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Geospatial open data sources in Brazil

Fontes de dados geoespaciais no Brasil

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ABSTRACT:
Geospatial open data opens research possibilities to users that do not have special requirements to deal with databases. This is an opportunities to discover new applications, especially when it comes to developing countries. In this sense, this paper aims to describe geospatial open data sources of Brazil. This investigation is qualitative and has description approach. The field research was online hunt and documentation of Brazilian research center; govern agencies, private companies, universities and their open GIS purpose identification. Results show that geospatial open data is provided by govern in federal instance and institute of research partnerships. Few universities participate on this process even though geography, economics and management are common graduate courses in Brazil. That exhibits a lack of high technology application under their teaching and formation human resources process. Other results points to INPE, which was the pioneer on the use of this technology and maintains trough Terra (and its derivations) many partnerships with different institutions to different applications. Limitations were in finding a major organization in Brazil that complies all data or organize spatial data source. As future research is highly recommended developing a paper that can explore the most used, more usable, easer operation software in Brazil.
Keywords: geospatial data, open data, Brazil, geospatial sources, Geographic Information System.

RESUMO:
Open Geospatial Data abrem possibilidades de pesquisa para os usuários que não têm requisitos especiais para lidar com bancos de dados fechados disponíveis na internet. Esta é uma oportunidade de descobrir novas aplicações, especialmente quando se trata de países em desenvolvimento. Neste sentido, o presente trabalho tem como objetivo descrever as fontes de Open Geospatial Data no Brasil. Esta investigação é de natureza qualitativa e tem abordagem descritiva. A pesquisa de campo foi feita on-line e por pesquisa documental nos sites de centros de pesquisa, agências governamentais, empresas privadas, universidades no Brasil, buscando Sistemas de Informações de Dados Geoespaciais (GIS) que tivessem acesso livre, mesmo com diferentes propósitos. Os resultados mostram que Open Geospatial Data é fornecida, em sua maioria, pelo governo federal e institutos de pesquisa. Poucas universidades participam neste processo, apesar de Geografia, Economia e Administração serem cursos de graduação comuns no Brasil. Exibe-se aqui a falta de aplicação de alta tecnologia sob processo de capacitação dos recursos humanos no ensino e formação. Outros resultados apontam para o INPE, pioneiro no uso desta tecnologia, mantendo através do GIS Terra (e suas derivações) muitas parcerias com diferentes instituições para diferentes aplicações. A limitação foi encontrar uma organização no Brasil que compilasse os dados ou organizasse as fonte de dados espaciais. Como investigação futura é altamente recomendável desenvolver um estudo exploratório e um software de operação mais simples que possa ser disponibilizado aos cursos de graduação nas áreas correlatas ao estudo no Brasil.
Palavras-Chave: dados geoespaciais, open data, Brasil, fontes de dados, Sistemas de Informações Geográficas.

Introduction

World Wide Web had radically changed the way to create and treating information making easier to access data and develop secondary data research. Researches can use the web as a tool to global data where it is possible to categorize and organize human knowledge.

Given the efforts to create a dataset and their worth in showing information about the world online, access to them has been limited in certain ways. Licenses, fees, identified users can be used to bound access. Even though the data is open (no requires access) specialized tools as software, computes and particular understanding are required. Consequently, knowledge that could be obtained by research using datasets is naturally closed.

The open data movement seeks to radically transform this situation, both opening up data for wider users but also providing easy-to-use research tools that negate the need for specialists' analytic skills. Indeed, gaining access to datasets that can help answer particular questions has been a centuries-old frustration of researchers, journalists, and civil society organization (HALL; LEAHY, 2008).

According to Auer et. al. (2007) perhaps the most effective way of spurring synergistic research along these directions is to provide a rich corpus of diverse data. This enables researchers to develop, compare and evaluate different extraction, reasoning into uncertainty management techniques and deploying operational systems on the web

Online datasets or databases can be specific about geospatial data when it deals with satellite images, maps, remote sensing and other applications. Recent advances in spatial databases have changed both the nature and process of Geospatial Information

System (GIS). To Jolma et. al (2008) GIS are used for creating, viewing, managing, analyzing, and utilizing geospatial data that are open or not.

GIS with hundreds of functions to a generation of spatial information applications tailored to suit specific user needs. These capacities have been a major boon for the free and open source geospatial (FOSS4G) community, many members of which are using the new generation of databases to build unique and innovative applications. One of the expected impacts of open source software (OSS) is its benefits for developing nations. (CAMARA ET. AL, 2008).

Beyond that, developing countries can generate research and data development by using open data and especially spatial open databases. In this sense, this paper aims to describe geospatial open data sources of Brazil. This investigation is qualitative and has description approach. The field research was online hunt and documentation of Brazilian research center; govern agencies, private companies, universities and their open GIS purpose identification.

1. Theory Background

1.1. Open Data System

By adopting Berners-Lee's proposal an information in something that can be only read while data processed in different ways to create a new information. By that, World Wide Web is a global space of sharing data, the Web of Data (RIZZO ET. AL., 2009).

Open Data is the thinking movement to available and answer society needs to legal open access, using data for any reason or scope. The provider did not decide the data format but instead is the reader that combine and relates into a dataset. To Rizzo et. al. (2009) the goal of open data can be achieved by law, as in US where the generated information by federal public sector is public domain, or by choice of holders right, through appropriate license. Technically, Linked Open Data is about using web techniques to share and interconnect pieces of data by following a few simple principles. Linked Open Data builds on Semantic Web technologies, wherein data is encoded in the form of <subject,predicate,object> RDF-triples (OTRMANN, 2011).

One of the most common ends of open data is the public management. Governs domains a large variety of data that can be available to society. In this case, the readers are the citizen that can manipulate the data that is public domain to their research scope.

According to Janssen et. al. (2012) public is outside the organizational boundaries and outside the control of the hierarchy. In fact the public becomes part of the data processing system and might process data, enrich data, combine it with other sources and might even collect their own data (for example through the use of their mobile phones). This resembles a change in the traditional boundaries between public organizations and the public in which virtually anybody in the world has access to the data. The traditional system boundaries are vanishing and the system is opened.

In this direction, governs are putting efforts to raise open data but in a more objective way, more interpretable filtered. A decision is made along the transparency philosophy of each govern and their politics activities. This state movement priority is to provide citizen pure or raw data, without filters, used and linked to any other one facilitating knowledge creation (RIZZO ET. AL., 2009).

However, not only governs have a responsibility on availing open data. According to researchers might still be disinclined to share their data until they have fully completed analyzing and reporting on their observations and results. The concern is that if data are made openly available in the interim other investigators, effectively scooping the data originators, may use them. Properly curated data alleviates this concern, as the use of data without permission or colleagues would condemn attribution and funding sources. Proper curation requires time and money and is inadequately supported in research funding (REICHMAN, 2011).

In an open system, boundaries and flows cannot be predefined only guide and the opening of data in ways that were not previous considered. Jackson (2003) affirms that the notion of feedback is relevant to open system and refers to the situation in which activity within a system is the result of the influence of one element and another.

The implication of the notion of feedback in systems theory is that in opening their data governments should not simply instigate one-way communication of their data but should expect or actively solicit feedback and be able to make sense of this feedback. The opening of systems provides the opportunity for creating feedback loops in which the government can learn from the public. By embedding hermeneutics, the closed system is placed in the social context. The consequence is that the social context will also influence the (formerly) closed system. This implies that the relationship between a government and its environment is subject to change and that the government needs to accept that traditional planning and control instruments are no longer suitable. Opening a system typically requires a shift from mechanistic control to an evolutionary perspective, which is dominated by self-organization. New governance mechanisms, capabilities and processes are necessary for dealing with these feedback loops (JANSSEN ET. AL, 2012).

1.2. Geospatial Open Data

Spatial data are everywhere. Making a map that is suited to its purpose and does not distort the underlying data unnecessarily is easy. Beyond creating and seeing maps, spatial data analysis is concerned with questions not directly answered by looking at the data themselves. These questions refer to hypothetical that generated the observed data (BIVAND ET. AL., 2013).

To Jolma et. al. (2008) geospatial data can include socioeconomic, environmental, geophysical, and technical data about the Earth and societal infrastructure and it is pivotal in environmental modelling and management (EMM). Desktop, web-based, and embedded geospatial systems have become an essential part of EMM, providing pre- or post-processing of geospatial data, analysis and visualization of results or a graphical user interface (GUI). Many local, regional, national, and international efforts are underway to create geospatial data infrastructures and tools for viewing and using geospatial data.

Before mass use of Internet and its technologies, and still today largely, spatial data have been stored in different physical locations, and often using different standards or formats. This makes it difficult for a potential user to access and utilize the data. Potential users of these "islands of data" might be organizations that cannot afford to acquire data on their own, or need data from outside their jurisdictions. Besides the technical components that connect data 'islands' via the Internet, other aspects such as licensing agreements, data transfer standards, and data access policies must also be put in place to ensure consistent and reliable access. Consequently, a spatial data infrastructure is not only a technical facility, but also a complete framework that includes political, technical, business and social aspects (STEINIGER; HUNTER, 2012). When environmental attribute data is linked to these

infrastructures, powerful tools for environmental management are instantly created. The growing culture of Free and Open Source Software (FOSS) provides an alternative approach to software development for the field of GIS (FOSS4G) (JOLMA et. al., 2008).

While traditional mapping is nearly exclusively coordinated and often carried out by large organizations, crowdsourcing geospatial data refers to generating a map using informal social networks and web 2.0 technology (HEIPKE, 2010). OpenStreetMap (OSM) 2 project is a source of spatial data freely available. It is currently used primarily for rendering various map visualizations, but has the potential to evolve into a crystallization point for spatial Web data integration (STADLER; 2012).

1.3. Brazilian Data Spatial Infrastructure

Early adoption period of GIS in Brazil to span from 1986, when INPE released its first GIS software, to 1994 when FatorGIS promoted the first major user conference. Besides INPE, PRODABEL and FatorGIS, also Unicamp, Embrapa, and TecGraf played a significant role in fostering the adoption of spatial information technology (DAVIS JR.; FONSECA, 2010).

According to Camara et. al. (1996) from 1994 to 1997 Unicamp, University of Campinas, led cooperative project in Geoinformatics with INPE, Cnpq, Embrapa, and PUC-Rio. They took different ways, Unicamp invested on interoperability and semantics as well as INPE worked with Embrapa to agriculture solutions.

One of strategies adopted by the early adopters was to support initiatives for interaction with other groups interested in GIS in Brazil. The adopters had an active role in pursing partnerships with groups in various disciplines that had an interest in spatial technologies. These included research groups in different areas: (a) spatial epidemiology in partnership with the National School for Public Health; (b) social exclusion in partnership with the Catholic University of São Paulo; (c) crime analysis in partnership with the Federal University of Minas Gerais (DAVIS JR.; FONSECA, 2010).

In 1991 INPE designed SPRING part its success can be traced to its use of what was then an innovative technology and also to the fact that remote sensing imagery is an essential component of most geospatial applications in large countries such as Brazil (DAVIS JR.; FONSECA, 2010).

In 2008 the National Spatial Data Infrastructure (INDE-Brasil) is stablished beyond the scope of the Federal Govern trough Law nº 6.666 of 2008. It is about an initiative to organize the generation, storage, access, sharing, dissemination and use of geospatial data. Among the various components of an infrastructure of this nature, metadata - usually defined as "information describing the data" (CONCAR, 2011).

Because of the large number of institutions that currently are involved in the chain of production and distribution of geospatial data, a set of common rules and standards was created by National Commission of Cartography (CONCAR) to deal with interoperability between different systems, facilitating the sharing of data between the different institutions and organizations.

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2. Results - Geospatial Open Data Sources

Many activities of Brazilian government require geographic information, and there is a large number of applications that support those activities. There is no organized catalog of geographic applications, but widespread usage of GI technology can be assessed by browsing government-related papers in national conferences and journals, which describe GI gathering and treatment, GIS implementation and usage, and even SDI creation (DAVIS JR.; FONSECA, 2010).

The availability, sharing and access to data and geospatial information (GI), and related services will be made possible, by INDE through a network of integrated Internet server, which will bring together producers, managers and GI users in cyberspace. This network of servers is called Brazilian Directory of Geospatial Data, or DBDG. The Brazilian Portal of Geospatial Data - SIG Brazil is the gateway users to distributed resources of DBDG. The technology proposed for the implementation of DBDG incorporates solutions for institutions with high technological capacity to the smaller capacity, to integrate between different institutions systems. To effectively achieve interoperability between the various systems must follow the rules of CONCAR and e-PING (Electronic Government Interoperability Program). In the case of data on the GIS area, the e-PING defines a set of open standards that should be used mainly based on OGC settings (Open Geospatial Consortium - http://www.opengeospatial.org/) (SIG BRASIL; 2016).

There are several Web pages from which the interested user might download spatial information, but these are usually spread throughout Web sites of the data producing organizations. In special cases, such as Brazilian Institute of Geography and Statistics (IBGE) there is a more structured site for downloads, which works much as a clearinghouse. IBGE, for instance, maintains an FTP server with a wide variety of geographic data layers and statistical information.

Only a few institutions are currently offering access through Web services. These include the Ministry of environment (MMA), CPRM, the Brazilian geological survey, and, of course, IBGE. MMA has the most advanced site, with a GeoNetwork installation, from which a variety of metadata can be searched. Available information includes data on environmental reserves, species distribution maps, ecological zoning, land use maps, and others. MMA also offers direct viewing and manipulation of data using an i3Geo installation. IBGE has recently installed GeoNetwork8 , and is currently undergoing the production of metadata and the creation of services related to basic cartographic data (DAVIS JR.; FONSECA, 2010).

2.1. Institutes of Research

INPE - National Institute for Space Research

INPE was created at 1961 at Presidential statement. Today it makes part of the Ministry of Science and Technology (MCT) of Brazil. It is located at Sao Jose dos Campos in the state of Sao Paulo (SP) but has regional nucleus on Amazonia, South and Northeast of Brazil. Its principles products and services are disposal on Table 1.

According to editorial on Nature (2008) “Brazil has set an important precedent by making its Earth observation data available, and the rest of the world should follow suit”. INPE has pledged to make its expertise available to all countries and institutions interested in preserving the world’s rain forests. INPE generates “yearly totals of deforested land that scientists regard as reliable” and “provides automated weekly clearcutting alerts that other tropical nations would love to emulate”.

Currently, the Amazonia rainforest in South America is being covered regularly (by LANDSAT-5 and CBERS-2B satellites) and, through INPE, this data is available freely on the Web, at no cost. INPE“s open data policy enables experts from all over the world

to analyze satellite images over the internet. This means that for experts from Central Africa, using Brazil"s open data policy for example, it is more attractive to look for relevant satellite images through Brazilian-provided data of satellites such as CBERS (the Chinese-Brazilian Earth Resources Satellites) than to use commercially available data (DAVIS JR.; FONSECA, 2010).

Table 1 – INPE's Satellite Engineer and Data Services Description

CBERS	Brazil and China governments signed on July 6, 1988 a partnership agreement involving the and CAST (Chinese Space Technology Academy)) for the development of a program to build two advanced satellites remote sensing, called CBERS (China - Brazil Earth Resources Satellite, China-Brazil Earth Resources Satellite). With the union of financial and technological resources between Brazil and China, an investment of US$ 300 million, a system of divided responsibilities was created (30% Brazilian and 70% Chinese), with the aim to implement a complete system world-class remote sensing
Amazonia 1	Polar orbiting satellite that will make images of the planet every four days. For this, it has an optical imaging of sight wide (camera with 3 bands in the VIS and NIR 1 band in) able to observe a range of 720 km with 40 meter resolution. Its characteristic of fast revisits allow improvement in deforestation alert data in the Amazon in real time to maximize the acquisition of useful images on the cloud cover in the region. The Amazonia-1 will also provide frequent images of the Brazilian agricultural areas. Amazonia-1 satellite is based on Multisession Platform (PMM).
PMM	PMM is a generic platform for satellites in the 500 kg class. With mass of 250 kg, it provides the necessary resources, in terms of power, control, communication and others to operate in orbit a payload of up to 280 kg.
DGI	Image Generations Division is responsible for the reception, processing and distribution of remote sensing images acquired by satellites.
DSA	Environmental Systems and Satellite Division. Focused on Environmental Brazil Data
MODIS	Tool for instant viewing time series derived from remote sensing images. This tool was developed within the concept of a Virtual Laboratory of Remote Sensing (Freitas et al., 2011) to support studies and analysis of changing land use and land cover.
CRC	Center for Satellite Tracking and Control (CRC) is an integrated set of facilities, systems and people dedicated primarily to the operation in orbit of the satellites developed by INPE by itself or in cooperation with foreign institutions. The center is able also to support the third-party space missions.

Source: INPE (2016).

Beyond these main services, INPE offers localized monitoring as Amazonia, Atlantic Forest, Burns, Climate and Weather, Astronomical Observations, Spatial Climate, Lightning and Antarctica Studies.

When it comes to GIS, INPE has developed as open data:

1. SPRING that has image processing functions, spatial analysis, numerical modeling of ground and query spatial databases. It is a project of INPE/DPI (Image Processing Division) with the participation of National Centre for Technological Research in Informatics for Agriculture (EMBRAPA), IBM Brazil - Latin American Center Solutions for Higher Education and Research, Group of Computer Graphics Technology at PUC-Rio (Tecgraf - PUC Rio) and Petrobras (CAMARA ET.AL. 1996) (CAMARA, 1996).
2. TerraLib available from the Internet open source. DPI, Tecgraf, and FUNCATE (Foundation for the Space Science and Technology Applied Research) are developing it. The main motivation for this project is the current lack of either public or commercial GIS libraries que cater for the diversity of GIS data and algorithms, Especially When viewed 'upon the latest advances in geographical information science. The basic idea behind TerraLib que is the current and expected advances in database technology will enable, in the next few years, the complete integration of spatial data types in database management systems (DBMS). This integration is bound to change completely the development of GIS technology, enabling the transition from the monolithic systems of today (that contain Hundreds of functions) to the generation of spatial information appliances. The transition from file-based GIS systems to spatial databases will enable different applications to use the same date, is being Also by the Proposed OpenGIS Consortium. On the practical side, TerraLib Enables quick development of custom-built applications using geographical spatial databases. As a research tool, TerraLib is aimed at providing a rich and powerful environment for the development of GIScience research, enabling the development of GIS prototypes que include new concepts such as spatial-temporal data models, geographical ontologies and advanced spatial analysis techniques. TerraLib defines the geographical data model and Provides support for this model over a range of different DBMS (MySQL, PostgreSQL, ORACLE and ACCESS), and is Implemented as a library of C ++ classes and functions, written in ANSI-C ++ (INCITS / ISO / IEC 14882: 1998) (TERRALIB, 2010).

3. TerraView is an application built on the geoprocessing library TerraLib that handles vector data (points, lines and polygons) and raster (grids and images), both stored in relational DBMS or geo-relational market, including ACCESS, PostgreSQL, MySQL, Oracle, SQLServer and Firebird (TERRAVIEW, 2010).
4. The TerraMA² computational platform was developed to fill a gap in line of products based on innovative technologies using open source software. These applications require systems that integrate geographic services and modeling based on access to real-time geo-environmental data (meteorological, climatic, atmospheric, hydrological, geotechnical, socio-demographic, etc..), which are available on servers connected to the Internet allowing data to be read, processed and used to various applications. Therefore, the TerraMA² is a computational system platform based on a service-based architecture, which is open and provides the technological infrastructure required to develop and implement operating systems to monitor early warnings of environmental risks (TERRAMAE2, 2010).
5. LuccME: Land Use and Cover Change (LUCC) Modeling Framework is an open source framework for spatially explicit Land Use and Cover Change (LUCC) modeling developed by the Earth System Science Center (CCST) and collaborators, built on top of TerraME as an extension. Using LuccME the modeler can easily create deforestation, agricultural expansion, desertification, forest degradation, urban sprawl models and other LUCC process models at different scales and areas of study, combining existing model components and/or creating new ones. LuccME was officially released on November 18th, 2011, during the GLP Land Use Transitions in South America: framing the present, preparing for a sustainable future Workshop. Now, we present the initial results of MAS/BNDES Project, with users and developers guides, new demand components and simple GUI. Version 3.0 will include full documentation, tutorials, examples, training material and courses. It will also include GUI and new features (LUCCME, 2010).
6. INPE-EM system (INPE - Emission Model) is a service of the National Institute for Space Research (INPE), which aims to generate annual estimates of emissions of greenhouse gases (GHG) by land cover change in Brazil in a spatially explicit way. The current system version provides annual estimates of emissions for the Brazilian Amazon based on the PRODES system data. Estimates are available of 1st Order (assuming the simplification that 100% of the emissions occur at the time of the land cover change) and 2nd Order (which represent the gradual process of liberation and carbon absorption as occurs in fact) (INPE-ME, 2010).

EMBRAPA - Brazilian Agricultural Research Corporation

It was founded on 1973, and is under the aegis of the Brazilian Ministry of Agriculture, Livestock, and Food Supply. Since foundation and with our partners from the National Agricultural Research System, it develops Brazilian model of tropical agriculture and livestock research to deal with barriers that limited the production of food, fiber, and fuel in the country, with a focus on agro innovation. (EMBRAPA, 2016).

Its applications are:

1. SOMCode – Self-Organizing Map Code Project. Self-Organizing Feature maps are competitive neural networks in which neurons are organized in a two-dimensional grid (in the simplest case) representing the feature space. According to the learning rule, vectors that are similar to each other in the multidimensional space will be similar in the two-dimensional space. SOFMs are often used just to visualize an n-dimensional space, but its main application is data classification. (CODE PROJECT, 2016).
2. CASAA – Connectionist approach for spatial analysis of areal data, a tool for exploratory data analysis

FUNCATE – Foundation of the Science, Applications and Spatial Technology

FUNCATE operates in the capture and management of resources to projects developed by partner institutions. The FUNCATE support covers all stages of the life of a project cycle - from proposal preparation to the accountability approval, hiring professional staff and acquiring goods and services necessary to develop the project. Either through agreements, terms of cooperation or agreements with government agencies or private companies in the country or abroad, the action of FUNCATE is primarily focused on supporting government institutions in research and development in projects through specialized consultants, the cost of laboratory tests, including expert reports, metrology services, etc (FUNCATE, 2016).

The provision of GIS services on the use of remote sensing focused on the study of natural resources of the soil and, therefore, has a multidisciplinary team capable of developing work is in the field of conventional photo interpretation, as in digital image analysis satellite. The activities related to this area are related to remote sensors processing and analysis of natural resource satellites and meteorological satellites (FUNCATE, 2016).

1. ZEE – Brazilian ecological and economical zoning program. It was set up in 1990 initially only to cover the Legal Amazon, but it was formally extended in 1992 to the whole country. It is an instrument that has since then been funded by multilateral organizations associated with the territorial materialization and land use (ACSELRAD, 2002).
2. GMI – Integrated urban geographic information systems, a generic GIS for municipal applications (FUNCATE, 2016).

2.2. Govern agencies and institutes

1. **GeoBahia** developed by Environmental Institute (IMA) of the state of Bahia, is a spatial database for environmental and socio-economic information in the state of Bahia. The current version of Geobahia introduces new features and functionality, including: power module base vectors and satellite images, decentralized by specific password, available in simplified form and easy operability via the Internet; geolocation points; integration with Google Maps; new print patterns, monitoring online tool to technical legal and environmental development action with the General Attorney of the State of Bahia; implementation of metadata storage system called Geonetwork , used by MMA; download and save georeferenced information bank data to the user's computer (MAIA ET. AL., 2013).
2. **IDEMA** the Institute for Sustainable Development and Environment of Rio Grande do Norte develops its own data base, the environmental data for the state of Rio Grande do Norte and aims to formulate, coordinate, implement and supervise the preservation of state policy, conservation, utilization, rational use and protection of environmental resources, and monitor compliance with the standards of protection , control, use and protection of environmental resource , applying disciplinary penalties and / or compensation for cleared offenses (IDEMA, 2016).
3. **INCRA**, the National Institute of Colonization and Agrarian Reform is a federal agency whose primary mission is to implement agrarian reform and realize the national land planning. (INCRA, 2016). It develops a free software to rural farms certification for Brazil.
4. **MMA,** Ministry of Environment. It maintains the i3Geo-based interactive Web map showing several environmental themes and the SISLA (Interactive System of Environmental Licensing Support) a Web interactive system that provides support for environmental licensing (MMA, 2016).

2.3. Private organizations

According to Davis Jr. and Fonseca (2010), companies offering services based on open source software form 15% of the service provider market. The linkages between the various players and the private companies can be grouped in three main categories: (a) data providers; (b) service providers based on commercial software; and, (c) service providers based on open source software.

Although there are some cooperation agreements for GIS development which allow private companies (especially those involved in public services, such as utilities companies) to participate and contribute, there is to the best of our knowledge no initiative to involve the private sector deeper in GIS or SDI projects. Brazilian legislation allows for public-private partnerships, but these usually apply to large engineering works or to physical infrastructure, such as roads or subways (DAVIS JR.; FONSECA, 2010).

InfoPAE is the result of a partnership between Tecgraf, the Computer Graphics Technology Group of PUC-Rio and PETROBRAS, the Brazilian Oil Company. InfoPAE is an automated system designed to improve the response to emergencies. The system offers sophisticated action plans, easy access to vital information and tight control over the resources allocated to face an emergency. The system is applicable to pipelines, oils terminals, oil refineries and offshore installations, and it proved a valuable training tool. InfoPAE works with local emergency action plans, which are structured collections of actions, coupled with information stored in geographical as well as conventional databases. During an emergency, the team follows a previously stored plan, backed up by its ancillary information.

The team registers the actions taken and documents eventual difficulties. Later on, upper level management may use the system to generate reports that are useful to detect eventual problems with the plan or to assess the performance of the team. The system is structured into four major modules, one to create plans and to insert new information into the databases, one that controls the execution of a plan during an emergency, one that manages the geographical as well as conventional data stored in the database and finally the visualization module, that allows users to browse data related to the location where an emergency occurred. TerraLib is used with the visualization module, to support typical geographical information system functionality. The system is exclusive for PETROBRAS use (TERRALIB, 2016).

2.4. Universities

1. **PUC-RIO**. The Pontifical Catholic University of Rio de Janeiro is a private institution without profit interest that focus knowledge production and transmission based on respect for human values and Christian ethics (PUC-RIO, 2016). The InterIMAGE system is an open source knowledge based framework for Automatic Image Interpretation. The interpretation strategy implemented by the system is based on a knowledge model defined by the user, structured as a semantic network. The nodes of the network represent concepts, classes of image objects expected to be found in a scene. Specialized image processing operators built using TerraLib are attached to the system, which controls their execution (TERRALIB, 2016).
2. **UFMG.** The Federal University of Minas Gerais also obtains free licenses software's geospatial data.. They are the Epidemiologic Surveillance Support System. In order to increase the competence of the health sector in the control of transmissible diseases it is necessary to develop new tools for epidemiological surveillance, integrating environmental aspects, risk factor detection, and automatic and semiautomatic methods, allowing outbreak detection and follow-up in space and time. The main aim of this project is to produce critical technological tools to make possible anticipate and amplify preventive interventions, optimizing activities and resources in health promotion. In addition, the TerraStat The TerraStat library is a fundamental part of TerraLib GIS library. It is a set of algorithms of statistical spatial-temporal analyses for data stored in Geographic Databases. This project is being developed and conducted by the Spatial Statistics Laboratory-LESTE at UFMG and the Image Processing Division (DPI) at INPE. This work was partially supported by CNPq as part of the SAUDAVEL Project.
3. **UFPR.** Federal University of Paraná. Two major applications are on their using. LEG – Geoformation Statistical Lab and aRT (API R-TerraLib) is an R package that provides the integration between the software R and the GIS classes TerraLib. The aim is to have a package for analyzing spatial data in R. R is a freely available open source.
4. **USP.** University of Sao Paolo has developed the SISGIS – a geographic system that presents seismological data

3. Considerations

This paper has as general objective to describe spatial open data sources in Brazil. Goal reach has shown that the data is mostly provided by govern in federal instance and institute of research partnerships. Few universities participate on this process even though geography, economics and management are common graduate courses in Brazil. That exhibits a lack of high technology application under their teaching and formation human resources process. Other results points to INPE, which was the pioneer on the use of this technology and maintains trough Terra (and its derivations) many partnerships with different institutions to different applications.

Most important sources for open data were found to be SPRING and Terra both developed by INPE with financial support of Cnpq and partnership with EMBRAPA (for agriculture means) and universities as PUC-RIO and UFMG mostly, for diverse means including health and geographical mapping and statistics. Other applications were found relevant on MMA when it comes to environmental purposes.

Limitations were in finding a major organization in Brazil that complies all data or organize spatial data source. The research required the sites visitation one by one and the tracing of evidences to evidences. As future research is highly recommended developing a paper that can explore the most used, more usable, easer operation software in Brazil and make simple tutorials to geography and management courses on graduation disciplines.

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