiliar with jurisdictional boundaries – does not.

Individual decisions about when to open shelters also lead to inconsistent services. While there are thresholds in California for when emergency shelters must open, cities can use discretion on whether to open them more often. This results in shelters opening due to public pressure, and, in particular, recent deaths (Clift, 2020).

During our interviews, we heard multiple examples across locations about miscommunications that led to people showing up at a shelter during an emergency and being turned away or redirected far across town. In some cases, these people were then redirected again when they reached the new destination. Sometimes, information and resources came too late for outreach workers to successfully help PLU find spots in shelters. In one example, when someone eventually did receive shelter, they were unable to get back to their original location after the event because they did not know how or have resources to access transportation back to where they were previously staying. In Sacramento County in 2023, people lined up outside a closed shelter expecting that it would open since it had accepted people the night before (Clift, 2023c).



Since shelters may have different requirements for admittance and may open under different conditions, we heard frustration about the ways in which information about services is shared. In a few cases in Los Angeles County, calling the "211" line, which PLU were directed to in order to secure shelter, had five to nine hour wait times. Without calling this line, service providers, volunteers, and PLU did not know where and how to access shelter beds. This meant that someone seeking shelter needed an outreach worker to help them, but these outreach workers only had the bandwidth to assist the most vulnerable individuals. Because resources must be individually matched to a person, outreach workers generally utilize the time- and resource-intensive one-on-one and face-to-face communication strategy.

Even when information was publicly available, volunteers helping PLU access these services and resources were frustrated that there were different websites to get information depending on the type of emergency (e.g., if it was rain instead of heat instead of COVID-19).

### **3.2.2.2 Strategies**

#### ***Extreme Weather Hazard Awareness and Communication to People Living Unsheltered***

Respondents to our surveys learned about the specific weather hazard, weather events in general, and services/shelters in different ways. Figure 14 shows that word-of-mouth, phone alerts, and the internet were the most common ways that people reported learning about a specific weather hazard. When asked about receiving news regarding extreme weather in general, respondents depended on word-of-mouth (55%), the internet (53%), phone alerts (34%), and radio/TV (19%). Outreach workers (11%) were less likely to provide initial information about extreme weather than these other sources. However, communication methods and information sources were different for receiving information about shelters or services available during these extreme weather events. Figure 15 shows the breakdown. In general, outreach workers played a larger role in communicating information about shelters or services available during extreme weather events, as did community centers and phone calls. The firefighter/police officer category included those communicating on foot, by vehicle, in a boat (most relevant for flash flooding), or from a helicopter. Police officers also told us about sending people on horseback to reach PLU in remote locations and expressed an interest in sending out drones to understand exactly where PLU may be living.



**Figure 14. How Respondents Initially Learned About the Specific Hazard**

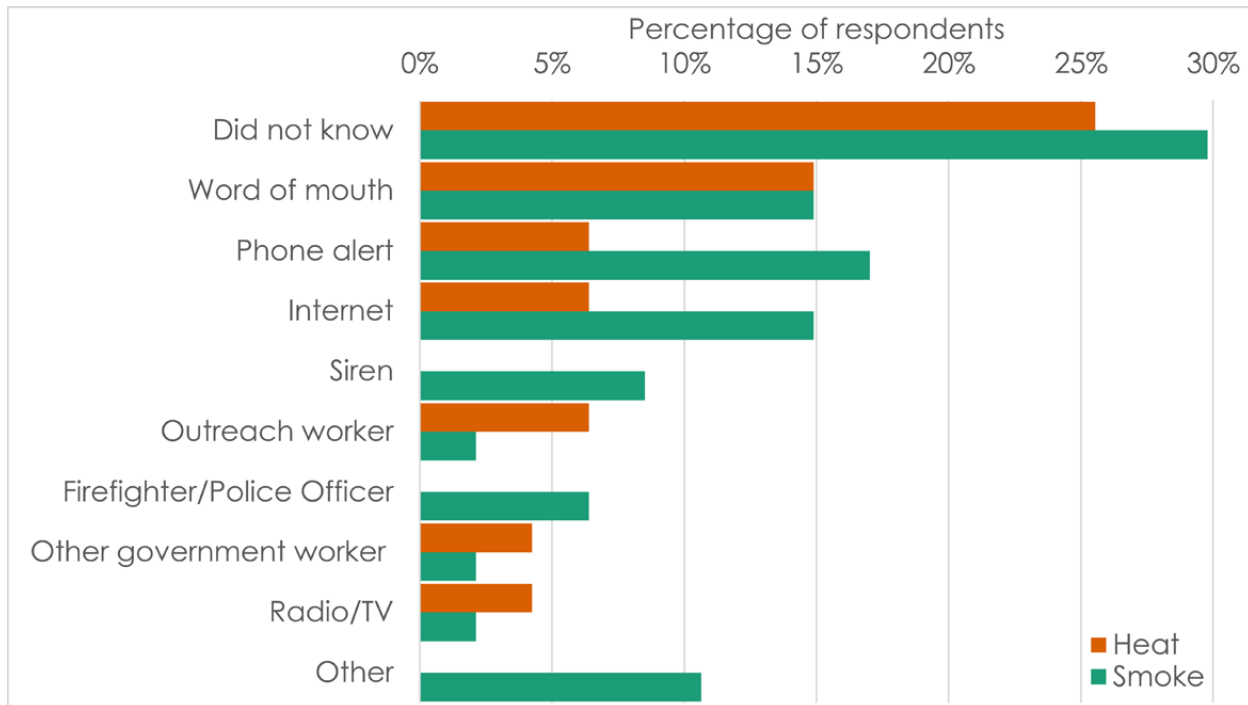


*Figure 14 Note. Respondent answers to how they initially learned about the heat wave or wildfire smoke event (out of 47 total respondents). Note that, in other responses to the survey, many respondents indicated that a siren response was more likely to be the siren from a fire engine than a general weather-alert siren. The “Did not know” category includes those who learned about the wildfire smoke event by seeing either smoke or a fire/glow in the distance. Note that some of these responses were reclassified from the “other” (fill in response) category. The “word of mouth” category includes hearing from a neighbor, friend, or someone else living unsheltered. A phone alert is distinct from a phone call. Those who learned via the internet may have accessed the internet from a mobile phone (including using apps) or via other means. Other government workers include park rangers and employees of Caltrans. Data from surveys of people living unsheltered.*



**Figure 15. How Respondents Generally Get Information about Shelters or Services Available During Extreme Weather Events**

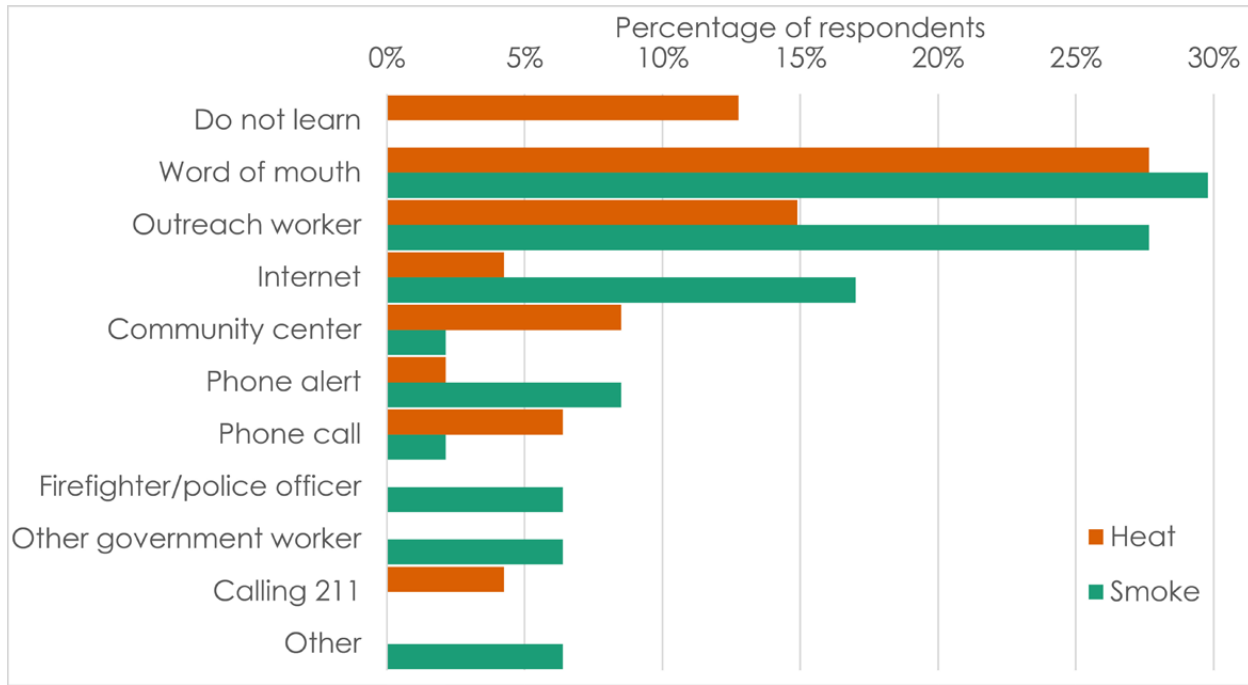


*Figure 15 Note. Respondent answers to how they generally learn about shelters and services available during extreme weather events (out of 47 total respondents).*

*The orange responses are those surveyed in Antelope Valley and the green are those surveyed in Malibu. The "Do not learn," "Community Center" (which includes churches), and "Calling 211" categories were all added based on responses to the "Other" option. The "word of mouth" category includes hearing from a neighbor, friend, or someone else living unsheltered. A phone alert is distinct from a phone call. Those who learn via the internet may access the internet from a mobile phone (including using apps) or via other means. Other government workers include park rangers and employees of Caltrans. Data from surveys of people living unsheltered.*

Many of those surveyed in Malibu first learned about the smoke in the middle of the night. One respondent reported informing their neighbors: "When I saw the flames, I rang the church bell and then I left. I rang the church bell to wake everybody up." Since word-of-mouth was the predominant way that PLU learned about weather events, PLU sharing information about hazards with others living unsheltered is an important strategy for increasing awareness.

The practitioners that spoke to us also indicated that one-on-one communication was the most effective means of communication and their primary way of reaching PLU. Although communication from outreach workers was not the main way that PLU learned about weather hazards, outreach workers were often the ones to



communicate about shelters or other services available during extreme weather. Since outreach workers and emergency responders rely on anecdotal evidence to identify the areas of most concern, one practitioner noted that it would be helpful to have **more real data on which locations will be the most hazardous**, especially for flash flooding.

Volunteers can supplement the one-on-one outreach that outreach workers conduct. For all extreme weather events, service providers can organize **groups on social media of neighbors** who assist PLU during extreme weather, as a community in Boulder Creek, CA did during storms (Bennett, 2017).

At an agency or policy level, **more funding for or a redistribution of existing funding for outreach workers** may help to increase the number of PLU who know about services and shelters, since this was how many people learned this information and, in interviews, outreach workers expressed their need to prioritize outreach to those most at risk because of limited resources and workers. Note that, for specific groups, designated liaisons may make sense: for example, local liaisons focused on children living unsheltered through the McKinney-Vento Act.

In times of extreme heat, outreach workers in another state **adjust their start and end times** (i.e., working earlier in the day) so that staff avoided the hottest and most unsafe times of the day to be outside and could work more efficiently. This strategy could also make collaboration between outreach workers, who have hours that tend to be stricter, and law enforcement, who have hours that tend to be more flexible, smoother by alleviating the inconsistencies in the times they work.

Though many surveyed PLU learned about weather events through phone alerts and various sources suggested this is effective (Ramos, 2023; Seivold, 2022), practitioners had mixed opinions about the efficacy of this means of reaching people. There are two types that are used: alerts that one can sign up for and automatic alerts. Respondents mentioned that opt-in alerts are ineffective because many PLU often change their numbers or have their phones stolen and are therefore less likely to have effective opt-in alerts available on their device. Some also mentioned that automatic alerts are impractical because location-based alerts send messages to too many people. We heard that mobile alerts, in general, can be ineffective because it is often difficult for someone living unsheltered to keep their phone charged. Some practitioners mentioned how SMS messages could be preferable to an app that alerts you because many PLU may be in areas with minimal service or access to WiFi, where SMS messages reach when apps do not work. In extreme heat, reaching people via their phones can be even more challenging because phones overheat. Access to televisions may also help: a study in Fort Lauderdale, FL found that many PLU trusted the news media and would watch publicly available televisions, though few of our survey respondents reported having this access (Ramos, 2023).



Previous research suggests EMTs and firefighters may be more effective and trusted communicators during disasters than law enforcement (Canavan & Ledger, 2004). Our survey respondents did not show these preferences. Among respondents in Malibu, both police officers and firefighters were fairly well trusted; 41% specifically mentioned trusting the police and 32% specifically mentioned trusting firefighters when asked an open-ended question about who they trust. When asked why, one person responded: “they’re usually the ones that know the quickest on stuff like that for emergencies and stuff, and they’re the ones that are supposed to be the responsible parties for making everybody aware of it as quickly as they can.”

Throughout the practitioner interviews, we heard that nearly everyone responsible for communication to PLU during an emergency was familiar with the PLU in that community prior to an event. This assisted service providers and volunteers with knowing where to go, who to target for assistance, and with establishing trust when they arrived. This **familiarity pre-emergency** is critical for success.

Language barriers can contribute to PLU not having necessary information. During flash flooding in San Jose, CA, materials only in English (or only in English and Spanish) led to some not knowing about a hazard (Kurhi & Giwargis, 2017). One practitioner noted that there are over 200 languages spoken in Los Angeles County, so they would appreciate a **technology that could provide quick and reliable translations of materials**.

### *Consistent and Early Activation of Resources and Services*

Interviewees responsible for opening or managing shelters expressed their strong support for **clear and consistent state or local guidelines on when to open shelters and what shelters to open**. Without these guidelines, they found their agencies were responding in a tense, ad hoc manner to complaints from local news or community members. They indicated clearer guidelines would result in PLU knowing where to go, how to get there, and what to expect when they arrive. Clear guidance would also prevent shelter management from experiencing staffing challenges each time the shelter opened. Lastly, streamlining communication sources and improving communication reliability and promptness could help PLU quickly learn where to go during an emergency.

Minimal notice that a shelter will open makes it difficult for service providers to make efficient use of available resources. One service provider in Los Angeles County said that, with three to four days of notice, they could generally find enough PLU interested in shelter so as to fill it to capacity and coordinate the necessary transportation to it. Any less time than this and they had a lot of trouble, though that timeline was dependent on the weather event in question. In general, it was easier for service providers to find PLU interested in shelter and to organize transportation to the shelters during times of heavy rain, especially if it was also cold, than during



heat waves. Note that, most commonly, we heard that there was a 48-hour notice for opening shelters, though we heard as much as five days was common for heat in some situations and a 24-hour notice was fairly standard in others.

### **3.2.3 Challenge 3: Shelters Do Not Have Appropriate Services**

There are many different types of shelters, from vouchers for hotels and motels, congregate or group shelters, dedicated camping or RV sites, and respite centers (including cooling centers, augmented cooling centers that operate during off-hours, and clean air centers).

#### **3.2.3.1 Discussion of Challenge**

The people we surveyed cited various reasons for why they would not accept different shelter options. We asked those who did not or would not accept different shelter types the primary reasons for nonacceptance (with instructions to mark all that apply with 11 options, plus an Other-please describe option), as shown in Table 6.



**Table 6. Reasons People Living Unsheltered Do Not Accept Shelters**

| <b>Response</b>                                                   | <b>Group Shelter</b> | <b>Cooling Center</b> | <b>Short-term Stay in Hotel/Motel</b> |
|-------------------------------------------------------------------|----------------------|-----------------------|---------------------------------------|
| <b>Sample Size</b>                                                | <b>n=25</b>          | <b>n=11</b>           | <b>n=6</b>                            |
| Don't want to be around other people                              | 44%                  | 36%                   | 33%                                   |
| Don't feel safe                                                   | 44%                  | 18%                   | 33%                                   |
| Lack of independence                                              | 32%                  | 9%                    | 17%                                   |
| Not in the right area                                             | 20%                  | 18%                   | 17%                                   |
| Option has too many rules                                         | 16%                  | 9%                    | 0%                                    |
| Needed transportation                                             | 12%                  | 18%                   | 0%                                    |
| Not enough secure storage or not allowed to bring more belongings | 12%                  | 9%                    | 0%                                    |
| Previous bad experience                                           | 12%                  | 9%                    | 0%                                    |
| Not allowed to stay with pets                                     | 4%                   | 18% (9%)              | 0%                                    |
| Not enough time to get there before the event began               | 4%                   | 9%                    | 0%                                    |
| Not allowed to stay with partner, spouse, child, roommate         | 4%                   | 0%                    | 0%                                    |

*Table 6 Note. The reason(s) cited by each respondent living unsheltered who said that they either did not or would not, if offered, accept the shelter type in the column. The results for those surveyed about extreme heat and wildfire smoke are combined. The first row indicates the number of people, out of 47 surveyed, who would not accept each shelter type. Note that there was a separate question about cooling centers during and outside of business hours. The only difference in answers was for "Not allowed to stay with pets," where the result for outside of business hours is shown as a parenthetical. Data from surveys of people living unsheltered.*

Those who did not or would not accept group shelter primarily cited concerns about safety, a lack of independence, and a desire not to be around other people. For example, one respondent gave the explanation: "I don't like being around other



people. I want my own space.” Another respondent said, “I’ve heard a lot of bad things about the shelter,” and another mentioned feeling “confined” in a shelter. Other frequently cited reasons for not accepting group shelter included that it was not in the right area, had too many rules, there was not enough storage, they were not allowed to bring enough belongings, or they needed transportation to get there. Despite literature on issues with accepting pets, belongings, and partners or family members (Baiocchi et al., 2022; Montgomery et al., 2024), only one person out of the 25 who would not accept group shelter indicated that one of the reasons they would not accept was that their pets or partners/spouses/children/roommates would not be permitted to stay with them.

Transportation was an issue that contributed to lack of acceptance (Table 6) and has been noted as an issue in other parts of California (Baiocchi et al., 2022). Even those who have cars or bicycles may have trouble operating them if it is, e.g., very hot (Smith et al., 2021).

More than 40% of the respondents in Malibu mentioned problems related to transportation in open-ended responses, especially since buses were no longer in operation during and following the wildfire event: “even if I had somewhere to go, how would I get there?” one respondent asked. Another, who was offered a room in a hotel, said that the last time they received such an offer, they missed the van sent to pick them up. Another respondent indicated they had wanted to evacuate from the Malibu fire area and “called the 911 operators, and they said they would come get us and bring us into town. . . but they never showed up.”

Practitioner interviewees across locations and agency types brought up transportation to and from shelters as a major barrier to risk mitigation during extreme weather events. Some of the challenges stemmed from the locations of the shelters: because jurisdictions do not necessarily have shelter space close to where people are living, many shelters are not accessible by foot and/or are quite far away from where PLU reside or from public transit. For example, during a tropical storm that affected much of Los Angeles County, PLU in the Antelope Valley were directed to shelters in Pasadena (i.e., 80 miles away with poor public transportation options).

Other aspects that made shelters undesirable include worries about being arrested (HUD, n.d.) and, as we heard in our interviews, the inability of some shelters to accept new residents outside of standard hours. Interview respondents mentioned that specific shelter admission hours are due to staffing constraints and can mean PLU interested in shelter cannot access it at nighttime.

Similar to the communication challenges previously described, our interviews uncovered friction between organizations focused on emergency management and those focused specifically on housing and homelessness that resulted in inefficient



use of resources for providing shelter. One employee at the latter type of organization discussed how emergency management is poorly set up to handle people experiencing homelessness because they expect people to have somewhere to go as soon as a disaster ends and their volunteers sometimes do not want to or are not equipped to help people experiencing homelessness. Additionally, this interviewee mentioned that because emergency managers may be unfamiliar with how or when different shelters are in use, their activation plans may call for activating shelters that are, by the time a formal emergency is declared, already in use and at capacity.

### 3.2.3.2 Strategies

#### Shelter Types

We asked respondents whether they had been offered various types of shelter during the hazard event and if they had not been offered a particular type of shelter, whether they would have accepted it, if it had been offered to them. Generally, those surveyed about extreme heat were more likely to want to accept shelter or respite (see Figure 16); everyone in Antelope Valley did or would accept a room in a hotel/motel (compared to 73% of those surveyed about smoke) and 60% would accept a spot in a group shelter (compared to 32% of those surveyed about smoke).

**Figure 16. Different Shelter Options and Rates of Acceptance**

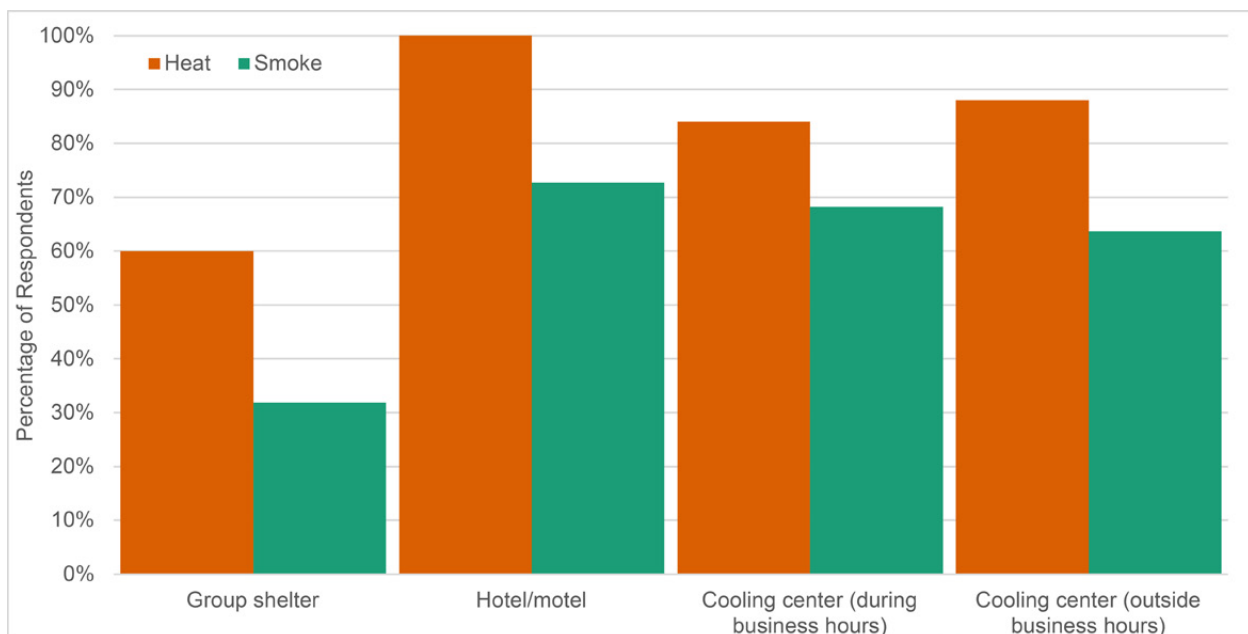


*Figure 16 Note. The percentage of respondents who did or would have accepted each of the shelter or respite options during the heat wave (for those surveyed in Antelope Valley) or wildfire smoke event (for those surveyed in Malibu). Data from surveys of people living unsheltered.*



While we found a high rate of acceptance of hotel and motel vouchers, service providers we interviewed noted a number of issues with this strategy: vouchers are very expensive; it is difficult to maintain motel relationships since there can be damage to rooms; during a weather crisis, there is no real way to get people food; there is not someone at the site providing services; transportation to/from is difficult (especially for rooms far away); and the motels are not always perceived as appropriate given the vulnerabilities of the people being placed in them. There also are not enough hotels or motels in places with the greatest need. It can also result in case management provision challenges, for example, workers being required to travel long distances between sites. Interviewees told us that motel/hotel vouchers are best used when there is someone vulnerable that promptly needs housing, but it is off-hours (i.e., other shelters are not accepting clients), when there is a family that could not stay together in another type of shelter, or when a full motel/hotel is being converted into permanent accommodations.

Cooling centers, both during and outside of business hours (the latter are sometimes called augmented cooling centers), were frequently cited as acceptable by survey respondents. Note that cooling centers also serve as clean air or respite centers. In many cases, cooling centers are public buildings, such as libraries, that are regularly open to the public. Because many of these buildings have their own rules, service providers described the difficulties of adding services to them. For example, changing rules about pets at some of these cooling centers was not under the purview of many service providers because, for example, if a facility serves food, then it often cannot accept animals.

The service providers we interviewed noted that, while many PLU do not particularly like group shelters, these shelters take much less of a case worker's time and allow for the centralization of other services, such as providing food.

We examined whether any demographic characteristics were associated with acceptance rates in group shelter, because previous research suggests that group shelters are not acceptable to many PLU (Ward et al., 2024). While not statistically significant, more women (60%) than men (40%) and everyone who identified as gender non-conforming would have accepted a spot in a group shelter if it had been offered. Additionally, more non-white (55%) than white (38%) respondents would have accepted a spot in a group shelter if they were offered one.

We also examined whether acceptance rates of different shelter options were associated with respondents' current living conditions (vehicle, tent/makeshift shelter, or outside). Those with vehicles tended to be less interested in going to a cooling center such as a library during business hours than others.



Other shelter options that were discussed either as write-ins or in the open-ended section of the surveys with PLU and interviews with practitioners included **dedicated parking locations** for cars and RVs, **dedicated camping sites**, sober living, and **housing with a path to permanency**. Some of these options may be lower cost in certain circumstances and could potentially reduce exposure. In particular, PLU with vehicles who are less interested in cooling centers may be more interested in dedicated parking in shady locations, though this was not covered by our survey.

During large-scale disasters, emergency shelters are set up to serve everyone who has been displaced (and not just those who were previously living unsheltered). In one jurisdiction, a government employee working in homelessness management discussed the success they had experienced by installing a **homelessness liaison in the corresponding office of emergency management** to address issues with discrimination against PLU in these types of shelters. The liaison was responsible both for coordinating with those who work directly with those experiencing homelessness and for ensuring that the interests of this vulnerable population were considered in emergency management plans.

### *Transportation*

Door-to-door transportation would increase shelter acceptability (see Table 7), but significant challenges were cited that prevented implementation of this strategy. Many practitioners told us that getting transportation during a serious weather event, especially a rainstorm, and on short notice is difficult. They described a number of barriers:

- High demand for rideshare services make this option difficult to access during extreme weather events;
- PLU may have personal belongings that make it challenging to transport them in single vehicles;
- Arranging for bus transport requires advance planning and communication so that people know where to access it (note that, even on a bus, it can be hard to accommodate people's belongings); and
- Transport by law enforcement may not be accepted due to the stigma of the vehicle.



**Table 7. Strategies That Would Increase Shelter Acceptance**

| <b>Response</b>                                                       | <b>Group Shelter</b> | <b>Cooling Center</b> | <b>Short-term Stay in Hotel/Motel</b> |
|-----------------------------------------------------------------------|----------------------|-----------------------|---------------------------------------|
| <b>Sample Size</b>                                                    | <b>n=25</b>          | <b>n=11</b>           | <b>n=6</b>                            |
| Secure storage for belongings                                         | 28%                  | 0%                    | 0%                                    |
| Door-to-door ride from location to shelter option                     | 20%                  | 18%                   | 0%                                    |
| Guaranteed transportation back after the event                        | 20%                  | 18%                   | 0%                                    |
| Relative/friend/neighbor accepted or allowed to stay in same location | 20%                  | 0%                    | 0%                                    |
| Better understanding of the extent of the hazard                      | 16%                  | 0%                    | 0%                                    |
| Free fares on public transportation                                   | 12%                  | 18% (9%)              | 0%                                    |
| Image of or information about the shelter option                      | 12%                  | 0%                    | 17%                                   |
| Kennels for pets                                                      | 8%                   | 0%                    | 0%                                    |
| More security/safety                                                  | 4%                   | 9% (0%)               | 17%                                   |

*Table 7 Note. Strategies (rows) that would increase the likelihood of those surveyed accepting a shelter option (column). The results for those surveyed about extreme heat and wildfire smoke are combined. The first row indicates the number of people, out of 47 surveyed, who would not accept each shelter type. Light gray shading indicates strategies related to transportation. Two rows ("Better location" and "More security/safety") were added based on responses to an "Other" category. Note that there was a separate question about cooling centers during and outside of business hours; where they differ, the result for outside of business hours is shown as a parenthetical. Data from surveys of people living unsheltered.*

Free fares on public transit might be helpful but also come with challenges. In Malibu, during the wildfire that caused the smoke, buses stopped running. Interviewees shared how, in Sacramento, people traveling to shelters can ride public transit for



free to get there. However, to do so, they must show a flyer. Obtaining this flyer can be logistically difficult, since not everyone has a smartphone, and printers are not readily available. Additionally, if it is raining, then outreach workers must laminate these flyers to prevent them from disintegrating. This may also be an instance of poor collaboration; we heard that, in many instances, these flyers are not needed at all. However, an interviewee speculated that the transit agency does not want to be in the position of generally providing free rides and so technically requires them. Additionally, if transit does not drop off very close to the shelter doors, then some people with mobility issues will not be able to reach it.

### *Strategies to Improve Acceptability of Group Shelters*

In our interviews and from the literature, we cataloged seven strategies that could improve the acceptability of group or congregate shelters – shelters that provide limited privacy and often provide beds in open spaces such as gymnasiums – to PLU.

The main strategy that would encourage PLU to accept group shelter is **secure storage for belongings**. A respondent from a location that provides lockers (whether a person is staying in a group shelter or not) noted that their facility with the locker amenity is highly popular. This facility does experience challenges with people leaving their belongings long-term. However, the respondent expressed that since setting up and clearly communicating a protocol for removing materials from the locker to free up space for others after it is abandoned for a specific period of time, the process has been smooth.

While few people reported not choosing group shelters because of their pets, one service provider that runs a group shelter that provides **kennels for pets** said that the program was well utilized. Others noted that this strategy may not always be effective because people may not want to be separated from their pets or some pets may not be accustomed to being kenneled. Additionally, while many shelters accept pets, there is often a limit on the number of animals permitted or it may be difficult to transport multiple pets to a shelter. We heard about a case where someone requesting shelter had 14 dogs and could not be accommodated by a motel/hotel voucher or a shelter.

During our interviews, we also heard about two more strategies that those who ran or managed shelters said PLU preferred: **flexibility with curfews** (i.e., allowing people to enter or return to a shelter after curfew) and **awake rooms** so that people who want to stay awake during the night hours had a place of respite.

One of our respondents mentioned **pairing service connection fairs**, which help people find interim housing by getting all their documents, vaccinations, etc. together in one place, with shelters open during emergencies to help set PLU up for finding more permanent housing.



**Clearer and more communication about some of these services** can increase their efficacy, since currently some shelters have differing official and unofficial policies (Azad, 2023). These communication strategies include disseminating information on what will happen to pets and belongings, clear rules about permitted behavior, and consequences for not meeting them.

While our survey respondents did not mention this concern, some PLU are worried about being arrested if they arrive at a shelter (HUD, n.d.). Therefore, **policies to exercise prosecutorial discretion** to not charge someone seeking shelter with a crime, to disseminate amnesty rules, and to provide information about these rules may increase group shelter acceptability.

### **3.2.4 Challenge 4: Shelter Space is Full During Extreme Weather Events**

During extreme weather events, there is not enough space for everyone who wants it (The Sacramento Bee Editorial Board, 2021). PLU in Antelope Valley told us about calling “211” – a service that is designed to connect people to resources such as shelter space (United Ways of California, 2025) – during heat waves and being told there was no available shelter. One person, who has been living unsheltered for seven years, reported giving up on calling “211” for help after many instances of being told by the 211 operator that no shelter was available during extreme weather, this respondent expressed: “I don’t bother calling anymore.”

Practitioners we interviewed confirmed that shelters were sometimes full. They also indicated that the utilization of, for example, winter shelters in Los Angeles County tends to follow a pattern that corresponds to the severity of the cold and rain; there is generally space in November, they tend to be full in January and February when cold and rain are most severe, and then there is more space in March. One interviewee hypothesized that this pattern was both because of the weather and because of knowledge transfer about where the shelter is and if it is a good place to stay. In this section, we describe some of the reasons there is not enough space during extreme weather events and provide strategies to address these. While funding would likely help alleviate some of the challenges meeting demand for shelters, an influx of funding would not solve all issues involved in providing enough shelter.

#### **3.2.4.1 Discussion of Challenge**

Many service provider interviewees described a central tension in providing shelter for PLU during extreme weather events: the limited resources and funds involved in providing services to PLU currently meant that, when additional resources were available, these service providers focused on present needs instead of saving those resources for a potential future extreme weather event. However, when the weather event came, many of the respondents needed more funding and resources.



Beyond funding, we heard three reasons for not meeting the demand for shelter and services during extreme weather: 1. There are not enough spaces suitable, authorized, and available to be quickly stood up as shelters during a hazard event, especially spaces that are easy for PLU to access; 2. There is poor coordination between agencies, leading to a lack of resource activation or delays in activation; and 3. Even when funding for shelters is available, facilities struggle to recruit and retain staff.

Additionally, interview respondents discussed issues with contracting rules; for example, contracting rules prevented the use of funded hotel and motel vouchers in Los Angeles County because service providers were permitted to contract only with motels for which they already had an existing contract and relationship.

From our interviews, we learned that resources often came too late for service providers to deploy, either because the decision to deploy them comes shortly before the event or because of staffing issues and miscommunications. For example, we learned that when an email authorizing resources to a non-profit service provider landed in a government staffer's inbox on a day that staffer was not working, it delayed the service provider's timely access to those resources. Similarly, we heard outreach workers missed information about meetings that were scheduled less than a day in advance when the messages about those meetings arrived on the weekend.

Across locations and weather events, we heard how shelter decisions are affected by staffing capabilities. In general, there is a shortage of staff operating shelters. It can be difficult to get staff members to work overtime during weather emergencies because, among other reasons, the workforce is already overworked. Additionally, because of extreme weather conditions, shelter staff may be unable to access their workplace.

The current schedules of outreach staff also affect shelter availability and efficiency. For example, fewer outreach staff work over the weekend, so outreach needed to effectively inform people about and bring people to the shelter is limited or not conducted during these times. This means that shelters sometimes open earlier than is warranted by the weather event (i.e., on a Friday instead of a Sunday). In other cases, emergency shelters stay open later than is warranted by the event because of the need to have outreach workers available during regular business hours to help connect people with services and to transport them back to their preferred location when the shelter closes. Because resources are limited, keeping shelters open longer than necessary during a weather event can reduce their availability when they are most needed and most effective.



### 3.2.4.2 Strategies

In the following paragraphs, we outline strategies identified to address the lack of shelter space and include a discussion on the advantages and disadvantages of each strategy.

During extreme weather events, shelters often need to be opened quickly. From our interviews, we heard of strategies to address this. One was **choosing dedicated locations that open as emergency shelters** instead of needing to find a new location in each emergency. For example, using county offices as a location for emergency beds and partnering with faith communities, who may have space to use as shelters and community members willing to volunteer time to staff sites.

While county offices can be available to deploy as shelters, this strategy can be logistically cumbersome because, among other reasons, those sheltering there would have to be out early in the morning so county workers could report to work and protected materials would need to be moved each day.

One interviewee mentioned that partnering with faith communities can keep the community engaged with issues of needed shelter but had several drawbacks including a lack of appropriate funding and coordination. Incidents have occurred because well-intentioned volunteers were not necessarily well trained. Additionally, the faith communities were not always located in areas close to where people lived unsheltered, and thus, needed nightly chartered buses that were expensive. Some faith communities were also unable to handle sustained usage of their spaces and volunteers as a shelter.

From our interviews, we heard about challenges with quickly activating shelters when they are needed. To address this problem, some shelter operators choose to **stay open rather than shut down when they expect another activation soon** because quickly staffing up and down is difficult. While this allows shelters to be open when they are needed, it can contribute to PLU's confusion about why a shelter is open on one day and not another.

**More resources or a reallocation of resources for different shelter types or to prioritize weather events** could allow for more shelter availability during emergencies.



## 4 Conclusions and Future Directions

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In this report, we answered two research questions (see Table 1): 1. What is the expected change in the exposure of people living unsheltered (PLU) to extreme weather events in California? And 2. What are the most effective and feasible strategies to reduce harm to PLU during extreme weather events? To answer the first question, we connected information on where people currently are living unsheltered with past, current, and future projections of extreme heat and heavy precipitation. To answer the second question, we combined findings from three different methodologies (a literature review, practitioner interviews, and surveys with PLU after an extreme weather event) to identify four main challenges and catalog strategies to address them, including descriptions of their advantages and disadvantages. In this section, we present the strategies categorized by acceptability and implementation plausibility to assist with policy and decision making. We also discuss how the answers to research questions 1 and 2 relate. Next, we describe this study's limitations and implications. We end by suggesting some future directions for the research.

### 4.1 Strategies By Acceptability to PLU and Implementation Plausibility

In the previous section, we provided strategies to address each of the four challenges described in Section 3.1, noting - when relevant - considerations we encountered for adopting those strategies. A true feasibility assessment would need to account for the upfront and operational costs of a strategy, the political and institutional barriers to implementation, and any changes in institutional capacity. Since these considerations will vary significantly based on the specifics of a particular strategy (e.g., scope and location), we instead offer thoughts on which of these strategies are the best candidates for a feasibility assessment (that is, which have high implementation plausibility). This judgement is based on the interviews, surveys, and literature described above; the importance and centrality of the challenge that the strategy addresses; the scale and downstream effects of a change; and professional judgement.

Any organization interested in implementing these strategies should consider performing a feasibility assessment that accounts for its specific implementation. Not all plausibly implementable strategies will make sense in every jurisdiction.

To help summarize what we learned about strategies to address the challenges PLU face during an extreme weather event, we present strategies (see Table 8) organized by: acceptability among PLU, implementation plausibility, relevant hazard (extreme heat, flash flooding risk, wildfire smoke), and key implementation actor(s) (i.e., the



party responsible for leading the strategy). In Table 8, we also present strategies that do not have enough acceptability and plausibility information to be categorized but have the potential to require only limited resources and have significant impact. Note that we did not use a cost threshold to determine implementation plausibility as we did not collect cost estimates. The remaining strategies (unlisted) discussed in the previous section were not identified by interviewees as strategies that were a change from the generally accepted current practice, required improvements, or would benefit from scaling. For some strategies, the barriers to implementation felt insurmountable; conversely, for others, implementation was straightforward and scaling-up required almost exclusively more resources (e.g., distributing more water bottles). Of note, nearly all the strategies would require funding or funding reallocation from a policy- or agency-level actor; this is not considered in the plausibility analysis.

**Table 8. Prioritized and Categorized Strategies Including Relevant Hazards and Actors**

| <b>Strategy</b>                                                                                                       | <b>Relevant Hazard(s)</b> | <b>Challenge(s) Addressed</b> | <b>Actor(s)</b>                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Higher Acceptability, Higher Plausibility</b>                                                                      |                           |                               |                                                                                                              |
| Ease prosecutorial discretion and, when relevant, communicate about it                                                | H,F                       | 1,3                           | Policy, service providers (communication)                                                                    |
| Remove need for transportation by locating centers or infrastructure closer to where people living unsheltered reside | H,F,S                     | 3                             | Policy (contracting rules), agency (implementation, choosing sites), service providers (cooling tents, etc.) |
| Allow adjustable working hours for outreach workers                                                                   | H,F,S                     | 3,4                           | Policy/agency (contracting rules), service providers (staff)                                                 |
| Streamline and improve communication sources to make them reliable and prompt                                         | H,F,S                     | 2                             | Agency                                                                                                       |



| Strategy                                                                                                                                                   | Relevant Hazard(s) | Challenge(s) Addressed | Actor(s)                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------------|-----------------------------------------------------------------------------------|
| Provide technology (phones, radios) to people living unsheltered. For phones, include the infrastructure to use them (charging access) and an alert system | H,F,S              | 2                      | Agency (infrastructure, alert system), service providers (phones, infrastructure) |
| Provide clear communication about existing services                                                                                                        | H,F,S              | 2                      | Service providers                                                                 |
| Improve services at group shelters, including secure storage (lockers), awake rooms, and kennels                                                           | H,F,S              | 3                      | Service providers                                                                 |
| Allow for flexibility with curfews at group shelters                                                                                                       | H,F,S              | 3                      | Service providers                                                                 |
| Provide trainings about weather hazard effect symptoms and signs                                                                                           | H,F,S              | 1                      | Service providers                                                                 |
| Provide transportation for shelter staff                                                                                                                   | F,S                | 4                      | Service providers                                                                 |
| Provide specific resources for wildfire smoke                                                                                                              | S                  | 1                      | Service providers                                                                 |
| <b>Higher Acceptability, Lower Plausibility</b>                                                                                                            |                    |                        |                                                                                   |
| Use 72- to 96-hour warning times                                                                                                                           | H,F,S              | 2                      | Policy, agency                                                                    |
| Consistently deploy resources and services                                                                                                                 | H,F,S              | 2                      | Agency                                                                            |
| Use county offices as emergency shelters                                                                                                                   | H,F,S              | 4                      | Agency                                                                            |
| Increase access to short-term hotel and motel vouchers                                                                                                     | H,F,S              | 3,4                    | Agency (changed rules), service providers (implementation)                        |



| Strategy                                                                          | Relevant Hazard(s) | Challenge(s) Addressed | Actor(s)                      |
|-----------------------------------------------------------------------------------|--------------------|------------------------|-------------------------------|
| Provide door-to-door transportation from street or encampment to shelter and back | H,F,S              | 3                      | Service providers             |
| <b>Little Information (Potential Higher Acceptability, Higher Plausibility)</b>   |                    |                        |                               |
| Install a homelessness liaison in offices of emergency services                   | H,F,S              | 3                      | Agency                        |
| Provide more dedicated parking and camping areas                                  | H,F                | 3                      | Agency                        |
| Increase public shade structures, misters, and water features                     | H                  | 1                      | Agency                        |
| Use drones to reach people in remote locations                                    | H,F,S              | 2                      | Service providers             |
| Use IV drips                                                                      | H                  | 1                      | Service providers             |
| Create neighborhood groups to assist people living unsheltered                    | H,F,S              | 1                      | Service providers, individual |

*Table 8 Note. This table is a synthesis of strategies provided in this report grouped by level of acceptability to people living unsheltered and plausibility to practitioners. Strategies for which there is little information on acceptability or plausibility, but have potential to meet both, are listed at the bottom of the table. The relevant hazard "H" is extreme heat, "F" is flash flooding, and "S" is wildfire smoke. The challenge number is given where 1 = People living unsheltered are exposed directly to extreme weather events and vulnerable to its effects; 2 = People living unsheltered lack timely information about hazards, services, or shelters during extreme weather events; 3 = Shelters do not have appropriate services; and 4 = Shelter space is full during extreme weather events. The actor-level that might lead an effort is also listed. Note that nearly all the strategies would require funding or funding reallocation from a policy- or agency-level actor.*



The following section discusses the strategies listed in the first two sections of Table 8.

### 4.1.1 Higher Acceptability, Higher Plausibility

The strategies considered acceptable and generally plausible address issues we heard from practitioners and PLU. If implemented, these could reduce the risk to PLU from extreme weather events.

#### 4.1.1.1 Policy- and Agency-Led Strategies

Formalized policies on **prosecutorial discretion** to not forcibly move PLU during or just prior to an extreme weather event is a low resource way to reduce exposure by allowing PLU to remain in relatively cooler (during extreme heat) or higher ground (during heavy precipitation) areas. For example, policies in Sacramento protected PLU from being moved during some extreme heat events (Miranda, 2025). Additionally, prosecutorial discretion to ensure that no one seeking shelter is arrested for doing so, and communication about this policy, is an important and easy way to increase shelter use.

Another strategy is to remove or alleviate the need for extensive transportation to shelters or services by **locating shelters and services (such as cooling or clean air tents or centers) closer to where unsheltered people live**. While there are challenges to siting shelters, many resources and much time is spent transporting PLU and their belongings. Any effort that could reduce this need would be an efficient use of resources and potentially increase shelter use. If shelters cannot be sited more extensively, cooling or clean air tents can be moved more easily to increase access and provide respite during weather hazards.

**Adjusting working hours for outreach and other shelter staff** could help with the consistency of services as weather events do not follow a Monday to Friday, 9 a.m. to 5 p.m. schedule. Providing support on weekends and evenings is often needed both in the field and at shelter/center settings, so that PLU have help when they need it most. While current policies on overtime and, when relevant, union contracts may make implementation more difficult in some contexts, we heard examples of outreach workers shifting hours to reduce exposure to heat. Additionally, those in law enforcement spoke to us about how their hours were more flexible to the needs of the community than outreach staff; this could be a model for adjusting hours.

**Providing an accessible and well-resourced call line (i.e., 211) and website** with all the information relevant to PLU in one place would save the time of PLU, outreach workers, volunteers, and first responders. It would also lead to far less confusion about what resources are activated when and who can access them. This strategy may be especially relevant in a large region, such as Los Angeles County, where multiple government and non-government agencies operate.



Another strategy in this category is to **provide technology (phones or radios) to alert people of hazards**. Phones are preferential to radios as they can be used to reach out for help and be programmed to receive alerts based on location. However, phones are less useful when people are out of cell range or are unable to keep the phone charged. Both types of technology may be easily lost, stolen, or broken, which can happen frequently when one is unstably housed. Based on our survey effort among PLU who had experienced an extreme weather event in Los Angeles County, one-third of respondents did not have phones and, of those with phones, 58% reported challenges with keeping them charged. Therefore, not only phones but phone battery packs, locations for charging, and an alert system would increase the likelihood that PLU know about dangerous weather events and how to access relevant resources. While costly, it may be a more efficient use of resources than sending an outreach worker to meet with someone one-on-one, which is currently the primary means of communication. Additionally, an alert system may either be automatic and based on location or be based on a sign-up list. Automatic, location-based alerts could lead to people who are housed in the area receiving information not relevant to them, and sign-up list alerts would need to be constantly updated whenever a new phone is received and may lead to people who should be informed not being notified. The former reduces risk to PLU more than the latter.

#### **4.1.1.2 Service-Provider-Led Strategies**

**Clear communication about existing services** is another generally lower resource way to increase shelter use.

Regarding group settings, **ensuring specific amenities are in place** (e.g., lockers, kennels, awake rooms) may make them more acceptable to PLU. PLU and practitioners told us that curfews also prevented people from using shelters and may be inappropriate during extreme weather events, where the need is dictated by the current weather conditions. **Flexible curfews** could address the desire for independence that our surveyed sample described as a major reason that they do not accept group shelter spaces.

Outreach and shelter staff need additional support to assist PLU. **Providing training** on what symptoms are dangerous or how to recognize a hazard could help PLU reduce and recognize their own exposure. **Transportation for shelter staff** could increase the pool of staff available at any given time. **Distributing resources** for wildfire smoke, which is an emerging hazard, could also reduce exposure.

### **4.1.2 High Acceptability, Low Feasibility**

#### **4.1.2.1 Policy- and Agency-Led Strategies**

Practitioners expressed a need for more **consistency and warning for available resources and services**. Since a rule of thumb provided to us is three to four days



for a shelter to be optimally used and to secure transportation to the shelter, instead of deciding 24 or 48 hours before a hazard whether the severity warrants opening a shelter, agencies should make that **decision three or four days in advance**. Because hazards move quickly, one option is to more generously open shelters using specific thresholds. This would be effective but might lead to fewer overall resource and staffing availability. However, if thresholds for opening are too high, they may not open when they are needed.

To increase shelter space quickly, **using county offices as emergency shelters or finding spaces in hotels and motels** are good options, though there are feasibility challenges discussed in Section 3.2.2 and 3.2.3, respectively.

While hotel and motel spots are difficult to find and use, especially close to where people live, they are still a good option for certain situations, especially as they were very acceptable to the PLU we surveyed. To use this option most effectively, adjustments to contracting policies are needed.

#### **4.1.2.2 Service-Provider-Led Strategy**

**Door-to-door transportation**, while difficult to arrange on short timelines and not always available even when resourced, is a priority when shelters are far from where people live. Some options for achieving this, each with their own limitations, include providing gas cards to those with working cars, free public transit (e.g., see Sacramento County, 2024), and buses with ample storage capacity.

## **4.2 Implications of Increased Frequency and Severity of Extreme Weather Events**

The strategies related to transportation to shelters, shelter spaces themselves, staffing, and resources in Table 8 involve resources: money, staff, and/or space. This demand will scale with the duration of an extreme weather event, assuming that the number of PLU remains similar. Using the 90°F (32.2°C) heat index threshold, by the end of the century, almost one-third of PLU will reside in a CoC where we expect to see a doubling in the number of extreme heat days. This means that resources for these strategies will need to increase to provide the same level of protection if the number of PLU and the use of resources remain similar to today. The projections of extreme heat days we provide are averages over a long timeframe, so we can expect an increase over time but, also, significant variability from year to year, which may make resource allocation even more difficult. Note that there are not enough resources to meet the current need, so an increased need may make this resource shortage more dire.



Extreme heat may become less of an isolated event and more of a seasonal occurrence. More specifically, two-thirds of the CoCs will see dangerous heat for vulnerable groups at least one-third of the year by the end of the century. That is essentially the entire summer. If heat is so pervasive, we may need to start treating it like rain or cold in many parts of the state, where shelters are always open during the entire season and extra space is deployed when the event occurs off-season. Note that, unlike rain or cold, where the greatest exposure is at night, heat is most severe during the day (although it can also affect sleep).

Resources for some other strategies in Table 8 – such as providing technology (e.g., phones and the associated infrastructure), streamlining and improving communication sources, prosecutorial discretion, and trainings – scale with the number of PLU and other factors, rather than scaling with the number of extreme weather events.

## **4.3 Study Implications and Limitations**

Our methodology for determining changes in extreme heat relied on collapsing information from sometimes large, meteorologically disparate areas into one number that could be matched with estimates of the PLU in that area. This does not account for changes in where and how many people are living unsheltered over time and does not capture specific exposure within CoCs. Additionally, we used daily maximum heat indices to estimate exposure to extreme heat. Heat waves can be more dangerous when they occur at the beginning of a hot season, last for a long time, and/or include high nighttime temperatures.

While we discuss three hazards (extreme heat, flash flooding from extreme precipitation, and wildfire smoke), analysis of research question 1 focuses on extreme heat. This is because flash flooding from extreme precipitation is difficult to predict, especially in California, where extreme precipitation often occurs from atmospheric rivers (Norris et al., 2021). Wildfire smoke is an emerging issue and difficult to project into the future, which means that we were unable to analyze expected frequency increases.

Many of our findings, especially the identified strategies, rely on data collected for this study. In general, the literature review and practitioner interviews covered Los Angeles and Sacramento Counties more extensively than other areas in the state, and the surveys of PLU included adults in Los Angeles County. We had planned to conduct surveys with PLU in Sacramento County following a flash flooding/extreme precipitation event, but none occurred during our data collection window (November 2024-April 2025).

Because our analysis and strategies relied more heavily on Los Angeles County, a populous region with many PLU, our results may be less relevant for mid-sized cities, suburban and rural areas, inland areas, and Tribal land. Nationwide, about 21% of



PLU reside in largely rural CoCs, 24% in largely suburban CoCs, and 6% in non-major cities (Soucy et al., 2025). Additionally, census tracts on federal Tribal land in the western United States tend to have a higher risk for wildfires than non-Tribal land, which means they may also have a higher risk for wildfire smoke (Davies et al., 2018).

Since we focused on unsheltered adults, we did not engage with County Offices of Education or McKinney-Vento homeless liaisons, however we recognize they may play an important role in coordination. Additionally, we did not gather any information about experiences or strategies specifically related to unsheltered families. Because physiological differences make children more susceptible to extreme heat and poor air quality, and can result in long-term developmental setbacks (Anderko & Pennea, 2022; Sampath et al., 2025), it is important that future research addresses this vulnerable population in greater depth.

While we interviewed a variety of staff at organizations focused on emergency management or providing services to people living unsheltered, we did not speak with members of neighborhood or commercial business associations or other actors that might be impacted or involved in some of the strategies we provide in Table 8. A full feasibility assessment might consider engaging all interested parties.

Additionally, since our data collection relied heavily on interviews and surveys, most of our analysis of implementation barriers relied on subjective reports. We did not use external data sources to verify the cost, safety, or other aspects of the strategies considered in this report. Also, after completion of the literature review and during the practitioner interview phase, we learned about several new resources developed by the State of California to address these issues (e.g., see California Interagency Council on Homelessness, 2024a; California Interagency Council on Homelessness, 2024b). Because these resources were not developed in time for inclusion in the literature review and none of the local practitioners we spoke to mentioned the resources, they are not discussed in detail in this report. The sample sizes were relatively small for the practitioner interviews and surveys of PLU. While we learned new information from the different practitioners, based on their role and responsibilities, we reached saturation in terms of learning similar information from interviewees who had similar roles and responsibilities (e.g., service providers from similar locations expressed similar perspectives). Due to the relatively small survey sample based on location and the specific hazard event, we recommend interpreting any general conclusions about the survey population with caution.

Shortly after we completed our surveys on wildfire smoke in the Malibu area, this area and all of Los Angeles were impacted by very severe wildfires and tens of thousands of people were forced to evacuate (Greene et al., 2025). The Palisades Fire burned in or very close to many of the areas where we surveyed PLU. Many parts of the region were covered in wildfire smoke for weeks. This was such a large disaster that isolating



the response to PLU was difficult and not the goal of this report. Nevertheless, the responses we heard from people after the Franklin Fire were harbingers of the response to the Palisades Fire for people that were previously living unsheltered and people forced to evacuate their houses and apartments: shelter was hard to come by, transportation out of Pacific Palisades was difficult, and information was inconsistent (Haggerty, 2025; Jarvie, 2025; Khouri, 2025). By successfully responding to the needs of PLU during less severe weather events, we may be better prepared to handle the most severe disasters for everyone.

## **4.4 Future Directions**

Because we had a small sample size for the data we collected, surveys and interviews in other parts of California and with other populations, including families with children, unaccompanied youth, in more rural CoCs, and on Tribal lands would add to the information we provide here. Information about other hazards (especially flooding) would provide more reliable information about the specific regional needs of PLU.

More location-based information about wildfires and smoke transport, which are difficult to project into the future, would also assist with understanding which parts of the state should expect more smoke in the coming years and approximately how often each area should expect that smoke.

Additionally, future research should investigate the strategies in Table 8 that currently lack sufficient data, alongside diverse geographic locations. As many strategies in Sections 3.2 and 4.1 were derived from reported challenges (i.e., interviewees, survey respondents, article authors, or researchers identifying solutions to observed barriers), further research should evaluate practical case studies of their implementation. Furthermore, to better understand the feasibility and acceptability of these strategies, targeted surveys should be deployed to a larger, representative sample. Finally, engaging with policy, agency, and service provider actors to assess the associated strategy costs and cost uncertainties is an important next step to prepare for actual implementation.



# Appendix A: Research Question 1 Details

## A.1 Different Perspectives on Where in California People Live Unsheltered

Figure A1. California Map of Where People Live Unsheltered by CoC Number

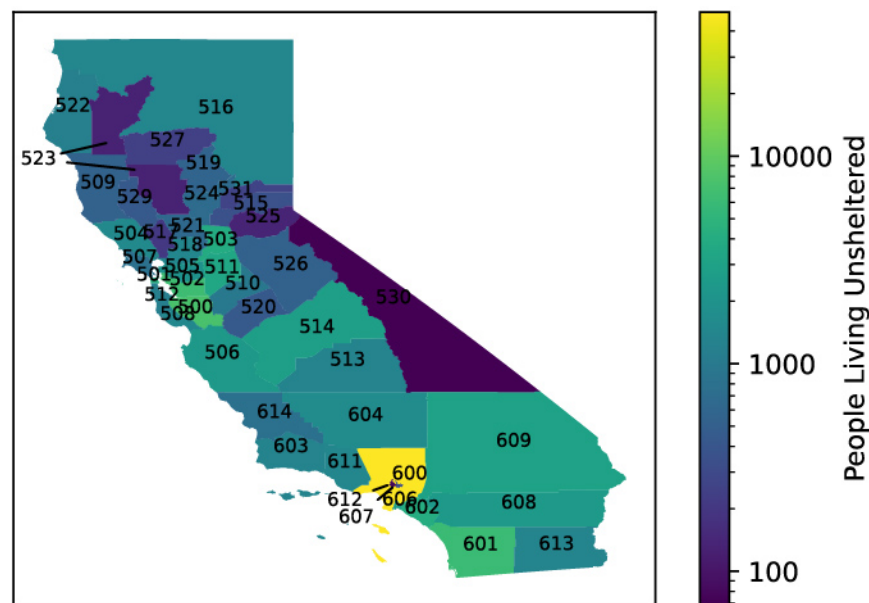


*Figure A1 Note. The number of people living unsheltered in each California Continuum of Care (CoC) from the 2024 Point-in-Time Count on a log scale from few people (purple) to many (yellow) with the number of the CoC labeled. Data from HUD Exchange (2024b).*

Note that the Los Angeles CoC (CA-600) has far more PLU in it than any other CoC in numbers, but it also covers a large area. San Francisco (CA-501) has more than seven times the per capita population of PLU of the Los Angeles CoC (see Figure A2). Long Beach (CA-606) and Pasadena (CA-607) both also have higher densities of PLU in them than live in the general Los Angeles CoC. Sacramento (CA-503) is ranked eighth for the PLU who live in it per capita.

**Figure A2. California Map of Where People Live Unsheltered Per Capita**

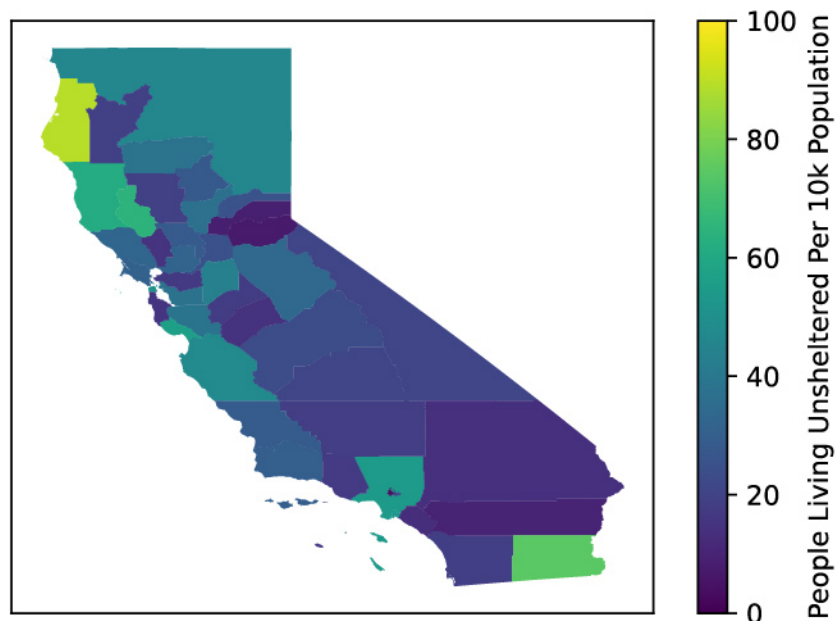


*Figure A2 Note. The number of people living unsheltered per 10,000 people in each California Continuum of Care from the 2024 Point-in-Time Count on a log scale from few people (purple) to many (yellow). Data from HUD Exchange (2024b).*

Similarly, the more sparsely populated Humboldt County (CA-522) and Imperial County (CA-613) have higher per capita concentrations of PLU than Los Angeles: 89 (Humboldt), 74 (Imperial), and 55 (Los Angeles) PLU per 10,000 total population, respectively (see Figure A2). Sacramento County has about 25 PLU per 10,000 total residents.

## A.2 More Information on Extreme Heat Across the State

Figure A3. Extreme Heat Methodology

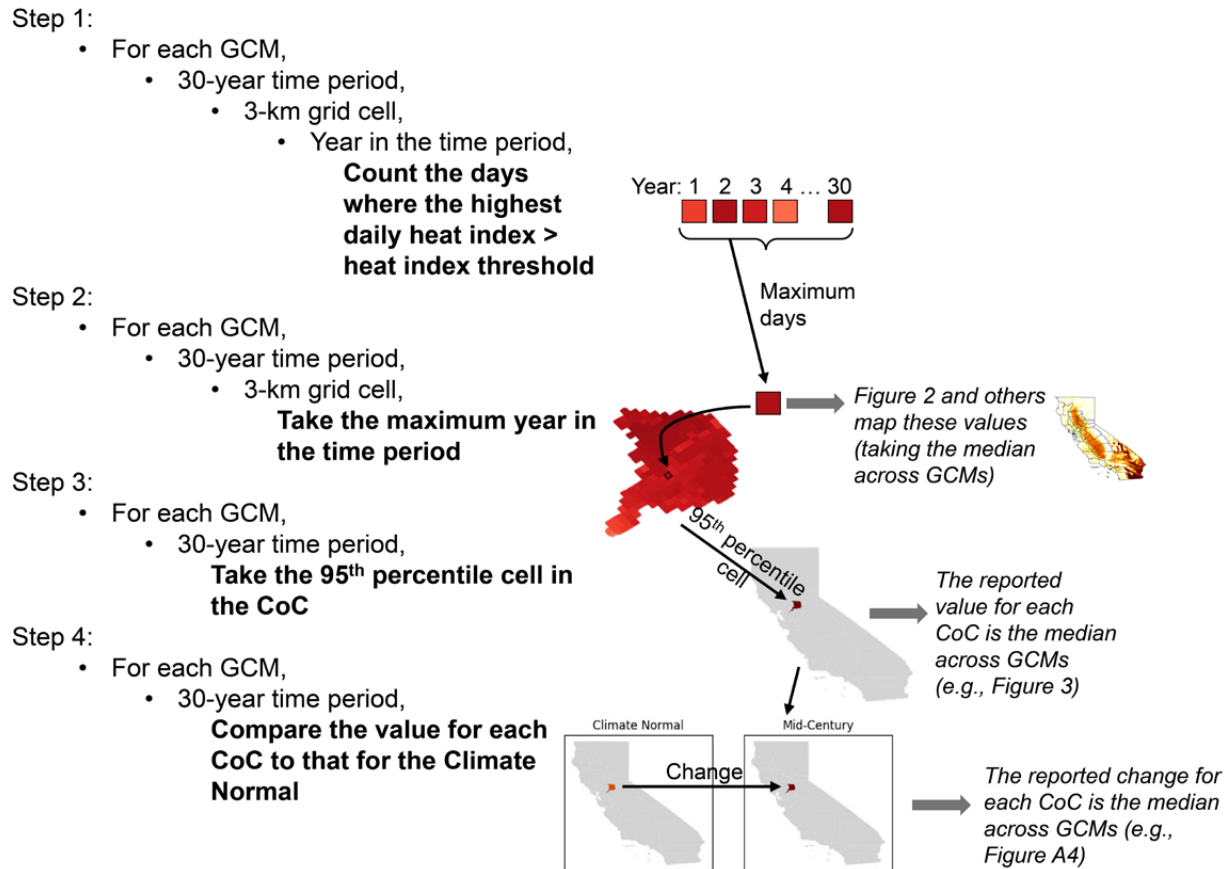


*Figure A3 Note. The methodology for calculating extreme heat values for each Continuum of Care (CoC). The heat index threshold for vulnerable groups is 90°F (32.2°C) and for all groups is 100°F (37.8°C).*



**Table A1. Annual Days Above a Heat Index Threshold of 90°F (32.2°C) for Each CoC**

| <b>CoC #</b> | <b>CoC Name</b>                           | <b>People Living Unsheltered</b> | <b>Climate Normal (Annual Days)</b> | <b>Mid-Century (Annual Days)</b> | <b>End-of-the-Century (Annual Days)</b> |
|--------------|-------------------------------------------|----------------------------------|-------------------------------------|----------------------------------|-----------------------------------------|
| 500          | San Jose/Santa Clara City & County CoC    | 7401                             | 27                                  | 37                               | 78                                      |
| 501          | San Francisco CoC                         | 4354                             | 3                                   | 5                                | 6                                       |
| 502          | Oakland, Berkeley/Alameda County CoC      | 6343                             | 31                                  | 40                               | 79                                      |
| 503          | Sacramento City & County CoC              | 3944                             | 83                                  | 110                              | 136                                     |
| 504          | Santa Rosa, Petaluma/Sonoma County CoC    | 1577                             | 31                                  | 47                               | 87                                      |
| 505          | Richmond/Contra Costa County CoC          | 1959                             | 49                                  | 72                               | 107                                     |
| 506          | Salinas/Monterey, San Benito Counties CoC | 2379                             | 46                                  | 79                               | 100                                     |
| 507          | Marin County CoC                          | 788                              | 14                                  | 21                               | 46                                      |
| 508          | Watsonville/Santa Cruz City & County CoC  | 1485                             | 14                                  | 22                               | 49                                      |
| 509          | Mendocino County CoC                      | 552                              | 23                                  | 50                               | 73                                      |
| 510          | Turlock, Modesto/Stanislaus County CoC    | 980                              | 87                                  | 116                              | 143                                     |



| <b>CoC #</b> | <b>CoC Name</b>                                                                 | <b>People Living Unsheltered</b> | <b>Climate Normal (Annual Days)</b> | <b>Mid-Century (Annual Days)</b> | <b>End-of-the-Century (Annual Days)</b> |
|--------------|---------------------------------------------------------------------------------|----------------------------------|-------------------------------------|----------------------------------|-----------------------------------------|
| 511          | Stockton/San Joaquin County CoC                                                 | 3469                             | 73                                  | 101                              | 129                                     |
| 512          | Daly/San Mateo County CoC                                                       | 1145                             | 11                                  | 16                               | 39                                      |
| 513          | Visalia/Kings, Tulare Counties CoC                                              | 1341                             | 109                                 | 136                              | 161                                     |
| 514          | Fresno City & County/Madera County CoC                                          | 2758                             | 101                                 | 128                              | 159                                     |
| 515          | Roseville, Rocklin/Placer County CoC                                            | 366                              | 82                                  | 112                              | 140                                     |
| 516          | Redding/Shasta, Siskiyou, Lassen, Plumas, Del Norte, Modoc, Sierra Counties CoC | 1434                             | 34                                  | 74                               | 95                                      |
| 517          | Napa City & County CoC                                                          | 203                              | 41                                  | 66                               | 104                                     |
| 518          | Vallejo/Solano County CoC                                                       | 1436                             | 60                                  | 89                               | 119                                     |
| 519          | Chico, Paradise/Butte County CoC                                                | 580                              | 105                                 | 132                              | 148                                     |
| 520          | Merced City & County CoC                                                        | 428                              | 91                                  | 121                              | 149                                     |



| CoC # | CoC Name                                                 | People Living Unsheltered | Climate Normal (Annual Days) | Mid-Century (Annual Days) | End-of-the-Century (Annual Days) |
|-------|----------------------------------------------------------|---------------------------|------------------------------|---------------------------|----------------------------------|
| 521   | Davis, Woodland/<br>Yolo County CoC                      | 633                       | 93                           | 119                       | 142                              |
| 522   | Humboldt County CoC                                      | 1194                      | 15                           | 32                        | 56                               |
| 523   | Colusa, Glenn,<br>Trinity Counties CoC                   | 129                       | 104                          | 131                       | 147                              |
| 524   | Yuba City & County/<br>Sutter County CoC                 | 682                       | 99                           | 124                       | 146                              |
| 525   | El Dorado County CoC                                     | 135                       | 42                           | 73                        | 103                              |
| 526   | Amador, Calaveras,<br>Mariposa, Tuolumne<br>Counties CoC | 525                       | 69                           | 99                        | 128                              |
| 527   | Tehama County CoC                                        | 247                       | 97                           | 127                       | 146                              |
| 529   | Lake County CoC                                          | 435                       | 32                           | 69                        | 99                               |
| 530   | Alpine, Inyo, Mono<br>Counties CoC                       | 69                        | 149                          | 170                       | 185                              |
| 531   | Nevada County CoC                                        | 258                       | 45                           | 79                        | 105                              |

*Table A1 Note. The estimated annual number of days with a heat index that exceeds 90°F (32.2°C) for each Continuum of Care (CoC) during Climate Normal, Mid-Century, and the End-of-the-Century organized by the CoC number. The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. Data sources: Cal-Adapt CMIP6, HUD Exchange (2024b).*



Figure A4. Estimated Change in Annual Days of Dangerous Heat for Vulnerable Groups by CoC

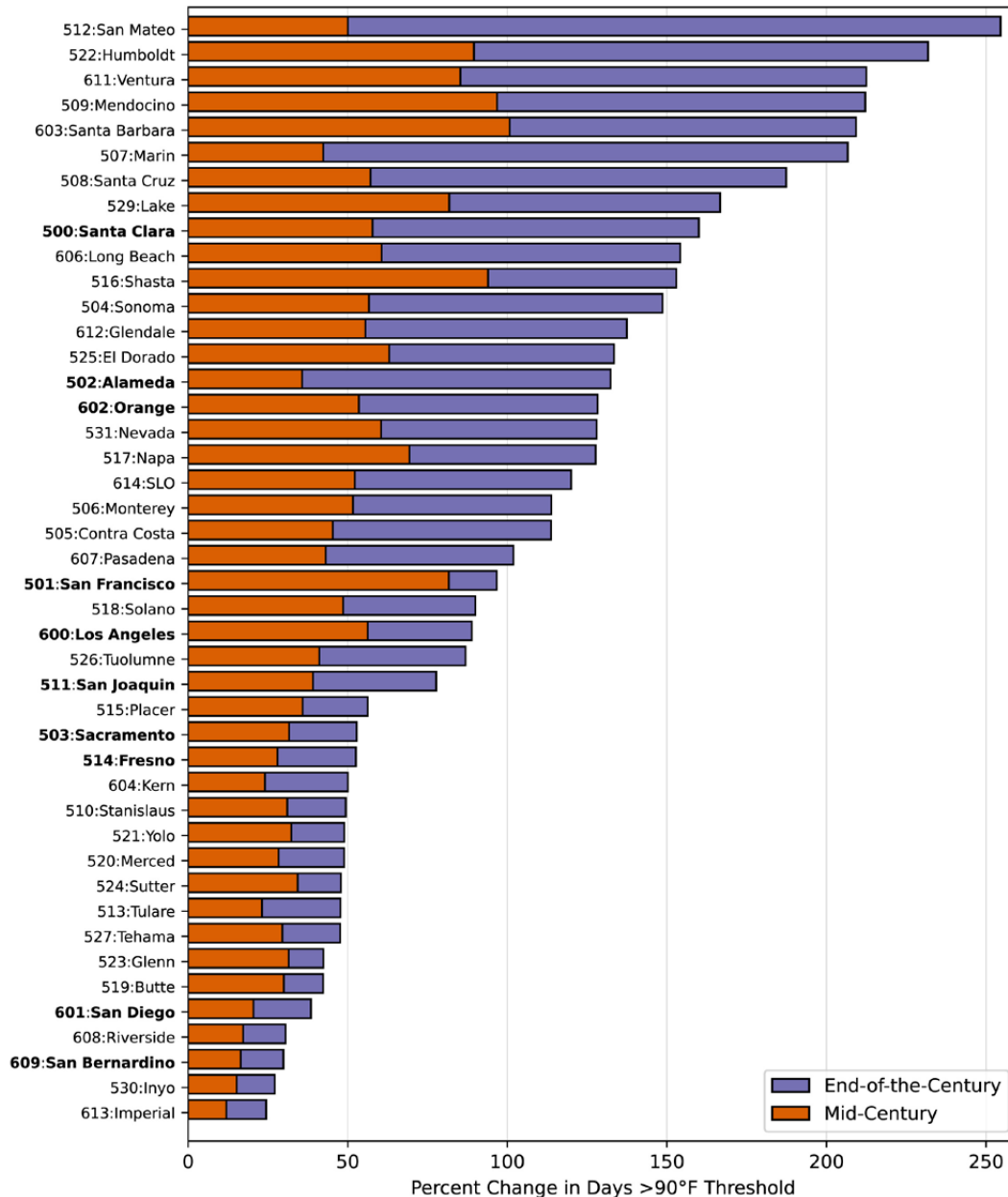


Figure A4 Note. The estimated change from Climate Normal in the annual number of days with a heat index that exceeds 90°F (32.2°C) for each Continuum of Care (CoC) during Mid-Century (orange), and End-of-the-Century (purple). The CoCs, labeled by number and the most populous county in their jurisdiction (or city for Glendale, Long Beach, and Pasadena), are organized by decreasing End-of-the-Century change. The 10 CoCs with the most people living unsheltered according to the 2024 Point-in-Time Count are bolded (data from HUD Exchange, 2024b). The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. Data Source: Cal-Adapt CMIP6.



**Table A2. Annual Days Above a Heat Index of 100°F (37.8°C) for Each CoC**

| <b>CoC #</b> | <b>CoC Name</b>                           | <b>People Living Unsheltered</b> | <b>Climate Normal (Annual Days)</b> | <b>Mid-Century (Annual Days)</b> | <b>End-of-the-Century (Annual Days)</b> |
|--------------|-------------------------------------------|----------------------------------|-------------------------------------|----------------------------------|-----------------------------------------|
| 500          | San Jose/Santa Clara City & County CoC    | 7401                             | 1                                   | 3                                | 6                                       |
| 501          | San Francisco CoC                         | 4354                             | 0                                   | 0                                | 0                                       |
| 502          | Oakland, Berkeley/Alameda County CoC      | 6343                             | 2                                   | 3                                | 8                                       |
| 503          | Sacramento City & County CoC              | 3944                             | 12                                  | 17                               | 43                                      |
| 504          | Santa Rosa, Petaluma/Sonoma County CoC    | 1577                             | 2                                   | 5                                | 9                                       |
| 505          | Richmond/Contra Costa County CoC          | 1959                             | 4                                   | 8                                | 21                                      |
| 506          | Salinas/Monterey, San Benito Counties CoC | 2379                             | 3                                   | 6                                | 17                                      |
| 507          | Marin County CoC                          | 788                              | 0                                   | 2                                | 4                                       |
| 508          | Watsonville/Santa Cruz City & County CoC  | 1485                             | 0                                   | 2                                | 4                                       |
| 509          | Mendocino County CoC                      | 552                              | 0                                   | 3                                | 11                                      |
| 510          | Turlock, Modesto/Stanislaus County CoC    | 980                              | 10                                  | 21                               | 50                                      |



| <b>CoC #</b> | <b>CoC Name</b>                                                                 | <b>People Living Unsheltered</b> | <b>Climate Normal (Annual Days)</b> | <b>Mid-Century (Annual Days)</b> | <b>End-of-the-Century (Annual Days)</b> |
|--------------|---------------------------------------------------------------------------------|----------------------------------|-------------------------------------|----------------------------------|-----------------------------------------|
| 511          | Stockton/San Joaquin County CoC                                                 | 3469                             | 8                                   | 13                               | 43                                      |
| 512          | Daly/San Mateo County CoC                                                       | 1145                             | 0                                   | 1                                | 2                                       |
| 513          | Visalia/Kings, Tulare Counties CoC                                              | 1341                             | 13                                  | 45                               | 69                                      |
| 514          | Fresno City & County/Madera County CoC                                          | 2758                             | 11                                  | 36                               | 61                                      |
| 515          | Roseville, Rocklin/Placer County CoC                                            | 366                              | 11                                  | 18                               | 43                                      |
| 516          | Redding/Shasta, Siskiyou, Lassen, Plumas, Del Norte, Modoc, Sierra Counties CoC | 1434                             | 2                                   | 12                               | 22                                      |
| 517          | Napa City & County CoC                                                          | 203                              | 3                                   | 7                                | 15                                      |
| 518          | Vallejo/Solano County CoC                                                       | 1436                             | 5                                   | 11                               | 30                                      |
| 519          | Chico, Paradise/Butte County CoC                                                | 580                              | 17                                  | 33                               | 55                                      |
| 520          | Merced City & County CoC                                                        | 428                              | 11                                  | 22                               | 53                                      |
| 521          | Davis, Woodland/Yolo County CoC                                                 | 633                              | 12                                  | 21                               | 47                                      |



| <b>CoC #</b> | <b>CoC Name</b>                                    | <b>People Living Unsheltered</b> | <b>Climate Normal (Annual Days)</b> | <b>Mid-Century (Annual Days)</b> | <b>End-of-the-Century (Annual Days)</b> |
|--------------|----------------------------------------------------|----------------------------------|-------------------------------------|----------------------------------|-----------------------------------------|
| 522          | Humboldt County CoC                                | 1194                             | 0                                   | 3                                | 6                                       |
| 523          | Colusa, Glenn, Trinity Counties CoC                | 129                              | 15                                  | 32                               | 55                                      |
| 524          | Yuba City & County/ Sutter County CoC              | 682                              | 15                                  | 28                               | 50                                      |
| 525          | El Dorado County CoC                               | 135                              | 3                                   | 7                                | 16                                      |
| 526          | Amador, Calaveras, Mariposa, Tuolumne Counties CoC | 525                              | 6                                   | 10                               | 38                                      |
| 527          | Tehama County CoC                                  | 247                              | 16                                  | 35                               | 56                                      |
| 529          | Lake County CoC                                    | 435                              | 2                                   | 5                                | 17                                      |
| 530          | Alpine, Inyo, Mono Counties CoC                    | 69                               | 70                                  | 100                              | 123                                     |
| 531          | Nevada County CoC                                  | 258                              | 4                                   | 9                                | 19                                      |
| 600          | Los Angeles City & County CoC                      | 49509                            | 4                                   | 8                                | 19                                      |
| 601          | San Diego City and County CoC                      | 6110                             | 31                                  | 64                               | 83                                      |
| 602          | Santa Ana, Anaheim/Orange County CoC               | 4173                             | 2                                   | 5                                | 10                                      |



| CoC # | CoC Name                                     | People Living Unsheltered | Climate Normal (Annual Days) | Mid-Century (Annual Days) | End-of-the-Century (Annual Days) |
|-------|----------------------------------------------|---------------------------|------------------------------|---------------------------|----------------------------------|
| 603   | Santa Maria/Santa Barbara County CoC         | 1332                      | 1                            | 2                         | 4                                |
| 604   | Bakersfield/Kern County CoC                  | 1663                      | 13                           | 44                        | 66                               |
| 606   | Long Beach CoC                               | 2455                      | 2                            | 3                         | 5                                |
| 607   | Pasadena CoC                                 | 321                       | 2                            | 6                         | 10                               |
| 608   | Riverside City & County CoC                  | 2441                      | 49                           | 90                        | 111                              |
| 609   | San Bernardino City & County CoC             | 3055                      | 51                           | 85                        | 110                              |
| 611   | Oxnard, San Buenaventura/ Ventura County CoC | 1431                      | 1                            | 3                         | 5                                |
| 612   | Glendale CoC                                 | 80                        | 2                            | 4                         | 6                                |
| 613   | Imperial County CoC                          | 1375                      | 66                           | 105                       | 131                              |
| 614   | San Luis Obispo County CoC                   | 800                       | 2                            | 5                         | 12                               |

*Table A2 Note. The estimated annual number of days with a heat index that exceeds 100°F (37.8°C) for each Continuum of Care (CoC) during Climate Normal, Mid-Century, and End-of-the-Century organized by the CoC number. The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. Data sources: Cal-Adapt CMIP6, HUD Exchange (2024b).*



Figure A5. Estimated Change in Annual Days of Dangerous Heat for All Groups by CoC

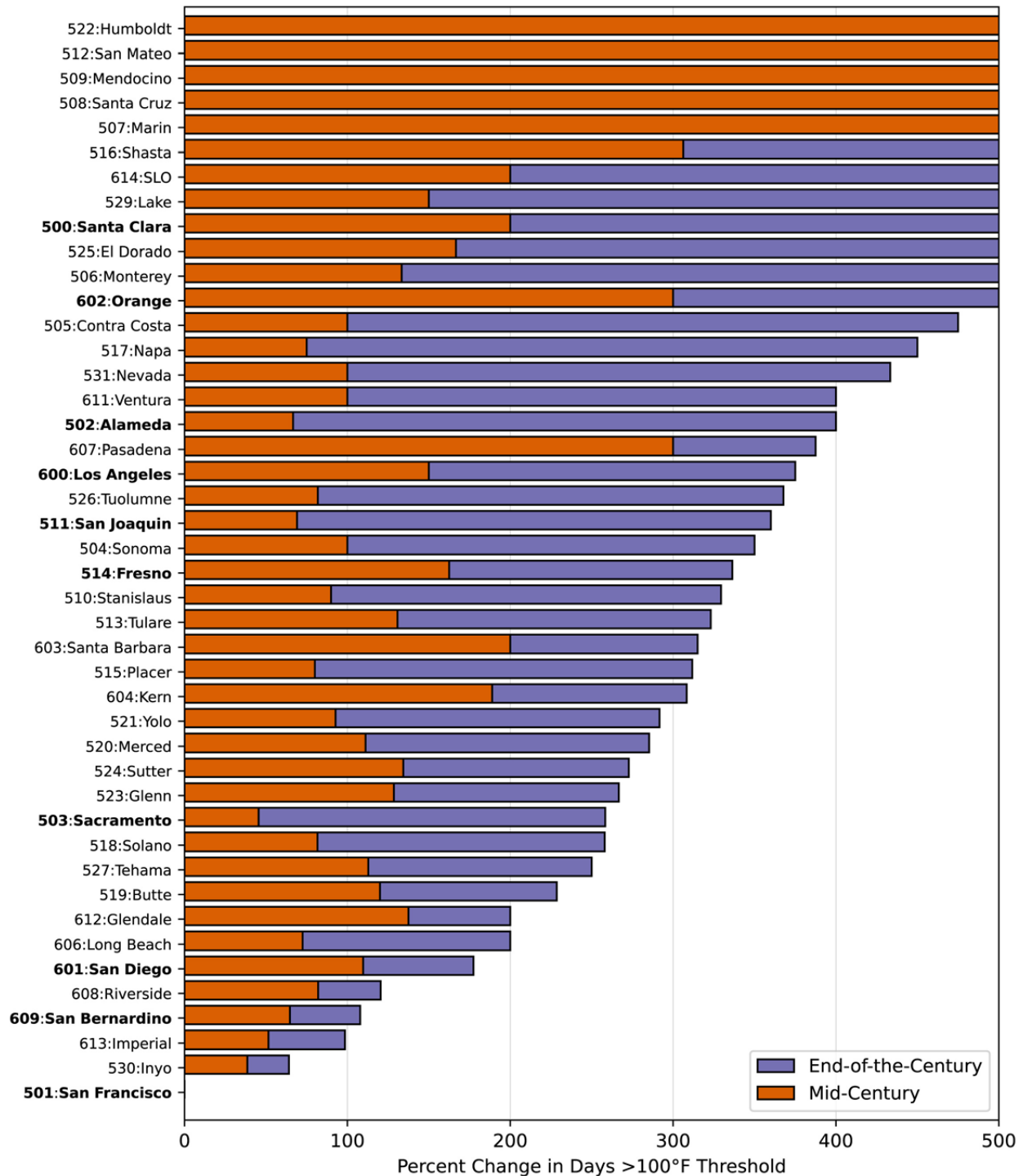


Figure A5 Note. The estimated change from Climate Normal in the annual number of days with a heat index that exceeds 100°F (37.8°C) for each Continuum of Care (CoC) during Mid-Century (orange), and the End-of-the-Century (purple). The CoCs, labeled



by number and the most populous county in their jurisdiction (or city for Glendale, Long Beach, and Pasadena), are organized in decreasing End-of-the-Century change. The 10 CoCs with the most people living unsheltered according to the 2024 Point-in-Time Count are bolded (data from HUD Exchange, 2024b). The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value. The y-axis is cut off at a 500% increase, though some CoCs are predicted to see a greater percent increase than this. Note that GCMs with Climate Normal values of zero days and Mid- or End-of-the-Century days of at least one are treated as infinite increases and show up above a 500% increase. CA-501 (San Francisco CoC) sees zero days above the threshold at all three time periods, and therefore no change. Data source: Cal-Adapt CMIP6.

## A.3 Case Studies

Figure A6. Change in Extreme Heat for Los Angeles CoC (>90°F [32.2°C] Heat Index) by Simulation Model

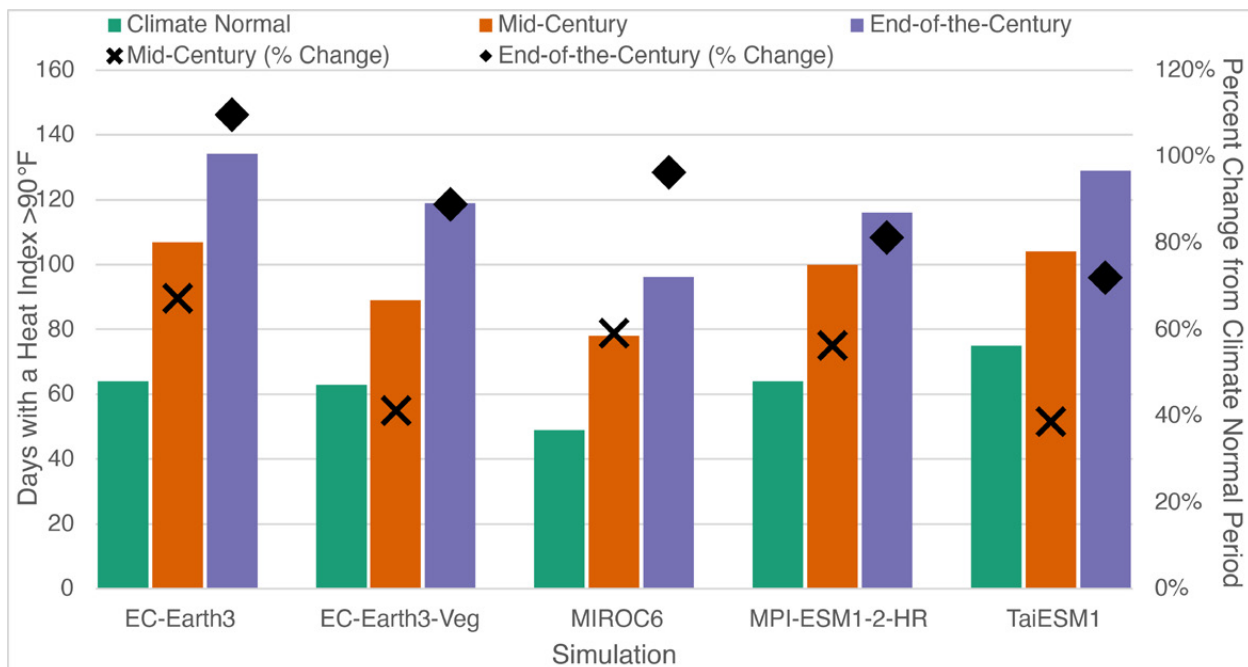


Figure A6 Note. The 95th percentile grid cell for the Los Angeles Continuum of Care for each of the five GCM simulations showing the annual number of days with a heat index that exceeds 90°F (32.2°C)(left axis) for the Climate Normal (green), Mid-Century (orange), and the End-of-the-Century (purple) time periods and the percent change (right axis) from the Climate Normal for Mid-Century (black Xs) and the End-of-the-Century (black diamonds). Data source: Cal-Adapt CMIP6.

**Figure A7. Change in Extreme Heat for Sacramento CoC (>90°F (32.2°C) Heat Index) by Simulation Model**

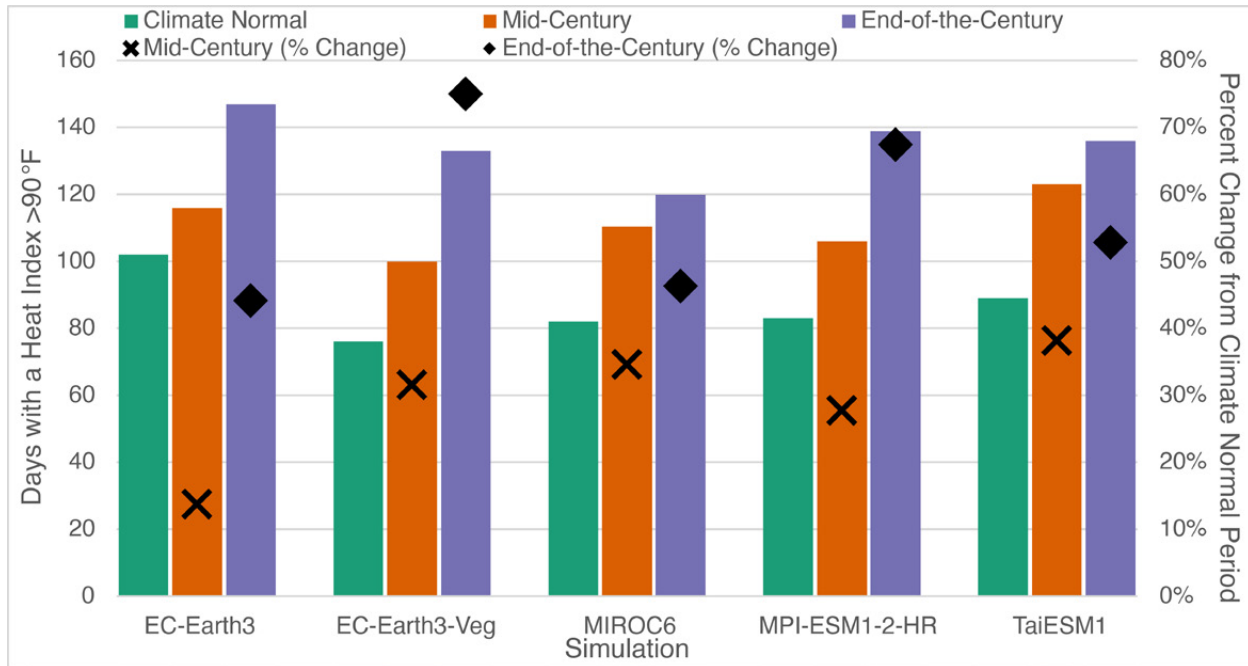


*Figure A7 Note. The 95th percentile grid cell for the Sacramento Continuum of Care for each of the five GCM simulations showing the annual number of days with a heat index that exceeds 90°F (32.2°C) (left axis) for the Climate Normal (green), Mid-Century (orange), and the End-of-the-Century (purple) time periods and the percent change (right axis) from the Climate Normal for Mid-Century (black Xs) and the End-of-the-Century (black diamonds). Data sources: Cal-Adapt CMIP6.*

## A.4 More Information on Extreme Precipitation

### A.4.1 Extreme Precipitation and Flash Flooding Risk Methodology

The level of extreme precipitation that could lead to flash flooding is highly location dependent. Because of this, unlike for extreme heat, we did not use a threshold value for determining extreme precipitation. This methodology is represented with the diagram in Figure A8.

**Figure A8. Extreme Precipitation Methodology**

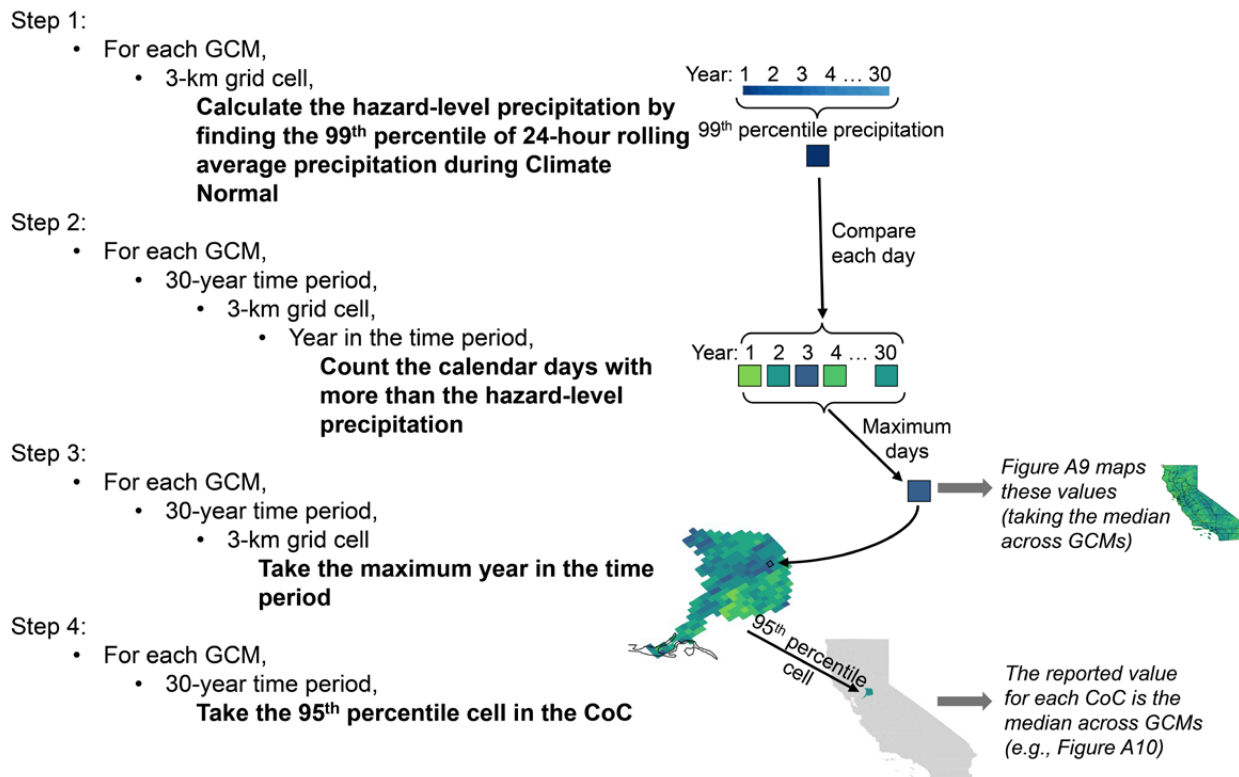


*Figure A8 Note. The methodology for estimating days of extreme precipitation for each Continuum of Care (CoC).*

In the first step, we determined the amount of rainfall for each grid cell that reached a hazard level. To do this, we calculated a rolling sum of precipitation (variable: prec) over the preceding 24 hours for every hour in the Climate Normal period. Then, for each grid cell, we calculated the 99th percentile of that summed precipitation over those 30 years and used that value as the hazard-level threshold for risk for each grid cell for each GCM.

To assess the validity of this approach, we used the Cal-Adapt Extreme Precipitation Tool (Cal-adapt, n.d.-b), which reports that the 99th percentile 24-hour extreme precipitation event depth is 1.57 inches for Sacramento County. For the EC-Earth3-Veg simulation, the mean 3-km grid cell had a 99th percentile 24-hour precipitation value of 1.71 inches; the maximum grid cell was 2.07 inches.

Next, for the second step, for each simulation for each time period, we calculated the number of calendar days in each year in each grid cell that exceeded the hazard-level precipitation.

In the third step, because we are concerned with extremes, we then calculated the maximum annual number of days above that threshold for each grid cell.

Because the data we have on PLU is aggregated to the CoC-level, in the fourth step we aggregated the days exceeding our extreme precipitation threshold from the 3-km domain to the CoC-level by taking the 95th percentile of the grid cell values within each CoC for each time period for each GCM, similar to the approach used for extreme heat.

### A.4.2 Expected Future Frequency and Severity of Flash Flooding from Extreme Precipitation

Figure A9 shows the map of the median GCM annual number of days with precipitation exceeding the flash flooding threshold defined by our analysis. Though this figure suggests some shifting patterns in where extreme precipitation will occur, there is no obvious increase in flash flooding risk between time periods. This may be because our method does not account for atmospheric rivers, which often contribute significantly to flash flooding events. There is also no significant difference in the projected number of days exceeding the hazard-level threshold or difference in the change between time periods for CoCs with large populations of PLU (see Figure A10). Note that while we do not see increases in flash flooding risk from extreme precipitation, we also do not see significantly diminished risk.

**Figure A9. Expected Number of Extreme Precipitation Days at Different Timeframes**

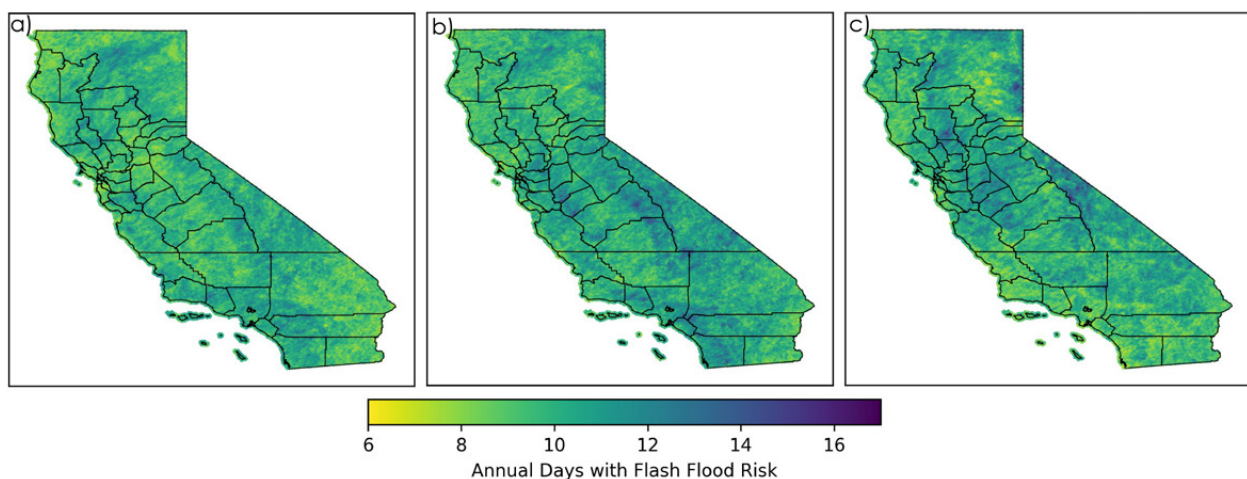


*Figure A9 Note. The expected annual number of days where the 3-km grid cell exceeds the 99th percentile daily precipitation level during (a) the Climate Normal period, (b) Mid-Century, and (c) the End-of-the-Century colored from yellow to purple. Calculations are for the mean GCM in each grid cell. The black outlines correspond to the 44 Continuums of Care in California. Data source: Cal-Adapt CMIP6.*



Figure A10. Expected Number of Extreme Precipitation Days at Different Timeframes by CoC

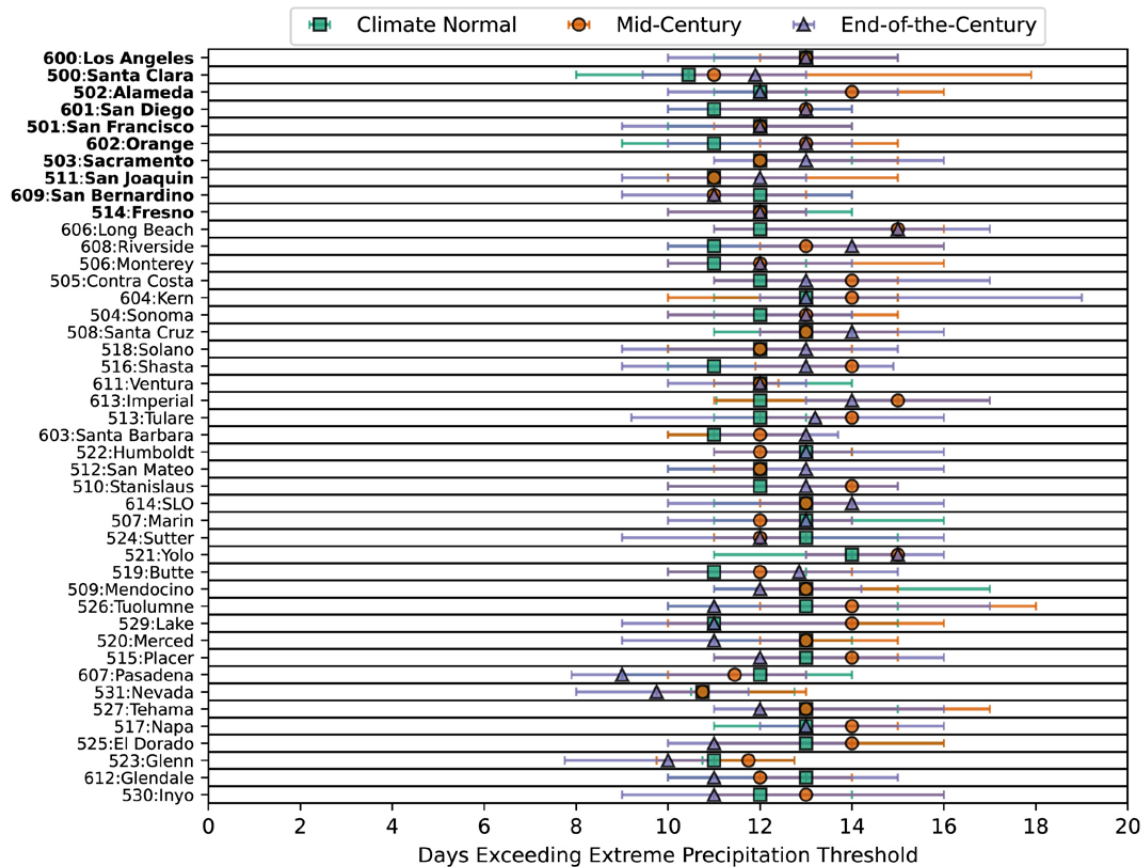


Figure A10 Note. The estimated annual number of days that exceed the 99th percentile daily precipitation level for each Continuum of Care (CoC) during Climate Normal (green squares), Mid-Century (orange circles), and the End-of-the-Century (purple triangles) organized by the CoCs ranked from those with the fewest people living unsheltered to those with the most from the 2024 Point-In-Time Count (top 10 bolded). The estimated days reported are the 95th percentile grid cell in the CoC for the GCM with the median value (error bars show the range of median values for all GCMs). Data sources: Cal-Adapt CMIP6, HUD Exchange (2024b).



# Appendix B: Details on Data Sources and Methodologies

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## B.1 Literature Review Methodology

The primary objective of this literature review was to identify existing strategies employed to mitigate the harm from three extreme climate change events as they pertain to people living unsheltered (PLU) in California. The secondary objective of performing this review was to gain an understanding of the specific exposure to and vulnerability from extreme weather events that Californians living unsheltered experience.

### B.1.1 Search Strategy

Though we are particularly interested in PLU, we include literature that covers the broader category of people experiencing homelessness when relevant. Additionally, we look at the literature for extreme events beyond extreme heat, flash flooding, and wildfire smoke because much of the research on the extreme weather events we consider is grouped with other hazards. That is, cold, rain, and severe storms often co-occur with flash flooding, and therefore are covered in similar literature; wildfire flames co-occur with wildfire smoke; and poor air quality concerns from exposure to vehicle exhaust or ozone is often covered along with wildfire smoke. Strategies to mitigate the harm from some hazards, such as extreme cold, were directly applicable to hazards we cover, such as extreme heat, and so were included in the broad literature search.

In recent years, much of the literature on rethinking shelters or evaluating strategies to mitigate the risk of extreme weather events on PLU considered, or was, centered around reducing exposure to the Coronavirus of 2019 (COVID-19). Since concerns about COVID sometimes touch on air quality, some of this literature is occasionally relevant to strategies that mitigate harms from wildfire smoke.

### B.1.2 Selection Criteria

Given this project's scope, we used the following key words or phrases (asterisk indicates variations) to identify relevant literature:

- Targeted population: encampment\*, homeless\*, unhoused, unsheltered
- Extreme weather: atmospheric river\*, climate change, cold, disaster, extreme weather, flood\*, heat, particulate matter, precip\*, rain, smoke, storm, wildfire, wildland fire
- Risk communication: attitude chang\*, decision mak\*, evacuat\*, percept\*, persuas\*, protective acti\*, risk



Because some of these key words gave irrelevant results (e.g., articles related to tobacco smoke or that used the phrase “risk of homelessness” or “perceptions of homelessness” or “left people homeless”), we chose words or phrases from the key words above to yield the most relevant articles.

We generally gave preference to the targeted population words (especially “unsheltered”) and the extreme weather words. For many articles, “homelessness” or a variation nearly always also appeared when discussing PLU. For academic literature, we gave preference to reviews or meta-reviews over individual studies. For searches focused on newspapers, we filtered for the last 15 years (since January 1, 2009). Searches were conducted on February 29, 2024. Exact search terms for each database are provided below.

#### Scopus:

- Search terms for the 102 reviews: TITLE-ABS-KEY ( ( unsheltered OR homeless\* OR unhoused OR encampment\* ) AND ( heat OR flood\* OR precip\* OR rain OR cold OR “wildland fire” OR wildfire OR smoke OR “particulate matter” OR “extreme weather” OR “climate change” OR disaster OR storm OR “atmospheric river\*” OR persuas\* OR evacuat\* OR “attitude chang\*” OR “protective acti\*” ) AND NOT ( tobacco OR cannabis OR “common cold” ) ) AND DOCTYPE ( re )
- Search terms for the 16 general articles: TITLE-ABS-KEY ( unsheltered AND homeless\* AND ( heat OR flood\* OR precip\* OR rain OR cold OR “wildland fire” OR wildfire OR smoke OR “particulate matter” OR “extreme weather” OR “climate change” OR disaster OR storm OR “atmospheric river\*” OR persuas\* OR evacuat\* OR “attitude chang\*” OR “protective acti\*” ) AND NOT ( tobacco OR cannabis OR “common cold” ) )

#### Web of Science:

- Search terms for the 67 reviews:
  - o Filter document types: review article.
  - o Search terms: TS=((Unsheltered OR homeless\* OR unhoused OR encampment\*) AND (Heat OR Flood\* OR Precip\* OR Rain OR Cold OR “wildland fire” OR Wildfire OR Smoke OR “particulate matter” OR “extreme weather” OR “climate change” OR disaster OR storm OR “atmospheric river\*” OR evacuat\*))
- Search terms for the 16 general articles: TS=((Unsheltered AND homeless\*) AND (Heat OR Flood\* OR Precip\* OR Rain OR Cold OR “wildland fire” OR Wildfire OR Smoke OR “particulate matter” OR “extreme weather” OR “climate change” OR disaster OR storm OR “atmospheric river\*” OR evacuat\*))



#### Google:

- Scanning the top 500 results using the program Publish or Perish indicated that, after about result 275, sources were still mostly about homelessness, but unrelated to extreme weather. Search conducted in ZIP code 90401.
- Search terms: (Unsheltered AND homeless\*) AND ( heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*)

#### Homeland Security Digital Database:

- Search terms for the 78 sources: All of the words: unsheltered homeless\*; any of the words: Heat, Flood\*, Precip\*, Rain, Cold, "wildland fire", Wildfire, Smoke, "particulate matter", "extreme weather", "climate change", disaster, storm, "Atmospheric river\*", evacuat\*; without the words: COVID.
- Note that there were 63 additional sources that we excluded because we did not have access to them.

#### Los Angeles Times:

- Searched using the database U.S. Newsstream.
- Search terms for the 79 articles: (SUMMARY((unsheltered OR homeless\* OR unhoused OR encampment\*) AND (heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*)) AND bdl(1005692)) AND pd(20090101-20251231)

#### The Sacramento Bee:

- Searched using Google from the ZIP code 90401 and on the site <https://www.sacbee.com/>.
- 38 results from the search terms: all of these words: homeless\* unsheltered; any of these words: heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*.
- The top 100 results (Google estimated over 10,700 total results) from the search terms, eight of which were redundant from the first search: all of these words: homeless\*; any of these words: heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*



#### Western United States Newspapers:

- The top 100 (out of 2099 with full text results) of a search using U.S. Newsstream database, filtered to U.S. West Newsstream and excluding the Los Angeles Times.
- Search terms: (summary((unsheltered OR homeless\* OR unhoused OR encampment\*) AND (heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*)) AND bdl(1009070) AND pd(>20081231)) NOT bdl(1005692)

#### Rest of the United States Newspapers:

- The top 100 (out of 3224 with full text results) of a search using U.S. Newsstream database, excluding the Los Angeles Times and the U.S. West Newsstream results.
- Search terms: (summary((unsheltered OR homeless\* OR unhoused OR encampment\*) AND (heat OR flood\* OR precip\* OR rain OR cold OR "wildland fire" OR wildfire OR smoke OR "particulate matter" OR "extreme weather" OR "climate change" OR disaster OR storm OR "atmospheric river\*" OR evacuat\*)) AND bdl(1009070) AND pd(>20081231)) NOT bdl(1005692)

### **B.1.3 Study Inclusion/Exclusion Criteria**

Our searches yielded 102 reviews and 16 general articles from Scopus, 67 reviews and 16 general articles from Web of Science, 275 sources from Google, 78 sources from the Homeland Security Digital Database, 79 articles from the Los Angeles Times, 130 articles from The Sacramento Bee, 100 articles from other newspapers in the western United States, and 100 articles from the rest of the United States.

After removing duplicates, we were left with 892 articles. Of these, we filtered out 73% based on the title, abstract, or review of the article introduction section because they were not relevant or, for nine sources, because of issues with accessing them. We added five relevant articles referenced by the sources we kept. Of these 249 included articles, about half were newspaper articles, almost one-quarter were peer-reviewed articles, nine percent were dissertations, six percent were reviews, and four percent were opinion pieces. The number of studies at each step of this process is shown in Figure B1.

**Figure B1. Flowchart of Studies Included and Excluded**

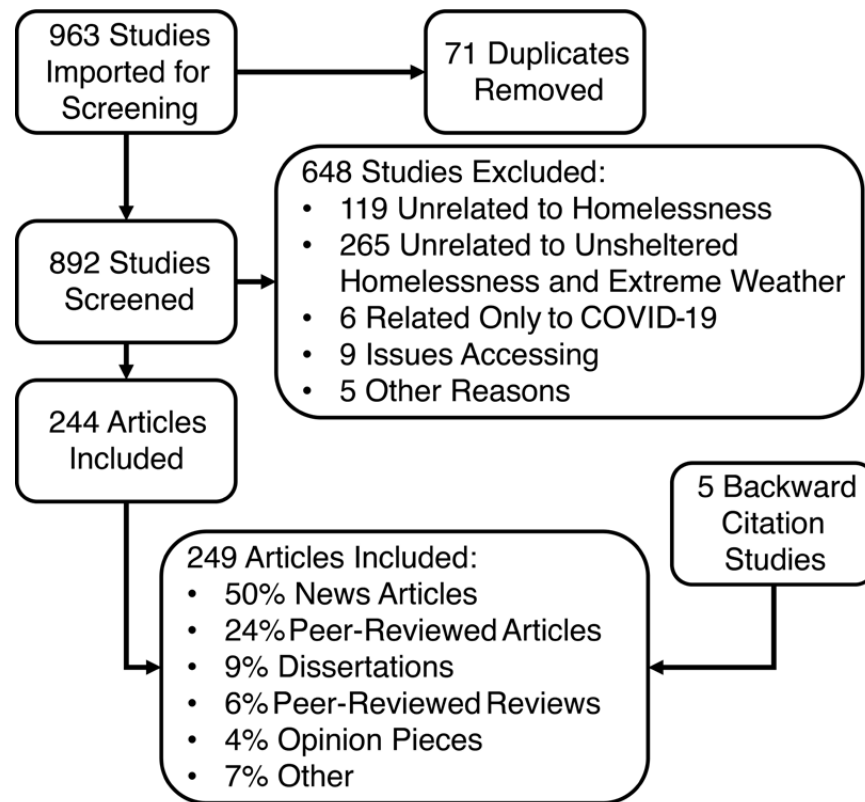


*Figure B1 Note. A flowchart showing the sources and types of the 249 articles reviewed.*

## B.2 Details on Practitioner Interviews

### B.2.1 Interview Methods

We conducted one-hour semi-structured interviews with people responsible for and familiar with emergency response and/or unsheltered homelessness to identify what strategies were being used to address the needs of PLU during extreme weather events. Additionally, we received one emailed response to our questions. Most of our interviews focused on Los Angeles or Sacramento Counties, though we also interviewed experts from elsewhere in California. We did interview one provider outside of California who was using an innovative strategy to address extreme heat.

To gather a list of qualified people to interview, we started with a list of experts that the study team identified through the literature review, personal experience, or from visiting organizational websites to identify relevant personnel (e.g., county emergency response websites). We reached out to potential interviewees by email, describing the study, research questions, and funding source. More specifically, we stated that we wanted to understand what was currently being done to reduce risk and harm



to PLU during extreme weather, what challenges there are to implementing these strategies, and what barriers currently prevent PLU from utilizing these resources. We used a snowball sampling method such that at the end of each interview, we asked interviewees for references of any other individuals that they thought should participate in our study. We offered an Amazon e-gift code of \$50, however many participants were unable to accept it. All interviews were virtual, conducted using MS Teams.

We developed and utilized a semi-structured interview protocol that had a general set of questions that we asked all interviewees, and sub-sections based on a person's role (e.g., for those who operated or managed shelter services, we asked specific questions about shelter operations). First, we asked about the person and organization's role and responsibilities in providing services during extreme weather (and/or to PLU) and how the services were tailored to different weather events (i.e., heat, wildfire smoke, and extreme precipitation/flash flooding). We also asked about how special action is determined/about thresholds to offer extreme weather services and the discretion around these actions. For those mainly responsible for emergency management, we asked if protocols and procedures were different or tailored for PLU. For those who provided services to PLU, we asked how those services were different or tailored during an extreme weather event. We asked about the challenges to implementing the services and for PLU utilizing those services. We also probed regarding specific barriers, including funding, workforce, physical-siting, and warning times. We probed about risk communication (if it had not already been discussed). We ended the interview with an open-ended question offering the interviewee a chance to convey any additional information about which we did not specifically ask.

## **B.2.2 Interview Participation**

We reached out to a total of 53 people across 40 unique organizations, departments, and programs. The number by jurisdiction and organizational focus were:

- Jurisdiction:
  - Los Angeles City/County: 20 (14 Unique)
  - Sacramento City/County: 16 (12 Unique)
  - Other Californian City/County: 6 (4 Unique)
  - California State: 5
  - United States: 5 (4 Unique)
  - Non-Californian City/County: 1
- Focus:
  - Government Agency Focused on Emergency Management: 9 (7 Unique)
  - Government Agency Focused on Homelessness/PLU: 15 (13 Unique)
  - Local Legislators' Offices: 3 (2 Unique)



- o Service Providers: 19 (13 Unique)
- o Advocacy Organization: 2
- o Law Enforcement/First Responders: 5 (3 Unique)

We completed 16 interviews with 26 people, 8 interviews representing Los Angeles County, 5 representing Sacramento County, and 3 that were state-level or from elsewhere. One person also sent us an email response to our questions rather than participating in a virtual interview. Interviews were conducted between July 2024 and February 2025.

### **B.2.3 Interview Data and Analyses**

All interviews were recorded, and the interview facilitator took notes during the interview. Following each interview, one member of the research team reviewed the facilitator notes and recordings to create an interview summary. Next, one member of the research team created a summary memo that summarized what interviewees conveyed in terms of resources provided during different extreme weather events and strategies used to address unsheltered homelessness during extreme weather events. For each resource and strategy that interviewees discussed, information about implementation facilitators and barriers to utilizing them were also noted. Following the conclusion of the interviews, a list of themes that outline the challenges to addressing the needs of unsheltered homelessness during extreme weather events was developed, by review of the interview summaries. All three members of the interview team reviewed and provided feedback on the interview summary and list of themes as it was being developed and approved the final version.

## **B.3 Details on Survey Methodology**

### **B.3.1 Method for Approach**

Figure B2 provides an overview of the screening and survey eligibility and completion rates. To complete the surveys, trained members of the RAND Survey Research Group approached people in locations related to the target hazard (i.e., extreme heat in Antelope Valley and smoke in Malibu) where PLU frequent and offered a \$3 incentive to complete a screener to determine eligibility for the full (longer) survey. The screener asked about the respondent's age and experiences living unsheltered in the target area. Individuals who agreed to complete the screener and were determined to be eligible (i.e., were 18 or over; living unsheltered in the target area during the specific weather event, that is, during extreme heat in Antelope Valley in September 2024 or in Malibu during the December 2024 fire event) were then offered an opportunity to complete the full survey that took between 30 and 60 minutes. The survey was administered by field staff and consisted of both close-ended and open-ended questions; responses to the open-ended questions were audio-recorded and transcribed. Respondents were provided \$40 for completing the full survey.



We did not recruit people under the age of 18 to participate in our survey given the additional privacy protections for minors. Of the individuals that were screened by field staff in the two areas, no one was screened ineligible due to age (i.e., were less than 18 years old). To put these findings into context, unaccompanied youth represent less than one percent of the estimated PLU in Los Angeles County (LAHSA, 2025).

### B.3.2 Eligibility

We approached 71 individuals to take part in a screener, which led to the completion of 47 full surveys (66%; see Figure B2). Of those approached, 14% refused to be screened, and 4% were unable to screen either because of language (one person) or because they were too disoriented, intoxicated, or cognitively impaired. Of those screened, 12% did not meet our definition of being unsheltered (they reported living in an apartment or home; emergency shelter; foster care or group home; hospital, substance abuse, or psychiatric treatment facility; hotel or motel; jail or prison; safe haven; transitional housing; or youth shelter; or they reported living elsewhere but having another place to stay) and 5% were not living in the relevant location during or in the week prior to the hazard event that was the focus of the survey, and therefore were deemed ineligible. Of those deemed eligible ( $n = 48$ ), one person declined to take the full survey.

**Figure B2. Study Sample Recruitment and Completion**

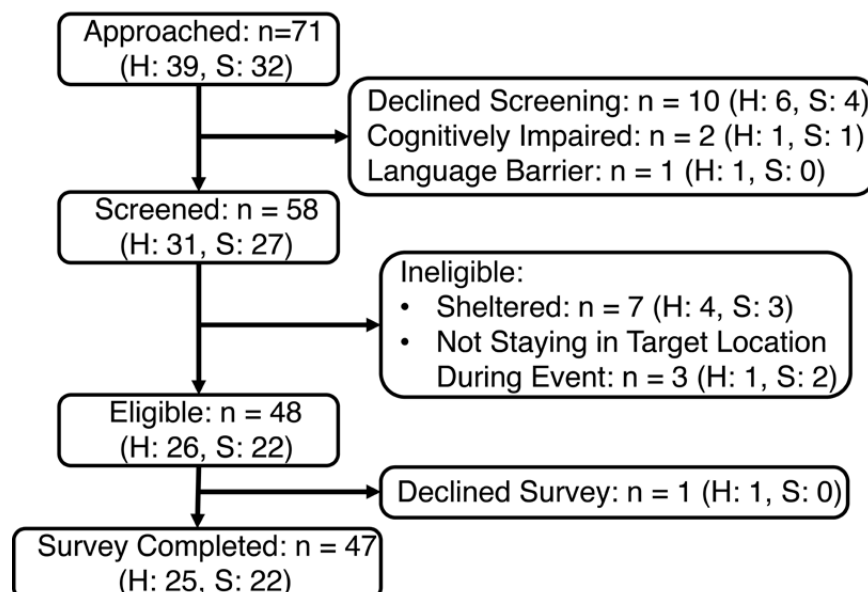


*Figure B2 Note. The number of people that participated in each step of study recruitment and completion, with the relevant reason for exclusion. "H" refers to people recruited to discuss extreme heat and "S" refers to people recruited to discuss wildfire smoke.*



### **B.3.2.1 Heat**

We screened 39 people in Antelope Valley about extreme heat and conducted 25 surveys. The surveys were conducted on December 26, 2024 (n = 13) and January 2, 2025 (n = 12) at locations such as public libraries (Palmdale Library, Lancaster Library), encampments in and around parks, and vehicles parked near service provider offices.

### **B.3.2.2 Smoke**

We screened 32 people about smoke in Malibu from the Franklin Fire and completed 22 surveys. These people were approached between December 18 and December 24, 2024, at a few different locations in the Malibu area including Legacy Park, the Malibu library, an encampment along the Pacific Coast Highway, and a strip of empty land during a food-distribution event by a local church. We also spoke with homeless service providers conducting outreach during this time, and they referred us to one respondent who was evacuated to an interim housing setting in Koreatown, Los Angeles where we conducted the survey.

### **B.3.3. Survey Content**

The survey was composed of 42 main questions and some sub-questions based on responses to the main questions. Most of the questions were developed for this survey effort, based on information from the literature review and practitioner interviews. A few questions, such as the determination of unsheltered homelessness status and homelessness experiences, were borrowed from the Los Angeles Longitudinal Enumeration and Demographic Survey (LA LEADS) effort (Ward, Garvey & Hunter, 2024). Note that the term “emergency shelter” in the survey referred to shelters that are open specifically during a disaster or emergency, shelters that are open during a particular season, and shelters that are open year-round.

**Problems during extreme weather.** We first asked respondents about, since the time they have been unsheltered, whether they had been affected by any of the following issues on [hot or smoky] days: access to drinking water, showers, or bathrooms; challenges at night and other items specific to weather event (hot: shade; air-conditioned spaces; high temperatures in structure; or smoke: access to clean air spaces, trouble breathing, coughing).

**Health issues while unsheltered.** We asked respondents how affected they had been (from “not at all” to “extremely” on a five-point scale) to several specific health issues (e.g., pre-existing conditions, including medications that increase heat sensitivity), substance use issues (alcohol, drugs), and mental health issues (stress, trauma, and mood).

**Resources.** We asked respondents about, since the time they have been unsheltered, whether they had received any of the following (with yes or no response options):



water bottles, frozen water bottles, masks, cooling rags, handheld fans, ice, sunscreen, socks, tents, tarps, ponchos, towels, first-aid kits, and radios. If they said yes to any of these items, we then asked when they received that particular item with the following response options: during a heat wave, during a wildfire smoke event, during a severe rainstorm, in the week prior to a heat wave, in the week prior to a rainstorm, in the week prior to a wildfire smoke event, or another time. We also asked whether they received any other resource, and, if they said yes, we asked them to describe it and when they received it using the previous response options.

**Information about extreme weather events.** Next, we asked a question about information receipt regarding the weather event in question (i.e., in Malibu, the Franklin Fire, and in Lancaster/Antelope Valley, the September 2024 heat wave). We asked prior to the event (with a specified date range), “how did you initially learn about the [weather event in question]” with 13 response options and an opportunity to specify “other” with a write-in description. The 13 response options were: I didn’t know; outreach worker; word of mouth (neighbor, friend, or another person living unsheltered); firefighter/police officer on foot or by vehicle; firefighter/police officer in a boat/helicopter; other government worker (CalTrans, park ranger); siren; radio; TV; phone alert; phone call; internet access via a phone; and internet (other). We then asked how, in general, respondents get news or information about extreme weather with the same response options used previously, except excluding the “I don’t know” option. Next, we asked how, in general, respondents get information about shelters or services available during extreme weather events, including the same 12 response options as previously described.

**Information about risk.** We asked respondents about, since the time they have been unsheltered in this area, whether they received information about (with yes or no response options) each of the following four issues: heat risk or dehydration symptoms, flood risk, wildfire risk and wildfire smoke protection. If they said yes, then we asked a follow-up question about how they received the information with the following response options: flyer; conversation with outreach worker; conversation with neighbor, friend or another person living unsheltered; conversation with firefighter/police officer; phone call; TV; radio, phone alert; internet; or other (please describe). We also asked respondents whether they have ever ignored warning messages given to them about (heat wave/air quality) with yes or no response options.

**Sensitivity to heat and smoke.** We asked respondents if they had any medical conditions or take any medications that make them more sensitive to heat with the following response options: yes, no, unsure. We asked the same question and provided the same response options about wildfire smoke.



**Medical attention.** We asked respondents since they have been unsheltered about whether they have ever received or sought medical attention for either heat stroke, heat exhaustion, or dehydration in the heat survey or asthma, bronchitis, or respiratory problems (coughing/wheezing) in the wildfire smoke survey effort using yes or no response options. If a respondent said yes, we then asked all respondents how often this happened (with the following response options: once per year, twice a year, 3-6 times a year, or more than 6 times a year), when the most recent instance occurred (with the following response options: in the past week, in the past month, in the last year, 1-5 years ago, or more than 5 years ago), and where were they staying at the time (with the following 16 response options: emergency shelter, hotel or motel, street sidewalk or alley, on a bus or a train, bus or train stop/station, transit center or airport, unconverted garage, attic or basement, campground or woods, park, beach or riverbed, under bridge or overpass, other outdoor location, abandoned building, parking lot (surface), parking structure, car, truck or van, RV or camper, and sidewalk encampment or tent). Those who endorsed attention for heat-related conditions were also asked about how hot it was outside during the most recent incident (with the following response options; over 100 degrees, 90-100 degrees, 80-90 degrees, less than 80 degrees) and what they thought caused the heat-related condition (with the following response options: heat, drugs or medication, not enough water, physical exertion, health condition or other-please describe). Those who endorsed attention for any of the smoke-related conditions, were also asked what they thought caused this condition (with the following response options: air quality, wildfire smoke, cigarette or other smoke, drugs or medication, physical exertion, health condition or other-please describe).

**Drinking water access.** We asked all respondents where they usually get their drinking water and asked them to choose one option from: bottle provided by friend, outreach worker or neighbor; tap, bathroom, or water fountain; purchased; or other-please describe. We also asked them how long it usually takes to get safe drinking water (tap, bottled, protected, or pretreated), with two response options: less than 30 minutes roundtrip and more than 30 minutes roundtrip. We also asked them to rate how easy or difficult it was to usually get drinking water with the three response choices: easy, neither easy nor difficult, and difficult.

**Housing/shelter offers.** We asked all respondents whether, during a weather event [heat or wildfire smoke day], they had ever been offered the following five options: group shelter; short-term stay in hotel or motel setting; cooling center or public building (library, mall) during business hours; cooling center or public building (library, mall) during non-business hours; and other shelter-please describe. If they said yes, we asked whether they accepted it or not. If not, we asked why not, where they could endorse all that applied, selecting from the following options: not enough secured storage or not allowed to bring more belongings; not allowed to stay with pets; not allowed to stay with partner, spouse, child, or roommate; not in the right



area; needed transportation; not enough time to get there before the event began; option has too many rules; don't feel safe; don't want to be around other people; lack of independence; previous bad experience; and other-please describe. We also asked if any of the following would have increased the likelihood of accepting the option with the following response options that respondents could select all that applied: a better understanding of the extent of the heat/flooding/smoke; secure storage for belongings; kennels for pets; free fares on public transportation; door-to-door ride from location to shelter option; guaranteed transportation back after the event; relative/friend/neighbor accepted or allowed to stay in same location; image of or information about the shelter option; and something else (please describe).

**Forced moves.** We asked about during or immediately before the last extreme weather event (heat wave/wildfire smoke event), whether respondents were forced to move locations, using a yes or no response option. If they said yes, we then asked the following two questions: 1). who or what prompted you to leave with the following response options: police or other law enforcement; sanitation, Caltrans, Metro or other local or state government staff; firefighters or other emergency response workers; outreach worker; neighborhood residents or a local business owner; private security; other unhoused people; sirens; or I personally choose to leave on my own; 2). what was the reason you were asked to or choose to move with the following response options: your safety, disturbing neighbors, street or area cleaning, other-please describe.

**Protective behaviors.** We asked respondents whether they do the following activities to protect themselves from (extreme heat/smoke) using yes or no response options: seek a covered area, reinforce tent/RV makeshift structure; go inside of tent/RV makeshift structure; sit outside tent/RV makeshift structure; go into bus/train or bus/train station; go into public building (library); go into business (store, restaurant); go into the home of family/friend; seek emergency shelter; drink water; seek shade (heat only); and wear a mask (smoke only).

We also asked about behaviors related to the specific weather event, using open-ended audio-recorded responses. We first asked respondents if they decided to do anything differently due to the weather. If respondents said yes, they were asked to describe what they did. If respondents said no, they were asked to describe why not.

We also asked more generally if it is extremely hot outside or if there is wildfire smoke, whether the respondent goes to shelter or prefers to stay outside. If they told us they go to shelters, we asked them to describe why. If they responded that they stayed outside, we also asked them to describe why.

For the wildfire smoke participants, we also asked (among those with a vehicle or structure), "From your perspective, do you feel like your tent, structure, car, RV or



trailer protects you from the heat/wildfire?" We asked them to describe their yes or no response. We then asked, "What motivated your decision to stay in your tent, structure, car, RV or trailer or go to a shelter during this last heat/wildfire smoke event? Can you tell me more about that?".

All participants were also asked the following open-ended questions that were audio-recorded: "Please tell me more about how the weather affects your daily life?"; "When you are asked to evacuate or seek shelter, who do you trust and why?"; "When do you consider it would be necessary for you to evacuate and seek shelter?"; "Where would you go to seek shelter if it was necessary?"; and "Is there anything else you would like to share about your situation that I haven't already asked you about?".

**Homelessness experiences.** We asked respondents how long they have been unhoused this time with the following response options: less than 30 days, 30-90 days, 3-6 months, 6-12 months, 1-2 years, 2-3 years, and 3 years or longer. We also asked, since they have been unhoused this time, how many outreach or case managers they have engaged with, using the following response options: none, one, two, three, four, five or more. If respondents answered more than none, then we asked when their last contact with an outreach worker or case worker was, using the following response options: within the past 7 days, between 7-14 days, between 1-2 months, more than 2-3 months and more than 3 months ago.

**Demographic and other individual characteristics.** The last section of the survey collected information about respondents' gender; race/ethnicity; ability to read in English, Spanish, or another language; whether they had any pets and, if so, how many; ability to swim (from cannot swim, not well, fine to well); whether they had a working cellphone and, if yes, whether they could access the internet with it and how often the phone is charged and turned on (with the following response options: always, usually, more than half the time, occasionally, rarely); whether they current have or have access to a working radio, working TV, and working computer with yes and no response options.

### **B.3.4 Missing Data**

When a response to a question was missing or illogical, responses were either entered based on: (a) consultation with the surveyor or other documentation (e.g., a missing date on a screener form about extreme heat was chosen on a day and location where extreme heat screening was conducted ); (b) review of the original survey or screener (e.g., in a few cases where a survey administrator crossed out a section and answers were incorrectly filled in by scanning software when a bubble intersected with the X); (c) verification based on the other survey data (e.g., if a question about heat was not supposed to have been asked because it was a survey about smoke, then the response was removed). In some cases, an "other"



write-in response was recategorized into one of the available response options for consistency. If a question should have been asked and was not, and the response was not available based on the answers to other questions, then the response was considered missing from the summary statistics that are presented.

### B.3.5 Demographic Information

Figures B3 through B5 provide demographic information for the entire surveyed sample, with indicators for the group queried about heat and those about smoke indicated.

Figure B3 shows the composition of our survey sample based on racial identification. Of all respondents, 23% identified as Hispanic or Latine (40% of those surveyed about heat and 5% of those surveyed about smoke).

**Figure B3. Racial Identification of Survey Respondents**

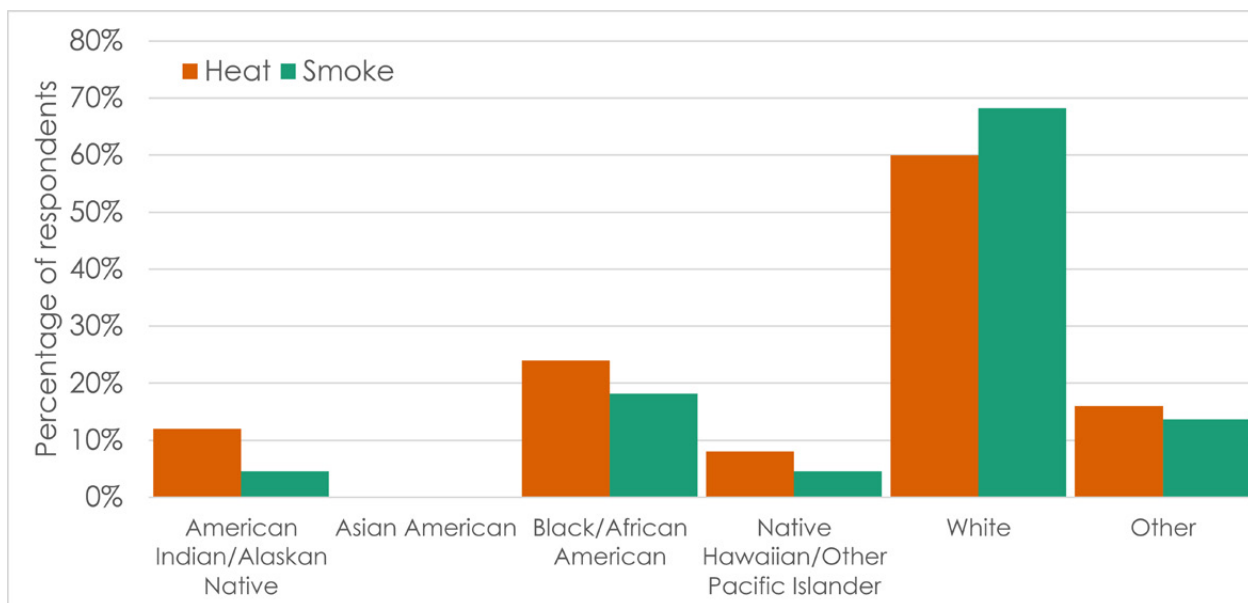


*Figure B3 Note. Response to the question “What race do you identify with?” where respondents were allowed to choose more than one option (47 respondents total, 25 on extreme heat and 22 on wildfire smoke). Note that racial identification among those surveyed about extreme heat and about wildfire smoke were similar. Data from surveys of people living unsheltered.*

Respondents were split between living in a vehicle during or in the week prior to the extreme weather event (32%), living in a tent or makeshift shelter (40%), and sleeping outside (28%), as shown in Figure B4. This was in response to the question “Where were you living during and in the week prior to that event?”, and those that responded with “Car, truck or van” or “RV or camper” were categorized as being

in a vehicle, those that responded with “outdoor encampment or tent” or “other makeshift shelter not meant for human habitation” were categorized as being in a tent or makeshift shelter, and those that responded with another eligible answer were categorized as sleeping outside. Note that these statistics are inferred from answers that indicated multiple options for some respondents. Those that provided answers that qualified as sleeping outside and in a tent/makeshift shelter (n=3) were recorded as sleeping in a tent/makeshift shelter. Those surveyed about heat were more likely to be in an informal structure (i.e., vehicle or tent/makeshift shelter) compared to sleeping outside. Those surveyed about smoke were most likely to report sleeping outside relative to the other options.

**Figure B4. Location Respondents Slept**

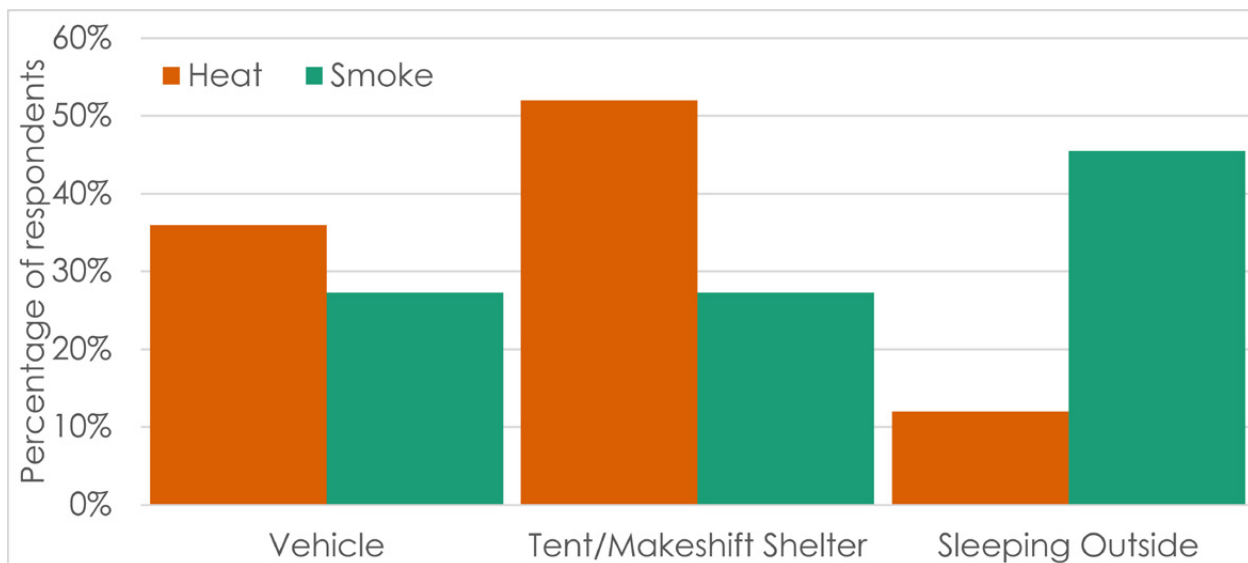


*Figure B4. Interpolated location of where respondents slept in the week prior to the event for those surveyed about heat (orange) and smoke (green). There were 47 total respondents, 25 on extreme heat and 22 on wildfire smoke. Data from surveys of people living unsheltered.*

Most of the respondents reported being unhoused “this time” for at least two years (see Figure B5), and this response was not significantly different across heat and smoke respondents.



**Figure B5. Length of Current Unhoused Episode**

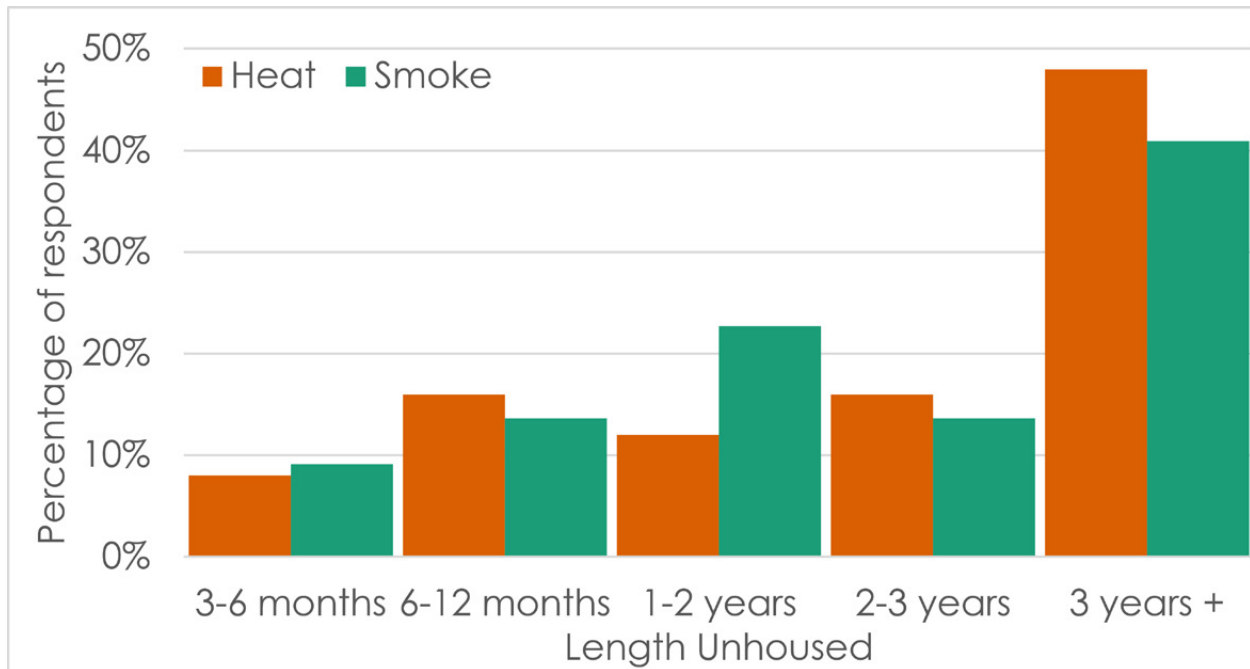


*Figure B5. The length of time that survey respondents reported living unsheltered, out of 47 respondents. Those surveyed about heat are shown in orange, those surveyed about smoke are shown in green. Data from surveys of people living unsheltered.*



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