Science Linking Drought to Global Warming Remains Matter of Dispute

By Justin Gillis
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In delivering aid to drought-stricken California last week, President Obama and his aides cited the state as an example of what could be in store for much of the rest of the country as human-caused climate change intensifies.

But in doing so, they were pushing at the boundaries of scientific knowledge about the relationship between climate change and drought. While a trend of increasing drought that may be linked to global warming has been documented in some regions, including parts of the Mediterranean and in the Southwestern United States, there is no scientific consensus yet that it is a worldwide phenomenon. Nor is there definitive evidence that it is causing California's problems.

In fact, the most recent computer projections suggest that as the world warms, California should get wetter, not drier, in the winter, when the state gets the bulk of its precipitation. That has prompted some of the leading experts to suggest that climate change most likely had little role in causing the drought.

"I'm pretty sure the severity of this thing is due to natural variability," said Richard Seager, a climate scientist who studies water issues at the Lamont-Doherty Earth Observatory of Columbia University.

To be sure, 2013 was the driest year in 119 years of record keeping in California. But extreme droughts have happened in the state before, and the experts say this one bears a notable resemblance to some of those, including a crippling drought in 1976 and 1977.

Over all, drought seems to be decreasing in the central United States and certain other parts of the world, though that is entirely consistent with the longstanding prediction that wet areas of the world will get wetter in a warming climate, even as the dry ones get drier.

What may be different about this drought is that, whatever the cause, the effects appear to have been made worse by climatic warming. And in making that case last week, scientists said, the administration was on solid ground.

California has been warming along with most regions of the United States, and temperatures in recent months have been markedly higher than during the 1976-77 drought. In fact, for some of the state's most important agricultural regions, summer lasted practically into January, with high temperatures of 10 or 15 degrees above normal on some days.

The consequence, scientists say, has been that any moisture the state does get evaporates more rapidly, intensifying the effects of the drought on agriculture in particular. "We are going through a pattern we've seen before, but we're doing it in a warmer environment," said Michael Anderson, the California state climatologist.

The White House science adviser, John P. Holdren, said in a briefing last week: "Scientifically, no single episode of extreme weather, no storm, no flood, no drought can be said to have been caused by global climate change. But the global climate has now been so extensively impacted by the human-caused buildup of greenhouse gases that weather practically everywhere is being influenced by climate change."

The drought eased a bit with heavy rains in Northern California this month, but many major reservoirs have only half the water expected for this time of year. "I think the situation is still pretty severe," said Prof. Alex Hall, who studies climate at the University of California, Los Angeles.

California gets much of its water from snow in the winter along the western slopes of the Sierra Nevada. That means 38 million people and a $45 billion agricultural economy are critically dependent on about five heavy storms a year.

If a ridge of high atmospheric pressure develops off the California coast, it can easily push moisture-bearing winds to the north, so that the water falls closer to Seattle than Sacramento. Just such a ridge has been parked off California for much of the last three years.

A decade ago, scientists at the University of California, Santa Cruz, published a tantalizing set of papers that predicted a greater likelihood of such a ridge. The lead researcher, Jacob O. Sewall, harnessed

substantial computing power to run forecasts of what would happen in a future climate after a substantial melting of sea ice in the Arctic. The ice is already melting because of fast-rising temperatures in the region that many scientists attribute to human emissions.

Dr. Sewall expected some sort of disturbance in the circulation of the atmosphere, but he and his adviser, Lisa Cirbus Sloan, were not prepared for the answer they received. “The surprise jumped out that, wow, all of a sudden it got a whole lot drier in the western part of North America,” Dr. Sewall recalled.

His first study on the question was published in 2004, and was based on conditions that were expected by midcentury. Arctic sea ice then fell much faster than expected, hitting a record low in 2007 and then another record low in 2012.

He and several other scientists said the loss of ice has allowed extra heat to escape from the Arctic Ocean into the atmosphere in the fall and early winter, disturbing weather patterns over vast distances. That, they said, has made extreme weather events of all kinds more likely in the Northern Hemisphere, possibly including winter extremes like the cold blasts hitting the East Coast these days.

At the same time, the California drought, now in its third year, bears a striking resemblance to the atmospheric pattern predicted in Dr. Sewall’s computer analysis.

The resemblance is so uncanny that Dr. Sewall, who now works at Kutztown University in Pennsylvania, suspects an element of coincidence, but he also calls the correlation “frightening.” If this kind of drought has indeed become more likely for California, that means the state — where some towns are now worried about running out of drinking water — is getting a glimpse of its future.

Since his studies were published, other research has come to somewhat different conclusions. Many of those studies have found a likelihood that climate change will indeed cause the American West to dry out, but by an entirely different mechanism — the arrival of more dry air from the tropics. And the most recent batch of studies predicts that effect will not really apply to the western slope of the Sierra. Climate projections show that the area should get somewhat more moisture in the winter, not less.

It may take years to resolve the scientific uncertainty. But with California’s growing population, the state faces increasing pressure to resolve tensions involved in apportioning its water among city dwellers, farmers, industry and an environment under increasing strain from global warming.

Dr. Seager of Columbia University pointed out that much of the Southwestern United States had been in a drought of fluctuating severity for 15 years. In some areas, moreover, the warmer climate is causing winter precipitation to fall as rain rather than snow, meaning less melting snowpack to help parched states through the hotter summers.

“It all adds up across the Southwest to an increasingly stressed water system,” he said. “That’s what they might as well get ready for.”