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A man collecting water from a well in Madagascar last month. While the study established a correlation between changes in the amount of carbon dioxide in the atmosphere and drought events that have hit the world's tropical belt over the past 60 years, the exact way forest habitats are impacted by drought is still not very well understood. PHOTO: REUTERS

Droughts may affect forests' ability to take in carbon dioxide: Study

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Tropical forests are the lungs of the planet, providing humans with the free service of sucking up carbon dioxide (CO_2) – the main greenhouse gas driving climate change – from the atmosphere.

But a new study led by a National University of Singapore (NUS) researcher has found that the amount of CO_2 taken in by land ecosystems, such as forests, could be linked to the availability of water, which is in short supply during droughts.

The lead author of the study, Assistant Professor Luo Xiangzhong from the NUS' geography department, said: "The key message from our study is that extreme droughts in the tropics are particularly important to the global carbon cycle."

There are three tropical forest basins in the world – in the Amazon, Congo and South-east Asia.

But, while the study established a correlation between changes in the amount of CO_2 in the atmosphere and drought events that have hit the world's tropical belt over the past 60 years, the exact way forest habitats are impacted by drought is still not very well understood, he said.

"This means that we are unsure if we can estimate forest carbon uptake correctly under future climate scenarios," Prof Luo said.

Drought events could become more intense and frequent in a warming world, climate scientists have warned.

Human activity is producing a lot of CO_2 that accumulates in the atmosphere like a blanket, causing excess heat to be trapped on earth and weather patterns to change as a result.

But tropical forests help slow the knitting of the CO_2 blanket in the atmosphere, with the land absorbing roughly 25 per cent of the emissions from human activities.

Indeed, so integral are the world's tropical ecosystems to the global carbon cycle that the three forest basins literally throb – like human lungs heaving with each breath – on satellite imagery showing CO_2 fluxes in the atmosphere.

At night, the forest breathes as humans do. On satellite images, plumes of CO_2 can be seen coming out from the three forest basins during these times.

But when the sun is up, the plumes disappear. Instead, these habitats take in CO_2 through photosynthesis, converting the carbon into sugars that are stored in tree trunks, leaves or the soil, keeping the carbon out of the atmosphere where it can trap heat.

However, the amount of CO_2 that forests take in and release varies from year to year.

The researchers wanted to find out why.

Prof Luo said previous studies had shown that one or two major droughts in the Amazon or in Australia have had an outsized influence on the amount of CO_2 being released into the atmosphere that year, he said.

"That led us to think that perhaps past drought events could explain the variability of the global carbon uptake."

The study found, using historical atmospheric CO_2 observations, earth system models and statistical methods, that these variations became more pronounced, with greater fluctuation, in the late 20th century, compared with the 1950s to 1960s.

The variability then became slightly reduced in the early 21st century.

Prof Luo said this pattern in global carbon fluctuations mirrored changes in drought-affected areas in tropical Asia, which includes South-east Asia.

"For example, the decrease in global carbon variability in the recent two decades can be largely attributed to the decrease in drought in tropical Asia," he added.

Prof Luo said this finding shows that tropical forests in South-east Asia are crucial in regulating the global climate.

"While larger areas of tropical Africa have been affected by drought, that basin comprises more savanna ecosystems," he said, referring to more open, grassland habitats.

"In tropical Asia, we have rainforests, which are very carbon-dense and have larger carbon fluxes," Prof Luo said. "If similar droughts happen in these two places, tropical Asia is likely to suffer from larger carbon loss."

He said that droughts can influence carbon uptake even after a drought ends.

"We often assume ecosystems can fully recover to their normal status after extreme droughts. But droughts may have some long-lasting impacts, such as shifted species composition, higher fire possibility and deadwood decomposition," he said.

"All of these processes release carbon, but they do not necessarily happen during droughts and are often ignored."

Professor Koh Lian Pin, a conservation scientist from NUS, who was not involved in the study, said extreme water deficits from droughts may worsen carbon emissions through tree mortality, forest fires and deadwood decomposition. These compound the negative effects of deforestation and forest degradation, he said.

Added Prof Koh, who heads the NUS Centre for Nature-based Climate Solutions: "This finding strengthens the case for us to do everything we can to halt avoidable emissions from human activities through forest conservation, and start to remove carbon dioxide from the atmosphere through reforestation."

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