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ACTIVITIES OF LATIN AMERICAN AND CARIBBEAN ORGANIZATIONS RELATING TO THE PEACEFUL USES OF OUTER SPACE: A BASIS FOR DEVELOPING HORIZONTAL CO-OPERATION */

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Introduction

"Space is a very broad and complex field and consequently the development of co-operation towards the equitable use of outer space represents probably the most significant attempt at co-operation ever undertaken by man."*/

As a contribution to the progress of the activities and studies related to the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82), ECLAC has prepared the following document in fulfilment of the mandate of the United Nations General Assembly contained in paragraph 11 of resolution No. 37/90.

Existing documentation on the peaceful use of outer space is plentiful, but there are no documents with a specific regional orientation similar to the present document.

In most cases documents fail to take into account the readers' requirement for an integrated regional presentation of the state of space science and technology and its application.

The information presented in this document represents a compendium of information obtained from publications by governmental, non-governmental, United Nations and specialized agencies, and in particular the publications and documentation which were prepared for UNISPACE 82, and from documents provided by the member countries themselves.

The present publication offers the reader an overall view of the ways in which it is possible to work in this field and in what areas. The information presented here is of a factual nature and its sole purpose is to set out the state of space science and technology in Latin America.

It becomes clear from reading the document that it would be desirable for the countries of the region to:

a) set up focal points, centres of co-ordination, or national committees to institutionalize horizontal co-operation in space and its applications. Such centres or focal points could be provided from the existing space commissions or by organizations or mechanisms which each country considers most suitable to achieve this aim;

b) stimulate the exchange of information, to which end countries are encouraged to set up national space centres or space commissions, so as to pinpoint potential areas or specific projects for horizontal co-operation, particularly the drawing up of a directory of institutions;

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*/ Instituto de Estudios Internacionales, Universidad de Chile, La utilización del espacio exterior y las comunicaciones: Nuevas perspectivas y problemas, "Los mecanismos de cooperación horizontal y la utilización del espacio exterior (Algunos comentarios)", 1984, pp. 188-204.

/c) define

c) define a space policy which is able to count upon adequate planning, financing, organization, legislation and regulations to permit the carrying out of projects corresponding to national requirements and priorities;

d) intensify efforts to ensure that at the national level funds are earmarked for the peaceful use of outer space, as a means for economic and social development in each of the countries of the region;

e) provide continuity with the projects of the United Nations and the specialized agencies on the peaceful use of outer space;

f) give sufficient importance and continuity to the support of space research and training.

"There exist sufficient resources and technological potential to erradicate underdevelopment in the developing countries and to improve the well-being of humanity as a whole. Achievement of this aim requires on the one hand full control of the developing countries over their own resources, and on the other hand equitable distribution and creation of scientific and technological capacity in the world."

"The developing countries --in spite of their highly diverse levels of economic, scientific, technological and industrial development-- are aware of the similarity of their problems and the complementarity of their requirements and resources. In fact, their varying levels of scientific, technological and industrial development may serve as a basis for mutually beneficial co-operation in the sphere of the application of space science and technology, ..."

The concept of technical co-operation between developing countries (TCDC) was extensively explored at the United Nations Conference on Technical Co-operation between Developing Countries, held in Buenos Aires, in 1978. Application of these concepts and ideas is yet in its beginning and space technology offers a major opportunity for putting them into practice.

The space age has transformed many of mankind's concepts about the world. It has provided a dynamic image of the world as a planet of great beauty, full of life and colour, yet fragile and isolated within the universe.

Man's great paradox is that he has to look at the earth from afar in order to better understand what is going on there ...

I. NON-GOVERNMENTAL INTERNATIONAL SCIENTIFIC ORGANIZATIONS

A. INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS (ICSU)

1. Origins

"In view of the great importance of prolonged observation of extra-terrestrial radiation and the geophysical phenomena in the upper reaches of the atmosphere, and in view of the advanced state of present rocket technology, the special committee of the International Geophysical Year recommends that consideration be given to the launching of small satellite vehicles, to their scientific instruments and to the new problems covered by satellite experiments, such as energy sources, telemetry and the guidance of the vehicles." With this recommendation made in 1954 by its Special Committee for the International Geophysical Year, ICSU for the first time expressed interest in satellite based research. Nevertheless, the council's interest in space research dates from 1919, when its predecessor, the International Research Council, accepted a proposal made by one of its affiliated scientific unions, the International Union of Geodesy and Geophysics (IUGG), to co-operate with the International Astronomical Union (IAU) in investigating the relationships between solar phenomena and terrestrial electricity and magnetism. One of the fruits of this co-operation was the setting up in 1925 of a commission for the study of relationships between solar and terrestrial phenomena.

The experience gained as a result of the programme of the International Geophysical Year demonstrated the utility of permanent and joint research in rockets and satellites, and in October 1958, the ICSU set up the Committee on Space Research (COSPAR), to provide the international scientific community with a means of taking advantage of the opportunities opened up by new "space" technology and to stimulate participation by scientists who were not directly involved in the International Geophysical Year's Rocket and Satellite Programme.

In addition to the Unions and the Committee, two other committees are devoted to space research: the Scientific Committee on Antarctic Research (SCAR) and the Scientific Committee on Problems of the Environment (SCOPE).

ICSU was set up in 1931, as the direct successor to the International Research Council (founded in 1919), to act as the central organization through which the scientific community would be able to deal with problems of mutual interest and develop international scientific co-operation.

2. Aims and objectives

The aims of the council are:

a) to develop international scientific activity for the benefit of humanity;
b) to facilitate and co-ordinate the activities of the international scientific unions;
c) to stimulate, prepare and co-ordinate the international scientific activities of its member nations.

/3. Organization

3. Organization and composition

The members of the International Council of Scientific Unions fall into two categories: on the one hand the scientific unions, and on the other, research academies and councils. The scientific members are composed of the scientific unions affiliated to the council, each one of which represents one branch of science. The national members are represented by the national academies of science, national research councils or similar organizations in the affiliated countries. At present there are 17 scientific unions, 64 national members and one associate national member on the council.

In order to develop international scientific co-operation, the council co-operates with various specialized United Nations agencies and with a wide range of non-governmental organizations.

4. Auxiliary organisms of ICSU

Nine auxiliary organisms dealing with concrete areas of space research and activity are centered on ICSU:

a) The International Astronomical Union (IAU), established in 1919;
b) The International Union of Geophysics and Geodesy (IUGG), established in 1919 on the foundations of the Geodesy Association, founded in 1867;
c) The International Radio Scientific Union (IRU), founded in 1913 and established as a union in 1919;
d) The Scientific Committee on Antarctic Research (SCAR), founded in 1958;
e) The Special Committee on Solar-Terrestrial Physics (SCOSTEP);
f) The Inter-Union Commission on frequency allocations for radio astronomy and space science (IUCAF), established in 1960;
g) The Inter-Union Commission on Radio Metereology (IUCRM), founded in 1959;
h) The Federation of Astronomical and Geophysical Services (FAGS), established in 1959;
i) The Global Atmosphere Research Project (GARP), established in 1962.

B. THE COMMITTEE ON SPACE RESEARCH (COSPAR)

1. Origins

In the Conference on Rockets and Satellites during the International Geophysical Year (IGY) held in Washington, D.C., in October 1957, following the success of the launching of Sputnik 1, the first artificial satellite, a resolution was adopted emphasizing the importance of continued scientific research after the IGY, using rockets and instrument-bearing earth satellites, and the international scientific unions belonging to ICSU were recommended to seek out appropriate methods of continuing their activities.

/In fulfilment

In fulfilment of the final recommendation of the Fifth Assembly of the Committee for IGY, which was held in Moscow in August 1958, ICSU in its General Assembly of October 1958 established the Committee on Space Research (COSPAR) as a specialized committee of ICSU; in 1959 the present charter of COSPAR was approved.

2. Aims and objectives

The purpose of COSPAR is to pursue on an international scale all types of scientific investigation carried out using rockets or rocket launched vehicles. In 1958 its mandate was extended to cover space research experiments carried out using balloons. COSPAR is responsible for fundamental research and does not usually deal with technical problems such as those associated with the propulsion and manufacture of guided and controlled rockets.

3. Organization and composition

At the present time, 35 national academies of science or research from the following countries belong to COSPAR: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia, Denmark, the Federal Republic of Germany, Finland, France, the German Democratic Republic, Greece, Hungary, India, Indonesia, Iran, Irak, Israel, Italy, Japan, Mexico, the Netherlands, Norway, Pakistan, Poland, the United Kingdom of Great Britain and Northern Ireland, the United States of America, Rumania, South Africa, Spain, Sweden, Switzerland and the Union of Soviet Socialist Republics.

4. Interdisciplinary scientific commissions belonging to COSPAR

Following the reorganization of COSPAR, completed in 1980, its internal structure is based upon interdisciplinary scientific commissions, having the following responsibilities:

a) Examining, planning and co-ordinating joint experimental research at the international level;
b) Promoting inter-action between experimental and theoretical scientists with the aim of optimizing the results of space science, and above all, of the interpretation obtained from the analysis of observations;
c) Stimulating and co-ordinating the exchange of scientific findings;
d) Organizing symposiums and specialized meetings to consider the findings from space research;
e) Carrying out the above activities in the closest possible collaboration with other organizations interested in these and allied fields;
f) Preparing an exhibition relating to recent scientific development in the commission's field of interest for a report to the United Nations on COSPAR.

The interdisciplinary scientific commissions are the following:

/a) Studies

a) Studies of the Earth's Surface, Meteorology and Climate from Space;
b) Studies of the Earth-Moon System, Planets and Asteroids of the Solar System (including the Earth) from Space;
c) Studies of the Upper Atmosphere of the Earth and the Planets, including the Reference Atmospheres from Space;
d) Plasma in Space within the Solar System, including the Planetary Magneto spheres;
e) Astrophysical Research from Space;
f) Biological Science in Relation to Space;
g) Materials Science in Space;
h) Expert Group on Space Research and developing countries;
i) Group on the Technical Problems relating to Scientific Balloons;
j) Group on Space Activities Potentially Harmful for the Environment;
k) Technical Group on the Dynamics of Artificial Satellites and Space Probes;
l) Expert Committee on Problems relating to Data and Publications;
m) The Spacewarn Network, a mechanism for the rapid transmission of information relating to satellites and space rockets.

5. Sessions and symposiums organized by COSPAR

COSPAR organizes its own symposiums in different places and sponsors the meeting of other organs. Since 1980, plenary sessions have been held every two years; the next will take place in Toulouse-France in 1986.

C. INTERNATIONAL ASTRONAUTICAL FEDERATION (IAF)

1. Origin

The first International Astronautical Congress was held in September 1950 in Paris, at the initiative of the astronautical societies of France, the Federal Republic of Germany and the United Kingdom. The delegates of the above societies met with delegates from societies in Argentina, Austria, Denmark, Spain and Sweden, with the aim of setting up an international association or federation "to promote the development of interplanetary travel".

In 1951 the federation was joined by the delegates of the Italian, Swiss and United States Astronautical Societies. In 1952 delegates from the societies (eleven at this point) gave their approval to the first constitution of the International Astronautical Federation. In 1956 they were joined by the members of societies in the Union of Soviet Socialist Republics and those of the socialist countries in Eastern Europe.

In 1960 IAF founded the International Academy of Astronautics (IAA) and the International Institute of Space Law (IISL), which operate autonomously.

The scientific and technological themes which appear most frequently in the programme are:

/a) fluid

a) fluid mechanics in space application;
b) propulsion;
c) energy problems of space vehicles;
d) materials and structures;
e) bioastronautics;
f) space transport;
g) the reliability of space systems;
h) satellite applications: meteorology, communications, earth resources, geodesy and geodynamics, manned space stations and
i) exploration of solar systems;
j) supervised rocket experiment for young people;
k) education in astronautics.

2. Aims and objectives

IAF is a non-governmental organization of national societies, institutions and organs which share the aims set out in the Constitution of IAF. Its aim is to promote development of astronautics for peaceful uses and to guarantee the broad dissemination of scientific and technical information relating to space.

IAF has the following aims:

a) to promote the development of peaceful uses of astronautics;
b) to promote the generalized dissemination of technical and other information relating to astronautics;
c) to promote interest among the general public in the development of all aspects of astronautics through the media;
d) to encourage participation in astronautical research within the framework of other relevant projects of national and international research institutions, universities, commercial firms and individual experts;
e) to create academies, institutes and commissions devoted to permanent research and promotion of all the peaceful uses of all aspects of natural and extra-terrestrial sciences, and to provide backing to such academies, institutes and commissions as a central part of the federation's activities;
f) to convene and organize --with the backing of the respective academies, institutes and commissions-- congresses, symposium and colloquiums on astronautics, as well as other international scientific meetings;
g) to provide collaboration with the appropriate governmental and non-governmental national and international organizations and institutions, and to provide expert advice upon all aspects of engineering and natural and social sciencies linked to astronautics and the peaceful uses of outer space.

3. Organization and composition

The federation, founded in 1950 now has more than 60 members from 40 countries, who fall into three categories:

/a) National

a) National members. Various astronautical societies from the same country may be accepted as national members of the federation, however, only one member from each country has the right to vote on questions considered in the general assembly;
b) Institutional members. Institutional membership is open to universities, schools, institutes or laboratories concerned with astronomical education or research;
c) Associate members. Associate membership is open to international organizations whose aims and activities are related to the aims of IAF.

4. IAF congresses

The annual IAF congress is organized and held in the home country of one of the national societies. The congresses are open to all who wish to participate, whether or not they are affiliated to a society belonging to IAF.

5. IAF committees

There are two types of committee: a) administrative and b) substantive.

a) Administrative

i) International Programme Committee
ii) Publications Committee
iii) Finance Committee
iv) Committee for Promoting Activities and Affiliation
v) Committee for Students Activities
vi) SYRE Research Group
vii) United Nations Liaison Committee

b) Substantive

i) Education Committee
ii) Bioastronautics Committee
iii) Space Applications Committee
iv) Committee on Lighter than Air Systems
v) Working Party on Energy and Space Potential

D. THE INTERNATIONAL ACADEMY OF ASTRONAUTICS (IAA)

The Academy was set up by the International Astronautical Federation in 1960. The Academy is composed of individuals elected by the members of IAF and is composed of three sections: basic sciencies, engineering and biological sciencies. In 1980 IAA had 560 members and associate members in more than 30 countries, in addition to 11 honorary members.

The Academy's activities centre upon innovative concepts in space exploration and themes of importance for the future.

/The spheres

The spheres of interest of the Academy's committees reflect this orientation; for example, communication with extra-terrestrial intelligence, space economics and benefits, energy in space, space safety and rescue, studies involving man in space, the dynamics of gases in explosions and reactive systems, space relativity, legal-scientific links, exploration of celestial bodies by manned vehicles, the history of the evolution of rockets and astronautics.

E. THE INTERNATIONAL INSTITUTE OF SPACE LAW (IISL)

The international nature of space activities rapidly revealed the need to organize international co-operation in studying the legal problems of outer space. Consequently, IAF, in 1958, set up a Permanent Committee on Space Law.

In 1960 the committee was replaced by IISL. The Institute at present has 430 individual members from 48 countries.

In addition to setting up various working parties, the principal activity of the Institute is its annual colloqium on outer space law, which is held within the framework of the IAF congress.

The IISL provides assistance to IAF in connection with its participation in the meetings of the legal matters subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).

F. THE SOCIETY OF LATIN AMERICAN REMOTE SENSING EXPERTS (SELPER)

This Society composed of specialists and technicians devoted to scientific-technical work in the field of remote sensing was set up in 1980 in Quito, Ecuador.

In accordance with its founding charter, the Society's headquarters moves from one country to another, and is provisionally established in the country of its present head.

At the moment the Society's headquarters is in Chile, as its head is a Chilean professional.

The members of SELPER are individual specialists from the following Latin American countries: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Chile, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru, the Dominican Republic and Venezuela.

II. MULTILATERAL GOVERNMENTAL ORGANISMS

A. UNITED NATIONS ORGANIZATIONS DEALING WITH SPACE ACTIVITIES

1. United Nations

a) Outer Space Affairs Division

When the United Nations Commission on the Peaceful Uses of Outer Space was evented in 1961 the Outer Space Affairs Division was made responsible for applying the decisions taken by the Committee and its subsidiary bodies related to the promotion of international co-operation and the peaceful uses of outer space. Among the basic tasks which the Commission carries out, with the assistance of the Secretariat, is the drawing up of international treaties, agreements or legal principles to regulate the activities undertaken by States in the exploration and peaceful uses of outer space and the application of overall systems or programmes sponsored by the international community.

Once the Commission on the Peaceful Uses of Outer Space had decided to assume responsibility for promoting international co-operation in the practical application of space technology, in 1979 the United Nations Programme on Application of Space Technology was set up with the following aims: a) to develop awareness among the officials responsible for formulating policies, and the relevant governmental organisms, of the benefits which may be drawn from the applications of space technology, and b) to present training and teaching programmes to enable officials from developing countries to acquire practical experience in the applications of space technology. The Programme's activities are subject to annual review by the Commission.

The Programme for the Application of Space Technology organizes, sponsors and runs various seminars, meetings with groups of experts and practical courses relatin to the practical applications of space technology, in particular in the field of space communications, space meteorology and remote sensing, as applied in a variety of disciplines, among which are cartography, agriculture, forestry, geology, oceanography, and other earth sciencies. Depending on the interest shown by countries, seminars, meetings of groups of experts, or practical courses relating to concrete problems or specific regions are organized, in collaboration with the specialized organisms or the member States concerned. More than 30 international seminars, meetings of groups of experts or practical courses have been organized (which were attended by more than 1 000 participants from the developing countries) in various parts of the world, including developing countries which have initiated programmes to include space technology within their economic and social development.

By virtue of the Programme for the Application of Space Technology, the United Nations, at the request of member States or organizations of the United Nations system and in so far as the available resources allow it, may provide technical consultancy services on the application of space technology for development. The Programme has also co-ordinated various surveys into the

/requirements of

requirements of developing countries, including missions to countries in the Middle East and Africa. The Programme is also responsible for administering grants for further training in space sciencies and technology offered by the member States to nationals from the developing countries. In 1978, a typical year, a total of 37 fellowships were awarded.

b) Natural Resources and Energy Division

Within the Department of Technical Co-operation for Development, the Natural Resources and Energy Division is responsible for a wide programme of activities in the fields of cartography (reconnaissance and map drawing), energy, geology and in minerals and water resources. The Programme contains two basic types of activity: operational projects or field projects involving technical assistance, and non-operational projects, including surveys, seminars and conferences. Both aspects of the programme concentrate upon the needs of developing countries.

Use of remote sensing as an instrument for resource exploration is of prime interest for the Natural Resources and Energy Division, above all as it may benefit developing countries. In this respect, the Division's remote sensing unit co-operates with the sectors of the United Nations and its organisms responsible for the execution of projects, in particular in the area of the natural resources utilization. Such co-operation involves activities such as the provision of substantive assistance in designing and assessing projects related to remote sensing from space; facilitating access to data obtained by remote sensing from satellites; providing expert advice on the viability of specific applications of remote sensing and providing backing to remote sensing centres which are being established in various regions. In the non-operational sphere, the Division, in conjunction with other United Nations agencies, sponsors a variety of seminars and training programmes and provides grants to nationals from developing countries.

The Division will pursue its activities, giving special emphasis to the use of remote sensing in exploiting natural resources. Attention is being given above all to the need to facilitate access to data obtained by remote sensing and to disseminate the latest techniques in data collection and analysis.

c) Regional commissions

The Economic Commission for Africa (ECA) shares the aspirations of its member countries to contribute to their own development. In accordance with resolution 2955 (XXVII) and 3182 (XXVIII) of the United Nations General Assembly on peaceful uses of outer space, and the need for international co-operation in that sphere, ECA has attempted to develop among its member countries an awareness of the possibilities offered by satellite communications and remote sensing from space. Its aim is to promote the application of satellite communications and remote sensing to surveying, assessing and planning the rational use of the natural resources of Africa and the supervision of the effects of human activities upon the environment. The representatives of the member States who attended the Conference of Ministers of ECA, which was held in February 1975 in Nairobi (Kenya), unanimously approved resolution 280 (XII) which requested the Executive Secretary to establish a programme of remote sensing for Africa and gave support to the decision to set up in Africa a regional earth station to receive and develop data transmitted by remote sensing satellites.

/An advisory

An advisory mission led by an ECA official visited various African states which have planned or ongoing remote sensing projects in order to inspect the services and installations which each of them was able to offer to accommodate the station. The mission's report proposed that three earth stations for receiving and developing data should be set up in Kinshasa (Zaire), Ouagadougou (Burkina Faso) and Nairobi (Kenya) and five centres for training and assistance to users in Kinshasa (Zaire), Ouagadougou (Burkina Faso), Nairobi (Kenya), Cairo (Egypt) and Ile-Ife (Nigeria). Of these five centres, those in Nairobi and Ouagadougou are at present providing regional services and the one in Cairo is already operational.

The aim of these centres is, in the first place, to train African personnel to use data and satellite images in planning the economic development of their countries and, in the second place, to provide African personnel who will in the future direct the receiving stations and the centres for training and assisting the users.

In September 1978 the first meeting of the Conference of Plenipotentiaries of the African Remote Sensing Council was held in Ougadougou (Burkina Faso), to approve the constitution of and to officially set up the African remote sensing programme. On this occasion, the constitution was ratified by seven States.

At the inaugural meeting of the African Remote Sensing Council (in Ouagadougou, October 1979), which was summoned by ECA after ten signatories had been recorded, 13 States joined the Council. In accordance with article II of its Constitution, the main objectives of the Council are:

a) To harmonize the policies of member States relating to remote sensing;
b) To provide member States with an efficient mechanism for the application of a broad policy in the field of remote sensing;
c) To promote the development of remote sensing activities and to co-ordinate such activities with the intention of improving the use and exploitation of natural resources of economic interest for more than one member State;
d) To promote the development of closer relations between the member States in the application of remote sensing;
e) To use remote sensing techniques to supervise the ecological consequences of the exploitation of natural resources;
f) To promote the setting up of centres for receiving and developing data and providing assistance to training personnel and to users in the member States as well as co-ordinating the activities of such centres;
g) To ensure that all the member States have access to the benefits of remote sensing;
h) To promote and stimulate between the member States training and exchange of personnel, ideas and experience in the field of remote sensing.

The Economic and Social Commission for Asia and the Pacific (ESCAP) and the Economic Commission for Latin America and the Caribbean (ECLAC) have also recognized the possibilities offered by use of remote sensing in their own regions. Nevertheless, plans for the setting up of regional centres are still the subject of study and analysis.

/d) Office

d) Office of the United Nations Disaster Relief Co-ordinator (UNDRO)

UNDRO was set up on 1 March 1972. Its mandate is to mobilize, direct and co-ordinate, in the name of the Secretary General, relief activities by the United Nations system requested by countries affected by catastrophies, to promote the investigation, prevention, control and forecasting of natural disasters and to provide advice on planning to face disasters.

The activities of UNDRO are centered upon the development and use of data collection techniques for anticipating and forecasting natural phenomena which may cause disasters. In co-operation with the United Nations, UNDRO sponsors programmes to train personnel from developing countries subject to disasters in the use of such techniques and to disseminate information relating to the technical progress which may be of use in cases of disaster. UNDRO is also investigating the possibility of using satellites to obtain images with the aim of co-ordinating relief operations following disasters.

e) United Nations Environment Programme (UNEP)

UNEP was set up in 1972 in fulfilment of a recommendation made by the Conference on the Human Environment. The General Assembly entrusted the UNEP Secretariat, directed by a Governing Council made up of 58 nations, with a variety of responsibilities, among which are the co-ordination of environmental programmes within the United Nations system, continuous examination of the execution of these programmes and assessment of their efficiency. Similarly, the UNEP Secretariat is responsible whenever necessary for advising the intergovernmental organs within the United Nations system on the formulation and execution of environmental programmes.

Use of remote sensing as a tool for the systematic collection of data upon environmental variables is of fundamental interest for UNEP. The Global Environmental Monitoring System (GEMS), which was set up and is co-ordinated within the United Nations system, by UNEP, constitutes an important long-term project in this field. By using data collected by GEMS, it is possible to make quantitative assessments of both natural and man-made trends, of critical environmental variables and renewable natural resources at the world and regional levels. In this way a variety of projects are underway within the GEMS programme in areas such as control of desertification, the development and management of grazing land and assessment of the earth's resources, including forests and soils.

UNEP continues to co-ordinate GEMS while at the same time extending its activities within the framework of this system. One of the main sectors in which new tasks are to be undertaken is in the use of remote sensing to monitor agricultural and land use problems in conjunction with monitoring of the climate by satellites. Emphasis will also be placed on training, in particular such training as will be useful for nationals from developing countries.

One of the principal tasks of UNEP is to stimulate and co-ordinate environmental activities within the United Nations system; to this end, it works in close collaboration with the specialized agencies, so that many programmes sponsored and backed by UNEP figure as part of the activities of the respective agency, the most noteworthy of which are those undertaken by WMO and FAO.

/f) United

f) United Nations Development Programme (UNDP)

UNDP is a funding and co-ordinating organization which works in collaboration with some 150 governments and more than 20 international organizations to promote economic growth and better standards of living in developing countries throughout the world. UNDP provides assistance to developing countries through technical co-operation activities covering practically all aspects of economic and social development --including agriculture, education, industry, energy, production, transport, communications, public administration, health, housing and trade-- in accordance with the differing requirements of the receiving governments. Activities receiving assistance from UNDP fall into five principal categories: study and assessment of natural resources and other potential factors for development; encouragement of capital investment to contribute to making use of these possibilities; training in a wide range of technical and professional fields; the transfer of suitable technology and improvement of local technological capacity together with economic and social planning. As the role of UNDP declines, particular importance is attached to assisting national personnel to assume full responsibility, by promoting technical co-operation between developing countries and helping the less developed countries and the poorest sectors of the population in any developing country. A Governing Council, composed of 48 member States is responsible for supervising the content and management of operations as well as the attribution of funds.

Most projects financed by UNDP in the field of space science and technology fall into three spheres: the study of natural resources, the transfer of technology and planning. Among those activities which are of particular interest are those related to communications, forecasting the weather and attacks by pests and diseases, the use of radio and television broadcasting for development and surveys of various resources, including agricultural, forestry, mineral, earth and water resources.

In accordance with the priorities assigned by governments, in the future UNDP will maintain its present variety of projects, although it will probably give greater importance to providing training and consultancy services. Within the field of space science and technology, it is probable that remote sensing and satellite-based communication will continue to be areas of major interest for UNDP. Perhaps, in the light of requests made by governments and the assessment carried out bearing in mind other priorities and requests for assistance, greater emphasis will be placed on regional projects, such as the setting up of specialized centres for research, development and training, the establishment of communications networks and remote-sensing stations.

g) United Nations Industrial Development Organization (UNIDO)

The mandate given to UNIDO is to contribute to speeding up the industrialization of developing countries and to provide assistance in achieving this end. At the global level, UNIDO has been given responsibility for attaining the objectives and targets set by the Lima Declaration and Plan of Action, i.e., to increase to a maximum the participation of developing countries so as to ensure that, as far as possible, they represent at least 25% of total industrial production in the world in the year 2000. This objective was confirmed by the New Delhi Declaration and Plan of Action.

/As the

As the preparation and pursual of activities in outer space together with the associated technical operations on earth involve, among other things, research, development, application and use of technology, as well as technical testing, training and support, it is obvious that a large number of industries and industrial services will be concerned by such activities. Consequently, in view of its co-ordinating role within the United Nations system in all matters related to industrialization, UNIDO is highly concerned by the industrial aspect of development and the application of space technologies. The industries which in fact participate in space activities are both traditional industries (mechanical, metallurgical, electrical and electronics, chemical, engineering and construction) and technologically advanced industries in the telecommunications and electronics fields. UNIDO possesses experience in these industrial areas and intends to develop its activities and operations in them in accordance with the requirements of the international community in general and the developing countries in particular, in so far as technical co-operation, research, studies, the gathering and dissemination of industrial and technological data and information, training, consultancy and meetings of groups of experts are concerned.

2. Specialized organisms and other organizations

a) International Telecommunications Union (ITU)

Within ITU (which has 154 member countries) development of space technology has not led to any totally new activity requiring the establishment of structures to deal with outer space. On the contrary, as early as 1959, at a world administrative conference frequencies had been attributed to the radio communications service for space research and in 1963 the World Administrative Radio Conference on space telecommunications was held in Geneva and was responsible for attributing frequency bands for radio communications in space. This World Conference attributed frequencies to all the radio communications services using space techniques. In addition, compulsory procedure for the co-ordination, notification and recording of the use of radio electrical frequencies and the orbits of geostationary satellites were developed, approved and included in the international treaty entitled: "International Telecommunications and Regulation of Radio Communications Agreement". These procedures and attributions were re-examined, improved and reviewed in the world radio communications conferences held in Geneva in 1971 and 1979.

ITU has the following objectives: a) to maintain and extend international co-operation for the improvement of the rational use of all types of telecommunications; b) to promote the development and most efficient use of technical measures, and c) to harmonize efforts undertaken by nations for the achievement of these common aims.

In accordance with the objectives, ITU is responsible for the day-to-day ordering and application of regulations covering the spectrum of radio electrical frequencies and the orbit of geostationary satellites. Any innovations which occur in space technology in the telecommunications field may be studied and integrated within the framework of the existing structures. All the components of ITU deal with space telecommunications since the term space telecommunications covers "any radio communication using one or more space stations or one or more reflector satellites or other objects in space"; in other words, any radio communications

/services which

services which use space techniques. These include the space research service, the Earth exploration by satellite service, the fixed satellite service, the mobile satellite aeronautical service, the mobile satellite maritime service, the satellite radio navigation service, the satellite meteorological service, the satellite radio broadcasting service, among others. The International Radio Consultative Committee (IRCC) considers technical and operational questions connected to all these space services and their use of the spectrum, and puts forward recommendations. The International Telegraph and Telephone Consultative Committee (ITTCC) studies the technical aspects of interconnection between satellite systems and earth systems and their operating principles, and puts forward relevant recommendations.

ITU is also pursuing an extensive technical assistance programme which has helped countries to carry out viability surveys and to train experts in the use of space technology for communications.

b) World Meteorological Organization (WMO)

The arrival of artificial satellites has had considerable repercussions upon the activities of WMO and has produced enormous benefits to meteorological services throughout the world. The repercussions for WMO have been in fact so considerable that practically all of the constituent organs of the Organization are directly or indirectly devoted to space activities.

Among the organization's aims are the following:

a) facilitating international co-operation in setting up networks of stations and centres for providing meteorological and hydrological services and observations;
b) promoting the establishment and maintenance of systems for the rapid exchange of meteorological and other allied information;
c) promoting standardization of meteorological observations and other allied observations so as to achieve uniformity in the publication of observations and statistics;
d) promoting the application of meteorology to avaiation, navigation, problems related to water, agriculture and other areas of human activities;
e) promoting operational hydrology activities and close collaboration between meteorological and hydrological services;
f) promoting research and training in the meteorology and, where required, in allied fields.

The role played by satellites has grown considerably, not only for the purposes of collecting data by surveying and in particular quantitative data, but also for gathering and distributing information to support the various WMO programmes. It is acknowledged as a matter of fact that satellites are essential to ensure success in activities such as the World Weather Watch (WWW), the Global Atmospheric Research Project (GARP), the Integrated Global Ocean Station System (IGOSS), the Hydrology and Water Resources Programme, the agrometeorological programmes, research and other WMO programmes.

/WMO has

WMO has also undertaken far-reaching teaching and training programmes for experts from the developing countries to educate them in the use of data from meteorological satellites.

c) United Nations Educational, Scientific and Cultural Organization (UNESCO)

Within UNESCO, activities relating to space communications are the responsibility of the Cultural and Communications Sector (in particular the Free Flow of Information and Communications Policies and the Development of Communications Systems Division), the aim of these activities is to study the use of space communications in promoting the aims of UNESCO, on the basis of the Declaration on the Guding Principles in the Use of Satellite Communications, and to provide advisory assistance to member States in this area. The sector has also for some time provided training programmes for radio and television personnel in the production of programmes, which are equally relevant to broadcasting systems by earth station and satellite. International agreement and conventions are drawn up in close collaboration with the International Standards and Legal Affairs Office. Assistance to member States, principally in the form of technical advisory missions on the use of space communications in education and national development, is provided with the help of the Methods, Materials and Techniques Division which is part of the Education Sector. The interest of UNESCO in remote sensing of the earth by use of satellites and other space vehicles is closely connected to the study of the natural environment and its resources. The use of spaceborne remote sensing, together with conventional techniques of remote sensing (using aircraft) is a subject of interest for the following units of the UNESCO science sector: the Ecological Sciencies Unit, the Earth Sciences Unit, the Water Sciences Unit, the Sea Sciences Unit and the Secretariat of the Intergovernmental Oceanographic Commission.

Within the culture and communications section, the Cultural Heritage Unit uses remote sensing techniques in relation with the protection of major historical and cultural monuments.

d) United Nations Food and Agriculture Organization (FAO)

In 1973 FAO appointed a remote sensing officer, and in 1976 a Remote Sensing Unit within the Department of Agriculture to co-ordinate and attain the aims agreed upon in the FAO conferences. In 1980 new measures were taken to attain these objectives in that FAO, on the basis of the recommendations made by the Commission on the Peaceful Uses of Outer Space, transformed its Remote Sensing Unit into a Centre for Remote Sensing of Renewable Resources within the Agricultural Department. The Centre for Remote Sensing co-ordinates the activities of the organization in this area. The Centre provides technical support to a large number of field projects in which remote sensing is required and carries out those projects in which such applications predominate. It also plays a part in formulating and executing the day-to-day activities of programmes which have a remote sensing element, including various activities carried out in collaboration with other United Nations agencies. It has set up services at FAO Headquarters which include a world index of LANDSAT images on 16 mm film, a library for developing countries containing these images, which also contains publication on remote sensing, and a laboratory for interpreting and analysing aerial photographs and images transmitted by satellite.

/FAO also

FAO also carries out a broad range of training activities both in developing countries and in the installations of its Remote Sensing Centre. A considerable part of its work is devoted to providing advice and assisting developing countries and international organizations in applying remote sensing and setting up programmes and services with this aim. In addition, the centre represents the FAO within the United Nations system and in international scientific organizations concerned with remote sensing.

e) World Health Organization (WHO)

WHO has made every effort to keep in touch with progress in space research, as the possible results of such research may have implications for some of its programmes, in particular those which bear upon the relationship between man and his environment.

The sectors of main interest to WHO in relation to its various present and future activities are: transmissible diseases, environmental hygiene, epidemiology and communication sciencies, hygiene at work, cardiovascular diseases, the effects of radiation on health, nutrition, mental health, human genetics, organization of medical care, medical training and instruction and health education. Of particular interest are those techniques which are used to identify the habitat of malaria, schistosomiasis and trypanosomiasis vectors.

Remote sensing of air and water pollution seems to be more efficient than load based monitoring systems as it allows large areas to be covered in a short time. In addition, the use of remote sensing may prove to be even more economical in the long term and provide faster results than conventional methods of sampling and laboratory analysis. Nevertheless, many of these techniques are at present in varying stages of development and few of them are used on a regular basis.

f) International Civil Aviation Organization (ICAO)

The basic task of ICAO is to ensure safe and methodical progress in international civil aviation and to set up international air transport services based upon the principle of equal opportunities and which are operated both efficiently and economically.

Economical application of satellite services to international civil aviation is a major aim of ICAO, and great efforts have been undertaken to specify the appropriate operating requirements and to find the best means of meeting these. The fixed aeronautical service, which sets up the interconnections between the land-based infrastructures responsible for flight security, already makes use of the available satellite links, whenever viable. The mobile aeronautical service, which transmits communications from planes in flight to the land-based communication network, could for the first time make use of instantaneous and interference-free communication between pilots and air traffic controllers through the use of satellites. The aeronautical radio navigation service is able to make use of the application of satellites for radio plotting of the position of a plane in flight on any point of the earth's surface, using a variety of navigation techniques. In the last two applications, the convenience offered by services which cross over the

/polar region

polar region increases the complexity of the possible solutions and considerably augments the range of technical problems which ICAO has to face.

In addition to the above, ICAO is interested in and is working on various aspects of the peaceful uses of outer space, including the use of satellites in search and rescue services, the definition of outer space, transport to, from and through outer spece, and other problems concerning the earth which are more immediately connected to safety. An example of these is that posed by the return of debris from outer space to earth, which may represent a danger, particularly for civil aircraft in flight.

In each of these sectors of activity, ICAO pays particular attention to the potential which exists for the peaceful application of space technology to the provision of essential aeronautical safety services in developing countries, as part of its role in establishing international air transport services based upon equality of opportunity, and in ensuring that such services are provided both safely and economically. Particular emphasis is given to the co-ordination of ICAO activities with allied activities of other international organizations so as to reduce to a minimum the waste involved in duplicating international efforts.

g) International Maritime Organization (IMO)

Since 1966, IMO has shown considerable interest in the development of space techniques for maritime purposes. Until 1971 its activities in the use of space techniques had been principally connected with the formulation of maritime requirements in preparation for the World Administrative Conference on Space Radio Communications. IMO Technical agencies prepared two propositions which presented a concerted viewpoint on maritime requirements. Among other things, these propositions specified that space technology could be used to give warning to and to find the position of ships in danger and in other cases of emergency, to facilitate search and rescue operations benefiting from more efficient communication and to transmit emergency and safety messages.

Thus a rough outline was drawn of a system of maritime satellites principally meeting requirements in the field of telecommunications (safety, warning signals and public communications), while in addition also fulfilling some other functions which are specified on the basis of priority, depending on their respective merits, and which have to be compatible and consistent with optimum use of the spectrum of frequencies available and the organizational and financial factors involved in the development and future operation of the system.

Between 1975-1976 IMO called an International Conference on the setting up of an international maritime satellite system, in which two instruments were approved: the Convention on and the Operating Agreement for the International Maritime Satellite Telecommunications Organization (INMARSAT). The Conference also established a Preparatory Committee which carried out a complete survey to facilitate efficient use of INMARSAT, founded in 16 July 1969. The convention and operating agreement also came into effect on the same date.

/In October

In October 1980 IMO drew up a list of requirements for a future worldwide maritime warning and safety system which it is hoped will enter operation before 1990 and which will replace the present Morse radiotelegraph system. Long-range distress signals from ship to shore in the future maritime system will rely on low power distress transmittors which will operate through the intermediary of geostationary orbiting satellites, and polar orbiting satellites which will also be used to transmit long-range warning signals from shore to ship. Ship's lifeboats will also be fitted with low-power distress transmitters. The possibility of using a combination of passive and active distress signals which will even provide data upon the ship's position is also being examined. The future worldwide system of distress signals and maritime safety will be developed in close collaboration with ITU and INMARSAT.

h) The World Intellectual Property Organization (WIPO)

In 1969 WIPO and UNESCO made joint efforts to ensure that the "piracy" of radio and television signals, which are broadcast through the intermediary of artificial communications satellite and which carry a "programme", was declared illegal. The term "programme" covers all signals intended for domestic radio or television receivers. As a result of this effort, in 1979 a new convention was adopted on the protection of programme-bearing signals broadcast by satellites. This convention does not apply when the signals are broadcasted directly from a direct broadcasting satellite.

i) World Bank (International Bank for Reconstruction and Development (IBRD))

As an international funding institution, the World Bank is particularly interested in the peaceful uses of outer space and in deciding in what way progress in this sphere may help the evolution of developing countries which are members of the bank. The bank is especially interested in the analysis of the information obtained by satellites and in its application to education and telecommunications.

Two sections of the bank deal with images provided by satellites: the Economics and Resources Division of the Agricultural and Rural Development Department and the Cartography Division of the Administrative Services Department; in addition, the Educational Projects Department calls upon the services of a mass media specialist to help the governments of developing countries to draw up a plan for using the media including satellites, in order to raise the level of education and to render it accessible to a greater number of people.

B. INTER-AMERICAN DEVELOPMENT BANK (IDB)

Since 1961 a total of US$ 16 billion has been spent in funding projects for economic and social development in the region, implying an investment of more than US$ 61 billion. In 1979, loans for the first time exceeded US$ 2 billion, as a result of which the value of authorized operations in the last decade was four times higher than the total for the previous decade.

/The preferential

The preferential treatment given to 17 relatively lesser developed countries with a limited market is on the increase. During the last decade they received 76% of the currency component of loans approved by the Fund for Special Operations, a proportion which rose to more than 85% after 1976.

The sectoral distribution of total loans reveals the attribution of virtually the same amount of resources (1979/1980), between US$ 6.4 and US$ 6.2 billion respectively to agriculture and fishing and industry, mining and tourism and to those which represent the economic infrastructure (energy, transport and communications). As far as the social infrastructures (public health and environment, education, science and technology and urban development) are concerned, they received US$ 2.72 billion and export funding, pre-investment and others the remaining US$ 545 million.

Experience shows that in addition to the energy crisis countries have to overcome serious restrictions in the exploration and development of their natural resources, which is an equally essential requirement if they are to establish their industrial development on sound bases. This potential in natural, human and technical resources, offers a great opportunity for the contribution of external investment and technological capacity, and for the development of Latin American national and regional firms. Nowadays the worldwide progress in science and technology considerably facilitates prospection, exploration and development of natural resources. However, investments whose yield is multiplied if they are undertaken in co-operative fashion are required. This is the basis of operations using the LANDSAT satellite which the bank has been supporting for a certain number of years, and whose benefits are fully available to the countries of the region.

C. ORGANIZATION OF AMERICAN STATES (OAS)

Major efforts are being undertaken through the intermediary of the OAS in all areas of the organization's competence. Within the field of evaluation of natural resources and training of specialized personnel using space techniques, the OAS has since 1979 been developing regional courses on the utilization of remote sensing. As a first step these were intended for persons at the decision-making level and later, each year concerned a different speciality, but always used remote sensing as a tool for the development of space technology.

The following countries are member states of the OAS: Argentina, Barbados, Bolivia, Brazil, Colombia, Costa Rica, Chile, Dominica, Ecuador, El Salvador, Granada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, the Dominican Republic, St. Lucia, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

III. MULTILATERAL INTERGOVERNMENTAL CO-OPERATION IN SPACE ACTIVITIES

A. INTERNATIONAL TELECOMMUNICATIONS SATELLITE ORGANIZATION (INTELSAT)

1. Origin

On 20 August 1964, the representatives of 11 nations signed interim agreements establishing the "International Consortium for Satellite Telecommunications", whose aim was the design, development, construction, establishment, operation and maintenance of a worldwide satellite communication system. When this came into being and proved its commercial viability, many other nations joined this consortium. Between 1969 and 1971, a Conference of Plenipotentiaries attended by the governments of the member countries of the consortium held a series of meetings in Washington D.C. to provide a structure for the consortium.

The Conference culminated in the signing of two agreements, the Intergovernmental Agreement and the Operating Agreement. These agreements came into force on 12 February 1973. The parties to the Agreements are the governments of member states; the signatories to the Operating Agreement are those governments who are parties to the Agreement or else the telecommunications bodies designated by them, be they public or private. These two agreements replaced the Interim Agreement under whose terms INTELSAT had operated as a "International Consortium for Satellite Telecommunications" since 20 August 1964.

2. Aims and objectives

In accordance with its final Agreement, the principal aim of INTELSAT is "to definitively pursue the design, development, construction, establishment, operation and maintenance of the worldwide satellite telecommunications system in accordance with the terms of the Interim Agreement and the Special Agreement".

3. Composition

The agreement specifies that the government of any State which is a party to the Interim Agreement or the Government of any other member State of the International Telecommunications Union is entitled to join the INTELSAT Agreement.

The preamble to the INTELSAT Agreement declares that satellite communications should be available to the nations of the world, "on a worldwide non-discriminatory basis". Bearing this in mind, the INTELSAT system is also open to countries who are not members. The rates for use charged to these users are the same as those paid by member countries.

/4. Financial

4. Financial aspects and participation in the share capital

INTELSAT is run as a financial co-operative and all the member countries are joint owners. The members participate in the capital of the organization by taking out shares in accordance with the use they make of the system, as measured by payment of tariffs for use. Capital requirements are subject to a ceiling, which is constituted by the accumulated capital contribution made by the members, minus the accumulated capital which has been repaid to them plus the unpaid contractual capital obligations of INTELSAT.

Initially, when the Operating Agreement came into effect, the capital ceiling was set at US$ 500 million. This amount was later raised on account of the expansion of the system and is at present US$ 1 billion.

The assets of INTELSAT are principally composed of the cost of construction of satellites and their launching. In general, the satellites are acquired through long-term contracts which provide for payments by INTELSAT throughout the periods covered by the contracts. At present more than 100 countries belong to INTELSAT.

The income of the INTELSAT system from the rent of the satellites' capacity to the users of the system is calculated so as to cover operating expenses, depreciation of the system and a 14% repayment of the signatories' net investment. Once the operating expenses have been met, the income is distributed among the member countries. This is despite the fact that these same countries, as users, will have originally contributed most of this income. In this way the countries set the level of their participation in the organization and are required to contribute to the same extent in the capital investment of the system.

In addition to establishing the percentage of investment capital which each signatory contributes to the system and the income he receives in return for his shareholding, it also establishes voting rights on the Governing Board.

5. Organic structure

The INTELSAT structure consists of four organs: an Assembly of Parties, made up of representatives of all the governments who are parties to the INTELSAT Agreement a Meeting of Signatories, composed of representatives of all the signatories (governments or telecommunication agencies designated by them) to the INTELSAT Operating Agreement; a Board of Governors, principally made up of representatives of the signatories whose share of the Consortium's capital, either individually or in groups, is not less than a fixed sum, and an executive organ.

The Assembly of Parties considers those aspects of INTELSAT which are principally of interest to the parties in their quality as sovereign States, together with the resolutions, recommendations or opinions originating from the other INTELSAT organs. Each Party possesses a vote.

/The Meeting

The Meeting of Signatories considers resolutions, recommendations or opinions from the other INTELSAT organs, and also examines questions relating to financial, technical and operational aspects of INTELSAT.

Within its responsibilities, the Meeting of Signatories examines recommendations formulated by the Board of Governors concerning increases in the capital ceiling and takes decisions in this respect; it establishes each year the minimum level of participation required to be represented on the Board of Governors, and lays down standards and general policies, on the recommendations of the Board of Governors which provide the Board with criteria, for the operating and managing the INTELSAT satellite system upon a non-discriminatory basis. Each signatory has one vote.

The Board of Governors is responsible for all decisions relating to the design, development, construction, establishment, operation and maintenance of the space component of INTELSAT, as well as for the decisions required to carry out any other of INTELSAT's activities. The Board examines all the resolutions, recommendations and opinions put forward by the other INTELSAT organs. It is advised by the Consultative Commission on Technical and Planning Matters and by the Examining Commission on Budgets and Accounts.

The Board generally manages to take decisions on a unanimous basis. If it fails to do so, decisions are taken after a weighted vote on the basis of the members' share of the capital.

In December 1980, the Board was made up of 27 governors representing 91 signatories. In accordance with the dispositions of the INTELSAT Agreement, 22 governors sit on the Board by virtue of the fact that their share of the capital is equal or higher than the minimum amount laid down. Five other governors represent the regional groups of ITU, i.e.: African Group I, African Group II, Caribbean Group, Central American Group and Nordic Group.

The Executive Organ has its headquarters in Washington D.C. and is under the responsibility of a Director General, who is the Chief Executive and legal representative of INTELSAT and responsible before the Board of Governors for the day-to-day management and running of INTELSAT.

6. Programme and activities

The worldwide INTELSAT satellite system is composed of two elements: the space segment, made of satellites and allied installations belonging to INTELSAT, and the earth segment, made up of the earth stations which belong to telecommunications bodies in the countries in which they are situated.

INTELSAT operations started up on 6 April 1965 with the launching of the INTELSAT I (Early Bird), which had a capacity for 240 telephone circuits or one television channel. The satellite was used for transoceanic communications between a station in North America and one of the many stations in Europe. The system expanded rapidly and became worldwide. Between 1968 and 1969, the

INTELSAT III satellites with a capacity for 1 200 simultaneous telephone circuits and additional television channels came into operation. The INTELSAT IV satellites, launched in 1971, had a capacity for 4 000 telephone circuits and additional television channels. The growth of international traffic made it necessary to introduce new INTELSAT satellites to satisfy demand.

In 1982 INTELSAT had 13 satellites in orbit, including five intended for international operations: three over the Atlantic Ocean (AOR), one over the Indian Ocean (IOR) and one over the Pacific Ocean (POR). In addition to the international operational satellites, each ocean region had reserve satellites to ensure communications in emergencies, in addition to satellites providing national services

B. INTERCOSMOS

1. Historical background and composition

INTERCOSMOS is a programme of multilateral co-operation between the socialist countries in the peaceful uses of outer space. In 1982, the member countries of INTERCOSMOS were: Bulgaria, Cuba, Czechoslovakia, Hungary, Mongolia, Poland, the German Democratic Republic, Rumania, the Union of Soviet Socialist Republics and Viet Nam.

In April 1965 the Government of the Soviet Union sent a letter to the governments of other socialist countries proposing the study of concrete measures to combine efforts in the field of the exploration and peaceful uses of outer space, in accordance with the scientific and technical potential and interests of the various countries. In accordance with the agreement that was reached after an exchange of notes between the heads of governments, in November 1965 and in April 1967 two meetings were held in Moscow between the representatives of Bulgaria, Hungary, the German Democratic Republic, Cuba, Mongolia, Poland, Rumania, the USSR and Czechoslovakia, in which the aims and the forms of such co-operation were considered. At the second meeting an integrated programme of joint activities in space was approved, and given the name of INTERCOSMOS at the meeting held in 1970 between the heads of the national organs of co-ordination of the participating countries.

With the aim of consolidating the stock of positive experience in co-operation which existed in the field and of helping to increase it, on 13 July 1976, the representatives of nine socialist countries participating in the INTERCOSMOS programme signed the Intergovernmental Agreement on co-operation in the exploration and peaceful uses of outer space (which came into force on 25 March 1977). The Agreement is open to other countries interested in co-operating in the exploration of outer space, subject to the approval of the other parties. On 17 May 1979 Viet Nam signed this agreement, thus becoming the tenth member country of the INTERCOSMOS programme.

/Activities in

Activities in the following principal spheres are carried out within the INTERCOSMOS programme: space physics, space meteorology, space biology and medicine, space communications and exploration of earth using aerospace means.

National co-ordination bodies have been set up in all the countries participating in the programme to organize the activities and ensure fulfilment of the general programme which has been agreed upon, as well as the application of the bilateral and multilateral agreements relating to specific projects and themes.

The principal co-ordinating organ of INTERCOSMOS is the conference of the heads of the national co-ordinating organs, which considers questions of principle relating to the organization and carrying out of joint activities in space and which takes decision in this respect. Sessions of the conference of heads of the national co-ordinating organs are held once every year and alternate between the various countries which participate in the programme. The decisions and recommendations of the conference must be observed by the countries if the heads of their national organs of co-ordination have given their approval.

Permanent joint working parties, composed of scientists and specialists from the countries participating in the programme have been set up in order to put into practice the programmes and plans agreed upon in the five spheres of co-operation mentioned above. The working parties deal with the execution of the joint space experiments and research, periodically examine the putting into practice of the projects which have been approved, as well as the propositions for new joint activities, those for the development of new forms and methods of co-operation, those for the creation and manufacture of scientific apparatus and equipment, and those relating to the scientific and practical application of the results obtained.

This organization of co-operation activities within the framework of the INTERCOSMOS programme, which has successfully operated for some 19 years, makes it possible to provide a rapid solution to the problems posed, while taking into account the interests of the different countries.

Between the sessions of the Conference, overall co-ordination of the activities of the national organs responsible for fulfilling the agreement of 13 July 1966 is borne by the national organ of the depository country: the INTERCOSMOS Council of the USSR Academy of Science.

The countries participating in the INTERCOSMOS programme do not possess a common financial fund. The countries finance the development and manufacture of the scientific instruments and the execution of the experiment which are of interest to them, at their own expense. The Soviet Union makes freely available the means of space rocket technology to the other countries participating in the programme of co-operation and ensures the launching of the space objects. The scientific results of the joint experiments are the common property of all participants in the programme.

/2. Aims

2. Aims and achievements of the INTERCOSMOS programme

Between October 1969 and November 1980 20 satellites in the INTERCOSMOS series, eight vertical high-altitude research rockets and a large number of meteorological projectiles to investigate the ionosphere and the magnetosphere, to study the earth and solar activity, cosmic rays and certain parameters of the upper strata of the atmosphere were launched. In order to carry out the experiments using these satellites and projectiles more than 200 pieces of scientific equipment and instruments were designed and manufactured. Apparatus designed by the scientists and specialists of the socialist countries within the framework of the INTERCOSMOS programme were installed on board various peace vessels, launched in the USSR in accordance with the national programme (the Cosmos and Meteor satellites, the Prognoz automatic space stations, the Soyuz space vessels and the Salyut-6 orbital station).

The aim of joint research in the biological and medical fields is to investigate the influence of the various factors in space flights on the body and to decide upon the necessary preventive measures.

Activities in the sphere of space communication have made it possible to set up an international system as well as the space communications organization known as INTERSPUTNIK which ensures the transmission of television programmes, telephone communications and other forms of information.

Within the sphere of exploration of earth using aerospace means, the aim of the joint activities is to solve scientific and methodological problems and to create experimental apparatus for remote sensing of the earth.

It was agreed that between 1978 and 1983, nationals from the states participating in the INTERCOSMOS programme should take part in space flights and man Soviet space stations, in conjunction with the Soviet astronauts.

C. INTERNATIONAL SYSTEM AND ORGANIZATION OF SPACE COMMUNICATION (INTERSPUTNIK)

1. Introduction

INTERSPUTNIK is an international intergovernmental organization open to all States. The Agreement for the establishment of the International System and Organization of Space Communications INTERSPUTNIK was signed on 15 November 1971; once it had been ratified, it came into force on 12 July 1972 and was registered with the United Nations.

INTERSPUTNIK was set up to meet the need to exchange radio and television programmes and other types of information and to set up telephone and telegraph communications between different countries.

/The legal

The legal and technical principles underlying INTERSPUTNIK were laid down within the context of co-operation between the socialist countries for the exploration and peaceful use of outer space (within) the INTERCOSMOS programme.

Membership of INTERSPUTNIK is open to any State which shares its aims and principles and accepts the obligations laid down in the Agreement.

In 1982, the member States of INTERSPUTNIK were Afghanistan, Bulgaria, Cuba, Czechoslovakia, Hungary, Mongolia, Poland, the German Democratic Republic, Romania, the Union of Soviet Socialist Republics, Viet Nam and Democratic Yemen.

2. Structure

The governing body of INTERSPUTNIK is the Board, composed of one representative for each member of the organization. Each member of the Board possesses a vote. The Board considers questions of general policy, approves plans for the establishment, operation and development of communication systems, decides as to the technical characteristics of earth stations, authorizes the inclusion of earth stations within the communications system, approves the plan for the sharing out of channels and the transmission rates per unit of information, elects the Director-General and decides the structure of management and appointment of management personnel in addition to examining other questions relating to activities of INTERSPUTNIK. The Board's sessions are held at least once every year.

The permanent executive and administrative organ of INTERSPUTNIK is the Authority, whose headquarters is in Moscow. The highest administrative officer is the Director-General who is delegated by the Board to represent INTERSPUTNIK in all matters which arise in relation to the Agreement. Authority personnel is composed of nationals from countries whose governments belong to INTERSPUTNIK, due consideration being given to their professional qualifications and to an equitable geographic representation.

3. The communications system

The INTERSPUTNIK communications system is composed of a space segment and earth stations. The space segment, which includes communication satellites and control systems, is the property of the organization or is otherwise rented out by it to the members. The earth stations are the property of the countries which constructed them or the organizations responsible for their operation.

At present, INTERSPUTNIK operates using Soviet satellites on the basis of a rental agreement. The system uses two STATSIONAR satellites, placed in geostationary orbit 14 degrees longitude west (Atlantic region) and 53 degrees longitude east (Indian region). Each satellite carries two retransmission units which are used for telephone or telegraph connections and for the exchange of radio and television programmes.

/The INTERSPUTNIK

The INTERSPUTNIK system includes 13 earth stations: seven in Europe (Bulgaria, Czechoslovakia, Hungary, Poland, the German Democratic Republic and two in the USSR), four is Asia (Afghanistan, Laos, Mongolia and Viet Nam), one in Central America (Cuba) and one in Northern Africa (Algeria).

There are plans to construct earth stations in Syria, Democratic Yemen, Guinea and other countries.

In addition to the members of the organization, other countries (Spain, France, Italy, Yugoslavia, etc.), also use channels of the INTERSPUTNIK system.

4. Level of use

The INTERSPUTNIK system of communications is principally used for the exchange of television programmes, with between four and eight hours of broadcasts a day. Approximately 40% of exchanges of television programmes between countries belonging to INTERVIDENIE are broadcast through the INTERSPUTNIK system. Programmes concerning the main political, cultural, sporting and other events throughout the world are broadcast.

More than 10 countries participate in the exchange of television programmes through the INTERSPUTNIK system. Approximately the same number use its channels for international telephone and telegraph links.

D. EUROPEAN SPACE AGENCY (ESA)

1. Introduction

The European Space Agency (ESA) is an international intergovernmental organization which directs co-operation between the countries of Europe and allows them to thus jointly develop, execute and finance European space projects.

The Agency, which was set up on 31 May 1975, carries out the space activities which were previously undertaken by the European Space Research Organization (ESRO), for the manufacture of scientific satellites, and the European space vehicle launcher development organization (ELDO). The creation of a single organization not only met the need for Europe to combine its efforts in a single organism, but also the need to ensure a more appropriate equilibrium between the European programmes. The priorities which have been established for the Organization are the result of the common political desire of the member States. This has allowed the agency to provide Europe with an efficient instrument permitting it to ensure its presence in space, and consequently, has given the member States a degree of political independence which none of them would have been able to achieve alone.

The member States of the European Space Agency (ESA) are the following countries: Belgium, Denmark, France, Federal Republic of Germany, Ireland, Italy, the Netherlands, the United Kingdom, Spain, Sweden and Switzerland. In addition, Austria is an associate member, Canada participates by virtue of a co-operation agreement and Norway is an observer.

/2. Principal

2. Principal aims

The principal aims of the Agency are laid down in its Convention. The Agency has the task of ensuring and developing, for purely peaceful purposes, technical co-operation between European states in the spheres of space research and technology. To this end, the Agency develops and applies a long-term European space policy and ensures the co-ordination and integration of national and European programmes. Determination of the programmes developed by the Agency is based upon the principles of independence, equilibrium and co-operation.

Europe's preoccupation with independence is above all reflected in the execution of the Ariane launcher programme, which permits satellites to be placed into orbit and thus ensures a greater freedom of action.

The preoccupation with the equitable distribution of resources between the various programmes is mirrored by the balanced distribution of budgetary funds between the scientific programmes (by 1982 the agency had placed 12 satellites in orbit) and the applications programmes (remote sensing, meteorology and telecommunications).

The interest in co-operation with other countries which have space programmes is particularly reflected by the development of the manned European space laboratory (SPACELAB) which was launched by the United States space shuttle, which allowed Europe to also participate in the development of manned space flights and facilitated the various scientific experiments involving man in space.

The development of a coherent industrial policy through the constitution of a common fund involving most of the resources intended for European space activity involves the need to share out the industrial projects in proportion to the financial participation of each of the member States. In this fashion steps are made towards one of the Agency's aims, i.e., the improvement of the conditions under which European industry competes.

3. Agency policies

The Council, which is made up of representatives of the member States, elaborates the Agency's policy. The decisions are taken by unanimous vote by a two-thirds majority or by simple majority depending on their importance. In certain important cases, which are nonetheless not primordial, such a system avoids vetos which would prevent the Agency from operating efficiently.

The Director-General is the highest executive official of the agency and represents it in all its activities. The Director-General is responsible for the Agency's management, the execution of the programmes, the application of policy and in addition, puts forward activities and programmes for approval by the member States. He is assisted in his functions by the directors responsible for the various spheres of activity and approximately 1 400 personnel.

/In accordance

In accordance with the convention, the agency makes maximum use of the installations and equipment which already exist in the member States. For this reason, the national space agencies are closely involved in the execution of certain of the agency's programmes. The most striking example is the Ariane programme, whose execution is the responsibility of the National Centre for Space studies (CNES) in France.

4. Funding

The agency's budget is funded by its member States. For 1981, the budget represented approximately 600 million units of account, or approximately US$ 720 million. All the member States contribute towards funding the compulsory activities in proportion to their national income. These activities are those which are included in the general budget and the scientific programmes. Financial participation in the optional programmes depends upon a flexible formula, which permits each of the States which participate in a particular programme to decide what its percentage contribution will be. States which are non-members but which co-operate in certain programmes also contribute to an extent which they themselves determine (for example, Austria participates in the SPACELAB and L-SAT programme, Canada participates in the L-SAT and in the definition of the remote sensing programmes and Norway participates in the MARECS and remote sensing programmes).

The agency shares out most of the contributions from the European governments among the firms constructing the satellite, the launcher vehicles and the earth stations; it also supplies the additional material and services required (from European firms) for the joint space programmes of the member States. Execution of the agency's programmes by European industry ensures that the latter receives, through contracts, a considerable share of the investments made by the participating States.

5. Co-operation with non-member States

The agency's convention encourages co-operation with non-member States. Accordingly, the agency establishes relations with non-member States and international organizations. The basic purpose of these is to propagate European space achievements and thus promote co-operation activities. The agency principally turns its efforts towards the countries or groups of countries which are interested in using the applications programmes of space technology. In many developing countries demonstrations of space applications systems which could be put into practice to accelerate development has been organized, in particular in the meteorological and remote sensing spheres.

6. Results

In 1980 the agency had four scientific satellites in earth orbit:

a) COS-B, launched in 1975 to carry out astronomical research into gamma rays.

/b) ISEE-2,

b) ISEE-2, launched in 1977 to investigate the magnetoshpere and the relationships between the sun and earth, and one of the three satellites of the international programme which the agency initiated in co-operation with NASA.
c) IUE, launched in January 1978 in collaboration with NASA and the United Kingdom scientific research organization. It is employed for astronomical research into the ultraviolet spectrum.
d) GEOS-2, launched in 1978, and which is employed in research into the magnetosphere which was started by GEOS-1.

Among the scientific projects already planned for 1982 are the following:

a) EXOSAT, whose mission will be to identify and study the celestial sources of X rays with a degree of precision so far not achieved.
b) The Space Telescope, which is another example of co-operation with the United States, since this programme provides for the use over a 15 year period of a 2.4 metre diameter telescope, which is to be placed in orbit by the space shuttle.
c) The international Polar Solar Mission, which is also a joint programme between the agency and the United States, in which two satellites will be used, one European and one American, which will be launched in 1985 by the space shuttle. This mission will explore distant regions of the plane of the earth orbit and in particular, space above the solar poles.
d) Hipparcos, which will be launched by Ariane and whose mission will be to observe the astronomical parameters of a large number of stars.
e) Giotto, which will be launched to meet with Halley's comet a year later.

7. Applications programmes

a) Earth monitoring

Meteorological satellites to study scientific phenomena occurring in the earth's atmosphere and to ensure the dissemination of images and some meteorological parameters obtained by calculations among the users have been built in Europe. METEOSAT-1, launched in 1977, represents the European contribution to the World Weather Watch and the Global Atmospheric Research Programme (GARP) which includes five satellites, three American and one Japanese. Ariane ensured the launching into orbit of METEOSAT-2.

The SIRIO-2 satellite will carry out two experimental missions of meteorological and geodesic interest. The first mission, which involves the dissemination of meteorological data, known as MDD (Meteorological Data Distribution) is intended to improve the circulation of data on the African continent. The second mission, known as LASSO (Laser Synchronization from a Stationary Orbit) is intended to improve worldwide synchronization of atomic watches through the use of laser ray techniques.

/The missions

The missions carried out by remote sensing satellites cover a wide range of applications: inventory of harvests and calculation of crop yield, exploitation of water resources, surveillance of coasts and coastal waters, fishing, marine currents and pollution. These applications may be of benefit both to the industrialized countries and to developing countries. The aim of the agency is to set up a system of remote sensing satellites over the ocean in coastal and oceanic areas and to establish a satellite system for earth applications.

b) Telecommunications

The next generation of European communications satellites has been planned to set up a European operational system of regional nature which will provide for the retransmission of telephone or television signals and data transmission between off-shore oil platforms and coastal stations. Five of these satellites will be made available to the European Organization of Telecommunications Satellites (EUTELSAT), to meet the needs of users in the 1980s.

The MARECS, a type of communication satellite, which uses the same platform, will be used to establish long distance links between ships and land stations. The MARECS-A and B satellites will be operated by INMARSAT.

Since 1976 the agency has been studying a programme of heavy platform suitable for Ariane, and which are capable of transporting telecommunications payloads for direct broadcasting and for the new services. It would be possible to receive the broadcasts directly in homes with the help of an aerial less than one metre in diameter. The L-Sat programme is sufficiently versatile for it to be adapted to the whole range of future applications.

c) Means

i) Ariane launch vehicle

Ariane is intended to provide Europe with the capacity to launch its own scientific or applications satellites and to enable it to carry out a share of the launchings which will be required by the large market forecast for the 1980s, which is estimated at around 200 satellites.

On the basis of hypothesis about the potential market for Ariane and assuming an average of four launches per year with the possibility of launching two satellites from the same vehicle, it has been estimated that in the 1980s between 30 and 50 launch vehicles will be required.

ii) SPACELAB

The manned and reusable space laboratory, which European industry has prepared for the agency, has been designed to be used with the space shuttle. This mission has been prepared jointly with NASA. SPACELAB is equipped to carry out a large number of scientific experiments on board.

E. INTERNATIONAL MARITIME SATELLITE ORGANIZATION (INMARSAT)

1. Establishment

By virtue of resolution A.305 (VIII), of 23 November 1973, the Assembly of the International Maritime Organization (OMI) convened an international conference to decide on the principle of establishing an international system of maritime satellite telecommunications and to draw up agreements in order to put this decision into practice.

In fulfilment of the decision, the international conference for the establishment of an international system of maritime satellite communications held its first session in London on 23 April 1975, and brought its activity to a conclusion at its third session in September 1976.

The conference approved the following instruments:

a) The Convention of the International Maritime Satellite Organization (INMARSAT).
b) The Operating Agreement of the International Maritime Satellite Organization (INMARSAT).

Both the agreements came into force on 16 July 1979, i.e., 60 days after the date on which the States who had contributed 95% of the initial capital became parties. The Organization's headquarters is in London.

2. Aims

The principal aim of INMARSAT is to provide the space component required to improve maritime telecommunications, thus helping to reduce the dangers to which those who work in maritime telecommunications are exposed, and to improve the efficiency with which ships are handled, public maritime communications and radio determination capacity. The aims of the Organization are purely peaceful.

3. Composition and structure

On 15 October 1980, 32 States were parties to the INMARSAT Convention. Membership of INMARSAT is open to all States; in addition, those countries who are not members may use the space component for navigation services in accordance with conditions laid down by the Organization.

The following countries are member States of INMARSAT: Algeria, Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Chile, China, Denmark, Egypt, Finland, France, Federal Republic of Germany, Greece, India, Irak, Italy, Japan, Kuwait, Liberia, the Netherlands, Norway, New Zealand, Oman, the Philippines, Poland, Portugal, Singapore, Spain, Sri Lanka, Sweden, the Union of Soviet Socialist Republics, the United Kingdom and the United States of America.

/INMARSAT possesses

INMARSAT possesses three principal organs: the Assembly in which all the member States are represented, each of them possessing a vote; the Council, made up of 22 signatories with voting rights on capital contributions; and the authority, under a Director-General. Substantive decisions require a two-thirds majority, both in the Assembly and in the Council. The role of the Assembly is to examine and consider the general policy and long-term aims of the Organization, express opinions and formulate relevant recommendations to the Council. In this way the Council decides all financial questions of an operational, technical and administrative nature.

Article 6 of the Convention provides that the Organization may either own the space component or rent it. The purpose of charges for using the space component is to provide sufficient income for INMARSAT to cover its operating, maintenance and administrative costs, supply sufficient operating funds, amortize the investments made by the signatories and compensate members for use of capital.

4. Scope of INMARSAT activities

At the international conference to establish INMARSAT the following operational requirements for a mobile maritime satellite telecommunications system were laid down:

a) Communications in emergencies, including the transmission of messages relating to emergencies, and communications relating to co-ordination of search and rescue operations, as well as the possibility of plotting the position of any ship in danger as well as those of search and rescue units taking part in the operations.
b) Transmission of urgent messages, including requests for medical assistance.
c) Communications between the ship or another moving vessel and a land-based station allowing information on the former's position to be obtained. As an extension of this information relating to atmospheric, meteorological, or oceanographic conditions could be provided, or the land-based station could call the ship at suitably determined regular intervals in addition to transmitting information about its position or other elements.
d) Plotting of the initial position to within one or two nautical miles. As technology evolves, it would be possible to increase precision so that the system would be suitable for coastal shipping and for use in narrow navigable stretches or passages.
e) Transmission of extremely precise frequencies and time signals.
f) Utilization of the selective calls and multiple access technique so as to facilitate communications.
g) Selective calls from coastal stations to ships so as to set up public communications using land-based stations.
h) Public communications, including commercial operations of ships and firms by telegraph and telephone.
i) Data transmission, including facsimile systems, teleprinting and broad band.

/j) Automatic

j) Automatic warnings to ships which are constantly tracked, if they approach shallow waters, underwater installations, drilling and production platforms, etc.
k) Information to ships which the system tracks continuously, concerning the measures they must take to avoid possible collisions and dangers to shipping which are also constantly tracked, i.e., risk of collisions with an iceberg.
l) Automation of the data transmission system relating to the position of ships, based on information mentioned in c).
m) Traffic control, including collision warning, particularly where shipping lanes cross, which is subject to the radio plotting system being sufficiently accurate.
n) Dissemination of meteorological, hydrographical and oceanographic information to ships.
o) Dissemination of meteorological and oceanographic information to ships from shore stations.
p) Collection of meteorological, hydrographical and oceanographic information provided by ships.

5. Entry into service of satellite communications

The large number of operational requirements will only be fulfilled gradually and in particular will depend upon co-operation from the international maritime community and on the growth of INMARSAT.

F. ARAB SATELLITE COMMUNICATIONS ORGANIZATION (ARABSAT)

1. Origin

Arab telecommunications services are the responsibility of the national post and telecommunications administrations, which co-ordinate their activities through the Arab Telecommunications Union (ATU) with the agreement of the Arab League. ARABSAT was founded on 14 April 1976. Twenty-one Arab states belong to ARABSAT.

The following countries are member States of ARABSAT: Algeria, Bahrein, Democratic Yemen, Iraq, Jordan, Kuwait, the Lebanon, the Libyan Arab Jamahiriya, Morocco, Mauritania, Oman, Qatar, Somalia, Sudan, Saudi Arabia, the Syrian Arab Republic, Tunisia, the United Arab Emirates and the Yemen.

2. Organic structure

This consists of the General Assembly, composed of all the members of the Organization and which meets once a year; the Board of Directors (composed of representatives of nine member States, five of whom are permanent: Kuwait, the Lebanon, Libya, Saudi Arabia and the United Arab Emirates; the four others are elected by the General Assembly), and the executive organ, composed of various units or administrative sections which are specified in the internal regulations of the Organization. The headquarters of ARABSAT is in Riyadh, Saudi Arabia.

/3. Aims

3. Aims

The principal aim of the Organization is the establishment, operation and maintenance of a regional telecommunications system for the Arab world. The ARABSAT system will complement the land network for transmission of interregional public telecommunications traffic between the main international switching centres so as to offer new possibilities for the exchange of television programmes between the Arab countries.

The users of the ARABSAT system will be the members of the Arab League; the structure of the ARABSAT system is based upon the requirements defined by meetings on traffic and multilateral consultations, as well as on studies carried out by ARABSAT groups. The ARABSAT system will be equipped so as to provide the following services: telephone, telegraph, telex and data transmission at a regional and national level; regional and national television; and community television.

4. System components

The space-borne component of ARABSAT is made up of two satellites which will be placed in geostationary orbit 19° east and 26° east; a third reserve satellite will be provided.

It will be necessary to set up earth stations, including transmitting stations, which will have to be compatible with the space-borne component of ARABSAT. The control network will consist of control stations and the control centre, which is situated in Riyadh.

It will be possible to launch the ARABSAT satellite either by the Ariane launch vehicle or the United States space shuttle.

The ARABSAT system has been designed to provide services to meet the immediate needs of the member Arab States, as well as their telecommunications requirements up to 1990.

IV. BILATERAL CO-OPERATION

Various Latin American countries have signed bilateral co-operation conventions in the field of outer space, as set out in the following table.

LATIN AMERICA: CONVENTIONS RELATING TO OUTER SPACE

	Argentina	Bolivia	Brazil	Chile	Colombia	Costa Rica	Cuba	Dominican Republic	Ecuador	El Salvador	Guatemala	Haiti	Honduras	Mexico	Nicaragua	Panama	Peru	Uruguay	Venezuela
Argentina		x	x	x					x								x	x	
Bolivia	x																		
Brazil	x			x	x	x								x			x		x
Chile	x		x																
Colombia			x																
Costa Rica			x																
Cuba																			
Dominican Republic																			
Ecuador	x																		
El Salvador																			
Guatemala																			
Haiti																			
Honduras																			
Mexico			x																
Nicaragua																			
Panama																			
Peru	x		x																
Uruguay	x																		
Venezuela			x																

/V. STATE

V. STATE OF INTERNATIONAL TREATIES RELATING TO OUTER SPACE, MARCH 1983

A. Treaty on Principles Governing Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies */

State	Signature	Ratification
Afghanistan	+	+
Argentina	+	+
Australia	+	+
Austria	+	+
Bahamas	-	+
Barbados	-	+
Belgium	+	+
Bolivia	+	-
Botswana	+	-
Brazil	+	+
Bulgaria	+	+
Burma	+	+
Burundi	+	-
Byelorussian Soviet Socialist Republic	+	-
Canada	+	+
Central African Republic	+	-
Chile	+	-
Colombia	+	-
Cuba	-	+
Cyprus	+	+
Czechoslovakia	+	+
Democratic Yemen	-	+
Denmark	+	+
Dominican Republic	+	+
Ecuador	+	+
Egypt	+	+
El Salvador	+	+
Ethiopia	+	-
Fiji	-	+
Finland	+	+
France	+	+
Gambia	+	-
German Democratic Republic	+	+
Germany, Federal Republic of	+	+
Ghana	+	-

*/ In force since 10 October 1967.

/(cont.)

State	Signature	Ratification
Greece	+	+
Guinea-Bissau	-	+
Guyana	+	-
Haiti	+	-
Holy See	+	-
Honduras	+	-
Hungary	+	+
Iceland	+	+
India	+	+
Indonesia	+	-
Iran	+	-
Iraq	+	+
Ireland	+	+
Israel	+	+
Italy	+	+
Jamaica	+	+
Japan	+	+
Jordan	+	-
Kuwait	-	+
Lao People's Democratic Republic	+	+
Lebanon	+	+
Lesotho	+	-
Libyan Arab Jamahiriya	-	+
Luxembourg	+	-
Madagascar	-	+
Malaysia	+	-
Mali	-	+
Mauritius	-	+
Mexico	+	+
Mongolia	+	+
Morocco	-	+
Nepal	+	+
Netherlands	+	+
New Zealand	+	+
Nicaragua	+	-
Niger	+	+
Nigeria	+	+
Norway	+	+
Pakistan	+	+
Panama	+	-
Papua New Guinea	-	+
Peru	+	+
Philippines	+	-
Poland	+	+
Republic of Korea	+	+
Romania	+	+

/(cont.)

State	Signature	Ratification
Rwanda	+	-
San Marino	+	+
Saudi Arabia	-	-
Seychelles	-	+
Sierra Leone	+	+
Singapore	-	+
Somalia	+	-
South Africa	+	+
Spain	-	+
Sri Lanka	+	-
Sweden	+	+
Switzerland	+	+
Syrian Arab Republic	-	+
Thailand	+	+
Togo	+	-
Tonga	-	+
Trinidad and Tobago	+	-
Tunisia	+	-
Turkey	+	+
Uganda	-	+
Ukrainian Soviet Socialist Republic	+	+
Union of Soviet Socialist Republics	+	+
United Kingdom of Great Britain and Northern Ireland	+	+
United Republic of Cameroon	+	-
United States of America	+	+
Upper Volta	+	+
Uruguay	+	+
Venezuela	+	+
Yugoslavia	+	-
Zaire	+	-
Zambia	-	+

B. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space */

State	Signature	Ratification
Argentina	+	+
Australia	+	+
Austria	+	+
Bahamas	-	+
Barbados	-	+
Belgium	+	+
Bolivia	+	-
Botswana	-	+
Brazil	-	+
Bulgaria	+	+
Burma	+	-
Byelorussian Soviet Socialist Republic	+	+
Canada	+	+
Chile	+	-
Colombia	+	-
Costa Rica	+	-
Cyprus	+	+
Czechoslovakia	+	+
Denmark	+	+
Dominican Republic	+	-
Ecuador	+	+
Egypt	+	+
El Salvador	+	+
Fiji	-	+
Finland	-	+
France	-	+
Gabon	-	+
Gambia	+	+
German Democratic Republic	+	+
Germany, Federal Republic of	+	+
Ghana	+	-
Greece	+	+
Guyana	+	+
Haiti	+	-
Hungary	+	+
Iceland	+	+
India	-	+
Iran	+	+
Iraq	-	+

*/ In force since 3 December 1968.

/(cont.)

State	Signature	Ratification
Ireland	+	+
Israel	+	+
Italy	+	+
Jamaica	+	-
Jordan	+	-
Kuwait	-	+
Lao People's Democratic Republic	+	+
Lebanon	+	+
Lesotho	+	-
Luxembourg	+	-
Madagascar	+	+
Malaysia	+	-
Maldives	+	+
Malta	+	-
Mauritius	-	+
Mexico	+	+
Monaco	+	-
Mongolia	+	+
Morocco	+	+
Nepal	+	+
Netherlands	+	+
New Zealand	+	+
Nicaragua	+	-
Niger	+	+
Nigeria	+	+
Norway	+	+
Pakistan	-	+
Papua New Guinea	-	+
Peru	-	+
Philippines	+	-
Poland	+	+
Portugal	+	+
Republic of Korea	+	+
Romania	+	+
Rwanda	+	-
San Marino	+	+
Senegal	+	-
Seychelles	-	+
Sierra Leone	+	-
Singapore	-	+
Somalia	+	-
South Africa	+	+
Swaziland	-	+
Sweden	-	+
Switzerland	+	+
Syrian Arab Republic	+	+

/(cont.)

State	Signature	Ratification
Thailand	-	+
Tonga	-	+
Tunisia	+	+
Turkey	+	-
Ukrainian Soviet Socialist Republic	+	+
Union of Soviet Socialist Republics	+	+
United Kingdom of Great Britain and Northern Ireland	+	+
United Republic of Cameroon	+	+
United States of America	+	+
Uruguay	+	+
Venezuela	+	-
Yemen	+	-
Yugoslavia	+	+
Zaire	+	-
Zambia	-	+

European Space Agency	Declaration of acceptance

/C. Convention

C. Convention on International Liability for Damage Caused by Space Objects */

State	Signature	Ratification
Algeria	+	-
Argentina	+	-
Australia	-	+
Austria	+	+
Belgium	+	+
Benin	+	+
Botswana	+	+
Brazil	+	+
Bulgaria	+	+
Burundi	+	-
Canada	-	+
Chile	-	+
Colombia	+	-
Costa Rica	+	-
Cyprus	+	+
Czechoslovakia	+	+
Democratic Kampuchea	+	-
Denmark	+	+
Ecuador	+	+
Egypt	+	-
El Salvador	+	-
Fiji	-	+
Finland	+	+
France	-	+
Gabon	-	+
Gambia	+	-
Germany, Federal Republic of	-	+
Ghana	+	-
Greece	+	+
Guatemala	+	-
Haiti	+	-
Honduras	+	-
Hungary	+	+
Iceland	+	+
India	-	+
Iran	+	+
Iraq	-	+
Ireland	+	+
Israel	-	+
Italy	+	-

*/ In force since 1 September 1972.

/(cont.)

State	Signature	Ratification
Jordan	+	-
Kenya	-	+
Kuwait	+	+
Lao People's Democratic Republic	+	+
Lebanon	+	-
Liechtenstein	-	+
Luxembourg	+	-
Mali	+	+
Malta	-	+
Mexico	+	+
Mongolia	+	+
Morocco	+	-
Nepal	+	-
Netherlands	-	+
New Zealand	+	+
Nicaragua	+	-
Niger	+	+
Norway	+	-
Oman	+	-
Pakistan	+	+
Panama	+	+
Papua New Guinea	-	+
Peru	+	-
Philippines	+	-
Poland	+	+
Romania	+	-
Rwanda	+	-
Saudi Arabia	-	+
Senegal	+	+
Seychelles	-	+
Sierra Leone	+	-
Singapore	+	+
South Africa	+	-
Spain	+	+
Sri Lanka	-	+
Sweden	-	+
Switzerland	+	+
Syrian Arab Republic	-	+
Togo	+	+
Trinidad and Tobago	-	+
Tunisia	+	+
Ukrainian Soviet Socialist Republic	+	+
Union of Soviet Socialist Republics	+	+
United Kingdom of Great Britain and Northern Ireland	+	+
United Republic of Tanzania		-

/(cont.)

State	Signature	Ratification
United States of America	+	+
Uruguay	-	+
Venezuela	+	+
Yugoslavia	-	+
Zaire	+	-
Zambia	-	+

European Space Agency	Declaration of acceptance

D. Convention on the Registration of Objects Launched into Outer Space */

State	Signature	Ratification
Argentina	+	-
Austria	+	+
Belgium	+	+
Bulgaria	+	+
Burundi	+	-
Byelorussian Soviet Socialist Republic	+	+
Canada	+	+
Chile	-	+
Cuba	-	+
Cyprus	-	+
Czechoslovakia	+	+
Denmark	+	+
France	+	+
German Democratic Republic	+	+
Germany, Federal Republic of	+	+
Hungary	+	+
India	-	+
Iraq	+	-
Mexico	+	+
Mongolia	+	-
Netherlands	-	+
Nicaragua	+	-
Niger	+	+
Pakistan	+	-
Peru	-	+
Poland	+	+
Republic of Korea	-	+
Seychelles	-	+
Singapore	+	-
Spain	-	+
Sweden	+	+
Switzerland	+	+
Ukrainian Soviet Socialist Republic	+	+

*/ In force since 15 September 1976.

/(cont.)

State	Signature	Ratification
Union of Soviet Socialist Republics	+	+
United Kingdom of Great Britain and Northern Ireland	+	+
United States of America	+	+
Uruguay	-	+
Yugoslavia	-	+

European Space Agency — Declaration of acceptance

/E. Legislative

E. Legislative Agreement on the Activities of States on the Moon and other Celestial Bodies */

State	Signature	Ratification
Austria	+	-
Chile	+	+
France	+	-
Guatemala	+	-
India	+	-
Morocco	+	-
Netherlands	+	+
Philippines	+	+
Peru	+	-
Romania	+	-
Uruguay	+	+

*/ Did not come into effect.

Member States of the ESA. The following countries are member States of the European Space Agency (ESA): Belgium, Denmark, France, Germany, Federal Republic of, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland, United Kingdom. In addition, Austria is an associate member while Canada participates by virtue of a co-operation agreement and Norway is an observer.

Member States of INTERSPUTNIK. In 1982, the member States of INTERSPUTNIK were: Afghanistan, Bulgaria, Cuba, Czechoslovakia, Democratic Yemen, German Democratic Republic, Hungary, Mongolia, Poland, Romania, Union of Soviet Socialist Republics and Viet Nam.

Member States of INTERCOSMOS. Up to 1982 the member States of INTERCOSMOS were: Bulgaria, Cuba, Czechoslovakia, German Democratic Republic, Hungary, Mongolia, Poland, Romania, Union of Soviet Socialist Republics and Viet Nam.

Member States of COSPAR. At the present time, 35 national academies of science or similar institutions from the following countries are members of COSPAR: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Czechoslovakia, Denmark, Finland, France, German Democratic Republic, Germany, Federal Republic of, Greece, Hungary, India, Indonesia, Iran, Iraq, Israel, Italy, Japan, Mexico, Netherlands, Norway, Pakistan, Poland, Romania, Spain, South Africa, Sweden, Switzerland, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland, United States of America.

Member States of ARABSAT. The following countries are member States of ARABSAT: Algeria, Bahrain, Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Democratic Yemen and Yemen.

Member States of INMARSAT. The following countries are member States of INMARSAT: Algeria, Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Chile, China, Denmark, Egypt, Finland, France, Germany, Federal Republic of, Greece, India, Iraq, Italy, Japan, Kuwait, Liberia, Netherlands, Norway, New Zealand, Oman, Philippines, Poland, Portugal, Singapore, Spain, Sri Lanka, Sweden, Union of Soviet Socialist Republics, United Kingdom, United States of America.

Member States of OAS. The following countries are member States of OAS: Argentina, Barbados, Bolivia, Brazil, Colombia, Costa Rica, Chile, Dominica, Dominican Republic, Ecuador, El Salvador, Granada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Lucia, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

/Member States

Member States of INTELSAT. The following countries are member States of INTELSAT: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Federal Republic of, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States of America, Afghanistan, Algeria, Angola, Argentina, Bangladesh, Barbados, Bolivia, Brazil, Central African Republic, Chad, Chile, China, Colombia, Congo, Costa Rica, Cyprus, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Gabon, Ghana, Guatemala, Guinea, Haiti, Holy See, Honduras, India, Indonesia, Iran, Iraq, Ivory Coast, Israel, Jamaica, Jordan, Kenya, Kuwait, Lebanon, Libyan Arab Jamahiriya, Liechtenstein, Madagascar, Malaysia, Mali, Mauritania, Mexico, Monaco, Morocco, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Qatar, Republic of Korea, Saudi Arabia, Senegal, Singapore, Somalia, South Africa, Sri Lanka, Sudan, Syrian Arab Republic, Thailand, Trinidad and Tobago, Tunisia, Uganda, United Arab Emirates, United Republic of Cameroon, United Republic of Tanzania, Upper Volta, Uruguay, Venezuela, Viet Nam, Yemen, Yugoslavia, Zaire, Zambia.

Member States of the Committee on the Peaceful Uses of Outer Space (COPUOS). The following countries are member States of COPUOS: Albania, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chad, Chile, China, Colombia, Czechoslovakia, Ecuador, Egypt, France, German Democratic Republic, Germany, Federal Republic of, Hungary, India, Indonesia, Iran, Iraq, Italy, Japan, Kenya, Mexico, Mongolia, Morocco, Netherlands, Niger, Nigeria, Pakistan, Philippines, Poland, Portugal, Romania, Sierra Leone, Sudan, Sweden, Syrian Arab Republic, Turkey, Union of Soviet Socialist Republics, United Kingdom, United Republic of Cameroon, United States of America, Upper Volta, Uruguay, Venezuela, Viet Nam, Yugoslavia.

Member States of SELPER. The members of SELPER are individual specialists from the following Latin American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru and Venezuela.

VI. NATIONAL SPACE AGENCIES IN LATIN AMERICA

A. Argentina: National Commission for Space Research

The National Commission for Space Research (CNIE) is the national organism which has been responsible for promoting and co-ordinating research in Argentina into the peaceful uses of outer space since 1960, when it was set up by a decree of the National Executive Authority.

Another of its principal responsibilities is advising the National Executive Authority; the Commission has at the same time directed its efforts towards promoting interest in the peaceful uses of aerospace as well as scientific research into technological development of the means for its furtherance and application.

In assuming these responsibilities, priority was given to training and improving the skills of scientific and technical personnel through courses, grants, the exchange of specialists and information of national and international character.

From the outset, the CNIE has stressed the importance of co-operative efforts, by drawing up conventions and agreements with universities and public or private institutions within the country and abroad.

1. San Miguel Centre

Space Systems Department-Advanced Training Programme. In 1980 the Centre began to provide the Post-Graduate Course in Aerospace Technology, unique in Argentina and which is of an international standing. The principal aim is to train students capable of acquiring scientific knowledge sufficiently rapidly and thoroughly so as to be able to provide creative solutions in the application of space technology, creating a medium which provides continuous training for experienced specialists who will be able to take part in development projects.

The course is taught by Argentine and foreign professors, coming from development projects from within European and United States space agencies.

This post-graduate course is run by virtue of an agreement between the CNIE and the National Technological University. The course curriculum covers the following areas: communication satellite systems, meteorology, basic research and monitoring of the earth; remote sensing of natural resources: statistics and data on agricultural resources, classification of usable land and application to geological and energy resources.

/Satellite applications

Satellite applications programme, Project I: "Argentine Domestic Satellite Communications System" (DOMSAT). An inter-institutional commission presided over by the Minister of Communications and to which the CNIE belongs, is responsible for running this project.

The first part of the project, "Systems Architecture" is considered to be complete; the second phase, "Systems Definition", is at present under way. The Federal German Republic's Institute of Aerospace Research (DFVLR) is collaborating in this latter phase. This is a documentary phase and involves drawing up propositions, and will end with the choice of the prime contractor. The third phase concerns the formalization of the contract for acquiring and operating the satellite, its control system and the establishment of the main communications station. During the fourth and final phase, the earth communications stations will be built and completed.

The Scientific Applications Satellite (SAC-1) is a project under the responsibility of the CNIE in conjunction with the Institute of Space Astronomy and Physics (IAFE), which depends upon the National Council for Scientific and Technical Research (CONICET).

The SAC-1 project involves launching an Argentine applications technology satellite into orbit. The main aim is to lay down the basis of fundamental techniques in planning satellite systems, so as to develop in Argentina the necessary capacity to solve the problems posed by this type of system. Similarly, the project will make it possible to conceive a series of experiments included in the satellites payload, involving specific research into solar phenomena.

The present state of the project makes it possible to define the profile of the SAC-1 mission, which is now in its definition phase: launch vehicle: SCOUT-D type; mass: 130/150 kgs; dimensions: a cylinder 80 cm high and 90 cm in diameter; stabilization: magnetic rotation-control; mission length: approximately one year; mission: detection of hard X, gamma X-rays (linear and continuous) and neutron emissions from solar flares; orbit: quasi-polar circular helio-synchronous, at an initial altitude of approximately 500 km; radio-electric velocity: minimum 15 minutes per day, maximum 18.4 minutes per day. The Institute of Space Astronomy and Physics (IAFE) has already completed design of the on-board instruments for the satellite.

Department of Physics, Geophysics Programme, regional analysis of aerial, terrestrial and satellite magnetism. The aim of this project is to obtain experimental data on the magnetic profile of Argentina and to compare the results with the predictions made by global models and with the Satellite Chart.

Magnetotelluric evaluation of the sedimentary basins in the Antarctic The purpose of this project is to determine the thickness of the sedimentary basins in the Antarctic by using magnetotelluric soundings. The results reveal the existence of a thick sedimentary basin beneath Segmour Island and an ascendance of the crystalline base in the Larsen nunatak, within the group of the Foca nunataks.

/Regional assessment

Regional assessment of geothermal resources. The purpose of this study is to assess the geothermal resources in the central area of northwestern Argentina by geological, geophysical and magnetotelluric methods. Within this programme, the calchaquí geothermal anomaly (in the area of Belén, Catamarca province) has been investigated. Among the most significant results are: the absence of seismic activity in the area which has an Andean structural profile and whose hydrothermal activity possesses marked spatial continuity. The magnetotelluric geophysical survey reveals a thinning of the continental lithosphere which coincides with the transition area. This thickness makes it possible to conclude as to the existence of a regional geothermal gradient between 3.5 and five times the normal figure, as an energetic anomaly appears in the depressions in the area.

Atmospheric Physics Programme. Spatio-temporal description of thermo-hydrodynamic variables in stratospheric layers. Thermohydrodynamic variables were studied together with ozone concentration in the stratosphere by use of balloon and rocket-borne sounding instruments. In addition, data provided by GARP (FGGE) is used to analyse aspects related to the interaction between the troposphere and the stratosphere during periods of stratospheric warming.

Programme on Solar Physics, Transport and liberation of energy during solar flares. The aim of this survey is to increase knowledge about the sun as a star and about its relationship with the earth. At the present time there is concrete proof of the dissipation of energies in interacting magnetic structures; a relatively high percentage (above 25%) of the energy dissipated during flares is consumed by the particle acceleration process; in addition concrete evidence of the existence of high temperature nuclei (less than 10^8 K), within the magnetic structures is observed. This project is being carried out in collaboration with researchers from the Space Research Laboratory in Utrecht (Holland), the University of Maryland (United States), the Goddard Space Flight Centre (United States), the Paris Observatory and the Argentine Institute of Space Astronomy and Physics (IAFE).

Application of digital images to solar physics. The aim of this project is to obtain data upon sun spots and to record the same automatically using computer techniques; routine monitoring of sun spots has been carried out as well as calculations of Wolf's number. As far as automation is concerned computer programmes for the specific interphase have been completed.

2. Remote Sensing Centre

The Centre's installations are in the Mar Chiquita region (LANDSAT receiver antenna), 400 km from Buenos Aires; the processing centre is situated in Buenos Aires itself and the applications centre, a few kilometers from Buenos Aires, in the town of Vicente López. The Centre's technical sector consists of three divisions: research, applications and collection, processing and distribution of satellite data.

/The research

The research division includes the research department which develops algorithmic techniques for the digital analysis of images and its consequent application to the design of computer programmes.

The following equipment is available: a VAX 11/780 computer with a central memory of 1 Megabyte, seven alphanumeric terminals for interactive processing, COMTAL VISION ONE/20 and RAMTEK 9300 systems for image analysis, an Optronics COLORMATION C-4500 image digitalizer, a PDP 11-34 central processing unit, a MAGNAVOX geographical co-ordinate setter (which uses satellite images), the PIDARG system which was completely developed by specialists from CNIE, and which consists of an interactive system for image analysis which is constantly expanding; this system can operate using data from LANDSAT type satellite and from multispectrum scanners on board planes, as well as other types of data suitable for digital processing, such as photographs or X-rays.

The applications division consists of an interdisciplinary group of specialists in agronomy, geology, meteorology, physics, statistics, etc. It has worked in the following fields: estimation of harvests, forest resources, vegetables biomass, urban areas and geological surveys, etc.

3. Mendoza Space Research and Development Centre (CIDEM)

Background. Scientific research in Argentina using stratospheric balloons began in 1962.

A large numbr of local and foreign groups carried out launching. At the present time balloons of up to 20 000 000 cubic feet (562 000 m^3) are launched; also, flights lasting 10 hours or more are commonplace during the period of wind inversion.

Launchings have been carried out from the following sites:

- Paraná, 31°47'S; 60°20'W, situated in the centre of the country in Entre Ríos province.
- Río Cuarto, 33°05'S; 64°16'W, situated in the centre of the country in Córdoba province.
- Reconquista, 29°13'S; 59°43'W, situated in the northeast of the country in Santa Fe province.
- Mendoza Airfield, 32°52'S; 68°52'W, situated in the west of the country in Mendoza province near the Andean Cordillera.

The Balloon Section is situated at the Mendoza base, and possesses permanent installations enabling it to carry out the corresponding operations.

The national programme for controlling hail involves fundamental research into the study of storms, of convective clouds and the structure of hail, as well as operational field campaigns to identify hail clouds and act upon them so as to change their behaviour if necessary. This programme is carried out in co-operation with Mendoza province. The Institute of Space and Aeronautical Research belonging to the Argentine Air Force, the universities and other official and private bodies also take part.

/The programme

The programme of atmospheric data collection by satellite possesses a direct reading ground station operating with the GOES ESTE satellite. This station was set up in 1981 and came into operation in 1982 for hydrometeorological measurement programmes in the high cordillera. In 1983 an automatic meteorological station was set up in the Argentine Antarctic. A far-reaching programme for setting up automatic stations, which will depend upon various research institutes belonging to the National Council for Scientific and Technical Research (CONICET) is underway. At the present time various Argentine scientific bodies are interested in participating in this programme relating to arid regions, glaciology, study of snow and underground water.

4. National Meteorological Service

This was the first organism made responsible for the scientific aspect of the EXAMETNET (Inter-American Experimental Network of Meteorological Rockets) in Argentina. In addition, it has been working for more than a decade on information provided by meteorological satellites.

As far as directly-received information is concerned, the Meteorological Service receives daily visible radiation and infra-red as well as low-resolution satellite images from the NOAA 7.8 and METEOR 2 (08-09) satellites. Information and images from the GOES OESTE satellite is also available; in addition, a receiving station for High Resolution Picture Transmission (HRPT) satellite information and data from automatic platforms has been in experimental service. This station is also capable of producing vertical temperature and humidity profiles.

5. Institute of Space Astronomy and Physics (IAFE) depending on the National Council for Scientific and Technical Research (CONICET)

Solar astronomy and physics. This programme includes studies into Wolf-Rayet stars, Of and Be stars, the central stars of eclipsing planetory nebulae of the W-UMa type. Observations are completed by spectrograms obtained from the Inter-American Observatory in Cerro Tololo. Spectrographic and photometric observations are regularly made at the Cerro Tololo Observatory and the European Southern Observatory (ESO) in Chile, at the Bosque Alegre Station of the Córdoba Observatory and the El Leoncito Station, of the San Juan Observatory in Argentina.

Operations using stratospheric balloons have been carried out since 1979; in most cases these experiments are run jointly with the National Commission for Space Research.

Scientists from the Institute have been invited by the National Commission for Space Research to participate in defining the mission for a solar research satellite. A solar experiment to capture high energy electromagnetic radiation and fast neutrons given off by solar flares has been proposed. In addition, personnel from the Institute has also received responsibility for studying a satellite's attitude control, for which a system stabilized by rotation with magnetic control has been chosen.

/6. Argentine

6. Argentine Radioastronomy Institute (IAR)

Between 1981 and 1983 work was continued on the 21 cm hydrogen line, galactic HI and investigation of HI in Gould's Belt was pursued. Gas distribution was revealed to possess a high degree of clustering, with disturbances to density and velocity probably as a result of interaction with young star systems.

Investigation of neutral hydrogen associated with the remains of supernovas was continued. As regards high-velocity clouds, readings have been completed from -12° to -90° declination using a 2° x 2° grid.

New components of the Magellanic Current were discovered together with the existence of a direct connection between this and the gas surrounding the Magellanic Clouds.

The presence of negative high-velocity clouds in the centre and anti-centre indicates that the gas is falling towards the galaxy.

Interaction between high-velocity clouds in the anti-centre, and the galactic gas has been observed at low and intermediate velocities.

The H166 recombination line was observed throughout the galactic plane between 298° and 4° (through 360°) at 1° longitudinal intervals with four hour integration times and 16 km filters.

7. National Radiopropagation Programme (PRONARP)

PRONARP is a CONICET programme and is recognized as a national programme by the Ministry of Science and Technology. It involves the following research units:

- Army Ionospheric Laboratory (LIARA)
- Ionospheric Station belonging to the Institute of Electrical Engineering of Tucumán National University (EITUC)
- Ionosphere Laboratory belonging to the Physics Institute of the National University of Tucumán (LIIF)
- Upper Atmosphere Unit of the Argentine Antarctic Institute (GAIA)
- Argentine Centre for Radiocommunications Studies and Electromagnetic Compatibility (CAERCEM)
- San Juan Centre for Regional Studies (CIRSA)
- Radiopropagation Unit of the Electrical Engineering Department of La Plata National University (GRULP).

Regular vertical ionospheric soundings have been carried out from Tucumán, San Juan, Buenos Aires and Ushuaia. Measurements of ionospheric absorption using rheometers were carried out at the General Belgrano Argentine Antarctic base. The amplitude and phase of extremely low frequence signals were recorded in Tucumán.

/Research was

Research was continued in the following fields:

- Ionospheric effects of geomagnetic storms, using data from vertical probes of signals from beacon satellites and ionic composition measured by satellites.
- F-region dynamics.
- Gravity waves in different levels of the ionosphere, using data from ionospheric soundings and ionic density data measured by satellites.
- Structure and monitoring of the D region.
- Satellite radiometry.

B. Brazil

1. Background

The Brazilian Space Research Institute, Instituto de Pesquisas Espaciais (INPE) is the main civilian organization devoted to space activity in this country.

The INPE was set up in 1971 and replaced the National Committee for Space Activities which had been in existence since 1961 (CNAE). The Institute is affiliated to the National Council for Scientific and Technological Development (CNPq).

Policy for these activities is decided by the Brazilian Commission for Space Activities (COBAE).

INPE headquarters are situated at São José dos Campos, and it has further installations in Cachoeira Paulista, Cuiabá, Natal, Fortaleza, Atibaia and São Paulo; the principal research activity is carried out at São José dos Campos, Atibaia and São Paulo.

2. Space and atmospheric sciences

At the present time INPE runs two national centres, the Radio-Astronomy Centre (at Atibaia) and the Centre for Balloon Launchings (Cachoeira Paulista 22°70'S; 45°00'W), both of which are also used by foreign scientists.

Payloads are launched by Brazilian or foreign rocket probes from the Barreira do Inferno Launching Centre, which is run by the Brazilian Air Force, in Natal.

3. Astrophysics

The programme which INPE is pursuing in this field is aimed at carrying out experiments with X-rays, low-energy gamma rays and observations of ultraviolet and infra-red radiations; the principal projects are:

/- GELI,

- GELI, designed to detect cosmic gamma rays within the 0.05-8 MeV emission lines using $\lesssim 10^{-4}$ photon/cm^2 -s high-resolution telescopes.
- SOURCE, which consist of a new type of gamma-ray telescope. The angular field of vision of the telescope is 30° FWHM at 1 MeV and its point sensitivity is 2.4×10^{-3} photon/cm^2 -s at 0.662 MeV.
- FUVE, devoted to studying average galactic and extra-galactic 2 000 Angstrom to 3 000 Angstrom ultra-violet light.

4. Solar radioastronomy and physics

The existing centre is situated in the Itapetininga Radioastronomy Observatory at Atibaia, which includes a 45 foot diameter antenna and radiometers in the region of one millimeter.

Construction of a new millimetric antenna with a coherent radiometer for use at 300 GHz has been planned for the 1982/1985 period.

Most activities in this field are carried out in collaboration with the Haystack Observatory in the United States.

Within the field of solar physics, activities are principally concentrated upon study of solar plasma in active regions. The Observatory is participating in the Solar Maximum Mission.

5. Nuclear geophysics

INPE plans and carries out research in this field, including investigation into the spectrum and distribution in space of nuclear radiation: cosmic radiation, primitive radio elements (potassium 40, thorium, uranium) and artificial radio elements.

The main lines of investigation in this field are:

- Investigation of natural gamma radiation over Brazil in different regions and different altitudes: radiogeological and geochemical studies together with projects related to measurements in the area of gamma spectrometry. Influence of vegetation on the gamma spectrum at different altitudes (above 100 m).

- Investigation of radon and its variations in the lower atmosphere (natural, in rock and soil form, meteorological conditions) conditions in the natural balance, anthropogenic conditions (urban centres, mining activities, etc.).

- Expansion of nuclear geophysical research in the planetology and cosmochemical fields, cosmophysics including measurement in meteorites and sediments of cosmonuclei.

/- The Geophysics

- The Geophysics Laboratory possesses the full range of equipment necessary to carry out research in the nuclear geophysics field (radon meter, alpha and gamma spectrometers).

6. Geomagnetism

The following experiments are underway:

- Continuous recording of the D, H and Z geomagnetic components at Eusebio 38°7'S; 38°43'W and in Cachoeira Paulista 22°7'S, 45°00'W, using flux magnetometers.

- Measurement of the electrical field and Bremsstrahlung X-rays produced by atmospheric precipitation from the South Atlantic Magnetic Anomaly, using balloons launched between November-December each year.

- Micropunsations in the geomagnetic field are measured at Cachoeira Paulista.

- Magnetotelluric measurements in a range stretching from 200 seconds to 24 hours are recorded at Eusebio and Cachoeira Paulista.

7. Ionosphere

INPE's interest in this field is centered upon research into the equatorial dynamics of the ionosphere, its effects upon communications, as well as propagation and ionospheric forecasts.

Two ionospheric sounders are used in Cachoeira Paulista and in Fortaleza to obtain E sporadic, F scattered ionospheric parameters, equatorial irregularities, ionospheric bubbles, TIDs, etc.

Two VHF Faraday rotation polarimeters in Cachoeira Paulista and São José dos Campos are used to study equatorial and tropical dynamics of the ionospheric region in the F region.

The most significant results are: calculation of the velocities of plasma bubbles in the equatorial ionosphere, analysis of data from the sporadic E layer and of the phase of VLF signals.

8. Upper atmosphere

Activities centered upon the areas of atmospheric composition, dynamics and photochemistry, the mesosphere and low thermosphere including experimental research into stratospheric aerosol, the distribution of sodium in the mesosphere, emissions of atomic oxygen. The results are analysed in terms of atmospheric photochemistry and dynamics. A laser radar belonging to INPE is used in these investigations to obtain information relating to the distribution of aerosol and sodium particles.

/9. Plasma

9. Plasma physics

INPE at present possesses a double plasma machine to study the propagation of low density homogeneous and non-homogeneous longitudinal waves and low temperature plasma.

A linear magnetic plasma producer is used in studying the propagation of transversal waves and the evolution of instability in medium density and low temperature plasma.

10. Satellite technology

- Structure of space vehicle and thermo control.
- Solar energy production, conditions and distribution.
- Data handling on board space vehicles.
- Telecommunications.
- Attitude and trajectory control.
- Functions and payload of space vehicles.
- Space vehicle assembly and testing.
- Data handling and range finding, remote control and control.

11. Systems engineering

Research in the field of systems engineering includes the development of methodology for economic analysis of space projects, in particular cost-benefit analysis of space projects, economic analysis of the Brazilian satellite programme and economic analysis of technology transfer resulting from space activities.

12. Data processing and computer sciences

This programme develops the computer programmes necessary for the execution of INPE's technological research activities. The following lines of research are pursued:

- Image processing and configuration reconnaissance with applications to remote sensing and sets of images from meteorological satellites.

- Artificial intelligence and programming languages, together with the development of language translators and studies of the man-machine interphase applied to space activities.

- Development of applications programmes for special requirements of INPE, stressing the engineering techniques in computer programmes, reliability, portability and maintenance possibilities.

/The research

The research team will improve efficiency in the following areas:

- image processing
- image classification
- heuristic research methods
- compilors
- interpreters and translators
- real-time language
- data compression
- computer graphics
- data bases
- programme testing of engineering instruments in computer programmes
- debugging and documentation
- project control and planning using computers
- mission control programmes
- data management for replacement systems
- remote sensing and meteorological programmes

13. Materials science and technology

Present research includes monocrystalline silicate cells with ternary semiconductors for detecting infra-red $Pb_{1-x}Sn_xTe$ and theoretical and experimental research into the physics of MOS devices, the physics of doped semiconductors. For example, Si:P and non-orderly materials.

14. Sensor systems

The principal aim is the development of sensor elements and complete sensor systems. Initial emphasis was placed on infra-red, but other regions of the spectrum are being considered, in accordance with requirements, in particular those of the Brazilian Full Spatial Mission (MECB).

Existing infra-red detectors will be modified by the inclusion of a pre-amplifier stage integrated within the SIC substratum itself. Criogenic quantum detectors with ternary alloys developed in INPE will also be built.

A high resolution multispectral camera intended for remote sensing satellites, which uses single access electronic sweep with CCD detectors will be developed by MECB. Preliminary tests will be carried out in stratospheric balloons. The sensor systems which have already been built will be improved by the inclusion of a system for measuring UV fluorescence using a nitrogen laser to detect petroleum on the ocean surface.

15. Combustion

This field covers fundamental and technological research into combustion and micropropulsion processes.

/Small motors

Small motors powered by cold gas and hydrazine decomposition are being developed to control the altitude of artificial satellites and of payloads of stratospheric balloons.

Research is being carried out into biomass combustion and alternative fuels.

Biopropellents and pulse-stream micromotors are also being developed and will be used for controlling the altitude of satellites in orbit.

16. Space geodesy

Geodetic co-ordinates are calculated in part, and used jointly with images retrieved from LANDSAT in mapping, for which the Doppler tracking station belonging to INPE is used.

Data obtained from the Doppler station will be used in calculating the orbits of artificial satellites and in perfecting models of satellite movements.

In order to produce a forecast and exact calculation of orbits it is necessary to possess complete knowledge of the geopotential state of that part of space which lies above Brazil.

17. Analog and digital systems

This programme is devoted to the development of analog and digital processing systems and includes two data networks, one for backing up space missions and the other for data collection and distribution.

The following equipment and computer programmes are being prepared for data processing: systems for handling data on board space vehicles and aircraft, programmable data collection platforms, image processing systems and an incremental computer.

A new computer, the ASTRO B/2, is being developed for use in missions on board stratospheric balloons and aircraft carrying out remote sensing.

Computers belonging to other ASTRO S series and various peripheral equipment is being designed and programmed on land for reception functions in range finding and remote data transmission, within the configuration of the nodes of the projected data network.

Microcomputers microprogrammed with 16 bits word length are being developed for the collection, processing and transmission of images and similar data.

The ASTRO L array type incremental computer, will be capable of carrying out parallel multiprocessing with up to 63 processing units (in addition to control and supervisory units). The ASTRO computers will be designed, developed and programmed by INPE.

/Various types

Various types of equipment have already been constructed for use as prototypes in data collection applications in INPE laboratories. These include programmable and non-programmable teletype terminals, the multiple tape and cassette digital memory controller (including tape transport), programmable units for data collection platforms (DCPs) for use with geostationary satellites.

18. Satellite telecommunications

With a view to the development of geostationary telecommunications satellite technology in the future, INPE is carrying out preliminary studies into systems with an emphasis on the onboard telecommunications subsystems (antennae, filters, transponders, etc.).

As far as the earth-based segment of satellite telecommunications is concerned a programme to develop small earth communications stations (voice, data, telegraph) is underway. The first prototype for communications between 6 and 4 GHz was completed in 1982.

Work is also being carried out into the propagation of radio waves within the 10 GHz frequency in space. Propagation of these frequencies is of great importance as it is fundamental in equatorial regions and tropical climates; to this end land measurements, in some cases, using radio telescopes are being carried out.

19. Remote sensing and communications satellites

The Brazilian Government has authorized studies towards a complete space mission.

INPE will design, develop, construct, assemble, test and operate in orbit the country's applications satellites.

The launchers will be developed by the Institute for Space Activities (IAE) which depends on the Air Ministry, and which has also been made responsible for the construction of the new launching site in Alcántara in the State of Maranhao (close to Ecuador). Brazilian industry will make a major contribution to the construction of the vehicle. It is planned to carry out tests on the vehicle in October 1984 at the Barreira do Inferno base.

Four satellites are programmed, each of which has a minimum life span of two years; they will orbit at an altitude of between 600 and 700 km and weigh approximately 150 to 250 kg.

The first two satellites will be employed to transmit atmospheric, meteorological, climatic and hydrological and other data collected from a network of automatic platforms set up throughout the country, to a central station. INPE has already developed a prototype platform.

/The other

The other two satellites will carry a high resolution (40 meters) multispectral camera on board which will take repeated shots of the earth's surface, operating on four channels. This will ensure that the Brazilian remote sensing programme has a certain degree of status and independence.

The last two satellites are more complex than the former, as they possess an extremely modern sensor and optical system together with a more perfected orbit control system.

A high proportion of the equipment used in the range finding, remote control and monitoring stations as well as the data processing stations has been developed in Brazil.

The third stage of the Brazilian space programme (Brazilian Complete Space Mission), involves the complete development of a satellite in Brazil.

Communications satellites fall within another area of applications. It is highly probable that a national communications satellite for Brazil will be put into orbit in 1986. It is considered that at the present rate of development Brazil will be able to take an active part in the next generation of communications satellites by the middle of the next decade.

C. Cuba

1. Background

Space research started in Cuba in 1964 when for the first time systematic visual monitoring of artificial satellites was carried out. Activity has increased since then, and with the collaboration of the academies of science and other scientific institutions in the Soviet Union and the other socialist countries modern equipment and installations have been set up.

In April 1967, with the setting up of the Intercosmos Programme, a significant means of participating in space research with other socialist countries came into being.

The Cuban Intercosmos Commission, which was initially under the responsibility of the Ministry of Communications, was transferred to the Cuban Academy of Sciences in 1974.

2. Space physics and technology

Satellite communications have been considerably developed in this country. Prior to 1974, the Ministry of Communications was wholly responsible for them. Cuba belongs to the Intersputnik space communications system.

/The Caribbean

The Caribbean earth station was built in Cuba with Soviet assistance. From the beginning this station worked in conjunction with the Molnia 2 and 3 elliptical orbit satellites, before starting operations with the Horizont Geostationary Satellite over the Atlantic.

A Standard B station was also set up in 1979 so as to utilize the services of the Intelsat system. This station is of medium capacity.

Research is being carried out at the present time to determine the influence of tropical climatic conditions upon the frequency bands used at present for the permanent communications service. This research is carried out at the Institute of Geophysics and Astronomy of the Cuban Academy of Sciences.

In 1980 experiments were carried out on board, the Saliut Six Space Laboratory to establish the degree of influence of the communications channel and conditions in space on board the vessel, as well as the quality of images reconstituted using holograms transmitted along a television channel.

Within the field of space physics, the principal subjects of research by the Institute of Geophysics and Astronomy of the Cuban Academy of Sciences are related to solar astronomy, geomagnetism, the ionosphere and radiopropagation.

Since 1970 research has been carried out in Cuba during the different solar and lunar eclipses visible there. Research into sun spots during different periods and years has been carried out, together with an analysis of their evolution and the relationship between photospheric fields and the production of flashes.

In recent years research has been pursued into geomagnetic phenomena; data from Cuban and other international observatories has been used in this field, and completed by data from geostationary satellites.

The fundamental aims of research in this field concern study of behaviour between the phenomena and the ionosphere so as to be able to forecast its average state.

Work has begun within the Space Physics Working Party of the Intercosmos Programme run by the Institute of Geophysics and Astronomy using installations capable of receiving coherent signals broadcast by radio beacons from artificial satellites; this is completed by data from the Explorer 22, Intercosmos 1 and Intercosmos 3 satellites.

A satellite tracking station operated by the Institute of Geophysics and Astronomy and situated near Santiago de Cuba has been operating since 1967. This station includes a laser radar, used in conjunction with satellites to carry out high precision geodetic calculations.

/The modernization

The modernization of the radio range-finding station which was carried out in 1979 made it possible to pick up signals from the Intercosmos 19 satellite (Ionospheric sounder). The IS-338 ionospheric station installed on board the satellite provided ionograms from the vertical sounder above the F region maximum. At present analog measurement signals of plasma around the satellite are received; similarly, Faraday rotation is being explored by means of signals broadcast from a radio beacon installed on the satellite.

The Space Physics Group began studies of the growth of crystals in zero gravity conditions. This research has two principal aims: first of all, study of the mechanisms of nucleus formation and growth of crystals of different insulating, semi-conductor and metallic materials, and secondly, investigation of the technological possibility of obtaining mono-crystals with a high degree of perfection.

A number of these experiments were carried out on board the Saliut 6 space ship during the joint Soviet-Cuban space flight.

3. Meteorology and remote sensing

The Institute of Meteorology of the Cuban Academy of Sciences receives meteorological information from satellites every day. Its installations allow systematic monitoring which is of great importance in following hurricanes or cold fronts.

In 1977 the Remote Sensing Department was set up within the Institute for Fundamental Tcchnical Research of the Cuban Academy of Science. The task of this Institute was to develop in the country all methods for remote sensing of the earth's resources using aereospace means.

Research teams are working in a variety of fields: geology, geography, agriculture, forestry, hydrology, environmental protection, etc.

In 1977, together with other national institutions and in conjunction with the Academy of Sciences of the Soviet Union, the Cuban Academy of Sciences carried out the first multispectral aerial survey of the country, known as the Trópico I programme.

In May 1979 the Trópico II programme was carried out. In addition, the Trópico III experiment was carried out during the joint Soviet-Cuban space flight.

A number of Cuban scientific institutions take part in remote sensing activities: the Cuban Institute of Geodesy and Cartography, the Institutes of Hydrology, Geology and Paleontology, Botany, Sugar Cane and Meteorology.

4. Space biology and medicine

Towards the end of 1978 Cuban specialists began to participate in the first biomedical research activities within the Intercosmos Programme, in preparation for the first joint Soviet-Cuban space flight.

/Within the

Within the field of space physiology, the Cuban specialists concerned themselves with themes linked to the influence of space flight upon the body and developed prophylactic and protective measures.

At the present time investigation is underway into cellular biology, the division and multiplication of yeast in a state of zero gravity, the higher nervous activity of man, which among other things includes research into the electrical activity of the astronaut's brain. Cardiac activity, the hydromineral balance, the concentration of hormones in the blood, etc., are also the subject of investigation.

Within the field of space psychology, the specialists are pursuing investigation into the psychological safety of crews during flights, the co-ordination of voluntary movements and perception, as well as the psychological adjustment of the astronaut to the conditions and rythm of work and rest in orbital space stations.

5. Research in materials science

A series of experiments have been carried out in this field: study of welding on the Soyuz 6 space ship (1969), study of the processes of crystallization of different materials in Skylab and the Soyuz-Apollo complex, experiments on board Saliut 5, etc.

Work has begun in Cuba on technological experiments in the conditions of outer space and for the execution of a whole series of space experiments in this field. All the member countries of Intercosmos have provided their scientific collaboration.

Research into semi-conductors is carried out in the Solid State Research Laboratory (LIES) of the University of Havana. The work underway includes the obtention and study of optical electronic devices, such as electroluminescent diodes which operate in the visible regions and in high yield solar cells, based on the $Al_xGa_{1-x}As$-GaAs system.

During the joint Soviet-Cuban flight in Saliut 6, research was carried out into the feasibility of obtaining mono-crystals from the melt and liquid epitaxy with forced cooling. The Crystal and Splav ovens which were sent on board in the space vehicle were used in these experiments.

The first experiment involved cultivation of mono-crystals of germanium from a melt heavily doped with indium, with the aim of studying the distribution of indium in the mono-crystal which was obtained in a state of zero gravity. In this way it is possible to study the coefficient of distribution of indium in germanium in conditions close to thermodynamic equilibrium and to investigate the properties of the inter-phase and the high concentrations of indium in the structure of the mono-crystalline matrix.

/The second

The second experiment involved the obtention of epitaxial layers of GaAs-AlGaAs, doped with zinc in the Splav oven on the Saliut 6 station, using forced cooling. It is known that this distribution is a result of the processes of diffusion and convection during the decomposition of the material from the hypersaturated Ga with GaAs and Al solution in the process of liquid epitaxis. It is nevertheless important to observe the distribution of aluminium and the variation in the refractive index in conditions of zero gravity.

A considerable amount of research into the growth of crystals from impure saccharose solutions has been carried out by the Institute for Sugar Research (ICINAZ).

The Sugar experiment, put forward by Cuba as an experiment for the Cuban astronaut to carry out, involves kinetic study of the growth of mono-crystals of sacchrose in conditions of zero gravity, together with study of the growth of mono-crystals of organic substances from liquid solutions.

D. Mexico

1. Background

Although at present this country possesses no national space organization, it will probably be among the first Latin American countries, together with Brazil, to possess a national satellite communications system.

The Ministry of Communications and Transport, and in particular the Telecommunications Administration is responsible for the Mexican Satellite System project.

The principal technical features of the Mexican satellites are:

Number of satellites:	Two in operation
Manufacturer:	Hughes Communications International (HCI)
Frequency bands:	C and K
Antennae:	Dish reflector with plane adjustment for the K Band
Design life:	10 years
Mission life:	9 years
Launching system:	Space shuttle (STE/MAC-D)
Launch date:	April and September 1985

STE/MAC-D System of Space Transport with Delta type payload assistance module.

/- C - Band

	- C - Band		
	Channels		
	Narrow	Broad	X Band
Number of channels	12	6	4
Band width (MHz)	36	72	108
Redundancy	2(7x6)	2(4x3)	6x4
Output amplifier rating	7	10.5	19.4
Radiated isotropic equivalent power (DBw)	36	39	44
Frequency bands (GHz)			
Transmission (declining link)		3.70-4.20	11.70-12.20
Reception (rising link)		5.925-6.425	14.00-14.50
G/T ratio (Db/°K)			
Minimum at the edge of coverage		-2.0	+1.0

2. Antenna system (transmission/reception)

a) Diameter — Less than five meters

b) Manoeuvrability — Although the antenna will operate in a fixed position, it should not prove difficult to aim it at any satellite on the equatorial plane between 53° and 150° longitude West without any modification to the base or structure of the antenna

c) Frequency
Reception — 3 700-4 200 MHz
Transmission — 5 925-6 425 MHz

d) Polarization — Circular and linear

e) Gain — 42.5 dB to 4 GHz
46.0 dB to 6 GHz

f) G/T — 21.0 dBw/K or better than 4 GHz with a 20° elevation under clear skies and in conjunction with a low noise receptor whose noise temperature is lower than 90° K.

g) Mounting — EZ/AL

/3. Low

3.	Low noise amplifier (LNA)	
a)	Frequency	3.7 to 4.2 GHz
b)	Noise temperature	Lower than 90° K, at the input socket, at an atmospheric temperature of 25° C
c)	Gain	Minimum 50 dB
d)	Gain stability	Changes in gain must remain within ± 1 dB for up to a week
e)	Dynamic range	Above -50 dBm
4.	Video receivers	
a)	Frequency	Any frequency at 250 KHz depth within 3.7 to 4.2 GHz, without any need for critical adjustments
b)	Noise figure	17 dB or better
c)	C/N threshold	8 dB or better
d)	Video accentuation	In accordance Rec. 405-1 of the CCIR
e)	Polarity	Black and white
f)	Audio FM carrier	6.2 MHz central frequency
g)	Audio emphasis	Constant at 75 microseconds
h)	Video parameters:	
	- Range	+1 dB between 25 Hz and 4.2 NHz
	- Impedance	75 ohms disbalanced with return higher than 20 dB
	- Level	0 dB volts p.p.
i)	Audio parameters:	
	- Response	± 1 dB between 40 Hz and 10 MHz
	- Impedance	600 ohms balanced
	- Level	0 dBm
j)	Non-linear distortions:	
	- Differential gain	10%
	- Differential phase	± 5%
k)	Linear distortion:	
	- Short time	3%
	- Line time	± 2%

/E. Peru

E. Peru

1. Infrastructure

The Huancayo Observatory was the first observatory belonging to the Peruvian Geophysics Institute and is one of the oldest observatories in the world devoted to observation of the ionosphere and of geomagnetic effects.

In the field of space activities the instruments of interest are: a C-4 type ionospheric probe; optical instruments for monitoring nocturnal luminiscence; geomagnetometers; high altitude solar observatory COSMOS); satellite receiver system for studying scintillations and the ionospheric irregularities which produce them; cosmic radiation monitors; infra-sound detectors; seismic instruments and a synoptic meteorologic observatory.

The Jicamarca Radio Observatory was constructed with the collaboration of the Peruvian Geophysics Institute by the National Bureau of Standards between 1960 and 1961.

The observatory essentially consists of a gigantic radar operating in the 50 MHz frequency, with a maximum output of 6 million watts and 90 000 square metre antenna (the largest in the world). Data relating to the different parameters of the upper atmosphere are obtained by analysis of the spectral characteristics of the signals picked up by the radar.

The Ancón Observatory was initially one of the stations which made up the range finding and tracking stations network set up by the NASA to backup its artificial satellite programme.

When NASA decided to suspend its backing to the station the equipment was transferred to the Peruvian Geophysics Institute. The equipment is principally used for tracking and range finding, and consists of a complete interferometer system using the 136 MHz frequency (minitrack) and several range finding channels in the 240 MHz and 1 500 MHz frequencies with their respective modulation and tape recording systems.

The Punta Lobos base which is the principal installation under the responsibility of the National Commission for Aerospace Research and Development (CONIDA), is situated some 60 km south of Lima and was initially under the responsibility of the Peruvian Geophysics Institute. This base possesses installations for assembling vehicles and payloads launching towers and a meteorological tower and is now capable of carrying out rocket launches independently.

The National Office for the Assessment of Natural Resources (ONERN), mainly consists of an analog analysis laboratory and a digital classification laboratory for analysing data from natural resources satellites, in addition to a colour photography laboratory.

/The Characato

The Characato Observatory, which operates under a convention between the Peruvian Geophysics Institute, the National University of San Agustín and NASA is a satellite tracking station. The observatory belongs to the worldwide network set up by the Smithonian Institute and NASA to monitor satellites.

The observatory is designed to make precise calculations of the positions of satellites. When the orbit has been calculated it is possible to obtain information relating to the earth's gravitational field, the prime purpose of the network, which in turn makes it possible to produce precise forecasts of the behaviour of satellites and rockets.

2. National Commission for Aerospace Research Development (CONIDA)

CONIDA is the organism responsible for aerospace affairs in Peru. It belongs to the National System for Scientific and Technological Research and was set up on 11 June 1974 with the following aims and tasks:

a) Sponsoring and developing peaceful research and activities towards ensuring the country's progress in the field of outer space.

b) Monitoring theoretical and practical space studies, research and activities carried out by individuals or legal entities within the country and abroad and making proposals for such activities to be carried out in conjunction with national or foreign state organizations.

c) Entering into collaboration conventions with national or foreign private institutions of a similar nature, in accordance with the law, and proposing the making of agreements with foreign or national public organizations as well as with national and international organizations and administrative units.

d) Encouraging the exchange of technology and promoting the training of specialists.

e) Putting forward the relevant national legislation applicable to outer space.

f) Carrying out or sponsoring the practical and theoretical studies and activities requested of it by the Ministry of Aeronautics and taking part in studies and the development of other allied activities as well as those of a socio-economic nature, so as to ensure the nation's well-being and security.

g) To examine and provide information on the various consultations relating to space and allied activities which are made by national and foreign State and private bodies.

/3. National

3. National Office for the Evaluation of Natural Resources (ONERN)

This is the national organization which is responsible for making inventories and integrated assessment of the country's natural resources. It was set up in April 1962 and at present is a decentralized public body depending on the National Institute for Planning. Its aims are:

a) to carry out integrated investigations of the country's natural resources so as to ensure economic and social development;

b) to collaborate with the National Institute for Planning in deciding policy relating to the use and conservation of such resources; and

c) to study, at the national level the interdependence between man and the natural environment, putting forward alternatives for action which will provide for the conservation of the latter.

ONERN is training its personnel in the use of remote sensing techniques by means of a convention with the Canadian Government, and another in which CONIDA and IGP participate, with the Environmental Research Institute of Michigan (ERIM).

4. Peruvian Geophysics Institute (IGP)

The Peruvian Geophysics Institute is a decentralized public body within the education sector, possessing legal status under domestic public law, with administrative and economic economy. It is responsible for drawing up, proposing and carrying out scientific and technological development policy in the geophysics field.

Its functions are; a) to develop national scientific and technical capacity in the geophysics field; b) to investigate all geophysical phenomena of interest to the country and knowledge of which is of importance in the State's scientific and technical policy; c) to promote scientific and technical research in its special field and to provide the necessary expert advice to national organizations requiring it.

5. National Aerophotography Service (SAN)

The service was set up in April 1942 and authorized to carry out aerophotogrammetric and aerogeophysical activities upon the national territory making an active contribution to the country's development, providing the aerophotographic and cartographic information necessary for specific studies and projects.

/6. Military

6. Military Geographical Institute (IGM)

This is a technical unit of the army, whose role is: a) to draw up the map of the national territory using different scales; b) to provide cartographic backing to the country's development plans, and c) to provide cartographic information.

7. National Meteorological and Hydrological Service (SENAMHI)

This is a decentralized public institution, responsible for planning, organizing, co-ordinating, centralizing, directing and carrying out the general policy of the State in the meteorological and hydrological fields.

8. Applications of space science and technology

Satellite communications are provided in Peru through its earth station in Lurín, as it is a member of INTELSAT.

Activities relating to the reception and processing of images and data from meteorological satellites started in 1968 at the IGP and are still carried out at the present time. Data has been received from the NIMBUS C, ESSA 3, TIROS 1 and TIROS-N satellites.

The IGP and the Navy's Hydrographic and Navigation service receive images from meteorological satellites on a daily basis and also possess processing capacity.

In the field of ionospheric physics, the existence of the equatorial electrojet was revealed by magnetic measurements carried out at the Huancayo Observatory, as was the "Forbush effect", which involves a reduction of the cosmic radiation flow prior to a magnetic storm.

The following scientific research has been carried out at the Jicamarca Radio Observatory:

a) Ionospheric irregularities within the E layer in the equatorial region and phenomena associated with the equatorial electrojet.

b) Ionospheric irregularities within the F layer in the equatorial region which provide an explanation for the dispersed F phenomenon.

c) Structure and dynamics of the equatorial F region and the protonosphere.

d) Dynamic of the neutral atmosphere at stratospheric, mesospheric and thermospheric altitudes using radar.

e) Radio communications using ionospheric dispersion or reflection.

/f) Development

f) Development of scientific rocketry in the country.

g) Ionospheric irregularities using the techniques of scintillation of signals broadcast by satellites.

The following studies and activities have been carried out at the Ancón Observatory:

a) Ionospheric irregularities and their effect.

b) Development of a satellite navigation system.

c) Design and construction of a measuring and receiving system for geodesic location using navigational and geodesic satellites (Geo-sat project).

d) Design and construction of low cost earth stations for a tele-education project using the ATS-1 and ATS-F satellites.

The first scientific rocket was launched from the Punta Lobos base in March 1974. The project was known as EQUION I, and CONIDA, IGP, SAN and NASA participated in this. Its aim was to study equatorial ionospheric phenomena known as the dispersed F phenomena.

A larger scale experiment was carried out in 1975 involving the launching of more than 30 rockets and balloons to study the atmosphere at an altitude between 10 and 160 km. CONIDA, IGP and SAN took part in this project.

The CASTOR-PERU project took place in March 1979 as a result of the agreement between CONIDA and the Argentine CNIE. Two Argentine manufactured CASTOR rockets were launched from the Punta Lobos base to study the F dispersed ionospheric phenomenon by injecting a cloud of barium vapor at an altitude of 290 km. The payloads used in this experiment were prepared at the Max-Planck Institute in the Federal German Republic.

9. Satellite navigation and geodesy

For the moment such technology is mainly used for maritime and aerial navigation in Peru. The IGM and the Hydrographic and Navigation Unit of the Navy use it for geographic siting in mapping.

The Characato Observatory in Arequipa possesses the necessary installations to work with Laser rays; nevertheless, little activity is carried out in the country in the field of inertial systems in view of its costs.

/10. International

10. International co-operation

Advisory capacity to the IGP (1973-1977). Aim: training of institute personnel in electronics in co-operation with France; the foreign contribution represented US$ 124 250.

EQUION (1974). Aim: detailed study of the phenomena known as dispersed-F. Sources of co-operation: CONIDA, Joint Armed Forces Command, IGP, NASA, University of Texas, the Aerospace Corporation, SAMSO, National Science Foundation, Bristol Aerospace Limited.

ANTARQUI (1975). Aim: detailed studies of the dynamic structure of the atmosphere between 10 and 160 km, in the vecinity of the geomagnetic equator, in co-operation with IGP, CONIDA, NASA, Goddar Space Flight Center, Dudley Observatory, Geophysical Corporation of America, University of Pittsburgh, University of Illinois, State University of Pennsylvania and the University of Denver.

IGP-Stanford Research Institute (SRI) project (1975-1980). Aim: technology transfer, development of infrastructure for receiving and processing satellite microwave signals, collection of data relating to ionospheric behaviour, in co-operation with SRI; external contribution US$ 500 000.

Utilization of remote sensing systems in assessing natural resources in pilot areas in Peru (PERCEP I) (1977-1981). Aim: establishment of a remote sensing programme to assess natural resources. Carried out by: ONERN, IGP, CONIDA, in co-operation with Canada (CIDA/CCRS), the external contribution represents US$ 634 000.

Project to study the environment and development (1978-1979). Aim: support for technical training in the environmental and development field. Carried out by: ONERN, in co-operation with OAS; external contribution US$ 59 700.

Project related to the use of remote sensing techniques in assessing the Aguaje Palm in the Peruvian Selva (1978). Aim: use of remote sensing systems to assess the Aguaje Palm in the Peruvian Selva and for professional training. Carried out by: ONERN, in co-operation with USAID; external contribution US$ 20 000.

IBM project (1979). Aim: studies to determine land use in the Mantaro river valley between Jauja and Huancayo by means of automatic classification employing digitalized data from LANDSAT. Carried out by: ONERN, in co-operation with the IBM Scientific Center in Mexico.

6687-II project. Aim: study of the dynamic properties of the stratosphere in relation to geographic latitude. Carried out: CONIDA, in co-operation with IGP, SENAMHI, CORPAC, FAP, AFGL, Germantown Laboratories, Georgia Institute of Technology.

/IGP-NASA

IGP-NASA project (underway since 1958). Aim: technology transfer, development of the Ancón Observatory designed for satellite range finding, development of the Characato Observatory, ionospheric studies, contribution to the development of the Punta Lobos launching site. Carried out by: IGP in co-operation with NASA; external contribution of approximately US$ 5 million.

Solar physics advisory project (since 1965). Aim: advice on the operation of the astrophysics equipment in the Huancayo Observatory. Carried out by: IGP, in co-operation with Japan; external contribution US$ 500 000.

IGP-AFGL project (since 1966). Aim: technology tranfer, development of the range finder receiving system in the Huancayo and Characato Observatories which is designed for ionospheric studies. Carried out by: IGP, in co-operation with AFGL; external contribution of approximately US$ 800 000.

USAID project (since 1980). Aim: utilization of information from several sensors in assessing natural resources, in co-operation with USAID; external contribution US$ 1 million.

PECCEP II project (present). Aim: improvement of the existing remote sensing laboratory and the satellite tracking station in Ancón. Carried out by: ONERN, IGP, CONIDA, in co-operation with the Canadian Agency for International Co-operation and Development.

F. Uruguay

1. National Space Policy

National Space Policy was defined by decree 325/974 (Standards in Aerospace Policy) in April 1974. The standards lay down the bases for the formulation of concrete decisions applicable in the aeronautical and space fields with two fundamental aims: safety and development.

2. International Space Law

Uruguay has ratified or adhered to all the legal instruments which make up the "Corpus Iuris Spatialis". Law No. 13 854 of 4 June 1970, ratified the Treaty on Principles Governing the Activities of States in Exploration and Use of Outer Space, including the Moon and other celestial bodies; Law No. 13 685 of 17 September 1968 ratified the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; Law No. 14 545 of 22 July 1976 ratified the Convention on International Liability for Damage Caused by Space Objects, and Law No. 14 675 of 1 July 1977, ratified the Convention on the Registration of Objects Launched into Outer Space. Finally, on 1 June 1981 Uruguay signed the Agreement which is to regulate the activities of States on the Moon and other celestial bodies, signed at the United Nations in December 1979.

/3. Communications

3. Communications

Uruguay belongs to the World Satellite Telecommunications System. In December 1970 the first direct link with the United States was set up by INTELSAT III. All activities in this field are carried out by the National Telecommunications Administration (ANTEL).

In December 1980 ANTEL inaugurated the Standard "B" Earth Station, equipped with 60 SCPC channels. This station establishes connections by telephone and telex channels with Germany, Canada, Spain, the United States, France, Italy, the United Kingdom, Switzerland and Venezuela.

There is also another project relating to the Standard "A" Earth Station, which will in principle possess 228 circuits. Direct circuits will be set up with Australia, Brazil, Colombia, Holland and Peru.

4. Meteorology

The National Meteorology Administration was set up on 21 February 1973; meteorological information provided by the NOAA 4, ESSA 8 and ATS 3 satellites was used, the equipment having been provided by the voluntary aid programme (URU/OB/3/1/1). In 1978, information started to be received from the NOAA 6 and 7 and the GEOS E satellites.

5. Remote sensing

Data provided by remote sensors in areas which are considered to be of priority is being analysed under the mining inventory programme run by the Geological Institute of the Ministry of Industry and Energy. This programme is carried out in co-ordination with the French Bureau des Recherches Géologiques et Minières (BRGM).

The Land and Fertilizer Administration of the Ministry of Agriculture and Fisheries, has carried out through the Department for Research into Use, Management and Conservation of Soils, experiments aimed at localizing and quantifying areas under rice cultivation in the Tacuarembó river basin, with the use of different bands of LANDSAT images. Worthwhile results have been achieved.

6. Centre for Aeronautical and Space Research and Propagation

This centre was set up by governmental decree No. 607/975 of 5 August 1975; it is a scientific-technical institution dependent upon the Civil Aviation Authority.

/Among the

Among the aims of CIDA, are the carrying out and promotion of studies into problems posed by outer space; making known the results of its investigations so as to provide the inhabitants of the Republic with a real knowledge of aerospace; providing expert advice and collaborating with various public and private bodies; carrying out studies and research in the field of space in those areas which are of national interest and which are likely to be of practical use; analysing the possibilities of Uruguay's participating in international programmes and research; examining the legal problems raised by the exploration and use of outer space, the moon and other celestial bodies; carrying out research into Space Law so as to promote the constitution of adequate and updated regulations both domestically and internationally; assisting and co-operating with other national or international organizations or bodies; participating in national and international scientific events; preparing and disseminating scientific and teaching material; assuming responsibility for and carrying out the constitution of documentary archives and technical information, etc.

The centre has carried out scientific, academic, teaching, editorial and advisory activities and has sent delegations and monographs to various international forums. On the subject of space, it has contributed to the study and preparation of instructions to the national representatives before the United Nations General Assembly, UNCOPUOS, etc.

7. Extra Curricula Course on Aeronautical and Space Law

Since 1975 an Extra Curricula Course on Aeronautical and Space Law has been run annually within the Faculty of Law and Social Science of the Republic's Universidad Mayor.

8. International co-operation agreements

Since 1977 a scientific co-operation agreement with the Institute of Aeronautical and Space Law of the Faculty of Law and Social Science of the National University in Córdoba (Argentina) has been in effect. In 1979 a similar agreement was signed with the National Institute of Aeronautical and Space Law (INDAE). A co-operation agreement between CIDA and the CNIC in Argentina is also in force, as part of the Special Agreement on co-operation in the field of outer space, which complements the agreement relating to scientific and technological co-operation between the Government of Uruguay and the Argentine Government.

/Annex

Annex

REMOTE SENSING

CHILE

1. In Chile, the National Centre for Research in Natural Resources (IREN-CORFO) is the national organization responsible for maintaining up-to-date information on natural resources. In 1979 an Information Centre was created on the basis of the visual interpretation of aerial photographs on a scale of 1:50 000.

2. Some national organizations, such as the Air Force of Chile and the Department of Chemistry and Geology of the University of Concepción, are able to process tapes compatible with a computer containing data from LANDSAT. Areas in which the use of remote sensing is of major importance include geology, soil sciences, forestry, hydrogeology and marine resources.

3. There is a NASA tracking station created under an agreement entered into in 1959 and operated entirely by Chileans since 1971. In 1976 Chile initiated a programme for the application of different disciplines using some of the existing NASA installations. The Centre has about ten professionals financed through the University of Chile. It is also assisted by staff financed by NASA. The reception of NOAA, GEOS and MSS data is provided for in an agreement with NASA for an experimental phase, and data received from the Coastal Zone Colour Scanner (CZCS) is obtained under an agreement for the exchange of information on sea-truth data.

4. NASA intends to close its installations in 1985, but in all likelihood this will involve the transfer of some of the equipment (antennas, receivers, computers) to the University while the building will continue to belong to the University's space programme. If financial assistance can be obtained, the applications programme, including the programme on the dynamics of the earth's crust, will be continued. Possibly the station might be used to support the launching of the MOSS by Japan in 1986 and for similar purposes.

5. For purposes of turning HDDTs into CCTs (9 tracks), the station uses a computer which takes about 35 minutes to produce a CCT, with no geometric correction. The CCTs are at the 7-bit level (127 levels of gray).

6. The Application Centre aims at processing the images with a national computer, which can receive data from the CCTs and store some of it on a flexible disk (12 Mbytes). The system's memory accepts up to 256 x 256 pixels for three bands simultaneously. At present the system cannot apply geometric corrections, nor are facilities available for obtaining copies printed in the future. Considerable capacity also exists for receiving data from GEOS, TIROS and NIMBUS satellites, although not in operational terms.

7. In June 1983 the first national seminar was held for the purpose of transferring the existing national capacity for remote sensing to potential users. Although Chile is a mining country, the first results have been concentrated in the forestry area.

8. The Space Study Centre (CEE) of the University of Chile has been able to receive LANDSAT data by means of its own facilities since 1982. CEE carried out research within the field of image analysis, primarily with regard to the construction of a low-cost image processing system. The research includes the fields of urban development planning for the Santiago area, physical planning and forest research. Oceanographic studies are also being carried out through the use of images from new weather satellites.

9. Results so far include completion of a project in March 1983 in co-operation with CONAF (National Forestry Corporation), entitled: "Remote sensing for dynamic forest management". The area covered by this project is located between 34°30' - 35° latitude south and 70°30' - 72°15' longitude west. The project used LANDSAT images only for visual analysis. The interpretation produced 30 different classes, approximately two thirds of which are related to different forest types. Images from satellites will also be interpreted by users in CODELCO (National Copper Corporation).

10. Chile recognizes the importance of the use of remote sensing for geology and fishing. Remote sensing by satellite has a big role to play in the fishery industry; the application of remote sensing to resources in the coastal zone, for which there is adequate reception and interpretation capacity is of high priority.

11. Interest has been expressed in a training course for officials with decision-making power, which would be beneficial in drawing the attention of governmental authorities to the possibility of using data obtained by remote sensing as an instrument for planning. So far the following institutions have been using remote sensing:

GEOLOGY:	Juan Kargulorico (a private geological company) Copper Corporation (CODELCO)
METEOROLOGY:	Navy Meteorological Service Meteorological Department of Chile (Air Force) Department of Geophysics of the University of Chile
FORESTATION:	National Forestry Corporation (CONAF) Celulosa Constitución INFORSA (Cellulose Company, Concepción)
AGRICULTURE:	Internal Revenue Service Crops and Livestock Service (Ministry of Agriculture)

12. The progress made in recent years by different institutions in putting remote sensing techniques into operation has resulted in the build-up of a material and human structure which makes it possible to advance in the three levels of observation used --space, air, and land observation. Many institutions are working in different areas concurrently, e.g.:

- The Faculty of Physical Sciences and Mathematics of the University of Chile is developing many remote sensing applications and is managing an environmental data collection platform programme in co-ordination with other user bodies.

- The Aerophotogrametric Service (SAF) of the Air Force of Chile, in addition to having the capacity to obtain photographs from aircraft, has assembled a system for digital analysis of images based on EARTHVIEW equipment and a computer. It has photographic laboratories for colour and black-and-white film.

- The National Institute for Research in Natural Resources (IREN-CORFO) has created a computerized centre for information in agricultural, forestry, mining and production (railways, energy, population, etc.) resources and will be adding to it by region.

- The Navy and Air Force Meteorological Services receive information useful to other institutions involved in the development of natural resources. APT reception systems.

- The Army Geographical Institute.

- Copper Corporation (CODELCO).

13. Many projects have been carried out in Chile, the most important of which are listed below:

- Agricultural and land use. A number of bodies participated in these projects, and various studies were carried out by digital analysis in the north and central zones of Chile (250 000 km2 and 300 000 km2, respectively).

- Geology and mining. A number of studies were carried out in the Institute of Natural Resources and State Mines Service, primarily in the North of Chile.

- Cartography. The set of national maps is being prepared on different scales (ranging from 1: 1 000 000 to 1: 50 000), a project in which several agencies are participating.

- Oceanography and meteorology. Using Nimbus output, LANDSAT 4 data and data collection platforms.

- Antarctic resources and environmental conditions. An important remote sensing programme is being carried out in the Antarctic Peninsula, primarily through the use of an experimental network of automatic meteorological stations which send data to Santiago via LANDSAT or GEOS.

- Geothermal resources in the Andes. Geothermal resources were studied by correlating regional geology and geothermal and regional seismological activity.

- Snow and water resources in the Andes. This study is very important because during the dry period, from October to April, all available water is derived from the melting process so that there is need to gauge the amounts.

- Environmental pollution and urban problems. This study was carried out in the urban area of Santiago, using multiband cameras and a thermal infra-red scanner. A thermal map of a pilot zone was prepared.

- Forest resources. Many studies were carried out. The most important of these included studies conducted in the north and central zones of Chile and a "TEMFORD" (remote sensing for dynamic forest management) study covering 89 000 hectares in the San Fernando area, in which different types of forests were picked out and species of trees in artificial plantations were identified.

COLOMBIA

1. The use of conventional aereal photography is so highly developed in Colombia that the Agustín Codazzi Geographic Institute (IGAC) not only has available to it the equipment needed for reconstituting and taking air photographs but also semi-automatic instruments for producing maps based on recent advances in technology; as a result, the use of orthophotography is now being introduced in engineering studies, population studies, agricultural planning, exploration and exploitation of minerals, urban studies, agrarian reform and above all in cadastral surveying.

2. Close to 70% of the country's total land surface (1 138 914 km2) has been photographed from the air on different scales. It has not been possible to record the remaining 30% in aereal photos because of physical limitations (cloudiness) and economic constraints. In some such cases radar has been employed.

3. Of all the surveys carried out with radar (SLAR), the most important was that performed in the Amazon Basin in 1973, in which an area of 289 000 km2 was covered. This has been the most important survey owing to the fact that for the first time in this country an inter-agency and interdisciplinary project was carried out, the main objective of which was to make a preliminary evaluation of the renewable natural resources of a vast area of the country. As a result of this project, a report entitled "La Amazonia colombiana y sus recursos" was published in 1979.

4. In 1978 work was begun on the preparation of an up-to-date map of Colombian forests; for purposes of that survey SLAR was again an important element, but this time Landsat images and aereal photographs were also used.

5. In 1979/1980, INGEOMINAS, working in collaboration with the Inter-American Photo Interpretation Centre (CIAF) and IGAC, prepared the first mosaic of the country, with Landsat images on a scale of 1:1 000 000. Subsequently IGAC prepared another mosaic with similar characteristics.

6. Between 1975 and 1980, IGAC, CIAF and INGEOMINAS trained a group of Colombian photo-interpreters and, working outside the country, made the first interpretations based on digital image processing. In 1979-1980, Landsat images were processed digitally for the first time in Colombia to obtain alphameric information, an effort in which programmes formulated in the country were included.

7. In 1980 and 1981 progress was made on some digital processing studies, in which controlled classification systems were used in ecological projects in Ciénaga Grande and Sierra Nevada in the north of the country.

8. In 1979 a study was published entitled "El mapa del uso de la tierra mediante la interpretatión visual y automática de imágenes Landsat: un ejemplo colombiano". The objective of this study was to prepare a land-use map and compare the use of visual and automatic methods of interpretation in a tropical environment.

9. The great majority of studies and surveys of natural resources carried out at various levels have been based on the use of thematic maps, among which mention may be made of the following: the physical-political relief map of Colombia (1971-1980); the general forestry map; the geological map, the erosion map; the general soil and land-use map and the map of national parks and forest reserves.

10. The Institute for the Development of Natural Resources (INDERENA) is concerned with the management of the renewable natural resources which are national property and with seeing that they are distributed more equitably and used more appropriately.

11. The Inter-American Photo Interpretation Centre (CIAF) is a national agency under the Ministry of Public Works and Services. It was established in 1967 as a result of the desire of the governments of Colombia and the Netherlands to establish an institution which offered advanced training in the use and application of aereal photographs by professionals and research workers concerned with the development of natural resources in Colombia and other Latin American countries. Its primary activity is teaching and training manpower working in close collaboration with the International Institute for Aerial Survey and Earth Sciences (ITC) of the Netherlands. It is also engaged in research and advisory services.

12. Other institutions which carry out studies through the use of remote sensing or are concerned with its applications include:

- The Agustín Codazzi Geographical Institute (IGAC), a key entity in the field of cartography.

- The Agricultural Plannig Office (Ministry of Agriculture) (OPSA).

- The Bogotá Savannah Corporation (CAR).

- The National Corporation for Forestry Research and Development (CONIF), an organization under private law with some State participation. Has no experts in remote sensing.

- The Colombian Institute for Hydrology, Meteorology and Land Development (HIMAT)

- The National Federation of Coffee Planters, which profits greatly from studies made by remote sensing and carried out the most recent coffee census on the basis of aerial photographs.

- INGEOMINAS, the National University of Colombia, the National Planning Department and other entities.

13. With regard to training courses, in CIAF training has been provided for some 520 professionals from 21 Latin American countries. Mention may also be made of the seminar on radar images (1972), the Seventh International Seminar on Integrated Surveys for Development (1974), the Seminar on Remote Sensing and Photo Interpretation for the teaching staff of Colombian universities (1978), the International Seminar on Remote Sensing in Decision-taking (1979), the First Seminar on the Four-hundredth Anniversary of Colombia (1980) and the Meeting of Experts on Erosion Processes in the Northern Andes (1981).

14. In July 1981, CIAF, working in collaboration with other national bodies, organized the first Colombian Symposium on Remote Sensing. Participants included 32 professionals from 10 Latin American countries as well as experts from OAS, the United Nations and FAO.

15. A project on Regional Agricultural Planning at national level (Col 79/001) was carried out with the participation of FAO, UNDP and the Government of Colombia working through the Ministry of Agriculture and the departmental governments. It is planned to prolong this study for three additional years after 1983. A project has also been presented in respect of training for CIAP staff and other people from the region and for the purchase of equipment with support from IDB and the Government of the Netherlands in addition to the national counterpart contribution; the total estimated amount of this project is US$ 5 million for four years beginning in 1984.

16. So far there is no equipment available for interactive digital analysis of Landsat data.

ARGENTINA

1. Remote sensing in Argentina has from the onset of its use enjoyed great interest on the part of various official agencies, which bring all their questions to the National Space Research Commission (CNIE), which has performed intensively in the field of remote sensing with regard to data reception and processing, research and training.

2. The applications of this technology employed all the disciplines involved in the evaluation of natural resources, knowledge concerning which is essential in a country of extensive territory and low population density. The use of areal photography on a widespread basis in nearly all agencies dates back to the 1960s. Subsequently recourse was had to other sources such as scanning, photographs taken by camera from aircraft and rockets and finally images obtained by LANDSAT satellites, purchased first in the United States of America and Brazil and later received in the country through the receiving station located at Mar Chiquita (Buenos Aires Province) which has been in operation since 1980. This station is supplemented by the processing station located in Buenos Aires, which produces images for users from all over the country as well as from neighbouring countries.

3. CNIE has promoted the use of data from satellites through numerous courses and seminars held since 1976 and has also organized yearly national symposia in which Argentine professionals have presented the research they do in connection with soil studies, floods, crop identification, preparation of geological maps, restrictions on land use, etc. The most important bodies active in the field of remote sensing include:

- The Air Brigade of Paraná, which works with multispectral scanners and photographic cameras in carrying out air surveys for other government or private bodies.

- The Military Geographic Institute which uses LANDSAT images to update maps and for provincial and national satellite mapping.

- The National Institute of Agricultural Technology (INTA) which prepared the country's soil map on the basis of air photographs and has worked on problems relating to land, floods, crop inventories, water and wind erosion and agriculture in general. The INTA experimental stations located in various parts of the country are intensely active in this respect.

- The National Forestry Institute prepares forest maps and studies of changes occurring in wooded areas.

- The National Geological Service carries out geological surveys and produces geological maps on the basis of information received from satellites; the same is true of Yacimientos Petrolíferos Fiscales (YPF).

- The National Meteorological Service (SMN), responsible for obtaining and supplying meteorological and agroclimatic data on the country, has recently installed a modern receiving station to obtain GEOS high-resolution images and information from GEOS and TIROS data collecting platforms.

- The National Institute of Water Sciences and Technology (INCYTH) uses LANDSAT information for studying water basins and has established networks for long-distance collection of data at its regional centres in Mendoza and Córdoba.

- The Institute for Applied Research in Space Sciences (IIACE) is creating a system of interactive analysis using a COMTAL terminal and a VAX 780 computer.

4. With respect to equipment, in addition to that found in other institutions engaged in studying remote sensing applications and in the LANDSAT receiving station and the processing centre, we might mention:

- The Bendix nine-channel multispectoral scanner (SAMPOI) with a band in the infra-red terminal. This scanner was installed in a Guaraní II IA50 aircraft.

- The DAEDALUS 12-channel multispectoral scanner installed in a Lear Jet.

- The Bendix interactive system which works with multispectoral information from LANDSAT satellites and multispectoral scanners.

- The OPTRONICS high-resolution system for reading and recording colour films.

- The DIPIX interactive system, which works on a PDP 11/34 computer.

- The VAX 11/780 computer with several interactive terminals, including the COMTAL Vision ONE/20 terminal.

- The Magnavox system used in connection with TRANSIT satellites to determine earth co-ordinates.

- The multicamera photographic system, consisting in four Hasselblad cameras.

5. As for the use of data collecting platforms, CNIE has a GEOS receiving station and some eight platforms (DCPs) located in various parts of the country, by agreement with other institutions. CONICET is installing a network consisting in 35 new platforms for measuring various environmental parameters in the Andean region and Patagonia.

OTHER BODIES ENGAGING IN REMOTE SENSING ACTIVITIES IN ARGENTINA

Body	Activity
National University of La Plata (UNLP), Faculty of Natural Sciences, Remote Sensing Department	- Use of LANDSAT images applied to hydrogeology. Geological studies in Tierra del Fuego. Use of LANDSAT images to obtain basic information in hydrology.
U.N.S.M. of Tucumán, Faculty of Natural Sciences	- Soil studies (physiography) in the northeast of Argentina, based on LANDSAT images.
National University of the South, Department of Agrarian Sciences	- Studying water by digital analysis of information received by remote sensing. - Geomorphological studies in the area of Bahía Blanca, based on LANDSAT images.
National University of San Juan, Faculty of Engineering and Architecture	- Studies of land use in the Valle del Ullum, Ullum-Zonda, Jachal-Huaco and Valle Fértil, using LANDSAT images. - Studies of mineral deposits carried out by means of satellite images.
CONICET	- Evaluation of crop yields with LANDSAT information.
National University at Cuyo, Faculty of Petroleum Engineering	- Oceanographic measurements.
Acustical Research Centre (INTI, National University at Córdoba)	- Applications of infrasound remote sensing.
National Meteorological Service (SMN)	- Techniques for diagnosing meteorological systems by means of remote sensing. - Studies of the impact of the climate in the Chaco Deprimido subregion.
National University at Buenos Aires (UNBA)	- Geological and water studies with LANDSAT images.
Faculty of Exact and Natural Sciences	- General report on soils in the area influenced by the Río Chabut carried through the use of satellite images. - Application of LANDSAT images to geomorphological studies.

Body	Activity
National Observatory at La Rioja	- Studies of water basins based on satellite images. - Water study and geophysical prospecting in Antofagasta (La Rioja), based on satellite images.
CONICET, Patagonian National Centre	- LANDSAT data applied to the survey of natural resources.
CONICET, Argentine Institute of Snow and Glacial Studies	- Application of LANDSAT data in hydrology, glaciology and geocreology.
CONICET, Argentine Institute for Arid Zones	- Aerophotographic and multispectoral survey carried out by CNIE of the lower valley of the Río Chubut.
Institute of Ecology, Natural Resources and Technology of Chaco Province	- Water system and drainage pattern of Chaco Province, study carried out by remote sensing. - Inventory of natural resources of Chaco Province through technical application of photogrammetry. Digital LANDSAT system.
University of Tucumán, Faculty of Natural Sciences, Miguel Lillo Foundation	- Seasonal change as a factor in the interpretability of physiographic aspects of LANDSAT images and of land occupation of Tucumán Province (II/80). - Evaluation of the morphogenetic and morphodynamic characteristics of Catamarca Valley carried out on the basis of LANDSAT information (II/80).
Department of Renewable Natural Resources and Ecology	- Integrated survey of natural resources, environmental associations and aptitude for afforestation of the Chaqueña region (II/80).
University of Rosario, Faculty of Sciences	- Study of alignment and drainage of the Pampa carried out by remote sensing (LANDSAT) (ERIM, Costa Rica).
Ministry of Health of the Province of Buenos Aires	- Application of satellite images to the study on environmental regionalization (II/80).
University of Tucumán, Faculty of Natural Sciences	- Use of LANDSAT images in geomorphological and edaphic small-scale mapping, southeast of Santiago del Estero.

Body	Activity
National University at Mar del Plata, Faculty of Exact Natural and Biological Sciences	- Application of satellite images and their correlation in comparative study of temperature and salinity fields in areas bordering on Mar del Plata.
Institute of Ecology, Natural Resources and Technology of Chaco Province	- Inventory of natural resources of Chaco Province, Argentine Republic, South America, carried out through the application of photogrammetric techniques. Digital LANDSAT system. - Farm occupation of Chaco Province.
Institute of Ecology, Natural Resources and Technology of Chaco Province	- Evaluation of the farmed surface in the central area of the Province. - Systems of alternatives for channelling water from the Teuco-Bermejo river to the Bermejito river.
Provincial University of La Rioja, Photocartographic Department	- Description of remote sensing activities in the Photocartographic Department of the Provincial University of La Rioja.
University of Tucumán, Faculty of Natural Sciences	- Classification of topography using LANDSAT information as a basis for the integrated evaluation of the landscape.
National Fund for Environmental Management, Continuous Environmental Evaluation Programme	- Use of LANDSAT images for delimiting and characterizing natural units in environmental diagnosis.
National Forestry Institute	- Accuracy of forestry map based on LANDSAT images. - A methodology for the evaluation of areas in accordance with their forestry possibilities: integrated survey of natural resources.
Military Geographic Institute (IGM)	- Digital computers in the automatic analysis of land use.
Federal Research Council (CFI)	- Urban study of Buenos Aires. - Estimation of areas subject to flooding in periods of maximum and minimum precipitation in the Saldado subregion of the submeridional lowlands of the Santiago del Estero subsystem. - Evaluation of the natural resources of the Añatuya subregion in the submeridional lowlands of the Santiago del Estero subsystem.

Body	Activity
CFI - INCYTH	- Photointerpretation and analysis of satellite images. Area: Perilado de Río Hondo (Tucumán Province).
CONICET	- Survey of the soils of Chubut, carried out through the use of LANDSAT images.
IBM Argentina	- Computer programmes applied to the digital processing of LANDSAT images. ERMAN II programme.
General Irrigation Department Mendoza	- Analysis of LANDSAT information for the west-central region of Argentina.
Ministry of Agriculture of the Province of Santa Fe	- Soil surveys carried out through the use of LANDSAT images. - Study of littoral geomorphology carried out by LANDSAT images.
INCYTH - National Institute of Water, Science and Technology	- Comparative analysis of natural units mapped in photomosaics and LANDSAT images.
INTA	- Use of delimitated satellite images for retention and evaluation of agricultural productivity in the Province of La Pampa. - Study of the flooding of the Pampa Depression with special references to the economic significance of the floods of April-May 1980.
INTA	- Map in which the land of Chaco Province is classified in terms of land-use capacity, prepared by interpreting LANDSAT images.
INTA	- Floods in the north-west region of the Province of Buenos Aires viewed in the light of information supplied by satellite images.
INTA	- Satellite images as an instrument for use in subdividing land surfaces into areas with different agricultural potential and for establishing the country's global and sectoral agricultural policies.

Body	Activity
INTA	- Use of satellite information in the preparation of a 1:200 000 scale soil map of one sector of the Entrerriano Delta.
National University at Rosario	- Contribution made by LANDSAT images to the study of the Pampa (I/79).
National University at San Juan	- Geotechnical map of Cuyo. - Structural analysis of the Sierra Pintada (Mendoza). - Structure of the Sierras of Córdoba. Analysis of LANDSAT images.
CONICET	- Lithological, geomorphological, and soil survey of the north-east of the Chubut.
Universidad Nacional del Sur	- Macro-survey with LANDSAT images.

Interactive analysis system

6. During 1892 a series of interactive programmes making it possible to attend simultaneously to a number of users with the VAX-11/780 computer was put into operation. This system provides for the services of an expert working in the field of natural resources; no previous computer experience is necessary.

Microsystem for image processing

7. A microsystem is available for digital processing of images through the use of a national microcomputer at very low cost. The programmes are appropriate for areas of limited size and include a classification process which operates on the basis of hypercubes and various processing modules; the images, which are stored on five-inch flexible discs, are presented by means of a highly simplified, low-cost colour monitor. Programmes are also available for making geometric corrections on the basis of ground control points.

Crop assessment

8. This project, which is sponsored by the United Nations Development Programme and will be completed in 1985, is now in phase II of its execution.

9. The figures corresponding to production are obtained by combining area estimates (by means of agrometeorological modules). A special programme is also being carried out to obtain digital maps showing agrometeorological conditions as an aid to crop supervision and monitoring in the area under study.

Forest assessment

10. Under an agreement between CNIE and the National Forestry Institute (IFONA), provision is made for a study of an area covering 1 800 000 hectares in the Salta and Jujuy Provinces (a subtropical mountainous region).

11. The forest types identified included: mountainous jungle, transitional rain forest and Chaco woodlands (pastures and farmlands).

12. The final result was a classified image of the area, indicating that the system makes it possible to divide the classes referred to with considerable accuracy.

Evaluation of plant biomass

13. In 1982 a study was carried out to evaluate the plant biomass which will be covered by water when the Itaipú dam is filled.

14. The study made it possible to:
- identify, delimitate, describe and count the main types of vegetation;
- maintain control models of the various types of vegetation located and recognized in Argentina, duplicating those found in the area of the dam;
- estimate the amount of biomass corresponding to the various types of vegetation, especially for purposes of assessing the probability of pollution by it.

15. Totals were obtained in respect of the biomass relating to the different types of vegetation and vegetated areas and of the herbaceous biomass which is easily degradable. On this basis the amount of oxygen which would be dissolved in the water of the dam in the days after it was filled was calculated.

Study of urban areas

16. At the end of 1986 a methodology was developed for recognizing and evaluating the main uses of the land in urban centres with medium-sized populations, including suburbs, in which digital processing of LANDSAT information is used.

17. It is hoped that it will be possible to obtain ratios between physical (LANDSAT information) and socioeconomic variables and a land-use map.

18. The digital processing has been carried out, and the geometric corrections are still to be performed. Finally, the classifications will be adjusted through the use of on-site verification data and subsequently correlated with the socioeconomic variables.

Geological studies, prospecting and exploration of alcaline metals in saltmarshes

19. Interactive digital analysis of LANDSAT images was employed. The studies have been aimed primarily at establishing the dominant geo-structural and lithological characteristics of each basin in evaporation primarily in order to differentiate the volcanic rocks.

20. The main objectives are to determine the composition of the brine and the concentration of alcaline metals (lithium, potassium, rubidium, caesium), sulphates and borates.

Natural contamination by arsenic and other trace elements of ground waters in the plain of Córdoba Province

21. The method used was interactive digital analysis of LANDSAT images obtained in the southeastern part of the Province of Córdoba.

22. The studies were designed to establish the main structural and hydrological characteristics of the area.

23. On-site studies were carried out for the systematic proof and demonstration of surface and ground water and also of sediments and soils.

24. The geochemical analysis revealed:

- High contents of solids totally dissolved in alcaline bycarbonated-sulphuretted-chlorineted water.
- High contents of fluorine, arsenic, vanadium, molybdenum and uranium; elsewhere, high selenium content (sediments in suspension).
- The contents are found in concentrations regarded as toxic according to drinking water standards established by international health organizations and by Argentina.

URUGUAY

1. Because of its size, the Republic of Uruguay was covered by aerophotographic surveys of the kind usually used for the preparation of maps on soil use; crop resources; river basins, shores and beaches; erosion, etc., primarily carried out from aircraft in 1966/1967. Subsequently, between 1979 and 1981, maps on a scale of 1:20 000 were made of the central farm area and of the south-east.

2. The use of LANDSAT images offers an interesting perspective for keeping maps up to date and carrying out numerous projects in which various institutions in the country are involved. Some institutions working on or having expressed interest in remote sensing applications include:

- The Military Geographic Service, which is responsible for satellite image control and prepares maps; it is here that LANDSAT images are interpreted for use in the forest inventory, for which the Ministry of Industry and Energy is responsible. The Photographic Unit of the Air Force has been made responsible for aerial surveys.

- CONEAT, in the Ministry of Agriculture and Fisheries, has staff trained in remote sensing and carries out studies on crops and land use; it has a computerized system for detailed cadastral surveying of the country.

- The National Water and Environmental Protection Department (DINASA) has, with support from UNESCO, carried out a study on conservation and improvement of the beaches of Uruguay, which provides an appropriate basis for periodic additions and monitoring by means of LANDSAT information.

- The National Fishery Institute (INAPE), provides the fishery sector with technical advice. In 1972 the Oceanographic and Fisheries Service, with help from FAO, prepared a fisheries development project, which is being expanded. There is also a project in conjunction with IDB amounting to close to US$ 13 000 000 for the purchase of a vessel for scientific research in fisheries and also for the purchase of equipment for the reception of metereological satellite data.

- The National Meteorological Department, with its network of receiving stations, offers other institutions climatological and agrometereological support. It is reported to be interested in implementing a project together with other bodies on manpower training and equipment to strengthen remote sensing applications.

3. Mention should also be made of the UNESCO Regional Office for Science and Technology for Latin America and the Caribbean, located in Montevideo, which has a team of experts in ecological sciences, soil sciences, hydrology, engineering and other disciplines of growing importance in the use of remote sensing.

4. As for trained staff which has completed courses abroad in different fields relating to remote sensing, eight people have completed the CNIE courses in Argentina, one has studied at CIAF in Colombia and another at LARS (Purdue) in the United States.

PERU

1. The application of remote sensing in Peru dates back to 1960, when full use was made of panoramic air photography in the national programme relating to the inventory of natural resources. In 1971 approval was given for a programme in which IGP, ONERN and the Agrarian University would participate in the NASA ERTS programme. In addition to the visual interpretation of images, provision was made for digital analysis carried out on a Hewlet Packard 200 minicomputer.

2. In view of the fact that 65% of Peru's surface is covered by jungle, technology was also developed for the application of remote sensing using radar. Between 1973 and 1975, 75% of the country was covered by SLAR images as provided for in contracts with Grumman and Aeroservice Corporation.

3. In 1974, the National Commission on Aerospatial Research and Development (CONIDA) was established as part of the National Scientific and Technological Research System to supervise the aerospatial activities of Peru. The Committee's activities included the use of extraterrestrial space for peaceful purposes; the supervision of research; the development of space applications; the establishement of co-operative agreements with private, public and international organizations; the development of a legal framework relating to space and the carrying out of studies on the social and economic consequences of space activities.

4. The Geophysical Institute of Peru and the Department of Hydrography and Navigation receive and process data from metereological satellites in the TIROS-N and GEOS series on a daily basis. These data constitute an important contribution to weather forecasting for navigation.

5. Use has been made of remote sensing by LANDSAT satellites in conjunction with aerial photography, side-looking airborne radar (SLAR) studies and soil studies. Remote sensing has been particularly useful for analysing the Amazon Basin. Applications of remote sensing data include the preparation of land use maps and geothermal studies. These projects have been carried out with international assistance concentrating on the supply of equipment and training.

6. The Canadian International Development Agency (CIDA) has co-operated with the Government of Peru in a remote sensing programme which includes research, training and the purchase of equipment. The cost of this co-operation project is estimated to be about US$ 465 000. Peruvian scientists have received training at the Canadian Remote Sensing Centre and are analysing data from LANDSAT satellites relating to selected pilot areas in various regions of economic importance. On this basis the project known as PERCEP was formulated in 1965 with the aim of contributing to the integrated development of remote sensing in the programme for the evaluation of Peru's natural resources (in which CONIDA, ONERN and IGP are co-operating).

7. Institutions engaged in projects using remote sensing include the National Office for the Evaluation of Natural Resources (ONERN), the National Commission for Aerospatial Research and Development (CONIDA), the Water Department and the Office for Rural Cadastral Surveying (OGCR) (the latter two are both sponsored by the

Ministry of Agriculture, the National Metereological and Hydrological Service, the Department of Water and Land Resources of the La Molina National Agrarian University and the National Geographical Institute).

8. With regard to studies carried out with remote sensors, attention should be drawn to the forest inventory carried out by ONERN in 1977, in which data obtained through the use of the multispectoral scanner of the LANDSAT satellite was used. This inventory records the distribution of the aguaje palm, which is economically important in that it yields oil, foods for human and livestock consumption and cellulose used in the production of wood pulp, thereby promoting the paper industry.

9. The inaccessibility of the jungle makes it impossible to determine its distribution except through the use of the LANDSAT, which was used in making an inventory of this forest resource and managing it. In 1979 a study on ground water prospecting was also carried out using remote sensing techniques.

10. OGCR has performed the following tasks:

- Identification of land uses in the Cajamarca area (1978) using data obtained from LANDSAT I.

- Use of LANDSAT I images to determine land use in the jungle for a study submitted to the seminar organized by the La Molina Agrarian University in 1979.

- Applications of colour aerial photographs in agriculture (1975).

- Cadastral surveying by means of aerial photographs (1975).

- Progress made in a cadastral survey of Peru (1983).

11. According to ONERN data, there are about 40 professionals from various disciplines in Peru working in the field of remote sensing, and it would be desirable to train at least 15 professionals a year in such areas as geology; edaphology, hydrology, land use and the preparation of agricultural, forestry, environmental and other studies.

12. In Peru studies on natural resources are carried out through the use of photointerpretation techniques employing conventional aerial photography, which makes it possible to cover most of the national territory. Recently steps have been taken to use SLAR and LANDSAT data. The National Office for the Evaluation of Natural Resources (ONERN) is the governmental organization responsible for computing an integral evaluation of natural resources.

13. This agency also plays a role in the formulation of policies for the use and conservation of natural resources and carries out the necessary studies relating to the interaction of man with the environment. ONERN was established in 1962. Since January 1981, it has been a decentralized agency in the National Planning Institute.

14. In 1977, CONIDA began a study in the area of the Chancay-Huaral Valley, in which multispectral photography was used for the first time in the country for crop identification. This study was supported by the Inter-American Geodesic Service (IAGS), which supplied support in the form of the multispectral camera which was essential for carrying out this study.

15. Once LANDSAT was launched in 1972 and the data collecting platforms were established, it became possible rapidly to obtain a real time control of the hydrometeorological, oceanographic and seismic parameters and also to transmit the data by conventional means economically and safely.

16. Within this context, IGP and the National Institute for Energy Research, working under a co-operation agreement, put into operation an experimental platform to collect data at the Stuart bridge on the Mantaro River.

17. With a view to covering the entire surface of Peru with a full set of maps obtained by satellite, on a scale of 1:250 000, between 1983 and 1985 ONERN prepared a programme for co-operation with the Applied Geodesic Institute (IFAG) in Frankfurt, Federal Republic of Germany. The World Bank is financing another project. The full set of LANDSAT data will consist in 80 colour maps, based on a coverage of approximately 64 LANDSAT frames.

18. The computer centre in ONERN has two computer systems available to it for image processing (sponsored in part by the Agency for International Development (USAID)):

a) One is a DIPIX system from Canada with LCT 11/23, a memory of 112 Mbytes and a disk with an interactive image processing system, in combination with a Conrac colour monitor and a small digitilizer panel.

b) The other system consists in a PDP 11/44 with a memory capacity of 512 Mbytes, two RLO2-10 Mbyte disks, three RA80-121 Mbyte disks and two tape units for CCT. The system is connected to the Ramtek colour monitor and three digitilizer panels in order to create a geographic data bank. In 1983 an ERIM package of programmes was installed for image processing, with ample capacity for combining up to 25 different GIS transparencies. The only output apparatus for this system is a Versateo V-80 B and a DW printer. ONERN also has a special library dealing with the subject of remote sensing and a conference room big enough for 250 people.

19. Black-and-white and colour film rolls are developed in Peru, while an automatic colour developing system is being installed with Versamat. SAN also launched a SLAR device and carried out an aereophotographic survey of Peru on different scales. Five jet and six turbo-jet aircraft are available for this purpose. Each aircraft can transport one or two Wild RC-10 cameras equipped with ordinary black-and-white film and pancromatic film. Proofs were made with false infra-red colour film. A SLAR and a magnetic studio for photogrametric rectification, a digital Bendix AP-C, three Wild rectifiers and two Kern rectifiers are available.

PARAGUAY

1. Activity

1. In Paraguay the first use made of remote sensing technology came in connection with the development of renewable natural resources in 1977, and a project on classification of woodlands and land use was carried out by FAO and the National Forestry Service over an area of 159 000 square kilometres. This study has made it possible to estimate the wooded surface, the deforestation index and the extent of human settlement. The interpretation has been performed visually through the use of data provided by LANDSAT I and II consisting in two images on a scale of 1:250 000 and seven images on a scale of 1:500 000 from the 4, 5, 6 and 7 bands acquired in the Panamanian Office of the Inter-American Geodetic Survey (IAGS) Earth Resources Observation Systems (EROS).

2. In 1979 the Faculty of Agronomic Engineering and a firm of private consultants prepared, also by visual interpretation, a map showing the vegetation of the eastern region based on satellite images.

3. In 1980, the International Co-operation Agency of Japan (JICA) and the National Forestry Service conducted a forest inventory in a 1 500 000-hectare area northeast of the eastern region, using aerial photos on a scale of 1:20 000 and two satellite images on a scale of 1:500 000 from bands 4, 5, 6 and 7.

4. Digital interpretation has been made of the images in Japan with support from a test programme in the area of the inventory (supervised method). On this basis a map of woodlands and land use was prepared, which differentiates between nine categories of forest for purposes of the forest inventory. Estimates were also prepared concerning the rate of forest growth in recent years and predicting the rate in the years to come.

5. In 1982, the Organization of American States (OAS) prepared a map of the vegetation and soils of the western region of Paraguay; for this study use was made of black-and-white and false colour images on a scale of 1:250 000 and 1:500 000. The interpretation was made visually by a Brazilian adviser. This study has still not been published.

6. The plans of the Ministry of Agriculture and Animal Husbandry provide for a centre for processing LANDSAT data and images in the future. In the first stage of its operation visual interpretation will be performed. At the end of that stage there are plans to train staff for digital interpretation.

2. Institutions

7. Institutions expressing interest in working on this task include the Ministry of Agriculture and Animal Husbandry, the National Forest Service, the Faculty of Agronomic Engineering, the Department of Forest Engineering, the National Computer Centre (Polytechnical Faculty), the Ministry of National Defence (Office of the Military Geographic Institute), the Institute of Basic Sciences and other private enterprises.

3. Staff

8. The professional staff with some training in this technology and experience gained in certain studies include two agronomical engineers who have participated in nine-month photointerpretation courses in Colombia; one engineer who received a master's degree in forest management with a thesis in remote sensing, in Brazil, and two engineers who are taking two-month courses in remote sensing and land use in Japan. In addition, between 1977 and 1983, eight professionals from Paraguay have taken intensive remote sensing courses in various fields of specialization at the CNIE in Argentina. These courses, whose duration is from three to four weeks, including a practical exercise at the end and a field visit, have been sponsored by the Organization of American States (OAS).

9. In Paraguay, the Division of External Technical Assistance of the Planning Department (STP) has indicated that everything relating to the evaluation of primary data is of great interest, in particular where evaluation assisted by remote sensing is concerned.

10. Consideration is being given to the training of manpower in the use of information obtained by remote sensing and also to a national plan designed to further the use of remote sensing for soil conservation.

11. During its first phase, the national plan will concentrate on the training of manpower in visual interpretation, while the second phase (1988-1989), will focus on digital interpretation of data received from satellites.

12. It is planned to cover the entire country by means of visual interpretation of colour photographs on a scale of 1:250 000 to 1:1 000 000.

13. It has been proposed that, as part of a UNDP/DTCD programme, a geological map of Paraguay should be prepared on a scale of 1:1 000 000 and that another map on a scale of 1:50 000 should be produced as an aid to regional work in the country. Basic information obtained by means of stereoscopic coverage is also available.

14. The National Defence Ministry has taken steps leading to the designation of a national office for co-ordinating remote sensing activities for the development of national resources. In each discipline there is a need for at least two experts trained in the use of remote sensing. In this connection, the National Defence Ministry is very eager to receive technical assistance related to its activities.

15. The Ministry of Agriculture and Animal Husbandry is in touch with IICA, FAO, BID and JICA, and is prepared to use remote sensing technology for its projects.

16. In an attempt at quantifying the forest resources of Paraguay, the University at San Lorenzo is working with aerophotography and, to some extent, with remote sensing techniques. Substantial interest has been displayed in the training programme which might be provided by the regional remote sensing project sponsored by UNDP/DTCD, which would be centered in Argentina. There is need for intensive training in Paraguay, but at present equipment for visual analysis is not available. With regard to the cadastral survey of the country's resources, JICA previously provided technical assistance, but the information available dates back to 1973.

17. The Basic Sciences Institute showed interest in the regional remote sensing project and identified the need for training in the following disciplines:

Geology: To identify structural characteristics and lithological changes;

Geomorphology: To identify morphological characteristics and drainage structures and to determine land use.

18. With regard to training, there is an estimated need for at least one expert in each field. Since there is almost no infrastructure for the interpretation of images, an additional requirement for effective participation would be the establishment of a photointerpretation laboratory.

19. The Military Geographic Institute is using data obtained by remote sensing to update national maps, in co-operation with the Military Geographic Institute of Argentina.

20. An IBM 4331-II computer, with a 248-Mbyte memory, is available at the Polytechnical Faculty of the University of Paraguay. The University has a 6-disk memory, with 17 terminals, a tape recorder (800-1 600 BPI) and two flexible disks. Although the computer is used primarily for administrative procedures, considerable capacity is available for digital analysis of LANDSAT data.

PANAMA

1. The Panamanian Association of Engineers and Architects in conjunction with the American Society of Photogrammetry conducted the first seminar on remote sensing from 8 to 11 September 1980 with a varied agenda which awakened great interest. The National Geographic Institute (IGN) purchased radar images taken by the space shuttle; these images covered the eastern region of the country; on the basis of the information thus obtained, the Technical School of Cartography of the National University of Panama made visual interpretations of a geological and geomorphological type.

2. In October 1982, during a week devoted to the exchange of technology, a number of conferences were held on remote sensing systems, obtaining images by satellite, earth orbit photography, etc. Recently a group of students at the Fort Clayton School of Cartography prepared a mosaic with LANDSAT images and false colour proofs using bands 5 and 7.

3. A seminar entitled: "Cartography and Remote Sensing: Science for National Development" was held at the Santa María la Antigua University (USMA) from 15 to 19 August 1983. Subsequently, at a meeting at which a large number of State institutions, independent bodies, universities and international organizations were represented, the need was expressed to establish a national institution for the application of space technology in Panama, as a result of the Unispace 82 recommendations.

4. The country has some 10 institutions in this field, and they are becoming increasingly aware of the importance of the application of remote-sensing technology to national development and have begun to use visual interpretation of aerial photographs; these institutions include the Ministry of Planning and Economic Policy (MIPPE); the Tommy Guardia National Geographic Institution (IGNTG); the Institute for Renewable Natural Resources (RENARE); the National Telecommunications Institute (INTEL); the Institute of Hydraulic Resources and Electrification (IRHE); the Institute of National Aquaducts and Sewers (IDAAN) and the National Department of Mineral Resources (DNRM).

5. A programme costing over US$ 2 000 000, of which IDB will supply 75% and the Government of Panama, the remaining 25%, has recently been put into operation. The programme provides for the following activities:

1) Training of eight professionals in visual and digital techniques and three in the management of hydrometeorological networks.

2) Preparation and design of a digital mosaic of the country and creation of a geographic information system.

3) Inventory and evaluation of renewable and non-renewable natural resources.

4) Creation of meteorological and hydrographic networks and of a telemetering reception antenna.

MEXICO

1. Remote sensing, that is the use of sophisticated sensors and films from aircraft and satellites is concerned, began in Mexico in April 1969 when a full air mission was carried out. The flights involved in this mission corresponded to a third stage of the international co-operation programme on remote sensing established between Mexico and the United States. This was NASA mission Number 91 and was carried out by a Lockheed Electra aircraft owned by NASA. Its objective was to prove the efficiency of new instruments, methods and systems for the study of natural resources.

2. This mission was provided with the widest range of equipment available at that time, which was soon after side-looking radar had been freed of the restrictions imposed by military secrecy. The mission included the overflight of six test sites in the central region of Mexico, with the general objective of ground water assessment location of springs and aquiferous subdischarges and detection of water pollution and insect attacks on plants. Studies were carried out on soil use and an effort was made to determine thermal anomalies in soils, rocks and water bodies. Generally speaking, the results of Mission 91 were successful. The new sensors and film types proved to be of great usefulness in this kind of study and the main objective, which was to familiarize new expertise with the use of technological innovations, was realized.

3. As for the use of the satellite, in 1972 the possibility arose of using satellite information in connection with natural resources, under the aforementioned Co-operation Agreement between Mexico and the United States. Branches of the Mexican Government and universities could participate in projects as principal research bodies, receiving information from NASA and thereby acquiring precise knowledge of the new technology.

4. Some research was carried out through the use of images received from the LANDSAT satellite; one of the studies was aimed at comparing findings obtained by aircraft with findings obtained by satellite with regard to use of land and lithological units. The other studies were aimed at proving the efficiency of methods of remote sensing from satellites in various geographical areas. For these studies, which were carried out by the Department of Water Resources, three test sites with different physiographic and climatic characteristics were selected, two of which are important crop production centres.

5. In the quantification of images, use was generally made of the direct two dimensional photointerpretation method. Consideration was given to transparencies from which applications up to six times as large as the size of the original were obtained. These applications still maintained a good resolution, so that they could be used directly. Applications of this kind have proved to be an economic and feasible way of using LANDSAT information without having to depend on costly investment in instruments, which is an important consideration in technological applications.

6. In 1972-1973, within the LANDSAT research conducted by the Department of Water Resources, specific studies were prepared to determine the characteristics of soil use at present: hydrology, geological aspects and oceanological details.

7. Later on, under the Co-operation Agreement, Skylab information was made available to Mexico, which included, inter alia, observations made in the three Skylab missions concerning natural resources:

SKYLAB II, 25 May to 22 June 1973.

SKYLAB III, 28 July to 25 September 1973.

SKYLAB IV, 16 November 1973 to 8 February 1974.

8. Information obtained in these three missions was received on photographic film and digital tape depending on which of the various cameras and radiometric sensors employed was used. The sensors provided information obtained from radiometers Bond L and from the multispectral scanner. Broadly speaking, the results of the Skylab photographic research consist in sketches and plans relating to crops, soils and rocks and bodies of water.

9. Skylab information regarding irrigated farmland reveals the limits of the area, the parts affected by salinity and places where expansion is possible. At the same time, it could be seen that the resolution of Skylab information would probably make it possible to supervise sown areas. In coastal areas information of the Skylab type was introduced.

10. The system has been applied mainly to information from LANDSAT, in projects conducted by the Department of Water Resources either above or in conjunction with other national agencies with which work agreements exist. Those projects have related to subjects such as quantification and detection of seaweed, water quality (there is a methodology for classifying water in accordance with the amount of solids in suspension) and inventories of tropical vegetation. This particular project was carried out under an agreement established with the Institute for Research in Biotic Resources.

11. At present, the various remote sensing groups are to be found within the Photointerpretation, Photogrammetry and Geodesic Society of Mexico. The majority of professionals working in this field are members of either the Photointerpretation or the Photogrammetry branch of the Society. With support from the General Department of Geography (DGG), symposia are held on a specific topic, such as, image processing or the recognition of patterns. Short remote sensing courses (three to four weeks) are held in a number of institutions. These courses are basically internal and are aimed at filling the need for staff in the institution in question. In the Institute of Geophysics a one semester master's degree course on image processing and pattern recognition is being offered. Various degree candidates are writing theses in this area.

12. In Mexico, unlike other countries, there is no institution dedicated specifically to work in remote sensing. Instead the different groups are employed in academic or development organizations which include remote sensing as one of their chief activities --bodies which use these techniques as tools for attacking emergency situations at national level. Remote sensing activities in Mexico are concentrated basically on computer processing of multispectral digital images, in combination with the study of aerophotographs and prints of satellites images.

Use has been made of the multispectral data operationally derived from the satellite and interpreted at the same time. This resulted, inter alia, in the preparation of the geological and land-use map (scale 1:1 000 000) of the entire country. Thus, the global objective is first and foremost to develop image processing, pattern recognition and photointerpretation techniques, on the basis of which the country's natural resources can be identified, evaluated and quantified Evaluation is carried out directly or through models of the terrain, which makes it possible to establish surface conditions, estimate potential productive areas and identify parameters in the prediction of volumes of food and inputs. Much of this work is carried out at experimental level, as in the case of the preparation of data banks for decision-taking.

13. Many activities consist and will continue to consist in establishing a relationship between the various entities which play a role in remote sensing in order to identify complex projects aimed at resolving the country's special problems These projects must cover not only the application and development of remote sensing techniques but also manpower training and the design of systems for the automatic analysis of spatial and aerial data. The present trend is towards systems based on macroprocessors, with programme packages providing the basic elements used in image analysis. In connection with remote-sensing techniques, mention should also be made of the development of systems of information for decision-taking. At present a number of geographic and cartographic data banks, whose special characteristics are that they are designed for a specific purpose and are rapid and easy to handle, are being installed. This is of particular relevance in view of the fact that many phenomena in the realm of remote sensing are relatively dynamic, which means that decision-taking calls for a system supplied with reliable information which can rapidly be updated.

MEXICO: REMOTE-SENSING GROUPS

Group	Objectives	Equipment
CC-IBM Science Centre (IBM)	Digital processing of images by satellites, maps, data banks	IBM 370/158 disk units and tapes, TV monitor, micro-density measure
National Water Plan Commission (CPNH)	Inventory of aquiferous resources	NOVA/3, disk and tape unit
Council on Mineral Resources (CRM)	Search for mineralized areas	All-purpose computer
Colegio de Postgraduados de Chapingo (Chapingo Postgraduate School) (CPCH)	Identification of cartographic units	All-purpose IBM 370/158
Department of Geography (DGG)	Identification, location and quantification of natural resources	PDP 11/34, disk and tape units, TV monitors, static electric coordinatograph
Mexican Petroleum Institute (IMP)	Structural analysis and tectonic interpretation	All-purpose IBM 370/150
Geophysical Institute, UNAM	Geohydrology, tectonis, development of techniques in image processing and pattern recognition	NOVA/3, diskettes, disk and tape units, TV monitor, digitalizer, laboratory and field radiometre
National Institute for Research in Biotic Resources (INIREB)	Inventory of biotic resources	VAXS, disk and tape unit
Institute for Research in Applied Mathematics and Systems (IIMAS)	Computer programmes, systems design and construction	PDP 11/34, disk and tape unit, TV monitor, static electric coordinatograph
National Institute for Research in Forest Inventories (INIF)	To update cartographic information and learn the dynamics of forest areas due to changes produced by human activities	
Interdisciplinary Laboratory, UNAM	Models of bodies of water, impact of pollutants	
Department of Agriculture and Water Resources (SARH)	Changing the climate, environmental factors, conservation of soil and water	PDP 11/34, disk and tape units

EL SALVADOR

1. There are two institutions which have some relationship with work associated with remote sensing:

- The National Geographic Institute (IGN) of MOP, which is responsible for producing and supplying aerophotogrametric and cartographic products for any national project. Up to 1976 it worked with Landsat products on a rather irregular basis.

- The Centre for Natural Resources (CRN) of the Ministry of Agriculture and Animal Husbandry, which is the main user of IGN products, including maps, aerial photographs in black and white and orthophotos. CRN's mission involves the recognition, inventory, classification and administration of natural resources.

2. However, there has been little participation on the part of either institutions in connection with applied research showing the possibilities and limitations of products obtained from natural resource satellites; efforts in this connection have instead been made on an individual basis and in isolation. There are no educational centres in remote sensing at university level.

3. Studies carried out include:

a) Study of an area of El Salvador in May 1973, using colour and multispectoral photographs, in co-operation with the EROS-IAGS Programme. The area studied covers 65 000 hectares on a Pacific coastal plain, and the objective of the project was to evaluate applicability in the identification and recognition of crops, woodlands, salt marshes, areas with drainage problems, the effect of fresh water on salty woodlands and the destruction of diseased plants in cotton and cocoa crops.

b) Study of an area on the coast of El Salvador in 1978 with a view to the recognition and identification of land use, carried out as part of the training received by two LARS technicians (Purdue University, USA), with support from IDB.

c) Comprehensive study of arboreal vegetation in El Salvador carried out in 1981 through visual interpretation of Landsat Images. The result was the publication of a coloured map on a scale of 1:200 000.

4. As for professionals trained abroad, four of them took courses on basic principles in remote sensing held at the Cartographic School of the Inter-American Geodesic Service, two trained at LARS at Purdue University, and two at CNIE in Argentina.

ECUADOR

1. The Centre for Integrated Surveys of Natural Resources by Remote Sensing (CLIRSEN) is the body responsible for the planning, administration, co-ordination, implementation and supervision of activities concerning remote sensing. This Centre is under the supervision of the Military Geographic Institute (IGM), which is responsible for cartographic studies and mapping of the country.

2. The Centre is staffed by professionals and engineers in various biological and geographical fields of specialization. Some have received training abroad, at LARS (Purdue) or at the IBM centre in Mexico. In addition, 30 people received training at CIAF in Colombia and eight at CNIE (Argentina). The first national seminar on remote sensing in the country was held from 9 to 12 July 1979 with 89 people in attendance. Subsequently, an introductory course in remote sensing was held from 9 to 20 November 1980. The introductory course on the application of remote sensing to agriculture was held from 6 to 20 March 1982.

3. With support from IDB, a programme is being developed for the purpose of increasing the applications of remote sensing in the management of natural resources; this programme includes training of experts from the country in different applications of remote sensing and the purchase of equipment, including some 12 data-collecting platforms (DCP) which will be installed in inaccessible parts of the country. In addition, Earthview equipment is being installed for the digital processing of images.

4. Many integrated surveys have been carried out through the use of aerial photography, radar and Landsat images.

5. On 31 July 1982, NASA transferred to Ecuador the equipment in the old tracking station located at Cotopaxi, 50 km outside of Quito. In this connection, many studies have been carried out with a view to turning this station into a Landsat satellite receiving station; some consultancy studies have been carried out, including an advisory study made by CNIE in Argentina.

6. The third station would play an important role in the completion of the studies on Central America and the northern part of South America. This station, in conjunction with the stations in the United States, Brazil and Argentina, would make it possible to cover practically the whole of America.

7. As for training needs, CLIRSEN has carried out a survey in the country, and it is estimated that about 12 institutions would be interested in various applications of remote sensing, photointerpretation and visual and automatic image analysis. There would seem to be a need to train about 60 people a year on average.

8. CLIRSEN provides services in different areas, such as forestry, oceanography, hydrology and geology. It also works with information from radar, aerial and aeromagnetometric satellites.

9. CLIRSEN has worked with different organizations under the agreement; for example, in 1981 it carried out a forest inventory of the Amazon region of Ecuador (Pastaza province), for the Ministry of Agriculture and Animal Husbandry; it conducted multidisciplinary studies on natural resources for the National Institute for Settlement of the Amazonian Region of Ecuador (INCRAE) and surveys by radar in certain parts of the Amazonian coastal regions.

10. The study on Cotopaxi is subject to change when satellite data is received and processed. The infrastructure and equipment needed to process MSS data is under preparation and Earthview equipment for image processing has been installed. The staff for this project is now being trained in the United States and France.

11. The staff of CLIRSEN is made up of 120 people, 38 of whom are technicians in various fields --geology, oil science, forestry, marine biology, mechanics and electronics; thus multidisciplinary studies can be carried out. The remaining staff is engaged in maintenance and administration.

INSTITUTIONS AFFILIATED TO THE CENTRE FOR INTEGRATED NATURAL RESOURCE SURVEYS BY REMOTE SENSING (CLIRSEN)

Ministry of National Defence
- Military Geographic Institute
- Department of Industry of the Army (DINE)
- Navy Oceanographic Institute (INOCAR)

Secretariat of the National Security Council

Atomic Energy Commission of Ecuador (CEEA)

National Preinvestment Fund (FONAPRE)

National Development Fund (FONADE)

Ministry of Natural and Energy Resources
- Ecuadorian State Petroleum Corporation (CEPE)
- Department of Geology and Mines (DGGM)
- National Institute of Meteorology and Hydrology (INAMHI)
- Ecuadorian Electrification Institute (INECEL)

Ministry of Agriculture and Animal Husbandry (MAG)
- Ecuadorian Institute of Water Resources (INERHI)
- National Institute for Agricultural Research (INIAP)
- Ecuadorian Institute of Agrarian Reform and Settlement (IERAC)
- Reconversion Centre of Azuay, CAÑAR and Morona Santiago (CREA)
- Regional Programme for the Development of the South (PREDESUR)

National Planning and Economic Co-ordination Board (JUNUPLA)

Ministry of Public Works and Communications (MOP)

Ministry of Industry, Commerce and Integration
- Industrial Development Centre of Ecuador (CENDES)

National Department of Land Assessment and Registration (DINAC)
- Río Guayas Basin Research Centre (CEDEGE)

Central University of Ecuador

State University of Guayaquil

Polytechnical School of the Coast

National Polytechnical School

COSTA RICA

1. Because of the need to preserve its natural resources, the Government of Costa Rica has established a number of remote sensing programmes to produce a survey and inventory of the country's natural resources and the patterns of urban land use.

2. The country's mainstays, are agriculture and forestry, substantial amounts of coffee, sugar, bananas, cotton and forest products being produced. Prior to the destruction caused by man, Costa Rica was covered by a tropical forest made up of some 1 200 species.

3. The development of agriculture made it necessary to cut down vast stretches of this virgin growth, with 50% to 70% being turned into cropland pastures and urban areas. This changeover was totally uncontrolled and took place under constant pressure to intensify the use of the land.

4. Some 50 000 hectares are being cut down every year. In view of the fact that 50% of Costa Rica's 51 000 km^2 still contain woodlands, this rate of felling will result in total destruction of the natural ecological systems in little more than 25 years. This felling resulted in the destruction of ground water reserves and a great increase in soil erosion, such that the soil cover on many slopes was removed.

5. At the same time croplands are being turned into urban areas. For example, San José, the capital has grown in terms of population (from 145 000 inhabitants in 1945 to 487 000 in 1973) and in area (from 1 000 hectares in 1945 to 4 000 hectares in 1973). This urban expansion has taken place at the expense of crop production, especially with regard to coffee and sugar cane.

6. This led to a search for ways of maintaining the rate of economic growth while at the same time ensuring that the country's natural resources were managed effectively. To this end the Institute of Renewable Natural Resources was created, and plans were adopted for the reforestation of some 1 000 hectares a year.

7. At the same time, the Government of Costa Rica established a number of remote sensing programmes with the participation of the following bodies: Ministry of Agriculture and Animal Husbandry (MAG), National Geographic Institute (IGN), National Institute for Housing and Town Planning (INVU), Department of Statistics and Censuses (DGEC), Office of Agricultural Sector Planning (OPSA), Planning Department of the Office of the President (OFIPLAN), Institute of Technology (ITCR), University of Costa Rica (UCR) and the National University (UNA).

8. Other institutions have participated in the remote sensing programme or have used the results obtained in, and data emerging from each project. In addition to the institutions referred to above, the following may be cited in this connection: National Council for Scientific and Technological Research (CONICIT), Ministry of National Planning and Economic Policy, Agrarian Development Institute, State University for Tele-Education (UNED) and the National Association of Banana Growers (ASBANA).

9. Since 1969, IGN has been acquiring and using air photographs. The whole territory of Costa Rica has been photographed by air on panchromatic film, but some of these photographs are now out of date. In addition the country has been mapped in its entirety on a scale of 1:200 000 and 1:50 000.

a) Projects and reports completed

- Application of remote sensing images to the inventory of natural resources of Costa Rica (1976).

- ATN/SF - 1550 - RE technical co-operation non-reimbursable agreement between IDB and the Government of Costa Rica (1977-1978) on training of six Costa Rican professionals.

- AID CP - 255 Agreement relating to the remote sensing pilot project (No. 515 - 0144) between USAID and the Government of the Republic of Costa Rica (1978-1979)

- Evaluation of the use of remote sensors in planning relating to the natural resources of Costa Rica (1979).

- Application of radar data from space for developing countries: a case study carried out in Costa Rica (1979).

- Preliminary evaluation of urban land use in the Central Valley of Costa Rica, based on information obtained from LANDSAT (1979).

- Spectral enhancement of images of Costa Rica derived from LANDSAT and super-imposed on topographical maps (1980).

- Study of SEASAT data for purposes of research and geomorphological surveying of Costa Rica (1981).

10. Many of the studies were carried out in co-operation with ERIM and were submitted to the fourteenth International Symposium on Remote Sensing of the Environment (ERIM 1980) held at San José.

The following bodies helped to finance these programmes:

1) Latin American Development Bank (IDB)
2) United States Department of Agriculture
3) United States Agency for International Development (AID)
4) Federal Republic of Germany
5) University of Michigan, ERIM
6) Laboratory for applications of remote sensing (LARS) of Purdue University.

b) Staff

The programme has made it possible to train various technicians and professionals in remote sensing. About 40 such people belong to the institutions listed above and were trained in the United States.

c) Equipment

Equipment includes Zeiss RMK 15-23 cameras, A8 cameras, Zeiss C-8 cameras and a Bausch and Leomb transferoscope. IGN uses an IBM 370 computer, but there is no interactive analysis system.

VENEZUELA

1. In 1983, Venezuela initiated the installation of a digital image processing system. Prior to that, only visual interpretation of data provided by satellite and air photography carried out through the Ministry of the Environment and Renewable Natural Resources (MARNR) had been available. Standard equipment, including mirror stereoscopes and zoom stereoscopes, is available. Multispectral photographs are analysed on the basis of Mark II and Wild RC-9 multispectral cameras, which are usually transported on a Queen aircraft.

2. The National Institute of Cartography is using two systems for colour compositions: the ADDCOL Mini I²S and the Mode 1200B Data Control system, which is similar. LANDSAT data and other photographic materials have been processed in black and white; the LANDSAT images are being enlarged up to a scale of 1:250 000. Work has begun on the installation of automatic equipment for colour development. For digital analysis, the Central Statistical Office (OCEI) of the Venezuelan Scientific Research Institute has created the Digital Image Processing Centre (CPDI), which went into operation at the end of 1983.

3. CPDI is provided with the following equipment:

- An IBM 370/148 computer with a 2-Mbyte memory capacity;
- Three disk units with a capacity of 1 600 Mbytes;
- A Ramtek graphic system;
- An Optronics image digitaliser for colour and black-and-white with a scanner.

4. CONADIN has expressed interest in the regional remote sensing project in connection with its uranium prospecting studies. This is a regional project which is sponsored by the Organization of American States.

5. LANDSAT and radar data have been used to map parts of Venezuela at a scale of 1:250 000, and the data is stored in the National Mapping Office. There is also a need for training in the use of digital data, and there is a recognized need for staff specializing in remote sensing.

6. The point of contact with the government in the field of mapping is the National Mapping Office in the Ministry of Environment and Renewable Natural Resources. There is a recognized need for training, in particular for carrying out the inventory of natural resources, photographing the land, etc. Computers are not being used although IVIC can provide access to a modern IBM 370/148 with a 2-Mbyte memory capacity and three disks, each with 1 600 Mbytes. IVIC also has a Ramtek terminal and an Optronics colour image digitaliser.

BRAZIL

1. In Brazil, the Space Research Institute (Instituto de Pesquisas Espaciais (INPE)) is the main government organization dealing with space activities. INPE was created in 1971 to replace the National Committee on Space Activities (Comissão Nacional de Atividades Espaciais (CNAE)). The Institute is affiliated with the National Council on Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)). However, normative decisions relating to activities to be carried out in the Institute are taken by the Brazilian Committee on Space Activities (Comissão Brasileira de Atividades Espaciais (COBAE)), at ministerial level.

2. The Institute for Space Research is located at São José dos Campos (SP), where most of its research activities are carried out; Cuiabá is the place where data is acquired and Cachoeira Paulista is the seat of the processing centre.

3. The present position of space application in Brazil may be summarized as follows:

- there are facilities for the reception, processing and dissemination of data gathered by all meteorological and remote sensing satellites;

- a great effort has been made to develop methodologies for the application of data in the study and monitoring of natural resources and land development, environmental observation, climatic mapping, regional and urban planning, pollution studies, disaster forecasting and control, weather forecasting, crop research and management of atmospheric processes;

- the necessary technical know-how has been acquired for the design and construction of terrestrial systems for receiving and processing data results from satellites;

- data results obtained so far have shown that the economic returns to the country have fully justified the investment made.

4. The ITOS/NOAA Station project began in 1975 and was regarded as a decisive technological step with regard to terrestrial stations for the reception of information from meteorological satellites.

5. Prototypes of data collection platforms (DCPs) are being developed. In addition, INPE is now in a position to receive and decode data transmitted directly from satellites. The infrastructure exists for receiving and diffusing GOES data from receiving stations to users by means of a commercial telephone link-up with a system constructed locally (UAR-M).

6. The Institute is participating in the LANDSAT programme and has a well-established system for tracking, receiving, processing and distributing data transmitted by satellites in the LANDSAT series. The Cuiabá tracking and receiving station makes it possible to cover a large portion of South America.

7. INPE offers its users various LANDSAT products, such as colour and black-and-white images and computer-compatible tapes. It is improving its receiving and processing system so that data from the multispectral scanner, thematic maps from LANDSAT-4 and, in the near future, SPOT data can be received and processed.

8. The main function of the Multispectral Image Processing Laboratory (LTID) is to extract thematic information and raise the visual quality of multispectral images obtained by aircraft and satellites. LTID has been provided with the Image-100 System, and the majority of the programmes have been developed in INPE.

9. The Image-100 System is connected to a video camera and a DCOMED film recorder. The processing of images is supported by the central computer.

10. The Burroughs 6800 has a capacity of 2.4 Mbytes and a disk memory of 800 Mbytes; 20 terminals are connected to the image processor. A Calcomb tape system is available. INPE also has access to the Cyber CDC 175 at the Aerospatial Institute.

11. The processing and examination of images includes the development of algorithms, programmes and documentation for:

a) image processing which includes edge detection, visual contrast, two dimensional filters, recording techniques and interpretation;

b) the selection of attributes through mathematical transformations;

c) image classification;

d) context analysis by classifying the texture of edges.

12. In addition, a new system of image processing (SITIM), designed for general use and based on a national computer, is being put together. It is also possible to digitalise photographic materials up to one meter, by using other facilities existing in the department.

13. A turbo-jet aircraft (Bandeirante) can transport the Barnes PRT-5 for infra-red sensing and cameras for panchromatic and black-and-white film. The Bendix M2S scanner used previously is out of commission and will be replaced by a Daedalus multispectral scanner. The remote-sensing aircraft conducts studies at the request of users. A terrestrial monitoring vehicle with an elevation platform and a spectral radiometer is also in preparation.

14. The Brazilian Institute for Forestry Development (IBDF) belongs to the Ministry of Agriculture and is divided into five departments.

15. In 1977, the preliminary phase went into operation through an agreement between IBDF and INPE. In 1979 IBDF created the National Remote Sensing Programme in order to supervise and monitor the activities organized under a deforestation project, a reforestation project and a national parks project with the objective of periodically preparing a map of the country's forestry resources. This process is carried out annually on the basis of visual interpretation and by means of a computer, LANDSAT MSS and RBV data, low survey flights and intense field work in ten different laboratories distributed throughout the country. In 1980 the Forest Cover Monitoring Programme was expanded to include the whole country.

16. The Brazilian Forest Cover Monitoring Programme is now the world's largest ongoing project for forest coverage. Periodically maps covering over 800 million hectares are made through the use of a three-stage system for acquiring data; in this process, LANDSAT products are used as a primary source of interpretation.

17. The Brazilian Institute for Forestry Development makes intensive use of the maps and reports obtained through this programme. In certain projects, such as that relating to the supervision of deforestation in the Amazon region, illegal exploitation of timber within national parks is monitored periodically. The use of the maps within the National Ongoing Forest Inventory System (NCFIS) under IBDF is also of great importance. A number of governmental agencies are also provided with support. In view of the growing volume of data acquired both by the Monitoring Programme and by the Forestry Inventory, a National Forestry Information System (SISF system) is being developed.

18. Within this project, some 5 000 LANDSAT images have been acquired since 1973. Interpretation is carried out visually by using LANDSAT images on a scale of 1:250 000. Use is also made of a spectral data system with colour added based on LANDSAT 70-mm chips. Digital analysis is carried out in INPE or IBM/Brasilia, by special request only, so as to reduce costs. Visual interpretation of LANDSAT images is controlled by air missions and field experiments.

19. Maps of forested areas are produced on a scale of 1:100 000 or 1:250 000 depending on the age and species of the trees and the density of the plant cover. These maps are brought up to date every two years and are used as planning instruments in controlling both deforestation and reforestation.

20. Previously maps were produced by means of visual interpretation of LANDSAT images. Efforts have been made to train interpreters in remote sensing methods. In addition to short-term courses, long-term training programmes have also been carried out; three technicians will receive their diplomas at the end of 1985 and another two will begin the programme next year. More "internal" digital analysis of images in co-operation with IBM/Brasilia is envisaged as a firts step. At that

time, IBDF will need to train forestry engineers in the interactive digital processing of images if the system is to operate. In future IBDF will require support in order to purchase new technology, but, at the same time, it will be able to provide other users with services related to the interpretation of forest data obtained by remote sensing.

21. The Institute for Space Research has developed a post-graduate curriculum at the master's and doctor's levels, in co-operation with Brazilian universities.

22. Since the programme for remote sensing by satellite began in 1973, the number of images produced and the number of users have risen constantly. The production of images in Brazil gives some idea of the intensive use made of LANDSAT information by over 1 000 Brazilian users.

23. Following the installation of the LANDSAT satellite receiving station in 1974, work increased in the fields of agriculture, forestry, geology, oceanography, hydrology, cartography, geography and environment. At the first Brazilian symposium on remote sensing held in INPE in 1978, 100 reports prepared by Brazilians were presented. At the second national symposium held from 10 to 14 May 1982, 106 reports were presented.

24. Among the studies carried out in Brazil on the basis of satellite images, mention may be made of the one conducted on the extensive coastal plain, in which important coastal phenomena occurring in connection with the sea and lagunas in the Province of Río Grande do Sul were observed. The work was done by visual and automatic interpretation, the results being a study of the biological productivity of the system.

25. Another study was carried out on dry areas in the State of Balua. In it, the dynamics of land use were observed. Information was obtained in the fields of geology, geomorphology, climate, hydrology and land use. The study made it possible to formulate plans for monitoring and preserving the processes involved in soil acidification.

26. Under agreements with other institutions, INPE is carrying out an active applications programme.

Agronomy

A system for predicting yields by satellite was established and used in the years 1982-1985 in the States of São Paulo and Paraná in connection with sugar cane, soya beans and wheat. In the district of Jardinópolis, automatic interpretation was carried out in connection with sugar cane, and this was extended throughout the State of São Paulo, which produces 70% of the country's sugar cane crop. Another study concentrated on the identification of maize, soya beans and wheat. Special studies have been made to determine the agricultural forest in an attempt to establish the boundary between the savanna and the arid regions or marshlands. A study was also made of fires and scorched land.

Forestation

In this field studies were carried out on woodlands, deforestation and reforestation. Information provided by remote sensing is used to study the production of timber, charcoal, paper and alcohol. Reforestation is an alternative source of low cost, renewable energy which creates few environmental problems. A number of reforestation studies were carried out on pines and eucalyptus with a level of accuracy of 90%. Maps showing the deforestation of the Amazonian jungle, which are of value nationally and internationally, are prepared very successfully by remote sensing, which is the major source of information in view of the vastness of the jungle. There is also a programme to detect changes in the plant cover throughout the country.

Geology

In this discipline geological maps at regional scale were prepared --a task of the utmost importance in view of the enormous scale of Brazil. An evaluation was also made of mineral resources and of petroleum resources in particular.

Oceanography and hydrology

Studies were made of oceanographic data using VHRR data from NOAA satellites, which were also used in constructing a model map for use in sardine fishing. Other model fishery maps were also prepared. In the field of hydrology, a number of studies were made of various water basins.

Geography

Studies were carried out on current land use and also on such factors as the pollution of bodies of water and the sedimentation of harmful substances in reservoirs, with a view to determining potential land use. Environmental deterioration, such as that represented by desertification, was also evaluated in a number of regions.

Cartography

A cartographical study was carried out and aeronautical charts prepared. In this connection, the plan provides for the photogrammetrical study of all of Brazil on a scale of 1:250 000 with internal accuracy of 120-150 meters, and for the preparation of aeronautical charts on the same scale.

Other institutions which are working with INPE on remote sensing projects and applications such as those mentioned above include:

- Brazilian Forest Development Institute (IBDF)

- Brazilian Enterprise for Agricultural Research (EMBRAPA) with headquarters in Brasilia and dependencies, such as CPAC, CPATSA and CPAEU, which are concerned, respectively, with agricultural research in the savanna, semi-arid tropics and the tropical wetlands.

- Brazilian Institute of Geography and Statistics (IBGE)
- The Department of the Environment (SEMA)
- The Rio Grande Rice Institute (IRGA)
- The Amazonian Development Authority (CODEAMA)
- The Amazonian Development Superintendence (SUDAM)
- The Amazonian Radar Project (RADAM)
- The Fishery Development Superintendence (SUDEPE)
- Department of Agriculture (various States)
- Federal universities, e.g., the Federal University of Santa María and the University of Rio Grande Do Sul
- IBM Scientific Centre in Brasilia, which offers interactive analysis systems based on IBM 7350 computers and RAMTEX and HACIENDA terminals.

27. In addition to the system referred to, INPE is planning to purchase a VAX 780 computer and COMTAL equipment for digital analysis of images. CPAC is provided with a RAMTEX terminal which uses the IBM 4341 and 3350 central computers belonging to EMBRAPA.

28. The meteorological information obtained by satellite, in addition to being used in many important traditional meteorological applications, is used in basic research for the construction of numerical models of the atmosphere; in this way weather and climate forecasting and the simulation of climatic variations are improved. The meteorological information obtained by satellites is of great importance for Brazil and plays an important role in the determination of the meteorological and climatic characteristics of the country.

29. With respect to climatic and environmental data, different institutions, in addition to INPE, such as the National Institute of Meteorology of the Ministry of Agriculture (INEMET), DNAEE (a branch of the Ministry of Mines and Energy), DNOS (a branch of the Ministry of the Interior) and the Air Force Meteorological Service, obtain information for the network. There is a network consisting of some 10 data collecting platforms (DCP) which extends along the basin of the Tocantins river.

The main events in the INPE remote sensing programme are as follows:

1967 - Co-operative programme established with NASA.
- Training for a group of experts from various institutions in Brazil.

1968 - Agreement signed between CNPq/INPE and NASA.
- The first phase dedicated to training experts from Brazil in the United States of America.
- The second phase consisted in the training of a group of 40 Brazilian experts.
- Demonstration areas selected in Brazil.
- Instruments designed for a Brazilian remote sensing aircraft.

1969 - Third phase consisting in NASA aircraft flights over the demonstration areas in Brazil.

1970 - Sensors are installed in the Brazilian Bandeirante belonging to INPE.

1971 - Fourth phase consisting in the flight of the Bandeirante over the demonstration areas.
- CNPq/INPE embark on studies using data obtained by the ERTS satellite and Skylab.

1972 - CNPq/INPE decide to purchase an ERTS satellite receiving and processing station, which is installed in Cuiabá, while the processing station and the distribution centre are installed at Cachoeira Paulista.

1973 - Receiving station begins to function under INPE.

1974 - Processing station begins to function.

1975 - CNPq/INPE purchase a GE IMAGE 100-image analysis system.

1976 - NASA agreement renewed.
- LANDSAT data received directly and processed by INPE.

1977 - Master's programme in remote sensing approved by the Federal Council of Education.

1978 - First national symposium on remote sensing held with 300 participants in attendance and 85 studies presented.
- CNPq/INPE purchase a second image analysis system (BENDIX-MDAS).

1979 - CNPq/INPE decide to modify the receiving and processing stations to receive the future LANDSAT D and SPOT satellites.

1980 - A new Bandeirante aircraft is purchased by CNPq/INPE.

1982 - Second national symposium on remote sensing held with 500 participants in attendance and over 100 studies presented.
- Master's degrees granted in remote sensing and its applications.
- Completion of reception facilities and recording subsystems for the LANDSAT 4 and TM.

1983 - LANDSAT 4 and TM processing station begins its trial period.

1984 - National meeting on remote sensing to be held.

BOLIVIA

1. In Bolivia, the ERTS Programme of the Geological Service of Bolivia carried out its activities in 1972 by using LANDSAT data in multidisciplinary studies. Radar and conventional air photo images were also used within the area covered by the map survey.

2. The main applications of remote sensing are in the fields of natural resources, geology, geomorphology, forestry and land use. Digital processing of multispectoral data was introduced in the programme at an early date. Fifteen technicians are working in different sciences associated with the land (geologists, geomorphologists, geographers, hydrologists, forestry experts, botanists and zoologists). These integrated multidisciplinary studies are supported by a modern cartographical and photo laboratory which processes satellite images on different scales in black-and-white and in colour.

3. For the interpretation of these images, a density slicer, zoom transferoscopes, stereoscopes and optical enlarger are used. Multispectoral data analysis is supported by the DEC 10, DEC 20 and IBM 370 systems. In co-operation with Purdue University, Bolivia's first geographic information system has been created by using an Apple II microcomputer in connection with a digitalizer and a plotter.

4. Bolivia has the necessary infrastructure for organizing remote sensing courses, with experts trained in Europe and the United States. In this context, the Argentine initiative for the establishment of a regional remote sensing programme has been received with great interest.

5. The ERTS Geobol programme (CIASER) is well equipped for developing and interpreting air and satellite images. The following equipment is available for photographic reproduction and enlargement:

- A Durst 189 enlarger;
- A contact copier (1 x 1 metre format);
- Facilities for black-and-white development;
- An automatic developer for colour film (1 x 1 metre format);
- A densitometre.

6. Infrastructure is also available for printing maps with a cromalin system. Images are for the most part interpreted visually, but the laboratories are also equipped with an Addcol I2S miniviewer and an analogous VP8 ISI image manipulator with a video camera connection.

7. The institute is provided with a LANDSAT image archive which covers the country by means of 70-mm chips and prints on a scale of up to 1:250 000. Unfortunately, the coverage by LANDSAT data is incomplete after 1980. A terminal connected to a DEC 10 computer by a telephone line makes it possible to use the Larsy programme for image processing.

8. The National Aerophotogrammetry Service (SNA) is conducting a photogrammetric study of Bolivia. Four aircraft equipped with Wild RC-10 cameras are covering the country with black-and-white photos on scales of between 1:50 000 and 1:40 000. Infra-red/false-colour images have only reached the testing phase.

9. Photogrammetric equipment is available for interpretation. The Service consists in a team of six experts in natural sciences who interpret aerial photos in different branches of the natural resources and who also conduct mapping surveys and are responsible for administration. Data interpretation is supported by Wild mirror stereoscopes and a Zoom transferoscope. On the basis of the aerial photos, SNA carries out projects in different parts of Bolivia, with emphasis placed on forestry and land use. In 1982, SNA initiated an integrated project in the Cuenca del Río area. The project draws upon a number of disciplines, including forestry, agriculture, soil science, geology and geomorphology. The scale of the maps produced is 1:25 000 to 1:50 000; normally maps on a scale of 1:100 000 are used for studies whose coverage is extensive.

10. LANDSAT images were used to plot optional routes for a pipeline between Santa Cruz (Bolivia) and Corumbá (Brazil). The LANDSAT satellite data provided basic information for plotting an optional route for a project for the construction of a railway valued at many millions of dollars, running from Santa Cruz to Trinidad, in Bolivia, which had been paralyzed because of a lack of basic information on the geomorphology, geology and hydrography of the land. Other projects carried out in Bolivia include the national census of 1976 (a population and housing census), a map of the land surface of the entire territory of Bolivia, on a scale of 1:100 000, and soil and land-use maps on a scale of 1:50 000, covering approximately 34 000 km2 in the Altiplano. These maps are now being used to carry out settlement projects in that area.

11. Bolivia has received international assistance for remote sensing projects, having obtained funds from the International Centre for Research in Development (CIDA) of Canada, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the Agency for International Development (AID) of the United States. The Inter-American Development Bank has carried out a project for investigating natural resources in the Department of Oruro (in south-eastern Bolivia). So far, these international agencies and Bolivian organizations have, in conjunction with the Government of Bolivia, which provides counterpart funding, financed a total of 24 projects whose overall cost is estimated at close to US$ 730 000.

12. In the project relating to the construction of the pipeline mentioned above, about US$2 000 was budgeted for purchasing and interpreting for LANDSAT images, and those images enabled geologists to shorten the length of the route originally proposed by 17 km, thereby saving to US$12 million on construction costs. In terms of the 1976 budget, the cost reduction of US$12 million represents a considerable saving for the government.

13. Data collection platforms have also been installed for collecting data concerning the water in river flows, their depth and temperature; the water content of snow, the depth of snow, air moisture, wind direction and the concentration of sediments.

14. Institutions and the work they perform:

- UPFB (Petroleum Company). Petroleum and mineral prospecting.
- Bolivian Mining Corporation (COMIBOL). Petroleum and mineral prospecting.
- Bolivian Geological Service (GEOBOL). Updating of geographical maps at various scales and geology and mining studies.
- Ministry of Agriculture. Soil and forestry maps.
- Military Geographic Institute of Bolivia (IGM). Updating of existing maps on the basis of information provided by satellites.
- National Meteorological and Hydrological Service. Hydrological maps using remote sensing data.

15. Other work performed included an evaluation of the natural resources in a 500 km^2 area in the Amazon basin as an initial step towards an assessment of land intended for settlement. Thirty-eight LANDSAT images relating to relief, soil and vegetation were processed. The study provided the information needed to select certain areas for settlement projects.

16. Remote sensing was also used to classify land in another taxonomical work.

17. In this effort, 50% of the country, or 680 000 km^2, were mapped on a scale of 1:250 000. The rest of the country will be covered shortly.

18. Another study was carried out to record land use. This made it possible to classify the entire country in eight categories on a scale of 1:1 000 000.

19. Another extensive study dealt with the geomorphology of an area located in the Department of Oruro.

20. In this area a semiarid climate predominates, and the topography was affected by the action of volcanoes, wind, rivers and lakes.

21. Wind action has caused serious problems in areas where there are sand banks.

22. River action is causing floods due to the low lie of the area, and a high rate of evaporation is causing rapid salinization of the soils.

23. In view of the fact that Bolivia is basically a mining country, mineral resources have been the subject of many studies. This has not been true of resources such as water, soils or vegetation so that it is necessary to become familiar with the geomorphology of the land supporting them, which may be studied very successfully through the use of satellite information. The study referred to here resulted in the classification of the area in geomorphological units, each of which is directly associated with renewable resources.

TRAINING COURSES IN REMOTE SENSING OFFERED BY THE TECHNOLOGY TRANSFER PROGRAMME OF THE REMOTE SENSING DEPARTMENT OF THE INSTITUTION FOR SPACE RESEARCH (INPE), 1974-1981

Name of course	Entity	Period	Place	Number of participants
Remote sensing applications with emphasis on LANDSAT images, with natural resource surveying (this course was given 14 times)	Public and private enterprises, governmental agencies and universities	1974 to 1979	Various cities in Brazil	299
Introduction to remote sensing techniques and applications	Public and private enterprises, governmental agencies and universities	25 to 29 August 1980	São José Dos Campos, SP	29
Remote sensing applications with emphasis on the use of LANDSAT images in natural resource surveying	Public and private enterprises, governmental agencies and universities	1 to 12 December 1980	São José Dos Campos, SP	20
Use of LANDSAT images in describing cleared areas and drainage networks	Araguaia Tocantins Executive Land Groups (GETAT)	22 to 27 June 1981	Imperatriz, MA	10
Use of LANDSAT images in surveying current land use and describing drainage networks	Cândido Rondon Foundation	10 to 21 August 1981	Cuiabá, MT	12
Remote sensing applications with emphasis on the use of LANDSAT images in surveying natural resources	Public and private entities of various Brazilian states	14 to 25 September 1981	Natal, RN	47
Introduction to the techniques of remote sensing applications	Units in the Ministry of Aeronautics	25 November to 4 December 1981	São José Dos Campos SP	15

LATIN AMERICAN PARTICIPANTS IN THE INTERNATIONAL SEMINAR HELD BY THE EROS CENTRE (USA) AND IN THE SHORT COURSE OFFERED BY THE LARS, REMOTE SENSING PROGRAMME FOR VISITING SCIENTISTS. PURDUE UNIVERSITY, WEST LAFAYETTE, INDIANA (USA)

Country	Number of participants	
	1973-1982 EROS	1972-1978 LARS
Argentina	3	0
Bolivia	2	9
Brazil	14	3
Colombia	1	0
Costa Rica	5	6
Chile	14	1
Ecuador	2	0
El Salvador	4	4
Guatemala	5	4
Guyana	1	0
Haiti	2	1
Honduras	4	4
Mexico	13	3
Nicaragua	3	3
Peru	0	1
Dominican Republic	1	0
Uruguay	1	0
Venezuela	4	0

COLOMBIA: REMOTE SENSING COURSES AT CIAF, 1963-1980

(Students per course and country)

Country	Soils	Forestry	Geology	Civil engineering	Total
Argentina	9	7	19	3	38
Bolivia	7	12	14	1	34
Brazil	12	8	25	-	45
Colombia	84	47	29	30	190
Costa Rica	4	1	1	-	6
Cuba	1	-	-	-	1
Chile	3	2	2	1	8
Ecuador	14	7	15	3	39
El Salvador	6	-	1	1	8
United States of America	-	-	1	-	1
Guatemala	4	1	-	2	7
Haiti	2	-	-	-	2
Honduras	1	3	1	1	6
Mexico	4	5	15	4	28
Nicaragua	4	1	-	2	7
Panama	5	2	-	1	8
Paraguay	-	2	1	-	3
Peru	9	12	7	2	30
Dominican Republic	12	-	-	-	12
Uruguay	-	-	-	1	1
Venezuela	26	7	8	1	42
Total	207	117	139	53	516

ARGENTINA: FOREIGN PARTICIPANTS IN REMOTE SENSING COURSES AT CNIE, 1977-1982

Country	General	Hydrology	Pollution	Oceans	Agriculture	Seminar	Geology	Total
Bolivia			1		3			4
Brazil		1			1	1		3
Colombia					1	1	1	3
Chile	1			1	1	3	1	7
Ecuador		1	1	1	3	1	1	8
Dominican Republic		1			1	1		3
Mexico		1	1	2	3		1	8
Venezuela		2	2	2		2	2	10
Honduras			2			2		4
Panama			1					1
El Salvador		1	1					2
Uruguay	1	1	2			3	1	8
Paraguay	1	4	1				1	7
Peru		1	1	1		1		4
Nicaragua			1					1
Costa Rica				1	1	1	1	4
Cuba						2		2
Argentina	25	25	20	22	40	14	20	166
Total	28	38	34	30	54	31	30	245

ARGENTINA: TRAINING COURSES IN REMOTE SENSING HELD BETWEEN 1976 AND 1984

Name	Organized by	Sponsored by	Date	Place	Participants		
					Argentines	Foreigners	Total
First Latin American remote sensing course	CNIE	OAS and Argentine Engineering Centre	1 to 26 November 1976	Buenos Aires	33	2	35
Second Latin American remote sensing course	CNIE	CNIE-EROS DATA CENTER (USA)	6 June to 1 July 1977	Buenos Aires	22	2	24
First national remote sensing course	CNIE	CFI	10 to 28 July 1978	Las Vaquerías Córdoba	21	-	21
Second national remote sensing course	CNIE	National University of San Juan	16 October to 3 November 1978	San Juan	28	-	28
Latin American seminar on remote sensing applications in the evaluation of natural resources	CNIE	OAS	4 to 8 June 1973	Buenos Aires	17	15	32
Seminar on remote sensing		Engineering Centre Province of Buenos Aires	3 to 7 September 1979	La Plata	25	-	25
Interpretation of LANDSAT images	CNIE	National University at La Pampa, Ministry of Economics and Agrarian Affairs, La Pampa	10 to 14 September 1979	Salta	28	-	28
Third national remote sensing course	CNIE	CFI - Government of the Province of Chubut	1 to 19 October 1979	Esquel Chubut	26	-	26
United Nations training course on remote sensing applications	CNIE	United Nations (OSAD)	5 to 23 November 1979	San Miguel Buenos Aires	11	15	26
Fourth national remote sensing course	CNIE	Regional Centre for Scientific and Technological Research (CRICYT)	19 to 30 May 1980	Mendoza	28	-	28

ARGENTINA (cont.)

Name of course	Organized by	Sponsored by	Date	Place	Participants		
					Argentines	Foreigners	Total
Latin American course on applications of remote sensing in geological exploitation and mining	CNIE	OAS	6 to 27 October 1980	San Miguel Buenos Aires	11	12	23
Fifth national remote sensing course	CNIE	CFI, Government of the Province of Salta	24 November to 5 December 1980	Salta	27	-	27
Postgraduate course in the application of remote sensing to the study of natural resources	CNIE	Scientific Research Commission of the Province of Buenos Aires	1 April to 30 December 1981	San Miguel Buenos Aires	14	-	14
Sixth national remote sensing course	CNIE	CFI, Government of the Province of Misiones	22 June to 3 July 1981	Posadas Misiones	24	1	25
Latin American course on application of remote sensing in hydrology	CNIE	OAS	7 to 25 September 1981	San Miguel Buenos Aires	13	13	26
Extensive course on application of remote sensing to agriculture and coastal studies (nine months duration)	CNIE	CIC, Province of Buenos Aires	March to December 1981	San Miguel Buenos Aires	15	-	15
Third national meeting on automatic collection of environmental data by satellite	CNIE	CNIE	27 and 28 April 1982	San Miguel Buenos Aires	68	1	69
First course of application of remote sensing to the teaching of geography	CNIE	National Ministry of Education	19 to 23 July 1982	Buenos Aires	37	-	37

ARGENTINA (cont.)

Name of course	Organized by	Sponsored by	Date	Place	Participants		
					Argentines	Foreigners	Total
Second course on application of remote sensing to the teaching of geography	CNIE	National Ministry of Education	26 to 30 July 1982	Buenos Aires	39	-	39
Introductory course on remote sensing	CNIE	Environment Office	2 to 6 August 1982	Buenos Aires	30	-	30
Course on application of satellite images	CNIE	CFI, Government of the Province of Jujuy	9 to 13 August 1982	San Salvador de Jujuy	29	-	29
Basic and specialized course on remote sensing	CNIE	CNIE	23 August to 3 September 1982	Buenos Aires	32	-	32
Seventh national remote sensing course	CNIE	CFI, Government of the Province of Neuquén	27 September to 8 October 1982	Ciudad de Neuquén	...	...	...
Latin American course on application of remote sensing to environmental pollution	CNIE	OAS	18 October to 2 November 1982	San Miguel Buenos Aires	23	14	37
Eighth national remote sensing course	CNIE	CFI, Government of the Province of Entre Ríos	8 to 12 November 1982	Paraná Entre Ríos	27	-	27
Course on digital analysis of LANDSAT images	CNIE	CNIE	7 to 25 March 1983	Buenos Aires	12	-	12
Third course on application of remote sensing to the teaching of geography	CNI	National Ministry of Education		Buenos Aires	37	-	37
Fourth course on application of remote sensing to the teaching of geography	CNIE	National Ministry of Education		Buenos Aires	39	-	39

ARGENTINA (cont.)

Name of course	Organized by	Sponsored by	Date	Place	Participants		
					Argentines	Foreigners	Total
Fifth course on application of remote sensing to the teaching of geography	CNIE	National Ministry of Education		Buenos Aires	39	-	39
National course on application of remote sensing to agriculture and forestry	CNIE	University of La Plata	20 June to 1 July 1983	La Plata Buenos Aires	32	-	32
National course on application of remote sensing to agriculture	CNIE	CFI, Government of the Province of San Luis	8 to 16 August 1983	San Luis	24	-	24
Latin American course on application of remote sensing to oceanography	CNIE	OAS	17 October to 1 November 1983	Mar del Plata	19	-	19
Remote sensing course	CNIE	Environment Office	25 April to 6 May 1983	Buenos Aires	29	-	29
Remote sensing course	INTA	INTA	5 to 30 September 1983	Buenos Aires	25	-	25
Course on application of remote sensing to prospecting and evaluation of natural resources	Ministry of Education and Culture, Province of Buenos Aires	Ministry of Education and Culture, Province of Buenos Aires	15 August to 15 December 1982	La Plata Buenos Aires	28	-	28
Course on application of remote sensing to prospecting and evaluation of natural resources	Ministry of Education and Culture, Province of Buenos Aires	Ministry of Education and Culture, Province of Buenos Aires		La Plata	24	-	24
Course on remote sensing	Universidad del Centro	Universidad del Centro	1 July to 30 September 1982	Tandil Buenos Aires	20	-	20
First course on hydrology and remote sensing	National University at Tucumán	National University at Tucumán	12 to 17 April 1982	San Miguel de Tucumán	16	-	16

ARGENTINA (concl.)

Name of course	Organized by	Sponsored by	Date	Place	Participants		
					Argentines	Foreigners	Total
Course on application of remote sensing to the teaching of geography	CNIE	National Ministry of Education and Justice	July 1984	Buenos Aires	30	-	30
National remote sensing course	CNIE		September 1984	Buenos Aires	30	-	30
Regional course on application of remote sensing to agriculture	CNIE	OAS	22 October to 9 November 1984	Buenos Aires	15	12	27

NATIONAL SYMPOSIA ON REMOTE SENSING APPLICATIONS HELD IN ARGENTINA BY CNIE

Name of symposium	Date	Place	Number of participants
First National Symposium: Analysis of LANDSAT Information	6-10 August 1979	Buenos Aires	57
Second Symposium	17-21 November 1980	Buenos Aires	91
Third Symposium	16-20 November 1981	Buenos Aires	81
Fourth Symposium	26 November 1982	Buenos Aires	62
Fifth Symposium	26-30 November 1984	Buenos Aires	

ATTENDANCE BY LATIN AMERICAN EXPERTS AT ERIM SYMPOSIA

Country	Ann Arbor 1979	Costa Rica 1980	Ann Arbor 1981	Egypt 1982	Total
Argentina	2	14	3	2	21
Bolivia	1	8	-	-	9
Brazil	1	8	-	2	11
Costa Rica	4	304	1	-	309
Cuba	-	2	-	-	2
Chile	1	4	-	1	6
Ecuador	1	5	-	1	6
Colombia	-	2	-	-	2
Guatemala	-	3	2	-	4
Haiti	-	1	-	1	2
Honduras	-	2	-	-	2
Jamaica	1	3	-	1	5
Mexico	5	25	8	1	39
Panama	-	4	-	-	4
Peru	-	4	2	-	6
Dominican Republic	-	5	-	-	5
Venezuela	1	4	-	-	5

LARGEST SALES BY ERIM IN LATIN AMERICA OF DATA OBTAINED BY REMOTE SENSING, FEBRUARY 1977-MARCH 1978

Country	Purchasers	Sales (in dollars)
Argentina	23	135
Bolivia	7	1 490
Brazil	39	972
Colombia	21	679
Costa Rica	4	50
Chile	11	2 295
Ecuador	2	41
El Salvador	1	0
Guatemala	4	26
Honduras	2	0
Mexico	45	25 552
Nicaragua	1	50
Paraguay	4	0
Peru	6	63
Dominican Republic	4	400
Uruguay	3	68
Trinidad and Tobago	2	16
Venezuela	10	2 613

CUBA

1. In the early stages of the exercise in Cuba, work was performed with photographic material obtained in aerophotogrammetric initiatives designed primarily with a view to updating maps on various scales.

2. The majority of the experts who participated in the early stages of the photointerpretation belonged to private enterprises prospecting various mineral resources.

3. In 1975, as a result of the progress made in the Intercosmos Programme, the working group on remote sensing of the earth by aerospace was established, and Cuba has been a member ever since.

4. The "Tropical Experiments" were used to obtain basic photographic material to embark on remote sensing in Cuba. The multiregional aerial experiments Tropical I, Tropical II and Tropical III were carried out in 1977 and 1978, 1979 and 1980, respectively; the last experiment was carried out in association with the first joint Soviet-Cuban flight.

5. In these three experiments, land measurements were made simultaneously with the objective of learning the truth about the earth, especially while the air and space photographs were being taken. In addition to all the information referred to, data obtained from Soviet and North American satellite observations were available.

6. In 1976, a remote sensing department was established in the Institute for Basic Technical Research (ININTEF) of the Academy of Sciences of Cuba, where the work done in remote sensing in Cuba is co-ordinated.

7. At the end of 1980, some 50 experts and technicians were available from institutions working in basic technical research, geography, sugar cane, geology and paleontology, botany, soil sciences, oceanography and meteorology, all belonging to the Academy of Sciences of Cuba. The Institute of Hydrology and the Institute of Geodesy and Cartography were also so involved.

8. In the five-year period 1976-1980, research in remote sensing was covered in the Plan relating to Major Problems of State. In the current five-year period, this research is included in that part of the Plan which relates to the main problems confronted in basic research.

9. The studies carried out have been supported by the Cuban Geodesic and Cartographical Institute, which was responsible for the specialized air surveys. For this task, IL-14 aircraft and especially equipped AN-30 aircraft were utilized. The aircraft were equipped with Soviet instruments, such as AFA-39 cameras, which were used in the Tropical I and II experiments; these were subsequently replaced by the MKF-6M multispectral camera from the Democratic Republic of Germany, which was used in the Tropical III experiment.

10. The research carried out included that conducted in respect of the evaluation of fields sown in sugar cane; as part of the studies, it was possible to evaluate and categorize in subclasses, to study the importance of varieties, strains, age, soil, etc.

11. A comparison was made of traditional remote sensing methods upon the study of marine platform structures. Concrete elements were obtained in the interpretation of photographic images of various components of the coastal area, such as water lines, sand beaches, abrasion and accumulation costs, cumulative marine terraces, etc.

12. In soil mapping, it could be shown that remote sensing makes it possible to correct the limit of taxons with 20% greater accuracy than with traditional surveys.

13. Many studies have been carried out by means of multispectral photograph and surface water, dams and ground water. It was possible to interpret clearly permanent and temporary water flows; natural and artificial water deposits and very wet, marshy areas.

14. The application of remote sensing methods in combination with geological, geophysical and geomorphological data showed the presence of circular structures and lines, whose sources and means of formation were highly variable and which were presumably associated with neotectonic movements and were unknown or only guessed at in the past.

15. The Biosphere C experiment consisted in the instrumental and visual examination of the environment from the Saliut-Soyuz orbital complex. The research was designed to study objectives of a geological, oceanological and meteorological nature.