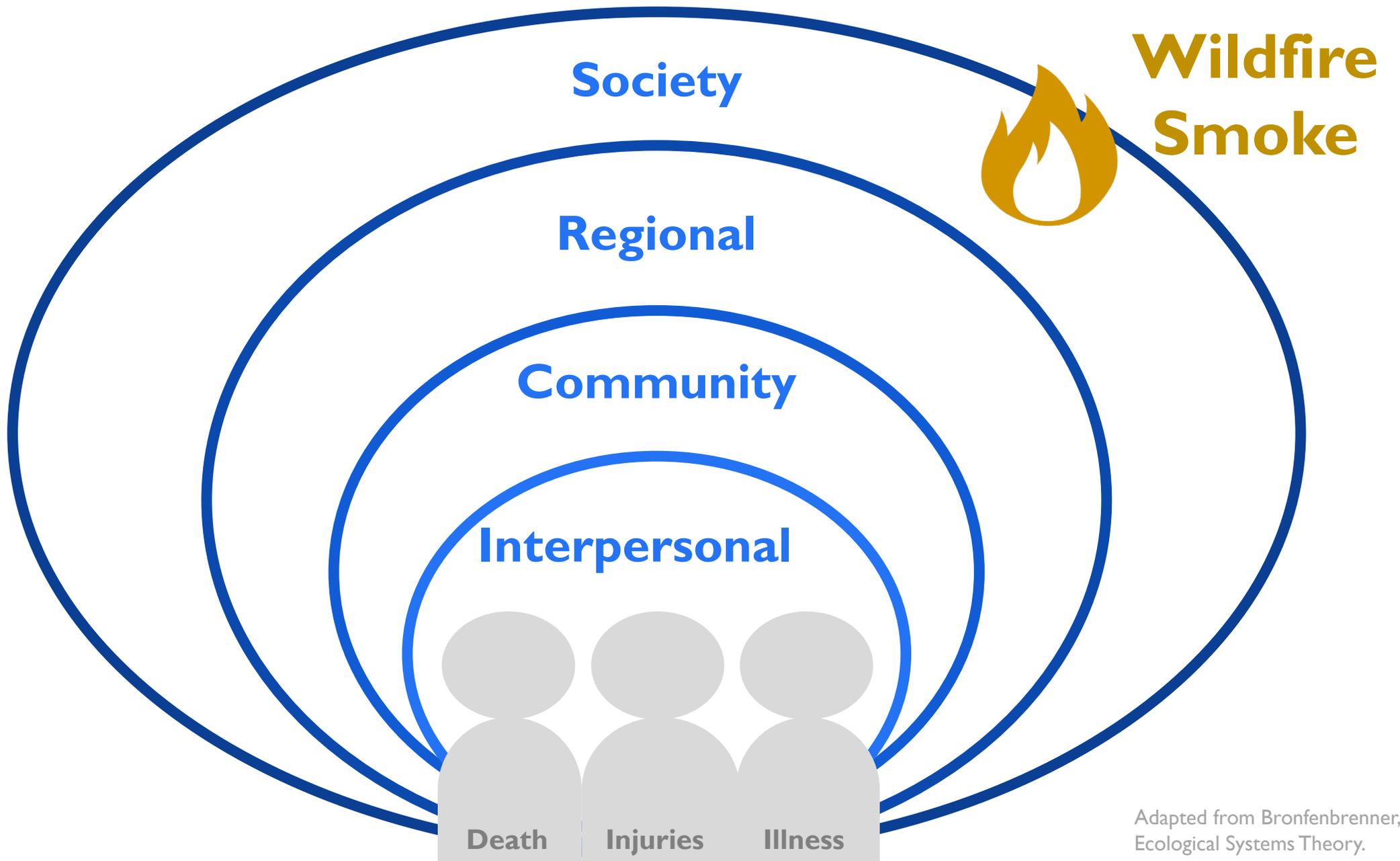




Assessing Population-Level Health Outcomes Associated with Wildfire Smoke Exposures

23 March 2020

Kathryn Conlon, PhD, MPH
Assistant Professor



Assessing Evidence for Public Health Adaptations

Three types of public health evidence for adaptation to climate-related health effects

- Type One:** Evidence linking climate-sensitive exposures to health outcomes of interest⁶
- Type Two:** Evidence on effectiveness of interventions
- Type Three:** Evidence on evaluation and implementation within a community^{4,5,7,8}

- Substantial interest and focus on climate and health interventions
- Evidence-based public health practice

Climate and Health Intervention Assessment

Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change

Climate and Health Technical Report Series

Climate and Health Program,
Centers for Disease Control and Prevention

Anderson, Henry. Wisconsin Department of Health Services	Hanson, Angelina. Wisconsin Department of Health Services	Raab, Kristin. Minnesota Department of Health
Brown, Claudia. Climate and Health Program, Centers for Disease Control and Prevention	Hess, Jeremy J. University of Washington	Saha, Shubhayu. Climate and Health Program, Centers for Disease Control and Prevention
Cameron, Lorraine L. Michigan Department of Health and Human Services	Hoppe, Brenda. Minnesota Department of Health	Schramm, Paul J. Climate and Health Program, Centers for Disease Control and Prevention
Christenson, Megan. Wisconsin Department of Health Services	Horton, Jane. Climate and Health Program, Centers for Disease Control and Prevention	Shipp-Hilts, Asante. Office of Public Health Practice, New York State Department of Health
Conlon, Kathryn C. Climate and Health Program, Centers for Disease Control and Prevention	Jagger, Meredith. Florida Department of Health/Oregon Health Authority	Smith, Sara J. North Carolina Department of Health and Human Services
Dorevitch, Samuel. University of Illinois at Chicago School of Public Health	Krueger, Stephanie. Wisconsin Department of Health Services	Thelen, Margaret. Wisconsin Department of Health Services
Dumas, Justin. Florida Department of Health	Largo, Thomas W. Michigan Department of Health and Human Services	Thie, Lauren. North Carolina Department of Health and Human Services
Eidson, Millicent. Office of Public Health Practice, New York State Department of Health	Losurdo, Giovanna M. Wisconsin Department of Health Services	Walker, Robert. Michigan Department of Health and Human Services
Ferguson, Aaron. Michigan Department of Health and Human Services	Mack, Stephanie R. Office of Public Health Practice, New York State Dept. of Health	
Grossman, Elena. University of Illinois at Chicago School of Public Health	Moran, Colleen. Wisconsin Department of Health Services	
	Mutnansky, Cassidy. Florida Department of Health	

National Center for Environmental Health
Division of Environmental Hazards and Health Effects



CDC, 2017

**Cal/OSHA Emergency
Regulation**

**Wildfire
Smoke**



Society

Regional

**Forest
Management
Practices**

Community

**Older, "Leaky"
Buildings**

Interpersonal



Death

Injuries

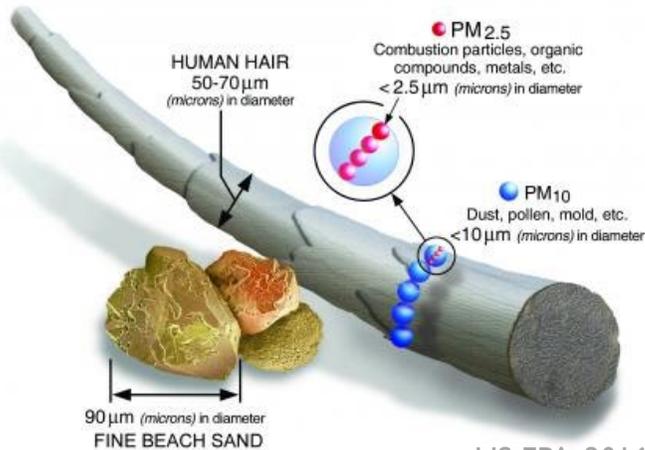
Illness

Adapted from Bronfenbrenner, 1987.
Ecological Systems Theory.

Wildfire Smoke Epidemiology

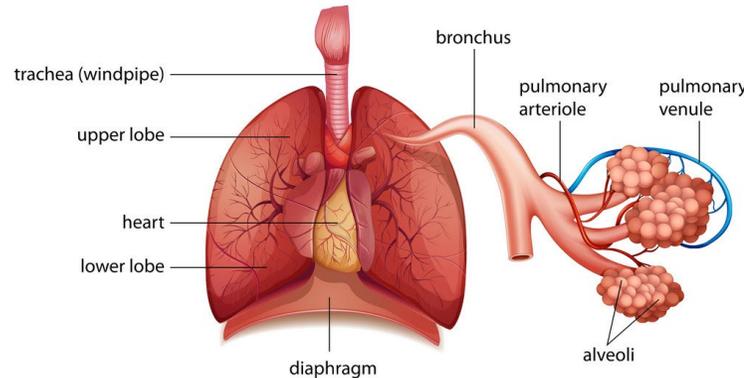
Emissions from Wildfires

- Primary air pollutants
 - CO
 - NO₂
 - PAHs
 - VOCs
 - Particulate Matter (PM₁₀, PM_{2.5})
- Secondary air pollutants
 - Particulate Matter
 - Ozone (O₃)



US EPA, 2016

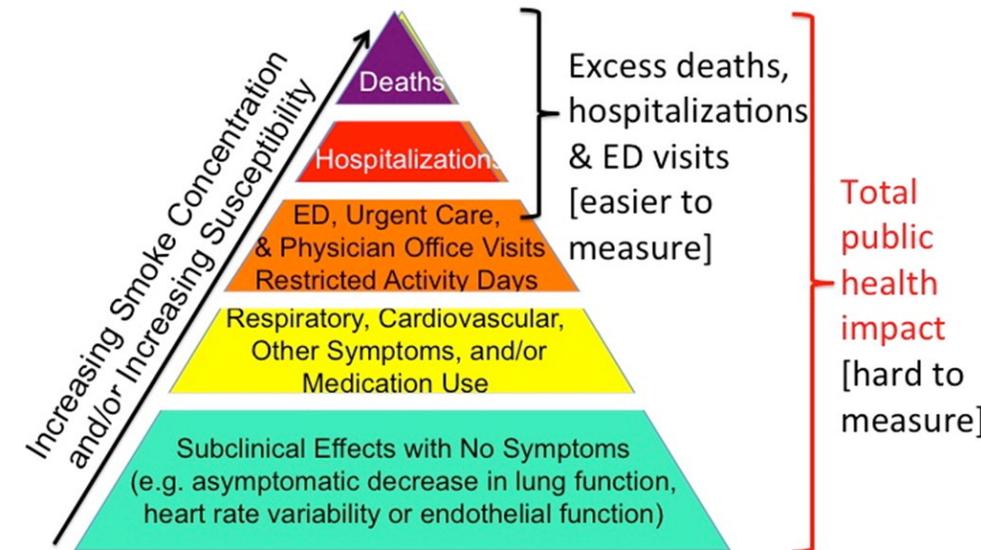
Human Respiratory System



Shutterstock, 2020

Studying Populations Impacted by Wildfire Smoke

- Retrospective study design
 - Rely on administrative datasets
- Acute events
- Behavior (e.g., exposure) difficult to ascertain
- Potentially low statistical power



Size of Population Affected by Exposure to Wildfire Smoke

Cascio, 2017

Wildfire Smoke & Health Impacts

Strong Evidence of Impacts on Respiratory Health

- Asthma, chronic obstructive pulmonary disease (COPD) significantly associated with higher wildfire smoke
 - Increased medication use
 - Increased physician visits
 - Increased ED visits
 - Increased hospitalizations
 - Particulate Matter (PM₁₀, PM_{2.5})
- Respiratory infections (e.g., pneumonia, bronchitis)
 - Growing area of research

Strong Evidence of Impacts on Cardiovascular Health

- Results mostly null
- Recent studies found significant results:
 - ED visits for all-cause cardiac symptoms in CA (Wettstein, 2018)
 - Out-of-hospital cardiac arrests in CA (Hoshiko, 2019), Australia (Haikerwal, 2015; Salimi, 2016)
 - ED for congestive heart failure in NC (Rappold, 2011)
- More research to verify CV health impacts
 - More statistical power

Additional health impacts – including mental & psychological health – to be studied, evaluated.

Recent Risk of Wildfire Smoke & Health Impacts in CA

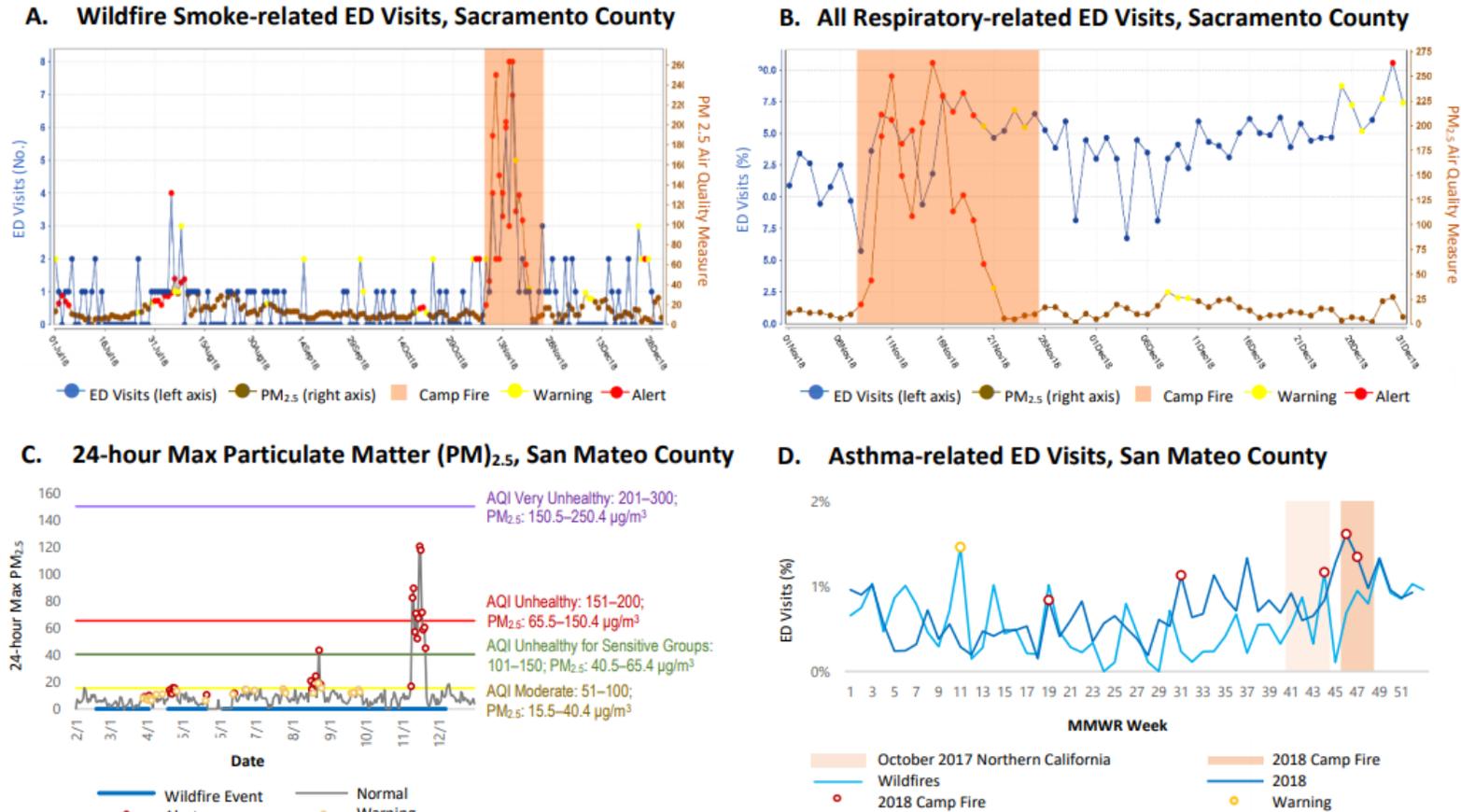


Figure 2: (A) Wildfire smoke-related ED visits, Sacramento County, July–December 2018; (B) All respiratory-related ED visits, Sacramento County, November–December 2018; (C) 24-hour maximum PM_{2.5} concentrations in San Mateo County and California wildfires, February–December 2018; (D) percentage of ED visits due to asthma or RAD in San Mateo County during the October 2017 Northern California Wildfires and 2018 Camp Fire, February–December 2018.



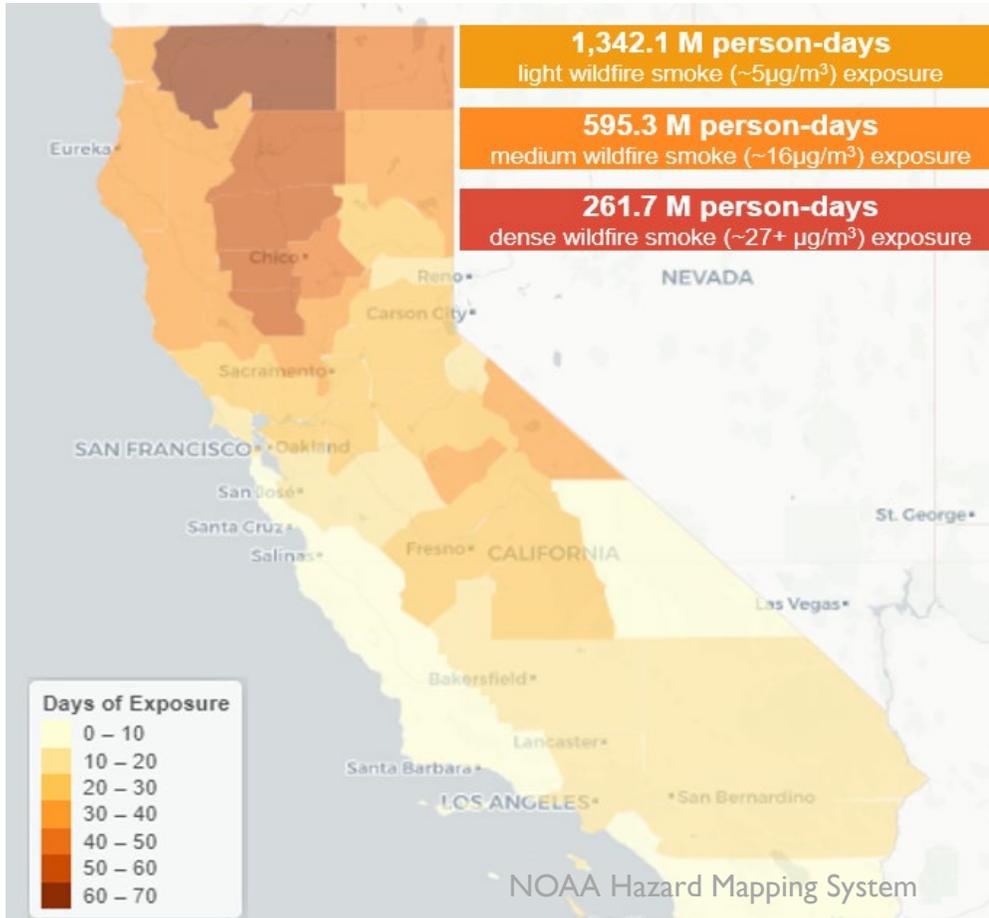
At-Risk Populations During Wildfire Smoke Events



California Outdoor Worker Populations



Estimating Population-Level Wildfire Smoke Exposure



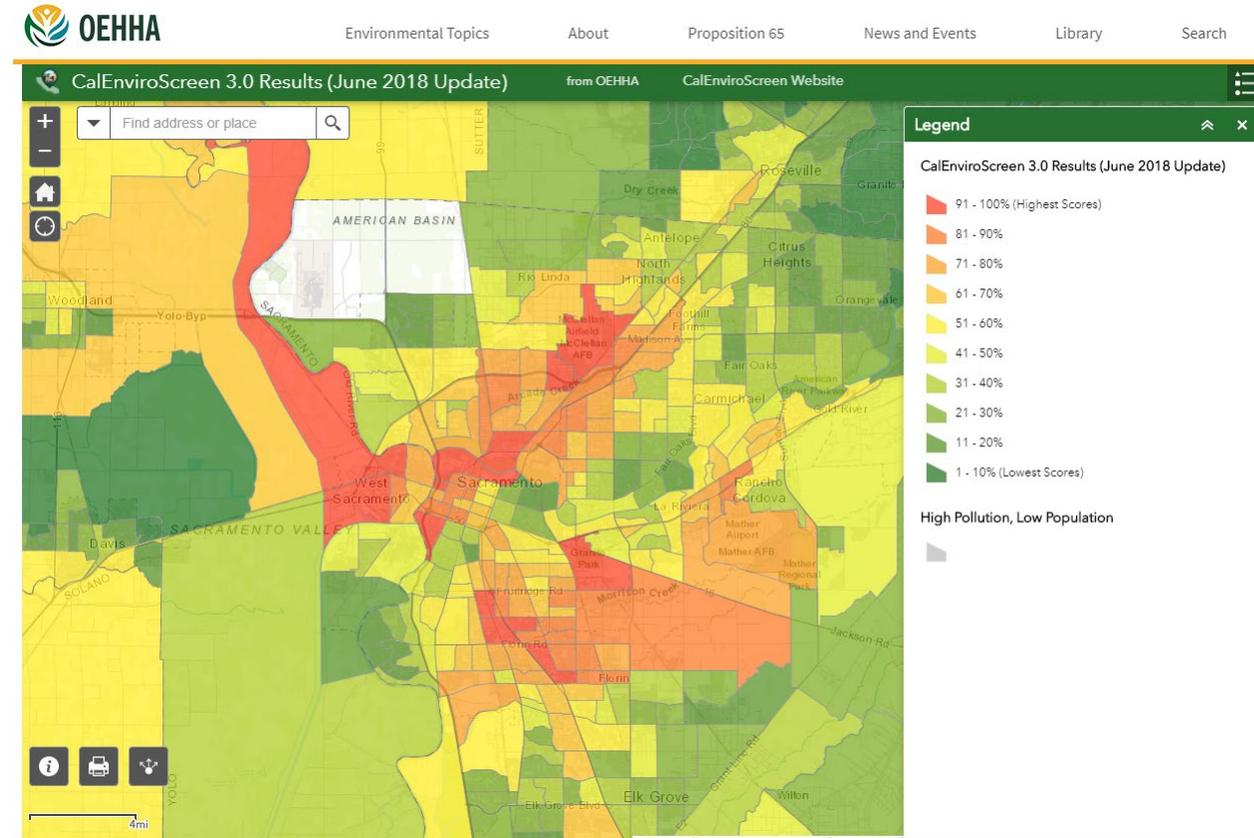
- Between 2011 – 2018, on average, 47% of US population experienced heavy smoke > 1 day/year
 - ~ 3.2 billion affected person-days across period
- Half of all heavy smoke person-days occurred 2017-2018
- In all years, at least one day of light smoke occurred across entire US

Vargo, Mirabelli, Conlon (Forthcoming)

Creating Exposure Profiles

Place-Based Population Exposure Profiles

- Represent most common populations at risk to wildfire smoke in California
- Fine-scale (ideally, sub-county)
- Contain information on risk factors relating to:
 - Environment
 - Demographics
 - Socioeconomic status
 - Health status
 - Housing

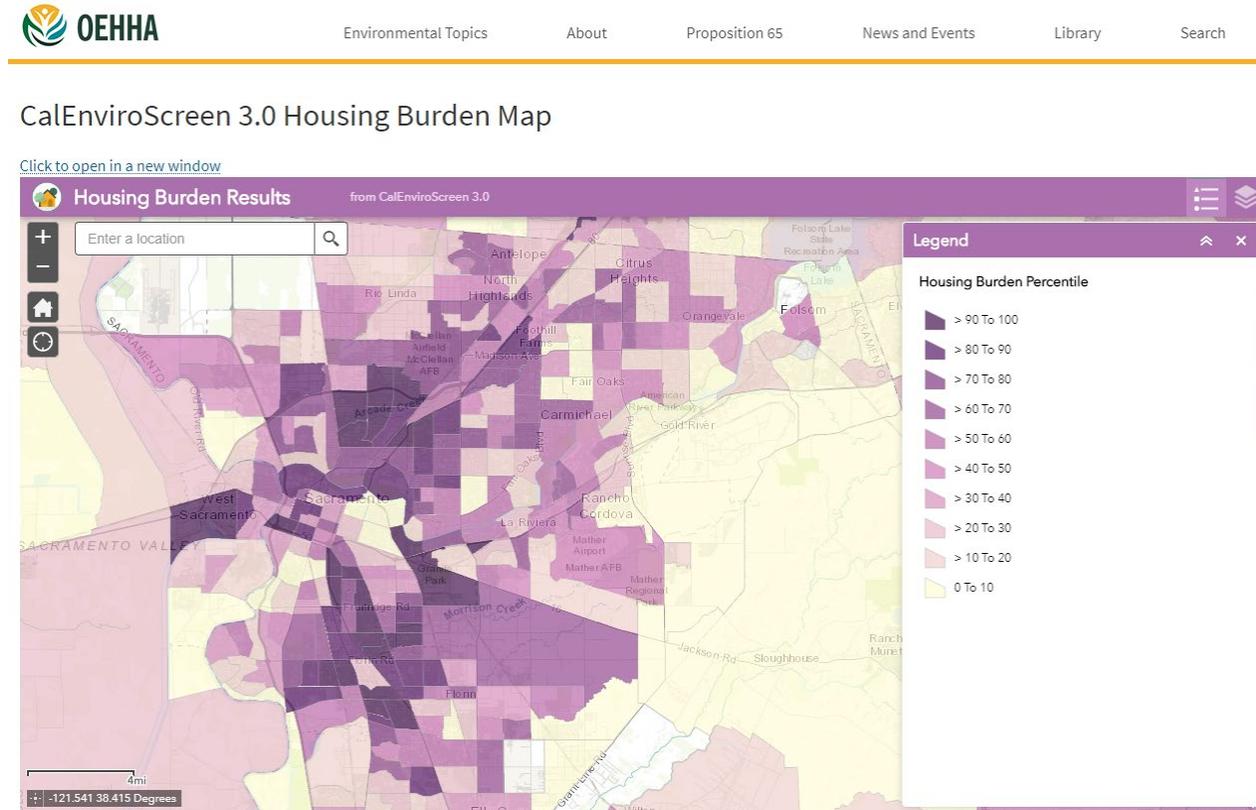


CalEPA EnviroScreen
OEHA, 2020

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CalEPA EnviroScreen
OEHHA, 2020

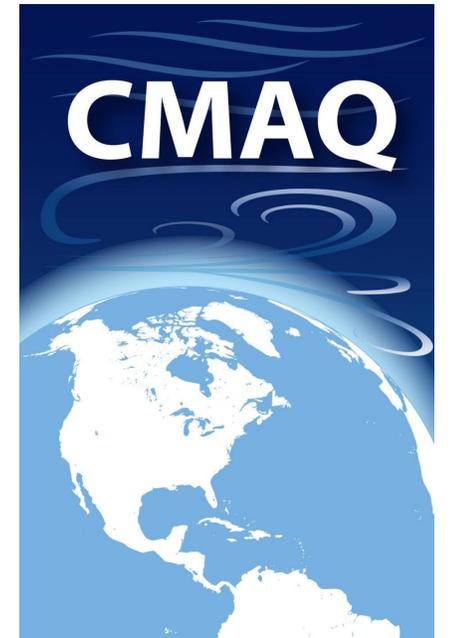
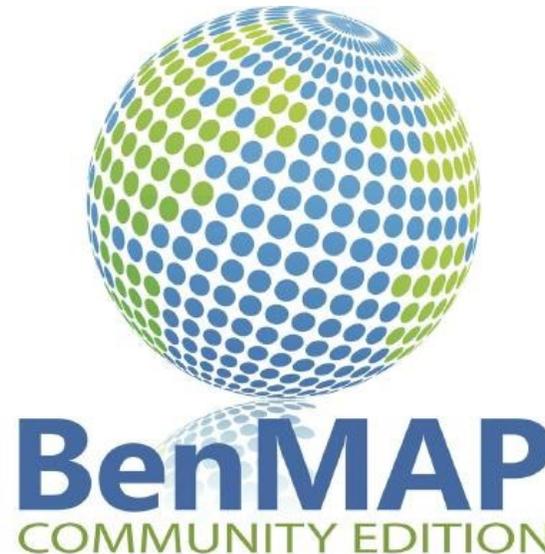
Linking Exposure Profiles to Modeled Exposures

Calculating the Health Effects of Wildfire-Driven Air Quality Scenarios (Aim 3.3)

- Estimate baseline burdens (hospitalization data)
 - Respiratory
 - Cardiovascular
 - Cerebrovascular
- Apply modeled air quality (from fire emissions and ambient air quality resulting from Aims 1, 2, 4) to estimate health burden
 - Current
 - Future
- Further population-level changes in cause-specific disease burden under 4 distinct mitigation scenarios (Aim 4)

OSHDP

Office of Statewide Health
Planning and Development



A helicopter is flying in the upper right portion of the frame against a backdrop of a large fire. The fire is intense, with bright orange and yellow flames rising from a base of dark, smoldering material. Thick, billowing white and grey smoke rises from the fire, filling much of the sky. The overall scene is hazy and dramatic, suggesting a wildfire or a controlled burn operation.

Thank you!

Kathryn Conlon

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