CLIMATE CENTRAL

WILDFIRES AND AIR POLLUTION

THE HIDDEN HEALTH HAZARDS OF CLIMATE CHANGE

By Alyson Kenward, PhD, Dennis Adams-Smith, and Urooj Raja

2013

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Princeton: One Palmer Square, Suite 330 Princeton, NJ 08542
Phone: +1 609 924-3800
Toll Free: +1 877 4-CLI-SCI / +1 (877 425-4724)
www.climatecentral.org

SUMMARY

Across the American West, climate change has made snow melt earlier, spring and summers hotter, and fire seasons longer. One result has been a doubling since 1970 of the number of large wildfires raging each year. And depending on the rate of future warming, the number of big wildfires in western states could increase as much as six-fold over the next 20 years.

Beyond the clear danger to life and property in the burn zone, smoke and ash from large wildfires produces staggering levels of air pollution, threatening the health of thousands of people, often hundreds of miles away from where these wildfires burn. The critical component of a fire's smoke is so-called "fine particle" air pollution, which is a direct threat to human health even during relatively short exposures. And the pollution levels produced by these wildfires are extremely high: high enough to potentially increase mortality in susceptible populations, like the elderly and those with heart conditions, and increase emergency room visits for asthma sufferers and others with respiratory conditions.

This analysis looks at air pollution from some of the largest wildfires in the West over the past 12 years.

We found that:

- Wildfires caused the worst air pollution day of the year in the affected areas, for all of the fires analyzed. And the worst day of the year was bad, often as bad or worse than air pollution levels in Beijing. In 9 of the 11 fires analyzed, particulate pollution from the fire made the air unhealthy to breathe for anyone, not just children and sensitive populations.
- Wildfires burning within 50-100 miles of a city routinely caused air quality to be 5-15 times worse than normal, and often 2-3 times worse than the worst non-fire day of the year.
- This year has seen particularly bad examples of this. Grants Pass, Ore. experienced hazardous air quality this summer, caused by the Douglas Complex and Big Windy Comples fires burning in Southern Oregon. For nine days this summer, Grants Pass had air quality so poor that it was unhealthy for anyone to be outside. On five of these days, fine particle pollution was literally off the charts- higher than the local air quality meter could read.
- Big metro areas are also susceptible to wildfire pollution. At least twice in the last 12 years, cities like Los Angeles, San Diego, and Riverside, Calif. have seen Beijing-level air pollution caused by wildfires burning in southern California.

Rapidly warming spring temperatures and a shrinking snowpack make for a longer fire season, up to two months longer on average across the West. Hotter summers dry out the forest more rapidly and intensely than in the past, and fire suppression practices have increased the fuel supply further increasing the risk of large, intense fires. Exposure to fine particulates in wildfire smoke – particles about 30 times smaller than the width of a human hair – pose a significant health risk for anyone, but particularly children, the elderly, and people with existing respiratory problems. They can penetrate deep into the lungs, increasing the mortality risk and health and lung problems, according to the U.S. EPA. As we continue to warm the planet, wildfires will increase in intensity and size, causing an increasing number of severely unhealthy air pollution days that in turn increase mortality in the elderly and those with heart conditions, while sending a growing number of children and sensitive people to emergency rooms in respiratory distress.

Reno, August 2013, During Rim Fire

Beijing, Average pollution, September 2013

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01. INTRODUCTION

IN BRIEF

Every summer, wildfires rage across the American West, burning millions of acres of forest. These wildfires cost taxpayers hundreds of millions of dollars to control and extinguish, and each year there are lives lost and hundreds of homes that burn.

There is another, far-reaching impact of these raging western wildfires. The smoke and soot billowing from wildfires can spread hundreds of miles; nearby cities are cloaked in a dangerous haze. In moderate amounts, the fine particles in this smoke can be irritating for children, the elderly and people with respiratory problems. But in higher concentrations this smoke can be hazardous for anyone, causing severe health problems and potentially death.

In recent decades, more large wildfires have been burning in the West and their average size has also increased. And as the climate continues to warm, researchers predict that the area burning each year will increase dramatically. More wildfires means more people will be exposed to dangerous levels of smoke, an unexpected health impact of our changing climate.

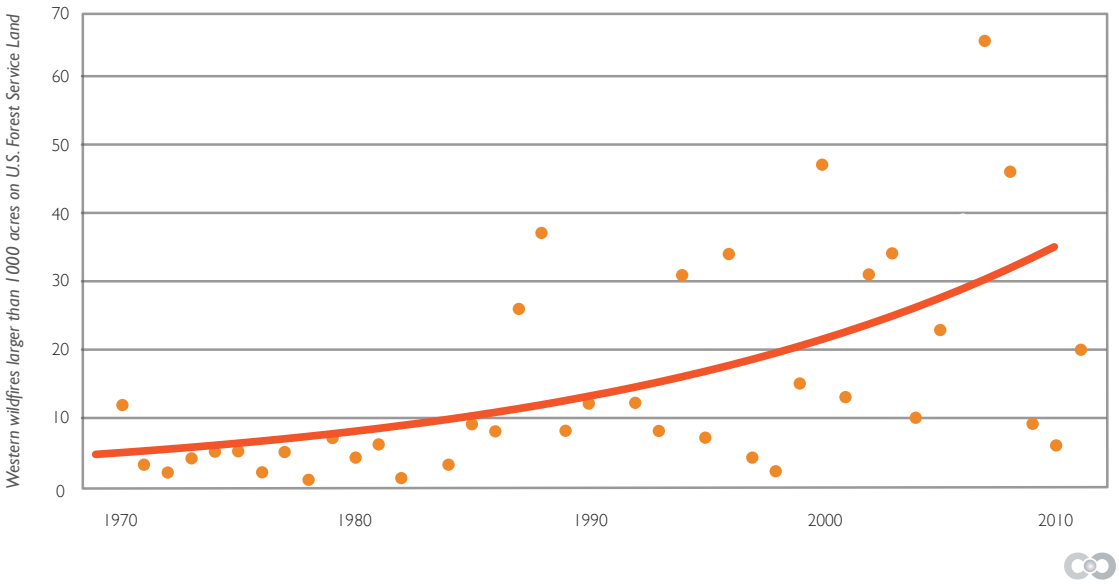
This analysis examines how some of the most iconic wildfires of the past decade affected air quality in nearby cities and towns across the West, including this year's Rim Fire burning in the Sierra Nevada of California.

WILDFIRES

Wildfires are an iconic part of the American West and, while we typically regard them as a destructive force, they are also an essential component of a healthy forest ecosystem. As fires burn, they clear out old or dead vegetation, making way for new growth. Over the last century, there have been periods of more fire in the West, and periods of less.

In particular, over the past 40 years, the number and size of wildfires on Forest Service land increased substantially. According to a 2012 Climate Central analysis of large wildfires on U.S. Forest Service Land and other federal lands, on average there are now twice as many fires burning every year in the West as compared to in the 1970s.[1] The total area burned each year has also doubled. In some states, the trends are even more dramatic; in Arizona and Idaho the average number of large fires burning each year has quadrupled since the 1970s.

Large Western Wildfires Are Much More Common Than 40 Years Ago

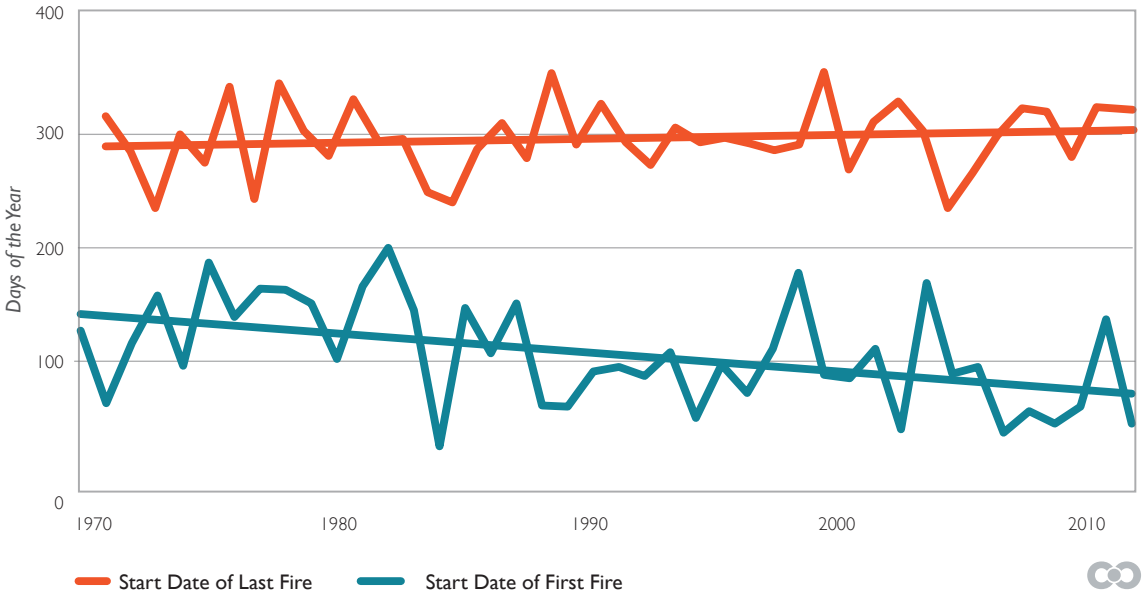


Over this same time period, temperatures and snowpack trends have also been changing, which is likely contributing to the changing wildfire trends. The continental U.S. has been warming at a rate of 0.44ºF per decade since the 1970s, and Arizona, New Mexico, and Utah are among the fastest warming states.[2] In particular, when spring and summer are warmer than average, the risk of wildfires increases because warmer temperatures dry out the trees and brush, making them easier to ignite and more likely to burn. Our 2012 analysis also illustrated that years with the hottest spring and summer temperatures were often the worst years for wildfires in most states.

In addition, warming temperatures have also contributed to reduced spring snowpack, which alters risks of wildfires later in the season. The earlier snow melts each spring, the sooner the ground dries out, which means fires are likely to burn earlier and longer each year. Our analysis, and work by Westerling *et. al.*,[3] demonstrated that these warming temperatures and reduced snowpack appear to be leading to an overall lengthening of the wildfire season (the time between the first and last fire of the year). Compared to the 1970s, the typical wildfire season is now about 75 days longer than it used to be.

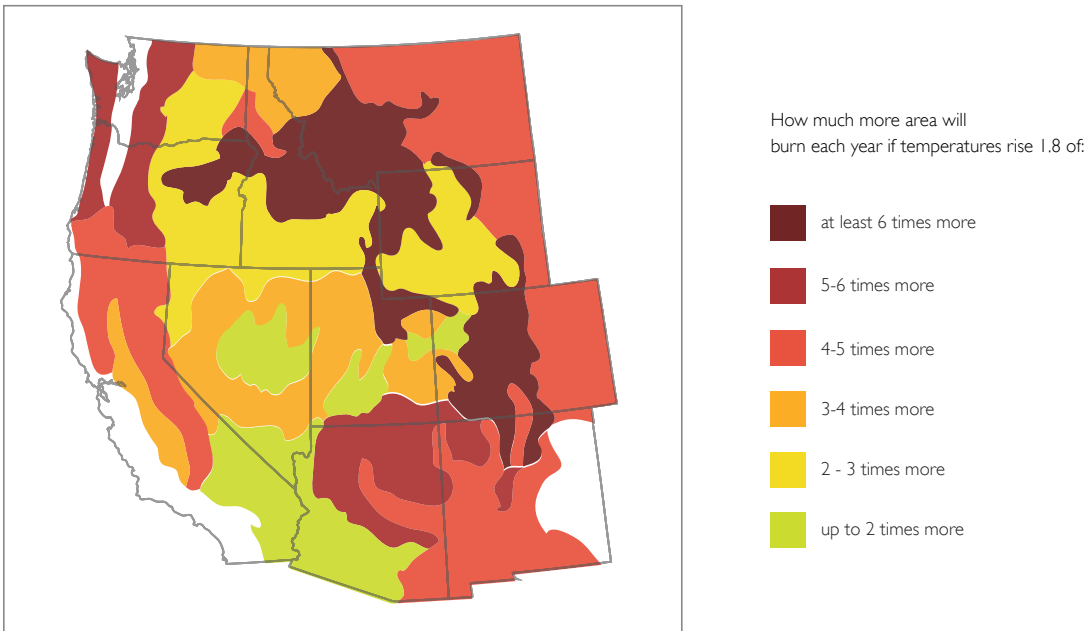
The climate is not the only factor that may have influenced increasing wildfire trends in recent decades. As more people populate western states and recreate in the wilderness, the risk of human-ignited wildfires has increased. In addition, for much of the 20th century, the U.S. Forest Service maintained a policy that all wildfires be actively extinguished to prevent them from becoming destructive. This contributed to a buildup of fuel in forests across the West. In the latter half of the century, as researchers better understood how fires promote overall forest health, wildfire suppression policy was revised. Forest managers now aim to contain wildfires and prevent them from threatening human development, but otherwise let them burn.

The Wildfire Season Is Growing Longer In the Western U.S.



While warming temperatures and snowpack trends have already, in part, contributed to increasing fire risks in the western U.S., in the coming decades, researches predict further climate changes will only exacerbate the trends towards more big fires. A recent report from the National Research Council predicted that for every 1.8°F of temperature increase, the amount of area burned each year in the West could quadruple and large areas of Colorado, Idaho, Oregon, Montana, and Wyoming could see a sixfold increase in the area burned.[4]

Higher Temperatures Will Increase Burn Areas In The West



AIR QUALITY AND PARTICULATE MATTER

According to the Clean Air Act, the U.S. Environmental Protection Agency (EPA) monitors the concentration of different pollutants in the air that pose health risks or negative environmental effects. Monitoring stations located across the country record the levels of these different pollutants on an hourly, daily and annual basis, and the EPA has established safe limits for these pollutants. Pollutant concentrations that exceed these limits are unhealthy for some or all of the population.

Among these pollutants are particulate matter, tiny solid and liquid particles that are suspended in the air. These small particles pose a health risk because they can be inhaled, passing the throat and entering the lungs.

The most hazardous particulates are those classified as "fine particulates," which are smaller than 2.5 microns in diameter, or about 30 times smaller than the width of a human hair. These microscopic particles, known as $PM_{2.5}$ are so tiny that they can travel deep into the lungs, causing short term health problems and aggravating long-term respiratory disorders. Higher-than-normal $PM_{2.5}$ concentrations can cause wheezing, coughing, eye, nose, throat and lung irritation, and shortness of breath. While long-term exposure to $PM_{2.5}$ has long been know to be associated with increased mortality, recent research has shown that even short-term exposure can trigger heart attacks in at-risk populations and leads to an overall increase in mortality. [5]

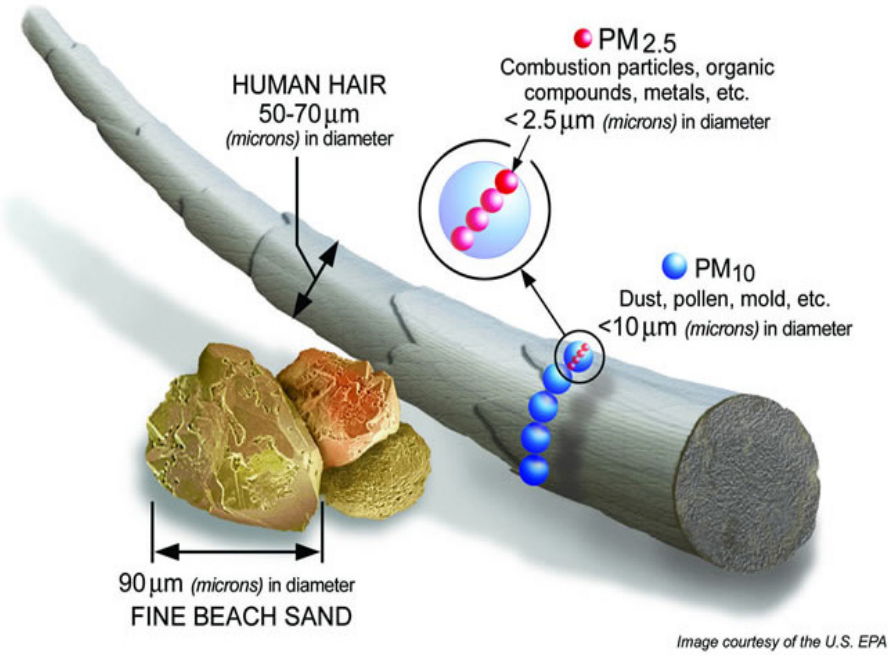
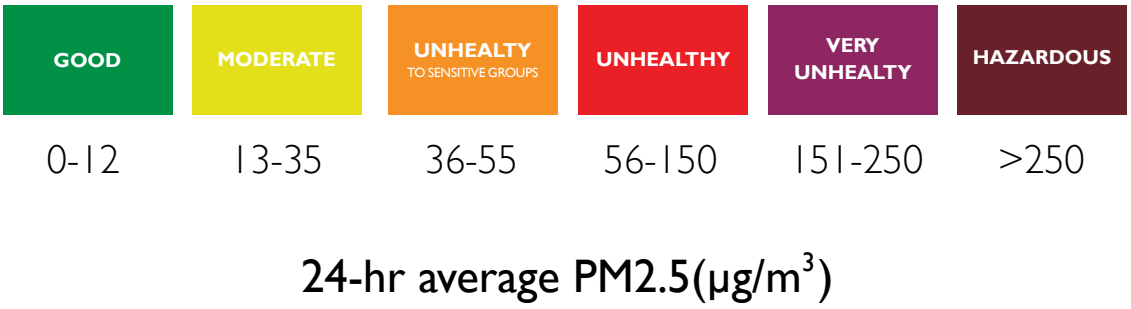


Image courtesy of the U.S. EPA

Some groups of people are particularly sensitive to $PM_{2.5}$, including children, the elderly and people with existing respiratory problems, including asthma and other breathing and heart problems.

The EPA has established an Air Quality Index that reflects the national air quality standards for several pollutants, including $PM_{2.5}$. The index categorizes the safety of these pollutants as they are recorded at the monitoring stations. The figure below illustrates the EPA's Air Quality Index for $PM_{2.5}$, including the concentrations limits for each designation.

Air Quality Index (AQI)



One of the most common sources of $PM_{2.5}$ is wildfires. Wildfire smoke carries these tiny particulates, and often, during wildfires, the $PM_{2.5}$ concentrations exceed the safe limits established by the EPA.

02. IMPACT OF WILDFIRES ON AIR QUALITY

Smoke from all the fires we analyzed caused the worst air quality days of the year. In cities and towns near the wildfires, and in some cases, up to hundreds of miles away from the burn areas, air quality was often so bad it was comparable to an average day in Beijing, China, which, with a population of nearly 20 million people, is among the worst polluted cities on the planet with an average $PM_{2.5}$ level of 120 $\mu g/m^3$.

Wildfires burning within 100 miles of a city routinely caused air quality to be 5-15 times worse than normal, and often 2-3 times worse than the worst non-fire day of the year.

In all of the fires we analyzed, air quality was so poor that it was classified as unhealthy for children, the elderly, and people with respiratory conditions. And in all but one of the fires, particulates in the air exceeded the level that was unhealthy for anyone.

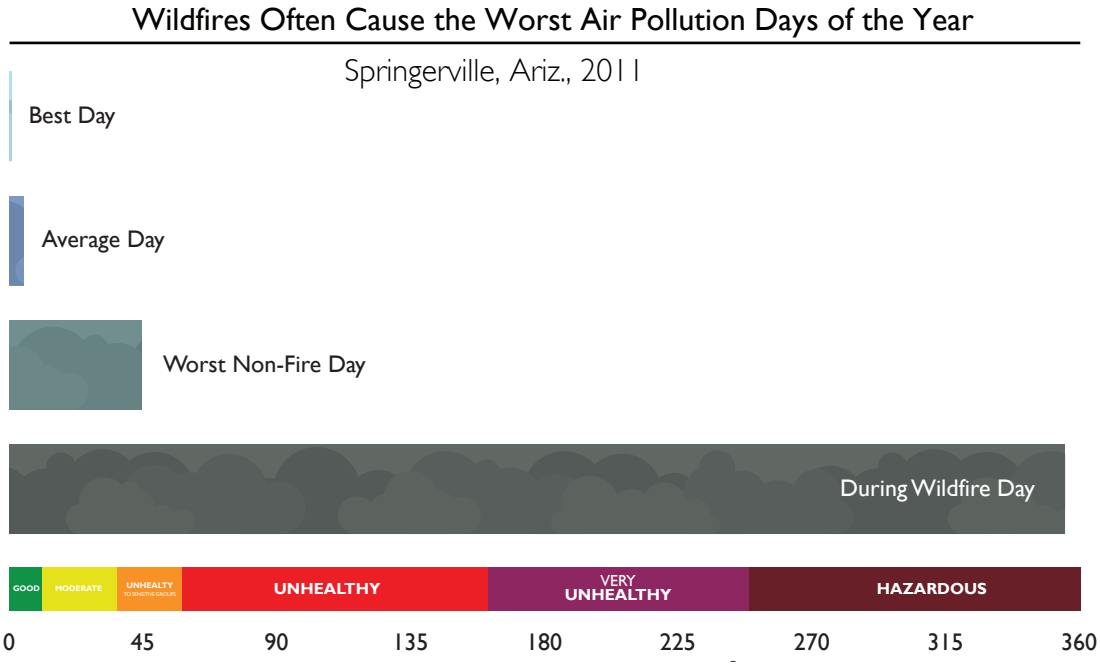
Exactly how bad the air quality was during these wildfires depends on how large a fire was and how far away from a city it burned, and also what the weather and wind conditions were like during the fire.

The following are analyses of air quality during individual fires over the past twelve years.

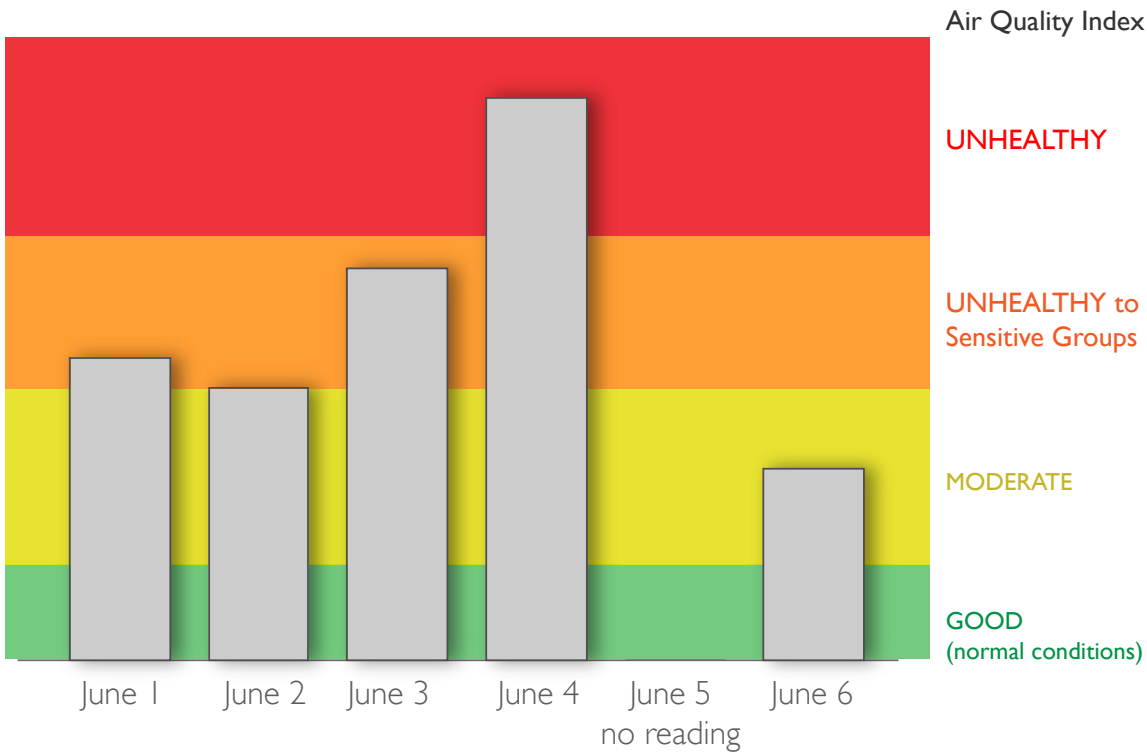
ARIZONA/NEW MEXICO

Wallow Fire, 2011

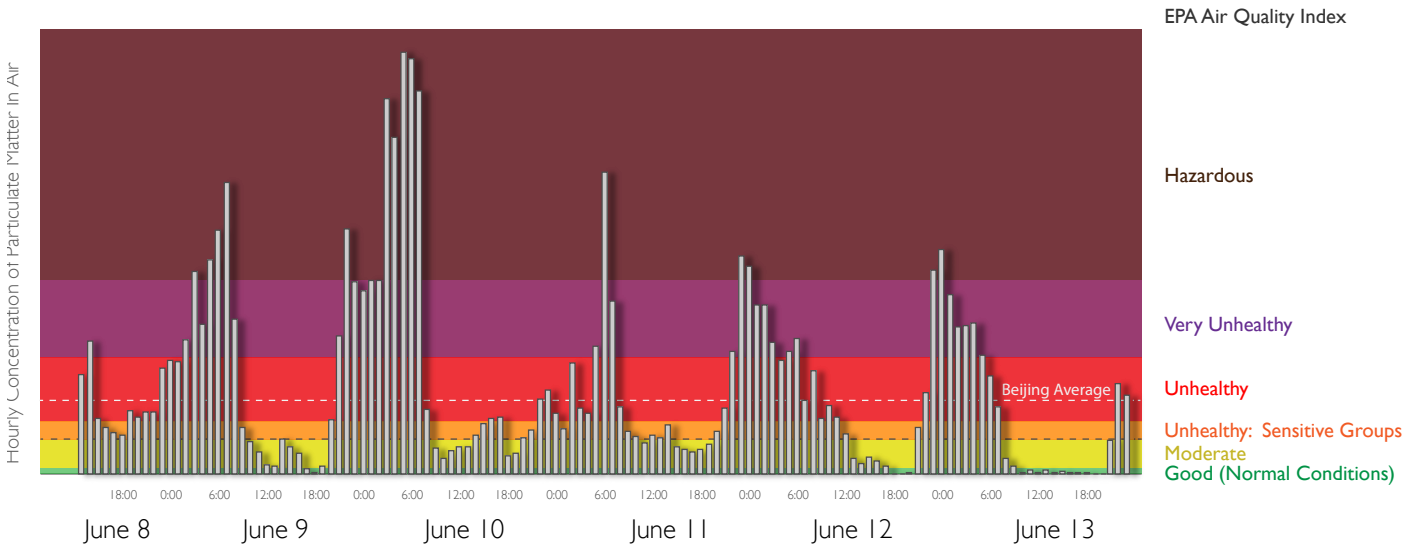
- Several cities in Arizona and New Mexico saw their worst air quality days of 2011 during June's Wallow Fire.
- At its worst, air pollution in Springerville, Ariz., was five times worse than an average Beijing day.
- For more than a week it was very unhealthy for anyone to breathe the air in Springerville.
- In Albuquerque, NM, the combination of the Wallow Fire and the Horseshoe 2 Fire (also in Arizona) caused unhealthy levels of particulates for six days in early June.
- At its worst, air quality in Albuquerque was six times worse than normal.
- Taos, NM – over 350 miles away from the Wallow Fire – recorded $PM_{2.5}$ levels that were unhealthy for children, the elderly, and people with respiratory problems, for one day.



Alburquerque Air Quality Reached Unhealthy Levels During the 2011 Wallow Fire Burning 150 Miles Away

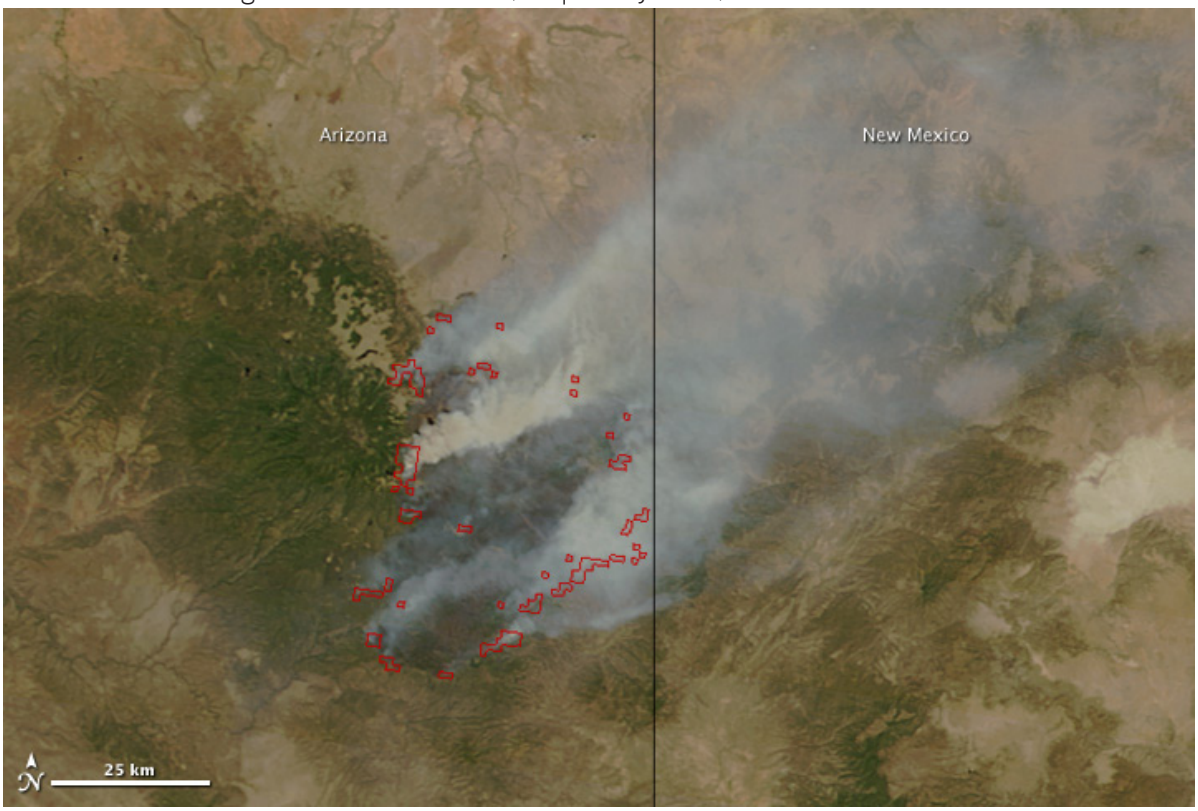


In June 2012, Air Quality In Springville, AZ Was Up To Five Times Worse Than Is Typical For Beijing. Hazardous Smoke Came From the Wallow Fire



02. IMPACT OF WILDFIRES ON AIR QUALITY

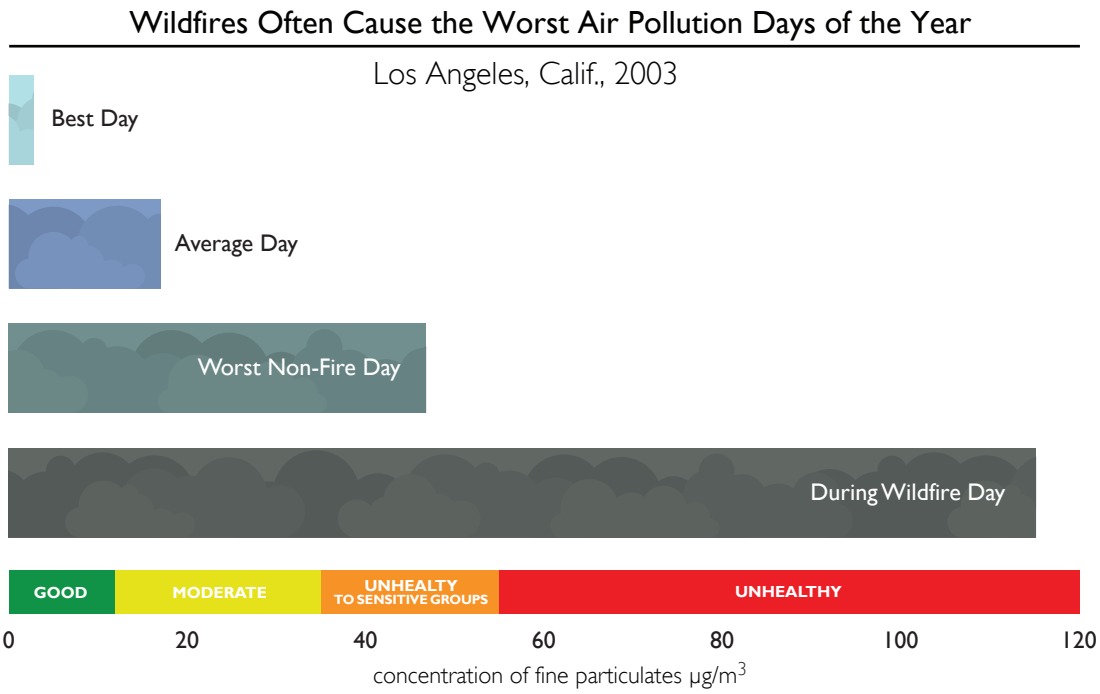
NASA satellite image of the Wallow Fire, acquired June 9, 2011

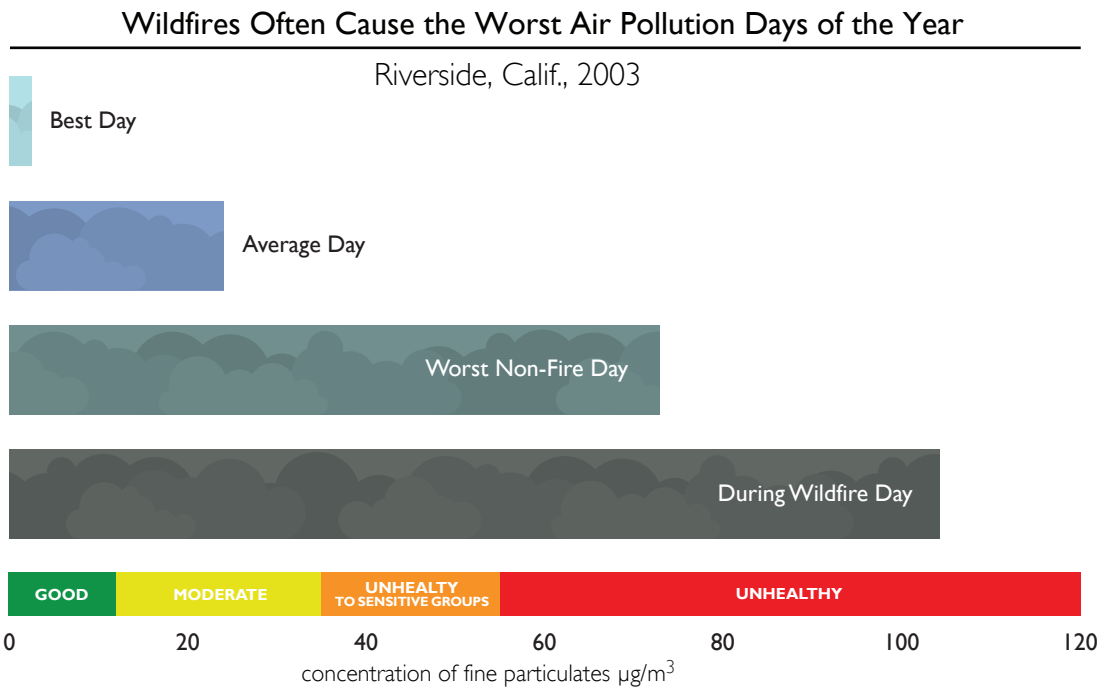


CALIFORNIA

Southern California Fires, Fall 2003

- During California's 15-day fire siege of 2003, pollution hit Beijing levels in Los Angeles, Riverside, Anaheim, and Simi Valley, and all saw their worst air quality of the year.
- In Los Angeles and Riverside there were at least four days where air pollution levels were unhealthy for everyone, according to EPA standards.
- In North Long Beach, air quality during the fires was more than six times worse than average and nearly three times worse than the worst non-fire day of the year.
- Inland, in Riverside, air quality was more than four times worse than average.
- The largest of the 14 wildfires that burned in late October was the Cedar Fire, which ignited on October 25. The worst air quality days in the Los Angeles area were October 26 and 27.



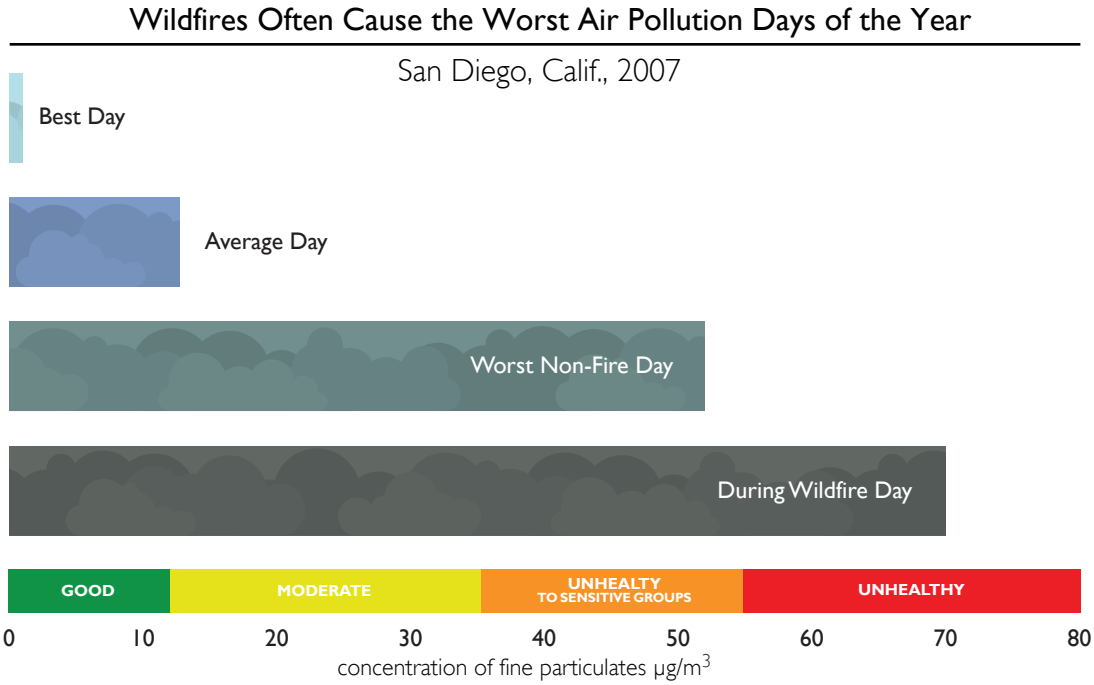


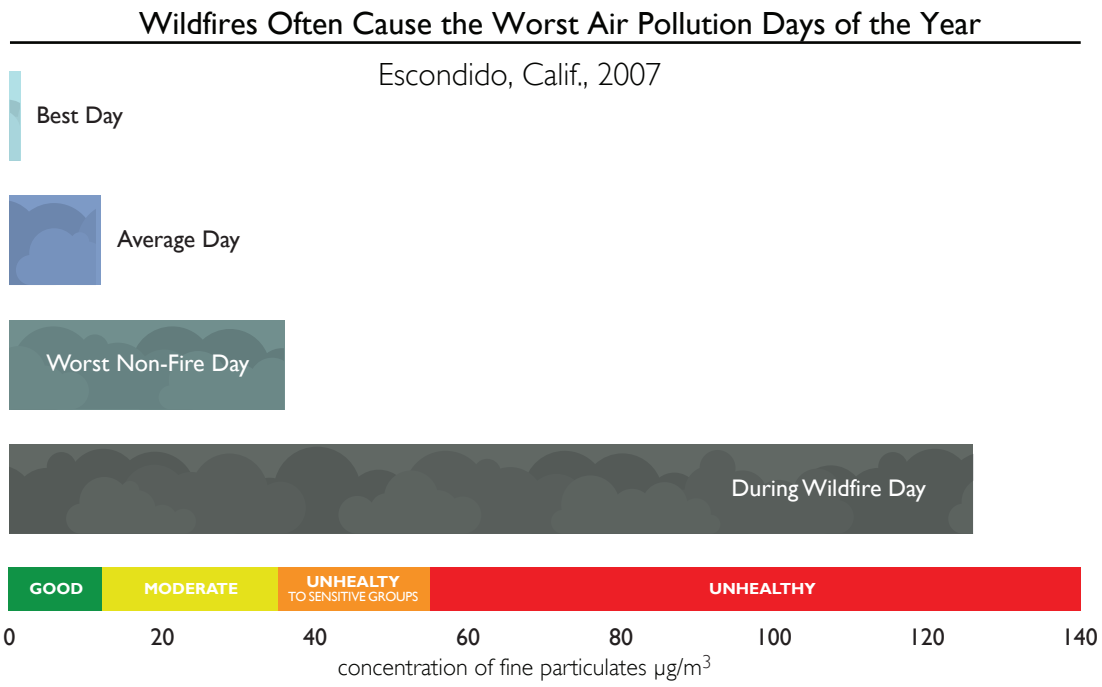
NASA satellite image of 2003's southern California wildfires, acquired October 3

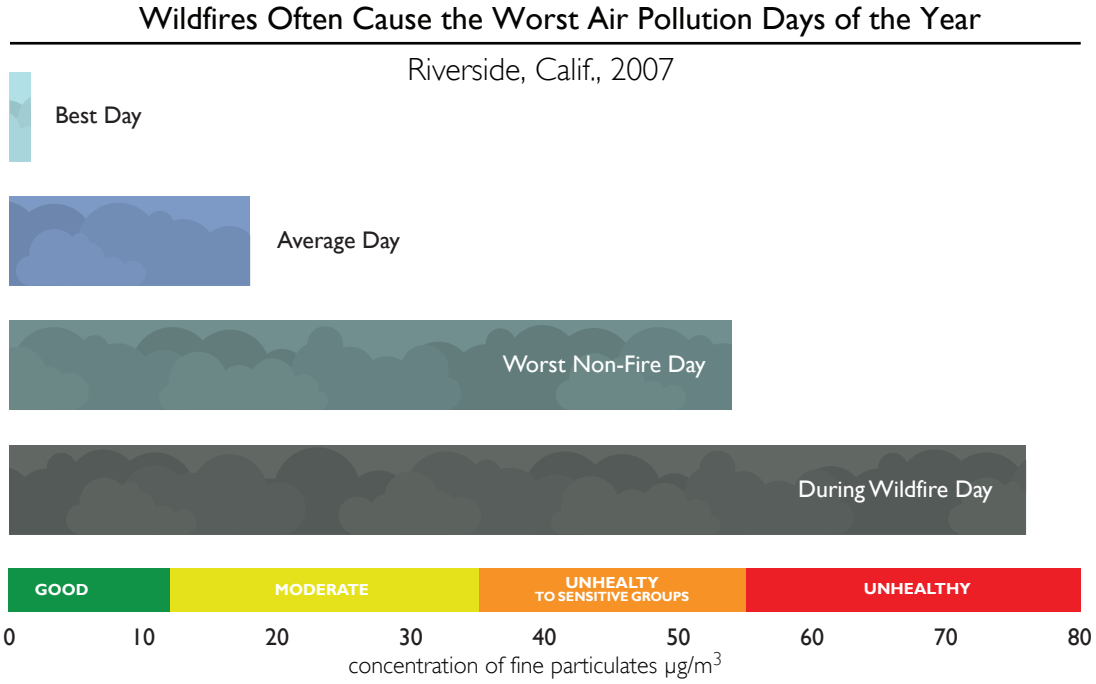
02. IMPACT OF WILDFIRES ON AIR QUALITY

Southern California Fires, 2007

- San Diego, Escondido, and Riverside all saw their worst air quality days of 2007 during that year's October wildfires.
- For more than a week pollution levels made it unhealthy for anyone to be outside.
- In Escondido, air pollution was eight times worse than normal and two days were as bad as a typical Beijing day.
- At its worst, air quality in Escondido was about four times worse than the worst non-fire day of the year.
- In San Diego, air quality was almost six times worse than normal and in Riverside it was about four and a half times worse than normal.
- Wildfires ravaged more than 500,000 acres of Southern California between Santa Barbara and San Diego Counties in October 2007.




Wildfires Often Cause the Worst Air Pollution Days of the Year
Escondido, Calif., 2007
Best Day
Average Day
Worst Non-Fire Day
During Wildfire Day
GOOD
MODERATE
UNHEALTY TO SENSITIVE GROUPS
UNHEALTHY
0
20
40
60
80
100
120
140
concentration of fine particulates µg/m3


Wildfires Often Cause the Worst Air Pollution Days of the Year
Riverside, Calif., 2007
Best Day
Average Day
Worst Non-Fire Day
During Wildfire Day
GOOD
MODERATE
UNHEALTY TO SENSITIVE GROUPS
UNHEALTHY
0
10
20
30
40
50
60
70
80
concentration of fine particulates µg/m3

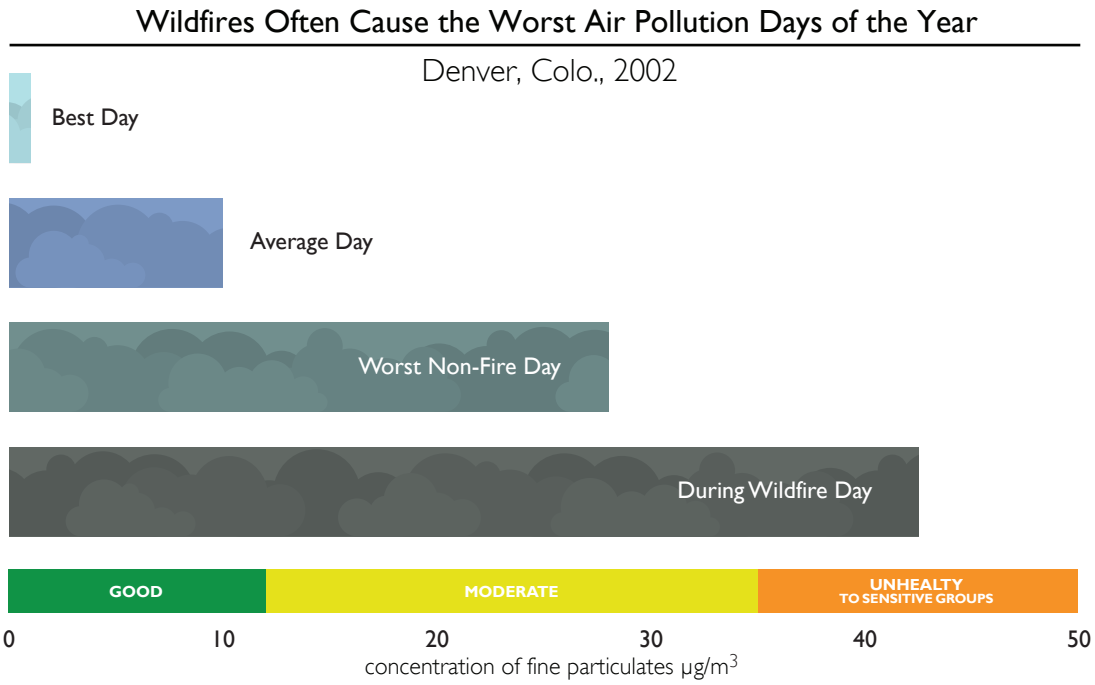
02. IMPACT OF WILDFIRES ON AIR QUALITY

NASA satellite image of 2007's southern California wildfires, acquired October 23

COLORADO

Hayman Fire, Denver, 2002

- Denver had its worst air quality days of 2002 during June's Hayman Fire, burning nearly 100 miles away.
- Air quality was more than four times worse than average in Denver at some points during the fire and about 50 percent worse than worst non-fire day of the year.
- On at least two days, air quality was deemed unhealthy for children, the elderly, and people with respiratory conditions.



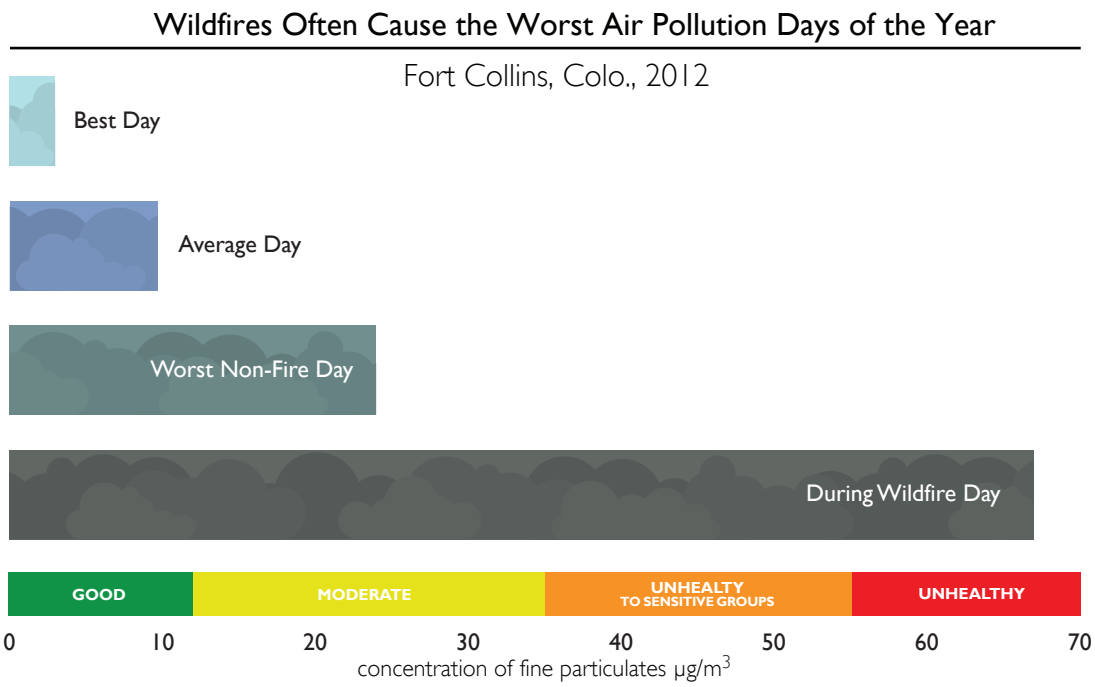
02. IMPACT OF WILDFIRES ON AIR QUALITY

Satellite image of the 2002 Hayman Fire near Denver, acquired June 12, 2002

02. IMPACT OF WILDFIRES ON AIR QUALITY

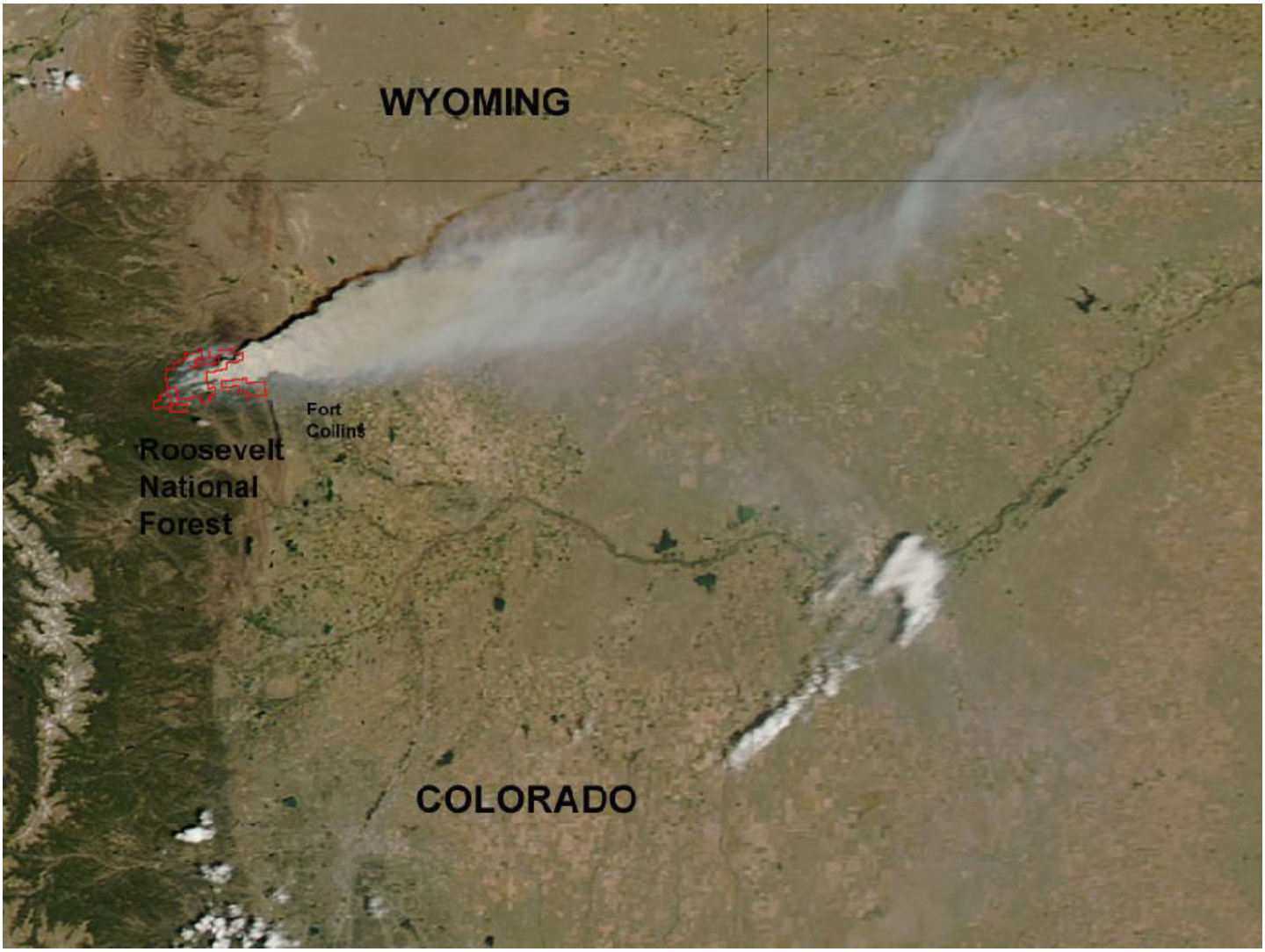
High Park Fire, Colorado, 2012

- Fort Collins, Colo. had its worst air quality of 2012 during the High Park Fire, in June.
- Air quality was up to seven times worse than normal in Fort Collins, nearly as bad as a typical Beijing day, and unhealthy for anyone to be outside.
- There were two days where air pollution in Fort Collins was rated unhealthy for children, the elderly and people with respiratory conditions, and one of these days was also so polluted it was unhealthy for anyone to be outside.
- In Longmont, air pollution reached unhealthy levels for the very young and old, and people with existing respiratory problems.
- The High Park Fire burned nearly 90,000 acres in Roosevelt National Forest, and was the third largest wildfire on record for Colorado. Fort Collins is about 15 miles from burn area.



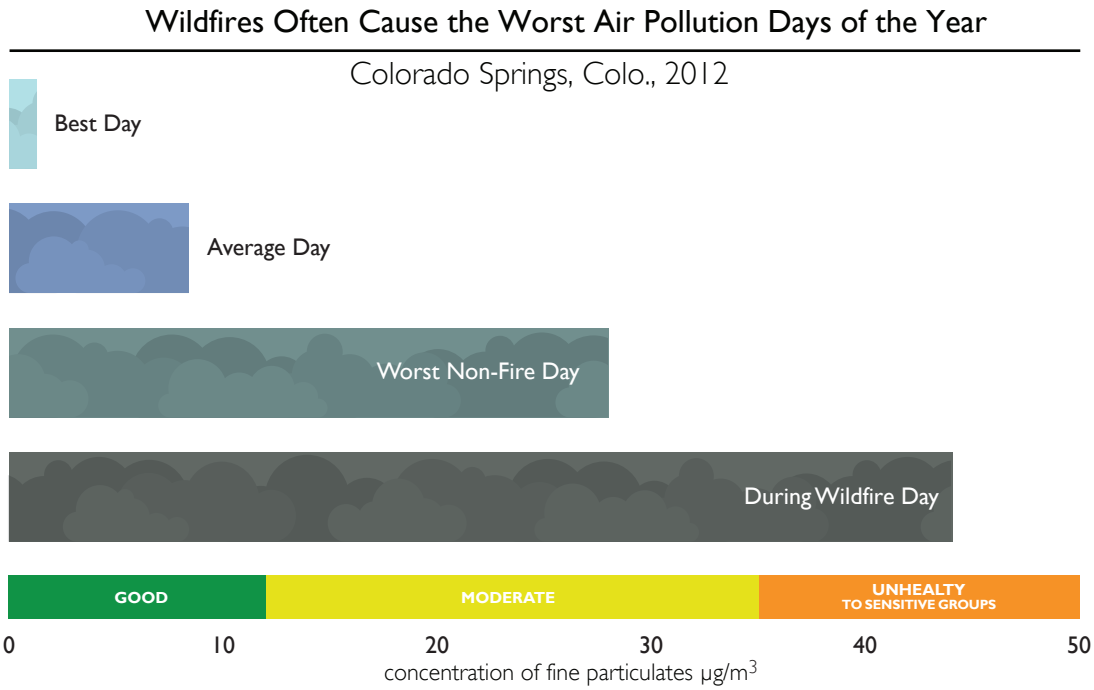
02. IMPACT OF WILDFIRES ON AIR QUALITY

NASA satellite image of the High Park Fire, acquired June 10, 2012.



Waldo Canyon Fire, 2012

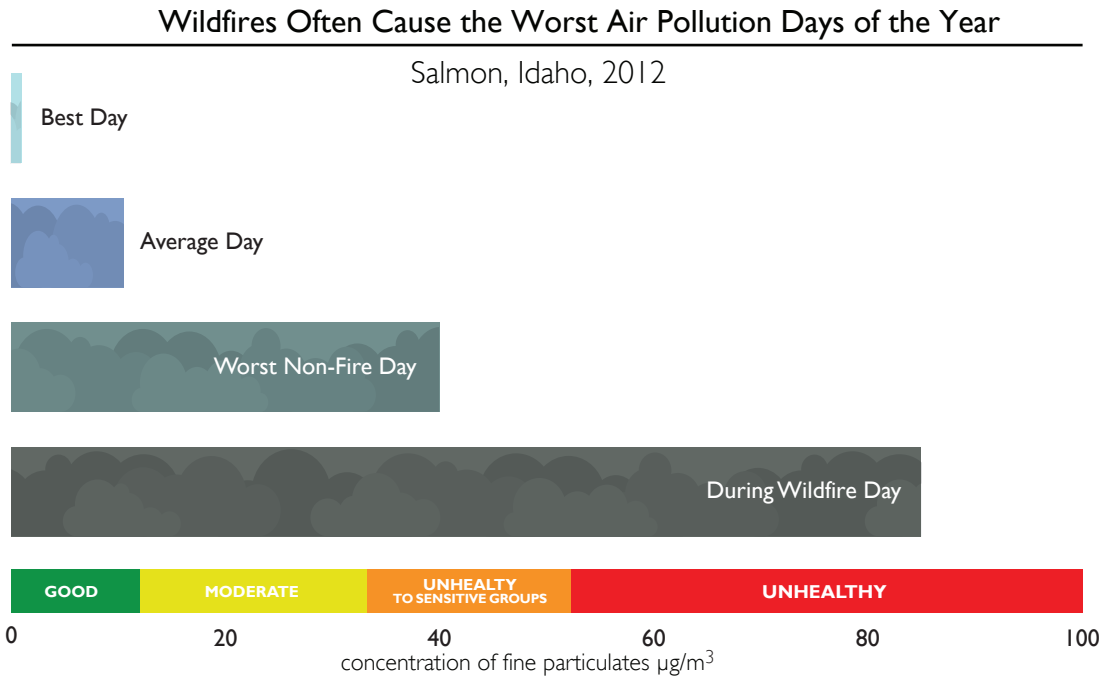
- The worst air quality days of 2012 in Colorado Springs, Colo. were during the Waldo Canyon fire in late June.
- On the worst day, air pollution was five times worse than normal, and almost twice as bad as the worst non-fire day.
- For several days after the fire, air quality was unhealthy for children, the elderly, and people with respiratory problems.
- The Waldo Canyon Fire ignited in Pike National Forest on June 23, about 4 miles from Colorado Springs. It burned almost 20,000 acres, and destroyed nearly 350 homes.



IDAHO

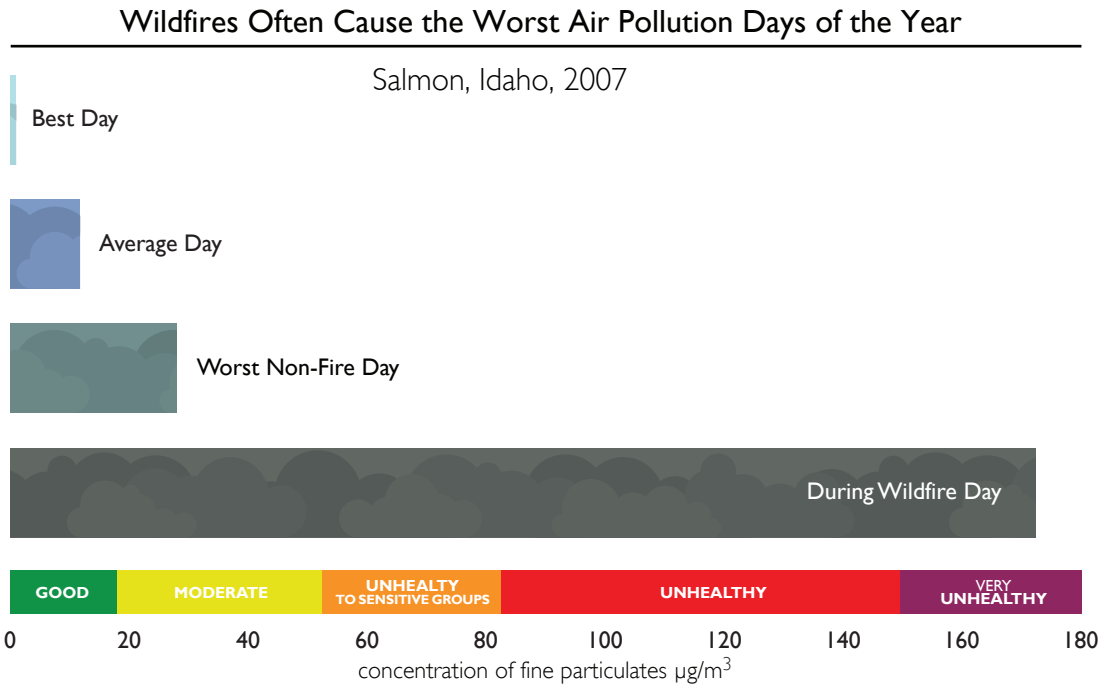
Halstead Fire, 2012

- Boise and Salmon, Idaho, experienced their worst air quality of 2012 during the Halstead Fire in August 2012.
- Air quality in Salmon was unhealthy for anyone for two days, and unhealthy for sensitive groups, like children and the elderly for another day.
- For two days, air quality was eight times worse than normal in Salmon, and was nearly as bad as a typical day in Beijing, China.
- On the worst day in Boise, air quality was so poor that it was unhealthy for anyone to be outside, about five times worse than normal, and nearly three times worse than the worst non-fire day of the year.
- The Halstead Fire burned nearly 20,000 acres in the Salmon-Challis National Forest in August 2012. The fire area was about 80 miles northeast of Boise and about 70 miles southwest of Salmon.



Salmon, Summer 2007

- Air quality in Salmon, Idaho reached "very unhealthy" levels, according to EPA standards, during August, more polluted than an average Beijing day and 15 times worse than normal air quality for the area.
- For at least five days in late August the air in Salmon was unhealthy for anyone to breathe with pollution levels roughly five times worse than the most polluted non-fire day and 10 times worse than a normal day.

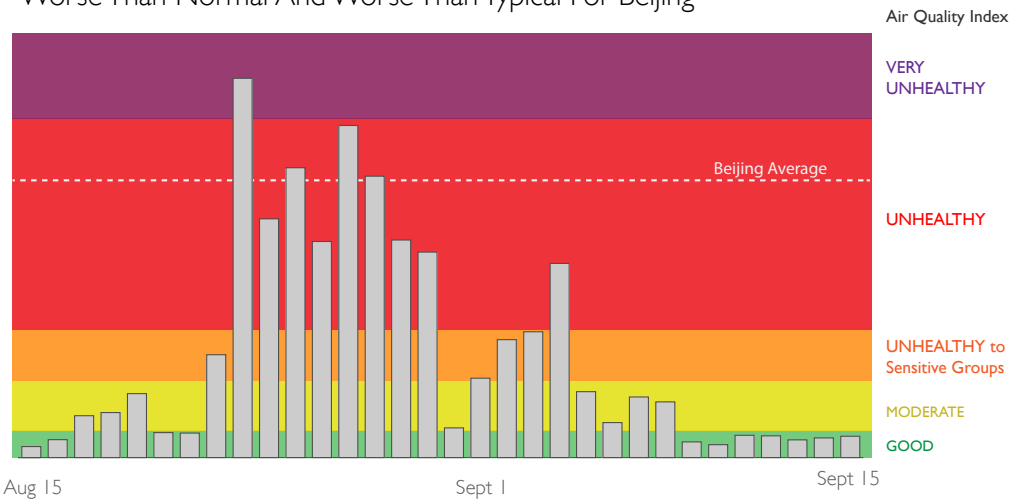


NEVADA

Rim Fire, 2013

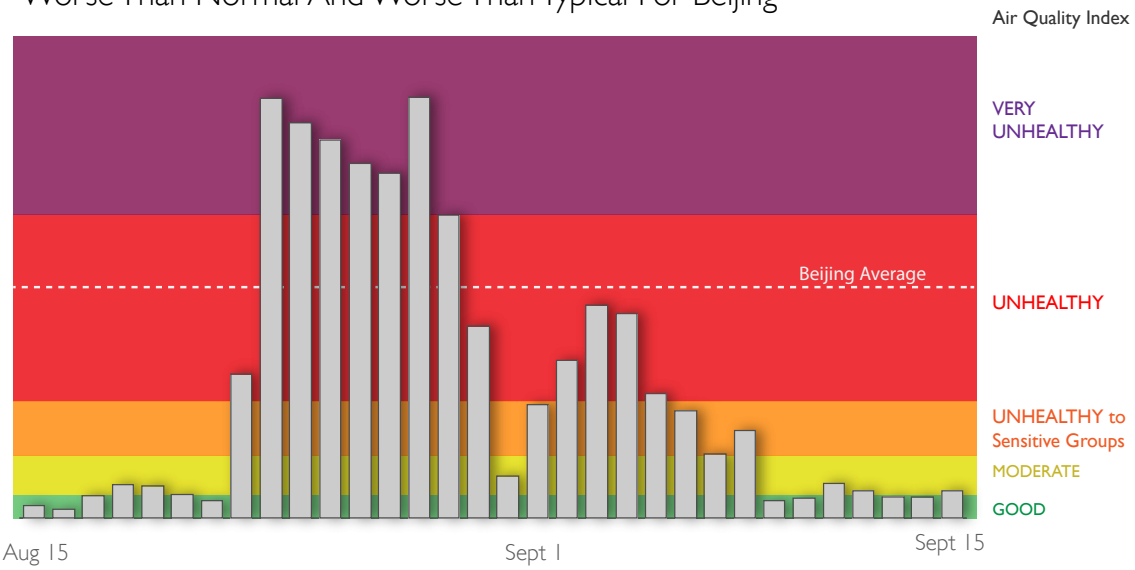
- During the Rim Fire in August and September 2013, several cities in western Nevada experienced unhealthy air quality caused by the wildfire, including Reno, Sparks, Carson City, and Gardnerville.
- Carson City, Nev. had one day with very unhealthy conditions, and three days were the air quality was as bad or worse than an average day in Beijing.
- In August and September, Carson City had 11 days were air quality was unhealthy for anyone, and an additional three days were it was unhealthy for the very young and old, and people with respiratory problems.
- Reno, Nev., about 150 miles from the Rim Fire, had four days of unhealthy conditions, and three days where conditions were unsafe for children, the elderly, and people with respiratory problems.
- In late August, air quality in Reno was about 4-7 times worse than average.
- Gardernville, Nev., experienced six days where the air quality was classified as very unhealthy, and worse than the air quality on an average day in Beijing, China.
- In total, there were 16 days in Gardnerville with unhealthy levels of fine particulates in the air, about four times worse than normal.
- In Groveland, Calif., near Yosemite National Park, air pollution hit Beijing levels for three days, and levels unhealthy for everyone for an additional 6 days.
- In Yosemite Valley, air pollution hit unhealthy levels for children and other sensitive groups for four days.

Air Quality In Carson City During the 2013 Rim Fire Was 15 Times Worse Than Normal And Worse Than Typical For Beijing



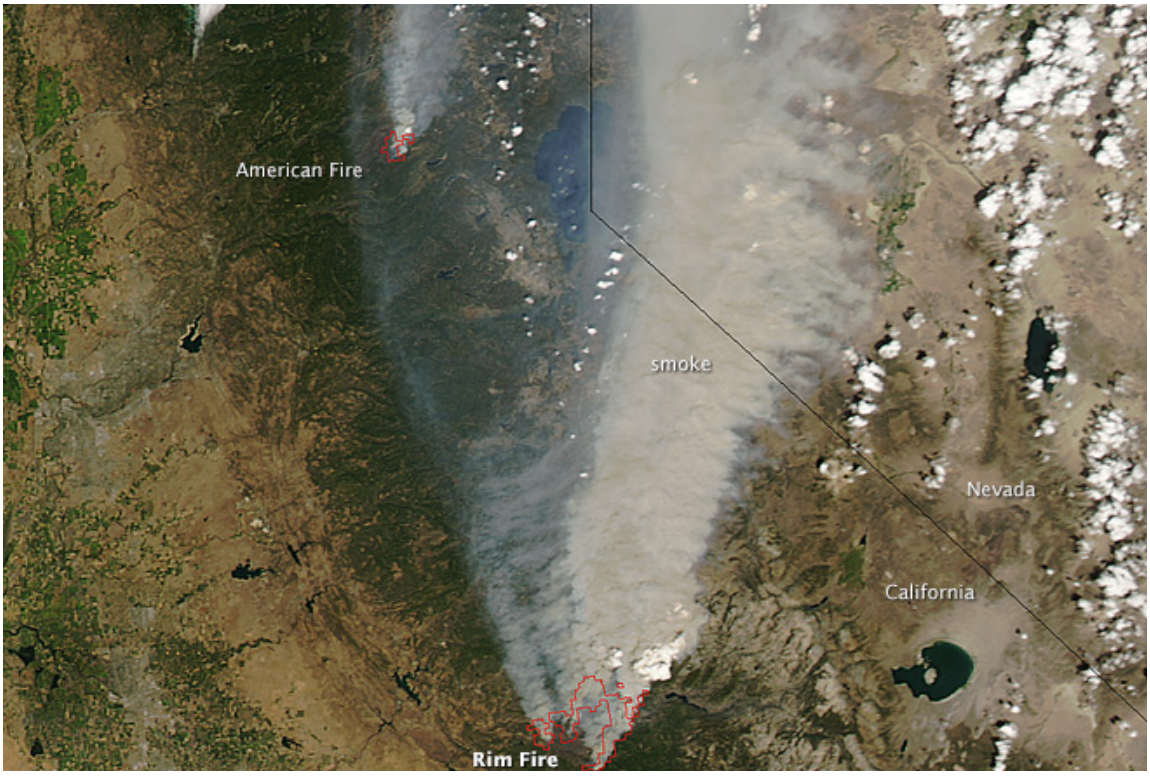
02. IMPACT OF WILDFIRES ON AIR QUALITY

Air Quality In Gardnerville During the 2013 Rim Fire Was 20 Times Worse Than Normal And Worse Than Typical For Beijing



*Air quality readings during the Douglas Complex fire have not yet been quality assured

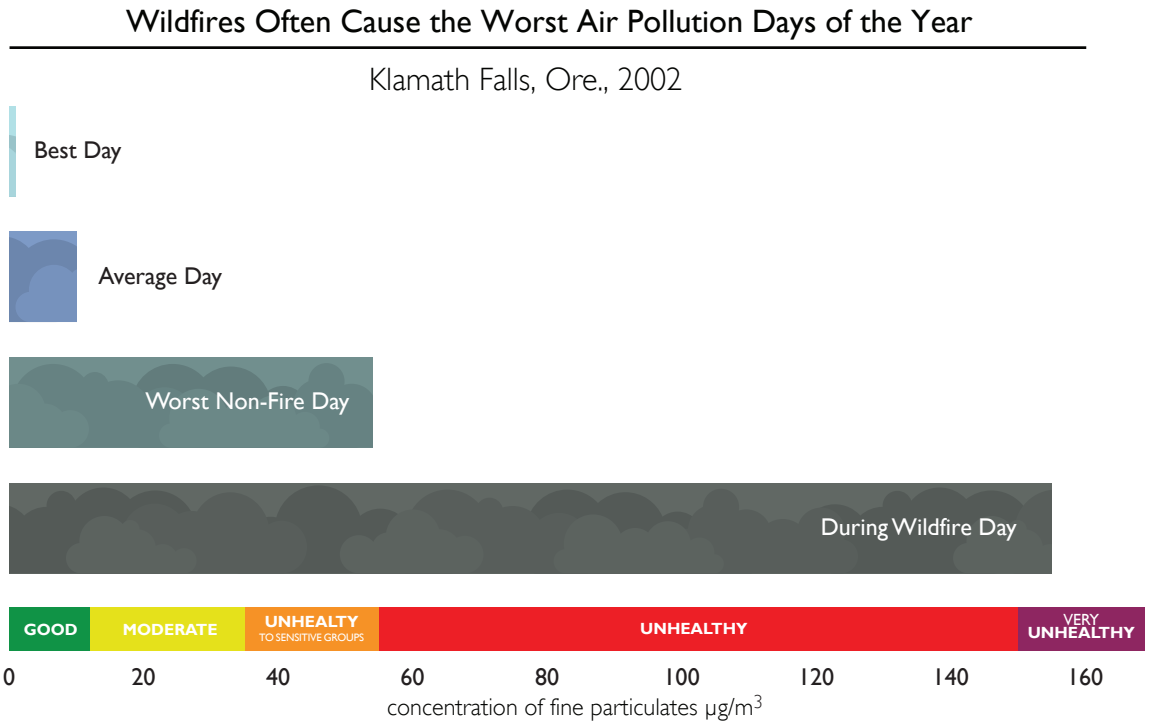
NASA satellite image of the Rim Fire, acquired August 22, 2013

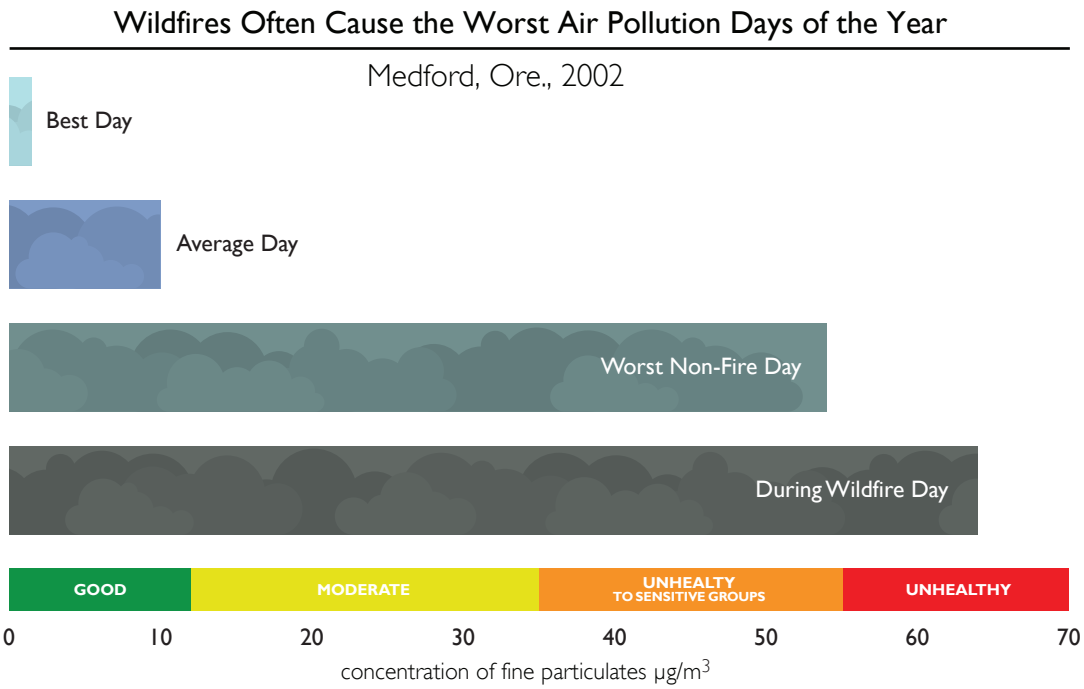


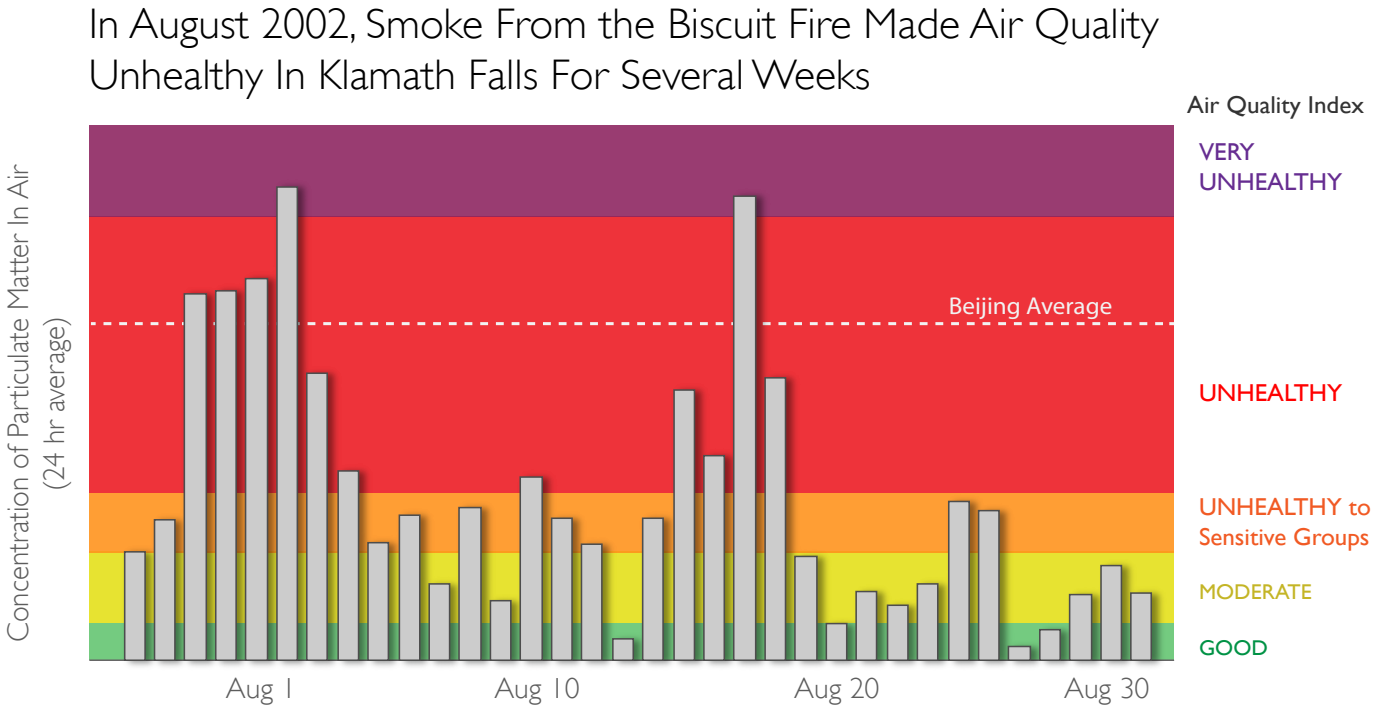
OREGON

Biscuit Fire, 2002

- For 10 days in Klamath Falls air quality was designated unhealthy for anyone.
- For five days air pollution in Klamath Falls, Ore. was worse than a typical Beijing day, which is also considered unhealthy for anyone to breathe.
- On at least 18 days, air quality was unhealthy for children, the elderly, and people with respiratory conditions.
- During the fire, air pollution was up to 15 times worse than average in Klamath Falls, and six times worse than average in Medford, Ore.
- For nearly a month, air pollution in Klamath Falls was much worse than normal.
- In Klamath Falls, Medford and Lakeview, Ore., Biscuit Fire days were the worst air pollution days of the year, as much as three times worse than the worst non-fire days.




Wildfires Often Cause the Worst Air Pollution Days of the Year
Medford, Ore., 2002
Best Day
Average Day
Worst Non-Fire Day
During Wildfire Day
GOOD
MODERATE
UNHEALTY TO SENSITIVE GROUPS
UNHEALTHY
0
10
20
30
40
50
60
70
concentration of fine particulates µg/m3


In August 2002, Smoke From the Biscuit Fire Made Air Quality Unhealthy In Klamath Falls For Several Weeks
Concentration of Particulate Matter In Air (24 hr average)
Beijing Average
Aug 1
Aug 10
Aug 20
Aug 30
Air Quality Index
VERY UNHEALTHY
UNHEALTHY
UNHEALTHY to Sensitive Groups
MODERATE
GOOD

02. IMPACT OF WILDFIRES ON AIR QUALITY

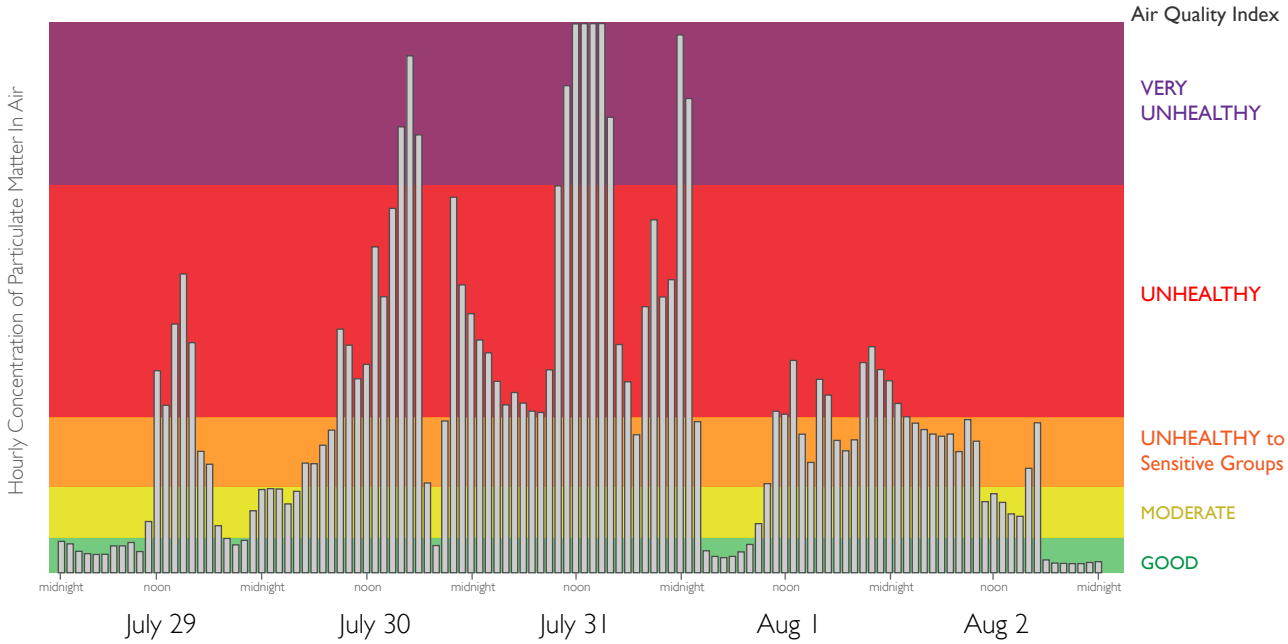
NASA satellite image of the Biscuit Fire, acquired on August 12, 2002

02. IMPACT OF WILDFIRES ON AIR QUALITY

Douglas Complex and Big Windy Complex Fires, 2013

- During this summer's Douglas Complex and Big Windy Complex Fires in Southern Oregon, air quality was unhealthy for at least a week in several cities and towns.
- For nine days between July 29 and August 9, air quality in Grants Pass, Ore. was classified as hazardous (one day), very unhealthy (two days), or unhealthy for anyone (six days), all at or above Beijing levels of pollution.
- On five separate days, the concentration of fine particulates in the air exceeded the upper limit of the air quality monitor in Grants Pass. On July 31, there were six consecutive hours where particulates exceeded the monitor's upper limit.
- At its worst, the average daily air quality in Grants Pass was about 30 times worse than average, and was about twice as bad as an average day in Beijing.
- In Medford, Ore., there were seven days between July 29 and August 8 where air quality was classified as very unhealthy (one day) or unhealthy for anyone (six days).
- On July 31, there were two consecutive hours where the air quality was worse than could be measured by the air quality monitor in Medford.
- There were four days this summer in Medford where air quality was as bad or worse than is typical for Beijing, China.

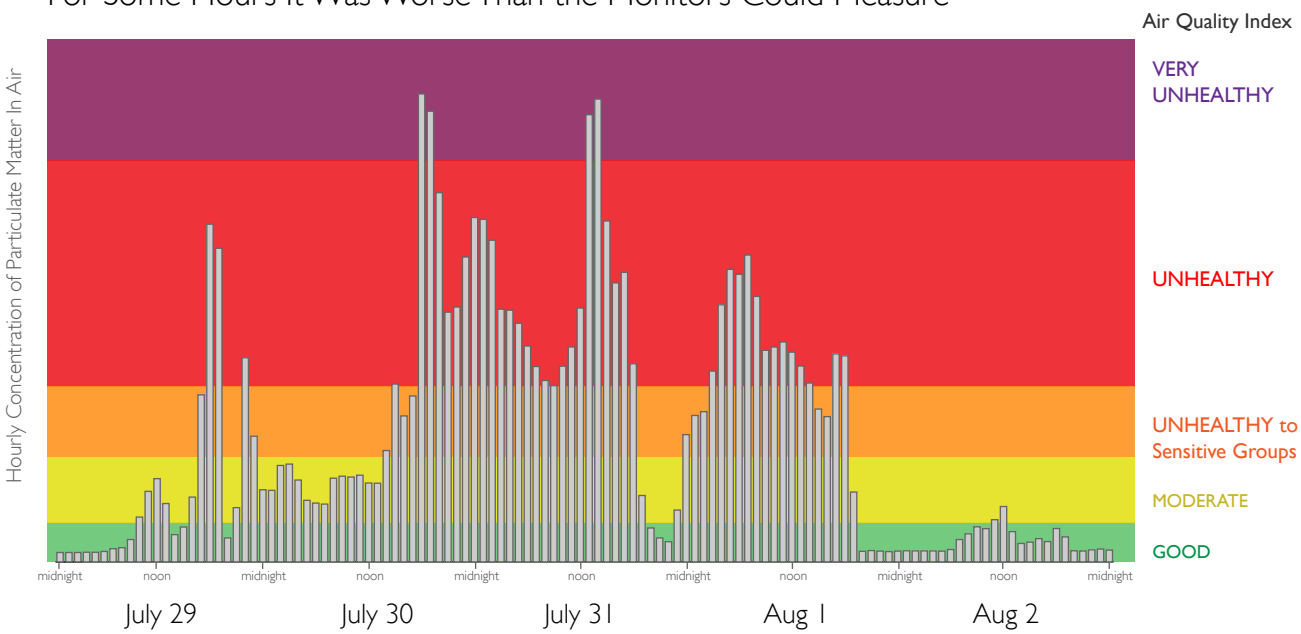
Air Quality In Grants Pass Was About 30 Times Worse Than Normal And For Several Hours It Was Worse Than the Monitors Could Measure



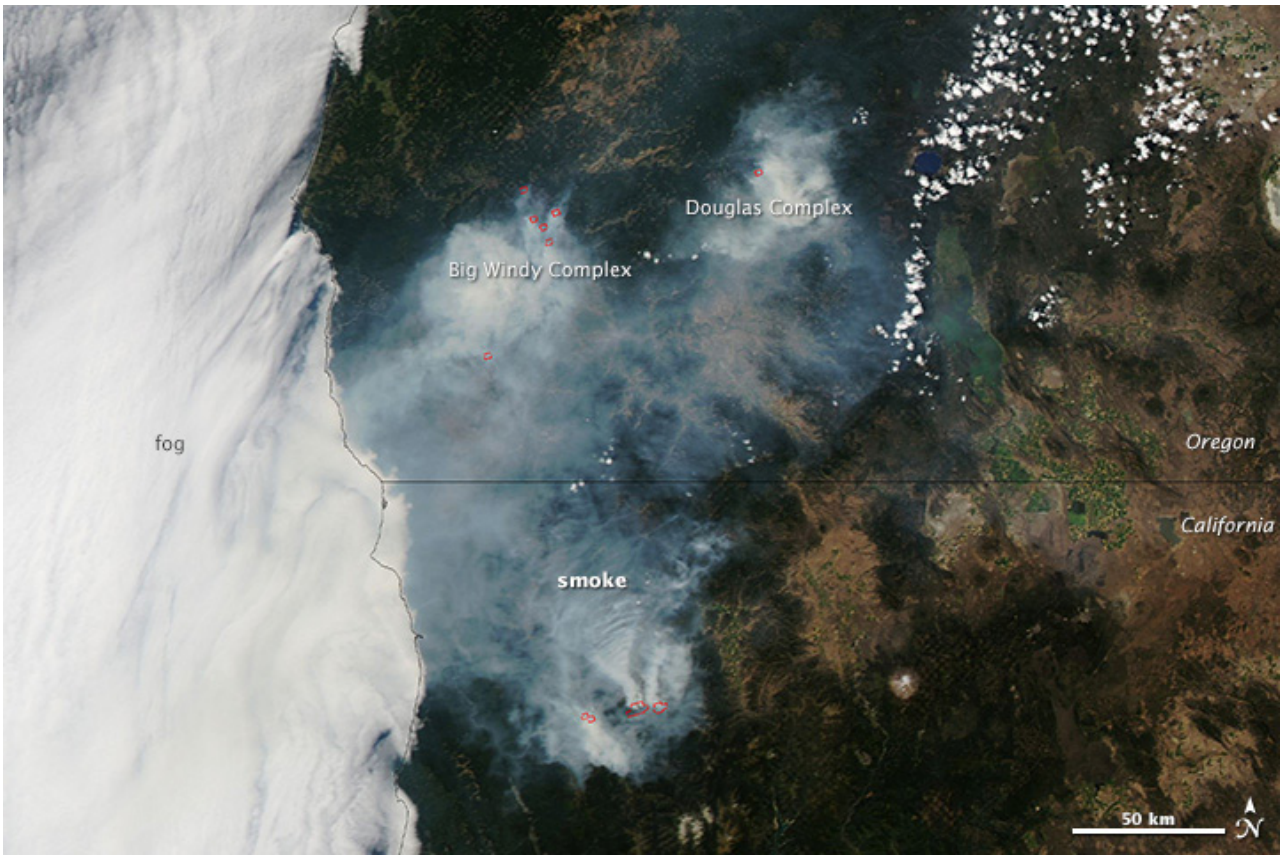
*Air quality readings during the Douglas Complex fire have not yet been quality assured

02. IMPACT OF WILDFIRES ON AIR QUALITY

Air Quality In Medford Was About 25 Times Worse Than Normal And For Some Hours It Was Worse Than the Monitors Could Measure



*Air quality readings during the Douglas Complex fire have not yet been quality assured



03. HEALTH IMPACTS OF WILDFIRES

In the past decade, the consequences of long-term exposure to even moderate amounts of fine particulates have been widely reported. Living in polluted cities poses a distinct health and mortality risk, increasing the likelihood that a person will develop cardio-pulmonary diseases or even lung cancer.[6] To reflect this risk, the EPA established a national standard for annual average exposure to $PM_{2.5,}$ 15 µg/m^3 , and since 2001 most of the U.S. has seen a steady decline in average annual $PM_{2.5}$ concentrations. Since 2007, more than 90 percent of monitoring stations report annual average concentrations well below this national standard.[7]

SHORT-TERM EXPOSURE TO FINE PARTICULATES

The effects of short-term exposure to higher concentrations of fine particulates are not as well-understood, but several recent studies have revealed that there are significant risks even to limited exposure to high $PM_{2.5}$ levels. For people with preexisting heart and lung conditions, sudden exposure to higher-than-average $PM_{2.5}$ levels increases the risk of asthma attacks, coronary events, and even death.[8] In fact, for every 10 µg/m^3 increase in the $PM_{2.5}$ levels over the day before, the risk for these events can increase by 2-5 percent. During wildfire events, when daily concentrations of $PM_{2.5}$ can routinely be 30-100 µg/m^3 and sometimes 200 µg/m^3 higher than normal, acute health risks may increasing by 40-50 percent or more for sensitive groups.

For children, whose lungs have not yet fully developed, exposure to $PM_{2.5}$ is also more hazardous than for a regular adult – particularly because children typically breathe through their mouths, which may make it easier for more fine particulates to reach the lungs. In particular, children are at risk for asthma attacks, wheezing and coughing when exposed to higher-than-average $PM_{2.5}$ levels.[5]

In a recent review of the health risks posed by fine particulates, the EPA found that short-term $PM_{2.5}$ exposure increases mortality for *everyone*, particularly due to heart- and lung-related complications.[8] Two more recent studies have also demonstrated that for every 10 µg/m^3 increase in the $PM_{2.5}$ concentration, the mortality risk increased for all people, and not just sensitive groups.[9,10]

WILDFIRE SMOKE-RELATED HEALTH PROBLEMS

Researchers have also specifically investigated the health risks from wildfire smoke. While linking mortality and health risks to wildfires has historically proven to be statistically difficult – because the number of fires and people reporting health problems during these events is small compared to what is normally considered for a large-scale statistical analysis – there are a few studies that demonstrate that wildfires increases the risk of health problems, particularly for sensitive groups, like children and people with preexisting health conditions.

03. HEALTH IMPACTS OF WILDFIRES

Following the southern California Fire Siege of 2003, researchers studied the relationship between fine particulate exposure and hospitalizations. They found that hospitalizations for asthma increased by 5 percent, but among the elderly (over 65 years old), asthma admissions increased by 10 percent.[11] Researchers also investigated the health impacts of the wildfire smoke on children. They concluded that children without asthma were at least twice as likely to have problems with wheezing, coughing, and sore eyes and throat during the fire than at other times. And for kids with asthma, reports of wheezing increased by nearly four times during the wildfires.[12] A separate study also found that babies born to women that were pregnant in southern California during the 2003 wildfires tended to have slightly lower birth weight (compare to women pregnant in the same area during times without the wildfires). [13]

Researchers also tracked the number of hospitalizations and asthma diagnoses at six San Diego County hospitals during the 2007 wildfires. They found that during the wildfires, emergency room diagnoses for respiratory syndrome increased by 25 percent and asthma diagnoses doubled during the fires.[14]

Following the Arizona's 2011 Wallow Fire, health officials studied rates of hospitalizations and respiratory diagnoses in Albuquerque, NM, where air quality was affected during the wildfire. Emergency room visits for asthma increased for everyone by nearly 10 percent during the wildfires, and for people over 65 years old, asthma-related visits increased by 73 percent.[15]

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Princeton: One Palmer Square, Suite 330 Princeton, NJ 08542
Phone: +1 609 924-3800
Toll Free: +1 877 4-CLI-SCI / +1 (877 425-4724)
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