Permanent Program Update of Continual Cartographic Base from Brazil, the millionth (BCIM)

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Abstract. This paper has the aim to present the Continual Cartographic Base from Brazil on scale of 1:1.000.000 – BCIM inside the Permanent Program Updating from IBGE. This program consists in update and maintenance permanent of the whole Brazilian territory, this mean a strategy to subsidize the regions management and also contribute to studies that use environmental politics. These activities of updating require uses of satellite images, like ALOS, Landsat, RapidEye, information from other institutions and field work. The incorporation of technologies like Geographic Information System and Remote Sensing in the systematic mapping contributed to developing of a base unique and integrated of the whole brazilian territory. This continual vectorial base is available for consulting on the IBGE website (www.ibge.gov.br) and in the National Infrastructure Spatial Data (INDE) website (www.inde.gov.br). This cartographic base is now into the new standard of the Geospatial Data Vectorial Structure (EDGV) that contemplate a new structure of storage of geospatial data for integration with data of INDE.

Key-word: remote sensing, cartography, geoprocessing.

1. Introduction

The technological evolution has promoted the popularization in Geotechnology, renewing the interested of the society in recognising and disseminate phenomenons of the geographic space. This fact has encouraged the production and spreading of cartographic products all over the world as well as its improvement.

The technologies associated to Remote Sensing (RS) and Geographic Information Systems (GIS) have been contributing to significant changes in systematic work and in the collecting of information (Reis et al, 2011).

The IBGE, Brazilian Institute of Geography and Statistics, as an active actors of the National Cartographic System, coordinator geographical mapping, has throughout its existence improving the methodologies work with the incorporation of new technologies, thus maintaining the production and dissemination of cartographic databases of the national territory reference.

One of the products that are periodically been disseminated by IBGE is the mapping updates on the scale 1:1,000,000 in digital format, covering 100% of national territory. The first edition of Continual Cartographic Base from Brazil, to the millionth, then called Integrated Digital Cartographic Base from Brazil, at the millionth (BCIM), it was concluded

in October 2003, taking into account the control and specifications of the variety of production process, all represented elements compatible with scale of 1:1,000,00.

The Continual Cartographic Base from Brazil, to the millionth - BCIM (figure 1) is the fundamental geospatial data component reference of the INDE and covers the entire Brazilian territory. Its data model contemplates categories of information about physical-biotic reality (hydrography, relief and vegetation), territory (limits, public administration) and anthropic (locations, transport system, communications, economic structures and energy and communications) of national reality.

Figure 1: Continual Cartographic Base from Brazil, to the millionth - BCIM.

The BCIM constituted a cartographic base of reference, it is a geospatial input for a production of a map series (Brasil, Regionals and State), maps and thematic maps that contemplate data of: population, soil, geology, vegetation, natural resources and others. And it is the basic input of the Global Mapping Project – GM (UN / ISCGM, 2014).

2. Objective

The Permanent Updating Programme of BCIM aims to provide society a digital cartographic base, vectorized, structured, integrated, Continual and updated from all Brazilian territory, on the scale of 1:1,000,000, allowing to obtain information about the positioning, the geographical name and classification of elements represented. The vectorial data allow users to edit the data, adjusting them to their needs.

3. Methods

The IBGE presented in its National Geography Conference – CONFEGE (2006), the Permanent Updated Program – PAP of Continual Cartographic Base of Brazil, the millionth - BCIM, that had accession of sectoral organs and members of the SCN. The guidelines for update are based in conventions of data sharing with sectoral bodies.

The cartographic information present in this Continual Cartographic Base derived from compilations of mapping at larger scales, with the input the photo-reduction of topographic maps in 1:250,000.

The digital versions have been updated and reset in its geometry and attributes from a diversity of inputs and methods like:

- Compilation of the mapping at larger scales, mainly from base Continual 1:250,000;
- GPS survey and local knowledge with field work;
- Spatial, geometric and topological analyses;
- Remote Sensing. The IBGE cartographic coordination currently has a collection of RapidEye images, these had an original 5.8 meters resolution, getting to 5 meters after being resampled when got acquired by federal government for use in public institutions. Its two covering of territory, these images cover 96% and 98% of national territory, and have based in years 2011]/2012 and 2012/2013, respectively.
- Inputs from sectoral partners like: National water agency(ANA), National Civil Aviation Agency(ANAC), National Electric Energy agency(ANEEL), National petroleum agency(ANP), National telecommunication angency(ANATEL), National land transport agency(ANTT), National agency of water way transportation (ANTAQ), Operations and Management Center of the Amazonian Protection System(CENSIPAM), Company Research and Mineral Resources (CPRM), National Department of Transport Infrastructure(DNIT), Civil Aviation Board (DAC), Directorate of Hydrography and Navigation(DHN), The Army Geographical Service Board (DSG), National Indian Foundation (FUNAI), Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), Institute Chico Mendes Biodiversity Conservation(ICMBio), Institute of Aeronautics Cartography (ICA), National Institute of Colonization and Agrarian Reform (INCRA), Mines and Energy Ministry, Ministry of Transport, Brazilian Oil (PETROBRAS) and State Institutions and Academic, among others.
- Finally, through joint activities with the Managements of Geodesy and Cartography IBGE (GGC) that collects data and participate in internal and external projects.

The work plan of the Permanent Update Program BCIM forecasts meetings for consolidation and approval of the data contributed by sectoral participants, subsidized by technical reports produced during the incorporation and quality control of the data from base Continual.

4. Results and Updates

The first change made in the last version of BCIM is related with data models used in the cartographic base. Its data models, in the firsts versions, followed the standards of the Topographic Map Collection Digital (MDT) and contemplated eight categories of information: Hydrography, hypsography, vegetation, reference points, boundaries, locations, transport systems and general economic activities.

In this latest version, the data model MTD was changed to abide the Technical Specification for Geospatial Vectorized Data Structuring (ET-EDGV) as defined in the board below.

Board 1: Categories of information of ET-EDGV

EDGV Categories	Categories contemplated on BCIM 4th version	Abreviation (in portuguese)	Categories used on BCIM 3th version	Abreviation (in portuguese)
Hidrography	Hidrography	HID	Hidrography	HD
Relief	Relief	REL	Hipsografia	HP
Vegetation	Vegetation	VEG	Vegetation	VG
Transportation System	Transportation System	TRA	Transportation System	ST
Energy and Communications	Energy and Communications	ENC	General Economic Activities	AG
Basic Water Supply and Sanitation				
Education and Culture				
Economic Structure	Economic Structure	ECO	General Economic Activities	AG
Localities	Localities	LOC	Localities	LC
Reference Points			Reference Points	PR
Boundaries	Boundaries	LIM	Boundaries	LM
Public Administration	Public Administration	ADM		
Health and Human Services				

The Conversion Methodology comprises the mapping process between data modeling of BCIM and ET-EDGV and the conversion itself. In the mapping between the modeling it is raised a relation between same elements, describing where the elements of one modeling finds correspondence in the other modeling. In the next step is using a processing tool of spatial data transformation, which are indicated: the data source, the destination and transformations needed to the respective migration.

In this process changes were made in both data model and format and its storage structure. Furthermore, changes in categories nomenclatures, classes, attributes and geodetic reference (SAD69 to SIRGAS2000) are still identified.

All these migration steps were implemented by the FME software (feature Manipulation Engine) by converting flows (figure 2).

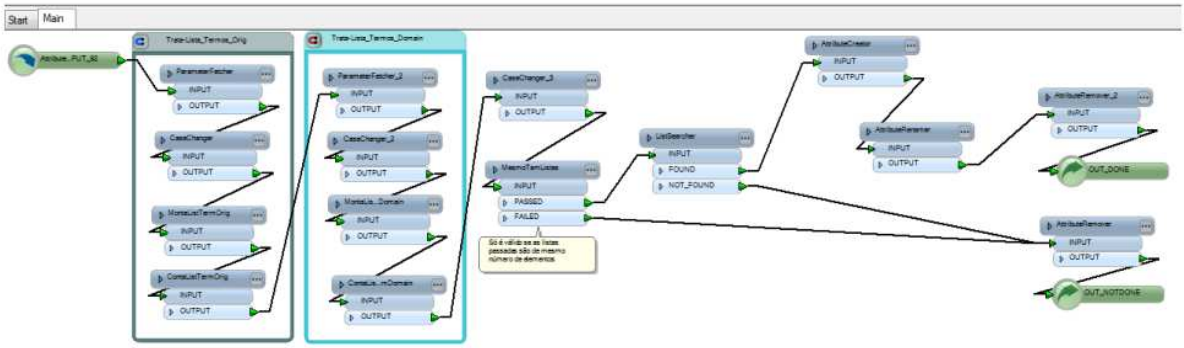

Figure 2: Example of data conversion flow from MTD to EDGV with FME.

Another type of significant update made by PAP are the geometric improvements in cartographic base held with help of remote sense products. The IBGE has a large collection of Georeferenced/orthorectified images from ALOS, Landsat, RapidEye and orthophotos. These products have brought substantial improvements with regards to positioning of the cartographic features as shown in figure 3.

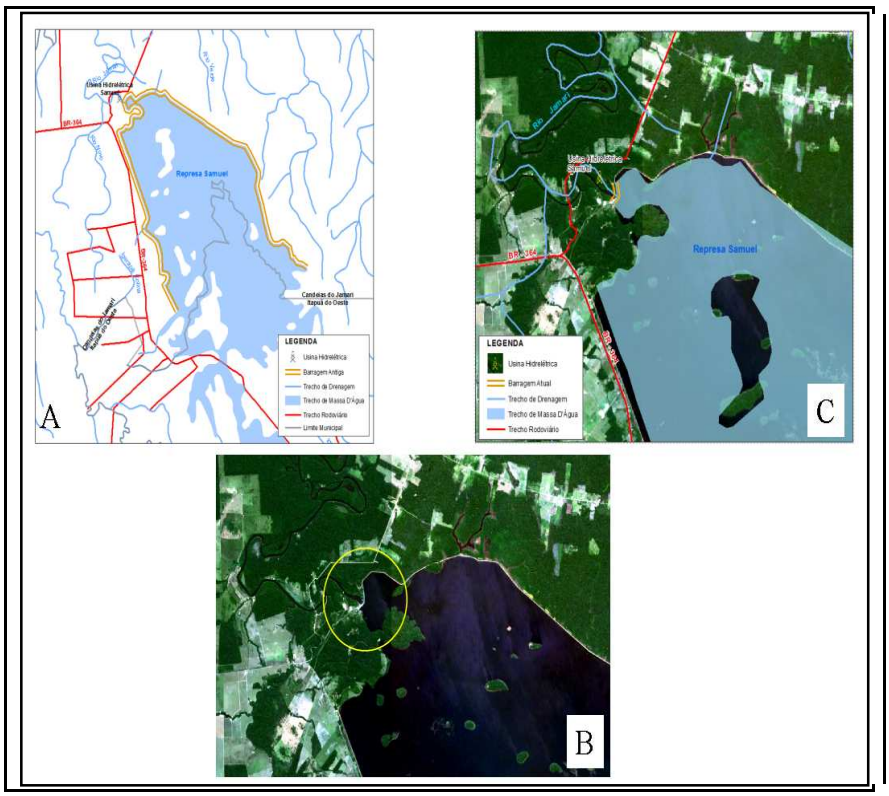

Figure 3: Example of update in the BCIM with orbital image use (RapidEye).

In the figure 3A we observe the old barrage representation of Samuel's dam in Rondônia, in northern Brazil. What can be noted is that the old dam representation circled almost the entire length of the dam. With the acquisition of RapidEye image, in the year 2011 (Figure 3B), the cartographic representation of the dam has been updated. The result can be seen in Figure 3C. This image also helped to update other classes , such as mass stretch of water, which were present in the mapping not restricted to the class that originated the demand for update.

Updates were also made from spatial analysis tools in conjunction with the images. With crosses between classes was possible to detect inconsistencies in the mapping. In Figure 4A

below, you can see the roads (road section) and the existing bridges in the area of Billings' dam in São Paulo, with a RapidEye image of 2011. After a spatial analysis between road stretch classes and water mass stretch held in Continual basis, were vectorized and updated the bridges that were missing in the mapping. The result can be seen in figure 4B.

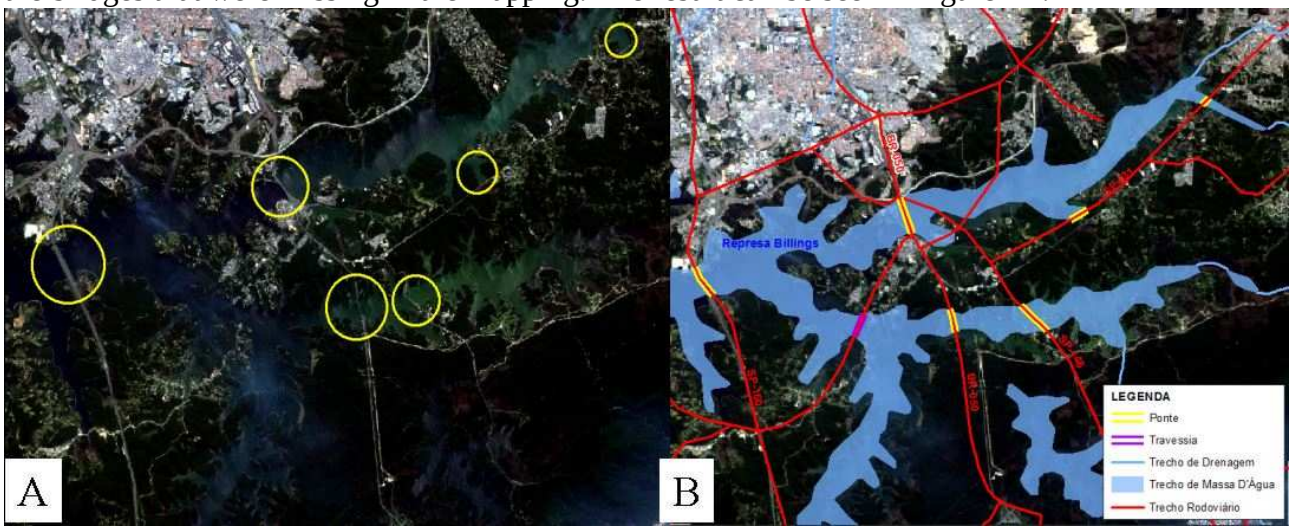

Figure 5: Example of update of bridges at the Continual basis.

This type of crossing also contributed to adjust the base because it was possible to see where the two classes (road stretch and water mass stretch), figure 6A, were confronting and with aid of satellite images, figure 6B, was observed that in some cases, the bridge element was not representative in the scale, thus the classes road stretch and water mass stretch were edited (figure 6C and figure 6D).

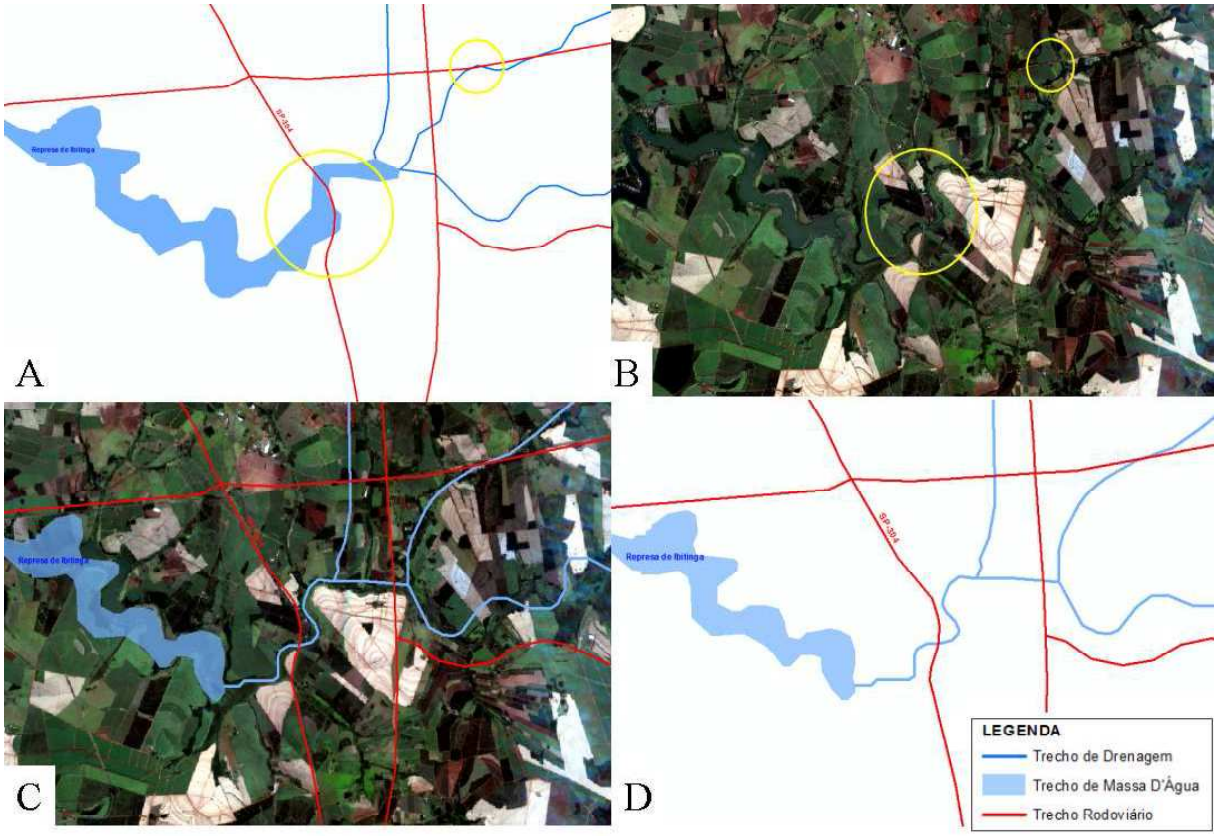

Figure 6: Update of cartographic features with aid of RapidEye image.

This BCIM last version, besides the examples cited were prioritized updates of the following categories: Localities (city and village), Hydrography (water mass stretch), Boundaries (city limits, and development and control area), Transport System (road stretch, bridges and sailings) and Relief (natural physiographic element). For the other categories were made revisions to the topological structure and place names in conjunction with the Reference Center on Geographical Names (CRNG) IBGE.

5. Conclusions

The BCIM is a fundamental geospatial base both for a National System Planning as a National Institutional Security System. The national transport infrastructure, energy, water, telecommunications, among others, should make use of that database BCIM for managing and updating information. The CINDE / CONCAR established the Action Plan of the INDE, in which the BCIM is identified as the reference data component of the geographical mapping.

The BCIM currently covers nine (9) of the thirteen (13) categories of information set out in ET- EDGV: Hydrography, Relief, Localities, Boundaries, Transportation System, Economic Structure, Energy and Communications, Public Administration and Vegetation. It is available in free format (shapefile and "dump" of PostGIS database), for use in Geographic Information Systems, and is compatible with different types of reading software for this kind of data. Regarding the geodetic and cartographic spatial reference, follows the current regulations, using the reference system SIRGAS 2000 with geographic coordinate system.

The BCIM serves as the basis to meet various application areas. The connection of each element to the attributes stored in a database allows you to run queries and other types of thematic maps, based on the selection of these attributes, such as: unpaved roads with temporary traffic; indigenous lands by state.

Among the many applications for which they are intended, stands out as the control plans and government programs because of the extensive territorial vision that it provides to monitoring and inspection activities. It is a basic input for the Global Mapping project. This Continual Cartographic Base from Brazil, the millionth can derived also state and regional maps and maps for the composition of the National and School Atlas, as well as serve as a basis for the thematic representation of statistical data, such as on population distribution and those pertaining to the systematization of natural resources and environmental research.

The IBGE along the Directorate of Geosciences and the Cartography Coordination intends to release a new update every two years.

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