

# Wildland Fire Research

## Overview and Highlights



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May 2, 2018





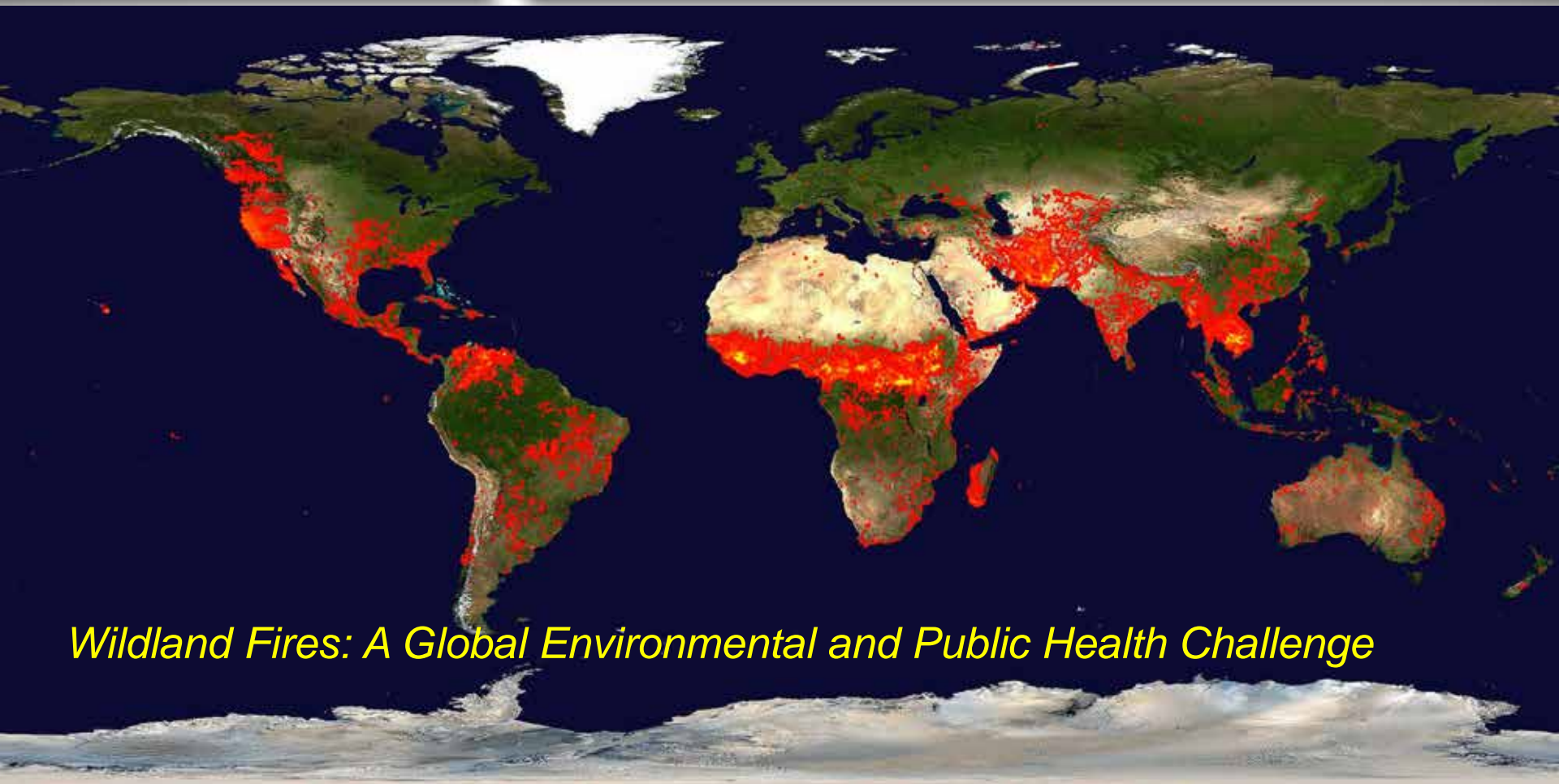
# EPA, Wildland Fire and Smoke

- The mission of EPA is to protect human health and the environment
- Wildland fires are a national challenge impacting population health and ecological health through complex multi-media pathways
- While there are ecological benefits, uncontrolled wildfires and use of prescribed burning for fire control and agricultural cycling are increasingly raising questions related to potential impacts on:
  - Ambient air quality
  - Land management
  - Water quality
  - Effects of ecosystem services
  - Public health
- The magnitude and frequency of these events is expected to worsen with our changing environment





# *Wildland Fires & Emissions* Global Public Health Challenge



*Wildland Fires: A Global Environmental and Public Health Challenge*

URL: [lance-modis.eosdis.nasa.gov/cgi-bin/imagery/firemaps.cgi](http://lance-modis.eosdis.nasa.gov/cgi-bin/imagery/firemaps.cgi)

Global Fire Map 2/20/2016 – 2/29/2016





# A National Concern

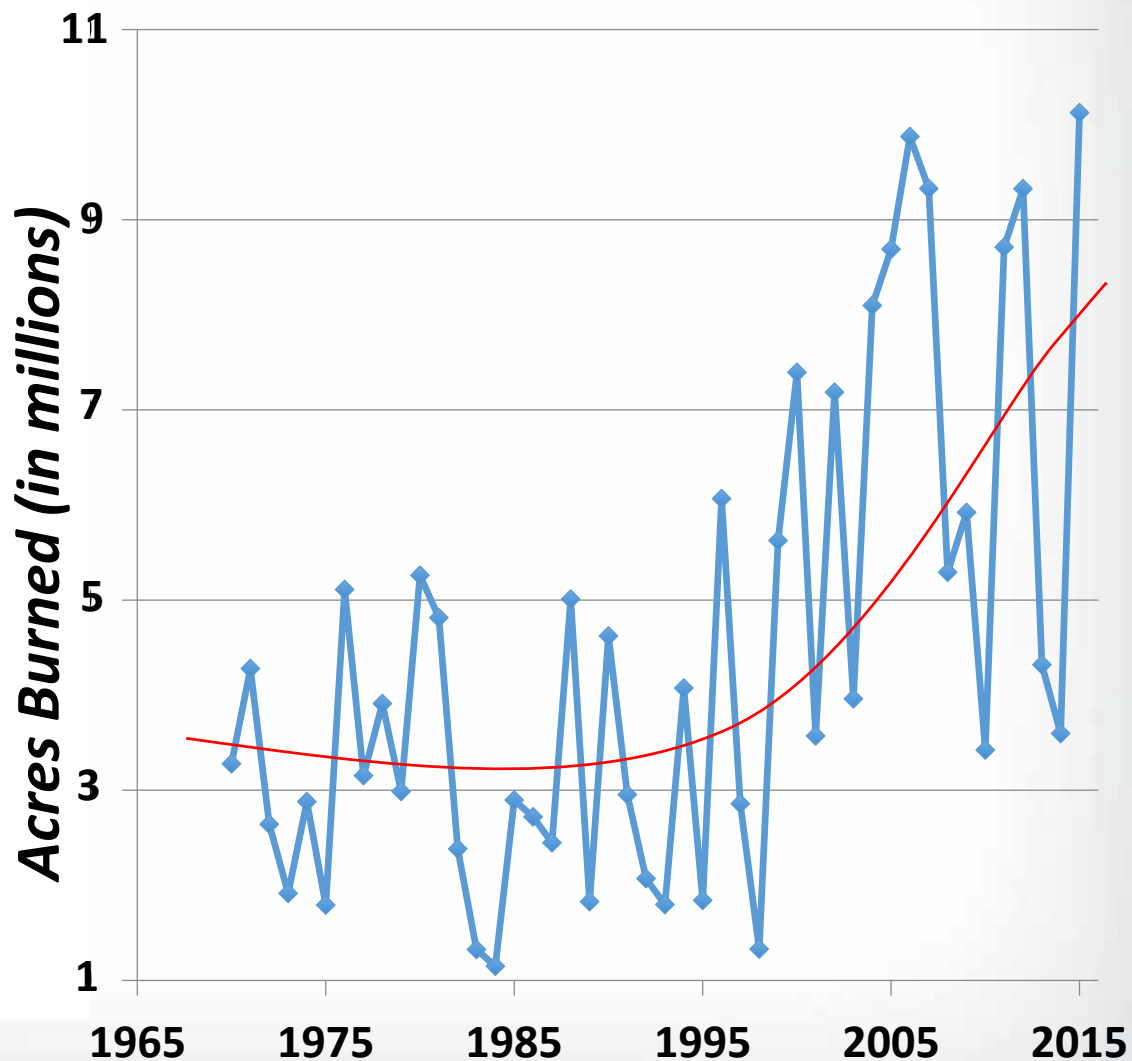
## Increased acreage burned

- According to NIFC data, 9 of 10 years with the largest acreage burned have occurred since 2000, including the peak year in 2015

## Increased impact on urban areas

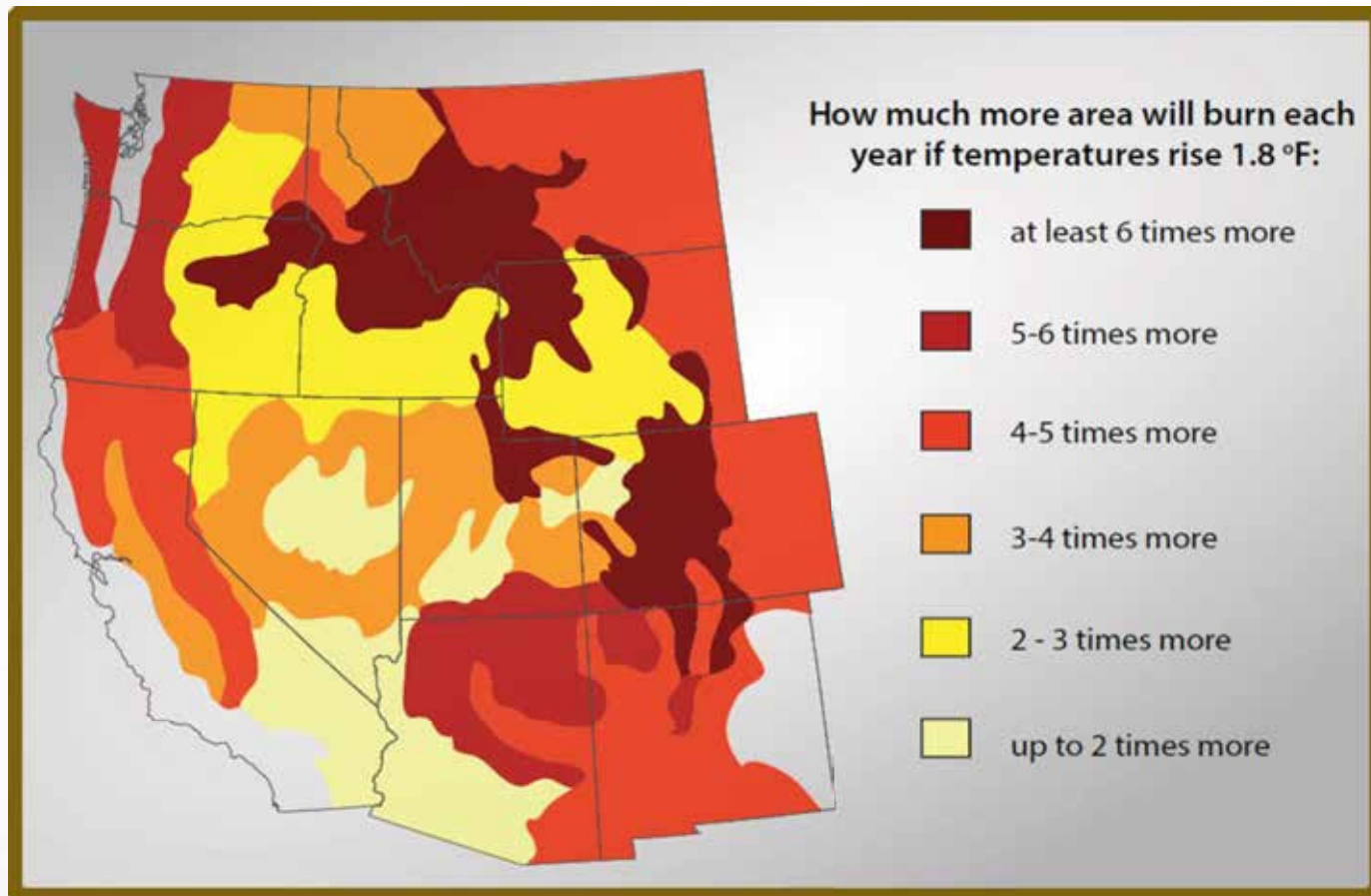
- 10% of all land with housing are situated in the wildland-urban interface
- 38.5% of U.S. housing units (Radeloff et al. 2005)

## >\$1 billion every year to fight wildfires



Adapted from [https://www.nifc.gov/fireInfo/fireInfo\\_stats\\_totalFires.html](https://www.nifc.gov/fireInfo/fireInfo_stats_totalFires.html)

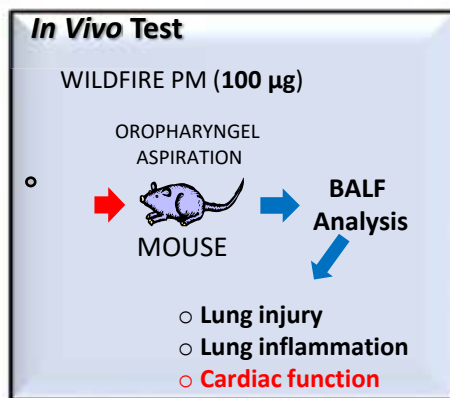
# Higher Global Temperatures will Increase Burn Areas in the West



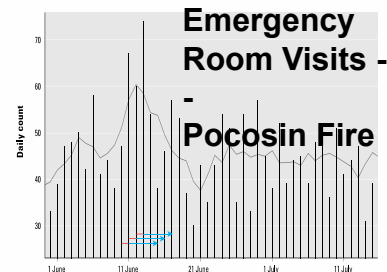
National Research Council



# Various Facets of Wildland Fire



**Smoke Toxicology**



**Smoke Exposure (Monitors/Sensors)**

**EPA ACE Wildland Fire Research**

**Smoke Epidemiology Public Health**



**Biomass Emissions Factors & Speciation**

**Smoke Emissions and AQ Impacts Modeling**

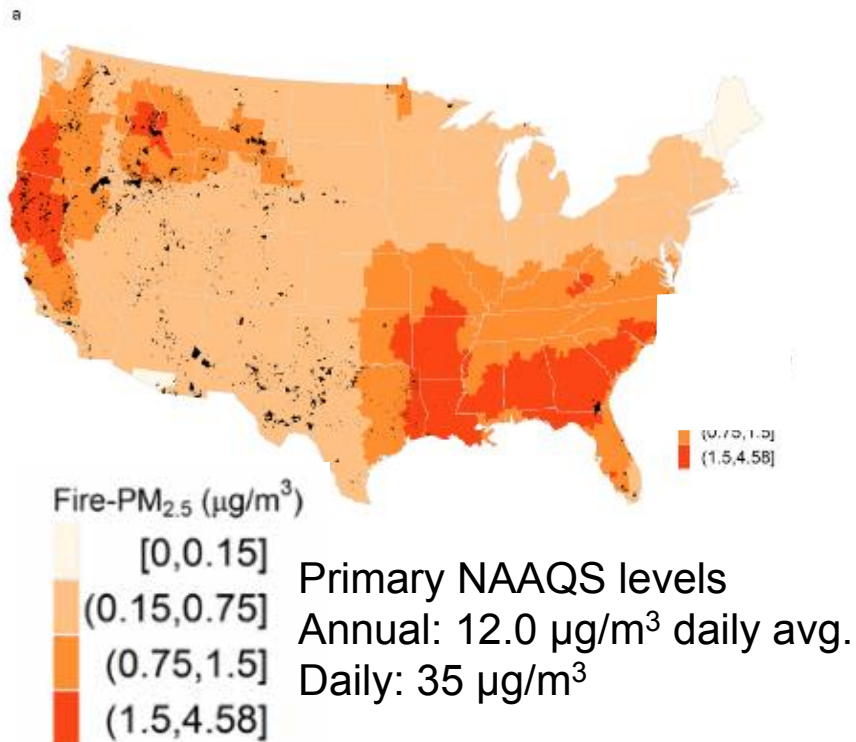




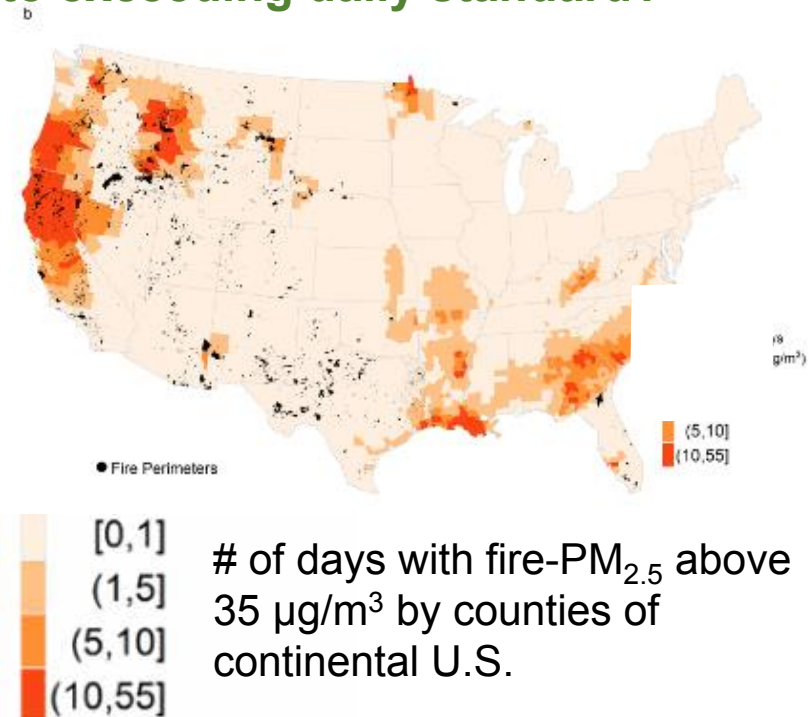
# Air Quality Impacts: Near and Far

**2014 National Emissions Inventory: ~32% of PM<sub>2.5</sub> emissions resulted from wildland fires**

## Annual average daily fire-PM<sub>2.5</sub> footprint for U.S. counties



## How much does smoke contribute to air quality and how often does it lead to exceeding daily standard?



Source: Rappold AG, et al. Environ Sci Technol 2017



# Health Effects Linked to Smoke from Wildland Fires

## *Health effects known or suspected to be caused by wildland fire smoke*

(Source: Studies reviewed in Liu et al 2015)

- All-cause mortality
- Asthma & chronic obstructive pulmonary disease (COPD) exacerbations
- Bronchitis & pneumonia
- Childhood respiratory disease
- Cardiovascular outcomes
- Adverse birth outcomes
- Symptoms such as eye irritation, sore throat, wheeze and cough







# Who's at Risk from Smoke?

## At-risk populations include –

- Pregnant women and fetuses
- Children
- Older populations
- Populations with pre-existing respiratory disease
- Populations with pre-existing cardiovascular disease

**27% of  
U.S. population  
is at-risk**

## Populations suspected to be at greater risk –

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



# Changing U.S. Demographic Increases Wildfire Smoke-Related Risk

## Changing U.S. Demographic

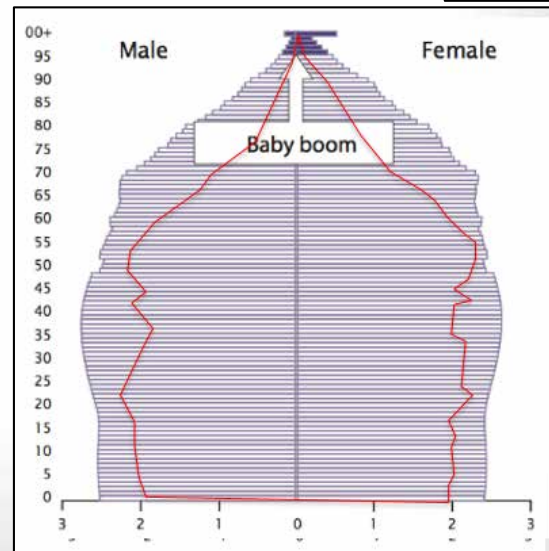
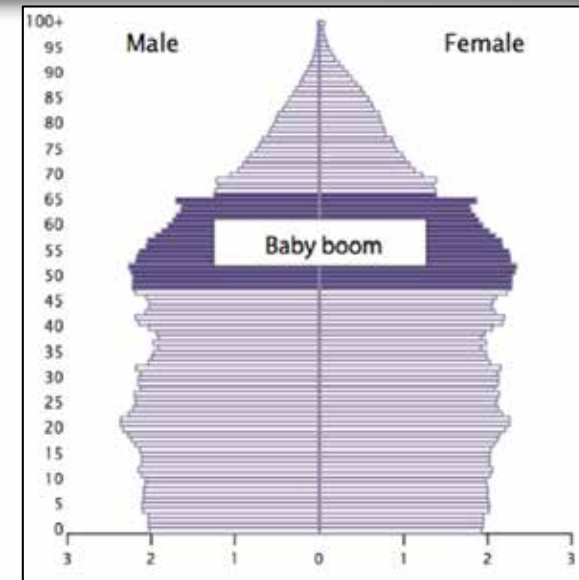
- U.S. population will continue to:
  - Grow
  - Median age will shift upward

## Higher Prevalence of Chronic Diseases Conferring Risk to Wildland Fire Smoke

- Aging U.S. population with increasing prevalence of:
  - Heart-lung disease, obesity, diabetes

Source: Xu J, Murphy SL, Kochanek DK, Arias E. NCHS Data Brief No. 267, 2016

U.S. Population  
2012



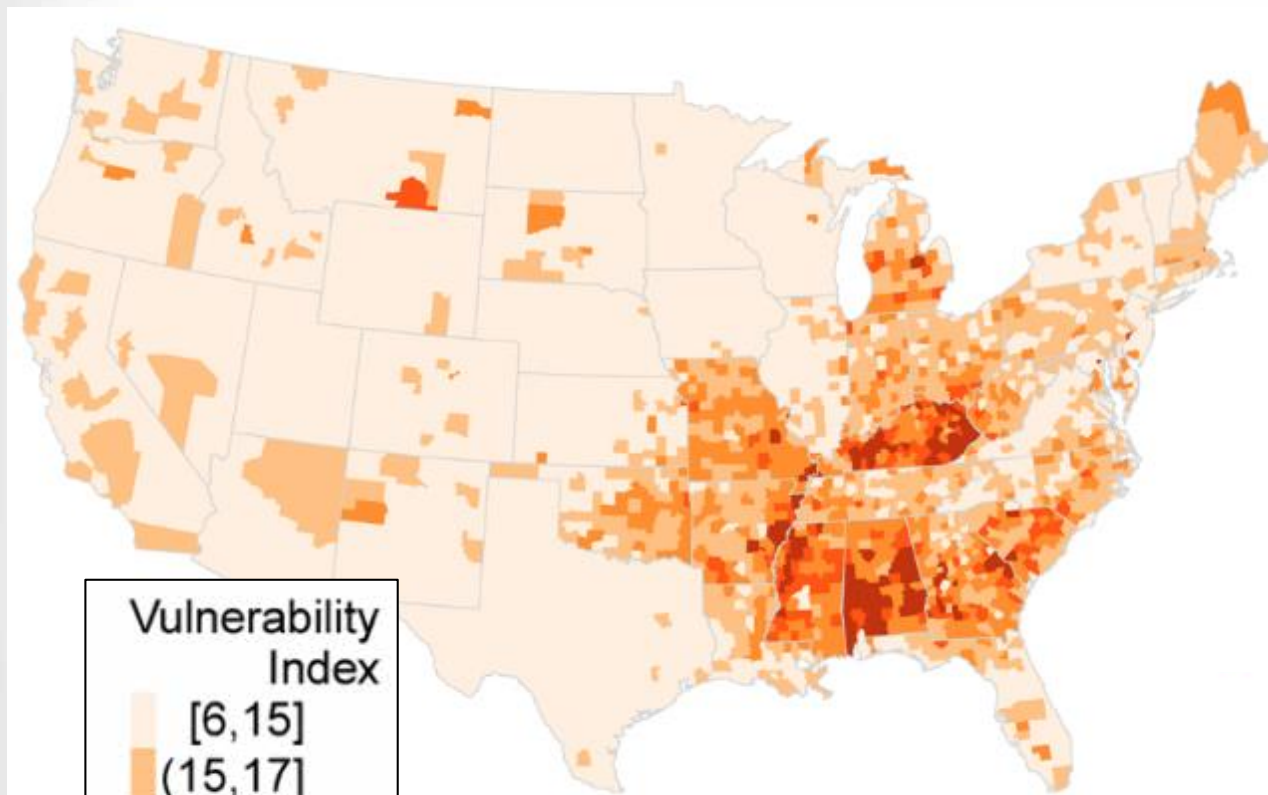
Projected U.S.  
Population 2060

(2012 U.S. Population –  
Red outline)



# Community Health-Vulnerability Index

## National map of community-health vulnerability index and air pollution awareness to adverse health effects



### Factors of Vulnerability

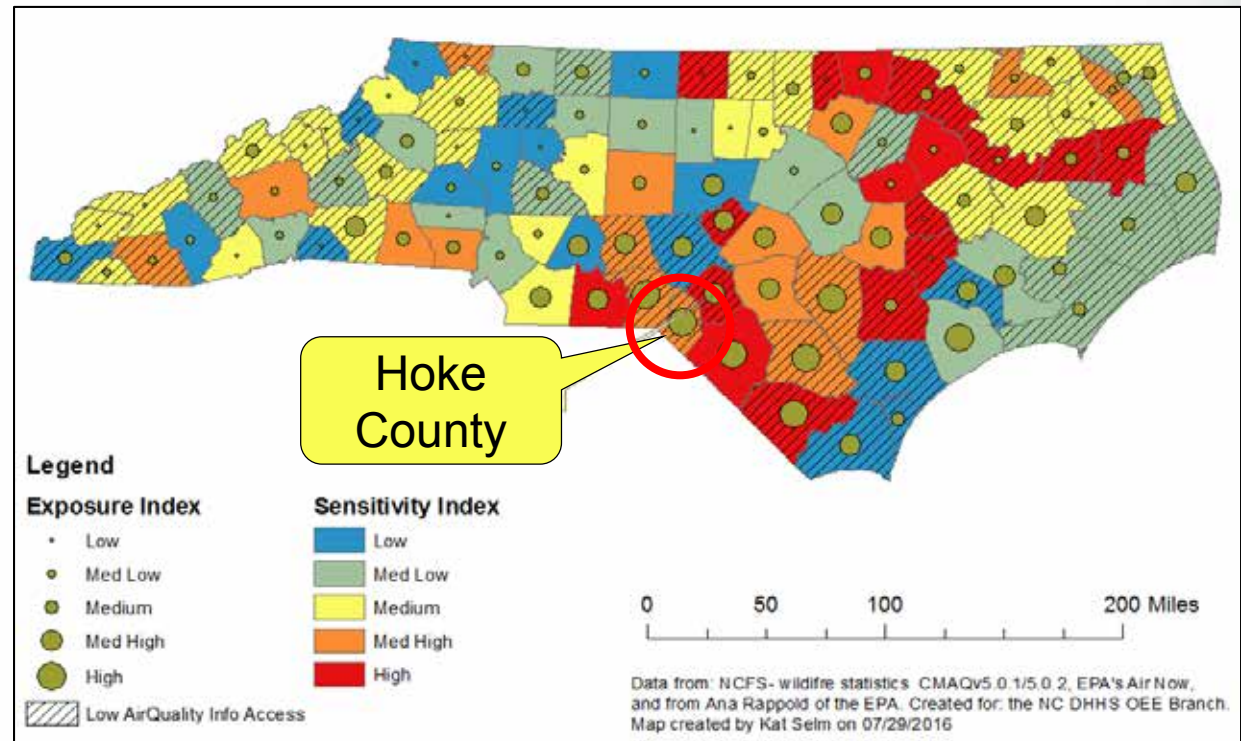
- Peds & Adult Asthma
- COPD
- Obesity
- Diabetes
- Hypertension
- % population age 65+
- Income, education, poverty, unemployment

Source: Rappold AG, et al Environ Sci Technol 2017



## Community-Health Vulnerability Index Used in CDC-funded North Carolina Health Program

- Community-Health Vulnerability Index was translated for use in North Carolina
- Utilized CHVI to identify NC community most at risk to smoke health impacts
- Used CHVI to identify & add NC-specific layers (e.g., NC Forestry data)
- Engaged Hoke County stakeholders (e.g., local fire departments) with CHVI to discuss vulnerability to smoke health impacts
- CHVI discussion has given way to implementing prevention efforts, e.g. Smoke Sense







# Smoke Sense App



## Aims of Smoke Sense:

- Measure the effect of wildfire smoke exposure on health and productivity
- Develop health risk communication strategies to improve public health outcomes

## As part of this, researchers have developed a Smoke Sense mobile phone application to:

- Collect user input on how smoke events impact their health and daily activities, and
- Provide information about the smoke exposure and recommended health risk messages

## Pilot Season

- 5,000+ individuals from across the nation made personal contributions by using the app over 50,000 times





# Wildland Fire Sensors Challenge

## Launched Wildland Fire Sensors Challenge in April 2017

- Intended to stimulate development of low-cost, light-weight, accurate, and easily deployable sensor technology that could be used by first responders and public health agencies during wildland fires
- Collaborative project between EPA, NASA, USFS, NOAA, CDC, NPS) and NGOs
- 9-month development window, testing and judging in 2018

Designing complementary projects with EPA Regional offices and other interested groups to field test sensors in a wildland fire scenario



**Wildland Fire Sensors Challenge**

**"Air pollutant measurement system to protect public health during wildland fires"**

**Do you have ideas on new air pollution measurement strategies for wildfire events?**

Wildland fires can produce significant air pollution, which may pose health risks to those in close proximity (first responders, residents in nearby areas) as well as downwind populations. Quickly deploying air pollution measurement stations has, to date, been limited by the cost of technology, portability issues, and maintenance problems. However, emerging technologies including miniaturized direct-reading sensors, compact micro-processors, and wireless data communications provide new opportunities to detect air pollution.

Collaborating partners have prepared a challenge opportunity to develop a prototype multi-node measurement system capable of rapid deployment and continuous real-time monitoring of highly dynamic air pollution levels during a fire event, including PM<sub>2.5</sub>, CO, O<sub>3</sub>, and CO<sub>2</sub>.

For more information, visit:  
<https://www.challenge.gov/challenge/wildland-fire-sensors-challenge>

Collaborating partners include EPA, NASA, USFS, NOAA, NPS, CDC, and Tall Timbers Research Station



# Shifting Gears: Water Impacts

## Wildfire Impacts on Water Resources

- Soil Erosion/Sedimentation/Turbidity
- Pollutant Mobilization
  - Low dissolved oxygen (DO)
  - Increased ammonia from fire retardants
  - Elevated phosphorus, metals, iron, manganese, and nitrate
- Hydrologic Impacts
  - Increased Flooding
  - Debris flow

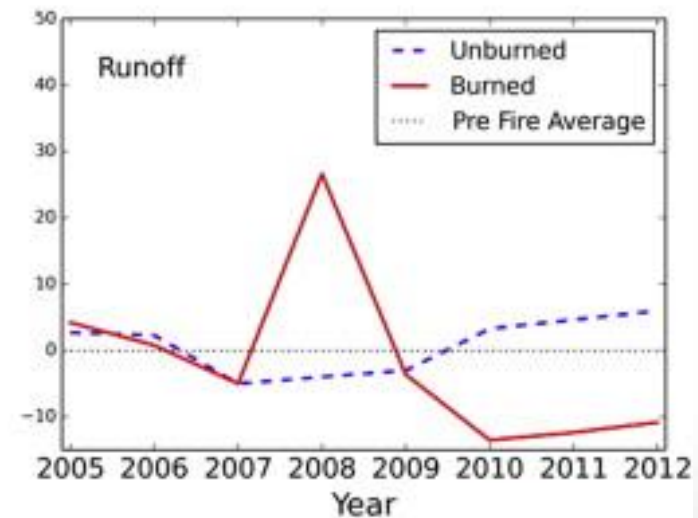
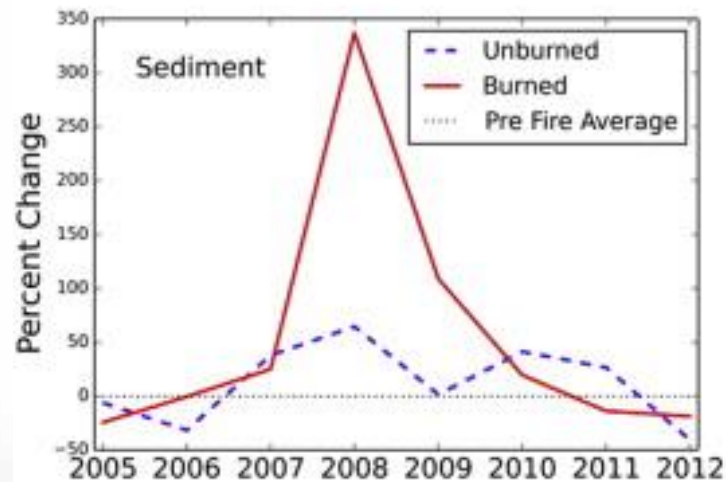
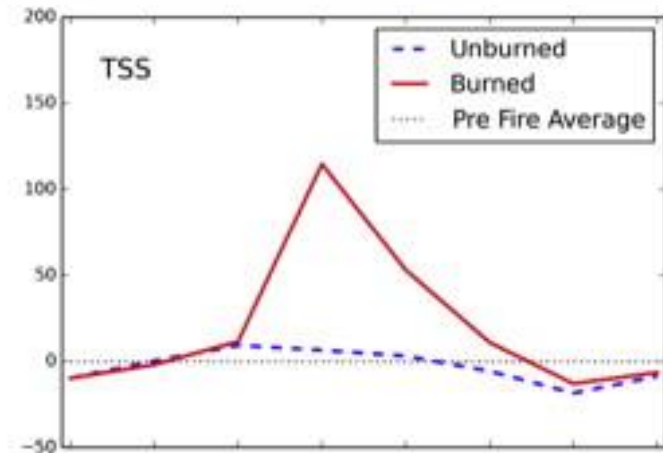
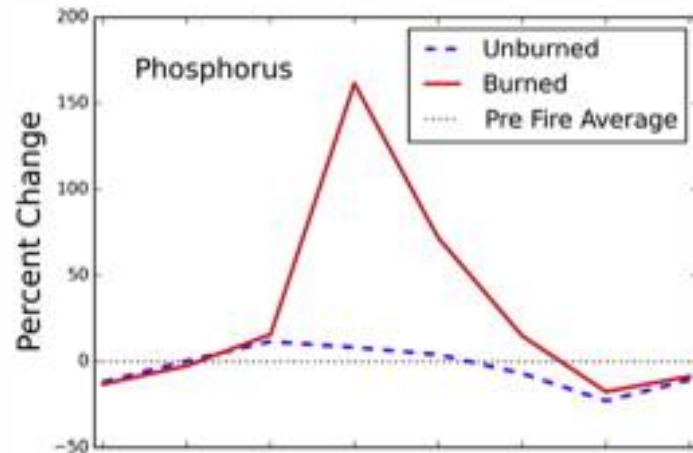


## Wildfire and Drinking Water Systems

- Fire Impacts on Facilities
- Post Fire/Stormwater Impacts
  - Treatment Plants (pollutants mobilized, debris management)
  - Source Water Management (watershed stabilization, relocating intakes, dredging reservoirs, new water sources)



# Wildfire and Surface Water Pollution





Tree roots hold soil and rocks. When fires come through and damages trees, what happens when it rains?

Mudslides



### 2014 NCA: Key Findings: Extreme Events

- Average precipitation has increased since 1900
- Heavy downpours are increasing nationally
- Recent trend towards increased heavy precipitation events will continue even in regions where total precipitation is projected to decrease, such as the Southwest



## Examples of Wildfire-Water Research

- Characterizing watershed vulnerability to wildfire-caused degradation of water quality
- Understanding impacts of wildfire on cold water refugia
- Forest health and water quality: assessment of how effects of disease and pests impact forest susceptibility to wildfire, and how these dead trees as fuel lead to water quality issues



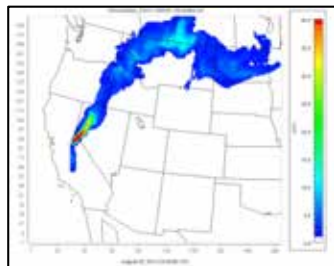
Courtesy of Jeff Peterson (Retired-Office of Water, EPA)



# A Few Highlights of Recent Activities

## Wildland fire emissions

- Field and chamber work estimating emission factors and emission speciation; includes open burn test facility
- Field study in Flint Hills, KS region to characterize grassland emission factors



## Improved AQ modeling of plume rise, transport, and chemical evolution

## Ongoing toxicological studies

- Differentiate wildland fire smoke impacts human health from a typical urban air
- How different phases of combustion (flaming to smoldering) impact health

## Monitors and sensors measuring fire exposures

- ACE wildland fire sensors challenge
- Leveraging research from other Federal agencies



## Water

- Grants to evaluate fuel reduction practices on drinking water quality and associated modeling of drinking water utility management

## Communication and outreach

- Smoke Sense App
- Pilot Social Science projects
- Smoke Ready Toolbox
- Wildfire Smoke: A Guide for Public Health Officials







# Summary

EPA's multi-disciplined fire-related research aims to address needs identified by our Program, Regional Office and State partners as well as other stakeholder groups, like you.

Thank you

[Baghdikian.Christina@epa.gov](mailto:Baghdikian.Christina@epa.gov)



EPA researchers lift a monitoring balloon to evaluate a prescribed fire in Camp Lejeune, NC



# Resources for Protecting the Public from Smoke and Ash

Susan Lyon Stone  
[stone.susan@epa.gov](mailto:stone.susan@epa.gov)




National Environmental Health Association  
NEHA  
Webinar  
May 2, 2018



# What Is the Air Quality Index?

- The Air Quality Index (AQI) is EPA's color-coded tool for telling the public how clean or polluted the air is
- It recommends steps people can take to reduce their daily exposure to pollution
- The AQI converts pollutant concentrations to a number on a scale from 0 to 500; generally a value of 100 is equal to the level of the short-term standard
- Cities and states use the AQI for reporting and forecasting air quality
- Metropolitan statistical areas with a population over 350,000 are required to report the daily AQI value (40 CFR Part 58 Appendix G)
- Reporting requirements:
  - Daily to the news media and a publicly available location such as the internet
  - When AQI is greater than 100, it is critical that reporting to the news media be as extensive as possible.
  - Real-time data reporting and voluntary action programs that provide timely air quality information may also be used to meet reporting requirements

# AQI Categories and Health Messages

Category Descriptor	Index Value	Message	
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.	
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.	
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.	
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.	

# Air Quality Index

- Pollutant-specific health effects and cautionary statements address question “who will be affected”
- Based on health information supporting the NAAQS
  - Controlled human exposure, epidemiological studies exposure/risk assessments used to set breakpoints
  - Epidemiological studies useful for identifying risk factors and more serious effects
  - Controlled human exposure studies useful for identifying proportion of healthy population affected, symptoms, mechanisms of effects, genetic variability

*How to use the AQI to lower the dose of inhaled pollution:*

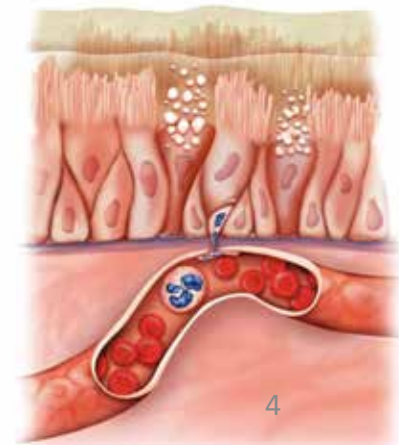
**Dose = Concentration x Ventilation rate x Time**

C - be active outdoors when air quality is better

V - take it easier when active outdoors

T - spend less time being active outdoors

**Since people respond differently - PAY ATTENTION TO SYMPTOMS!**





# Fires: Current Conditions



AirNow (airnow.gov)

# Fires: Current Conditions

AirNow redesign coming later this summer!!!!

Information will be available in

- Current Air Quality (circled)
- Map (below)

AirNow ([airnow.gov](http://airnow.gov))



# Fires: Current Conditions

The collage consists of three main components:

- Top Image:** A screenshot of the AirNow website's "Fires: Current Conditions" page. It features a map of the western United States with numerous green and orange dots indicating fire locations. A text box titled "How Smoke from Fires Can Affect Your Health" is overlaid on the map. The text in this box includes: "Smoke may smell good, but it's not good for you", "Smoke is made up of a complex mixture of gases and fine particles", and "Some people are more at risk".
- Bottom-Left Image:** A screenshot of the AirNow website's "Smoke Advisories and Forecasts" page. It shows a sidebar with links to "Smoke Advisories and Forecasts", "Smoke Advisories and Forecasts", "Smoke Advisories and Forecasts", and "Smoke Advisories and Forecasts".
- Right Image:** A booklet titled "Wildfire Smoke: A Guide for Public Health Officials". It features a black and white illustration of a wildfire with smoke rising from a forest. The text at the bottom of the booklet reads: "U.S. Environmental Protection Agency \* U.S. Forest Service \* U.S. Centers for Disease Control and Prevention \* California Air Resources Board".

Red arrows and circles highlight specific elements:

- A red arrow points from the "Current Advisories" link in the bottom-left image to the "Current Advisories" link in the top image.
- A red arrow points from the "Fires and Health" link in the bottom-left image to the "How Smoke from Fires Can Affect Your Health" text box in the top image.
- A red arrow points from the "More Fire Tools" link in the bottom-left image to the "Wildfire Smoke: A Guide for Public Health Officials" booklet in the right image.

# Fires Current Conditions Map

- Current Conditions map for August 18, 2017
- Smoke map generated by NOAA Hazard Mapping System (HMS)
- Updated about 5 times a day
- Uses satellite data, enhanced now that GOES-16 is operational





# Fires: Current Conditions – Current Advisories

Smoke Forecast Outlook issued August 18, 2017 at 10:45 AM EDT


## Outlook for Air Quality Report

**Smoke:** Satellite images show smoke from Chetco Bar fire reaching south to Brookings and Harbor area. Smoke, haze and poor air quality will continue with fluctuating air quality levels in some areas reaching 'Unhealthy for Sensitive Groups' (USG) rating. Smoke from Shan Creek Fire will also impact Brookings as well as Cave Junction as the northeast winds continues at 5-10 mph with gusts up to 17 mph. Today and tomorrow will be the driest days. High pressure aloft and surface thermal trough along the coast will continue to bring northeast winds (5-10 mph). Widespread haze is visible along southern Oregon and will continue for the next few days in Cave Junction, Grants Pass and Provoit.

**Fire:** Chetco Bar Fire is currently at 10,963 acres. The fire is burning fuels previously impacted by Silver and Biscuit fires, Douglas Fir stands, brush fuel with a heavy load of snags and down fuels within Kalmiopsis Wilderness. Low relative humidity and increasing northeast and east winds are pushing the fire on the west side. Shan Creek Fire is approximately 400 acres. The control lines are holding the fire along south, east and northern perimeters.

**Other:** Additional information can be found on [oregonSmoke.blogspot.com](http://oregonSmoke.blogspot.com)

## Daily AQI Forecast for Aug 18, 2017



Station	Yesterday hourly	Thu 8/17	Forecast Comment for Today -- Fri, Aug 18	Fri 8/18	Sat 8/19
Brookings-Oregon Coast Highway			Will experience fluctuating air quality		
Agness-National Forest Development Road 350					
Cave Junction Forest Service			Smoke and haze will be visible		
Grants Pass - Parkside School			Light haze may be visible		
Provoit - Seed Orchard			Light haze may be visible		

Issued Aug 18, 2017 by Nicole Bringolf, Air Resource Advisor

Air Quality Index (AQI)	Actions to Protect Yourself
Good (Green)	None
Moderate (Yellow)	Unusually sensitive individuals should consider limiting prolonged or heavy exertion.
USG (Orange)	People within Sensitive Groups* should <b>reduce</b> prolonged or heavy outdoor exertion.
Unhealthy (Red)	People within Sensitive Groups* should <b>avoid all</b> physical outdoor activity.
Very Unhealthy (Purple)	Everyone should avoid prolonged or heavy exertion.
Hazardous (Dark Purple)	Everyone should avoid any outdoor activity.

\*Disclaimer: thresholds may be among the most at risk. Use caution as conditions can change quickly. See your health professional as needed. Smoke sensitive groups should take appropriate precautions.

**Additional Links**  
[Oregon Smoke Blog](http://OregonSmokeBlog)  
[Chetco Bar Fire Information](http://ChetcoBarFireInformation)  
[Oregon Dept of Environmental Quality](http://OregonDeptofEnvironmentalQuality)  
<http://wildlandfiresmoke.net/outlooks/2017/ChetcoBar#Overview>



Current Advisories



CA Smoke Blog



USFS

Wildland Fire Air Quality Response Program

- State/Local/Tribal agency blogs
- Wildland Fire Air Quality Response Program

Smoke Forecast Outlook, Chetco Bar Fire, 8/18/17, 10:45 am

# How Smoke from Fires Can Affect Your Health

- New document - currently in html only
- May develop pdf version



The screenshot shows the AirNow website interface. At the top, there's a search bar and a navigation menu. The main heading is "How Smoke from Fires Can Affect Your Health". Below the heading, there's a sub-heading "Smoke may smell good, but it's not good for you". The article text explains that smoke is a complex mixture of gases and fine particles that can penetrate deep into the lungs, causing various health problems. It lists several groups of people who are more at risk, including those with heart or lung disease, older adults, children, and pregnant women. The article also provides tips on how to tell if smoke is affecting you and how to protect yourself, such as preparing for fire season and having an air cleaner. There are several images throughout the article, including a landscape with smoke rising from a fire, a person using a nebulizer, and a person wearing a mask.

**AirNow**

Local Air Quality Conditions

Zip Code Zip Code Go State Alabama Go My Current Location

## How Smoke from Fires Can Affect Your Health

Updated January 2017

### Smoke may smell good, but it's not good for you

While not everyone has the same sensitivity to wildfire smoke, it's still a good idea to avoid breathing smoke if you can help it. And when smoke is heavy, such as can occur in close proximity to a wildfire, it's bad for everyone.

Smoke is made up of a complex mixture of gases and fine particles produced when wood and other organic materials burn. The biggest health threat from smoke is from fine particles. These microscopic particles can penetrate deep into your lungs. They can cause a range of health problems, from burning eyes and a runny nose to aggravated chronic heart and lung diseases. Exposure to particle pollution is even linked to premature death.

### Some people are more at risk

It's especially important for you to pay attention to local air quality reports during a fire if you are:

- a person with heart or lung disease, such as heart failure, angina, ischemic heart disease, chronic obstructive pulmonary disease, emphysema or asthma.
- an older adult, which makes you more likely to have heart or lung disease than younger people.
- caring for children, including teenagers, because their respiratory systems are still developing. They breathe more air (and air pollution) per pound of body weight than adults. They're more likely to be active outdoors, and they're more likely to have asthma.
- a person with diabetes, because you are more likely to have underlying cardiovascular disease.
- a pregnant woman, because there could be potential health effects for both you and the developing fetus.

### How to tell if smoke is affecting you

High concentrations of smoke can trigger a range of symptoms:

- Anyone may experience burning eyes, a runny nose, cough, phlegm, wheezing and difficulty breathing.
- If you have heart or lung disease, smoke may make your symptoms worse.
- People with heart disease might experience chest pain, palpitations, shortness of breath, or fatigue.
- People with lung disease may not be able to breathe as deeply or as vigorously as usual, and may experience symptoms such as coughing, phlegm, chest discomfort, wheezing and shortness of breath.

### Protect yourself!

It's important to limit your exposure to smoke - especially if you are at increased risk for particle-related effects. Here are some steps you can take to protect your health:

#### Prepare for fire season if you live in a fire-prone area

If you have heart, vascular or lung disease, including asthma, talk with your health care provider before fire season to make plans. Discuss when to leave the area, how much medicine to have on hand, and your asthma action plan if you have asthma.

Have a several-day supply of nonperishable foods that do not require cooking. Cooking - especially frying and broiling - can add to indoor pollution levels.

Consider buying an air cleaner. Some room air cleaners can help reduce particle levels indoors, as long as they are the right type and size for your room as specified by the manufacturer. If you choose to buy an air cleaner, don't wait until there's a fire - make that decision beforehand. Note: Don't use an air cleaner that generates ozone. That just puts more pollution in your home.

Have a supply of N-95 or P-100 masks on hand, and learn how to use them properly. (For more, see [this link](#).) They are sold at many hardware and home stores and online.

#### During a fire

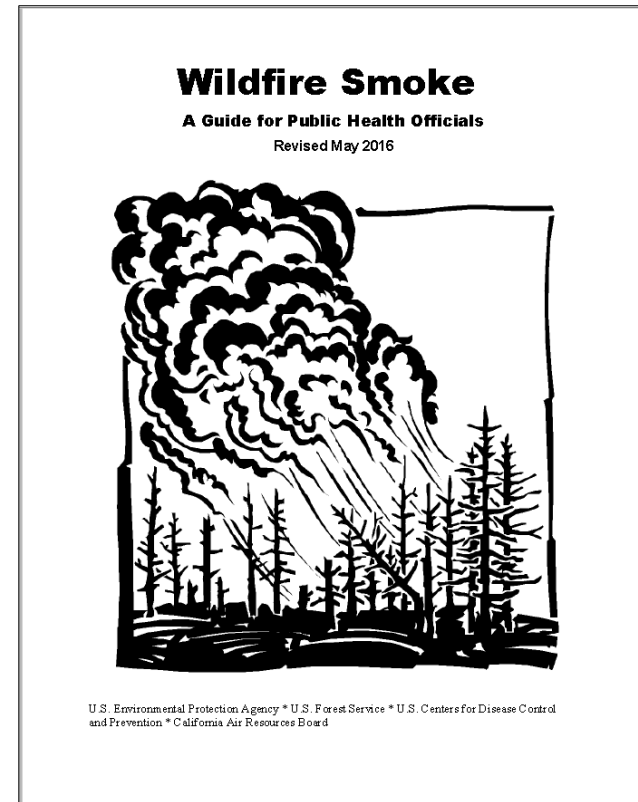
Pay attention to local air quality reports. As smoke gets worse, the concentration of particles in the air increases - and so should the steps you take to protect yourself. Air

<https://airnow.gov/index.cfm?action=smoke.index>

# Wildfire Smoke

## A Guide for Public Health Officials (2016)

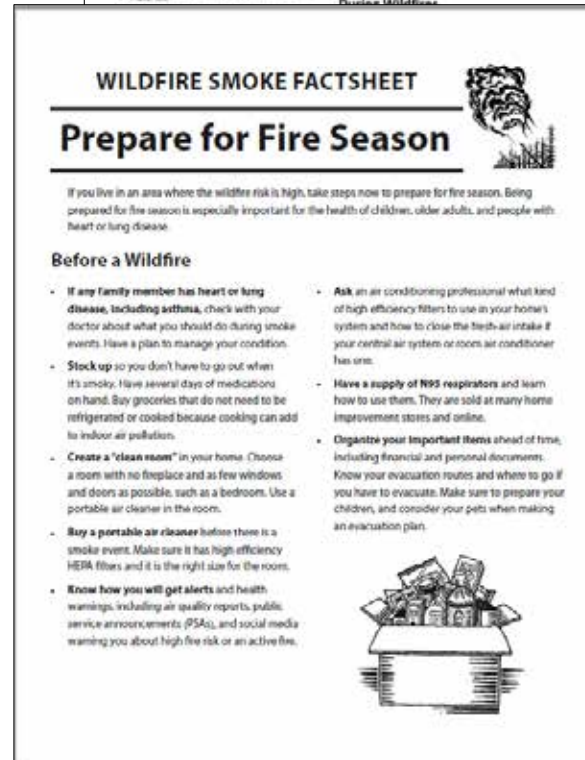
- Revised by EPA/CDC and NIOSH/USFS/California Agencies
- Updated air quality and health information
- Exposure reduction measures incorporate stronger evidence base
- Entirely new section on communicating air quality
  - Uses “Current PM” levels from AirNow
  - Uses satellite information on Fires: Current Conditions page
  - Visual range information updated
- New fact sheets about children’s health



[https://www3.epa.gov/airnow/wildfire\\_may2016-revised.pdf](https://www3.epa.gov/airnow/wildfire_may2016-revised.pdf)

# Coming Soon - Wildfire Guide Fact Sheets

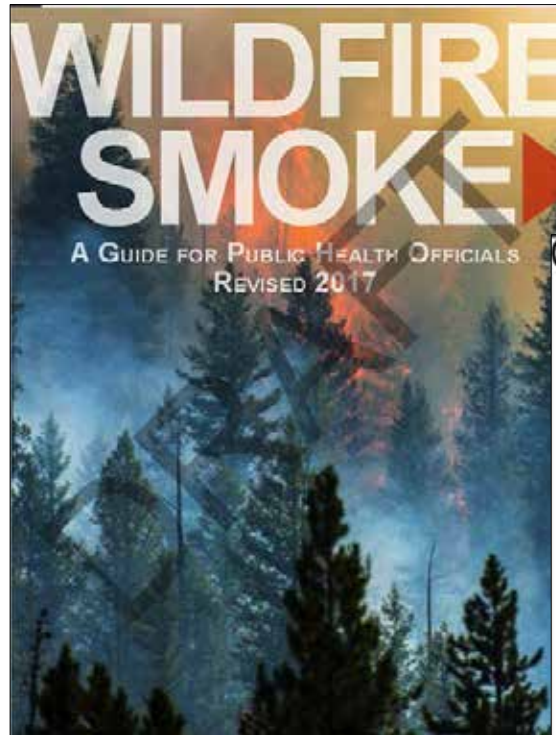
- ✓ Prepare for Fire Season
- Protect Your Lungs
- Indoor Air Filtration
- Reduce Your Smoke Exposure
- Children's Health and Wildfire Smoke
- Protect Yourself from Ash





# Wildfire Guide – Next Revision

- Updated look
- Health effects section
  - Addition of ozone
  - Multi-day exposure
  - Heat and smoke
  - Smoke vs urban particles
- Add sections
  - PM web course for health professionals
  - Sensor use
  - Ash clean-up
- Additional fact sheets
  - Older adults
  - Pets
  - Livestock
  - After the Fire



# Infographics

**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.

1 strap above and 1 strap below ears  
Do not cross

Fits over nose and under chin

Pinch bar to shape of nose

NIOSH with N95 or P100

Respirator should collapse as you breathe in and not let air in from the sides.

Ask your doctor before using if you have heart or lung health issues.	Throw mask away if it's dirty or you find it difficult to breathe.	If you are dizzy or nauseous, go to where there is less smoke and seek medical attention.
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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 smoky area.

airnow.gov

**Reduce health risks in areas with wildfire smoke:**

**Especially if you have family members with heart or breathing problems, or are older adults, children, or pregnant women.**

**DO**

- 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 you go outside when it is smoky
- 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**

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

[https://www3.epa.gov/airnow/smoke\\_fires/reduce-health-risks-with-wildfire-smoke.pdf](https://www3.epa.gov/airnow/smoke_fires/reduce-health-risks-with-wildfire-smoke.pdf)

# PM Web Course for Healthcare Professionals



The screenshot shows the EPA website's header with the logo and navigation links: Environmental Topics, Laws & Regulations, and About EPA. A search bar is also present. The main heading is 'Particle Pollution and Your Patients' Health'. Below this, a dark box states: 'An evidence-based training course for healthcare providers that:'. To the right of this box is an image of a female doctor and a male patient looking at a tablet. Below the image, two bullet points describe the course content. To the right of the image, a light blue box contains text about the course's design for various healthcare professionals and links to 'Start the Course' and 'Course developers'. At the bottom, there are links for 'Start the Course', 'Course developers', and 'Contact Us'.

**EPA** United States Environmental Protection Agency

Environmental Topics Laws & Regulations About EPA Search EPA.gov

## Particle Pollution and Your Patients' Health

Share Contact Us

An evidence-based training course for healthcare providers that:

- Describes the biological mechanisms responsible for the cardiovascular and respiratory health effects associated 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 protect their health.

This course is designed for family medicine physicians, internists, pediatricians, occupational and rehabilitation physicians, nurse practitioners, nurses, asthma educators, pulmonary specialists, cardiologists, and other medical professionals.

[Start the Course](#)

[Course developers](#)

[Start the Course](#) [Course developers](#)

[Contact Us](#) to ask a question, provide feedback, or report a problem.

This web course and the following tools can be found at:  
[https://airnow.gov/index.cfm?action=health\\_providers.index](https://airnow.gov/index.cfm?action=health_providers.index)

# What Is It? Who Is It For?

***Particle Pollution and Your Patients' Health*** is an evidence-based training course that:

- Describes the biological mechanisms responsible for the cardiovascular and respiratory health effects associated with particle pollution exposure
- Helps health-care providers advise their patients about particle pollution exposure
- Provides practical education tools to help patients understand how particle pollution exposure can affect their health and how they can use the Air Quality Index to protect their health

***Particle Pollution and Your Patients' Health*** is designed for family medicine physicians, internists, pediatricians, occupational and rehabilitation physicians, nurse practitioners, nurses, asthma educators, pulmonary specialists, cardiologists, and other medical professionals who counsel patients about lung, heart or vascular disease

***Offers Continuing Education Credits*** to physicians, nurses, health educators

- Continuing education for clinicians is required for continued licensure in many states





# Patient Exposure and the AQI


 United States Environmental Protection Agency

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

## Particle Pollution and Your Patients' Health

CONTACT US  
 SHARE    

- Particulate Pollution Course Home
- Learn About the Course
- What is Particle Pollution?
- Particle Pollution Exposure
- Cardiovascular Effects
- Respiratory Effects
- Patient Exposure & the Air Quality Index**
- Patient Exposure & High Particle Pollution Events
- Clinical Scenarios
- Frequent Questions
- Course Outline & Key Points
- Review Questions
- Patient Education Tools
- Course Evaluation
- References
- Glossary

## Patient Exposure and the Air Quality Index

On this page:

- [Should I recommend that my patients reduce their exposure to particle pollution?](#)
- [What is the Air Quality Index \(AQI\)?](#)
- [Where can I find daily air quality reports?](#)
- [What can I advise my patients to do when air quality is unhealthy?](#)
- [How can my patients reduce particle pollution exposure near roads?](#)
- [How effective are air quality notifications in reducing potentially adverse health effects?](#)
- [What education materials are available?](#)

### Should I recommend that my patients reduce their exposure to particle pollution?

Yes. All people should be educated about the health effects from unhealthy air quality and how to reduce exposure.

Patients more likely to be affected by particle pollution exposure that vulnerable populations. Exposure-reduction measures are:



**Effects of Common Air Pollutants**

**RESPIRATORY EFFECTS**

- Symptoms: Cough, Sore throat, Wheezing, Shortness of breath, Increased asthma and emphysema attacks, Irritation of nose, throat, and eyes, Development of lung disease, Chronic bronchitis, Emphysema, Asthma, Lung cancer
- How Pollutants Cause Symptoms: Particulate matter (PM) irritates the lining of the lungs, causing inflammation and narrowing of the airways. This leads to symptoms like coughing, wheezing, and shortness of breath. Long-term exposure can lead to chronic lung disease.

**CARDIOVASCULAR EFFECTS**

- Symptoms: Heart disease, Heart attack, Stroke, Increased risk of heart disease, Increased risk of heart attack and stroke, Increased risk of heart failure, Increased risk of heart disease
- How Pollutants May Cause Symptoms: Particulate matter (PM) enters the bloodstream and causes inflammation and narrowing of the arteries. This leads to symptoms like chest pain, shortness of breath, and increased risk of heart disease.

**AQI Scale:**

AQI Range	Health Concern	What You Should Do
0-50	Good	Enjoy outdoor activities.
51-100	Moderate	Unusually sensitive people should consider reducing outdoor activities.
101-150	Unhealthy for Sensitive Groups	People with heart or lung disease, older adults, children, and people who spend a lot of time outdoors should consider reducing outdoor activities.
151-200	Unhealthy	Everyone should consider reducing outdoor activities.
201-300	Very Unhealthy	Everyone should avoid outdoor activities.
301-400	Hazardous	Everyone should avoid outdoor activities.

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# High Particle Pollution Events



United States  
Environmental Protection  
Agency

Environmental TopicsLaws & RegulationsAbout EPA

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Particle Pollution and Your Patients' Health

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**Patient Exposure & High Particle Pollution Events**

Clinical Scenarios

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Course Outline & Key Points

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## Patient Exposure and High Particle Pollution Events

On this page:

- [Introduction](#)
- [What steps can I advise for my patients who live in areas where fires are likely to occur?](#)
- [How can my patients use respirators to protect themselves from smoke?](#)

### Introduction

Ozone and the other common pollutants rarely reach very high levels in many parts of the country, particle pollution levels reach ranges of the AQI. These events are usually associated with fires, wildfires, but on a smaller spatial and temporal scale high particle pollution events can also be associated with other types of fires or combustion. Examples of these high particle pollution events include urban particles and residential wood burning in valleys during winter months. For reducing exposure to particle pollution, discussed below, are particles are wildfires, other fires, transport of particles, or dusts. For reducing exposure to particle pollution, discussed below, are particles are wildfires, other fires, transport of particles, or dusts. For reducing exposure to particle pollution, discussed below, are particles are wildfires, other fires, transport of particles, or dusts.

Portions of the text in the following sections are adapted from the document "Guidance for Public Health Officials (May 2016)" which is designed to help local public health officials

Consistent with Wildfire Smoke  
A Guide for Public Health Officials



# Why a Course for Clinicians?

- Part of CDC's Behavioral Risk Factor and Surveillance System of health related telephone surveys
  - In 2005 six states included questions about how environmental factors and the AQI affect people's activity levels
  - The states: Colorado, Florida, Indiana, Kansas, Massachusetts, and Wisconsin
- Results highlights:
  - **People with lifetime asthma** were almost twice as likely to report a change in activity based on an air quality alert if they had been advised by a healthcare professional to do so (Wen et al., 2009)
  - **People without asthma** were than three times as likely to report such a change, if they had been advised by a healthcare professional to do so. (Wen et al., 2009)
  - **In Kansas**, people were almost four times as likely to change outdoor activity levels if they were advised by a healthcare professional.
  - BUT: only a small percentage of people in groups considered to be at increased risk from particle pollution reported that healthcare professionals had advised them to pay attention to the AQI. (Kansas Department of Health and Environment, 2006).

# PM Web Course Outreach Materials

Free CME, CNE, and CEU  
Training for healthcare professionals

## Particle Pollution and Your Patients' Health Web Course


An extensive body of scientific evidence shows exposure to fine particle pollution may lead to a range of adverse health effects, including heart and lung effects, and even premature death. This course will provide health professionals with knowledge they can share with patients to help reduce overall risk of particle pollution-related health effects, particularly in individuals with heart and lung disease.



 [www.epa.gov/pmcourse](http://www.epa.gov/pmcourse)

## Particle Pollution and Your Patients' Health Web Course



Free evidence-based training for healthcare professionals




CNE CEU CME

[www.epa.gov/pmcourse](http://www.epa.gov/pmcourse)

Learn about the health risks of exposure to ambient particle pollution and how to reduce your patients' exposure using the Air Quality Index.

-  **Cardiovascular effects of particle pollution:** can cause a heart attack, irregular heartbeat, stroke, exacerbation of heart failure, and early death in people with heart disease.
-  **Respiratory effects of particle pollution:** can trigger an asthma attack, aggravate other lung diseases, and impact lung development in children.



 United States Environmental Protection Agency

[https://www.airnow.gov/index.cfm?action=health\\_providers.index](https://www.airnow.gov/index.cfm?action=health_providers.index)



# Downloadable Factsheets for Heart and Lung Disease

## In English and Spanish

### ASTHMA AND OUTDOOR AIR POLLUTION

**1 Air pollution can make asthma symptoms worse and trigger attacks.**

If you or your child has asthma, have you ever noticed symptoms get worse when the air is polluted? Air pollution can make it harder to breathe. It can also cause other symptoms, like coughing, wheezing, chest discomfort, and a burning feeling in the lungs.

Two key air pollutants can affect asthma. One is *ozone* (found in smog). The other is *particle pollution* (found in haze, smoke, and dust). When ozone and particle pollution are in the air, adults and children with asthma are more likely to have symptoms.

**2 You can take steps to help protect your health from air pollution.**

► **Get to know how sensitive you are to air pollution.**




- Notice your asthma symptoms when you are physically active. Do they happen more often when the air is more polluted? If so, you may be sensitive to air pollution.

- Also notice any asthma symptoms that begin up to a day *after* you have been outdoors in polluted air. Air pollution can make you more sensitive to asthma triggers, like mold and dust mites. If you are more sensitive than usual to indoor asthma triggers, it could be due to air pollution outdoors.

► **Know when and where air pollution may be bad.**

- Ozone is often worst on hot summer days, especially in the afternoons and early evenings.
- Particle pollution can be bad any time of year, even in winter. It can be especially bad when the weather is calm, allowing air pollution to build up. Particle levels can also be high:
  - Near busy roads, during rush hour, and around factories.
  - When there is smoke in the air from wood stoves, fireplaces, or burning vegetation.

Asthma

### Heart Disease, Stroke, and Outdoor Air Pollution

**1 Did you know that air pollution can trigger heart attacks, stroke, and other health effects?**

Medical studies show that air pollution can trigger heart attacks, stroke, and irregular heart rhythms—especially in people who are already at risk for these conditions. Also, for people with a medical condition called heart failure, air pollution can further reduce the ability of the heart to pump blood the way that it should. Very small particles are the pollutants of greatest concern for triggering these effects. Particle pollution is found in haze, smoke, and dust—and sometimes in air that looks clean. This fact sheet tells you how you can:

- Get up-to-date information about your local air quality.
- Protect your health when particle pollution is at unhealthy levels.

**2 Are you at higher risk?**

Older adults and people with risk factors for heart disease or stroke may be at greater risk. You are at greater risk if you:

- Have had a heart attack, angina, bypass surgery, angioplasty with or without a stent, a stroke, blockages in the neck or leg arteries, heart failure, heart rhythm problems, diabetes, or chronic obstructive lung disease.

You may be at greater risk of heart disease or stroke (and therefore at greater risk from particle pollution) if any of these apply:

- You are a man 45 years or older, or a woman 55 years or older.
- You have a family history of stroke or early heart disease (father or brother diagnosed before age 55; mother or sister diagnosed before age 65).
- You have high blood pressure or high blood cholesterol.
- You are overweight or not physically active.
- You smoke cigarettes.

**3 How can you protect your health?**

Regular exercise is important for staying healthy, especially if you have heart disease. By adjusting when and where you exercise, you can lead a healthier lifestyle and help reduce your risk of heart problems or stroke triggered by air pollution. In addition:

- If you have heart disease or have experienced a stroke, check with your health care provider about the best ways to protect your health when the air quality is unhealthy.
- If you're at risk of heart disease or stroke and plan to exercise more than usual, discuss this with your health care provider.

► **Know when and where particle pollution levels may be unhealthy.**

Particle pollution levels can be high any time of year. Particle levels can also be high:

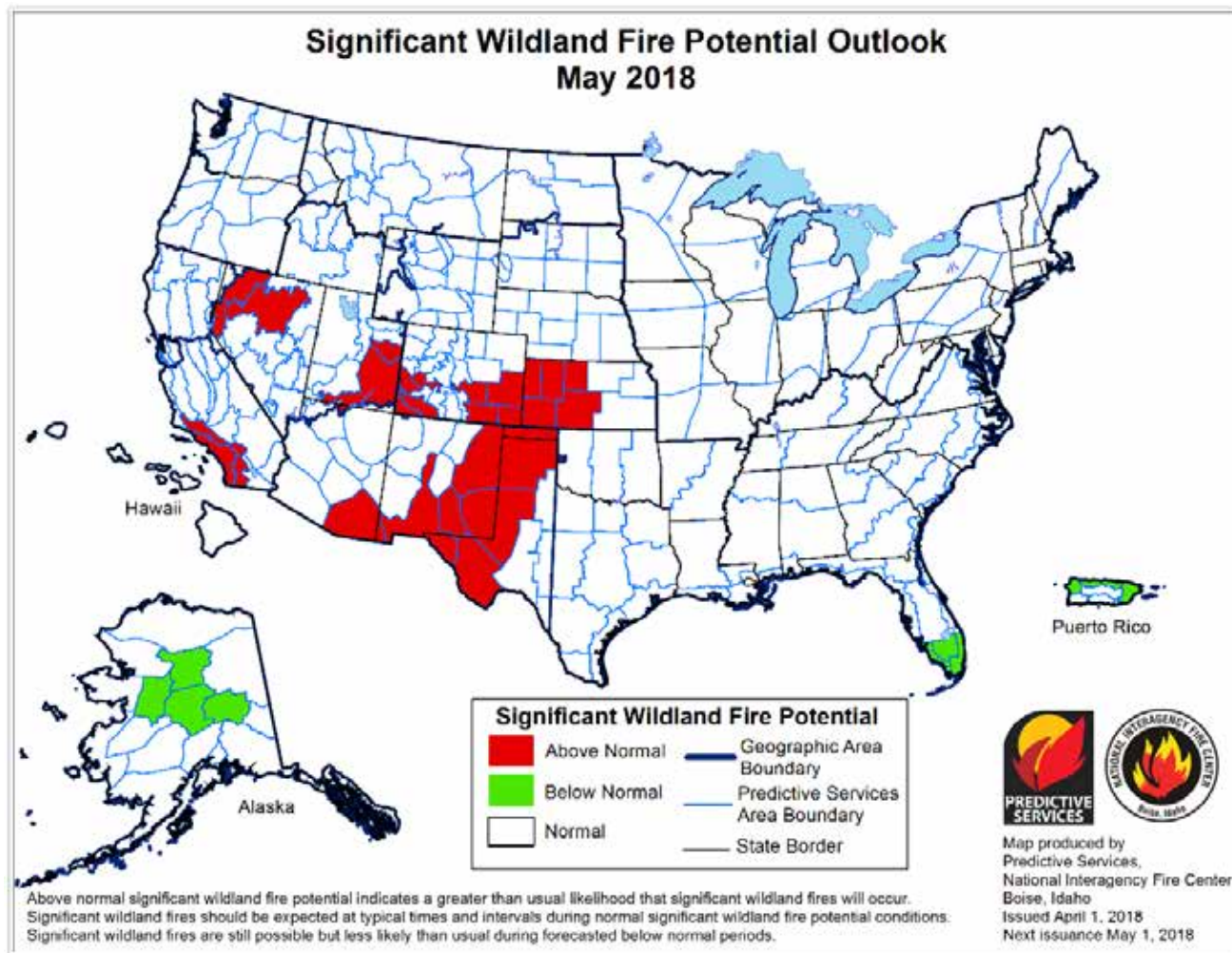
- Near busy roads, in urban areas (especially during rush hour), and in industrial areas.
- When there is smoke in the air from wood stoves, fireplaces, burning vegetation, or forest fires.

Cardiovascular Disease – February 2016

<https://www3.epa.gov/airnow/asthma-flyer.pdf>

<https://www3.epa.gov/airnow/heartflyer.pdf>

# Important Planning Tool



National Interagency Fire Center (NIFC) – updated monthly; current predictions through July 2018

<https://www.predictiveservices.nifc.gov/outlooks/outlooks.htm>

# Sensor Concentration $\neq$ Air Quality Index

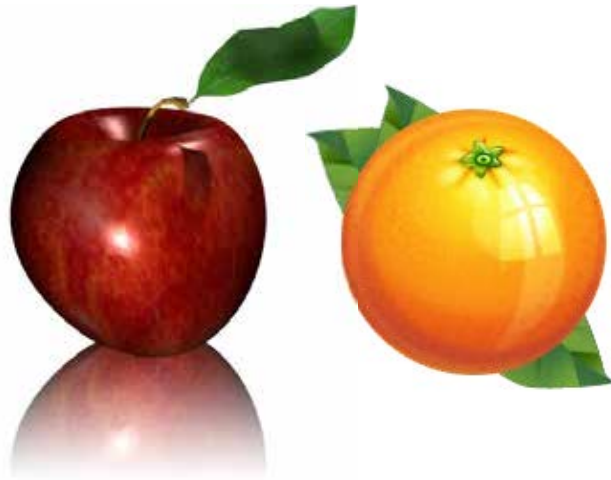


**Sensor Reading**

**Concentration**

**Short term  
(e.g. 1-minute)**

**Data Quality  
Unknown**



**Air Quality Index**

**Index Value &  
Color**

**Averaged (e.g. 8-  
hour, 24-hour)**

**Data Quality  
Assured**

# Air Resource Advisors: *Forecasting Wildfire Smoke*



Ali Kamal, PhD | Health Scientist  
Health & Environmental Impacts Division  
Office of Air Quality Planning & Standards  
U.S. Environmental Protection Agency

May 2, 2018



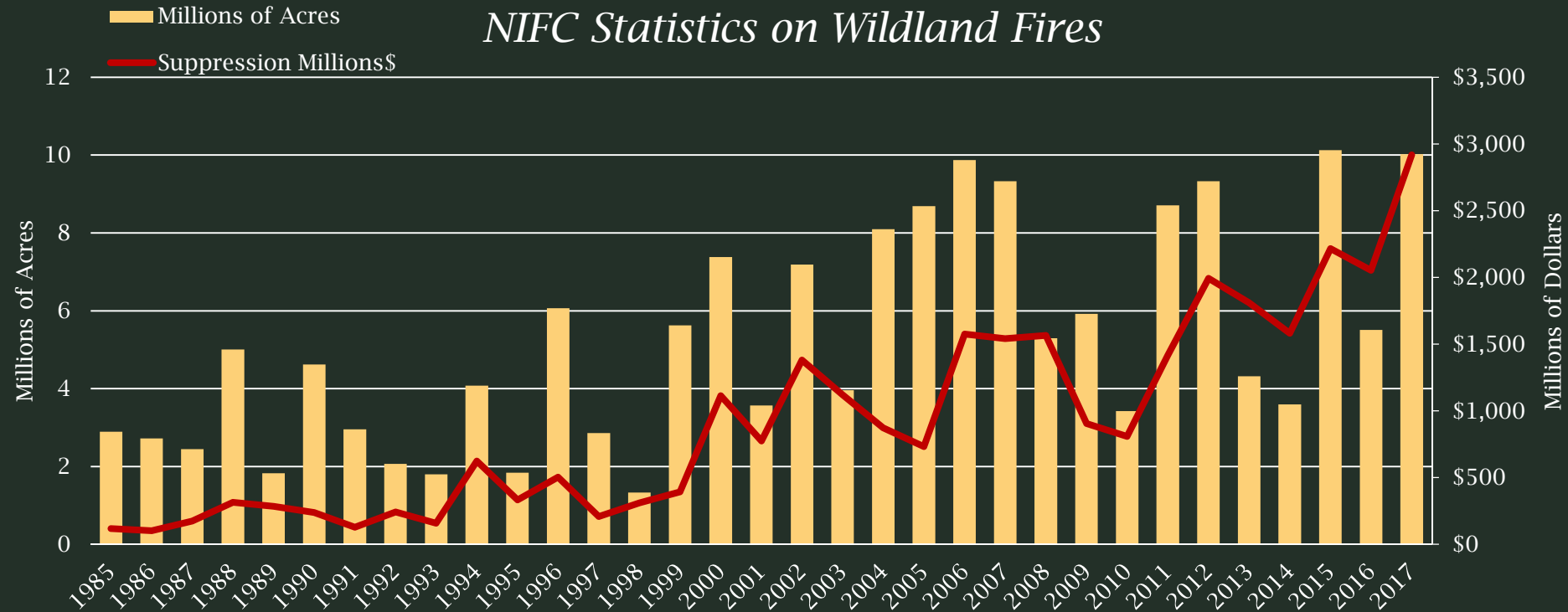
# Introduction to the ARA Program

- What is the Air Resource Advisor (ARA) Program?
- What does an ARA do?



# Introduction to the ARA Program

-Between 2005 and 2014, 6.4 Million Acres Burned on average in the US, in 2015, +10 Million Acres Burned, 2017 costs highest on record

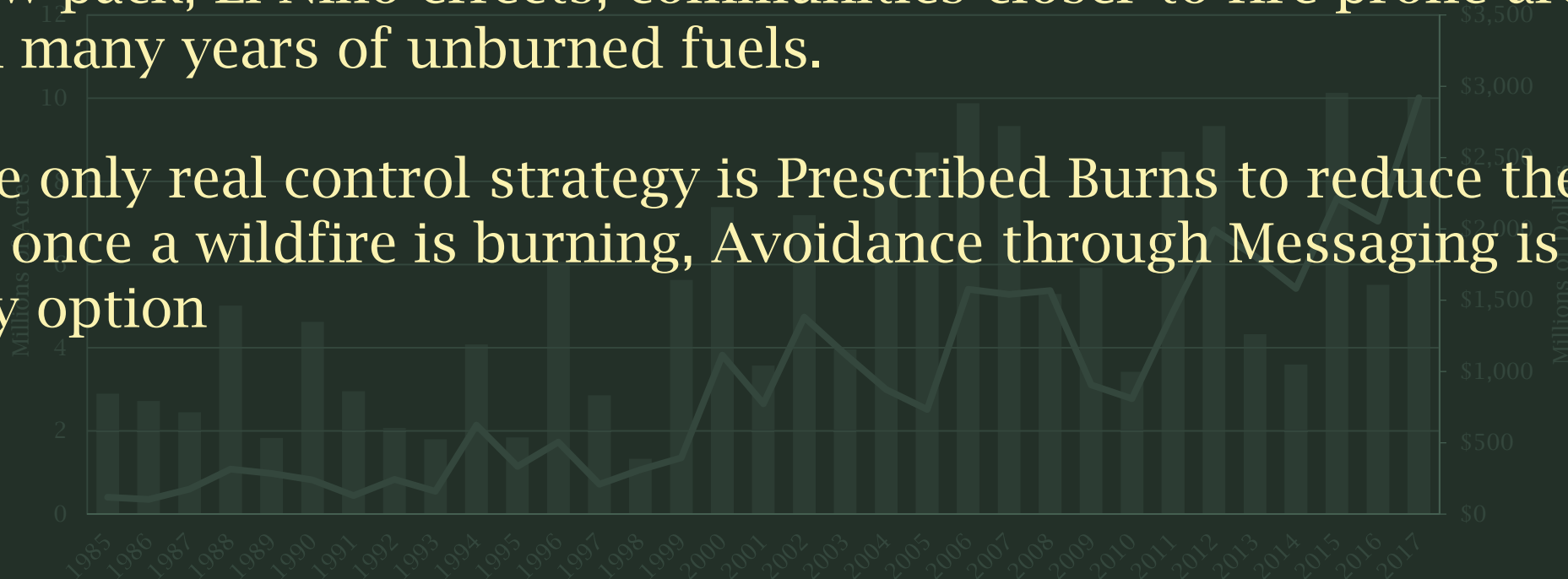


# Introduction to the ARA Program

- Between 2005 and 2014, 6.4 Million Acres Burned on average in the US, in 2015, +10 Million Acres Burned, 2017 costs highest on record

- The fire season is getting longer, drier and hotter summers, less snow pack, El Niño effects, communities closer to fire-prone areas, and many years of unburned fuels.

- The only real control strategy is Prescribed Burns to reduce the risk, but once a wildfire is burning, Avoidance through Messaging is the only option



# The Need for ARAs

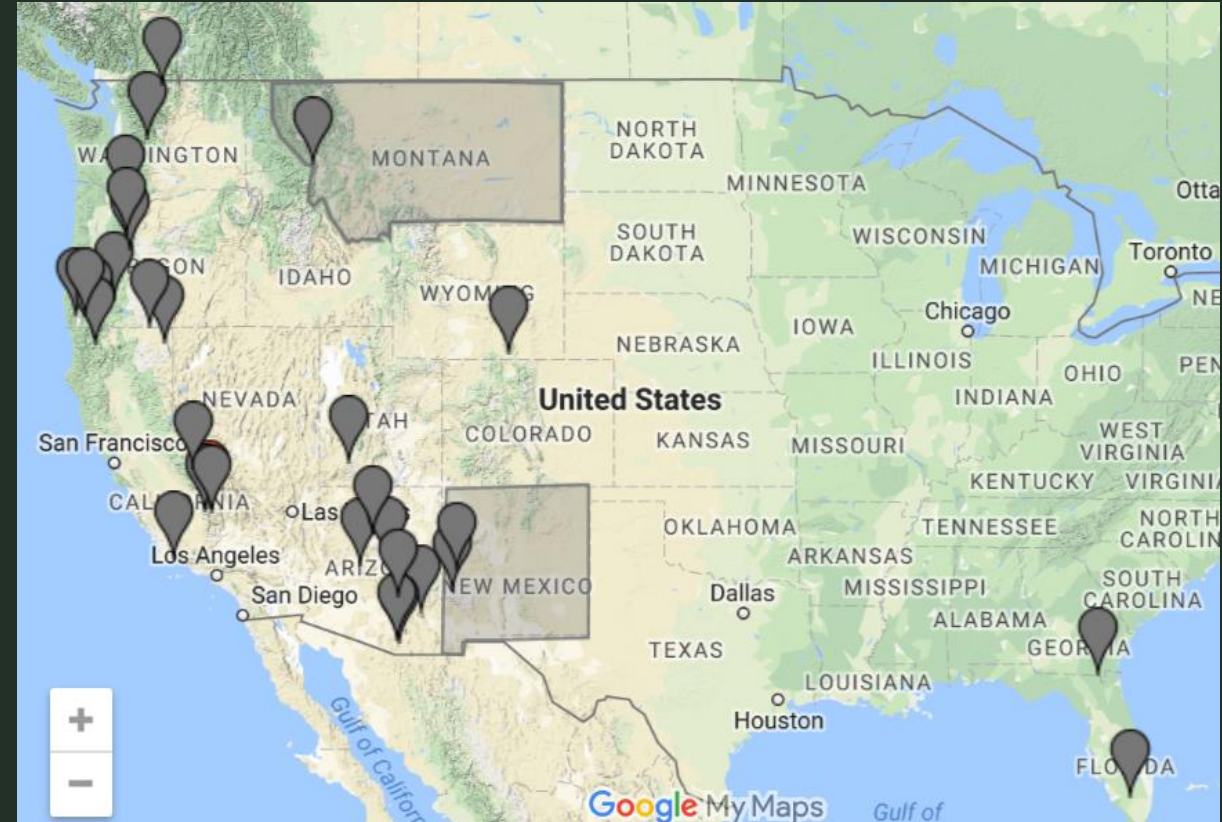


- Air quality early-warnings are effective at protecting at-risk populations (AirNow, AQI, Wildfire Smoke Guide)
- ARAs are dispatched to predict smoke impacts on the public & fire crews
- ARAs relay smoke information to the public to mitigate smoke exposure



# ARA Deployments

- Number of ARAs Dispatched
  - 2017: 101
  - 2016: 55
  - 2015: 40
  - 2014: 39
  - 2013: 25
  - 2012: 13
- More than 1200 Daily Smoke Forecasts were produced in 2017



# What does an ARA do?

## Modeling

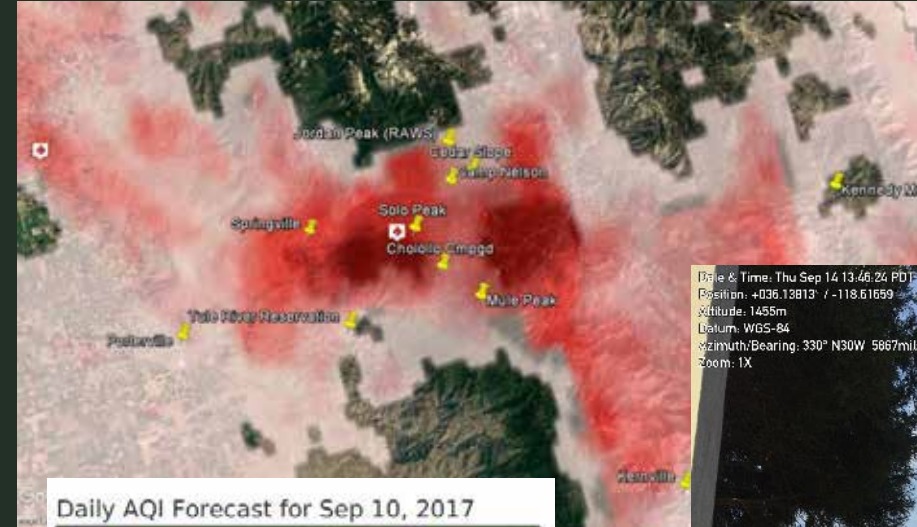
- Smoke Impacts (BlueSky)
- Hysplit/Playground 2.0

## Monitoring

- Real-Time PM Monitoring
- Observing Fire Behavior

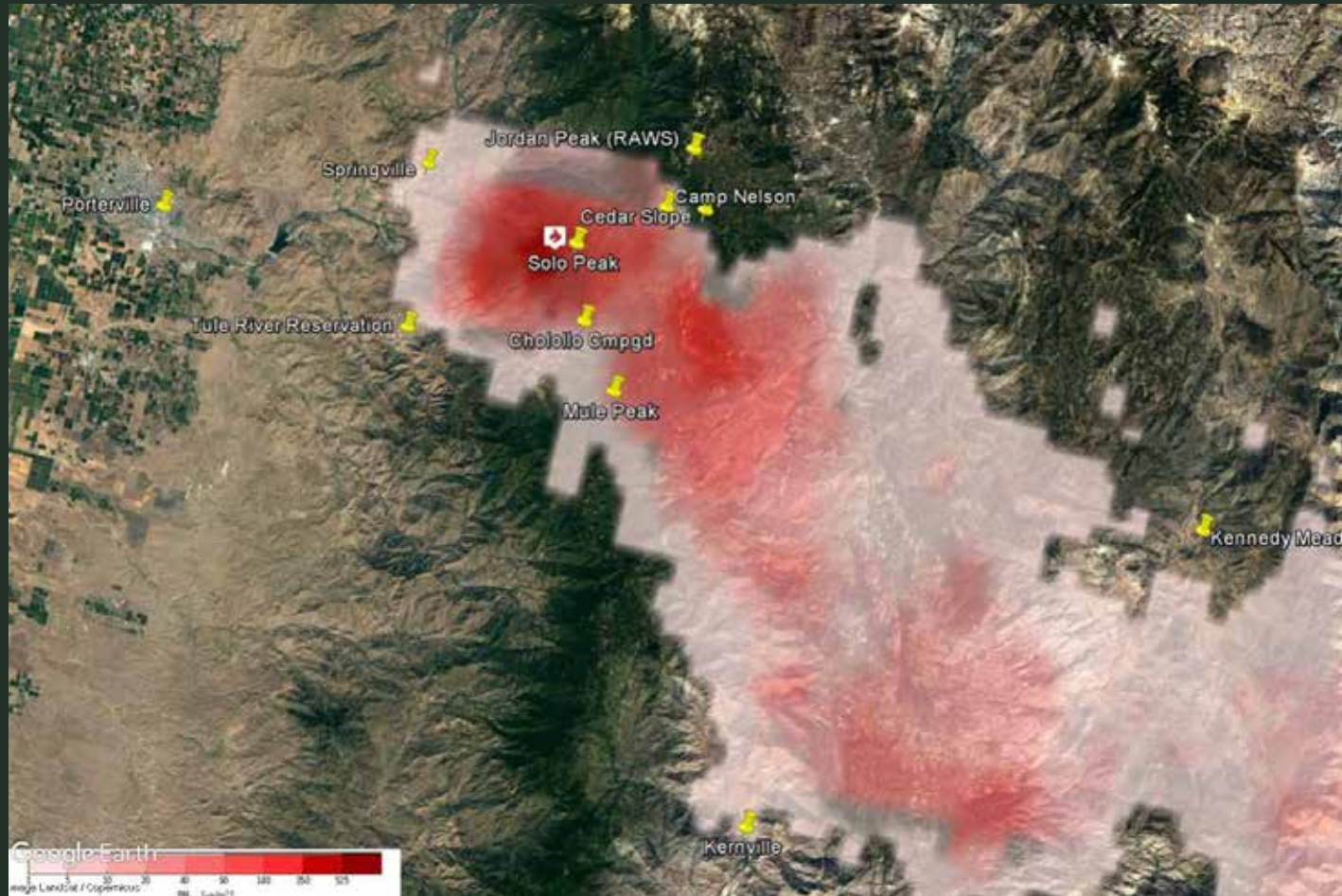
## Messaging

- Smoke Forecasts
- Meeting/Briefings





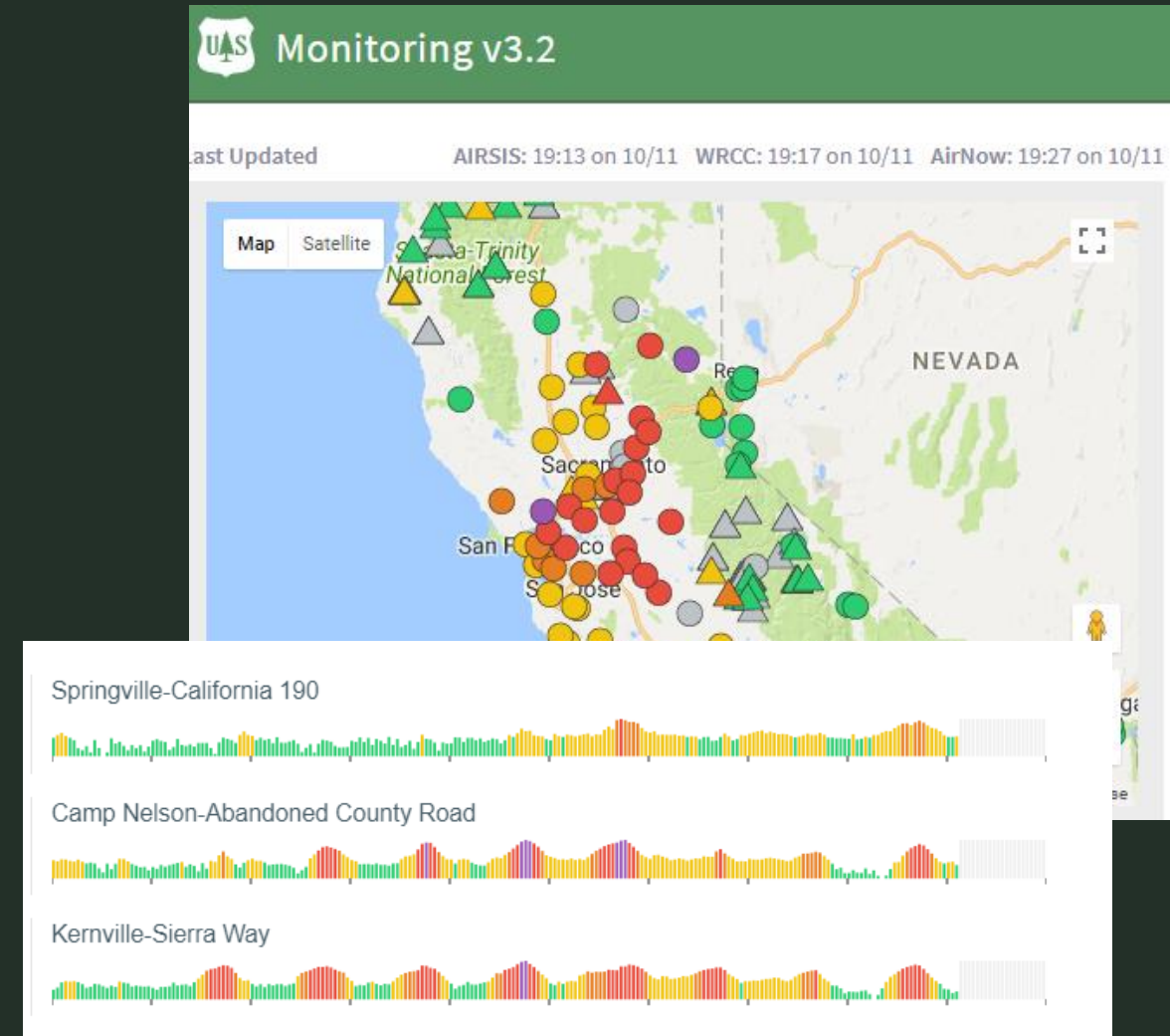
# Modeling: Projecting the Path of Smoke



- Meteorological Data
- Infrared Satellite Data
- 72 Hour Projections
- Help ARAs forecast the smoke for the next 1 to 2 days

# Monitoring: Smoke Observations

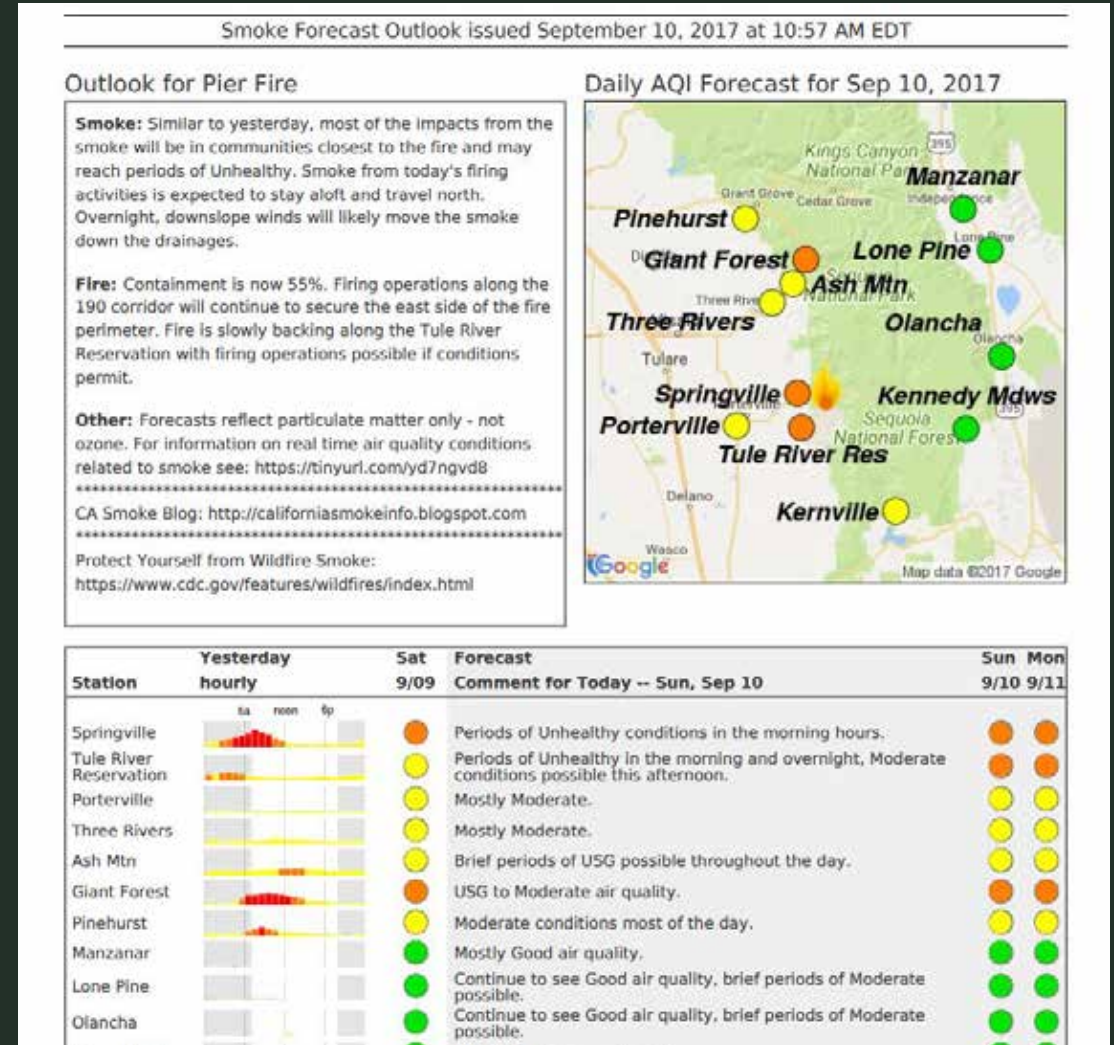
- Determine the siting of PM<sub>2.5</sub> monitors to track the smoke near at-risk communities
- Hourly PM<sub>2.5</sub> data is uplinked by satellite and accessible in an online database
- Observe day/night trends and how smoke behaves in downwind communities





# Messaging

- Daily Smoke Forecasts provide communities with expected smoke impacts
- Public can then make informed decisions on when to go outside and when to take shelter



# ARAs and the Public

- Social Media (Facebook/Twitter)
- Air Quality Blogs/Inciweb
- Reach Out to Local Groups
- *Inform* Incident Commanders
- Attend Public Meetings
- Available to Answer Questions
- Go out and talk to people!





Thank you  
wildlandfiresmoke.net

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