Public Attention Reduced Forest Fires in the Brazilian Amazon

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Article

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ABSTRACT

International frameworks and agreements to reduce anthropogenic environmental disasters rely on international pressure driving local action. Although environmental catastrophes can occasionally capture international attention, it is unclear if focused media and increased public outcry can reduce environmental damage. We study the unusual and concentrated increase in international scrutiny on forest fires in the Brazilian Amazon in August 2019. Comparing active fires in the Brazilian Amazon versus those in the Peruvian and Bolivian Amazon before and after a surge in public attention on the Brazilian Amazon, we find that increased public attention reduced fires by 22% (93,607 avoided pixel-days of active fire) avoiding 24.81 million $MtCO_2$ in emissions. Our results highlight the power of international pressure to compel governments to act on pressing environmental issues, even in political contexts hostile to environmental priorities.

Introduction

Environmental catastrophes can occasionally capture international public attention, especially if these are of global importance and when national governments are unable or unwilling to curtail damages. However, it is unclear whether such notoriety can reduce environmental damage, raising questions about whether efforts to raise public awareness about pressing environmental challenges have any local effects. We examine this issue in the context of forest fires in the Brazilian Amazon[1–4], one of the most biodiverse and carbon-rich tropical forests in the world.

There are three main types of fires that occur in Brazil: (i) wildfires from natural causes, (ii) anthropogenic wildfires (those from intentional fires to clear cut forest or from fires that escape from agriculture areas), and (iii) agricultural fires to clear crop residue. Most fires are of the two latter types. These fires are a pressing concern around the world, resulting in particulate emissions that harm human health[5–8] and contribute to global warming. Understanding policies and processes to reduce fires in the Amazon is a global environmental and public health priority.

Results

Although seasonal forest fires occur every year in the Brazilian, Bolivian and Peruvian Amazon biome (Fig. 1*A*), there was a surge in international attention on forest fires in Brazil in the second half of August 2019. We use data on Google searches to show two regularities[9, 10]. First, searches on fires in the Amazon increased sharply in August 2019 in English, Portuguese and Spanish (Fig. 1*B*). We see a similar pattern with articles on fires in the Amazon in leading newspapers (SI Appendix, Fig. S1). Second, even though fires were as much an issue in the Bolivian and Peruvian Amazon as they were in the Brazilian Amazon, the searches were specific to Brazil – a pattern evident either using the country's name (Fig. 1*C*) or using the respective President's name (Fig. 1*D*) in the search.

We show that this increase in attention in 2019 corresponds to a marked reduction in subsequent forest fires in the Brazilian Amazon. Figure 2*A* shows fire outbreaks per km^2 in two week increments in the dry season – June to November – averaged from 2016 to 2018 for the Brazilian, Peruvian and Bolivian Amazon. The patterns across the three countries in this period are nearly identical. Figure 2*B* shows fire outbreaks per km^2 for the same months in 2019. The shaded region represents the period before the spike in international interest in fires in the Brazilian Amazon. In this period, the fires in Amazon Biome of Brazil and that of its neighbors tracked each other reaching a peak in mid-August 2019. As increased international attention befalls Brazil, fires in the Brazilian Amazon decline but fires in neighboring Peruvian and Bolivian Amazon continue unabated.

We estimate this effect formally in a difference-in-differences framework comparing fires in Brazil versus those in Peru and
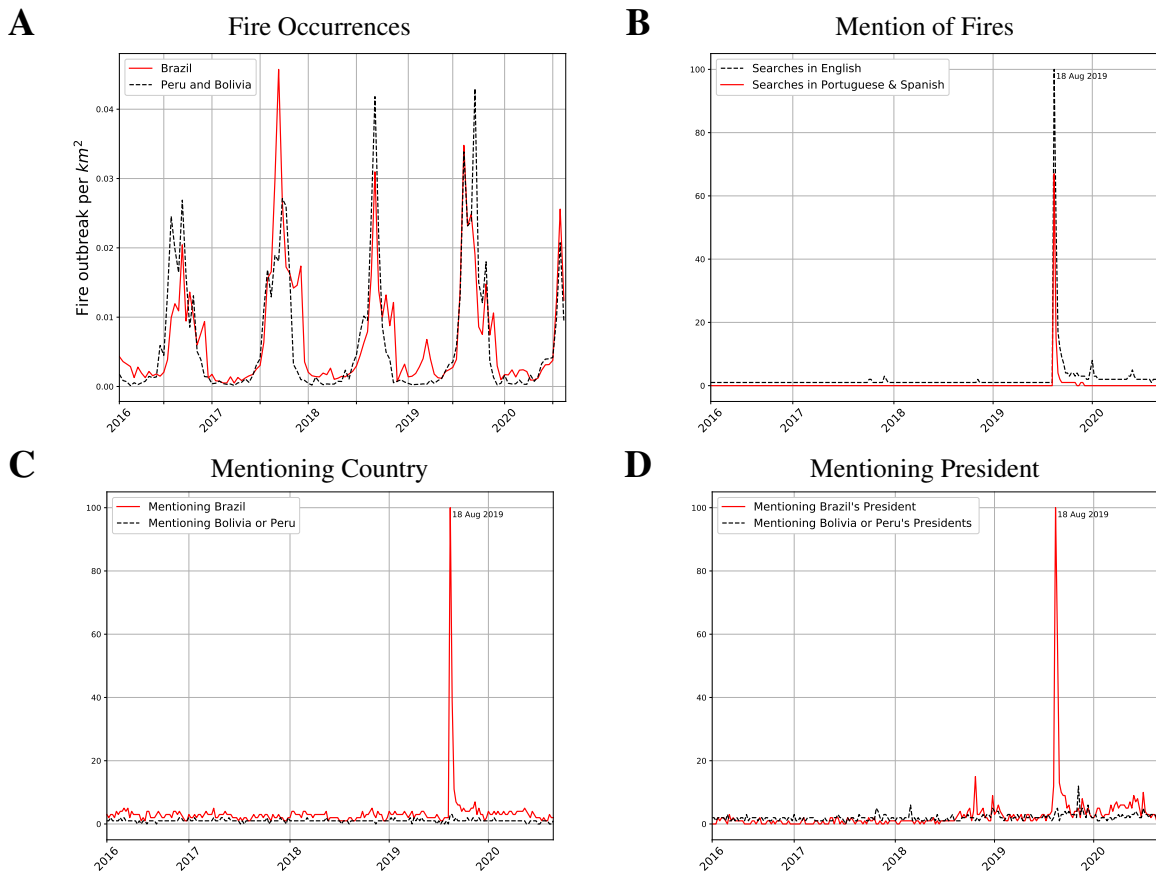
Figure 1. Searches on fires in Brazil increase in August 2019 but fire patterns are similar to previous years. A shows the number of days of active fire in each 1km^2 pixel in the Amazon biome in Brazil and Bolivia and Peru every two weeks from January 2016 through October 2020. **B** shows Google searches about Amazon fire in English and in Portuguese or Spanish since 2016. **C** depicts searches mentioning "Rainforest Brazil" and "Rainforest Bolivia" or "Rainforest Peru". **D** shows searches on Amazon and the name of each country's president.

Bolivia before and after the rise in international attention to the fires in Brazil[11]. Figure 2*C* shows the differential number of fire outbreaks per km^2 in the Brazilian Amazon every two weeks relative to the Peruvian and Bolivian Amazon. We observe no differential fires in Brazil prior to the international spotlight, supporting the common trends assumption that underlies a causal interpretation of difference-in-differences estimates. We observe that fires decline by 0.004 days of fire per km^2 after the spike in international attention. The effect is most prominent in September but persists through early November even as the fire season comes to an end in Bolivia and Peru. This corresponds to 36% of the average fires during the same period in the Peruvian and Bolivian Amazon. Altogether, our estimates indicate that international scrutiny resulted in 93,607 fewer pixels-days of active fires than would have occurred in the absence of the same attention. Our estimates are robust to controlling for precipitation and average fires from 2016-2018 at the pixel level (SI Appendix, Tab. S1, col. 1-4). Our estimates are robust to a triple-differences strategy where we compare Brazil with its neighbors before and after August in 2019 versus 2016-2018 (SI Appendix, Tab. S1, col. 5). We find that reductions in fires were at least two times larger in areas with denser forest cover (SI Appendix, Tab. S2, col. 1-4), suggesting that wildfires were the focus of the actions.

We find no evidence to suggest that these fires were simply displaced elsewhere. First, the map of fire intensity shows that the main locations of active fires in August 2019 were not close to the border (SI Appendix, Fig. S2). Second, we compare occurrences of fires around the Brazilian border with Bolivia and Peru using a regression discontinuity design[12]. SI Appendix Figure S3 shows the average number of fire outbreaks within 200km from the border in August and September. We see that the reduction of fires between August and September within 200km on the Brazilian side of the border was not followed by an equivalent increase in fires in the neighboring countries close to the border.

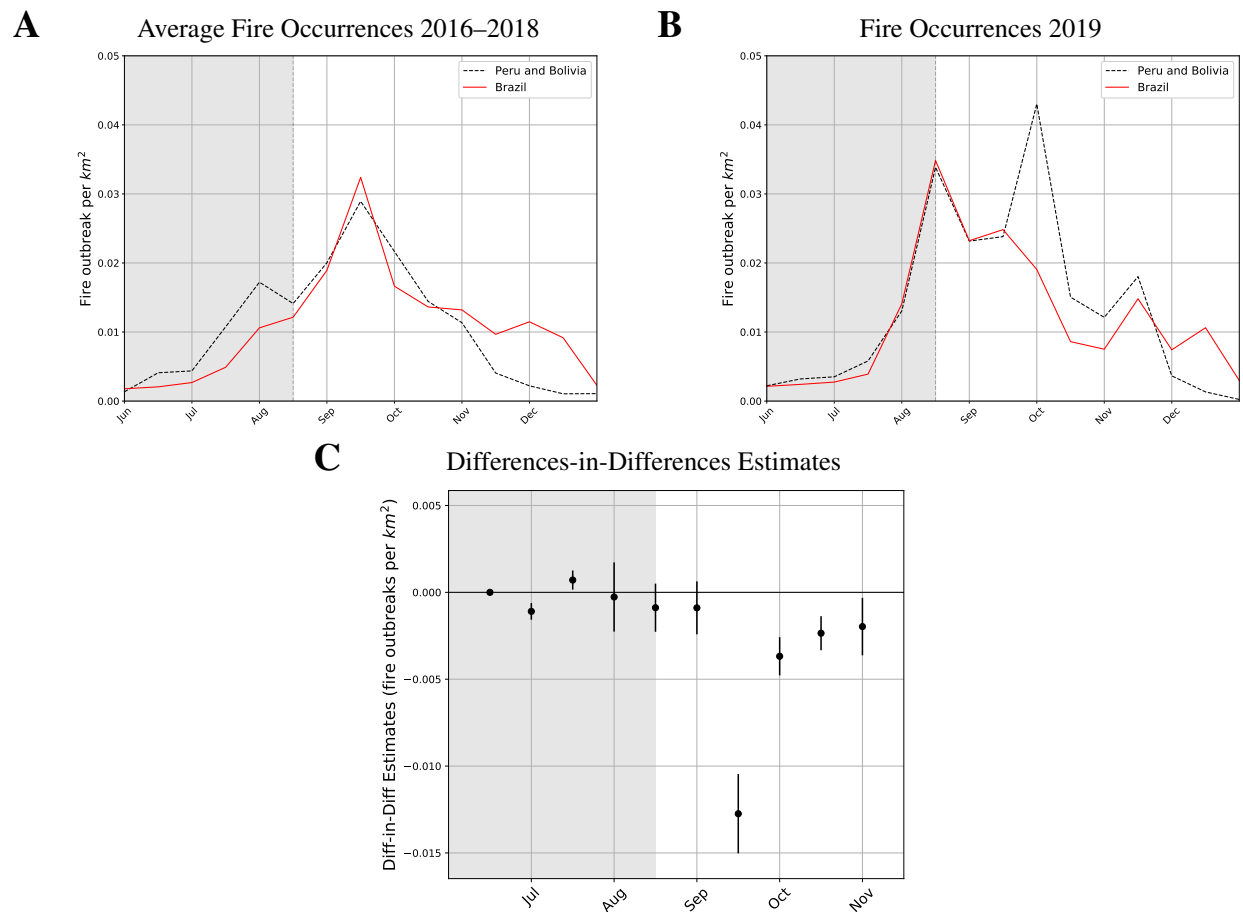**Figure 2.** **Amazon fires over the season in the Brazilian, Peruvian, and Bolivian Amazon. A** and **B** show the average number of fire outbreaks per km² for two-weeks intervals between 2016 and 2018, and in 2019, respectively. **C** Differences-in-differences estimates of forest fires in the Brazilian Amazon relative to fires in the Bolivian and Peruvian Amazon as captured γ_t in eq. (1). Each point indicates the point estimate for every two week period. Vertical bars present 95% confidence intervals. Shaded area marks the period before the rise of international attention. Standard errors clustered at 625km² grids. Number of observations (clusters): 63,883,604 (9,318).

Discussion

Forest fires in the Amazon are an annual phenomenon, but a marked increase in international attention resulted in nearly 22% fewer pixel-days of active fire in 2019. The reduction on fires can be broadly attributed to greater engagement of the civil society and to government actions taken after the outcry. The two main actions taken by the federal government were: (i) fire control actions by recruiting and dispatching fire brigades to specific areas – some under the military "Green Brazil Operation"; and (ii) a 60-day ban on the use of agriculture fires inside the Legal Amazon. As the timeline of events shows (see SI Appendix), both actions were initiated after the marked increase in public attention. We estimate heterogeneous effects of the international pressure on fires in municipalities that received external fire brigades or that received funds to recruit firefighters (under PREVFOGO/IBAMA program). Our estimates imply that fire brigades partially contributed to reducing fires following the international outcry (SI Appendix, Tab. S2, col. 5), suggesting that actions mediated by non-government organizations and local governments also contributed to the fire control. It is worth noting that the "Green Brazil Operation" launched in 2019 was a military operation that included additional fire-brigades over and above those sent by non-military agencies, such as IBAMA. Unfortunately, data from the military operations are not available and therefore excluded from our analysis. As such, our result is an existence result in that we show that increased public attention reduced fires in the Brazilian Amazon through a combination of various government and civil society actions. However, disentangling the relative magnitude of each government action in reducing fires is beyond the scope of this paper.

Our study has three caveats. First, we cannot determine the single element that led the global community to pay such

close attention to fires in 2019 as opposed to previous years. Although the fire season arrived earlier in 2019 than it did in 2016-2018[13], the peak in 2019 was similar to that in 2018 and lower than that in 2017 (Fig. 1*A*). Moreover, the accumulated number of fire outbreaks in August 2019 looks like an average case for the same month in the 2000's (SI Appendix, Fig. S4). This suggests that fire intensity was not the only driver of international attention. A more likely reason is that the newly elected Brazilian President Jair Bolsonaro had previously attracted international scorn for an anti-environmental agenda, prompting greater scrutiny of environmental incidents in Brazil[14]. Indeed, most newspaper articles included a mention of his anti-environmental stance.

Second, it is possible that domestic outcry also played a role in pressuring the government out of concerns for local air pollution. However, we do not think this was the dominant factor. For example, air pollution in São Paulo, the largest city in Brazil, was not a factor as the levels of air pollution were similar (if anything lower) in 2019 as compared to previous years (SI Appendix, Fig. S5). A unique episode, however, may have contributed to ignite the media coverage. On August 19, suspended particulates from the fires in the Amazon, brought by a cold front, reached São Paulo creating a black sky during the day. Such "black sky days" are a recurrent phenomenon in cities closer to the Amazon, but was a one-off event in a major city, such as São Paulo. This may have constituted a shock to public attention to the Amazon fires, as the population of the largest city in South America could see the smoke of the Amazon fires clearly for the first time. This certainly was covered in all national and some international news. Despite what sparked the surge in public attention, evidence from Google searches suggest strongly that the focus of both national and international attention was on the Amazon fires and not in São Paulo's "black sky day" (SI Appendix, Fig. S6). Nonetheless, it is not possible for us to disentangle the relative roles of national versus international public attention since the two likely catalyze each other.

Third, it is difficult to empirically disentangle why the increase in international attention led to domestic action. We include a timeline of key events in SI (Appendix I). Economic and reputational reasons might have encouraged the government to curtail the fires. For example, after the news of the fire reached the press, France threatened to block the Mercosur-European Union trade agreement, and foreign investors representing $16.2 trillion in assets signed a letter calling on firms to protect world's rainforest.

The Amazon remains one of the major strands of tropical forests in the world and preserving its integrity is crucial to meeting targets under the Paris Agreement and the United Nations Sustainable Development Goals. A back-of-the envelope calculation with our estimates shows that the fires averted in 2019 in the wake of international attention account for 3.8% of the reductions in emissions needed for Brazil to meet its commitments to the Paris Agreement. Our findings imply that even under administrations openly hostile to conservation, international outcry can lead to positive responses to urgent environmental catastrophes.

More work is needed to understand how long the effects of public attention are sustained. Although reports indicate that the area burned in the first half of September 2020 is equivalent to the whole area burned in September 2019, the marked attention that led to a decline in forest fires in Brazil in 2019 is largely absent in 2020.

Methods

Data

We obtain remote sensing data with the count of pixel-days of active fires at 1km resolution from Fire Information for Resource Management System (FIRMS), which we aggregate to a panel of pixel-weekly data between June and November for 2016 to 2019. Weeks are set starting on the first Monday of June of each year. Weekly precipitation data is obtained from ERA5.

Estimation Strategy

We employ a difference-in-differences strategy using fires in the Bolivian and Peruvian Amazon as a comparison group (control) for the fires in the Brazilian Amazon[15]. We use Bolivia and Peru over other neighboring countries (e.g., Venezuela, Colombia, Suriname, Guyana and French Guiana) since the fire seasonality in other neighbors is substantially different than those in Brazil, Bolivia and Peru[11].

Difference-in-differences is a statistical design where two groups, denoted treatment and control groups, are observed in time periods before an event affects the treatment group but not the control group. In broad terms, the estimated treatment effect takes the difference between time periods for each treatment and control groups (before and after the treatment period for each group) and then takes the differences between these two differences. When treatment is not randomly assigned, this method recovers causal estimates under the assumption that in the absence of treatment, the two groups would have been on similar trajectories after the treatment, as they did before the treatment. Since this assumption is axiomatically untestable, a commonly used alternative is to demonstrate parallel trends between the two groups prior to the treatment group receiving treatment. In our case, we follow best practices in difference-in-differences designs and show that fires in Brazil have followed similar trends as those in Peru and Bolivia before the increase in public attention (see Fig. 1*B-C*).

More precisely, we estimate the differential Amazon fires in Brazil relative to Bolivia and Peru over 2019 as captured by γ_t from equation:

$$fire_{i,r,w} = \alpha_i + \delta_w + \sum_{t=Jun3}^{Nov5} \gamma_t BrAm_i \mathbb{1}\{w=t\} + \eta_r X_{i,w} + \varepsilon_{i,r,w} \tag{1}$$

where $fire_{i,r,w}$ is the number of fires in pixel i in country r in week w, $BrAm_i$ is a dummy for the Brazilian Amazon region, α_i are pixels and δ_w are week fixed effects (weeks staring in the date indicated) – pixel fixed effects control for time-invariant factors that are specific to each pixel such as geography, regulatory context etc. $X_{i,w}$ is a vector of pixel-week controls (contemporary precipitation and average fire outbreaks between 2016–2018). We allow η_r to differ across countries r. $\varepsilon_{i,r,w}$ is the idiosyncratic error, which we cluster at 25km × 25km grids to account for serial and spatial correlation.

Under the assumption that forest fires in the Brazilian Amazon, absent media and public attention on fires here, would have followed a similar trend as the fires in Bolivia and Peru, γ_t estimates the average treatment effect of international pressure on fires over the remaining of the 2019 fire season. Figure 2*B* shows that the number of fire outbreaks followed a common trend from 2016 up to August 2019. Because we have over 120 million pixels, for computational reasons, we estimate the equation (1) using a random sample of 50% of pixels. We provide robustness checks and estimate heterogeneous effects in the SI Appendix.

Quantifying the effects in CO_2

We use Global Fire Emissions Database (GFED) to translate avoided forest fires into avoided CO_2 emissions[16–18]. GFED has revised data on fire count and emissions 2003-2015. We first run a linear regression of fire counts on emissions for those years. The R-squared of the regression is 0.746, larger than some regressions presented in GFED's regional estimates. Next, we predict emissions between September and mid-November using these estimates and the fire count in this period. We predict that the total emissions in the Brazilian Amazon in this period was 112 million tons of CO_2. Thus, we calculate the reduction of 22% of fire days caused by international pressure (SI Appendix, Tab. S2 col. 2) helped preventing the release of 24.81 million tons of CO_2 to the atmosphere.

We benchmark this number with the difference between Brazil's current emissions[19] and the Brazilian goal of emission reductions under the Paris Agreement. Such back-of-the-envelope calculations suggests that the effect of international pressure corresponds to 3.86% of CO_2 emissions that Brazil should have cut down in 2018 to reach the Paris Agreement goal.

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Author contributions statement

R.A, F.C and T.G wrote the paper.

Additional information

Competing Interests The authors declare they have no actual or potential competing financial interests.

Data and materials availability: Data and materials available upon request and posted publicly on publication.

Supplementary Information

A. Further Evidence of International Attention: To complement our results on google search terms in Figure 1, we also report trends in newspaper articles mentioning forest fires in Brazil appearing in leading English daily newspapers, the New York Times and the Guardian. As shown in Figure S1, these trends are similar to those seen in the google search data with a marked increase in the number of articles occurring just before the spike in related google searches.

B. Data: Remote sensing data with the count of fire outbreaks at 1km resolution is from Fire Information for Resource Management System (FIRMS)[1]. Using the standard MODIS Fire and Thermal Anomalies product, this data provides global coverage every 1-2 days. Each pixel is flagged if it contains an active fire which, under good conditions, can be as small as 100 m^2. Country borders and the limits of Brazilian Amazon biome are available from the Brazilian Institute of Geography and Statitics (IBGE)[2]. The limits of the Peruvian and Bolivian Amazon biome are available from the Amazon Geo-Referenced Socio-Environmental Information Network (RAISG)[3].

C. Statistical Methods: We estimate the causal effect of international attention on fires in Brazil by employing a difference-in-differences strategy using fires in the Bolivian and Peruvian Amazon as control for the fires in the Brazilian Amazon. As shown in Figure 1(c), the international attention on forest fires was entirely focused on Brazil with very little interest in the similar magnitude of fires taking place in Peru and Bolivia. This makes the Peruvian and Bolivian Amazon a suitable control group for evaluating the effect on fires in the Brazilian Amazon. The difference-in-differences strategy compares fires in Brazil against fires in Peru and Bolivia before and after the spike in international attention.

To generate Table S1, we estimate the average effect of international pressure on fires in the Brazilian Amazon between September and mid-November as captured by γ from equation:

$$fire_{i,r,w} = \alpha_i + \delta_w + \gamma BrAm_i \mathbb{1}\{w \geq Aug18\} + X_{i,r,w}\eta_r + \varepsilon_{i,r,w} \tag{2}$$

following a similar notation as in equation (1).

We also run a triple-difference estimate comparing fires in each pixel and fire-week in 2019 with its historical average between 2016-2018 for the same fire-week using the following equation:

$$fire_{i,r,w,2019} - AvgFire_{i,r,w,2016-2018} = \alpha_i + \delta_w + \gamma BrAm_i \mathbb{1}\{w \geq Aug18\} + X_{i,r,w}\eta_r + \varepsilon_{i,r,w} \tag{3}$$

where $AvgFire_{i,r,w,2016-2018}$ is the average fire outbreak in pixel i in fire week w between 2016 and 2018. γ in this equation captures the triple-difference estimate.

D. Were forest fires displaced to other regions or across national borders? One immediate concern could be that at least part of the reduction in fires in Brazil was driven by displacement of illegal fires across the border. Evidence does not support this hypothesis. If anything, we can observe an increase in fires in Brazil near the border around Rio Branco and the Chico Mendes Extractive Reserve in the state of Acre.

Second, Figure S3 shows the average number of fire outbreaks within 27km from the border in August **(a)** and September **(b)**; 27km is the optimal bandwidth for August[21]. Each point shows the average number of fire outbreaks by 1km bins of distance to the border; positive distance represent pixels in Brazil and negative distances represent pixels in Bolivia or Peru. We see that the reduction of fires between August and September on the Brazilian side of the border was not followed by an equivalent increase in fires in the neighboring countries close to the border, on the contrary. Performing a regression discontinuity estimation[21], we find no discontinuous fires outbreaks at the border. Point estimates (bias corrected p-values) for August is 0.003 (0.550), and for September-November is 0.003 (0.485); point estimates are smaller and less precise when we control for distance to water, access to cities, and above ground biomass.

E. Heterogeneous effects on forest areas. Whether the international pressure was more effective to prevent fires in areas with forest cover than in other areas, for example pastureland, is important to understand its impact on the amount of carbon released by the fires. We assess this issue by estimating heterogeneous effects of the international pressure on fires in areas with greater forest cover, as captured by γ_2 from equation:

$$\begin{aligned} fire_{i,r,w} = \alpha_i + \delta_w + \gamma_1 BrAm_i \mathbb{1}\{w \geq Aug18\} \\ + \gamma_2 BrAm_i \mathbb{1}\{w \geq Aug18\} \times Forest_i + X_{i,r,w}\eta_r + \varepsilon_{i,r,w} \end{aligned} \tag{4}$$

where $Forest_i$ is an index equal to one for pixels with greater forest cover.

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[1] Available at https://earthdata.nasa.gov/firms. Accessed through[20].

[2] available at https://www.ibge.gov.br/en/home-eng.html

[3] available at https://www.amazoniasocioambiental.org/en

Table S2 presents the results using four different definitions of forest cover: the share of forest cover in each pixel in 2015, pixels with more than 50% of forest cover, pixels with more than 75% of forest cover, and pixels with more than 90% of forest cover in 2015.[4] We see that international pressure was at least twice more effective to reduce forest fires than non-forest fires.

F. How did government actions curtail fires?   Although we cannot test for the extent to which each government action in the aftermath of international coverage of fires affected subsequent fires, we assess whether the fire brigades dispatched or recruited to control the forest can fully explain the effects we estimate. We use government records to identify the municipalities that received external fire brigades (data from the Registry of Fire Incidents from the Environmental Regulatory Agency, ROI/Ibama) or that received funds to recruit fire fighters (from the Ministerial Ordinance # 3020/2019). We regress equation 4 using a a dummy for the municipalities that received fire brigades instead of the *Forest$_i$* variable. The coefficients in Table S2 column 5 show a differential reduction of fires in areas that received fire brigades, however we also see statistically significant and meaningful effects on areas that did not receive the direct assistance captured on the records. This suggests that other actions, such as the 60-day ban on the use of fire in the field, also contributed to the reduction. A caveat of this analysis is that we could not obtain data on all missions under the Operation Green Brazil.

G. Air Pollution and Domestic Public Attention   Fig. S5 shows evidence that air pollution in major cities, for example, São Paulo was similar in August 2019 as it was in previous years. We take this as suggestive evidence that levels of air pollution in São Paulo were not driving domestic public attention and outcry towards forest fires. Although domestic public attention likely played some role in reducing forest fires, this evidence suggests that this effect was likely not driven by domestic air pollution concerns.

On August 19, São Paulo's sky became black during the day caused by suspended particles from the Amazon fires brought by a cold front. While this may have startled the local media, we show evidence that the focus of public attention remained in the Amazon fires, not in São Paulo's black sky. Fig. S6 shows Google searches for "Amazon fires" (in English and in Portuguese) and searches for the combination of the words "São Paulo" and "fire", "smoke", or "Amazon". We can see that the focus of public attention was the Amazon fires, not São Paulo.

H. Cumulative fire outbreaks   Figure S4 plots the accumulated number of fire outbreaks for the Brazilian Amazon for different years as evidence that 2019 was an average case for the 2000's. It shows there were higher cumulative fires as of August 2019 than in August 2018 but similar to those in 2017, and is similar to the trajectories of the 2000's. It also shows that cumulative fires in 2020 were similar to 2019 but accompanied with no surge in public attention (potentially because of COVID-19).

I. Timeline of the main events   Links in *italics*.

10/25/18 President-elect Bolsonaro pledges to quit Paris climate deal *(Reuters)*

11/28/18 Brazil backs out of hosting the 2019 Climate Change Meeting *(New York Times)*

12/10/18 Ricardo Salles is appointed as Minister of Environment, recommended by the Brazilian Rural Society. For him, the debate over Climate Change is "pointless" *(Guardian)*

01/01/19 Jair Bolsonaro's inauguration *(Washington Post)*

01/02/19 Brazil's Bolsonaro hands farming interests greater sway over Amazon lands *(Washington Post)*

05/17/19 Minister of Environment says he will change rules for applications of the Amazon Fund, accusing NGO's of failing to account for the use of money. Norway responds: "Norway is satisfied with the robust governance structure of the Amazon Fund and the significant results that the entities supported by the Fund have achieved in the last 10 years" *(Reuters)*

07/19/19 President Bolsonaro questions the satellite data on deforestation from the government's National Space Research Institute (INPE) after the data showed an increase in deforestation in May and June. "I am convinced the data is a lie. We are going to call the president of INPE here to talk about this." *(Guardian)*

08/01/19 Deforestation in the Brazilian Amazon hits the cover of The Economist *(Economist)*

08/02/19 The director of INPE is sacked *(Guardian)*

08/16/2019 Amazon Fund is shut down *(Guardian)*

08/19/2019 Suspended particulates from the Amazon reach São Paulo city *(Estadão)*

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[4]Forest cover data from MapBiomas available at https://mapbiomas.org/

08/21/19 Amazon fires in the New York Times and main media outlets *(New York Times) (Fox News) (CNN)*

Aug/19 President of France, on Twitter, calls the fires an "international crisis". He calls members of G7 Summit to discuss it. *(Twitter post. 08/22/19, 4:15 PM. https://twitter.com/emmanuelmacron/status/1164617008962527232)*

08/22/19 President Bolsonaro answers "The French president's suggestion that Amazonian matters be discussed at the G7 without the involvement of countries of the region recalls the colonialist mindset that is unacceptable in the 21st century." *(Twitter post)*

08/23/19 President Macron says France would oppose an EU trade deal "in its current state" with the Mercosur bloc. *(BBC)*

08/23/19 Government authorizes hiring fire brigades in the Amazon *(Agencia Brasil)*

08/29/19 Brazil bans the use of fire in the Amazon for 60 days *(CNN)*

08/29/19 Ibama delayed hiring of fire brigades *(O Globo)*

09/18/19 230 big investors representing $16.2 trillion call on firms to protect world's rainforests *(Reuters)*

06/23/20 In light of rising deforestation, 251 financial institutions representing over $17 trillion demand action over the dismantling of environmental policies and protection agencies *(Folha de São Paulo)*

09/15/20 On the first 14 days of September 2020, the Amazon already has more fires than in all September 2019 *(Folha de São Paulo)*

Table S1. Results: Difference-in-Differences

	Dep. var.: fire outbreaks per 1km^2				
	(1)	(2)	(3)	(4)	(5)
Brazilian Amazon $\times$ Sep-Nov (β)	-.0031***	-.0034***	-.0037***	-.0040***	-.0050***
	(.0005)	(.0005)	(.0005)	(.0005)	(.0004)
Precipitation	No	Yes	No	Yes	Yes
Avg fire 2016–2018	No	No	Yes	Yes	Yes
Triple difference27km from the border	No	No	No	No	Yes
Avg Fire Sep-Nov Bolivia & Peru	.0112	.0112	.0112	.0112	.0112
Avg Fire Sep-Nov Brazil 2016-2018	.0090	.0090	.0090	.0090	.0090
# Observations	63,883,604	63,883,604	63,883,604	63,883,604	63,883,604
# Clusters	9,320	9,320	9,320	9,320	9,320

[a] This table presents the results of the difference-in-differences approach. The table shows the coefficient of the interaction term of a pixel belonging to the Brazilian Amazon with a dummy indicating the period after the week of the rise in international attention (coefficient γ from expression (2)). All specifications include pixel fixed-effect and week fixed-effect. Units of observation are 1km^2 pixels in a bi-week period. From columns (1) to (4) we vary the controls included. The results are robust to including precipitation at the pixel-bi-week unit and the average fire count of each pixel in the equivalent bi-week of the years 2016-2018. Column (4) presents our preferred estimates. In column (5) we consider only pixels near the border (distance from the border with Peru and Bolivia < 27km). Column (5) shows the estimates of a triple-difference estimate as represented in equation 3.illustrates that the result we have found in columns (1)-(4) is not a displacement effect from Brazil to Peru and Bolivia. Number of observations (and clusters) from the main specifications: 72,893,026 (10,532). Standard errors clustered at 100km^2 grids in parentheses. Significance levels: *10%, **5%, ***1%.. Significance levels: *10%, **5%, ***1%.

Table S2. Results: Difference-in-Differences - Heterogeneous Effects

	Dep. var.: fire outbreaks per 1km^2				
	(1)	(2)	(3)	(4)	(5)
Brazilian Amazon × Sep-Nov (γ_1)	-.0044***	-.0016***	-.0015**	-.0015**	-.0031***
	(.0006)	(.0006)	(.0006)	(.0006)	(.0005)
Brazilian Amazon × Sep-Nov (γ_2)	.0005				
× Forest Cover	(.0004)				
Brazilian Amazon × Sep-Nov (γ_2)		-.0029***			
× Forest Cover > 50%		(.0003)			
Brazilian Amazon × Sep-Nov (γ_2)			-.0033***		
× Forest Cover > 75%			(.0004)		
Brazilian Amazon × Sep-Nov (γ_2)				-.0036***	
× Forest Cover > 90%				(.0004)	
Brazilian Amazon × Sep-Nov (γ_2)					-.0049***
× Brigades Sent or Budgeted					(.0007)
Precipitation	Yes	Yes	Yes	Yes	Yes
Avg fire 2016–2018	Yes	Yes	Yes	Yes	Yes
Avg Fire Sep-Nov Bolivia & Peru	.0112	.0112	.0112	.0112	.0112
Avg Fire Sep-Nov Brazil 2016-2018	.0090	.0090	.0090	.0090	.0090
# Observations	63,883,604	63,883,604	63,883,604	63,883,604	63,883,604
# Clusters	9,320	9,320	9,320	9,320	9,320

[a] This table presents the results of the difference-in-differences approach with heterogeneous effects. Columns (1) to (4) show the coefficient of the interaction term of a pixel belonging to the Brazilian Amazon with the a dummy indicating periods after the bi-week of the rise in international attention interacted with a pixel's forest cover in 2015 (coefficient γ_2 from equation (4)). All specifications include pixel fixed-effect, week fixed-effect, and controls for precipitation and average fires from 2016-2018 at the pixel-bi-week level. Units of observation are 1km^2 pixels in a bi-week period. In column (1) the forest cover variable is the share of the forest cover in that pixel. From columns (2) to (4) we create dummy variables that equals to one when the forest cover of a pixel is above a threshold (50%. 75%, and 90% respectively). In these columns we see that the effect of the reduction on fires was stronger in areas with greater forest cover. In column (5) we consider the interaction term of a pixel belonging to the Brazilian Amazon with a dummy indicating the period after the bi-week of the fire ban with a dummy variable that indicates if a fire brigade or a special budget to combat fire was sent to the municipality that the pixel belongs, after the fire ban. We observe a stronger effect of fire reductions on municipalities that receive such help. Nonetheless, it does not explain all the reduction on fires. Standard errors clustered at 100km^2 grids in parentheses. Significance levels: *10%, **5%, ***1%.
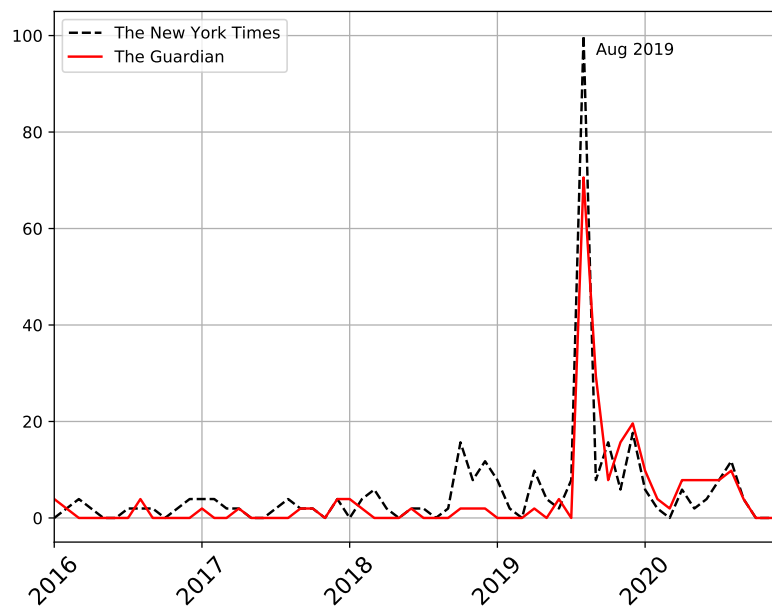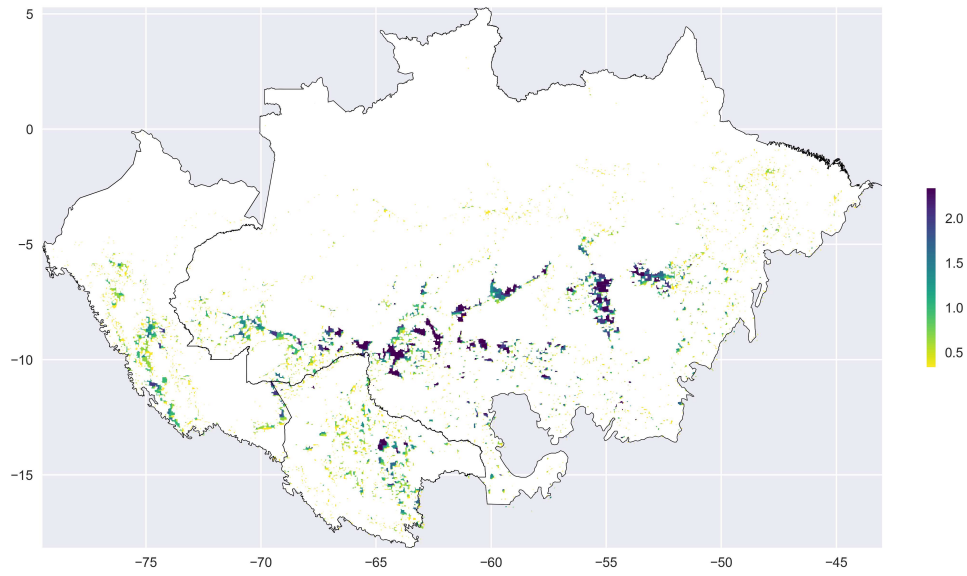
Figure S1. Hits on the New York Times and The Guardian newspapers. The figure presents the number of articles that mentioned the words "Amazon", "fires", and "Brazil" together, normalized by the maximum value (of August 2019). The data were built using The New York Times Developer Network (developer.nytimes.com) and The Guardian Open Platform (open-platform.theguardian.com)

(a) Average Fire Outbreak - August 2019
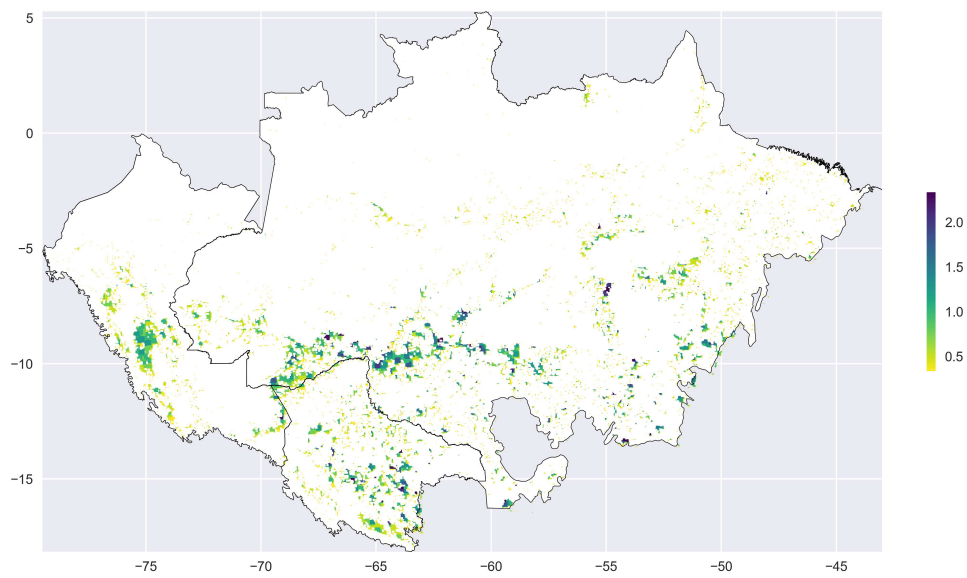
(b) Average Fire Outbreak - September 2019

Figure S2. Figure maps the intensity of fire outbreaks in August **(a)** and September 2019 **(b)**.

(a) August 2019

(b) September-November 2019
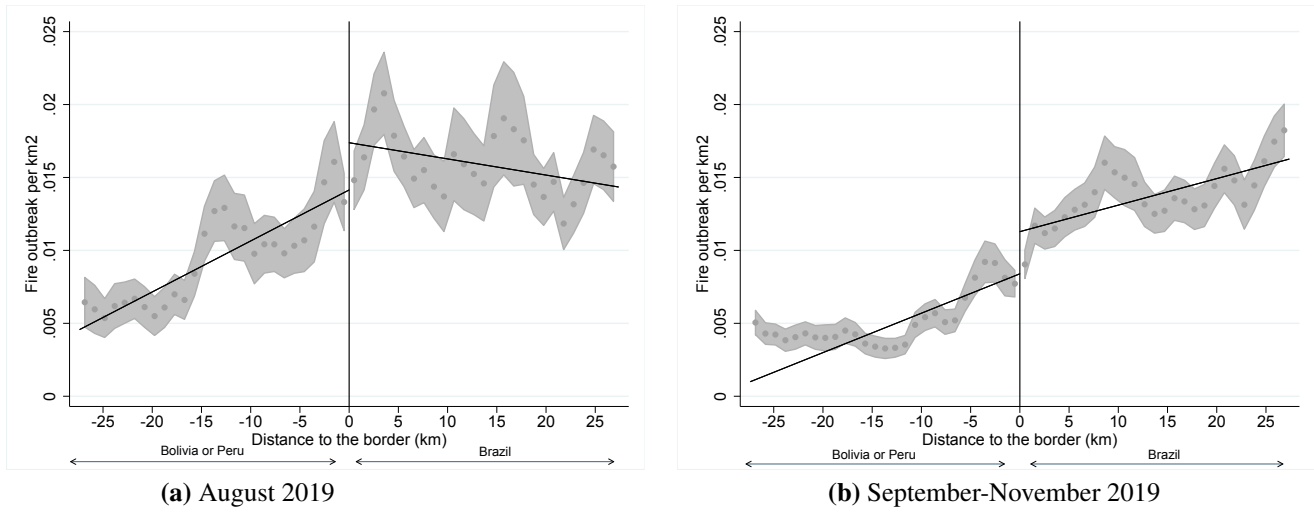
Figure S3. Figure shows average fire outbreaks in August 2019 **(a)** and in September-November 2019 **(b)** by 5km bins within 200km from the Brazilian border with Bolivia and Peru. Black solid lines depict linear polynomials, whereas the shaded grey region depicts the 95% confidence interval.
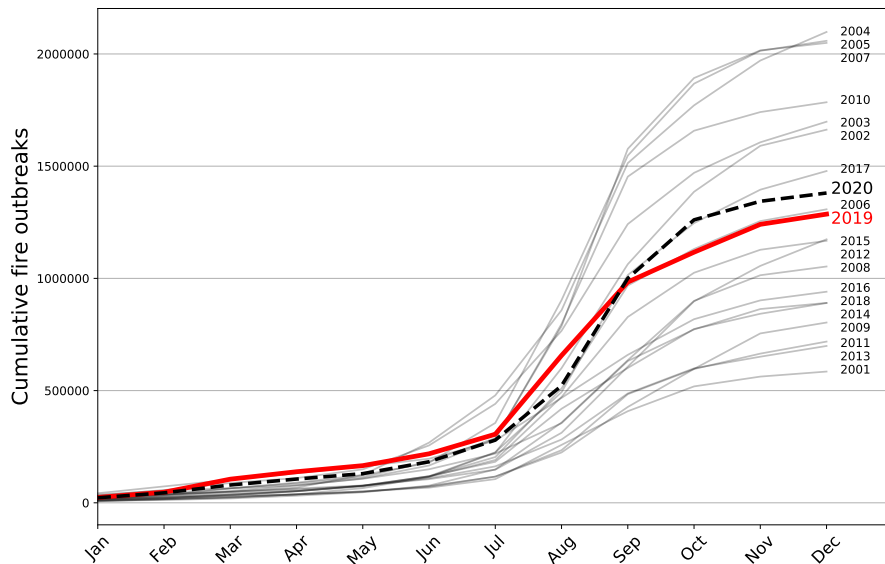
Figure S4. This figure shows the cumulative number of fires outbreaks in the Brazilian Amazon between 2001 and 2020.
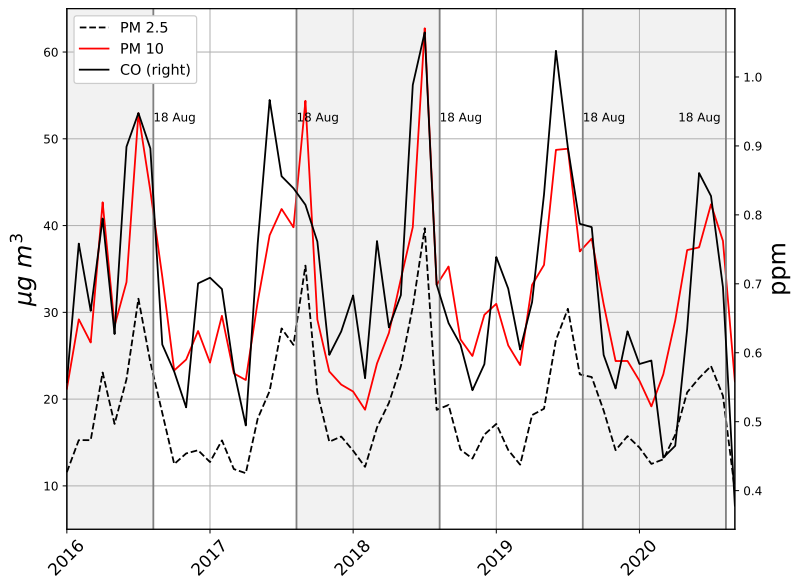
Figure S5. Pollution in São Paulo, Brazil followed similar trends in 2019 as in previous years. This figure presents different measurements of pollution for the city of São Paulo Brazil from 2016-2020. Data is from the Environmental Company of the State of São Paulo. We used data from the Marginal Pinheiros' station, aggregated by month. Data is available at https://cetesb.sp.gov.br/.
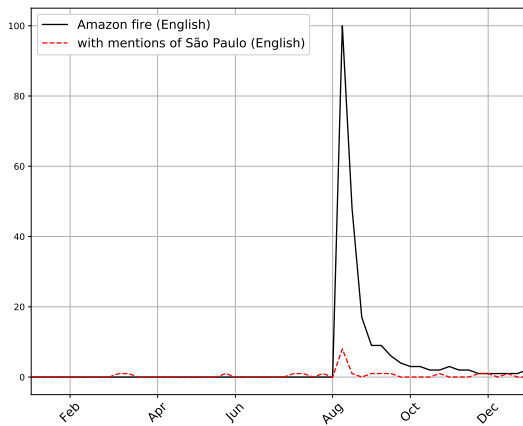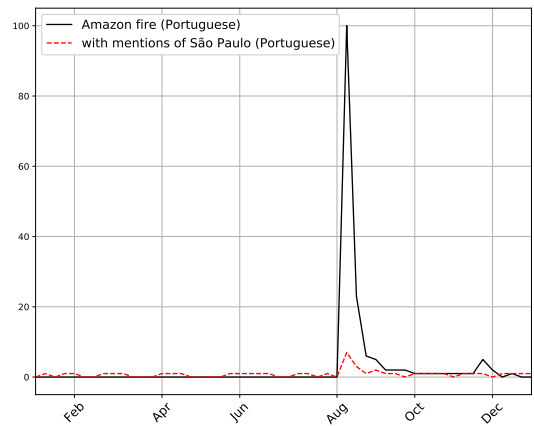

Figure S6. Searches on fires in Brazil compared with searches related with São Paulo A shows Google searches in English about Amazon fire compared with searches about Amazon fire and the dark sky day in São Paulo. For this we used the words "smoke", "fire", "sao paulo", and "amazon". **B** shows the same Google searches results in Portuguese. For this we used the words "fumaça", "fogo", "são paulo", and "amazonia".