

California drought likely a fixture, says Stanford study

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Human-caused climate change is increasing drought risk in California -- boosting the odds that our current crisis will become a fixture of the future, according to a major report Stanford scientists released Monday.

The finding comes as cities across the Bay Area wrap up the warmest three-month stretch of winter on record.

The new study looked at data from the past and simulations foretelling the future to understand the influence of greenhouse gases on California.

"What has happened in California has been a clear warming trend over the historical record ... that probably would not have happened without humans," said Stanford climate scientist Noah Diffenbaugh.

Two piers lay on the shoreline at Shadow Cliffs Regional Recreation Area in Pleasanton, Calif., on Friday, Jan. 9, 2015. The man-made lake's water level remains at historically low levels, about 10 feet below normal for the winter season. (Doug Duran)



The continuation of global warming "will result in more frequent occurrences of high temperatures and low precipitation that will lead to increased severe drought conditions," said Diffenbaugh. The research was published in the March 2 issue of the journal Proceedings of the National Academy of Sciences.

Low precipitation, alone, doesn't cause a drought -- what matters is whether it happens in a warm year, according to members of the Stanford team. They don't offer specific recommendations but say their findings could help California plan for the future.

The news comes on the eve of this winter's third manual snow survey, taken atop the Sierra on Highway 50. Other readings reveal that statewide, the snowpack water content is just 19 percent of the historical average for the date.

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Reinforcing the drought's threat, one weather agency is reporting that many Bay Area cities have broken records for the warmest winter in history. Average temperatures for December through February were 54.44 degrees in San Jose, up from the 54.42 degree record of 1996; 52.62 degrees in Livermore, up from the 51.72 degree record of 1996; and 57 degrees in San Francisco, up from the 55.70 degree record of 1970, according to Jan Null of Golden Gate Weather Services.

The Stanford study supports the growing recognition that warming temperatures can worsen a drought that is driven by declining precipitation, noted Richard Seager of Columbia University's Lamont-Doherty Earth Observatory, who was not involved in the research.

"This is happening all over the world -- there is nothing unusual in terms of California," said Seager.

The Stanford team previously reported that the conditions behind our current drought -- a high pressure system parked over the Pacific Ocean, diverting storms away from California -- are much more likely to occur amid concentrations of greenhouse gases.

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The new study goes further. Using a recently released trove of 120 years of historical data, the researchers found more than a doubling of the frequency of drought years. There were six droughts in past 20 years (1995-2014), compared to 14 in the previous 98 years (1896-1994.)

What's happening? Imagine flipping two coins, one for precipitation and one for temperature, said Diffenbaugh, associate professor of Environmental Earth System Science at Stanford.

Until recently, precipitation and temperature occurred independently.

But climate change means that the temperature coin is landing on warm weather most of the time. So even as precipitation varies, the combination of both warm and dry is more common. We see little rain, snow melts earlier, and soil and plants lose more water.

"Low precipitation isn't enough to create a drought. The key difference is temperature," said Diffenbaugh. And that's what is changing.

Seager agrees that climate change will produce warmer weather, although he contends that our recent extreme heat is due to natural variations in sea surface temperatures, "far in excess of what you would expect from background greenhouse gases," based on his National Oceanic and Atmospheric Administration-sponsored research.

He agrees that California "will also face tremendous water problems as the climate changes, because of warmer temperatures, less snow, shorter and sharper winters, and warming that takes moisture out of the soil."

The Stanford team doesn't have data for the future, of course, and it's impossible to run a real-world experiment. So they created climate simulations to peer into the future.

Their models show that the warming trend is likely to continue, boosting the odds that a heads-tails coin toss -- co-occurring warm and dry years, creating drought -- will climb in the coming decades.

Droughts have occurred throughout California's pre-human history, just as the coin toss example would predict, they say. And nature creates its own variability, with volcanic eruptions and solar fluctuations.

But steadily rising temperatures -- caused by burning fossil fuels and clearing forests -- increases the probability of such conditions, they found.

"Continued global warming will result in more frequent occurrences of high temperatures and low precipitation," said Diffenbaugh, "leading to more of the severe drought conditions that we've been experiencing."

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