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Climate change has less impact on drought than previously expected

Plants retain more moisture in high carbon dioxide conditions, keeping water on land

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Summary: As a multiyear drought grinds on in the Southwestern United States, many wonder about the impact of global climate change on more frequent and longer dry spells. As humans emit more carbon dioxide into the atmosphere, how will water supply for people, farms, and forests be affected?

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The implications of plants needing less water with more carbon dioxide in the environment changes assumptions of climate change impacts on agriculture, water resources, wildfire risk, and plant growth, say scientists.

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As a multiyear drought grinds on in the Southwestern United States, many wonder about the impact of global climate change on more frequent and longer dry spells. As humans emit more carbon dioxide into the atmosphere, how will water supply for people, farms, and forests be affected?

A new study from the University of California, Irvine and the University of Washington shows that water conserved by plants under high CO₂ conditions compensates for much of the effect of warmer temperatures, retaining more water on land than predicted in commonly used drought assessments.

According to the study published this week in the *Proceedings of the National Academy of Sciences*, the implications of plants needing less water with more CO₂ in the environment changes assumptions of climate change impacts on agriculture, water resources, wildfire risk, and plant growth.

The study compares current drought indices with ones that take into account changes in plant water use. Reduced precipitation will increase droughts across southern North America, southern Europe and northeastern South America. But the results show that in Central Africa and temperate Asia -- including China, the Middle East, East Asia and most of Russia -- water conservation by plants will largely counteract the parching due to climate change.

"This study confirms that drought will intensify in many regions in the future," said coauthor James Randerson, UCI professor of Earth system science. "It also shows that plant water needs will have an important influence on water availability, and this part of the equation has been neglected in many drought and hydrology studies."

Recent studies have estimated that more than 70 percent of our planet will experience more drought as carbon dioxide levels quadruple from pre-industrial levels over about the next 100 years. But when researchers account for changes in plants' water needs, this falls to 37 percent, with bigger differences concentrated in certain regions.

The reason is that when Earth's atmosphere holds more carbon dioxide, plants actually benefit from having more of the molecules they need to build their carbon-rich bodies. Plants take in carbon dioxide through tiny openings called stomata that cover their leaves. But as they draw in carbon dioxide, moisture escapes. When carbon dioxide is more plentiful, the stomata don't need to be open for as long, and so the plants lose less water. The plants thus draw less water from the soil through their roots.

Global climate models already account for these changes in plant growth. But many estimates of future drought use today's standard indices, like the Palmer Drought Severity Index, which only consider atmospheric variables such as future temperature, humidity and precipitation.

"New satellite observations and improvements in our understanding hydrological cycle have led to significant advances in our ability to model changes in soil moisture," said Randerson. "Unfortunately, using proxy estimates of drought stress can give us misleading results because they ignore well-established principles from plant physiology."

Planners will need accurate long-term drought predictions to design future water supplies, anticipate ecosystem stresses, project wildfire risks and decide where to locate agricultural fields.

"In some sense there's an easy solution to this problem, which is we just have to create new metrics that take into account what the plants are doing," said lead author Abigail Swann, a University of Washington assistant professor of atmospheric sciences. "We already have the information to do that; we just have to be more careful about ensuring that we're considering the role of the plants."

Is this good news for climate change? Although the drying may be less extreme than in some current estimates, droughts will certainly increase, researchers said, and other aspects of climate change could have severe effects on vegetation.

"There's a lot we don't know, especially about hot droughts," Swann said. The same drought at a higher temperature might have more severe impacts, she noted, or might make plants more stressed and susceptible to pests.

"Even if droughts are not extremely more prevalent or frequent, they may be more deadly when they do happen," she said.

Story Source:

The above post is reprinted from materials provided by **University of California - Irvine**. *Note: Content may be edited for style and length.*

Journal Reference:

- Abigail L. S. Swann, Forrest M. Hoffman, Charles D. Koven, James T. Randerson. **Plant responses to increasing CO₂ reduce estimates of climate impacts on drought severity**. *Proceedings of the National Academy of Sciences*, 2016; 201604581 DOI: 10.1073/pnas.16045811113

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