

A warmer climate will also be a drier climate, with negative impacts on forest growth

October 9 2018



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Warmer temperatures brought on by climate change will lead to drier soils and reduce tree photosynthesis and growth in forests later this century, according to a new University of Minnesota study published in the journal *Nature*.

That important conclusion comes as scientists have speculated the opposite: that a [warming climate](#) might speed up a forests' photosynthesis and facilitate growth in cold-weather climates found in North America, Europe and Asia.

"These results have important implications for the future," said Peter Reich, a professor of forest resources in the College of Food, Agricultural and Natural Resource Sciences and the study's lead author. "Typical dry spells already occur frequently enough to erase most of the potential benefits to tree growth of warmer summer temperatures. In a warmer future, the extra evaporation from warmer plants and soils will make those dry spells drier, further suppressing photosynthesis."

Cool summers slow the growth of forests in cold places. That's why scientists had hypothesized that warmer climatological conditions might help increase a forest's growth rate in the future.

In their study, University of Minnesota researchers looked at more than 2,000 young trees from 11 different species—including birch, maple, oak, pine and spruce—growing in 48 plots in two forests in northern Minnesota. During the three-year study, researchers increased temperatures at the test plots—without use of chambers of any kind—by 3.4 degrees Celsius (6 degrees Fahrenheit), an increase that might happen in Minnesota by the end of the 21st century.

During the course of the study, researchers routinely measured photosynthesis at the plots to see how fast leaves were taking carbon dioxide out of the air to make sugars for the trees. Researchers found that:

- when soils were moist, photosynthesis was higher in plants growing at warmer than at ambient temperatures;
- in moderately to severely dry soils, which occurred during two-thirds of the growing season, warmer temperatures reduced photosynthesis;
- as a result, photosynthesis was reduced—on average—by the experimental climate warming.

"These results show that low soil moisture will slow down or eliminate any potential benefits of climate warming on tree [photosynthesis](#) even in moist, cold climates like Minnesota, Canada and Siberia," said Reich.

The University of Minnesota research comes as the latest report from the United Nations' Intergovernmental Panel on Climate Change was released. The U.N. report explains the likely global impacts of climate change by the year 2040, highlighting the multiple ways [climate change](#) will impact nature and humanity, including sustainability of food, fibre, water and biodiversity.

"Our work, alongside that of the community of scientists worldwide, can inform decisions that can put the world on a path toward a sustainable future," said Reich. "This will be the largest challenge humanity has ever faced and unless we shift gears to effectively tackle it, future generations will view us as having completely failed in our responsibility as stewards of the earth."

The study is based on [B4Warmed](#), a multiyear project aimed at understanding how a changing [climate](#) might impact forests.

More information: Peter B. Reich et al. Effects of climate warming on photosynthesis in boreal tree species depend on soil moisture, *Nature* (2018). [DOI: 10.1038/s41586-018-0582-4](https://doi.org/10.1038/s41586-018-0582-4)

Provided by University of Minnesota

Citation: A warmer climate will also be a drier climate, with negative impacts on forest growth (2018, October 9) retrieved 19 April 2024 from <https://phys.org/news/2018-10-warmer-climate-drier-negative-impacts.html>

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