THE BRAZILIAN EXPERIENCE IN HANDLING 15 YEARS OF REMOTE SENSING SATELLITE DATA

Barbosa, Marcio Nogueira
Pereira, Sergio de Paula

MCT-INPE Instituto de Pesquisas Espaciais

Rod. Presidente Dutra, km 40
12630 - Cachoeira Paulista, SP
Brazil

COMMISSION II

Working Group II/4

ABSTRACT

This paper describes the Brazilian experience in acquiring, storing, processing and disseminating Remote Sensing data collected from satellites since the first Landsat in 1973 up to SPOT I in 1987/1988. INPE's roles in operating, upgrading, specifying, designing and integrating the related systems are covered, giving an evolution history which can be useful to other developing countries in the field of Remote Sensing.

1. INTRODUCTION

Fifteen years ago a decisive action took by the Brazilian Government placed our country in the promising position of becoming one of the leaders in the Remote Sensing field of activities in the Southern Hemisphere. Thus, at that time, presidential authorization was granted to install and operate in Brazil a LANDSAT (ERTS-1) Ground Station, the third in the world to become operational, after only Canada and United States.

The initial availability of data from the LANDSAT series of satellites since 1972 and the operation of its own ground station from 1973 on gave to Brazil the required conditions to develop their Remote Sensing plans in a more effective manner.

Today, fifteen years have passed and the activities and perspectives in Remote Sensing have undergone an unequivocal evolution giving rise to a solid Brazilian experience in the field.

This experience is represented both by the practical know-how and maturity of specialists in the use of orbital remotely sensed data for a wide variety of applications, and by their consolidated experience in the operation of satellite ground stations as well as in developing and establishing new image generating and processing systems for satellite data applications.

2. HISTORIC RETROSPECT

It seems proper to review now the results obtained during this long range effort and their main consequences in conjunction with the governmental priorities and the perspectives at internal level.

During this time two different (but complementary) actions were developed in Brazil on the Government Level: the RADAMBRASIL Project and the Satellite Remote Sensing Program.

The RADAMBRASIL Project, initially established to perform the Land Resources Integrated Survey of an area of 1,500,000 km^2 in the Amazonic Region, was gradually increased until, by 1975, to cover about the entire 8,500,000 km^2 of the Brazilian territory, thus becoming the world's largest airborne radar (SAR) data coverage project. 38 reports with excellent thematic maps in the 1:1,000,000 scale were generated and became important assets for Government planners both on the Federal and State levels. This event gave rise to a very important by-product which was the training of large number of technicians on the handling and assessment of non-conventional images. Until then, the Brazilian technical people were used almost exclusively to handle aerophotographs.

Today, both the data generated by the RADAMBRASIL project and a fairly large number of specialists can be found in the IBGE Foundation, the Brazilian Institute for Geography and Statistics, in Rio de Janeiro.

A different strategy had to be pursued, however, by the Satellite Remote Sensing Program. First, it was soon recognized the priority need of preparing the people for the then unknown techniques (even at international level) for generating and handling earth resources satellite data. Opportunities were then created to send Brazilian technicians abroad to be submitted to different levels of specialization (i.e. from short on-job-training courses all the way to MSc's and PhD's).

Further, it was enough just to look at the characteristics of Brazil to infer that very shortly the country would turn into a very important user of the data generated by these earth resources satellites. The authorization for purchasing a complete LANDSAT Satellite Ground Station was then issued by the Government in 1972, guided by the urgent need of better knowing the large country's territorial area and its renewable and non-renewable natural resources, the need of checking on the progress of large projects at remote areas, the need to access, in a global basis, the results of an agricultural policy, and the cost involved in obtaining data for theses objectives using traditional methods.

Benefiting from the strategic location of Cuiaba Receiving Station in the continent, a huge ammount of data of our own territory and also of several other countries in South America

became then directly accessible to a growing and potentially active user community.

During these past years a considerable experience was gathered by INPE technicians in the process of developing techniques and methodologies and also in the identification of problems which could be either solved or mitigated with the use of satellite images.

In this period a very large number of specialists from governmental agencies, universities and private companies were trained at INPE, through the offering of specialization courses in several levels and graduate courses, MSc level.

Such an effort was intended primarily to spread the Remote Sensing disciplines and techniques through the user community in order to awake them for this exciting new technology and its potential applications in many areas of earth resources management and monitoring of the environment. A well trained user community would surely promote the country's economic growth using satellite technology.

Using the experience gathered from monitoring, operating, adapting and enhancing sophisticated receiving and processing equipments and associated software to meet satellite specifications of the LANDSAT series and the requirements of a growing user community, INPE gradually became a competent R&D center able to develop fairly complex units mainly in the areas of receiving and data processing stations as well as image analysis systems. It is worth to mention that this experience enabled INPE to reach, in the early 80's, the status of co-participant in the design and implementation of the new LANDSAT 4/5 Brazilian ground processing system. In the mid 80's INPE, reaching a deeper knowledge and experience among its technical personnel, focused its attention to the French Satellite SPOT getting prepared to answer alone the requirements for the full integration of a ground processing system to handle SPOT data.

Nowadays the industry, strengthened by the government policies, is able to make and sell abroad, competitively, not only items but also systems developed by INPE.

Unfortunately, the economic crisis which hit Brazil in the last years reached very severely the R&D Centers, INPE among them. Suffering from lack of financial support and struggling for survival INPE (and some other important government R&D Centers too) was forced to pursue application target areas which naturally should have been transferred to the private companies, for example, biding for the execution of projects using technologies already established.

However, with the new Government installed in March 1985, opportunities were granted to review every policy in the country, including the Remote Sensing subject.

Meanwhile, a simple inspection of what is happening in the western countries led the observer to conclude that the satellite remote sensing activities are going now through the transition from a well proven technology to a commercial venture, with a very high probability of success. The new policy from the Remote Sensing in Brazil should certainly take these facts in consideration.

Thus, in harmony with the aims and priorities of the new Brazilian Administration and guided also by international trends, INPE, from 1985 on, revised its own policy and structure in the area of Remote Sensing with the firm objective of intimately interact with the user community, universities and private industry in order to attain a highly desirable technological union. This will end up positioning the satellite remotely sensed information as the decisive tool for the investigators, specialists, planners and managers to achieve daily, weekly, monthly, seasonal, annual or long term monitoring of changes in the country's environment and resources. In particular, consolidating its union with the private sector, INPE is in process to promote, as said, the country's economic growth using satellite technology.

3. SIGNIFICANT STEPPINGSTONES

3.1 - Ground Stations and Instrumentation

Once acquired its first Receiving and Processing Ground Station in 1972/1973, few months after lauching of LANDSAT-1, INPE, in a gradual way, became capable of modifying and upgrading the station to handle data from new satellites of the initial series (LANDSATs 2 and 3), to fulfill new operational needs and to improve overall efficiency. The knowledge absorbed in this process allowed INPE the effective participation in the system design and analysis as well as software development and system integration of the new ground station, capable of receiving and processing the Thematic Mapper data from the LANDSAT-D series of satellites, to come, sharing these efforts with the supplier.

These efforts were managed within what was called "INPE LANDSAT-D Project" which set up, from late 1980 on, several phased activites aiming the establishment of the new facility which would allow the Brazilian Remote Sensing user community to access the markedly improved capabilities of the new instrument. Not only that but it would also fulfill the increasing requirements of this fast growing community in terms of timely, accurate and reliable data on earth resources. The new ground station for TM then came to reality, starting in early 1984 the generation of Thematic Mapper products.

This joint development program was fundamental in giving INPE the ability to modify, improve and expand its station as needed. New products have been placed available to the user

community these last years and several extensions were made in the overall processing software to allow easier management, higher throughput and accuracy, and better quality of products.

This ability is being also put to test, in the last two years, through the efforts for upgrading the receiving and processing systems to handle the data from the french satellite SPOT. The development, implementation and tests of SPOT software as well as full system integration activities are being totally carried out by INPE specialists.

At this point it is most appropriate to mention the full support INPE has received from the Government in the procurement of the hardware subsystems necessary to upgrade their station for receiving and processing SPOT data. This financial support was provided despite of the severe economic crisis the country is lately suffering, in clear recognition from the governmental planners of the priorities and importance of INPE's role in fulfilling the country's needs.

INPE has also been developing equipments for meteorological satellite stations and for Data Collection Plaftorms (DCP's). In order to stimulate the use and fabrication of PCDs in Brazil long range efforts were engaged by INPE, reaching finally the successful development and testing of an ARGOS PCD prototype. This prototype was certified by ARGOS Service in France, end of 1983. Once certified the ARGOS PCD, INPE transferred to the Brazilian industry the associated technology endowing the country with this very effective tool for collecting data under remote conditions.

Efforts are also being conducted to test, certify and transfer to the industry PCDs compatible with GOES satellites, and a mini-station for directly receiving and processing ARGOS PCD data. The developments of both GOES PCD prototype and the ARGOS mini-stations have been concluded and the test and certification phases are in progress now. Worth to mention is also the development of the GOES-AAA format synchronizer capable of processing the new data format pertinent to the GOES-6 and 7 satellites. A prototype has been already developed and transferred to the industry which is now delivering the units to the national agencies which operate similar meteorological GOES stations.

Concerning the TIROS/NOAA Satellites, a software package has been developed to correct, in the digital domain, radiometrically and geometrically, the high resolution image data provided by the AVHRR instrument.

3.2 - **Image Generation and Distribution**

Table 1 and figures 1.1 and 1.2 summarize the volume of data (in photographic media and digital tapes) distributed to the users during these fifteen years.

TABLE 1 - IMAGES DISTRIBUTED TO USERS

YEAR	IMAGES (PHOTO)	CCTS	TOTALS
73	323	0	323
74	1,230	10	1,240
75	2,094	55	2,149
76	10,255	141	10,396
77	15,409	132	15,541
78	18,049	141	18,190
79	19,051	146	19,197
80	11,400	176	11,576
81	8,291	184	8,475
82	6,098	125	6,223
83	4,061	188	4,249
84	3,700	239	3,939
85	3,859	419	4,278
86	6,347	287	6,634
87	8,216	430	8,646

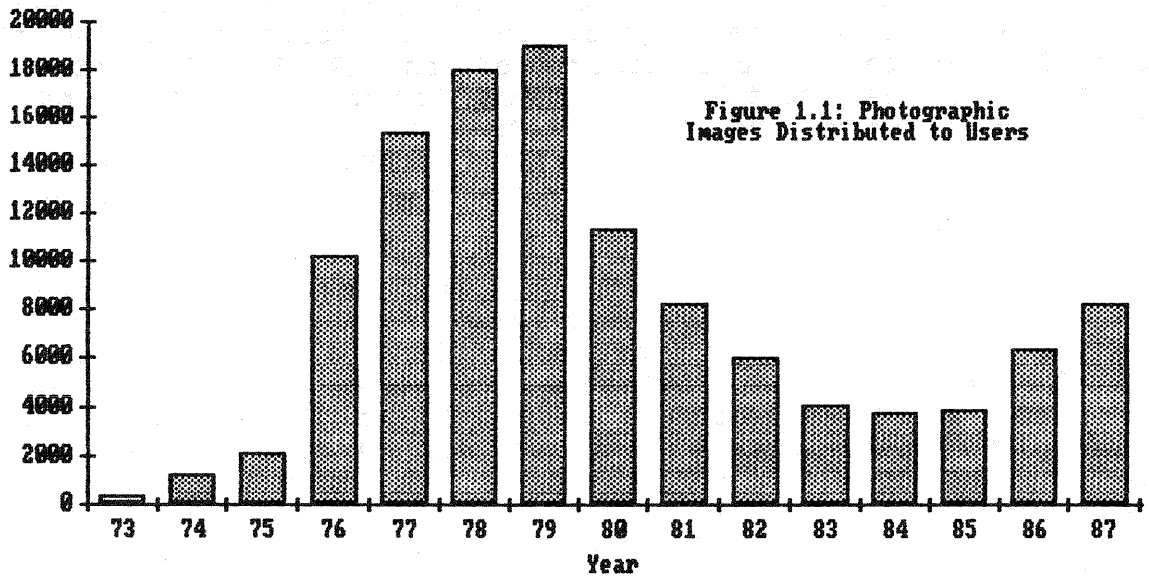

Figure 1.1: Photographic Images Distributed to Users

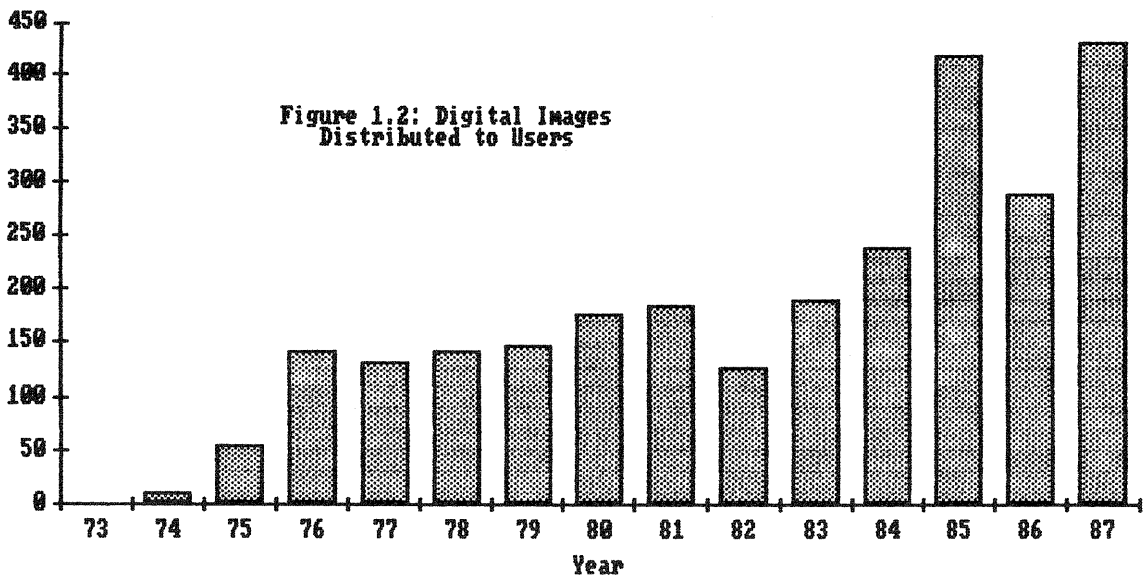

Figure 1.2: Digital Images Distributed to Users

The data above indicate an unprecedented utilization of photographic images by the user community during the years of '77, '78 and '79. However, during these years a big percentage (over 40%) of delivered products were processed in the smaller scales 1:3,704,000 and 1:1,000,000 (black and white). Only about 15% of the products were requested in the 1:250,000 scales. The profile of the requests indicated a user community mainly oriented to the use of LANDSAT products in global studies or analysis in smaller scales.

A very significant reduction in the user demand occurred particularly in the years of '83 and '84 as a result of the very restraining finantial actions took by the Government during those years, creating for the Brazilian private companies and governmental agencies in general great difficulties in reaching their desired anual budget.

The situation changed and in the last three years a clear recovery is being observed. Not only that but the user tendency is now markedly towards the larger scales 1:250,000 and 1:100,000 which account for more than 50% of the total volume of photo products distributed in the year. The interest for color products has significantly increased being now around 20% of the total. These reflect the growing maturity and knowledge of the user community which is accessing more deeply the greater potential of the remote sensing products and is using more sophisticated ways for monitoring the environment and managing of earth resources, taking advantage of the finer resolution and accuracy of the new sensors.

Another aspect which deserves notice is the increase of the number of CCTs distributed to the users. This is a clear answer from the community to the efforts INPE is conducting to make more known and accessible to the users the image analysis systems called SITIMs, manufactured by the Brazilian industry.

Brazil has an outstanding position among the countries operating the LANDSAT system. The data base includes nowadays nearly 200,000 LANDSAT images. The number of users (mostly institutions) is steadily growing and today exceeds 1,500, many of them being from outside the country.

During these fifteen years INPE has taken under its own responsibility the activities of marketing, selling and distributing the remote sensing images. In the last two years, a preparation is in progress to gradually transfer to the private sector, particularly the Aerosurvey Companies, the activities of marketing and commercialization of the data. This surely can improve the overall efficiency besides yielding better service to the user community. This is indeed most opportune, once SPOT data, which are being already handled in a commercial basis, are being acquired directly at the INPE Ground Station, and are in process to be placed available to the user community.

3.3 - Cartography

It is significant to mention the efforts developed by INPE since 1980 towards the implementation of techniques for geometric correction of orbital imagery, mainly LANDSAT-MSS data, in order to transform the images into means more efficiently usable by the cartographic community.

After TM data became available it was soon recognized their enormous potential for cartographic applications. The advanced characteristics of the orbital plaftorm, the new geometry of the instrument and the precise knowledge of its behaviour and associated modelling, made TM data of unprecedented value for cartography from space. Taking advantage of all these benefits, INPE specialists developed and implemented a processing station software capable of generating TM fully system-corrected products of very encouraging performance: internal geometric errors of the order of one pixel "rms", with no use of ground control points.

Benefiting, therefore, from special image treatments and from the existence of more advanced sensors, INPE has been directing its cartographic activities towards: a) production of planimetric satellite image-maps for future inclusion of altimetric information, b) production of thematic maps in different scales, and c) updating of conventional topographic maps in 1:250,000 and 1:100,000 scales. An achievement which also deserves notice is the successful experiment of digital mosaicking of two adjacent TM fully system-corrected scenes (Barbacena image-map), in preparation for the creation of a 1:250,000 satellite image-map. This product is particularly important in poorly mapped areas of the country.

Presently, INPE specialists are refining the operational procedures for the production of such image maps at 1:100,000 and larger scales.

3.4 - Image Analysis Systems

Intensive efforts have been made by INPE to develop, in the last few years, a family of image analysis systems called SITIMs. These systems, based on Brazilian-made microcomputers, are used mainly in the analysis of natural resources, although their frames allow the use in other areas such as Metallurgy, Meteorology and Medicine.

Four of these systems are presently installed at Image Processing Labs of INPE, supporting directly research and application projects in Remote Sensing and Meteorology. Twelve units are installed in other agencies.

Engineers and system analysts specialized in digital processing, modelling and simulation techniques have, since 1975, been doing research in enhancing, filtering, classification, registration, geometric correction and image analysis techniques.

INPE is also working in the field of Geographic Information Systems, conducting a project where satellite imagery is being incorporated and associated to other related information plans (maps, digital terrain models, etc.) with a wide variety of image analysis techniques, everything manipulated through a user-friendly software package. The hardware concept is based on Brazilian-made microcomputers and the first version is finished and being submitted to an evaluation from the user standpoint. Finished this phase it will be also transferred to the private industry.

3.5 - Environmental Analysis

Qualified people of INPE in the field of Environmental Analysis have been conducting projects on techniques and methods for gathering remote sensing environmental data through the use of orbital and airborne imagery. These projects have been oriented to the following areas:

a) Environmental Geomorphology with studies of erosion and equilibrium of inland water systems,

b) Hydric Systems with studies on water basin managing and water quality and availability analysis,

c) Land use with studies on the soil occupation, and

d) Urban Areas with studies of their growth and use.

3.6 - Geology

In Geology, studies have been conducted for mining and energy (i.e., oil, gas) surveys through the analysis of the land surface from not only satellite imagery but also airborne data and field conditions. It is known that to extract geological information from remote sensing data is necessary a careful work by experienced geological interpreters knowledgeable of both remote sensing system characteristics and field conditions. The reason is that most of the observed surface phenomena are often related to geologic parameters in only a tenuous manner. Despite these difficulties success has been verified on various cases being worth to mention projects on: a) Mineral and Energetic Resources with mineral and oil deposit studies through remote sensing for the establishment of prospection models, b) Geological Mapping with structural analysis and identification of lithostratigraphic units in different scales seeking the definition of evolutionary models, c) Engineering and Hydrological Geology with remote sensing applications on geotechnical and hydrogeological problems.

3.7 - Forestry

In the field of forestry INPE efforts have had the objectives of research and development of methodologies for utilization of remote sensing data in the effective monitoring and management of the forest resources. The main project lines in this area have been: vegetation mapping, forest management and inventory,

estimates of timber volumes, detection and assessment of damages due to burns, diseases or droughts. A number of forestry agencies are also becoming increasingly involved in the development of techniques for applying remote sensing methods to environmental monitoring problems.

3.8 - Agriculture

The use of remote sensing techniques to carry out projects on crop survey and potential yield of areas is of utmost importance for the national economy. In this framework INPE has conducted research and studies on wheat, soybean, corn, rice and sugar-cane. Estimates of planted and/or tilled areas are done through visual and/or automatic interpretation of satellite or airborne imagery, thus performing the integral or sampled mapping of regions of interest. These techniques can also be used to estimate the losses caused by plagues, diseases and periodic events such as frost or drought.

Yield estimates are obtained through modelling with data from orbital remote sensing, eventually suported from airborne data and conventional meteorological studies.

3.9 - Basic Research in Remote Sensing

The efforts in this area have been conducted primarily to increase the knowledge about the remote sensing data and its possible correlations with terrain features. Research acitivites encompass the study and analysis of the parameters which affect data acquisition and registration, such as characteristics and conditions of terrain features, spectral and radiometric properties, atmospheric effects, sensor specifications and image geometry, among others.

The efforts also deal with evaluation studies of the capability of certain sensors to well characterize certain target areas of the country. Under this point of view efforts are also being conducted to access the potential of SPOT data over the Brazilian territory.

3.10 - Technology Transfer and Technical Orientation

As said, the Brazilian remote sensing user community is steadily growing and INPE is vitally interested in promoting the establishment of a large team of specialists throughout the country in order to maximize the use of the advanced remote sensing tools and to join efforts with the universities and private companies in such way that a strategic bridge will be established between the space technology and the social and economical development of our country.

The efforts developed towards these objectives in the last years, particularly from 1985 on, can be summarized below:

a) Graduate courses in remote sensing and image analysis, with regular courses begining in February each year and leading to a MSc Degree,

b) On-the-job training for professionals needing a familiarization with the remote sensing techniques,

c) User assistance and orientation service with a specialized team. When applicable, INPE's user-aid services units spread throughout the country are used to facilitate user access to the data or to the techniques (presently there are centers in the following Brazilian cities: Natal, Manaus, Brasilia, Rio de Janeiro, São José dos Campos, Cachoeira Paulista and Campina Grande),

d) International cooperation in remote sensing with other countries and international agencies. To the present INPE develops cooperation programs with Argentina, Bolivia, Chile, Colombia, Equador, Canadá, GDR, France, FRG, Great Britain, Iraq, Japan, Panama, Paraguay, Peoples Rep. of China, Peru, Uruguay, USA, ESA, FAO, UN, World Bank and the Interamerican Development Bank.

e) International training courses, for Latin American Specialists (1985-1986) and for African Specialists (1987-1988), being offered in cooperation with the U.N. Outer Space Affairs Division and supported by other agencies such as SELPER (Latin American Society of Remote Sensing Specialists), ESA (European Space Agency) and CNPq (National Council of Scientific and Technological Development of Brazil).

f) Dissemination and establishment of regional remote sensing laboratories, organization of symposia, seminars, lectures, workshops, demonstrations, etc., on remote sensing have been very active in INPE in the last years. The goal is to familiarize the different professionals with the most recent developments in the field.

INPE is also working on another powerful way of transferring to the user community the remote sensing knowledge absorbed during this long range experience, which is the planning and installation of regional remote sensing laboratories. They are oriented, in general, to work guided by the characteristics and needs of each region. Regional Remote Sensing Laboratories are already in operation in Campina Grande, at Northeast of the country, and Belem, at the North. Eight new laboratories are already approved for the period '88-'89.

4. EXAMPLES OF RECENT APPLICATIONS AND ACTIVITIES ON REMOTE SENSING IN BRAZIL

4.1 - Land Reform Program

The Brazilian Land Reform Program which is being conducted by the Ministry of Land Reform and Agrarian Development includes among its activities the identification and selection of nonproductive land parcels for redistribution among small farmers. These activities include the identification of land suitable to establish new settlements. This process tackles

with technical, social, political and legal issues. The way it has been conducted in the past has been subject of criticism and laid on political grounds. INPE developed a methodology using satellite remote sensing techniques and is helping the government in the process of land identification and selection of land areas for allocation.

To date remote sensing techniques have been used to examine 1,000,000 km^2 in Brazil for the Land Reform Program. The following major conclusions may be mentioned regarding the application of remote sensing techniques in land reform issues:

. R.S. techniques have allowed to establish a technical approach to lessen the political aspects related with land redistribution.

. R.S. techniques have provided for lowering the cost of land selection and inspection and have expedited the process of land identification and selection.

. Satellite data have allowed multitemporal analyses which permitted the study of the historical evolution of the land use practice or degree during a time interval. This has provided a strong argument concerning the history of the occupation of the land.

. R.S. techniques have permitted to unveil "make up" practices. Some farmers, knowing that their lands were subject to land act decrees, would fastly plow their lands and question in judge government land misqualifications or errors. Through the historical archive of satellite images it has been possible to show the status of the land use before and at the time of the land reform acts.

. Government lawyers have been briefed upon remote sensing techniques, study areas, and provided with a kit of satellite images and reports on the historical land use. These space data have been present to the judges. Thus, remote sensing has been used now also as a legal tool.

4.2 - National Irrigation Program

Brazil has devoted considerable efforts in the development of its agriculture. In 1986 the federal government decided to promote an increase in grain production of the order of 20%, based on a National Irrigation Program. In order to reach that goal government has to apply the resources of the irrigation program in areas which have an agriculture vocation or a return potential. This required to know in a short period of time the actual distribution of the agriculture activities, a task that by conventional methods could take years. Based on this, INPE has developed a six-month remote sensing project which has covered an area of 3,500,000 km^2. The resulting maps provide updated information on the distribution of crops. Based on this information, government may now establish priority project areas and apply the resources more effectively.

4.3 - Water Resources

The Government of the Pernambuco State has been concerned with the drought in the semiarid Northeast of Brazil and has asked INPE to present alternative plans in 45 days. First it was identified by the governor himself that the first priority should be the man, that is, water for drinking. Drought periods in Northeastern Brazil causes migration of population from rural to urban areas or to more developed cities in Southern Brazil. During drought periods the government has to hire water trucks to distribute water to the population. INPE has developed a forty-five-days remote sensing project for the whole State of Pernambuco (91,000 km^2) which has included 1:100,000-scale maps containing information on the distribution of alluvial-sediment areas, updating of surface water resources (dams, ponds, drainage, etc.), human activity concentrations, actual drainage (including intermittent drainage) and road networks, and existing water wells.

Based on the maps provided to the government, a strategic and more efficient plan for water distribution might be made. Planning of the distribution of the water trucks and schedules (e.g. population versus pond distribution), planning for the establishment of public fountains and other actions may be taken.

5. FUTURE PERSPECTIVES

A challenging step has been taken by the Brazilian Government with the official approval of the so-called Brazilian Complete Space Mission, MECB. MECB has the objective of designing, building, integrating, testing, launching and operating four national application satellites: two for Data Collection and two for Remote Sensing. The launcher is being developed in Brazil by the IAE - Institute of Space Activities (Ministry of Aeronautics). The expected date for the first satellite launching is mid 1989. The first two satellites, i.e. the data collection ones, will use the Brazilian made DCP's (Data Collecting Platforms) which are an economically viable option for national applications. The greatest advantage of the telemetry via satellite is that costs are not too high and are not related to the distances involved.

The remote sensing satellites, whose launching is foreseen to occur early 1993 will relay information on natural resources evaluation, through moderate resolution and a highly repetitive global coverage, using an onboard Multispectral Earth Observation Camera. This will enable the country to achieve its own data bank at low cost and on nearly real time.

The INPE's opportunity to work as the designer and system integrator in the SPOT ground station turned out to be a necessary and very important step towards the preparation for the Remote Sensing Mission of the MECB where both ground and space segments will be designed and built in Brazil by INPE with the help of the Brazilian industry. There are similarities

on both missions. For example, the experience gathered in the calibration, correction and processing of the charge-coupled-detector (CCDs) arrays featured by the SPOT imaging process will be shared by the MECB-Remote Sensing which is using the same process in its multispectral camera.

Nowadays, as it has been already mentioned, the policy among the western countries is the transference to the private sector of the space technologies, which have been fully tested and approved after years of operation. This has happened to the telecommunication satellites, and is happening now with the French Satellite SPOT which the French government operates under commercial basis through the SPOT Image Co. LANDSATs 6 and 7, to be launched in the early '90s, will also be operated in a commercial basis by the EOSAT Co. in USA.

Drawn this picture, it becomes imperative the need for Brazil to possess its own satellites.

A satellite configuration is chosen to attend the aims of its owners. In a domestic satellite, the spectral bands and the channels of the observation camera are established as a function of parameters the country wants to observe, measure or collect. These actions will allow the establishment of long range economical and social programs, whithout incurring in the heavy satellite fees often imposed by the satellite operators abroad as well as gaps in the data availability due to political or economical reasons.

The definition of the Remote Sensing Mission of the MECB was then conducted in accordance with the above aspects. Aware of the present constraints of the satellite and taking them into account the remote sensing specialists of INPE have come to a proposal of certain mission characteristics in order to better fit it, as much as possible, to known needs in the areas of research and application of the Remote Sensing in Brazil.

A technically oriented inquiry was also conducted by these specialists to evaluate closerly the needs of Brazilian user community in terms of remote sensing data.

As result of this joint analysis it came up a mission with the following main characteristics: moderate spatial resolution, high temporal resolution with larger distance swath and a sensitivity in both the red and near-infrared regions of spectrum, most oriented to studies where the target phenomena are characterized by a high dynamics especially in the areas of Agriculture, Environmental Control and Oceanography.

Still in the international scenario, an ever growing number of new satellites and data acquisition systems will be placed in orbit, so that natural resources surveying processes and environmental monitoring techniques will become more and more simple, precise and less expensive.

So it is time to plan ahead, thinking in terms of the future.

Brazil has today thousands of Landsat images of its territory and a complete radar coverage (SAR) is available. Besides, it has data gathering and processing facilities which may be upgraded at reduced costs to handle future satellite data. More important, it has quite a reasonable number of skilled technicians who can make adequate use of the available technologies.

However, it is high time to bring in the private industry. Our electronics and informatics industries are capable of producing the items required by the remote sensing specialist. Besides, the aerosurvey companies can also be present in the data commercialization, thus improving the overall efficiency and yielding better service to the users community. The Government would stay in the area of the research of new technologies, improving the existing facilities (e.g. installing Regional Remote Sensing Laboratories), training personnel and warranting the data access to new satellites and systems of interest.

This way the base which will allow the Brazilian society to have an effective participation in defining future Space Missions, either national or international, will be established.

6. REFERENCES

Barbosa, M.N., Bastos Netto, D., Cunha, R.P.: Overview of the Brazilian Satellite Remote Sensing Program and Selected Examples of Recent Applications. 38th International Astronautical Congress of the IAF, Brighton, United Kingdom, Oct. 11-17, 1987.

Barbosa, M.N., Bastos Netto, D.: Brazilian Satellite Remote Sensing Program. International Conference Remote Sensing for Development, Berlin, East Germany, Sept. 1-7, 1986.

Parada, N.J.: Brazilian Remote Sensing Receiving, Recording and Processing Ground Systems in the 1980's. 18th International Symposium of the Environment, Paris, France, Oct. 1-5, 1984.