New measurements show widespread forest loss has reversed the role of tropics as a carbon sink

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Tropical forest in Martinique near the city of Fond St-Denis. Credit: Wikipedia

A new, cutting-edge approach to measuring changes in aboveground forest carbon density has helped scientists determine that widespread deforestation, degradation and disturbance has caused tropical forests to

now emit more carbon than they capture, countering their role as a net carbon "sink."

Previous measurements of forest carbon loss focused largely on areas subject to complete forest removal (deforestation). This is the first time, however, that scientists have been able to account for changes from subtle natural and human-caused losses (degradation and disturbance) such as small-scale tree removal and mortality while also measuring gains from forest growth.

The paper will be published online in the journal *Science* on Thursday, 28 September 2017.

The findings by a team of scientists at the Woods Hole Research Center and Boston University add new urgency to the critical need for aggressive global and national-scale efforts to reduce greenhouse gas emissions in order to meet the climate goals of the Paris Agreement. Importantly, the study suggests there is a critical window of opportunity to reverse the trend in emissions by halting deforestation and degradation, and actively restoring forests to degraded lands.

The study quantifies changes in aboveground forest carbon across tropical America, Africa and Asia—the most threatened forests in the world—and those with the greatest ability to act as significant carbon stores as well as globally recognized hotspots of biodiversity and essential ecosystem services including food, fiber, and fuel for millions worldwide.

"These findings provide the world with a wakeup call on forests," said WHRC scientist Alessandro Baccini, the report's lead author. "If we're to keep global temperatures from rising to dangerous levels, we need to drastically reduce emissions and greatly increase forests' ability to absorb and store carbon. Forests are the only carbon capture and storage

'technology' we have in our grasp that is safe, proven, inexpensive, immediately available at scale, and capable of providing beneficial ripple effects—from regulating rainfall patterns to providing livelihoods to indigenous communities."

Using 12 years (2003-2014) of satellite imagery, laser remote sensing technology and field measurements, Baccini and his team were able to capture losses in forest carbon from wholesale deforestation as well as from more difficult-to-measure fine-scale degradation and disturbance, which has previously proven a challenge to the scientific community over large areas.

"It can be a challenge to map the forests that have been completely lost," said WHRC scientist Wayne Walker, one of the report's authors. "However, it's even more difficult to measure small and more subtle losses of forest. In many cases throughout the tropics you have selective logging, or smallholder farmers removing individual trees for fuel wood. These losses can be relatively small in any one place, but added up across large areas they become considerable."

Using this new capability, the researchers discovered that tropical regions are a net source of carbon to the atmosphere—about 425 teragrams of carbon annually, which is more than the emissions from all cars and trucks in the United States. Gross annual losses were about 862 teragrams of carbon and while gains were approximately 437 teragrams of carbon.

Losses and gains of carbon are not evenly distributed across the tropical belt, the report finds. On a continental scale, the majority of the loss (nearly 60 percent) occurred in Latin America, home to the Amazon—the world's largest remaining intact rainforest. Nearly 24 percent of the loss is attributable to Africa while the forests of Asia experienced the least losses—a little more than 16 percent of the tropical

total.

Just as most of the forest loss took place in the Americas, so, too did most of the forest gain. Nearly 43 percent of the tropical gain is attributable to the Americas. A little more than 30 percent was gained in Africa; about 26 percent was gained in Asia.

The research showed that with the exception of Asia, degradation and disturbance were responsible for the majority of continental losses. In the Americas, 70 percent of losses were due to degradation and disturbance; in Africa, it was 81 percent. Less than half—46 percent—of losses in Asia are linked to degradation and disturbance.

As governments around the world develop plans to meet their commitments under the Paris Agreement, the study shows the enormous potential of tropical forests as a climate change mitigation tool. The authors note that ending tropical deforestation and forest degradation would reduce annual emissions by at least 862 teragrams of carbon, or about 8% of annual global emissions.

The United Nations' REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program provides incentives for countries to maintain forests intact. However, the program necessarily depends on regular access to accurate measurements of incremental gains and losses in forest carbon density.

"With this study, countries are now able not only to identify where degradation is taking place, but also, given the potential to now measure gains from growth, they can demonstrate their contribution to returning tropical forests to their more beneficial role as a carbon sink," Baccini said. "We envision this tool improving the way countries across the tropics tackle the challenges of deforestation and degradation."

More information: A. Baccini el al., "Tropical forests are a net carbon source based on aboveground measurements of gain and loss," *Science* (2017). science.sciencemag.org/lookup/ … 1126/science.aam5962

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