

# THE ENVIRONMENTAL ATLAS OF THE CORUMBATAI WATERSHED – SP, BRAZIL

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## ABSTRACT

The Corumbatai watershed (1.710 km<sup>2</sup>) in the State of São Paulo – Brazil, is a well known region, mainly because one of the branches of the São Paulo State University – UNESP is located there, where most of the departments are related on environmental sciences. However all available data are in the analogical format and stored in different libraries and departments, which means that they are not as useful as they could be, not only for the University, but mainly for the society. The project followed four steps: 1 – Data Identification and Collection, 2 – Data Completion, 3 – Data Preparation and 4 – Data Input/Multimedia Programming. The Environmental Atlas is structured as follows: PRESENTATION; LOCALIZATION; ABIOTIC ENVIRONMENT: Geology, Geomorphology, Pedology, Climatology, Hydrology; BIOTIC ENVIRONMENT: Natural Vegetation, Forestry and crops, Fauna; SOCIO-ECONOMY; PHOTOGRAPHIC COLLECTION; WORKING TEAM. All information was integrated through the FLASH 5 (Macromedia) multimedia software. The final product is available at the IGCE-UNESP's website [www.rc.unesp.br/igce/ceapla/atlas](http://www.rc.unesp.br/igce/ceapla/atlas).

**Keywords:** Environmental Atlas; Database; Watershed.

## 1. INTRODUCTION

Since the very beginning was easier learn and understand different matters through the use of texts associate with images. According OLSON (1997) the multimedia of the 70's was a sound track synchronized with one or more slides projector. Today, the components of the multimedia technology include appropriate hardware and software and specific programming techniques, allowing the combination of text, videos, sound and images (BILL, 1994).

According KLEINER & MENEGUETTE (2002) the availability of geographic data through the Internet can reach much more users. However at the same time there is a greater responsibility to keep the databases updated.

The multimedia represents the utilization of the technology to develop products and data integration from different sources, using computer techniques (EARNSHAW & VINCE, 1995). One of the most important product of this new technology is the Electronic or Digital Atlas which is an organized and systematized set of maps and qualitative/quantitative information about one or several subjects, representing a piece of the physical space or the natural environment.

The use of digital atlas has been growing in the last years mainly due to the use of the multimedia technology which means more interactivity between the user and the database. There is no doubt that the most important applications are in the educational field, especially when related to the environment (SCHNEIDER, 1999).

Today atlases can be found in CD-ROM or DVD formats and in websites, but independently the media the most important technological change is the increase of the interactivity.

Interactivity is related with the data flow between the user and the databank using a selected computer program. Selection of specific data set and transformation of data characteristics are related with interactivity (BUCKLEY, 2003).

According SIEKIERKA (1996) and KRAAK & ORMELING (1998) the electronic atlases are classified as:

- Visualization Atlas – Minimum interaction with the user, except the multimedia possibilities;
- Interactive Atlas – Is possible to draw maps, using the existing data;
- Analytical Atlas – The functionality is greater, allowing comparisons, overlapping, evaluation etc.

According SCHNEIDER (1999) and KOOP (2003) the Atlas Information System (KRAAK & ORMELING, 1998), which is an analytical electronic atlas, is considered one of the most powerful tool. The following characteristics are related to this system (DELAZARI & CINTRA, 2002):

- a. There is no data input like in a GIS. The information is reached through the navigation, according the possibilities provided by the program, over the existing maps or over new ones created from the original maps storage in the databank;
- b. The Atlas can be developed for experts or non experts users, under different levels of complexity;
- c. The time consumption in an atlas system includes the navigation process, the computer speed, the archives sizes and the data transmission velocity.

The following atlases are “visualization atlas” or include one or more functions of the “interactive” or “analytical” type.

- Environmental Atlas of the São Paulo County, Brazil – Available at <http://www.atlasambiental.prefeitura.sp.gov>
- Atlas of Oregon – Available at <http://millrace.oregon.edu>
- Atlas of Ottawa – Available at <http://atlas.city.ottawa.on.ca>
- Internet Atlas of Switzerland – Available at <http://www.karto.ethz.ch/neumann/atlas>
- Atlas Interativo do Pontal do Paranapanema – Available at [www.prudente.unesp.br/atlaspontal](http://www.prudente.unesp.br/atlaspontal).

The first step to produce an atlas is the development of a geographic database with all necessary links between the different categories of the data set allowing the manipulation and data retrieval (PEREIRA, 1999).

Electronic or digital atlases are not considered GIS, since in a GIS system the main objectives are spatial analysis, data retrieval and modeling. In the digital atlas the main objective is the cartographic production.

Several attempts have been made to integrate GIS and multimedia system. The approach to integrate GIS and multimedia cartographic proposed by BAR & SIEBER (1997) and simplified by HU (1999) is considered to be the most feasible, since an interface between both systems is developed, trying to keep the best characteristics of each system.

The main objective of this research was in the first step the development of an Environmental Digital Atlas of a small, but important watershed in the State of São Paulo – Brazil using the multimedia technology and released at the university’s website. The second step, to be concluded near the beginning of 2006, is a second version of the Environmental Atlas of the Corumbatai Watershed (40% more data) including a graphic module to explore the geographic database.

## 2. MATERIAL AND METHODS

### 2.1. Study Area

The Corumbatai watershed (Figure 1) is an example of hydrographic basin developed during the Cenozoic. The topography is moderate undulated and the size of the basin is about 1710 km<sup>2</sup>. The altitude on the springs of the Corumbatai river is near 1058 m and at the discharge near 470 m.

The first settlements are of the beginning of the XIX century (Rio Claro, 1827) and since then the economy is based on the agriculture and dairy cattle. Recently there is an increase in the level of industrialization, mainly in Rio Claro. The following counties are, total or partially, located in the basin: Rio Claro, Santa Gertrudes, Corumbatai, Analandia, Itrapina, Ipeúna, Charqueada and Piracicaba.

The available water of the watershed is to be used by the local population (530.000 people), agriculture, beef cattle and industry. According the DAEE (2004), most of the streams are classified as Class 2, which means that the water can be treated and used as drink water.

According the Köppen classification, the climate is Cwa, subtropical, dry in the winter and rainy in the summer. The average temperature in the warmest month (January) is higher than 22°C and in the coldest month (July) is higher than 17°C. The precipitation in the watershed varies from 1531 mm/year (Ipeúna) to 1393 mm/year (Rio Claro).

The most important soils on the watershed are: Argissolos Vermelho - Amarelos (Typic Palendult), Latossolos Vermelho - Amarelos (Quartzipsammentic Haplorthox), Litólico (Typic Udorthent), Latossolos Vermelhos (Typic Eutrorthox) and Neossolos Quartzarênicos (Orthoxic Quartzipsamment), after field surveys by OLIVEIRA & PRADO, 1984, 1989).

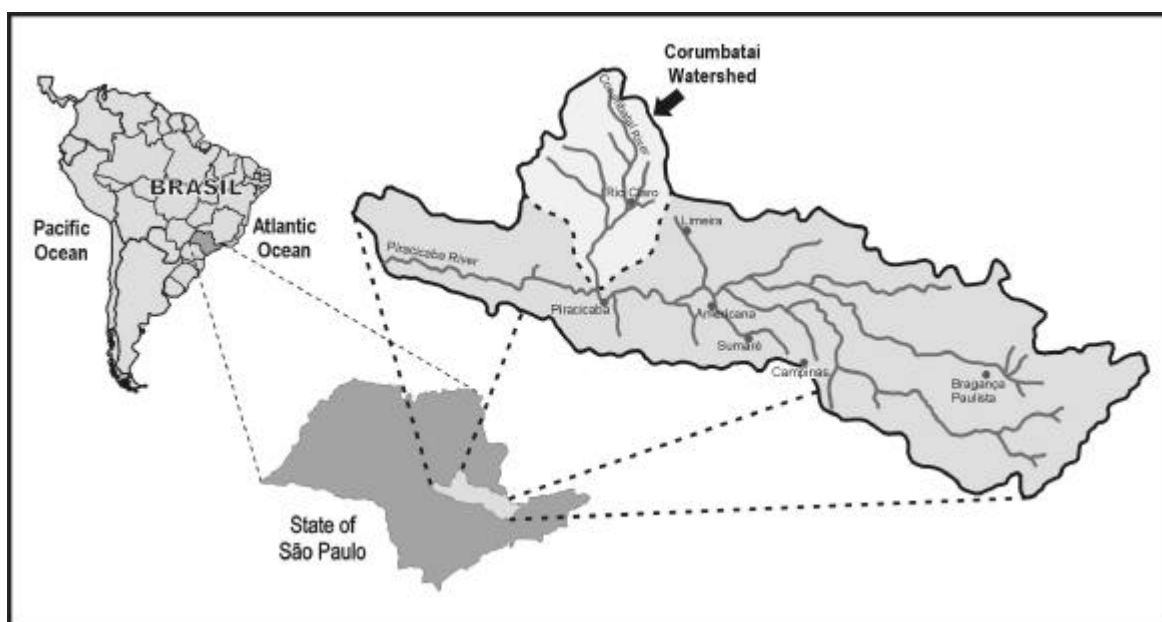


Fig. 1 – Localization of the Corumbatai Watershed

## 2.2. Data Set

The project followed four steps: 1 – Data identification and collection; 2 – Data completion; 3 – Data preparation and 4 – Data input/multimedia programming.

Since the branch of the São Paulo State University is mainly involved on geosciences and biosciences there is a significant amount of environmental information about the watershed.

The team also considered that the atlas content should be helpful not only for university students (undergraduates and graduates), but also for high school students or lower. The practical result is that all maps are georeferenced and in the vector format. The atlas content includes:

### PRESENTATION

#### STUDY AREA

- Map of Brazil in South America
- Map of the watershed in the state of São Paulo – Brazil + Text
- Detailed map of the watershed + Text

### ABIOTIC ENVIRONMENT

#### Geology

- Map of Geology + Text
- Map of Mineral resources
- Bibliography

#### Geomorphology

- Map of Relief (DEM) + Text
- Map of Classes of Slope + Text
- Map of Slope Exposition + Text
- Map of Hypsometry + Text
- Bibliography

### Pedology

- Map of Soils + Text
- Map of Erosional Risk + Text
- Map of Land Suitability + Text
- Maximum Utilization Potential + Text
- Bibliography

### Climatology

- Temperature (Text) + graphs and tables
- Rain (Text) + graphs
- Available Water in the Soil (Text) + graphs
- Bibliography

### Hydrology

- Map of the Drainage Network + Text
- Outflow (Text) and link to [www.sigrb.sp.gov.br](http://www.sigrb.sp.gov.br) (State Government)
- Water Quality (Text)
- Critical Analysis (Text) + graphs
- Bibliography

### BIOTIC ENVIRONMENT

#### Flora

- Map of Natural Vegetation + Text
- Photographs of the main trees and shrubs + Text
- Map of Crops, Forestry and Pasture + Text
- Bibliography

#### Fauna

- Photographs of wasps and bees + Text
- Photographs of mastofauna, fishes and amphibians + Text
- Bibliography

### SOCIO-ECONOMIC ENVIRONMENT

- History and Economic Development (Text)

- Link to [www.investimentos.sp.gov.br](http://www.investimentos.sp.gov.br) (State Government)
  - Bibliography
- PHOTOGRAPHIC COLLECTION

#### WORKING TEAM

- Content
- Development
- Support

### 2.3. Data Completion

When necessary, the information was up-to-dated. For example, a new map of land use was prepared using satellite images.

### 2.4. Data Preparation

In this step the maps were uniformized, mainly in terms of scale/fragmentation, datum, legend and cartographic control.

### 2.5. Data Input

Most maps were firstly rasterized in an A0 scanner (Summagraphics, model LDS 5000) and then vectorized using the software CAD Overlay R14 and AutoCAD MAP 3.0.

Some maps were digitized using an A0 digitizing table (Digigraf Velásquez). At the end all maps were georeferenced and the data prepared in the dxf format file.

The photographs of animals and plants were scanned in an A4 scanner, HP ScanJet 6300C.

Two computers, IBM compatible, were used each with the following configuration: Pentium III, 800 MHz, HD 20 GB, 256 MB DIMM.

### 2.6. Multimedia Programming

A benchmarking was performed among three softwares; Authorware, Director and Flash all of them developed by Macromedia. However in a later decision the team decided to develop the Atlas directly to be presented in the Web and this characteristic was fundamental to choose the Flash 5.

The Figure 2 shows the flowchart of the information.

The Flash 5 fuses the precision and flexibility of vector graphics with bitmaps, audio, animation, to create Web experiences. The Flash is also friendly, easily integrating with existing Web production workflow, providing powerful development tools for creating advanced Web sites and applications. (MACROMEDIA, 2000). Using the Flash 5 is possible the creation and visualization of fast Web pages with good design and full screen navigation interfaces highly compacted as well as, technical illustrations, long animations and other effects.

### 2.7. Overview of specific features

- Approachable
  - New user interface; Macromedia User Interface; Macromedia Free Hand import; Macromedia Generator-Developer Edition support; Improved documentation and learning aids; Intuitive Timeline; Asset management – Public command
- Creative
  - Bezier pen tools; Shared Symbol Libraries; Intuitive drawing tools – vector effects; Bitmap support; Advanced buttons & menus; MP3 streaming audio – Precise layout control
- Standard
  - Movie Explorer; Macromedia Flash Player; Web-native printing; QuickTime and Real Player support; Action Script development tools; Smart Clips; XML transfer and HTML text support; Flash based forms – Bandwidth profiling

## 3. RESULTS AN DISCUSSION

As cited before, maps, graphs and tables were prepared using AutoCAD MAP, CAD Overlay, Corel Draw and PhotoShop.

All subsets of data were linked using the Flash 5, integrating maps, texts, photographs and tables. When necessary, links with others sites were inserted allowing the user to access stronger database. The Main menu and an example of map are shown on figures 3 and 4.

The Flash 5 vector technology produces very small files even when executed in full screen, allowing the visualization of maps on regular size or enlarged, without loss of resolution. This is the reason because was possible to introduce the zoom possibility on the maps.

The maps in the dxf format are graphically prepared to be seen by the multimedia software and to do this the Corel Draw 9.0, Idrisi 2.0, Surfer 6 and Photoshop 5.5 were used.

The final product was released at the site [www.rc.unesp.br/igce/ceapla/atlas](http://www.rc.unesp.br/igce/ceapla/atlas). A second version is under construction and is expected to be released in the beginning of 2006.

## 4. CONCLUSION

- The utilization of different software packages were easier than thought, showing high compatibility.
- The Flash 5 is a friendly and powerful multimedia software and the Atlas can be considered a good product from the user's point of view.
- All maps are available for download in the dxf format.
- Together with maps, tables, graphs and explaining texts are available for the users.

- The content and the format of the Atlas are not fixed, or in another words, “the work never ends”.

The team is still working, processing new data and trying to improve it.

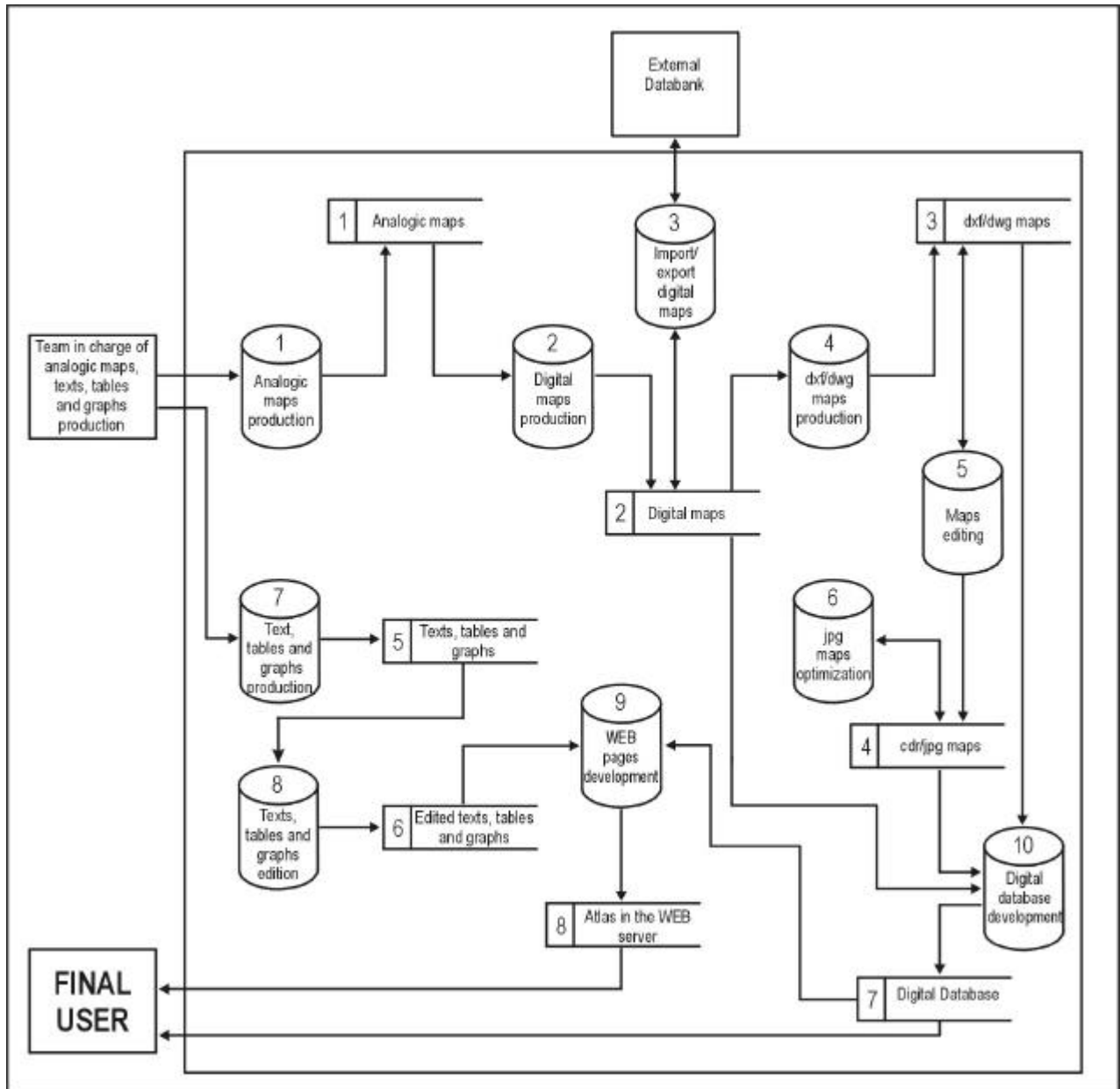


Fig. 2 – Flowchart of the system

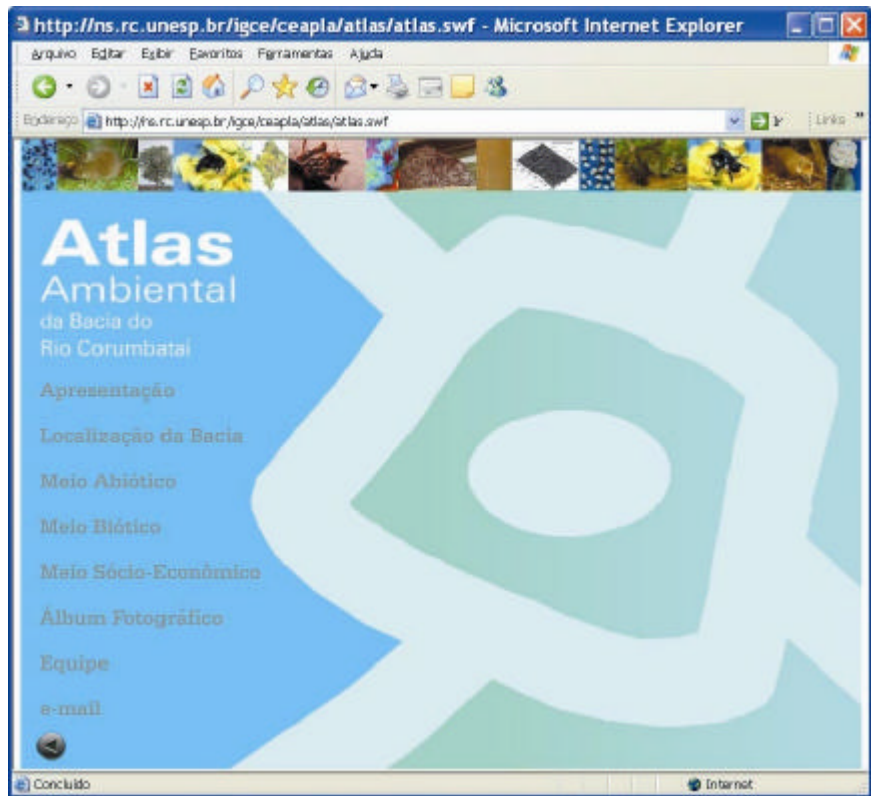


Fig. 3 – Main menu

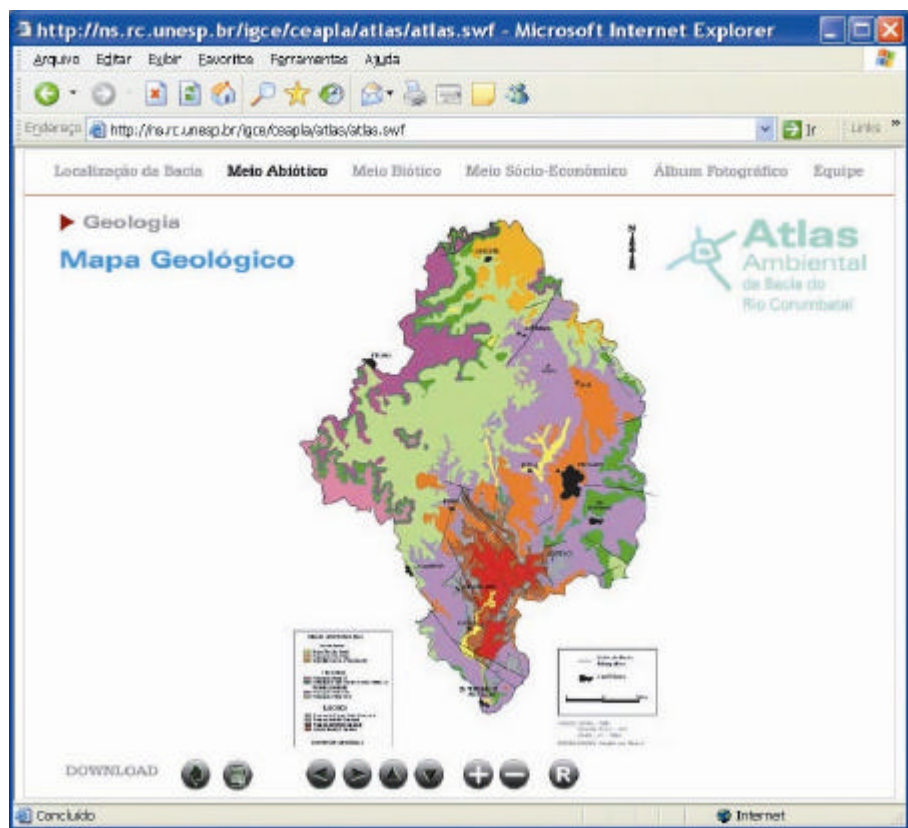


Fig. 4 – Geology of the watershed

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