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COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

CONTENTS

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INTRODUCTION

1. In the report on the work of its tenth session (A/AC.105/637, annex II), the Working Group of the Whole to Evaluate the Implementation of the Recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space made recommendations concerning the preparation of reports and studies by the Secretariat and the compilation of information from Member States.

2. In paragraph 9 of its report, the Working Group recommended that, in the light of the continued development and evolution of space activities, the Committee on the Peaceful Uses of Outer Space should request all States, particularly those with major space or space-related capabilities, to continue to inform the Secretary-General annually, as appropriate, about those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries.

3. The report of the Working Group was adopted by the Scientific and Technical Subcommittee at its thirty-third session (A/AC.105/637, para. 25), and the recommendations of the Working Group were endorsed by the Committee on the Peaceful Uses of Outer Space at its thirty-ninth session.[1]

4. Subsequently, in a note verbale dated 19 July 1996 from the Secretary-General to all permanent representatives to the United Nations, the Secretary-General requested all Governments to communicate to the Secretariat by 30 September 1996 the information requested in the above-mentioned recommendations.

5. In addition, the Secretary-General, in his note verbale, drew the attention of Governments to the recommendation, endorsed by the Committee, that the Secretariat should invite Member States to submit annual reports on their space activities. Besides information on national and international space programmes, the reports could include information in response to requests from the Working Group of the Whole, on spin-off benefits of space activities and other topics as requested by the Committee and its subsidiary bodies.[2]

6. In accordance with the recommendation of the Committee, the Secretary-General, in his note verbale, suggested that Governments could submit in a single report information on topics requested by the Committee and its subsidiary bodies, in particular information on the following topics:

(a) Those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries;

(b) Spin-off benefits of space activities;

(c) National and international research concerning the safety of nuclear-powered satellites;

(d) Studies conducted on the problem of the collision of nuclear power sources with space debris;

(e) National research on space debris.

7. The present document was prepared by the Secretariat on the basis of information received from Member States by 30 November 1996 on the topics listed above in paragraph 6, subparagraphs (a) and (b). Information received subsequent to that date will be included in addenda to the present document. Information received regarding the topics listed in paragraph 6, subparagraphs (c) to (e), is presented in a separate document (A/AC.105/659).

Notes

[1]Official Records of the General Assembly, Fifty-first Session, Supplement No. 20 (A/51/20), para. 31.

[2]Ibid., para. 167.

REPLIES RECEIVED FROM MEMBER STATES *

AUSTRIA

[Original: English]

The Austrian report presents Austria's activities in space research and some related fields in 1994 - 1995. They are largely collaborative efforts with other nations or international organizations. The funding for the various space activities is predominantly provided by the Federal Ministry for Science, Transport and the Arts and distributed to the individual institutions through the Austrian Academy of Sciences and the Austrian Research Foundation ("Fonds zur Förderung der Wissenschaftlichen Forschung - FWF"). Other projects were carried out under ESA contracts.

The booklet with the full text of the report will be available during the session of the Scientific and Technical Subcommittee of COPUOS.

A. Liaison and coordination

The Austrian Space Agency (ASA), which was established in 1972, serves the Austrian Federal Government as a focal point for the coordination of space activities in Austria.

1. Coordination of Activities Related to ESA Programmes

In addition to the involvement in the mandatory programme (general activities including general studies, the technology programme and the science programme) Austria participates in the following optional programmes:

- Earth Observation Programme:
  - European Remote Sensing Satellite ERS-2
  - Earth Observation Preparatory Programme (EOPP - Extension)
  - Polar Orbit Earth Observation Mission (ENVISAT-1 and METOP-1)
  - Meteosat Second Generation (MSG)
  - Programme for the Development of Scientific Experiments (PRODEX)
  - General Support Technology Programme (GSTP)

- Telecommunications:
  - Advanced Systems and Technology Programmes (ASTP)
  - Data Relay Technology Mission (DRTM)
  - Advanced Research in Telecommunications Systems (ARTES)

- Space Transportation Systems:
  - Ariane-5 Development Programme
  - Complementary Ariane-5 Programmes
  - Future European Space Transportation Investigation Programme (FESTIP)

Staff members of ASA attend the meetings of the relevant program boards to represent the Austrian interests in these activities.

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*The replies have been reproduced in the form in which they were received.

A general evaluation of Austria's collaboration in ESA activities shows satisfactory results. The industrial return coefficient calculated by ESA for all countries, showing the geographical distributions of contracts awarded, amounted to 1.02 for Austria as of December 1995. 86.4% of the contracts were awarded to Austrian industrial companies and 13.6% to scientific research institutions and universities.

2. Remote Sensing Activities

An ASA working group on remote sensing is continuing to operate with the tasks of information exchange and promotion of remote sensing activities in Austria. ASA acts as the National Point of Contact (NPOC) for the distribution of remote sensing satellite data in close co-operation with the Earthnet programme of ESA and EURIMAGE. ASA possesses a data file of all LANDSAT images (in the form of photographic quicklooks) taken over Austrian territory. ASA is member of the European Association of Remote Sensing Laboratories (EARSeL) and acts as national representative since June 1989.

3. Coordination of Bilateral Space Activities

Basic agreements without financial obligations exist between ASA and NASA and with the space authorities of France, Germany, Norway, Sweden and Switzerland and serve as a basis for co-operation. Joint space projects can be based on these agreements.

4. United Nations

ASA actively participates in the UN Committee on the Peaceful Uses of Outer Space (COPUOS) and its Scientific and Technical Sub-Committee. Main topics on the agenda are the applications of remote sensing from space for the needs of developing countries, the future utilization of the geostationary orbit, the safe use of nuclear power sources in space and the protection and monitoring of the environment including space debris.

B. Space research institutes

1. Austrian Academy of Sciences, Space Research Institute Graz

(a) Department of Experimental Space Research

There are four major spacecraft missions in which the Space Research Institute of the Austrian Academy of Sciences (SRI) is involved with flight hardware. The four spacecraft mission Cluster is carried out jointly by the European Space Agency (ESA) and the United States National Aeronautical and Space Administration (NASA). It was aimed to probe the Earth's plasma environment with four identical spacecraft on almost identical orbits. Its primary scientific objectives lie in the analysis of boundary layers and wave fields in the plasma environment near the Earth in three dimensions. In 1994 and 1995 the testing of instrument hardware the spacecraft had its most active phase. The Department contributes to Cluster with hardware for two experiments: an instrument to actively control the floating potential of the spacecraft with respect to the ambient plasma (Active Spacecraft Potential Control, ASPOC) and a fluxgate magnetometer, FGM.

The constellation between Earth and Mars favours the launch of Mars missions for 1994 or 1996. The Space Research Institute (IKI) of the former Soviet Union initiated an international effort called Mars-94 with two almost identical spacecraft. For a variety of reasons the missions were postponed to launch windows in 1996 and 1998, respectively. Austria participates with hardware in both missions, namely the experiment MAREMF, a package dedicated to measure magnetic fields and electron spectra, and MARIPROBE-D, a multi-purpose, directional plasma probe. The latter instrument is being built in co-operation with the Institute of Communications and Wave Propagation of the Technical University Graz. The magnetometer design is based on previous experience with devices flown in the missions VEGA and PHOBOS and consists of two

sensor, one inside and the other outside the spacecraft. All of the above instruments are cooperative efforts with one or more institutes from France, the Czech Republic, Russian Federation, Hungary, Ireland, Belgium, the United States or Germany.

The mission INTERBALL consists of two pairs of satellites, one in a fairly low orbit (Auroral Probe, apogee 20,000 km) and the other with an apogee of 200,000 km (Tail Probe). These two very different orbits were chosen in order to cover the auroral and the tail region of the Earth's magnetosphere, respectively. Each of these large satellites is accompanied by a small subsatellite in order to allow differentiation between spatial and temporal effects. Aboard the low-apogee main satellite which is to be launched in mid-1996, the potential will be controlled by an instrument SPEX, similar to ASPOC in the Cluster mission. The goal of SPEX is to maintain a low spacecraft potential in order to allow accurate measurements of the cold plasma components. SPEX is a joint project of the Space Research Institute and the Research Centre Seibersdorf in collaboration with the Space Science Department of ESA/ESTEC.

The joint NASA/ESA mission CASSINI/HUYGENS to Saturn and its moon Titan, planned to be launched in 1997, will also include a lander. In a co-operative project with institutes in Italy, Spain, France and ESTEC an experiment package HASI is being prepared which will measure physical and electrical parameters of the atmosphere in the descent phase starting at an altitude of around 170 km down to the surface. The main experiment topics are measurements of the AC- and DC-fields, permittivity, acoustic fields and electrical relaxation time constant during descent and after impact. At lower altitudes also data processing for an onboard altitude radar will be performed. If the capsule survives the landing, it will also carry out measurements on Titan's surface.

Another experiment of this mission is the Aerosol Collector Pyroliser (ACP). According to observations from the ground and the fly-by of the spacecraft Voyager, Titan is expected to have a nitrogen-methane atmosphere and - probably as a result of polymerisation of carburetted hydrogen - aerosols in it. The ACP experiment is designed to collect, heat, and analyze atmospheric aerosols in the Titan stratosphere and upper troposphere during the descending phase of the HUYGENS capsule. Among the scientific objectives is the determination of the composition of the aerosols and the relative abundance of its constituents, the relative abundance of condensed organic compounds, the mean size of aerosol nucleation sites and the radiative properties of low stratospheric and upper tropospheric particles. The Prime Investigator for the ACP instrument is from the Service d'Aeronomie, CNRS, Paris. Austria is responsible for the development of the flight electronics, the software and the complete ground test equipment. The Austrian hardware contribution is performed under the ESA-PRODEX programme. The Department is responsible for the technical co-ordination, Austrian industry (Joanneum Research and Schrack-Aerospace) are contractors responsible for design, manufacture and tests.

The ACP complex consists of a movable filter which serves as the aerosol collecting target, a drag fan pump to ensure the flow of the Titan atmosphere through the filter, an oven, a nitrogen gas tank, several valves and all dedicated electronics to control the system. After the sampling procedure, the filter is retracted into the oven and isolated from the atmosphere. By heating the filter to two different temperatures the absorbed aerosols are evaporated and carried away by nitrogen gas via an external heatable tube and transferred to the Gas Chromatograph/Mass Spectrometer (GCMS) instrument for further analysis. Both flight instruments have successfully passed all tests and are ready for integration and tests at probe level.

The CASSINI spacecraft will be launched from Cape Canaveral Air Force Station (CCAFS) in October 1997 with a Titan V/Centaur launcher. During the flight to Saturn the space-vehicle will undergo gravity assists by Venus, Earth and Jupiter. The coast phase will start about 22 days before the Titan encounter. After separation of the HUYGENS probe from the CASSINI spacecraft, the probe reaches Titan and enters its atmosphere. During the entry phase the probe will be decelerated from 6.8 km/s to 300 m/s. The atmospheric descent phase will begin with the deployment of the parachute, all instruments are released to activate their experiments.

Of the results of past missions, the one to comet Halley is still of prime interest. In a co-operative study with NASA (Goddard) and IKI (Moscow) the relevance of solar wind structures (changes in the interplanetary magnetic field, IMF) for the so-called disconnection events (detachment of the comet's plasma tail) were studied. Combined in-situ and ground based measurements revealed no correlation between the two phenomena which contradicts earlier computer simulations. Another topic of interest of the Halley observations is the modulation of particle fluxes observed by both the VEGA and Giotto spacecraft. It hitherto only appears certain that the modulation is not exclusively caused by magnetic field variations. The numerical simulation showed the formation of condensations in the plasma tail after a 90° change in the IMF sweeping over the comet.

The mission PHOBOS to Mars and its moon Phobos provided data with a unprecedented time resolution and data from regions near Mars never explored before. The correlation between solar wind parameters and parameters of the boundaries were investigated in detail. It became apparent that the Martian magnetospheric tail depends in a similar way on the solar wind dynamic pressure as that of the Earth - another confirmation of the hybrid character of the solar wind-Mars interaction. In view of the interpretation of observations obtained by the two plasma packages TAUS and ASPERA on board Phobos 2 a comparative study of particle and magnetic field data was initiated. The numerical model of the magnetosheath was extended by incorporation of a draped field geometry within the tail, thus allowing to compute the plasma flow and magnetic field at any point around Mars. Test particles were launched in these prescribed fields and their statistical properties analyzed. The preliminary results are in reasonable agreement with measurements suggesting that the draped field is a meaningful first order approximation to the real Martian wake.

The search in the magnetic field data of the MISCHA experiment aboard the spacecraft VEGA 1 and 2 for phenomena in the solar wind which are thought to be relevant for processes in the coma of Comet Halley was continued. It turned out that for such studies the necessity to simulate disturbances in the solar wind is indispensable. In a joint endeavour with the University of Saint Petersburg (Russian Federation) an MHD code which is capable to advance perturbations in the solar wind from the solar surface into the interplanetary space was implemented. Already first computational results demonstrated the usefulness of the code for simulating the location of sector boundaries.

By means of multi-spacecraft analysis based on data from VEGA 1/2, PHOBOS 1/2, Pioneer Venus Orbiter and IMP 8 a special magnetic field structure known as "magnetic cloud" could be identified. The propagation of test particles in a combined magnetosheath/induced tail field geometry was studied, taking magnetic field and particle data of the magnetic field near Mars (experiment MAGMA) and automatic space plasma experiment with a rotating analyzer (experiment ASPERA) on board Phobos 2 as a basis. It turned out that the model results only match the observations when magnetic shear stresses in addition to the convection electric field are taken into account in the equation of motion of the particles. Hence the main features of the Martian particle environment can be understood within the framework of a pickup process with consideration of additional forces acting on the plasma.

The behaviour of the magnetic field in the close vicinity of the Mars moon Phobos in the upstream region was studied in detail. Variations of the field direction were detected, which are not only due to variations in the solar wind. They might be caused by the interaction of the solar wind with Phobos' ionized gas or charged dust environment. For the circular orbits, all upstream disturbances in the magnetic field were studied in the framework of foreshock physics. Unlike at Venus or Earth, many disturbances were seen in the pure upstream region in front of, but close to the magnetic field line tangent to the bowshock. Spacecraft observations from the Earth's magnetotail show that the flaring angle depends on the downtail distance, the upstream solar wind dynamic pressure and the Bz component of the interplanetary magnetic field. Using Phobos 2 measurements, we investigated the Martian magnetotail and compared it with Earth's tail.

(b) Department of Extraterrestrial Physics

The Department is primarily involved in theoretical, but also in experimental research, covering the physics of the interplanetary medium, the interaction between the solar wind and solar system bodies, and detailed magnetospheric processes like planetary radio emission, magnetic field re-connection, solar terrestrial relationships, and planetary aeronomy, as well as the physics of comets.

Extensive measurements have been done in July 1995 during the collision of the comet Shoemaker-Levy 9 (SL 9) with Jupiter and the possible implications regarding radio burst emission. Analogue/digital converter units, specifically designed for the digital recording of millisecond radio bursts, were integrated into a PC configuration installed at the receiving station at Kharkov (Ukraine) which comprises the world's largest radio telescope for decameter radio waves. However, the comet SL 9 - Jupiter collision did not yield a significant increase in decameter radio emission, but the routine Io triggered decameter radio bursts have been recorded with hitherto unprecedented time and frequency resolution.

As part of the NASA/ESA Cassini/Huygens project detailed analyses have been performed regarding the direction finding of the "Radio and Plasma Wave Science" (RPWS) experiment. By means of so-called rheometric measurements the effective antenna length vectors could successfully be determined. Rheometry serves as a method for the determination of the pattern of an antenna system by using a down-scaled spacecraft model immersed into a quasi-static electric field within a water-filled tank. By rotating the model around defined axes the antenna pattern can be sampled, thus obtaining a three-dimensional characteristic pattern of the antenna system. In the case of the Cassini/Huygens spacecraft the effective antenna length vectors deviate from their physical directions, due to the interference of the metallic spacecraft body onto the antenna system, by about 5 to 8°. Knowledge of the electric planes of the Cassini/Huygens spacecraft is of essential importance for the whole Cassini RPWS experiment which determines the polarization and direction of arrival of radio waves (designed for the Saturn Kilometric Radiation, SKR) and provides relevant information for a number of other experiments onboard Cassini. These research activities have been performed in close co-operation with the Cassini RPWS team (University of Iowa, Iowa City, USA).

As part of the participation in the Cassini/Huygens mission of NASA/ESA possible mechanisms for the origin and evolution of Titan's massive nitrogen atmosphere was investigated. A model was developed comparing the possible thermal history of Triton and Pluto whose atmospheres consist like Titan's of nitrogen and methane, allowing the estimates of methane content in Titan's atmosphere. On the basis of previous studies on atmospheric mass loss of Titan by 'sputtering' this method was extended to Neptune's moon Triton with the result that magnetospheric nitrogen ions and magnetic protons represent the most important loss process of molecular nitrogen from Triton. The escape flux of nitrogen ions also contributes to the aurora of Neptune observed by Voyager 2. Based on the study it appears that Triton has lost approximately 1,500 times its present atmospheric mass.

(c) Department of Satellite Geodesy

Austria participates with geodetic contributions in the "Global Change Program" and the "International Decade for Natural Disaster Reduction" (IDNDR). Basic to such investigations is the realization of an International Reference Frame (ITRF), which consists of a selected number of permanently observing geodynamic observatories and precise satellite orbits in the same ITRF for space-borne measurements such as radar altimetry. Changes in ITRF can be attributed to global and regional crustal movements, local monitoring leads to the detection of seismic events, radar altimeters measure the vertical distance between the instantaneous sea surface as a natural reflector and the satellite in a straight-forward manner.

In order to link satellite orbits to the ITRF, the Department of Satellite Geodesy of the Space Research Institute in Graz operates the geodynamical observatory Graz-Lustbühel on a permanent basis. It disposes of an ultra-precise Satellite Laser Ranging System (SLR), a permanently recording Global Positioning System

(GPS)-receiver, a radar altimeter transponder, software expertise for GPS, laser and altimetry data reduction and processing. It operates a data centre for serving geodynamical projects within the Central European Initiative and has carried out regional and local investigations for determining the geoid and the sea surface topography of the Mediterranean and the Red Sea, the movement of the Adriatic microplate, as well as crustal motions in the Eastern Alps and its correlation to local microseismics.

The activities of the laser-station Graz consists in the contribution to international projects like DOSE, ERS-1/2, TOPEX/POSEIDON, IERS, ENVISAT, GPS35/36, GLONASS, and the continuous update of the laser-station itself. The number of tracked satellites increased from 12 in 1994 to 16 in 1995. By now Graz attains the worldwide highest data-density for most of the tracked satellites (e.g. twice the data rate for LAGEOS-1/2). During the 1995 about 2630 satellite passes were tracked and about 7 millions echoes recorded.

With a single-shot accuracy of 7-8 mm (ERS-1/2, GPS35/36) and a normal-point accuracy of 1 mm to all satellites Graz shares the leading position with the most accurate stations worldwide. Special attention was paid to the compensation of "time-walk" effects down to the mm-level, to the influence of satellite signatures, and the automation of the whole tracking procedure. Daylight measurements have been routinely carried out to all satellites whenever manpower allowed.

Within the project ENVISAT considerable efforts were undertaken to implement multi-colour laser-ranging, which should improve laser-accuracies by eliminating influences of the dry-part of the troposphere. Two additional laser-frequencies were derived by a Raman-tube and returns successfully detected from a representative selection of satellites (including LAGEOS). Routinely this technology is hitherto available only in Graz, it will be implemented in forthcoming new laser-systems (e.g. TIGO/Wettzell) during the next year.

In the frame of the International Geodynamics Service (IGS) the Graz observatory continued its task as a permanent GPS core station. Two additional stations near Innsbruck (Hafelekar and Patscherkofel) have become operational in October 1994 and March 1995, respectively. The former station is included in the IGS network, the latter acts as an additional station for monitoring local geodynamic displacements connected with microseismic events which are detected by four fully automatic seismic stations operated by the Central Institute of Meteorology and Geodynamics in Vienna. The Department carried out two autonomous GPS-campaigns (IDNDR) and participated in the campaigns, organized by a sub-project of Section C of the Central European Initiative (CEI).

The IDNDR-part covered the region of southern Austria, northern Italy, and Slovenia, as well as re-measurements of a considerable part of the Austrian Geodynamic Reference Frame (AGREF). It was mainly designed to study the local behaviour along fault lines at the northern boundary of the Adriatic microplate. The data/analysis centre Graz was updated for optimal automation of data management and the monitoring of remotely controlled permanent GPS-stations including the daily automatic computation of respective co-ordinates which may serve as an input to the forthcoming EUREF permanent station network.

2. Technical University Graz

(a) Institute of Communications and Wave Propagation

(i) Upper Atmospheric Research

An international rocket and ground-based campaign was conducted from the Brazilian equatorial range Alcantara in August 1994 under the leadership of NASA (Goddard and Wallops) and participation of the Universities of Colorado, Pennsylvania and Cornell. The involvement of the Technical University Graz aboard the four sounding rocket payloads consisted of various plasma density instruments and the procurement of telescopic booms for other experimenters. The four rockets to measure plasma densities, both

absolute and with high resolution, were flown on two key days, one each near local noon, the other at midnight. These measurements aimed at studying turbulence and other transport phenomena were accompanied by a large number of meteorological rockets equipped with falling spheres, and by MST radar measurements from the ground. Apart from the primary scientific aims of the campaign for which the data are still being evaluated, the measurements revealed interesting differences between the results of the various plasma probes; nonetheless these rocket data are currently believed to constitute "good measurements". Earlier flights did not carry so many redundant probes on one payload, so that one could not become aware of possible deficiencies of certain types of instruments.

The international satellite project INTERBALL comprises two large satellites, one in a fairly low orbit (Tail Probe), whereas the other is in a highly eccentric one (Aurora Probe) - see also activities of the Space Research Institute Graz. As a specialty of this mission each of these large satellites is accompanied by a small subsatellite of the order of 50 kg. They carry instrumentation similar to the one aboard the main satellites and are at a variable distance (up to a few thousand kilometres away) and thus allow to differentiate between spatial and temporal effects. The original concept of these subsatellites was developed by the Institute of Atmospheric Physics in Prague (Czech Republic). The involvement of the Technical University Graz in these subsatellites came rather late, such that the main participation is in upgrading the Earth station in Panská Ves (Czech Republic) and data processing and interpretation. The first of these satellites (Tail Probe) was launched successfully on August 3, 1995. Apart from one boom which did not deploy properly, the subsatellite yields good data which can be received from Panská Ves even at the apogee of 200,000 km.

The international mission MARS-96 under the leadership of the Russian Space Research Institute contains plasma-diagnostic instruments to study the Martian ionosphere. In addition to the novel instrument MARIPROBE-D developed by the Space Research Institute Graz, a more conventional multi-purpose, spherical ion probe (SIP) provided by the Technical University Graz will also be flown. Although SIP can not provide information on the spatial and energy distribution of ions, it has a much higher time resolution and is - due to its more conventional design - potentially more reliable. The flight and the spare models have undergone qualification test and the flight model is currently being integrated into the spacecraft.

(ii) Timekeeping and Satellite Communications

The main aim is to develop and study high precision and accurate time transfer methods by satellite techniques. One-way methods using the signals distributed by the Global Positioning System (GPS) in common-view mode and two-way techniques employing pseudo-noise(PN)-signals distributed via communication satellites were investigated.

Since 1988, two single-frequency GPS receivers of different types are operated at TUG in an air-conditioned laboratory. From late 1989 to the middle of 1995 both receivers were in continuous operation using a common-clock set-up thus enabling the study of the behaviour of the differential delay of the receivers. The differential delay (daily mean of the differences of all tracks recorded according to the BIPM common-view tracking schedule) shows a seasonal behaviour, but the character is changing over the time and there is no obvious correlation with outside temperature; the same applies to humidity. Further studies are clearly necessary.

In August 1993, two-way time transfer line-up tests via the 53° INTELSAT satellite were performed between six European laboratories and followed by two-way measurements between a varying number of stations using different measurement schedules. In February 1994 two-way measurements began on a regular basis - the so-called INTELSAT field trials - between the above mentioned European laboratories and between these laboratories and two laboratories in the United States. At TUG, all measurements were done using a 1.8 m VSAT-satellite terminal which is INTELSAT and EUTELSAT approved. Since 1994 a satellite simulator is included allowing individual measurement of the difference of the transmit and receive delays

in conjunction with each time transfer measurement. The data obtained can immediately be used to correct the two-way satellite time and frequency data for variations of the differential signal delay of the station.

The Institute of Applied Systems Technology in close cooperation with the Institute of Communications and Wave Propagation developed a novel satellite video conference system for the European Space Agency in the framework of the DICE (Direct Inter-Establishment Communications Experiment). In contrast to conventional systems it can support multiple sites simultaneously. Special data transmission are provided to distribute documents electronically during the session. Total of 21 stations are now in operations in Europe and form two networks. One is used by Matra-Marconi Space for business communications between five sites in the UK and two in France, the other setup by ESA has been heavily used for support of the EUROMIR-94 and 95 missions to the MIR space station. The mission control centre near Moscow and the Cosmonauts' training centre in Star City have been connected with the ESA establishments (ESTEC, EAC, ESOC, ESA HQ) and the control centres Toulouse and Oberpfaffenhofen, respectively. The conduct of the mission was entirely managed and controlled remotely and proved the successful concept of DICE for telescience applications. DICE will also be used for the French CASSIOPEE mission in summer 1996. Further enhancements of DICE, such as an ISDN gateway and a FEAL encryption system are currently under development.

As part of the CODE (Co-operative OLYMPUS Data Experiment) a novel portable communications system for Ka-band (20/30 GHz) has been developed by Joanneum Research in collaboration with Technical University Graz, Telefonica Sistemas and SIRE (Spain) under contract by ESA. The system supports vocoded voice or data at rates of 4.8 kbit/s. All communications equipment (modem, notebook PC, telephone handset) together with a 35 cm parabolic antenna are integrated into a briefcase. A built-in GPS receiver facilitates pointing of the antenna and provides positioning information.

The primary network topology is a star, using a central inexpensive mini-hub station (dish size 1.5 - 2.4 m). Mesh mode of operations (from terminal to terminal) is also possible. In that case the small hub station has the function of monitoring and network control only. The initial system has been designed to be compatible with OLYMPUS, the European DFS-KOPERNIKUS and ITALSAT. A Ku-band version (12/14 GHz) with 50 cm dish, compatible with EUTELSAT or INTELSAT, is also planned. The transmission scheme has been made compatible with the relevant ETSI recommendations. Applications of the systems are communications in areas with inadequate terrestrial telecommunications infrastructure, Internet access, collection of environmental data and emergency communications. Since Ku- and Ka-band capacity are considerably cheaper than L-band (used for the INMARSAT-M system), this Picoterminal is also interesting from an economic point of view. The field trials start in June 1996 in co-operation with Deutsche Telekom. Another trial in co-operation with Telespazio follows, using ITALSAT in the second half of 1996.

3. University of Graz

(a) Institute of Astronomy

Diffraction limited multi-spectral images of the asteroid 4 Vesta have been obtained in the near IR at ESO-La Silla station. These pictures have an effective spatial resolution of 0.1" and complement nicely a series of HST-FOC images in red light obtained at 24 different rotation phases of Vesta. Supporting ground based photometry has also been obtained at ESO.

(b) Institute of Meteorology and Geophysics

Observations of the Differential Doppler effect on the signals of the polar orbiting US Navy Navigation Satellites (NNSS) continued. The measurements provide the latitude dependence of ionospheric electron content (TEC). The data base collected at Graz also includes the results of the NNSS observations made at the Max-Planck-Institute for Aeronomy, Lindau/Harz, Germany. At the beginning of 1995 two receiving

stations were put into operation in Italy (Gibilmanna/Sicily and L'Aquila) by IROE Florence and close co-operation in evaluation and interpretation of the results was established. By the end of 1995 NNSS receiving equipment went into operation at DLR Neustrelitz/Germany. Joint evaluation programs now exist to make optimal use of all data gathered in the longitude sector 10°E to 15°E.

In Graz, the European electron content data are used for three purposes: investigations of "geophysical events" (geomagnetic storm effects, Travelling Ionospheric Disturbances, etc.), long-term studies (ionospheric modelling, solar cycle effects, etc.) and calculation of radio wave propagation effects (error assessment for geodetic and radioastronomical applications, error corrections, etc.).

The Institute participates in several international corporations. We name here COST251 (the successor of the COST238/PRIME) a European project with the title "Improved Quality of Service in Ionospheric Telecommunication Systems Planning and Operation" and TECUA (Total Electron Content for Upper Atmosphere Investigations) which is a German - Argentinean - Austrian co-operation.

In 1994, the Institute also started research in the field of remote sensing of the atmosphere from space for studies of climate and weather, especially in connection with the use of the GPS/GLONASS-based radio-occultation technique for profiling and imaging of the Earth's atmosphere and ionosphere and with passive microwave sounding. The Institute is involved in several international scientific consortia in this context, a major part of the work being done in close co-operation and under contract with ESA/ESTEC (Earth Observation Preparatory Programme).

4. University of Innsbruck

(a) Institute of Astronomy

The "Dust in born-again Planetary Nebulae", and "Edge-on Dust Disks in Planetary Nebulae" programmes received observing time on the Infrared Space Observatory (ISO) satellite. The first project aims at observing the centres of some old, evolved planetary nebulae (PNe) harbouring a hot central star which has recently ejected highly processed hydrogen-poor material. We investigate the physical properties of very hot dust that has formed and survived in this hostile environment. The second project investigates evolved PNe which show a bipolar morphology with a pronounced dust disk, seen edge-on. Spatially resolved images shall be recorded with ISOCAM in order to understand the distribution, properties and physical state of he dust grains. Both projects will be supplemented by several ground-based observations.

(b) Institute of Meteorology and Geophysics

The main research activities were concerned with methods and applications of Earth observation from space for hydrology and cryospheric research. Spaceborne experiments in combination with field activities at test sites in the Austrian Alps focused on microwave signature research and on the development of methods for SAR data analysis. Earth observation satellite data were applied for studies of glacier/climate interactions in Antarctica and Southern Argentina, and for hydrological research in the Alps.

On the sensor side, emphasis has been on Synthetic Aperture Radar (SAR), in the frame of the ERS-1 and ERS-2 Missions of ESA and of the Synthetic Aperture Radar-C (SIR-C)/X-SAR Experiment of NASA/DLR/ASI. The following experiments have been carried out as Principal Investigator:

- ERS-1 Experiment Nr. A1: "Snow and ice properties by ERS-1 AMI SAR data".
- ERS-1 Experiment Nr. A2: "Active microwave signatures of the polar ice sheets based on ERS-1 AMI data".

- ERS-1/ERS-2 Experiment AO2.A101 "Comparative investigations of climate sensitivity and dynamics of glaciers in Antarctica, Patagonia, and the Alps".

- SIR-C/X-SAR Experiment: "The High Alpine SAR Experiment".

The ERS-1 Experiments Nr. A1 and A2 were completed in 1995. Within these experiments a method was developed for generating digital snow cover maps in mountain areas based on multi-temporal SAR data, and the usefulness of ERS-1 SAR-derived snow cover maps for runoff modelling in alpine drainage basins was demonstrated. ERS-1 AMI scatterometer mode was found to provide valuable information also over land surfaces. The scatterometer was applied for mapping snow and ice morphology over Antarctica and for soil moisture mapping over the Canadian Prairies. The most remarkable observation was the rapid collapse of two sections of northern Larsen Ice Shelf, Antarctic Peninsula, within a few days in January 1995 which was analyzed in detail by means of close time sequences of ERS-1 SAR images. A disintegration event of this type has never been observed before. The rapidity of the collapse implies that ice shelves may respond much faster to climatic change than anticipated. Further investigations on ice dynamics, on glacier/climate relation, and on snow hydrology are going on within the ERS-1/ERS-2 Experiment AO2. A101 in Antarctica and on the Patagonian Icefield in cooperation with the Instituto Antarctico Argentino and with the German Alfred-Wegener-Institute for Polar and Marine Research.

In April 1994 as well as in October 1994, five swathes were acquired over the Ötztaler Alpen in Austria by SIR-C/X-SAR which operated on board of the Space Shuttle Endeavour providing polarimetric radar data at 1.25 GHz and 5.3 GHz, and VV-polarized data at 9.6 GHz. During both flights a near real time analysis was carried out over glaciers to determine the accumulation and ablation areas and estimate glacier mass balance, important parameters for climate research and hydrology. The investigations after the flights were aimed at the relations between physical target properties and polarimetric radar measurements and at the development of classification methods for complex terrain. Interferometric studies were carried out over glaciers in Patagonia with SIR-C and X-SAR data which were acquired in one day repeat intervals. L-band data were applied successfully for mapping ice velocities even over melting ice surfaces and in heavily crevassed zones, emphasizing the high potential of SAR for studies of ice dynamics.

5. University of Vienna

(a) Institute of Astronomy

The impacts of the Shoemaker-Levy 9 fragments on Jupiter caused the formation of micron-sized dust particles. On Galileo pictures, they appeared as conspicuous Earth-sized dark spots in visual and UV light. Based on a time-dependent description of dust formation, condensation of amorphous carbon grains (soot) was proposed as a mechanism to provide particles with the observed properties. The question whether carbon or silicate grains will form critically depends on the chemical composition of the Jovian atmosphere. If the abundance analysis of the Galileo Probe data supports a carbon-rich environment at the impact sites our model demonstrates that there is enough time to grow amorphous carbon grains in the fireballs rising immediately after the impacts.

Due to a delay of the launch of MARS-94 to November '96, additional resources became available for the EVRIS experiment. A larger photometric telescope was built which allows to observe even fainter target stars. The new flight hardware was successfully tested and delivered to LAS (Marseille). In addition, the Institute participated in studies for future ESA (STARS) and CNES (COROT) astronomy missions related to asteroseismology.

A reply to an ESA Announcement of Opportunity for an X-Ray Multiple Mirror (XMM) Survey Scientist Centre led to the involvement on a co-investigator (Co-I) level. This centre will perform the

automatic pipeline processing of all the XMM data from all experiments. In addition, it will undertake the systematic analysis with respect to the field survey archive data leading to the production of catalogues of all serendipitous sources detected by XMM, and it will organise follow-up ground and space based observations.

Three project proposals for the Infrared Space Observatory (ISO) were granted a total of 87,000 seconds of observing time. For "Spectral Variability of Long Period Variables" a number of selected objects will be repeatedly observed over the whole pulsation cycle. "Atmospheric Structure of Oxygen-Rich Semiregular Variables" aims at a comparison of stars with different pulsational characteristics, both with respect to the dust emission and the molecular features sensitive to the stratification of the photospheres. Both projects use the short wavelength spectrometer and deal with the interaction between pulsation, atmospheric structure and dust formation. The third project "Dust and Gas Environment of Lambda-Bootis Stars" shall clarify whether the chemical surface abundances are caused by a mass loss - diffusion process of these peculiar stars or by accretion from the interstellar matter. A Co-I participation in the program "Mass-Loss and Evolution of AGB Stars in the LMC" will focus on the IR emission of variable AGB stars using ISOCAM. Furthermore, collaboration with various ISO instrument teams will provide access to guaranteed time observations.

A noise model for the Fine-Guidance-Sensors (FGS) of the Hubble-Space-Telescope (HST) was developed which allows for an automatic survey of all FGS Data concerning variability of guide stars. The main scientific objective of this survey is to investigate microvariability in a large parameter space of the Hertzsprung-Russel diagram and to determine astrophysical boundary conditions for stellar instabilities. The analysis of Faint-Object-Camera (FOC) and the Wide-Field-Planetary-Camera (WFPC) images showed that the cores of most elliptical galaxies contain a non-resolved central source which is often embedded in a gas/dust disk. The central point-like source, which is particularly bright in the UV wavelength range, is interpreted in terms of a super massive black hole (108 to 109 solar masses). In one galaxy the UV bright central source was observed to brighten by a factor of 7 over a period of 2 years, probably due to the disruption of a star passing by the black hole.

The active K0 IV star HU Virginis was observed with the High-Resolution Imager onboard the X-ray satellite ROSAT in the time between June 15 and July 12, 1994, and a gigantic X-ray flare was caught in the flare-onset phase.

(b) Institute of Geochemistry

New lunar meteorites recovered from Antarctica were analysed in collaboration with the Naturhistorisches Museum in Vienna. In addition, several members of the rare and previously not well studied meteorite group of iodranites were studied in collaboration with colleagues from the University of Bern (Switzerland). The collaboration with the Naturhistorisches Museum in Vienna and the Centre de Spectrometrie Masse et Spectrometrie Nuclaire, Orsay (France) on the study of micrometeorites from Antarctic blue ice is progressing well. Trace element analyses on numerous small micrometeorites were performed using neutron activation analysis, followed by scanning electron microscopy and microprobe analysis. The result of this work showed that Antarctic micrometeorites are a separate class of extraterrestrial material, with properties that are different from those of known meteorite classes and interplanetary dust particles.

Several meteorite impact craters and impact products have been studied, including materials from the Chicxulub crater in Mexico, which is currently believed to be the crater responsible for the mass extinctions at the Cretaceous-Tertiary boundary 65 million years ago. Another structure that was thoroughly studied is the Manson crater in Iowa, USA. The crater is currently covered by sediments, and has recently been extensively drilled. The results of an international consortium that studied drill core samples from the structure were published as a book by the Geological Society of America.

In addition, detailed research (field and laboratory studies) was performed on various impact craters around the world. These craters include: Chesapeake Bay (United States - demonstrating the impact origin of this 90 km diameter structure, and showing that a link with the 35 million year old North American tektite strewn field is very likely); Red Wing Creek and Newporte (North Dakota, United States); Ames (Oklahoma, United States); Saltpan and Kalkkop (South Africa); Roter Kamm (Namibia); Highbury (Zimbabwe); Gardnos (Norway), and others. Also studied were the isotopic composition of various tektites (rare natural glasses that form in meteorite impacts). Work on the rhenium-osmium (Re-Os) isotopic system as indicator of the presence of an extraterrestrial component in impact-derived materials was continued. Most of the research is done in collaboration with national and international research institutions.

6. Museum of Natural History, Vienna

(a) Department of Mineralogy-Petrography

In spite of the concentration of its resources on the study of cosmic dust (micrometeorites), the Department was able to investigate a large spectrum of meteoritic or planetary subjects. The main mass of infalling matter on Earth is related to rare meteorite classes (CM and CR carbonaceous chondrites) but has mineralogical and bulk chemical features of its own. Thus, the interplanetary dust is not represented by any of the meteorites in our collections and in all likelihood micrometeorites represent the silicate portion of comets.There is still no consensus on the origin of these crystalline melt droplets after which the most common meteorites, the chondrites, are named. The results of continuous studies of the mineralogy, geochemistry, and isotope geochemistry of single chondrules (diameter: 500 µm) support a nebular origin but indicate disturbances in the isotopic systems at times long after the formation of the solar system.

The very unusual Kaidun chondrite is a chondrite breccia consisting of a variety of highly oxidized and highly reduced lithologies. It demonstrates mixing of lithologies from very different regions of the solar nebula. Detailed studies of the constituents should provide for physical-chemical constraints for the diverse formation regions.

7. Austrian Research Centre Seibersdorf

(a) Department for Physics

For the NASA mission Equator-S, Seibersdorf provides the ion emitter modules for the S/C charge compensation system. Two ion emitter modules have been built and are now undergoing extensive tests at Seibersdorf. The charge compensation system for GEOTAIL which Seibersdorf together with ESA and ISAS developed for this Japanese spacecraft is now going into its fourth year of flawless operation. Data on ion emitter operation are continuously being evaluated and show excellent operational behaviour of the system. Charge control is working as expected at 10 µA ion emission current, so that similarly good operation can be expected for the CLUSTER mission.

Seibersdorf, together with Joanneum Research (JR) in Graz and RKK ENERGIYA/Kaliningrad is developing the space-qualified ion microprobe MIGMAS which will be installed 1997 as permanent equipment on the Russian space station MIR: Onboard of MIR it will form the centre of a materials analytical laboratory for investigation of space exposure effect on materials. In 1995 the engineering model of the materials analysis section of MIGMAS has been completed and is currently undergoing performance tests.

Seibersdorf, together with JR Graz participated in the EUROMIR 94 and EUROMIR 95 - missions of ESA. Experiments were performed in preparation for the installation of the microanalysis station MIGMAS on MIR in 1997. Materials returned from MIR were analysed and characterised at Seibersdorf and showed the good conditions of MIGMAS components after 3 years of operation onboard the space station.

8. The Austrian Society for Aerospace Medicine & Life Sciences

Following the successful completion of the AUSTROMIR project, the Principal Medical Investigators approached the Austrian Federal Ministry for Science, Transport and Arts seeking support to continue activities in the space medicine domain - to this end the Austrian Society for Aerospace Medicine & Life Sciences in Space (ASM) was established in 1991. Essentially, ASM was founded to provide a basis for multi-disciplinary approaches to spaceflight bio-medical research. ASM is to act as a platform where diagnostic, prognostic and elective, operational and preventative countermeasures can be developed e.g. health status monitoring, space sickness, crew compliance, food supply, ergonomics and de-conditioning counter measures.

One of the major goals of ASM is to perform basic research in the areas of Space Medicine, Life Sciences in Space and Radiobiology in cooperation with international partners, of which the Institute for Bio-Medical Problems in Moscow is certainly the most significant. The major areas of research are: Life Sciences, Neurology, Physiology and Radiobiology.

Most recently, ASM has at the invitation of its Russian partner institution, the Institute for Bio-Medical Problems (IMBP) in Moscow, contributed 9 medical experiments within the Russian Long-term Flight (RLF) project. This flight constituted part of the Russian National Space Programme and was the longest spaceflight to date performed by the Russian Physician Cosmonaut Valery V. Polyakov totalling a duration of 437 days and 17 hours. During his stay on the Space Station MIR, Dr. Polyakov and rotating crews made regular use of the ASM medical experiments, these being the only medical experiments used over the entire period of Dr. Polyakov's stay on-board the Space Station MIR.

The scientific/medical part of the complete RLF Project was managed, controlled and coordinated by the IMBP on the Russian side. Similarly, on the Austrian side, ASM has prime responsibility. The following table gives a brief overview of the missions, during which Austrian medical experimentation was performed since AUSTROMIR:

Project/Crew	No. of Cosmonauts	Approx. mission durations	Total months
AUSTROMIR	1	0,2	0,2
AUSTROMIR E	2	4	8
AUSTROMIR Med-F	2	6	12
RLF	1	14,5	14,5
Crew 15	2	6	12
Crew 16	2	4,5	9
Crew 17	2	6	12
Crew 19	2	3	6
Crew 20	2	5	10
TOTAL	**16**	**45.2**	**83.7**

BULGARIA

[Original: English]

In 1996, the National Aerospace Program Until the Year 2000 and the Directions for Development Until the Year 2005 were drawn up. The framework of the National Aerospace Programme contains the following fields and directions for developments and projects:

- Aerospace Sciences.
  - Astronomy and astrophysics;
  - Plasma physics;
  - solar system studies;
  - fluid dynamics;
  - other aerospace sciences;
  - aerospace education issues.

- Aerospace Remote Sensing.
  - cartography and satellite geodesy
  - meteorology and climate studies;
  - oceanography;
  - environment monitoring and conservation issues;
  - crop and forests monitoring;
  - satellite monitoring utilization in projects of national importance.

- Aerospace Biology and Medicine.
  - space biology and medicine;
  - aviation medicine and human factor issues;
  - maritime medicine;
  - radiobiology;
  - closed cycle ecosystems.

- Space Telecommunications and Navigation.
  - satellite communication system;
  - satellite information systems;
  - space-based navigation systems;
  - ground stations for space data reception and processing.

- Aerospace Material Science and Microgravity Technologies.
  - aerospace materials;
  - microgravity technologies.

- Aerospace Transportation Systems.
  - satellite systems, micro- and small satellites;
  - jet propulsion systems;
  - orbital stations;
  - aircraft.

- Aviation and Aeronautics Issues.
  - Air Traffic Control (ATC) and navigation;
  - aviation meteorology;

- flight safety issues;
- operational problems in the:
- Air Force
- civil aviation
- sports aviation
- private aviation
- national Search-and-Rescue (SAR) system;
- training of pilots and aviation specialists.

- Utilization of Aerospace Science and Technologies in Civil Protection and National Security Applications.

- Space technology Spin-off, Industrial Programs and Space Commercialization Issues.

- Other Aerospace Developments and Projects.

The National Aerospace Program will operate for a four-year term until the year 2000. It is endorsed by a Government Interdepartmental Commission on Aerospace Problems, headed by a Deputy Prime Minister and administered by the Bulgarian Aerospace Agency (BASA).

The Bulgarian Aerospace Agency is managing or participating in the following programs and projects:

- Neurolab-B: a system for real-time evaluation of the psycho-physiological state of crewmembers in long-term flights. The equipment was successfully launched on 23 April, 1996 with the Priroda module and is currently operational on board the Mir Space Station.
- R-400 Radiometer: the R-400 Radiometer remote sensing system was also launched with the Priroda module in April 1996 and is currently in operation on board the Mir Space Station.
- SVET-2: BASA is managing the SVET-2 Space Greenhouse project, a successor to the SVET Space Greenhouse, which has been in operation on board the Mir Station since 1989.
- COMPASS: BASA is also participating in the COMPASS international microsatellite project. The microsatellite is to be launched from a submarine in the beginning of 1996. The evolution of this project could provide low-cost remote sensing benefits to developing countries.
- The Agency is also participating in the following projects: Mars-96, Interball, Gonets (Russian digital communications satellite network), A33 (ecological atlas of the republic of Bulgaria).
- The Agency is also deeply involved in spin-off applications of space projects: a version of the Neurolab-B for aviation and maritime medicine is being developed, a device for personal UV (ultra-violet) -detection is being produced on a series basis UV-Indicator. Space foods are being produced following a long-established tradition.

International contacts have been established with:
- NASA and the US Space Foundation;
- ESA/ASA - representatives of BASA took part in the Alpbach Summer School 1996;
- the National Aerospace Agency of Kazakstan - an agreement of cooperation was signed;
- the National Space Agency of Ukraine - an Agreement for cooperation is being prepared;
- the Romanian Space Agency - an Agreement for cooperation was signed.

CZECH REPUBLIC

[Original: English]

This report deals with three selected activities: the microaccelerometric measurements, the continuation of the MAGION programme of small satellites and applications of remote sensing.

A. The microaccelerometer

Methods for accelerometric measurements are being developed at the Astronomical Institute of the Academy of Sciences of the Czech Republic. The aim is to detect and measure non-gravitational forces affecting the motion of artificial satellites. The instrument is a three-axial electrostatically compensated microaccelerometer with a cubic proof-mass. Its prototype has been developed at the Astronomical Institute but the following models have been manufactured by an industrial group.

The prototype was successfully tested on board of a spacecraft launched by the Russian Federation in 1992. Another model has been prepared for a flight on the STS-79 Atlantis, in collaboration with the University of Alabama in Huntsville. The space shuttle Atlantis with the accelerometer on board was launched on September 16, 1996. The results of the accelerometric experiment were not known at the time of writing the report. The main goal of this project is to test the accelerometer with respect to measurements by other similar devices placed in the scientific rack on the STS Atlantis. The preparation of the accelerometer was effected during 1995-1996. It is a further qualification test of the accelerometer before it will be mounted on board of scientific satellites.

The first of them will be the satellite "CESAR" which is now being prepared in collaboration with the Italian Space Agency ASI and with agencies of other Central European countries. The project is aimed at atmospheric, ionospheric and magnetospheric studies. It is at present in phase B an the satellite is envisaged to be launched in 1999.

The Czech Grant Agency allocated to the Astronomical Institute a financial support to a project aimed at the study of non-gravitational forces affecting the dynamics of close Earth artificial satellites with a high sensitivity of 10^{-12} G. The data will be used to improve the model of the distribution and variations of the total density of the atmosphere between 250 and 700 km altitude. It might be possible to determine, besides the atmospheric effects, also the effects of direct and reflected solar radiation pressure and of the infrared radiation of the Earth, as well as the respective radiative fields. The proposed satellite will be a small body (60 cm diameter) of a regular shape, preferably spherical. In order to reduce the disturbing effects of other instruments, the accelerometer will be the only instrument on board. The orbit of the satellite will be elliptical with a perigee height of km and apogee height of 1400 km. The expected time span of collecting data will be at least 4 years.

B. The MAGION series of small satellites

The scientific programme based on small satellites of the MAGION-type has continued in the course of 1995-1996 in two main directions:

(a) Processing and physical interpretation of data from the MAGION 2 and 3 satellites which were manufactured in the Czech Republic and launched as a part of the ACTIVE and APEX missions, were directed towards active experiments in the ionosphere-magnetosphere plasma. This activity - which was carried out in international cooperation - resulted in a large number of scientific papers. For example, at the COSPAR 1996 Symposia in Birmingham, 42 papers based on the results of MAGION 2 and 3 experiments were presented.

(b) The two following MAGION-type satellites have been launched in the framework of the INTERBALL international cooperation mission aimed at the study of the interaction between the solar wind and the magnetosphere and of physical processes in different parts of the Earth's magnetosphere.

The first pair of the INTERBALL mission satellites, the INTERBALL 1 and MAGION 4, were launched on 3 August 1995 from the Plesetsk cosmodrome. The high elliptical "Tail" orbit with an apogee of 193.000 km allowed to study during the first year in orbit the magnetopause and bowshock regions as well as the tail region of the magnetosphere using the two-point simultaneous measurements. The maneuvering capability of MAGION 4 was successfully used to control and optimize the distance between INTERBALL 1 and MAGION 4. Measurements by the two spacecraft in the "Tail" orbit continue. They have been extended by the second pair of INTERBALL mission spacecraft, the INTERBALL 2 and MAGION 5, launched on 29 August 1996 into the "Auroral" orbit with an apogee of 20,000 km

C. Remote Sensing Activities in 1994-1996

National activities in remote sensing have been focused on various kinds of applications. Environment, forestry, agriculture and cartography are the main fields where remote sensing is applied together with geoinformation.

Two nationwide projects have been undertaken in the country. One is the mapping CORINE Land Cover project accomplished in the framework of the PHARE Programme. It includes production of the digital database of land cover units over the entire country at a scale of 1:100000. The data have been obtained by visual interpretation of Landsat TM geocoded images followed by digitalization. In total, nine scenes have been used to cover the Czech Republic. The database will be consistent with similar products elaborated in other European countries. The database is being used in various applications like soil degradation assessment or more accurate pollution modelling. In the follow-up of the project, the method and corresponding nomenclature has been developed to mapped land cover in a more detailed scale of 1:50000. The method was tested on an area of about 10.000 sq.km.

The second large project gives fast information about crop areas to the Ministry of Agriculture. Based on classification of the Landsat or Spot satellite imagery, the information provided updates averages of the main crops on regional or district levels. Due to the cloud coverage it is not possible to get the information over the whole country during one vegetation season. Simultaneously, NOAA low resolution data were used to study the dynamics of the vegetation development during the season and to assess its phenological stage.

Traditionally, satellite data play an important role in monitoring conditions of the forest. Landsat TM scenes are processed to get maps presenting the distribution of different stages of damaged forests. The first complete map of the forest health stages of the country based entirely on satellite data has been prepared by the Ministry of Agriculture in 1995. In another project, Landsat TM data were processed on the area of two test sites of 20 x 25 km each for forest ecosystem mapping. Almost 20 classes have been detected distinguishing different forest types in combination with forest management practices.

Space maps are used in a growing number of cases by local district offices. Production of the maps is done routinely using topographic maps and a set of ground control points. The standard size of one map sheet of various scales is available on commercial basis. It can be obtained in printing as well as in digital format ready for direct input to GIS.

New activities are connected with usage of radar data. ERS-1 and ERS-2 data have been used for the production of space map at the scale of 1:200,000. The image map provides a base for geological and geomorphological analysis of the area along a new oil pipeline construction.

Stereo Spot panchromatic scenes have been processed to obtain a digital elevation model. The PC software has been applied to get grid model description with a spatial resolution of 20 m and an error in elevation of 10-20 m.

ECUADOR

[Original: Spanish]

A. Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos (CLIRSEN)

The Centre for Integrated Surveying of Natural Resources by means of Remote Sensing (CLIRSEN) was established in 1977, pursuant to Executive Decree 207, issued by the Office of the President of the Republic, as a public-law agency with legal personality and with financial and administrative autonomy.

It is based in Quito, the capital city of the Republic of Ecuador, and administers the Cotopaxi satellite data receiving, recording and processing station, which is located 70 kilometres south of Quito.

1. Purpose of the Cotopaxi Station

The purposes of Cotopaxi ground station are:

- To receive, record and process data from the LANDSAT, SPOT, ERS and GOES satellites;
- To make such information available for research on natural resources and the environment, on an on-going basis and when required, to the countries within the radius of coverage of the Station;
- To generate and transfer technology regarding the use and applications of remote sensing, with a view to expanding the community of users of such data, through different media;
- To establish a library of such data, which is continuously updated with data from new sources;
- To promote studies and research on natural resources and the environment on a collaborative basis between countries in the region.

The Cotopaxi Station is located at a latitude of 0°37′21″ south and a longitude of 78°34′46″ west. The site covers 64 hectares, of which 17 are occupied by the main installations.

The radius of coverage is approximately 2,500 kilometres, from the Yucatán Peninsula in the United States of Mexico to Antofagasta in the Republic of Chile, and comprises Central America, the Caribbean and part of South America.

(a) Results obtained

In the period from 1 July 1995 to 30 June 1996, the Cotopaxi Station received the following data transmissions:

Passes by the Landsat 5 satellite	368
Passes by the Spot 2 satellite	41
Passes by the ERS-1 satellite	49
Passes by the ERS-2 satellite	9

Of all the images received from the LANDSAT and SPOT satellites, 10 per cent are considered to be usable, owing to the cloud cover in the area.

Through the GOES satellites, meteorological data are received from ocean and land platforms in the following locations:

- Lobos and Talara in the Republic of Peru;
- Coastal and Arica in the Republic of Chile;
- Isobamba in the Republic of Ecuador.

The Cotopaxi Station generates the following satellite outputs:

- Bulk digital data;
- Geo-referenced digital data;
- Geo-codified digital data.

It also has a photographic laboratory for the production of:

- Geo-referenced black-and-white and colour paper;
- Geo-referenced black-and-white and colour film;
- Geo-codified black-and-white and colour paper;
- Geo-codified black-and-white and colour film;
- Reduced images: microfilm and quick looks.

During the period covered by this report, CLIRSEN has been using the satellite data to carry out the following studies:

- Inventory of banana-growing areas in Ecuador;
- Production of a digital mosaic of the Amazon Region in Ecuador, with reference to plant coverage and current land use;
- Climatic changes in the Republic of Ecuador;
- Multi-season study of mangrove swamps, shrimp ponds and saline areas;
- Validation of agro-ecological models;
- Zoning of algae beds in the Galápogos Islands;
- Threats of flooding in the Ecuadorian coastal region;
- Suspended solids in the Gulf of Guayaquil;
- Structure of the database on natural resources in the Republic of Ecuador (scale 1:250,000);
- Training centre:
    - Regular remote sensing courses,
    - Regular geographical information system courses.

COUNTRIES COVERED BY THE COTOPAXI STATION

No.	Country	Total area (km2)	% coverage of the country	Area covered by the antenna	% of total area covered	Number of images or segments of images (LANDSAT)	Number of images or segments of images (SPOT)
1	ARGENTINA	2 771 300	1%	27 713	0.37	4	66
2	GUATEMALA	108 889	100%	108 869	1.46	9	64
3	HONDURAS	112 088	100%	112 088	1.45	12	57
4	JAMAICA	10 991	100%	10 991	0.15	4	14
5	MEXICO	1 958 201	3%	58 746	0.79	26	79
6	NICARAGUA	140 750	100%	140 750	1.89	11	64
7	PANAMA	77 080	100%	77 080	1.04	11	50
8	DOMINICAN REPUBLIC	45 734	100%	45 734	0.62	6	28
9	EL SALVADOR	21 393	100%	21 393	0.29	4	12
10	TRINIDAD AND TOBAGO	4 827	100%	4 827	0.07	2	7
11	CHILE	756 945	25%	189 236	2.53	14	83
12	GUYANA	214 969	98%	210 670	2.82	15	56
13	BRAZIL	8 512 100	20%	1 702 420	22.63	116	1 050
14	COSTA RICA	50 700	100%	50 700	0.68	7	34
15	BELIZE	22 963	100%	22 963	0.31	3	16
16	HAITI	27 700	100%	27 700	0.38	7	25
17	PUERTO RICO	8 897	70%	6 228	0.09	4	9
18	GRENADA	311	100%	311	0.01	1	1
19	CUBA	114 471	100%	114 471	1.54	16	74
20	PERU	1 285 210	100%	1 285 210	17.18	69	508
21	BOLIVIA	1 098 581	70%	769 007	10.28	54	388
22	ECUADOR	283 561	100%	283 561	3.80	21	130
23	COLOMBIA	1138 914	100%	1 138 914	15.23	61	428
24	VENEZUELA	912 047	100%	912 047	12.20	56	365
25	SURINAME	163 265	100%	163 265	2.19	10	63
	TOTAL			7 480 894	100%	543	3 701

IMAGES THAT STRADDLE BORDERS ARE INCLUDED IN THE FIGURES FOR EACH OF THE TWO OR THREE COUNTRIES COVERED.

FIJI

[Original: English]

The Government of Fiji reports that it does not have any outer space related programmes or activities.

GERMANY

[Original: English]

The Government of Germany reports that it will furnish the Scientific and Technical Subcommittee with a sufficient number of copies in English of the Annual Report 1995 of the "Deutsche Agentur für Raumfahrtangelegenheiten" (DARA) for distribution during the Subcommittee's session.

INDIA

[Original: English]

India made substantial progress during the last one year in the development and application of technology aimed at rapid socio-economic development of the country. India also continued to further enhance international cooperation in exploration and peaceful uses of outer space.

A. INSAT System

India successfully launched INSAT-2C, the third satellite in the indigenously-built INSAT-2 series, on December 7, 1995. INSAT is a multi-purpose satellite system for telecommunication, television broadcasting, meteorology, disaster management and search and rescue. INSAT-2C has now joined the other three satellites of the INSAT system launched earlier, namely, INSAT-1D, the last of the INSAT-1 series, and the indigenously built INSAT-2A and INSAT-2B, in vastly enhancing the space segment capacity. INSAT-2C provides additional services like mobile satellite communication, corporate communication in Ku-band and extended coverage for Indian television broadcasting.

India plans to launch the follow-on satellites in the INSAT-2 series, namely, INSAT-2D, identical to INSAT-2C, during 1996-97 and INSAT-2E, carrying advanced meteorological payloads in adciition to communication payloads during 1997-98. Eleven transponders on INSAT-2E are to be leased to the International Telecommunication Satellite Organisation, INTELSAT.

India continues to employ INSAT system for broadcasting educational programmes at school and college levels. A channel has been exclusively reserved on INSAT system for interactive developmental education and training, especially in the rural areas. A two-year pilot project for practical demonstration of satellite-based developmental communication and training network for rural upliftment has been taken up in a tribal district of Madhya Pradesh in Central India.

B. Indian Remote Sensing Satellite System (IRS)

India had two major achievements during the last one year in the field of satellite-based remote sensing - one was the successful launch of Indian Remote Sensing Satellite, IRS-1C, the third satellite in the IRS-1 series, on December 28, 1995, by a Russian Molniya rocket from Kazakstan and the other was the successful launch of IRS-P3, on board the Indian-built Polar Satellite Launch Vehicle, PSLV, on March 21, 1996. Thus,

today, India has a constellation of four remote sensing satellites, IRS-1B, IRS-1C, IRS-P2 and IRS-P3, which are providing a variety of space-based remote sensing data. IRS-1C is a more advanced satellite compared to its predecessors providing a high spatial and spectral resolution, stereo-viewing and on-board data recording capability. IRS-P3 carries on board a Modular Opto-Electronic Scanner designed and built by the German Space Agency, DLR, in addition to the payloads built by India for remote sensing and X-ray astronomy.

India plans to launch the follow-on satellite in the IRS-1 series namely, IRS-1D, identical to IRS-1C, during 1997-98. Another series of satellites known as IRS-P series have also been planned for applications like ocean resources survey, high resolution mapping and environmental monitoring. IRS-P4, carrying oceanography payload, is scheduled for launch during 1997-98.

Data from IRS satellites is being put to use for several applications in the country like agricultural crop acreage and yield estimation, drought management and assessment, flood mapping, landuse and land cover mapping, wasteland management, ocean/marine resources survey, urban planning, mineral prospecting, forest resources survey and management.

Data from IRS satellites is also available to the world user community through a US company.

C. Integrated mission for sustainable development

The implementation of locale-specific action plans under the Integrated Mission for Sustainable Development (IMSD), which was launched in 1992, continues to make further progress. IMSD, coordinated by the National Natural Resources Management System (NNRMS) under the Department of Space, mainly uses data from IRS satellites and other collateral socio-economic data. The mission now covers 174 districts in the country and, specifically, 92 blocks have been identified for generation of action plans on priority for integrated development of land anti water resources.

D. Launch vehicle technology

A major achievement in the last one year has been the completion of the developmental flights of Polar Satellite Launch Vehicle (PSLV) with the successful third developmental launch on March 21, 1996, when PSLV placed the 922 kg Indian Remote Sensing Satellite, IRS-P3, in the intended 817 km polar sunsynchronous orbit. Thus, India has now achieved self-reliance for launching IRS class of 1,000-1,200 kg remote sensing satellites.

Substantial progress has also been made in the development of Geosynchronous Satellite Launch Vehicle, GSLV, including its cryogenic upper stage. GSLV will enable India to launch 2,000-2,500 kg class of communication satellites into the geosynchronous transfer orbit. The first developmental flight of this vehicle is expected to take place in 1997/98.

E. Progress in space science

The launch of Indian Remote Sensing Satellite, IRS-P3, carrying an X-ray astronomy payload, has provided further encouragement to high energy astronomy in the country. The gamma-ray burst experiment payload and the retarding potential analyser payload on board SROSS-C2 satellite, launched in 1994, continues to provide valuable data to the scientists. The National Mesosphere-Stratosphere-Troposphere Radar Facility (NMRF) near Tirupati, in southern India is fully operational and is benefiting the study of various characteristics of upper earth atmosphere. India has initiated a Solar Terrestrial Energy Programme (STEP) which will form an important contribution to the international science campaign in this field.

F. International cooperation

India continues to pursue cooperation in space with several countries. Under a cooperative agreement, IRS-P3 satellite, launched by India in March 1996, carried on board a Modular Opto-Electronic Scanner designed and developed by DLR of Germany. The inauguration of the UN Asia-Pacific Regional Centre for Space Education in India in November 1995 is a significant milestone. The first course on Remote Sensing and GIS has already begun at the Centre, which has been established at Debra Dun in India. In this course, 26 students from 15 developing countries are taking part. Under the Sharing of Experience in Space (SHARES) programme, India continues to train personnel from developing countries in space science and applications.

G. Conclusion

With the successful launches of INSAT-2C, IRS-IC and IRS-P3, India continued to enhance the application of space technology for national development in the areas of telecommunication, television broadcasting, meteorology, disaster warning, search and rescue services and, resources survey and management. India has also achieved self-reliance for launching the IRS class of satellites with the success of PSLV-D3 during the year.

The inauguration and start of the first training course under the UN Asia-Pacific Regional Centre for Space Education and the successful launch of a payload from DLR Germany on board India's IRS-P3 signify the importance India attaches to international cooperation in space.

IRELAND

[Original: English]

A. The LION Instrument on SOHO

On December 2, 1995 NASA launched a $l billion European Space Agency spacecraft called SOHO (The Solar Heliospheric Observatory) on a mission to investigate the Sun. Among the sophisticated, state of the art instruments onboard is the Irish national Low Energy Ion Detector LION, which was designed/ constructed mainly at Space Technology Ireland, Ltd. (STIL).

LION was first switched on during the evening of Thursday, December 7, 1995. The instrument is presently measuring charged particles streaming outwards from the Sun (the Solar Wind) into interplanetary space Detection range 40 keV to several tens of MeV).

B. The RAPID Instrument on CLUSTER

The CLUSTER Mission involves four identical spacecraft designed to compositely monitor, in different geo-regimes, subtle changes in the interaction between the Earth and the Sun. Included in the payload of each of the four spacecraft is the instrument RAPID, which is an imaging energetic particle spectrometer. RAPID was developed under the aegis of an international consortium lead by the Max Planck Institut für Aeronome at Lindau, Germany. Due to the failure of the Ariane V rocket during its first launch in May 1996, the outboard CLUSTER spacecraft constellation was lost. Plans are presently under development for a rescue mission (C-5), and the RAPID instrument will be included in the payload of any replacement spacecraft associatively flown.

C. The WAVES instrument on NASA's WIND spacecraft

The WAVES instrument on NASA's WIND spacecraft, to which STIL made significant design/construction inputs for an international consortium lead by the Departement de Recherche Spatiale, Paris, France, continues, since its launch in 1994, to return important data to Earth concerning radio and plasma processes in the solar atmosphere.

D. The Russian Mission to Planet Mars

A Russian space mission is scheduled for launch to planet Mars in November, 1996. Included in the payload is the Irish national instrument SLED-II, which has been designed and built by STIL to investigate in greater depth energetic particle populations discovered close to Mars by the first Irish SLED instrument on the Phobos Mission to Mars and its Moons (1988/89).

Ireland is also the official manufacturer of the Mars-96 Mariprobe (cold plasma) instrument on behalf of an international consortium lead by the Space Research Institute at Moscow, Russia. Mariprobe would investigated, for the first time, the nightside ionosphere of Mars.

STIL has further designed and constructed a fault tolerant data processing unit for the FONEMA instrument. This is an ultra high speed ion composition analyser which should investigate plasma processes in the Martian neighbourhood for an international consortium lead by the Mullard Space Science Laboratory, England.

E. The Energetic Particle Monitor on NASA's Relativity Mission

STIL has recently been awarded, in international competition, a prestigious contract (the first of its kind in Ireland) to design and build a high energy proton detector and data processing unit for Stanford University, California. This instrument will fly on NASA's Gravity Probe B (Relativity) Mission, which is designed to test important aspects of Einstein's Theory of General Relativity. This spacecraft is scheduled for launch before the turn of the century.

Gravity Probe B will investigate two key predictions of Albert Einstein's General Theory, namely that space and time are warped by the presence of the Earth and that the Earth's rotation drags space-time around with it. So precise will the measurements be, that the tiny changes produced by the warping of space-time can be detected by onboard equipment with an accuracy equivalent to the width of a human hair seen from a distance of 160 km.

These delicate measurements can be disturbed by electrical charging and heating effects produced by very high energy particles trapped in the Earth's magnetic field and by energetic particles produced in association with the explosive events on the Sun called solar flares. Monitoring and taking account of the influence of such high energy particles is essential to the successful recording of the precise measurements required to test Einstein's Theory. This essential monitoring task will be carried out by the Space Technology instrument using a state of the art design featuring high reliability, fault tolerant, electronics.

F. A High Energy Electron Monitor for ESA

STIL, under contract to the European Space Agency, has successfully designed and delivered the electronic and mechanical breadboard of a high energy electron monitor for ESA's European Space Research and Technology Centre, Noordwijk, Holland. This lightweight, low cost detector, which requires minimal onboard resources for its operation, has been designed to fly on the next generation of European mini and micro satellites.

G. Future Plans

1. Space Plant Biology

Collaborative activity between STIL and G. Hyenga of NASA/Ames Research centre has been initiated, with a view to developing areas of plant habitat subsystem design, and plant natural production formations specific to long term flight conditions. It is envisaged that the development and application of space plant biology will contribute significantly to the establishment of extraterrestrial human life support systems, in addition to advancing and contributing to Earth based biological and biomedical requirements.

2. IAA Workshop on Small Satellites

A Workshop of the International Academy of Astronautics entitled “Small Satellites for European Countries Emerging in Space Technology” was held at St. Patrick's College Maynooth, Ireland (7-10 May, 1996). Representatives of 12 countries, namely Austria, Denmark, England, Germany, Hungary, Ireland, Netherlands, Norway, Portugal, Russian Federation, Sweden and Switzerland were in attendance and expressions of interest in, and support for, the topic were received from Bulgaria, the Czech Republic, Finland, Spain and Turkey.

A Preliminary Proceedings providing an overview of 22 scientific and technical papers presented at the Workshop, together with the deliberations of the participants concerning future planned activities, has been produced in two volumes at Maynooth College.

JAPAN

[Original: English]

A. National organizations for space activities

1. Space Activities Commission

The Space Activities Commission (SAC) was established within the Office of the Prime Minister in 1968 under the Law for the Establishment of the space Activities Commission. Its purpose was to unify the space activities of various government agencies and actively promote them.

SAC formulates plans, deliberates and takes decisions on the matters listed below, and submits its opinions to the Prime Minister, whose decision is guided by the opinion of SAC thus submitted. The matters dealt with by SAC are as follows:

- Important policy matters relating to space activities;
- Important matters bearing on the coordination of space-related affairs among the government agencies concerned;
- The estimate for space activity budget of the government agencies concerned;
- Matters relating to the fundamental policy of the education and training of space researchers and engineers (excluding instruction and research at universities or colleges);
- Other important matters concerning space activities.

SAC consists of five persons noted for their learning, nominated by the Prime Minister following approval by the Diet, and including the Minister of State for Science and Technology serving as Chairman. Its secretariat functions are performed by the Space Policy division of the Research and Development Bureau of the Science and Technology Agency (STA).

2. Science and Technology Agency

STA established the Space Science and Technology Preparation Office in July 1959. In July 1964, STA set up the National Space Development Centre to serve as the primary promoter of space activities in Japan.

Attracting able personnel from industry, the academic world and Government, and maintaining flexible budgetary and organizational procedures are necessary to ensure the full and effective implementation of space activities. To that end, STA reorganized the National Space Development Centre into the National Space Development Agency (NASDA) of Japan, a special entity under the law, in operation since 1969.

STA now plans and promotes basic space-related policy and the overall coordination of space activities among government agencies, and conducts research and development activities through the National Aerospace Laboratory (NAL), a research organization attached t it, and NASDA. It thereby plays the central role in the space activities of Japan.

As the secretariat of SAC, STA also maintains liaison and conducts negotiations between various government agencies, thereby allowing smooth and effective development and utilization of space science and technology.

3. National Aerospace Laboratory

NAL, formerly called the National Aeronautical Laboratory, was established in July 1955 as a subsidiary organization of the Office of the Prime Minister to expedite the development of aeronautical technology in Japan. After the establishment of STA in 1956, NAL was placed under its administration. In 1963, NAL was charged with the additional task of conducting research in space technology and renamed National Aerospace Laboratory.

NAL established its Rocket Division in 1963 and its Kakuda Research Centre in 1966 to allow research on a broader scale. The Rocket Division was reorganized into the Space Technology Research Group in October 1969 to encourage progress in space research within a stronger, more fully structured organization. Since then, the Space Technology Research Group and the Kakuda Research Centre have played a dominant role in the development of space technology in NAL, although close cooperation with other divisions is occasionally required. Most NAL divisions are conducting research on key technologies for winged systems of space transport, which NAL considers essential to the pursuit of autonomous space activities by Japan in the coming century.

NAL has strong connections with NASDA, with which it jointly conducts various experiments required for the development of space technology. NAL offers its research data to other organizations to promote further progress in that area, and undertakes basic as well as advanced studies which are considered to be essential to future development. The liquid oxygen turbopump developed at the Kakuda Research Centre is installed in the LE-7 engine.

The principal activities of NAL in the field of space technology are as follows:

- Research on basic technologies for spaceplanes, with the focus on aerodynamics, advanced composite structures, flight control, propulsion systems, manned space flight and orbiter manoeuvreing engines;
- Joint research with NASDA on the aerodynamics, guidance and control, and structure of the H-II Orbiting Plane (HOPE);
- Research on oxygen-hydrogen rocket engine components;
- Research on in-orbit base systems and utilization of the space environment.

4. National Space Development Agency of Japan (NASDA)

NASDA was established by law in October 1969 as the central body responsible for the development of space technology in Japan and the promotion of space activities solely for peaceful purposes.

NASDA's main tasks are to develop satellites and their launching vehicles; to launch and track the satellites and promote the utilization of space technology; and to develop methods and facilities required for these activities.

NASDA orbited various satellites by means of N-I, N-II and H-I launch vehicles. To meet the demand for launching large-scale satellites in the 1990s, NASDA developed the H-II launch vehicle with its indigenous technology, and its first flight was successfully made in February 1994.

NASDA is also striving to promote research and development of experimental technology in the space environment, and to implement the space station project with other countries.

NASDA has four centres to implement its activities.

(a) Tanegashima Space Center

The Tanegashima Space Center is NASDA's largest facility, located in the Tanegashima Island 115 kilometres south of Kyushu. The Center has launch pads, test facilities and tracking systems.

(b) Tsukuba Space Center

The Center conducts the Agency's research and development program, equipped with up-to-date test facilities. It also plays a central role for tracking and control of satellites in Japan.

(c) Kakuda Propulsion Center

This Center is responsible for research and development of constituent parts of propulsion system.

(d) Earth Observation Center

The Earth Observation Center receives and processes remote sensing data sent by earth observation satellites.

5. Institute of Space and Astronautical Science

Directly under the auspices of the Ministry of Education, Science, Sports and Culture is the Institute of Space and Astronautical Science (ISAS), a central institute for space and astronautical science in Japan. ISAS conducts scientific research using space vehicles. For this purpose, it develops and operates sounding rockets, satellite launchers, scientific satellites, planetary probes and scientific balloons. As of August 1996, 21 scientific and test spacecraft had been launched, including Suisei and Sakigake, which explored Halley's comet in 1986.

ISAS was founded in April 1981 as a result of the reorganization of the Institute of Space and Aeronautical Science University of Tokyo, which was the core of space research in Japan from 1964 to 1981. It launched the first Japanese satellite Ohsumi in 1970. As one of the inter-university research institutes run with the cooperation of researchers in universities, ISAS takes part in graduate education. Some of its students are from the University of Tokyo, where a number of ISAS faculty members have positions as

professors or associate professors. Other students from various universities receive part of their education at ISAS by working under the guidance of ISAS staff.

The main campus of ISAS is at Sagamihara, about 20 kilometres west of metropolitan Tokyo. Several ISAS centres are set up around the country.

(a) Kagoshima Space Centre

The Kagoshima Space Centre (KSC) is located in a mostly hilly area of Uchinoura-machi, on the east coast of Ohsumi Peninsula, Kagoshima Prefecture. Covering a total of 72 hectares, the area of KSC includes various facilities for launching rockets, telemetry and tracking, command stations for rockets and satellites and optical observation posts, at sites developed by flattening the tops of several hills. Building in KSC have a total floor space of 17,038 square metres.

(b) Noshiro Testing Centre

The Noshiro Testing Centre (NTC) was established in 1962 at Asanai Beach, Noshiro City, Akita Prefecture. The ground firing test stand, workshop, measurement centre, optical observatory and other facilities are provided for ground-based test firing of large-scale solid motors. Basic research on liquid-hydrogen and liquid-oxygen engines was started in 1975, and several research facilities have been constructed. ISAS, which began studies on the development of the air turboramjet engine in 1976, tested the engine at NTC from 1990 to 1996 under sea-level static conditions using a quarter-scale model. With a total floor space of 3,835 square meters as of August 1996, NTC stands facing the Sea of Japan, far from towns and highways to ensure the safety of its firing range.

(c) Usuda Deep Space Centre

Surrounded by mountains that block out city noise, the Usuda Deep Space Centre is located 1,456 metres above sea level at Usuda-machi, Nagano Prefecture. It started operating in October 1984. A large parabolic antenna 64 metres in diameter, a receiver, a transmitter and a ranging system in S-band are provided at the Centre to serve as a deep space tracking, telemetry and command station. The facilities can be controlled by the Deep Space Operation Centre at the ISAS main campus at Sagamihara, Kanagawa.

(d) Sanriku Balloon Centre

The Sanriku Balloon Centre is located at Sanriku-machi, on the east coast of Iwate Prefecture, facing the Pacific Ocean. The balloon launch site is on a hill 230 metres above sea level. The control centre stands beside the launch site, where launch control and assembly of the balloon and its payload are conducted. On a hill about 700 metres south-west of the launch site is the telemetry Centre, where balloon tracking, telemetry receiving and telecommanding are conducted. In May 1987, a new telemetry centre was constructed at the top of Mount Ohkubo, 4-1 kilometres west of the launch site.

(e) Collaboration of ISAS and NASA in space experiments with particle accelerators and Geotail

ISAS conducted space experiments with particle accelerator (SEPAC) jointly with NASA in 1983 and 1992. In SEPAC, accelerated ion and electron beams were ejected from the space shuttle. In 1992, the Geotail satellite developed by ISAS was launched by NASA using a Delta II launch vehicle. The Geotail satellite carries scientific instruments developed by both ISAS and NASA.

6. Ministry of Transport

The space-related organizations under the Ministry of Transport are the Transport Policy Bureau and Civil Aviation Bureau acting as a headquarters, the Electronic Navigation Research Institute as a subsidiary organization, and the Japanese Maritime Safety Agency and the Japan Meteorological Agency as affiliated agencies. Those bodies have been using meteorological, geodetic and aeronautical satellites, and accumulating knowledge about their use.

Recently, the importance of space technology development and its use in the field of transport has increased, as reflected in such areas as meteorological and maritime observation, maritime geodetic control, search and rescue of ships and aircraft, air traffic control and operational control of ships, aircraft and land vehicles. In addition, space technology, such as large-scale geostationary satellite technology, has been steadily progressing.

It is now believed that it would be much more economical and effective to launch a large, multi-purpose satellite instead of launching several kinds of satellites separately in order to conduct meteorological observations and air traffic control. As a result, the Ministry of Transport contracted to manufacture a Multifunctional Transport Satellite (MTSAT) which will be launched in 1999 for its purpose.

The Ministry also supervises NASDA, a quasi-governmental agency, thus exercising control over satellite development. Important projects under way include the following:

(a) Electric Navigation Research Institute (ENRI)

ENRI is now conducting research and development activities of satellite-based technologies for air navigation and air traffic control.

Major research and development projects relating to these areas which are now proceeding are as follows:

- Automatic Dependence Surveillance (ADS) - a surveillance system which gives pseudo-radar images to air traffic controllers by using aircraft-derived position data transmitted through satellite data link.
- Global Positioning System (GPS) Wide Area Augmentation System (WAAS) - a system which improves integrity, accuracy and availability of GPS for civil aviation in Japan.
- GPS-based altimetry - an altitude measuring method which gives high accuracy and absolute altitude for aircraft by using GPS.
- Satellite data link - a system which improves air traffic control communication quality and surveillance capability for safety of transoceanic flights.

(b) Japanese Maritime Safety Agency (JMSA)

To establish Japanese territorial water, the positions of the mainland and the off-lying islands must be registered with the World Geodetic System (WGS). The Japanese Maritime Safety Agency has therefore been participating in a joint international observation plan using the United States laser geodynamics satellite (LAGEOS) since 1982 to fix the precise positions of the mainland based on WGS. The Agency has been conducting a maritime geodetic survey to determine, to a high degree of accuracy, the positions of the mainland and its off-lying islands and the distances between them, using the geodetic satellite of Japan, AJISAI, launched in August 1986.

(c) Japan Meteorological Agency (JMA)

The Japan Meteorological Agency conducts space-based meteorological observations using GMS and meteorological rockets as part of the World Weather Watch programme of the World Meteorological Organization (WMO).

GMS observes cloud images and temperatures of sea surface and cloud top, and collects meteorological data from aircraft, buoys and meteorological observation stations in remote areas. It also distributes by facsimile the cloud images obtained.

As the ground facility to operate GMS, the Agency has the Meteorological Satellite Centre, which comprises the Data Processing Centre for image data processing and the Command and Data Acquisition Station for communication between the Data Processing Centre and GMS.

The Satellite data are useful to weather forecasting on an operational basis, and are used in the International Satellite Cloud Climatology Project (ISCCP) and the Global Precipitation Climatology Project (GPCP) of WMO. In addition, the Data Processing Centre receives and analyses data from the polar-orbiting meteorological satellites of the United States National Oceanic and Atmospheric Administration.

The Meteorological rockets observe temperature, atmospheric pressure, wind etc, at altitudes of between 30 and 60 kilometres. Launching of the meteorological rockets are carried out by the Meteorological Rocket Observation Station, the sole facility capable of meteorological rocket observation in East Asia and the western Pacific.

The meteorological Research Institute develops techniques for the more effective use of meteorological satellite data, and conducts studies on sensors for the next generation of earth observing.

7. Ministry of Posts and Telecommunications

The Ministry of Posts and Telecommunications plans and promotes policies governing the use of radio waves and space-related research and development in the same field. The Communications Research Laboratory is attached to the Ministry, which also supervises Kokusai Denshin Denwa Co,. Ltd (KDD), Japan Broadcasting corporation (NHK), NASDA, Nippon Telegraph and Telephone Corporation (NTT) and the Telecommunications Advancement Organization (TAO, formerly known as TSCJ) of Japan. The main activities of the Ministry include research on and development of long-range space communication concepts, compels satellite systems and a pilot plan for promoting satellite utilization and advanced satellite communication systems.

(a) Communications Research Laboratory

The Communications Research Laboratory is conducting research and development work of various kinds of space technologies to meet diversified communications needs in an area of advanced information technology and manned space flight. Specific activities of the laboratory include the following:

- Research on and development of small, low Earth-orbiting satellite communication systems;
- Research on cluster satellite communications;
- Research on and development of advanced mobile satellite communications using Ka-band and millimetre-wave and advanced satellite broadcasting using the communications and broadcasting technology satellite (COMETS);
- Research on and development of mobile satellite communications and satellite sound broadcasting using the technology of large deplorable antennas operating in the S-band using ETS-VIII;
- Research on high-data-rate satellite communications systems with Ka-band and optical techniques;

- Research on geostationary servicing satellite systems and technology for detecting space debris;
- Research on and development of space weather forecasting system for predicting solar flares;
- Research on and development of an airborne two-frequency Doppler radar and a space-borne radar for the tropical rainfall measuring mission (TRMM) to observe global rainfall from outer space;
- Experiments for the precise measurement of crustal movement and rotation of the Earth using the very long baseline interferometer (VLBI) and satellite laser ranging (SLR) systems, which are also used to monitor possible precursors of the next big earthquake in the Tokyo metropolitan area;

(b) Telecommunications Advancement Organization of Japan

The Telecommunications Satellite Corporation of Japan was renewed as TAO in 1992. The Corporation was established in 1979 to develop radio communications and seek effective utilization of radio waves in space by controlling the location, attitude etc. of communications and broadcasting satellites and efficiently using the telecommunications facilities installed on those satellites. The main tasks of TAO are as follows:

- Controlling the location, attitude etc. of communications and broadcasting satellites;
- Having radio systems installed in communications and broadcasting satellites utilized by those who open radio stations using the systems.

The Kimitsu Satellite Control Centre tracks and control satellites. N-STAR a/b and BS-3a/3b/3n currently tracked and controlled using eight antennas (in the 6 to 18 diameter class). To promote the spread of high-vision satellite broadcasting (high-definition television), TAO owns one of the transponders aboard BS-3b, and leases it to NHK and commercial broadcasting companies.

8. Other organizations

In addition to the above-mentioned organizations, the Ministry of International Trade and Industry, the National Police Agency, the Geographical Survey Institute of the Ministry of Construction and the Fire Defense Agency of the Ministry of Home Affairs have made space-related budgetary appropriations.

B. Development of Space Science and Technology in Japan

1. Lunar and planetary exploration

(a) LUNAR-A Project (Moon Penetrator Mission)

ISAS plans to send a spacecraft called LUNAR-A to the Moon in 1997. It will be the second flight of the M-V vehicle being developed by ISAS. LUNAR-A will drop three penetrators onto the Moon. The penetrators are supposed to penetrate the lunar surface, and form a network that will explore the internal structure of the Moon using on-board seismomenters and heat flow meters.

(b) PLANET-B Project (Mars Atmosphere/Plasma Mission)

PLANET-B is the first Japanese Mars mission and is scheduled for launch in 1998 by the M-V-3 vehicle. It will be injected into orbit around Mars, and will study the Martian upper atmosphere, especially its interaction with the solar wind.

(c) MUSE-C Project (Asteroid Sample Return Mission)

MUSE-C is a sample return mission of 4660 Nereus, a near-earth asteroid which seems to be one of the most primitive bodies in our solar system.

(d) Projects under discussion

The following are among the lunar and planetary missions under discussion by ISAS: Comet Coma Sample Return Mission; Mars Rover Mission; and Venus Aerocapture/Balloon Mission.

2. Astrophysics

(a) Project in the ASTRAY series (satellites for astronomical observations)

The fifth X-ray astronomy satellite (ASTRAY-E) is now being developed for launch in 1999 and an infrared astronomy satellite is being studied for launch in the 21st Century first. In infrared astronomy, observations from stratospheric balloons and sounding rockets have been conducted. Observations from the Space Flyer Unit that was launched in March 1995 were carried out.

(b) VLBI Space Observatory Programme

A satellite for very long baseline interferometry from space, called MUSES-B, will be launched by ISAS early in 1997. It will be the first flight of the M-V vehicle which developed by ISAS.

3. Communications

The N-STAR communications satellite (N-STARa) being procured from the United States by Nippon Telegraph and Telephone was launched by an Ariane rocket in August 1995 to maintain the satellite communication services being provided by CS-3.

4. Broadcasting

In order to increase the reliability of the satellite broadcasting system, a back-up broadcasting satellite (BS-3N) is being procured from the United States by NHK and Japan Satellite Broadcasting (JSB). This satellite is scheduled to be launched by an Ariane rocket. The BSAT broadcasting satellites (BSAT-1a and BSAT-1b) are also being procured by NHK, JSB etc., and are scheduled to be launched in 1997 and 1998 to maintain the satellite broadcasting services currently being provided by BS-3.

5. Research and development satellites for communications and broadcasting technology

(a) Communications and broadcasting Engineering Test Satellites (COMETS)

The objectives of COMETS are to develop and experimentally demonstrate new technologies of advanced satellite mobile communication, interorbit communication and advanced satellite broadcasting. The satellite weights about 2,000 kg and is scheduled to be launched by the H-II launch vehicle in the middle of 1997, into a geostationary orbit.

(b) Optical Inter-orbit Communications Engineering Test Satellite (OICETS)

OICETS will be launched into low Earth orbit aboard the J-1 launch vehicle in the middle of 2000 to conduct on-orbit demonstrations of pointing, acquisition and tracking technology and other key technological elements for optical communications. The on-orbit demonstrations will be conducted using the ARTEMIS geostationary satellite of ESA.

6. Earth observation

GMS-5 was launched in March 1995 as a successor to the GMS-4. The functions of the Visible and Infrared Spin Scan Radiometer (VISSR) of the GMS-5 have been enhanced compared with those of the GMS-4. For example, in addition to the visible channel and the infrared channel, a water vapour channel has been newly introduced. Moreover, the infrared channel has been divided into two channels. The former provides information on the water vapour distribution in the atmosphere, and the latter enables more accurate determination of the sea surface temperature extraction and detection of volcanic ash clouds.

Multi-functional Transport Satellite (MTSAT): JMA is going on procedures for production of MTSAT as a successor to GMS-5 in cooperation with the Japan Civil Aviation Bureau (JCAB), Ministry of Transport since 1994. MTSAT has two kinds of functions; one is for continuation of meteorological services in JMA and the other for air-traffic control services in JCAB. MTSAT will be launched in around August 1999 using H-II rocket by the National Space Development Agency of Japan (NASDA). It will be finally put into geostationary orbit at 140^{o} E. The MTSAT is a three axis stabilized satellite. The same type of imager as the one loaded on GOES-8 will be equipped on the MTSAT. As for the meteorological mission, the specifications of GMS-5 will be fundamentally succeeded and a near-infrared sensor will be added.

(a) Advanced Earth Observation Satellite (ADEOS)

NASDA launched ADEOS by the H-II launch vehicle in August, 1996. The main objectives of ADEOS are (a) to develop advanced Earth observation sensors; (b) to develop a modular satellite that will be the key technology of the future platform; (c) to contribute to domestic and international cooperation by carrying announcement-of-opportunity (AO) sensors developed by domestic and foreign organizations; (d) to acquire data on world wide environmental changes in order to contribute to international global environmental monitoring.

ADEOS carries two core sensors, Ocean Color and Temperature Scanner (OCTS) and Advanced Visible and Near Infrared Radiometer (AVNIR), as well as other six AO sensors. Data gained by those sensors are expected to elucidate mechanisms of global environmental changes

(b) Tropical Rainfall Measuring Mission (TRMM)

TRMM is being jointly conducted by Japan and the United States to measure tropical rainfall. Over two thirds of total rainfall on the earth occurs in tropical areas and this rainfall is one of the main sources of global climate change. TRMM will be the first mission carrying a precipitation radar to monitor tropical rainfall from space. TRMM will be launched in mid-1997 by the H-II launch vehicle.

(c) Advanced Earth Observation Satellite II (ADEOS-II)

ADEOS-II, a successor to ADEOS, will be launched by the H-II launch vehicle around February 1999. The objectives of ADEOS-II are to observe global environmental change, to contribute to international science programmes such as the International Geosphere-Biosphere Programme, and to follow the ADEOS mission. The satellite is of a modular type with a flexible solar array paddle. ADEOS-II will have two core sensors developed by NASDA, namely an advanced microwave scanning radiometer (AMSR) and a Global Imager (GLI).

7. Development of engineering test satellites (ETS)

The objective of the ETS programme is to develop the high-level technologies required for the practical utilization of satellites. ETS-VII is to be dual-launched with TRMM from the Tanegashima Space Center.

The purpose of ETS-VII is to acquire the basic technologies of rendezvous-docking and space robotics that are essential to future space activities. ETS-VII consists of a chaser satellite and a target satellite.

8. Space transportation system

NASDA is planning to upgrade the H-II launch vehicle for the purpose of responding flexibly to a variety of future launching needs. Based on the H-II launch vehicle, the advanced H-II launch vehicle (H-IIA) will meet various needs through reconfiguration of the type and number of boosters.

(a) Launch vehicles in the M or Mu series

ISAS has started to develop the M-V launch vehicle to provide larger launch capability to meet the requirements of space science in the late 1990s and the twenty-first century. M-V will be 2.5 metres in diameter and 30 metres in length, and will weigh 35 tons. It will be able to launch a payload of 1,800 kilograms into low Earth orbit or 400 kilograms beyond the Earth gravitation region. The first M-V flight is scheduled for 1997 Five spacecraft, MUSES-B for the space VLBI (1997), Lunar-A for the Moon Penetrator Mission (1997) and PLANET-B for the Mars Orbiter (1998), ASTRAY-E for X-ray astronomy (1999) and MUSES-C for asteroid sample return (2001) have already been approved for launching by M-V.

The use of M-V launch vehicles is being discussed for the pursuit of a variety of space science projects and fields of study in the near future, including the following: the Comet Coma Sample Return Mission; the Lunar/Mars Rover; the Venus Aerocapture/Balloon Mission; infrared astronomy; solar physics; and atmospheric science.

9. Space experiments and utilization of the space environment

(a) Space Flyer Unit (SFU)

SFU is an unmanned, multi-purpose, reusable free-flying platform that has been developed since 1987 by ISAS, MITI and the Science and Technology Agency (through NASDA). It was launched in March 1995 and retrieved by a Japanese astronaut aboard the Space Shuttle in January 1996.

(b) Space Station Project

Japan participates in the International Space Station Programme by developing Japanese Experiment Module (JEM). JEM is composed of four main parts: the Pressurized Module, Exposed Facility, Experiment Logistics Module, and Manipulator. There will also be sub-systems such as electric power, environmental control, communication, and heat control. JEM will be launched by the Space Shuttle and will then be assembled in orbit by the space station manipulator and by the extravehicular activities of crew members.

10. Basic and pioneering space technology research

(a) Hypersonic Flight Experiment (HYFLEX)

HYFLEX is one of the flight experiment series in HOPE-X project. The purposes of HYFLEX were to accumulate data on design, production technology, as well as for flight technology and flight data of a craft flying at hypersonic speeds. It was launched by the J-I launch vehicle and separated at an altitude of 110 km in February, 1996. Unfortunately the rope was torn off and the body sank into the sea, experimental data were found to well match the estimation.

(b) Automatic Landing Flight Experiment (ALFLEX)

The purpose of ALFLEX project was to develop design and production technology for a craft during low-altitude flights and landing operations. It also intended to establish technology for automatic landings. All test flights were carried out successfully from July to August, 1996 at Woomera Airfield, Australia. The flight body was released from a helicopter at high altitude and automatically landed at the test site after gliding through the air. Collected data would be used to establish the basic technology for the fully unmanned automatic landing.

(c) HOPE-X

HOPE-X will be developed to perform flight experiments as a part of reusable type transportation system, which should reduce transportation costs drastically. HOPE-X will establish major technologies for and unmanned winged space plane and enable us to accumulate technology for a future study of reusable transportation systems.

C. International cooperation

In accordance with the basic principles of its space development policy, Japan has attached great importance to international cooperation in its space activities.

Japan launched three Earth observation satellites; Marine Observation Satellite-1 (MOS-1), MOS-1b, Japanese Earth Resources Satellite (JERS-1). Observation data from MOS-1, MOS-1b and JERS-1 have been received directly in Australia, Canada, China, Indonesia, Republic of Korea, Thailand, the United States and the European Space Agency.

1. Cooperation through ASTER

NASA plans to develop and operate an Earth observing system-AM1 (EOS-AM1) polar orbiting platform, thereby creating an integrated scientific observation system through international cooperation. The advanced resources searching sensor of MITI will be mounted on EOS-AM1.

2. Inter-Agency Consultative group for Space Science

In 1981, when preparations for missions to encounter Halley's comet were about to begin, four space agencies -- ESA, Intercosmos of the Academy of Sciences of the former Union of Soviet Socialist Republics, ISAS and NASA -- formed the Inter-Agency Consultative Group for Space Science (IACG). The task of IACG was to informally coordinate all matters relating to the space mission to Halley's comet and the observations of the comet from space.

The collaboration of IACG proved to be invaluable for the success of the cometary mission. Vital information was exchanged on the cometary path, the cometary dust environment and experiment design. Hence, when the encounter ended, all delegations recognized the advantages of the close cooperation that had occurred, and agreed to continue IACG.

As its next project, IACG adopted the Solar-Terrestrial Science Programme at its meeting held at Padua, Italy, in 1986. The Solar-Terrestrial Science Programme addresses the effects of solar ultraviolet and plasma emissions on the atmosphere and the magnetic field of the Earth. Beginning with AKEBONO in 1989, about 20 mission were approved or planned for the period from 1989 to 1996. ISAS collaborates in the AKEBONO (EXOS-D), Geotail and YOHKOH (SOLAR-A) missions.

Japan has been attending sessions of the United Nations Committee on the Peaceful Uses of Outer Space and its Legal Subcommittee and Scientific and Technical Subcommittee. Japan has also participated in the activities of ESCAP through holding seminars.

JORDAN

[Original: English]

The Hashemite Kingdom of Jordan intends, as part of the development of an ICAO CNS/ATM (Intenational Civil Aviation Organization's Communications, Navigation and Surveillance/Air Traffic Management) plan for the Middle East Region to introduce into experimental exploitation a satellite-based Global Positioning System (GPS). The improved CNS/ATM system will allow more direct routing of aircraft which will generate savings in fuel costs and other aircraft operating costs.

Details of this plan were presented at the Middle East Regional Air Navigation Meeting in Cairo, 7-17 January 1996.

LEBANON

[Original: English]

A. Introduction

Space activities were introduced in Lebanon in the 1960's with the installation of an earth station for telephone communications through satellite. As noted in our previous report to the United Nations Committee on the Peaceful Uses of Outer Space, the economic sectors with outer space related activities in Lebanon are Telecommunications, TV Broadcasting, and Meteorology.

In each of these sectors an evolution in infrastructure was evident during the course of the year, especially in the sector of satellite-based telecommunications. In addition, there was an expansion of the use of satellite for Internet where satellites are used in order to communicate with the outside world.

Space research did not exist in Lebanon until the National Council for Scientific Research (NCSR) established the National Centre for Remote Sensing (NCRS) in 1995. Since its establishment, the Center has been playing an active role in planning programs needed for remote sensing technology.

The present report of space activities in Lebanon prepared by the National Center for Scientific Research (NCSR) is divided in two parts:

- Space communications, broadcasting and meteorology
- National Center for Remote Sensing

B. Space-Related Activities in Lebanese Economic Sectors

1. Space Telecommunications

Presently the Ministry of Power and Telecommunication has five earth stations for satellite communications based in two localities, Arbaniye & Jouret El Ballout. The Ministry is undertaking a project

to make the transition from analogue to digital transmission. These earth stations are used for telephone communications and TV broadcasting.

(a) Arbaniye

In this locality, two earth stations are connected to INTELSAT using digital transmission. They are built by ALCATEL and TELSPACE. Each station has a communications capabilities of 10 channels (of 1 and 2 Mb/s).

(b) Jouret El Ballout

There are 3 earth stations in this locality, of which one is used for direct TV broadcasting. The other two earth stations are connected with INTELSAT and are used for telephone communications. One is analog and the other is digital. A project will be conducted in the near future to make the transition from analog to digital. The digital earth station can be linked to the satellite via 8 channels (l Mb/s & 2 Mb/s). The earth station used for broadcasting TV is connected to ARABSAT satellite using analog transmission.

2. TV Broadcasting

As mentioned previously, the Ministry of Post and Telecommunications has an earth station dedicated to TV broadcasting. Lebanon has two TV stations which broadcast their programmes to other countries through ARABSAT and PANAMSAT.

Soon the Lebanese Government will introduce new legislation to control TV stations broadcasting outside Lebanon.

3. Meteorological Information

The Directorate of Climatology of Lebanon has an earth station to gather analog images (Wefax format) from the climate based satellites (geostationary satellites). In 1997, this Administration will acquire a new earth station that has the capability to record very accurate digital imagery. The Directorate of Climatology actively cooperates with the NCSR Lebanon in assisting the research sector in obtaining climate data as required.

4. Internet

This year, 6 private enterprises are connecting people in Lebanon to the Internet using their own each stations to establish the communication link with the satellites. Currently, there are about 5000 subscribers in Lebanon, with the largest number in Beirut.

The Lebanese NCSR is a main founding member of LARN (Lebanese Academic and Research Network) whose mission is to set up and manage a national computer network linking all institutions of higher learning, academic research and non-commercial scientific research.

The NCSR is about to provide full Internet access to all its members individually with the purchase of a SUN NETRA server. It is planned to link all the Universities and Institutions to it. This undertaking also entails acquiring a high speed, large bandwidth link with the outside world and with large local customers. Negotiations are already underway to establish the link and several solutions are being considered.

C. National Center for Remote Sensing

1. Justification

Establishing the National Center for Remote Sensing in Lebanon is a reflection of the country's efforts to catch up with the huge scientific advances, notably those related to data gathering and information. This is in line with the aspirations of the National Council for Scientific Research. The Lebanese terrain, complex as it is, requires by necessity the application of such techniques as remote sensing and related fields such as geographic information systems (GS).

2. Aims

The Center's main goal is to apply the new techniques to development projects that are planned or implemented in Lebanon. This starts at the planning stage and goes all the way to implementation. Help is extended to public and private sector organizations to plan and implement the use of remote sensing in their operations, with a notable emphasis on environmental concerns. The Center's main task is to secure the needed databases on timely, accurate and wide national coverage, for different developmental sectors, both on land and marine aspects. Interaction with the remote sensing community on the national, regional and international scene is essential. This ensures the quality standards that must always be observed by the Center. It will also assure that training and capacity building is an ongoing process. As such, the expertise at the Center will put at the disposal of decision makers the proper advice on actions and policies of relevance to remote sensing and space.

3. Functions

Three main functions are carried out:

- Making use of the wealth of data supplied from remote sensing platforms, with needed conversion, rectification and processing;
- Producing the needed documents on an accurate basis, both geographically and scientifically, to comply with proper decision making for development;
- Ground truthing and material verification, for accuracy and quality.

4. Organization

The Center is part of the Engineering and technical Division of the National Council for Scientific Research. The Center's structure/staff consists of two main specialities: sectoral specialists, i.e. in geology and natural resources, agriculture, water environment, etc. and systems specialists covering computer science, image processing and GIS.

5. Strategy and Policy

The Center's strategy reflects that of the NCSR, which boils down to promoting the development of Lebanon through the application of science and technology. The policies that such strategy require are exemplified in the creation of research centres, enhancing scientific contribution into development projects and capacity building.

6. Projects

Although still at its formulation stages, the Center has leaped forward onto the road to scientific productivity and economic return by starting to be involved in some projects and at the same time planning for others. More than one Ministry and regional and international agencies are cooperating with each other. The topics cover water sources, agriculture, iron ore, environmental concerns and archaeological sites. The Center is looking for more and wider relationships.

C. Conclusion

This report indicates that Lebanon is developing sectors related to satellite activity quite rapidly.

The development of space technology and its applications has resulted in significant contributions to key sectors of the Lebanese national economy.

PAPUA NEW GUINEA

[Original: English]

The Government of Papua New Guinea reports that it does not have any outer space related programmes or activities.

SWEDEN

[Original: English]

A. National organization of space activities

1. The Swedish National Space Board (SNSB)

The Swedish National Space Board, established in 1972 under the Ministry of Industry and Trade, is the central governmental agency responsible for the Swedish national and international space and remote sensing programmes. For the research programme the Board receives funds from the Ministry of Education and Science.

The responsibilities of the Board include:

- initiating research, development and other activities connected with the Swedish space and remote sensing programme;
- coordination of Swedish activities within the fields of space technology and research as well as remote sensing;
- distribution of government appropriations for Swedish space activities;
- authorization and supervision of space activities in accordance with space law;
- maintaining contacts with international organizations and institutions operating within the field of space activities and remote sensing.

The Board, which is located in Stockholm, has three advisory committees: for industrial policy, science (incl. microgravity) and remote sensing respectively.

The technical implementation of the national space and remote sensing programmes are mainly contracted by the Board on an annual basis to the state owned Swedish Space Corporation (SSC).

2. The Swedish Space Corporation (SSC)

In addition to performing its tasks for the Board, the Swedish Space Corporation is now active in a number of areas related to space technology and remote sensing. It is organized in five divisions with the following main activities:

- Esrange Division; sounding rocket and balloon launchings, scientific satellite support;
- Earth Observation Division; satellite TT&C services, data acquisition, archiving and processing of data from earth observation satellites, production and marketing of satellite data and enhanced products;
- Science Systems Division; design and project management for space science research satellites, development of sounding rocket and balloon payloads, supply of microgravity services and satellite navigation systems;
- Telecom Division; television broadcasting, business television, data communication services contribution and news gathering;
- Remote Sensing and Technology Division; assistance to SNSB and other domestic and international government agencies, systems and methodology development within earth observation, development and marketing of airborne systems for maritime surveillance and environmental control.

The Swedish Space Corporation has three establishments, two in Kiruna (Esrange and Satellitbild) and one in Stockholm (headquarters).

B. Space applications programmes

1. Remote sensing of earth resources and environment

Development and consolidation of remote sensing activities in Sweden is continuing. New advanced equipment has been made available through own development, through purchase, or through international co-operation. Several major co-operative field experiments have been carried out. The objective is to assess the potential of the technology for various applications, but above all to acquaint the potential users with the available technology at an early stage.

The Esrange facility, which has been receiving and processing Landsat data on behalf of ESA since 1978, receives SPOT data on behalf of Spotimage, France. Data is also regularly received from the polar orbiting satellites JERS-1 and EXOS-D (Japan), and from Resurs (RF).

There is an agreement with ESA to receive and process ERS-1 and ERS-2 data. A separate ESA facility has been established for that purpose at Salmijärvi (near Esrange).

SSC Satellitbild in Kiruna is processing and distributing SPOT data in co-operation with the French company SPOT Image. SSC Satellitbild specializes in providing geometrically precision corrected and analyzed SPOT and Landsat data for the world market.

Sweden co-operates with France in the SPOT remote sensing satellite programme and the Kiruna facility is one of the two principal stations in the SPOT network.

Sweden participates in the ESA programme for receiving, preprocessing, archiving and distribution of images from remote sensing satellites (Earthnet). The Swedish ground station at Esrange, Kiruna, forms part of the system and is collecting Landsat data on a routine basis.

Sweden also participates in the remote sensing programmes of ESA such as the programme for development of remote sensing satellites (Envisat-l/Polar Platform) and the earth observation preparatory programme (EOPP).

The Swedish Space Corporation, in co-operation with the Swedish National Environmental Protection Agency and the local authorities, is in the process of establishing the Environmental Satellites Data Centre (MDC) in Kiruna. The primary tasks of the Centre will be production and management of environmental data bases. It will also develop new data bases and carry out surveillance activities in the environmental field.

2. Meteorology

Cloud cover photographs and other meteorological data from ESA, United States and Russian weather satellites are received regularly by the High-Resolution Picture Transmission (HRPT) and Automatic Picture Transmission (APT) stations of the Swedish Weather Services and are used in weather forecasting.

A project concerning the establishment of short term weather forecasting and regional weather service based on advanced space and remote sensing techniques, including weather radar, SODAR, microwave radiometry and weather satellites, has entered into an operational phase.

Development of the operational use of advanced digital image analysis of polar weather satellite data is going on. A microwave radiometer for sounding of temperature and humidity of the atmosphere has been developed for operational use.

Sweden participates in the meteorology programmes of ESA and Eumetsat, such as the programmes for development of the geostationary satellites Meteosat Second Generation (MSG) and the polar satellites Metop.

3. Communications

Sweden participates in the telecommunications programmes of ESA such as the programmes for Advanced Research in Telecommunications Systems (ARTES), the technology demonstration mission (Artemis) and data relay satellites (DRS).

On a national level, the Swedish Space Corporation operates the Tele-X/Sirius telecommunications satellite system, which provides the following services:

(a) High-speed digital data and video communications, 64 kbit/s - 2 Mbit/s, using small earth stations.
(b) Direct TV-broadcasting to small (50 cm antenna diameter) home receivers.

4. Navigation

Satellite navigation equipment is in routine use on Swedish merchant vessels using Transit/Navstar-type satellites.

Sweden (SSC) is active in the development of GPS (Global Positioning System) technology for aeronautical, maritime and landmobile applications, using the Swedish GP&C (Global Positioning and

Communication) invention. This invention makes possible the location of several thousand mobiles on a single radio channel.

Sweden participates in the ESA programme element (ARTES 9), which is part of a cooperation project between ESA, Eurocontrol and the European Commission aiming at a European contribution to a Global Navigation Satellite System.

5. Space transportation

Sweden participates in the ESA programmes for development of the Ariane launchers, i.e. the present Ariane 5, as well as in the programmes aimed at improving the launcher.

C. National scientific space programmes

1. Satellites

(a) Viking

Sweden´s first satellite was launched from Kourou in February 1986. The mission ended in May 1987. The scientific objective of the Viking satellite was to study the ionospheric and magnetospheric phenomena at high geomagnetic latitudes in the attitude region up to about two Earth radii. Simultaneous measurements were made of electric and magnetic fields, particle distributions, plasma composition and waves as well as imaging in the ultraviolet of the aurora beneath.

(b) Freja

Sweden´s second one, is also a scientific satellite designed to carry instruments for research into the aurora and other magnetospheric/ionospheric phenomena. The low cost designed satellite was launched on October 6, 1992, on the Chinese carrier Long March 2 and is still in operation. The project has been carried out in cooperation with Germany.

The satellite weighs 214 kg in the final orbit, which ranges in altitude between 600 and 1 756 km. The inclination of the orbit is 63 degrees. The scientific mission of Freja has many similarities with that of Viking. The auroral zone is the "mission target" and the satellite carries energetic particle detectors, magnetic and electric wave experiments, electric field sensors and a UV imager. The Freja design provides substantially higher data rate than that used on Viking. Freja is operated from Esrange. Data is received at Esrange and at Prince Albert Satellite Station in Canada.

(c) Astrid 1

Astrid 1 is a Swedish microsatellite, launched in January 1995 from Plesetsk in the Russian Federation into a polar orbit. Astrid´s main scientific mission was to investigate near-space plasma, particularly neutral particle phenomena. High resolution measurements in the upper ionosphere and the lower magnetosphere have contributed to increasing the knowledge of basic processes of fundamental importance to the physics of neutral particles. The payload was designed by the Swedish Institute for Space Physics in Kiruna. The scientific payload ceased to function in March 1995, but the technical experiments part held on till September. The satellite ceased to function on September 27, 1995. Successors to Astrid (2 and 3) are being planned.

Sweden´s next scientific satellite **Odin**, with a combined astronomy and aeronomy mission, is under development. Odin is a scientific satellite for spectroscopic studies at submillimetre wavelength of

astronomical objects and processes in the Earth´s atmosphere. The project is carried out in cooperation with Canada, France and Finland. The launch, on a Russian launcher, is planned for early 1998 with an operational lifetime of two years.

(d) IBIZA/IMPACT

The Investigation of Magnetospheric Particle Acceleration and Turbulence is a project under study in co-operation with Germany´s Max Planck Institute for Aeronomy. The project comprises two satellites (300 kg each) with the mission to perform coordinated measurements in the Earth´s magnetosphere from highly elliptic orbits. Current plans envision launching in the early period of the next decade.

(e) Hannes

Hannes is another Swedish satellite project under study. The planned mission is to study a number of asteroids in order to increase the understanding of the evolution of the planetary system (cosmogony) and the local effects of the solar wind in interplanetary space on the nature of the plasma processes. The project is being planned for international cooperation.

(f) Other Satellite Projects

The Institute of Space Physics in Kiruna and the Swedish Space Corporation have built experiments for measurements of mass and energy distribution for ions and electrons in the magnetosphere. One experiment has been launched within the Interball-project.

The Institute of Space Physics in Kiruna will participate with hot plasma experiments (ASPERA) in the planned project Mars-96.

The Institute of Space Physics in Kiruna has participated in the development of a particle experiment for the ESA-satellite Ulysses.

Both the Kiruna and the Uppsala departments of the Institute of Space Physics and the department of Plasma Physics of the Alfvén Laboratory, the Royal Institute of Technology in Stockholm, are involved in the Cluster project in the Solar Terrestrial Science Programme, the first cornerstone in ESA space science programme Horizon 2000.

The Stockholm Observatory and the Astronomical Institutes in Lund and Uppsala participate with several quest investigator programmes on the International Ultraviolet Explorer (IUE) satellite launched in January 1978 and still operating.

The Stockholm Observatory also takes active part in the ESA satellite project Infrared Space Observatory (ISO) in the construction of an IR-camera (ISOCAM).

2. Sounding Rockets and Balloons

Swedish sounding rocket and balloon launches have been carried out since 1962 and since 1968 from Esrange. Most of these have been and are international cooperative projects.

The Swedish sounding rocket and balloon programme is concentrated on four main areas:

- magnetosphere and ionosphere physics
- upper atmosphere physics and chemistry
- astrophysical infrared and sub-millimetre studies

- material, fluid and bio-science in microgravity

The Swedish Space Corporation is responsible for the technical execution of the projects as well as for the operation of Esrange.

The Swedish MASER programme (Materials Science Experiment Rockets) which started in 1987, offers one launch per year for experiments within material physics, fluid- and bio-science.

There is an increasing interest in microgravity experiments of long duration. A programme, named MAXUS, is carried out jointly with Germany and it is based on a required payload weight of 750 kg and 14 - 15 minutes of microgravity. The first successful MAXUS launch took place at Esrange in 1992, the second one in 1995 and the third in 1996. The main MAXUS users are the European Space Agency ESA and the German space agency DARA.

3. Ground based experiments

Sweden is participating in the work of the European Incoherent Scatter Scientific Association - EISCAT. The association has installed a multistatic incoherent scatter facility in the auroral zone, comprising a system of stations at Tromso and Svalbard (Norway), Kiruna (Sweden) and Sodankylä (Finland).

4. Swedish Research Groups

The scientific activities of Swedish research groups are mainly:

- Magnetospheric and ionospheric physics, in particular measurements of charged particles and electric and magnetic fields using satellite experiments, sounding rockets and balloons.
  Research groups are the Swedish Institute of Space Physics, Kiruna; Swedish Institute of Space Physics, Uppsala; and Dept. of Plasma Physics of the Alfvén Laboratory, Royal Institute of Technology, Stockholm
- Study of the upper atmosphere, (80 - 150 km) in particular atmospheric processes and Komposition at high latitudes using sounding rockets.
  Research group is the Institute of Meteorology, Stockholm University
- Astrophysics in particular studies of solar and stellar UV radiation and IR and sub-millimetre studies using satellites, sounding rockets and balloons in international co-operation.
  Research groups are the Lund Observatory, University of Lund; Stockholm Observatory, Stockholm University; Uppsala Astronomical Observatory, University of Uppsala; Onsala Space Observatory, Chalmers; and University of Technology, Gothenburg
- Material sciences, in particular solidification processes of metals, diffusion processes in liquid metals and crystal growth in microgravity using sounding rockets.
  Research groups are the Department of Casting of Metals, The Royal Institute of Technology, Stockholm; and University of Sundsvall
- Life sciences, in particular studies of human physiological processes in microgravity.
  Research groups are the Environmental Physiology Laboratory and the Karolinska Institutet, Stockholm
- Biophysics, in particular electrophoretic and protein crystal growth studies in microgravity.
  Research group is the Dept. of Physical and Inorganic Chemistry, Chalmers University of Technology, Gothenburg
- Remote sensing, in particular microwave radiometry, spectral signatures and image analysis using satellite data or data registered by airborne or landbased sensors.
  Research groups are the Dept. of Radio and Space Science, Chalmers University of Technology, Gothenburg; Remote Sensing Laboratory, Dept of Physical Geography, Stockholm University; Remote Sensing Laboratory, Dept of Physical Geography, University of Lund; Dept of Physics,

Lund Institute of Technology; and Remote Sensing Laboratory, Swedish University of Agricultural Sciences, Umeå.

(Note: Several groups are engaged in research concerning remote sensing; only the largest and most active groups are listed here. Details on the activities are given in "Space Research in Sweden", published biannually for the COSPAR meetings.)

D. ESRANGE

Esrange is a Swedish space research range situated in northern Sweden, close to the town of Kiruna at a latitude of about 68 degrees N. The base is managed by the Swedish Space Corporation. Space research activities are carried out at Esrange in international co-operation using ground based instrumentation, sounding rockets, balloons and satellites. Due to the geographical location studies of the aurora and other high latitude phenomena are of particular interest.

The land recovery possibility makes Esrange very suitable for all sounding rocket experiments needing recovery, for instance microgravity research. Esrange has the capacity to launch most types of sounding rockets. The range also has long experience of launching scientific balloons.

The Esrange sounding rocket and balloon activities are performed as an ESA Special Project. Contributing ESA members can use the range on a marginal cost basis. Also non-ESA members are welcome to use the facilities. Esrange is also used in various satellite projects. A number of ground facilities for the support of national and international spacecraft programmes are in operation or under development. The majority of the passages of polar orbiting satellites are inside the coverage zone of the Esrange satellite ground stations.

A Tracking, Telemetry and Control (TT&C) station is used to support polar satellites during the launch phase and when in service in their nominal orbits. The station includes a dedicated Operations Centre and a display and analysis facility for scientific data. The Ground Control Station for the geostationary Tele-X/Sirius satellites is located at Esrange.

E. Other space-related facilities and installations including telemetry and acquisition

A subsidiary to the Swedish Space Corporation, the SSC Satellitbild, is situated in Kiruna : Its main tasks are to process, analyse and distribute images from the SPOT and Landsat satellites on a commercial basis.

The Onsala Space Observatory, located on the Swedish west coast, operates radiotelescopes, chiefly for radioastronomical observation. The newest telescope has a radome-enclosed 20 m diameter reflector with very high surface accuracy for work at millimetre wavelengths.

A joint Scandinavian Intelsat earth station is located at Tanum on the west coast of Sweden. A joint Scandinavian earth station for the European Communication Satellite System (ECS) is located near Stockholm. A number of HRPT and APT weather picture receiving stations are in operation.

F. International cooperation

Most of Sweden´s international cooperation is performed within the framework of European Space Agency, ESA. In addition to the mandatory basic and scientific programmes, Sweden participates in the Ariane launcher programme as well as in the projects for future space transportation systems, the programmes for manned space, telecommunications, remote sensing and microgravity.

Bilateral scientific cooperation between Sweden and the United States is carried out under an agreement with NASA. Similarly scientific co-operation is carried out with the Russian Federation.

Bilateral co-operation on space science and applications (SPOT) is carried out between Sweden and France under an agreement with Centre National d´Etudes Spatiales, CNES.

Sweden and the Federal Republic of Germany have concluded Memoranda of Understanding on i.a. scientific co-operation in the Freja-project and in the field of hypersonic technologies/SÄNGER.

Memoranda of Understanding have been concluded as basis for co-operation with Austria, Canada, India and China. Other bilateral cooperative efforts are carried out on ad hoc basis.

Sweden is a member of Intelsat, Eutelsat, Inmarsat and Eumetsat.

G. Other activities

Sweden has a broad experience of remote sensing and Geographical Information Systems (GIS) at governmental agencies, universities and companies.

This experience and know-how can be made available to developing countries where there is need for mapping and other forms of remote sensing applications. There is thus an increasing demand for technology transfer in the form of training of personnel from developing countries.

For this purpose a Swedish Institute for Geographical Information Technology (SIGIT) has been established in Kiruna. The institute offers courses in practical application of remote sensing. The courses are based on the resources of i.a. university institutes, the SSC Satellitbild company and the Swedish Land Survey in the area. The aim is to meet high vocational demands of both national as well as international students and trainees in the field of remote sensing and geographic information technology.

Annual UN Training Courses on Remote Sensing Education for Educators started in Sweden in 1990 and are hosted by the Swedish Government. The courses are carried out jointly by the University in Stockholm (Department of Physical Geography) and the SSC Satellitbild.

SYRIAN ARAB REPUBLIC

[Original: Arabic]

A. Remote sensing

Since the early seventies, the Syrian Arab Republic has paid particular attention to the field of space and remote sensing research and applications. In the eighties, the Public Corporation for Remote Sensing (PCRS) was established, through five years of foundation laying and training and development of scientific personnel. Appropriate plans were formulated to make use of the experience of similar agencies in several countries that had made great progress in the field of remote sensing and space research, such as the United States of America, the former Soviet Union, the European Community, Japan and India.

Established in the Syrian Arab Republic in 1986 by Legislative Decree No. 8, PCRS is entrusted with the following Functions:

- Space, aerial and ground survey using remote sensing techniques.

- Analysis of remote sensing data for use in the exploration and utilization of natural resources and in environmental studies.
- Scientific studies and research concerning remote sensing.
- Education anti training of specialists and establishment of the necessary training centres and institutions.
- Supervision of the acquisition and dissemination of remote sensing data in the Syrian Arab Republic.
- Monitoring of international activities in remote sensing matters and proposal of projects for making use of remote sensing techniques.

Since its establishment, PCRS has been implementing development projects. The following projects were completed:

- Development of domestic capabilities in the field of the use of remote sensing techniques. For this purpose, PCRS regularly organizes local training courses and international seminars on various aspects of remote sensing applications in the areas of environment, desertification, geology, hydrology and the use of geographical information systems (GIS) and environmental information systems. It also organizes training courses and specialized seminars in cooperation with COPUOS and cooperates with the United Nations and UNESCO to organize workshops on such important topics as the use of remote sensing techniques in the mitigation of natural hazards like earthquakes as well as in archaeological exploration. Since the creation of PCRS, many technicians are being sent to pursue training courses in centres specialized in remote sensing as well as to obtain post-graduate degrees.
- Implementation of development projects through the activities of PCRS and in accordance with the requirements of the country. Thus PCRS has concluded cooperation agreements with most public sectors, universities and Arab and international centres in Syria (ACSAD and ICARDA), Turin University in Italy and the Global Geospace Science Programme (GGS) of Austria. Under these agreements PCRS has implemented many projects using remote sensing and GIS techniques including the following projects:

    - Town planning scheme for Damascus, Aleppo and Gardaha.
    - Comprehensive environmental planning for Damascus town and surroundings.
    - Soil erosion in Latakia and Tarsus provinces.
    - Assessment of natural resources in Jebel Abdel-Aziz.
    - Potable water in Syrian coastal cliffs.
    - Study of pollution emanating from Baryas refinery and the hydroelectric generation station.
    - Monitoring and control of desertification in the Syrian semi-desert (Jebel Al-Bushra).
    - Study of pollution caused by phospho-gypsum residues.
    - Forest management.
    - Preparation of a land-use map of Asia (in cooperation with ASIAN).
    - Comprehensive environmental planning for the Syrian coast.
    - Predictive study of new promising areas of phosphate in Tadmur area.
    - Preparation of geo-environmental maps for the southern and Damascus regions.
    - Oil and gas exploration.
    - Archaeological exploration and archaeological study of Silk-Road (in cooperation with Turin University).
    - Water prospection and study of the ice sheet.
    - Environmental and taxonomic study of economic fish along the Syrian coast.
    - Preparation of a map of Damascus and surroundings from satellite images.
    - Study on multiple uses of iron ores.
    - Study of volcanic and tectonic phenomena in several areas of the Syrian Arab Republic.
    - Several geological and hydrological projects.

In cooperation with the National Centre for Remote Sensing, Lebanon, PCRS is presently implementing several projects using remote sensing for exploration of iron-ore deposits in the border areas between Lebanon and the Syrian Arab Republic, a thermal photography project for the Syrian and Lebanese coast, an archaeological survey project and another project involving the study of the tectonic system of the Great Syrian Rift along the Mediterranean coast of the Syrian Arab Republic and Lebanon, with a view to preparing accurate maps for it. Another project currently under implementation is the preparation of a unified large-scale earth-science map of Lebanon.

- Establishment of a station to receive climatic information from several satellites (e.g., METEOR, METEOSAT, etc) for the national meteorological agency, which receives and analyses data and visual information and disseminates them to the relevant beneficiary agencies. There are also plans to establish stations to receive data from the National Oceanic and Atmospheric Administration (NOAA).

It should be noted that there are various other stations for meteorology and reception of climatic data, operated by the Syrian Directorate General for Meteorology. These receive images from meteorological satellites, particularly to obtain information on the cloud cover, monitor pollution, register solar radiation and collect climatic, meteorological and rainfall information. PCRS has participated with the Directorate General for Meteorology and the Ministry of Agriculture in the implementation of several projects involving the seeding of clouds and the improvement of rainfall levels in the Syrian Arab Republic. There are also plans to develop communications through the Inmarsat satellite network for maritime navigation. The guidance of ships and prediction of hazards and disasters that might face them.

PCRS is responsible for the dissemination of space images and data in the Syrian Arab Republic. To fulfil this responsibility, PCRS has established contacts with several agencies that disseminate space images: SPOT Image of France to obtain data from the French satellite SPOT, EURIMAGE of Italy and EOSAT of USA to obtain data frown the USA satellite LANDSAT, from NOAA, from the European Earth resources satellite ERS, from the Information Retrieval Service (ESA-IRS), etc. An agreement has recently been made between PCRS of the Syrian Arab Republic and RADARSAT of Canada to disseminate the outputs of the Canadian satellite RADARSAT which produces advanced space information.

B. Activities in the field of space exploration and peaceful uses of outer space

The space activities undertaken by the Syrian Arab Republic are realistic, based on the understanding that the use of outer space is becoming more developed, extensive and diversified. The Syrian Arab Republic has participated in several activities in this field, the most important of which are the following:

1. The Joint Soviet-Syrian space mission, 1987

In cooperation with the former Soviet Union, the Syrian Arab Republic implemented an important space programme. Preparations for the programme were extremely careful and conformed to the most modern advanced technologies. The time-schedule included intensive programmes to train two Syrian astronauts to conduct scientific experiments in outer space as well as carry out space photography of the territory of the Syrian Arab Republic using state-of-the-art technology.

The joint Soviet-Syrian space mission started on 22 July 1987 and continued for nine days, using the SOYUZ-MIR space complex.

In addition to a space photography programme, the Syrian astronaut carried out the following scientific experiments:

- The Afamia experiment to produce high-quality unilateral semiconductor crystals in the state of weightlessness.
- The Qasion experiment to study the effect of weightlessness on the microstructure of aluminium-nickel alloys.
- The Tadmur experiment to produce polyhedral solid structures formed by micro-crystals during their accumulation and growth.
- The Basra experiment to measure the width of the red (Doppler) line of oxygen using an optical instrument (interferometer). High sensitivity of light detectors used in the instrument was obtained through the use of small cooling coils allowing measurement of the neutral temperature of the spacecraft in the dark parts of the orbit, i.e. the temperature of high strata of the atmosphere at night.
- The Euphrates experiment to obtain space information on the territory of the Syrian Arab Republic for the study and utilization of natural resources.

The Syrian astronaut also participated with Soviet astronauts in other space programmes. PCRS, in cooperation with other science agencies in the Syrian Arab Republic and the former Soviet Union, participated in preparations for this important space mission. It also implemented aerial photography programmes simultaneously with space photography.

Scientific agencies in the Syrian Arab Republic also participated in the interpretation and analysis of space images obtained through the joint space mission for various geological, hydrological, agricultural and environmental purposes for several regions of the Syrian Arab Republic.

It should be noted that the Syrian Arab Republic is a member of COPUOS in accordance with the United Nations General Assembly resolution A/35/791 of 12 January 1981. It has participated in most of the international conferences and international scientific and technical committees in this field. The Syrian Arab Republic is also a member of INTELSAT and is a member State of ARABSAT. It has several satellite communication stations and direct television and radio broadcasting stations. The Public Corporation for Telecommunications of the Syrian Ministry of Telecommunications is responsible for international telephone and television communications and the promotion of satellite communications in both the public anti the private sectors through INTELSAT and ARABSAT satellites. The Syrian Arab Republic has several ground reception stations used to exchange television programmes all over the world and to relay them from the Atlantic to the Indian Ocean and vice-versa.

It should also be noted that the Syrian Arab Republic hosted, in cooperation with COPUOS, the United Nations regional training seminar on the use of remote sensing in the study and determination of Earth resources. Held in 1979, it was the first seminar of its type to be held in the Arab world in the field of space and remote sensing. It was followed by the organization of several conferences and seminars in this field, the latest being the First Arab Conference on Space Exploration, Remote Sensing and Survey Sciences, organized and hosted by the Syrian Arab Republic in October 1995 in cooperation witty the League of Arab States and the Arab League Educational, Cultural and Scientific Organization (ALESCO).

C. International cooperation in outer-space exploration and remote sensing:

This is a source of advanced remote sensing information and data that enables the Syrian Arab Republic to keep abreast of developments in and make use of advances in outer-space exploration and remote sensing techniques for the continuous and comprehensive advancement of all humanity. The most important activities in this area can be summarized as follows.

1. Cooperation with the COPUOS

The Syrian Arab Republic has participated in all the work and meetings of COPUOS and has followed up its activities designed to promote international cooperation in outer-space exploration and remote sensing. It has actively participated in all meetings of the Scientific and Technical Subcommittee. In furtherance of this cooperation and in accordance with United Nations General Assembly resolution 45/72 of 11 December 1996 concerning the recommendations of COPUOS on the establishment of regional centres for space sciences and technology in developing countries, the Syrians Arab Republic requested to host the Western Asia regional centre through the Economic and Social Commission for Western Asia (ESCWA) in order to enhance remote sensing technical capabilities. PCRS received a mission from ESCWA and COPUOS. The mission met with representatives of official agencies in Syria. The meeting, held in early 1994, was attended by the UNDP Resident Representative in Damascus. The request was renewed in 1995.

An agreement has been reached with COPUOS to hold in PCRS headquarters in Damascus a training workshop, scheduled to be held in the third quarter of 1995 but postponed to a date to be determined as soon as possible, on the use of remote sensing techniques to monitor and control desertification.

2. Cooperation with the Food and Agriculture Organization (FAO)

PCRS is implementing an 18 months project to enhance its technical capabilities in the exploration of ground-water sites through remote sensing techniques. It has already implemented several similar projects in cooperation with FAO in the field of agricultural and hydrological applications.

3. Cooperation with the Islamic Space Science and Technology Network (INSET) in Pakistan

The Syrian Arab Republic, represented by PCRS, has become a member of the Executive Council of INSET. The Council undertakes important technical activities to exchange advanced technical information, connect Member States through to a data bank and implement plans to establish and develop scientific capabilities in the field of space sciences and satellite technology.

Developing countries are in need of continuous enhancement and development of their national economies. Advanced remote sensing techniques can serve as a basis supporting several developmental objectives, such as identification of the condition of agricultural land and water and mineral resources, provision of accurate information for early detection of crops infected with pests and estimation of crop yields, determination of water levels in ice formations, early detection of bush fires, and monitoring of environmental changes, detection of industrial, water and air pollution, monitoring of climatic changes, etc. Thus, remote sensing can make a great contribution to the development process of any country and constitute a factor in the enhancement of the national economy. Furthermore, in view of the numerous important applications of space research and remote sensing, international cooperation in this field can constitute a useful basis for international development.

THAILAND

[Original: English]

A. Earth observation

1. Data reception

Thailand Remote Sensing Center (TRSC), under the auspices of the National Research Council of Thailand (NRCT), is the national centre for remote sensing activities. NRCT has operated a ground receiving station for acquiring remote sensing data from 6 satellites: Landsat, SPOT, ERS, JERS, MOS and NOAA. In the near future, the station will be upgraded to receive data from new operational satellites such as IRS

and RADARSAT. The Station is still one of the leading stations in the world capable of obtaining data from 6 earth resources satellites.

2. Data distribution

As a regional satellite data distribution centre, TRSC provides multi-level satellite data to users worldwide. The Ground Receiving Station of the centre is continuously receiving and processing satellite data. At present, TRSC has a large archive of satellite data which could serve the need, of users, both domestic and international. The available imagery are in the form of photographic (film and paper print) and digital products (computer compatible tape and 8mm cartridge tape). In 1995 the value of data distributed to both domestic and international users was approximately US$ 1.7 million.

Since the beginning of the Remote Sensing Programme in Thailand, various government agencies involved in natural resources and environmental management have widely applied remote sensing technology to their respective fields. Image analysis as well as a large number of important research project have been carried out by TRSC Application Group to meet the need of the decision-makers. Regarding facilities for data application, the centre is equipped with major IAS and GIS systems such as: MERIDIAN, MIPS, PCI, Intergraph, SPANS, ARC/INFO etc. These facilities serve to both research and training activities of TRSC as well as other related agencies.

3. Research grant allocation

Each year the centre awards a grant up to 4.8 million Baht for about 10 research projects proposed by local researchers from various agencies. Up to now, more than 150 projects were funded. These grants aim to promote remote sensing technology within the country, particularly in its application to natural resource management and environmental monitoring.

In order to promote the application of remote sensing technology, TRSC offers annual training courses on the principles of remote sensing, digital image analysis and the geographic information technology for various agencies concerned. The centre also, in cooperation with international agencies organize annually international seminars and workshops on remote sensing and GIS such as:

- The 16th Asian Conference on Remote Sensing; jointly organized by Asian Association on Remote Sensing, Japan
- The EC-ASEAN Advisory Board; jointly organized by ESA, EU
- Workshop on Rehabilitation of Logged-over Forest in Asia/Pacific Region/sub-project III; jointly orgariized by Japan
- The FORTROP' 96 International Conference on Tropical Forestry in the 21st Century; jointly organized by Finland.

4. International cooperation

TRSC continuously cooperates with international agencies to conduct research activities on the application of remote sensing in natural resources management and environmental monitoring. At present, the centre has some major collaborative research activities with several international agencies including:

- EC-ASEAN Regional Radar Remote Sensing ERS-1 Programme with EU/ESA
- ASEAN-JERS-1 Verification Programme win NASDA, Japan
- GlobeSAR Programme with, CCRS, Canada
- Global Research Network System with NASDA/STA, Japan

- Tropical Forest Change Monitoring with FFPRI/STA, Japan
- IGBP/START LUCC Project for Southeast Asia with UN
- Correlation between Malaria incidence in Thailand and changes in vegetation cover using satellite remote Sensing techniques with WHO
- Application for Remote Sensing Technology to the Study of Water and Sediment Movement in Chao Phraya River in Thailand with Lingdingyang Bay in China with China
- Application of OPS and SAR Satellite Data to Tropical Forest Monitoring with USA
- Joint Research Project with JOFCA, Japan
- PAC-RIM AIRSAR/TOPSAR Project with NASA, USA

5. SEAWATCH THAILAND

SEAWATCH THAILAND is a complete marine environmental monitoring and forecasting system which integrates data collection, data analysis, environmental modelling and forecasting with an advanced computerised system for distribution of marine information and forecast to interested operators and/or authorities. Real-time data coverage is provided by a network of moored data buoys (called TOBIS buoys), which includes meteorological parameters (oxygen/nutrient contents, light attenuation, waves, currents, temperature/salinity profile, radioactivity). The buoys have also their own data logging equipment, on-board processing (for data analysis & quality control), and a transmission system. The collected data are then transmitted to a shore station through the INMARSAT and ARGOS systems.

The data is processed and stored in the database in time series format. The data can be represented in the form of tables or graphics. A number of numerical modelling and forecasting software have been developed under the programme, including: HYBOS, NOMAD, OILSPILL, OILSTAT. The data is distributed through an electronic bulletin board system (NRCT BBS) and World Wide Web (WWW). The Bulletin Board System (BBS) has been in operation since November 1995. Users can connect to the BBS to transfer buoy data, communicate with over users using electronic mail and browse through conferences containing information around the world (including usenet). The system allows users to connect through telephone line (via modem) and through TCP-IP. The World Wide Web Server of NRCT can be accessed at *http://www.nrct.go.th/*. SEAWATCH activities are also described in the WWW pages.

6. Future trends

TRSC is planning to provide users with more convenient services by using computer systems in order management. Data catalog searches via the Internet will also be included. When the development of the computer network of the User Services is successfully completed, the users can login to place the order on-line. However, at the moment, the Remote Catalog Search system is available for users worldwide. Login can be done via modem. In addition, through the TRSC Home Page, users can access information on the Center and its activities.

In addition to utilizing state-of-the-art technology by acquiring and processing the data from sophisticated satellites, TRSC also plans to launch a Remote Sensing Small Satellite, keeping pace with the dynamic development of remote sensing technology.

7. Conclusion

Satellite remote sensing programmes in Thailand have progressively developed in parallel with the global development of space technology. With the capability of the ground station to receive and process a variety of satellites data, Thailand can provide to the users multi-level satellite data at national and international levels. The establishment of three Regional Remote Sensing Promotion Centers at Chiangmai University, Khon Kaen University and Prince of Songkhla University will enhance and support the capability in the application of satellite remote sensing for the local users within the region. Furthermore, planning to

develop its own small satellite, Thailand will steadily play an important role in the fields of remote sensing and space technology in the Asia and Pacific region.

B. THAICOM-3 Satellite

"THAICOM", the national communications satellite system of Thailand, provides services to the government and private sector, with excess capacity being offered to neighbouring countries. Shinawatra Satellite Public Company Limited has been selected by the Ministry of Transport and Communications to acquire, launch and operate THAICOM. At present, THAICOM- 1 & THAICOM-2 satellites are in operation and collocated at 75.5 degrees E.

The next generation of THAICOM is THAICOM-3, a SpaceBus 3000 model built by Aerospatiale of France. The new satellite will have a much larger capacity than its predecessors. THAICOM-3 is a three-axis stabilized satellite spacecraft with a payload of 24 C-Band and 14 Ku-Band transponders. It will have 6 C-Band Global Beams with footprint coverage that spans over four continents and can service users in Asia, Europe, Australia, and Africa. The high-powered Ku-Band transponders, both spot and steerable beam, will be ideally suitable for Digital DTH services for Thailand and other countries in the region as well. Between the end of 1996 and early 1997, THAICOM-3 will be launched into its orbital position at 78 degrees E.

THAICOM-3 will weigh 2,610 kg at launch. Its mass in orbit will be 1560 kg at the beginning of its life. It will have a mass of 1160 kg and 5000 W power at the end of a lifetime of approximately 15 years.

TURKEY

[Original: English]

The Coordinating Committee on Space Sciences and Technologies (UBITEK) was established in Turkey in 1992. Its activities were supplemented by a United Nations Development Programme and UNIDO project, mainly funded by the Turkish Government. A Space Sciences (later Space Technologies) Department within the National Council's (TUBITAK) main research institute: the Marmama Research Center, (MRC) was also established to provide technical consultation and implementation of activities of UBITEK. The Committee has conducted an implementation programme with a focus on the following main areas.

A. Space and airborne remote sensing & image processing including GIS

A well equipped remote sensing and image processing laboratory is now functioning within the Space Technology Department of the Marmara Research Center. The needs of the laboratory are provided (as hardware, software, personnel) through the above-mentioned UNIDO project and local TUBITAK funds. Two national ("Grain Acreage by Remote Sensing" and "Erosion Mapping by Remote Sensing and Geographic Information Systems Technologies") and two international projects ("Water Pollution in the Eastern Mediterranean", in cooperation with Israel, Palestine and Egypt, and "Use of images from new sensors is environmental applications in Turkey" - together with Germany using their MOMS-2 Remote Imaging System on board various space platforms) are conducted or being implemented in the same laboratory. These projects include the formation of Geographic Information Systems for the topics aimed.

B. High radio frequency/radar technologies for use in space and air-borne remote sensing and ground-based observations

A "Radiophysics and Antenna Laboratory, (RAL)" is also established through the same programme. Design production and application of various microwave and millimetre radio wave instrumentation and techniques including scatterometer, radiometer and Doppler radar creation, a millimetric radio telescope with

solar and ozone monitoring capabilities, sensitive radio receivers, studies for vegetation canopy modelling, millimetre wave tomography for mm-destructive testing purposes in the RAL are presently achieved, being implemented and/or planned. Use of the same technologies for land mines, which are becoming widely abundant all over the world is also under consideration.

C. Radio Astronomy

A 2 meter dish size millimetric radio telescope (dubbed as 2m Marmara Radio Telescope, MRT 2) is now installed at Gebze- Kocaeli/Turkey. Its calibration work is in progress in cooperation with Ukrainian (Institute of Radio Astronomy, Kharkov), Azerbaijanian (Institute of Physics, Azerbaijan Academy of Science, Baku) and American (the University of Illinois Astronomy Dept. Urbana, Illinios) scientists and engineers. The use of the instrument for the study of molecular clouds in the Milky Way, observations of the sun and planets at millimetre waves and also the study of the ozone in the earth's atmosphere are being planned by MRC in cooperation with various national and international research groups, including Egypt, Israel, Ukraine, the Russian Federation and the United States.

Other activities in Turkey have been the following:

- Training and technology transfer activities by UBITEK to universities and public and private implementation groups, in the areas of remote sensing, image processing, radio astronomy, radar and microwave technologies for use in environmental and space related research, are continued. Several scientific and application projects proposed by various research groups within the country are also funded for their implementation.
- Establishment of the National Optical Observatory of Turkey (NOOT) at the Western Taurus mountains, in cooperation with the Russian Federation and the Tataristan Autonomous Republic is now underway. Other countries like Holland also contributed to the optical telescope and related observational and other instrumentation of the observatory. The site has superb observing conditions (height 2,500 m) and groups are encouraged to place their instruments and contribute to the growth of an international scientific research centre around the seed observatory. A possible millimetre wave radio telescope erection at the same site is now under consideration.
- Donation of 3m size millimetric disk at the cost of transportation to Turkey, to MRC by the Universitat Koln KOSMA Observatory is now under processing. It will give a new impetus to activities and international cooperation in the area of millimetric radio astronomy in Turkey.
- Turkey is a participant of the x-ray astronomy experiment called Spectrum X-Gamma, built under the coordination and leadership of the Russian Federation's Cosmic Research Institute (IKI), Moscow. There is a strong international commitment and contribution to the complex. Presently, the system is being integrated and calibrated. Its launching date has been shifted from 1996 to 1997. Optical identification studies for the newly discovered x-ray objects will be carried out by NOOT.
- The second of the Turkish Communication Satellite Systems, TURKSAT - 1B, (1A was ill-fated and burned in the unsuccessful launching in 1994) has now been in orbit for more than a year, providing the communication link - including TV reception and re-direction - between Western Europe, Turkey and the Central Asian Republics of the former Soviet Union. A replacement for - 1A has now been completed and was successfully put into orbit on July 9 1996, from French Guyana. It will replace TURKSAT 1B at 42°E longitude (TURKSAT 1B is to be transferred to 31°E longitude).
- A ground receiving station for receiving high and medium resolution remote sensing satellite images is now under consideration by the Turkish Government. A call for proposals for and an international bidding process is under preparation. Proposing agencies will be asked to bring their credit sources and terms for the implementation of the project.

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

[Original: English]

The annual report of the United Kingdom is contained in the brochure entitled UK space activities 1995-1996, distributed to the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space at its thirty-fourth session.

UNITED STATES OF AMERICA

[Original: English]

A publication entitled "Aeronautics and Space Report of the President: Fiscal Year 1995 Activities" will be distributed to the Scientific and Technical Subcommittee at its thirty-fourth session.

A. International Aeronautical and Space Activities

1. Cooperation with foreign partners

The United States Department of State (DoS) and the National Aeronautical and Space Administration (NASA) continued negotiations on the formal agreements relative to the International Space Station program. During FY 1995, DoS held five rounds of negotiations between the existing partners and the Russian Federation on the Space Station Intergovernmental Agreement. In parallel, NASA continued negotiations with the Russian Space Agency (RSA) on a bilateral memorandum of understanding, as well as with the European, Japanese, and Canadian space agencies on amendments to their respective Space Station memoranda of understanding to reflect Russian involvement in the program and modifications to respective contributions by the partners. The plan for shared design, development, operations, and utilization of the International Space Station already has provided concrete opportunities for successful international collaboration among the various governments, industries, universities, and individual scientists. The ongoing interaction with the Russian Federation on the Shuttle-Mir and International Space Station programs has contributed positively to the United States policy of encouraging the Russian Federation to continue on its course to democratization and a market economy.

The most visible symbol of United States-Russian scientific and technological cooperation was the first rendezvous and docking of the Space Shuttle Atlantis with *Mir*, which occurred on June 29, 1995. This coincided with the fifth meeting of the United States-Russia Commission on Economic and Technological Cooperation, known more widely as the Gore-Chernomyrdin Commission after its leaders, United States Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin.

Another highlight at the fifth meeting of the Gore-Chernomyrdin Commission was the new cooperation involving seven Russian aeronautics institutes and four NASA aeronautics research centres. During FY 1995, NASA signed five grants with Russian aeronautics institutes for a wide range of research, such as advanced aviation metals, atmospheric effects of aviation, and composite structure research. Joint aeronautics projects included modifying the Russian Tu-144 supersonic transport plane with new engines to flight-test new technologies for the next-generation supersonic civil transport and cooperative work on scramjet propulsion technology, a critical element in the development of hypersonic aerospace vehicles.

Under the auspices of the Scientific and Technical Committee of the Gore-Chernomyrdin Commission, NASA, the Russian Ministry of Science and Technology Policy (MinSci), and the Russian Space Agency (RSA) signed the Memorandum of Understanding on Cooperation Relating to the Space Biomedical Center for Training and Research. The Center, to be based at Moscow State University, will support a range of

United States-Russian medical exchanges, including cross-training and research in aerospace medicine, space biology, internal medicine, public health issues, biotechnology, microgravity sciences, informatics, and telemedicine.

In April, 1995, the "Integrated Plan for Science and Research," the first major deliverable to NASA under the Space Station contract with RSA, was submitted to NASA by the Russian Scientific and Technical Advisory Council (STAC). RSA established STAC to provide peer review of Russian research and technology proposals related to the International Space Station. Fifty Russian organizations submitted more than 250 research proposals, and more than 100 were selected during the first round of peer review, leading to the approval in June 1995 of $3.5 million to support the selected researchers.

In July 1995, the agreement between the United States and Japan concerning the cross-waiver of liability for cooperation in the exploration and use of space for peaceful purposes entered into force. This agreement is to facilitate further space cooperation between the two countries, which is already well established in the areas of human spaceflight, space science, and Mission to Planet Earth. An Memorandum of Understanding (MOU) between NASA and NASDA went into effect in October 1994, providing for the flight of two NASA sensors onboard the Japanese Advanced Earth Observing Satellite (ADEOS).

President Clinton and Ukrainian President Kuchma signed the Agreement Between the United States of America and Ukraine on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes in November 1994. This Agreement identified NASA and the National Space Agency of Ukraine (NSAU) as the implementing agencies and stated that the United States and Ukraine shall carry out civil space cooperation in such fields as space communications, life and microgravity sciences and applications, and Earth studies. In November 1994, NASA and the Paton Welding Institute in Kiev, Ukraine, initiated a joint project called the International Space Welding Experiment. This project involves the flight demonstration of the Ukrainian Universal Hand Tool (UHT), an electron beam-welding tool developed by Paton, to assess the capability of the UHT to perform new emergency repairs on the International Space Station.

In addition to cooperation with traditional spacefaring partners, cooperation with developing countries, especially in Latin America, was significantly expanding. In the fall of 1994, NASA conducted a series of sounding rocket launches, known as the Guara campaign, from Brazil's Alcantra launch range in coordination with Brazil's National Space Research Institute.

NOAA continued its support for the international satellite-aided search-and-rescue program known as Cospas-Sarsat (from a Russian acronym meaning Space System for the Search of Vessels in Distress and an English one for Search and Rescue Satellite-Aided Tracking). To date, more than 30 countries and organizations are associated formally with Cospas-Sarsat. Since its inception in 1982, Cospas-Sarsat has helped in the rescue of more than 4,600 people. The Cospas-Sarsat space segment (provided by the United States, Russian Federation, France, and Canada) detects distress signals from maritime, aviation, and land based users and relays them to the appropriate rescue coordination authorities. Cospas-Sarsat is currently supported by six United States and Russian polar-orbiting satellites, which provide global coverage, and an international network of ground stations, including six in the United States and its territories. The United States Mission Control Center for Cospas-Sarsat is located in NOAA's Suitland, MD, facility.

In September 1995, an intergovernmental Sarsat memorandum of agreement was signed in Washington by the United States, France, and Canada. The new agreement commits its signatory governments to long-term support of satellite-aided search and rescue. It establishes the means by which the Sarsat parties will manage their space segment obligations under the International Cospas-Sarsat Program Agreement, which was signed in 1988 by Russia, the United States, France, and Canada. The 1988 and 1995 agreements are to remain in force through 2003, with automatic 5-year extensions.

NOAA also used search-and-rescue equipment on its GOES-7, GOES-8, and GOES-9 satellites to relay alert data over most of the Western Hemisphere. NOAA and its foreign partners began evaluating the operational use of geostationary satellites and related ground stations to augment Cospas-Sarsat's polar orbiting system.

The Department of Commerce's (DoC) Office of Aerospace pressed for expanded export opportunities for the United States aircraft manufacturers through negotiations in the World Trade Organization (WTO). The Office of Aerospace has been actively encouraging as many countries as possible to sign the General Agreement on Tariffs and Trade (GATT) Agreement on Trade in Civil Aircraft (Aircraft Agreement) before becoming members of WTO. Negotiations are continuing with key and emerging aerospace manufacturing countries, such as the Russian Federation, China, the Republic of Korea, and Poland, to sign and implement the provisions of the Aircraft Agreement and the provisions of WTO, especially the Subsidies Code. The Aircraft Agreement eliminates duties on aircraft and most aerospace engines and parts. The Office of Aerospace also participated in United States Government efforts to reduce Russian tariffs on imported aircraft and components. This activity caused the Russian Federation to lower its tariff from 50 to 30 percent and provide verbal assurances of providing tariff waivers, on a case-by-case basis, for leased United States aircraft for the next 7 years.

The Department of Transport's Office of Commercial Space Transportation (OCST) provided representation and indepth analytical and policy support to negotiations led by the United States Trade Representative (USTR) to establish a commercial space launch trade agreement between the United States and Ukraine. This included participation in two rounds of negotiations held in Kiev and Washington, D.C. DoC's Office of Air and Space Commercialization and its Office of Aerospace also supported these efforts.

The first space launch trade agreement between the United States and China expired in December 1994. In support of United States Trade Representative-led trade negotiations for a new agreement, OCST provided expertise in commercial space launch technology and industry concerns. Negotiations were completed in January, and the agreement was signed into force on March 3, 1995. OCST continued to serve as Chair of the Working Groups on Information responsible for monitoring foreign compliance under both the United States/Russian Federation and United States/China launch trade agreements. DoC's Office of Air and Space Commercialization and the Office of Aerospace assisted with commercial space launch agreements with the Russian Federation and China.

Under the United States-Russia Business Development Committee/Aerospace Subgroup, the Office of Aerospace organized a trade visit of Russian aeronautics officials to the United States in November 1994. The event was cosponsored by the United States Trade and Development Agency, the Federal Aviation Authority (FAA), NASA, and the Foreign Trade Association of Southern California. Activities included a press conference highlighting the Russian passenger aircraft IL-96M/T, equipped with United States engines and avionics, and a conference titled "Emerging Aerospace Cooperative Opportunities between the United States and Russia."

DoC's Office of Aerospace also provided export counselling and trade development support, often in cooperation with other Federal agencies, to support and promote the interests of United States air traffic control and airport equipment and service suppliers overseas. In March 1995, the Office of Aerospace co-sponsored with the FAA and the United States Trade and Development Agency a symposium on future aviation infrastructure and technology developments in the Asia-Pacific region. The Office of Aerospace continues to provide input and policy guidance on air traffic control technology developments, including the GPS.

During FY 1995, Smithsonian Astrophysical Observatory (SAO) scientists and Russian astronomers worked to set up the United States Data Center for the Spectrum-X-Gamma mission, an international collaborative space x-ray observatory led by the Institute for Space Research in Moscow. SAO will collect

and archive data from the mission and make the information available worldwide through the Internet. Computers that will give Russian scientists easy access to these data were shipped from SAO to the institute in June 1995. The Spectrum-X-Gamma mission will conduct multiple experiments in a broad wavelength range from ultraviolet through Grays to gamma rays.

Nearly 200 scientists and engineers from approximately 16 countries attended the Fourth International Conference on Tethers in Space at the Smithsonian Institution in April 1995. Experts from SAO, NASA, the Italian Space Agency, and industry discussed the results of several successful missions using tethered-satellite systems, as well as experiments planned for the future.

2. International Organizations

DoS served as the lead agency for United States delegations at meetings of the International Telecommunications Satellite (INTELSAT) and the International Mobile Satellite (Inmarsat) organizations. It provided relevant policy guidance to Comsat, the United States signatory to both of these organizations. DoS participated in the creation of the Intelsat 2000 Porlamar Working Party in October 1994. It began considering options for restructuring INTELSAT, including the creation of one or more corporate subsidiaries that would function as ordinary multinational companies. DoS worked to support administration objectives that INTELSAT restructuring improves competition in the international satellite market and benefits users. The INTELSAT Twentieth Assembly of Parties endorsed these objectives in August 1995 and created a new working party to implement the subsidiary arrangement. DoS began the task of ensuring that the working party's efforts fulfil the objectives of full and fair competition.

To reflect more clearly the changing nature of its expanded services, INMARSAT changed its name from the International Maritime Satellite Organization to the International *Mobile* Satellite Organization (Inmarsat) in December 1994. At the 10th session of the IT Assembly of Parties in December 1994, the assembly decided that Inmarsat could provide handheld mobile satellite services via an affiliate called ICO, provided that it not interfere with Inmarsat's main purposes especially its public service obligations and that there should be no cross-subsidization between ICO and Inmarsat. Additionally, there should be nondiscriminatory access to national markets for all mobile satellite communications networks. Following the Assembly's decision, Inmarsat and some of its signatories set up ICO Global Communications Ltd. to acquire, launch, and operate a constellation of 12 satellites in medium-Earth orbit. In July 1995, ICO placed a $1.3 billion order for these satellites with the United States manufacturers. In the interest of fair market competition, DoS sought to ensure that ICO does not benefit indirectly from Inmarsat's treaty status. Similarly, DoS participated in an intercessional working group examining Inmarsat's structure to see whether it could and should be converted from a treaty-based organization into a commercial one without special privileges and immunities.

In FY1995, the Scientific and Technical Subcommittee of the United Nations' Committee on Peaceful Uses of Outer Space (COPUOS) continued its discussions on orbital debris and its potential adverse impact on space operations. The debate focused on the development of a continuing, deliberate, specific multiyear plan for the committee's work on space debris. The multiyear work plan adopted by the Subcommittee included measurements of space debris, understanding of data and effects of this environment on space systems, modelling of space debris environment and risk assessment, and space debris mitigation measures. The work plan evolved from statements by the United States, France, Germany, Canada, India, and the European Space Agency.

During FY 1995, the Scientific and Technical Subcommittee and the Legal Subcommittee of COPUOS also continued their work on international cooperation in meteorology, space science, space transportation, human space flight, and environmental monitoring. Since its founding in 1958, COPUOS has made significant progress in promoting international collaboration in outer space for science and engineering, communications, transportation, weather forecasting, global change research, and medicine.