OPEN JOURNAL SYSTEMS
ISSN:2237-2202

Available on line at Directory of Open Access Journals

Journal of Hyperspectral Remote Sensing v.6, n.4 (2016) 219-224
DOI: 10.5935/2237-2202.20160022

Journal of Hyperspectral Remote Sensing
www.ufpe.br/jhrs

Detection of spread fire at the mesoregion of Paraíba backwoods

José A. V. Pereira*, Janaína B. da Silva**

*Student in Geography, Federal University of Campina Grande - UFCG, R. Aprígio Veloso, 882, Bairro Universitário. Campina Grande – PB/Brazil. E-mail: joseantoniovilar36@gmail.com.
** Professor of Geography of the Academic Unit of the Federal University of Campina Grande – UFCG.

Received 10 may 2016; accepted 08 june 2016

Abstract

The spread fire is an early agricultural technique widely used in Brazil; such technique causes serious harm to environment as well as damage to human health. Knowledge of spread fire cause and their localization is important for taking preventive measures. In Brazil, the National Institute of Spatial Research (INPE) manages the spread fire by detecting heat spots. The objective of this research was to identify the main heat spots over the mesoregion of Paraíba backwoods' at the year of 2014. It was used heat spots' data captured by the MODIS sensor, which is onboard of the AQUA_M-T satellite. It was registered heat spots in 56 of 83 cities inside the backwoods' mesoregion, summing up to 304 heat spots. The occurrence of spread fire huddled mainly between July and December, months of drought in the studied area, therefore, it was concluded that the phenomenon is a product of the climate features which act simultaneously together with human deed related mainly to agriculture, where the fire is used by farmers as a tool for handling animal husbandry.

Keywords**:** Heat spots, spread fire, Remote Sensing.

1. Introduction

Spread fires consist of a widely used agricultural equipment in Brazil, according to Miranda et al. (2006) and used both in primitive ways by farmers as well as in production systems highly intensified as the sugarcane. According to Vasconcelos et al. (2005), this practice causes various damage to the environment as emissions of greenhouse gases, reduction of biodiversity and the depletion and soil erosion.

Brazil is the leader among the countries of South America spread fires, and this phenomenon is concentrated in the Midwest, North and Northeast respectively (INPE, 2015). According to the Brazilian Agricultural Research Corporation (EMBRAPA, 2010) human actions are the main causes of these fires.

In northeastern Brazil, fires arise with greater intensity during the dry season, especially in years that is the El Niño phenomenon. In Africa, the effects of this phenomenon anticipate agricultural spread fire, extending the traditional period, increasing the occurrence of fire outbreaks throughout the year (Brumatti, 2012).

Knowing what the causes are and where fires occur with greater intensity is important to create plans to prevent and fight the fire. For Fonseca and Ribeiro (2003) preventive activities are most effective when based on information such as which areas catch fire more often and which favored its happening in these areas.

Through this perspective, Santos et al. (2011) state that geotechnology emerge as an important resource for identifying spread fires allowing locate, quantify and make studies of areas of spatiotemporal analysis where there are fires. An important tool for this identification is the Remote Sensing allowing cross georeferenced information and know the amount and location of heat sources (Tomzhinski et al., 2011).

Since 1980 in Brazil, the National Institute for Space Research (INPE) has been perfecting a system using satellite-sensing images for the detection of fires. They are called hot spots which according Gontijo et al. (2011) are geographical points obtained by space borne sensors when detected a temperature above 47 °C in a minimum area of 900 m².

Thus, the objective of this research was to identify the main hot spots in the middle region of Paraiba backlands in 2014, aiming to understand the factors that determine the causes and intensity of this phenomenon in the area.

2. Materials and methods

2.1 Study Area

The middle region of the Hinterland has an area of 22,720 square kilometers, is located in the state of Paraiba between parallels 6 ° and 8 ° S and between the meridians 37 ° and 38 ° W (Figure 1). In 2015 presents 83 municipalities, all inserted in the area considered semi-arid. According to Köppen the climate is Bsh (hot semi-arid) (Rodriguez, 2012; IBGE, 2015).

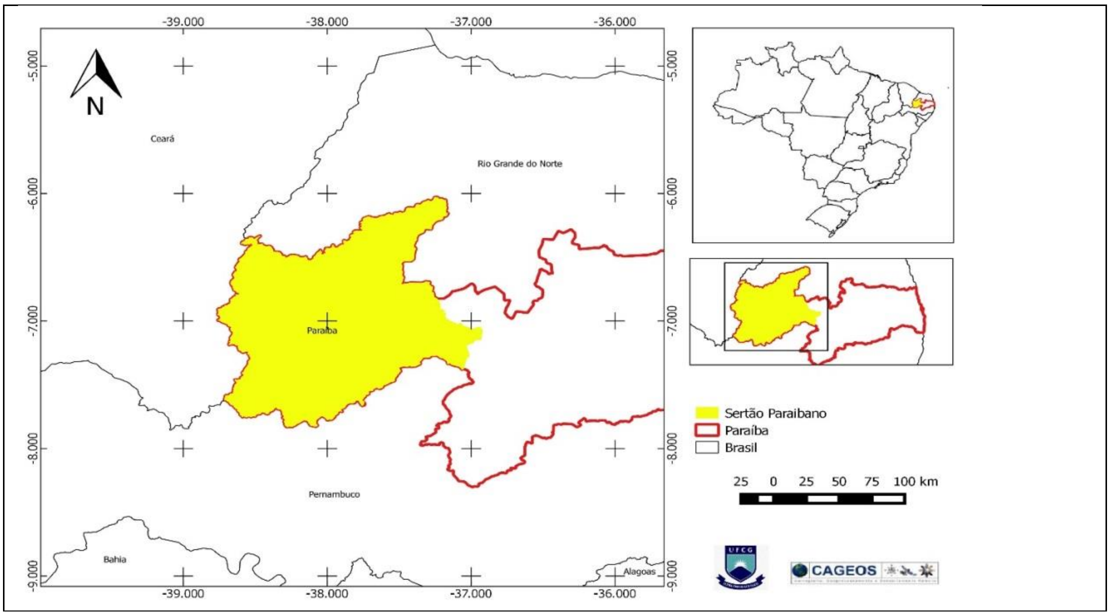

Figure 1- Location of the study area. Database: AESA (2015).

2.2 Choose the statistical method for the selection of municipalities

For the selection of municipalities and identification of critical areas in terms of spread fire, a test was performed between two statistical measures. The arithmetic mean is which was added to the data and divided by the total number of observations. The median observation that divides the data set in half when the data are arranged in ascending order. The best fitted was used as a criterion.

To calculate the arithmetic mean was used to equation 1:

$$X = \sum_{i=1}^{n} X_i /n \qquad (1)$$

Where: Σ is a symbol indicating the sum in mathematics, n is the number of elements of the series or sample, i = 1 indicates that the sum begins with the first element of the series, x_i are the values of each element of serious and X indicates the value of simple arithmetic average.

Equation 2: used for median:

(2)

$$Md = Li + \frac{\left(\frac{n}{2}\right) - Fa}{f_{md}} h_{md}$$

Where: **Li** is the lower limit of the class containing the median; **n** is the number of set of data elements, **Fa** is the sum of the frequencies of the above classes to containing the median, **fmd** is the frequency of the class containing the median and **hmd** is the amplitude of the class containing the median.

After the tests, the median was chosen as selection criteria. It observed that the arithmetic mean failed to draw the correct profile of the analyzed group, due to the data set to present outliers, that is, very low and very high numbers, making the result was influenced could divert the selection of municipalities which in fact did not present such high numbers of outbreaks, thus leading to a false result.

2.3 Spotlights heat

Data on heat sources used for this research refer to the year 2014 and were obtained through spread fires Database (BDQUEIMADAS) INPE, available in shapefile format free access on the internet. These data are generated from various methodologies using satellite images in polar orbit of NOAA, EOS (TERRA and AQUA) and satellites in orbit geo seasonal GOES and METEOSAT (INPE, 2015).

For the development of this study were chosen data detected by the sensor Spectrum Imager Radiometer Moderate Resolution (Moderate Resolution Imaging Spectroradiometer) or MODIS who is aboard the AQUA_M-T. Goddard Space Flight Center Aeronautics developed the MODIS and National Space Administration (NASA) in 36 spectral channels operates at a wavelength ranging from 0.4 to 14,4μm and spatial resolution of 250 to 1000 m. For identifying spread fires scientific team responsible for creating the MODIS sensor, developed the MOD14 fire detection algorithm, which provides the location of hot spots based on energy emitted by spread fire at wavelengths of 4 micrometer (channel 21:22) and 11 micrometer (channel 31). In addition to the monitoring of fires, the MODIS sensor is also used for the measurement of properties of clouds, radiant energy flow, aerosol properties, changes in the use and coverage of land, volcanic activity, among others (Piromal et al., 2008; EMBRAPA, 2013).

3. Results and discussion

Orbital monitoring of fires recorded between the months of January to December 2014 hotspots in 56 of the 83 municipalities that make up the middle region of the Hinterland, totaling 304 outbreaks (Figure 2).

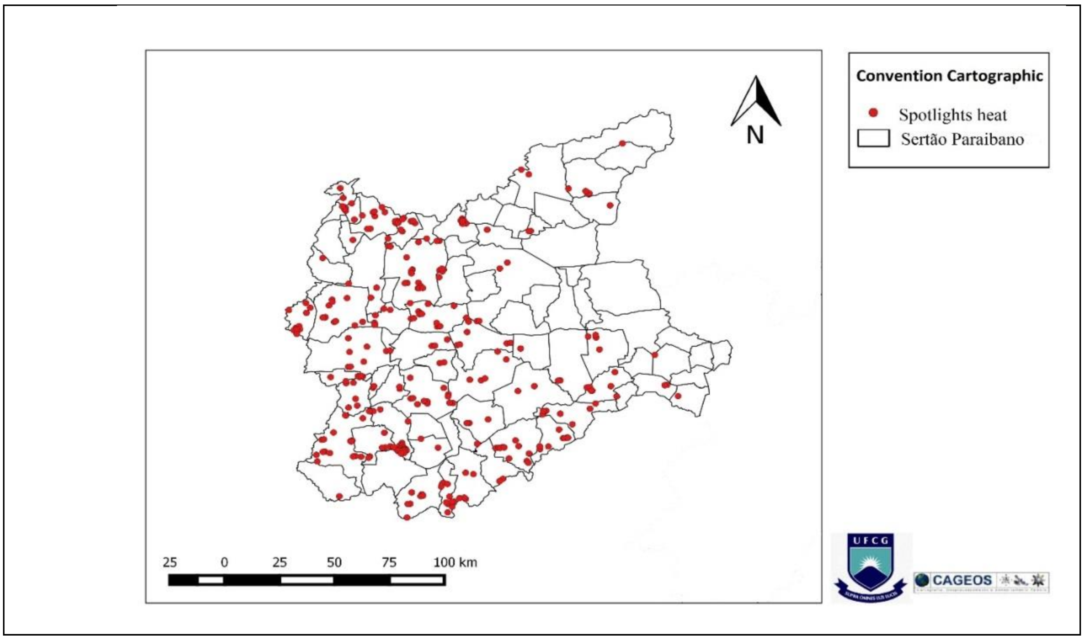

Figure 2- Spotlights Detected Heat in 2014. Database: INPE, 2015 and AESA in 2015.

Of the municipalities that make up the area, they had 28 number above the median outbreaks, which was 3.5 (Table 1). The high concentration focuses on the number of municipalities 33.7%, these possibly related to the characteristics of semi-arid climate. According to Moreira (2002) the rains in this area occur from December to April with prolonged drought, which can reach seven months, annual rainfall totals ranging around 800 to 1,000 mm, the relative humidity is around 70% the annual temperature range is about 10°C and the average temperature is 27°C with maximum around 34°C.

Table 1: Municipalities with above median outbreaks. Database: INPE, 2015.

County	**Outbreak**	**County**	**Outbreak**
Água branca	08	Nazarezinho	05
Bonito de Santa Fé	08	Piancó	07
Brejo do Cruz	04	Pombal	04
Cachoeira Índios	11	Princesa Isabel	07
Cajazeiras	11	Santa cruz	06
Conceição	18	Santa Teresinha	04
Coremas	06	Santana de mangueira	06
Diamante	26	Santarém	06
Ibiara	07	São José da lagoa tapada	11
Imaculada	07	São José de piranhas	07
Itaporanga	11	São José de princesa	08
Juru	11	Sousa	23
Mãe D'Água	06	Uiraúna	11
Manaira	09	Vieirópolis	09

Analyzing Figure 3, which brings the temporal distribution of detection of hot spots throughout the year, found that between the months of February to June was not registered the occurrence of outbreaks, which rules out the possibility caused fires by lightning because this is usually the wettest period of the middle region. The occurrence of outbreaks concentrated in January and between July and December, months that comprise the dry season in the area, this factor associated with dry vegetation, low relative air unit and high temperatures facilitate the development and spread fires.

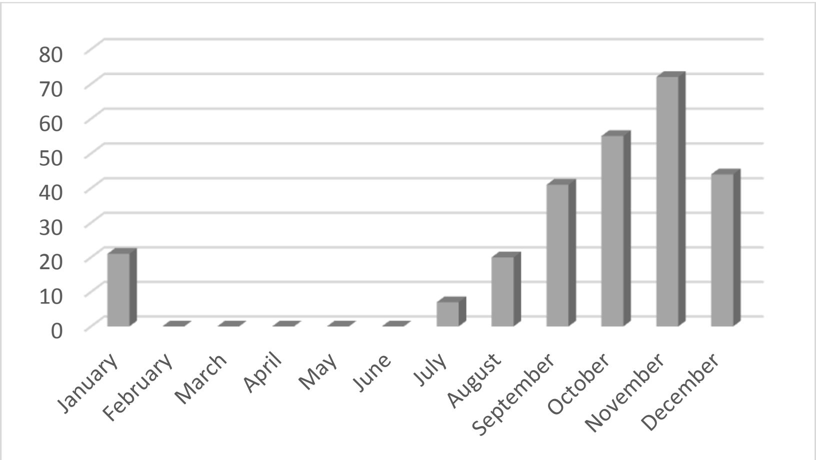

Figure 3- Temporal distribution of occurrence of hot spots. Database: INPE (2015).

The climatic characteristics provide favorable conditions for the occurrence of spread fire of anthropogenic sources. This middle region, according to Rodriguez (2012), stands out in the state by the size of cattle raised in extensive system, requiring large areas of pasture; these are usually created through the use of fire. These observations are consistent with studies by Vasconcelos et al. (2005) studied the evolution of fires in 2003 and 2004 in the regions of Madre de Dios in Peru, Acre in Brazil and Pando in Bolivia where it was found that the fires are used intentionally by livestock farmers for maintenance of pastures.

Spread fire is a phenomenon that occurs throughout the state of Paraiba from climate characteristics that act in conjunction with human actions practiced mainly through agriculture. However, analyzing the Figure 4, we find that the Hinterland was the middle region with the highest concentration of hotspots in relation to other meso state, 69% of outbreaks, followed by Mata with 16% Agreste with 10% and last Borborema 5% of the total.

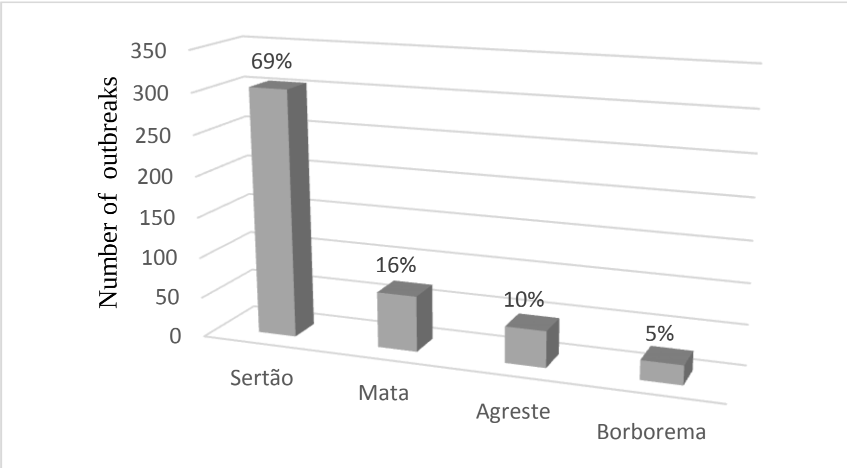

Figure 4- Distribution of outbreaks by meso. Database: INPE (2015).

4. Final considerations

Spread fire is a state phenomenon, however through the orbital monitoring of hot spots was found that this phenomenon occurs with greater intensity in the middle region of the Hinterland. By analyzing the temporal distribution of outbreaks detection showed that these occur more frequently during the dry season, which shows the influence of dry weather in the emergence of this phenomenon.

Climate characteristics favor the spread fire; however, most of the fires are caused by human activities resulting from the tradition of using fire as agricultural management tool to create pastures, agricultural areas and or to facilitate harvest.

The selection of critical areas in terms of spread fire and the indication of the causes that lead can be used to create preventive actions in order to reduce the use of fire. For this it suggests the creation of awareness campaigns, mainly farmers and cattle ranchers, showing them techniques of control and use of fire, schedules and more suitable for spread fire periods and alternatives to replace the use of fire.

Acknowledgements

The authors thank the colleagues Elânia Daniele Silva Araújo for the suggestions and contributions to the development of this research and Alexandre Henrique Carvalho Marques for bibliographic loans and help with the data.

References

AESA. Agência Executiva de Gestão das Águas do Estado da Paraíba, 2015. Geo Portal. Available: http://www.aesa.pb.gov.br/geoprocessamento/geoportal/shapes.html. Access: may, 27, 2015.

Brumatti, D.V., 2012. Avaliação do impacto do aquecimento global no risco de fogo na África. Thesis (Master). Viçosa, UFV.

EMBRAPA. Empresa Brasileira de Pesquisa Agropecuária, 2013. Banco de produtos MODIS. Available:

http://www.modis.cnptia.embrapa.br/geonetwork/srv/pt/main.home. Access: may, 28, 2015.

EMBRAPA. Empresa Brasileira de Pesquisa Agropecuária, 2010. Alternativas para a prática das queimadas na agricultura. Available: http://www.queimadas.cnpm.embrapa.br/qmd_2000/index.htm. Access: may, 27, 2015.

Fonseca, E.M.B., Ribeiro, G.A., 2003. Manual de Prevenção de Incêndios Florestais. CEMIG, Belo Horizonte.

Gontijo, G.A., Pereira, A.A., Oliveira, E.D.S., Júnior, F.W.A., 2011. Detecção de queimadas e validação de focos de calor utilizando produtos de Sensoriamento Remoto. XV Simpósio Brasileiro de Sensoriamento Remoto, 7966-7973. Available: http://marte.sid.inpe.br/col/dpi.inpe.br/marte/2011/07.21.14.32/doc/p1587.pdf. Access: may, 25, 2015.

IBGE. Instituto Brasileiro de Geografia e Estatística, 2015**.** Estados. Available: http://www.ibge.gov.br/estadosat/perfil.php?sigla=pb. Access: may, 23, 2015.

INPE. Instituto Nacional de Pesquisas Espaciais, 2015. Queimadas (monitoramento de focos). Available: http://www.dpi.inpe.br/proarco/bdqueimadas/. Available in: may, 27, 2015.

INPE. Instituto Nacional de Pesquisas Espaciais, 2015. Portal do monitoramento de queimadas e incêndios. Available: http://www.inpe.br/queimadas. Access: may, 27, 2015.

Miranda, E.E.de, Moraes, A.V.C.de, Oshiro, O.T., 2006. Queimada na Amazônia Brasileira em 2005. Embrapa, São Paulo. (Comunicado Técnico, 18). Available: http://www.cnpm.embrapa.br/publica/download/cot19_bal_ucstis06_vf.pdf. Access: may, 18, 2015.

Moreira, E.deR.F., 2002. O Espaço Natural Paraibano. Gasplan, João Pessoa.

Piromal, R.A.S., Rivera-Lombardi, R.J., Shimsbukuro, Y.E., Formaggio, A.R., Krug, T., 2008. Utilização de dados MODIS para a detecção de queimadas na Amazônia. Acta Amazônica 38, 77-84.

Rodriguez, J.L., 2012. Atlas Escolar Paraíba: espaço geo-histórico e cultural. 4th ed. Grafset, João Pessoa.

Santos, C.A.P.de, Souza, U.B.de, Silva, W.L., 2011. Quantificação dos focos de calor na Meso-região do Extremo Oeste Baiano. XV Simpósio Brasileiro de Sensoriamento Remoto, 7926-7933. Available: http://marte.sid.inpe.br/col/dpi.inpe.br/marte/2011/07.21.17.15/doc/p1541.pdf. Access: may, 25, 2015.

Tomzhinski, G.W., Coura, P.H.F., Fernandes, M.C., 2011. Avaliação da detecção de focos de calor por sensoriamento remoto para o parque nacional do Itatiaia. Biodiversidade Brasileira I, 201-211.

Vasconcelos, S.S., Rocha, K.S., Selhorst, D., Pantoja, N.V., Brown, I.F., 2005. Evolução de focos de calor nos anos de 2003 e 2004 na região de Madre de Dios/Peru –Acre/Brasil – Pando/Bolívia (MAP): uma aplicação regional do banco de dados INPE/IBAMA. XII Simpósio Brasileiro de Sensoriamento Remoto, 3411-3417. Available: http://marte.sid.inpe.br/col/ltid.inpe.br/sbsr/2005/02.12.16.31/doc/@sumario.htm. Access: may, 25, 2015.