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Conference Paper · August 2006

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A GIS Based Satellite Data Management Application

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ABSTRACT : Remote sensing is becoming a more complex technology. There are a great diversification on sensor systems and applications, and the demand of digital satellite images and products is growing. Demand is prompted by the technological progress, the data appreciation as commodity, and their impact on global change and sustainable development studies. Due to this new scenario, the role of geo-scientific institutes -like geological surveys- is changing. They should give a new kind of technological services as, for example, specialized remote sensing services.

Despite the increasing demand on satellite images is accompanied by the development of more powerful systems, the increasing data volume and complexity requires of special systems that facilitate management of data.

This paper present an ASTER data management application developed as part of a data infrastructure program. In this project a data bank with about 2000 ASTER images was created. The application, developed in ArcView 3.3, is composed by several modules: data input, management database, spatial information support, query and selection, and report system. Using GIS as developing platform we can search by metadata information, and by absolute and relative geographical location. This application improves the management of digital products and projects, and accelerates the requesting images process.

KEYWORDS : ASTER, satellite image management, geological surveys, earth science institutes

1. Introduction

At present, geological surveys are taking new roles in the context of the development of national spatial data infrastructure and the impact of environmental and physical information on global change studies and sustainable development.
The information technologies manage by these institutions are considered essential to the development of countries, and the protection of lives, public or private property, etc. (MSC, 2004). The experience acquired in remote sensing technology, spatial infrastructure operations, and geophysics, environmental and territorial knowledge during the last years, gave to the earth science institutes a preferential position in the development of the National Spatial Data Infrastructure (NSDI) framework. But, the public demands and requirements will not be reached if special information policies are not developed. Special applications for data management and production systems and systematic data surveying programs are some initiatives that should be performed (CCIDGDC and CGED, 2003). In this context geological surveys will play an important role as specialized data providers.
The GeoSat-AR, a Japan to Argentina ASTER technology transfer project, was developed from 2001 to 2005. The agreement consisted in the transference of special processing equipment and software, and a specific training in ASTER data processing. Since satellite

data are considered as a very important source of basic information in peripheral and large countries like Argentina (Asato and Wright 2005), the project was conceived as support for the national geological mapping program at 1:250.000 and 1:100.000 scale, as well as for specific mining exploration, and environmental and territory planning projects (Marín, 2002). In the context of this project Argentina was the first country, after Japan, that provided level 3A ASTER images (orthorectified with satellite ephemeral data) to external users like mining companies, government agencies, other South America geological surveys, etc. Actually the original image data bank increase considerably and it have about 2.000 images (ASTER Level 1A) in stock.
Due to the difficulties to manage, search, analyse and select the suitable images from this large amount of data, we developed a special management application in order to satisfied the internal and external demand efficiently.

2. Development of ASTER data management application

As other well know image searching and image management system (Jin et. Al, 2005), the application was conceived as a system where images can be searched by geographical area, time, and data capture conditions (environmental and radiometric). Special institutional requirements also defined the necessity of data location by relative geographical position. That means, data can be search in reference to provincial territories, national cartographic division (1:250.000, 1:100.000), project areas, geographic features names, etc.
The application also was created to acquire experience and produce a conceptual framework for the development of more advanced systems. User data interactions, management operations, data input and reporting process are some of the facts that we analysed. This initiative was also developed as a strategy to illustrate and promote the institutional awareness about the role of corporate management applications in geological surveys. The current application was developed, as a standalone system, in Arc-View 3.3 using Avenue programming language.

3. Main components of the data base structure

3.1. Image scene and image data descriptive database

The ASTER images are described by two main datasets. The first are the ASTER scene shapefile and its attribute table that identified the area where the image were taken. The second is the ASTER image identification table where the image data is identified by its unique granule code and described by its data capture conditions. More technical information could be accessed by a link to the metadata file. Information about the complete description of metadata parameters are described in detail by ERSDAC (2001). The relationship between ASTER scene and identification datasets (one scene to many images) is made by a complex key conformed by path, row and view.

3.2. Geographic information framework

The geographic information associated with this system were selected in order to organize the spatial query in a hierarchical form: starting from provincial territories, national cartographic division at different scales (1:500.000 to 1:100.000) and then arriving to more specific objects like geographic names features. This schema was adopted because it gave an appropriate spatial structure framework to the spatial query process and a geographic context to the report process in the form of location maps.

4. Management Process

4.1. Data input process

Original ASTER data are stored as Hierarchical Distributed Format-Earth Observing System (HDF-EOS), data format files designed by the National Centre for Supercomputing Applications (USA). For this reason, it is necessary to use some applications in order to transform these data to generic binary and text data. We used the ASTER Data Opener Application (ERSDAC, 2002). This application extract image data as generic binary files, metadata as text, and quick looks as jpg image format. The data input process require the metadata file should be formatted in a array of rows and columns, and quick looks should be stored in a specific directory where they will be used for the report subsystem. The input module get the formatted meta information and normalise them by organizing the information in two datasets: scene data and image data. If scene and image data are already saved in the database, the program, by a consistency rule, will not introduce the last information.

4.2. Query process

As suggested above, the query process involves a selection by data capture conditions (geometrical, environmental and spectral), and by image location. Spatial query was classified in absolute and relative. Absolute location correspond to queries made by defining geographical areas by coordinates; relative location correspond to the spatial selection respecting any geographical object (image scene selection by spatial geographical object superposition). Relative spatial querying was considered very important because users usually express their image request in geographical relative terms: i.e. “I want to known which images are available in this map area”.

4.3. Reporting processes

The query result is resumed in a report created in HTML language. The report is mainly composed by a report header with a image location map, auxiliary information like total number of selected images, date, and user name. Then the selected images are described by their corresponding quick look, the granule identification code, and other auxiliary information like date of data capture, cloud coverage, sun position, etc. HTML format was selected due to its main advantages as a publishing format. It is well known as simple, structured, open, transportable and elegant hypertext language, and the resulting documents looks appropriates and fine.

5. Results and Conclusions

The described management application improve and accelerate the image requesting process by providing specialized querying tools to search image data by their data capture conditions and relative geographical position. Relative geographical querying was considered an important item because users usually express their requests in geographical relative terms.

This prototype is a first step to develop a more complex system that could efficiently and consistently manage a large amount of data. Due to the importance of institutional awareness in the development of adequate corporate data framework, this initiative was also promote to illustrate the importance of a management system in the development of data banks and their importance in the data request process.

The development of this kind of corporate applications is related to the increasing demand of satellite image data and applications, the data appreciation as commodity, and their impact on

global change and sustainable development growing. In this scenario geo-scientific institutes should assume new roles as specialized data providers and NSDI contributors.

Acknowledgment: to Geological and Mining Survey of Argentina for permission to publish this paper and to Dra. G. Lo Forte for the giving advice.

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