Fires in the Cerrado Biome (Brazil), between 1999 and 2018

Maíra Iaê S. Rocha

Master's Degree student at

State University of Goiás, Goiás, Brazil

Diego Tarley F. Nascimento

Ph.D and Professor at

Federal University of Goiás, Goiania, Brazil

diego_nascimento@ufg.br

Introduction

- Fires are closely related to deforestation and agricultural activities in Brazil;

- Commonly utilized by traditional peoples, fires are used for cleaning pastures, preparing crops and burning bagasse.

- However, this practice has also been used for the deforestation of natural vegetation to incorporate agricultural activities, especially for the production of commodities.

Introduction

- The Amazon and the Cerrado stand out with the highest amounts of fires among the Brazilian biomes, in the period from 1998 to 2019;

- Although the Amazon presents the highest incidence of fire outbreaks throughout the historical series;

- the Cerrado remains in second place. In some of these years, the amount of fires in the Cerrado approaches that recorded in the Amazon – as seen in 2010.

Introduction

- The objective here is to analyze the spatio-temporal distribution of the fire outbreaks registered from 1999 to 2018 in the Cerrado;

- The study area comprises the Cerrado biome, considered one of the 34 hotspots for the conservation of global biodiversity (MITTERMEIER et al., 2004), occupies an area of approximately 2,036 km² - 24% of the Brazilian territory (Figure 1);
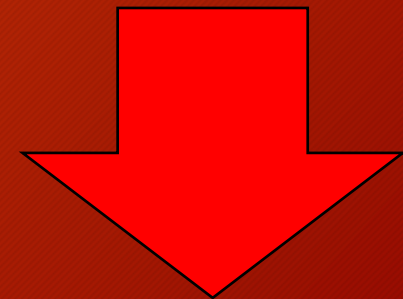
Figure 1

Location and soil cover of the Cerrado biome (2018).

Note: to view with higher quality and resolution, access the link: https://cutt.ly/0grNXJy
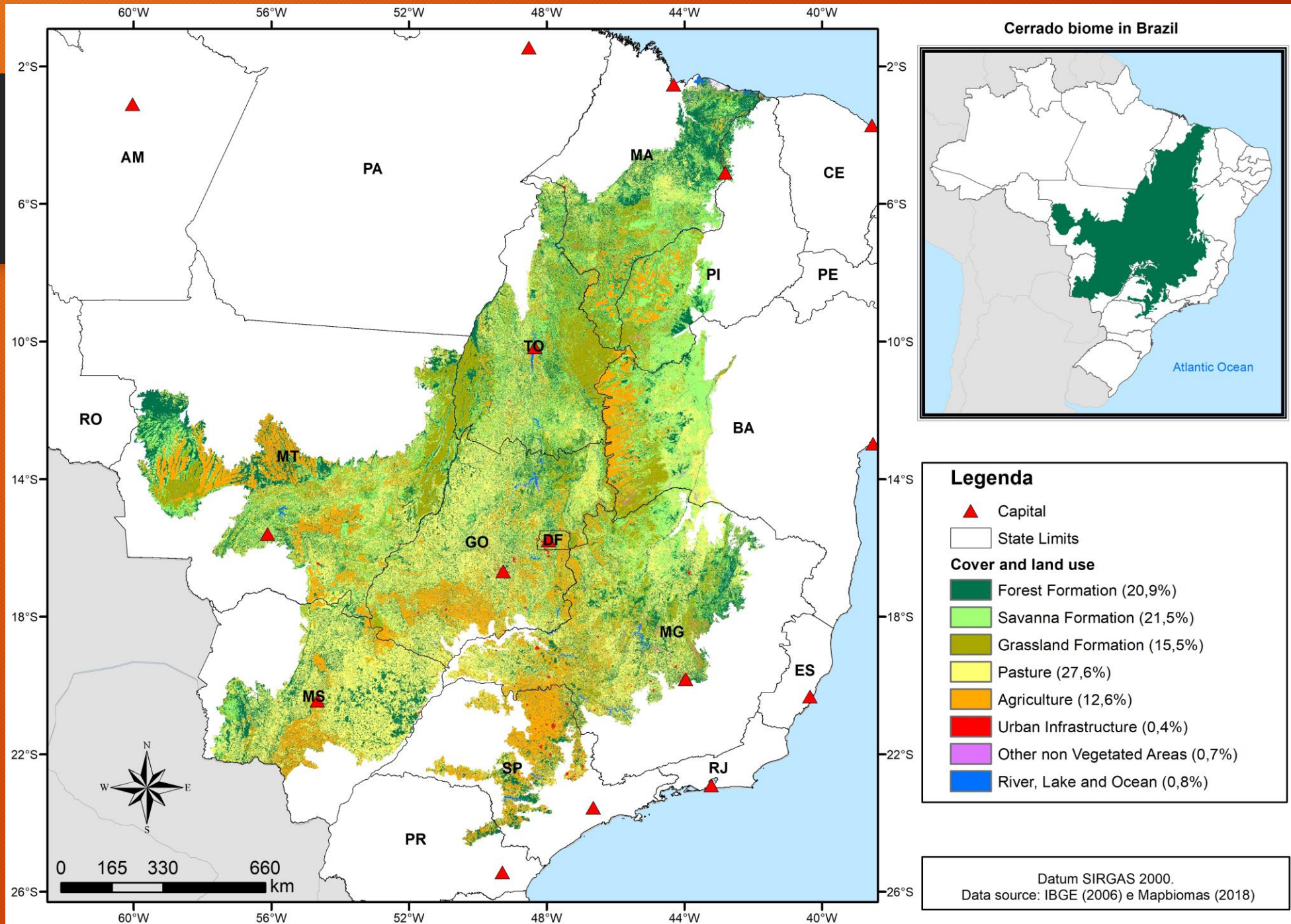
Method

- From the Burning Database of the National Institute for Space Research (http://queimadas.dgi.inpe.br/queimadas/bdqueimadas/), were obtained fire outbreaks (point data with number of set location (x, y)), in vectorial format, recorded in the Cerrado between 1999 and 2018;

- The data were treated in a Microsoft Office Excel and arranged in a ArcGIS version 10.3, for quantifying the fires outbreaks and estimating the spatial density by interpolation, using the kernel method.

Results

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1999	188	469	82	382	856	1.757	3.465	11.933	14.455	8.354	1.434	475	**43.850**
2000	266	89	114	253	914	2.556	2.530	6.995	10.117	9.038	1.149	372	**34.393**
2001	182	109	69	304	713	3.606	3.242	9.541	16.623	7.702	1.834	609	**44.534**
2002	368	355	391	777	1.884	4.210	7.462	17.815	30.105	16.744	5.273	1.802	**78.719**
2003	654	587	472	1.052	2.475	7.079	10.477	10.140	29.227	15.008	4.763	2.179	**84.113**
2004	452	376	773	970	2.975	7.047	8.804	12.473	33.509	15.148	8.243	2.792	**93.562**
2005	587	869	536	1.071	1.968	3.383	7.454	14.627	24.521	23.550	5.251	1.930	**85.747**
2006	1.001	413	498	584	1.650	3.415	6.442	11.705	16.566	7.524	5.274	1.808	**56.880**
2007	755	402	1.118	964	2.924	7.051	10.548	35.678	49.980	22.008	4.939	1.551	**137.918**
2008	421	321	339	590	1.320	2.632	5.229	8.643	15.477	17.024	5.486	1.452	**58.934**
2009	676	403	461	448	836	1.641	4.224	6.492	9.851	5.526	4.195	1.146	**35.899**
2010	717	751	883	1.438	2.508	6.443	12.359	35.226	52.491	14.419	4.623	1.536	**133.394**
2011	456	321	308	703	1.376	3.378	5.366	11.387	26.468	7.656	2.889	1.374	**61.682**
2012	421	478	764	1.092	1.896	3.817	9.362	22.737	30.053	16.515	1.830	1.635	**90.600**
2013	475	604	613	706	1.418	2.684	4.761	8.496	12.615	7.696	2.370	1.579	**44.017**
2014	567	315	497	897	1.673	3.849	6.220	15.525	15.523	16.357	3.085	1.363	**65.871**
2015	1.096	383	528	634	1.174	3.313	4.662	12.684	23.795	19.531	4.731	2.563	**75.094**
2016	392	1.048	767	1.449	1.782	3.187	8.675	13.730	13.256	9.968	3.647	932	**58.833**
2017	491	376	687	696	1.428	2.858	6.258	10.815	26.975	12.393	2.345	1.440	**66.762**
2018	521	235	842	549	1.729	2.922	5.220	7.992	11.467	5.041	1.763	1.168	**39.449**
Minimum	182	89	69	253	713	1.641	2.530	6.492	9.851	5.041	1.149	372	34.393
Maximum	1.096	1.048	1.118	1.449	2.975	7.079	12.359	35.678	52.491	23.550	8.243	2.792	137.918
Average	**534**	**445**	**537**	**778**	**1.675**	**3.841**	**6.638**	**14.232**	**23.154**	**12.860**	**3.756**	**1.485**	69.513
%	1	1	1	1	2	6	10	20	33	19	5	2	100

year with the highest record

the lowest occurrences

The average number of annual fire outbreaks

Results

August-September-October quarter that the highest incidence of fires occurs in the Cerrado, with an average of 72% of the annual amount of outbreaks

This period is consistent with the end of the drought and the return of the rains, when there is a renewal of pastures, the preparation of planting areas and the burning of bagasse

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1999	188	469	82	382	856	1.757	3.465	11.933	14.455	8.354	1.434	475	43.850
2000	266	89	114	253	914	2.556	2.530	6.995	10.117	9.038	1.149	372	34.393
2001	182	109	69	304	713	3.606	3.242	9.541	16.623	7.702	1.834	609	44.534
2002	368	355	391	777	1.884	4.210	7.462	17.815	30.105	16.744	5.273	1.802	78.719
2003	654	587	472	1.052	2.475	7.079	10.477	10.140	29.227	15.008	4.763	2.179	84.113
2004	452	376	773	970	2.975	7.047	8.804	12.473	33.509	15.148	8.243	2.792	93.562
2005	587	869	536	1.071	1.968	3.383	7.454	14.627	24.521	23.550	5.251	1.930	85.747
2006	1.001	413	498	584	1.650	3.415	6.442	11.705	16.566	7.524	5.274	1.808	56.880
2007	755	402	1.118	964	2.924	7.051	10.548	35.678	49.980	22.008	4.939	1.551	137.918
2008	421	321	339	590	1.320	2.632	5.229	8.643	15.477	17.024	5.486	1.452	58.934
2009	676	403	461	448	836	1.641	4.224	6.492	9.851	5.526	4.195	1.146	35.899
2010	717	751	883	1.438	2.508	6.443	12.359	35.226	52.491	14.419	4.623	1.536	133.394
2011	456	321	308	703	1.376	3.378	5.366	11.387	26.468	7.656	2.889	1.374	61.682
2012	421	478	764	1.092	1.896	3.817	9.362	22.737	30.053	16.515	1.830	1.635	90.600
2013	475	604	613	706	1.418	2.684	4.761	8.496	12.615	7.696	2.370	1.579	44.017
2014	567	315	497	897	1.673	3.849	6.220	15.525	15.523	16.357	3.085	1.363	65.871
2015	1.096	383	528	634	1.174	3.313	4.662	12.684	23.795	19.531	4.731	2.563	75.094
2016	392	1.048	767	1.449	1.782	3.187	8.675	13.730	13.256	9.968	3.647	932	58.833
2017	491	376	687	696	1.428	2.858	6.258	10.815	26.975	12.393	2.345	1.440	66.762
2018	521	235	842	549	1.729	2.922	5.220	7.992	11.467	5.041	1.763	1.168	39.449
Minimum	182	89	69	253	713	1.641	2.530	6.492	9.851	5.041	1.149	372	34.393
Maximum	1.096	1.048	1.118	1.449	2.975	7.079	12.359	35.678	52.491	23.550	8.243	2.792	137.918
Average	534	445	537	778	1.675	3.841	6.638	14.232	23.154	12.860	3.756	1.485	60.513
%	1	1	1	1	2	6	10	20	33	19	5	2	100

September, which reaches 33% of the annual amount of fire outbreaks

Results

in the north, northeast and northwest of the Cerrado predominance the highest density of fire outbreaks

The first two regions comprise the states of Maranhão (MA), Tocantins (TO), Piauí (PI) and Bahia (BA) –that form a region known in the literature as MATOPIBA, on of the most recent agricultural frontier in Brazil where fire is used as a management tool in agropastoral practices

The third region is denominate as "Arc of Deforestation", alluding to the intense devastation of the natural landscapes of this transition area (ecotone) between Cerrado, Amazon and Pantanal,
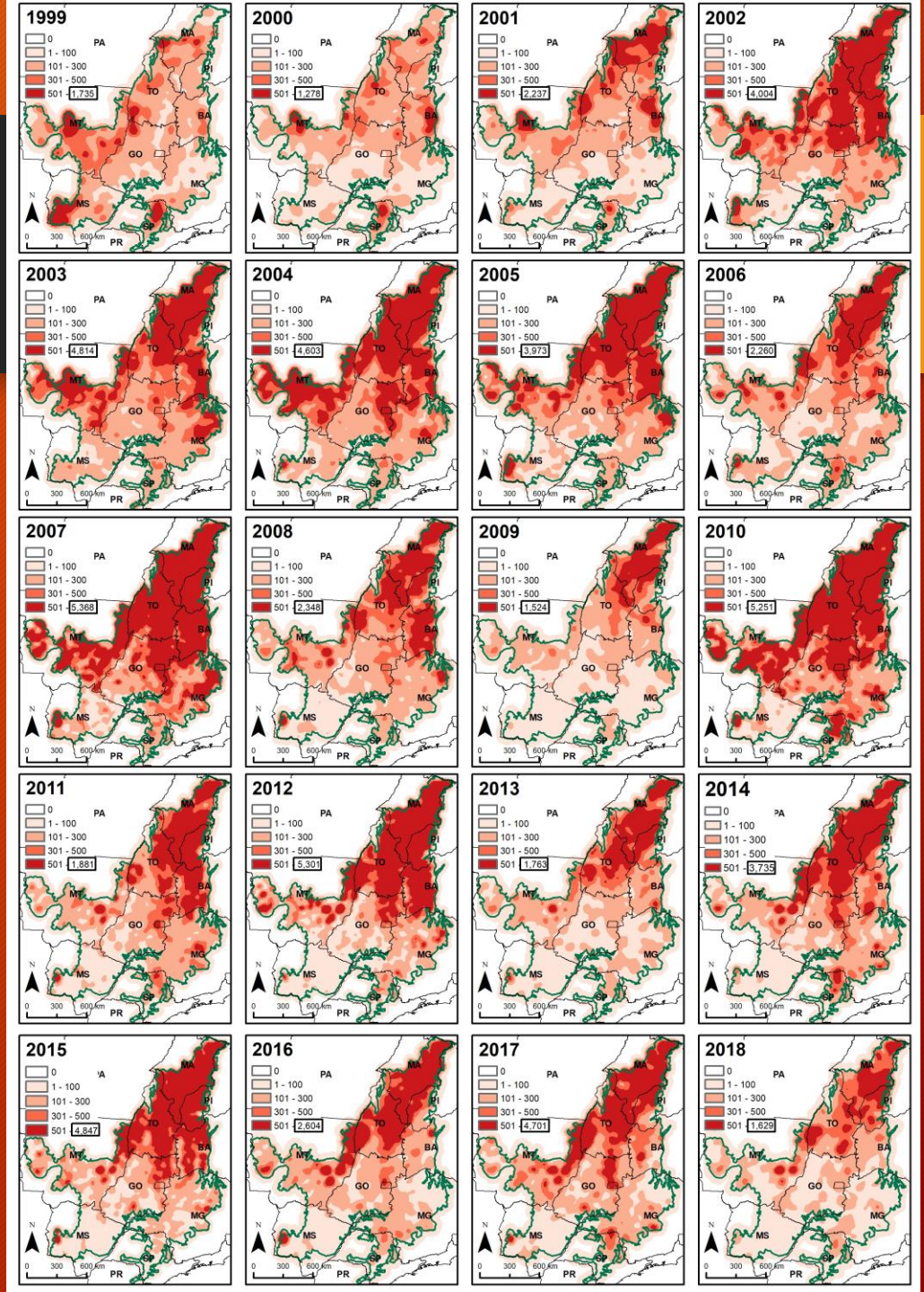
Discussion and Conclusion

- Between 1999 and 2018, the average occurrence of 65,513 fire outbreaks was recorded in the Cerrado biome, which can reach surprising amounts, such as 137,918 outbreaks (2007);

- There is an concentration of fires in the dry period, especially in the August-September-October quarter (72% of annual occurrences);

- Over the years, the largest amount of fire outbreaks occurs mainly in agricultural frontier areas, especially in the MATOPIBA region and Arc of Deforestation.

- The next step in our study is to undertake a rigorous and objective analysis of the data to identify trends over space and time, performing an emerging hot spot analysis.

References

- Barbosa, A. S. (2015). Um Bioma em Extinção. **Xapuri Socioambiental**, (4)

- Bond, W. J., keeley, J. E. (2005). Fire as a global 'herbivore': the ecology and evolution of flammable ecosystems. Trends Ecol. Evol., volume 20, issue 7, p. 387–394.

- Mittermeier, R. A., Gil, P. R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C. G., Lamoreux, J. & Fonseca, G. A. B. (2004). Hotspots revisited: earth's biologically richest and most endangered terrestrial ecoregions. México City: CEMEX.

- Projeto Mapbiomas (2018). Coleção 4.0 (1985-2018) da Série Anual de Mapas de Cobertura e Uso de Solo do Brasil. Disponível em <http://mapbiomas.org/> Acessado em 19 set. 2019.

- Nogueira, E. M., Fearnside, P. M., Nelson, B. W., França, M. B. (2007). Wood density in forests of Brazil's 'arc of deforestation': implications for biomass and flux of carbon from land-use change in Amazonia. For Ecol Manage, v. 248, n. 3, p.119–135.

- Nogueira, E. M., Nelson, B. W., Fearnside, P. M., França, M. B., Oliveira, A. C. A. (2008). Tree height in Brazil's 'arc of deforestation': shorter trees in south and southwest Amazonia imply lower biomass. For Ecol Manage, volume 255, issue 7, p. 2963–2972.

- Pereira, L. I., Pauli, L. (2016). O processo de estrangeirização da terra e expansão do agronegócio na região do Matopiba. Campo-território: revista de geografia agrária, 11(23). https://doi.org/10.14393/RCT112307

- Vieira Filho, J. E. R. (2016). Expansão da fronteira agrícola no Brasil: desafios e perspectivas. Rio de Janeiro: Ipea.