

# Abrupt climate change more common than believed

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It came on quickly and then lasted nearly two decades, eventually killing more than one million people and affecting 50 million more. All of this makes the Sahel drought, which first struck West Africa in the late 1960s, the most notorious example of an abrupt climatic shift during the last century.

Dramatic as this single event was, University of Wisconsin-Madison researchers have now uncovered 29 other regions worldwide that endured similarly precipitous climatic changes during the 20th century - far more than scientists previously thought. Their study publishes today (March 30) in the online edition of *Geophysical Research Letters*.

The work represents the first systematic survey of abrupt climate changes that have occurred in recent history, says postdoctoral researcher Gemma Narisma, who led the study with professor Jonathan Foley, director of the UW-Madison Center for Sustainability and the Global Environment in the Nelson Institute for Environmental Studies. The National Academies' National Research Council has called for more research on abrupt climate change, warning that it's more likely to happen as global temperatures rise and humans continue to alter the environment.

"This study is important, because previous work largely focused on ancient climates or theoretical changes in future climates," says Foley. "But our work here is showing that abrupt climatic changes are real, are with us today, and that they have major impacts on human societies."

By identifying diverse regions around the globe where rapid climatic shifts have taken place, the study opens up new opportunities for understanding why these changes happen and what makes areas susceptible to them, says Narisma. A range of factors is likely involved, including human activities, such as deforestation and land degradation, and natural phenomena, like sea surface temperatures.

The work might also lead to interventions that would make systems less vulnerable to sudden climate change, Narisma adds.

Unlike other research studies, which have focused on sudden shifts in ancient climates or possible future changes, Narisma's survey of abrupt climate change during the past 100 years offers something else: a chance to learn how people coped.

"We're interested in the human side mainly," says Narisma. "In the more recent history, you really get to see what the impacts were on the current society, and that gives you an idea of the potential impacts in the future, as well."

Abrupt climate change is generally known as a quick and drastic shift in climate that makes it difficult for society and the environment to adapt. In the study, Narisma and her colleagues defined it as a drop in rainfall to levels at least five percent below the normal average, which took much less time to settle in than the drought's total length. They also stipulated that drought conditions had to last at least five years.

"Since these changes are a switch to a new state - the drought state - the tendency is for them to persist for awhile," says Narisma. "It's the combination of abruptness and persistence that gives these events the potential to have serious consequences."

The scientists pored over precipitation records from 1901 to 2000 and

then used wavelet analysis and statistical techniques to pinpoint climate shifts matching their criteria. In addition to familiar events, such as the Sahel drought and the Dust Bowl in the Midwestern United States, they detected lesser-known droughts in virtually all corners of the globe, including Europe, North America, Australia, China, the former Soviet Union, the Middle East, Africa, India and Bangladesh.

Although diverse geographically, the 30 affected regions were mostly arid or semi-arid, says Narisma, a result consistent with other modeling studies. Most saw rainfall decrease by 10 percent or more below normal levels, and in all cases drought lasted for at least 10 years.

Why is abrupt climate change of such concern today? Narisma thinks much of it traces back to the tragedy in the Sahel, whose causes - and terrible consequences - have been well documented.

"The Sahel and the Dust Bowl had huge impacts," she says. "But we thought that before we can even begin to analyze the mechanisms behind these abrupt changes or their potential impacts, we had to ask ourselves, 'Are there other regions where abrupt changes have occurred?' We think this study is a major first step in answering these questions."

The paper's other authors are Rachel Licker of the Nelson Institute and Navin Ramankutty of McGill University in Montreal, Canada.

Source: University of Wisconsin-Madison

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