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New Study Projects Declining U.S. Carbon Sink

UNH Scientist Leads Research Team

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DURHAM, N.H. -- In a new study, scientists suggest that atmospheric concentrations of carbon dioxide could increase over the next century at an even faster rate than previously projected, due to a diminishing U.S. carbon sink.

The study, which appears in the Feb. 5 issue of the journal Proceedings of the National Academy of Sciences, estimates that the U.S. carbon sink will decrease to one-third its current size over the next century, under an optimistic scenario, and could actually become a source of atmospheric carbon dioxide, in the worst case.

The U.S. carbon sink currently stores between one-third and two-thirds of a billion metric tons of carbon per year, helping to mitigate the 1.4 billion metric tons of carbon dioxide the U.S. pumps into the atmosphere.

"Our projections for the future indicate that the ecosystem recovery processes that are primarily responsible for the contemporary U.S. carbon sink will slow over the next century as forests and other ecosystems mature, resulting in a significant reduction of the sink," says George Hurtt, assistant professor in the University of New Hampshire's Department of Natural Resources and Institute for the Study of Earth, Oceans, and Space and the study's lead author. "The rate of decrease depends strongly on the scenarios of future land use and the long-term effectiveness of fire suppression."

Carbon sinks are areas of land that soak up large amounts of carbon dioxide, a major greenhouse gas resulting from the burning of fossil fuels. Evidence is steadily mounting that greenhouse gases are the main culprit behind global warming.

The dominant factor governing carbon uptake in U.S. ecosystems currently is historical changes in land use and management, due primarily to the reforestation of agricultural land over the past century. Trees and other plants absorb huge amounts of carbon dioxide during photosynthesis.

Another important factor, according to Hurtt, includes an approximately 95 percent reduction in the area burned by fires in the U.S. since before the middle of the 18th century. Fires emit carbon dioxide when vegetation burns, whereas plant growth absorbs it from the atmosphere.

For their study, the scientists used two ecosystem models to estimate carbon stocks and fluxes in the U.S. from 1700 to 1900, and then to make projections to 2100.

"Our results were first compared with other historical reconstructions of ecosystem carbon fluxes and to a detailed carbon budget for the 1980s," says Hurtt. "This gives us some confidence in using these models to make future projections."

The scientists estimate that the U.S. carbon sink is at or near its peak capacity now. To project its future, they developed two alternative scenarios that span a wide range of future conditions.

In the first scenario, the scientists assumed that fire suppression efforts continue to be effective at reducing fires to their 1980s levels throughout the 21st century. In the second scenario, they assume that fire suppression ceases in 2000. Fire is an important variable because it releases massive amounts of carbon dioxide into the atmosphere. To focus on the future of the dominant sink mechanisms at present, both scenarios held environmental conditions constant and assumed that there are no future changes in land use.

"Even with continued fire suppression, the modeled U.S. carbon sink is projected to decline to one-third its current size by 2100," says Hurtt. "The reason the sink decreases is that woody encroachment from fire suppression approaches its maximum limit and forest ecosystem recovery slows and begins to equilibrate with forest harvesting and natural mortality."

If fire suppression efforts were to completely fail, the modeled U.S. carbon sink would rapidly become a source of atmospheric carbon dioxide caused by extensive burning from large-scale fires.

Taking either scenario into consideration, fossil fuel emissions must be reduced by an amount equal to declines in the carbon sink or atmospheric carbon dioxide will increase at an even faster rate than expected, says Hurtt.

"Total U.S. fossil fuel emissions would need to be reduced by an additional 7 to 30 percent to compensate for the declining sink, and equal the results of stabilizing net emissions at 1990 levels throughout the century," he says. "These requirements are in addition to the reduction in fossil fuel emissions currently needed to achieve 1990 net emissions.

"One implication of this study is that we will have to be even more proactive than previously thought to slow and eventually halt the growth rate of atmospheric CO2 concentrations," Hurtt continues. "Even if substantially positive net effects on carbon storage result from future environmental change, they will have to compensate for declines from the maturing process of ecosystem recovery that is so important now."

In addition to reducing emissions, he says, continued fire suppression and positive land use practices are important steps for slowing the growth rate of atmospheric carbon dioxide.

Hurtt's research is funded by the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA).

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