

Tipping Point

Regional and Global Cooperation to Prevent the Collapse of the Amazon

Key messages

- The Amazon is approaching a tipping point, with the risk of partial or total forest collapse.
- Stress on the Amazon stems primarily from the effects of global climate change, which is intensified by deforestation and fires.
- As stress increases, forest mortality rises, further intensifying climatic stress.
- Parts of the edges and interior of the Amazon show signs of approaching this point, as evidenced by historic droughts and mega forest fires.
- Prevention requires: reducing global emissions, restoring the biome's forest cover, and increasing local adaptive capacity.
- Regional Amazonian cooperation and financial support from the global North are crucial to containing the crisis. ACTO has a key role in coordinating these efforts and in producing and disseminating information about Amazon resilience.

The growing risk of the Amazon tipping point

Scientific evidence indicates that the Amazon forest system is moving toward a **tipping point**.¹ This means that forests may lose the ability to recover from disturbances and enter a process of self-degradation. There is growing concern that this transition could occur within this century, with drastic and irreversible changes to ecosystems and both local and global impacts.

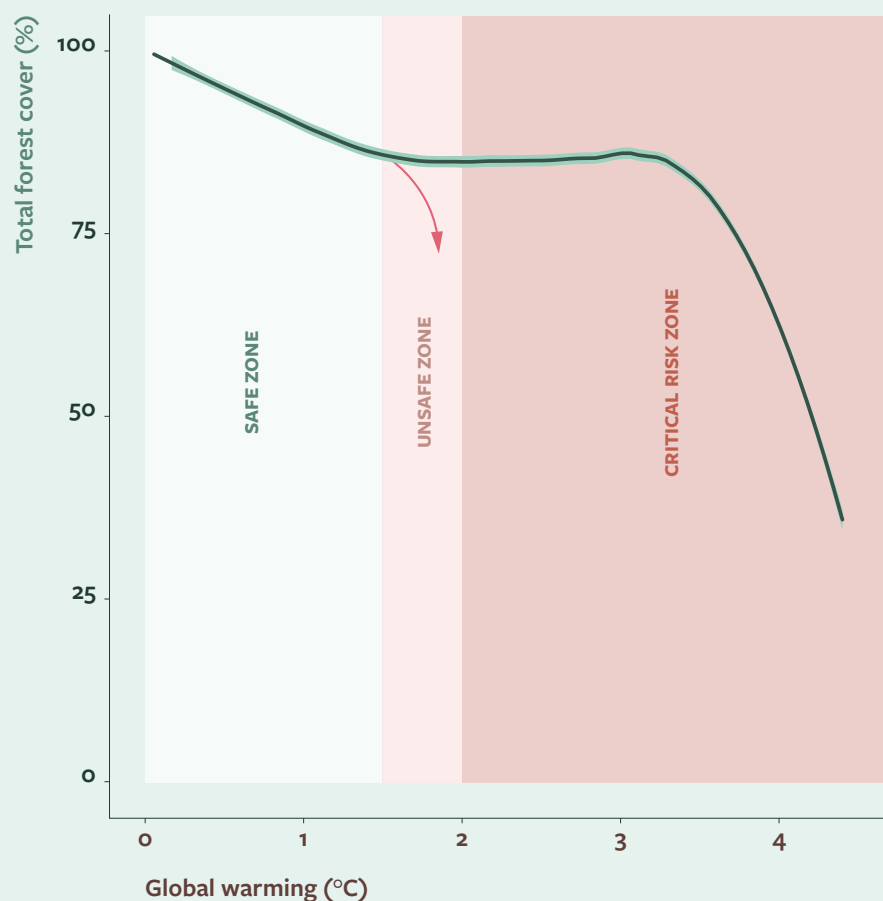
Once the tipping point is crossed, controlling disturbances becomes much more difficult because they are reinforced by the system's own dynamics. Droughts will become more severe, enabling forest fires of proportions never before seen and that are uncontrollable (fig. 1).

Even a partial collapse of the Amazon would have severe impacts on biodiversity and ecosystem functions, such as regional rainfall production and food availability, affecting the lives of Indigenous peoples and local communities and threatening the planet's climate stability. Changes to rainfall regimes would affect large areas of South America, threatening water and energy supplies for millions of people

inside and outside the Amazon through the **flying rivers** that carry moisture to regions to the west and south of the continent. This process would exacerbate extreme events, with severe impacts in both urban and rural areas of the Amazon.¹⁻⁴

In 2023 and 2024, consecutive extreme droughts, aggravated by a strong El Niño, produced highly unusual scenes, signaling that the Amazon system may indeed be destabilizing and moving toward a tipping point. Some of the largest river channels dried up completely, interrupting navigation and isolating cities and communities for months. Some riverside and Indigenous communities were left without access to drinking water, despite being located in the planet's most water-rich region. Thousands of animals died as rivers and lakes overheated. Massive fires penetrated remote Amazonian forests, resulting in the largest historical record of burned area.⁵ In the coming decades, parts of the Amazon may become uninhabitable due to extreme heat, isolation caused by navigation difficulties, and lack of water and food.^{4,6,7}

Figure 1. The tipping point and feedback mechanisms in the transformation of the Amazon system.



Amazon after the tipping point

Drought is one of the main factors that can push the Amazon toward collapse once the system crosses a tipping point (fig. 1). Forests depend on abundant water to remain stable. Reduced rainfall undermines this balance and triggers an accelerated cycle of degradation. Deforestation and other disturbances, such as forest fires and illegal logging, intensify the loss of vegetation cover, weakening moisture flows (flying rivers) and bringing forests closer to the tipping point.¹⁻³

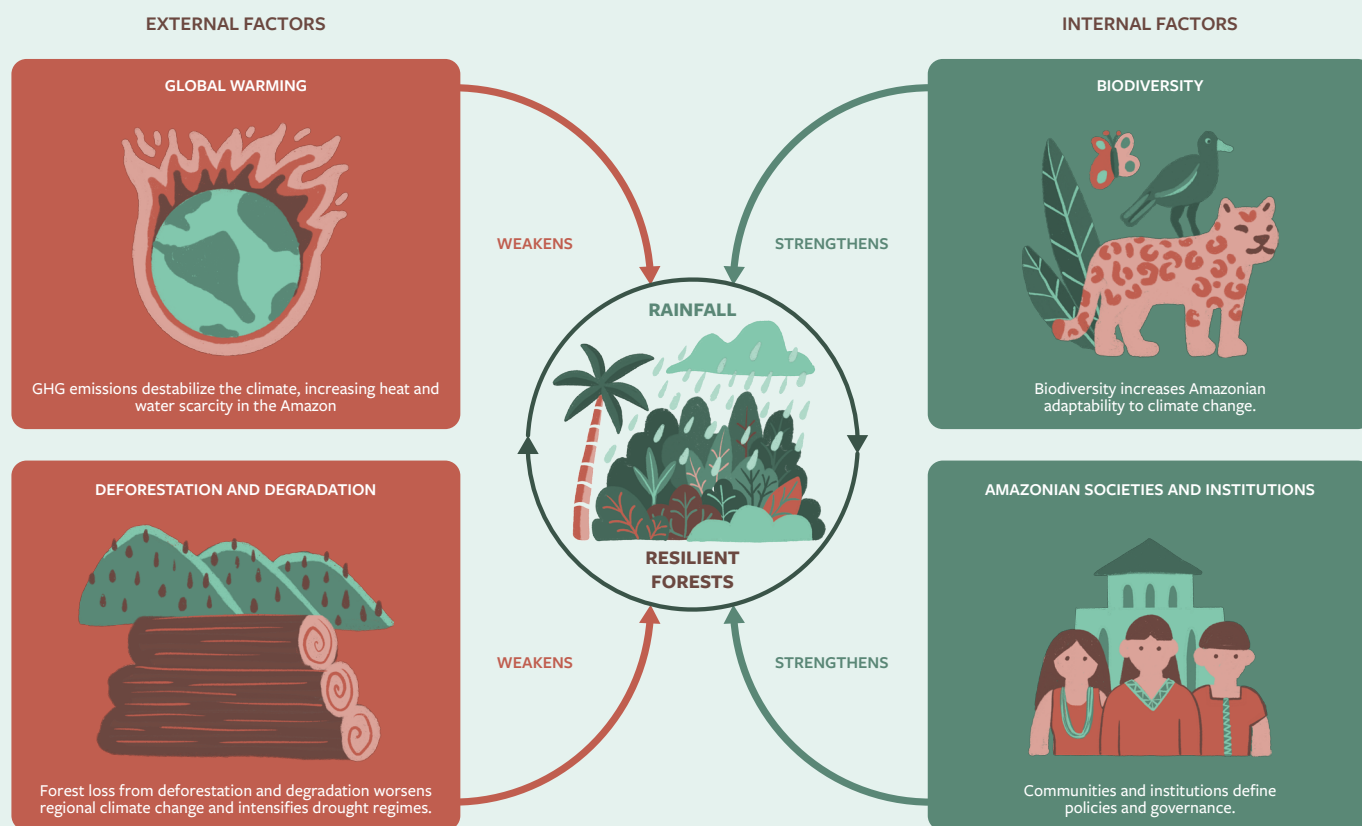
Fire is another central factor (fig. 1). Its ignition is strongly associated with human presence, especially in areas near roads, in extensive pastures, and in deforestation zones (fig. 2). When a tropical forest burns for the first time, it accumulates more fuel, becomes more open and dry, increasing its flammability and the likelihood of new fires. This process traps the ecosystem in an open, degraded state that is unable to contribute to the vital moisture flows of the region, and drastically reduces forest **resilience** at the biome scale.¹

With climate change, the Amazon accumulates stress and loses resilience (fig. 2). Today, forests can still withstand disturbances,

but continuous stress intensification can trigger an irreversible, self-organized transition leading the Amazon to partial or whole-system collapse. This **critical transition** is known in many natural, social, and economic systems,⁸ and there is a considerable risk that it could happen in the Amazon within this century.^{1,9}

The most recent and comprehensive review on the Amazon's tipping point¹ identified two critical system thresholds that could initiate a collapse process: global warming of between 2 and 6°C (relative to the pre-industrial period), and cumulative deforestation equal to 20% of the biome's total forest area. However, considering that extreme droughts, forest fires, and other increasing disturbances act together and amplify negative impacts, the tipping point could be reached earlier, triggering forest collapse sooner.¹ To prevent this risk and its global impacts, two safe Amazon limits were proposed: global warming must stabilize below 1.5°C, and cumulative deforestation must remain below 10%.^{1,9}

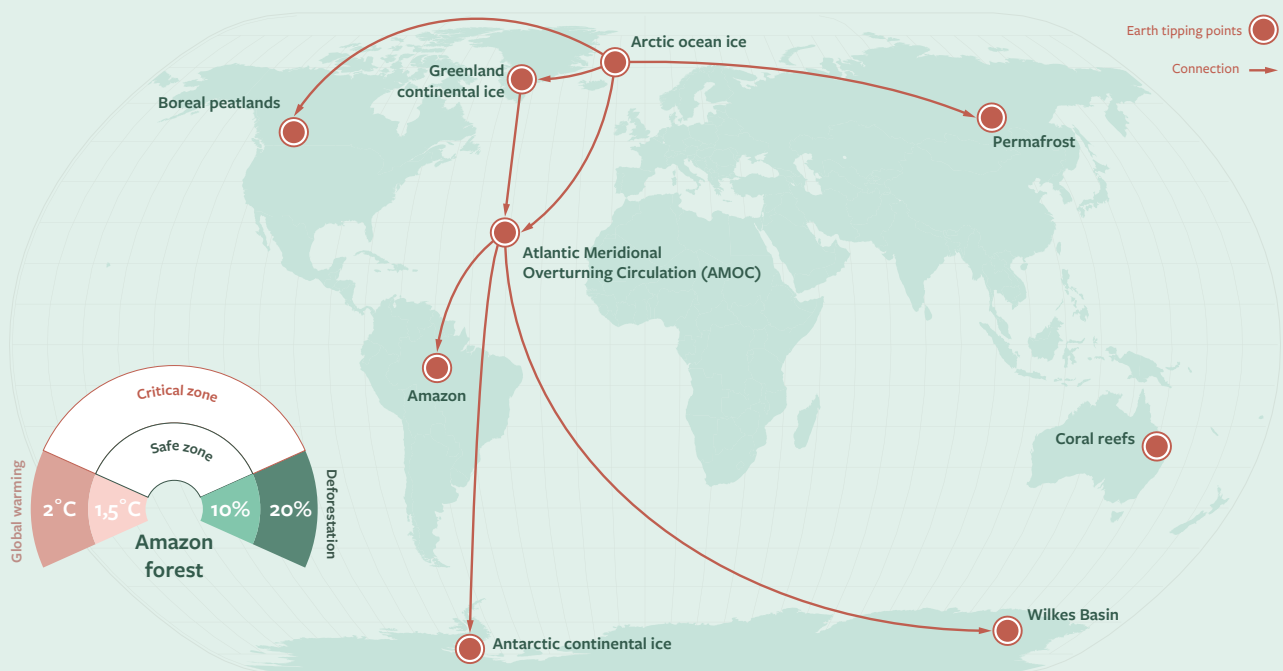
Figure 2. Drivers of change in the Amazonian resilience.



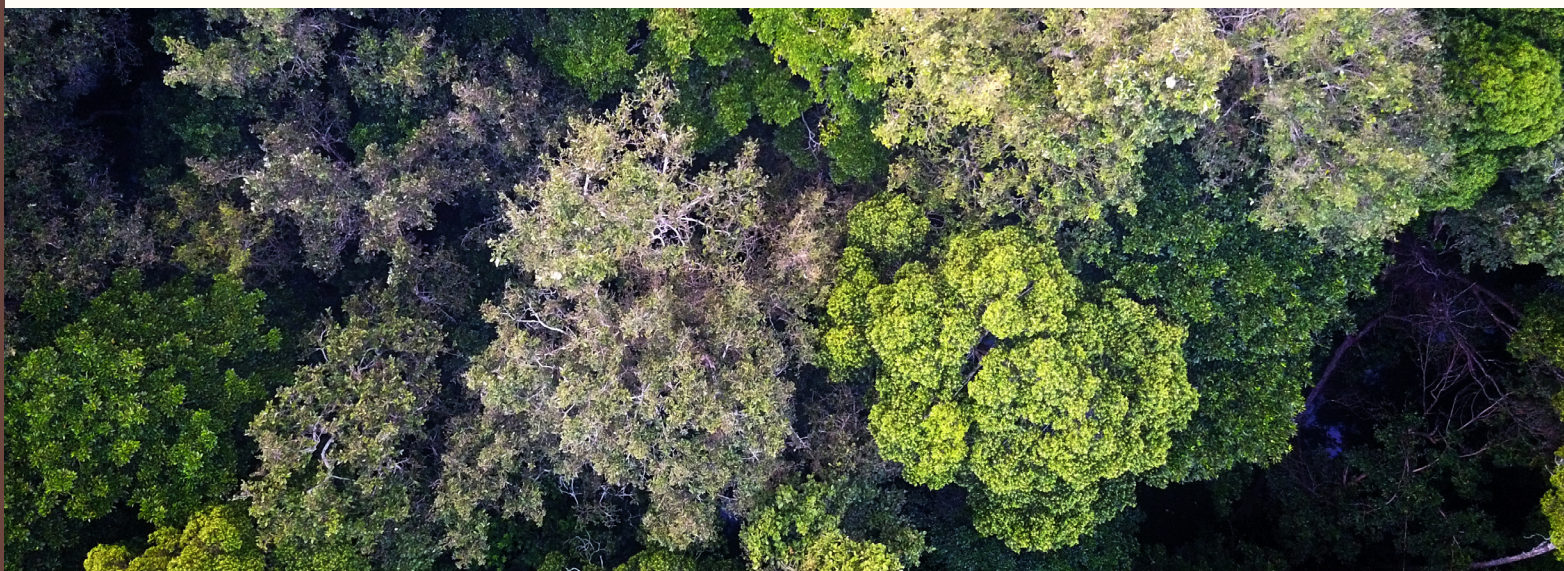
The Amazon as part of the Earth System

Projected global warming of between roughly 2°C and 4°C, as estimated by the IPCC, is already alarming, but these projections do not account for the possibility that it could trigger cascading effects at a global scale and destabilize fundamental elements of the Earth system. Elements such as the Atlantic Meridional Overturning Circulation (AMOC), boreal peatlands, and the continental ice sheets of Greenland and Antarctica also regulate the planet's temperature and could contribute to warming the

planet by up to 10°C and raising sea levels by 60 meters over this and the next century. These elements currently act to stabilize the Earth's climate, but because they have their own tipping points, they could collapse and accelerate planetary climate change. For this reason, the Earth's safe limit of 1.5°C is based on protecting these elements, and every fraction of a degree above it implies an enormous risk of destabilizing the Earth system as a whole.^{9,15}



Box. Earth tipping points



Positive Tipping Points

Positive tipping points are rapid and beneficial changes that can propel societies and ecosystems toward sustainability.^{9,11} In the Amazon, several actions can generate large-scale transformations that can be scaled up, such as subsidies for agroforestry, which increase food security and create new markets. Activating these positive tipping points is urgent to avoid the negative tipping point of Amazonian collapse and keep the system within its safe limits. (Box)

Three strategic pillars are fundamental (fig. 3) to keeping the Amazon resilient: 1) drastically reduce global net emissions, 2) restore the biome's forest cover, and 3) strengthen the adaptive capacity of local populations. These strategies require regional and global cooperation to trigger positive tipping points and accelerate the necessary transition.

The primary strategy involves reducing global net greenhouse gas emissions to keep warming below 1.5°C.¹² With this limit potentially being exceeded before 2030, it is urgent to accelerate the energy transition by the largest emitters, combining political and economic incentives, and ultimately legal bans on fossil fuels.^{11,13} If global cooperation fails, the Amazon will struggle to withstand climate change.

Regional cooperation among Amazon countries to reduce net deforestation and restore the biome's forest cover is urgent. Recovery of the “deforestation arc” is a priority because it has the largest impact on reducing the loss of the flying rivers^{3,10,14} Brazil plays a key role since its forests supply one-third of the rainfall in the Bolivian Amazon and one-fifth of that in the Peruvian and Colombian Amazon¹ — flows affected by deforestation but recoverable through forest restoration.¹⁴

Preventing Amazon collapse also requires strengthening the adaptive capacity of local societies, both urban and rural.⁴

In parts of the Bolivian Amazon, in the northern region of the biome in Brazil's state of Roraima, and in parts of Venezuela and Guyana, extreme climate events and mega forest fires are already recurrent. However, even central regions of the Amazon are experiencing unprecedented droughts and forest fires^{1,2} Therefore, strengthening climate adaptation across the Amazon is urgent, with a focus on integrated fire management and responses to drought and flood events, both to reduce damage to local peoples and to enable positive tipping points that make the system more resilient.

Large-scale forest restoration should promote a new Amazonian economy, with sustainable markets and infrastructure that help improve local populations' quality of life. This action must respect the rights and ancestral knowledge of forest peoples. Preserving the Amazon is a global challenge. Controlling deforestation, restoring forests, and developing a new sustainable Amazon economy should be funded by countries of the Global North, which are historically the main contributors to global warming and have greater economic capacity to support these initiatives.

The Amazon Cooperation Treaty Organization (ACTO) has promoted regional cooperation through initiatives such as the Amazon Network of Forest Authorities (RAFO), the Amazon Network for Integrated Fire Management (RAMIF), the Amazon Network of Water Authorities (RADA), and the Amazon Mechanism for Indigenous Peoples (MAPI). This multilateral coordination is fundamental to the success of forest restoration strategies and to strengthening the adaptive capacity of local communities. Conversely, reducing global net greenhouse gas emissions will depend on global-scale cooperation. In this regard, the UN Conferences of Parties (COPs) and other multilateral forums offer crucial opportunities to advance commitments capable of keeping the Amazon within its safe limits.

Figure 3. The strategic tripod to prevent Amazon collapse.



Recommendations



REDUCE GLOBAL NET GREENHOUSE GAS EMISSIONS

Negotiate with major emitting countries to reduce fossil fuel consumption, ecosystem degradation, and other emission-promoting activities in order to keep global warming below 1.5°C.



RESTORE FOREST COVER IN THE BIOME

Reduce net deforestation by 2030 and recover deforested and degraded forests by 2050, prioritizing the deforestation arc and areas influencing the flying rivers, integrating nature-based solutions.



STRENGTHEN THE ADAPTIVE CAPACITY OF LOCAL SOCIETIES

Implement climate adaptation plans, fire management, and responses to extreme events, with investments in key institutions, infrastructure, and basic services in Amazon countries.



BUILD A NEW SUSTAINABLE AMAZONIAN ECONOMY

Develop sustainable value chains based on sociobiodiversity, ensuring intellectual property rights for holders of local knowledge and expanding access to credit and technology for local populations.



ENSURE COOPERATION AND CLIMATE FINANCE

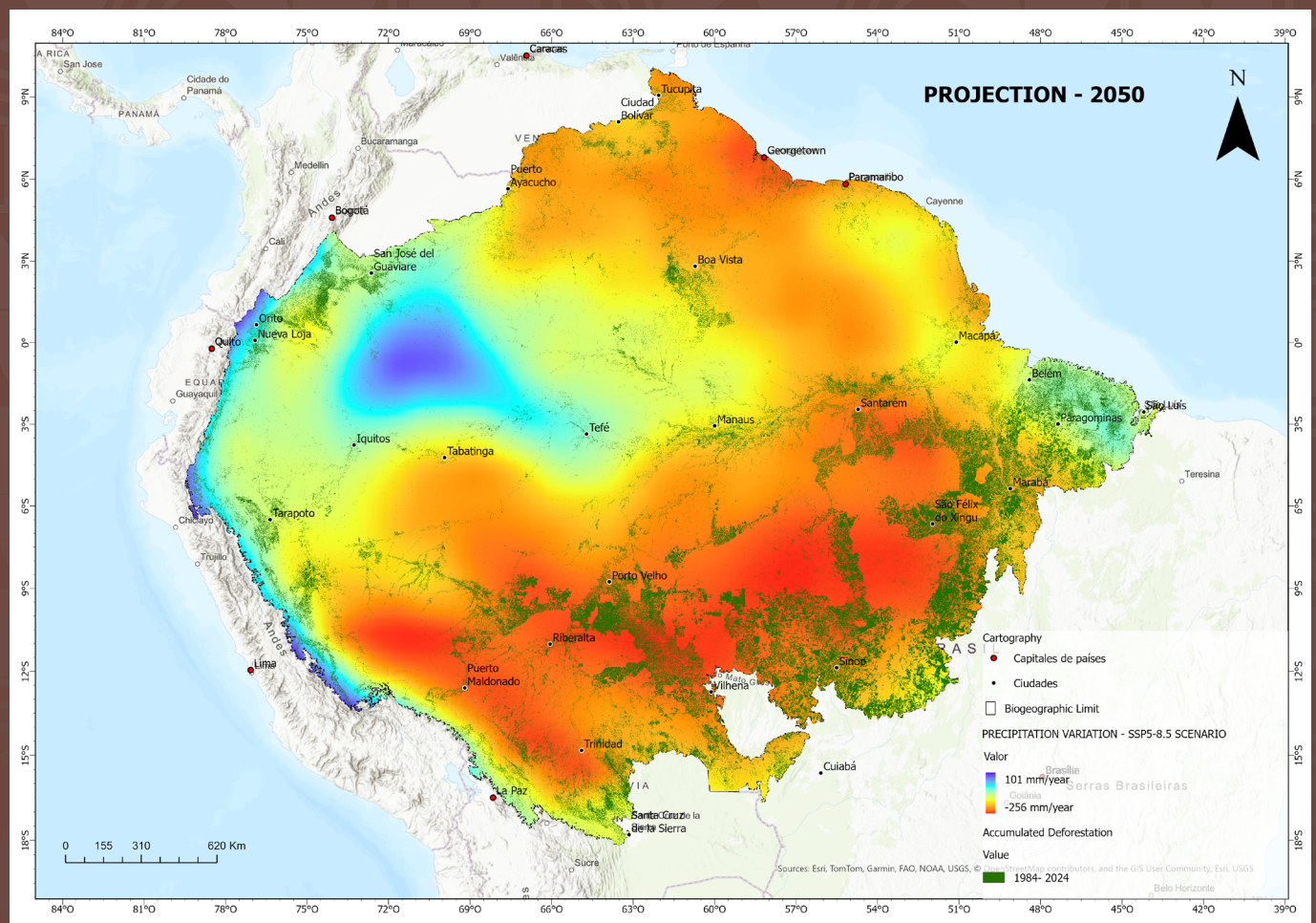
ACTO is committed to engaging Amazon countries in joint targets and securing financial investments from the Global North to support the strategies necessary to keep the Amazon within its safe limits.

Amazonian Trajectories and the Tipping Point

The success of strategies to combat the Tipping Point depends, to a large extent, on regional cooperation efforts, as well as diplomatic agreements in North-South relations.

Global warming has already caused reduced rainfall in the southern, northern, and central parts of the Amazon, and increased temperatures across nearly the entire biome.¹ According

to projections from the best models, these changes will intensify by 2050, testing the survival limits of trees, facilitating the spread of mega forest fires,² and increasing deforestation.³ This increase in aridity should make forest restoration of the biome more difficult, which is necessary to keep the Amazon system resilient. Restoration efforts are therefore urgent before the climate becomes unfavorable.



Map. IPCC models project that by 2050, there will be a reduction in annual rainfall in the southern, central-eastern, and northern regions of the Amazon, including the 'deforestation arc', where large-scale forest restoration projects are advancing. Restoring historically deforested areas (in green) can sequester carbon from the atmosphere and promote a new sustainable economy. However, increasing aridity in these regions indicates that these initiatives must accelerate before the climate becomes unfavorable.

Glossary

TIPPING POINT

Maximum level of stress that a system can tolerate before starting to collapse into another equilibrium state. Also known as a bifurcation point, or unstable equilibrium. As the system approaches this point, it loses resilience and can collapse more easily from disturbances.

FLYING RIVERS

Atmospheric moisture flows enriched by evaporation from oceans and water bodies and by vegetation evapotranspiration that move with prevailing winds, carrying clouds and rainfall to other regions.

RESILIENCE

The capacity of a system to persist in an equilibrium state in the face of disturbances that push it toward another equilibrium state. It can also be understood as the distance from the tipping point.

CRITICAL TRANSITION

Behavior in which the system crosses a tipping point and undergoes a transition to an alternative equilibrium state driven by self-reinforcing feedbacks.

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BERNARDO FLORES

bernardo.flores@otca.org

Holds a double-degree PhD in Ecology from the Federal University of Rio Grande do Norte and Wageningen University (Netherlands). He has spent 20 years researching Amazonian ecology, the effects of fire, and the resilience of forest systems to the risk of a tipping point.

ARO SCIENTIFIC COORDINATION

Arnaldo Carneiro

arnaldo.carneiro@otca.org

ORA EDITORIAL COORDINATION

Paula Drummond

ARO CARTOGRAPHIC PRODUCTION AND MODELING

Isabelle Vilela, Maycon Castro, Maria Fernanda Ribeiro, Mathias Alvarez e Rafaela Cipriano

DESIGN, LAYOUT AND ILLUSTRATIONS

Patrícia Sardá | Estúdio Abanico

PHOTOGRAPHY

Adobe Stock

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ARO is ACTO's reference center that integrates data, tests innovations, and disseminates information to support member countries in cooperation and decision-making.

AMAZON COOPERATION TREATY ORGANIZATION (ACTO)

ACTO is an intergovernmental organization formed by eight Amazon countries: Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela, which signed the Amazon Cooperation Treaty, making it the only socio-environmental bloc in Latin America.

ACTO / ARO

SEPN 510, Bloco A, 3º andar – Asa Norte | Brasília (DF), Brasil, CEP: 70.750-521
ora@otca.org | <https://www.oraotca.org/>

