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Press release For immediate release

New Cover Story of *Nature:* Tropical forests' carbon sink is already rapidly weakening

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The ability of the world's tropical forests to remove carbon from the atmosphere is decreasing, according to a study tracking 300,000 trees over 30 years, published recently as the cover story in Nature. The global scientific collaboration of 94 institutes, led by the University of Leeds, including Dr Alexander Koch, Postdoctoral Fellow from the Department of Earth Sciences, the University of Hong Kong (HKU), reveals that a feared switch of the world's undisturbed tropical forests from a carbon sink to a carbon source has begun.

Intact tropical forests are well-known as a crucial global carbon sink, slowing climate change by removing carbon from the atmosphere and storing it in trees, a process known as carbon sequestration. Overall, intact tropical forests removed 17% of human-made carbon dioxide emissions in the 1990s, but was reduced to just 6% in the 2010s. The switch is largely driven by carbon losses from trees dying. Study lead author Dr Wannes Hubau, a former post-doctoral researcher at the University of Leeds now based at the Royal Museum for Central Africa in Belgium, said, "By combining data from Africa and the Amazon we began to understand why these forests are changing, with carbon dioxide levels, temperature, drought, and forest dynamics being key. Extra carbon dioxide boosts tree growth, but every year this effect is being increasingly countered by the negative impacts of higher temperatures and droughts which slow growth and can kill trees."

To calculate changes in carbon storage the scientists measured the diameter and estimated the height of every individual tree in 565 patches of forest, returning every few years to re-measure them. By calculating the carbon stored in the trees that survived and those that died, the researchers tracked the changes in carbon storage over time. After the final re-measurement, the study authors used a statistical model and trends in carbon dioxide emissions, temperature and rainfall to estimate changes in forest carbon storage until 2040. By combining data from two large research networks of forests observations across Africa (AfriTRON) and Amazonia (RAINFOR) the authors show that the Amazon sink began weakening first, starting in the mid-1990s, followed by a waning of the African sink about 15 years later. The continental difference arises from a combination of Amazon forests being more dynamic than those in Africa, and Amazon forests facing stronger climate impacts. Typical Amazonian forests are exposed to higher temperatures, faster temperature increases and more regular and severe droughts, than African forests. Dr Koch from HKU said, "Until now we weren't sure what exactly caused the decline in carbon uptake that we've seen in Amazonian tropical forests, the data from Africa was the missing puzzle-piece."

Worse than predicted

Climate models typically predict that this tropical forest carbon sink will continue for decades. However, the new analysis of three decades of tree growth and death from 565 undisturbed tropical forests across Africa and the Amazon has found that the overall uptake of carbon into Earth's intact tropical forests peaked in the 1990s. Dr Koch from HKU said, "Climate models currently do not show this pattern of decline. This is something that we need to address if we want to predict how tropical forests carbon stores will act under future climate change in these models". Study author Professor Bonaventure Sonké from the University of Yaounde I in Cameroon added, "The speed and magnitude of change in these forests suggests that climate impacts in the tropics may become more severe than predicted."

Tropical forests still a vital carbon sink

In the 1990s intact tropical forests removed roughly 46 billion tonnes of carbon dioxide from the atmosphere, declining to an estimated 25 billion tonnes in the 2010s. The lost sink capacity in the 2010s compared to the 1990s is 21 billion tonnes carbon dioxide, equivalent to a decade of fossil fuel emissions from the UK, Germany, France and Canada combined. Senior author Professor Simon Lewis, from the School of Geography at Leeds, said, "Intact

tropical forests remain a vital carbon sink but this research reveals that unless policies are put in place to stabilise Earth's climate it is only a matter of time until they are no longer able to sequester carbon."

Environmental protection key

As tropical forests are likely to sequester less carbon than predicted, other human activities pose further risks. Professor Lewis said, "The immediate threats to tropical forests are deforestation, logging and fires. These require urgent action. In addition, stabilising Earth's climate is necessary to stabilise the carbon balance of intact tropical forests. By driving carbon dioxide emissions to net-zero even faster than currently envisaged, it would be possible to avoid intact tropical forests becoming a large source of carbon to the atmosphere. But that window of possibility is closing fast."

(The press release is adapted from the press release of the University of Leeds)

The paper 'Asynchronous Carbon Sink Saturation in African and Amazonian Tropical Forests' is published in Nature on 5 March 2020. DOI: https://doi.org/10.1038/s41586-020-2035-0 ; URL: https://www.nature.com/articles/s41586-020-2035-0

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Images and videos available at: www.scifac.hku.hk/press

Image1: Measuring trees in Lope National Park, Gabon; photo courtesy: Simon Lewis, University of Leeds

Image2: Measuring Amazon trees; photo courtesy: Roel Brienen, Roel Brienen

Image3: A large tree in Esuboni Forest Reserve, Ghana; photo courtesy: Sophie Fauset, University of Plymouth

Image4: Amazon Forest canopy at Dawn Brazil ; photo courtesy: Peter Vander Sleen

Image5: Above Ivindo National Park, central Gabon; photo courtesy: Kath Jeffery

Captions for videos:

Video 1. Footage of tree measurements, Salonga National Park, Democratic Republic of Congo; credit: Professor Simon Lewis, University of Leeds

Video 2: Fieldwork in Nouabale Ndoki National Park in the Republic of Congo - including canoe travel, tree and foliage measurements; credit: Dr Aida Cuni-Sanchez