

Environmental policies and fire regimes across contested deforestation frontiers: the case of the Brazilian Amazon

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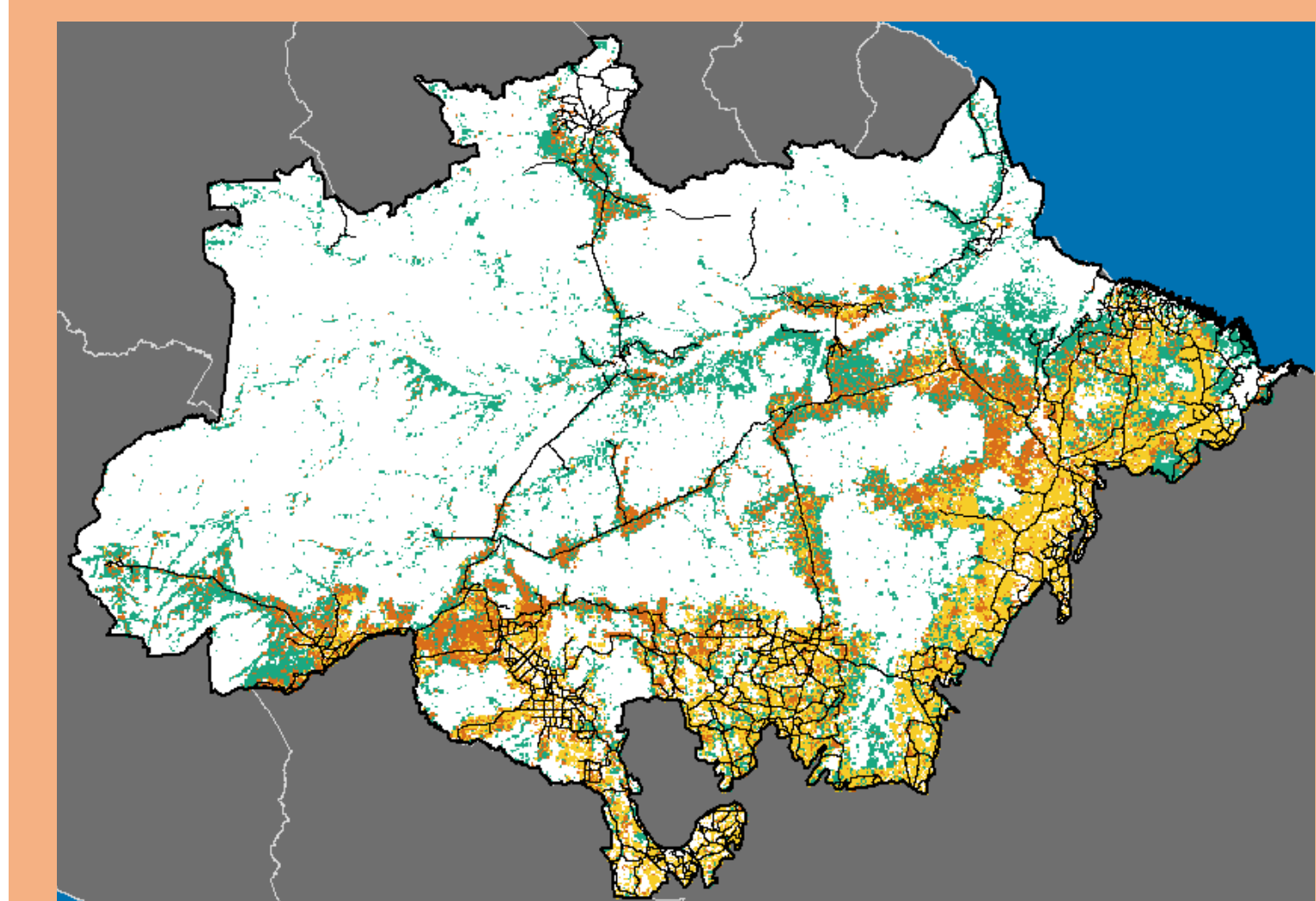
1. Land use and fires in the Brazilian Amazon

Since 2004, the Brazilian Amazon experienced the successful implementation of the world's largest **program to reduce deforestation**, before the re-emergence of developmentalist policies and new spurges in deforestation¹. Meanwhile, fires continued to be a **major source of forest degradation** regionally, emitting larger quantities of carbon than deforestation, jeopardizing biodiversity and affecting local landholders^{2,3}. Coupled with a drying climate, deforestation and fires could lead to **massive forest dieback** across the Amazon basin⁴. Most fires are used for deforestation and agricultural land maintenance, but these fires sometimes escape into nearby vegetation⁵. Through analysis of fires regimes drivers are a regional level, we investigated two research questions:

- What were the main drivers of different types of fires in the Brazilian Amazon and did they change during the last decade?
- What were the impacts of different policies on reducing deforestation on fire regimes?

2. Analysing drivers of the fire regimes

We used land use and deforestation data to **classify MODIS Active-Fires** into 3 categories: agricultural/deforestation/forest fires. Then, we fitted Bayesian Generalized Additive models using the **INLA-SPDE** approach to explain the point-process thanks to **spatio-temporal autocorrelation** and **14 variables**. The variables, identified in the literature, relate to climate, agriculture, infrastructure development, ecosystem integrity and environmental policies and have been reprocessed in 1km grid. We fitted the models for **two periods**: 2011-2015 (good governance of natural resources) and 2016-2020 (deteriorating governance of natural resources).



5 km pixels with the highest count of agricultural fires (yellow), deforestation fires (orange) and forest fires (green) in the Brazilian Amazon between 2011 and 2020 (MODIS AF)

3. Regional drivers of agricultural, deforestation and forest fires in the Brazilian Amazon

1. Pasture associated with more deforestation and agricultural fires than cropland
2. Blacklisting, a municipality-level policy to reduce deforestation, associated with fewer fires when successfully implemented
3. Perennials crops associated with decrease in agricultural and deforestation fires
4. Droughts, distance from agricultural lands, and, recently, forest fragmentation associated with more forest fires



Illustration of the drivers of fire regimes across the Brazilian Amazon. Credit: Manini Bansal (maninibansal107701@gmail.com)

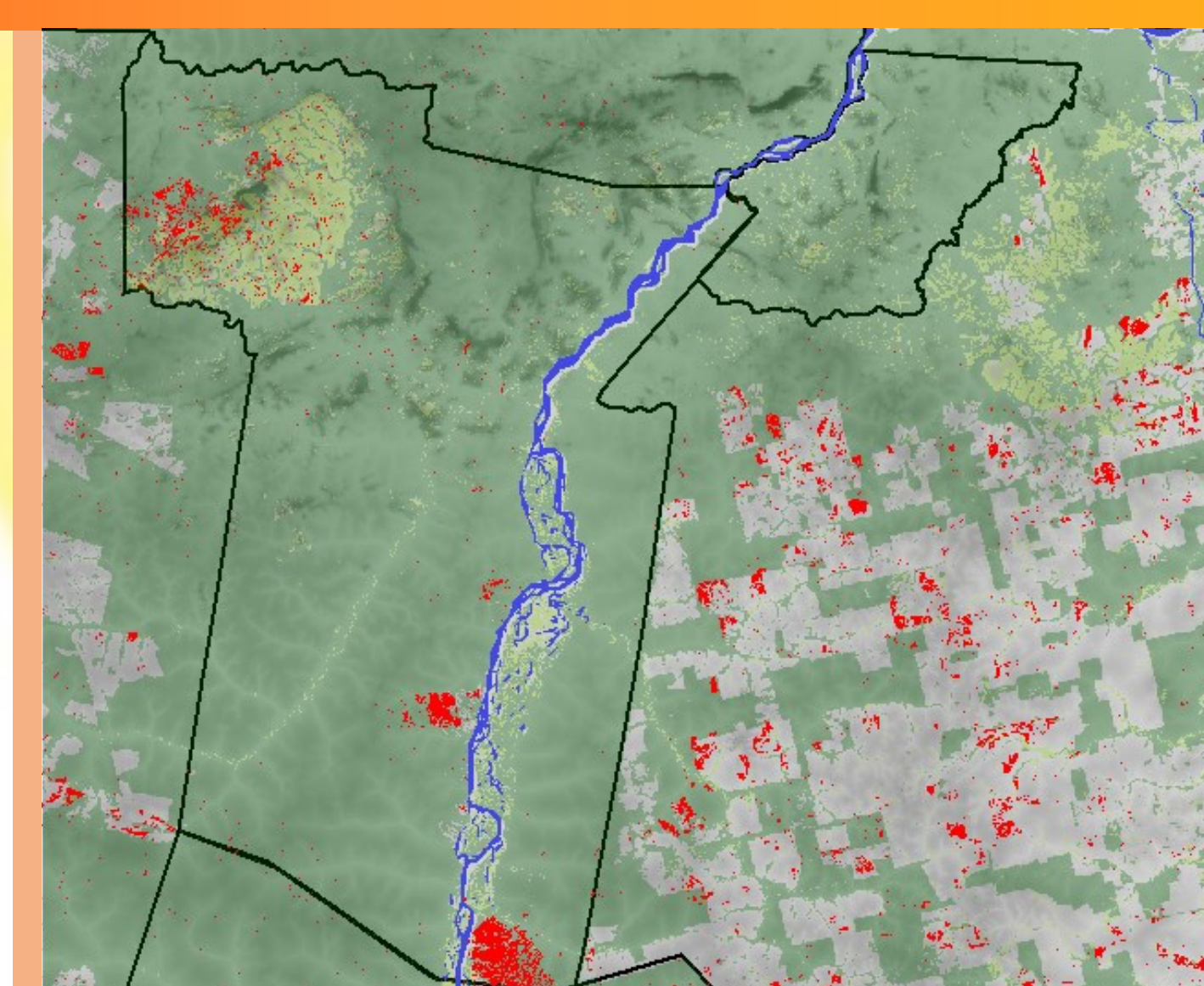
5. All types of protected areas associated with fewer fires, especially strictly protected (IUCN category 1 to 3) and indigenous lands
6. More fires close to the borders between sustainable use areas/ indigenous lands and unprotected lands than in the core of these protected areas
7. Protected area degazettement or down sizing associated with more deforestation and forest fires
8. Fires increased in the isolated areas of the Brazilian Amazon during the 2016-2020 period, as well as deforestation fires within indigenous land and sustainable use areas

4. Implications of changing fire regimes

Old deforestation frontiers intensify their agriculture and reduce their fire use, contrary to the new deforestation frontiers: need to understand enabling factors to adoption of **alternative land management practices** in new deforestation frontiers.

Indigenous land and protected areas, the cornerstone of regional environmental policies, experienced fewer forest and deforestation fires but under **increasing pressure**⁷: important to maintain their efficiency.

More fires in Central and Western Brazilian Amazon, where forests evolved **without fires disturbances**: potentially **higher mortality rates** and more **abrupt intensification** of local fires regimes



Map of the fires scars detected by Landsat in 2022 in and around the Capoto/Jarina indigenous land

5. Local drivers of fire regimes in and around the Capoto/Jarina

This analysis of drivers of fire regimes is useful to understand regional trends but remains correlative, has biases due to datasets used and oversimplifies complex socio-ecological systems.

In North Mato Grosso, the Capoto/Jarina region is composed of a mix of **cerrado** and **rainforest**. The region experience **longer dry seasons** and increasing **forest fires**, conditions likely to expand towards the Central Amazon with land use and climate change.

Using mixed methods, we will investigate fire management in and around the Capoto/Jarina indigenous land amongst different stakeholder groups. We will focus on changes in fire use and management due to **climate change** and other drivers of fire regimes.

6. References

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