The use of Geographic Information System to the Integration and Management of Historical Information: A Case Study in Jesuit-Guarani Reduction in Brazil.

Débora LAMBERTY, Maurício Roberto VERONEZ and Marcelo ZAGONEL-OLIVEIRA, Brazil

Key words: Geographic Information System, Historical Information, Guarani Jesuit Reduction

SUMMARY

Geographic Information System (GIS) are usually applied in areas of knowledge as Engineering, Geology, Ecology, Genetics, Education and others for the information management in an integrated system. However, in works of historical research, in which they have limitations such as difficulty of access to reference works and as the density of dispersed information on old and damaged cartographic products, this tool is not widely used, mainly in the processes of organization and management of the information. In this context, this paper proposes the structure of a Geographic Information System for the management of historical data. As a case study, there is the Jesuit-Guarani Reduction, communities that sheltered several ethnic groups and Jesuit priests of The Society of Jesus, which in some places, such as the region of "Rio De La Plata" (Argentina, Paraguay, Uruguay and part of Rio Grande do Sul, Brazil) reached such development, that has came to be aim as threats to the Portuguese and Spanish control over the region. The information about the Jesuit-Guarani Reduction is from the execution of "Itinerário Cultural as Missões Jesuíticas Guaranis" Project funded by Instituto do Patrimônio Histórico e Artístico Nacional – IPHAN – Brazil. The methodology passed compulsorily by a process of scanning, georeferencing and vectorization of the bibliographic information and of the information from the work of researchers on the project. The result of this work was a georeferenced database with an updated and organized cartographic base and a tool with facilities for the management and the integration of information, suitable for the promotion of historical research activities and that may be used in other research projects in this area of the knowledge. The information will be available in virtual character what allows that the data does not be reduced in big and limited libraries, this is, the information will be broadcast globally.

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1. INTRODUCTION

In the development of historical research turned to the occupation of certain territories we are faced with the limited number of documentary records, with restricted access to reference works and research materials, such as old and damaged cartographic products. Another problem found is the management of this information, which becomes complicated by the difficulty in integrating them in an organized way because of the large amount of data.
Colavite and Barros (2009) present other difficulties in claiming that working with old maps is not easy because there is not the same accuracy in old mapping as the data representation that exists today. The scale is not always homogeneous, and in many maps no projection system was adopted as well as geodetic reference system. Descriptive data are in several languages and nomenclature often does not coincide with that used today. These factors make the data overlay from old maps on map data current a very complex activity and time consuming activity, whereas the analysis should be point to point and bibliography should help to understand the data represented here.
Front of these problems, a Geographic Information System (GIS) could facilitate the organization and dissemination of historical research with a great advantage, that is, the fact that all the information is organized in a georeferenced database.
A Geographic Information System is the software tool included in the scope of geoprocessing techniques that, according to Câmara and Davis (1998), is the discipline of knowledge that uses mathematical and computational techniques for the treatment of geographical information. These allow you to create and manipulate georeferenced database from the integration of data from multiple sources and performing complex statistical analysis. According to Brindley and Maheswaran (2002) a GIS is a combination of elements designed to store, retrieve, manipulated and display spatial data, that is, information concerning location. A Geographic Information System is similar to overhead projector, with a series of transparencies laid upon it that show different data.
The potentials of a Geographic Information System are numerous and can be used, according to Câmara and Queiroz (1998), as a tool for maps producing, spatial analysis of phenomenon support and geographic database, with the storage and retrieval of spatial information. All information, within the system, is organized into attributes table.
Examples of uses of this tool in History can be found in literature as in Lo *et al.* (2009), who used Geographic Information System for History teaching and learning in schools, resulting in improved student achievement in learning the discipline. Or like Hillier (2010) that used a Geographic Information System as a support for studies of historians of urban planning and observed that this Geotechnology could open new opportunities for the area.

Menezes and Santos (2008), in their study, showed how it is possible the inclusion of Geoprocessing and Territorial Management working with a database to approach the issue toponymic and concluded that the use of geotechnologies such as Geographic Information System expand the study possibilities for join and generate new information. Rumsey and Williams (2002) emphasized the use of Geographic Information Systems for scan historical maps and create updated maps, important potential for the realization of any historical study and its methodology is applied in this study. The work of Colavite and Barros (2009) discussed the integrated use of Geographic Information System to the delimitation of "*Peabiru Historical Route*", in Paraná, Brazil, allowing, with the application of the described methodology, that new historical routes are outlined for the development of tourist routes. Santos *et al.* (2009) suggest the use of Geographic Information Systems to the georeferencing of historical maps, essential work to upgrade the historical cartography used in research activities in this area. French (2010) suggests the use of Geographic Information System to development of Archaeology event confirmed in Nazareno (2005) where conceived a GIS/Multimedia system named "*SIG Arqueologia*", in which data of an archeological project are used to show the efficiency of the GIS application.

There are also international projects that effectively promote and utilize Geographic Information Systems with historical purposes, also reported by Bodovsky (2005). In the United States of America there is The National Historical Geographic Information System (NHGIS) to create and free disseminate a database containing information from the censuses of the United States between 1970 and 2000. Great Britain Historical GIS, provided by the government of Great Britain, is an important source of research on the National History between the years 1830 and 1970. The China Historical Geographic Information System (CHGIS) provides a historical database in units about different periods in Chinese History, allowing researchers to use the GIS platform to spatial analysis, temporal statistical modeling and historical representations in digital maps. In contrast, in Brazil there are few databases that provide historical information. However, the proposal of the The National Institute of Artistic and Historical Heritage (IPHAN-Brazil) with the implementation of this project is exactly provide a historical georeferenced database about Jesuit-Guarani Reduction in Brazil, as a basis to developing the project "Cultural Route of Missions".

2. "CULTURAL ROUTES OF MISSIONS" PROJECT

The Society of Jesus, according to Gonçalves da Silva (2008), was founded in Europe in 1539 by the Spaniard Ignatius Loyola and his companions, and approved by the Pope Paul II the following year. This religious order whose members became known as Jesuits, spread across the European continent and went to settle in lands newly discovered in India, China, Japan, Africa and the Spanish and Portuguese America.

A group of six religious led by the priest Manuel de Nóbrega (1517-1570) arrived in Brazil in 1549. The order remained in Brazil for over two centuries, until they were expelled by order of Marquis of Pombal in 1759.

The responsibilities of the priests of the Society of Jesus in Brazil were different depending on the region where they settled. They have being installed in villages with the aim of, through the founding of colleges, offering education to children and youth, addition to providing

religious support to the community. In these sites were built schools seminaries and magnificent churches, many still existing. In areas not yet cleared the territory of the Society of Jesus played a "colonizer" and "civilizing" initially linked to the interests of the Iberian Crowns in land use and catechesis of native populations through "missions". Character wheel initially, so they were first installed "reductions" that contained native communities of sheltered several ethnic groups and Jesuit priests of The Society of Jesus, which in some places, such as the region of "Rio De La Plata" (Argentina, Paraguay, Uruguay and part of Rio Grande do Sul) reached such development, which has came to be aim as threats to the Portuguese and Spanish control over the region.
The "Cultural Route of Missions" Project was idealized within the "MERCOSUL Cultural" as a pilot project of cultural recognition and integration of historical processes common to different countries as Argentina, Brazil, Paraguay and Uruguay, and began to be developed in a pioneering way in Brazil, through the The National Institute of Artistic and Historical Heritage (IPHAN-Brazil). By the georeferencing and spatial distribution of historical information and the physical remains of the old Jesuit-Guarani Reduction in Brazil, expected to obtain a basis for the inclusion of new information produced on this territory in research that will still be made, make available existing information to researchers, as well as plan the development of projects for promotion of cultural heritage in the area (routes, itineraries, interpretation centers, and others). The same procedure should be done in the other participating countries in the project in order to integrate a single database.
This work, in turn, aims to present the results of the implementation of the project "Cultural Route of Missions", which sought to organize the cartographic and historical information extract from the literature about the Jesuit-Guarani reduction as well as organize information on tourist attractions and collections that preserve the history of the Jesuit-Guarani peoples.

3. MATERIALS AND METHODS

The Project previews a database organization with historical and touristic information about Jesuit-Guarani reduction in Brazil, specifically in the states of Rio Grande do Sul, Santa Catarina, Paraná, São Paulo and Mato Grosso do Sul. The international limits of these states have also been added because since one aim of the project is to allow the crossing of information with those produced by other countries (Argentina, Paraguay and Uruguay).
The process of database organization began with the selection of a georeferenced cartographic base with basic themes such as administrative boundary, hydrography, municipalities, and roads. The administrative boundary and municipal seats were taken from IBGE (2005). The roads, airports and hydrography were obtained in Schobbenhaus *et al.* (2004).
With a cartographic base organized began the process of treatment of cartographic information taken from two basic bibliographies: Maeder and Gutiérrez (2009) and Porto (1943). The Maeder and Gutiérrez (2009) paper presented old maps of the Jesuit-Guarani Reduction that were georeferenced and vectorized in ArcGIS 10. The information, contained in Porto (1943), were essential to cartographic information understanding, since it presented, in a descriptive way, the environments and locations, allowing greater precision for points location about missionaries people information.

The information relevant to the research, such as location of the Jesuit- Guarani Reduction in first and second phase, *Bandeiras Paulistas* and the consequent relocation of missions, locations of fights and marches of the Guaranitic War and the limits of the Treaty of Tordesillas, were traced, organized in extension *shapefile* (.shp) with respect to the reference system SIRGAS (Geocentric Reference System for the Americas).
The information collected by historical researchers and those available on the web were used for the organization and integration of data about tourist attractions in the missionary region as well about the collections, libraries and research centers.
With data capture and georeferenced, all information was organized into attribute tables using criteria considered most interesting.

5. RESULTS AND DISCUSSIONS

Once structured a Geographic Information System, there are countless possibilities for spatial analysis that can be developed. This paper presents the result of project execution to generate new cartographic products related to the area of study and the organization of a cartographic base, referenced to the Brazilian Geodetic System.
Forty *shapefiles* were generated; which included a cartographic base of the area, with historical content, reviews of routes and location of the Jesuit reduction in the platinum territory and content tourist information for visitors wishing to see archaeological parks, libraries and museums that keep the history of the Jesuit Guarani Peoples.
In order to exemplify the product for georeferencing and vectorization of basic cartography and historical information, it presents a comparison of the cartographic product named in Maeder and Gutierrez (2009) as "*Bandeiras Paulistas* and Relocation of the Missions" (Figure 1) and the product as a result of the vectoring information (Figure 2) in ArcGIS 10.

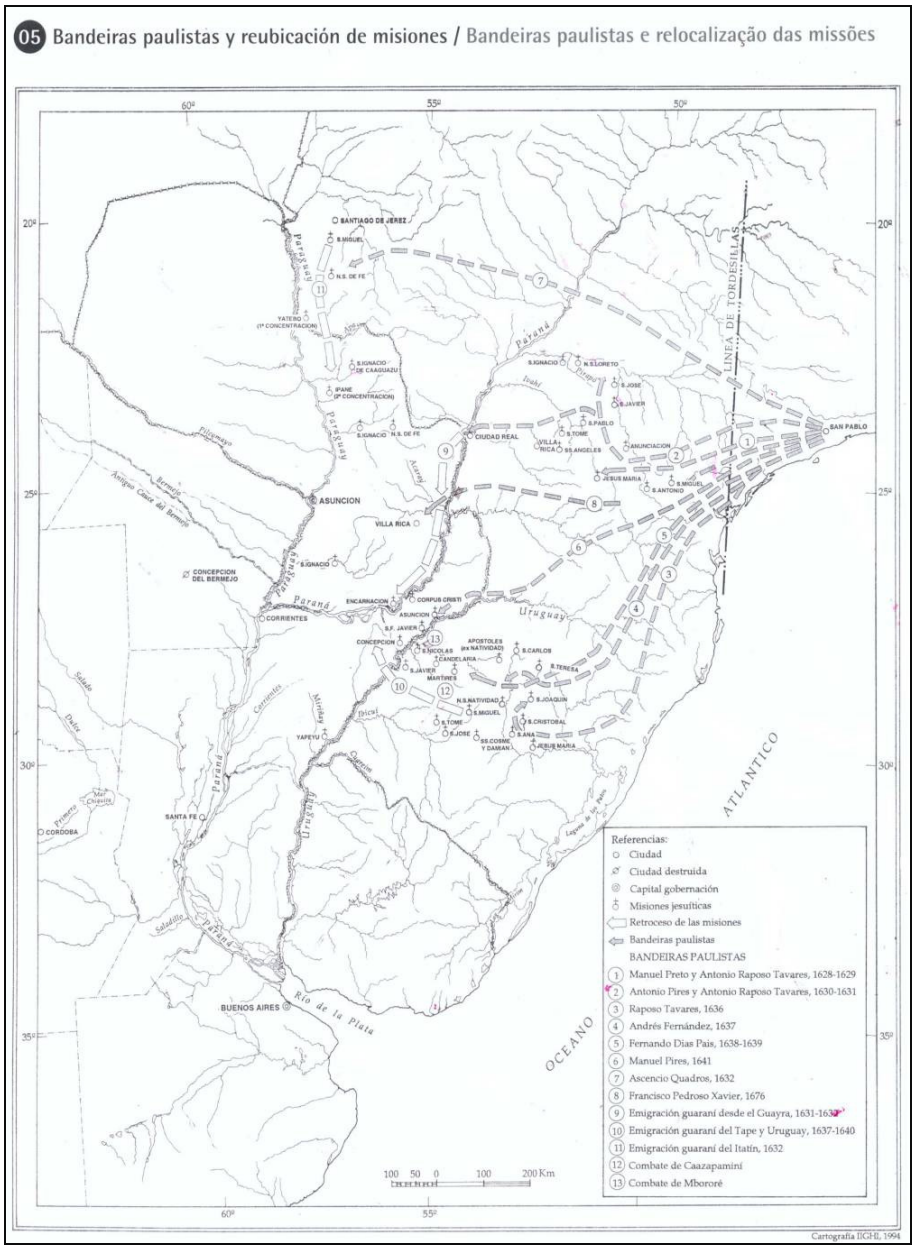

Fig.1- *Bandeiras Paulistas* and Mission Relocation. Product from Maeder and Gutierrez (2009)

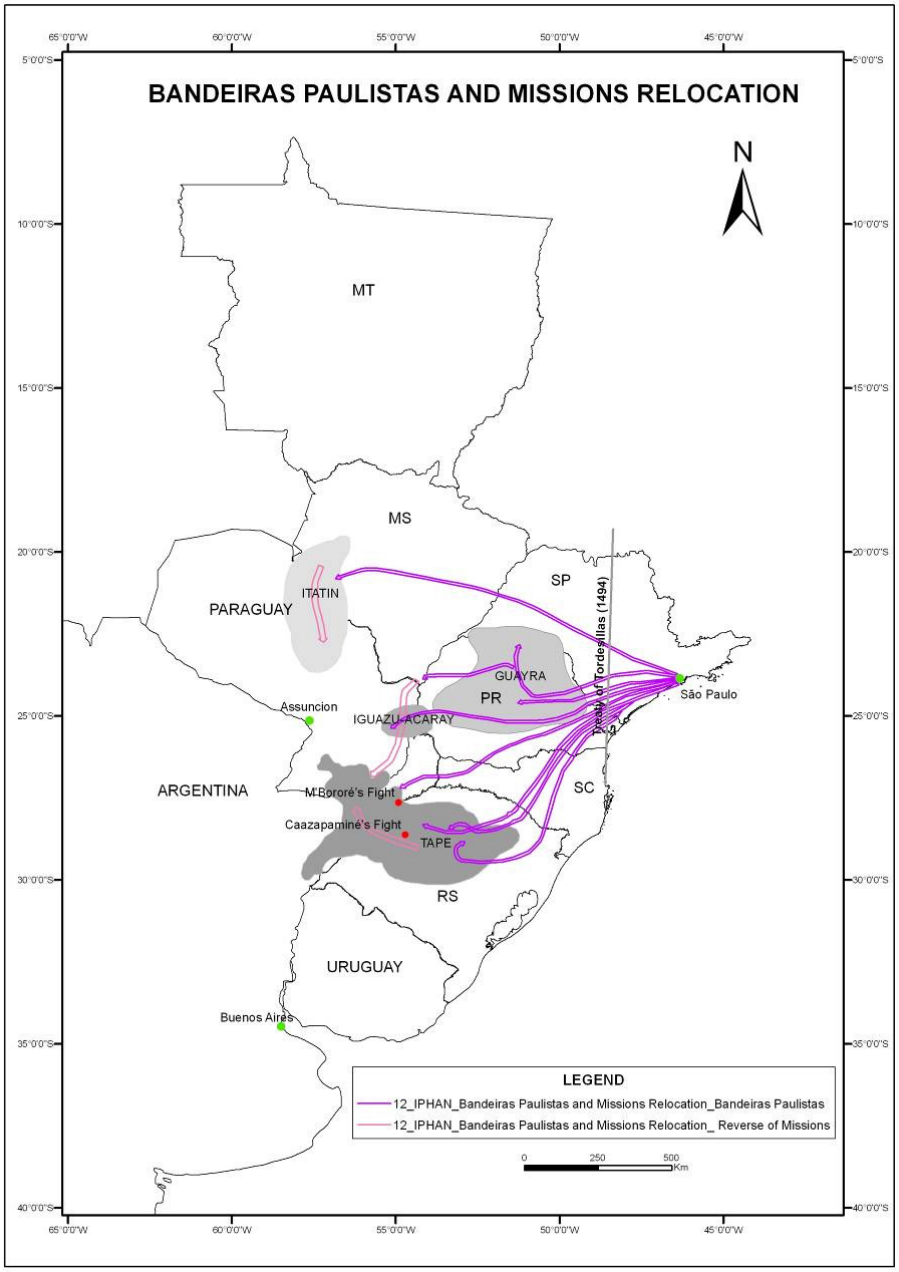

Fig. 2 - *Bandeiras Paulistas* and Mission Relocation. Product generated from the GIS and cartographic references updated on the Geocentric Reference System for the Americas (SIRGAS)

Comparatively, there is an updated cartography with a larger volume of information entered, which are accessed directly in a georeferenced database. The products generated have the option of selecting information, such as generating a product with dates of historical events, or only with the *Bandeiras Paulistas* excluding the relocation process of the missions, which facilitates the interpretation of information.

The Figure 3 presents a cartographic product generated from the Geographic Information System as a result of the organization with the cartographic base *shapefiles* of Administrative Boundary, Hydrography and Roads.

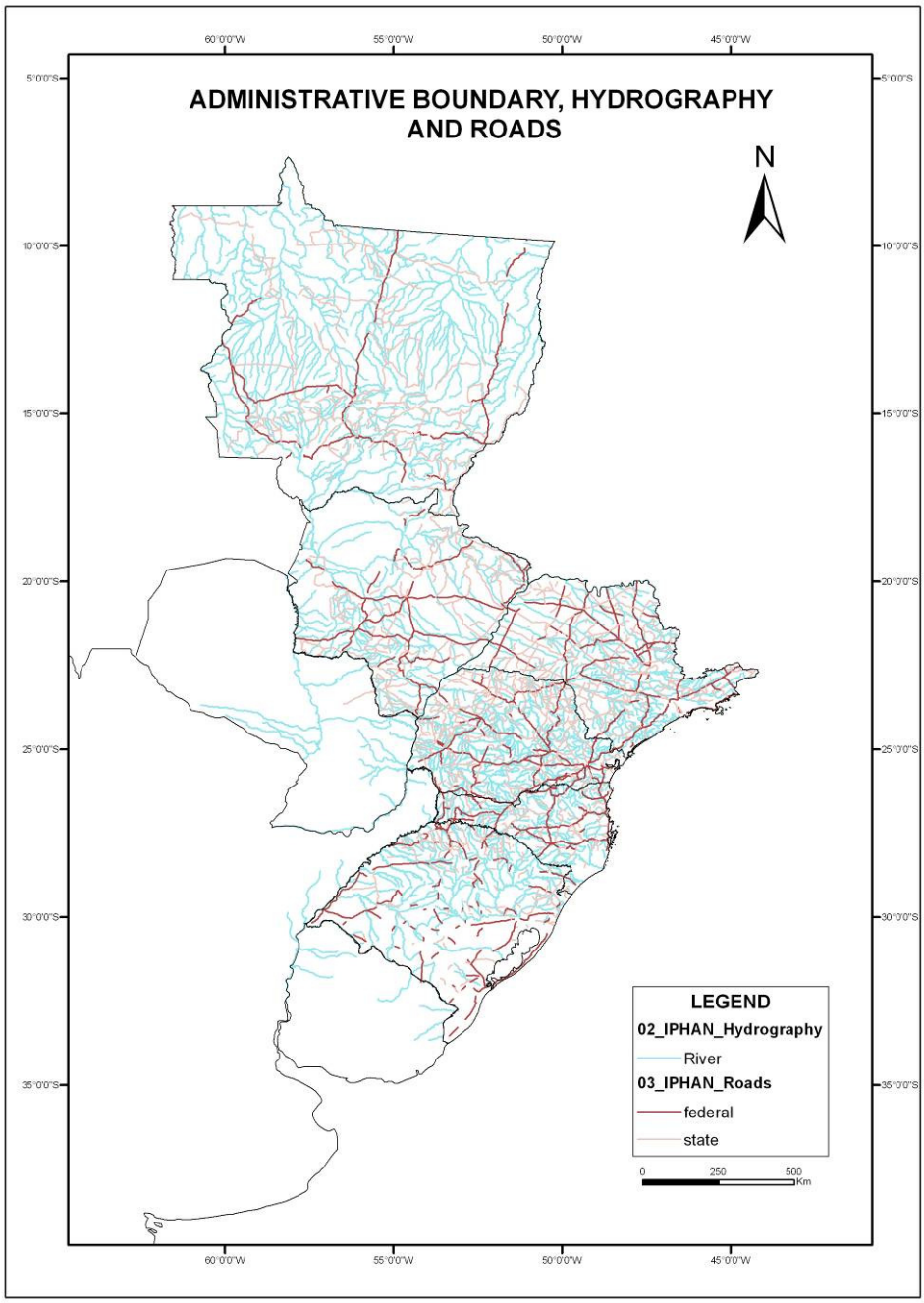

Fig. 3- Administrative Boundary, Hydrography and Roads. Georeferenced cartographic base in the Geocentric Reference System for the Americas (SIRGAS)

This cartographic base is essential for the interpretation of historical data, because in the absence of more accurate ways of listings, most of the mapping and descriptions of the territory is based on hydrography and relief for your records. The same way, it is crucial to the development of tourism projects, because it presents the main access roads and existing municipalities.

The resulting cartographic product of historical research about the location of the Spanish Jesuit-Guarani Reduction in its first phase is shown in Figure 4, where the missions are located in their groups Tape, Guayra, Itatin-Acaray and Iguazu, and their respective regions of influence.

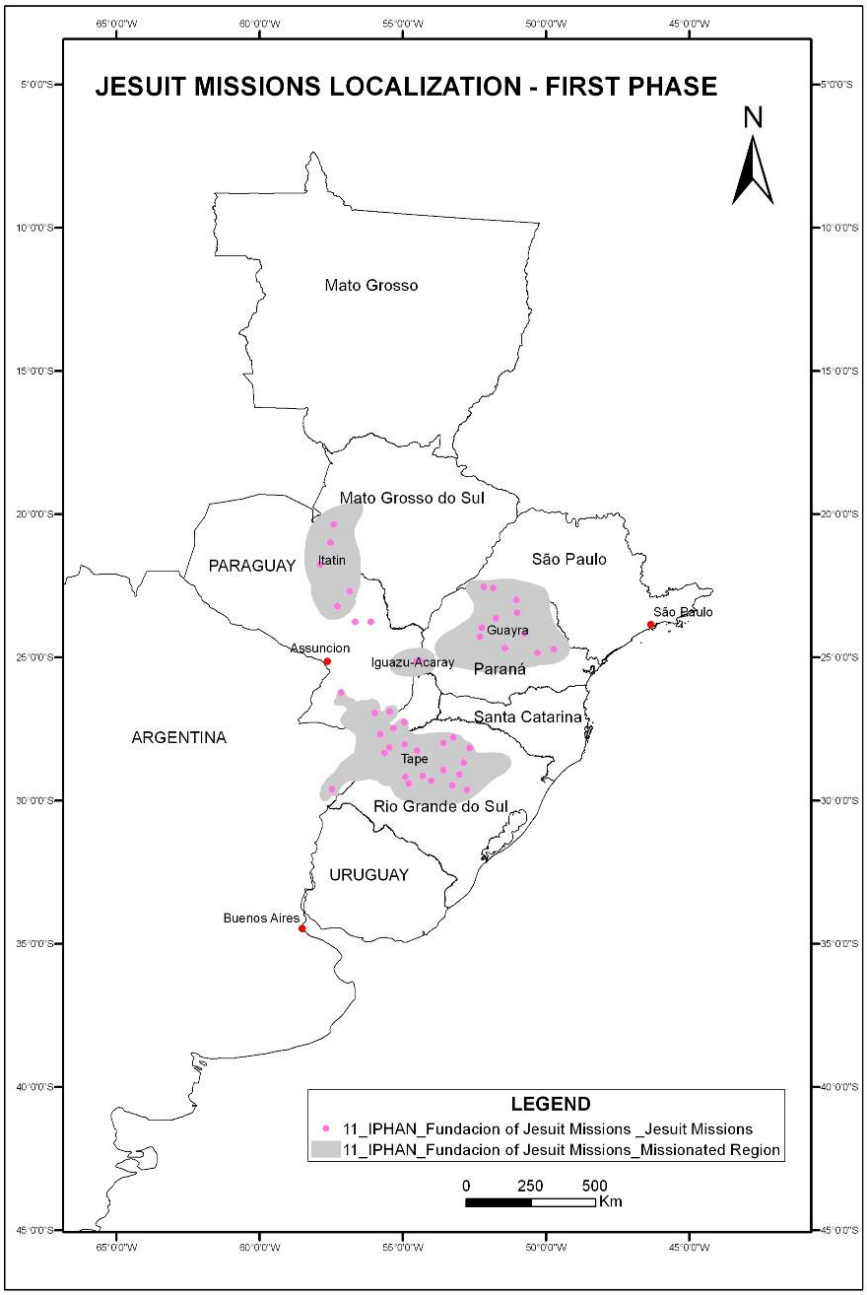

Fig. 4- The Jesuit Missions Localization in First Phase in Geocentric Reference System for the Americas

As a result of the organization of tourist information, a product is presented in Figure 5 in which we highlight the tourist attractions and collections that preserve the Jesuit-Guarani History in Brazil.

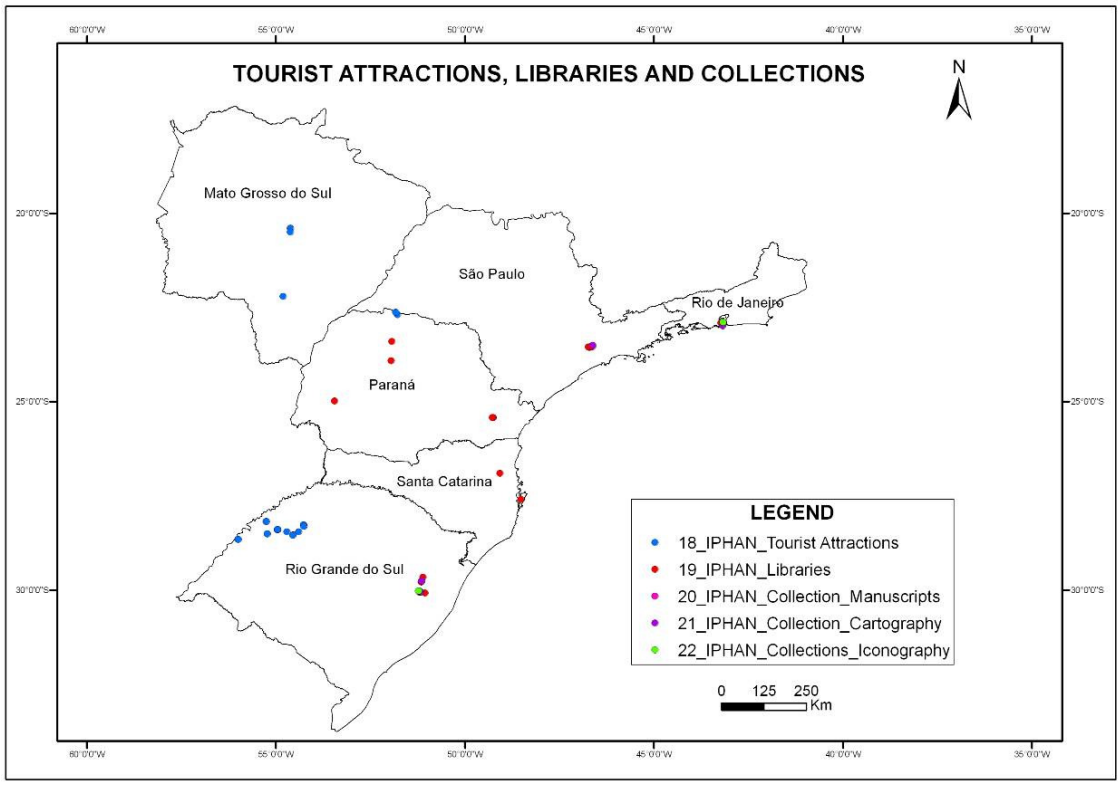

Fig. 5- Tourist Attractions, Libraries and Collections

The file Tourist Attractions present information related to 24 points of interest and includes, among others, archaeological parks, museums and churches of Jesuit architecture. The collections were classified according to their records, that is, cartography, manuscripts and iconographical beyond libraries. In total, 63 collections that preserve the Jesuit-Guarani History in Brazil were cataloged.

A Geographic Information System is a dynamic tool. Its use enables information to be manipulated according to the need for those using it. This potential for selection of information organizes and facilitates access to data and its subsequent interpretation in order that further research is executed.

6. FINAL CONSIDERATIONS

The final product of this work was the creation of a georeferenced database with files in format *shapefiles*. First, it wanted to organize territorial and historical information to provide subsidies for development of the project "Cultural Route of Missions" in the Brazilian territory. They may still be available to researchers and tourists who need information about the Jesuit-Guarani Reduction in Spanish America. The database will be available in the virtual character and allows the information not be reduced and limited to large libraries, but that will be broadcast globally.

In this study, we could see how a Geographic Information System is important and facilitator for the development of research in History. For this it was found that two points are important

in the organization of historical information in a georeferenced database. The first one is the standardization of file formats (.shp), allowing movement and access to information, since the programs for viewing information in this format are freely available. This point also allows the manipulation and edition of data and insertion of new information. The second point is the creation of maps in extensions (.pdf) and (.jpeg), which enhances the export of final files and allows any user to have easier access to products generated.
When completed the project in terms of MERCOSUL, this database will be available for consultations by the IPHAN of all people which happens to be interested in historical information relating to the Jesuit-Guarani reduction. Importantly, the success of any Geographic Information System depends on constant updating of georeferenced data, as data are tabulated by researchers.

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CONTACTS

Débora Lamberty
Postgraduate Program in Geology
Universidade do Vale do Rio dos Sinos – UNISINOS
Unisinos Avenue, n° 950 - Cristo Rei Zip Code: 93022-000
São Leopoldo, Rio Grande do Sul
BRAZIL
Tel. +55(51)3591-1122 (Ramal: 1727)
E-mail: deboralmty@gmail.com
Web site: www.unisinos.br

Dr. Maurício Roberto Veronez
Postgraduate Program in Geology
Universidade do Vale do Rio dos Sinos – UNISINOS
Unisinos Avenue, n° 950 - Cristo Rei Zip Code: 93022-000
São Leopoldo, Rio Grande do Sul
BRAZIL
Tel. +55(51)3591-1122 (Ramal: 1727)
E-mail: veronez@unisinos.br
Web site: www.unisinos.br

Ms. Marcelo Zagonel
Postgraduate Program in Genetics and Molecular Biology
Universidade Federal do Rio Grande do Sul - UFRGS
Bento Gonçalves Avenue, n° 9500 – Campus do Vale. Predio 43323M Zip Code: 91501-970
Porto Alegre, Rio Grande do Sul
BRAZIL
Tel. +55(51) 3308-6722
E-mail: mzagonel@gmail.com
Web site: www.ppgbm.com.br