Using the Air Quality Index In Emergency Events Such As Fires

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Air Quality Index (AQI)

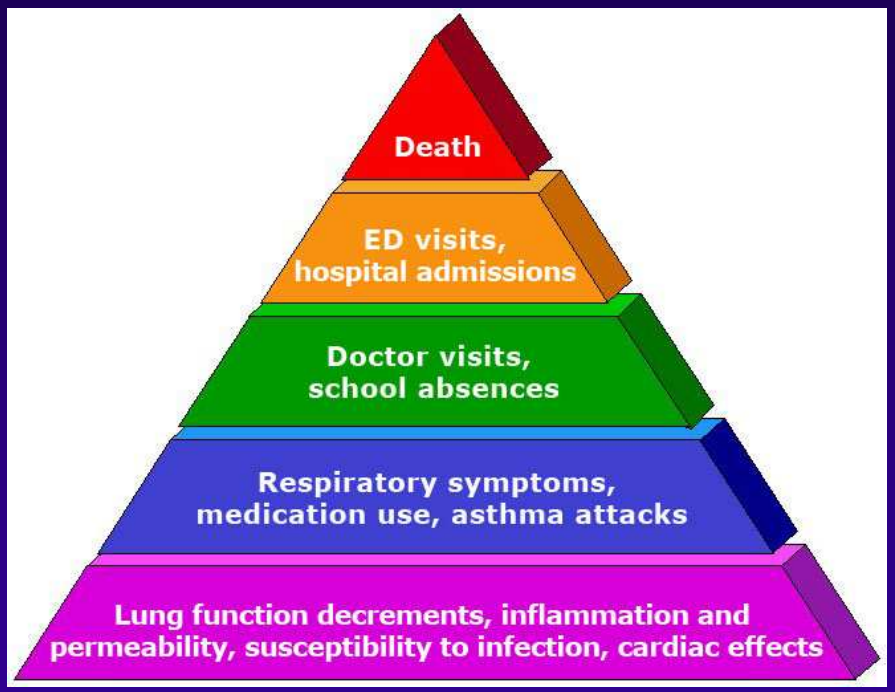
- Daily information about air quality and health risks, if any
- Normalized scale (0 – 500), the higher the value the greater the health risk
- Four common pollutants: O_3; PM; SO_2 and CO
- Based on the health information from the review of the national ambient air quality standards (NAAQS)
- Available through national and local media

Health Effects Assessment

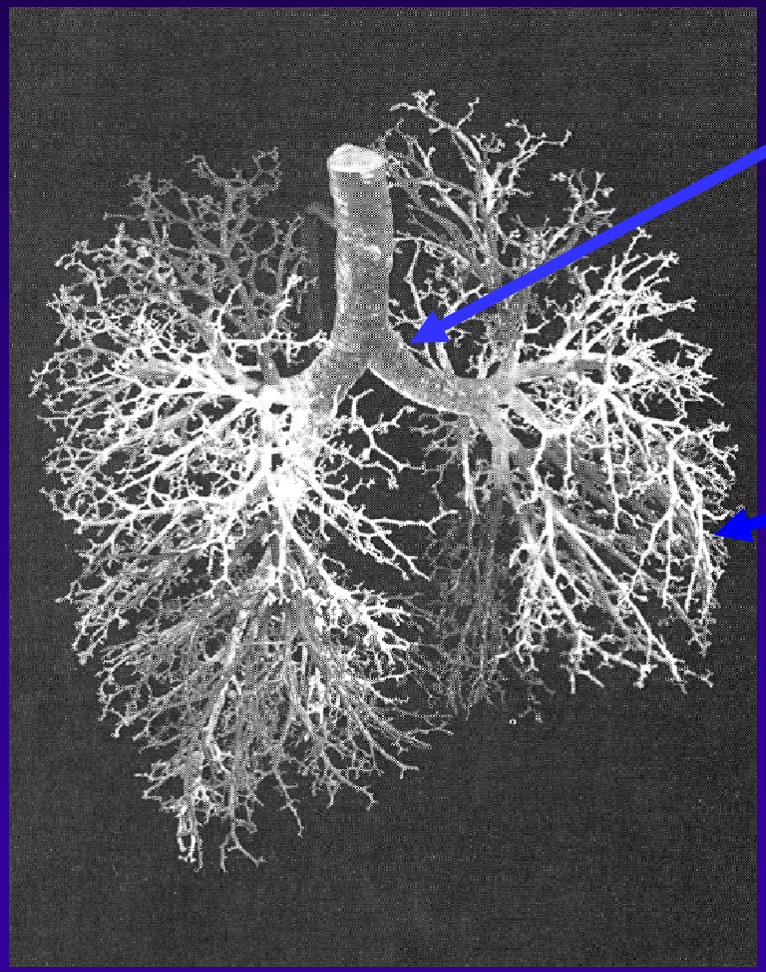
- Types of studies
  - Epidemiology/Field
    - Real-world exposures, including sensitive groups
    - Serious and chronic effects assessed
    - Confounders not controlled
  - Controlled human exposure
    - Exposures and confounders controlled
    - Healthy subjects; few members of sensitive groups
  - Animal
    - Exposures and confounders controlled
    - Extrapolation to humans; high dose exposures
- Consistency and coherence of data

“Pyramid of Effects”

- Consistent and coherent effects seen across a wide range of health outcomes
- Sensitive groups for PM include:
  - People with heart or lung disease
  - Older adults
  - Children

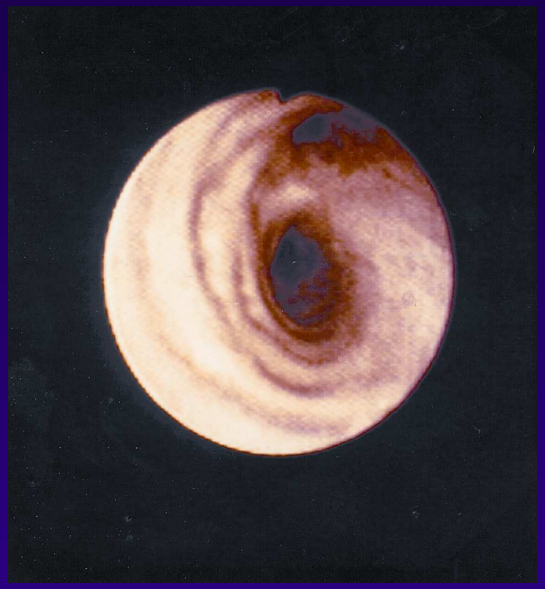


Human Lung



- Air conducting
  - Trachea
  - Bronchi
  - Bronchiole
- Gas exchange
  - Respiratory bronchiole
  - Alveoli

Particulate Matter Affects the Lungs



You are exposed to particles simply by breathing polluted air

Exposure increases when you exercise, because you breathe more vigorously and deeply than usual

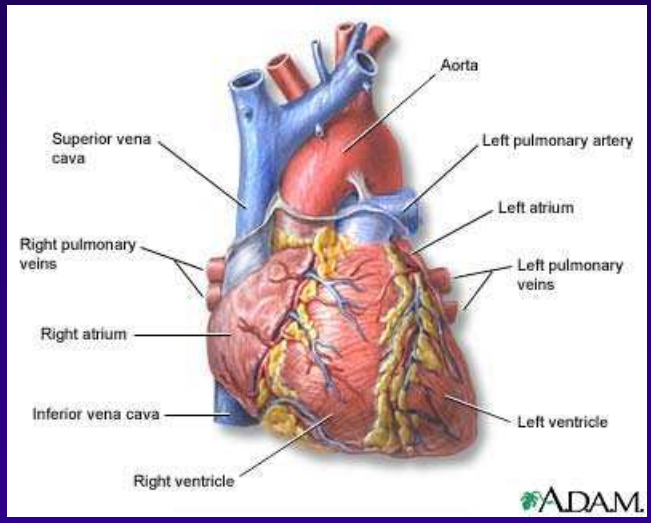
Respiratory effects include:

- Airway irritation
- Cough
- Phlegm
- Decreased lung function
- Airway inflammation
- Asthma attacks
- Bronchitis and chronic bronchitis

And Particulate **Matter** Affects the Heart

Particles have been linked to changes that indicate your heart isn't as healthy as it should be. These include:

- Arrhythmias and changes in heart rate
- Changes in the variability of your heart rate
- Blood component changes
    - C-reactive protein
    - Fibrinogen
    - Plasma viscosity
- Changes in vascular endothelial function
- Studies indicate that particle exposure can cause heart attacks
- Particles are linked with death from heart disease

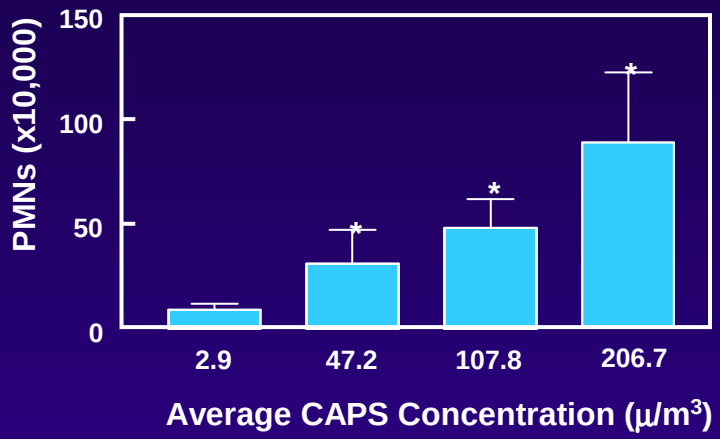


Particle exposure can cause heart attacks.

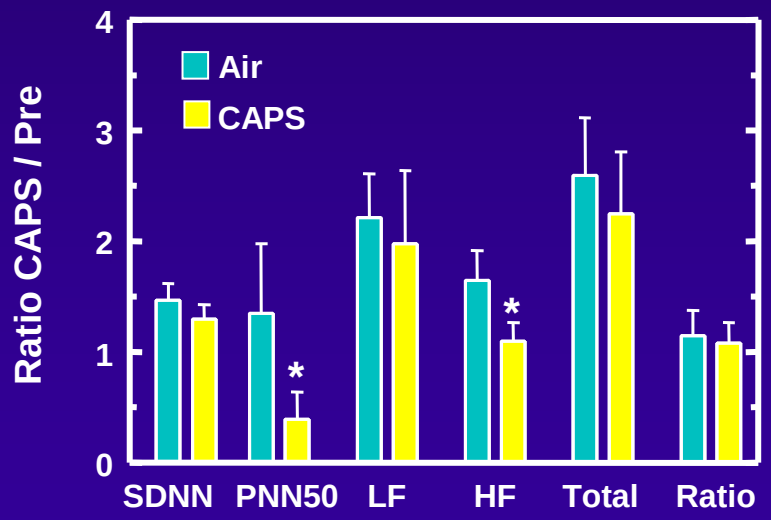
It’s a Public Health Concern

- When particles aggravate heart and lung diseases that means increases in:
  - Hospital admissions
  - Doctor and emergency room visits
  - Medication use
  - Absences from work or school
- Particulate matter is linked to significant public health risks – including premature death from heart and lung disease.
- Sensitive groups include: people with heart or lung disease, older adults, children

PM Can Cause Effects in Healthy People



Ghio et al., 2003



Devlin et al., 2003

Air Quality Index

Descriptors	Cautionary Statements
Good 0 – 50	No message
Moderate 51 – 100	Unusually sensitive individuals
USG 101 - 150	Identifiable groups at risk - different groups for different pollutants
Unhealthy 151 - 200	General public at risk; sensitive groups at greater risk
Very Unhealthy 201 - 300	General public at greater risk; sensitive groups at greatest risk
Hazardous 301 - 500	Health warnings of emergency conditions

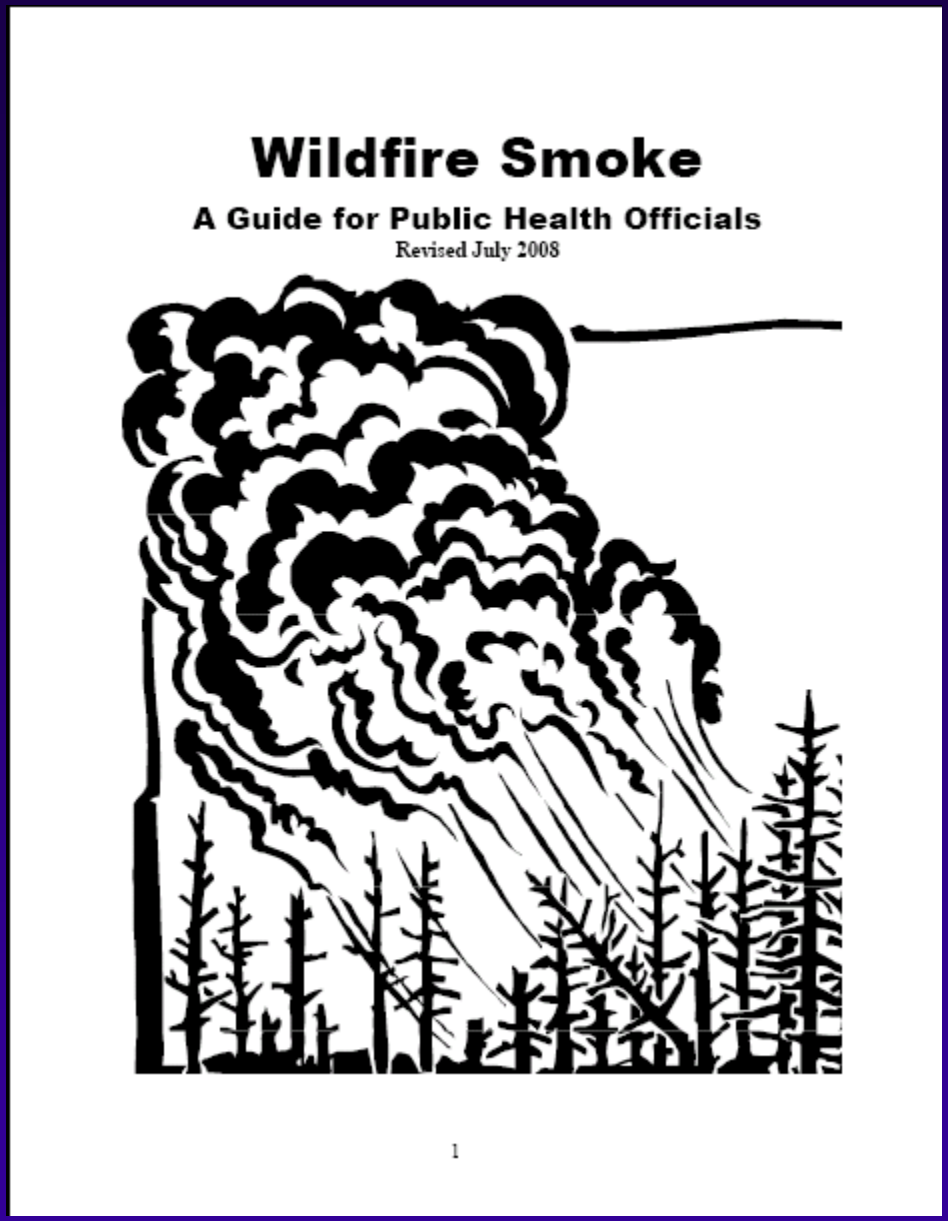
NAAQS

Use AQI to Reduce Risk

Dose = Concentration x Ventilation Rate x Time

- Reduce these factors to reduce dose
- Pay attention to symptoms
- People with asthma – follow asthma action plan
- Coaches – rotate players frequently
- People with heart disease
  - Check with your doctor
  - Don’t exercise near busy roads

- Revised July 2008
- Multi-agency collaboration
  - CA Department of Public Health
  - Office of Environmental Health Hazard Assessment
  - Air Resources Board
  - Missoula County Department of Health
  - US Environmental Protection Agency



Sections on:

Composition and characteristics of smoke

Health Effects and sensitive populations

Strategies to reduce exposure

Estimating PM levels

Recommendations for public health actions

Health effects of smoke

The effects of smoke range from eye and respiratory tract irritation to more serious disorders, including reduced lung function, bronchitis, exacerbation of asthma, and premature death. Studies have found that fine particles are linked (alone or with other pollutants) with increased mortality and aggravation of pre-existing respiratory and cardiovascular disease. In addition, particles are respiratory irritants, and exposures to high concentrations of particulate matter can cause persistent cough, phlegm, wheezing, and difficulty breathing. Particles can also affect healthy people, causing respiratory symptoms, transient reductions in lung function, and pulmonary inflammation. Particulate matter can also affect the body's immune system and the physiological mechanisms that remove inhaled foreign materials from the lungs, such as pollen and bacteria. As noted earlier, particulate matter exposure is the principal public health threat from short-term exposures to wildfire smoke.

Carbon monoxide (CO) enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. CO concentrations typical of population exposures related to wildfire smoke do not pose a significant hazard, except to some sensitive individuals and to firefighters very close to the fire line. Individuals who may experience health effects from lower levels of CO are those who have cardiovascular disease: they may experience chest pain and cardiac arrhythmias. At higher levels (such as those that occur in major structural fires), CO exposure can cause headache, weakness, dizziness, confusion, nausea, disorientation, visual impairment, coma, and death, even in otherwise healthy individuals.

Wildfire smoke also contains significant quantities of respiratory irritants, which can act in concert to produce eye and respiratory irritation and potentially exacerbate asthma. Formaldehyde and acrolein are two of the principal contributors to the cumulative irritant properties of smoke.

One concern that may be raised by members of the general public is whether they run an increased risk of cancer or of other chronic health conditions (e.g. heart disease) from short-term exposure to wildfire smoke. People exposed to toxic air pollutants at sufficient concentrations and durations may have slightly increased risks of cancer or of experiencing other chronic health problems. However, in general, the long-term risks from short-term smoke exposures are quite low. Short-term elevated exposures to wildfire carcinogens are also small relative to total lifetime exposures to carcinogens in diesel exhaust and other combustion sources. Epidemiological studies have shown that urban firefighters exposed to smoke over an entire working lifetime have about a three-fold increased risk of developing lung cancer (Hansen 1990). This provides some

Strategies for Reducing Exposure

- Stay indoors
- Reduce activity
- Indoor air
  - Reducing indoor sources of pollution
  - Using air conditioners and room air cleaners
  - Creating a clean room
  - Avoiding ozone generators
  - Using humidifiers
- Inside vehicles
- Respiratory protection
- Cleaner air shelters
- Closures
- Evacuation

breathing. These can result in school absences and other limitations of normal childhood activities.

Pregnant women. While there have not been studies of the effects of exposure to wildfire smoke on pregnancy outcomes, there is substantial evidence of adverse effects of repeated exposures to cigarette smoke, including both active and passive smoking. Wildfire smoke contains many of the same compounds as cigarette smoke. In addition, recent data suggest that exposures to ambient air pollution in cities may result in low birth weight, preterm birth, and possibly other more serious adverse reproductive effects, including infant mortality. Therefore, it would be prudent to consider pregnant women as a potentially susceptible population as well.

Smokers. People who smoke, especially those who have smoked for many years, have compromised lung function. However, due to adaptation of their lungs to ongoing irritation, smokers are generally less likely to report symptoms from exposure to irritant chemicals than are nonsmokers. Nevertheless, they may still be injured by wildfire smoke. Therefore, because they may not experience the same degree of irritation from wildfire smoke as nonsmokers, some smokers may unwittingly put themselves at greater risk of potentially harmful wildfire smoke exposures.

Specific strategies to reduce smoke exposure

Stay indoors

The most common advisory issued during a smoke episode is to stay indoors. The usefulness of this strategy depends on how well the building limits smoke from coming in from outdoors and on minimizing indoor pollution sources. Staying indoors may therefore provide some protection, especially in a tightly closed, air-conditioned home in which the air conditioner re-circulates indoor air. Generally, newer homes are "tighter" and keep ambient air pollution out more effectively than older homes.

Staying inside with the doors and windows closed can usually reduce exposure to ambient air pollution by about a third or more. Homes with central air conditioning generally re-circulate indoor air, though some outdoor smoky air can still be drawn inside (e.g., when people enter or exit). In homes without air conditioning, indoor concentrations of fine particles can approach 70 to 100 percent of the outdoor levels. In very leaky homes and buildings, outdoor particles can easily infiltrate indoors, so guidance to stay inside may

- New section on use of disposable respirators – from California DPH
- These should not be used to increase time outdoors
- Includes instructions on mask choice and use
- Fact sheet for dissemination

Environmental Health Investigations Branch • California Department of Public Health

Protect Your Lungs from Wildfire Smoke

N95 respirators can help protect your lungs from wildfire smoke. Straps must go above and below the ears.

A one-strap paper mask will NOT protect your lungs from wildfire smoke.

A surgical mask will NOT protect your lungs from wildfire smoke.

Wildfire smoke can irritate your eyes, nose, throat and lungs. It can make you cough and wheeze, and can make it hard to breathe. If you have asthma or another lung disease, or heart disease, inhaling wildfire smoke can be especially harmful.

If you cannot **leave** the smoky area, good ways to protect your lungs from wildfire smoke include staying indoors and reducing physical activity. Wearing a special mask called a **"particulate respirator"** can also help protect your lungs from wildfire smoke.

How to Choose the Correct Mask to Protect Your Lungs

- Choose a mask called a **"particulate respirator"** that has the word **"NIOSH"** and either **"N95"** or **"P100"** printed on it. These are sold at many hardware and home repair stores and pharmacies.
- Choose a mask that has **two straps** that go around your head. **DO NOT** choose a mask with only one strap or with straps that just hook over the ears.
- Choose a size that will fit over your nose and under your chin. It should seal tightly to your face. These masks do not come in sizes that fit young children.
- Do not use bandanas (wet or dry), paper or surgical masks, or tissues held over the mouth and nose. These will not protect your lungs from wildfire smoke.

How to Use a Mask

- Place the mask over your nose and under your chin, with one strap placed below the ears and one strap above.
- Pinch the metal part of the mask tightly over the top of your nose.
- The mask fits best on clean shaven skin.
- Throw out your mask when it gets harder to breathe through, or if the inside gets dirty. Use a new mask each day if you can.
- It is harder to breathe through a mask, so take breaks often if you work outside.
- If you feel dizzy or nauseated, go to a less smoky area, take off your mask and get medical help.
- If you have a heart or lung problem, ask your doctor before using a mask.

For more information about protecting yourself from wildfire smoke, call your local health department.

June 30, 2008

Table 3 Recommended Actions for Public Health Officials[2,3]

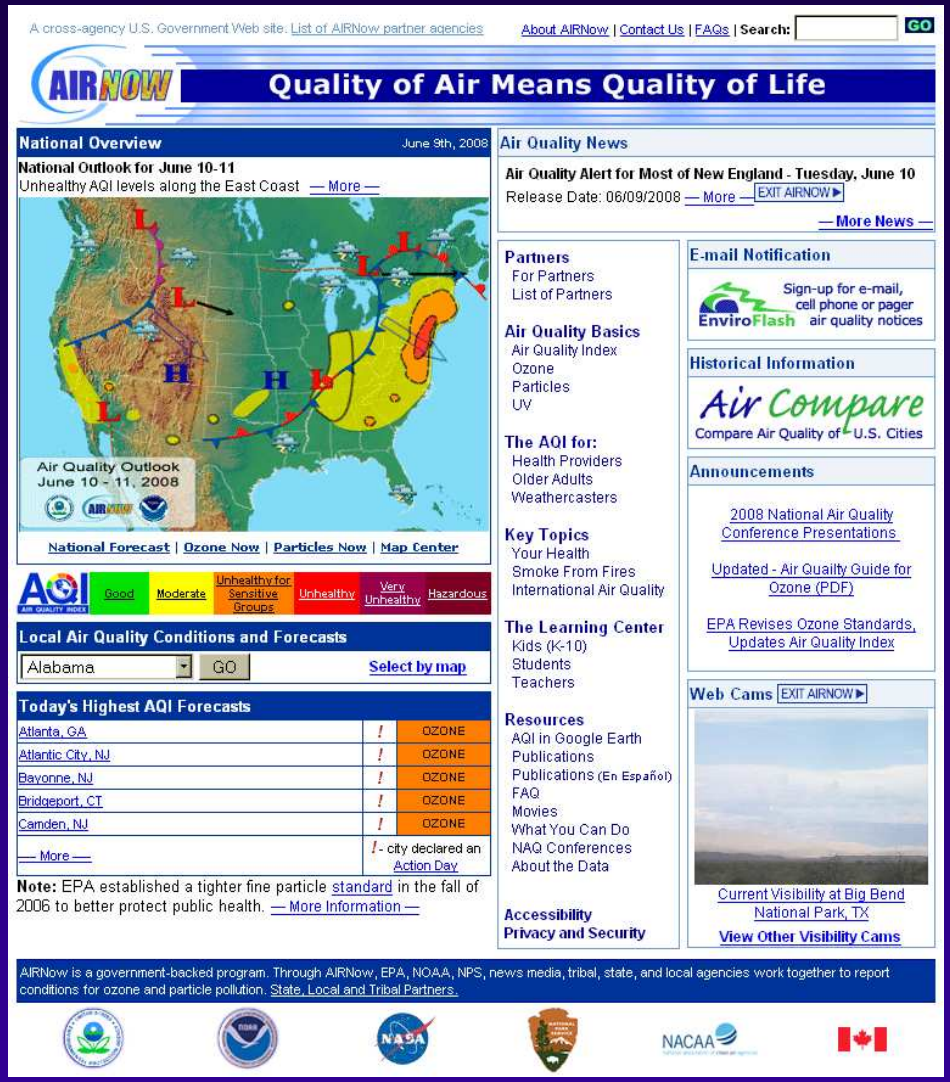
AQI Category (AQI Values)	$PM_{2.5}$ or PM_{10} Levels ($\mu g/m^3$, 1- to 3-hr avg.)	$PM_{2.5}$ or PM_{10} Levels ($\mu g/m^3$, 8-hr avg.)	$PM_{2.5}$ or PM_{10} Levels ($\mu g/m^3$, 24-hr avg.)	Visibility - Arid Conditions (miles)	Recommended Actions
Good (0 to 50)	0 – 38	0 – 22	0 – 15	≥ 11	If smoke event forecast, implement communication plan
Moderate (51 to 100)	39 – 88	23 – 50	16 – 35	6 – 10	• Issue public service announcements (PSAs) advising public about health effects and symptoms and ways to reduce exposure • Distribute information about exposure avoidance
Unhealthy for Sensitive Groups (101 to 150)	89 – 138	51 – 79	36 – 65	3 – 5	• If smoke event projected to be prolonged, evaluate and notify possible sites for cleaner air shelters • If smoke event projected to be prolonged, prepare evacuation plans
Unhealthy (151 to 200)	139 – 351	80 – 200	66 – 150	1.5 – 2.75	• Consider "Smoke Day" for schools (i.e., no school that day), possibly based on school environment and travel considerations • Consider canceling public events, based on public health and travel considerations
Very Unhealthy (201 to 300)	352 – 526	201 – 300	151 – 250	1 – 1.25	• Consider closing some or all schools (However, newer schools with a central air cleaning filter may be more protective than older, leakier homes. See "Closures", below.) • Cancel outdoor events (e.g., concerts and competitive sports)
Hazardous (> 300)	> 526	> 300	> 250	< 1	• Close Schools • Cancel outdoor events (e.g., concerts and competitive sports) • Consider closing workplaces not essential to public health • If PM level projected to continue to remain high for a prolonged time, consider evacuation of sensitive populations

[2] These 1- and 8-hr $PM_{2.5}$ levels are estimated using the 24-hr breakpoints of the PM2.5 Air Quality Index included in the February 7, 2007 issue paper (http://www.epa.gov/airnow/aqi_issue_paper_020707.pdf) by dividing the 24-hr concentrations by the following ratios: 8-hr ratio is 0.7, 1-hr ratio is 0.4. Visibility is based on 1-hr values. If only PM_{10} measurements are available during smoky conditions, it can be assumed that the PM_{10} is composed primarily of fine particles ($PM_{2.5}$), and that therefore the AQI and associated cautionary statements and advisories for $PM_{2.5}$ may be used. This assumption is reflected in the column headings for Table 3.

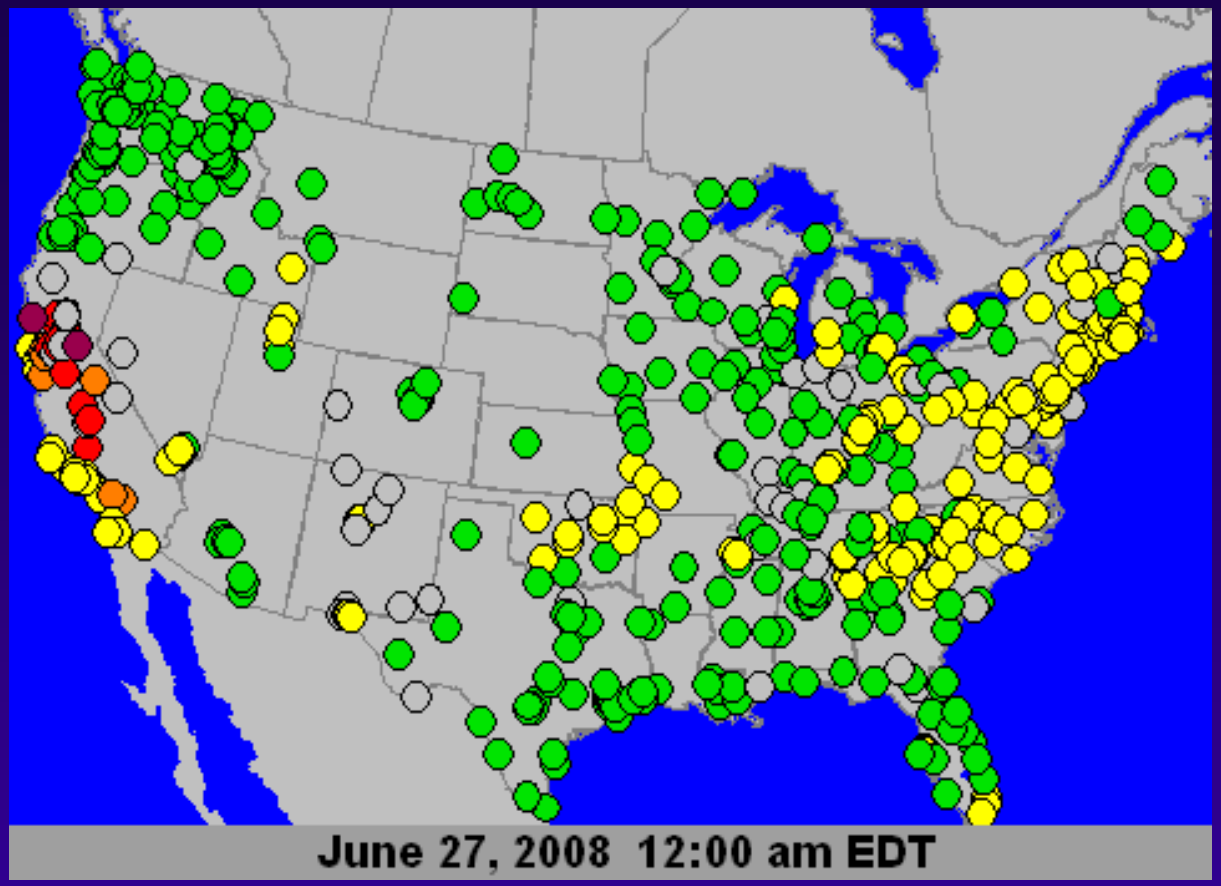
[3] Washington and Montana have developed more precautionary breakpoints, which can be found at: http://www.deq.mt.gov/FireUpdates/BreakpointsRevised.asp and http://www.ecy.wa.gov/programs/air/pdfs/WAQA.pdf

Recommended Actions for Public Health Officials

- Based on AQI values
  - With 3 different averaging times (i.e.,1- to 3-hour, 8-hour, and 24-hour)
- Actions include:
  - Public service announcements
  - Identifying cleaner air shelters
  - Closing schools and cancelling outdoor events
  - Evacuation
- Other considerations include:
  - Fluctuations in $PM_{2.5}$ levels
  - Predicted duration of high $PM_{2.5}$ levels
  - Potential indirect effects

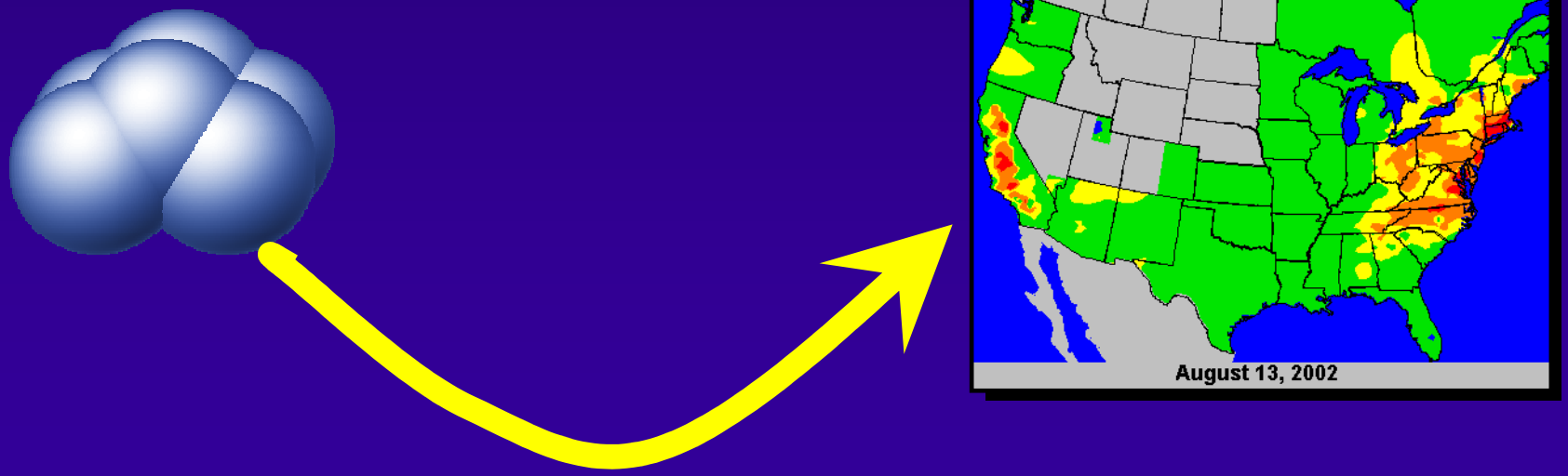


AIRNow Web site
www.airnow.gov



Near real-time $PM_{2.5}$ AQI levels

An Hour in the Life of an AIRNow Ozone Molecule



The journey begins…..

9:59:59

10:00:01

First stop: AQ Agency

89

34

76

67

39

101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AVG_TIME,          60
UNITS,            PPB
STATIONS,         1342
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WELLI             ,000020301,-999,-999,-999,-999,-999,-999,-999,-999
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OBS data file

Stats:

- 1200 monitors
- 78 agencies nationwide
- Collected every hour

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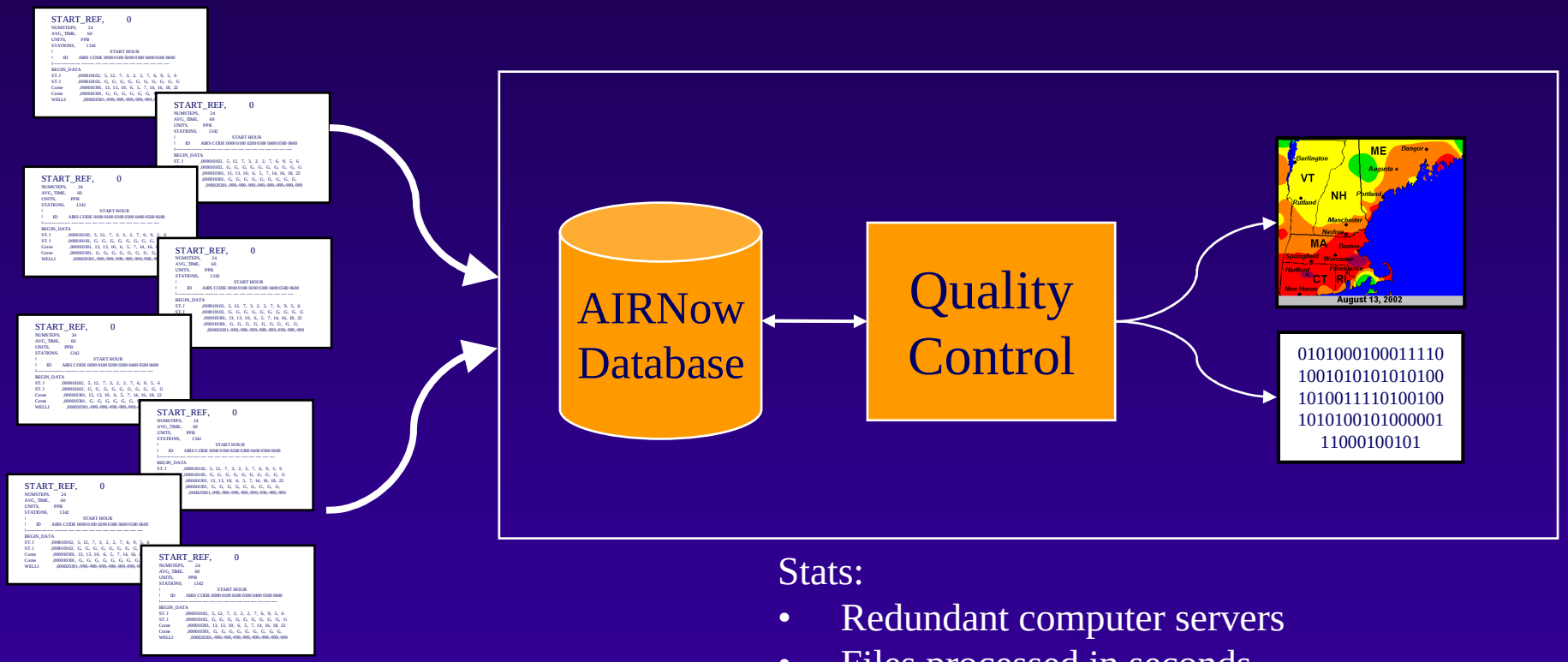
All roads lead to the DMC…



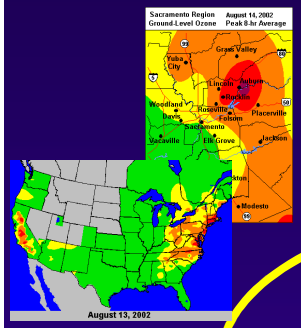
Stats:

- Redundant computer servers
- Files processed in seconds
- Over 30,000 data values per day
- 50 maps produced every hour

10:31:45

10:45:21

The last leg of the journey….



U.S. EPA AIRNOW
www.epa.gov/airnow

Weather/News Providers

THE WEATHER CHANNEL

meteorlogix

wsi

USA TODAY

The Weather Underground Inc.

ACCU WEATHER

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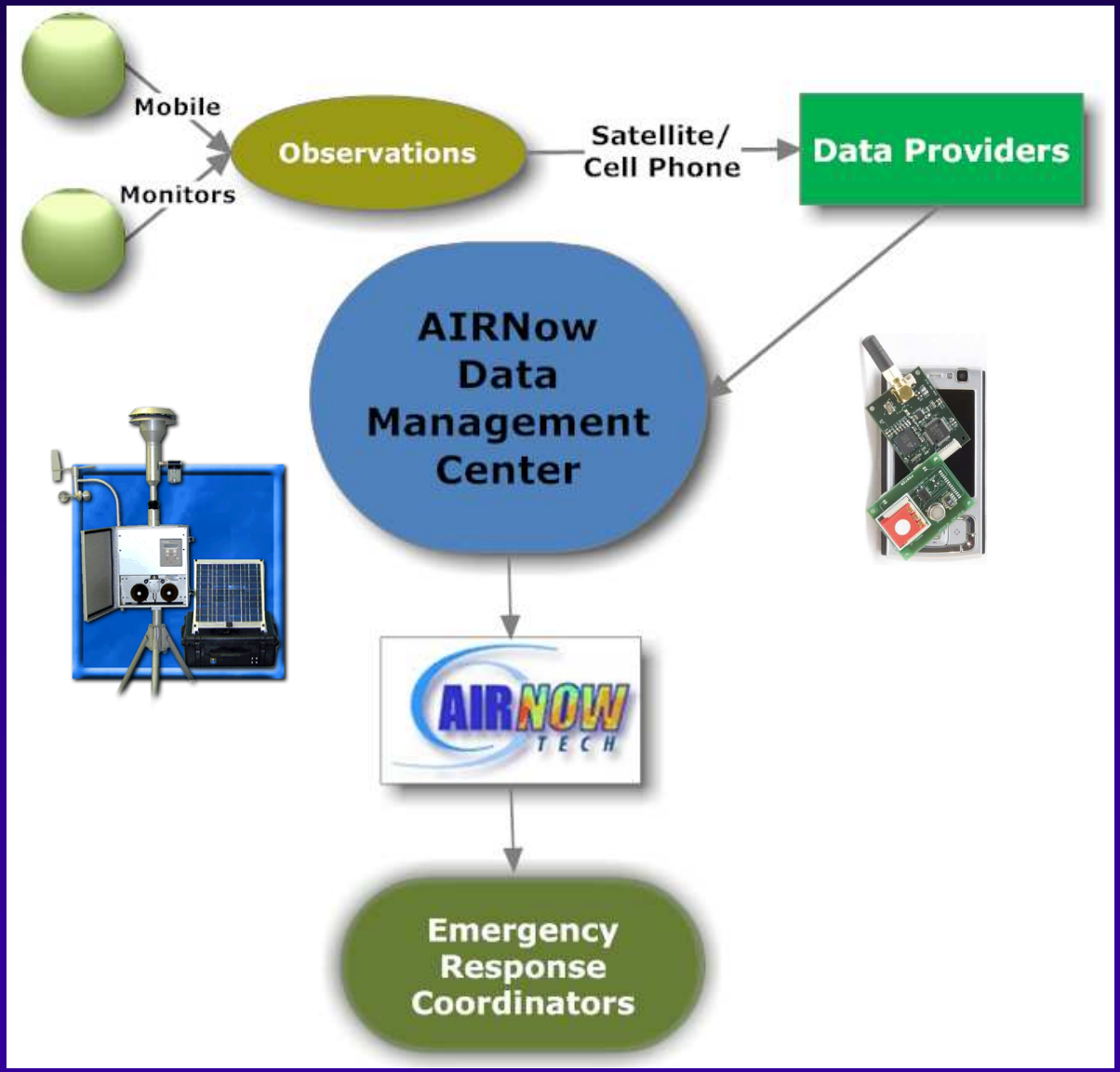
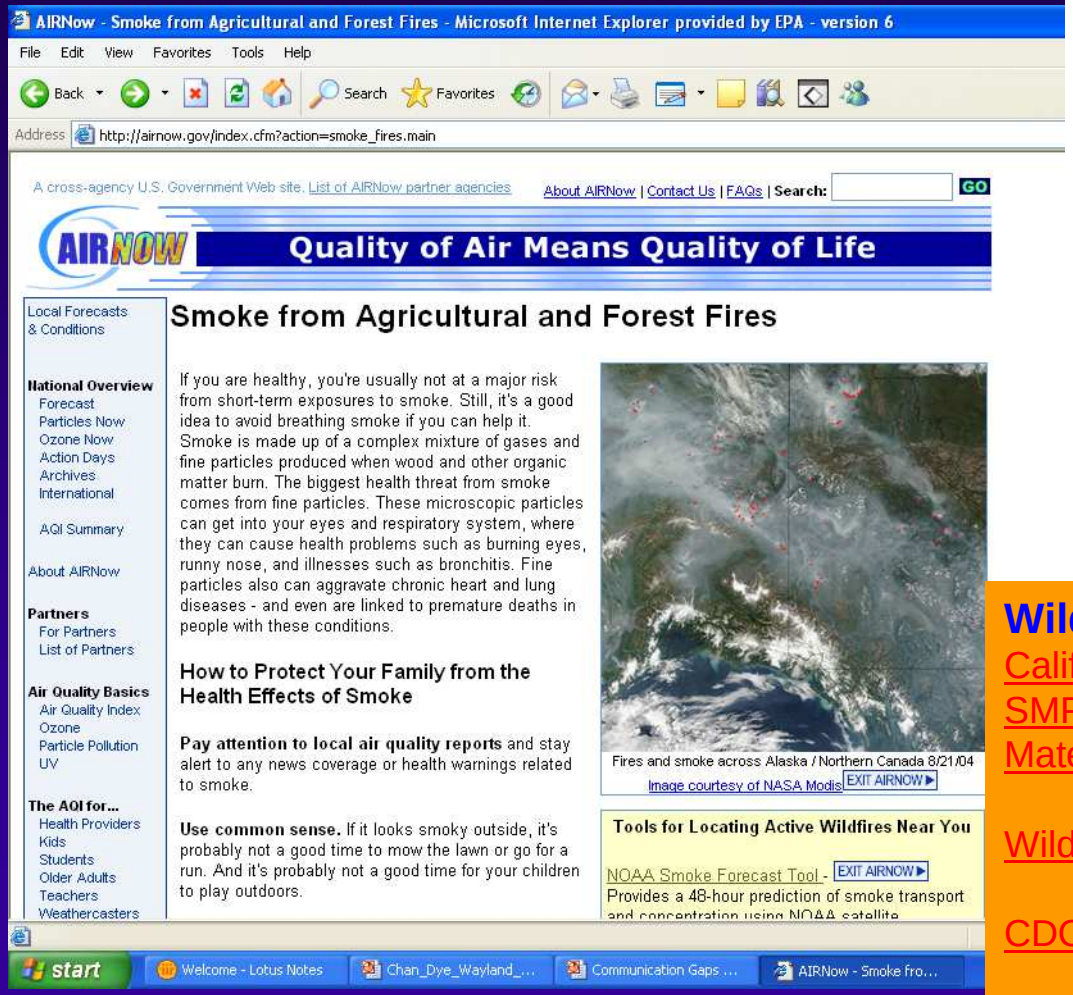
Public

10:45:55 10:55:21 11:00:00

Data Flow – Other Data Sources



Smoke Page



Tools for Locating Active Wildfires Near You

NOAA Smoke Forecast Tool Provides a 48-hour prediction of smoke transport and concentration using NOAA satellite information on the location of wildfires combined with NOAA National Weather Service weather forecast models. Tool is updated daily.

GEOMAC Wildland Fire Support The Geospatial Multi-Agency Coordination Group's internet-based mapping tool to access online maps of current fire locations.

MODIS Active Fire Mapping
USDA Forest Service Remote Sensing Applications Center's (RSAC) MODIS Active Fire Mapping web site.

Wildfire Resources

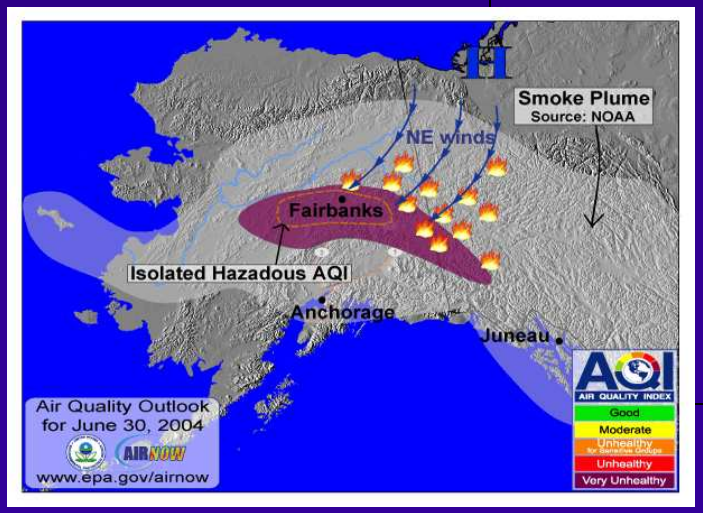
California Air Resources Board
SMP Public Outreach Protocol - Tools and Materials

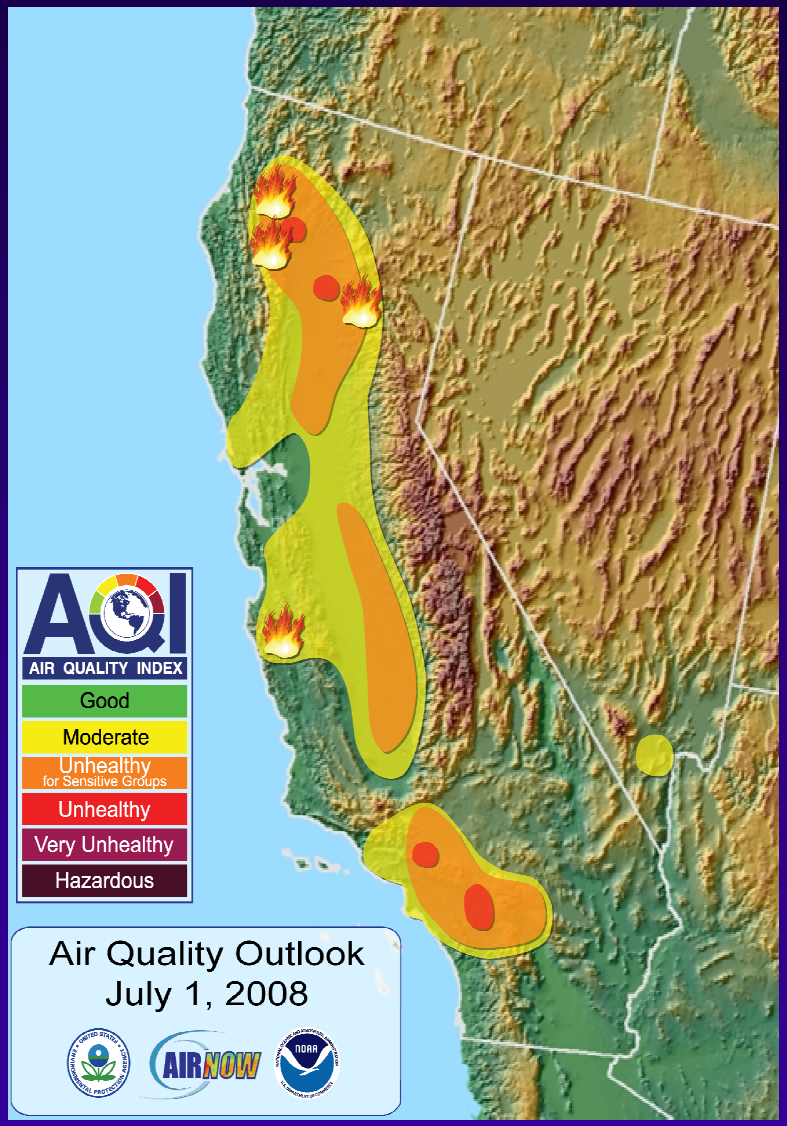
Wildfire Guide for Health Officials

CDC Wildfire Fact Sheet

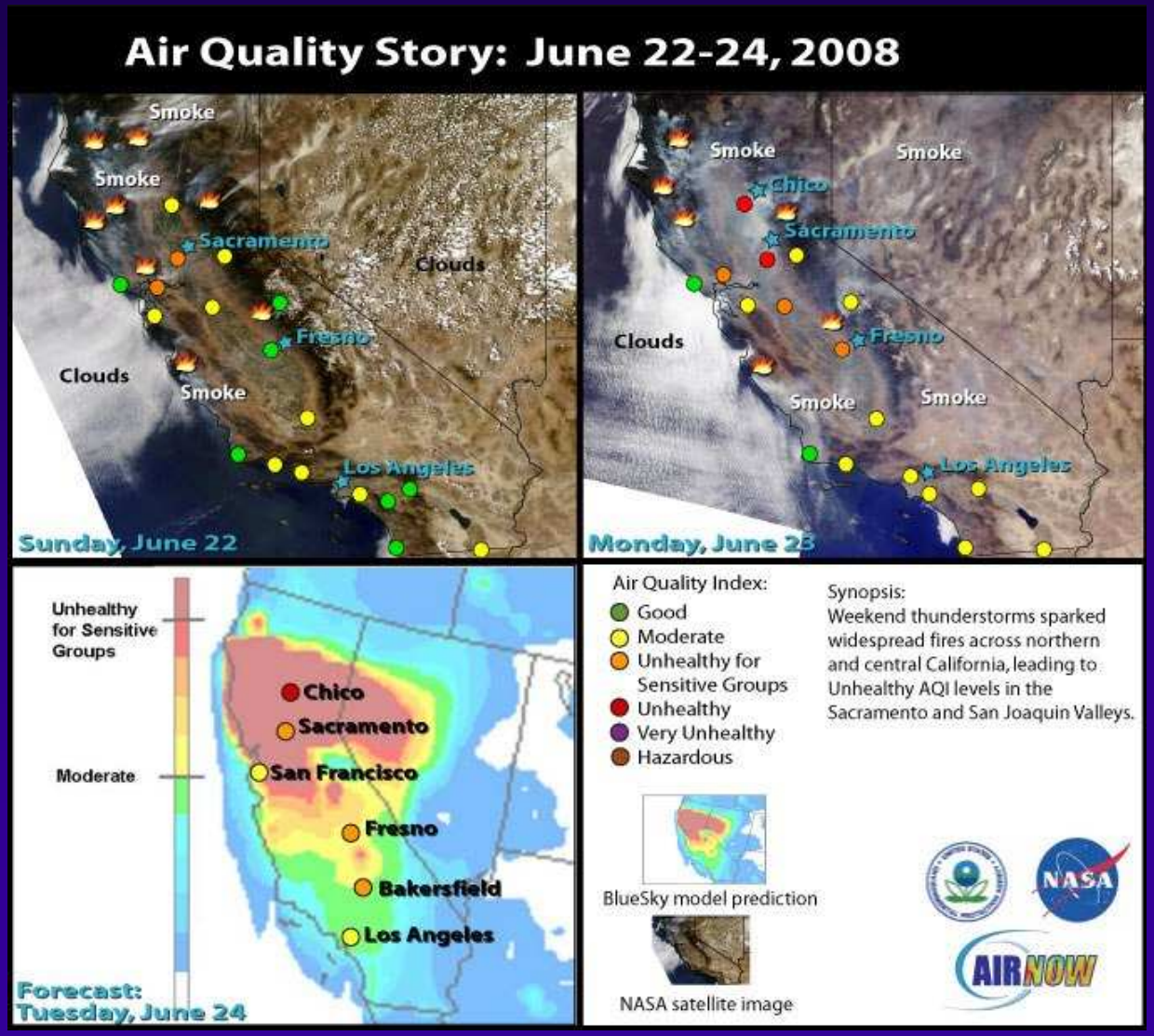
National Fire Plan

Graphical Displays

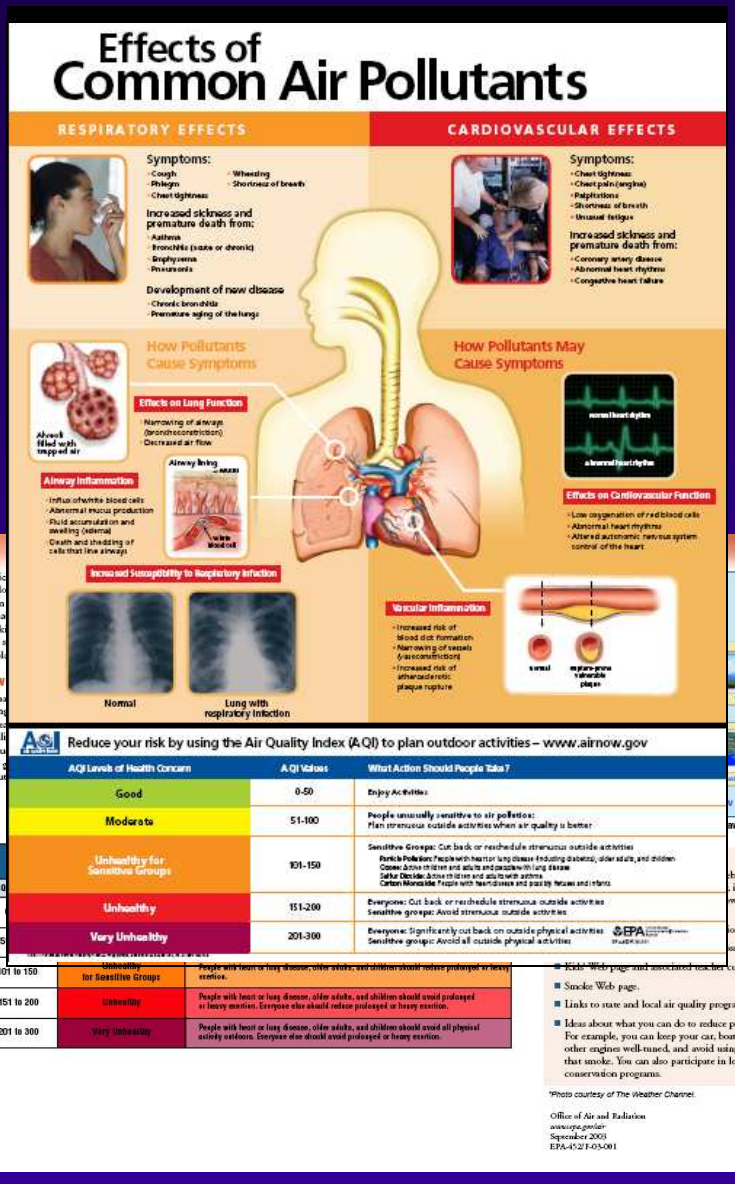


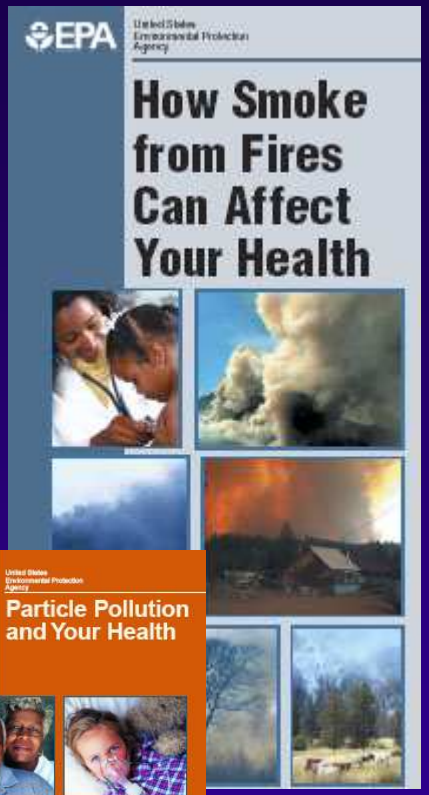


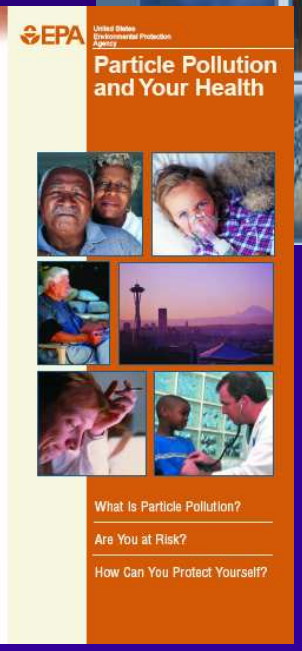
Air Quality Stories

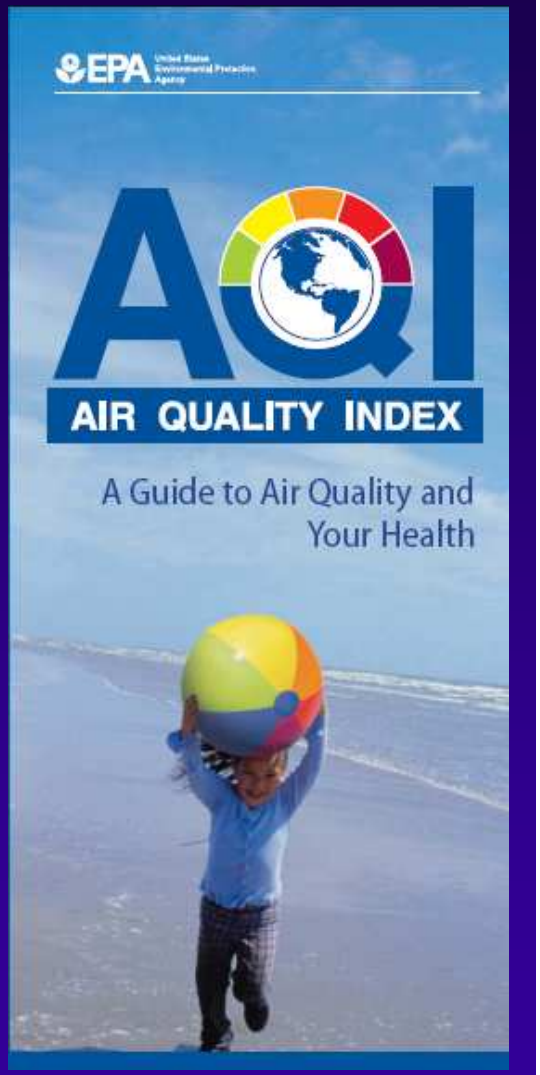


Health Information









Downloadable Factsheets

EPA

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.

EPA

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. Air pollution can also worsen heart failure.

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 levels are high.

2 Are you at higher risk?

For most people, the risk is small. 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 heart attacks, angina, bypass surgery or angioplasty, strokes, 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 you:

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

3 How can you protect your health from air pollution?

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

- If you have heart disease or have experienced a stroke, check with your health care provider about the best ways for you 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 high.***

Particle pollution levels can be high any time of year. Levels can be especially high when the weather is calm, allowing air pollution to build up. 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, or burning vegetation.

Draft – Available Soon