

Mapping the drought is a surprising mix of art and science

By Kelsey Fitzgerald for
WaterDeeply.org

They've become a familiar staple of California's four-year drought: the colorful drought severity maps, their blotches of red and orange creeping across the landscape to tell us just how bad the drought has become in different regions.

What most people don't realize is that those maps are not generated by software models and computer programs churning away in an air-conditioned server farm on a desert plateau somewhere. The maps are created by hand.

A team of climate and weather experts scattered around the country, working in partnership with the National Drought Mitigation Center, draws the maps each week using voluminous field reports about soil moisture, plant condition, stream flow and many other variables.

The [U.S. Drought Monitor map](#), upon which nearly half of California and parts of western Nevada now appear in dark-crimson (the color assigned to the most severe category), is a weekly product released every Thursday by the National Drought Mitigation Center in Lincoln, Nebraska. The map classifies areas of the country that are experiencing drought, on a scale that ranges from D0 (abnormally dry) to D4 (exceptional drought).

The federal drought map is drawn manually each week by one of a rotating team of 11 volunteer authors – meteorologists, climatologists and other professionals – working for different agencies around the country.

David Simeral drew his first drought map for the U.S. Drought Monitor during August 2012. It was a time when the Midwest and Great Plains states were in the midst of a severe drought.

"I got thrown in at this terrible time, with tons going on," Simeral said. "It was kind of like initiation by fire. It gets easier, but it's hard every single time."

The mapmaking isn't automated. The map is drawn manually each week by one of a rotating team of 11 volunteer authors – meteorologists, climatologists and other professionals – working for different agencies around the country. They call it "a blend of art and science."

Authors like Simeral compile data from hundreds of sources, including a network of more than 360 on-the-ground experts located around the U.S. Then they use their best judgment to determine where the lines should be drawn.

The map got its start in 1999, when Mark Svoboda from the National Drought Mitigation Center was tasked with creating a simple product to educate people about drought.

"We had a message that came loud and clear from decision-makers and policy-makers: We just want one map with one number on it," Svoboda said.

So he and a colleague, Doug LeComte, produced a prototype in May 1999. It was a time when the Internet was young, real-time data was hard to come by, and Corel Draw was at the forefront of mapping software.

Sixteen years and many iterations later, the map has evolved in accuracy and intricacy, as U.S. Drought Monitor authors now have access to large datasets, Geographic Information System (GIS) software and a large network of contributors.

The map is produced as a collaborative effort between the National Oceanic and Atmospheric Administration, the U.S. Department of Agriculture and the National Drought Mitigation Center. There is no overarching budget for the program; each author's employing agency allows them to put their normal responsibilities on hold while they take

their shift with the drought map.

The authors use GIS mapping software, which lets them draw shapes by clicking a series of map points. The software connects the dots. If they're working in a region with ongoing drought, they drag the boundaries of an existing mapped area to reflect the changes on the ground. In an area with a new drought, they draw an entirely new shape. The draft map is sent out for review, and other contributors may send back hand-sketched recommendations for changes, if they think the lines should be moved.

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Simeral works on the map from the Western Regional Climate Center in Reno, Nevada, one of six regional climate centers in the U.S. administered by the NOAA. Surprisingly, he is the only drought map author located in the West. There are none working in California.

"We'd like to have more Western authors on board, because they certainly have a more regional, specialized expertise that would help the effort tremendously," said Eric Luebehusen, a map author who works for the U.S. Department of Agriculture in Washington, D.C.

Simeral describes his shifts as lead mapmaker – which come around three times a year – as intense. During each two-week long turn at the drawing board, he spends 12-15 hours per day on the map, immersed in data, drafts, reviews and edits.

He begins by downloading the last published version of the map, then overlays data sources such as precipitation records, soil moisture records, stream flow records and reservoir levels. He's looking for potential areas of change. Next, Simeral incorporates information from on-the-ground observers located around the country, which pours in via an email listserv – reports, graphs, photographs, written descriptions, hand-drawn maps – all of which must be verified for accuracy.

"Sometimes we get photographs of stock ponds that are low, or fields that are left fallow," Simeral said. "The conversation never stops. On any particular day, if I'm on my shift, I could probably exchange more than 100 emails in a day."

The other 10 authors are scattered between Washington, D.C., Maryland, Tennessee and Nebraska. In some ways, it doesn't matter where they're located, says Simeral, because each author must be familiar with the climate, hydrology, soils and conditions of every region in the country.

"Every region has its unique set of features, and gets analyzed a little differently," said Simeral, whose primary job is associate research scientist in climatology and meteorology at the Western Regional Climate Center. "It's up to us to read between the lines and figure it out. That's why this can't be done as a model. There are too many factors involved."

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David Simeral, one of 11 volunteer authors of the federal drought map

In other ways, however, the author's location does matter. Simeral says that his personal network of contacts and data sources in the West allow him to obtain better information about on-the-ground conditions of drought in Western states than other authors may have access to, simply because he knows who to call.

"I have a really good network out here and I think that really helps, through all the federal projects and things that I've worked on through the years," said Simeral, who is also finishing up a PhD in geography at the University of Nevada at Reno. "I'll go make phone calls to people and be like, 'Hey, what's going on up here?' I do that a lot out West because we have so much open space here, and you can't rely on all the data products. They're just not accurate in

some areas.”

The accuracy of the map, after all, affects people. More than just an informational tool, the map is used to determine eligibility for drought aid for livestock producers, through the U.S. Department of Agriculture’s Livestock Forage Disaster Program. Over the past four years, more than \$5 billion has been distributed to livestock producers in the United States who have suffered grazing losses due to drought. To receive aid, a livestock producer must reside within a county rated by the U.S. Drought Monitor as having a D2 (severe) to D4 (exceptional) level of drought.

Authors must not let this knowledge of financial aid triggers sway their opinion.

“I personally don’t even want to know ... because that would kind of cloud my objectivity,” said Luebehusen. “If Congress wants to take the map and use it to trigger aid, so be it, but we’re just trying to do the most accurate, defensible, scientific work we can. How people use it is up to them.”

Drought’s physical indicators and impacts are elusive qualities to map. Because of the variety of information sources that are incorporated into the map, it isn’t a strictly qualitative product. When compared with a map from a year ago, for example, the area of California covered in D4 drought appears to have decreased from 58 percent to 46 percent. This shouldn’t be interpreted to mean that the drought has eased, says Svoboda.

In recent months, the drought appears to have shifted slightly east into the Sierra Nevada, now covering more of the state of Nevada than it did a year ago.

“Droughts sort of do have an ebb and flow to them,” Svoboda said. “They sort of have an evolution and a decay. They have these epicenters that move around.”

The duration of California’s drought matters, as well. “Even if the intensity, physically, isn’t as severe at D3 and D4 as it was this time last year, the impacts can actually be worse, because the drought continues to go on,” Svoboda explained.

WaterDeeply.org maintains a running tally on its home page showing the number of days during which at least 50 percent of California has been mapped in the “severe,” or D2, drought category or worse. This is based on the Drought Monitor’s work and it now exceeds a staggering 800 consecutive days.

“The longer it goes, you don’t need it to be D3 or D4 to have impacts, because you have this cumulative buildup of drought conditions, drawdown of water supply, pumping of groundwater,” Svoboda said.

“That D3-D4 core has been pretty entrenched in California for quite some time,” Svoboda adds. “Once that number gets down significantly lower or gone, then we can start talking about recovery.”

WaterDeeply.org is an independent digital media project dedicated to covering California’s water crisis.

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