

Climate Change and Air Quality

Analysis of the 2021 Summer Ozone Season



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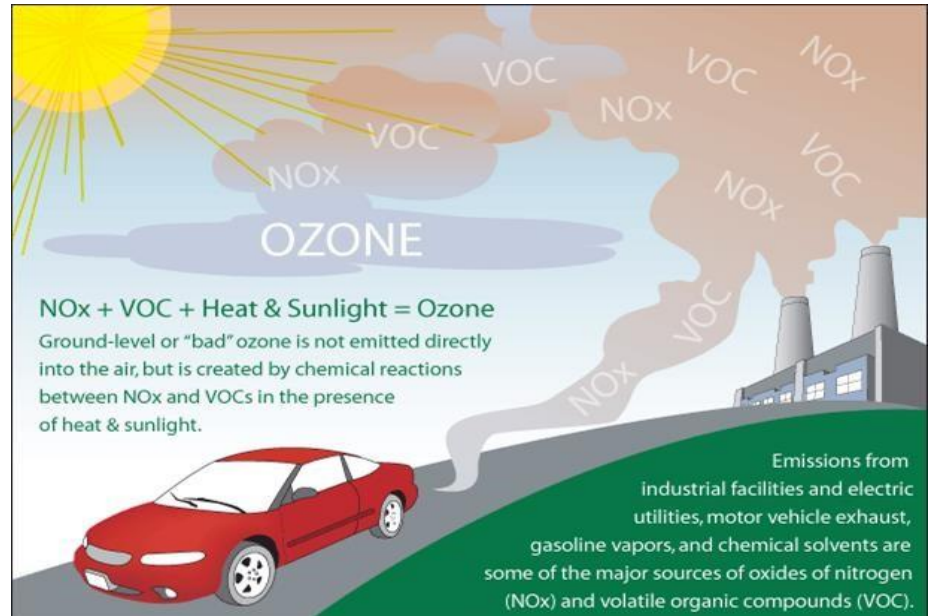
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PART I

Ozone Basics

Ground-Level Ozone

- Ozone forms through the interaction of heat, sunlight, volatile organic compounds, and nitrogen oxides (NOx).
- The most common sources of ozone-producing pollutants (NOx and VOCs) include vehicles, power plants, and industrial facilities, including oil and gas pollution.
- Since ground-level ozone requires heat and sunlight to form, summer months with higher temperature and more sunny days often have higher levels of ozone.



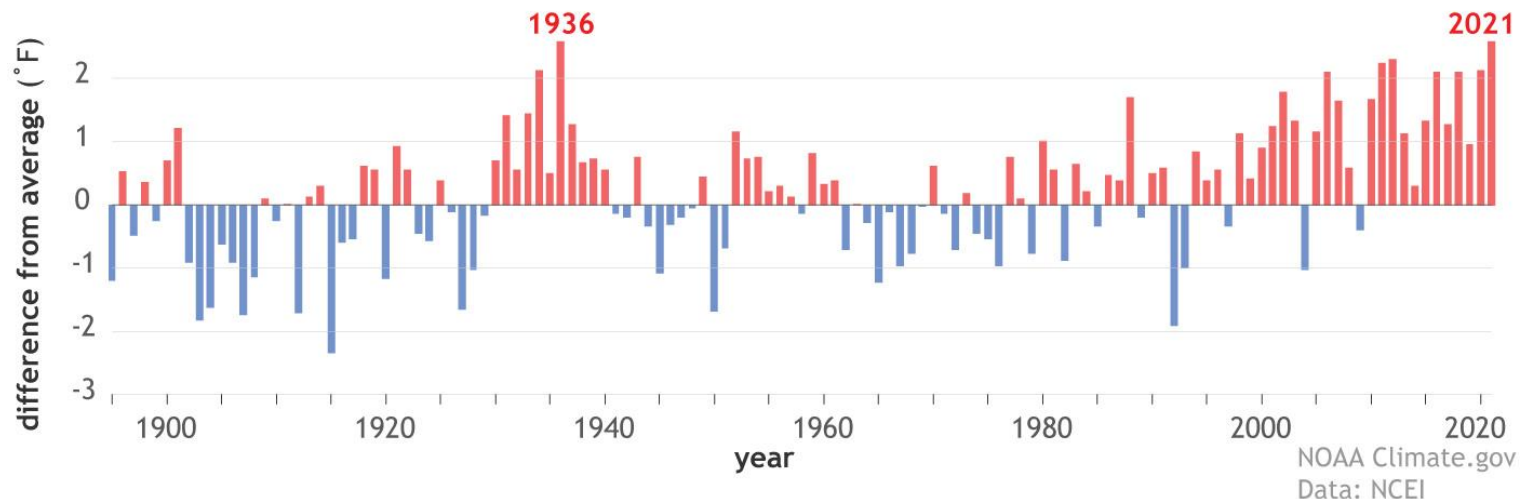
Source: EPA Ground-level Ozone Basics

- Ground-level ozone can seriously impact human health. A 2018 analysis by EDF found that ozone significantly increases the risk of:
 - Respiratory disease: reduced lung function, increased hospital admissions and emergency department visits for asthma and respiratory infections and possibly increasing rates of asthma development. School-aged children are particularly vulnerable.
 - Cardiovascular disease: specifically increased rates of strokes. There is also accumulating evidence supporting ozone's effects on cardiac arrhythmia in persons with preexisting heart disease.
 - Mortality due to short-term exposure to ozone. Studies reviewed indicate that ozone is responsible for ~5000 deaths per year in the US. New studies are adding to the evidence that long-term exposure to ozone also increases rates of mortality.

Climate Change Impacts on Air Quality

- Summer 2021 was the hottest on record for the contiguous United States, 2.6 F above the average (slightly exceeding the average during the 1936 Dust Bowl Summer).
- The Fourth National Climate Assessment states with “high confidence” that climate change will increase ozone levels and negatively impact air quality over most of the United States.
- Hot, sunny days and stagnant weather conditions can contribute to higher concentrations of ozone and particulate matter (PM).
- Wildfires, which are growing more frequent, release ozone precursors and are a major source of PM.
- According to the American Lung Association in its “State of the Air” 2021 report, reviewing data from 2017-2019, “high ozone days and spikes in particle pollution, related to extreme heat and wildfires, are putting millions more people at risk...”

U.S. summer temperatures compared to the 20th-century average (1895-2021)



Source: Climate.gov U.S. Climate Summary for August and summer 2021

PART II

EPA Air Quality Standards

National Ambient Air Quality Standards

- EPA establishes national air quality standards for 6 “criteria” air pollutants: carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide. These standards must be set at levels requisite to protect public with an adequate margin of safety and EPA establishes these standards based on numerous public health studies and consultation with scientific experts.
- States are required to measure and report air quality data for each of these pollutants. If an area fails to meet the standards, state air quality planners develop and submit plans including measures to restore healthy air.
- The current National Ambient Air Quality Standard (NAAQS) for ground-level ozone is set as a daily maximum 8-hour ozone concentration of 70 ppb (originally set in 2015 and retained in 2020).

Exceedance	Nonattainment
<ul style="list-style-type: none">• A maximum 8-hour ozone concentration at one monitoring station greater than 70 parts per billion (2015 ozone NAAQS)• An exceedance may indicate elevated pollution levels but does not necessarily mean that the area will be designated nonattainment. Nonattainment designations are based on three years of data• Ozone exceedances are most common on hot summer days and during heavy traffic periods, though can also occur in the winter, particularly in some areas of the western U.S.	<ul style="list-style-type: none">• Monitors record ozone concentrations over an 8-hour period• Attainment/Nonattainment status is based on the 3-year average of the annual fourth highest daily maximum 8-hour average ozone concentration• Nonattainment classifications range from “Marginal” to “Extreme” depending on how high above the standard ozone levels are

Protecting Vulnerable Populations



- The Clean Air Act requires that the NAAQS for ground-level ozone are set at a level “requisite to protect the public health,” with “an adequate margin of safety” to prevent any known or anticipated health-related effects from polluted air.
- It also requires that the standards protect vulnerable population – like children, the elderly, and people with heart and lung diseases – as well as the general public.
- A strong body of scientific evidences shows that there are health harms below the current standard of 70 ppb. During the 2020 review of the ground-level ozone NAAQS, public health and environmental organizations urged the EPA to adopt a more protective standard that reflects the most recent scientific evidence, advocating for a standard no less stringent than 60 ppb.

The Disproportionate Burden of Air Pollution

- While unhealthy air quality threatens Americans across the country, it's important to note that many studies have shown the burden of air pollution falls disproportionately on lower-income, Black, and Hispanic communities within the U.S.
- The American Lung Association "State of the Air" 2021 Report found that "people of color are 3 times more likely to be breathing the most polluted air than white people."
- A 2016 study found that predominantly minority communities were exposed to higher levels of ozone pollution, even after controlling for potential cofounders.



PART III

Summer Ozone Exceedances

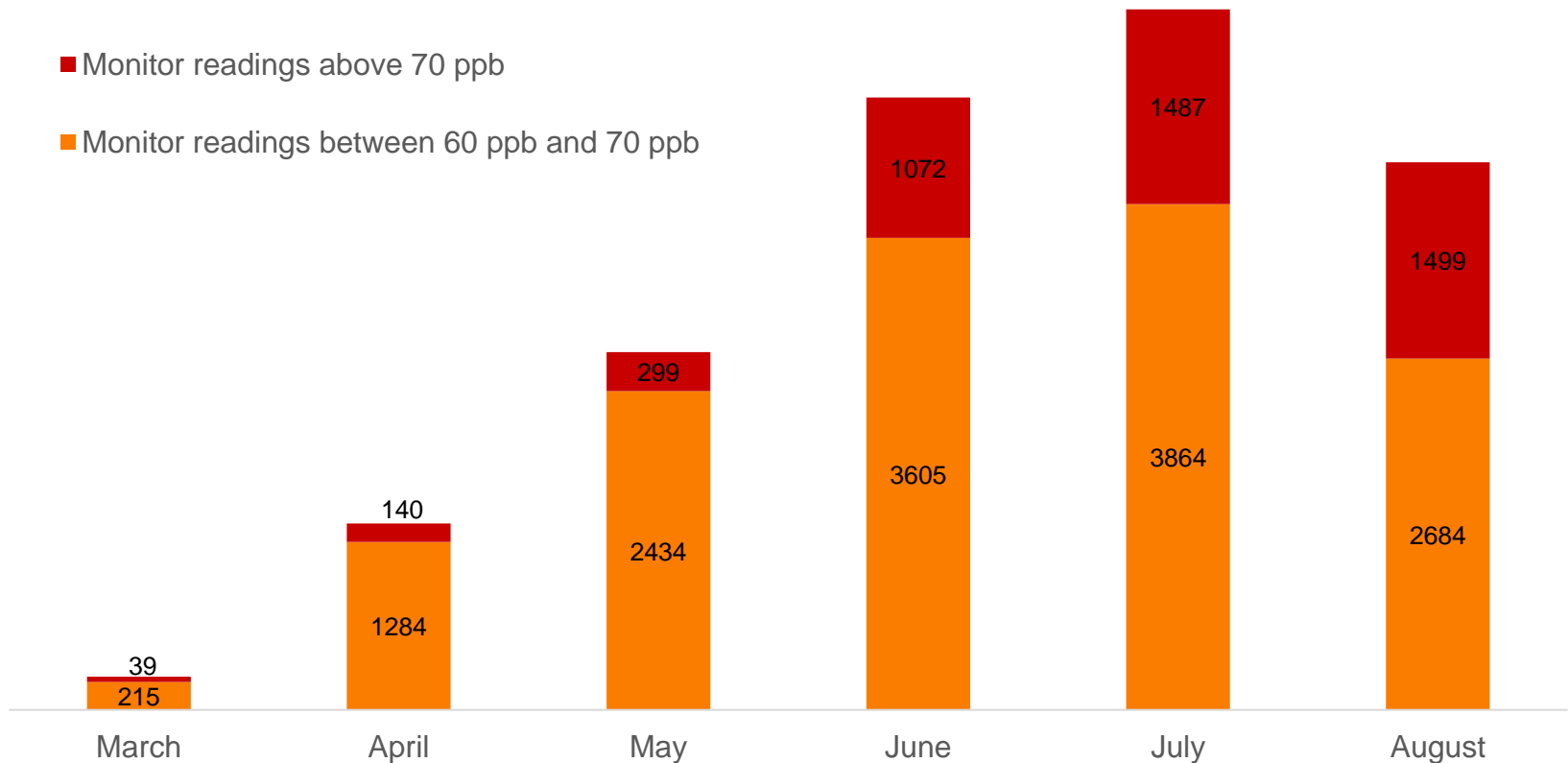
March – August 2021

Analytical Overview

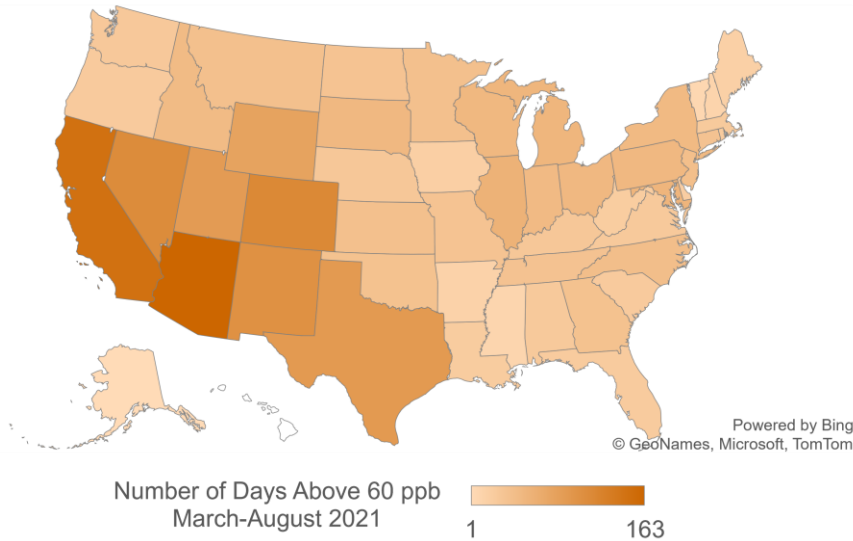
- Taking into consideration the strong body of evidence suggesting public health impacts from ground-level ozone levels below 70 ppb, this analysis includes both 8-hour ground-level ozone concentrations readings over 70 ppb (an exceedance based on the current NAAQS) and 60 ppb (an unhealthy level of ground-level ozone based on a substantial and growing body of scientific evidence).
- This analysis is based on publicly available data collected at EPA air-quality monitors across the country and looks at all daily 8-hour maximum ozone concentration monitor readings over 60 ppb that occurred between March 1, 2021 and August 31, 2021.
- Some of the data used in this analysis is AirNow data, which is not fully verified and validated through the quality assurance procedures monitoring organizations use to officially submit and certify data on the EPA AQS (Air Quality System) and, therefore, cannot be used to formulate or support regulation, guidance or any other Agency decision or position.
- As has been the case in recent summers, there were many wildfires, especially across the Western U.S., during the time frame considered in this analysis. Wildfire smoke is one of many sources of ozone precursors and can contribute to elevated levels of ozone pollution. EPA establishes standards based on health science alone, and the agency has long had policies in place that allow states to account for truly exceptional events. This analysis includes all recorded high ozone readings and does not exclude any high ozone days.
- The state and county level analysis captures high ozone days, in contrast to the number of high ozone monitor readings. In areas with multiple air quality monitors, there are often multiple exceedances recorded on the same day, which can skew the data when comparing areas with different concentrations of monitors.

The U.S. Recorded over 4,500 ozone Exceedances Between March and August 2021

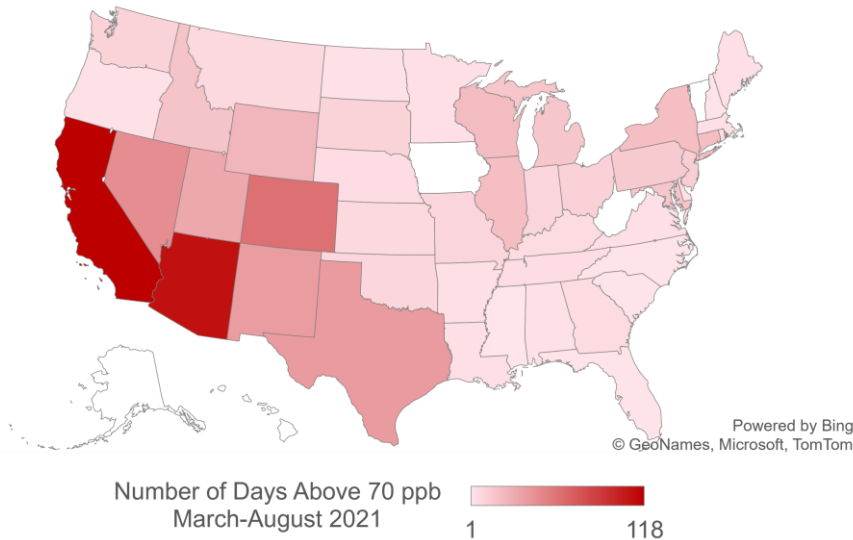
Based on preliminary monitoring data, between March and August 2021 the U.S. recorded 4,536 ground-level ozone exceedances (readings above 70 ppb), and 18,622 monitor readings above 60 ppb. The country recorded over 100 exceedances in April, which increased to nearly 1500 exceedances by August.



Almost Every State Experienced Unhealthy Ozone Levels at Least Once This Summer



49 states had at least one day above 60 ppb between March and August 2021.



45 states had at least one day above 70 ppb between March and August 2021.

California, Colorado and Arizona Experienced the Most High-Ozone Days

State	Number of Days Above 60 ppb, March–August 2021	Percentage of days above 60 ppb, March – August 2021
Arizona	163	89%
California	148	80%
Colorado	115	63%
Nevada	111	60%
New Mexico	104	57%
Texas	91	49%
Utah	89	48%
Wyoming	79	43%
Illinois	58	32%
Maryland	53	29%

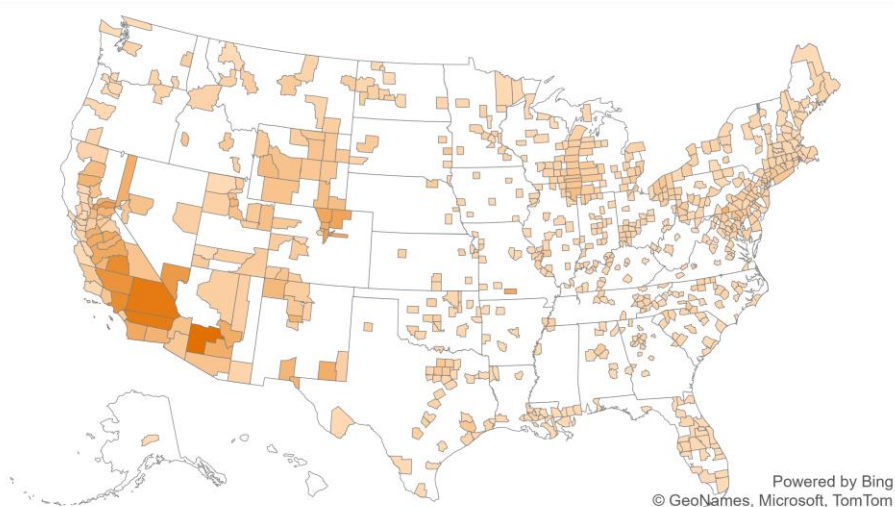
State	Number of Days Above 70 ppb, March–August 2021	Percentage of days above 70 ppb, March – August 2021
California	118	64%
Arizona	110	60%
Colorado	61	33%
Nevada	46	25%
Texas	39	21%
New Mexico	38	21%
Utah	32	17%
Wyoming	25	14%
Wisconsin	22	12%
Connecticut	21	11%

Across the West, Most Days Between March and August had Unhealthy Ozone Levels.

Days above 70 ppb
Days between 60 and 70 ppb
Days below 60 ppb

In Arizona, 89% of days
between March and August
had unhealthy ozone levels
somewhere in the state.

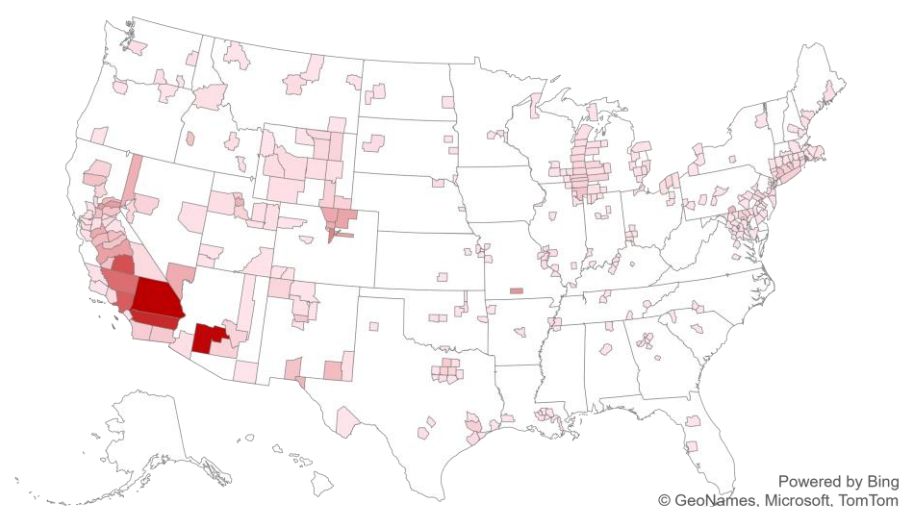
Hundreds of Counties Experienced Unhealthy Ozone Levels



Number of High Ozone Days (above 60 ppb)
March-August 2021

1 155

- 707 counties recorded at least one days with an 8-hour ozone concentration over 60 ppb
- Maricopa County in Arizona experienced 155 days with ozone levels over 60 ppb between March and August 2021 – averaging almost 26 days a month.



Number of High Ozone Days above 70 ppb
March-August 2021

1 112

- 343 counties recorded at least one 8-hour ozone concentration over 70 ppb
- San Bernardino County recorded the most high-ozone days: 112 high-ozone days between March and August 2021, including nearly every day in July and August.

It's important to note that this data is based on the existing air monitoring network. Just because a county is not included in this map does not mean that the county did not experience high ozone levels, since many counties do not have monitors.

Over 31.3 Million People Live in the 24 Counties with Over 20 High-Ozone Days

County	State	Number of Days Above 70 ppb March-August 2021	Population
San Bernardino	CA	112	2,180,000
Maricopa	AZ	109	4,485,000
Riverside	CA	92	2,471,000
Tulare	CA	73	466,195
Los Angeles	CA	67	10,040,000
Kern	CA	59	900,202
Jefferson	CO	48	582,881
Douglas	CO	40	351,154
Placer	CA	36	398,329
Fresno	CA	34	999,101
Arapahoe	CO	33	656,590
Weld	CO	32	324,492
Larimer	CO	30	356,899
Stanislaus	CA	29	550,660
Boulder	CO	28	326,196
Denver	CO	28	705,576
Clark	NV	28	2,267,000
Washoe	NV	26	471,519
Salt Lake	UT	25	1,160,000
El Paso	CO	24	720,403
Nevada	CA	23	99,755
Adams	CO	22	504,108
Merced	CA	21	277,680
Eddy	NM	21	58,460
TOTAL			31,353,200

Monitors in National Parks Have Recorded 250 Ozone Exceedances in 2021

Ozone Standard Exceedances in National Parks

2021

2020

2019

2018

2017

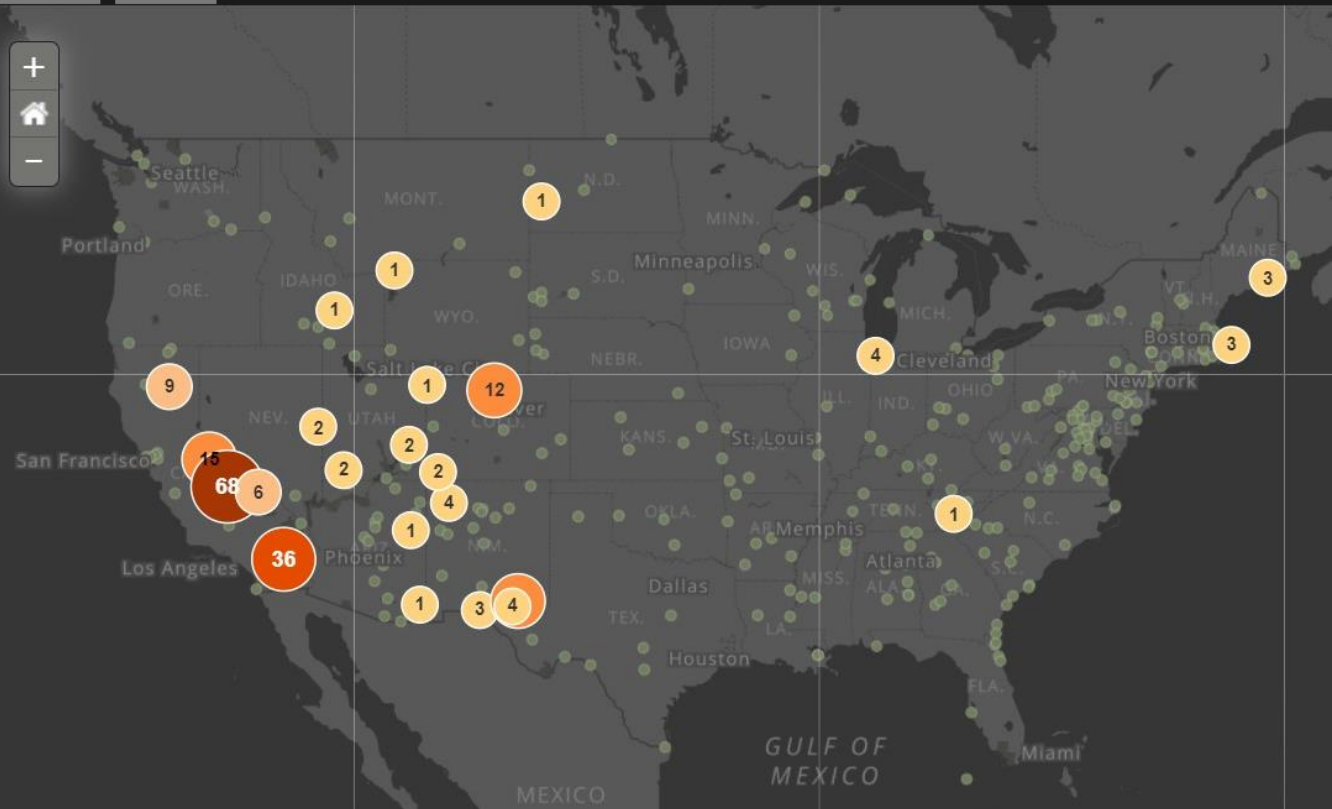
2016

This map shows the number of ozone exceedance days recorded in national parks with on-site monitoring so far this year (January- August 2021).

An exceedance day occurs when the daily maximum 8-hour ozone average is 71 parts per billion (ppb) or higher.

Number of Ozone Exceedance Days

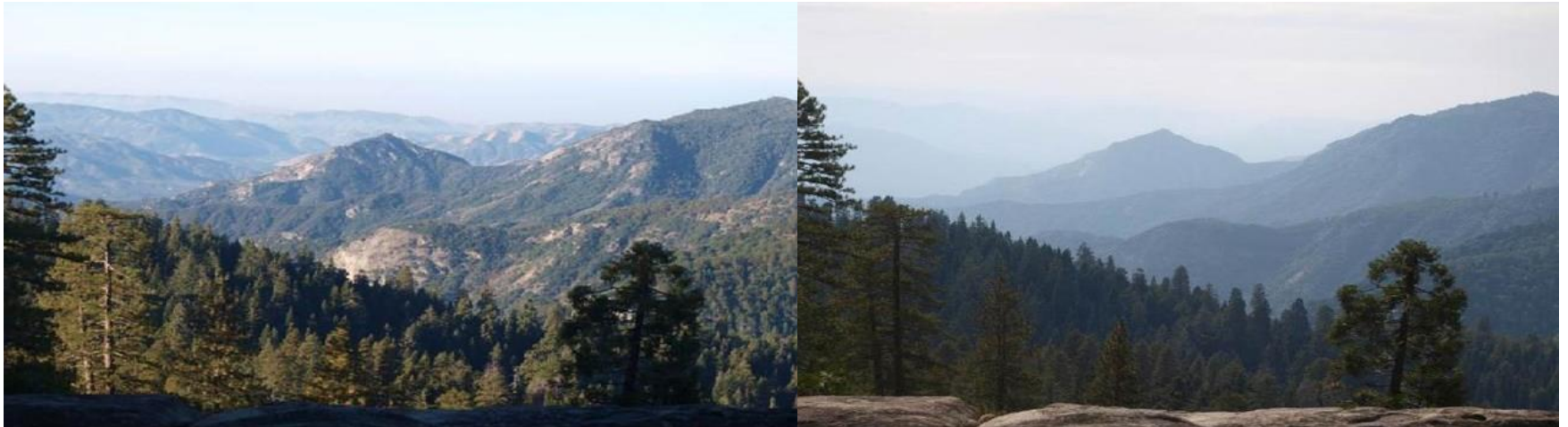
- 1 to 4 days
- 5 to 9 days
- 10 to 19 days
- 20 to 39 days
- 40+ days



National Parks Across the West Recorded Many Unhealthy Ozone Days

Number of Ozone Exceedances by Month for National Parks with More Than 5 Total Exceedances

National Park	Monitoring Location	March	April	May	June	July	August	Total
Sequoia and Kings Canyon National Parks	Ash Mountain	0	1	5	14	26	22	68
Sequoia and Kings Canyon National Parks	Lower Kaweah	N/A	0	1	8	22	21	52
Joshua Tree National Park	Black Rock	0	2	5	8	6	15	36
Yosemite National Park	Turtleback Dome	0	0	1	1	3	10	15
Carlsbad Caverns National Park	Biology Building	0	0	2	1	6	3	12
Rocky Mountain National Park	Long's Peak	0	0	0	2	8	2	12
Lassen Volcanic National Park	Manzanita Lake Fire Stn.	0	0	0	0	2	7	9
Death Valley National Park	Park Village	0	0	1	0	0	5	6



Source: Park Air Quality, Sequoia and Kings Canyon National Parks

References

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- American Lung Association, Disparities in the Impact of Air Pollution, <https://www.lung.org/clean-air/outdoors/who-is-at-risk/disparities>