

California Drought Is Made Worse by Global Warming, Scientists Say

By Justin Gillis

Aug. 20, 2015

SCIENCE

The New York Times

Global warming caused by human emissions has most likely intensified the drought in California by 15 to 20 percent, scientists said on Thursday, warning that future dry spells in the state are almost certain to be worse than this one as the world continues to heat up.

Even though the findings suggest that the drought is primarily a consequence of natural climate variability, the scientists added that the likelihood of any drought becoming acute is rising because of climate change. The odds of California suffering droughts at the far end of the scale, like the current one that began in 2012, have roughly doubled over the past century, they said.

“This would be a drought no matter what,” said A. Park Williams, a climate scientist at the Lamont-Doherty Earth Observatory of Columbia University and the lead author of a paper published by the journal *Geophysical Research Letters*. “It would be a fairly bad drought no matter what. But it’s definitely made worse by global warming.”

The National Oceanic and Atmospheric Administration also reported Thursday that global temperatures in July had been the hottest for any month since record-keeping began in 1880, and that the first seven months of 2015 had also been the hottest such period ever. Heat waves on several continents this summer have killed thousands of people.

The paper on the California drought echoes a growing body of research that has cited the effects of human emissions, but scientists not involved in the work described it as more thorough than any previous effort because it analyzed nearly every possible combination of data on temperature, rainfall, wind speed and other factors that could be influencing the severity of the drought. The research, said David B. Lobell, a Stanford University climate scientist, is “probably the best I’ve seen on this question.”

The paper provides new scientific support for political leaders, including President Obama and Gov. Jerry Brown of California, who have cited human emissions and the resulting global warming as a factor in the drought. As he races around his battered state, from massive forest fires to parched farms, Mr. Brown has been trying to cajole the Republican presidential candidates into explaining what they would do about climate change.

“To say you’re going to ignore that there’s a huge risk here, the way we’re filling the atmosphere with heat-trapping gases, is folly, ignorance and totally irresponsible,” Mr. Brown said Thursday in a telephone interview. “And virtually the entire Republican Party in Congress is saying exactly that. It’s inexplicable.”



Dry grassland south of the El Dorado Freeway near Folsom, Calif. The study credited human-caused climate change for between 8 percent and 27 percent of the state's soil moisture deficit.
Damon Winter/The New York Times

Several Republican presidential candidates, including Senator Lindsey Graham of South Carolina and Gov. John R. Kasich of Ohio, do acknowledge that climate change poses risks, but they are skeptical of the way Mr. Obama has gone about trying to limit emissions, with a plan expected to force the shutdown of many coal-fired power plants.

Chris Schimpf, a spokesman for Mr. Kasich, said Thursday that political leaders confronting questions about climate change “can’t stick their heads in the sand and pretend it isn’t happening. Instead we need to be about the business of taking action, but action that doesn’t throw the economy and jobs out the window at the same time.”

However, many of the leading Republican candidates are openly skeptical of climate science and play down the risks. In response to a letter from Mr. Brown asking about their plans, several of the candidates retorted last week that California should be building more dams to store water for future droughts. Senator Ted Cruz of Texas said that “alarmists” about global warming were trying to gain “more power over the economy and our lives.”

A report this week by researchers at the University of California, Davis, projected that the drought would cost the California economy some \$2.7 billion this year. Much of that pain is being felt in the state’s huge farming industry, which has been forced to idle a half-million acres and has seen valuable crops like almond trees and grape vines die.

As climate scientists analyze the origins of the drought, they have been tackling two related questions: What caused the dearth of rain and snow that began in 2012? And, regardless of the cause, how have the effects been influenced by global warming?

The immediate reason for the drought is clear enough: For more than three years, a persistent ridge of high pressure in the western Pacific Ocean has blocked storms from reaching California in the winter, when the state typically gets most of its moisture. That pattern closely resembles past California droughts.

Some scientists have argued that the ocean and atmospheric factors that produced the ridge have become somewhat more likely because of global warming, but others have disputed that, and the matter remains unresolved.

On the question of the effects, scientists have been much clearer. Rising temperatures dry the soil faster and cause more rapid evaporation from streams and reservoirs, so they did not need any research to tell them that the drought was probably worse because of the warming trend over the past century. The challenge has been to quantify how much worse.

The group led by Dr. Williams concluded that human-caused climate change was responsible for between 8 and 27 percent of the deficit in soil moisture that California experienced from 2012 to 2014.

But, in an interview, Dr. Williams said the low number was derived from a method that did not take account of the way global warming had sped up since the 1970s. That led him and his colleagues to conclude that climate change was most likely responsible for about 15 to 20 percent of the moisture deficit.

Since 1895, California has warmed by a little more than 2 degrees Fahrenheit. That increase sounds small, but as an average over an entire state in all seasons, scientists say, it is a large number. The warmer air can hold more water vapor, and the result is that however much rain or snow falls in a given year, the atmosphere will draw it out of the soil more aggressively.

“It really is quite simple,” said Richard Seager, a senior climate scientist at Lamont and a co-author on the Williams paper. “When the atmosphere is as warm as it is, the air is capable of holding far more water. So more of the precipitation that falls on the ground is evaporated, and less is in the soil, and less gets into streams.”

Dr. Williams calculated that the air over California can absorb about 8.5 trillion more gallons of water in a typical year than would have been the case in the cooler atmosphere at the end of the 19th century. The air does not always manage to soak up that much, however, because evaporation slows as the soils dry out.

How much more California will warm depends on how high global emissions of greenhouse gases are allowed to go, but scientists say efforts to control the problem have been so ineffective that they cannot rule out another 5 or 6 degrees of warming over the state in this century, a level that could turn even modest rainfall deficits into record-shattering droughts.

For politicians like Mr. Obama and Mr. Brown, the emerging question is whether Americans will awaken to the risks and demand stronger action before emissions reach such catastrophic levels.

“I don’t think climate change is anywhere near the issue that it’s going to be, but the concern is rising in the public mind,” Mr. Brown said Thursday. “The facts can’t be concealed forever.”

Alan Rappoport contributed reporting.

A version of this article appears in print on Aug. 21, 2015, Section A, Page 1 of the New York edition with the headline: Hotter Planet Fuels Drought, Scientists Find

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