JULES ANNUAL SCIENCE MEETING (2023)

Drivers of fire in Brazilian biomes: a novel approach using the Concept of Maximum Entropy

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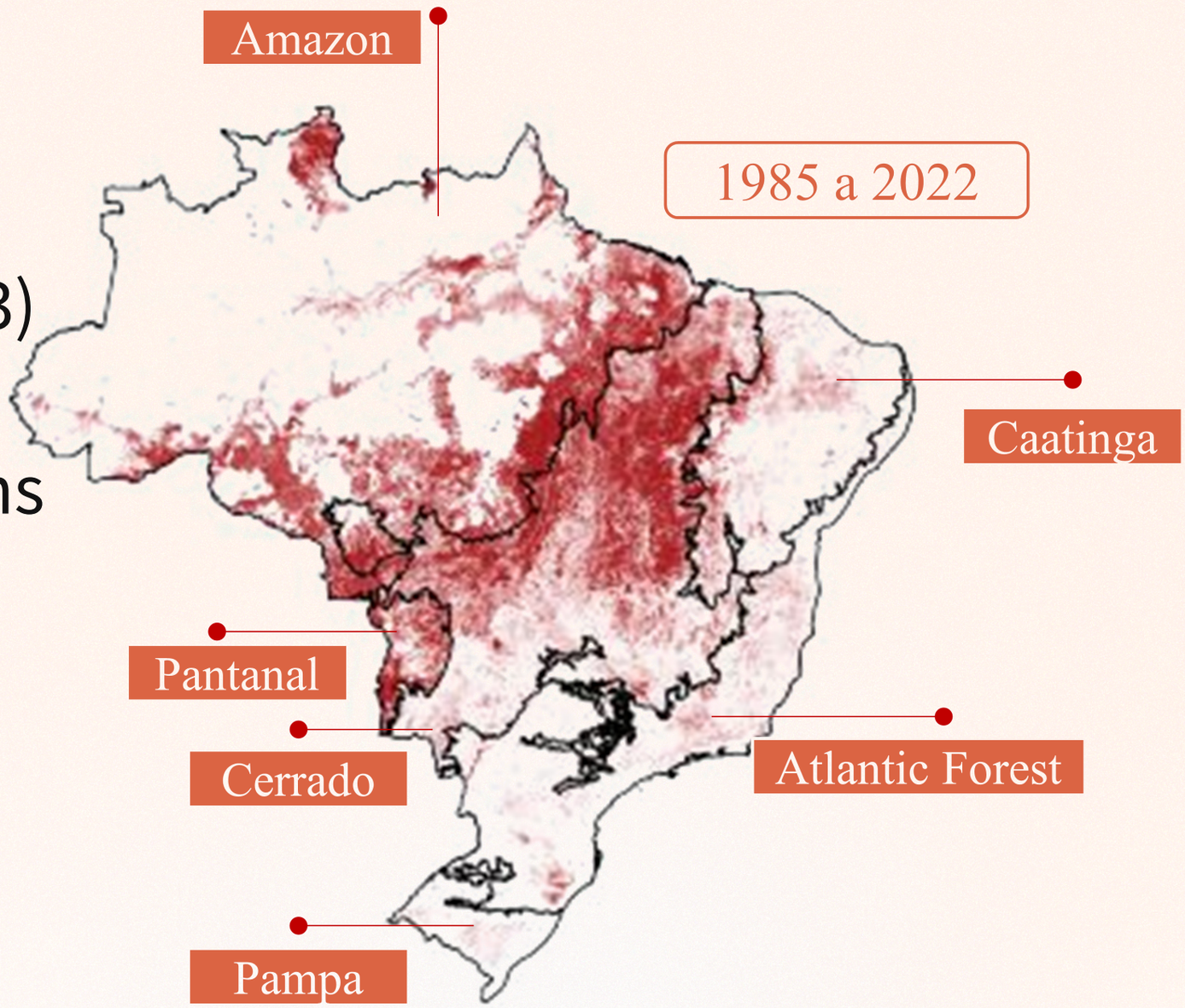
Introduction

- Since 1985, 21,8% (1,857,025 km²) of Brazil burned (Mapbiomas, 2023)
- Increasing of fire emissions
- Environmental and economic losses
- Loss of ~ U$ 300 million in Acre between 2008 - 2012 (Campanharo et al., 2019)



Cumulative burned area in Brazil (1985 – 2022)
Source: MapBiomas, 2023

Introduction

Bayesian inference

allows us to update our beliefs or predictions about an event or phenomenon based on new evidence or data

Maximum Entropy

helps estimate the most uncertain probability distributions while adhering to known constraints

- Limited info
- Unpredictable
- Complex interactions

Research Goals

1. Develop a new burned area model for Brazil using the Maximun Entropy concept

2. Assess the contribution of different factors in determining burned area probability in the Brazilian biomes

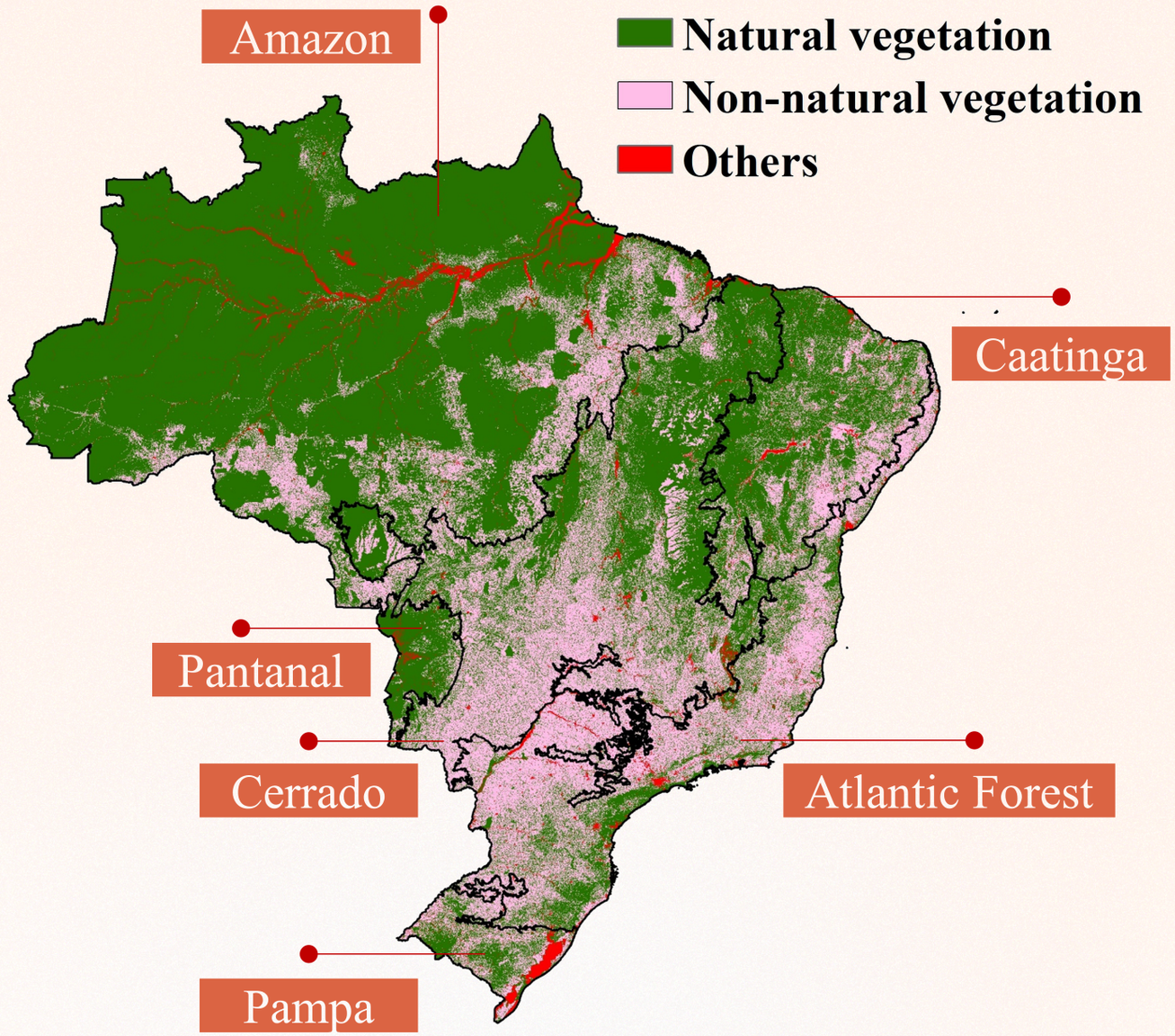
Approach

- FLAME model - Fire Landscape Analysis using the Maximum Entropy

- Divide into "fire types"

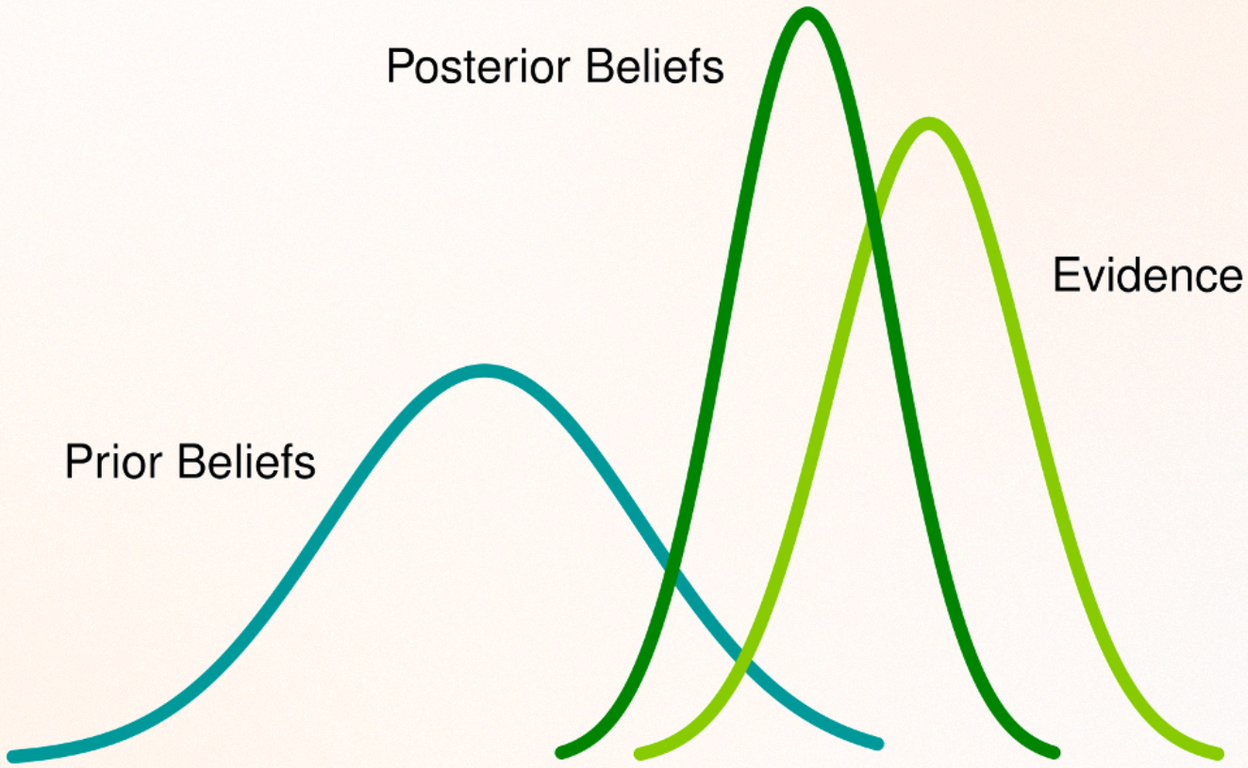
- Built one model to each biome; evaluate

- Identify the main drivers



FLAME

1. Modeling a probability distribution
2. Allow the quantification of uncertainties
3. Continuous data

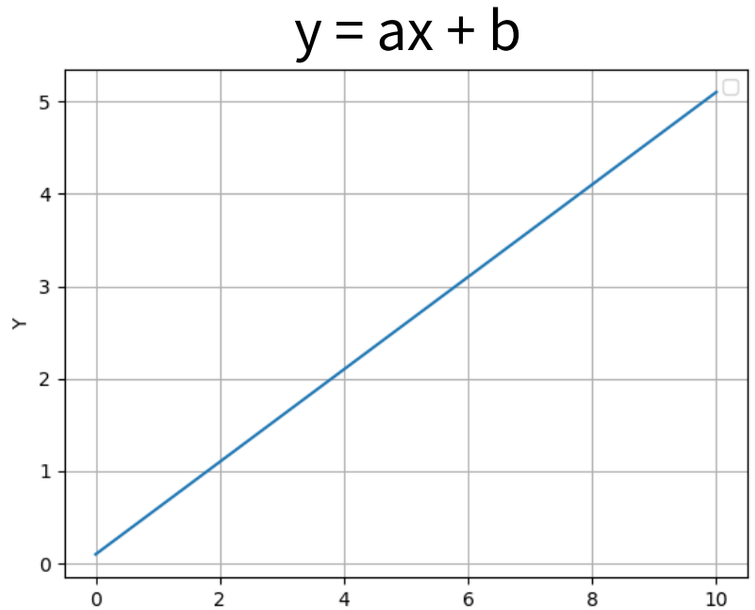


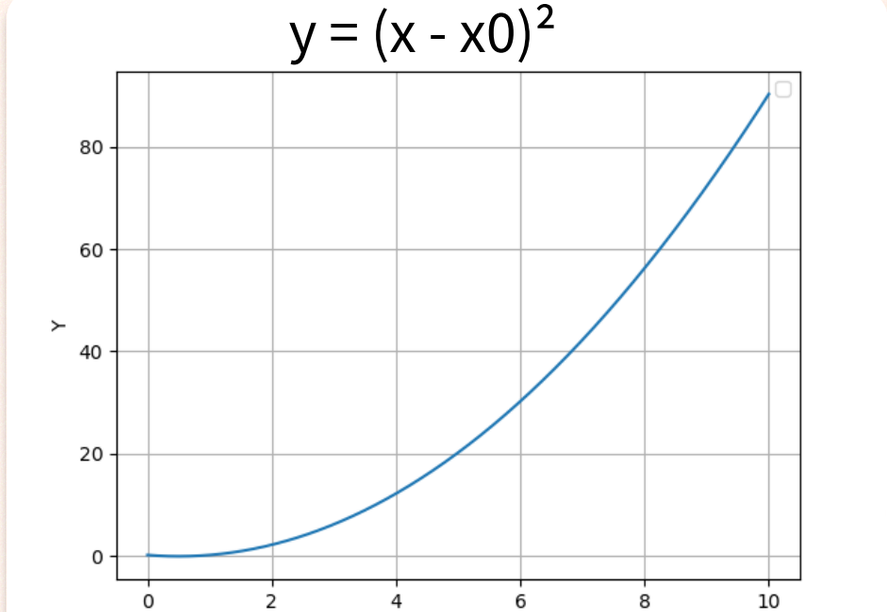
While seeking the most uncertain distribution that satisfies the priors

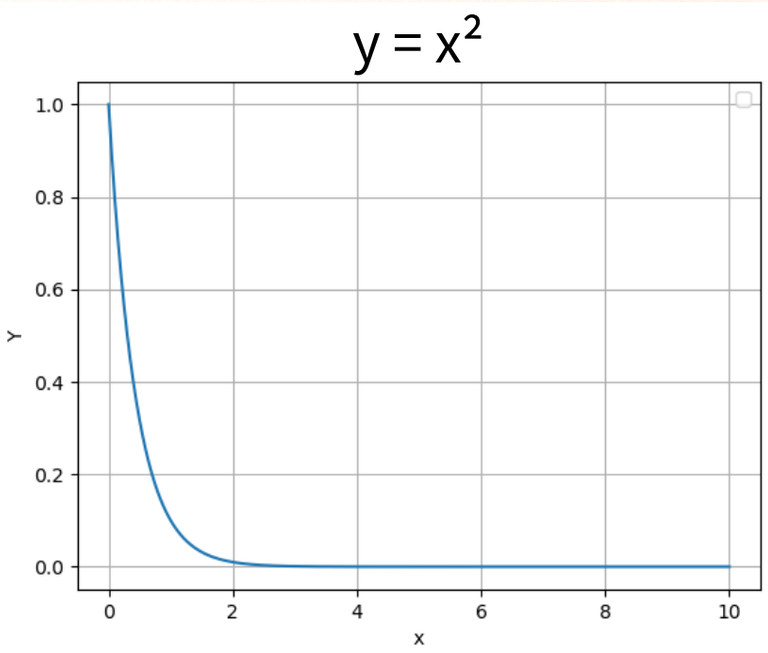
Relationship curves (priors)

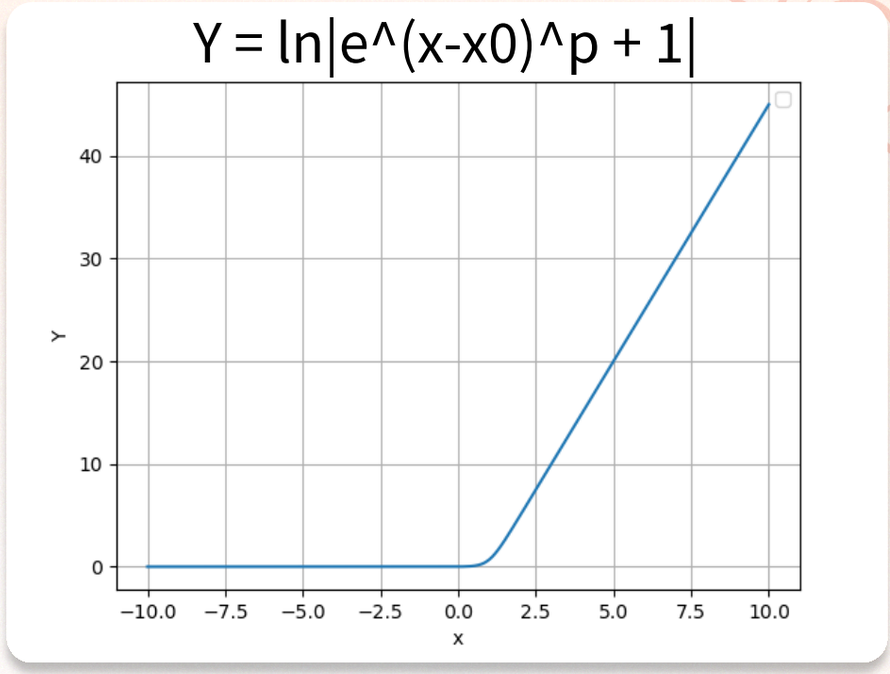
FLAME

We can always add more!









Variables

Training period - 2002-2011

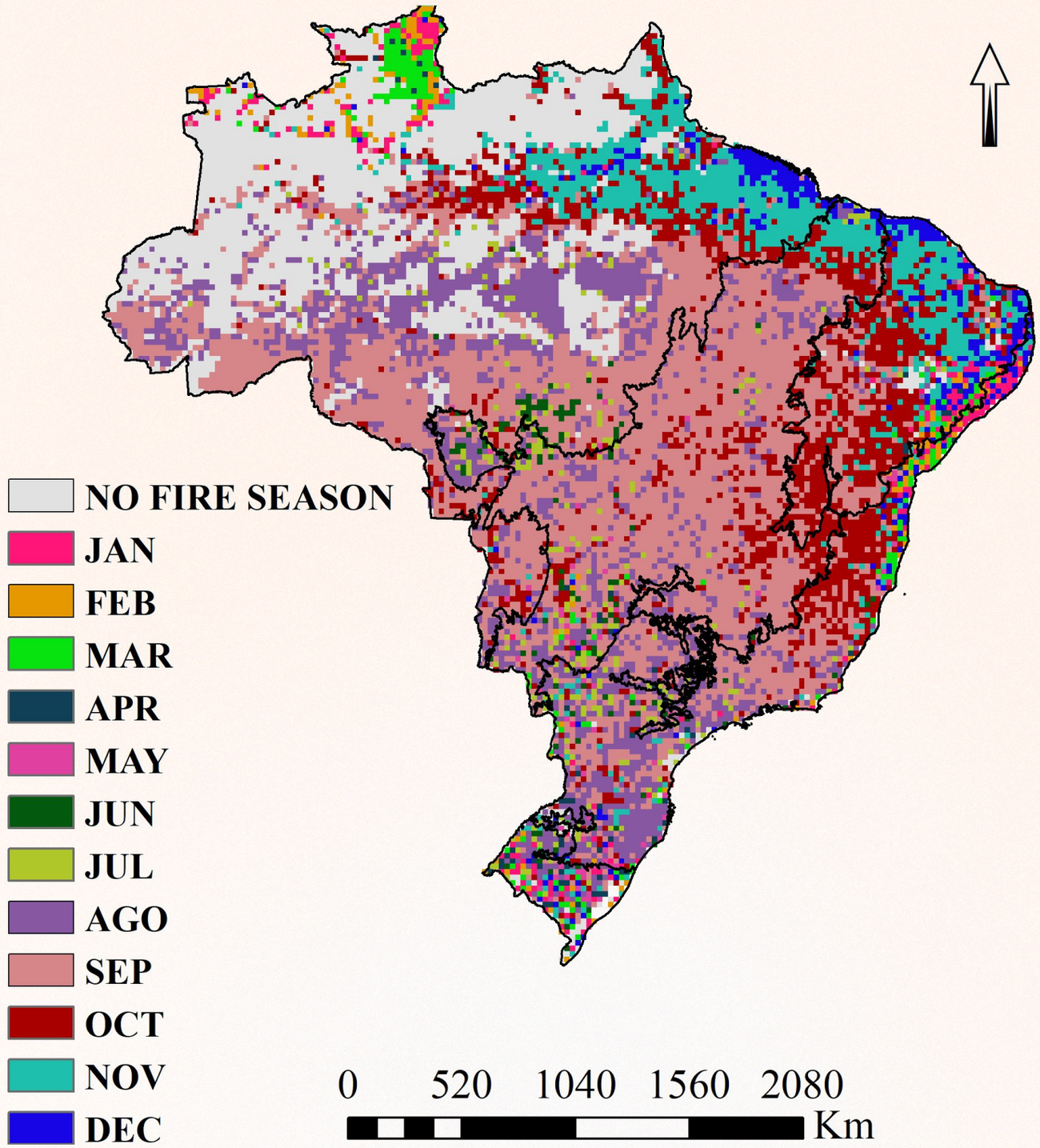
Forest configuration (calculated)	Number of patches, Mean patch area, Edge density and Total core area
LULC (Mapbiomas)	Forest, Grassland, Savanna, Pasture, Cropland, total vegetation
Climate (ISIMIP3A)	Consecutive dry days, Precipitation, Temperature, Relative Humidity, Vapour Pressure deficit, Soil Moisture
Fuel (JULES)	Carbon in live and dead vegetation
Ignition (ISIMIP3A)	Lightning, population density, distance to roads

Fire calendar

Peak Month:
month with the highest average number of active fires observed in the cell

Reference period:
2002-2021

Data: MCD64A1

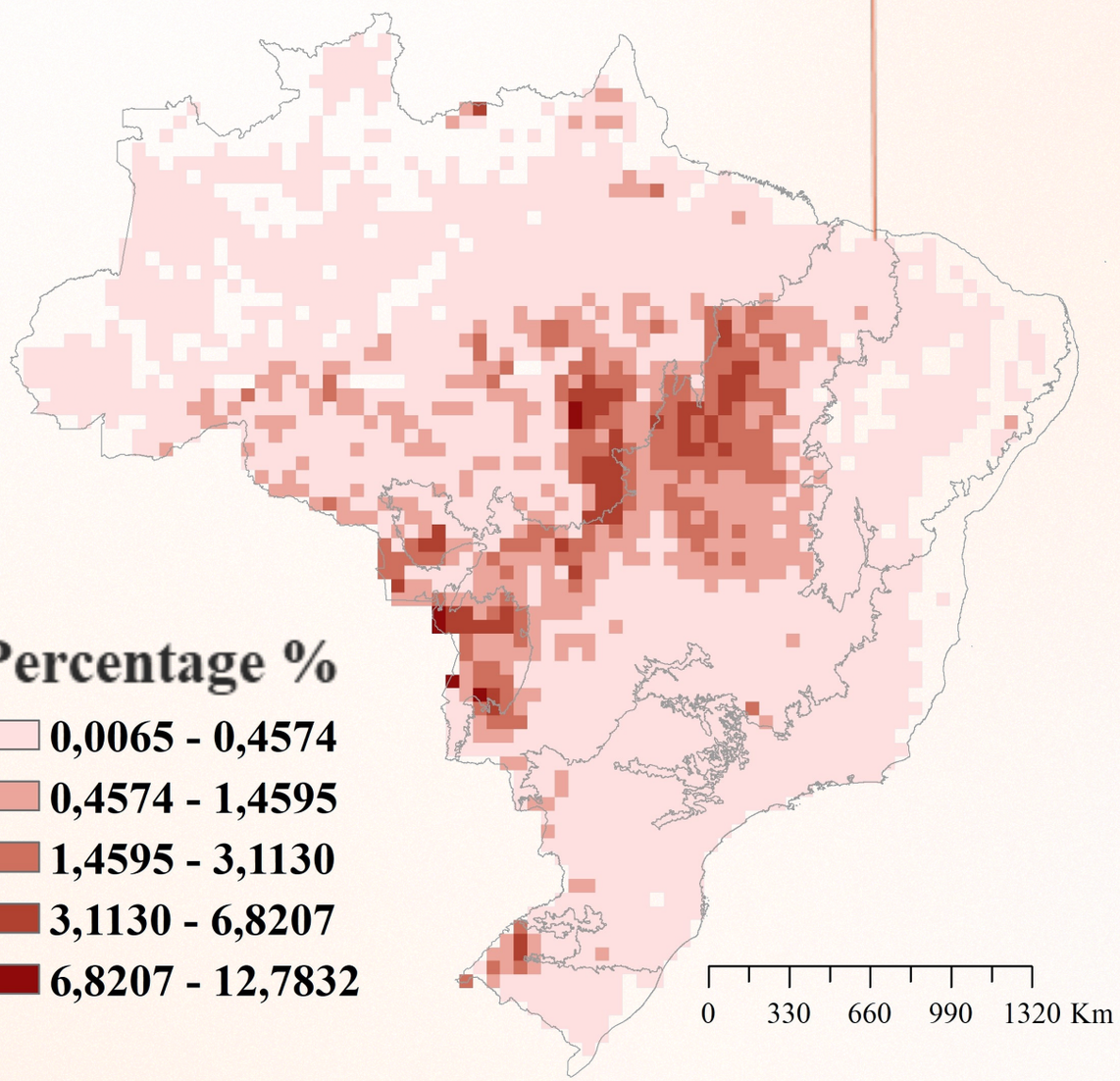


Divided fires

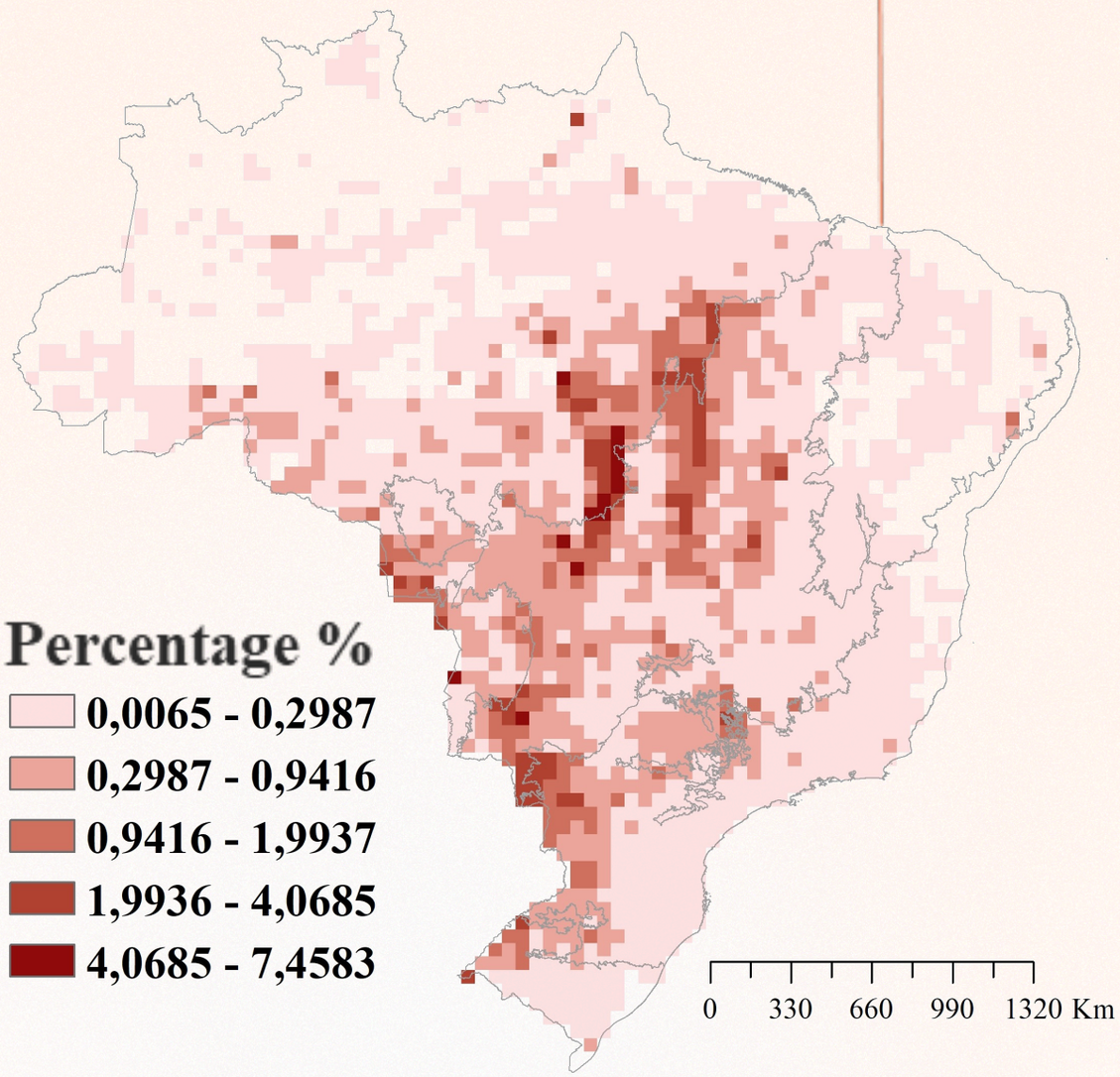
Average July, August and September
percentage (%) of burned area (2002-2021)

~ 55km grid

Natural

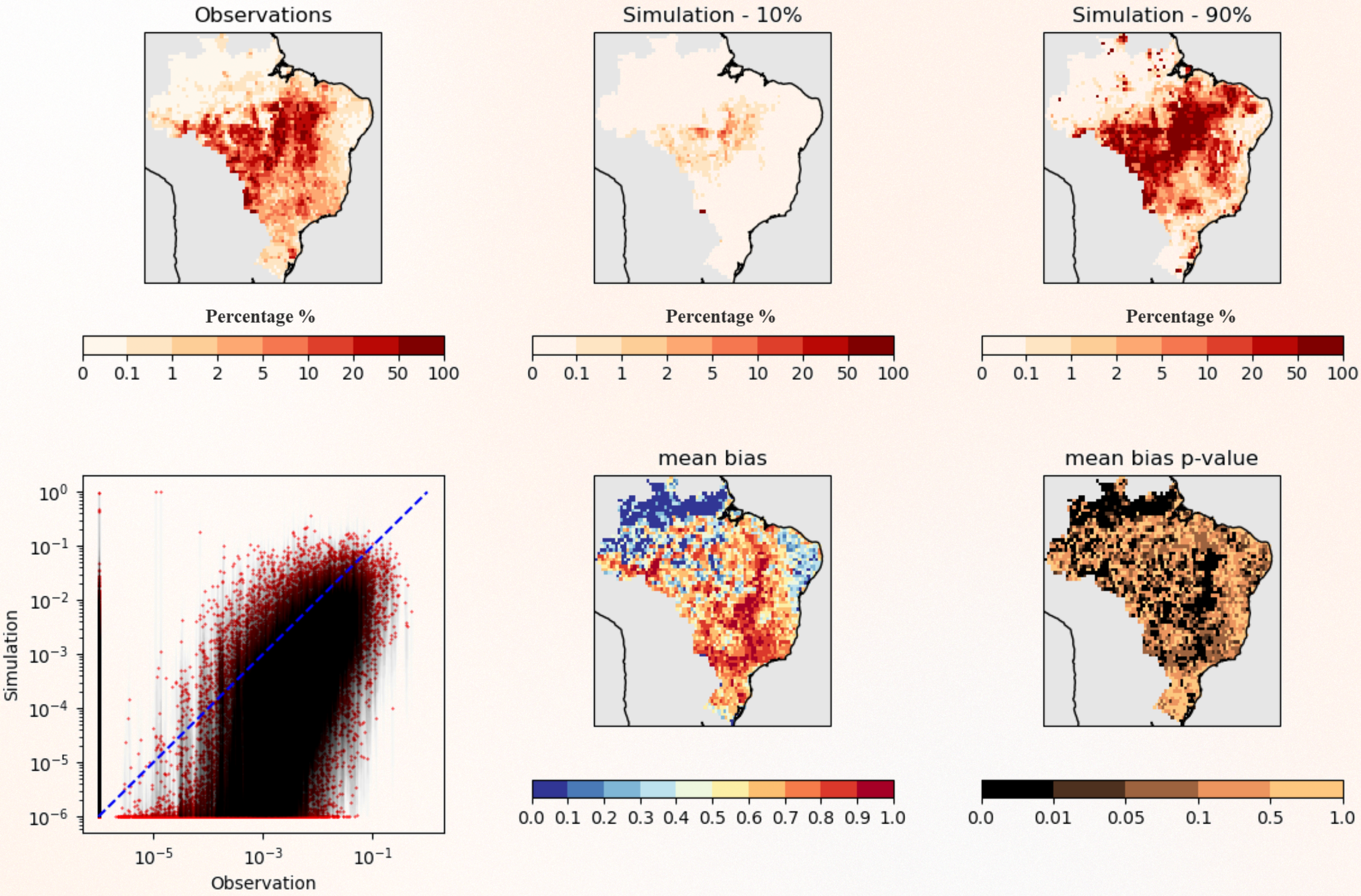


Non-natural

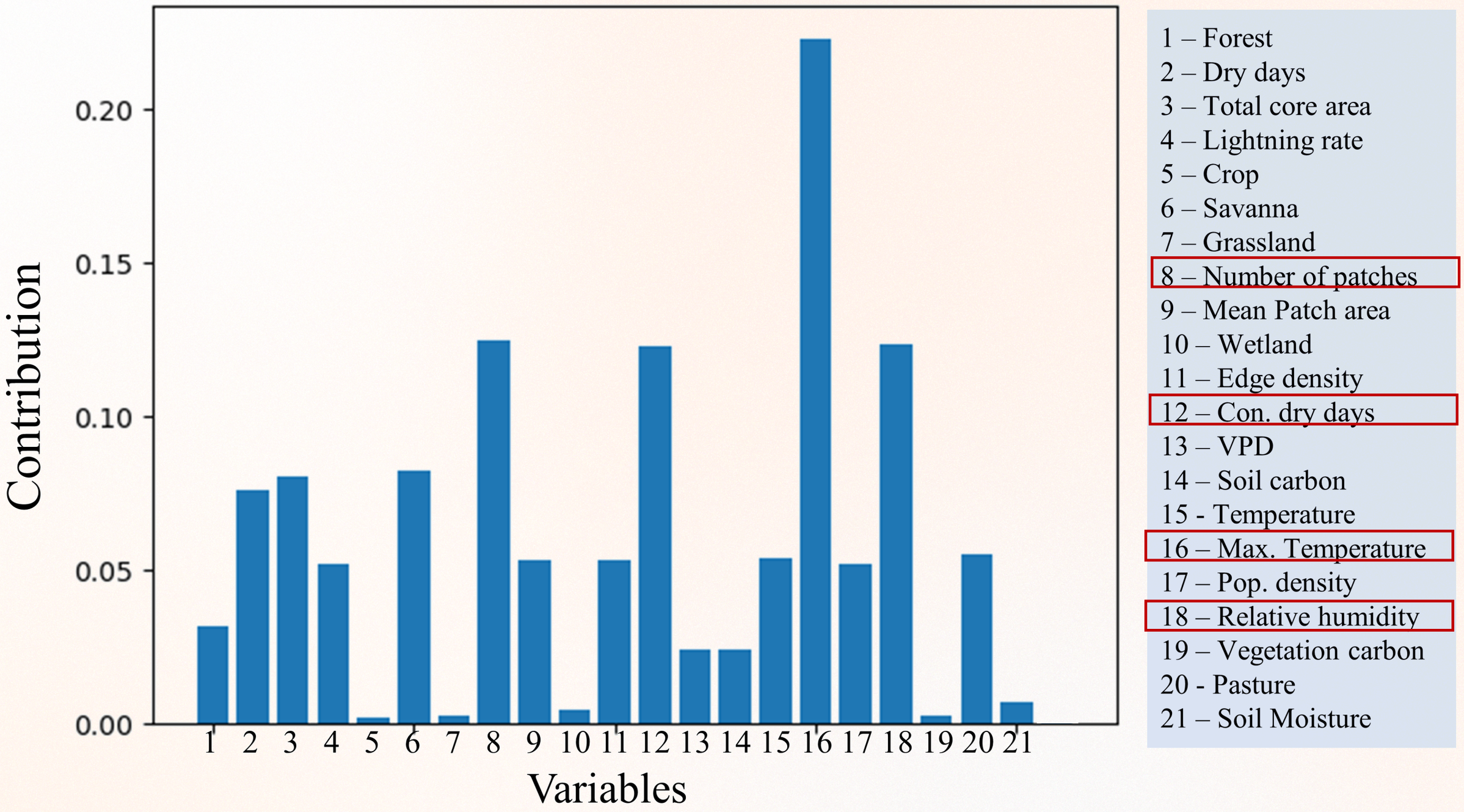


Results

Training period - 2002-2011
GDEF burned area - June



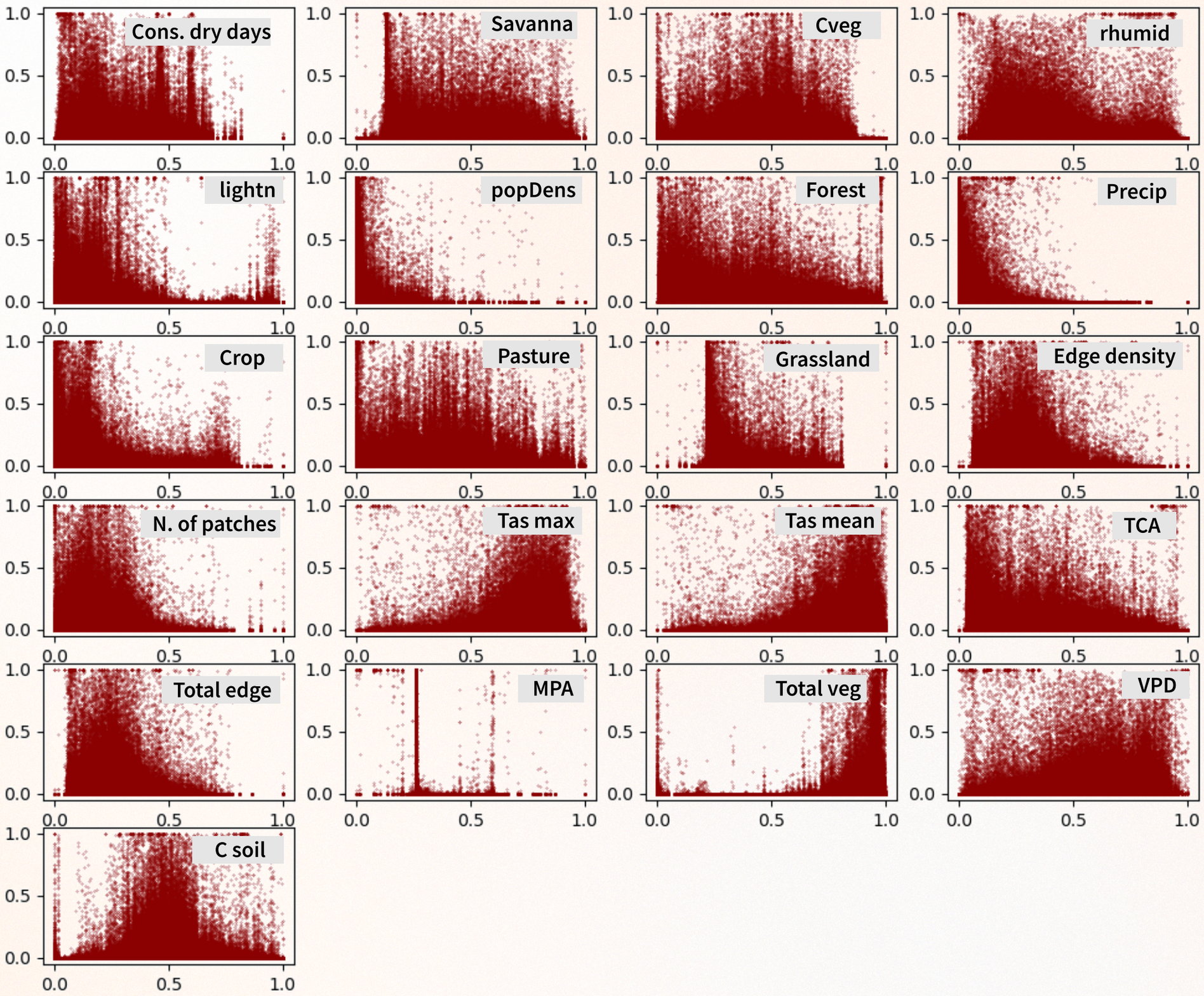
Variables contribution



1 – Forest
2 – Dry days
3 – Total core area
4 – Lightning rate
5 – Crop
6 – Savanna
7 – Grassland
8 – Number of patches
9 – Mean Patch area
10 – Wetland
11 – Edge density
12 – Con. dry days
13 – VPD
14 – Soil carbon
15 - Temperature
16 – Max. Temperature
17 – Pop. density
18 – Relative humidity
19 – Vegetation carbon
20 - Pasture
21 – Soil Moisture

Response curves

X axis = normalized variable
y axis = simulated burned area probability



Final considerations

- Promising results
- Divided fires need further look (assign weight for pixels)
- Replicable model in time and space
- Future fire projections
- Potential to assess other terrestrial impacts

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Thank you!
Obrigada!

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