Regional Environmental Change

Electronic Supplementary material

Characterization of land cover-specific fire regimes in the Brazilian Amazon

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Contents

Text S1 Fire variables in the FireTracks (FT) dataset

The FT algorithm (Traxl 2021) computes four key variables of individual fires: size (km^2), duration (d), intensity (MW) and rate of spread (km^2/d). Fire size reveals traits of the fuel type, load and flammability. It is commonly used to calculate biosphere-atmosphere emissions and fluxes (Strauss et al. 1989; Malamud et al. 1998). Fire intensity is defined as the rate of energy released per pixel and serves as a measure of the amount of biomass combusted (Wooster et al. 2005; Ichoku et al. 2008, Kumar et al. 2011). Therefore, it is directly related to fire emissions of gases and aerosols, and to the magnitude of the damage to the vegetation (Kaiser et al. 2012; Ichoku and Ellison 2014). Intensity fluctuates with local variations in the amount and condition of the fuel, and wind characteristics (Roy and Kumar 2017). Fire size and intensity are to some extent related because more intense fires usually result in larger fires (Fig. S4) (Laurent et al. 2019). Fire rate of spread, the daily amount of area burned by fire, is estimated as the ratio between fire size and duration. It is mainly driven by wind, moisture, and slope (Spessa et al. 2013).

Text S2 Land-cover classes description in the FT dataset

The FT algorithm employs the MODIS MCD12Q1 Land Cover Type collection 6 product, which maps global land cover at 500-m spatial resolution every year (Friedl and Sulla-Menashe 2019). The product is created using supervised classification of reflectance data from the MODIS sensors on-board the Terra and Aqua satellites. In this study, we use the following land-cover types from the classification scheme of the University of Maryland (UMD):

- *Croplands*: at least 60% of area is cultivated cropland
- *Cropland/Natural Vegetation Mosaics*: mosaics of small-scale cultivation 40-60% with natural tree, shrub, or herbaceous vegetation
- *Deciduous Broadleaf Forests*: dominated by deciduous broadleaf trees (canopy > 2m). Tree cover > 60%
- *Evergreen Broadleaf Forests*: dominated by evergreen broadleaf and palmate trees (canopy > 2m). Tree cover > 60%
- *Grasslands*: dominated by herbaceous annuals (< 2m)
- *Mixed Forests*: dominated by neither deciduous nor evergreen (40-60% of each) tree type (canopy > 2m). Tree cover > 60%
- *Savannas*: tree cover 10-30% (canopy > 2m)
- *Woody Savannas*: tree cover 30-60% (canopy > 2m)

We create the following aggregated land-cover classes from the list above to feed the FT algorithm and produce the individual fires dataset:

- Croplands: *Croplands* and *Cropland/Natural Vegetation Mosaics*

- Deciduous forests: *Deciduous Broadleaf Forests*
- Evergreen forests: *Evergreen Broadleaf Forests* and *Mixed Forests*
- Grasslands: *Grasslands*
- Savannas: *Savannas*
- Woody savannas: *Woody Savannas*

These aggregated land-cover classes correspond to the following categories of the IBGE's Phytogeographical classification of the Brazilian vegetation (2012) and the IBGE's Land-use classification scheme for anthropic areas (2013) for croplands and grasslands:

- Croplands: *culturas temporarias* and *permanentes*, *cultivo agroflorestal*
- Deciduous forests: *floresta estacional semidecidual*
- Evergreen forests: *floresta ombrófila densa* and *aberta*
- Grasslands: *pastagens*
- Savannas: *cerrado* (tree cover 10-30%)
- Woody savannas: *cerrado* (tree cover 30-60%); similar to the class *cerradão* described in Ribeiro and Walter (2008).

See IBGE (2012; 2013) for an exhaustive description, floristic composition and detailed pictures of the different land-cover classes.

Both the FT and GFA datasets employ the UMD land-cover scheme of the MODIS MCD12Q1 product and therefore, share the same land-cover classes. However, for the comparison of the fire variables in the different land covers estimated by the FT vs. Global Fire Atlas (GFA, Andela et al. 2019b), it is necessary to further aggregate our land-cover types into four final classes to match those given in the GFA dataset.

- Croplands
- Forests: Evergreen forests and deciduous forests
- Grasslands
- Savannas: Savannas and woody savannas

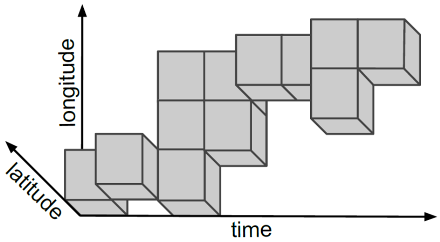

Fig. S1 Sketch of an individual fire in the FireTracks dataset propagating in space and time. Each cube depicts a MODIS 1-km size active fire (MOD/MYD14A1) within the individual fire. A temporal axis is added to the MODIS latitude and longitude coordinates and spatio-temporal connected active fires are identified as the components of the individual fire

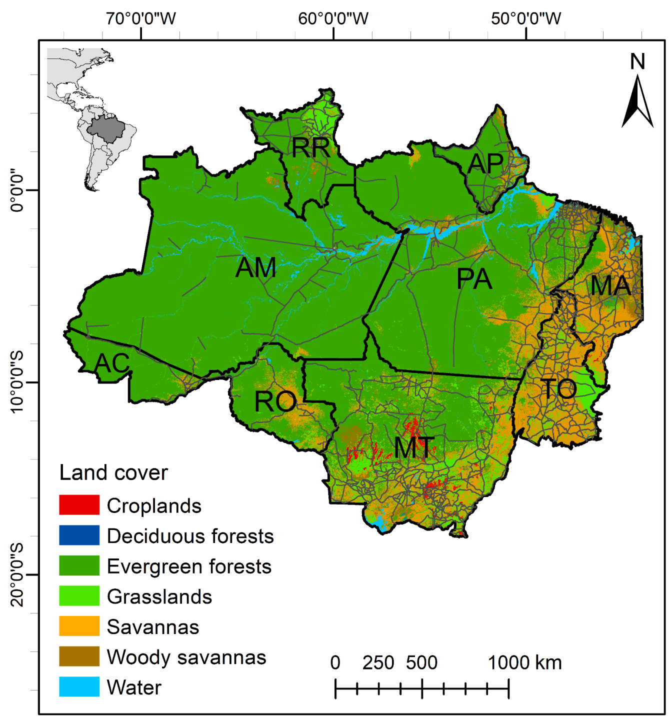

Fig. S2 Land-cover spatial distribution in the Brazilian Legal Amazon in 2001 (Friedl and Sulla-Menashe 2019), at the beginning of the analysed period (2002-2020). The inserted map shows the location of the BLA (in dark grey) within South America. The study area comprises the states of Acre (AC), Amapá (AP), Amazonas (AM), Mato Grosso (MT), Pará (PA), Rondônia (RO), Roraima (RR), Tocantins (TO), and part of Maranhão (MA). Black lines are political boundaries. Grey lines indicate the location of the main national roads (IBGE 2014). The few small deciduous forest spots are not visible at the scale of the map

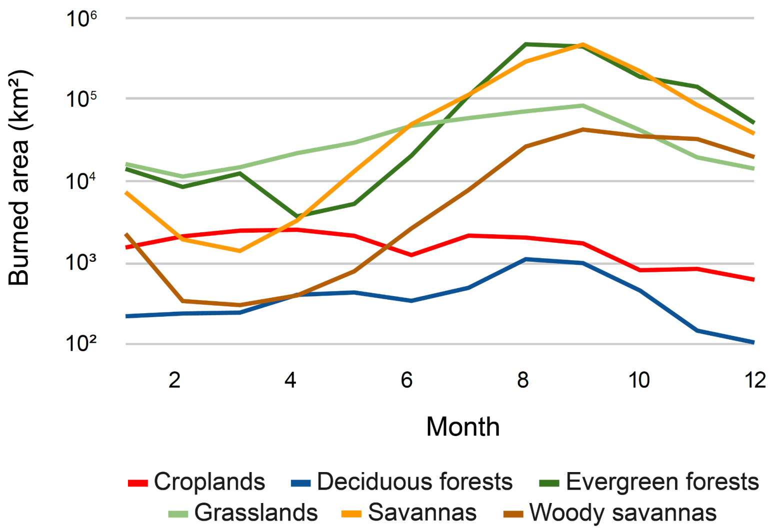

Fig. S3 Monthly burned area distribution in the different land-cover types in the FireTracks dataset (*n* = 857,942) in the Brazilian Legal Amazon over the period 2002-2020. Y-axis is in logarithmic scale

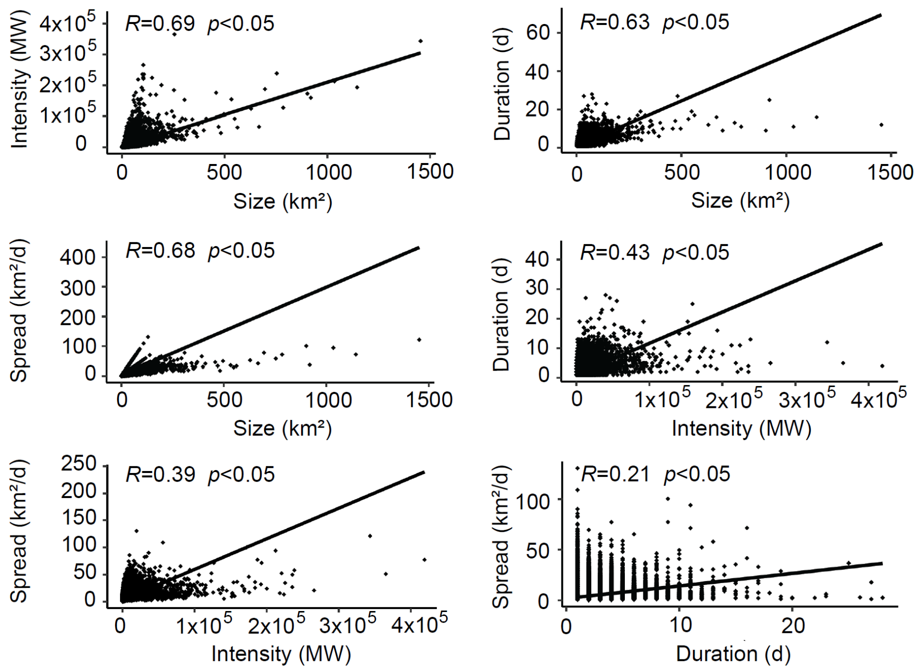

Fig. S4 Scatter plots of the fire variables in the FireTracks dataset (*n* = 857,942) plotted against each other. The Pearson correlation coefficient (R), p-value and the ordinary least squares regression line are shown in each panel

Table S1 Distribution of the fire variables in the FireTracks (FT) and Global Fire Atlas (GFA, in italics) datasets in the Brazilian Legal Amazon (2003-2016)

	Min.	1st Qu.	Median	Mean	3rd Qu.	95th	Max.
Size (km²)	0.86	0.86	2.58	4.16	4.29	12.88	1,453.67
	0.21	*0.21*	*0.86*	*3.96*	*2.36*	*13.51*	*2,915.63*
Duration (d)	1	1	1	1.14	1	2	27
	1	*1*	*3*	*5.33*	*8*	*17*	*80*
Spread (km²/d)	0.43	1.72	2.58	4.11	5.15	9.45	130.5
	0.03	*0.18*	*0.36*	*0.65*	*0.64*	*2.06*	*124.98*

Size, duration: n_{FT} = 652,892, n_{GFA} = 443,863; rate of spread: n_{FT} = 487,347, n_{GFA} = 315,648

Table S2 Distribution of the fire variables in the FireTracks dataset in the Brazilian Legal Amazon (2002-2020)

	Min.	1st Qu.	Median	Mean	3rd Qu.	95th	Max.
Size (km²)	0.86	0.86	2.58	4.15	4.29	12.88	1,453.67
Duration (d)	1	1	1	1.14	1	2	27
Intensity (MW)	1.7	18.6	49.6	357.5	169.6	1,226.9	418,976.1
Spread (km²/d)	0.43	1.72	2.58	4.1	5.15	10.59	130.5

Size, duration, intensity: n = 857,942; rate of spread: n = 639,579

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