

Open Source Tools for Integrated Production Information on Forest Areas - Study Case: Spatial Analysis of Forest Fragments in Rio Grande do Sul State, Brazil.

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Key words: Geoinformation/GI; Land Distribution; Land Management; Remote Sensing

SUMMARY

The monitoring activities of forests aims to qualify and quantify properly and provide information necessary for the production of consumer goods in a sustainable manner. In this context, the GIS market in Brazil, like many other countries, but has developed very predominantly, the marketing of computer applications based on the acquisition of licenses. Thus, there is a very large workspace and diverse to develop research with the goal of creating new tools for data processing by integrating existing Open Source tools but also to produce new technologies for spatial analysis resources natural. The Brazilian Federal Universities, Government institutions and the community that develops free software in Brazil, has achieved a very significant and successful, for the production of knowledge and new developments in Open Source GIS. The software I3Geo, produced by the Ministry of Environment, in a web environment, presents the database of natural resources in many regions of Brazil. It is an Open Source tool that allows configuration and therefore the proper use of the production of the spatial information needed. Also, in this context, the Federal University of Santa Maria, has a research group that develops geo-based programming solutions and integration of Open Source tools. For this work we used one of the three geographic blocks with approximately 1,500 km² of a total of 6,000 km², being monitored use and land cover for the years 2012, 2013 and 2014. The choice of these areas aimed to test the potential of integration of Open Source tools in the production and analysis of spatial information of forest fragments. The methodology of the study consisted of the following steps: a) thematic mapping of forest fragments using sensor images REIS, RapidEye satellite in GIS environment SPRING System (Georeferenced Information Processing) produced by the National Institute for Space Research of Brazil, b) integration of Tools Python (programming language), R, GoogleEarth, and I3Geo and QuantumGIS, for the production of spatial analysis and c) production of reports, charts and graphs for the interpretation and spatial analysis. The results of the integration of Open Source tools, it can be stated that the analyzes produced new information spatialized statistically characterizing forest fragments in the area chosen. We conclude that the integration of Open Source software's possible to develop complex spatial analyzes of great value in decision-making. The software's used were effective in the qualification, quantification, analysis and availability of spatial information in a web environment.

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1. INTRODUCTION

The state of Rio Grande do Sul as forest areas that are under intense pressure from productive sectors, especially a little physical areas considered and, in many cases, undergo pressure exploration activities to open spaces occupancy activities agricultural. In the area subject to the study, three Geographical blocks, there is a demand due to the presence of organized and productive sectors, are concerned with the correct deployment, conduct and operation of tobacco activity. It is important part of the production process, take care of management of these areas with a view to sustainabilities of their activities. Recently, he was recognized for this productive sector, the need for conduct research based on GIS activities and remote sensing in order to monitor what is effectively happening in forest areas in their regions of operation. Thus, the structuring of the project is based on the need to monitor the forest growth in the period of three consecutive years, from 2011 and extending until 2013 where by three occasions temporal, thematic mapping activities were developed Seasonal Forests Semidecidual and Mixed Rain in an area covering three geographic blocks. The availability of qualitative and quantitative data in these thematic geographic areas will later stage in the implementation of studies modeling the dynamics of use and integrated forest cover factors influencing changes in the landscape in these regions.

2. BACKGROUND

2.1 Open Source Tools for Integrated Production Information on Forest

First of all, we need to objectively answer the following question: What is Open Source (GIS)?

Open source means that the source code is available to the general public for use, distribution, and modification from its original design free of charge (among a long list of other requirements). The Open Source Geospatial Foundation (OSGeo) was created to support the use and development of open source geospatial software. The group focuses on applications for web mapping, desktop mapping, and geospatial libraries. For users who desire easy installation, they offer a batch installer (OSGeo4W) which can be used to install some or all of the software and libraries they support.

On past projects, I have found the desktop applications Quantum GIS and gvSIG to be valuable tools in my workflow. Through the Shapefile to PostGIS Import Tool, otherwise known as SPIT, Quantum GIS provides a graphical interface through which PostGIS layers can be quickly created and uploaded to a Postgresql database. Additional plugins, GdalTools and the Raster Terrain Analysis tool set, extend functionality for the import and analysis of raster layers not

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available in the base ArcGIS software.

2.2 Interpretation and classification of images

The image interpretation is based on the analysis of different elements, as location, spatial arrangements of tone and color (size, shape, texture, shadow pattern, depth, among other factors, site (appearance of the area and its surroundings), location in relation to other objects and associations between different phenomena (Jensen, 2009). The image classification can be defined as a process of extraction image information in order to "recognize patterns and objects homogeneous" which are used to map areas of the earth's surface correspond to the topics of interest (SPRING, 2010).

3. METHODOLOGY

3.1 Open Source tools

The main open source tools used for data processing RapidEye satellite imagery, and its spatial analysis was to establish a link between the applications that possessed different purposes in the context of the project. Among these tools, we can mention: *i3Geo*, *Python*, *Numpy*, *Scipy*, *QGIS*, *Matplotlib*, *SPRING* and *R* Software's. The Figure 1 shows the articulation of grouped by functionality and use tools to produce the information, analysis and availability for storage and subsequent transfer to a Web server.

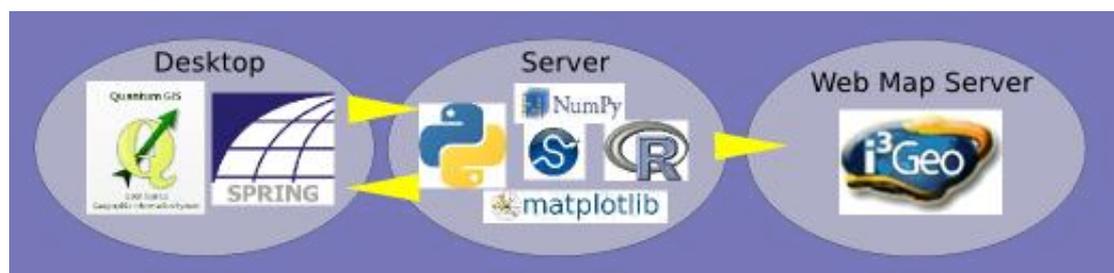


Figure 1 – Open Source tools to produce a information

3.2 Schematic view interoperable Web GIS

The availability of thematic data originated by digital imaging was possible using as guidance the proposition of OSGEO where on one side we have the user (client computer with a web browser) and on the other hand, the Web Server (Server computer's) . Figure 2 shows the structure chosen to provide data and information on the Web, generated at different stages of work.

Schematic View Interoperable Web GIS

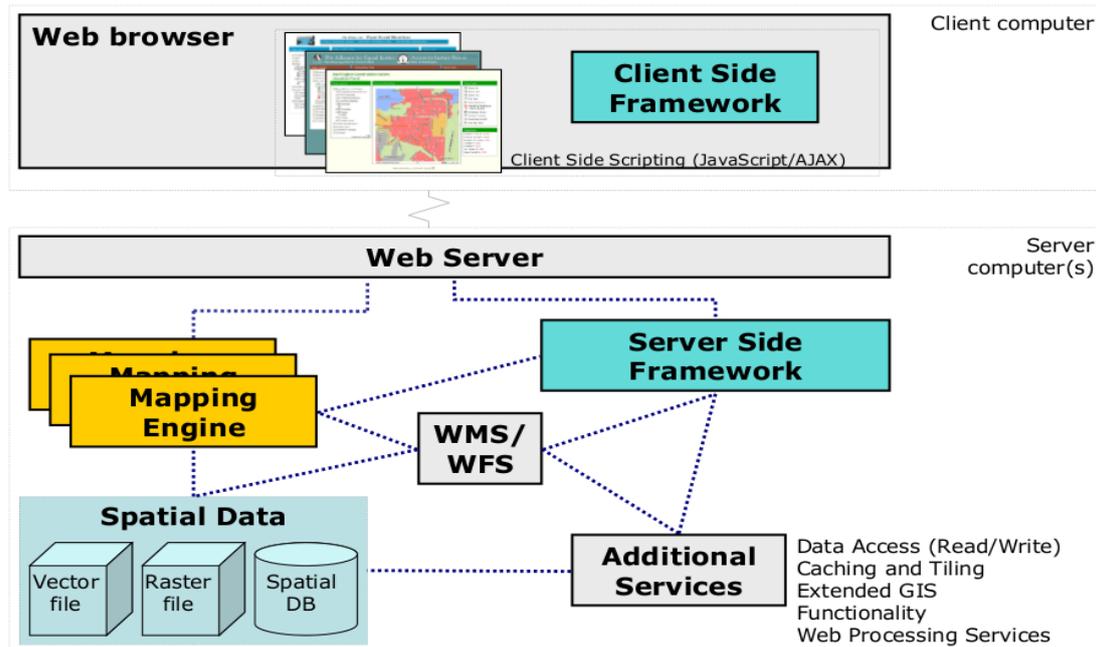


Figure 2 - Structure chosen to provide data and information on the Web.

Font: OSGeo

3.3 Data images processing

The methodology to images processing comprised the activities of preparing image data, creation of a database in SPRING software, development of color composites and application of techniques for manipulating contrast; setting subtitle of the themes of use and land cover; album creation reference; segmentation tests; classification of images; preparing the mosaic of images, development of thematic maps and availability of information on a Web GIS.

4. RESULTS AND DISCUSSION

4.1 Images classification

In this work, the results presented are referenced to Geographic Block 1. From the supervised digital classification process, using the Bhattacharya method to the images, we obtained maps of land use for each block, in which it was possible to analyze the spatial distribution of the following features: natural forest, planted forest, bare soil, agriculture, country side, water and urban areas for the years 2011 and 2012.

4.2 Land use and land cover in 2012

The Figure 3 shows the map of land cover and land use in the geographic Block 1 obtained for the year 2012.

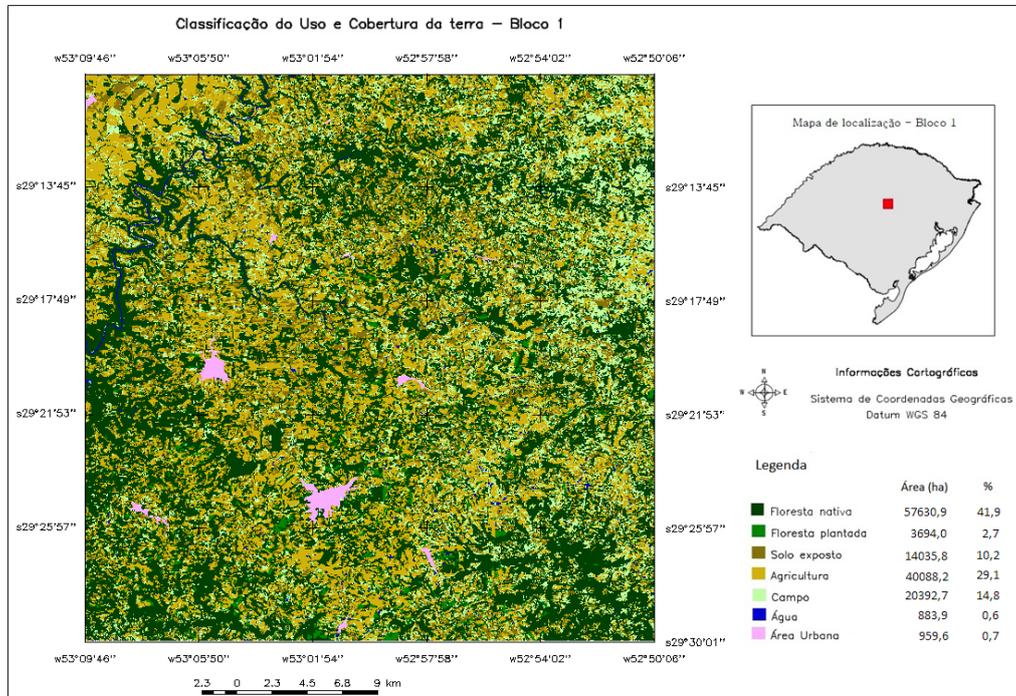


Figure 3 – Map of land cover and land use to the geographic block 1 in 2012.

Table 1 - Quantification of the areas of Block 1 for the different land uses and periods.

Land use classes	2011 year	2012 year	Difference		
	Area (ha)	%	Area (ha)	%	Area (ha)
Native forest	49.943,70	36,28	57.630,90	41,86	7.687,20
Planted forest	4.724,90	3,43	3.693,99	2,68	-1.030,91
Bare soil	34.360,70	24,96	14.035,79	10,19	-20.324,91
Agriculture	24.772,30	17,99	40.088,15	29,12	15.315,85
Field	22.081,80	16,04	20.392,70	14,81	-1.689,10
Water	798,60	0,58	883,90	0,64	85,30
Urban area	959,60	0,70	959,60	0,70	0,00
Areas not classified	21,90	0,02	-	0,00	-
Total area Block 1	137.663,50	100,00	137.685,03	100,00	-

In Table 14 it appears that the area of Block 1, comprised by municipalities Ibarama , Arroio do Tigre, Sobradinho, Segredo, Salto Jacuí, Estrela Velha, Passa Sete, Lagoa Bonita do Sul and Tunas, possessed of 49,943.70 ha native forest, while in 2012 this area increased to 57,630.90 ha. The areas of planted forest decreased by 1,030.91 ha of the year 2011 to the year 2012 , this variation is due to the constant use of wood as fuel for drying and smoking is related to the cycle of the species used. Approximately 40% of this territory is made up of cultivated areas and its main cultivars tobacco, soybeans, corn and rice. Because of this , in 2011 it was found that 17.99% (24,772.30 ha) of the total area of Block 1 are intended for agricultural use and 24.96% (34,360.70 ha) correspond to bare soil , but in the year following areas of agricultural use expanded from 17.99% to 29.12% to an increase of 15315.85 ha and areas of exposed soil decreased 24.96% to 10.19% , representing a reduction of 20324.91 ha . These changes are due to different planting dates, cultivars and date of acquisition of the images. Block 1 showed 16.04% (22,081.80 ha) field in 2011, this percentage decreased to 14.81% (20,392.70 ha) in 2012 . In these areas there is a predominance of native grasses characteristics of the country in the region vegetation. The water, which represented 0.58% of the total area (798.60 ha) remained practically unchanged, which is associated with the presence of rivers and ponds, often used for irrigation of agricultural crops.

4.3 Transition map to 2011 and 2012 years

From the classification of images was not possible to LEGAL analysis to detect possible changes in the period between 2011 and 2012 with respect to the subject class "native forest". We used the following classes to explain these changes: maintenance, deforestation, expansion and other uses. The result of LEGAL analysis yielded the transition map of forest dynamics Block 1 for the period 2011 and 2012. (Figure 4). Following (Table 2) lists the quantitative results for each class in Block 1.

Kind of evolution	Area (ha)	%
Deforestation	7.440,60	5,41
Maintenance	42.495,00	30,88
Expansion	15.115,80	10,98
Others uses	71.609,00	52,03
Urban areas	959,60	0,70
Total area	137.620,00	100,00

Table 2 - Quantification of the areas where each block has a kind of evolution occurs.

It was observed in this area that deforestation was a smaller proportion than the expansion, then the significant maintenance of forest areas. In order words, 7,440.60 ha of forest cover were suppressed, while 15,115.80 ha of other uses of the area were transformed into forest (5.58% more) and 42,495.0 ha remained preserved. This approach supports the idea Farias (2010), which says that the region, mainly colonized by Germans, advocates the conservation of forests and also by the topography that hinders the deployment of more extensive crops.

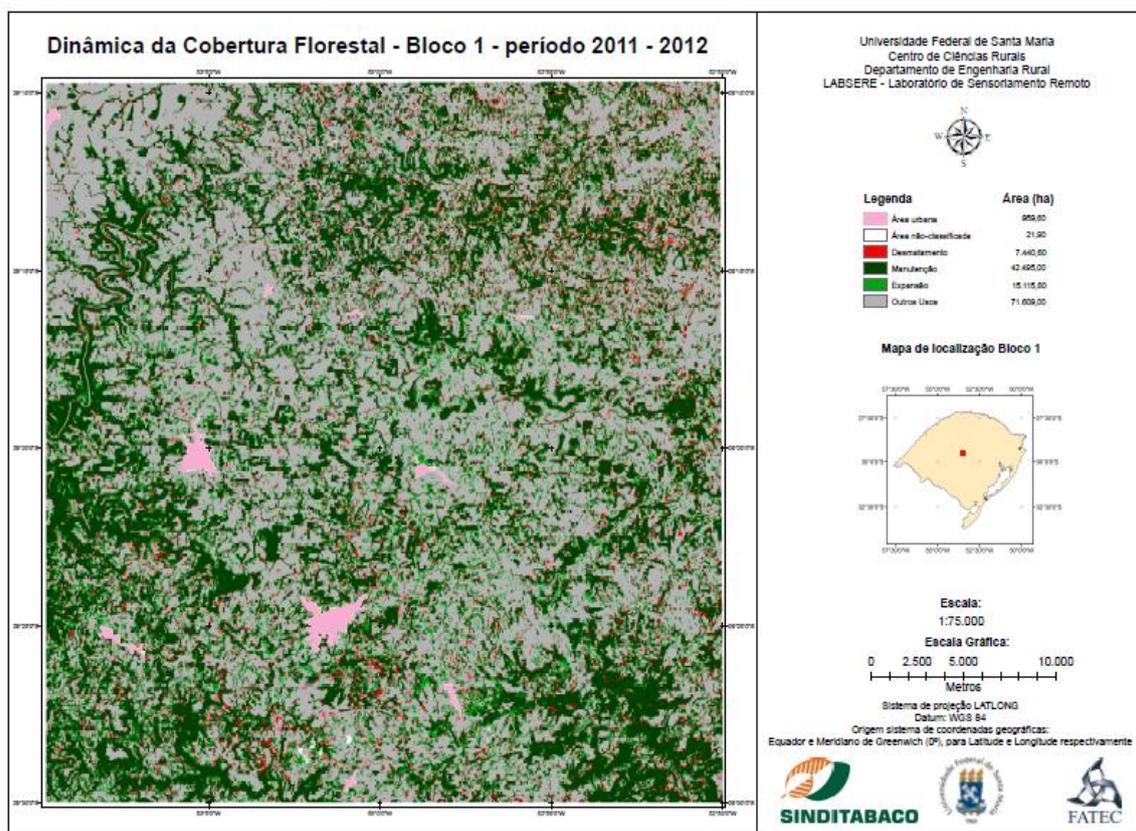


Figure 4 – Dynamic forest cover in Block 1 in 2011 and 2012 years.

5. CONCLUSION

Open sources tools used in this study, through its different modules allow structured data preparation, processing, analysis and availability of thematic maps and information on Web GIS environment.

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