

Climate & Environment

The U.S. Drought Monitor is a critical tool for the arid West. Can it keep up with climate change?

By Hayley Smith
Staff Writer
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Saline brine and salt sediments on Owens Lake in February in Lone Pine, Calif. Winter storms have helped to revive Owens Lake more than a century after its inflows were diverted to the Los Angeles Aqueduct. (Brian van der Brug/Los Angeles Times)

Known for its glowing swaths of yellow, orange and red, the U.S. Drought Monitor has warned farmers, residents and officials throughout the nation of impending water scarcity every week since 1999.

Backed by data on soil moisture, temperature, snow cover, meltwater runoff, reservoir levels and more, the map has become an essential instrument for determining the outlook of water supplies, declaring drought emergencies and deciding where and when government aid should be distributed, among other things.

But this critical diagnostic tool is also struggling to keep pace with climate change as longer and more persistent dry spells plague the American West and take an increasing toll on groundwater

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reserves and the Colorado River, according to a recent study published in the journal AGU Advances.

One problem, researchers say, is that the monitor was launched just as one of the driest periods in the history of the Southwest began, and it has never been adjusted for the region's growing aridity.

"The product is essential, but it is also undoubtedly, in my opinion, being influenced by climate change," said Justin Mankin, one of the study's authors and an associate professor of geography at Dartmouth. "And we in the drought community need to have a conversation about what it looks like to think about drought monitoring in the context of an aridifying climate."

The monitor does provide an accurate and reliable snapshot of what's happening in the climate system at a given moment, including a mixture of global warming and La Niña conditions that contribute to drought conditions in the American Southwest, the study found.

But its introduction happened to coincide with the start of a multi-decadal period of dryness in the West, including the region's driest 22 years in at least the last 1,200 years, sometimes referred to as a megadrought.

During that period, some parts of California experienced exceptional drought — the worst of five possible categories — nine times more often than they should have, according to the drought monitor's probability. The areas were in that category 18% of the time — or for a period of nearly four years — compared with the normal benchmark of 2%, the study found.

The findings raise questions about how the familiar assessment can best address long-term trends, and whether a product designed for periodic anomalies can accurately capture a much larger, slower-moving crisis.

"Those trends ... stress the theoretical guidelines of the product itself, and I would argue undermine its utility as a decision-maker," said Mankin, who was also the former co-lead of the National Oceanic and Atmospheric Administration's Drought Task Force.

Indeed, the monitor is more than just a measure of dryness. It is used to inform social and economic policies, including decisions regarding state and local emergency drought declarations, federal funds for farmers and agribusinesses, and other disaster-related aid.

The Farm Services Agency, for instance, uses the Drought Monitor's weekly updates to dole out certain assistance programs such as emergency haying and the Livestock Forage Disaster Program. The Internal Revenue Service uses it for some livestock-related tax deferrals, while the U.S. Department of Agriculture uses it to determine eligibility for low-interest loans.

But resources triggered by exceptional conditions can quickly run dry if those conditions stretch for months or even years on end, said Jason Smerdon, another of the study's authors and a climate scientist at the Columbia Climate School.

"It's an emergency, but a different kind of emergency," Smerdon said. "If it's going to be dark red all the time, then short-term relief aid to address the challenge is not really the way to think about it. It's an emergency of a much longer, persistent nature that I think takes different planning and different relief."

Experts who work on the Drought Monitor said they're open to the feedback, and also acknowledged that the tool has its limitations.

"The Drought Monitor was never intended to be a climate change indicator — it was meant to be a real-time assessment of drought conditions," said Mark Svoboda, director of the National Drought Mitigation Center at the University of Nebraska-Lincoln, which produces the monitor in partnership with NOAA and the USDA.

The monitor uses a "convergence of evidence" approach that pulls in data from dozens of indicators each week, including measurements of precipitation, soil moisture, snowpack, snow water equivalents, streamflows, evapotranspiration, and groundwater and reservoir levels, he said. That means they're somewhat beholden to the limitations of those tools as well.



The Los Angeles Aqueduct flows through the Owens Valley in June 2023, in Lone Pine, Calif. (Brian van der Brug/Los Angeles Times)

Before its publication each Thursday, more than 400 experts around the country review a draft of the update and weigh in on its findings. It's rare for such a product to have so much input, and also adds a bit of art to the science, according to Svoboda, who co-founded the Drought Monitor in 1999 and was author of it for 17 years.

But the problem today is that it's not yet known whether the West's megadrought represents a permanent climactic shift that could warrant a recalibration of the tools, or whether there may still be wetter days ahead, he said. In regions that are already arid to begin with, who decides when small shifts in moisture pass a tipping point into a new era?

"We've seen these multi-decadal droughts where we've seen a flip back to a wetter regime after that," Svoboda said. "So the real challenge right now, 20 years in, because of climate change, is, are we not ever going to see the flip back? Therefore, do we classify and switch into a more

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arid climate in a given region? That's the real hundred-billion-dollar question, and our indicators right now — none of them are going to address that, because we're not a prediction tool."

The good news is the monitor is generally adept at standardizing its classifications for regional variations, such as how an "exceptional" drought might have vastly different implications in California versus a place such as Vermont, Smerdon said.

But the weekly snapshot is also "not sufficient for thinking about where we're going and what we're doing in light of the increasing water pressures we're going to experience in the West," he said.

For instance, Southern California was never classified in exceptional drought during the 23-year study period, the researchers found — despite the fact that millions of people in and around Los Angeles had been placed under their strictest-ever water restrictions amid the state's three driest years on record.

What's more, the Drought Monitor currently shows most of California and the Southwest are out of the worst stages of drought following two recent wet winters. But groundwater supplies are still depleted, and the Colorado River has not fully recovered from two-plus decades of dryness, with Lake Mead still only measuring about 35% of capacity.



The Colorado River flows along the California-Arizona state line on April 3, 2023. (Brian van der Brug/Los Angeles Times)

"Those are the central banks for the water economy of the West, but you look at the map and that is not featured there in any kind of substantive way," Mankin said.

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Svoboda said the current readings in the Colorado River region represent a “double-edged sword.” It’s unlikely that Lake Mead will ever reach full capacity again, but to continue to reflect that on the Drought Monitor would leave the map there indefinitely red.

“The challenge is always, you don’t want to cry wolf too soon, but you certainly don’t want to wait until the wolf’s eating you, either,” he said of declaring a drought. “And when you’re coming out of drought, the same applies. Impacts of drought can linger.”

Other tools, such as reservoir monitors from the U.S. Bureau of Reclamation and the California Department of Water Resources, are better equipped to measure water scarcity and supplies in the region than the Drought Monitor, he added.

But there are potential ways to help the tool evolve with the changing climate, including expanding its baseline to include wetter periods before the onset of the current megadrought, which would help even out the bell curve and reduce the frequency of extremes, the researchers said.

Tacking on a new “super-exceptional” category might also help with its calibration. It’s a move that has already been proposed for other worsening climate events, such as a new “Category 6” for hurricanes.

However, there are limits to that solution when it comes to drought, which is hard-bound by finite amounts of water, as opposed to hurricanes, which have no upper limit of strength, the researchers said.

Svoboda said similarly that the Drought Monitor is constrained by limited records in many of the products it relies on. What’s more, adjusting the “normal” would also mean that all the surrounding policies — such as relief from the Farm Services Agency — would have to change as well.

Such issues don’t necessarily indicate flaws with the monitor, but rather underscore the need for a variety of tools, both he and the researchers said. The U.S. Drought Monitor shouldn’t be the be-all and end-all for decision-making, and should continue be paired with reservoir observations, snow surveys and other measurements to form a complete picture.

Mankin said he hopes the study can shine a light on the need for long-term adaptation — and the increased possibility that California and other states will be in drought much more frequently than they once were.

However, he and Smerdon stressed that the study should not undermine the value of the Drought Monitor — or the work of those who keep it updated week after week.

“Monitoring drought and maintaining a sense of how hydroclimate is fluctuating across the United States is really important, and it really has been a game-changer to have it as a resource and for planning,” Smerdon said. “I just think it has to evolve. We have to think about what a tool like the Drought Monitor means under a climate that’s changing.”

Hayley Smith is an environment reporter for the Los Angeles Times, where she covers the many ways climate change is reshaping life in California, including drought, floods, wildfires and deadly heat.

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