

# Climate and Health Outlook

ISSUED APRIL 2024

The Climate and Health Outlook is an effort to inform health professionals and the public on how our health may be affected in the coming months by climate events and to provide resources for proactive action. Visit the [associated webpage](#) for additional resources and information and the new [Climate and Health Outlook Portal](#) for interactive maps with county-level forecasts for the current month along with county-level data on individual risk factors that may make people more vulnerable to negative health outcomes from these climate hazards. This edition provides forecasts for heat, flooding, drought, and wildfire in April 2024, information on well water considerations in times of drought and flooding, plus a look at how climate change is influencing pollen.



**Alaska:** Spring ice breakup and snowmelt flood\* potential this spring is forecasted to be normal for the majority of the state, with the exception of portions of the Copper River Basin due to above-normal snowpack.



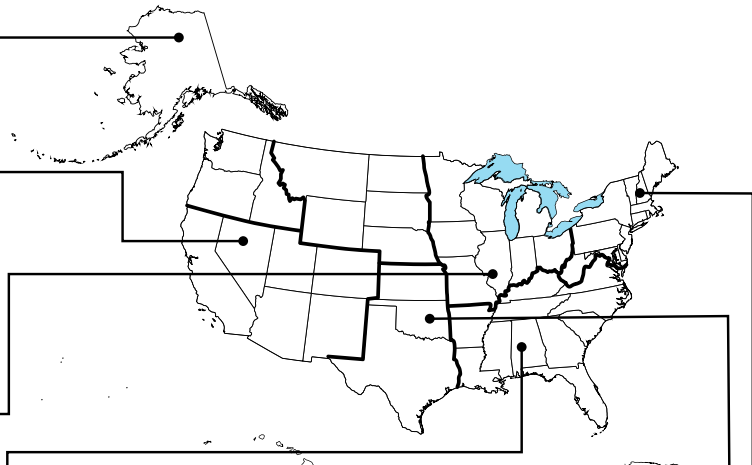
**Southwest:** Counties in California (2) are projected to have one or more heat exceedance days\*\* in April. Above normal significant wildland fire\*\*\* potential is forecast for eastern New Mexico and parts of southeast Colorado. Drought is favored to persist across most of New Mexico, eastern Arizona, and parts of Colorado and eastern Utah. Drought improvement and removal is likely for most drought areas of Arizona and southern Nevada.



**Midwest:** Moderate flooding is possible along several tributaries to the Missouri River in central Missouri this spring. Isolated minor flooding is expected on additional tributaries throughout this portion of the basin. Minor to isolated moderate flooding is possible along portions of the Lower Illinois River and tributaries in Illinois this spring. Minor flooding is possible across much of the combined Ohio, Cumberland, and Tennessee Valleys. Flooding in this region is mainly driven by springtime thunderstorm activity, and spring flooding is typical in this area. Above-normal significant wildland fire potential is forecast for Minnesota, much of Wisconsin, northwest Michigan, and northern Iowa. Drought persistence is forecasted in northern Minnesota, northern Wisconsin, and northwestern Michigan. Drought improvement and removal is favored across all drought areas of Missouri, Illinois, and Iowa, as well as southern Minnesota and southern Wisconsin.



**Southeast:** Minor flooding is possible throughout most of the Southeast, with isolated areas of moderate flooding potential. Flooding in this region is driven by springtime thunderstorm activity, and spring flooding is typical in this area. Below-normal significant wildland fire potential is forecast for Alabama, Louisiana, Georgia, much of Florida and South Carolina, and eastern North Carolina. Drought persistence is forecasted in a small portion of eastern North Carolina. Drought improvement and removal is favored across drought areas of Tennessee and Mississippi.



**Southern Great Plains:** Counties in Texas (9) are projected to have one or more heat exceedance days in April. Isolated moderate flooding is expected over tributaries to the Lower Missouri River in Kansas, as well as tributaries to the Lower Arkansas River in southeast Kansas and eastern Oklahoma along portions of the Neosho and Poteau rivers. Minor flooding is projected over much of eastern Kansas, eastern Oklahoma, and eastern Texas this spring. Above-normal significant wildland fire potential is forecast for parts of western Oklahoma and Kansas and North Texas. Below-normal significant wildland fire potential is forecast for southeast Texas. Drought persistence is forecasted in western Texas. Drought improvement and removal is favored in all drought areas of Kansas and Oklahoma, as well as central Texas.



**Northeast:** Minor flooding is possible across portions of Maryland, New Jersey, southern New York, and New England this spring. Areas including the Adirondack Mountains in northern New York, Vermont, New Hampshire, and the mountains of western Maine will be vulnerable to flooding from steady snowmelt through the spring, particularly if heavy rainfall occurs in the next few weeks. The potential for flooding due to ice jams is above normal across the northern portion of Maine. Most of the Northeast is forecasted to remain drought-free, except for a small portion western New York and Nantucket Island where drought is favored to persist.

\* It is important to remember that heavy and intense rainfall at any time can cause flooding conditions in excess of those predicted in the Spring Outlook. Communities are encouraged to monitor their flood risk at [water.noaa.gov](http://water.noaa.gov).

\*\* A "heat exceedance day" is when the daily maximum temperature is above the 95th percentile value of the historical temperature distribution in that county.

\*\*\* Smoke from wildfires can impact health hundreds of miles from the site of the fire.

Developed with data from the National Oceanic and Atmospheric Administration and the National Interagency Fire Center.



Drought



Wildfire

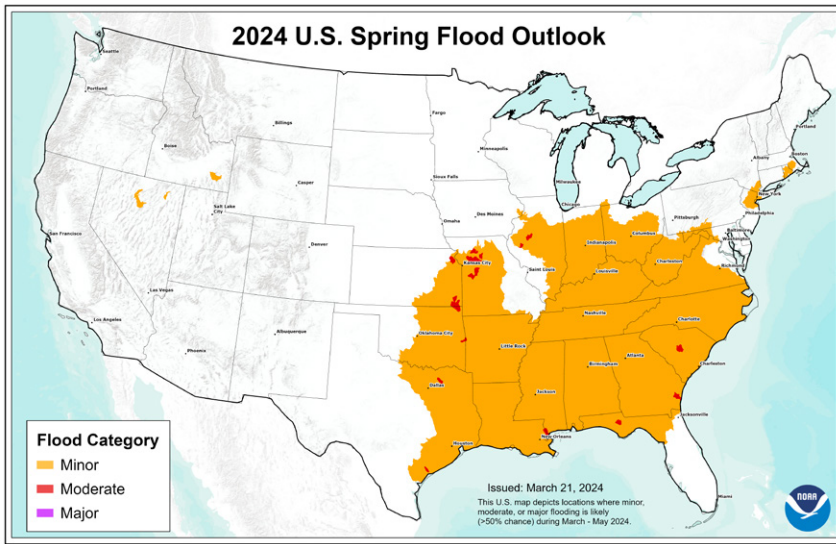


Flooding



Heat

## Spring Flooding



**Figure:** This map was developed by the [National Weather Service – Office of Water Prediction](#) and is reflective of forecast conditions on March 21, 2024. The map focuses on spring flood potential, using evaluation methods analyzed on the timescale of weeks to months, not days or hours. Heavy rainfall at any time can lead to flooding, even in areas where overall risk is considered low. For detailed hydrologic conditions and forecasts, go to [National Water Center Products and Services](#).

This year, NOAA does not project major spring flooding in any portion of the United States. However, approximately **133 million people** are at risk for some flooding in their communities this spring, with roughly 400,000 at risk for moderate flooding. The overall threat of significant flooding this spring is low due to above-normal temperatures and historically low snowpack across the Upper Midwest where seasonal signals are strongest. Isolated moderate flooding is expected over tributaries to the Lower Missouri River in Kansas and Missouri, and tributaries to the Lower Arkansas River in Kansas and Oklahoma. Minor flooding will be possible over much of the southern United States due to typical spring rainfall. In Alaska, spring ice breakup and snowmelt flood potential is forecasted to be normal for the majority of the state, with the exception of portions of the Copper River Basin due to above-normal snowpack.

### Climate Change and Spring Flooding

Climate change can impact the size and frequency of river and stream flooding events. Large floods have become more frequent across the Northeast, Pacific Northwest, and Northern Great Plains. Flood frequency has decreased in some other parts of the country, especially the Southwest and the Rockies. Warmer temperatures can cause more water to evaporate from the land and oceans, changing the amount and frequency of heavy precipitation (for example, rain and snow). In addition to precipitation, changes in river and stream size, the timing of snowmelt, and the amount of snowpack that accumulates in the winter can also affect flood patterns.

### Who Is at High Risk from Spring Flooding in the Counties with Elevated Potential for Moderate Flooding?

As indicated in the map to the left, **51** counties across **11** states are projected to have above-normal moderate flooding risk this spring. Of these counties:

- 7 (14%)** have a high number\* of people aged 65 or over living alone.
- 15 (29%)** have a high number of people without health insurance.
- 10 (20%)** have a high number of uninsured children.
- 10 (20%)** have a high number of adults with coronary heart disease.
- 5 (10%)** have a high number of people living in rural areas.
- 13 (25%)** have a high number of Black or African American people.
- 11 (22%)** have a high number of people with frequent mental distress.
- 13 (25%)** have a high number of people living in poverty.
- 4 (8%)** have a high number of people spending a large proportion of their income on home energy.
- 8 (16%)** have a high number of people with severe housing cost burden.
- 12 (24%)** have a high number of people with electricity-dependent medical equipment and enrolled in the HHS emPOWER program.
- 16 (31%)** have a high number of people with disabilities.
- 6 (12%)** have a high number of people in mobile homes.
- 13 (25%)** are identified as highly vulnerable by CDC’s Social Vulnerability Index.

\*“A high number” indicates that these counties are in the top quartile for this indicator compared to other counties.

### NOTES FROM THE FIELD:

## Protecting Private Well Water in Times of Flood and Drought

Climate change is affecting the frequency and severity of both flooding and drought in many areas of the U.S. Both conditions pose potential risks for well water, which are important considerations for health care and public health. To better understand the implications for families, we consulted Alan Woolf, MD, MPH, an internationally recognized environmental toxicologist, practicing pediatrician for nearly 40 years, and a part of the Pediatric Environmental Health Center at Boston Children's Hospital. In counseling families who have private wells, he has seen firsthand how climate-related hazards affect drinking water safety.

### Flooding

Flooding is a common cause of private well contamination with bacteria and other pollutants that can cause illness. Rapidly flowing flood water can carry large debris that hits wells, loosening or dislodging well hardware, while coarse sediment in the flood water can erode pump components. If the well is not tightly sealed, the sediment and flood water can enter the well and contaminate it. Floods may even cause some wells to collapse.

*“Well water quality has been a concern for my patients’ families throughout the Northeast due to major flooding in the summer of 2023. I recently cared for a patient who was having neurologic symptoms whose family discovered that their leaves had a coppery sheen. It turned out their well cap had been breached during recent flooding and their well water was contaminated with manganese, which was the cause of the patient’s symptoms. Another child in my care had gastrointestinal symptoms after a flooding event—the family had their well water inspected, and it showed high coliform bacteria, increased metals, and other evidence of contamination.” – Dr. Woolf*

### Drought

During a drought, aquifers can get depleted from over-extraction and inadequate replenishment, leading to a lack of potable water for families with wells. In addition, drought conditions can change the dynamics of groundwater, potentially leading to natural contaminants flowing into the water from bedrock such as arsenic, which can be harmful to health with chronic exposure. You can read more about these concerns from USGS: [Groundwater Decline and Depletion](#) and [Drought May Lead to Elevated Levels of Naturally Occurring Arsenic in Private Domestic Wells](#).

*“Water quality concerns are elevated when children are drinking from private wells. I recommend my patients’ families with private well water get their water tested regularly and be aware of these extra challenges during times of flooding and drought.” – Dr. Woolf*

### Resources to Protect Well Water

While EPA does not regulate private wells, they do [offer guidance to private well owners](#). To help protect your well during times when it may flood, make sure you can see and access your well cap to assess threats. Even without obvious damage, wells that are more than 10 years old or less than 50 feet deep are likely to be contaminated during a flood. If you suspect your well has been contaminated, EPA provides specific recommendations for well owners to follow in its short guide [What to do After the Flood](#), and CDC provides recommendations for [Disinfecting Wells After a Disaster](#).

The EPA does not have specific guidance for private wells during drought, but they recommend testing private wells annually (or more frequently if small children, elderly adults, or somebody who is pregnant or nursing is drinking the water, as these segments of the population have elevated vulnerability to pollutants), [immediately after significant flooding and other nearby activities](#), and if there are signs of drought impacts such as a change in taste or color of the water, sputtering faucets, sudden pressure changes, or air bubbles.

Dr. Woolf has also co-authored a policy statement for the American Academy of Pediatrics on [Drinking Water From Private Wells and Risks to Children](#).

### Floods Affect Health in Many Ways

Floods increase the risk for a diverse range of health outcomes. For example:



Floodwaters pose **drowning risks** for everyone, including those driving in floodwaters.



Objects in floodwaters can cause injuries such as **broken bones, cuts, and electrocution**.



Exposure to floodwater contaminated with chemicals, sewage, animal waste, and other pathogens can cause **burns, rashes, skin and eye infections, and gastrointestinal and respiratory illnesses**.

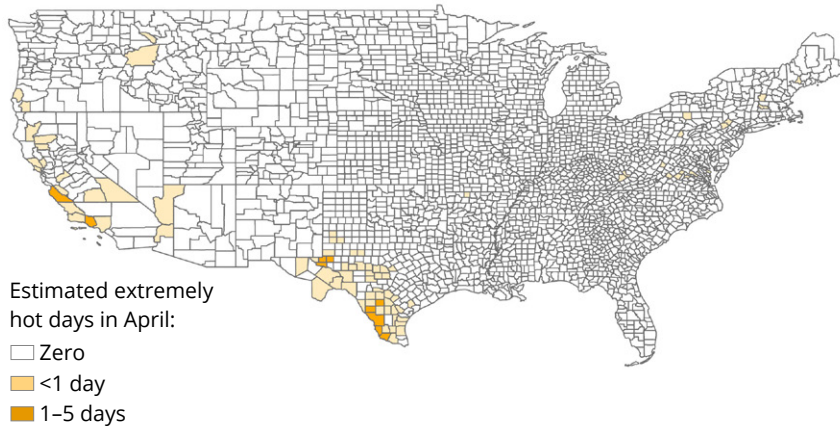


Post-flooding mold can present risks for people with **asthma and allergies**.



Power failure during floods can **harm patients** who critically depend on electricity-dependent medical equipment, both at home and at health care facilities.

## Where Are Extremely Hot Days Expected in April?



**Figure:** This map shows the expected number of extremely hot days in April in each county in the contiguous U.S. The forecast is based on the [NOAA Climate Prediction Center’s probabilistic outlook of temperatures](#) being above, below, or near normal in June. A county’s “normal” temperature is based on the 30-year average from 1991–2020. An “extremely hot day” is when the daily maximum temperature is above the 95th percentile value of the historical temperature distribution in that county. For more information on your county, please refer to the [Centers for Disease Control and Prevention \(CDC\) Heat and Health Tracker](#).

In April, **2 counties in California** and **9 counties in Texas** are expected to have one or more extremely hot days. In these counties, the total population at risk is **1,859,822**. Extreme heat is increasing in the U.S. Climate projections indicate that extreme heat events will be more frequent and intense in coming decades. In the U.S., an average of 702 heat-related deaths occur each year.

## Who Is at High Risk in the Counties With the Most Extreme Heat Days?

Some communities face greater health risks from extreme heat given various risk factors they face. These communities include people who: are elderly and live alone, have existing health conditions, have poor access to health care, live in rural areas, have disabilities, work outdoors, make a low income, face difficulty paying utility bills, live in poor quality housing, and live in urban areas without adequate tree cover.






## The Danger of Early Season Heat Waves

While early season extreme heat events are less common than those that occur later in the summer, they may be more deadly. This could be because as the summer progresses, our bodies get used to the higher temperatures and become more efficient at cooling, by increasing sweating rates, for example. When temperatures are very high early in the season, before our bodies have a chance to adjust, the risks of heat stress and heat stroke may be higher. [One study](#) of heat waves in 43 U.S. cities found that the first heat wave in a community had greater impacts on mortality on average than heat waves that were not the first in the season. Heat-related mortality risk early in the heat season is even greater for those who are more vulnerable to the impacts of heat, such as young children, older adults, pregnant people, or those with chronic medical conditions that make them more susceptible to heat-related illness. Because of the ways climate change increases temperature and temperature variability, these early season extreme heat events may become more common. This underscores the importance of taking precautions to protect yourself and those around you whenever temperatures are high and particularly during extreme heat events in the early heat season.

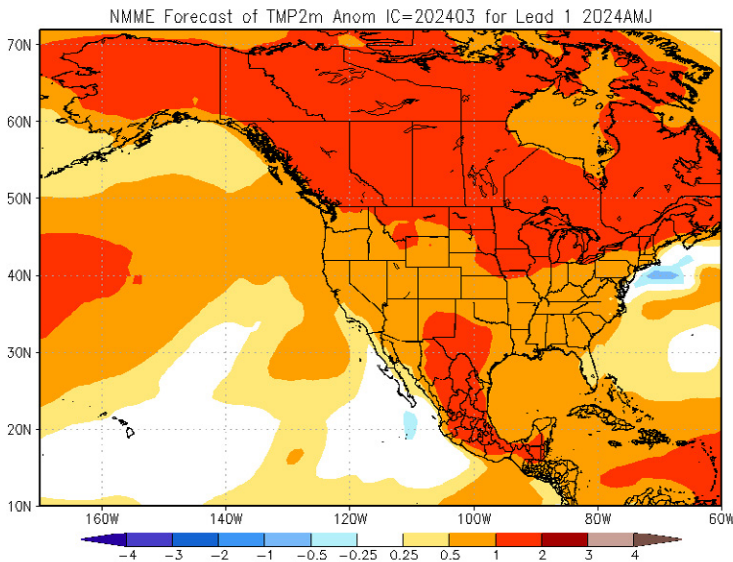
Some medications increase the risk of heat-related illness because they impair thermoregulation. These include diuretic medicines (sometimes called “water pills”), antihistamine medicines (including many allergy medicines), and many antipsychotic medicines used to treat a variety of psychiatric and neurologic illnesses. Check out [SAMHSA’s Tips for People Who Take Medication: Coping with Hot Weather](#) for more information.

### Heat Affects Health in Many Ways

Warmer temperatures increase the risk for a diverse range of health risks. For example:

-  An increased risk of **hospitalization for heart disease**.
-  **Heat exhaustion**, which can lead to **heat stroke** which, if not treated, can cause critical illness, brain injury, and even death.
-  Worsening **asthma** and **chronic obstructive pulmonary disease (COPD)** as heat increases the production of ground-level ozone.
-  Dehydration, which can lead to **kidney injury** and blood pressure problems. Some kidney damage can become irreversible with repeated or untreated injury.
-  **Violence, crime, and suicide** may increase with temperature, adding to the rates of depression and anxiety already associated with climate change.

## How Hot Will It Be, and Where, Over the Next 3 Months?



**Figure:** The North American Multi-Model Ensemble (NMME) predicts the average temperature over the next 3 months (April-June) will be 0.9-1.8°F (0.5-1°C) hotter than average across almost all of the contiguous United States. For more information about this model or prediction, please refer to the [NMME website](#).

For April-June, the North American Multi-Model Ensemble (NMME) predicts that the average temperature will be 0.9-1.8°F (0.5-1°C) above normal for across the entirety of the contiguous United States, except along the southern coast of California. However, large portions of the northern Great Plains, the Midwest, southeastern New Mexico, and western Texas may experience a higher 90-day average that is 1.8-3.6°F (1-2°C) above the normal average temperature for this period. The NMME integrates multiple forecasts of the next 90 days to build the best estimate of temperatures and precipitation over that time frame. Note that although many regions may expect a warmer 90-day average temperature, this is not the same as your local weather forecast, in which large fluctuations in temperature may be predicted from day to day.

### Resources

CDC’s [Extreme Heat](#) and [Keep Your Cool in Hot Weather!](#) webpages provide information and resources about heat-related illness and how to stay cool and safe in hot weather.

OCHE’s [Protecting Vulnerable Patient Populations from Climate Hazards: A Referral Guide for Health Professionals](#) aims to inform education and referrals in clinical settings for patients who are vulnerable to climate change’s health impacts.

### Pediatric Heatstroke Prevention

Between 1998 and 2023, more than 965 children died due to heatstroke when left in a vehicle alone, with an average number of [37 deaths each year](#). More than half of the deaths (54%) are children under 2 years of age. All of these fatalities were preventable. In 10 minutes, a car can heat up by as much as 20 degrees Fahrenheit and become life threatening for a child trapped inside. Rolling down a window does little to keep a vehicle cool. Since the body temperature of a child rises three to five times faster than that of an adult, a hot vehicle can become dangerous within a short period of time. Among the reported fatalities, 53% of children were forgotten by their caregivers, 25% gained access to the car on their own, and 20% were knowingly left in the car by the caregiver. **Three tips to remember: never leave a child in a car unattended, make it a habit to look in the backseat every time you exit, and always lock the car and put the keys out of reach.**

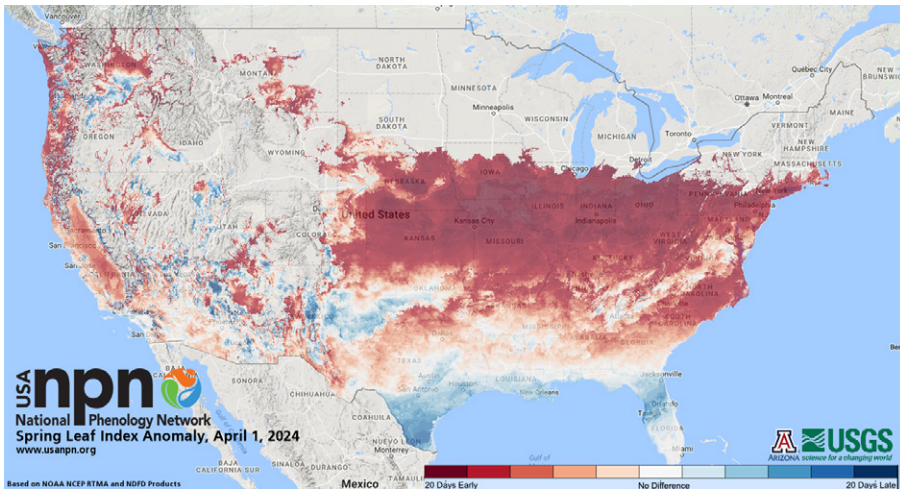


Image source: [NHTSA](#)

Finding and accessing resources for cooling centers differs at the state and county level. Calling or visiting the website of a state’s 2-1-1 program (a guide to local community services) can connect individuals with resources for extreme heat, including Extreme Heat Cooling Programs. [Find cooling centers by state.](#)

[LIHEAP](#) provides federally funded assistance to reduce the costs associated with home energy bills, energy crises, weatherization, and minor energy-related home repairs. You can find out if you qualify for assistance by using the [LIHEAP Eligibility Tool](#).

## Start of Spring Across the U.S. as of April 1, 2024

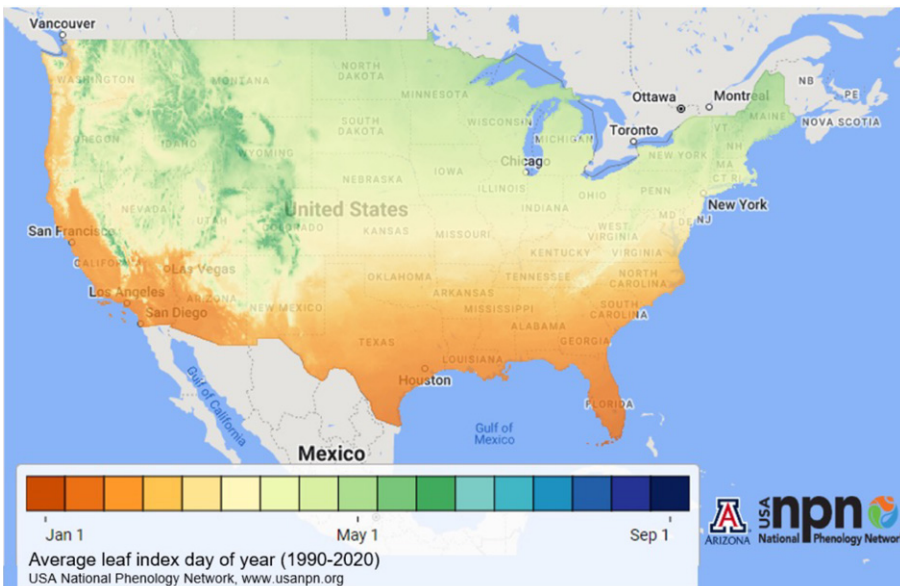


**Figure:** This map depicts where springtime biological activity has begun earlier than average (in red tones) and later than average (blue tones). Accordingly, we can expect an earlier start to the pollen season in these regions. For more information, visit the [USA-NPN Status of Spring page](https://www.usanpn.org).

Spring 2024 was slow to start in the southern states of the U.S, but it has now begun spreading more quickly across the central part of the country. So far in 2024, the **start of springtime has been up to three weeks ahead of schedule**, especially in parts of Kansas, Indiana, and Ohio. Denver, CO is a week early, Chicago, IL is two weeks early, and Detroit, MI is 23 days early compared to a long-term average from 1991–2020. The Sacramento Valley, coastal areas of Northern California, Oregon, Washington, parts of the Great Plains, and southern Midwest are seeing the earliest start to spring on record.

**Springtime pollen release is heavily shaped by winter and spring temperatures.** Plants must be exposed to sufficient warmth to emerge from dormancy, open their flowers, and release pollen. On average, plants release pollen about two weeks after showing signs of springtime activity.

## Spring Pollen Season Is Getting Longer & More Intense



**Figure:** This map from the [USA National Phenology Network \(USA-NPN\)](https://www.usanpn.org) shows when springtime activity in plants typically began over the last 30 years based on pollen monitoring stations certified by the American Academy of Allergy, Asthma & Immunology [National Allergy Bureau](https://www.aai.org). The start of spring occurs on the date when enough heat has accumulated to initiate growth (leafing and flowering) in temperature-sensitive plants. The [United States Global Change Research Program](https://www.usgcrp.gov) uses data from the USA-NPN as an indicator for the start of the spring season.

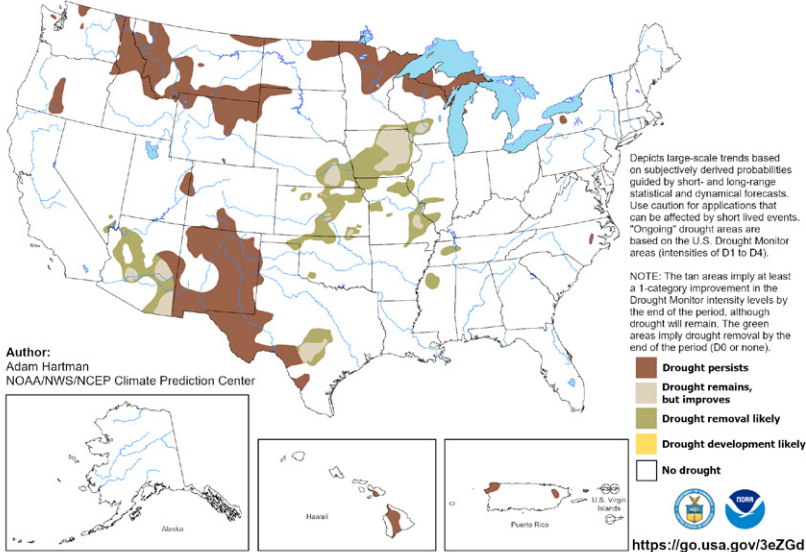
Our changing climate has caused shifts in precipitation patterns, more frost-free days, warmer seasonal air temperatures, and more carbon dioxide (CO<sub>2</sub>) in the atmosphere. These changes may lead to both **higher pollen concentrations** and **earlier and longer pollen seasons**. Overall, data from the USA National Phenology Network (shown on the map to the left) indicate that on average, the start of spring has occurred earlier in the contiguous United States since 1984. [One study](#) found that nationwide, total pollen amounts increased up to 21% between 1990 and 2018, with the greatest increases recorded in Texas and the Midwest.

Some of these changes in pollen due to climate change could have major impacts on human health such as **increasing individuals' exposure to pollen and their risk of having allergy and/or asthma symptoms**.

## Drought

### U.S. Monthly Drought Outlook Drought Tendency During the Valid Period

Valid for April 2024  
Released March 31, 2024



**Figure:** The National Weather Service Climate Prediction Center’s [Monthly Drought Outlook](#) is issued at the end of each calendar month and is valid for the upcoming month. The outlook predicts whether drought will persist, develop, improve, or be removed over the next 30 days or so. For more information, please refer to [drought.gov](#).

During April, drought improvement and removal is favored in portions of the Southeast, Midwest, Northern Great Plains, Southern Great Plains, and the Southwest. No drought development is predicted during April, but drought persistence is forecasted across drought areas of the Southwest, Northwest, Northern Great Plains, Southern Great Plains, the Midwest, and in parts of Hawai’i, Puerto Rico, western New York and Nantucket Island, and eastern North Carolina. Drought can have direct and indirect impacts on health—increasing incidence of illness among those living in the affected area and worsening mental health outcomes as livelihoods are challenged.

### Who Is at High Risk in the Counties Projected to Have Drought in April?

As indicated in the map to the left, **274 counties** across **18 states** are projected to have persistent/remaining drought or drought development in November. In these counties, the total population at risk is **11,602,878 people** and, of those, **211,337 people** work in agriculture. Of these counties:

**106 (39%)** have a high number\* of people aged 65 or over, living alone.

**81 (30%)** have a high number of people living in rural areas.

**70 (26%)** have a high number of people living in poverty.

**48 (18%)** have a high number of people with frequent mental distress.

**49 (18%)** have a higher number of adults with asthma.

**71 (26%)** have a high number of people without health insurance.

**108 (39%)** have a high number of uninsured children.

**8 (3%)** have a high number of Black or African American persons.

**63 (23%)** have a high number of people with severe housing cost burden.

**74 (27%)** have a high number of people in mobile homes.

**64 (23%)** have a high number of people with one or more disabilities.

**75 (27%)** are identified as highly vulnerable by CDC’s Social Vulnerability Index.

\*“A high number” indicates that these counties are in the top quartile for this indicator compared to other counties.

### Drought Affects Health in Many Ways

Drought increases the risk for a diverse range of health outcomes. For example:



Low crop yields can result in rising food prices and shortages, potentially leading to **malnutrition**.



Dry soil can increase the number of particulates such as **dust and pollen** that are suspended in the air, which can irritate the bronchial passages and lungs.



Dust storms can spread the fungus that causes coccidioidomycosis (**Valley Fever**).



If there isn’t enough water to flow, waterways may become stagnant breeding grounds for **disease vectors** such as mosquitoes as well as viruses and bacteria.

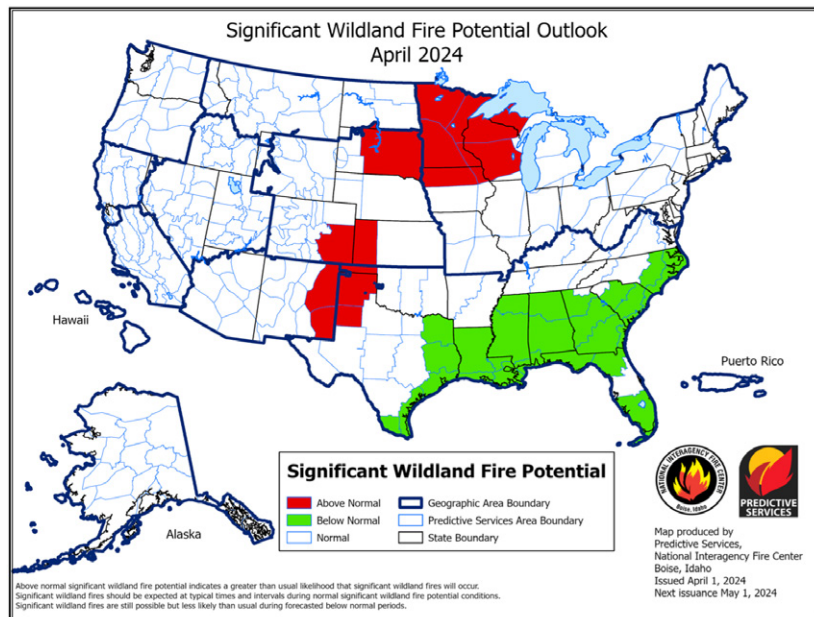


Drought’s complex economic consequences can increase **mood disorders, domestic violence, and suicide**.



Long-term droughts can cause **poor-quality drinking water** and leave inadequate water for hygiene and sanitation.

## Wildfire



**Figure:** The [National Significant Wildland Fire Potential Outlook](#) identifies areas with above-, below-, and near-normal significant fire potential using the most recent weather, climate, and fuels data available. These outlooks are designed to inform decision makers for proactive wildland fire management.

Fire activity was active at the beginning of March for the Southern, Eastern, and Rocky Mountain areas, but subsided at the end of the month. In April, much of the Southeastern U.S. is forecast to have below normal significant fire potential, extending eastward from southern and east Texas, along the Gulf Coast states, and up the Atlantic coast to North Carolina (excluding a portion of the central Florida Peninsula).

### Who Is at High Risk in the Counties with Above Normal Wildland Fire Potential?

Some communities face greater health risks from wildfire smoke given various risk factors they face. These communities include people who: are elderly and live alone, have asthma or coronary heart disease, have poor access to health care, have disabilities, work outdoors, have low income, rely on electricity-dependent medical equipment, and live in poor quality housing.

### Resources to Reduce Health Risks Associated with Wildfires

The [Ready.gov Wildfires site](#), [CDC Wildfires site](#), and EPA [Smoke-Ready Toolbox for Wildfires](#) include information about how to prepare for wildfires, stay safe during a fire, and return home after a fire.

The [AirNow Fire and Smoke Map](#), a joint project of EPA and the U.S. Forest Service, provides information on fire locations, smoke plumes, and air quality, using the color-coding of the Air Quality Index (AQI), along with recommended actions to take to reduce smoke exposure. The [AirNow Wildfires site](#) provides additional information on steps to protect your health. The Map is also available in the [AirNow app](#).

If you have children, these resources may help: CDC's [Ready Wrigley Prepares for Wildfires & Smoke](#), [Helping Children Cope with Emergencies](#), and [Helping Teens Cope After a Natural Disaster](#).

## Wildfires Affect Health in Many Ways

Wildland fire increases the risk for a diverse range of health outcomes from both the fire itself and smoke. For example:

- Due to the nature of their work, firefighters are at risk of developing severe heat-related illness (such as **heat stroke**) and rhabdomyolysis (**muscle breakdown**).
- Wildfire can cause **burns** through contact with flames and hot surfaces as well as chemical and electrical burns.
- Wildfire smoke can lead to disorders including **reduced lung function**, **bronchitis**, exacerbation of **asthma**, and cardiovascular effects like **heart failure**.
- For pregnant people, smoke exposure may increase the risk of **reduced birth weight** and **preterm birth**.
- Wildfire smoke may affect the immune system, potentially leading to increased vulnerability to **lung infections** like COVID-19.
- Smoke from wildfires can travel downwind and affect air quality hundreds of miles away from the fire.



**THANK YOU** to the partners who provide invaluable information, expertise, and data for the Climate and Health Outlook series:

