1. Publication Nº	2. Version	3. Date	5. Distribution
INPE-3297-PRE/612		Sept., 1984	☐ Internal ☒ External ☐ Restricted

4. Origin	Program
DGR	ADIR

6. Key words - selected by the author(s)

REMOTE SENSING
LATIN AMERICA
BRAZILIAN SPACE PROGRAM
BRAZILIAN REMOTE SENSING EXPERIMENT

7. U.D.C.: 528.711.7(8=6)

8. Title: INPE-3297-PRE/612

REMOTE SENSING ACTIVITIES IN LATIN AMERICA

10. Nº of pages: 14

11. Last page: 12

12. Revised by

George Eric Wootton

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14. Abstract/Notes

This paper presents the status quo of Remote Sensing in Latin America. It opens with a brief discussion on the reasons, motivations and importance of Remote Sensing activities in the Latin American environment. In the field of data reception, processing, distribution and utilization it presents the efforts made to improve those aspects, which are vital to the whole process of Remote Sensing. Here, specific countries with their programs and projects are mentioned, briefly, depicting the unique position of Remote Sensing in Latin America. It also concisely describes the Brazilian Remote Sensing Experiment - BRESEX, and its future utilization on the Brazilian Complete Space Mission, to be held on board the Shuttle. Finally, the importance of Regional Societies, Symposia and Training Programs is presented, followed by conclusions and recommendations.

15. Remarks: Presented at the Eighteenth International Symposium on Remote Sensing of Environment, Paris, France, October 1-5, 1984.

REMOTE SENSING ACTIVITIES IN LATIN AMERICA

18th International Symposium on Remote Sensing of the Environment
ERIM 1-5 October 1984 - Paris, France

Invited paper presented
by

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REMOTE SENSING ACTIVITIES IN LATIN AMERICA*

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ABSTRACT

This paper presents the status quo of Remote Sensing in Latin America. It opens with a brief discussion on the reasons, motivations and importance of Remote Sensing activities in the Latin American environment. In the field of data reception, processing, distribution and utilization it presents the efforts made to improve those aspects, which are vital to the whole process of Remote Sensing. Here, specific countries with their programs and projects are mentioned, briefly, depicting the unique position of Remote Sensing in Latin America. It also concisely describes the Brazilian Remote Sensing Experiment - BRESEX, and its future utilization on the Brazilian Complete Space Mission, to be held on board the Shuttle. Finally, the importance of Regional Societies, Symposia and Training Programs is presented, followed by conclusions and recommendations.

1. INTRODUCTION

The aim of this paper is to discuss the important role that remote sensing is playing in the economical development of Latin America. Although the title is quite general, the presentation will be focussed on satellite remote sensing.

In order to better understand why remote sensing has been facing such a spectacular utilization in Latin America, it is necessary to know a little more about the conditions that are encountered in that region.

First of all, Latin American countries are developing nations which do not have efficient conventional data collection systems to provide the basic information necessary for planning and for the efficient utilization of their

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* Presented at the Eighteenth International Symposium on Remote Sensing of Environment, Paris, France, October 1-5, 1984.

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national resources. Most of them present either large territories, or large areas of difficult access, or even both. Also, the population distribution is not uniform, normally concentrated on the ocean borders.

In general, they are not industrialized nations and, for that reason, their economy is strongly based on their natural renewable and non-renewable resources. Consequently, the survey and monitoring of these resources become a crucial and indispensable activity, providing a useful and important tool for establishing procedures for policy and decision making in the area.

On the other hand, natural and man-made modifications that are taking place in the Latin American environment have to be monitored and well understood, in order to prevent, whenever possible, or at least mitigate their undesirable consequences.

Geological and climatic conditions in the region are such that a large number of natural disasters occur every year, producing major social and economical impacts. Floods, droughts, frost, vulcanic eruptions, earthquakes, are some examples of such events. Also desertification is a process that starts to become very important lately in some areas of Latin America.

Another point that should be commented here is the importance that both the Atlantic and the Pacific oceans have for almost all the Latin American countries, due to their large influence on the weather and climate in the region and on food production (agriculture and sea products). If gathering direct information in land is difficult, the situation in the oceans is even worse.

Latin American countries, besides not being well known with respect to their natural resources, are also poorly mapped. Although a large effort is being made in the direction of solving this problem, the amount of time necessary to reach a final solution is tremendously high.

So, territory integration and the necessity of obtaining low-cost reliable and periodic information about it and about the neighboring oceans, were the key factors responsible for the large utilization of data collected and/or transmitted by the so-called application satellites in Latin America. For some nations, like Brazil, this is the only possible way of gathering important data about the country and promoting their indispensable integration, basic ingredients that contribute for national security and development.

In the following sections a general discussion about remote sensing activities in Latin America will be presented. It will cover the fields of data reception, processing, distribution and utilization; satellite and shuttle experiments; image processing systems; regional societies and symposia; and training programs.

2. DATA RECEPTION, PROCESSING AND DISSEMINATION

It is worth-while mentioning that Latin America was the third region in the world where a Landsat receiving and processing station was installed*. Today, two ground stations cover almost all South America, while data of only a small portion of Central America is routinely obtained through the US stations (see figure 1).

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* The Brazilian receiving station was established in 1972 and the processing station in 1974.

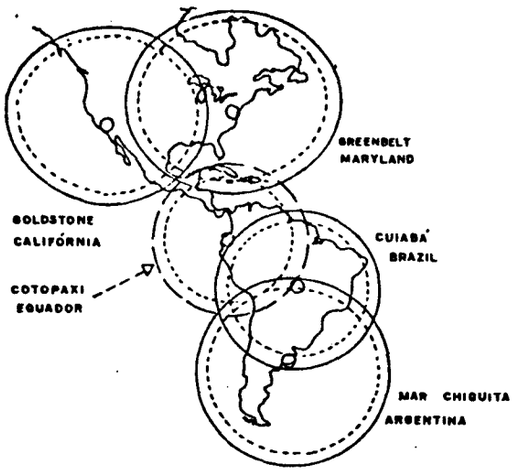

Figure 1. Landsat Ground Stations in Latin-America.

The Brazilian Landsat receiving station is located at Cuiabá, MT 15°33'S; 56°04'W), covering Brazil and great part of the neighboring countries; the processing station is located at Cachoeira Paulista, SP. Data distribution centers are strategically located at different cities in the country in such a way that any user can very easily obtain information about the quality and characteristics of the satellite data available (figure 2). In Brazil, the satellite remote sensing program is under the responsibility of the Institute for Space Research (Instituto de Pesquisas Espaciais - INPE). Today, both MSS and TM data from LANDSAT 4 and 5 are routinely received and processed in INPE's facilities. Modifications on the stations to receive and process SPOT data have been programmed to occur in a very near future. According to the Memorandum of Understanding signed between the US National Oceanic and Atmospheric Administration (NOAA) and the Brazilian Commission on Space Activities (Comissão Brasileira de Atividades Espaciais - COBAE) data received and processed by INPE's Landsat ground stations are distributed to national and foreign users on a non-discriminatory basis.

The Argentine Landsat receiving station was established in Mar Chiquita (38°00'S; 57°32'W) and the processing and distribution centers in Buenos Aires. The National Commission on Space Research (Comission Nacional de Investigaciones Espaciales - CNIE) is the organization responsible for running the above-mentioned facilities. Today, only MSS data (S-band) is routinely received and processed; however there are plans to upgrade the stations, in order to also receive and process TM data (and possibly SPOT).

Data received by the US station located at Goldstone (35°31'N; 116°48'W) and operated by NASA/NOAA are processed and distributed by EROS Data Center, Sioux Fall, South Dakota.

As it can be observed in figure 1, there is a part of Latin America which is not covered by any of the existing ground stations. Lengthy discussions have taken place at different times and places about the necessity of having and the feasibility for implementing such a third station. But the only effective result was the proposal made by the Equatorian Center for Integrated Surveys of National Resources by Remote Sensing (Centro de Levantamientos Integrados de Recursos Naturales por

Sensores Remotos - CLIRSEN) to its government for upgrading the Catopaxi Ground Station (NASA's Tracking Station until August 1982, located at 00°37'S; 78°30'W) to receive at least MSS Landsat data. The corresponding processing and distribution centers will probably be located at Quito. If such facilities are installed in Equador then, as a consequence, periodic remote sensing data from all Latin American countries will be available.

Also, some MSS Landsat data reception facilities exist at NASA's Tracking Station located near Santiago, Chile and operated by the University of Chile (Universidad de Chile). In Colombia, the Interamerican Center of Photogrametry (Centro Interamericano de Fotogrametria - CIAF) is studying the possibility of having local reception of remote sensing data of the Colombian territory.

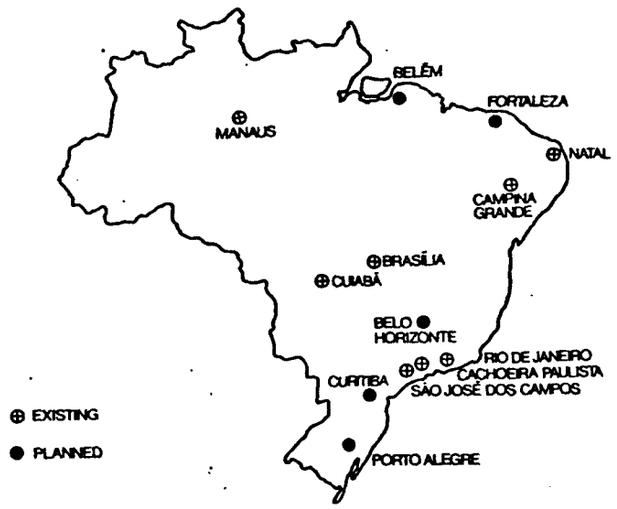

Figure 2. Brazilian Data Distribution Centers.

As far as the meteorological satellites are concerned, INPE operates in Cachoeira Paulista, SP a complete receiving and processing ground station for both NOAA's polar orbiting (Advanced TIROS-N) and geostationary (GOES) satellites. The data received at the station - that was projected, built and integrated by INPE - includes GOES/VISSR-VAS visible and infrared images (also water vapor content) and TIROS-N/AVHRR-TOVS images and soundings. The images are distributed to the users both in film/paper format or in almost-real-time digital form through telefone lines. In this last case, the users (in general operational entities) possess digital image storage and processing systems which were also developed by INPE*. The Brazilian Navy Hidrography and Navigation Directory (Diretoria de Hidrografia e Navegação - DHN) recently installed a GOES receiving and processing station manufactured

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* With the failure of GOES-5, studies are under way at INPE to receive data from both GOES 6 and METEOSAT, in order to cover the Pacific and Atlantic Ocean areas.

by the Brazilian industry, where digital visible and infrared data are received, processed and analysed for almost-real-time utilization. TIROS-N/APT and GOES/WEFAX transmissions are received in almost all Latin American countries (including Brazil) by a large number of users. Data Collection Platforms (DCP) are also used by many countries in the area in order to obtain environmental data (basically meteorological and hydrological information) through the utilization of both polar orbiting (ARGOS System) and geoestationary (GOES) satellites. INPE operates ground receiving, processing and distribution stations for both systems in Brazil.

3. DATA UTILIZATION

A large number of meteorological and remote sensing data utilization methodologies have been developed in Latin America by an increasing group of institutions and persons in a wide range of applications, which includes, among others, the survey and monitoring of natural resources (mineral, agronomical, forest, hydrological, oceanographic), observation of the environment, monitoring of land use, conventional and thematic cartography, regional and urban planning, pollution, disaster forecast and monitoring.

In this brief presentation it is almost impossible to summarize all the applications that have been developed in all Latin American countries. Probably more than 300 different satellite remote sensing methodologies have been derived after Landsat data of the region started to become available. One should also add to this figure, a reasonable number of case studies and proof-of-content analysis which were performed in order to show the importance and to demonstrate the potentialities of the new technology. However, only its effective utilization in operational applications produces concrete benefits and conclusively contributes for the solution of existing problems.

The size and relevance of the national programs in general depend upon the existence or not of a national remote sensing agency or organization. In the first category one should necessarily include Argentina, Brazil, Colombia and Ecuador and, in a less restrictive manner, Bolivia, Chile, Mexico and Peru. In the remaining countries, the remote sensing activities are, like the former ones, scattered among universities and governmental and private institutions, but with no coordination, and this brings undesirable consequences for the national programs, which include research, development and training.

In Central America, most of the remote sensing applications have been devoted to the area of cartography, land use and forest and agricultural surveys. Interesting projects are under way in Mexico, with the participation of many institutions, particularly the University of Mexico (Universidad Autonoma de Mexico - UAM). Image processing is also an area where work is being carried out at the Geophysics Institute of UAM. In Panama, a recently approved IDB-funded remote sensing project calls for the establishment of national competence in remote sensing data utilization (visual and digital image interpretation), including applications in tropical agriculture and forestry and in digital mosaics*. Several institutions in Costa Rica have also been active in the utilization of remote sensing data. However, the lack of periodic Landsat data about the region has prevented Central American countries from becoming large users of remote sensing satellite information. One should observe however that the obtention of fishing charts through the use of oceanographic, meteorological and remote sensing satellite data has become increasingly important for all nations in the area.

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* ERIM and INPE will provide the necessary basic and on-the-job training for the project.

In South America, the existence of the high Andes Mountains, crossing a large number of countries, and of the unpenetrated Amazon Forest, covering a large part of its surface, have prevented the obtention of the indispensable and important ground data on the region. So, remote sensing techniques became the only available and effective way to obtain information about the resources and to monitor the modifications that are occurring in those areas.

One of the first utilizations of Landsat data in South America was performed in Bolivia. Geological mapping and the obtention of information on mineral deposits were the main interests of the project, which was realized under the coordination of the Bolivian Geological Service (Servicio Geológico de Bolivia - GEOBOL). More recently, a geo-coded data base of part of the country (including digital remote sensing data) was also developed.

In Colombia, CIAF is coordinating the remote sensing activities. A reasonable number of applications have already been developed and today special interest exists in digital geo-coded data systems and crop survey (specially coffee). With a recently approved IBD-funded project, CIAF will increase its capabilities mainly in the area of digital image processing.

The Peruvian Laboratory for Evaluation of Natural Resources (Oficina de Evaluación de Recursos Naturales - ONERN) has been the main organization in the country devoted to satellite remote sensing data applications. Today, under the auspices of the World Bank, a digital mosaic of the whole Peruvian territory is being made.

In Equador, the establishment of CLIRSEN was responsible for the increasing utilization of remote sensing data in different projects of national interest. Many application methodologies have been developed by or under the coordination of CLIRSEN. One of the most interesting projects under way is related to geological mapping and to hydrocarbon (oil and gas both in Guayaquil and Andean regions) and mineral deposit surveys. It is interesting to mention that today, besides Landsat images and aerophotos, airborne side-looking radar (SCAR) data of the Equatorian territory are used in the studies. A digital image processing system is available at CLIRSEN for utilization by the user community.

The University of Chile (Universidad de Chile) and other Chilean organizations have been using Landsat and aerophotographic data in a variety of areas. The Air Force Aerophotographic Service (Servicio Aerofotografico del Chile), for example, utilizes a digital image processing system for cartographic applications.

In Argentina, most of the work presently done in the area of satellite remote sensing application is still performed by CNIE or under its direct supervision. A reasonable number of users have been trained by that Commission and are today using remote sensing data at universities and other governmental and private organizations. However, the remote sensing projects developed by CNIE's interdisciplinary group are conclusively those which are contributing more for the economical and social development of the country. Crop identification and area estimation (mainly wheat), reforestation monitoring, natural forest mapping, land use, geological mapping and mineral deposits survey are some examples of application methodologies that have been developed by the above-mentioned group. Presently, efforts are being made in the development of geographical information systems. CNIE's digital image processing facilities are utilized by the user community in their studies.

Also, the interest on the survey of saline deposits using remote sensing satellite data exists in almost all Andean countries.

Brazil, however, is the Latin American country that has the most advanced remote sensing data utilization program. Today, more than 1,500

Brazilian institutions are using Landsat data and more than 200 application methodologies have been already developed.

Soil mapping, survey of potential areas for agricultural expansion, crop identification and area estimation, crop forecasting, survey and control of potential mineral and oil deposits, monitoring and evaluation of reforestation, natural vegetation mapping and deforestation, cartographic applications, control of sedimentation in water reservoirs, obtention of fishing charts, survey and control of pollution, land use, and survey of potential areas for water obtention in semi-arid regions are important examples which have reached an operational stage in the country.

The Brazilian Satellite Remote Sensing Program, coordinated by INPE, besides developing new application projects, is greatly interested in increasing further the utilization of the data. Throughout this national program, grants are given to individuals or groups of individuals to support remote sensing research and development on both governmental and private institutions. Also, Regional Remote Sensing Research Centers*, equipped with the necessary software and hardware, including low cost image processing systems developed by INPE and manufactured by Brazilian industries, are being established, preferably at universities and under INPE's responsibility.

One of the characteristics of the Brazilian Program - probably the key factor responsible for its amazing success - is the mandatory engagement of the user organization in the development phase of the application methodology. Consequently, training, absorption and technology transfer and the operational utilization of the data, basic objective of the program, occur at the same time.

INPE's image processing facilities are utilized not only by its multidisciplinary group (which includes today almost 150 professionals), but also by members of the Brazilian user community and foreigners. The facilities comprise two large remote sensing image processing systems based on imported hardware** and many indigenously-made systems (one medium size interactive system for meteorological applications and one medium size system for remote sensing applications based on Brazilian minicomputers; and some low-cost systems based on Brazilian microcomputers).

Another important point that should be mentioned here is that a large number of applications of remote sensing satellite data which are today operational in Latin America cannot be performed by conventional methods; thus making them unique and consequently with a low cost/benefit ratio. One example is the continuous monitoring made by Brazilian institutions of the deforestation in the Amazon region and of the consequent establishment of cattle raising farms in some of the deforested areas and the occurrence of desertification processes in others.

On the other hand, applications producing information which are of direct interest for the country's economical planning, evaluation and development are those that major impacts create on government opinion and, as a consequence, better justify the investiment made. As an example, one can mention the Brazilian national sugar cane crop forecasting program conducted by INPE and based on both meteorological and remote sensing satellite data. Started in 1978, today it is operational for the region responsible for 80%

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* Five centers will be established in the 1984-1985 period.

** Most of the software, however, has been developed by INPE's specialists.

of the national production*. The information generated by the program is important not only for the sugar production itself but also for the planning, monitoring and evaluation of the alcohol production in the country**. Another outstanding result of the program is the possibility to determine, farm by farm, the area prepared for plantation, information of great value for federal, state and private banks that lend money to farmers for the implementation of agricultural projects.

Also, the routine utilization in Brazil of Landsat data as planimetric basis for both new and upgraded 1:250,000 cartographic maps and also in the monitoring and classification of reforested areas with pynus and eucaliptus has produced enourmous economical impacts.

The discovery and mapping of mineral and oil deposits in Latin America is another example of great economical impact. With a few Landsat scenes and some hours of image processing it is sometimes possible to identify prospective areas of production which, after ground-based observations and analysis, become economically exploitable.

It is worth-while mentioning here that Brazil presents a large and succesful experience on the utilization of combined microwave and optical/infrared remote sensing data. For that reason, efforts are being made for the country to participate both on optical/infrared and microwave space-borne foreign programs. The participation could vary from the utilization of data obtained over selected areas of the Brazilian territory (e.g. data from SIR-A, SIR-B and MOMS experiments on board the Space Shuttle), to the reception and processing of the data acquired by remote sensing satellites or even in the development of the space segment itself.

4. SATELLITE AND SHUTTLE EXPERIMENTS

Due to the importance that satellite remote sensing has for the country and the degree of development attained by its earth observation satellite application programs, the Brazilian Government accepted in 1979 the challenge to carry out a small but ambitious Space Mission, tuned to the country's modest means, but in keeping with its unbending desire to close the gap that exists between it and the most advanced nations in the world. Proposed by COBAE, the Brazilian Complete Space Mission, as it became known, calls for the design, manufacturing, launching and operation of four satellites; and is to be completed in the early nineties. The first and second satellites of this Mission will relay information transmitted by environmental data collection platforms, while the third and fourth satellites will be devoted to Remote Sensing. INPE is responsible for the satellites and the respective ground segment, and the Brazilian Air Force for the launching vehicle and the launching facilities.

The first objective of the remote sensing mission is to design a satellite with characteristics optimized for applications of national interest. These include tropical climate agriculture and vegetation, geology, geomorphology, soils, land use, and special problems of hydrology and coastal regions.

The second objective is to master the basic technology needed to build such a satellite within stringent limitations imposed by the Brazilian launching vehicle.

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* The program is expected to be fully operational by 1987.

** One should recall that nearly 40% of the Brazilian cars run with alcohol engines; in 1984 the total alcohol production in Brazil is expected to be 9 billion liters.

The relevant unfrozen characteristics of the Brazilian remote sensing satellites are presented in Table I; the first of the two satellites is scheduled to be launched in 1991.

The technological success of the US Space Transportation System, and the opportunity offered by the President of the United States to the President of Brazil to participate in a cooperative experiment with NASA have introduced a significant new factor in the preparation of the Brazilian Complete Space Mission. The possibility of flying an early version of the CCD Multispectral Camera on the Shuttle greatly motivates INPE's team of development engineers, much increases their confidence of ultimate success, and enhances the capabilities of accurately determining optimal specifications for the hardware that will have to reach the goals of the Mission.

The basic objectives of the Brazilian Remote Sensing Experiment (BRESEX) which should fly on the Shuttle probably in mid 1987 are, thus, to develop a prototype of the instrument that will, four years later, fly in the Brazilian Remote Sensing Satellites; to use this instrument on board the Shuttle to obtain data over Brazil in the greatest possible variety of conditions (time of day and off-nadir especially); and to help freeze specifications on the final satellite instrument. The important technical specifications for BRESEX are listed in Table II. A breadboard model of the camera, using a Hasselblad lens and non-optimized structural mounting, was successfully tested in February 1984 on board INPE's Bandeirante aircraft.

Table I. Unfrozen characteristics of the Brazilian remote sensing satellites

Orbit	Circular, heliosynchronous, 98^{o} inclination; 650km altitude (transfer orbit: 350km x 550km) Equator crossing time = 12hs; repetition cycle = 35 days (4 days with off-nadir pointing)
Dimensions	Prism (octogonal basis); 100cm diam. x 90cm high; Two deployable solar panels
Mass, Power	170kg; 140 watts
Orbit and altitude Control	Three axis stabilization; excentricity $\leq 10^{-3}$; Pointing accuracy $\leq 0.5^{o}$ in all axis
RS Camera	Derived from BRESEX (see Table 2); resolution $\leq$ 50m at 650km
Lifetime	Greater than 2 years

Table II. BRESEX characteristics

Orbit	Circular orbit; 28.5° inclination (ideally); 300km maximum altitude
Mass; Volume and Power	Not more than 30kg x 30dm³ x 30 watts
Characteristics	Push-broom multispectral imager (CCD array technology); resolution = 20m at 300km altitude; radiometric sensitivity ≤ 1%; ± 15° side pointing flat mirror for cross track imaging; 40km swath at 300km altitude; encoding = 8 bits/pixel
Spectral bands	Band 1: 0.47 - 0.53μm Band 2: 0.63 - 0.68μm Band 3: 0.83 - 0.91μm

5. REGIONAL SOCIETIES AND SYMPOSIA

Latin America is probably the only developing region in the world that has its own Remote Sensing Society. Conceived in the ERIM International Symposium held in Costa Rica in 1980, the Society of Latin American Experts on Remote Sensing (Sociedad de Especialistas Latinoamericanos en Percepcion Remota - SELPER) was created later on, in November 1980, in a meeting that took place in Quito - Equador.

Today, SELPER has more than half a thousand members from almost all Latin American countries and is responsible for a large number of important activities in the region, which includes seminars, workshops, courses, programs etc. The society sponsors an Annual Meeting in the country where its headquarters is located, when, besides administrative sections, a large number of technical papers are presented. This year the annual meeting will be held in Santiago, Chile (next November) and next year it will take place in Brazil. The permanent secretary of SELPER is located in Quito, Equador.

Most of the Latin American countries have their own national remote sensing symposia and workshops. It is not the intention of the author to list all the technical meetings that occurred or are scheduled to take place in the near future in the region. However, due to its importance and its regularity, it is worth mentioning the Brazilian Symposium on Remote Sensing, which is offered every two years under the sponsorship of INPE. The 1984 Symposium will be held in Rio de Janeiro (next November), where almost 130 remote sensing technical papers will be presented.

6. TRAINING PROGRAMS

In countries with a national agency, one always finds remote sensing training programs regularly offered or coordinated by the above-mentioned organization, because one of its goals is the dissemination of information and the establishment of national competence in the area of remote sensing science, technology and applications.

The characteristics and level of those courses may vary from one country to another, depending upon its stage of development, as far as remote sensing

is concerned. They are in general offered by a multidisciplinary group of professionals and are specially designed to meet the country's needs and to create the necessary know-how and manpower. On-the-job training, specialized courses and seminars, and graduate courses are examples of such programs.

In Mexico and Chile, the training courses are normally offered by the corresponding universities, and in Bolivia and Peru they are part of the program of the respective remote sensing organizations.

However, the largest effort in remote sensing training is presently being dedicated in Equador, Argentina, Columbia and Brazil. While in the first two nations the courses are basically structured for national use, in the last two they have been assisted by members of both national and international communities.

In Equador, a large number of trainees belonging to different organizations have participated on specialized and on-the-job training courses, regularly offered by CLIRSEN. In Argentina, CNIE is the agency responsible for such program, while some universities present the possibility of remote sensing specialization on their traditionally offered disciplines.

CIAF is a well known international training organization on photogrametry and remote sensing. In all Latin American countries one always finds photogrametry professionals who have been trained there. More recently, satellite remote sensing specialized courses are part of the curricula of the training programs offered by this Colombian Center.

In Brazil, while some universities offer the opportunity for undergraduate and graduate remote sensing studies on their traditional courses, most of the specialized and on-the-job satellite meteorology and remote sensing training programs that exist in the country are organized and taught by INPE's staff at its training facilities or at user organization. With the establishment of INPE's Regional Remote Sensing Centers, regular and specially-designed courses will also be offered there. Regular tuition-free graduate programs at Master and Ph.D degree level on Meteorology and on Remote Sensing can be attended by Brazilians and foreigners at INPE's facilities in São José dos Campos. International short-term courses on meteorological satellite data applications for weather and climate forecasting and other utilizations and on satellite remote sensing have been regularly offered by INPE. Also, a one year remote sensing course dedicated to Latin American professionals* will be held at INPE's headquarters next year.

7. CONCLUSIONS

Research and technological development on Remote Sensing have been carried out in Latin America for more than one decade. The experience acquired during that period has confirmed that the benefits provided by this new technology are enormous, helping the governmental and private sectors of the society to establish efficient planning and procedures for policy and decision making.

Another characteristic of Latin America is that some of the countries in the region have indigenously developed national capabilities to deal with space science, applications and technology. At least one of them (Brazil) has programmed a complete satellite remote sensing program, which includes indigenously developed space and ground segments, application methodologies and low cost image processing systems.

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* The course will be given in cooperation with the United Nations; the Brazilian Government is offering 10 scholarships for foreign participants.

Because developing countries - despite their widely ranging levels of economic, scientific, technological and industrial development - recognize the similarity of their problems and the complementarity of their needs and resources, it can be assumed that the cooperation among them will be the most effective tool to solve the faced problems and to allow them to profit from space science, applications and technology. Developing countries with greater experience in a particular space application or with greater scientific and technological capability in a given field, can help other developing nations which may be entering these areas.

The above concepts which were developed at UNISPACE-82* are completely applicable to Latin America. Cooperation among countries in the region has been one of the key factors responsible for the increasing utilization of data and the development of national capabilities in the field of satellite remote sensing. It is important to mention here the important role played by SELPER in the establishment of such an atmosphere of mutual confidence and benefits.

In order to further increase the cooperation among those countries, regional research and training programs should be established. Many useful suggestions on how to implement such programs that have the advantage of making optimal use of all available existing competence in the area and especially designed for the benefit of all Latin-American and Caribean developing countries were presented by the author elsewhere**.

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* UNISPACE-82, Report of the Conference.

**N.J. Parada, "UNISPACE-82 Recommendations Addressed to Member States on the Development of Indigenous Capabilities and Follow-up Actions for their Implementation" UN Regional Seminar on Space Applications in Consideration of the Implementation of the Results of UNISPACE-82, São José dos Campos, Brazil, 2-6 May 1983.