

# Global temperatures rise; heat creates drier conditions Climate change fuels wildfires in the West

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PHOENIX – As flames tore through California’s Santa Cruz Mountains, Craig Clements drove toward the fire in a specialized radar-equipped Ford pickup, watching the plume of smoke billowing from the forest.

Clements is a professor who leads San Jose State University’s Fire Weather Research Laboratory, and he chases wildfires to study their behavior.

As the late afternoon sun filtered through the smoke on Aug. 19, an orange glow enveloped the road and the forest. Ashes, oak leaves and twigs from burning fir and redwood trees rained down from the smoky sky.

Clements parked on a roadside about two miles from the active fire zone, and together with a graduate student, he turned on the generator and powered up the radar.

The radar allows them to measure the winds inside a fire, to see the most active parts and to track where the smoke is going and how high it’s rising into the air.

Clements and his students have had a lot to study in the explosive surge of fires in California this summer.

Wildfires sparked by an unusual siege of lightning have been raging through parched forests, brush and grasslands across Northern California. The fires have burned more than 1.3 million acres, an area bigger than the state of Delaware. At least seven people have died.

The fires have destroyed more than 1,800 homes and other buildings. More than 100,000 people were told to evacuate from their homes.

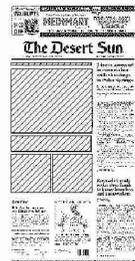
In Colorado, four large fires have burned more than 200,000 acres this year. And in Arizona, more than 800,000 acres have gone up in flames.

In the mix of factors that have influenced California’s fires, Clements pointed out that the past winter brought little rain.

He’s seen the dryness while snipping off branches

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from plants at three sites where he and his students take samples to monitor the fuel moisture. Beneath the green foliage in early August, he saw brush that



was dying and gray.

Analyzing samples from the living plants, they found the moisture well below average for this time of year and on par with the levels in 2014-2015 during California's severe drought. By this July, the vegetation was already as dry as it typically is in August, Clements said, "so we were a month ahead of the dryness."

Then in early August came record-breaking heat across the Southwest. The heat further compounded the drying.

"That exacerbates the fuel moisture and causes it to decrease even more," Clements said. "So, that sets the stage for higher intensity fires."

When the lightning storms struck, the dry vegetation was primed to burn.

Scientific research has shown that dryness has been intensifying in the West in recent years with climate change. As global temperatures have risen, the heat has contributed to drier conditions.

Clements said he thinks of climate change functioning something like a carpet in a room, which raises the level of the furniture higher off the floor. As that baseline level is pushed higher, he said, the fuel loads in forests are becoming drier than they would be without the influence of climate change.

"We're raising that floor a little bit more," Clements said. "It's well established that climate change has impacted aridity and dryness of fuels and decreased soil moisture. And so when you then think about fire behavior, the fuel moisture content, it increases the fire danger."

When the conditions and fuels are drier, he said, that produces bigger, hotter fires.

The CZU Lightning Complex Fire, which Clements visited, has now burned more than 81,000 acres across the Santa Cruz Mountains, reaching all the way to the coast. It has become the largest wildfire in the area since flames raged through the mountains in 1904 and 1905.

Over the past few decades, people in Western states from Arizona to Colorado have lived through fires that have grown bigger, more destructive and costlier in lives and property lost.

Expanding development in wildland areas has put more people and homes at risk, and a century of prioritizing fire suppression has in many areas left overgrown forests with accumulated fuels that increase the danger.

Flames have historically swept across vast areas of the West. Many blazes are started by people. And lightning outbreaks have previously sparked fires in California, including in 2003 and 2008. But the number of large fires has risen dramatically in the West in the past two decades as compared to the 1970s and '80s.

In California, nine of the state's 10 largest wildfires have occurred since 2003, according to CalFire's figures. This summer brought the second- and third-largest fires on record, the SCU Lightning Complex and the LNU Lightning Complex, which follow the Mendocino Complex of 2018.

In Arizona, all 10 of the largest wildfires have occurred since 2002.

As more megafires have erupted, federal and state firefighting costs have skyrocketed.

In the mix of drivers behind the worsening fires, humanity's heating of the planet stands out as one particularly harmful ingredient, and one that's intensifying.

"We're warming the climate, we're drying the fuels, so fuel aridity is increasing," Clements said. "And when that happens, whether it's this week or last week or next month, you get these really dry events, really dry fuel conditions. Then when things ignite, they're going to burn more readily... more intensely."

### **A 'Fire Age'**

Since 2000, much of the West has been plagued by intense heat-driven dry spells that have persisted for years.

In a recent study based on tree rings in areas from Montana to northern Mexico, scientists found that the 19 years from 2000 to 2018 ranked as the worst "megadrought" since the 1500s, and that global warming has turned what would have been a period of moderate aridity into one of the most extreme two-decade droughts of the past 1,200 years.

The dryness has put growing strains on water supplies, contributing to the need for water cutbacks along the overallocated Colorado River, and it has also stoked the fires.

During the past year, drought has spread and worsened in Western states from Oregon to New Mexico. As of last week, 83% of the region is now classified as being abnormally dry or in drought, according to the U.S. Drought Monitor website, compared to 28% a year ago.

This summer has also brought extreme weather. The summer monsoon rains that typically bring a bit of cool relief to Arizona and the desert Southwest have failed to materialize, contributing to record-breaking heat and driving more aridity.

Then came the unusual flurry of lightning in Northern California. Starting on Aug. 15, the skies lit up with an estimated 12,000 lightning strikes.

Elsewhere in Northern California, the intense Loy-alton Fire generated such extreme conditions that it spawned a fire tornado.

In Colorado, the lightning-sparked Pine Gulch Fire continues to burn near Grand Junction and has become the largest fire in the state's history.

The blazes have made for an extremely busy fire season, and it's still only August.

Traditionally, some of the driest conditions fuel big fires in September and October. That's when California's hot and dry Santa Ana winds, or Diablo winds, often feed the flames.

This fall, the National Weather Service's latest forecasts point to continuing drought conditions in much of the West through November, indicating the fire dangers will persist.

And in the years to come, scientists predict the risks of large, intense wildfires will continue to grow.

As temperatures have risen, scientists have found the fire season has grown longer on average. Researchers wrote in a 2016 report for the organization Climate Central that with fires now occurring during much of the year in the American West, the situation "is approaching the point where the notion of a fire season will be made obsolete."

In a 2018 study, scientists examined the increasing frequency and severity of fire weather and found many parts of the world will face "substantial increases in fire potential" as temperatures rise with climate change this century.

A striking example has appeared over the past two summers in fast-warming Siberia, where fires have been burning in the Arctic.

In another study, published last month in the journal *Environmental Research Letters*, researchers found that climate change is increasing the likelihood of extreme wildfire conditions in California in the fall. Their analysis, based on climate models, showed that in the coming decades "continued climate change will further amplify the number of days with extreme fire weather."

Stephen Pyne, an author and emeritus professor at Arizona State University, has written that humanity is entering a "Fire Age." He calls it the "Pyrocene."

In an article last year, Pyne wrote that the warming of the planet from burning fossil fuels "acts as a performance enhancer on all aspects of fire on Earth."

"What we are seeing is the cumulative effects of a fossil fuel civilization aggravating it," Pyne said in an interview. He said those effects include not only the heating of the planet but also other patterns based on our reliance on fossil fuels, including how people have fought fires and shaped the landscape and how suburban sprawl – enabled by gas-powered commuting – has pushed deeper into what previously were rural areas and wildlands.

"Fire has no vaccine. We're going to have to live with it. And right now, we're doing things to make it worse," Pyne said. "And we could certainly be reversing a lot of that. This is mostly a problem of our making. So, the good news is that it's possible for us to begin unwinding things."

## Becoming more resilient

With several major fires burning in California, fire-fighting crews have been stretched to their limits, and other states have sent reinforcements.

The rising costs of fighting wildfires represent one piece of a bigger problem: The country and the world are being hit with more destructive, costlier disasters. The increasing damage inflicted by wildfires and other climate-related disasters, including floods, hurricanes and heat waves, have been cited by environmental groups as they push for combating climate change and moving away from fossil fuels.

Worsening wildfires have also led to more discussion about helping vulnerable communities and taking steps to reduce fire dangers year-round, before the flames are raging.

“There are things that we can and should be doing to address the fire problem and fire risk in California, and to get ahead of it, and to make ourselves more resilient,” said Lenya Quinn-Davidson, a fire adviser with the University of California Cooperative Extension and director of the Northern California Prescribed Fire Council.

She said efforts should include landscape-level projects, such as more prescribed burns or forest-thinning, as well as changes by individual homeowners to reduce fire risks.

Quinn-Davidson said she was encouraged when California Gov. Gavin Newsom and U.S. Forest Service officials announced an agreement last month on a joint strategy to reduce wildfire risks. As part of the initiative, federal and state agencies committed to treating a combined 1 million acres a year to thin vegetation in forests and other wildlands.

Newsom’s office said in a statement that California’s wildlands have become more vulnerable to catastrophic wildfires due to “unnaturally dense forests, a century of fire suppression and climate change.” Because the federal government owns about 58% of California’s forestlands, it said, “joint state-federal management is crucial to California’s overall forest health and wildfire resilience.”

Quinn-Davidson called the agreement a step in the right direction.

“Just that idea that those agencies could have a shared vision and work plan around fire is a big deal, because we haven’t historically had that,” she said.

“We need more coordination and more collaboration among all of the different groups who work on these issues,” Quinn-Davidson said. “The number one thing we need is more coordinated vision around what fire is going to look like in California, how people can live with fire.”

That includes building a “fire workforce,” beyond

just the firefighting crews, she said, to train more people who will do the proactive work of reducing fire risks all year round.

Wildfire risks cross lines between public lands and private property, so “landscape-level management requires that everyone do their part to mitigate their risk,” said Amanda Stasiewicz, an assistant professor of environmental studies at San Jose State University’s Wildfire Interdisciplinary Research Center.

Those risk-mitigation efforts, she said, range from forest restoration programs to investments by homeowners’ associations to create firebreaks or install sprinklers. Individual property owners, she said, can also make a big difference in reducing risks around their homes.

“Climate change makes it even more imperative that we are restoring our fire-deprived systems, making room for prescribed fire,” Stasiewicz said in an email, “and doing everything we can on private property to enhance the survivability of our homes.”

Those “home hardening” precautions can include a variety of measures, such as pruning trees, clearing vegetation in a zone around the house or cleaning out gutters that are filled with leaves.

When burning embers float in the wind, they can enter a house through a vent and spark a fire inside. To guard against that, Quinn-Davidson said, people can replace their vents with smaller-mesh vents that meet new fire-resistant standards.

“In the case of wind-driven fires, where there’s a lot of embers coming down, those things can really help,” Quinn-Davidson said. “Things like that can really protect a lot of homes.”

*Environmental coverage on azcentral.com and in The Arizona Republic is supported by a grant from the Nina Mason Pulliam Charitable Trust.*



**A wildfire in Northern California on Aug. 15 spawned at least one fire tornado and prompted the National Weather Service to issue a fire tornado warning. The Loyalton Fire in Lassen County burned intensely amid hot and dry conditions.** KATELYNN & JORDAN HEWLETT/AP



**Scott Purdy, a graduate student from San José State University, prepares to take measurements using a specialized Doppler radar in Felton, Calif., on Aug. 19, near the CZU Lightning Complex fire.**  
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