THE MAP-IMAGE: A SOLUTION FOR ENVIRONMENTAL MONITORING

Lic. Ramiro Salcedo Gálvis, MSc.

Servicio Autónomo de Geografía y Cartografía Nacional
Avda. Este 6 -Edificio Camejo Caracas 1010 - Venezuela - FAX: (582) 545.03.74

ABSTRACT:

The need of overcoming the problem arised by the lack of updated cartographic information which has to be used for environmental monitoring, among other uses, has lead to find practical answers which are the consequence of both, the development of the Remote Sensing and the expertise of Cartografía Nacional to handle the tools provided by recent technological developments in this field.

In this work, a new cartographic product at the scale of 1:100.000 is presented as an alternative to make it easier and more efficient the generation of basic information, and the environmental monitoring as well.

Some considerations around the implications of this new product are discused , with the purpose of allowing the reader to be placed in the general context.

The methodology is presented in a sequential fashion, with not so much of technical details.

Finally, some conclusions and limitations faced during the making of Map-Images are drawn .

INTRODUCTION:

The National Autonomous Service of Geography and Cartography of the Ministry of Environment (MARNR) has initiated the generation of a new cartographic product which has been designated with the name of MAP-IMAGE.

Landsat-TM imagery will be used as primary source of data, because its 30 m spatial resolution widely satisfies the need for information at the scale of 1:100,000, wich is the scale chosen for this Program.

The above mentioned product will have the characteristics of a topographic line map in the sense that it is going to be georeferenced to the corresponding one, having its coordinates, identification and size.

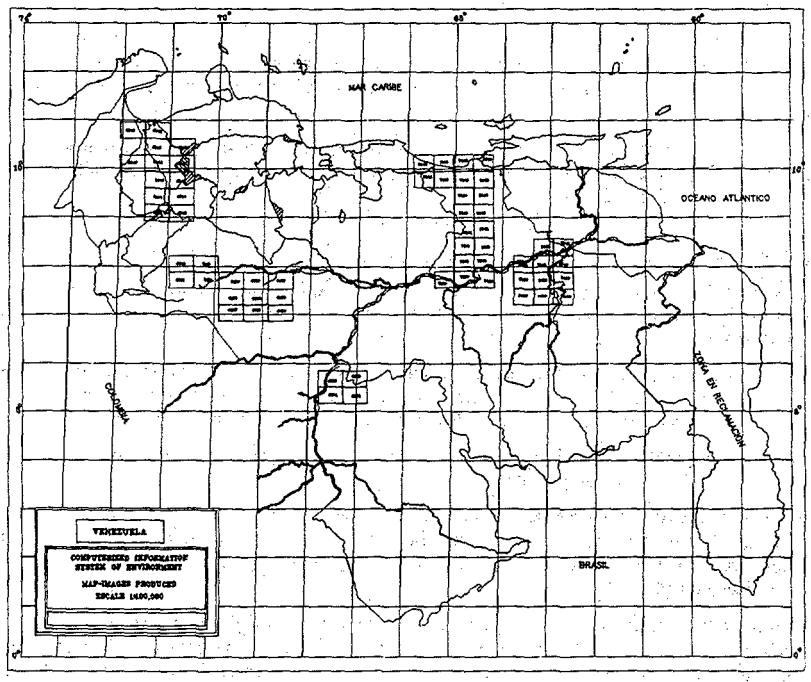
Aditionally, linear elements such as roads, geographic names and updated municipal boundaries will be incorporated.

The possibility of making an alternate cartographic product such as this, has arised great expectations not only among MARNR users, but to a wide spectrum of users who require accurate and updated information concerning the real conditions present in a given area.

The new series will not pretend to substitute in any way the already topographic map series at that scale. Nevertheless, it will hope to become the most atractive, quick to produce, and economic alternative.

The production of Map-Images has been started by processing data on different areas of the country having as the main decission element the availability of digital data (see Graphic No. 1) as well as the users demand.

GRAPHIC N° 1



A LITTLE OF HISTORY:

Venezuela, as every developing country, has an accentuated dynamics regarding land occupation processes. Naturally, this situation doesn't occur uniformly, from the spatial point of view. On the contrary, its intensity and characteristics are rather different in every region.

Likewise, it is of primary importance to have in mind that the venezuelans have the responsability with themselves and with the future generations for making rational use of the natural resources as well as implement preservation practices of them in view of the tomorrow's inhabitants needs.

In that context, a very complex situation arises in what is referred to maintaining an updated cartographic

data base, specially if it is referred to the topographic map 1:100,000, which in our case, is a compilation from the basic map at the scale of 1:25,000.

On the other hand, having the aerial photography as one of the most widely used sources to produce thematic information (land use/cover, soils, geology, geomorphology) it is relied basically on a single mean for data extraction, which by extension, is costly, of limited spatial coverage, and monochromatic (in most cases).

From the former discussion, and thanks to the availability of remotely sensed data, we can make use of highly powerful and efficient tools to produce land information, as well as to effectively monitor at a low cost considerable portions of our territory.

TECHNOLOGICAL DEVELOPMENT:

Since the early 70's a systematic production of data recorded by a multispectral scanner (MSS) started on board of the first orbiting satellite of the Landsat series (ERTS-1). In this way, a new era of looking at our planet was initiated.

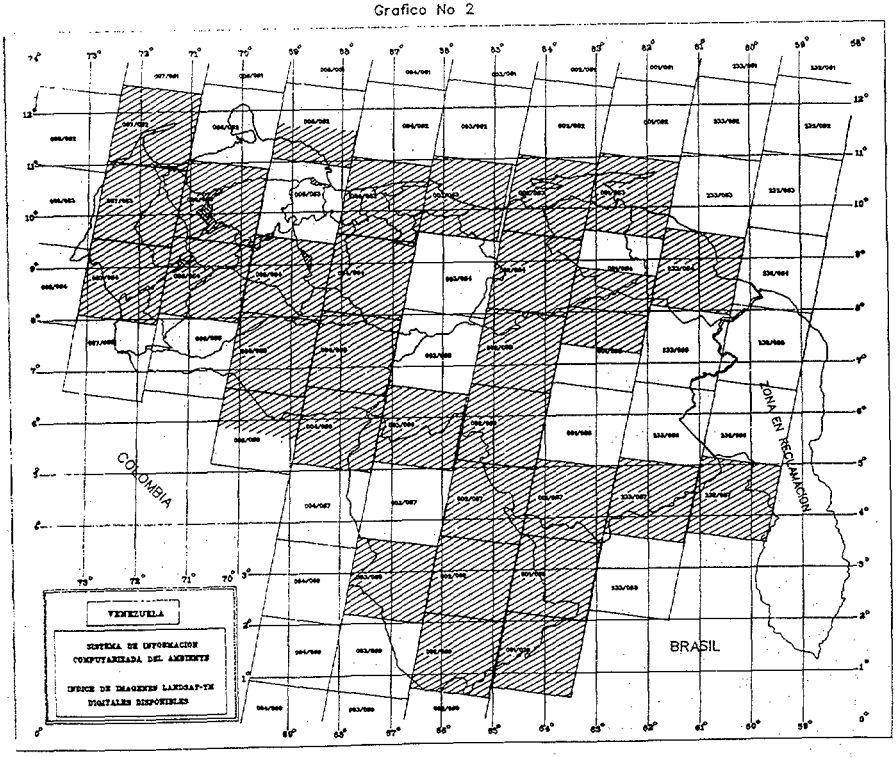
Currently, a wide sort of orbiting sensors provide, on a continuos basis, with data recorded in the visible, infrared (both reflected and emitted) and microwave portions of the electromagnetic spectrum. At the same time, considerable progress has been made in terms of improving the spatial resolution of data.

Constant developments in the production of high performance microprocessors, has provided the users with more powerful and less costly hardware.

In Venezuela, the use of remote sensing imagery from satellite, was initiated in the early 70's by acquiring the data on analogical format (film). But was only in the mid 80's when the use of this technology was done in digital terms. It happened thanks to the total dedication of at least two technical groups to research and development in this field.

In this way, in the last ten years, a solid platform of technological expertise was developed. Having as a result of that, a long list of public and private organizations who are permanent users of remotely sensed data and its related products. As a consequence, an almost total coverage of the country has been obtained (see graphic No. 2).

Grafico No 2



THE MAIN ADVANTAGES OF THE MAP-IMAGE:

1.- National coverage.

2.- Fast and economic production method as compared with the photogrammetric one.

3.- The kind of information provided by the Map-Image allows data extraction for thematic uses such as land use/cover, hydrographic network, among others, which can not be possible having the topographic map as the only source of data.

METHODOLOGY OF PRODUCTION:

1.- THE DIGITAL PROCESSING OF THE IMAGE:

1.1 It starts once the satellite scene and the topographic maps are chosen.
1.2 Stable linear features are digitized.
1.3 Homologous control points are collected on the image having the digitized elements as reference file.
1.4 Once a set of control points is collected, its acceptability is assessed in terms of latitude/longitude displacement with regard to the same point located on the topographic map. Generally, sub-pixel accuracy is sought, but topographic relief and the real possibility of collecting a properly distributed set of control points doesn't make it always feasible. Moreover, in highly complex regions such as those located in the southern part of the country, digital elevation models produced by radar interferometry, will probably be the most reliable source of elevation data.
1.5 As soon as the geometric rectification algorithm has been applied (bilineal or cubic convolution), radiometric enhancement is performed by histogram stretching on each band. This can be done on the scene as a whole, or by 20' x 30' size sub-images, if evident radiometric differences are found throughout the scene.
1.6 If necessary, atmospheric corrections and border filtering algorithms are applied.
1.7 Next, marginal information is generated.
1.8 A final proof is plotted to verify details both in the image and in the marginal text.

2.-THE PRODUCTION OF COLOR SEPARATES:

The workflow that leads to the generation of color separates can be schematized as follows:

2.1 Definition and making up the marginalia. It implies the setting of font types, sizes, color, and width.
2.2 Rasterizing of marginalia files according to plotting resolution. A 12.5 microns resolution has been adopted to guarantee both, the text and image quality.
2.3 Placing the image on the map-image's frame.
2.4 Selection of priorities regarding the order that every element should has during the final printing.
2.5 Plotting a final proof.
2.6 Final review for quality control.
2.7.Plotting the color separates on film
2.8 Final printing

SOME APPLICATIONS OF THE MAP-IMAGES FOR ENVIRONMENTAL MONITORING AND THEMATIC DATA EXTRACTION:

The visual quality of the map-image convert it in a tool from which data extraction of cultural and physical features can be easily interpreted. Typical examples of the above are: land use/cover, monitoring of agricultural activities, identification of multi-temporal changes occurred in the hydrographic network, urban developments, illegal activities along international borders (narcotrafic, illegal mining, smugling); roads and dams mapping, among others.

Emphasis should be placed that for users the format of the map-images is very handy and convenient to take to the field as well as working with it in the office.

The map-image series processed until now have had the following applications:

- Monitoring of the Ticoporo Forest Reserve
- Reactivation of the Módulos de Apure Project
- Hydropower Project of the Low Caroní River
- Support in oil exploration activities.

CONCLUSIONS:

The venezuelan cartography has been doing constant efforts during the last years, in order to enter into the new technological world of digital cartography. This however, doesn't imply the mere acquisition of hardware and software, or the implementation of new workflow processes, but which is much more complex, is assimilating those changes introduced by new technologies, by people who has been producing maps by conventional methods for long time.

Since the processing of map-images was initiated, the users response has been highly satisfactory.

The limitations associated to the above mentioned product are mostly related to the logistics involved in data acquisition, not to say about natural constraints generally related to cloud cover , which in tropical areas is very difficult to overcome.