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Sources, sinks and cycles

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On the road to COP15 in Copenhagen this December, everyone is talking about the contribution to climate change of emissions from deforestation and degradation. But two recent articles led by scientists at the University of Leeds – and reflecting contributions from more than 100 authors from around the world – show there's much more to the story of forests in the global carbon cycle.

Until recently, it was widely assumed that mature, intact forests were neither sources nor sinks for atmospheric carbon, with sequestration from growth on average balancing out emissions from decay of woody material. But a few years ago, conventional wisdom was challenged by studies from the Amazon region showing that old-growth forests were in fact increasing their carbon stock.

Now Simon Lewis and his colleagues have begun filling a big gap in the global picture with similar findings from Africa. In 'Increasing carbon storage in intact African tropical forests' published in *Nature*, they report on measurements of the growth of tree trunks at 79 plots in 10 countries, and extrapolate the results to account for overall forest biomass at a continental scale. They estimate that mature moist forests in Africa have been absorbing a net 340 million tonnes of carbon per year in recent decades. This amount is roughly equivalent to the total emissions from deforestation in Africa, and much greater than fossil fuel-based emissions from the continent.

What could account for such unexpected growth? The authors discount the possibility that the forests are still recovering from a disturbance in the past, as there is no evidence of a decline in the proportion of less dense species, as would be predicted by ecological theory. Instead, bigger trees may be due to an increase in availability of resources, including fertilisation by increased CO_2 in the atmosphere.

In 'Drought sensitivity of the Amazon rainforest', Oliver Phillips and his colleagues report in *Science* on the results of a natural experiment: the response of forests to the severe 2005 drought, which could prefigure what might happen in the Amazon if certain climate change models that predict a drier future are correct. Using data from long-term monitoring plots in old-growth forests across the region to compute changes in biomass matched to meteorological data, the authors were able to determine the response of the forest to reduced availability of moisture.

In contrast to recent decades, in which the forests absorbed a net 450 million tonnes of carbon per year, those most intensely affected by the 2005 drought lost biomass and became net contributors of carbon to the atmosphere. Scaling up from the plot level to the drought-affected area and including unmeasured biomass, the authors estimate the total impact of the drought was a net change of 1.2 billion tonnes as the carbon sink turned into a major source. For comparison, fossil-fuel based emissions from the United States were 1.6 billion tonnes of carbon in 2005.

Taken together, the papers suggest the role of forests in the global carbon cycle is more significant and more complex than commonly appreciated. We need to keep an eye not only on the impacts of forest-based emissions on climate change but also on the impacts of climate change on forests and their ability to store carbon and provide other ecosystem services. In order to do so, support for long-term forest monitoring is crucial; without it, neither of these studies would have been possible.

Frances Seymour
Director General

For a copy of the paper by Lewis et al, please write to Simon Lewis at s.l.lewis@leeds.ac.uk. For more information, visit the website of the African Tropical Rainforest Observation Network at www.afritron.org.

For a copy of the paper by Phillips et al, please write to Oliver Phillips at o.phillips@leeds.ac.uk. For more information, visit the website of the Rainfor research network at http://www.geog.leeds.ac.uk/projects/rainfor/

Center for International Forestry Research (CIFOR).
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