

AMAZON ON FIRE

TECHNICAL NOTE FROM THE AMAZON ENVIRONMENTAL RESEARCH

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Introduction. Fire is a well-known element in rural Brazil. It is a commonly used tool to get rid of fallen forests and to manage pastures and other types of land use. These fires frequently escape from open fields into primary tropical forests and can ignite catastrophic wildfires (Nepstad et al., 1999). In the Amazon, fire activity peaks during drought years, when deforestation, management, and forest fires can easily get out of control (Alencar et al., 2015).

Droughts create the needed conditions for widespread, increasing chances of great forest fires (Nepstad et al., 1999). In the years of 2007 and 2010, for example, when the dry season in South Amazon was more intense than usual, great areas of forest were burnt, causing high tree mortality (Brando et al., 2014). When deforestation is lower, as the last seven years, the severity of the dry season is one of main factors determining fire occurrence (Aragão et al., 2018).

Over the last two decades, the Amazon experienced several extreme droughts and associated increases in fire counts. In non-drought years, in contrast, fire activity sharply declined, because management, deforestation, and escaped fires had also declined (Brando et al., 2019). Now that Amazon deforestation is on the rise again, after several years of stagnation, fires may once again be a major driver of environmental, social, and economic damage for the region. The perfect firestorm can be created with both occurring together, increased deforestation and droughts.

Amazon firestorms have increased incidence of respiratory diseases, crop and infrastructure losses, and forest degradation, when deforestation and management fires ignite wildfires. Economic losses resulting from forest fires can be dramatic. The 1998 fires in the Amazon, for example, caused a US\$ 5 billion

worth of damage to local and regional economies (Mendonça et al., 2004). Further, Brazil's public health system (SUS) alone had to spend US\$ 11 million in health treatment related to respiratory diseases in the Amazon region.

With the drop in deforestation between 2005 and 2012, forest fires cooled down. In recent years, however, deforestation picked up again, bringing the flames back and smoke to the daily life of people in rural and urban areas of the Amazon. The relationship between deforestation and forest fire has become particularly strong in 2019. People in the Amazon and even outside it began to breathe an air that is more polluted than in big cities like São Paulo. Health damages can be potentially catastrophic (Alves et al., 2015).

This technical note evaluates during this year's dry season, IPAM used several geospatial data sources derived from satellites to compare this year's fire season with previous ones. Active fire count represented a metric for fire activity, which captures mostly deforestation and management fires (but the burning of primary forests); the maximum dry spell length, and accumulated deforestation were the two variables used to explain the variability in fire activity in the Brazilian Amazon.

Method. To evaluate the dynamics of fire activity and its relationship with deforestation and maximum dry spell length, we used three main datasets: 1) fire counts, we used dataset from the AQUA satellite's (considered a reference satellite by National Institute for Space Research, INPE) hotspot detection system, accumulated for the Amazon biome between January 1st and August 14th for each year, from 2016 to 2019; 2) the maximum dry spell length (maximum of consecutive days with precipitation below 1 mm), which was calculated based on precipitation dataset of CHIRPS (Climate Hazards Group InfraRed Precipitation with Stations), and resolution of nearly 5 km. Maximum dry spell was also calculated considering the period between January 1st and August 14th for each year, from 2016 to 2019; and 3) deforestation in the year of 2019, we used the monthly deforestation information from the Deforestation Alert System (SAD)¹ summed-up from January to July 2019. To evaluate the relationship between fire counts and the maximum dry spell length or the deforestation area, we summarized the data for states and municipalities.

¹ SAD, July 2019. Available at: <https://imazon.org.br/publicacoes/boletim-dodesmatamento-da-amazonia-legal-julho-2019-sad/>.

Results. Figure 1 points to deforestation driving most of the fire activity in Amazonia in 2019, with climatic conditions having a very low explanatory power. Furthermore, while the fire season is only half way through, fire activity in 2019 has already surpassed the last four years in most Amazonian states.

Over the past 15 years, similar peaks in fire activity were only observed during extreme drought conditions, which is not the case for 2019 (figure 2). Up to August 14, 32,728 hotspots had been registered, an increase of 60% relative to the average of the last three years for the same period (average of ~20,4 thousand hotspots, varying from ~15 and 25,5 thousand; figure 2). The maximum dry spell up to August 14 of 2019 averaged by state varied between 11 days (Amazonas State) and 29 days (Roraima State).

The top ten Amazon municipalities in fire counts were also the ones deforesting the most (figure 1 and table 1). Considering all municipalities in Amazonia, those 10 were responsible for 37% of the fire counts and 43% of the accumulated deforestation up to July in 2019 (table 1). This concentration of fires in municipalities experiencing high deforestation rates in a non-drought year strongly indicates that the fires of 2019 have been intentional and mostly for clearing recently deforested areas.

Fire registries in 2019, when compared to the last four years, are notably greater in the states of Acre, Amazonas, Mato Grosso, Rondônia and Roraima. In Pará, the current number of fires is only 7% greater than what was observed in 2017, when the drought period was twice harsher than this year (figure 3).

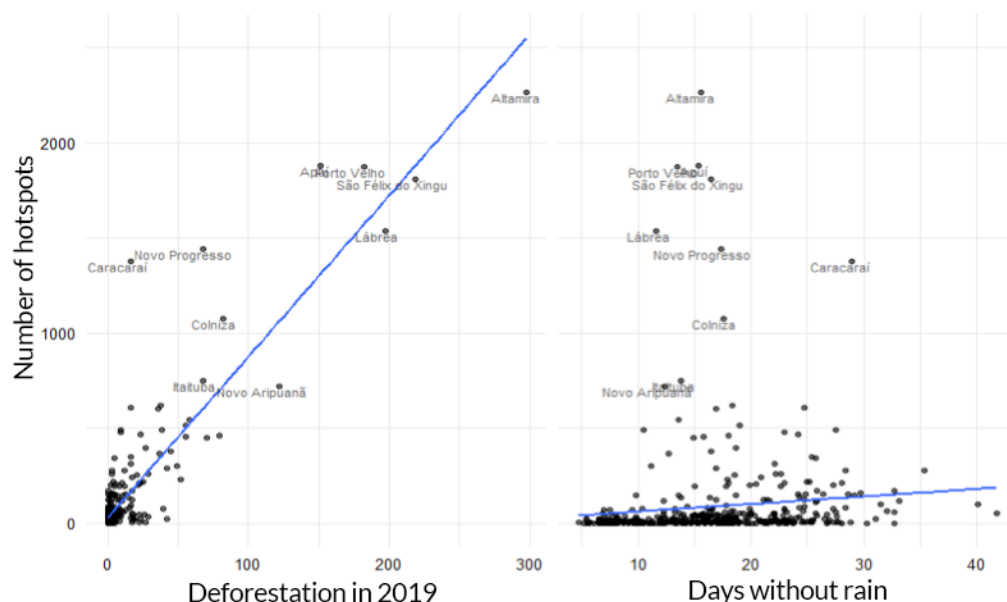


Figure 1. Relationship between the number of hotspots until August 19 and deforested area (left) and cumulative days without rain (right) for Amazon municipalities in 2019. Municipalities identified in the map are those where the number of fires was particularly high. Source: IPAM.

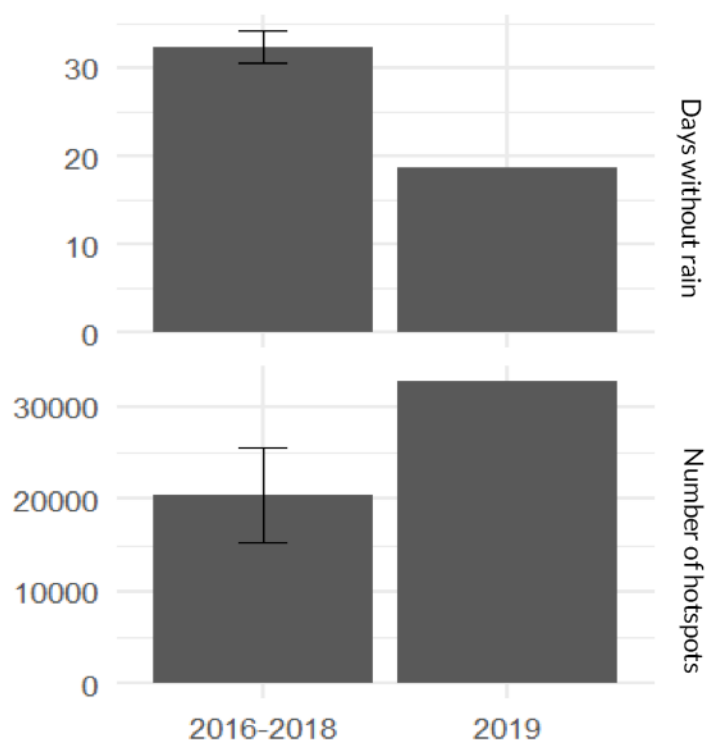


Figure 2. Average number of hotspots and cumulative number of days without rain for the Amazon biome in 2019, compared to the averages registered for the period between 2016 and 2018. Source: IPAM.

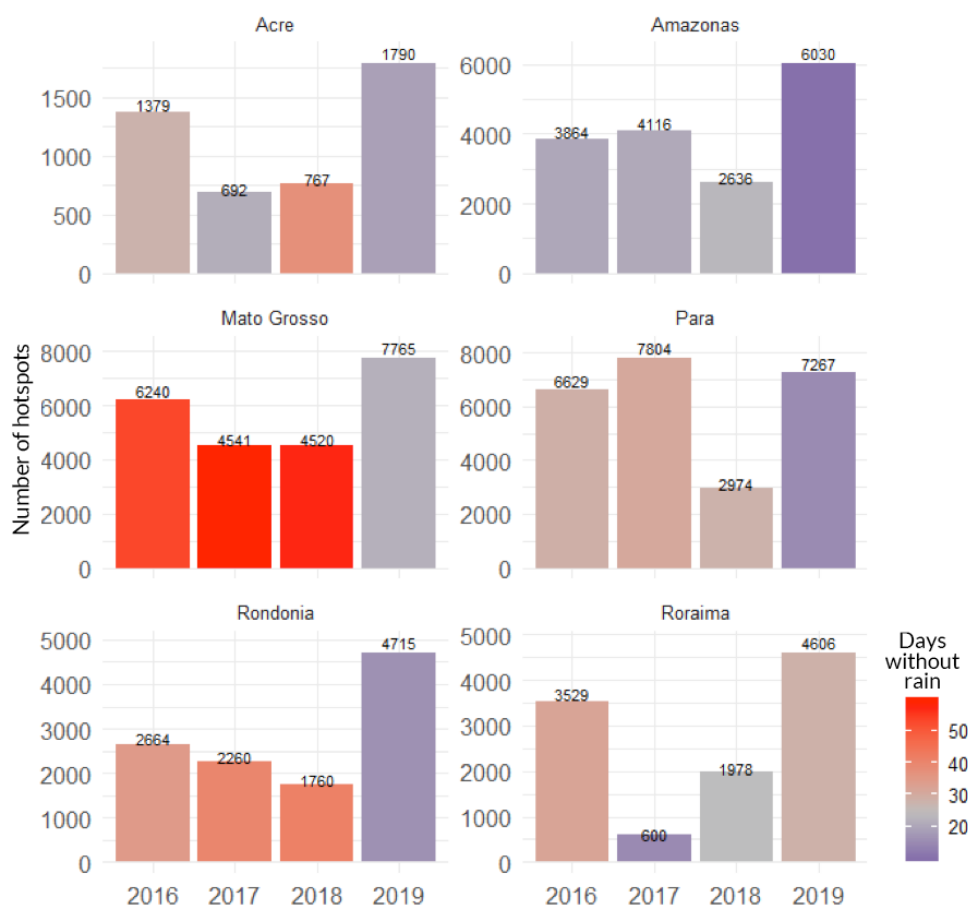


Figure 3. Number of hotspots accumulated for the period between January 1st and August 14th from 2016 to 2019, in six Amazon states. Differences in color within the same state indicate the cumulative number of days with precipitation below 1mm. Mato Grosso data includes only information for the Amazon biome. Source: IPAM.

Table 1. Top 10 municipalities in the Amazon in number of hotspots in 2019, and deforested area in the period between January and July 2019. Source: IPAM, with data from INPE and SAD/Imazon.

Municipality	State	Hotspots	Deforestation between January and July 2019 (km ²)
Apuí	AM	1754	151.0
Altamira	PA	1630	297.3
Porto Velho	RO	1570	183.5
Caracaraí	RR	1379	16.0
São Félix do Xingu	PA	1202	218.9
Novo Progresso	PA	1170	67.8
Lábrea	AM	1170	197.4
Colniza	MT	869	82.4
Novo Aripuanã	AM	665	122.3
Itaituba	PA	611	67.8

The Acre case. A worrying effect of forest fires is its impact on the quality of air. In the last three weeks, cities in Acre have faced pollution from smoke, with critical situation in the following municipalities: Assis Brasil, Manoel Urbano, Rio Branco and Sena Madureira. In all of them, the concentration index of particulate matter is way above recommendations by the World Health Organization². State government has declared state of alert due to fires on August 9th ³. In face of this scenario, we hereby analyze the state of Acre as an example.

By August 14 of the present year, a total of 1,790 hotspots had already been registered in Acre. This number is 57% greater than what was registered in 2018 and 23% greater than the observed in 2016, a year with extreme drought caused by one of the strongest El Niños of the last decades. Nevertheless, the number of days without rain in 2019 indicates that the Amazon region, including Acre, is

²² Information about air quality in Acre municipalities can be obtained in real time since June at: <https://www.purpleair.com/map#6.42/-9.383/-71.082>

³ <https://www.agencia.ac.gov.br/focos-de-queimadas-levam-estado-a-decretar-situacao-de-alerta>

not facing a harsh drought this year, and is far from the intense drought registered in 2016 (figure 3).

We highlight here that the hotspot registration used as reference by INPE (from the AQUA satellite) can be underestimated. An analysis of fire alerts using multi sensors (images from Sentinel, Landsat and Cbers satellites) (Silva, 2019; figure 4) already accounts for over 19 thousand hectares of fire scars in the state.

Great fires, in years of significant rain absence, may become extremely intense and even uncontrollable, causing fauna and flora mortality. A similar situation happened in Acre in 2005, 2010 and 2016, when the interaction between forest fires and intense drought reached over 525 hectares of forest (Silva et al., 2018).

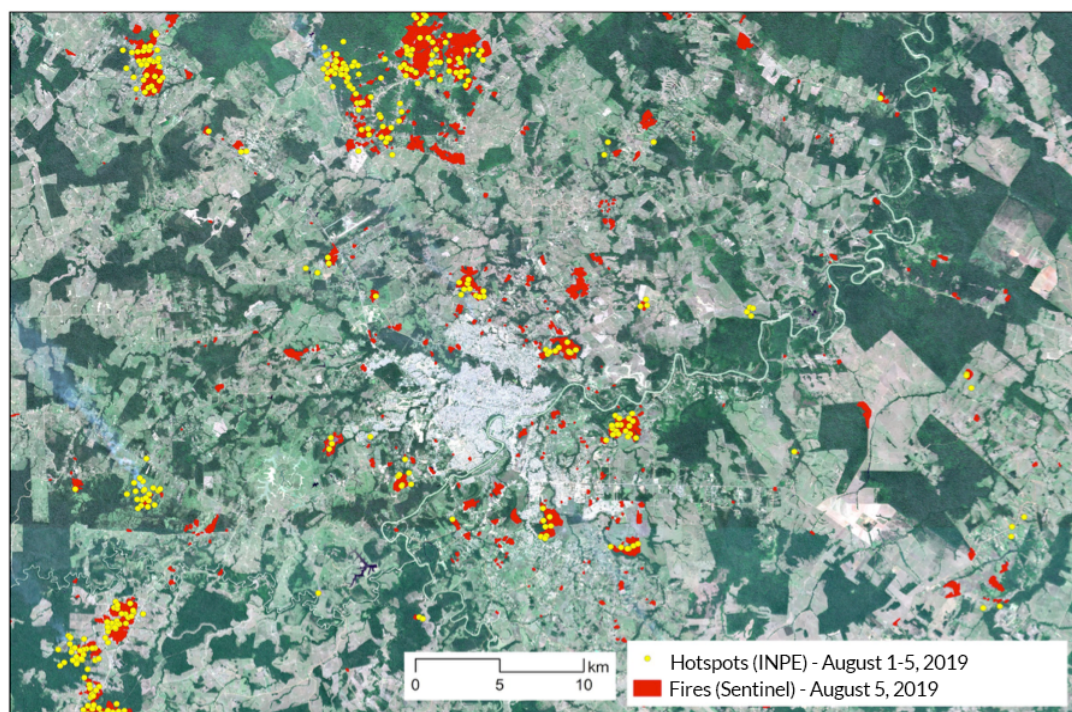


Figure 4. Map of the relationship between hotspots registered by INPE (yellow) and fires identified using Sentinel data (red). Source: Universidade Federal do Acre.

Recommendations. Considering that deforestation is a direct driver of forest fires, the fight against illegal deforestation must be intensified, and producers must be supported to adopt better practices and quit using fire to prepare the land. Reducing the use of fire in land management has positive impacts in the well being of populations both in rural and urban areas and results in lower costs with health and recovering of forest areas. Campaigns to prevent forest fires and use proper techniques to control the fire must be urgently resumed. Landholders

must be encouraged to use proper management practices, such as firebreaks, to avoid the accidental propagation of fires. Finally, we also alert to the risk of these high numbers of forest fires following deforestation becoming commonplace in the Amazon, in a future where the forest gives way to other land uses. It is crucial to understand that, without great forest areas acting as barriers to fires, future damages to human health and to agriculture may be unforeseen. Both governments and the civil society must make an effort to exterminate illegal deforestation, under the risk of the next generation of Brazilians becoming ashes.

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