Flash droughts present challenge for warning system

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In 2012, countless lakes across the central United States went dry, including Teller Lake No.5, in Boulder County, Colorado. Sceintists are exploring the physical processes that can drive flash droughts, the existing capabilities to predict them and what is needed to establish an effective early warning system. Credit: UCAR/Carlye Calvin.

Flash droughts are a type of extreme event distinguished by rapid intensification of drought conditions with severe impacts. They unfold

on subseasonal to seasonal timescales (weeks to months), presenting a new challenge for improving predictions of when flash droughts occur.

In new research published in the March 2 edition of *Nature Climate Change*, a multi-institutional collaboration including Lawrence Livermore National Laboratory (LLNL) climate scientist Celine Bonfils, explored current understanding of the physical processes that can drive flash droughts, the existing capabilities to predict them and what is needed to make progress to establish effective early warning of flash droughts.

"There is a growing awareness that flash droughts can trigger severe agricultural impacts while the mechanisms at their origin need more investigation. This makes flash droughts a compelling frontier for research, monitoring and prediction," Bonfils said.

Drought is perhaps the most complex and least understood of all weather and climate extremes. Despite an increasing drought risk in a future warmer climate, this risk is often underestimated and continues to remain a "hidden hazard." Drought can span timescales from a few weeks to decades, and areas from a few kilometers to entire regions. Impacts usually develop slowly, are often indirect and can linger for long after the end of the drought itself.

"A better understanding of the physical processes leading to different types of droughts and how they affect societal and environmental vulnerability is more important than ever," Bonfils said.

The impact of droughts arise in part from their long duration, such as the Dust Bowl and the 2011-2015 California drought, and have formed strong imagery in the U.S. Megadroughts lasting more than 20 years also have been documented in tree-ring records.

While plenty of research has been done on long-term droughts, not as much has been conducted on the rapid development, in the space of a few weeks, that sometimes occurs.

One flash drought that brought attention to the phenomenon occurred in the Midwest in 2012. The extent of abnormally dry conditions expanded from 30 percent of the continental United States in May 2012 to more than 60 percent by August. This event had significant impacts for agriculture and water-borne transportation in the region. The widespread impacts of the 2012 event caught the attention of the U.S. public and leaders.

But flash drought is not confined to the U.S. Processes that can produce flash droughts are the focus of research in China. In southern Queensland, Australia, a flash drought in early 2018 de-vegetated the landscape and drove livestock numbers to their lowest level in a century, a significant impact for agriculture.

"A drought monitoring and early-warning system is the foundation of effective, proactive drought policy, because it enables notice of potential and impending drought conditions," said Angeline Pendergrass, a scientist at the National Center for Atmospheric Research and lead author of the paper.

An ideal early warning system would identify climate and water-resource trends and detect the emergence or probability of occurrence of a flash drought, as well as the likely severity of droughts and their impacts.

"Reliable information must be communicated in a timely manner to water and land managers, policy makers and the public through appropriate communication channels, to trigger actions documented in a drought plan, which is particularly critical for flash droughts," the authors said. "That information, if used effectively, can form the basis

for reducing vulnerability and improving mitigation and response capacities of people and systems at risk."

More information: Angeline G. Pendergrass et al. Flash droughts present a new challenge for subseasonal-to-seasonal prediction, *Nature Climate Change* (2020). DOI: 10.1038/s41558-020-0709-0

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