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Atlas Technology, a Digital Framework for Efficient Management and Use of Regional Data. The Argentina Satellite Atlas.

Carlos Gabriel Asato and Eugenia M Wright

Geological and Mining Survey of Argentina (SEGEMAR)
Av. Julio A. Roca 651 p.8 of.1 (C1067BB) Cdad. Autónoma de Buenos Aires.
ARGENTINA
E-mail g_asato2000@yahoo.com

1. Abstract

In Argentina, as in other developing countries, information availability could be a serious problem. Due to the lack of information such as topographical, geological and other kind of geospatial data, geoscientists have strong difficulties to make their regional studies especially when digital analysis should be made. Despite of the great effort of different international organisations (UNEP GRID, Geocover, etc.) to supply free geodata coverage, information could not be efficiently used and managed without a good technological support. The Argentine Satellite Atlas for Geological and Geographical Studies is a special cartographic product generated by automatic procedures based on GIS technology and public and institutional data. The aim of this project is to provide a useful reference document for students, geologist and other earth science professionals. This paper describes the conceptual model, digital components, database structure and cartographic criteria that provided a framework for the quick generation of a high quality cartographic product.

2. Introduction

In developing countries like Argentina the generation of geoinformation infrastructure and operational applications systems are very complicate issues, especially when the project have to deal with a large territory (about 3.000.000 km²) and insufficient financial resources.

In this context, geoinformation system design is a delicate balance among infrastructure capability, computer and software possibilities, theoretical knowledge and technical experience, data availability, and public requirements.

The free geodata availability on Internet can partially solve some of the problems generated by the lacking of digital information in developing countries. Even so, is necessary to develop special applications to guarantee that those data could be efficiently managed and well used.

In the special case of large territory countries as Argentina, “popular” digital cartographic techniques are inadequate for the production of digital maps. The amount of data and geographic complexity requires the development of operational and systematic

cartographic production system similar to those used at manufacturing industry (Asato et al. 1995, Asato, 2005).

The Argentina Satellite Atlas for Geological and Geographical Studies is an automated GIS cartographic product based on Landsat TM GEOCOVER data (UNEP, NASA), elevation grids (GTopo 30, NOAA), institutional geographical information, and standards and special digital productions concepts developed at the Geological and Mining Survey of Argentina (SEGEMAR). The Atlas consists in a series of index maps, and 80 sheets maps at 1:1.000.000 scale, printed at full colour, in an A3 paper size.

The aim of this cartographic product is to provide to the general public, students and scientists a general guide for regional studies of the country and a reference document for geographical space comprehension, and identification or localisation of related spatial information.

3. Hardware and Software Description

The atlas project was adjusted to hardware, software and facilities available at SEGEMAR by using special digital procedures design, performance tests and effective programming.

The software and hardware were composed by Arc-info 8.0 on Sun Enterprise 250, 400 mhz, one Pc Pentium 200 Mhz, 32 mb RAM, Windows NT4.0 and one Pentium II, 400 Mhz 250mb RAM, Windows NT4 both of all running X-Terminals, one Pentium III, 250 mb RAM, with Corel-Draw 9. Xerox Docucolor 450 printing system.

4. Database and Geo-Information Subsystems

The system design conception was based on centralised geospatial database architecture and composed by different modules or subsystems:

- Image Catalogue
- Cartographic names system
- Visual interpretation key areas geodatabase and display system
- Central cartographic database management system
- Geoinformation institutional infrastructure system
- Cartographic AML programs
- Cartographic Finishing Process

4.1 Image Catalogue

An image catalogue is an organised collection of spatially referenced images that can be accessed as one logical image (ESRI, 1999). The catalogue construction involved several steps: a) GEOCOVER images were degraded to 1/3 the original pixel size by pixel average method, as a technique to avoid resampling problems at 1:1.000.000 scale and reducing data volume; b) those images were projected to national standard projection system, the POSGAR reference, based on Gauss-Kruger projection and WGS84 ellipsoid; c) the obtained images were mosaiked and reorganized in the corresponding seven cartographic POSGAR zones of the Argentine Republic territory.

4.2 Cartographic Names System

This is a special database-application constructed for administering geographic name places. With this kind of system cartographic names can be easily managed: a) places without geographical object reference may also be included; b) names are much more efficiently managed by centralizing information in one database; c) data could be spatially indexed by relating the data to the national map grid; d) names could be used in different map scales and representations (Leskinen,, Asato and Wright, 2004b). Although the cartographic name system was specially constructed for the Atlas project, this new development also reinforced the institutional GIS capability.

4.3 Visual Interpretation Keys Areas geo-database

The visual interpretation keys area geo-database is a system composed by a listing of areas where there are identified different features that could be used as examples of visual interpretation of the Landsat TM images. Those areas are related to corresponding maps and classified following the CORINE criteria (CORINE, 1993). Associated with this information some AMLs programs can create specific visual interpretation reference for each image maps (Asato and Wright, 2004a).

4.4 Cartographic Database Management System

The cartographic database management system is part of the institutional cartographic production system that generates the maps corresponding to regular geological surveying. In few words is a general database with specific map information at different scales, map grid coverages and management and production applications. Sheet number, names, area, and geographic boundaries are some of the items included in this system. Mapping applications get those information for obtain contextual information, creating titles, frames, geographical coordinate grids, etc.(Asato et al 1996, Asato 2002)

4.5 Institutional Geo-data Infrastructure System

It is conformed by the basical support of general geographical information like roads, political boundaries, hidrography, auxiliary map creation system, auxiliary data like graphics, logos, colour definitions, data dictionaries, etc. (Asato et. al 1996, Asato 2002)

4.6 Specific Cartographic Programs

Each of the last modules has their own set of associated programs (methods) written in AML that retrieve different type of data. The cartographic generator program was designed following some criteria given by Object Oriented methodology (Martin and Deelee, 1994).

4.5 Cartographic Finishing

Cartographic finishing is only applicable at the end of the automated process. Some details that are difficult to manage by GIS were completed by manual digital edition using Corel-Draw. One of the remarkable cartographic techniques was the enhancement of geographical names by a special masking procedure.

5. Future Developments

The created technological and geoinformation infrastructure will promote the development of new systematic products. At the present, there are other projects in progress based on those developments, like others specific versions of the Argentina Satellite Atlas and the Metallogenic Atlas of South America. The last one consists in nearly 100 metallogenic maps at 1:2.000.000 scale, based on the Metallogenic Map of South America (Zappettini and Asato 2004). A preliminary version is actually being used by several southamerican geological surveys. Other applications, as disaster management at large scales, are expected.

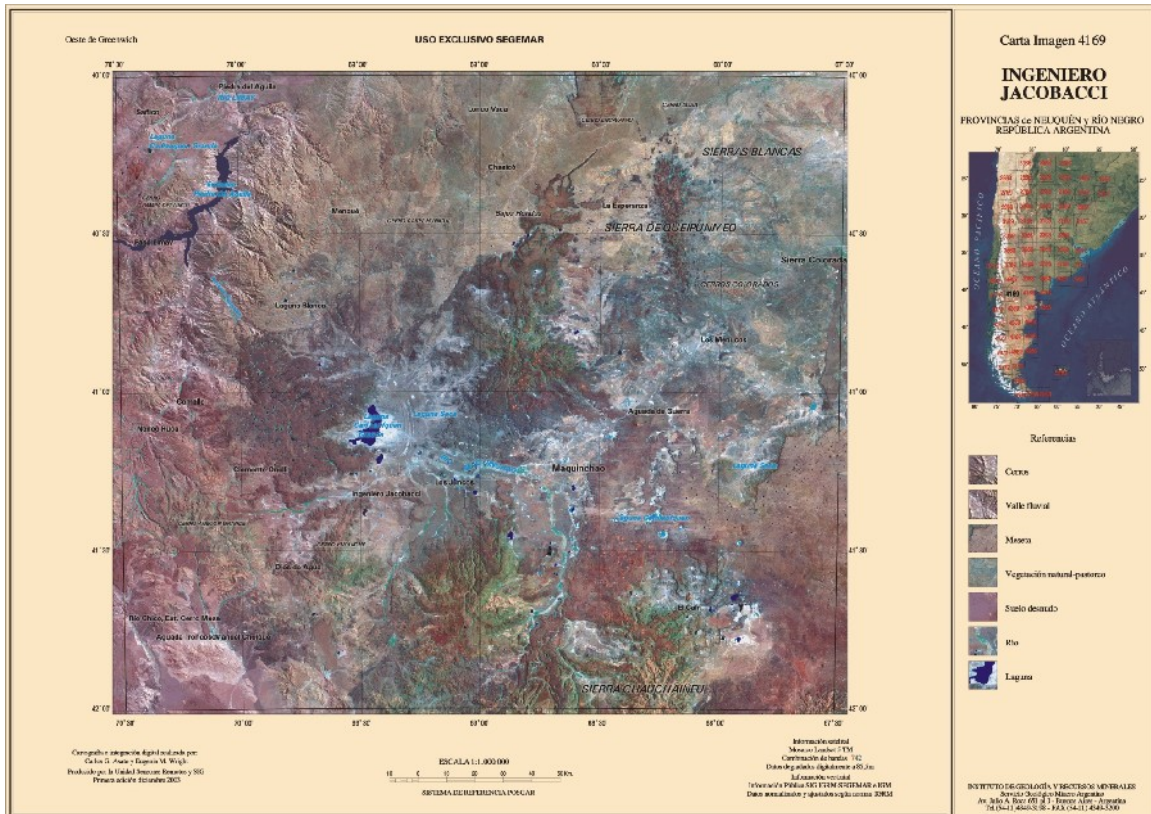


Fig. 1 Example of final cartographic product

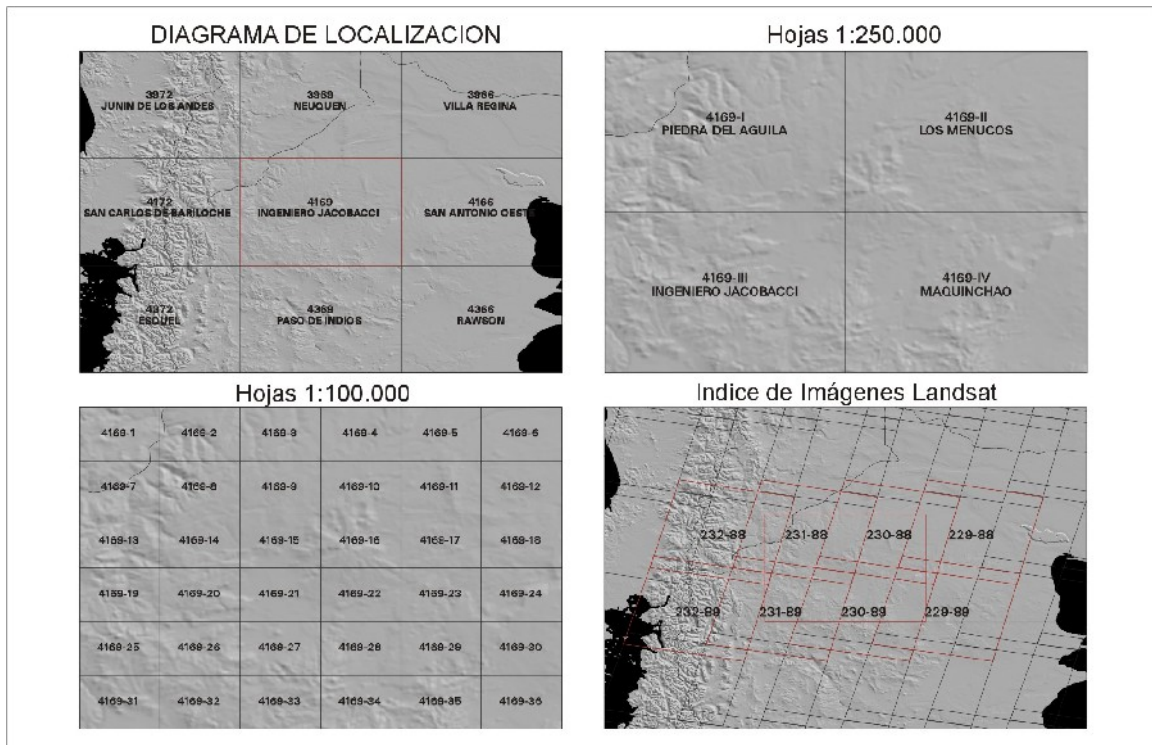


Fig. 2 Examples of auxiliary maps in the backward side

6. Conclusions

The Argentine Satellite Atlas for Geological and Geographical Studies is a high quality cartographic product that could be developed by using a GIS technology and by integrating special geodata management and digital cartographic techniques.

Using automated cartographic procedures –similar to industrial production methods- was possible to create a cartographic product in a short time (7200 working hours/man) with little human resources (two persons). Automated process also gives a much more consistent way for cartographic error handling, facilitating map corrections.

The Argentine Satellite Atlas is a valuable reference document that facilitates the comprehension and development of different regional studies of the country.

This project has allowed the creation of a technological basement and geoinformation infrastructure, which will promote the development of new systematic products.

7. Acknowledgment

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