



# Overview of EPA Wildland Fire Research

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Wildfires: Air Quality and Policy Updates

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# Presentation Outline

- Water Quality Impacts of Wildland Fire
- Measurement of Smoke Emissions
- Air Quality and Health Impacts of Wildland Fire
- Community Tools and Resources



Eagle Creek Fire, OR (BBC)



Camp Fire, CA (CBS News)



# Wildland Fire Impacts on Water Quality

- About two-thirds of western US municipalities rely on water from forested watersheds
- Healthy forests maintain water quality by stabilizing the soil, reducing nutrient and sediment transfer to streams
- Wildfires can abruptly and adversely impact these watersheds



Courtesy of Jeff Peterson (Retired-Office of Water, EPA)



# Wildland Fire Impacts on Watersheds



- Fire can kill the vegetation and remove organic matter from the soil
- This can cause runoff/leaching of ash, sediment, nutrients, metals, and other material into water bodies through increased erosion
- May also get subsequent deposition of airborne ash and materials
- Often effects last until vegetation is reestablished

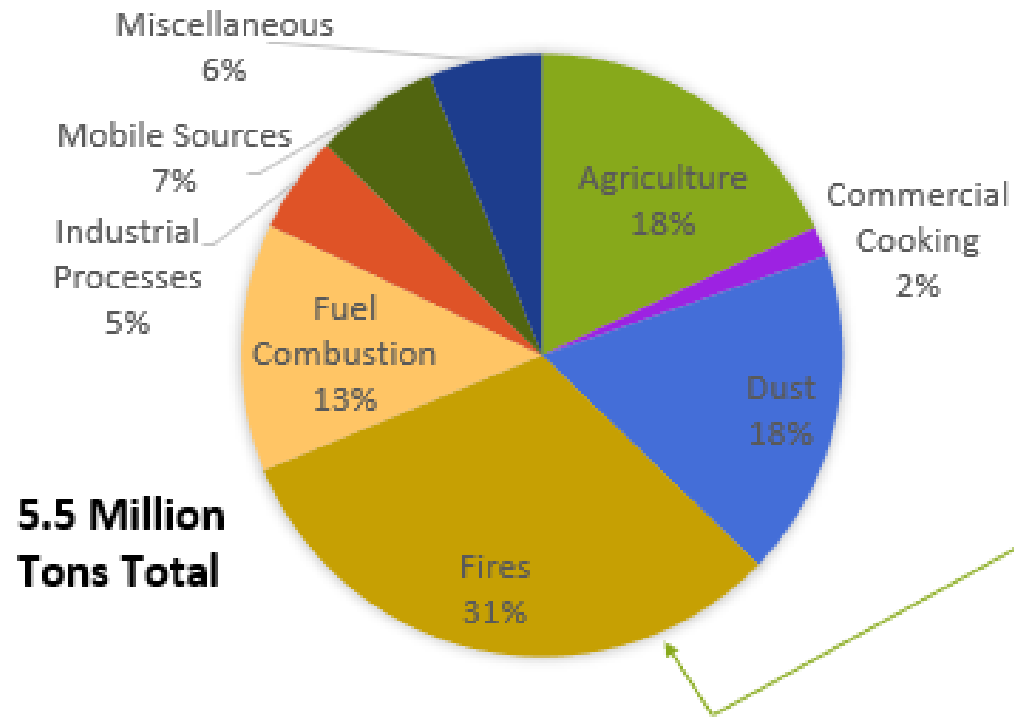
- **Drinking water research issue:** How do wildfires affect primary contaminants (e.g., turbidity, arsenic, disinfection byproducts) and secondary contaminants (e.g., pH and chloride)?
- **Water bodies research issue:** How does wildfire impact designated uses and water quality criteria? For example, cold water fish (e.g., salmon) habitat and stream temperature criteria?



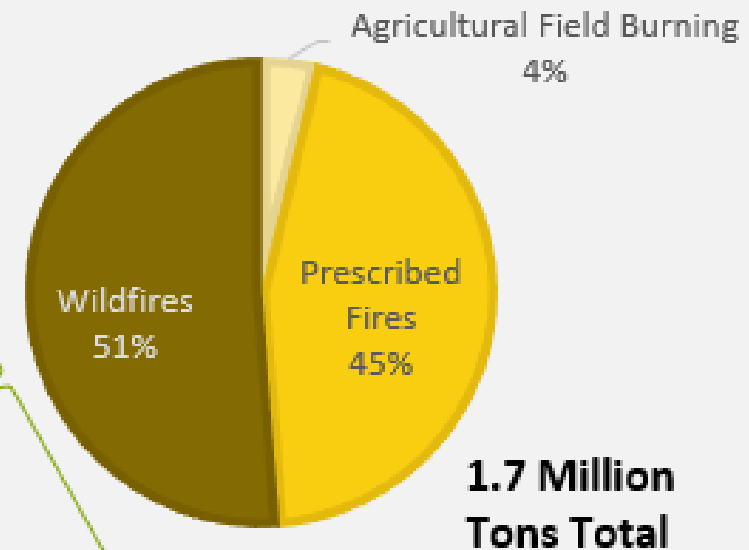


# Wildfire Emissions Contribution

**PM<sub>2.5</sub> Emissions in the  
2014 National Emissions Inventory (NEI)**



**PM<sub>2.5</sub> Fire Emissions in the 2014 NEI**







# Measurements of Wildland Fire Smoke

## Mobile Ambient Smoke Investigation Capability (MASIC)

- Provide enhanced ambient monitoring capability to evaluate smoke impacts and inform air quality modeling
- Evaluate performance of various instruments and sensors during wildfire smoke conditions



*EPA trailer with enhanced measurement capabilities*

## Measurements: Evaluations and Development

- Evaluation of low cost and commercially available PM samplers
- Ozone measurement methods in smoke plumes
- Performance of multi-pollutant sensor pods from the EPA Wildland Fire Air Sensor Challenge
- Vehicle add-on mobile monitoring system (VAMMS)



*Sensor pod evaluation at USFS Missoula Fire Science Lab*

## The Effect of Fuel Characteristics and Fire Dynamics on Emissions, Dispersion, and Air Quality Impacts (SERDP funded)

- Determine how prescribed burning emissions can be reduced by studying the effects of fuel structure, wind conditions, and ignition methods on fire dynamics

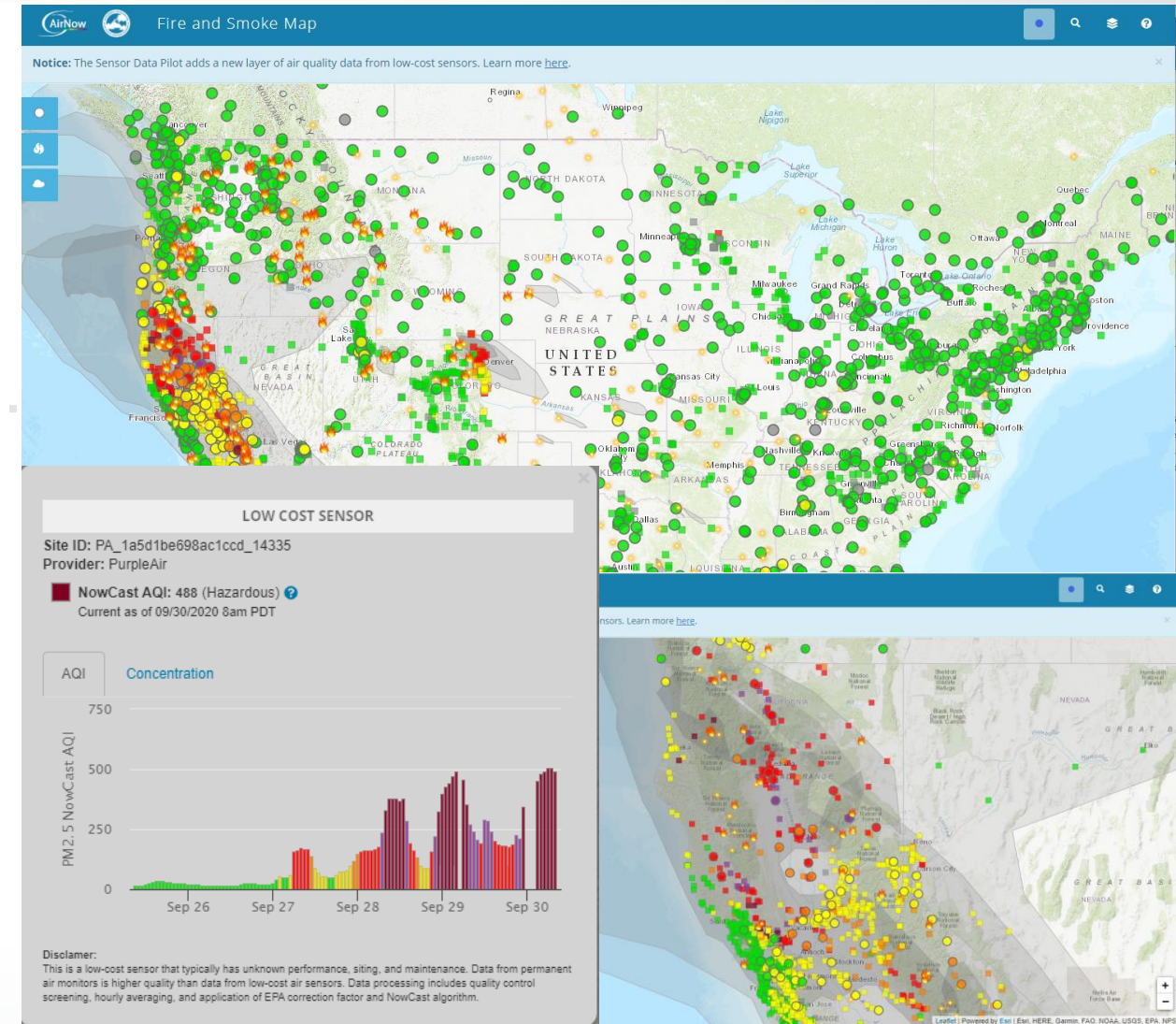


## AirNow Fire and Smoke Map - Sensor Data Pilot

To provide the public with additional air quality information they can use to protect their health during wildfires.

- EPA developed correction equation for low-cost PurpleAir Sensors
- Corrected data from PurpleAir Sensors have been added as a layer to the AirNow Fire and Smoke Map
- Improves coverage of air quality information where there are no regulatory grade monitors

<https://fire.airnow.gov/>







# Health Effects of Wildfire Smoke

## Known, Suspected and Knowledge Gaps

### ***Known***

- **Respiratory morbidity**
  - *Asthma & COPD exacerbations*
  - *Bronchitis & pneumonia*
- **Susceptible populations**
  - *Children, older adults and those with chronic disease*

### ***Suspected***

- **All-cause mortality**
- **Cardiovascular morbidity**
- **Adverse birth outcomes**

### ***More data needed***

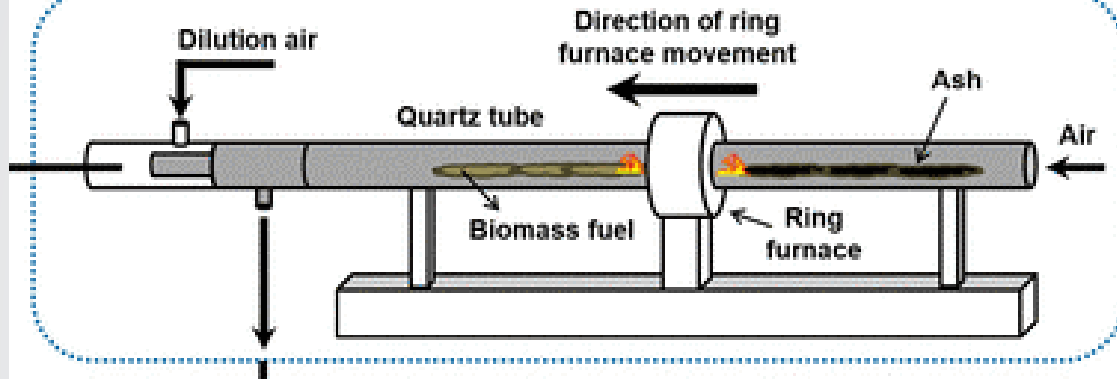
- **Risk of mortality**
- **Cardiovascular morbidity**
- **Susceptible populations**





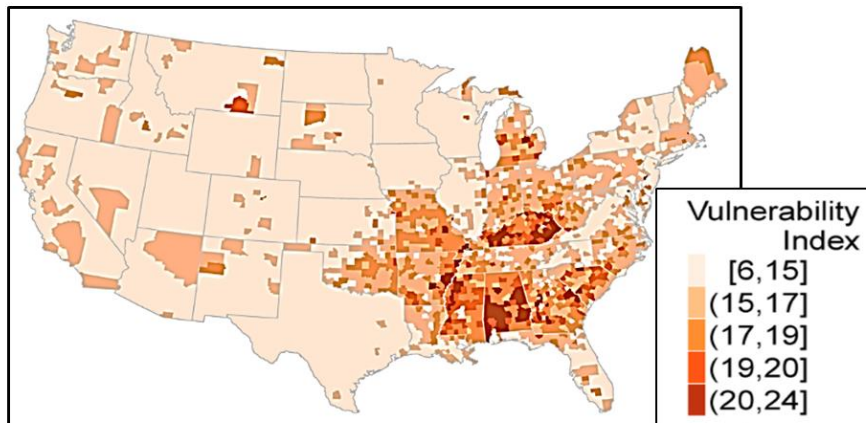
# Research to Understand Fire Emission Impacts on Public Health

Tube Furnace System



Toxicology

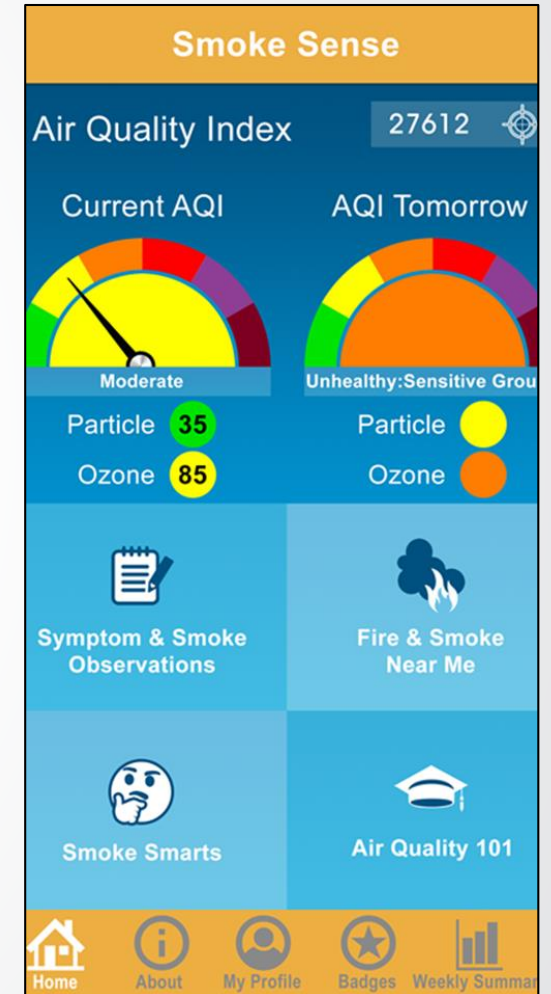
CHVI for Continental U.S.



Epidemiology



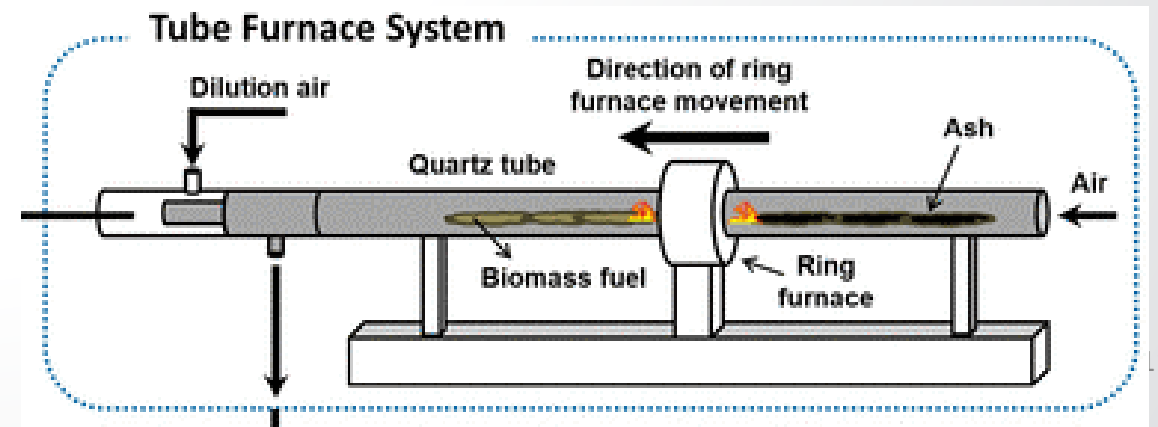
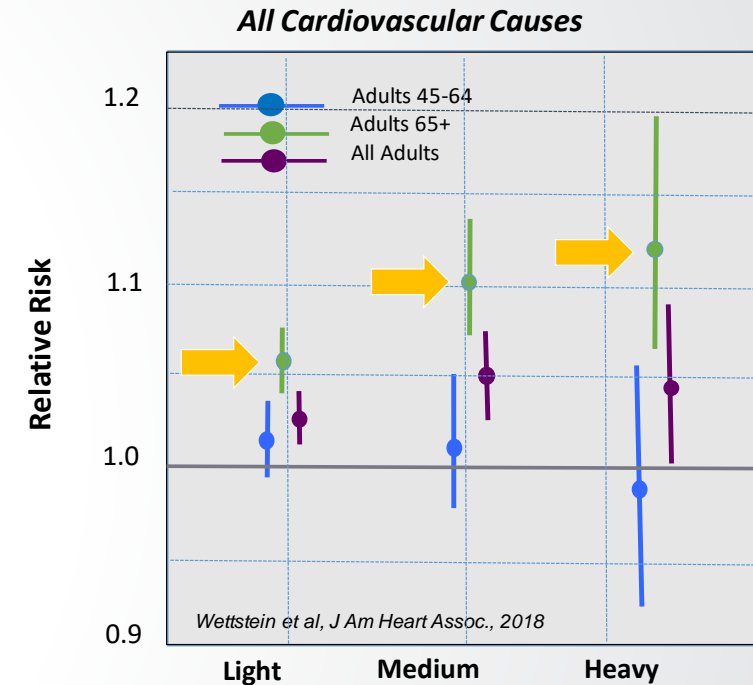
Interventions



Social Science and Risk Communication

# Wildland Fire Smoke Health Studies

- Epidemiology: evidence of increased cardiovascular emergency department visits, especially in those 65 and older
- Toxicology: PM from different wood burned (e.g., red oak, peat, pine, and eucalyptus) and wildfire combustion phases (e.g., flaming vs. smoldering) had appreciable differences in lung toxicity and mutagenic potency





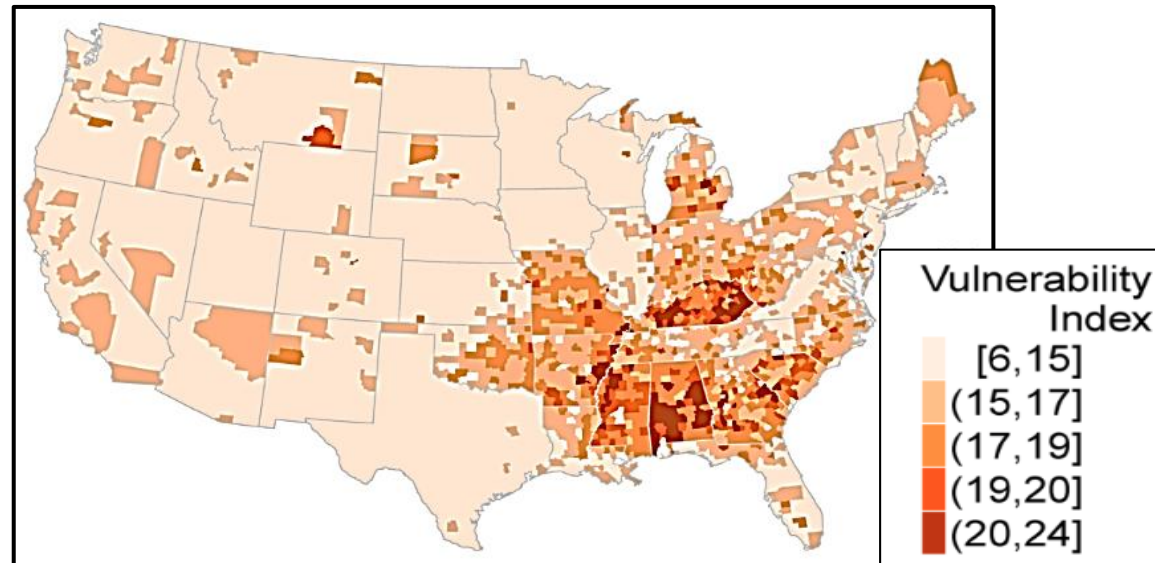


# Community Health-Vulnerability Index (CHVI)

**A tool for public health officials to identify vulnerable populations at risk from wildland fire smoke exposure**

- Considers factors known to define susceptibility to air pollutant-related health effects
- Can be combined with air quality forecast data generated by models to develop maps of counties, regions, or other designated areas where at-risk populations live

**CHVI for Continental U.S.**



## **Factors of Vulnerability**

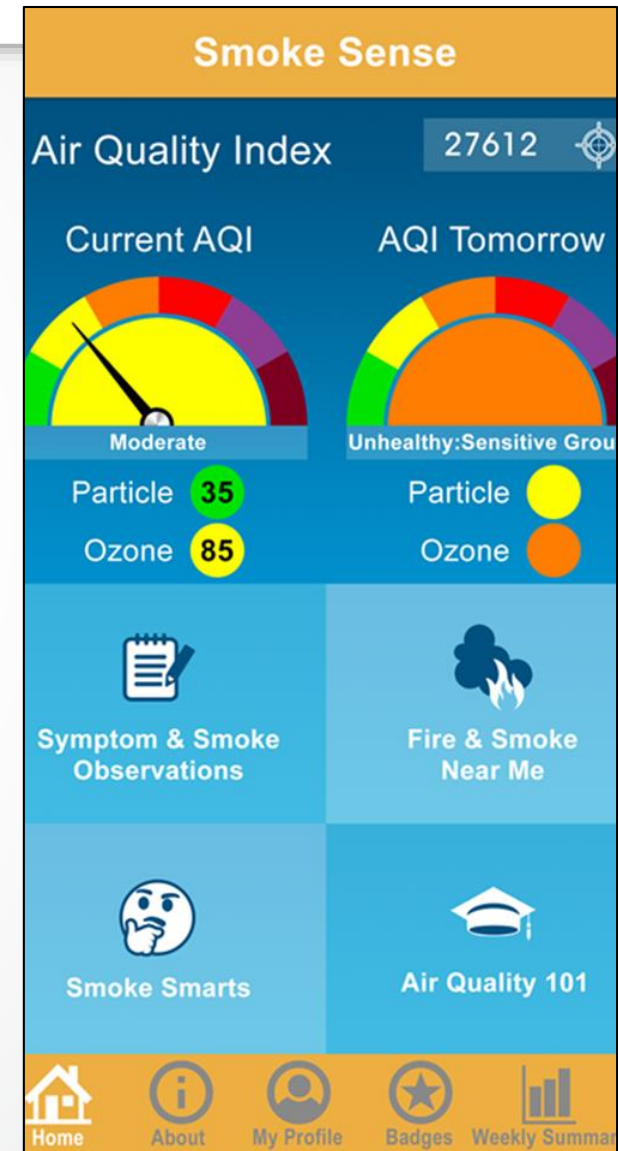
- Pediatric & Adult Asthma
- COPD
- Obesity
- Diabetes
- Hypertension
- % population age 65+
- Income, education, poverty, unemployment

*Rappold AG, et al Environ Sci Technol 2017*



# Smoke Sense Citizen Science Initiative

1. Provides participants with smoke and health information through a mobile app when and when it is needed
  2. Advances the state of the science on health risk communication related to actions that individuals take to protect their health during a wildfire
- Available since summer 2017 on both iOS and Android, in English and Spanish, currently more than 44,000 users from across the U.S. participate
  - Current Emphasis
    - Exploring the role of risk perception in adopting recommended exposure reducing behaviors by leveraging models of health behavior including theory of planned behavior, theory of reasoned action, health belief model, and stages of change models.
    - Further developing innovative research methods through continued collaboration with partners like researchers at Washington State University to adapt the research design in a range of contexts





# Respirator/Face Mask Study

- This year EPA will test effectiveness of a range of devices, including:
  - NIOSH-approved N95 or P100 respirators
  - Surgical masks
- Results will expand our understanding of the health benefits provided by these exposure-reducing devices during a wildland fire event and inform risk communication approaches







## Wildfire ASPIRE Study: Advancing Science Partnerships for Indoor Reductions of Smoke Exposures

- Targeted research questions based on discussions with stakeholders:
  - How effective are air filtration systems during smoke events?
  - How effective are portable air cleaners in reducing PM<sub>2.5</sub> concentrations?
  - What innovative approaches can help reduce wildfire exposures?
- Study Components:
  - Web Summit on Clean Air Spaces (Jun. 2019)
  - Field studies in Missoula, MT and Hoopa, CA (Jul. 2019-present)
  - Lab studies on effectiveness of air cleaning technologies (Oct. 2020-present)
  - Prize-based challenge (under development)
- Partners include
  - USFS Fire Sciences Laboratory
  - Missoula City-County Health Department
  - Climate Smart Missoula
  - University of Montana
  - Hoopa Valley Tribe



*Collocation of PurpleAir sensors with reference monitors at the USFS Missoula Fire Science Lab*



# Smoke Ready Communities Research

- Goals
  - To support communities in their efforts to reduce the public health burden of wildfire smoke events
- Objectives
  - Conduct applied research that
    1. Aids local communities in their smoke event preparedness efforts
    2. Characterizes the relationship between interorganizational collaborative planning processes, community capacity, and overall resilience to wildland fire smoke events
    3. Identifies actionable strategies that EPA and partner agencies can take to improve tools and resources in this context

## Two Phases

1. Examining local smoke planning processes.
2. Exploring the relationship among collaborative planning and community capacity/resilience





# Smoke Ready Toolbox For Wildfires

**U.S. Office of Air and Radiation and Office of Research and Development coordinate a page with information on air quality, health, and steps to reduce exposure to wildfire smoke**



Airnow.gov: Current Fire Conditions

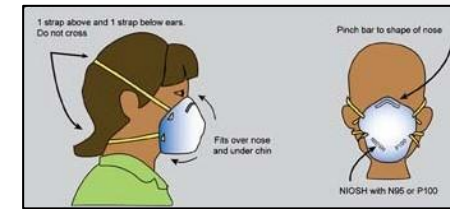


How Smoke From Fires Can Affect Your Health



Wildfire Smoke: A Guide for Public Health Officials

Updated Guide  
Released  
8/2019



Wildfire Smoke Exposure Infographics



Particle Pollution and Your Patients' Health Course



Online Healthy Heart Toolkit

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





Thank you for your time!

## Questions & Comments Welcome

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