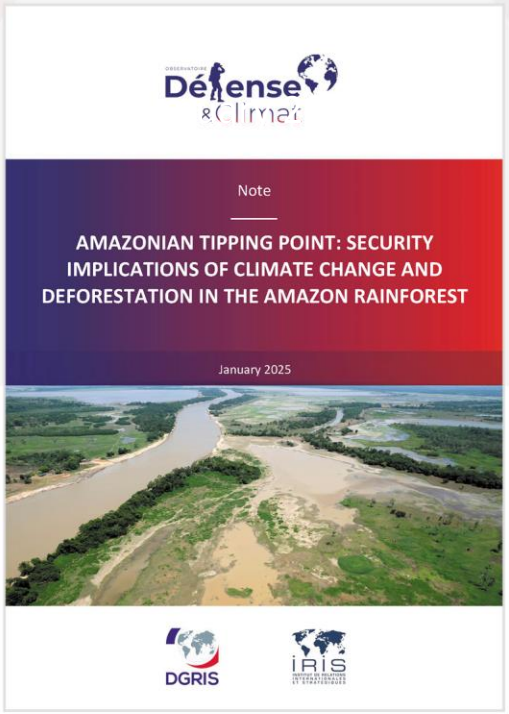
SYNTHESIS

AMAZONIAN TIPPING POINT: SECURITY IMPLICATIONS OF CLIMATE CHANGE AND DEFORESTATION IN THE AMAZON RAINFOREST

Novembre 2025



The Defence and Climate Observatory, launched in December 2016, aims to study climate-related security and defence issues.

It is coordinated by IRIS as part of the contract carried out on behalf of the French Ministry of Armed Forces' Directorate General for International Relations and Strategy (DGRIS). The Observatory's multi-disciplinary team includes researchers specializing in international relations, security, defence, migration, energy, economics, climatology and health. It is directed by Mathilde Jourde and François Gemenne.

The Observatory has initiated numerous collaborations with European partners (Netherlands, Luxembourg) and international partners (Australia, United States, India), international NGOs and national and international public bodies. These initiatives have strengthened cooperation on climate issues and their security implications.

The Climate and Defence Observatory produces reports and notes, organizes restricted seminars and conferences open to the public, and hosts the podcast "On the climate front".

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The Ministry of Armed Forces regularly calls upon private research institutes for outsourced studies, using a geographical or sectoral approach to complement its external expertise. These contractual relationships are part of the development of the defence foresight approach, which, as emphasized in the White Paper on Defence and National Security, "*must be able to draw on independent, multidisciplinary and original strategic thinking, integrating university research as well as specialized institutes*".

Many of these studies are made public and available on the Ministry of Armed Forces website. In the case of a study published in part, the Directorate General for International Relations and Strategy may be contacted for further information.

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This note is part of a series produced by the Defence and Climate Observatory dedicated to the tipping points identified by the Intergovernmental Panel on Climate Change (IPCC). Following an initial note on the slowing—even the potential collapse—of the Atlantic Meridional Overturning Circulation (AMOC), the present note now turns to the Amazon rainforest and its tipping point.

I. THE AMAZON BIOME AT A TIPPING POINT?

Understanding the functioning and role of the Amazon region

The Amazonian biome[1], commonly referred to as the "Amazon rainforest," covers the basin[2] of the Amazon River (the "Amazon basin") as well as lands to its north and east, including the Guiana Shield. When limited to the humid tropical forest biome, the Amazonian biome extends over approximately 7.7 million km². However, the Amazon rainforest can be defined in multiple ways (Brazilian Legal Amazon, Amazon biome, RAISG definition). Contrary to widespread perception, the Amazonian biome is not a homogeneous block of biodiversity[3]; rather, it encompasses a diversity of climatic and ecosystemic contexts.

The Amazon stands apart from other biomes due to two principal characteristics: its carbon storage capacity and its hydrological cycle[4], which make it a central component of the global climate system. Often described as a "carbon sink," the Amazonian biome plays a key role in capturing and storing CO_2 and is also distinguished by a hydrological cycle that ensures both the renewal of the humid tropical forest ecosystem and the provision of water at a continental scale.

Beyond its role in the functioning of the regional hydroclimatic system, the Amazonian biome is a structuring element of the continent's economic dynamics. However, climate change and direct human pressures (agriculture, logging, mining activities, etc.) are degrading this biome.

Understanding the Amazonian biome Tipping Point

A tipping point is understood as a degree of change in a system's properties beyond which the system undergoes a potentially chaotic reorganization. The potential tipping point of the

[1] A biome, or bioclimatic domain, is the largest ecological unit on Earth. It encompasses a set of ecosystems that share significant similarities in terms of climate and the species they host. It is named after the vegetation that predominates there (Bouron, 2024; Carion, 2018). Recent studies indicate that in the Amazon biome, 5.79 million km² can be classified as lowland tropical rainforest ecosystems, while the remainder consists of savanna and white-sand forest ecosystems, as well as freshwater and stagnant aquatic ecosystems (Moraes et al., 2021).
[2] The entire surface area that naturally drains toward the same river or underground water table.
[3] The variety of living species (microorganisms, plants, animals) present in a given environment.
[4] The water cycle, or hydrological cycle, refers to the entirety of water transfers in its different states among Earth's water reservoirs (oceans, atmosphere, lakes, rivers, groundwater, and glaciers).

Amazonian biome is often presented as a possible rapid and global transformation of its ecosystems into a state resembling a savanna. Based on current scientific knowledge, however, there remains considerable uncertainty regarding the timing, spatial scale, and type of vegetation into which the biome might shift. Indeed, according to the IPCC, the probability of a tipping point in the Amazon rainforest occurring by the end of the 21st century is low. Some studies highlight the geographical heterogeneity of the tipping point and that the more probable outcome would be a shift toward an advanced degraded forest state with a significant reduction in biomass. While there is no scientific consensus on the possibility of a generalized tipping, there is concern that the risk may increase as climate change and/or direct degradation intensify.

The Amazonian biome is primarily threatened by deforestation resulting from economic activities in the Amazonian countries and deforestation, in turn, increases the likelihood that the Amazon will reach a tipping point due to the loss of both quantity and quality of plant biodiversity. The effects of climate change also contribute to bringing the Amazon closer to a potential tipping point. In particular, global temperature increases and associated water stress raise plant and tree mortality. Although distinct and governed by different mechanisms, climatic factors and human activities interact, often producing cumulatively devastating effects. Fires, for example, are triggered both by droughts, extreme temperatures affecting the region and by human activities, such as accidental, deliberate, or deforestation-related fires.

Tipping Point's Consequences

The tipping of all or part of the Amazonian biome would significantly affect the global climate system. The mechanism of carbon storage and processing by trees would be severely disrupted, as they would be fewer in number and in poorer health. Beyond the intensification of climate change that such a tipping point would entail, its consequences would be primarily regional. By altering the processes of evapotranspiration[5] and the Amazonian atmospheric rivers, the risks of prolonged droughts, of flooding and increased local warming would be extremely high. The literature on the secondary effects of Amazonian biome degradation remains limited but some studies show the reduction in the Amazon biome ecosystemic services and functions would impact economic activities in the region especially the fisheries sector, the hydroelectric capacity and agriculture.

Direct and indirect effect would therefore pose a significant risk to the human security of the approximately 43 to 47 million inhabitants of the biome, whether Indigenous populations or

[5] Hydrological process of water transfer that evaporates from the soil, liquid reservoirs, and plant transpiration into the atmosphere.

urban residents regarding their water, food, physical securities and threat the cultural heritage of local populations.

II. GEOPOLITICS OF THE AMAZON TIPPING POINT: CLIMATE CHANGE AND DEFORESTATION OF THE AMAZON BIOME, BETWEEN SOURCE OF TENSION AND OPPORTUNITY FOR COOPERATION

Relative regional and international cooperation on the protection of the biome

Since 1998, the Amazon Cooperation Treaty Organization (ACTO) has been the main regional framework dedicated to the collective management of the Amazonian biome, primarily focused on reducing deforestation. More recently, another initiative, the Leticia Pact (2019), signed by the same states (Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname) except Venezuela, sought to improve coordination in response to environmental disasters and to develop satellite-based monitoring mechanisms for the Amazon rainforest. However, both ACTO and the Leticia Pact suffer from political and institutional deadlocks. The main obstacle lies in the primacy of national sovereignty within pan-Amazonian governance, which hinders the development of a collective response to potential tipping point drivers. In this context, environmental cooperation tends to develop primarily at the bilateral level.

International cooperation for the Amazon is structured around three main dimensions: environmental monitoring via satellite and radar, training of military personnel reflecting the militarization of the "fight against deforestation," and international development aid despite Amazon states opposition.

In this space, France occupies a unique position in international cooperation on the Amazon due to its direct presence within the biome through the department of French Guiana, despite a certain mistrust among Amazonian states toward France, linked to their strong attachment to the principle of national sovereignty. Nevertheless, the intensification of climate change impacts and efforts to combat deforestation—partly driven by illegal activities such as unlawful gold mining and drug trafficking—tend to foster the emergence of strategic cooperation between the security forces of French Guiana and its neighbours (Suriname, Guyana and Brazil) through common surveillance operations and information sharing.

Tensions Surrounding the Destruction of the Amazon Biome and Increasing Deforestation

International tensions over Amazonian biome management can be partly explained by the persistence of a discourse on the international governance of the Amazon, promoted over the decades by various political and academic actors, primarily from the Western world. These

discourses have fuelled Amazonian states' opposition to numerous international projects aimed at managing the biome since 1945. Moreover, several academic studies highlight the lack of political will among Amazonian states to implement truly binding environmental policies. This inertia contrasts with their claim to be the sole legitimate actors in protecting the Amazonian biome—a position that has drawn strong criticism within the international community.

At a more local scale, the management of the Amazonian biome generates tensions within Amazonian societies, particularly affecting Indigenous populations, who face both political and legal pressures as well as conflicts—sometimes violent—within their communities and against miners and agricultural operators.

III. OPERATIONAL AND CAPACITY IMPLICATIONS OF TIPPING POINT FACTORS FOR THE FRENCH ARMED FORCES

Among the actors in this governance, the armed forces of Amazonian states and territories play a central role in securing this space, reflecting its strategic importance. For France, the French Armed Forces in Guiana (*Forces armées en Guyane*, FAG) are particularly involved, notably through *Operation Harpie* (fight against illegal gold mining).

The FAG's operations are affected both in scope and in nature by climate change and deforestation: missions are expanding due to the growing number of people turning to illegal gold mining as a source of income, and are diversifying, particularly due to the increase in Humanitarian Aid and Disaster Relief operations (HADR).

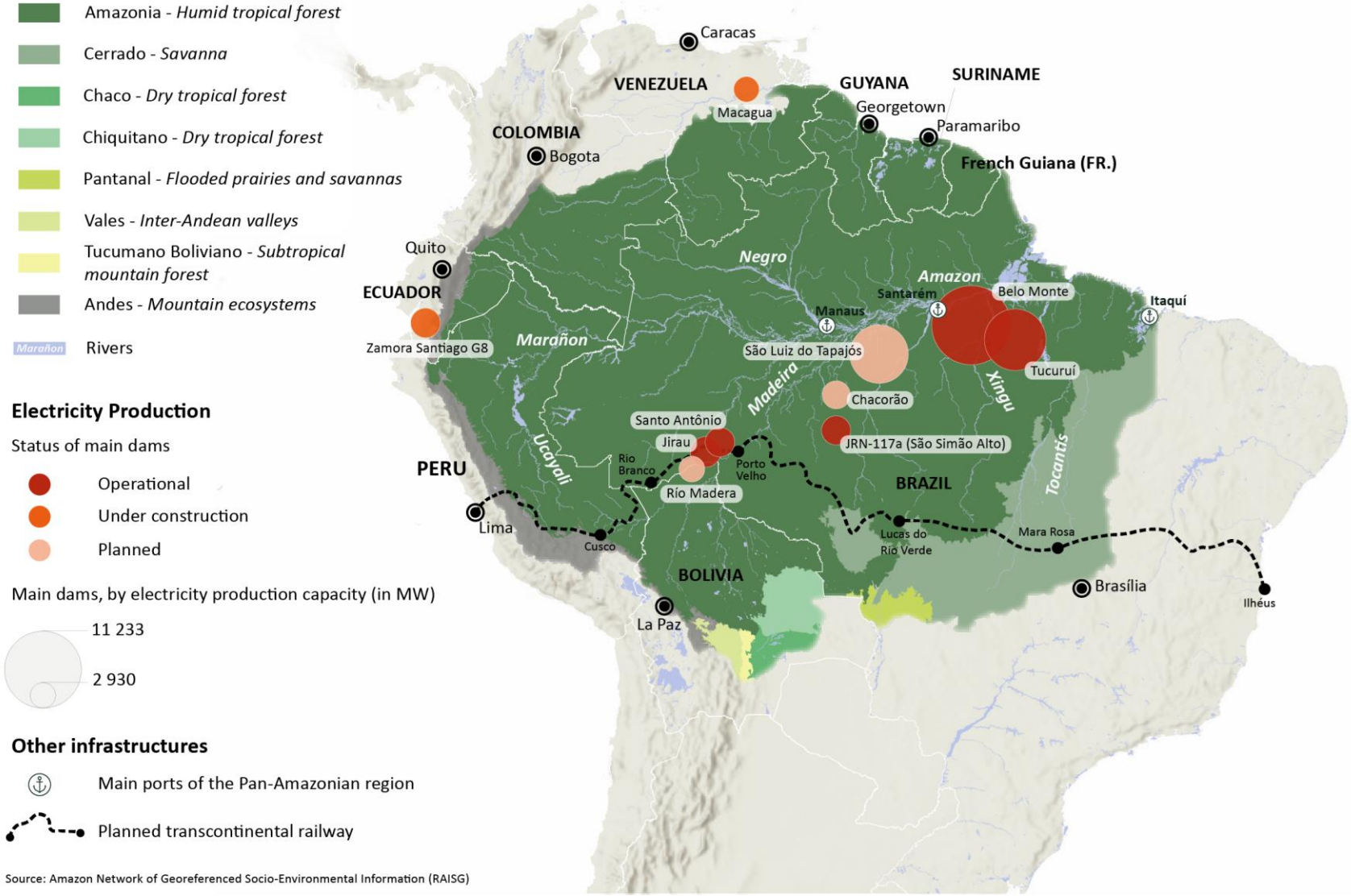
The new missions, or the transformation of existing ones place increased or altered demands on the FAG and require the mobilization of additional human and material resources. However, this adaptation remains slow, as the resources available in the territory are already heavily utilized and under significant strain.

This evolution requires a reorientation of FAG's capabilities. Firstly, combating illegal gold mining and other trafficking increasingly relies on aerial surveillance missions, which are resource-intensive in terms of personnel and equipment. Secondly, if the frequency of river drying continues to increase, access to certain forward military bases could become more difficult from the headquarters of the Joint Staff in Cayenne. Thirdly, a number of military equipment currently in service is not fully adapted to the new environmental and climatic conditions. Finally, military personnel deployed in the Amazon could be physically affected by the lengthening of drought periods and rising average temperatures in the region.

By highlighting the security consequences linked to the degradation of the Amazon rainforest and the risk of crossing its tipping point, this note underscores their impact on human security. The analysis of geopolitical stakes (tensions between ecosystem protection and state sovereignty, as well as internationalization) and the already significant operational (increase in HADR operations and rise in environmental crime) and capability-related (unsuitability of certain equipment and assets) impacts has also demonstrated that the security situation is likely to worsen if these degradations continue.

Due to the difficulty of making reliable predictions in a region marked by high meteorological and climatic variability (El Niño phenomena, tropical conditions, etc.), many uncertainties remain regarding the existence, mechanisms, and manifestation of the tipping point. Nevertheless, the scientific community agrees that, at the current rate of degradation, the Amazon rainforest will experience unprecedented mortality of its ecosystems, leading to a significant reduction in vegetation cover and considerable cascading effects. It is therefore essential that this information be considered at both the political and military levels so that appropriate responses can be implemented, both in terms of mitigating the degradation of the Amazon forest and in terms of adapting populations, institutions, and states.

Annex 1 - Carte 2 – La région pan-Amazonie : pilier économique, réservoir écologique, espace menacé



Source: Amazon Network of Georeferenced Socio-Environmental Information (RAISG)

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