SEASONAL VARIABILITY OF VEGETATION AND ITS RELATIONSHIP TO RAINFALL AND FIRE IN THE BRAZILIAN TROPICAL SAVANNA

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INTRODUCTION

The Cerrado biome is the predominant tropical savanna vegetation of central Brazil. Most of the cerrado region, in the last 50 years, has been converted especially for agriculture and pasture purposes. This conversion has impacted the biological diversity, the hydrological cycle, the energy balance, the climate and the carbon dynamics at local and regional scales. In this sense, the knowledge of spatial distribution, temporal dynamics and biophysical characteristics of the vegetation types, are important elements to improve the understanding of how vegetation interacts with the atmosphere.

The objective of this study is to determine the relationship of environmental variables such as precipitation and fire with the patterns of spatial and temporal distribution of the main vegetation type, in the Brazilian tropical savanna.

In this study, the potential of multi-temporal MODIS VI products for land cover mapping, mainly the cerrado physiognomies, by the use of remote sensing and geographic information systems (GIS) techniques, are explored.

MATERIAL AND METHODS

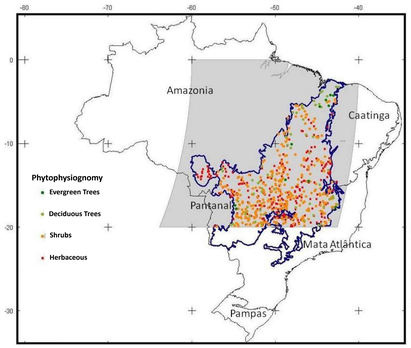

Fig. 1. Map of the Brazilian biomes with the study area within the savanna (Cerrado) biome. Gray area indicates the MODIS tiles and grid of points indicates the kind of sampling.

- Four MODIS-NDVI tiles (h13v09, h13v10, h12v09 and h12v10).
- Years: 2002, 2005 and 2008 (23 images for each year).
- Daily precipitation data.
- Daily fire spot data.

- The methodology consists of the spatial and temporal analysis of the following variables: precipitation, density of fire spot and vegetation (derived from normalized difference vegetation index-NDVI) for the years of 2002, 2005 and 2008.
- The temporal resolution is 23 periods of 16 days each to complete a year and the spatial resolution is 1 km to the vegetation indices and density of fire spots, and 20 km for precipitation.
- Points randomly distributed along the entire biome were sampled (N=800) to perform statistical analysis (Correlations and multiple regression models).

Phytophysiognomies:
E1, Herbaceous; **E2**, Shrubs; **E3**, Deciduous Trees, **E4**, Evergreen Trees.

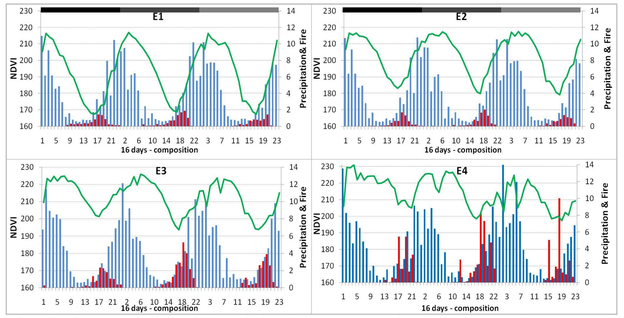

Fig. 3. Seasonality of Precipitation, Fire and NDVI for each phytophysiognomy (E1, E2, E3, E4)

Table 1. Correlations of NDVI, Precipitation and Fire variables for each phytophysiognomy

	PREC- E1	PREC- E2	PREC- E3	PREC- E4	FIRE- E1	FIRE- E2	FIRE- E3	FIRE- E4
IV- E1	0,60	0,58	0,67	0,70	-0,72	-0,70	-0,60	-0,46
IV- E2	0,52	0,51	0,60	0,65	-0,73	-0,74	-0,66	-0,48
IV- E3	0,20	0,19	0,31	0,36	-0,71	-0,75	-0,73	-0,56
IV- E4	0,0	-0,01	0,16	0,09	-0,54	-0,60	-0,64	-0,52

Table 2. Regression summary for all variables by phytophysiognomies

	Multiple R	Multiple R²	Adjusted R²	F(2,66)	p	Std.Err. of Estimate
E1	0.82	0.67	0.66	65.90	0.000000	9.55
E2	0.81	0.65	0.64	61.11	0.000000	7.30
E3	0.74	0.55	0.54	40.63	0.000000	6.41
E4	0.52	0.27	0.25	12.44	0.000026	8.12

		Beta	Std.Err. of Beta	B	Std.Err. of B	t(66)	p-level
E1	Intercept			191.953	2.322	82.661	0.000
	Prec	0.404	0.075	2.069	0.385	5.377	0.000
	Foco	-0.589	0.075	-20.831	2.658	-7.837	0.000
E2	Intercept			202.313	1.668	121.323	0.000
	Prec	0.334	0.076	1.245	0.282	4.416	0.000
	Foco	-0.648	0.076	-16.397	1.918	-8.551	0.000
E3	Intercept			214.729	1.464	146.694	0.000
	Prec	0.143	0.085	0.407	0.241	1.685	0.097
	Foco	-0.695	0.085	-5.653	0.690	-8.193	0.000
E4	Intercept			217.085	1.706	127.266	0.000
	Prec	-0.022	0.107	-0.061	0.295	-0.207	0.836
	Foco	-0.527	0.107	-2.346	0.477	-4.922	0.000

RESULTS AND DISCUSSIONS

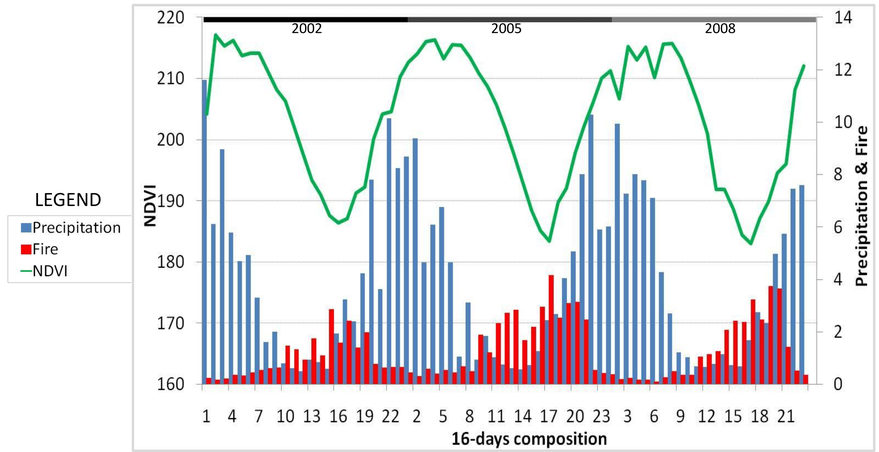

Fig. 2. Seasonality of Precipitation, Fire and NDVI for the savanna region

- The correlations analysis between environmental variables (precipitation and fire) and vegetation variable (NDVI) indicate that phytophysiognomies of low stratum (herbaceous and shrubs) were better correlated than high stratum (evergreen trees and deciduous trees).
- The multiple regression analysis indicate that there is a direct relationship between precipitation and fire, and vegetation index (NDVI) in the four phytophysiognomies of the savanna vegetation.

CONCLUSIONS

- The MODIS vegetation index products are useful to monitoring the seasonality of the savanna phytophysiognomies.
- There is a direct relationship between the seasonality of precipitation, density of fire spot and vegetation types analyzed along the savanna biome.
- Precipitation increases are related to increases in vegetation cover and decreased in density of fires spots. It was also found high density of fires spot in the dry season in deciduous trees, shrubs and herbaceous which indicates the high removal of CO2 (greenhouse gas) of the land cover to the atmosphere somehow influencing the dynamic equilibrium of this (atmosphere) in the region of the Brazilian tropical savanna.

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