



Overview of Wildfire Smoke and Health Impacts

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Chiwaukum Creek Wildfire 2014
Okanogan-Wenatchee National Forest
Photo Credit: <https://ecology.wa.gov/>

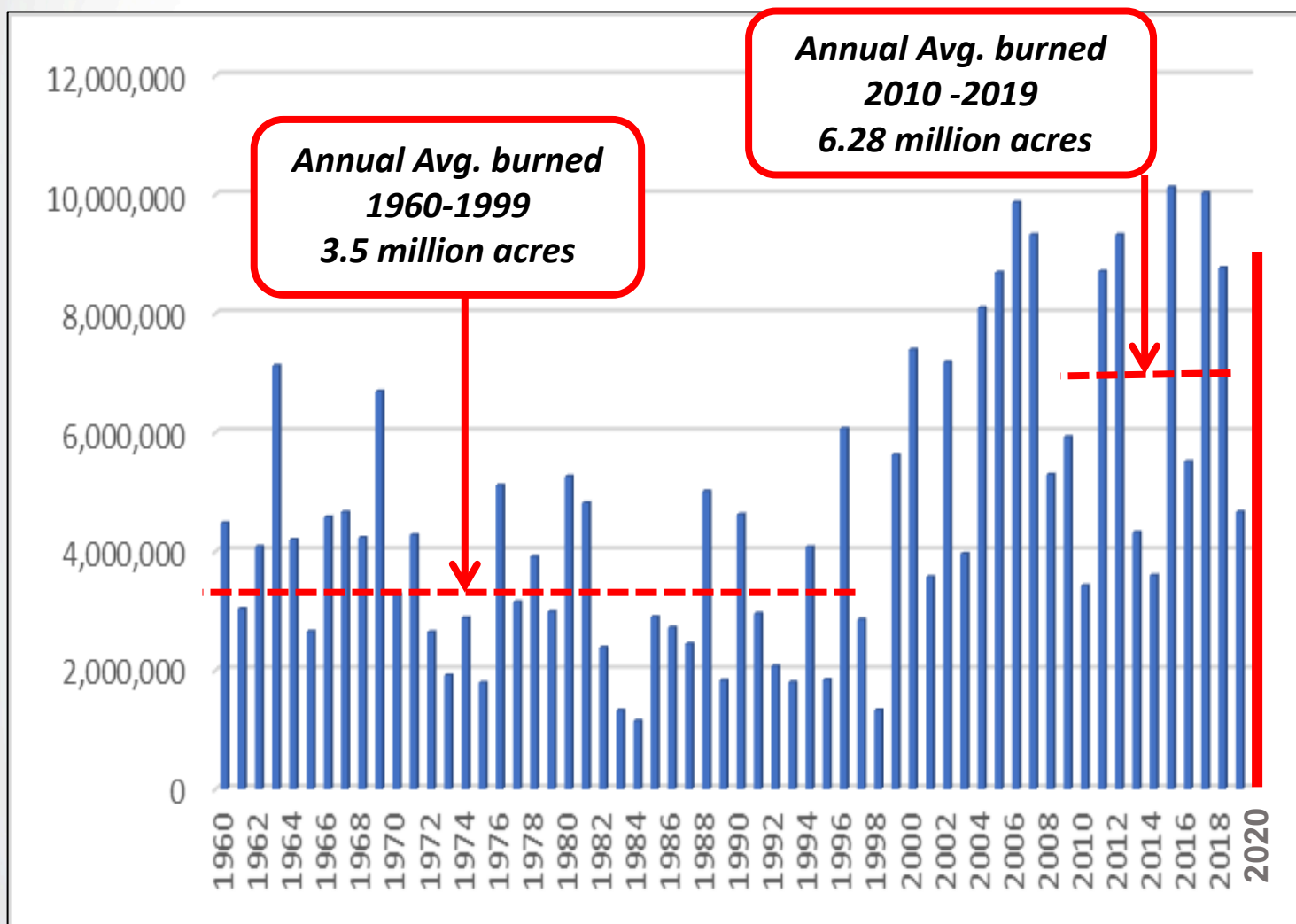
APHA Annual Meeting & Exposition
“Creating the Healthiest Nation: Preventing Violence”
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Disclaimer: The views expressed do not necessarily reflect the views or policies of the U.S. EPA.



Wildfire in the U.S.

Acreage Burned in the U.S. Annually



Present Concerns

- **Increasing acreage burned**
- **Increasing impact on urban areas**
 - 10% of all land with housing are situated in the wildland-urban interface
 - Between 1990 and 2010 housing in the WUI grew 41% and land by 33% (Radeloff et al. PNAS 2010)
- **Increasing vulnerable and sensitive populations**

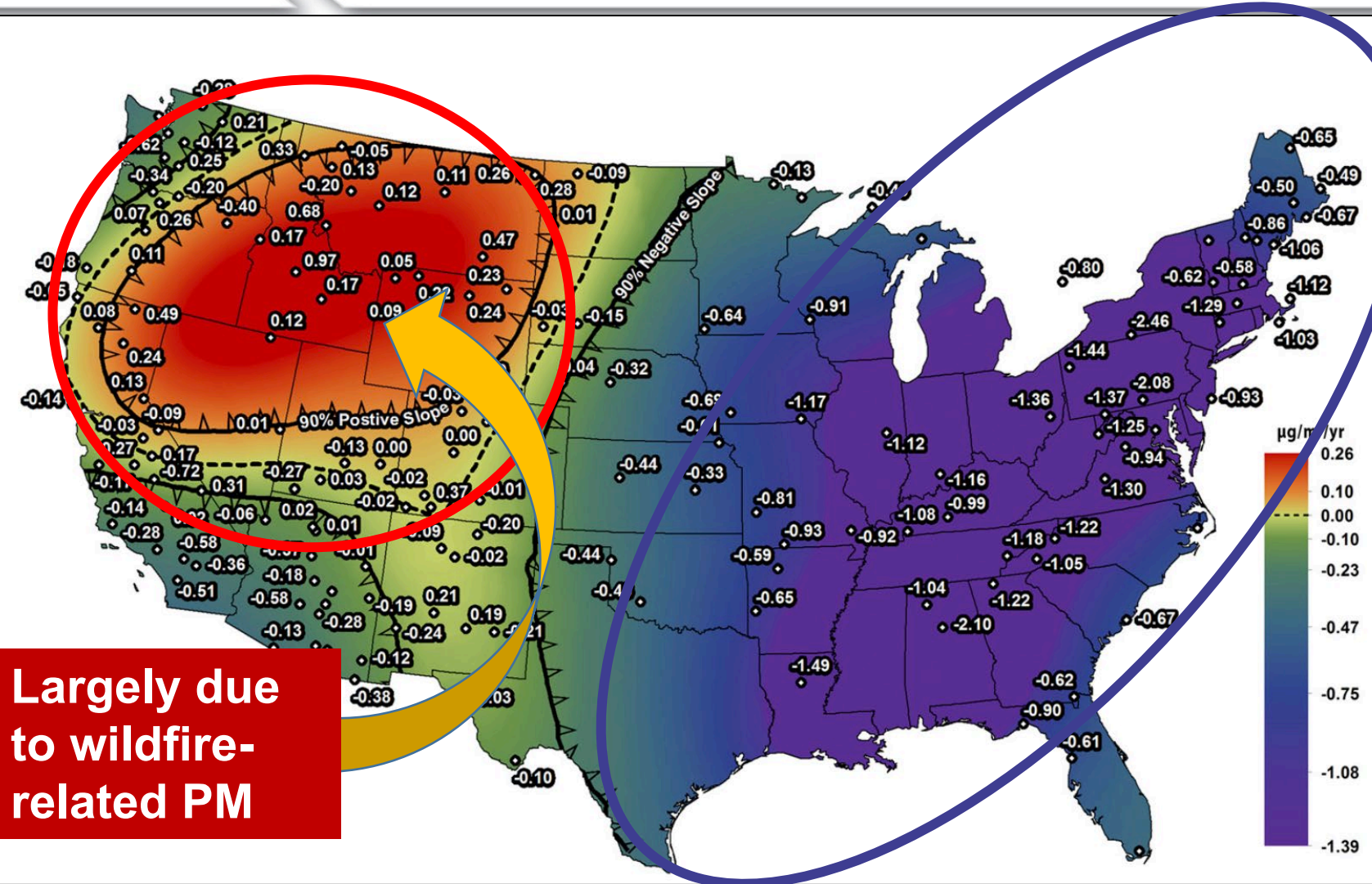


Air Quality Improves in U.S. from 1988-2016

Except in Wildfire-Prone Areas

**Worsening
Air Quality**

**Increasing
annual
ambient air
particle
pollution**



**Improving
Air Quality**

**Decreasing
annual
ambient air
particle
pollution**



Wildland Fires & Their Emissions

Rural & Urban Community Public Health Concern



*Brianna Paciorka, Knoxville
News Sentinel*



Stephanie Rodriquez, Courtesy of CAUSE



Health Effects of Wildfire Smoke

Known, Suspected and Knowledge Gaps

Known

- All-cause mortality
- Respiratory morbidity
 - *Asthma & COPD exacerbations*
 - *Bronchitis & pneumonia*
 - *Childhood respiratory disease*

Suspected

- Cardiovascular morbidity
- Adverse birth outcomes
- PTSD, anxiety and mood disorders



At-risk populations include –

- Aged adults
- Children
- People with respiratory disease
- People with cardiovascular disease
- Pregnant women and fetuses

A large blue oval with a black border, containing white text that states: "~30% of the U.S. population is at-risk".

**~30% of the
U.S.
population
is at-risk**

Populations suspected to be at greater risk –

- Women, Non-White and populations with lower socio-economic status*
- Populations with chronic inflammatory diseases (e.g., diabetes, obesity)

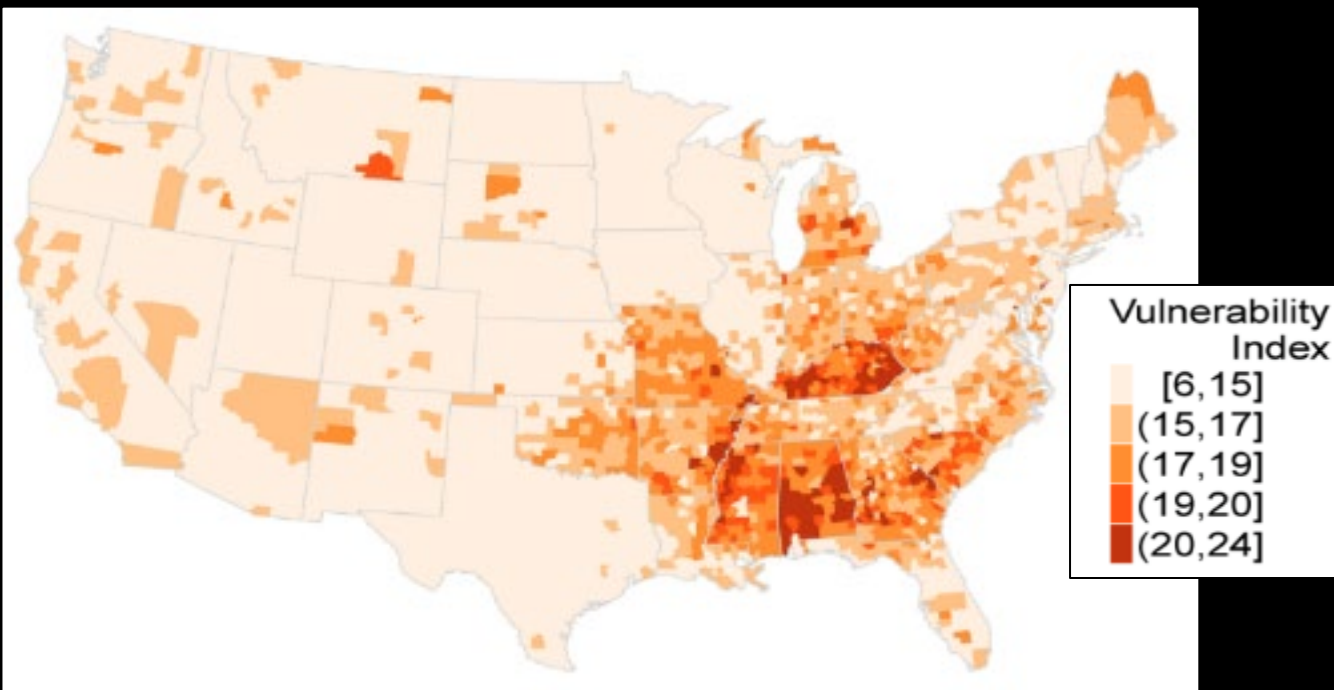
* Liu C et al. Am J Epidemiology 2017



Community Health-Vulnerability Index

EPA tool for public health officials to identify populations at risk from wildland fire smoke exposure

- More smoke in the West, but population is less vulnerable than those in the south
- This tool considers factors that define susceptibility to air pollutant-related health effects



Factors of Vulnerability

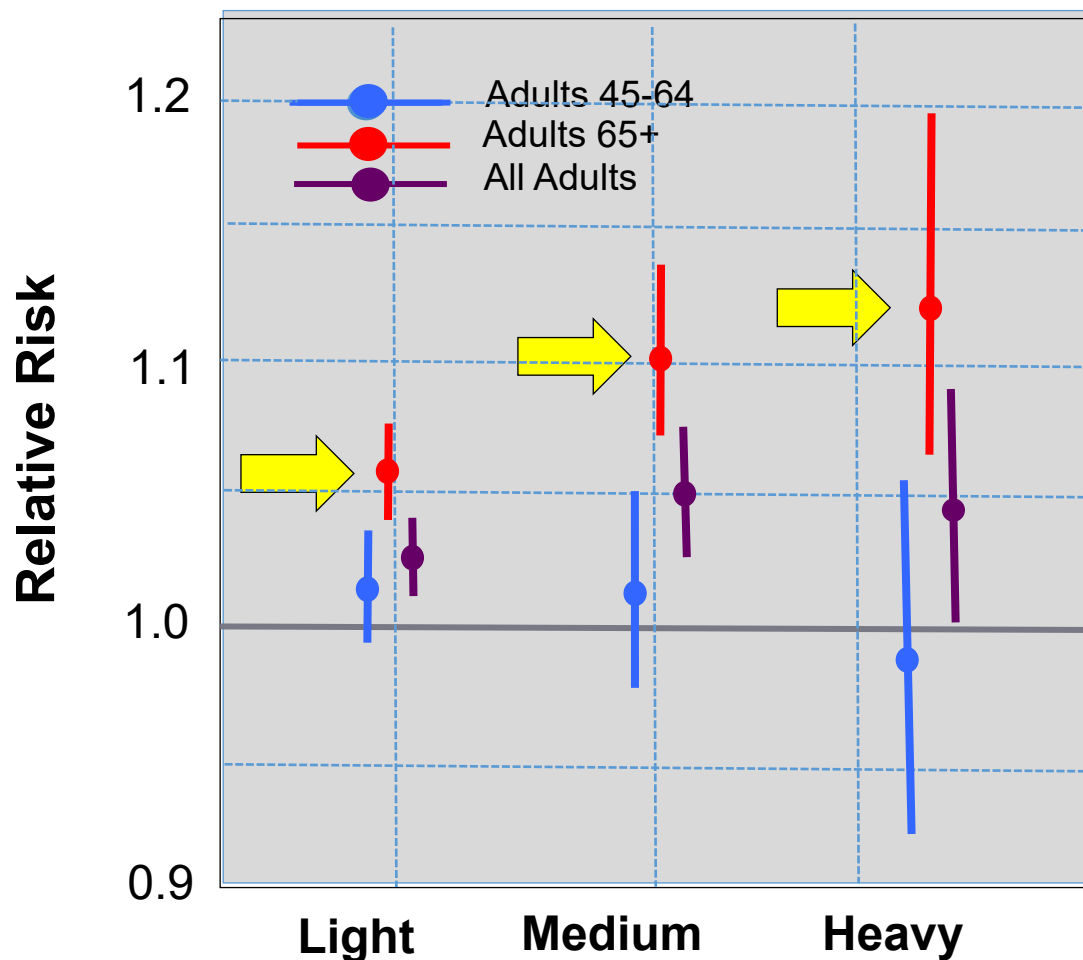
- Peds & Adult Asthma
- COPD
- Obesity
- Diabetes
- Hypertension
- % population age 65+
- Income, education, poverty, unemployment

Rappold AG, et al Environ Sci Technol 2017



Wildfire-PM_{2.5} May Increase Heart Attack & Stroke

All Cardiovascular Causes Lag Day 1



- *Wildfire-PM_{2.5} associated with heart attacks and strokes for all adults, particularly for those over 65 yr old*
- *Increase in risk the day after exposure:*
 - All respiratory causes, 18%
 - All cardiovascular, 12%
 - Heart attack, 42%
 - Heart failure, 16%
 - Stroke, 22%
 - Heart rhythm abnormalities, 24% (on the same day as exposure)



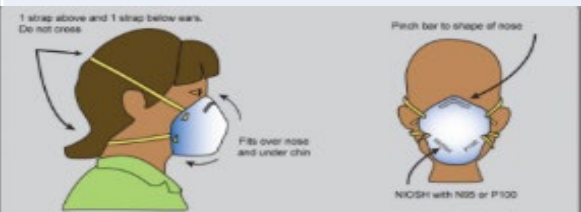
Smoke Ready Toolbox for Wildfires



AirNow.gov: Current Fire Conditions



How Smoke from Fires can Affect Your Health



Wildfire Smoke: Guide for Public Health Officials, and Wildfire Smoke Exposure Infographics



CME Course: Wildfire Smoke and Your Patient



Smoke Sense App

Toolbox

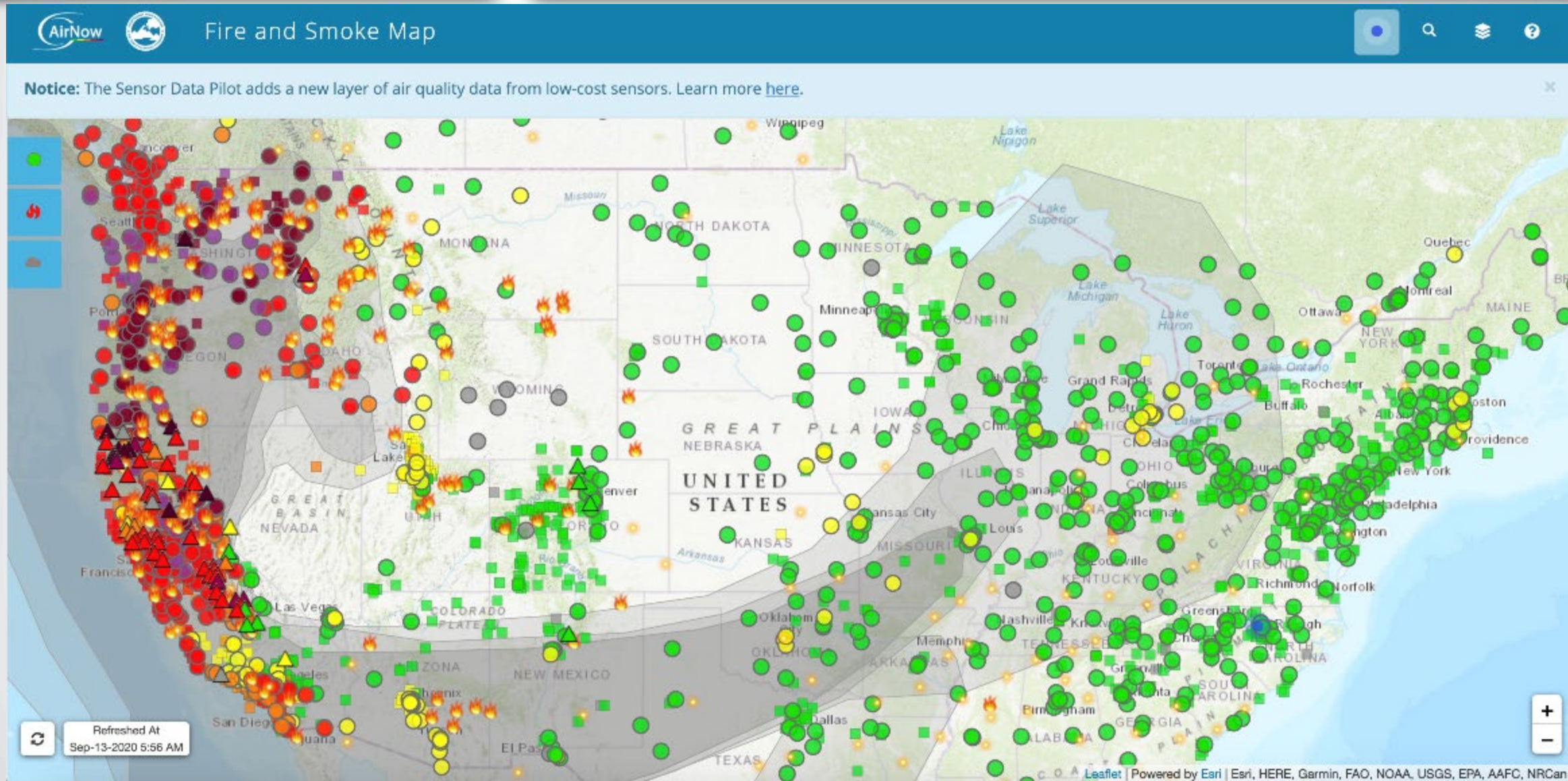
Resources health officials can use to educate the public about the risks of smoke exposure and actions people can take to protect their health

<https://www.epa.gov/smoke-ready-toolbox-wildfires>



AirNow Fires: Fire and Smoke Map

September 13, 2020



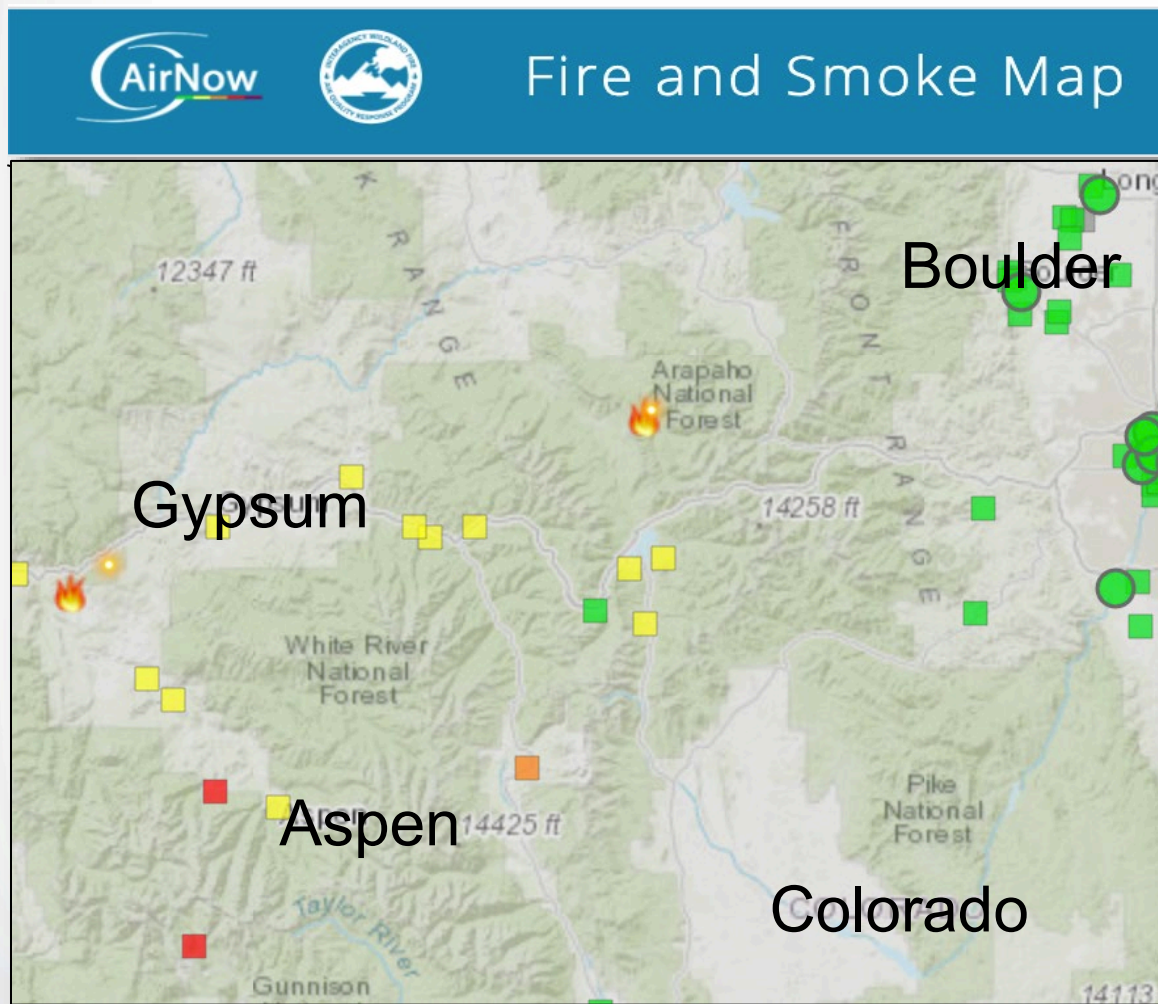


Enhanced Ambient Air Quality ($PM_{2.5}$) Data

Purple Air Now Displayed on AirNow

Air Quality ($PM_{2.5}$) Layers: Monitors and sensors reporting $PM_{2.5}$ data

- Permanent Monitors: Federal, State, Tribal
- Temporary Monitors: Typically gov. agencies
- Low Cost Sensors: Currently from Purple Air





Wildfire Smoke: A Guide for Public Health Officials

WILDFIRE SMOKE

A GUIDE FOR PUBLIC HEALTH OFFICIALS
REVISED 2019

IV. COMMUNICATING AIR QUALITY CONDITIONS DURING SMOKE EVENTS



- **Stand-alone fact sheets**
 - Prepare for Fire Season
 - Protect Yourself from Ash
 - Indoor Air Filtration
 - Reduce Your Smoke Exposure
 - Protect Your Lungs from Wildfire Smoke or Ash
 - Protecting Children from Wildfire Smoke and Ash
 - Protect your Pets and Wildfire Smoke
 - Protect Your Large Animals and Livestock from Wildfire Smoke

WILDFIRE SMOKE FACTSHEET
Children and Families

Background

- Wildfire smoke exposes children and women of reproductive age to a number of environmental hazards, e.g., fire, smoke, psychological stress, and the byproducts of combustion of wood, plastics, and other chemicals released from burning structures and furnishings.
- During the acute phase, the major hazards are:
- Children, Pregnant Women, and the Elderly: Populations are especially vulnerable to wildfire smoke hazards.

Recommendations

- Prepare Before Wildfire Season**
- Stock up so you don't have to go out when it's smoky. Have several days of medications on hand. Buy groceries that do not need to be refrigerated or cooked.

WILDFIRE SMOKE FACTSHEET:
Indoor Air Filtration

Exposure to Particle Pollutants

Indoor sources of particulate matter (PM) come from combustion events such as smoking, candle burning, cooking and wood-burning. During a wildfire event, outdoor PM can increase indoor PM levels well above the levels normally found. As outlined in the Guide, reducing indoor sources of pollution is a major step to lower the concentrations of PM indoors. Further reductions in indoor PM can be achieved using one of the filtration options discussed below.

Filtration Options

There are two effective filtration options in the home: upgrade the filter, or using high efficiency appliances. Before discussing efficiency.

Filter Efficiency

The most common and efficient is known as Reporting Value, or MERV for residential filters range from the MERV rating of the particles captured as the filter media. Higher MERV are especially effective particles that can most at

Central Air System

The filter used in the system of the home can PM. A home typically will

fiberglass filter that is 1" thick. Simply replacing this filter with a medium efficiency filter (MERV 5-8) can significantly improve the air quality in your home. Higher efficiency filters (MERV 9-12) will perform even better, and a true high efficiency filter (MERV 16) in the central system can reduce PM by as much as a 95%. However, these filters can also provide more resistance to air flow, which may increase the energy used by the blower motor for the system. You may wish to consult with a local HVAC technician or the manufacturer of your central air system to confirm that the system can handle a high efficiency filter. If you are not able to upgrade to a more efficient filter, simply running the system continuously by switching the thermostat from

WILDFIRE SMOKE FACTSHEET

Prepare for Fire Season

If you live in an area that is regularly affected by smoke or where the wildfire risk is high, take steps to prepare for fire season. Know how to get ready before a wildfire. Know how to protect yourself from smoke exposure during a wildfire. Being prepared for fire season is especially important for the health of children, older adults, and people with heart or lung disease.

Prepare Before a Wildfire

- Stock up so you don't have to go out when it's smoky. Have several days of medications on hand. Buy groceries that do not need to be refrigerated or cooked, because cooking can add to indoor particle levels.
- Create a "clean room" in your home. Choose a room with as few windows and doors as possible, such as a bedroom. Use a portable air cleaner and avoid indoor sources of pollution.
- Buy a portable air cleaner before there is a smoke event. High-efficiency particulate air (HEPA) filter air cleaners, and electrostatic precipitators that do not produce ozone, can help reduce indoor particle levels.
- Understand how you will receive alerts and health warnings, including air quality reports and public service announcements from local officials.

- If you have heart or lung disease, check with your doctor about what you should do during smoke events.
- If you have asthma or another lung disease, update your respiratory management plan.
- Have a supply of N95 masks and learn how to use them. They are sold at many home improvement stores and online.
- Organize your important items ahead of time and know where to go in case you have to evacuate.



Wildfire Smoke Guide Post-Publication Updates

CDC has provided important new considerations for protecting health during wildfire attendant to the COVID-19 pandemic.

Wildfire Preparedness and Response during COVID-19

- CDC - [Wildfire Smoke and COVID-19](#)
- CDC - [Public Health Strategies to Reduce Exposure to Wildfire Smoke during the COVID-19 Pandemic](#)
- CDC-USFS - [Wildfire Smoke and COVID-19: Frequently Asked Questions and Resources for Air Resource Advisors and Other Environmental Health Professionals](#)
- CDC - [COVID-19 Considerations for Cleaner Air Shelters and Cleaner Air Spaces to Protect the Public from Wildfire Smoke](#)
- CDC - [Natural Disasters and Severe Weather](#)
- CDC - [Interim Guidance for General Population Disaster Shelters During the COVID-19 Pandemic](#)
- CDC - [FAQs for Wildland Firefighters](#)
- CDC - [Environmental Health Assessment Form for Disaster Shelters](#)

[**https://www.airnow.gov/wildfire-guide-post-publication-updates/**](https://www.airnow.gov/wildfire-guide-post-publication-updates/)

Indoor Air Quality and COVID-19

- EPA - [Frequent Questions about Indoor Air and Coronavirus \(COVID-19\)](#)

Other Smoke and COVID-19 Related Materials

- CDC - [Open Burning during the COVID-19 Pandemic](#)



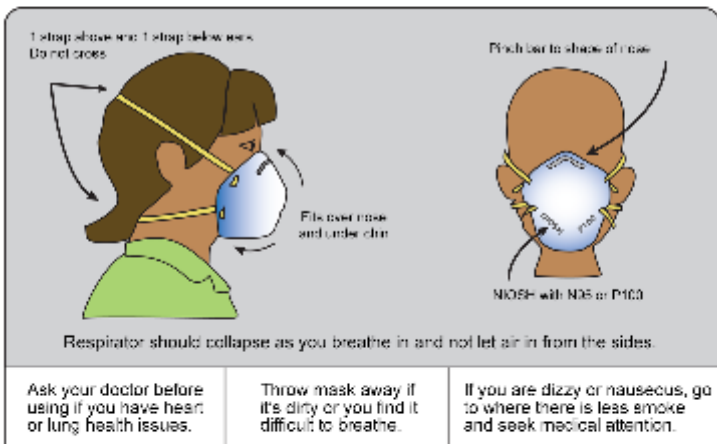
N-95 Respirator Use During Wildfire Events

Infographic Available for Download on AirNow

EPA The right respirator* and proper fit can reduce your exposure to wildfire smoke.

Cloth (wet or dry), paper masks, and tissues will **NOT** filter out wildfire smoke. Look for respirators (masks) marked NIOSH with N95 or P100. They can be found online, or in hardware, home repair, or drugstores.

* Respirators are not designed to fit children. Facial hair prevents proper fit and reduces effectiveness.



Use a respirator only after first trying other, more effective methods to avoid smoke. That includes staying indoors and reducing activity. When possible, people at risk should move away from the smoke area.

EPA Reduce health risks in areas with wildfire smoke:

Follow these tips, especially if someone in your family (including you!) has heart or breathing problems, is an older adult or child, or is pregnant.

DO

- Stay inside
- Pay attention to local advisories and check air quality (airnow.gov)
- Set car A/C on recirculate (to keep smoke out)
- Keep a supply of medicine and non-perishable food
- Use a well-fitted N-95 or P100 respirator if outside and smoky. Not approved for children at this time.
- Prepare to evacuate if smoke levels get too high



KEEP AIR CLEAN

Close windows and doors. Close fresh intake on A/C units. If your home is too warm, try to stay with friends or relatives.

Use a portable air cleaner with HEPA filters properly sized for a specific room.

DON'T

- X Play or exercise outdoors
- X Fry or broil foods, which can add particles to indoor air
- X Use a fireplace, gas logs or gas stove
- X Smoke indoors
- X Vacuum, it can stir up dust



Challenges:

- Inconsistent public health messaging across cities and states
- Of value only if used correctly
- Not designed or recommended for children
- Increases work of breathing that might increase risk among those with cardiopulmonary impairment

Research Opportunity:

- ORD plans to investigate these issues



Wildfire Smoke and PM Web CE Courses

For Healthcare Professionals and Educators

[Environmental Topics](#) [Laws & Regulations](#) [About EPA](#)

Particle Pollution and Your Patients' Health

[Share](#) [Contact Us](#)

An evidence-based training course for healthcare providers that:

- Describes the biological mechanisms of cardiovascular and respiratory health with particle pollution exposure.
- Provides education tools to help patients understand how particle pollution exposure can affect their health and how they can use the Air Quality Index to make decisions about outdoor activities.

This course is designed for family medicine physicians, internists, pediatricians,

Wildfire Smoke and Your Patients' Health

[CONTACT US](#) [SHARE](#) [f](#) [t](#) [e](#)

Learn about the health effects associated with wildfire smoke and actions for patients to take before and during a wildfire to reduce exposure.

This course is intended for physicians, registered nurses, asthma educators and others involved in clinical or health education.

**In September 2020
Over 40,000 visits
were made to the CE
courses for:**

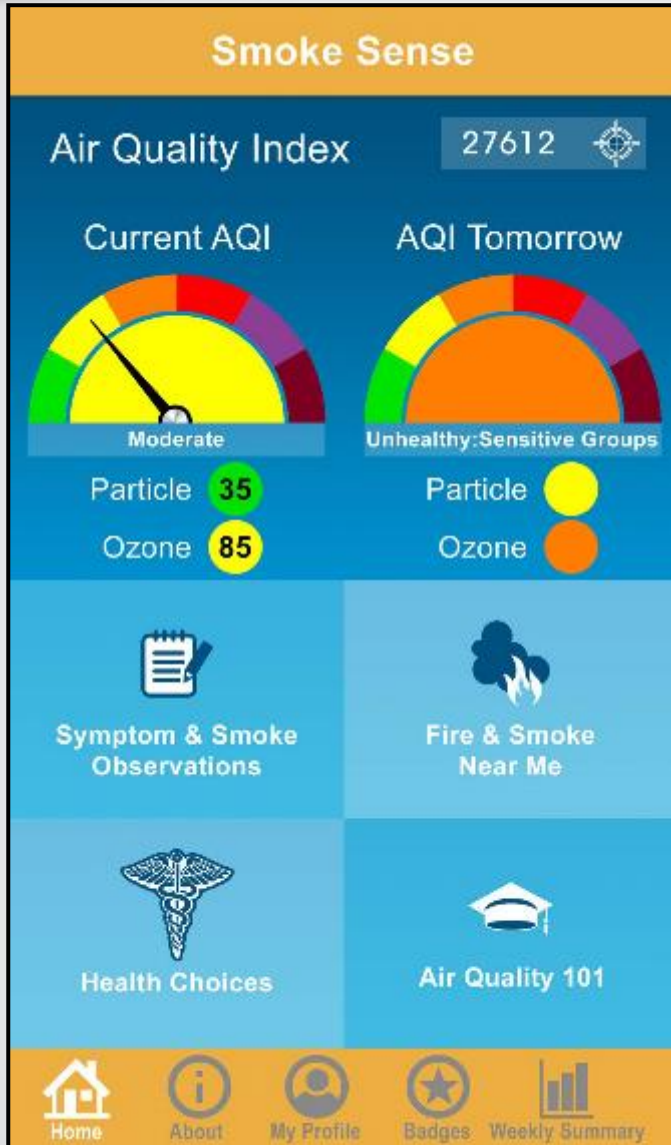
- **PM**
- **Wildfire Smoke**

CME credit from CDC to physicians, nurses and health educators

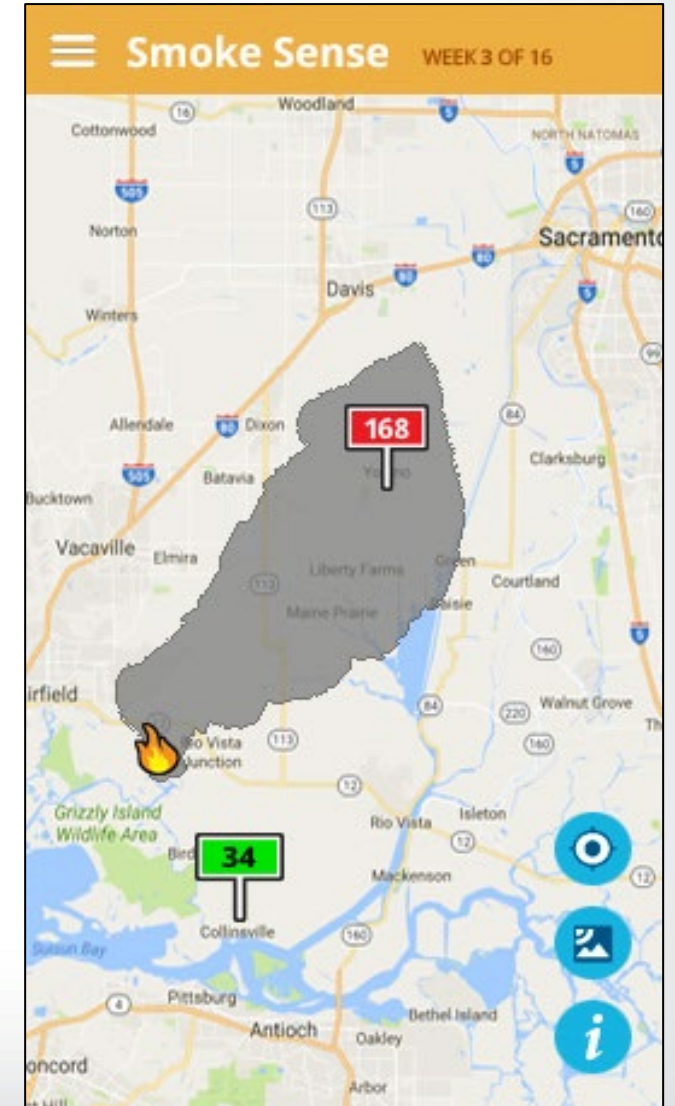


Smoke Sense Citizen Science Research

Provides Information about Current and Future Air Quality



- **Forecasted smoke plumes can be visualized**
- **Less time outside during smoke episodes to decrease exposure, & protect health**
- **Smoke Sense helps collect information about who, when, and how frequently people are impacted by smoke**
- **Information about smoke in the air and symptoms experienced in the past week will be logged**

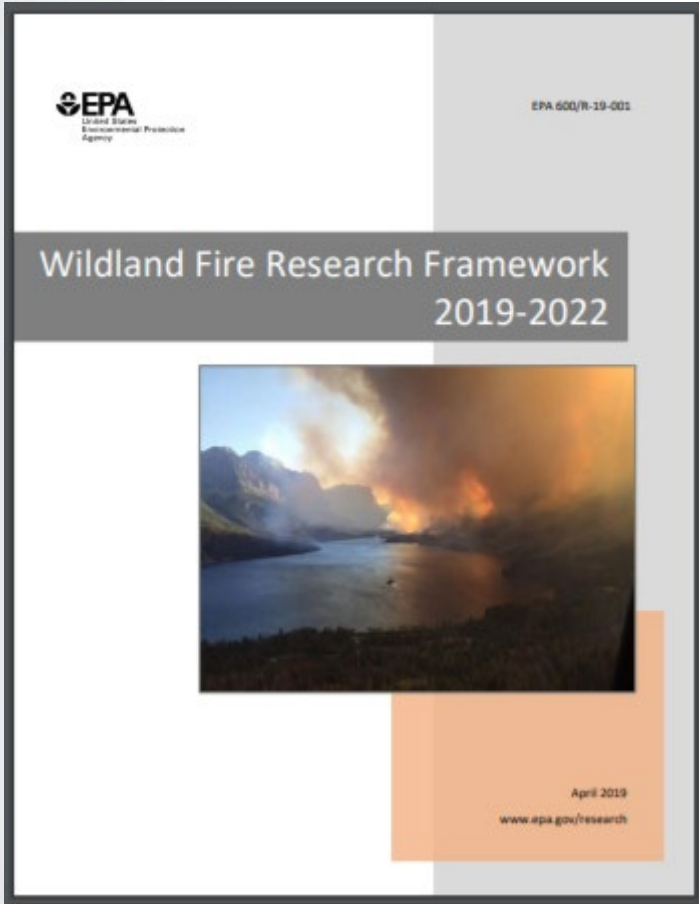




EPA's Wildland Fire Research Framework

Research focuses on:

- Exploring new ways to integrate social and natural science perspectives to reduce risks from wildland fires
- Advancing measurement and predictive tools and models to estimate environmental impacts
- Investigating opportunities to better understand, manage, and communicate public health risks



<https://www.epa.gov/air-research/wildland-fire-research-framework-2019-2022>



ORD researchers lift a balloon to evaluate air quality from a prescribed fire in Camp Lejeune, NC





Solutions-Driven Research Pilot: Creating Cleaner Air Spaces

Focus: Measuring the effectiveness of air cleaning filtration systems in wildfire smoke conditions

- **Stakeholders identified research priorities, including:**
 - How effective are portable air cleaners (PACs) or central air filtration systems during smoke events?
 - Under what operating and maintenance conditions and in what building types?
- **Laboratory and field studies**
- **Partnering with:**
 - Missoula City-County Health Department, Climate Smart Missoula, University of Montana
 - Hoopa Valley Tribe, California



Collocation of Purple Air sensors with reference monitors at the USFS Fire Science Lab



Reducing Adverse Health Outcomes of Ambient and Indoor Exposures to Wildfire Smoke

EPA Science to Achieve Results (STAR) program Request for Application



The Interventions and Communication Strategies to Reduce Health Risks of Wildland Fire Smoke Exposures

Open Date: October 9, 2020

Closed Date: December 15, 2020

URL: <https://www.epa.gov/research-grants/interventions-and-communication-strategies-reduce-health-risks-wildland-fire-smoke>

Background: EPA is seeking applications proposing research that will address behavioral, technical and practical aspects of interventions and communication strategies to reduce exposures and/or health risks of wildland fire smoke.



Thank You and For More Information

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US EPA, Office of Research and Development

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2019 Wildfire Smoke: Guide for Public Health Officials is available at:

<https://www3.epa.gov/airnow/wildfire-smoke/wildfire-smoke-guide-revised-2019.pdf>

Smoke Sense app is available at the Apple App Store and Google Play



Protecting Public Health

Research Questions Posed by State Health Officials

Environmental and Public Health Officials Want Evidence-Based Guidance:

- What's the most effective way to communicate with the public about preparing for wildfire smoke?
- Why don't people take steps to protect themselves? What are the barriers to changing their behavior?
- Are there cumulative effects of wildfire smoke exposure over weeks? months? years?
- What would a Clean Indoor Air Space certification look like? Would it change behavior?
- How effective are different air filtration methods during smoke events (HVAC filters, portable air cleaners)?
- Do N-95 respirators actually help?

ORIGINAL ORD RESEARCH

Out-of-hospital cardiac arrests and wildfire-related particulate matter during 2015-2017 California wildfires.
Jones CG, et al. JAHA. 2020

Cardiopulmonary effects of fine particulate matter exposure among older adults, during wildfire and non-wildfire periods, in the United States 2008-2010.
DeFlorio-Barker S, et al. EHP. 2019

Cardiovascular and Cerebrovascular Emergency Department Visits Associated With Wildfire Smoke Exposure in California in 2015. Wettstein ZS, et al. JAHA. 2018

Mortality in US hemodialysis patients following exposure to wildfire smoke. Xi Y, et al. J Am Soc Nephrol. 2020

Defining Clinical Populations at Risk

NHLBI/NIEHS RFA - Notice Number: NOT-HL-20-788
“Notice of Special Interest (NOSI): Stimulating Intervention Research to Reduce Cardiopulmonary Impacts of Particulate Matter in Air Pollution among High-Risk Populations”

More Prescribed Fire
Fewer Wildfires
and Air Quality
Exceedances

More Effective
Public Health
Smoke
Communication

Fewer Hospital
Visits,
Admissions,
and Deaths

Interventional
CRT Study
Evidence:
Reduced
Exposure
benefits health
in people at
high risk

Public and
Personal
Interventions

WCFL Aims
Trade-offs
between land
management
practices

Consistent
Federal Public
Health
Communication

Equitable
Interventions
to Improve
Indoor Air
Quality
**BUILDINGS
And
HOMES**

**WILDLAND FIRE
LEADERSHIP
COUNCIL**
Comparative
Assessment of the
Impacts of Controlled
Versus Uncontrolled
Fire (CAIF): A Case
Study of the Western
United States

**WILDLAND FIRE
LEADERSHIP
COUNCIL**
Wildland Fire Smoke
Public Health
Communication

**ORD SOLUTIONS
DRIVEN RESEARCH
PROJECT**
Wildfire ASPIRE Study
Update

**ORD SOLUTIONS
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PROJECT**
Wildfire – Indoor Air
Challenge