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TREES RESPOND TO CLIMATE CHANGE BY PRODUCING MORE CARBON DIOXIDE

New study warns that climate models have overestimated the ability of trees to sequester carbon

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A new research study conducted in part at Black Rock Forest in Cornwall, NY but with global implications shows that plants may emit more carbon dioxide into the atmosphere than previously believed through the process of respiration.

While plants and trees are considered one of the planet's greatest "carbon sinks" due to their storage of carbon dioxide during photosynthesis, the new research — published in November in the prestigious *Nature Communications* journal — shows that when plants "exhale," or respire, they emit around 30 percent more CO_2 than previously predicted.

This means that as the planet warms, elevated respiration levels worldwide may reduce Earth's ability to absorb the emissions created by burning fossil fuels, said Kevin Griffin, Ph.D., one of the researchers and president of the Black Rock Forest Consortium.

"Plant respiration is an essential metabolic pathway that provides the energy and building blocks that plants need to grow and survive, but the process also releases CO_2 to the atmosphere. For nearly 20 years my students, collaborators and I have been studying this process in Black Rock Forest and elsewhere, and we now have enough measurements to begin to identify global trends and make modeled predictions of future responses to climate change," said Griffin, a professor at the Lamont-Doherty Earth Observatory of Columbia University.

Working with colleagues in the United Kingdom and Australia, Griffin's findings were compared to more than 4,000 measurements of carbon dioxide respiration from plants across the globe.

The findings also raise a critically important question: trees and plants have long been considered a moderating force that will help counteract climate change, but what does it mean if their effect is not as great as once believed?

“The study shows that as global temperatures increase, the amount of carbon dioxide released through plant respiration will increase significantly,” said Professor Owen Atkin from the Research School of Biology and the ARC Centre of Excellence in Plant Energy Biology at the Australian National University. “Currently, around 25 percent of carbon emissions from the use of fossil fuels is being taken up and stored by plants, which is good, as it helps reduce the concentration of greenhouse gases in the atmosphere. Our work suggests that this positive contribution of plants may decline in the future as they begin to respire more as the world warms.”

Griffin, Heskel and a team of Columbia students sampled leaves from the multiple deciduous tree species of Black Rock Forest, the nearly 4,000-acre field station in New York’s Hudson River Valley. Nestled just 60 miles outside of New York City, Black Rock Forest provided the ideal setting for the research.

“Black Rock Forest’s size, biological diversity and relatively undisturbed nature, along with its 90-plus year history as a research station, make it useful to represent the oak-dominated portion of North America’s eastern deciduous forest in global-scale studies,” said Bill Schuster, the executive director of the Black Rock Forest Consortium. “The work of Dr. Griffin and colleagues in Black Rock has contributed to a more accurate understanding of our planet’s carbon cycle and a better ability to predict our future.”

In addition, Griffin’s study utilized plant respiration data from more than 100 other sites around the world, from hot deserts in Australia to the deciduous and boreal forests of North America and Europe, the arctic tundra in Alaska, and the tropical forests of South America, Asia, Africa and northern Australia.

The next phase of the team’s research will be to gather information on the growth respiration of leaves, which will provide two more important clues: how much additional energy is needed and how much CO_2 is released when new leaves are added each year.

"We are now one step closer to more accurately modeling carbon exchange in ecosystems across the world,” said Dr. Mary Heskel, a postdoctoral scholar at the Ecosystems Center, Marine Biological Laboratory in Woods Hole, MA. “The study provides the most informed picture to date of current and future carbon release from plants in terrestrial systems."

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Black Rock Forest Consortium advances scientific understanding of the natural world through research, education and conservation. The Consortium maintains a 3,870-acre forest and scientific field station in the Hudson Highlands, 60 miles north of New York City. The Consortium collaborates with its members — universities, schools, scientific and cultural institutions — to pursue and foster scientific inquiry and educational programs for K-16 students. For more information on the Consortium, visit www.blackrockforest.org.