

# More evidence that California weather is trending toward extremes

August 12 2022, by Robert Monroe

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Chaparral Fire in 2021. Credit: Jeff Hall/CalFire

A team led by Kristen Guirguis, a climate researcher at Scripps Institution of Oceanography at UC San Diego, found evidence that the risk of hazardous weather is increasing in the Southwest.

The researchers investigated the daily relationships among four major modes of weather affecting California. How they interact governs the

formation of weather events such as atmospheric rivers capable of bringing torrential rains and Santa Ana winds that can spread devastating wildfires.

"This study suggests that weather patterns are changing in a way that enhances hot, dry Santa Ana winds, while reducing precipitation frequency in the Southwest," said Guirguis. "These changes in atmospheric circulation are raising the risk of wildfires during California winters."

The study, "Winter wet—dry weather patterns driving atmospheric rivers and Santa Ana winds provide evidence for increasing wildfire hazard in California," was published in the journal *Climate Dynamics* July 17, 2022.

The basis of the research was an examination of the dominant [atmospheric circulation](#) patterns over the North Pacific Ocean, known as Baja-Pacific, Alaskan-Pacific, Canadian-Pacific, and Offshore-California modes. What distinguishes them from each other are the relative positions of ridges and troughs in the atmosphere.

The research team identified 16 recurring weather patterns that are created daily as these modes interact with each other. One product of the work was a summary of California [weather patterns](#) from 1949 to 2017. The patterns associated with the formation of dry gusty Santa Ana winds that often stoke Southern California fires are becoming more frequent. Patterns associated with what might be considered "normal" rainfall are decreasing in the Southwest thus promoting drought, but patterns associated with extreme precipitation and strong atmospheric river episodes have remained steady over the study period. The researchers noted that while the patterns associated with [heavy precipitation](#) and strong atmospheric rivers have not changed in frequency, a warmer atmosphere is capable of holding more water so these storms are

becoming more damaging.

The results suggest an increasing probability of compounding [environmental hazards](#) during California winters, said the research team. Though winter atmospheric rivers are the antithesis of hot, dry Santa Ana wind conditions, sequences of wildfires followed by strong atmospheric rivers often compound the damage from fires when they trigger flash floods and destructive debris flows from burn scars.

"This spells challenges for wildfire and [water resource management](#) and provides observational support to our previous results projecting that California will increasingly have to depend on potentially hazardous [atmospheric rivers](#) and floodwater for water resource generation in a warming climate," said study co-author Alexander Gershunov, a Scripps Oceanography climate scientist.

Study authors say this work is helping to inform an experimental subseasonal-to-seasonal (S2S) forecast product being developed at Scripps Oceanography's Center for Western Weather and Water Extremes (CW3E) that predicts extreme weather in California including atmospheric river landfalls, Santa Ana winds, drought, and heat waves.

**More information:** Kristen Guirguis et al, Winter wet–dry weather patterns driving atmospheric rivers and Santa Ana winds provide evidence for increasing wildfire hazard in California, *Climate Dynamics* (2022). [DOI: 10.1007/s00382-022-06361-7](https://doi.org/10.1007/s00382-022-06361-7)

Provided by University of California - San Diego

Citation: More evidence that California weather is trending toward extremes (2022, August 12) retrieved 4 May 2024 from

<https://phys.org/news/2022-08-evidence-california-weather-trending-extremes.html>

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