

The role of climate change in the catastrophic 2025 Los Angeles fires

Summer dry seasons are extending into winter, intensifying the impacts of Santa Ana winds

Jeff Masters and Bob Henson

The New Year has rung in with one of the most horrific wildfire events in world history: an urban firestorm in the Los Angeles metro area that has killed at least five people and reduced thousands of homes to smoking rubble. Two major fires in excess of 10,000 acres – the Palisades fire in the western suburbs of Los Angeles, and the Eaton fire in the northern suburbs – were intensified by severe drought and driven by winds gusting up to 100 mph (161 km/hr) from a severe Santa Ana wind event.



Image of the fires in Palisades, Los Angeles, on 8 January 2025. / California Department of Forestry and Fire Protection

Climate scientist [Daniel Swain](#) said on [CNN](#) that the Pacific Palisades fire alone may end up as the most expensive wildfire in history, and that he expected that collectively, the fires ravaging the region will be the costliest wildfire event in history. According to [NOAA](#), the most expensive wildfire season on record (in 2024 USD, to account for inflation) was the \$30 billion 2018 season, mostly because of severe fires in California. This included the most destructive wildfire on record – the November Camp Fire, which devastated Paradise, California, killing 85 and destroying over 18,800 buildings. That fire cost \$20 billion (2024 USD), according to EM-DAT, making it the most expensive single fire in world history.

The role of climate change in the fires

The main way that climate change worsens wildfires is by drying out vegetation. Prolonged heat turns forests and grasslands into tinder, fuelling faster, more intense burns. In the case of this week's fires, vegetation growth in early

The fire season in California has already been considerably extended.

2024 was enhanced by a wetter-than-average winter in Southern California. But during the summer of 2024, California experienced its hottest summer on record. This record heat, combined with near-record dryness, dried out the plentiful vegetation that grew in response to the wet winter. Moreover, Southern California's wet season, which usually begins in October or November, was delayed, and by January 2025, severe drought conditions were in place (Fig. 1).

U.S. Drought Monitor for 2 Severe Santa Ana Wind Events

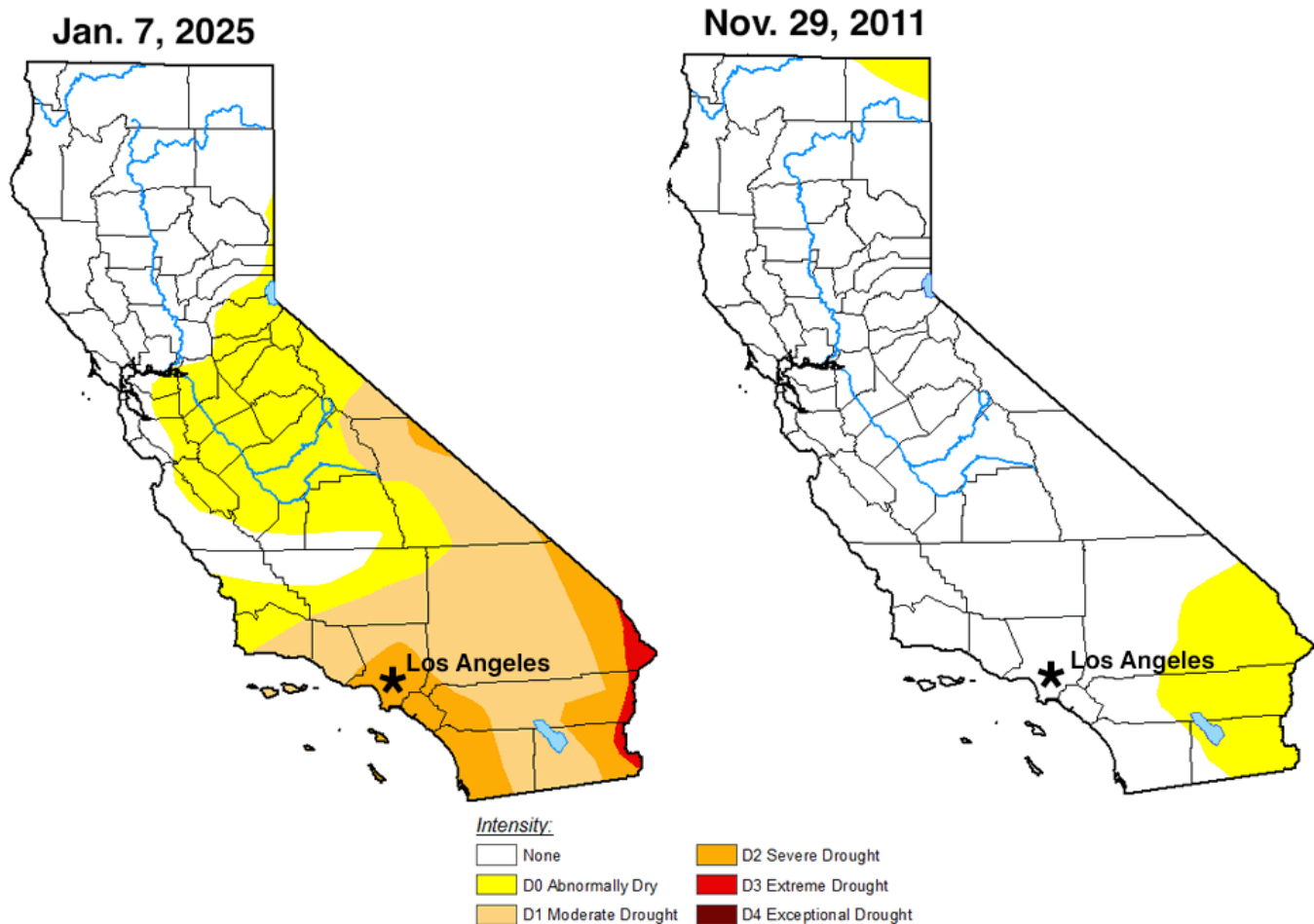


Figure 1. Weekly drought condition maps for California during two severe Santa Ana wind events: Jan. 7, 2025 (left) and Nov. 29, 2011 (right). Los Angeles was not experiencing drought for the 2011 event, but was in severe drought for the 2025 event. (Image credit: U.S. Drought Monitor)

In an email, climate scientist Daniel Swain offered these insights on the California climate change/wildfire connection:

California's fire season has already lengthened considerably in a warming climate. Critically, this has increased the overlap between "critically dry vegetation season" and "offshore wind season" (Oct-Jan). There is little evidence for climate change affecting Santa Ana winds themselves, but there is strong evidence that climate change has

greatly increased the occurrence of extreme fire weather conditions in Southern California in autumn and early winter (Goss et al. 2020, Climate change is increasing the likelihood of extreme autumn wildfire conditions across California). Climate change has also increased the seasonal overlap of dry/windy conditions (Swain 2019), and there is evidence that further warming will increase wet-to-dry “hydroclimate whiplash” transitions (which result in abundant vegetation growth then subsequent drying; see my new paper, Hydroclimate volatility on a warming Earth). Additionally, the California “shoulder season” precipitation (autumn and spring) will likely decrease with warming, adding to the effects of warming temperatures and increasing evaporative demand (drying out of vegetation) essentially year-round.

There are two other important ways that a longer dry season from climate change worsens wildfires:

- Scarcer water supplies because of more intense droughts hinder firefighting efforts and recovery.
- There are fewer safe days for prescribed burns, making it harder to reduce fuel loads in vulnerable areas before fire season starts.

A [2023 study](#) found from 1971 to 2021, human-caused climate change contributed to a +172% increase in burned areas in California, with a +320% increase from 1996 to 2021. In the coming decades, a further increase in annual forest burned areas is expected, ranging from 3% to 52%.

Comparing the 2025 and 2011 severe Santa Ana wind events

This week’s fires were driven by the intense winds of a severe Santa Ana wind event. On Wednesday, Jan. 8, at least 32 stations in the Los Angeles area recorded wind gusts of at least 70 mph, with the highest being a 100-mph (161 km/hr) wind gust at Mt. Lukens Truck Trail, located about 20 miles (32 km) north of Los Angeles. The last Santa Ana wind event of similar intensity occurred over 13 years ago, on Nov. 30-Dec. 1, 2011. During that event, widespread wind gusts over 70 mph (113 km/hr) toppled thousands of trees, and over 200,000 homes lost electricity, mostly in the northern Los Angeles suburbs of Altadena and Pasadena. Whitaker Peak (elev. 4,120 feet), located about 50 miles (80 km) northwest of Los Angeles, recorded a gust of 97 mph (156 km/h).

Fortunately, no major wildfires were sparked the 2011 Santa Ana wind event. This was largely because Los Angeles was not experiencing drought at that time. But in the case of the 2025 event, severe drought was in place (Fig. 1).

Spells of dangerous fire weather will continue into next week

There’s no immediate end in sight for the bone-dry conditions and periods of strong Santa Ana winds plaguing coastal Southern California. The most intense winds from Wednesday have slackened, but the overall pattern — a strong upper-level high over the eastern Pacific, and energy diving southward through California, pushing winds downslope and offshore — will stay in place well into next week. Not only will this keep the door closed for any major precipitation, but it will make it tougher to fight the ongoing fires and to address any new ones.

Critical fire-weather conditions are predicted to remain in place over coastal Southern California through early Friday, according to the NWS Storm Prediction Center. Winds could gust to 20-30 mph in the valleys and 40-60 mph at higher elevations, especially on Thursday night. After a brief break, another pulse of strong north to northeast winds is expected this weekend, and a more serious Santa Ana wind setup could develop on Monday and Tuesday. Forecasters at the National Weather Service office for the Los Angeles area were already noting next week’s setup in a forecast discussion on Thursday:

“This would be concerning with likely no rain expected and the Tuesday night-Wednesday time period being the fourth offshore event in the stretch. There is great concern that fire weather conditions could become exacerbated given the antecedent conditions, little rain across the area since the Spring of 2024, and another offshore wind event on top of all of what we have seen, so far. Residents are urged to stay tuned to latest information and remain vigilant in steps to protect your life and property.”

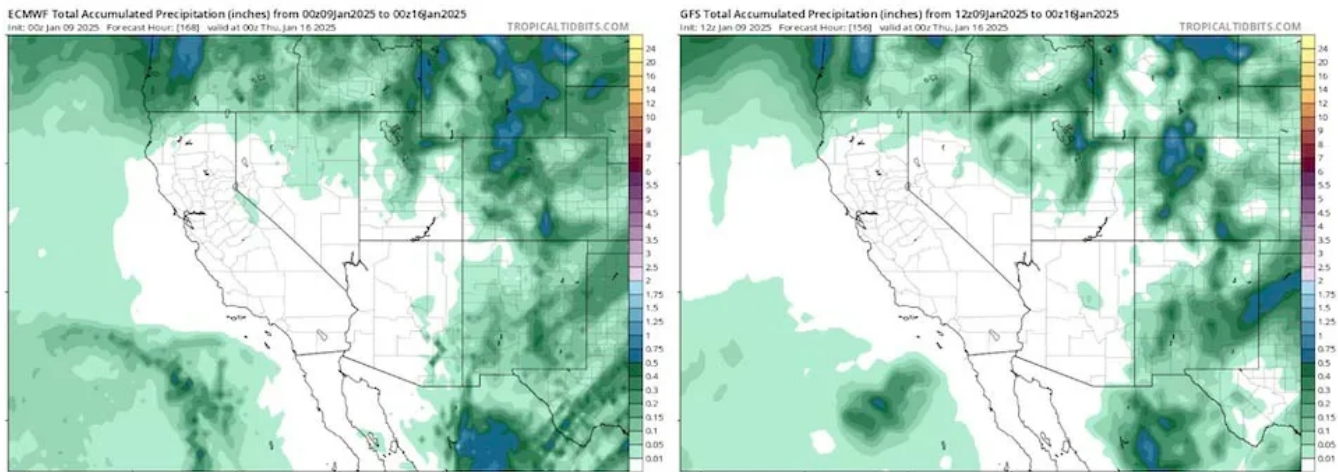


Figure 2. No rain is predicted for coastal Southern California through at least Wednesday, January 15, by two recent runs of the European (left) and GFS (right) forecast models. The official National Weather Service forecast also has no rain for the area through Wednesday. (Image credit: tropicaltidbits.com)

The intense fires are degrading air quality

The wildfires have created a large amount of smoke that is covering most of the Los Angeles metro area, bringing air pollution conditions in the red “Unhealthy” range, according to the latest maps from airnow.gov. The air quality should improve over the weekend as the winds drop and firefighters make progress containing the fires. However, a renewed round of northeasterly Santa Ana winds on Monday and Tuesday will blow smoke from the Eaton Fire over downtown Los Angeles, potentially interfering with the Los Angeles Rams NFL playoff game scheduled for Monday night.

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- ❖ **About the authors: Jeff Masters**, Ph.D., worked as a hurricane scientist with the NOAA Hurricane Hunters from 1986-1990. After a near-fatal flight into category 5 Hurricane Hugo, he left the Hurricane Hunters to pursue a safer passion - earning a 1997 Ph.D. in air pollution meteorology from the University of Michigan. **Bob Henson** is a meteorologist and journalist based in Boulder, Colorado. He has written on weather and climate for the National Center for Atmospheric Research, Weather Underground, and many freelance venues. Bob is the author of "The Thinking Person's Guide to Climate Change" and of "The Rough Guide to Climate Change," a forerunner to it, and of "Weather on the Air: A History of Broadcast Meteorology", and coauthor of the introductory textbook "Meteorology Today". For five years and until the summer of 2020 he co-produced the Category 6 news site for Weather Underground.
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