

RECORD BURNING OF AMAZONIAN FLOODED FORESTS IN 2023 AND 2024

OBJECTIVE

A detailed examination of the surge in fires affecting Amazonian flooded forests, especially in 2023 and 2024. These ecosystems are not adapted to fire and spend months submerged. Their burning indicates that a critical ecological threshold is being crossed.



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WHY ARE AMAZONIAN FORESTS BURNING?

Tropical rainforests, such as the Amazon, do not naturally burn – it is just too humid for fires to be able to propagate. Fires, in these ecosystems, must be ignited by humans. This normally happens outside the forests, where fires are used to burn vegetation that was downed during the deforestation process or to clear pastures invaded by growing trees¹.

However, due to climate change, the leaf litter on the forest floor, which is composed of fallen leaves and twigs, is increasingly drier, making the forest more flammable. As a result, when fires reach the forest edge, they can now consume the litter and spread beneath the canopy.

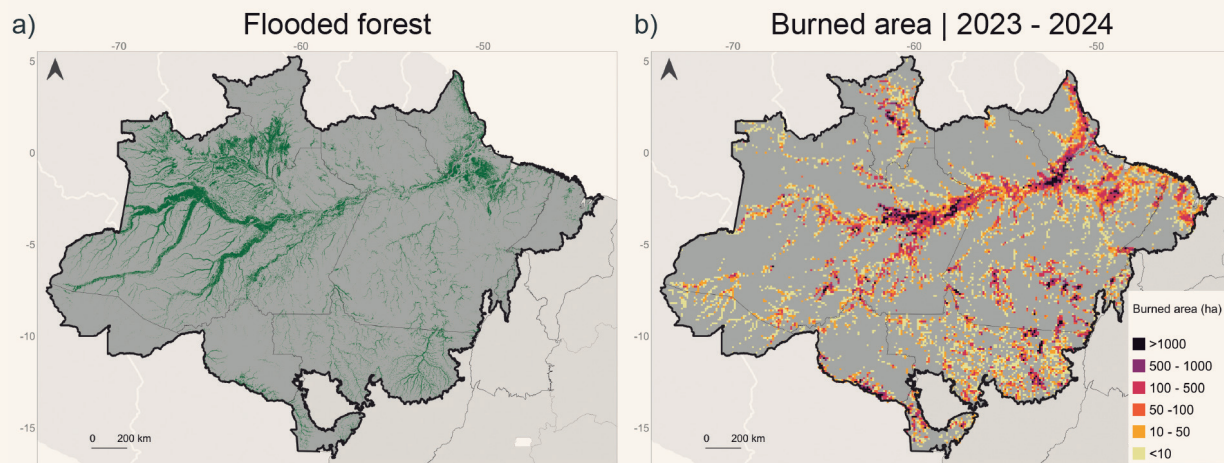


Figure 1 - Flooded forests in the Brazilian Amazon. a) Total area of flooded forests (in green). b) Area of burned flooded forests in 2023 and 2024 (11 x 11km grid cells); the darker the color, the more forest burned in the cell. Data come from MapBiomass Brazil² and MapBiomass Fire Monitor³.

FLOODED FORESTS ARE BURNING

Across the Brazilian Amazon, approximately 38 million hectares of forests are partially submerged at some point during the year – these are known as flooded forests. Despite being very humid ecosystems, flooded forests are increasingly affected by fires, with c. **1.4 million hectares burning during the extreme droughts of 2023 and 2024** (Figure 1), exceeding the combined area burned in the four previous years. Between 2019 and 2022, fires never affected more than 165,000 hectares annually (Figure 2a). **In 2024, the total area of burned flooded forests (i.e. 887,000 hectares) was greater than the area deforested across the whole Brazilian Amazon (i.e. 608,000 hectares)⁴.**

Post-fire tree mortality varies between 75-100% in flooded forests⁵, thus leading to large amounts of CO₂ emissions (Figure 2b). While annual CO₂ emissions in previous years ranged between 8.2-17.3 million tonnes, they climbed to 53.1 million tonnes in 2023, and reached a record of 108.9 million tonnes in 2024. **The CO₂ emissions from flooded forests in the Brazilian Amazon in 2024 were more than five times higher than the fossil fuel emissions from Kenya in the same year⁶**, a country with a population of 56 million people. The lack of post-fire recovery in these ecosystems⁷, means they are a net source of CO₂.

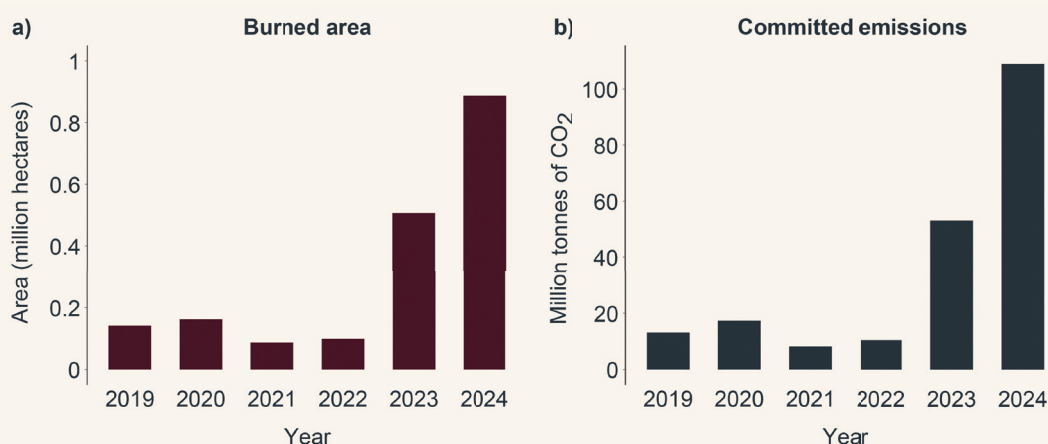


Figure 2 - The impacts of burning flooded forests. a) Total area burned between 2019 and 2024. b) Committed CO₂ emissions resulting from the burning of flooded forests. Emissions were based on the EBA biomass map⁸ and considering a conservative emission factor of 0.75 for flooded forests⁵.

THE SIZE OF BURN SCARS ARE INCREASING

Not only the total area of burned flooded forests has increased, but also the area affected by each fire – i.e. the burn scars. From 2019-2022, burn scars larger than 100 hectares were uncommon in flooded forests, ranging from 61 to 161 per year. In 2023, this number increased to 579, and in 2024 it more than doubled, reaching 1,195 scars >100 hectares (Figure 3). This suggests that fires are burning for longer, with each ignition event affecting larger areas.

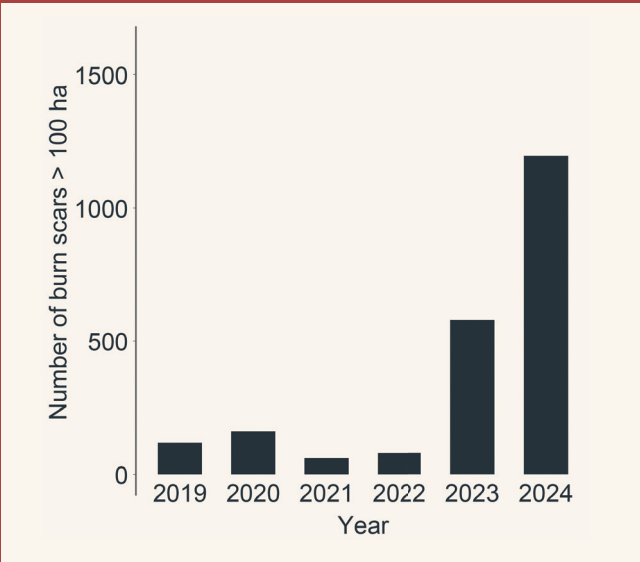


Figure 3 - The number of individual burn scars >100 hectares in Amazonian flooded forests.

CLIMATE CHANGE IS IMPACTING FLOODED FORESTS

Most fires in flooded forests are occurring in parts of the Amazon where climate extremes are increasing more rapidly⁹. In 2023 and 2024, **more than half a million hectares of these forests burned where extreme maximum temperatures in the dry season have risen by over 3°C since 1981** (Figure 4). An increase in temperature contributes to the drying of the vegetation and of the leaf litter on the forest floor, making forests more flammable.

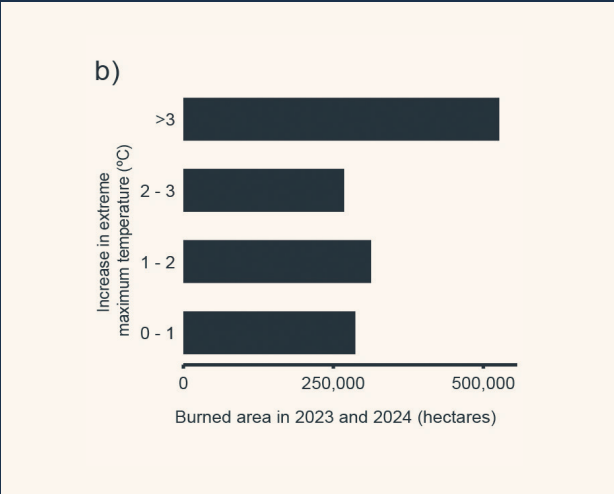
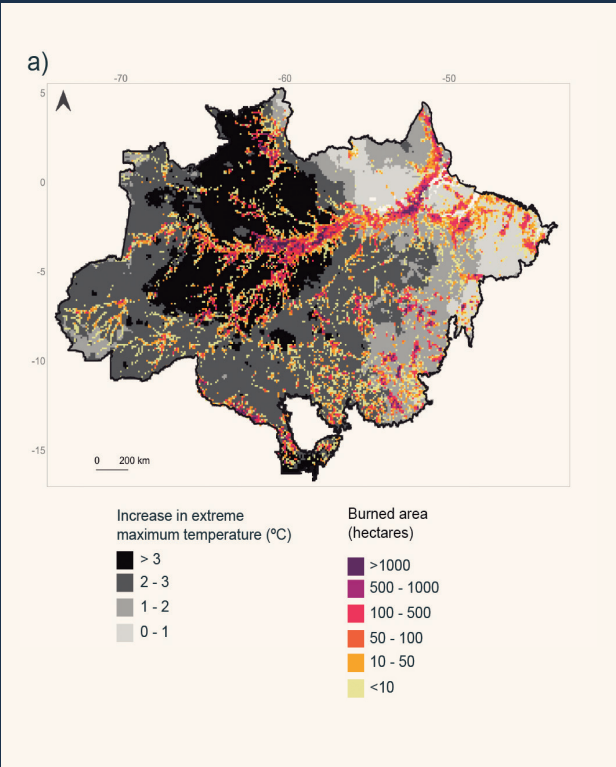


Figure 4 - Climate change and the total area of flooded forests that burned in 2023 and 2024. a) Spatial distribution of burned area in 2023 and 2024 according to the increase in extreme maximum temperatures during the dry season, observed over 43 years (1981-2023)⁹; b) total burned area in each class of extreme temperature increase during the dry season.



Figure 5 - Flooded forests. a) A flooded forest not affected by fire. b) A flooded forest that burned twice, in 2015 and 2023. All photos were taken in the Jaú National Park, in the state of Amazonas. Credits: Jos Barlow and Cássio Alencar Nunes.

CONCLUSION

Flooded forests are not fire-adapted ecosystems, yet they are burning more than ever before (Figure 5). In 2023 and 2024 there was a record in total area burned in flooded forests, leading to significant CO₂ emissions. Not only the total area of burned flooded forests has increased, but also the area of each burn scar. These fires were concentrated in areas that have seen the fastest increases in extreme maximum temperatures during the dry season.

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