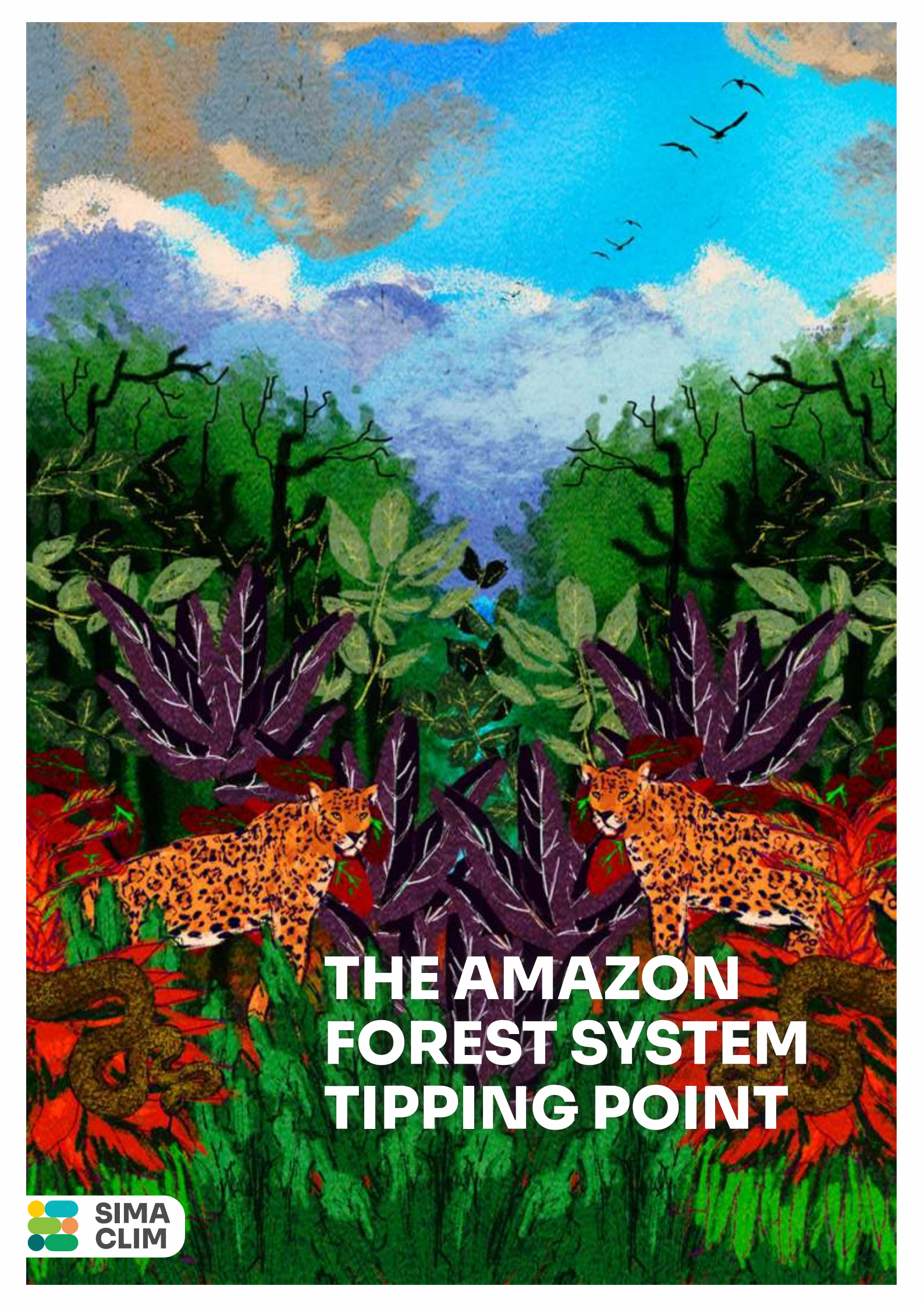




THE AMAZON FOREST SYSTEM TIPPING POINT

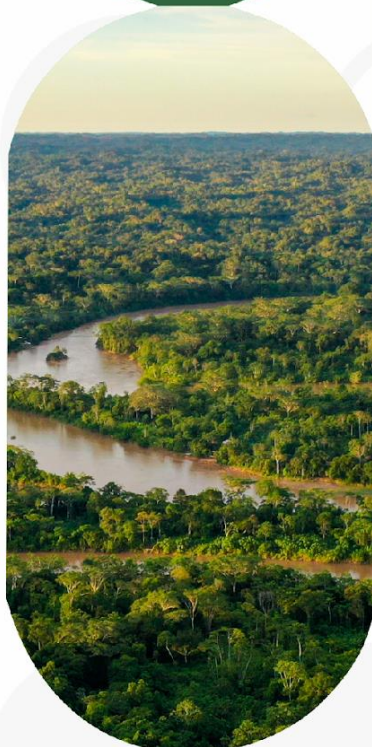


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THE AMAZON FOREST SYSTEM TIPPING POINT

Executive Summary

2025



Inflection point of the Amazon rainforest

Question

Human pressures and climate change are putting the future of the Amazon at risk. The consequences are potentially irreversible for the environment, society and the economy on a local, regional and global scale.

Problem

What causes this scenario?

The Amazon rainforest is approaching a *tipping point*, a critical threshold where small changes can trigger abrupt, self-sustaining transformations to a less diverse, less productive and more arid ecosystem state, possibly turning the forest into a source of carbon emissions rather than a sink.

Current impacts and future risks are driven by a combination of factors, also called *drivers*:

1. **Deforestation and forest degradation:** The continuous loss of forest cover and degradation due to activities such as illegal logging, conversion of areas for predatory agricultural production and fires reduce the forest's ability to recycle precipitation and store carbon. It is estimated that the loss of more than 40% of the original area of the Amazon could lead to a reduction in regional precipitation with an impact on the entire system;
2. **Changes in precipitation and temperature:** Rising global temperatures and changing rainfall patterns, with more intense and longer droughts, stress vegetation, increase tree mortality rates and can lead to transitions to savannah ecosystems. The Amazon rainforest is closer to a climatic threshold of risk of loss than other tropical forests. Annual rainfall below 1,000 mm makes forests rare and unstable, and between 1,000 and 1,800 mm, the Amazon can have two stable states of high and low tree cover, being more vulnerable to collapse under severe disturbances;
3. **Extreme climatic events:** The increased frequency and intensity of severe droughts and floods, exacerbated by climate change and human activities, are already causing significant impacts on forest dynamics. The recent drought of 2023/2024 was mainly driven by rising global temperatures. Another point of attention concerns the increase in fires in the Amazon region in recent years, whether caused by rising temperatures or derived from human practices and criminal activities.
4. **Ocean variability and change:** The surface temperatures of the tropical Atlantic Ocean strongly influence rainfall in the Amazon, and changes in the Atlantic Meridional Overturning Circulation (AMOC) can also affect the stability of the



forest, with risks of destabilization of the northern Amazon in the event of a collapse of the AMOC;

It is crucial to understand the positive feedbacks that can accelerate forest loss and the approach of the tipping point. The death of trees due to drought or deforestation reduces evapotranspiration, leading to less rain, which causes more tree mortality and increases the flammability of the forest. This feedback can lead to self-sustaining forest loss on a large scale.

Implications

What are the current and future impacts?

Ignoring the risk of a tipping point in the Amazon and failing to act decisively will have serious and far-reaching consequences for the climate, biodiversity and human relations, in particular risks to water, food and health security and socio-economic impacts.

1. **Climate impacts:** The loss of large areas and the current characteristics of the Amazon rainforest, a major carbon store, would release huge amounts of carbon dioxide (CO₂) into the atmosphere, accelerating global warming. Reducing the forest's ability to recycle precipitation would lead to a drier regional climate, affecting the forest itself and neighboring regions.
 2. **Loss of biodiversity:** The Amazon is home to a vast number of animal and plant species, many of which are endemic, and many of which have not yet been discovered, identified and described in detail. The deterioration of the forest will lead to the large-scale extinction of species and the loss of an irreplaceable natural heritage.
 3. **Water and food insecurity:** The Amazon regulates the water cycle in much of South America. Degradation of the forest will reduce the availability of water for human consumption, agriculture and hydroelectric power generation, affecting regional water and food security, including in important agricultural production areas in Brazil. It is estimated that the economic income of the agricultural sector in the states most benefited by the Amazon rainfall was R\$338 billion in 2021, representing around 57% of national agricultural income.
 4. **Impacts on human health:** The increase in forest fires causes respiratory and cardiovascular problems due to air pollution. Environmental changes can lead to an increase in vector-borne diseases and an increase in the risk of heat-related illnesses. Extreme weather events, such as droughts and floods, disproportionately affect vulnerable communities, causing diverse health problems and increased mortality. Food insecurity will also be exacerbated.
 5. **Socio-economic impacts:** Changes in the Amazon will affect the livelihoods, culture and well-being of millions of people who depend on the forest. The loss of ecosystem services and extreme weather events will cause significant economic damage, including a reduction in hydroelectric power generation capacity. A no-
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deforestation scenario, following a low-carbon path, would result in substantial and equitable economic growth for the region.

Solutions

What can we do?

Urgent and coordinated actions on multiple scales are essential to avoid the Amazon's tipping point

1. **Mitigating global climate change:** Drastically and rapidly reducing global greenhouse gas emissions is key to limiting global warming below dangerous levels (ideally 1.5°C). Achieving net-zero CO₂ emissions has the potential to stabilize global temperatures in the long term.
 2. **Ceasing deforestation and forest degradation:** Achieving zero deforestation by 2030, as committed to by the Brazilian government, is crucial. This requires strengthening enforcement, combating illegal activities, effectively implementing the Forest Code and recognizing and promoting the biological and socio-cultural diversity of the Amazon. Moratoriums may be essential, but they are insufficient without addressing local and national demands for activities that lead to deforestation.
 3. **Restoration of degraded ecosystems:** Implement large-scale forest restoration programs in abandoned and degraded areas to recover forest cover and ecosystem services.
 4. **Protecting areas and territorial rights:** Creating and maintaining protected areas (Conservation Units), demarcating Indigenous Lands, and titling the territories of Traditional Peoples and Communities is an effective strategy for preserving the forest and associated traditional knowledge. Protecting the rights of indigenous peoples and traditional communities and strengthening their participation and role as protagonists in the construction and evaluation of socio-environmental policies is crucial.
 5. **Investment in a sustainable socio-economy:** Developing and investing in a new economy for the Amazon, based on the sustainable use of standing forests and rivers, valuing biodiversity products and services and traditional knowledge. This includes promoting agroforestry systems, developing sustainable technologies and creating markets for non-timber forest products of sustainable origin.
 6. **Creation of Adaptation Plans for municipalities and states in the region:** This public policy instrument is essential for identifying the greatest climate risks, the most vulnerable areas and populations, as well as planning economically viable and socially just solutions in the Amazon region.
 7. **Strengthening governance and social participation:** Reaffirming the role of the public sector in territorial management and governance, with the active
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participation of civil society, non-governmental organizations and local communities in the decision-making process.

8. **Increasing the involvement of the private sector in the climate agenda:** the productive sector must be a catalyst for change and innovation for a new low-carbon economy in the Amazon region. Creating networks and alliances to debate and exchange experiences, ideas and technological innovations is essential to harness the potential of the region's bioeconomy.
9. **Support for research, technology and innovation:** Investing in scientific research to better understand forest dynamics, monitor early warning signs of a possible tipping point, develop predictive models and identify innovative solutions. Artificial intelligence and other technologies, such as the development and use of Early Warning Systems (EWS), can be important tools for monitoring and decision-making.
10. **Promote education and awareness** about the importance of the Amazon and the risks associated with its tipping point, engaging civil society and the different sectors of the economy in the search for sustainable solutions.
11. **Financing mechanisms:** Restore and strengthen financing mechanisms such as the Amazon Fund and the Climate Fund, as well as creating incentives for private investment in sustainable activities. It is essential to direct rural credit towards good low-carbon practices and eliminate subsidies for fossil fuels. International multilateral cooperation initiatives such as the *Tropical Forests Forever Facility* (TFFF) can also play an important role as a source of funding for the protection of the Amazon rainforest.
12. **International cooperation:** Strengthen international cooperation between the countries of the Amazon Basin and with the international community to tackle this global challenge.
13. **Constitutional recognition:** Consider including the 'fundamental rights of the Amazon' in the Brazilian constitution, following the example of Amazonian countries such as Ecuador, Bolivia and Colombia.

Benefits

Why should we invest in these solutions?

Implementing these solutions will bring multiple benefits, avoiding the serious consequences of a tipping point and promoting a sustainable future for the Amazon and the planet.

1. **Climate stabilization:** Maintaining the forest as a carbon sink and preserving the hydrological cycle will help mitigate climate change on a global and regional scale.
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2. **Protecting biodiversity:** Preserving the integrity of the forest will guarantee the survival of countless species and the maintenance of the Amazon's rich biodiversity. As well as keeping the ecosystem healthy and in balance, there is a great chance of identifying species in the region that have economic potential, with use in the pharmaceutical, cosmetics and food industries, for example.
 3. **Ensuring water and food security:** Maintaining the Amazon's hydrological cycle is crucial to maintaining water availability for populations and agricultural production, contributing to regional and national water and food security.
 4. **Improved public health:** Reducing deforestation and fires will reduce air pollution and the risk of disease, having a positive impact on the health and well-being of communities. In addition, as a consequence, there is a tendency to reduce public spending on health in the region's municipalities and states.
 5. **Sustainable economic development:** Investing in a standing forest socio-economy will generate new job and income opportunities, based on the sustainable use of natural resources and traditional knowledge, promoting fairer and more resilient economic development.
 6. **Strengthening resilience:** Protecting the Amazon will increase the resilience of ecosystems and communities to the impacts of climate change, reducing vulnerability to extreme events.
 7. **Economic and financial gains:** A deforestation-free scenario would result in equitable economic growth for the Amazon region and Brazil, including job creation. Estimates point to gains of R\$ 2.56 trillion by 2050.
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About the report "The Amazon Forest System Tipping Point"

This executive summary presents the main discussions contained in the Synthesis Report *"Tipping Point of the Amazon Forest System"*, produced and made available by the Center for Synthesis in Environmental and Climate Change – SIMACLIM (<https://simacлим.com.br/>).

The main mission of SIMACLIM is to integrate accumulated and ongoing research from various national and international research networks and groups, organizing information and supporting the planning of the Brazilian State to achieve the goals established in Climate Change agreements. SIMACLIM is funded by the Ministry of Science, Technology and Innovation (MCTI) through the National Fund for Scientific and Technological Development (FNDCT), FINEP Process 01.22.0584.00.

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Use of artificial intelligence

This summary was produced using *Large Language Model* (LLM) tools, also known as artificial intelligence (AI). To find out how these tools were used, see the methodological annex, available at this link: <https://simaclim.com.br/relatorios-de-sintese/>.



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The complexity of the effects of global environmental and climate change, including their future projections, requires interdisciplinary and transdisciplinary approaches. These approaches are essential for understanding the interactions between social, biophysical, and ecological systems, characterizing the risks of impact, vulnerability, possibilities for mitigating their causes, and adaptation solutions. The Synthesis Center on Environmental and Climate Change (SIMACLIM) has as its main mission to integrate accumulated and ongoing research from various national and international research networks and groups, organizing information and assisting in Brazilian government planning to achieve goals established in agreements on climate change. SIMACLIM is funded by the Ministry of Science, Technology and Innovation (MCTI) through the National Fund for Scientific and Technological Development (FNDCT), FINEP Process 01.22.0584.00.

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