

Soil nutrition affects carbon sequestration in forests

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Aerial view of free-air carbon dioxide enrichment (FACE) rings at Duke Forest, Durham, NC. Credit: Will Owens

On December 11, USDA Forest Service (FS) scientists from the FS Southern Research Station (SRS) unit in Research Triangle Park, NC, along with colleagues from Duke University, published two papers in *The Proceedings of the National Academy of Science* that provide a more precise understanding of how forests respond to increasing atmospheric concentrations of carbon dioxide, the major greenhouse gas driving climate change.

Building on preliminary studies reported in Nature, the researchers found that trees can only increase wood growth from elevated CO₂ if there is enough leaf area to support that growth. Leaf area, in turn, is limited by soil nutrition; without adequate soil nutrition, trees respond to elevated CO₂ by transferring carbon below ground, then recycling it back to the atmosphere through respiration.

"With sufficient soil nutrition, forests increase their ability to tie up, or sequester carbon in woody biomass under increasing atmospheric CO₂ concentrations," says Kurt Johnsen, SRS researcher involved in the project. "With lower soil nutrition, forests still sequester carbon, but cannot take full advantage increasing CO₂ levels. Due to land use history, many forests are deficient in soil nutrition, but forest management -- including fertilizing with nitrogen -- can greatly increase growth rate and wood growth responses to elevated atmospheric CO₂."

The studies took place at a Free Air Carbon Enrichment (FACE) study established by the U.S. Department of Energy on the Duke Forest in Durham, NC. In FACE studies, groups of trees are circled by rings of towers that provide CO₂ to increase atmospheric concentrations of the gas around the selected trees. At the Duke FACE experiment, half of each ring was fertilized with nitrogen to study the effect of added soil nutrients on tree growth under elevated CO₂.

The researchers further tested their hypotheses using data from FACE sites in Wisconsin, Colorado, and Italy. In the articles, the scientists identify critical areas needing further study, but the overall consistency they found across these diverse forests bodes well for developing accurate models to predict the ability of the world's forests to sequester carbon.

"Forests play a critical part in sequestering carbon, and may play a role in mitigating the elevated levels of carbon dioxide associated with

climate change," says Johnsen. "To predict how much forests can sequester, we need accurate ways to predict what happens to carbon within forest systems and how this partitioning is affected by environmental conditions."

Source: Southern Research Station - USDA Forest Service

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