Humans Are Pushing The Southwest Into An Even Drier Climate

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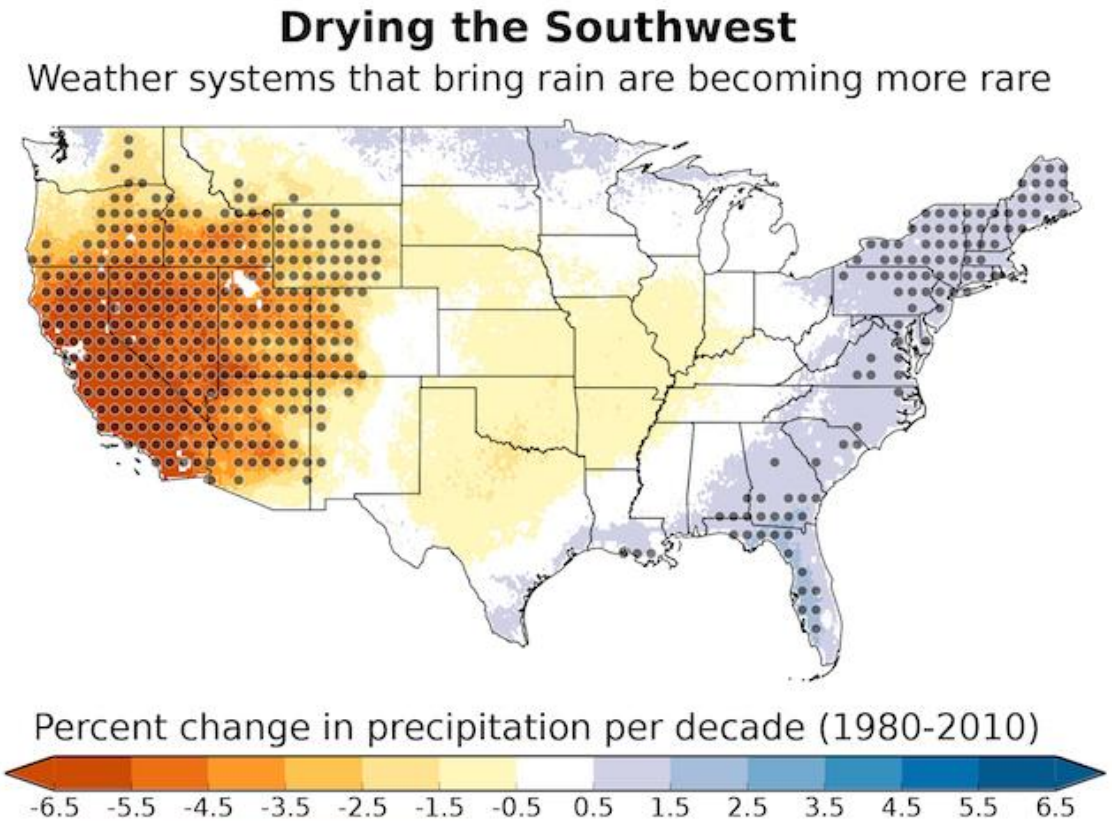
A new study finds that the semi-arid U.S. Southwest has begun to enter the "drier climate state" that had been long-predicted from climate models. These findings match ones from September documenting an expansion of the entire world's dry and semi-arid climate regions in recent decades because of human-caused climate change.

The new study from the National Center for Atmospheric Research (NCAR) concludes that "The weather patterns that typically bring moisture to the southwestern United States are becoming more rare, an indication that the region is sliding into the drier climate state predicted by global models."

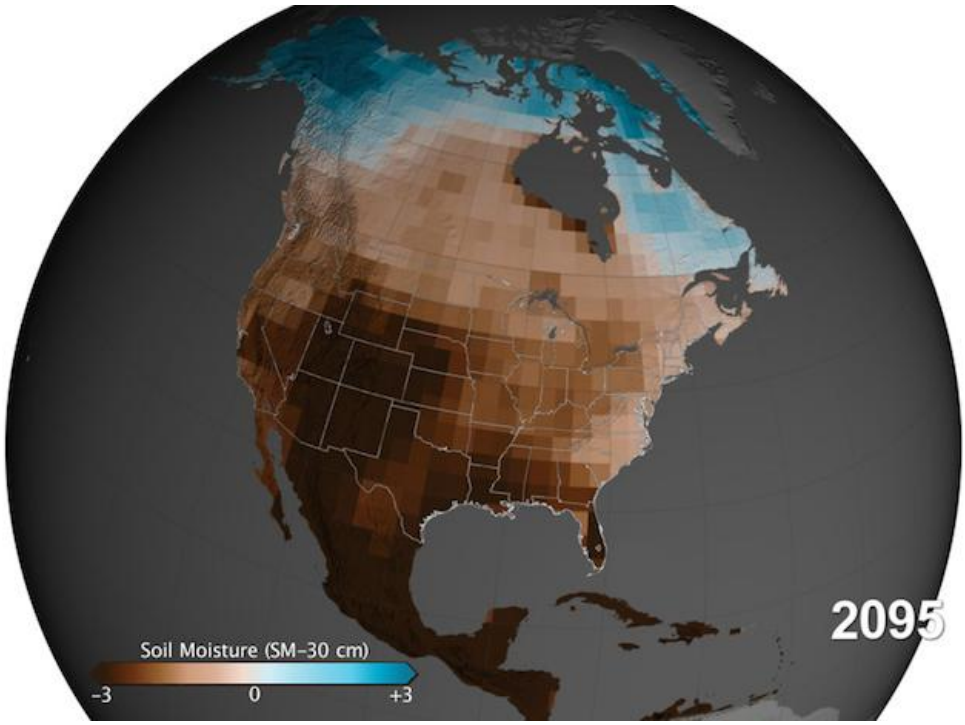


Weather systems that bring moisture to the southwest U.S. are forming less often, which is drying out resulting in a drier climate. This map depicts the changes in precipitation that can be attributed to these weather changes. The gray dots are areas where the results are statistically significant. Via NCAR.

Note that the data in this chart ends in 2010 — so it doesn't even include the devastating drying seen recently in large parts of the Southwest, such as the worst drought California has seen in over a thousand years!

The fact that climate scientists have turned out to write about this drying trend means we must take seriously their current projections of widespread global megadroughts in the coming decades on our current CO2 emissions pathway — including in the U.S.'s own breadbasket.

Here, for instance, is a 2015 NASA projection of what the *normal climate* of North America will look like unless we keep taking stronger and stronger measures to slash carbon pollution. The darkest areas have soil moisture comparable to that seen during the 1930s Dust Bowl.



I called this prolonged, multi-decadal warming and drying "Dust-Bowlification" in a 2011 *Nature* review article, "The Next Dust Bowl," because the 1930s Dust Bowl seems to be the best analogy to what's coming. But in fact, the coming multidecadal megadroughts will be much worse than the Dust Bowl of the 1930s — "worse than anything seen during the last 2000 years," as explained in a major 2014 study, "Assessing the risk of persistent drought using climate model simulations and paleoclimate data." They will be the kind of megadroughts that in the past destroyed entire civilizations.

That 2014 study concludes, "the risk of a decade-scale megadrought in the coming century [in the Southwest] is at least 80 percent, and may be higher than 90 percent in certain areas." It warns many other parts of the world are at even greater risk. And this confirms the finding of a 2012 NCAR that, unless we sharply reverse emissions trends, we risk having a situation by the 2060s where large swaths of the United States, Brazil, Africa, the Mideast, Australia, Southeast Asia, and Europe are routinely in severe drought.

Significantly, the actual warming-driven megadroughts we face in a business-as-usual future are actually worse than the new NCAR study — and the 2014 megadrought study — suggest because both of those studies based their analysis only on projections of precipitation trends. They don't look at the impact of temperature increases, which worsen any drought and lead to more evaporation of surface moisture. The 2014 study noted that studies that look at "precipitation minus evapotranspiration" — the overall impact of climate change on soil moisture — have found that Dust-Bowl-level drought conditions will "become normal in the Southwest and in other subtropical dry zones" in the next few decades. If so, "then the risk of decadal drought is 100 percent, and the risk of longer-lived events is probably also extremely high."

This is a key point. Drought can come about for two reasons: lower precipitation or higher temperatures over an extended period of time. If a region gets hit by both of those, it will suffer an unusually extreme drought, such as we've seen in California in the last few years, or Australia in the previous decade.

The rise in temperatures is a widely talked-about impact of human-caused global warming. Less well known is the basic prediction that climate change will physically expand the world's dry zones, shifting them poleward — which has already been observed globally, as the September *Nature* study documented, and in the U.S. Southwest, as the new NCAR study documented.

Climate models have long predicted that "a belt of higher average pressure that now sits closer to the equator will move north," as NCAR explains. "This high-pressure belt is created as air that rises over the equator moves poleward and then descends back toward the surface. The sinking air causes generally drier conditions over the

region and inhibits the development of rain-producing systems." NCAR points out that "Many of the world's deserts, including the Sahara, are found in such regions of sinking air, which typically lie around 30 degrees latitude on either side of the equator. Climate models project that these zones will move further poleward. The result is a generally drier Southwest."

Rainfall events in the Soutwest are associated with low-pressure systems in the North Pacific off the coast of Washington (especially in wintertime). NCAR explains that since 1979, the number of such low-pressure systems has dropped as high pressure has moved into the area. Indeed, "The associated persistent high pressure in that area over recent years is a main driver of the devastating California drought."

We've written about this persistent high pressure before, which has been labeled the ridiculously resilient ridge or Triple R. Many studies tie the Triple R directly to climate change. The National Science Foundation wrote of one such 2014 study they had funded: "The researchers found that the extreme heights of the Triple R in 2013 were at least three times as likely to occur in the present climate as in the preindustrial climate." A coauthor of the NSF-funded study noted, "We've demonstrated with high statistical confidence that large-scale atmospheric conditions similar to those of the Triple R are far more likely to occur now than in the climate before we emitted large amounts of greenhouse gases."

The NSF research matches the finding in an April 2014 study that "there is a traceable anthropogenic warming footprint in the enormous intensity of the anomalous ridge during winter 2013-14, the associated drought and its intensity." In fact, scientists a decade ago not only predicted the loss of Arctic ice would dry out California, they also precisely predicted the specific, unprecedented change in the jet stream that has in fact caused the unprecedented nature of the California drought.

Yet while the NCAR study says that "the study does not prove a connection" between the Southwest drying and climate change, the authors make clear that climate models have long predicted this outcome. So the title of the paper, "Running dry: The U.S. Southwest's drift into a drier climate state," seems a bit overly cautious.

Indeed the September study in *Nature*, "Significant anthropogenic-induced changes of climate classes since 1950," explicitly found that "About 5.7% of the global total land area has shifted toward warmer and drier climate types from 1950–2010, and significant changes include expansion of arid … climate zones." As for the cause, "we find that these changes of climate types since 1950 cannot be explained as natural variations but are driven by anthropogenic factors."

Bottom line: The U.S. Southwest isn't passively drifting into a drier state — humans are actively pushing it into a drier state.