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Report on INPE's activities during the period 1974 for COSPAR (XVIII Plenary Meeting, 1975). Emphasis is on interdisciplinary projects as an efficient way to prepare personnel for the country's development.

17. Remarks

INTRODUCTION

SPACE RESEARCH AS PART OF THE BRAZILIAN RESEARCH EFFORT

In order to allow more flexibility of action in the execution of the government policy for the sector of science and technology, the former National Research Council (CNPq) has had its legal structure changes into a foundation, from which it is expected greater emphasis on research for development.

The new council is now called "Conselho Nacional de Desenvolvimento Científico e Tecnológico" (National Council for Scientific and Technological Development), although it keeps its old acronym, CNPq. The present title reflect the emphasis mentioned above. INPE continues as one of the council's institutes.

As INPE activities have always aimed at (1) securing benefits through the application of space derived technologies; (2) using fundamental research as a tool in the formation of scientific personnel; and (3) improving the level of its personnel through appropriate post-graduate courses, so that the country can count on a supply of competent and motivated people, as the basis for an effective acquisition of useful new technologies. The work of the institute has not suffer changes

in orientation with the transition of CNPq.

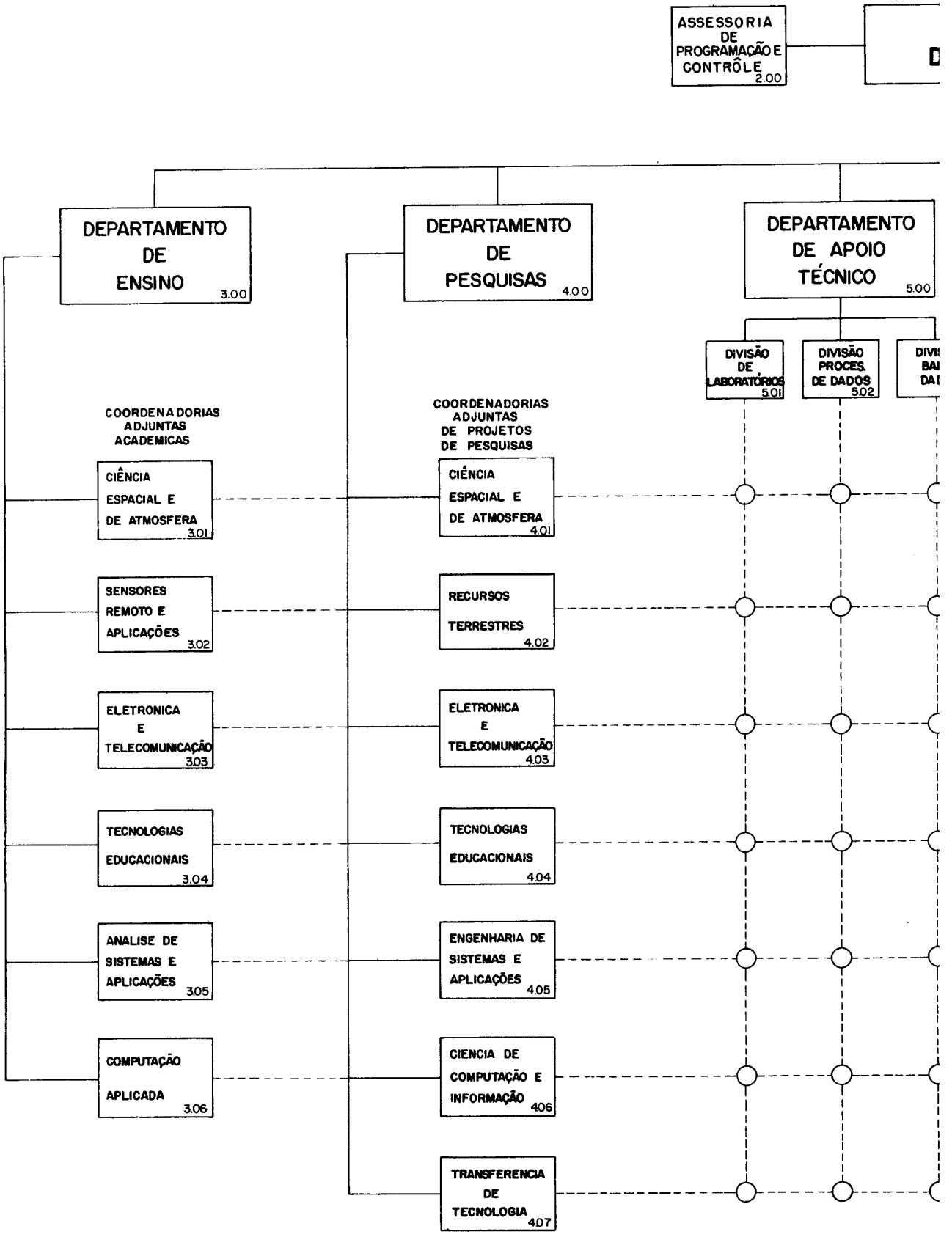
Recognising that scientific research and academic activities go hand-in-hand at INPE, its present organization chart shows this fact, as per diagram in the next page. There it can be seen that the academic department ("Departamento de Ensino") and the research department ("Departamento de Pesquisas") have coordinations that run parallel to each other, because of the affinities of the respective subjects.

The present chart also brings out the existence of the several sites of INPE activities. Their names appear under the box labelled "Unidades Subordinadas" (subordinate units).

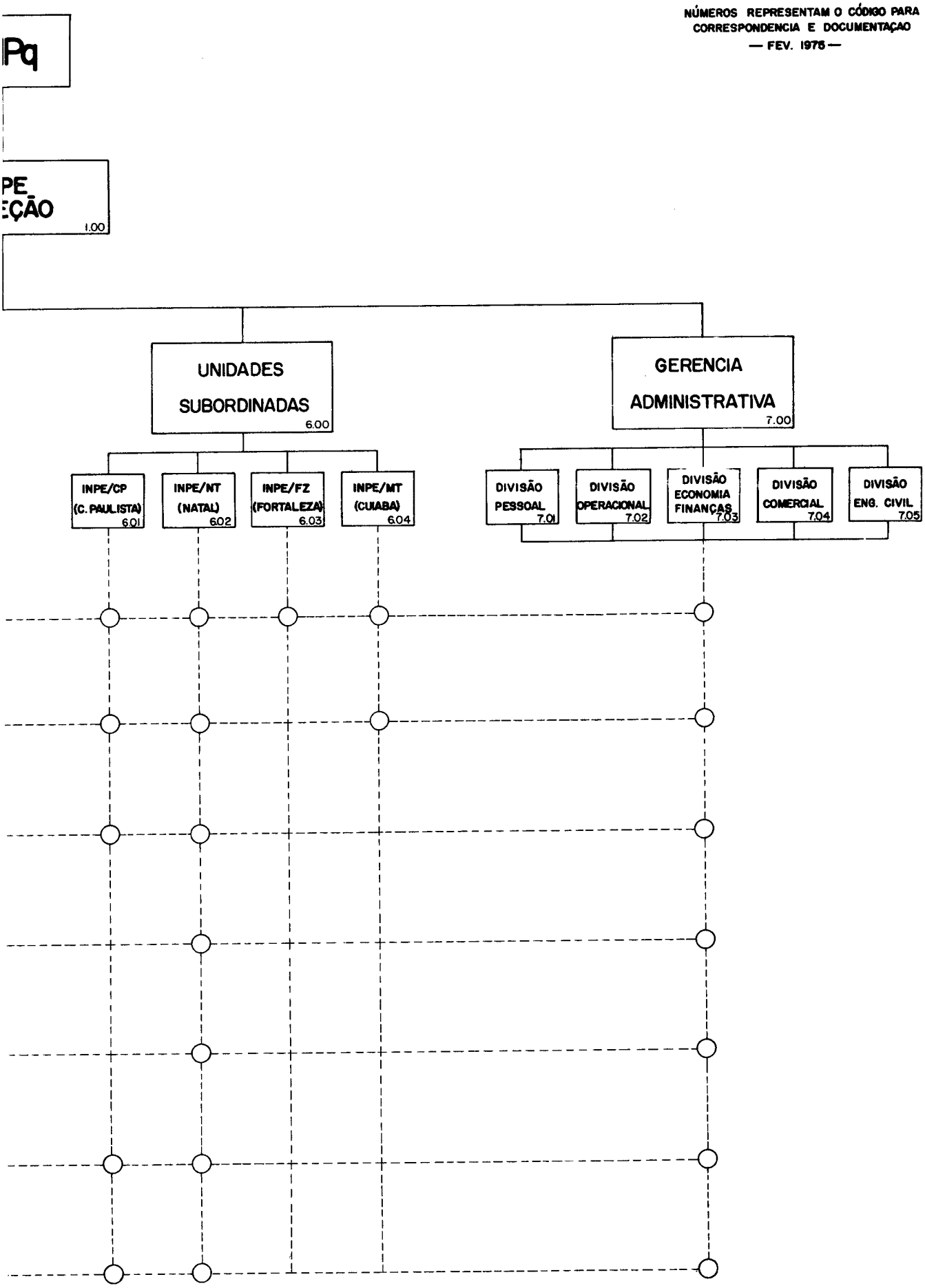
The volume and importance of the information handled and the need to keep in touch with other scientific organizations and to complement the country's scientific and technological information network, has required that the data bank activities be brought to full strength. This increased effort is beginning to give fruits which, however, still fall short of the desired level.

A new development in the internal organization is the formal creation of an office for the coordination of programs and the control of projects ("Assessoria de Programação e Controle"), directly attached to the Director's office. The main idea is to improve on the

PRESIDENCIA DA REPUBLICA
SECRETARIA DE PLANEJAMENTO (SEPLAN)
CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLÓGICO (CNPq)
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS (INPE)



NÚMEROS REPRESENTAM O CÓDIGO PARA
CORRESPONDENCIA E DOCUMENTAÇAO
— FEV. 1975 —



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system of decentralized execution with strong central control, already in use at the institute.

INPE has about 1000 persons working full time in its several sites, the bulk in São José dos Campos. Of the total, more than one third are college graduates, MS and PhD's.

This introduction will supply an overview of the work done in the principal projects since the last COSPAR meeting and some events like, for instance, the opening up of training opportunities, under UN sponsorship, for nationals of other developing countries; the adoption and expansion of the Rio Grande do Norte Educational Experiment, by the Brazilian Ministry of Education; the broadcasting of instructional programs via the ATS-6 satellite, from São José dos Campos to Natal, state of Rio Grande do Norte; and the decision of the Brazilian Government to implement a communications satellite system to integrate the remote areas of the country with the existing high capacity network. Such a system will also be useful for educational broadcasts.

REMOTE SENSING

Practically speaking, Brazil must rely on remote sensing techniques to obtain the necessary information in a useful time frame. Conventional methods have proved too lengthy, costly and insuficient. The less developed a country is, the more it needs efficient technologies

and Brazil is no exception.

Conscious of the importance of remote sensing for national development, the Federal Government has included it as a priority project in its plans for development, with INPE as the responsible agency for execution.

INPE is funded directly by the Federal Government and the several "user" ministries, which work jointly with the institute on the problems in the areas of agronomy, geology, oceanography, etc. They are:

- The Ministry of Agriculture which, through its several departments, maintains direct agreements with INPE for the study of agricultural and forest problems.
- The Ministry of Mines and Energy, for the evaluation and study of mineral resources. This Ministry has a vast remote sensing program of its own, the Project RADAM, which uses side-looking airborne radar (half of Brazil has been covered).
- The Ministry of the Interior has the large number of department working with INPE in various areas such as oceanography, geology, forestry, agronomy, pollution, geography, geodesy, cartography, etc.

Data is obtained from the LANDSAT (formerly ERTS)

of the Espírito Santo and Minas Gerais States. This work mapped more than 600,000km^2 and 13 types of vegetation using 3 researchers during 23 days of work.

- Estimation map of the deforestation to the implantation of Pasture projects in the Northeast region of the Mato Grosso State using ERTS-1 images.

- Basic map of the Vazante Region in the Minas Gerais State using conventional aerial photographies in the scale of 1:60,000.

- Estimation of the areas occupied by natural forests in the State of Paraná using ERTS-1 images.

- Map in the scale of 1:30,000 using aerial photographies of the Ipatinga Region related to forest problems.

Mineral Resources

- Analysis of the ERTS-1 images potentialities in the determination of the favorable areas to the mineral occurencies related to geological structures.

- Geological interpretation of the São Francisco River Basin in the scale of 1:1,000,000 using ERTS-1 images.

- Structural interpretation of the chart to the millionth, basing on ERTS-1 images, Radar and SKYLAB, of Goiás, Belo Horizonte, Brasília, Goiânia and São Francisco River.

- Contribution of the ERTS-1 images to the study of the Geological structures for the North of the Goiãs State.

- Contribution of the ERTS-1 images in the Geomorphological interpretation of the Upper Course of the Paraguai River.

- Geomorphological outline of part of the central western part of Brazil, basing on the ERTS-1 images.

- Geological, structural and geomorphological interpretation using the ERTS-1 images of the central northern part of the Mato Grosso State.

- Geological and Geomorphological interpretation of the Brazilian central western part using the ERTS-1 images.

- Geological and geomorphological interpretation of the East area of Niquelândia basing on the ERTS-1 images.

- Geological and structural interpretation of 13 ERTS-1 images, in the scale of 1:1,000,000, from several parts of the central western portion of Brazil.

- Geomorphological interpretation of 12 ERTS-1 images, in the scale 1:1,000,000, from several Brazilian regions.

- Preliminary report of the ALUMINIUM PROJECT aiming at testing the aplicability of the photographic sensors to detect the aluminium ore over the Alkaline Massif of Poços de Caldas.

- Preliminary report of the ZINC Project which aims at collecting and interpreting data from photographic sensors in the Bambuí Group (geological unit of estimated potentiality in non-ferrous ore (Zinc and lead)).

Geography

- Analysis of the ERTS-1 images potentialities to geomorphological mapping.
- Morphological analysis of the hydrographic basins using the ERTS-1 images.
- Drainage mapping of the Belo Horizonte chart with the ERTS-1 images.
- Soil use map of the São José dos Campos city.
- Estimation of the areas component of the São José dos Campos urban system.
- To characterize and hierarchize the São José dos Campos road system.
- Establishment of relationships between the urban occupation and the road system of the São José dos Campos city.
- Geomorphological mapping of the Belo Horizonte chart with ERTS-1 images.

- Mapping of the hydrography of the Brasília chart.

Sea Resources

- Project of a transmissometer to measure the light penetration in the water at different wavelengths.
- Use of the ERTS-1 images to coastal studies in the Guanabara Bay and adjacent waters.
- Development of a methodology aiming at the construction of fishing charts.
- Participation in the digitalization works of the NOAA Satellite images series.
- Elaboration of computer programs for the preparation and analysis of the digitalized images (NOAA).
- Preparation of a technical report about the Guaíba river to the Rio Grande do Sul State Government, considering problems related to the pollution of lagunar waters.
- Preparation of 48 original temperature and salinity charts of the Brazilian South coast, comprised between the São Tomé Cape and Itajaí.
- Definition of the system to the preparation and simulation of charts, profiles and diagrams of the oceanographical variables from

the information contained in the Oceanographical sector of INPE data bank.

- Participation in the GATE Project (GARP Atlantic Tropical Experiment). This project encircles a system observation with 37 ships, 13 aircrafts and satellites in the area of the East Atlantic, near the 10^{o}N and 27^{o}W. It aimed at carrying out experiments to increase the knowledge of the meteorological processes of the equatorial belts essential to complete a study about the atmosphere as a whole. In this Project participated: Brazil, Canada, Colombia, England, Federal Republic of Germany, Finland, France, Holland, Mexico, Portugal, Senegal, URSS, and USA. A large part of the Brazilian territory is of low latitudes and, consequently, it will receive benefits of this project results. Besides INPE was given the function of National Center for processing the GATE data (NPC), under the operational point of view.

- Preparation of nutrient charts to an oceanographic Atlas of the Brazilian South coast, between São Tomé Cape and Itajaí.

- Study of the sea water color and its relation to light penetration, chlorophyll and primary production, for future construction of fishing charts.

- Utilization of the historic oceanographic data, of the Oceanic part of the Rio Grande do Sul and preparation of 10 charts of surface temperatures distribution.

Special Activities

Establishment and reconnaissance of ecological correlation necessary to the aerospectrophotogrammetric identification of the esquistossomose (schistosoma) focus. Determination of spectral signatures of the vegetation habitat (calladium sp.) of the host mollusks.

HIGHLIGHTS OF PROJECT SACI

The importance of Rio Grande do Norte Experiment has been enhanced by the interest of the Minister of Education in having it expanded under the aegis of the Ministry and the Secretary of Education for the State of Rio Grande do Norte.

Besides, the planned broadcasts through NASA's ATS-6 satellite have taken place. The experiment with the satellite started in December 1974 and should last until the spacecraft is moved from its present position at longitude 110W to longitude 30E, in mid-1975.

With earth terminals at São José dos Campos and Natal and a few direct receiving sets in selected schools, the experiment still goes on. The bigger terminals have 10m diameter parabolic reflectors. The signal received at Natal is retransmitted via land TV to the schools of the

experiment.

The many years of work and demonstration finally resulted in the signature of an executive order to the effect that Brazil will have its own satellite communication systems. Requests for proposal are already being prepared.

SYSTEMS ENGINEERING AND APPLICATIONS

This multi and interdisciplinary group is engaged in the research and dissemination of advances in Systems Engineering. The group carries on internal work and also external consultation work, via agreements between INPE and the interested agencies. The applications have included modelling the economics and finance of business enterprises, a numerical dynamics model of a hidrographic basin, an algorithm for linear programming, applying operations research techniques to hospital administration etc. The example are not exhaustive, but only given as an idea of the range covered.

BASIC RESEARCH AT INPE

The Space and Atmospheric Sciences group, which spends about 20% of INPE's resources, carries out basic research in astrophysics, geophysics, and meteorology. INPE has 55 scientists working in this area.

1. Astrophysics

Balloon observations of cosmic rays, X-rays and Gamma-rays.

Solar cosmic ray propagation.

2. Geophysics

Geomagnetism:

- Geomagnetic fluctuations during magnetic storms and associated ionospheric effects.
- Precipitation of geomagnetically trapped particles at low latitudes.

Airglow:

- Atomic oxygen 6300 and 5577Å emissions.
- Hidroxyl (8-3) band emission.

Aeronomy:

- Stratospheric aerosols.
- Mesospheric sodium.

Ionosphere

3. Meteorology

APT Stations

EXAMETNET

VHRR Station

GATE

1. ASTROPHYSICS

Balloons Observations of Cosmic Rays, X-Rays and Gamma-Rays

In December 1974 and March-April 1975, 3 balloon borne payloads were launched from São José dos Campos, São Paulo, Brazil, with the objective of studying the precipitation of charged particles in the region of the Brazilian Magnetic Anomaly. In addition, 3 control flights were conducted in February 1975 from Fortaleza, Brazil near the geomagnetic equator and away from the main region of the Anomaly.

The detector in all these flights consisted of a thick 4" x 4" NaI(Tl) crystal, a thin 3" x 1/2" NaI(Tl) crystal, and a 3" x 2" NE110 plastic scintillator. Energy spectra were obtained in the energy range 30kev - 5MeV from both locations as a function of the altitude and at the ceiling altitude of 4mb. Integrated charged particle fluxes ($E \geq 100$kev) were also obtained in the same locations. Data were obtained during magnetically quiet and disturbed periods. The results are being analyzed taking into account models for the production of X- and γ-rays in the atmosphere by the primary cosmic rays, and models of precipitation of particles from the Van Allen Belts by geomagnetic disturbances.

In the flights from São José dos Campos, in addition to the detectors mentioned above, a Compton telescope was included, detecting γ-rays in the energy interval 0.3 - 5MeV. It was used to detect γ-rays

of extra-atmospheric origin, and the results so far obtained confirm the detection of the sources SCO-XI and the galactic center. An energy spectrum of SCO-XI was obtained. A more detailed analysis of the data from the galactic center is in progress.

Data from the spark chamber experiments flown by the Saclay group in 1973 were analysed in Saclay, France; Palermo, Italy and INPE, Brazil. Results indicate that for energies >20MeV the Galactic Equator line-like source is not as smoothly disturbed in b^{II} and l^{II} as previous results indicated. A pronounced enhancement shows up very close to the position on the X-ray source GX5-1, suggesting that this point source could be responsible for as much as 50% of the total gamma-ray emission at E > 20MeV. The integral flux above 60MeV of the line source related to the Galactic Disc was found to be 1.5×10^{-4} photons/$(cm^{-2}s^{-1}sr^{-1})$. As a part of the spark chamber payload, a 70cm NaI(Tl) crystal collimated at ($15^{o} \times 48^{o}$) F.W.H.M. surveyed the large scale features of the sky in the X-ray energy range 30 - 150keV. The results are consistent with a galactic plane extended source as derived by the unresolved contributions of the (2 - 6)kev sources. SCO-XI was detected in this energy range. Its relative strength with respect to the average for the source located near the galactic plane appears to be reduced by a factor of 4 in comparison to the relative at (2 - 6)kev obtained considering the maximum source intensity as quoted in the 3U catalogue.

Solar Cosmic Ray Propagation

Data from the low-energy solar cosmic rays on board the Explorer 34 and 41 satellites indicate that the time of maximum in the energetic storm particle increase occurs mainly from 6 to 12 hours after the passage of the interplanetary shock front, and that the direction of maximum intensity is usually along the nomical interplanetary magnetic field lines. Calculations show that the particles responsible for the increase propagate from the sun along these lines. In the case of solar flare induced shock waves, the field lines are most likely associated with the tangential discontinuity in front of the driver gas. It was concluded that in these cases the peak of the energetic storm particle increase could be used as a new way of signaling the arrival of the driver gas.

2. GEOPHYSICS

GEOMAGNETISM

Geomagnetic fluctuations during magnetic storms and associated ionospheric effects

Rapid run geomagnetic measurements at São José dos Campos ($23^{o}14'S$, $45^{o}51'W$) offer an opportunity of studying the effects of the South Atlantic Magnetic Anomaly on the magnetosphere-ionosphere interaction during magnetic storms. Magnetically disturbed periods like March 8-9, 1970, August 4-5, 1972, October 16-22, 1973 and July 4-7, 1974 have been studied in detail using magnetograms from São José dos Campos and several other observatories around the Anomaly. This comparative study has shown that during severe magnetic storms the total field intensity in the Anomaly undergoes more prominent fluctuations. Further, it seems that some features are of purely local characters and may be related to ionospheric currents similar to those occuring in the auroral region.

Precipitation of geomagnetically trapped particles at low latitudes

The precipitation of charged particles at low latitudes has been studied through direct measurements of charged particles and atmospheric X-rays and γ-rays at balloon altitudes, while ground based magnetometers have simultaneously recorded the geomagnetic field

variations. The balloons have been flown from São José dos Campos ($23^{o}14'S$, $45^{o}51'W$) and Fortaleza ($03^{o}45'S$, $38^{o}34'W$) carrying sodium-iodide and plastic scintillator detectors. São José dos Campos is located near the center of the South Atlantic Magnetic Anomaly and Fortaleza stands very close to the magnetic equator. Increases in the flux of precipitating electrons have been observed during geomagnetically disturbed periods at both locations.

Abrupt changes in the geomagnetic field and geomagnetic fluctuations with periods of few minutes show good correlation with particle precipitation.

AIRGLOW STUDIES

The Atomic Oxygen 6300Å and 5577Å Emission

Regular observations of the zenith intensities of the OI 6300 and 5577Å nightglow emissions using a tilting-filter photometer have been carried out at Cachoeira Paulista ($22.7^{o}S$, $45.2^{o}W$). An all sky scanning photometer to study these emissions, in addition to either NaI 5890 - 96Å or NI 5200Å emission will be shortly installed at Cachoeira Paulista.

In March 1974, ground based observations of the OI 6300Å emissions were carried out at Jicamarca, Peru in conjunction with a Black Brant IV rocket flight (EQUION) from Chilca, in collaboration with the University of Texas, Dallas, U.S.A.

In collaboration with the University of Michigan, Ann Arbor, U.S.A., we are participating in the Atmospheric Explorer C - Airglow Photometer Intercalibration project.

The Hidroxyl (8-3) band emission

Regular observations of the OH(8-3) band nightglow emission intensities and rotational temperature using a tilting-filter type photometer were carried out at Cachoeira Paulista. The diurnal and seasonal variations of this emission and rotational temperature at this low latitude station are being studied.

AERONOMY

Stratospheric Aerosols

Stratospheric scattering profiles obtained using a laser radar have shown that the aerosol concentration is now less than 10% of its values in 1964, shortly after the Mt. Agung eruption. These observations show occasional enhancements in stratospheric aerosol content, usually in September or October. This work is continuing in an attempt to determine the cause of such enhancements.

Mesospheric Sodium

The profile of mesospheric sodium is measured by means of a

laser radar tuned to the sodium D_2 line. An analysis of these observations suggests that the considerable fine structure observed in the sodium layer is dynamic in origin, and could be used to study mesospheric dynamics. Solar tidal oscillations in the layer have been observed, and attempt is being made to relate these observations to the theoretically predicted tidal components.

IONOSPHERE

INPE operates ionosondes at Cachoeira Paulista ($22^{o}70'S$, $45^{o}20'W$) and Fortaleza ($03^{o}47'S$, $38^{o}32'W$). Total electron content is monitored by means of a VHF polarimeter using signals from geostationary satellites. A riometer is used to measure ionospheric absorption, and the phase and amplitude of a transequatorial VLF transmission are continuously recorded with a view to studying D region phenomena. These measurements are made at São José dos Campos ($23^{o}13'S$, $45^{o}51'W$).

Incoherent scatter studies are carried out in conjunction with the Arecibo Observatory, Puerto Rico. This work includes studies of artificial heating of the ionosphere and plasma instabilities.

3. METEOROLOGY

APT STATIONS

Since 1967 INPE has been tracking meteorological satellites with a low cost APT station developped at the Institute.

Given the low cost and good performance of this station, 20 units were manufactured and installed at diverse locations, with the purpose of improving local weather forecasting, stimulating research and incorporating modern techniques into the Brazilian meteorological data collection system. Improvements and additional satellite techniques are readily passed on to these stations by INPE.

Tracking of NOAA satellites has been operational at INPE since October. A computer program which generates a grid for the satellite pictures has been developed.

The trainning program for APT operators offered by INPE will accept, starting 1975, personnel from any South American country.

EXAMETNET

Brazil actively participates in the Experimental Inter-American Meteorological Rocket Network (EXAMETNET) program together with the United States, Argentine and France, INPE being the institution responsible for

this participation.

At Natal ($5^{o}55'S$, $35^{o}10'W$) a total of 24 launches were performed in 1974, 7 being in the second semester. As usual, data reduction is being done at INPE and the reduced data is being sent to the WDC-A.

A new launching site at Marambaia ($23^{o}03'S$, $43^{o}40'W$) has been incorporated in the EXAMETNET program with the objective of improving the network density (Marambaia is the only EXAMETNET station at a latitude around $23^{o}S$). Launchings at Marambaia are expected to start in June 1975.

VHRR STATION

A tracking station equiped to receive the VHRR (Very High Resolution Radiometer) and VTPR (Vertical Temperature Profile Radiometer) is being assembled at INPE. This station is expected to become operational sometime during the second semester of 1975.

In the near future the VHRR station will be modified to allow tracking of the geosynchronous meteorological satellites.

GATE

INPE has been designated as the Brazilian National Processing Center for GATE. Planning and execution of operational procedures for processing and validation of all national land upper air and surface

meteorological data collected during the Experiment are INPE's responsibilities.

INPE has also participated in the acquisition of meteorological data on board of the Brazilian ships "Sirius" and "Almirante Saldanha".

The following research topics will be taken up in 1975 with the help of GATE data:

- Statistical study of tropospheric and stratospheric disturbances over tropical South Atlantic Ocean.
- Investigation of disturbances in Northeast Brazil and synoptic wind analysis.
- Budget of water-vapor in Northeast Brazil.
- Study of turbulent boundary layer.
- Synoptic studies and rainfall analysis.
- Inter-correlation studies.

In addition to the foregoing, directly to space research, INPE's meteorology group does research on the atmospheric boundary layer, meteorology of the stratosphere and numerical weather prediction.

PUBLICATIONS IN JOURNALS

ALLUN, F.R.; PALMEIRA, R.A.R.; CRACKEN, K.G.; FAIRFIELD, D.H., and GLEESON, L.G. - "Cosmic ray anisotropies observed in the decay phase of solar flare events". *Solar Physics*, 54(38):227, 1973.

ALLUN, F.R.; PALMEIRA, R.A.R.; RAO, U.R.; CRACKEN, K.G.; FAIRFIELD, D.H. and GLEESON, L.G. - "A comparison of cosmic ray anisotropies and interplanetary magnetic field data late in a solar flare". In: *Proceedings of the 13th International Cosmic Ray Conference*. Denver, 1973.

CALHEIROS, R.V.; MOHANA RAO, N.J.; MELO, M.H. - "Correlação entre precipitação e cobertura de nuvens por satélites". In: *Simpósio Nacional de Recursos Hídricos Subterrâneos*, São Carlos, 1973.

ELIAS, M. - "On the green glow of sodium sulfate in active nitrogen". *J. Chem. Physics*, 58(2), 1973.

KAUSHIKA, N.D. - "Ionospheric disturbances due to an ocean waves". *A.G.U.*, 54(4), 1973.

GONZALES, W.D. and MOZER, F.S. - "A quantitative model for the potential resulting from reconnection with an arbitrary interplanetary magnetic field". *Journal of Geophysical Research*, 79: 4186, 1974.

IBRAHIM, M.; KAUSHIKA, N.D. and MENDONÇA, F. - "On the determination of mean ionospheric height related to faraday rotation experiment". *Atmos. and Terrestrial Physics*, 36: 713-715, 1973.

KANTOR, I.J. - "High frequency induced enhancement of the incoherent scatter spectrum at Arecibo". *Journal of Geophysical Research*, 79: 199-208, 1974.

MARTIN, I.M.; RAI, D.B.: PALMEIRA, R.A.R.; TRIVEDI, N.B., ABDU, M.A.; COSTA, J.M. da - "Enhanced low-energy gamma-ray at balloon altitude in the Brazilian magnetic anomaly". *Nature*, 252(25): 5478, 1974.

MARTIN, I.M., TRIVEDI, N.B.; RAI, D.B.; COSTA, J.M. da - "Particle precipitation in Brazilian geomagnetic anomaly during storms". *Planetary Space Science*, 22: 1699-1704, 1973.

MEDRANO-BALBOA, R.A.; BLAND, C.J.; FREEMAN,Jr., J.W. - "The solar magnetic particle 'square wave' during the August 1972 solar storm". *IAGA Bulletin*, 34: 196, 1973.

MEDRANO-BALBOA, R.A.; FREEMAN,Jr., J.W.; HILLS, H.K.; VONDRAK, R.R. - "Penetrating solar flare particles and solar wind observations in the lunar night, August, 1972". *Solar Terrestrial Physics Report UAG*, 28: 361, 1973.

MEDRANO-BALBOA, R.A.; FREEMAN,Jr.,J.W.; VONDRAK,R.R.; HILLS, H.K. - "Observation of a driver gas tangential discontinuity". In: *International Symposium on Solar Terrestrial Physics*, 1, São Paulo, 1974. p.204.

MEDRANO-BALBOA, R.A. and KANTOR, I.J. - "Model associating energetic storm particle with flare sites". In: *International Symposium on Solar Terrestrial Physics*, 1, São Paulo, 1974. p.99

MOHANA RAO, N.J.; MENDONÇA, F. de - "Rainfall fluctuations break associated synoptic systems". *Pure and Applied Geophysics*, 109: 1877-1891, 1973.

MOHANA RAO, N.J.; NUNES, G.S.S.; ANANTHAKRISHNAN, S. - "Satellite range measurements - ionospheric refraction effects". In: *Space Research*. Berlin, Akademic, 1975. V. XV.

MOHANA RAO, N.J.; SATYAMURTY, P.; RAMANA RAO, T.V. - "On the values of stratospheric circulation index over Natal". *Pure and Applied Geophysics*, 104, 608-613, 1973.

MOZER, F.S. and GONZALEZ, W.D. - "Response of polar cap convection to the interplanetary magnetic field". *Journal of Geophysical Research*. 78: 6784, 1973.

MOZER, F.S.; GONZALEZ, W.D., BOGOTT, F: KELLEY,M.C.; SCHUTZ,S. - "High latitude electric fields and terrestrial magnetic fields". *Journal of Geophycial Research*, 79: 56, 1974.

TAKAHASHI, H., CLEMESHA, B.R.; SAHAI, Y. - "Nightglow OH (8,3) band intensities and rotational temperature at 23^{o}S". *Planetary Space Science*, 22: 1323, 1974.

VIEIRA DIAS, L.A. and GORDON, W.E. - "Artificially induced enhancements in the ionospheric backscatter spectrum near electron gyrofrequency and second harmonic plasma line". In: *Proceedings of the Symposium on Effects of the Ionospheric on Space Systems and Communications*, Washington, 20-22, Jan. 1975, U.S. Printing Office.

VIEIRA DIAS, L.A. and GORDON, W.E. - 'Observations of electrons cyclotron line enhanced by HF radio waves".*J.of Geophys. Res.*, 78: 1730, 1973.

PAPERS SUBMITTED TO JOURNALS

CLEMESHA, B.R.; SIMONICH, D.M.; KIRCHHOFF, V.W.H. - "Automatic wavelength control of a flashlamp pumped dye laser" - *Optoelectronics.*

MEDRANO-BALBOA, R.A.; FREEMAN, Jr., J.W.; VONDRAK, R.R.; HILLS, H.K. - "Solar wind tangential discontinuity observed at the lunar surface" - *Journal of Geophysical Research.*

MEDRANO-BALBOA, R.A., BLAND, C.J.; FREEMAN, Jr.,J.W.; HILLS, H.K.; VONDRAK, R.R. - "The solar cosmic ray 'square wave' of August 1972" - *Journal of Geophysical Research.*

SAHAI, Y., DRESCHER, A.; LOUCHE, H.; TEIXEIRA, N.R. - "First results of the 6300 Å nightglow measurements in the additional rocket program the satellite AEROS" - *Space Research XV.*

SAHAI, Y. and RAI, D.B. - "VLF propagations effects associated with magnetic storms on a transequatorial path passing through Brazilian magnetic anomaly" - *Journal of Atmospheric and Terrestrial Physics.*

SAHAI, Y. and SALES, M.A.O. - "Effects on transequatorial VLF propagation for retrospective world interval July, 26 - August 14" - *Solar Terrestrial Physics - WDC.*

TEIXEIRA, N.R.; ANGREJI, P.D.; SAHAI, Y.; TINSLEY, B.A.; CHRISTENSEN, A.B. - "Tropical twilight HeI 10830 emission" - *Planetary Space Science.*

ZAMLUTTI, C.J. and FARLEY, D.T. - "Incoherent scatter multiple-pulse measurements at Arecibo" - *Radio Science.*

LABORATORY REPORTS

482-RI/202 - *"On a barotropic, non-divergent model"* - P. Satyamurty, R. P. dos Santos, M. A. M. Lemes, January 1974.

485-RI/204 - *Increase in γ-ray flux at balloon altitude during a magnetically disturbed period"* - I.M. Martin, D. B. Rai, R. A. R. Palmeira, N. B. Trivedi, M. A. Abdu and J. M. da Costa, May 1974.

489-RI/207 - *"Utilização de imagens do ERTS-1, radar e infra-vermelho falsa cor, para estudo dos tipos de vegetação e áreas de exploração agrícola"* - C. V. B. Palestino e M. Valério Filho, novembro de 1973.

490-RI/208 - *"Utilização de imagens do ERTS-1 e radar para avaliação dos recursos de vegetação"* - M. Valério Filho, janeiro de 1974.

491-LAFE - *"Manual do usuário de dados do satélite ERTS"* - M. N. Barbosa, E. Santos e L. P. Tavares, junho de 1974.

504-LAFE - *"Sistemáticas para acesso às imagens do satélite ERTS"* - M.N. Barbosa, agosto de 1974.

510-RI/216 - *Determination des flux des photons gamma de basse energie d'origine cosmique dans l'atmosphere"* - I. M. Martin, S. L. G. Dutra, G. Vedrenne, P. Mandrou, août 1974.

511-RI/217 - *"Cálculo de azimute e da elevação a partir de um cruzamento*

com o Equador" - C. J. Zamlutti, agosto de 1974.

512-RI/218 - *"Procedimentos seguidos para o controle de qualidade da transcrição de dados meteorológicos de superfície do Departamento Nacional de Meteorologia (DNMET)"* - J. O. R. Aragão, agosto de 1974.

514-RI/218 - *"Observations of the OI 6300Å nightglow emission near the magnetic Equator"* - Y. Sahai, N. R. Teixeira and J. H. A. Sobral, August 1974.

516-RI/220 - *"X-Rays measurements in the Brazilian magnetic anomaly"* - I. M. Martin, August 1974.

521-RI/222 - *"Digitalização automática de curvas registradas em filmes"* - F. J. C. Barros, setembro de 1974.

524-RI/225 - *"Brazilian Project - The Royal Society - A meeting for discussions - The introduction of satellite into educational systems - London, 18-19 September 1974"* - F. de Mendonça, September 1974.

525-LAFE - *Função de transferência de modulação aplicada ao estudo do desempenho dos sistemas aerofotográficos"* - D. Blitzkow, setembro de 1974.

526-LAFE - *Influência da Zona I no cálculo do desvio gravimétrico da vertical"* - L. D. D. Ferreira, setembro de 1974.

528-RI/227 - *"Manual de processamento de dados de balão piloto"* - G.S.S. Nunes, setembro de 1974.

533-RI/230 - *"Méthode de Monte-Carlo appliquée au calcul de la perte d'energie d'un flux isotrope de rayons gamma dans un scintillateur cyclindrique de NaI(Tl) dans l'intervale d'energie 0.5 - 20 MeV"* - I. M. Martin, S. L. G. Dutra, R. A. R. Palmeira, septembre 1974.

534-RI/231 - *"Calcul du spectre des photons gamma atmosphériques entre 1 - 1000MeV"* - I. M. Martin, S. L. G. Dutra, R. A. R. Palmeira, septembre 1974.

535-RI/232 - *"Tidal oscillations in the meridional wind over Natal"* - V. B. Rao, Y. Yamazaki and T. V. Ramana Rao, September 1974.

537-RI/234 - *"On the annual temperature variation in the stratosphere"* - V. B. Rao, Y. Yamazaki, September, 1974.

544-RI/239 - *A digital control unit for an airglow photometer"* - B. R. Clemesha, October 1974.

555-RI/248 - *"Apresentação de um programa que calcula as sensibilidades relativas de combinações de filtros com o filme infra-vermelho colorido"* - V. C. de Carvalho e Y. E. Shimabukuro, outubro de 1974.

556-RI/249 - *"ERTS images sector of INPE's data bank"* - M. N. Barbosa, A. C. Buss Filho and M. M. Queiroz, November 1974.

557-RI/250 - *"Indicações gerais para lançamento de foguete Dartsonde"* (equipe INPE-Natal), novembro de 1974.

558-RI/251 - *"Gradeamento de imagens produzidas por radiômetros de varredura a bordo de satélites"* - P. H. A. Santana, J. R. de Oliveira, L. G. Meira Filho, outubro de 1974.

562-RI/255 - *"GATE National Data Management Plan"* - November 1974.

565-RI/258 - *"Telescópio - Compton de grande resolução angular para medir raios gama de 0.3 a 10MeV"* - A. Bui-Van, I. M. Martin, K. R. Rao e F. G. Blanco, dezembro de 1974.

566-RI/259 - *"Procedimento para transcrição de dados de ar superior para fita magnética"* - G. S. S. Nunes, dezembro de 1974.

567-RI/260 - *"Estudos de propagação em VLF"* - F. Vitaliano Filho, dezembro de 1974.

568-LAFE - *"Estudo da métrica no campo gravitacional terrestre"* - E.A.B. Stêdile, dezembro de 1974.

573-RI/265 - *"On the possible eigenoscillations of neutral sheets"* - W. A. Almeida, J. M. da Costa, E. G. Aruquipa and J. P. Sudano, December 1974.

580-RI/269 - *"Earth's magnetic field, weather and ozone"* - V. B. Rao, M. A. Abdu and I. J. Kantor, January 1975.

588-RI/277 - *"Determination experimentale du spectre des photons gamma dans l'atmosphère à 12GV de coupure geomagnétique"* - I. M. Martin, S. L. G. Dutra, R. A. R. Palmeira, G. Vedrenne, F. Albernhe, janvier 1975.

591-RI/280 - *"Contribuição ao conhecimento geomorfológico de Chapada das*

Mangabeiras e região adjacente, através de imagens do ERTS-1" E. M. L. de Moraes, janeiro de 1975.

607-RI/289 - *"Método de redução da pressão atmosférica ao nível do mar"* H. M. T. Nunes e G. S. S. Nunes, fevereiro de 1975.

609-RI/290 - *"Sistema Doppler de posicionamento"* - L. D. D. Ferreira e D. Blitzkow, fevereiro de 1975.

612-LAFE - *"Análise de cavidades anisotrópicas acopladas a linha de fita e síntese de circuladores de faixa larga"* - R. R. Bonetti, fevereiro de 1975.

613-RI/291 - *"A rapid method for leaf area estimation of citrus plant"* - S. C. Chen, February 1975.

617-LAFE - *"Mapeamento de vegetação natural dos Estados de Minas Gerais e do Espírito Santo (região Centro-Leste do Brasil) através de imagens MSS do ERTS-1"* - M. K. Nosseir, C. V. B. Palestino e G. T. Batista, fevereiro de 1975.

624-LAFE - *"Estudos teóricos e sinóticos dos distúrbios tropicais"* Y. Yamazaki, fevereiro de 1975.

630-RRE/003 - *"Uso do Sensoriamento Remoto para o levantamento da cultura da cana-de-açúcar com fins de previsão de safra"* - G. T. Batista, abril de 1975.

631-PE/001 - *"Turbulência e estabilidade da camada limite da atmosfera"* D. Nicolli e Y. Viswanadham, março de 1975.

635-LAFE - *"Determinação do espectro de raios gama produzidos na atmosfera pelos raios cósmicos primários"* - S. L. G. Dutra, fevereiro de 1975.

638-RI/298 - *"Estimation in ARMA model with correlated measurement noise"* - R. K. Saha, February 1975.

639-RI/299 - *"Cylindrical ground-clutter shield"* - C. S. Pereira, February 1975.

640-RI/300 - *"Optimal reception of signals having combined binary and continuous phase modulation"* - R. K. Saha, February 1975.

643-DIV/002 - *"The Brazilian Remote Sensing Program"* - System Engineering Group, May 1975.

644-LAFE - *"Time-height section of temperature and wind components over Natal, Brazil for the period August, 1973 - July 1974"* - Y. Yamazaki and P. Satyamurty, February 1975.

645-LAFE - *"Transporte de calor sensível na estratosfera do hemisfério sul"* - K. Hada, fevereiro de 1975.