

UCDAVIS
HEALTH

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MEDICINE

Public Health Sciences

Developing Exposure Risk Profiles for Populations Experiencing Wildfire Smoke

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Overview

1. Introduction
2. Phase I – Exposure Risk Profiles
3. Phase II – Epidemiologic Analysis
4. Under Review: Institutional Drivers of Planning for Cascading Disaster Risks



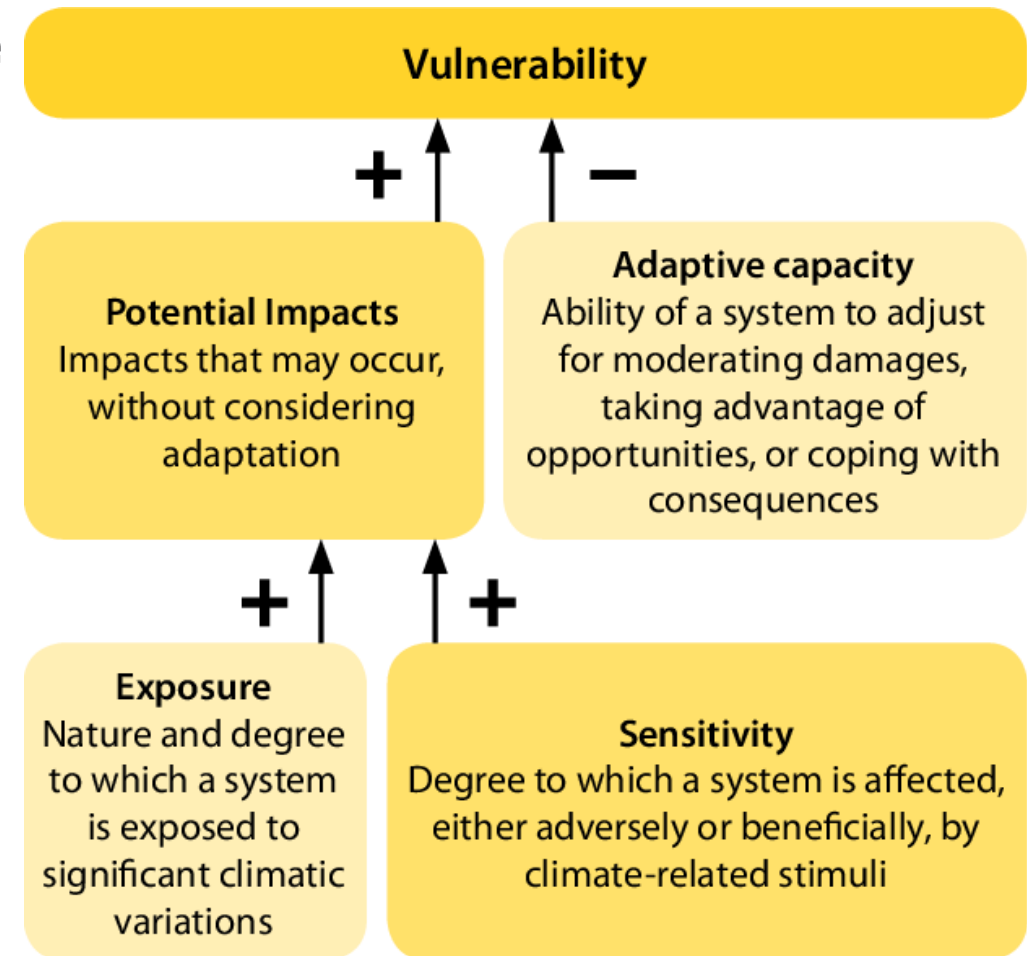
Introduction

Differential health effects of wildfire smoke exposure

- Sensitivity to impacts of exposure
- Risk of exposure

Exposure may differ by population characteristics

- Improve exposure assessment
- Estimate population-level changes in cause-specific disease burden



Source: Locatelli (2011)

Objectives

PHASE I

Construct place-based exposure risk profiles to wildfire smoke

PHASE II

Examine whether exposure risk profiles predict adverse health impacts

PHASE I

Building Wildfire Smoke Exposure Risk Profiles

Approach

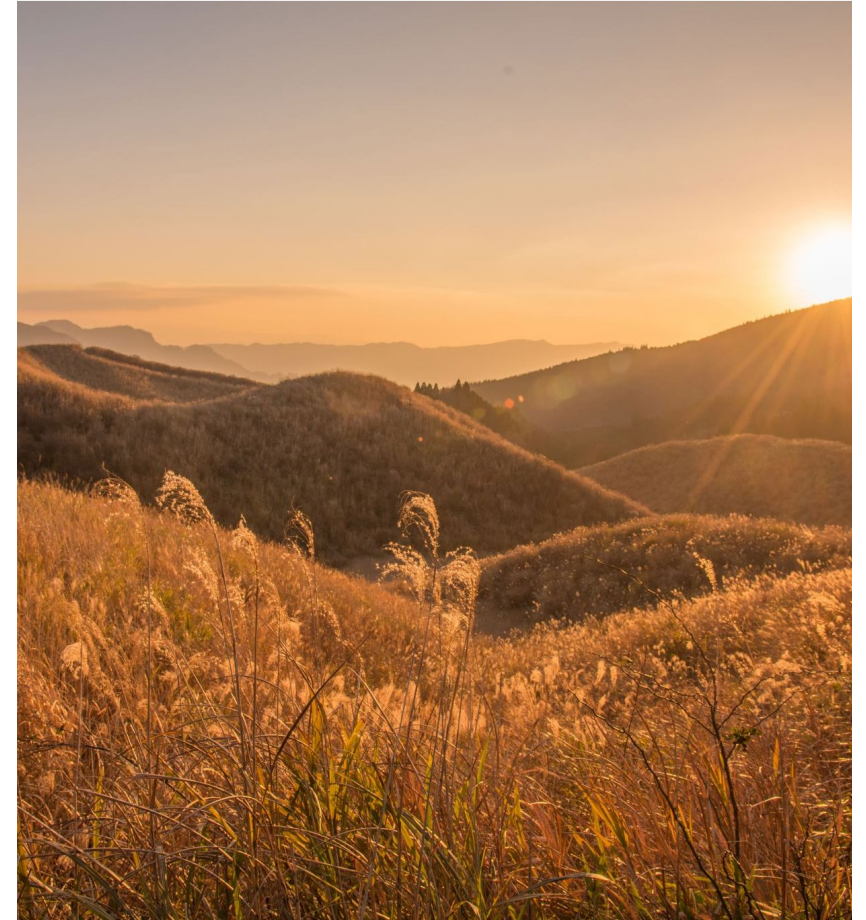
Review literature on:

- Environmental, demographic, socio-economic, health status, and housing risk factors

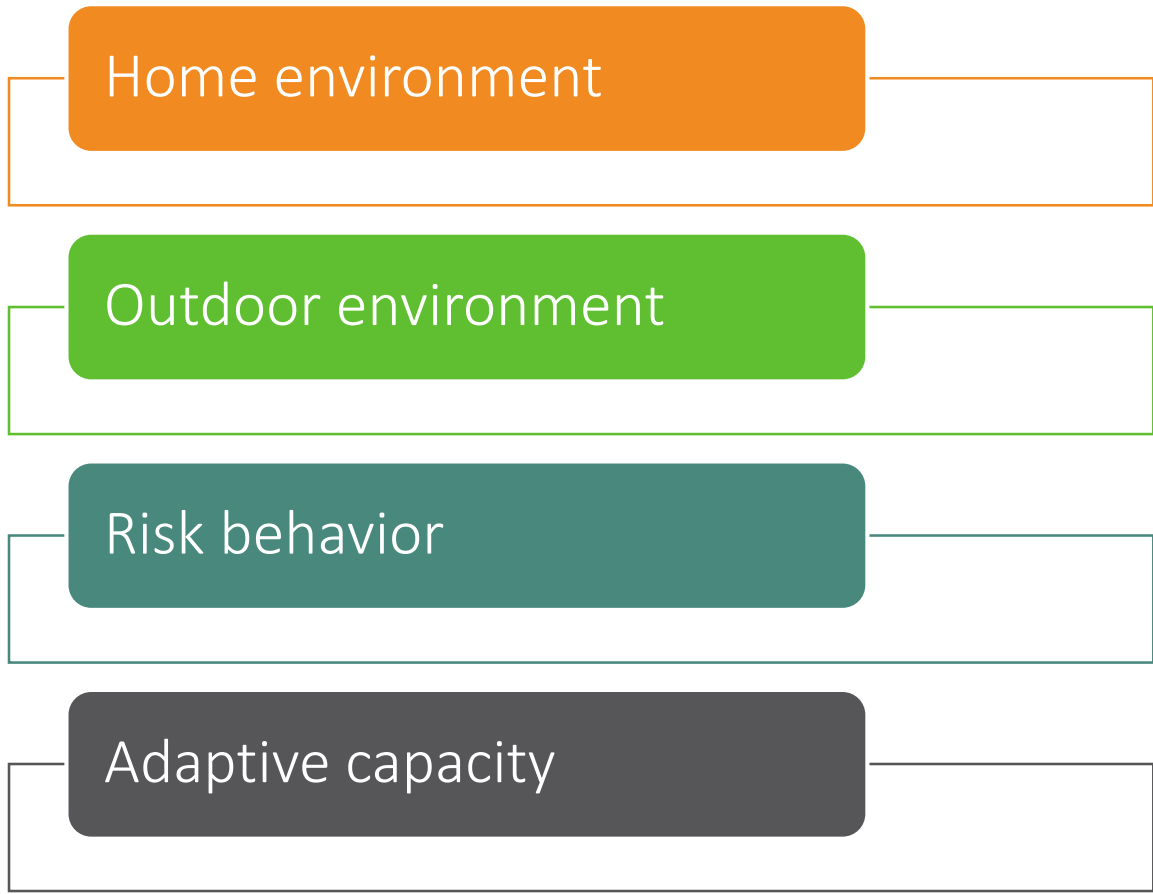
Identify measurable indicators of risk

Descriptive maps

Define census tract-level risks



Risk Categories



Measurable Indicators

Community-level

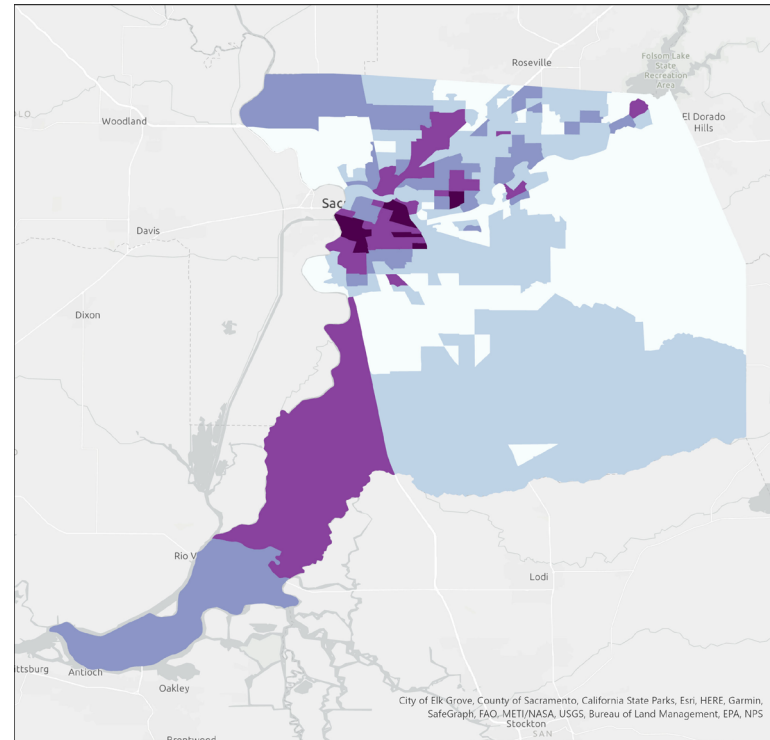
- US Census American Community Survey 5-year estimates (ACS)
- CDPH, California Building Resilience Against Climate Effects (CalBRACE)
- California Energy Commission Residential Appliance Saturation Study (RASS)
- CAL FIRE

Individual-level

- California Department of Health Care Access and Information (HCAI)

Home Environment

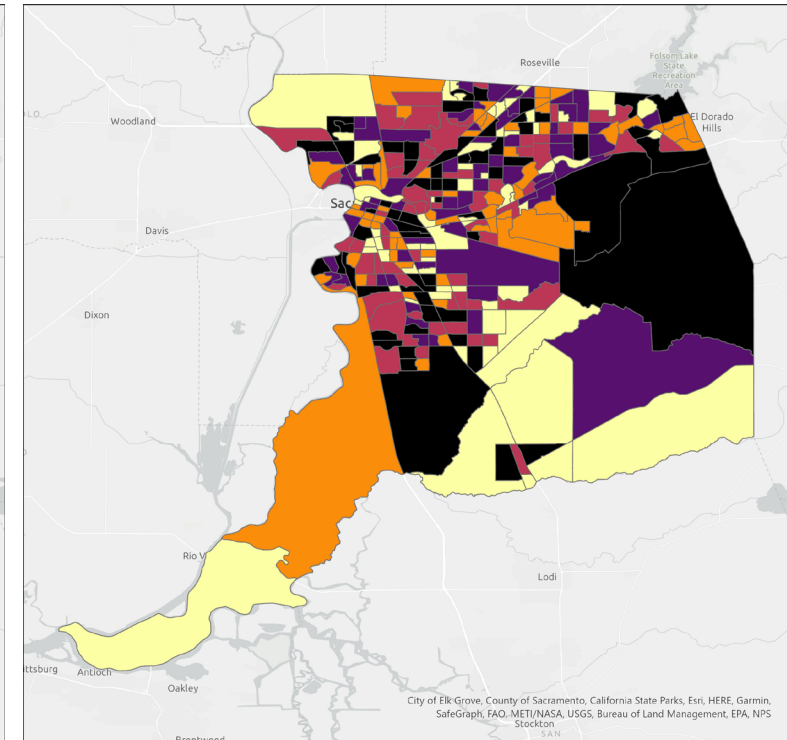
- A/C use
- Housing age
- Low-income housing



Sacramento Housing
housing_age_hr_PCT

0-5%
5-25%
25-50%
50-75%
75-100%

Proportion of occupied housing units built before 1960 in Sacramento census tracts



Sacramento County Tracts
housing_lowinc_count

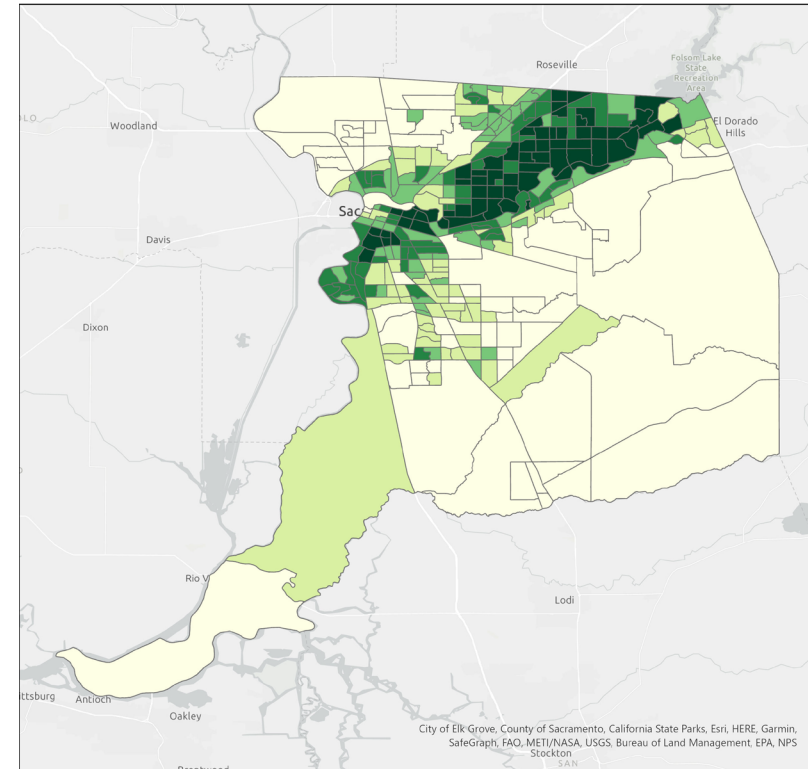
21 - 546
547 - 715
716 - 881
882 - 1055
1056 - 1902

Number of low-income occupied housing units in Sacramento census tracts

Data Source: US Census ACS, 2015-2019

Outdoor Environment

- Tree canopy

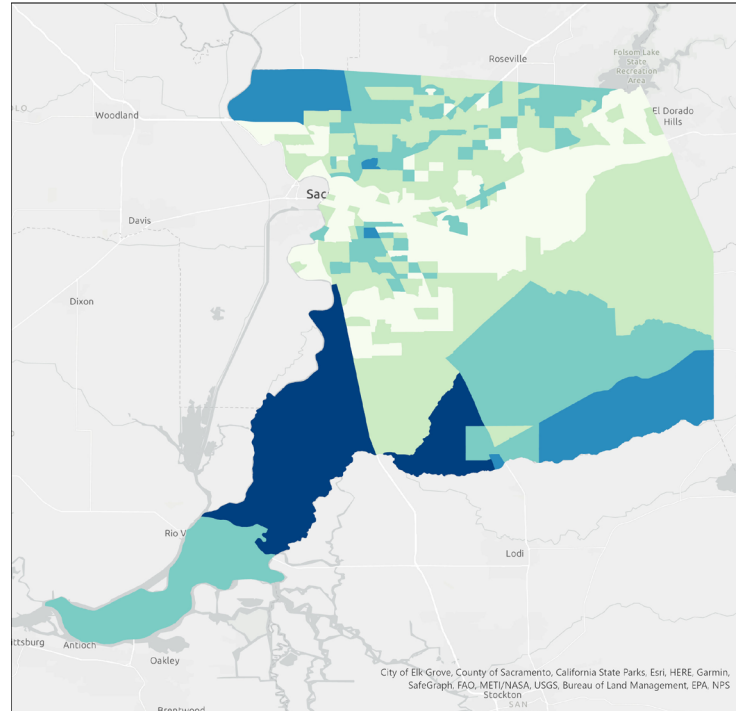


Sacramento Tree Canopy
Tree_Canopy_PCT
65.253109 - 81.117117
81.117118 - 86.835358
86.835359 - 90.728329
90.728330 - 94.581654
94.581655 - 98.856483

Percent land not covered by tree canopy in Sacramento census tracts

Risk Behavior

- Commute transportation
- Occupational industry
- Sex

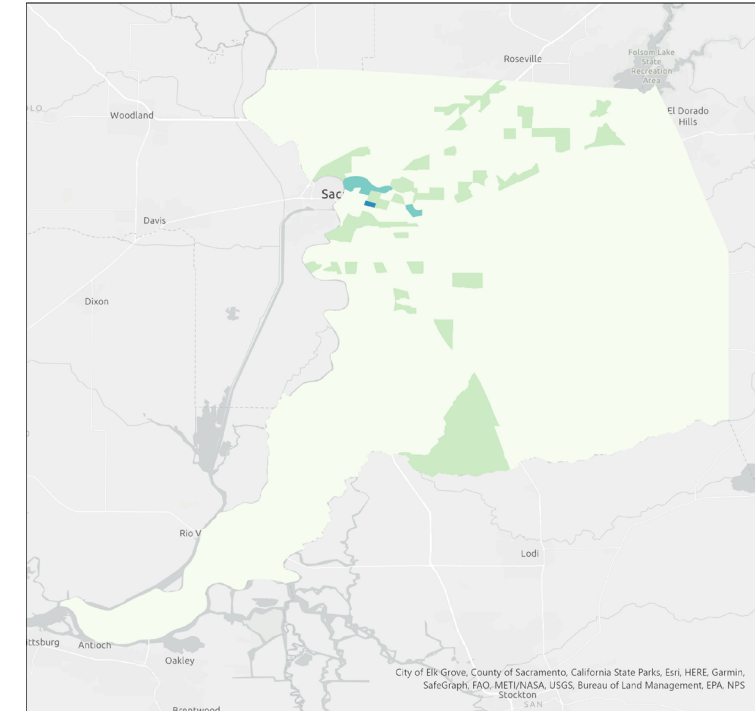


Sacramento County Tracts
Higher risk industries

0-5%
5-10%
10-18%
18-25%
25-33%

Proportion of workers in higher risk occupational industries in Sacramento census tracts

Data Source: US Census ACS, 2015-2019



Sacramento County Tracts
Highest risk commute

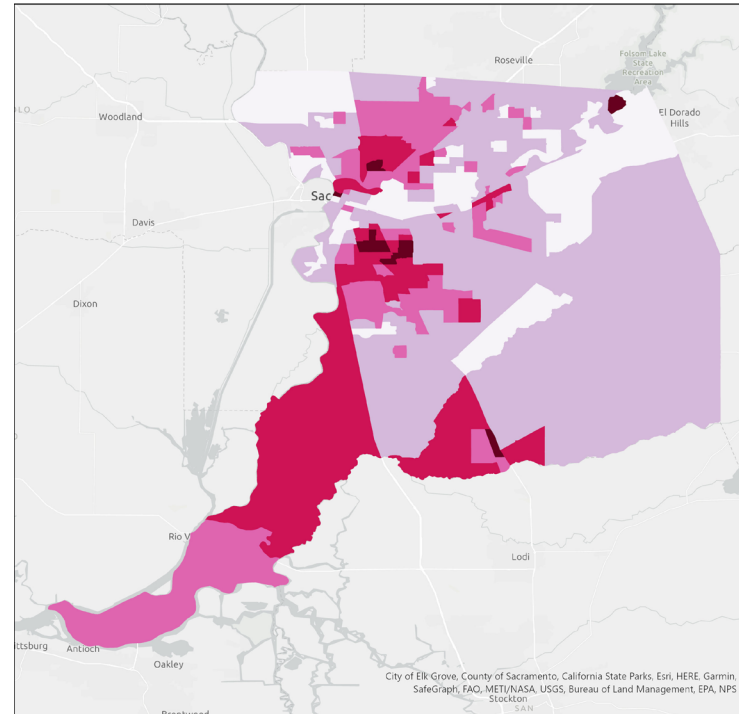
0
0-15%
15-25%
25-50%
50-100%

Proportion of workers commuting by walking, biking, or motorcycling in Sacramento census tracts

Data Source: US Census ACS, 2015-2019

Adaptive Capacity

- Income
- Education
- Language spoken at home
- Race/ethnicity

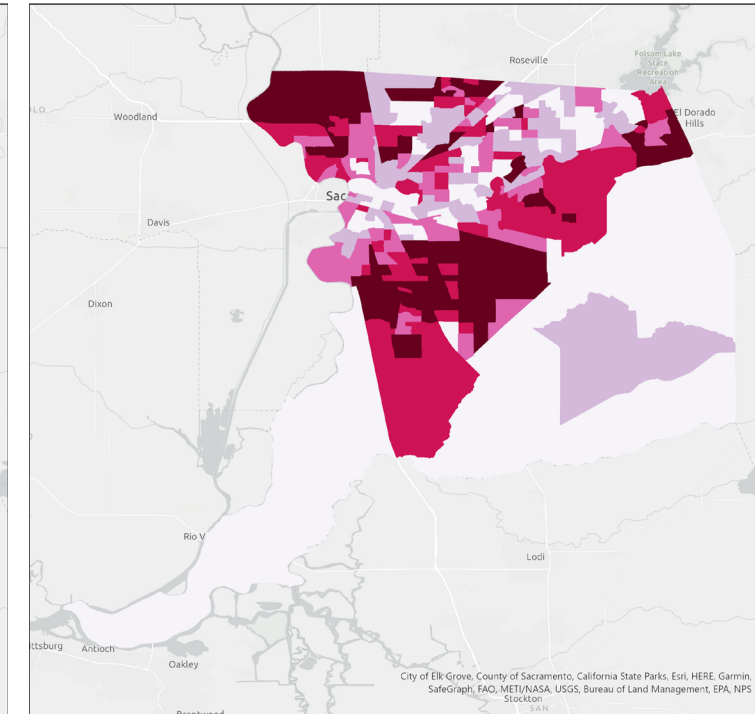


Sacramento County Tracts
Highest risk (Less than HS)

0-5%
5-12%
12-20%
20-30%
30-45%

Proportion of adults with an education less than high school in Sacramento census tracts

Data Source: US Census ACS, 2015-2019



Sacramento County Tracts
Other languages

1.5-7.8%
7.8-13.7%
13.7-19.7%
19.7-26.5%
26.5-61%

Proportion of households speaking other languages at home in Sacramento census tracts (including Indo-European, Asian, and Pacific Islander languages)

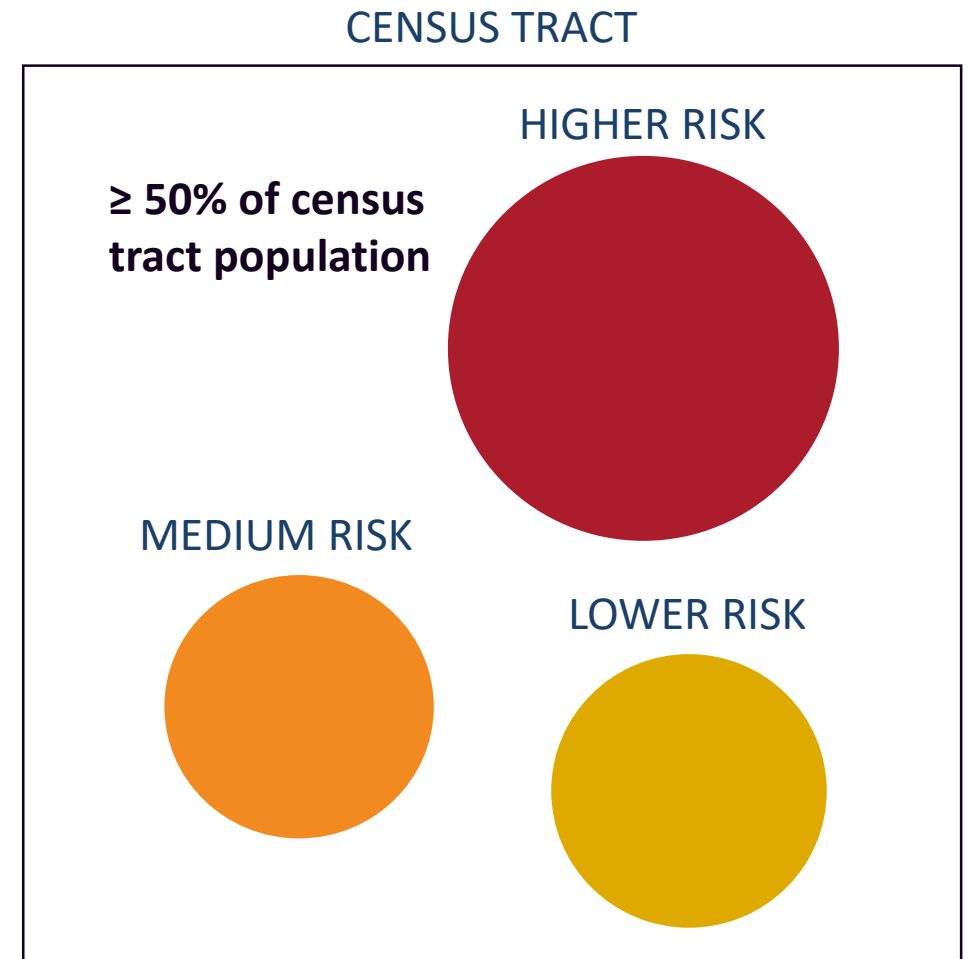
Data Source: US Census ACS, 2015-2019

Definitions of Exposure Risk

1. Large proportion of the **census tract population** is higher risk
2. Large proportion of the **higher risk population** resides in the census tract

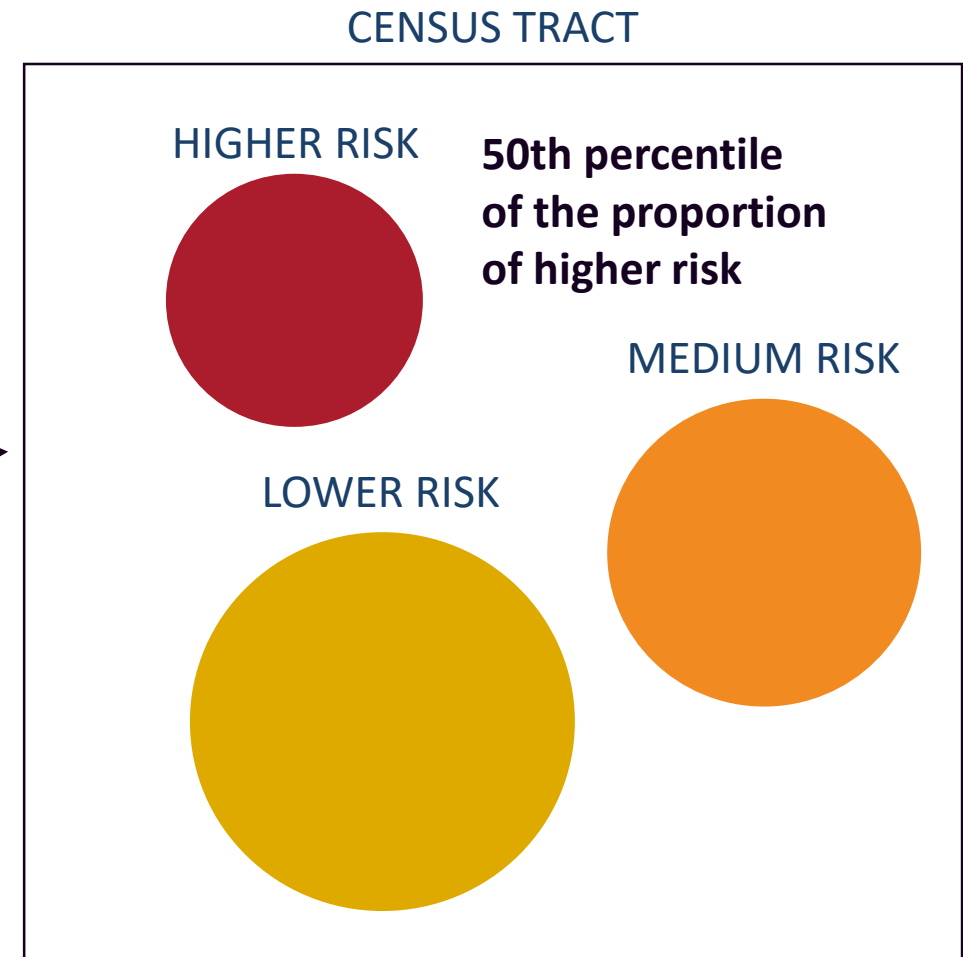
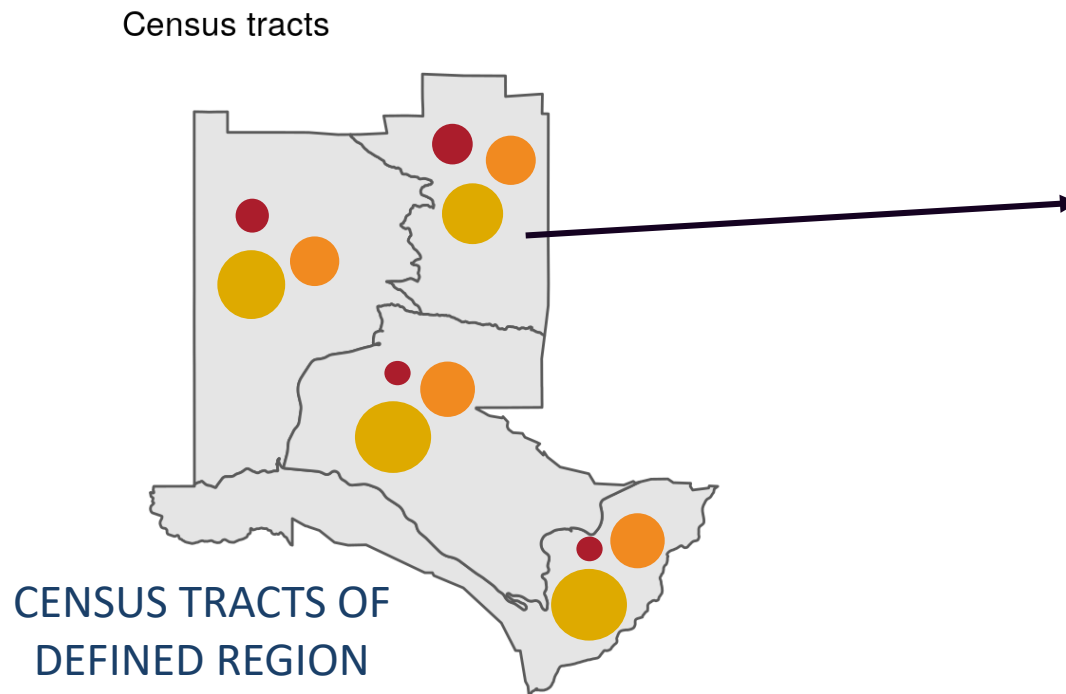
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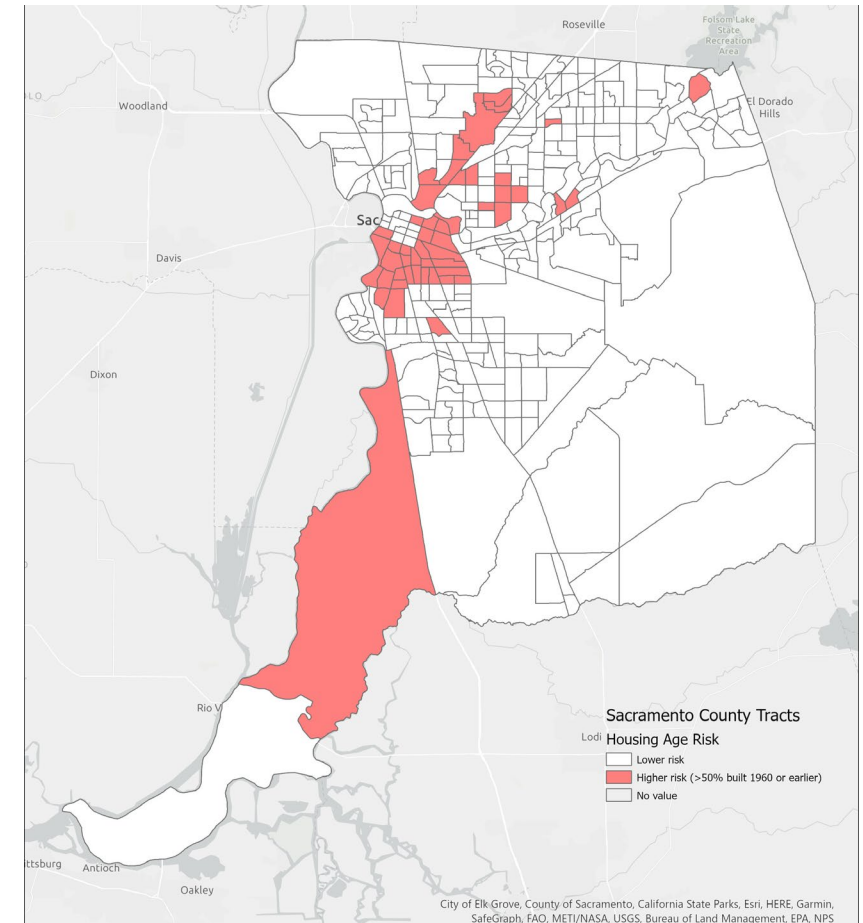
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Next Steps

1. Map each exposure risk variables
2. Construct risk matrix to classify vulnerable populations
3. Examine intersections of exposure risk profiles and wildfire smoke exposures

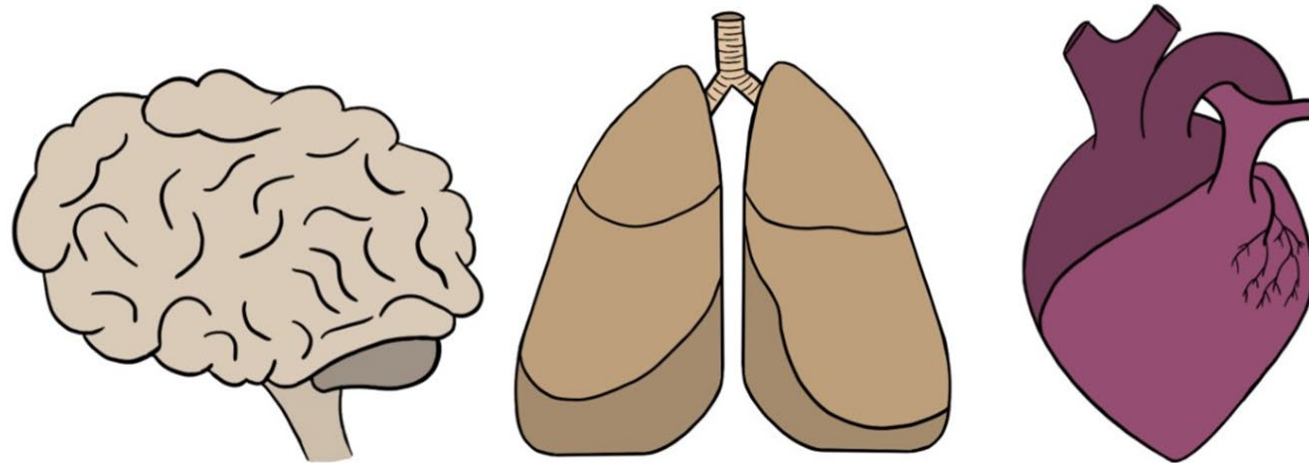


PHASE II

Linking health data to exposure risk profiles

Approach

- Cases of **respiratory, cardiovascular, and cerebrovascular** morbidities
- Hospitalization and ED data from HCAI – *anticipated Summer 2022*
- Link to community-level exposure risk profiles and wildfire smoke exposures



Anticipated Results

Higher risk of exposure to wildfire smoke will result in increased vulnerability to adverse health outcomes

The relationship may be modified by:

- Age
- Urbanicity, and
- Proximity to high fire risk landscapes



Institutional Drivers of Planning for Cascading Disaster Risks:

The case of Wildfire-Induced Air Pollution in California



Eric Chu
Asiya Natekal
Gemma Waaland
Michele Barbato
Kathryn Conlon

Under Review, *International Journal of Disaster Risk Reduction*

Planning for Cascading Risks

Cascading Risk Events

Exposure to multiple hazard impacts lead to successive, increasingly severe risks to populations and assets

- Drought
- Extreme heat
- Rapid WUI development

Goal: Assess knowledge on institutional approaches to addressing wildfire-induced air pollution in California

California wildfire advances as heat wave blankets US West

By DAISY NGUYEN July 10, 2021



Methods

1. Qualitative document analysis

Selection criteria:

- a. Relatively recent publication of local hazard mitigation plan *and* either community wildfire protection plan or air quality hazard mitigation plan
- b. High exposure to wildfire impacts, poor air quality
 - a. Identified by California agencies (CalFIRE, OEHHA)
- c. Clear engagements with wildfire, climate change, and air quality protection efforts

2. Ranked local hazard mitigation plans for categories: "wildfire", "air quality", and "climate change"

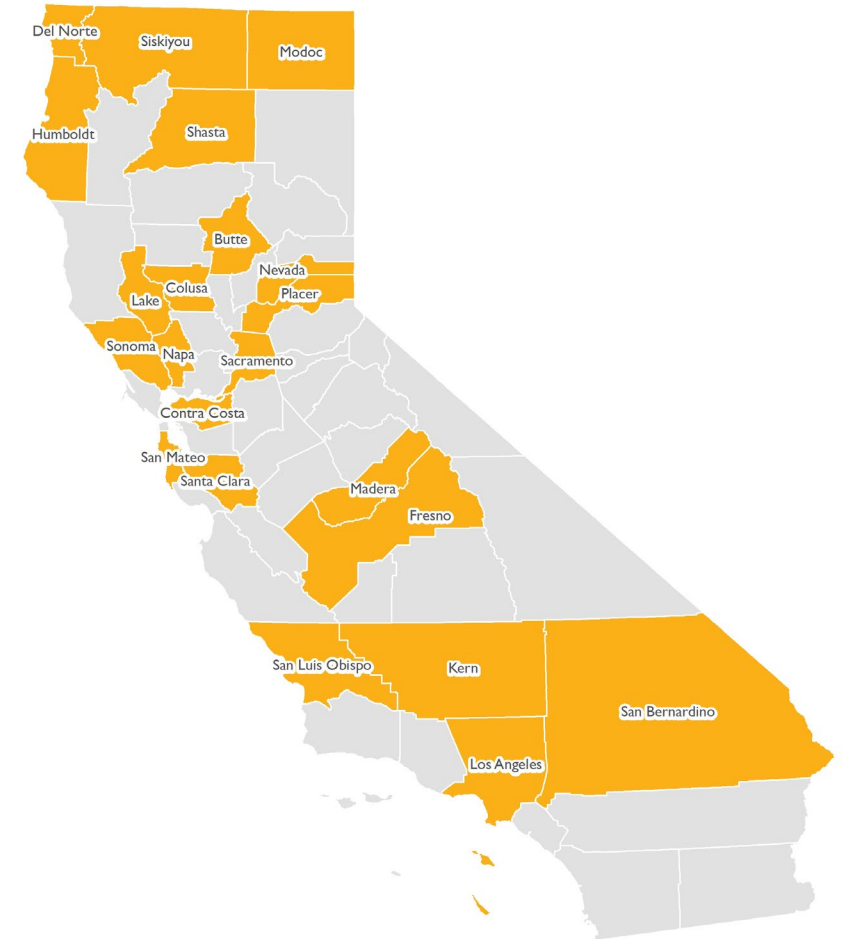
3. Focused on:

- Socioeconomic vulnerability
- Policy and institutional responses
- Planning and resourcing processes



Counties Selected for Analysis

County Name	LHMP	CWPP	AQP*
Butte	2019	2015	--
Colusa	2018	--	--
Contra Costa	2018	2019	2017
Del Norte	2019	2005	--
Fresno	2018	--	--
Humboldt	2019	2019	--
Kern	2012	--	--
Lake	2018	2009	--
Los Angeles	2014	--	2016
Modoc	2016	2017	--
Napa	2020	--	2017
Nevada	2017	2019	--
Placer	2016	2012	--
Sacramento	2016	2014	--
San Bernardino	2017	--	2016
San Luis Obispo	2019	2019	--
San Mateo	2016	2018	2017
Santa Clara	2017	2016	2017
Shasta	2017	2008	--
Siskiyou	2018	2019	--
Sonoma	2016	--	2017



Results: Data and Information

Current Practice

- Counties use existing data and models to assess vulnerability
- CalFIRE's Fire Hazard Severity Zones (FHSZ) is most frequently cited
- Local geographic, ecological features used to problem-frame for county-specific wildfire vulnerability

Future Opportunities

- Need to set criteria, metrics for monitoring & evaluation
- Including identification of cascading risks to support policy interventions

Spatial Data Type	Source
Wildfire Hazard Severity Zones	CAL FIRE/FRAP
Wildfire Threat	CAL FIRE/FRAP
Wildland Urban Interface	CAL FIRE/FRAP
Priority Projects	CAL FIRE/FRAP
Wildfire data	CalAdapt
Wildfire Mitigation Plans	California Office of Energy Infrastructure Safety
CalEnviroScreen	California Office of Environmental Health Hazard Assessment
CARB GIS Library	California Air Resources Board
Climate Change and Health Vulnerability Indicators for California	California Department of Public Health

Results: Regulatory Context

Current Practice

- FEMA, Cal OES regulations guide planning process for counties
- Hazard mitigation plans = "living documents"
- Emphasis on updating, can require technical consulting

Future Opportunities

- Develop institutional memory within local and regional agencies
 - FEMA Guidance
 - Consultancy work



Results: Planning Process

Current Practice

- Led external consultants
- Includes wide range of local, regional participants
- Processes based on tools, strategies from Disaster Management Act (2000)
- Must meet FEMA requirements for disaster plans
 - Prerequisite for accessing FEMA grants, funds

Future Opportunities

- Employing creative thinking, institutional experimentation outside of heavily structured regulatory requirements



Results: Funding & Resources

Current Practice

- Most jurisdictions rely on FEMA funding to support disaster planning process
- Supplemented with in-kind contributions from state-level resources

Future Opportunities

- Regional support that recognizes the transboundary nature of risks
- Recognition of dynamic vulnerabilities of communities
- Consideration of differential capacities across local governments



Thank you!

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