There have been three statistically one-in-100-year droughts in the Amazon in the space of a single decade. Photograph: Raphael Alves/EPA

Amazon rainforest

South American monsoon heading towards 'tipping point' likely to cause Amazon dieback

'Shocking' study finds Amazon rainforest will be unable to sustain itself and transport moisture once 'regime shift' occurs

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The South American monsoon, which determines the climate of much of the continent, is being pushed towards a "critical destabilisation point", according to a study that links regional rainfall to Amazon deforestation and global heating.

The authors of the report said they found their results "shocking" and urged policymakers to act with urgency to forestall a tipping point, which could result in up to 30% less rainfall, a dieback of the forest and a dire impact on food production.

The study, published on Wednesday in Science Advances, examines how forest degradation and monsoon circulation are interlinked.

Using past observations and computer modelling, it finds that the Amazon and the South American monsoon are "one coupled system", in which the evapotranspiration by the tropical rainforest recycles moisture from the Atlantic Ocean so that it can move south across the continent.

Human degradation of the Amazon – by land clearance, fire, logging and mining – is pushing that system towards a tipping point, after which drier conditions would be expected to cause an abrupt "regime shift" in the rainforest, which would be unable to sustain itself and transport moisture.

Other biomes in the region would also be affected, along with swathes of agricultural land because the monsoon stretches thousands of miles south from the Amazon to the River Plate (*Rio de la Plata*) basin. There would also be a climate impact because the Amazon – which would be worst affected – has historically served as an important carbon sink, though another study this week suggests it is now so degraded that it is at best carbon neutral. A dieback of the forest would release enormous amounts of carbon.

The researchers on the Amazon-monsoon paper saw several precursors of the tipping point, including falling rainfall in many areas, the steady lengthening of the Amazon dry season, reduced soil moisture and the increasing frequency and intensity of droughts. There have been three statistically one-in-100-year droughts in the space of a single decade.

"It is shocking to see these signs of destabilisation," said the lead author, Nils Bochow, of the University of Tromsø and the Potsdam Institute of Climate Impact Research. "But we shouldn't lose hope. We can still act. We need stricter rules regarding the rainforest."

Global heating is adding to the pressure on the forest. Not included in their paper because it is too recent is this year's fierce dry season, during which many Amazon rivers have fallen far below their average for this time of year, leading to navigation problems, water shortages and mass mortalities of dolphins and fish.

Previous studies have suggested a tipping point could be reached when 20% to 30% of the Amazon is cleared, though there is considerable uncertainty about exactly where the point might be. Currently, between 17% and 26% of the rainforest has been destroyed and at least that has been degraded.

The paper does not give a prediction of when the tipping point might take place, though its authors say their findings confirm the risks and the likelihood that such a tipping point is much closer than other possible climate tipping points, such as the collapse of the Greenland ice sheet.

Although deforestation in the Brazilian Amazon has halved since Brazil's centre-left president, Luiz Inácio Lula da Silva, came to power at the start of the year, the forest continues to shrink. In Bolivia, the loss is accelerating.

Niklas Boers, a professor of Earth system modelling at the Technical University of Munich and the Potsdam Institute, compared the Amazon-coupled monsoon system to a chair that is tilting further and further back to a point where even a breath of wind could knock it over.

"My emotional response is anger," Boers said. "With every square kilometre of deforestation, every fraction of degree of global warming, we are raising the risk of a tipping point. Yet, it is incredibly simple to just stop deforestation. It is an absolutely unique ecosystem that we really can't afford to lose."

Commenting on the paper, Dominick Spracklen, an Amazon expert and professor of environmental science at University of Leeds, said the study was worrying. "This rapid switch to a dry climate would have catastrophic implications for people living in Amazonia," he wrote. "The study highlights the urgent need for people across Amazonia to work together to find ways to reduce deforestation, prevent further loss of forest and start to restore areas that have been lost in recent years."