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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

Addendum

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INTRODUCTION

1. In accordance with the recommendations of the Committee on the Peaceful Uses of Outer Space at its fortieth session,[1] Member States have submitted 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 developing countries;

(b) Spin-off benefits of space activities.

2. The information on those topics submitted by Member States as at 31 October 1997 is contained in document A/AC.105/679.

3. The present document contains information on those topics submitted by Member States between 1 November 1997 and 15 January 1998.

Notes

[1]*Official Records of the General Assembly, Fifty-second Session, Supplement No. 20* (A/52/20), para. 163.

REPLIES RECEIVED FROM MEMBER STATES

CHINA

[Original: Chinese]

China's space policy includes the substantial development of applied satellites, accelerating their development process and putting them to widespread use. This conforms to the needs of national economic construction and sustainable social development, creates an environment responsive to the needs of the country and contributes to positive growth. At the same time, it also aims at keeping abreast of international technological advances, facilitating space exploration and research and applying space technology in other technical fields, as well as promoting international cooperation.

A. Satellite applications

1. Remote sensing technology and its application

China's commitment in the field of remote sensing is designed to satisfy the needs of national economic construction. After strenuous efforts during the past two decades, China has increased its application capabilities to serve the needs of national economic construction. A dynamic information service system on resources and environment, with an emphasis on agro-resources, is being developed, using remote sensing data to conduct a nationwide investigation of land resources in an effort to profile China's land resources on a macro scale. In the area of combating natural disasters, a remote sensing system for monitoring and assessing major natural disasters, focusing on flood and drought control has been set up. An aerial remote sensing real-time transmission system has been developed, thus making it possible to transmit real-time images of disaster-stricken areas. During the period 1996-2000, further improvements will be made to the system, which will then be put into service in the relevant departments.

On 10 June 1997, China successfully launched its Fengyun-2 meteorological satellite from the Xichang satellite launching centre, using the Long March-3 launch vehicles. On 17 June, under the control of the land-based monitoring and control station, the satellite was successfully positioned at 105 degrees east longitude over the equator. With an operational life of three years, it provides 100 domestic and 33 international channels for data transmission. This geostationary satellite is able to capture visible light images of clouds, 24-hour infrared images of clouds and pictures of vapour distribution, in addition to being capable of broadcasting climate pictures. The satellite is now operating normally. Its data can be received free of charge in China and by neighbouring countries.

Since 1995, the Chinese Government has organized a number of major research and development projects in response to the urgent needs in the field of resources and environment management. They include:

(a) Remote sensing, Geographic Information System (GIS) and Global Positioning System (GPS) technologies and their comprehensive utilization, featuring dynamic monitoring of land resources and environment, monitoring and assessment of accidental natural disasters, evolving into a practical and operational macro information service system to provide the country with constant macro information on resources and environment and information in support of analysis and decision-making. In the meantime, an operational monitoring and assessment system on major natural disasters has been set up which is able to carry out real-time monitoring on an instant basis in case of major natural disasters of floods, contributing to disaster mitigation and relief and minimization of damages by providing relevant data on disasters. At present, work on information collection, test area selection and system construction is well under way;

(b) Aerial remote sensing real-time transmission systems, designed for the monitoring and assessment of accidental natural disasters such as floods, forest fires and earthquakes. The construction of the systems has been completed and trial operation has begun;

(c) Crop yield estimation by way of remote sensing technology. In terms of yield estimation for staple crops, fields of winter wheat, maize and paddy rice, comprising 85 per cent of total grain output, have been chosen for the work, covering 10 provinces and municipalities. Using the county as the statistical unit, yield estimates at the provincial (or regional) level have been forecasted. The yield estimation accuracy (area and total output) for wheat is above 95 per cent; for maize, above 90 per cent; and for paddy rice, above 85 per cent. Output forecast can be provided 1-2 weeks in advance of harvest. Experiments of yield estimation for wheat and maize in northern China and paddy rice in southern China have been completed. Work on a more extensive application of the technology is in full swing;

(d) Application of remote sensing technology in farmland investigation. Four provinces or autonomous regions—Heilongjiang, Gansu, Nei Mongol and Xinjiang—and a group of agricultural counties have been chosen as test areas for investigation of typological and acreage changes in land;

(e) Development of China's GIS software. Domestic institutions have been called upon in its joint development and evaluation, so as to come up with, and put into widespread use, a package of GIS software under China's own patent;

(f) Remote sensing monitoring of spontaneous ignition in coalfields. Remote sensing and GIS technologies are being used to conduct fundamental surveys of 56 spontaneous ignition spots in coalfields in northern China, including the impact and extent of conflagration etc., with a view to providing a scientific basis for coal fire control and extinction;

(g) Remote sensing monitoring of the marine environment. An all-dimensional marine monitoring system receiving data from satellites, aircraft and land is being developed to monitor environmental elements such as sea temperature, water colour, sea waves, mud and sand suspending in sea water and superficial oil pollution.

At the same time, considerable progress has also been made in remote sensing archaeology, radar application and basic theoretic research.

2. Satellite communication and application

On 12 May 1997, China succeeded in launching its Dongfanghong-3 broadcasting and communication satellite, which was developed exclusively by its own efforts. The satellite, with 24 transponders on board and an operational life of eight years, was positioned on 21 May at 125 degrees east longitude over the sky in the geosynchronous Earth orbit. This satellite, together with the satellite channels currently rented, constitute China's national network of broadcasting, television, telephone and satellite communication, ushering the country's telecommunication industry and its application into a period of modern construction. In the meantime, the setting up of a satellite television network for education has brought remarkable changes to the backward status quo in education and literacy in remote regions. In addition to public networks, rapid advances have also been made in the construction of specialized satellite networks.

In recent years, China has made considerable progress in applying satellite communication technologies in the areas of banking, civil aviation, tele-education via satellite television, petroleum, transportation, water conservancy and power supply. The use of very small aperture terminals (VSAT) has also increased extensively. There are now more than 500 two-way VSAT stations and over 1,000 one-way stations in the country, and the number is growing rapidly. In China, VSAT systems are being used in voice and data transmission, e-mail, faxes, video-conferencing and dedicated lines of communication. Meanwhile, mobile communication in recent years has found extensive

application and received increasing attention, becoming one of the fastest developing fields. China has successfully used VSAT technology in pager relocation and regional networking of mobile communication. The advanced technology has also been used extensively in telephone, live TV broadcasting and emergency communication.

B. Applied satellites

Research and manufacturing of applied satellites is currently one of the fastest developing high-technology fields in China. Intensified efforts are being made to develop the China-Brazil Earth Resources Satellite, a small satellite for observing the colour of ocean water, and the Fengyun-1 polar orbiting satellite. The development of these satellites will substantially enhance China's capabilities in satellite data collection. Meanwhile, ground stations of remote sensing satellites that have already been set up in the country have provided the relevant departments and local governments with a large amount of data for remote sensing applications. Basic research in space applications has also been further enhanced. For example, efforts are being intensified to develop a new generation of high-resolution on-board radar sensors and scientific experimental satellites. The construction of ground systems and preliminary studies are also under way.

In the coming years, China will try to develop small satellites, with an emphasis on small-scale Earth observation satellites.

C. Space research activities

On 20 October 1996, using the LM-2D launch vehicle, China successfully launched the seventeenth recoverable satellite for scientific exploration and technological experiments. Following its successful entry into the intended orbit, all the equipment on board the satellite functioned normally. The satellite was then successfully recovered after 15 days of orbiting in space. Apart from obtaining remote sensing data, experiments in biological development, crop seeds and crystal composition under microgravity and biological tests were carried out using on-board scientific devices.

The agencies concerned continued to carry out space research. In 1997, the Chinese Academy of Sciences completed tests related to the release of balloons in high altitudes and the improvement of monitoring and control equipment. It also continued high-altitude balloon tests, such as atmosphere aerosol tests, solar ultraviolet spectrum tests and hard X-ray astronomic observations. Experiments will be conducted at the Beijing Observatory using its solar magnetic field telescope with high-altitude (above 30 km) balloons.

Scientific research in microgravity with recoverable satellites is also continuing.

D. Launch vehicles

Since April 1970, China has developed and launched over 40 satellites of various categories, successfully launched 10 satellites for foreign clients, undertaken many scientific space explorations and conducted more than 300 on-board experiments in space. A number of important results have been achieved. China's LM-3A launch vehicle is an improvement over the LM-3, with many advanced technologies and its carrying capabilities at geosynchronous Earth orbit having been raised to 2,600 kg. China's more recent development—the LMB-3B—is a tethered three-stage liquid-powered launch vehicle, capable of delivering a 5,000 kg payload of mass into geosynchronous Earth orbit. It represents, for the present time, China's most powerful rocket for launching satellites into geosynchronous transfer orbit. The following are some recent examples of successful launches:

(a) On 3 July 1996, China's LM-3 launch vehicle successfully sent the AP-1A communication satellite into space. Manufactured by the Hughes Company, United States of America, the satellite weighed 1.4 tons, with 24 C-band transponders on board and a designed operational life of 10 years. After finally being positioned at 134 degrees east longitude over the equator, it is providing communication services to the Asian and Pacific region;

(b) On 12 May 1997, a DFH-3 communication satellite developed in China was successfully launched from the Xichang satellite launching centre, using a new type of launch vehicle—the LM-3A;

(c) On 10 June 1997, the LM-3 launch vehicle successfully launched the Fengyun-2 meteorological satellite into orbit from the Xichang satellite launching centre. In the morning of 17 June, the satellite was successfully positioned at 105 degrees east longitude over the equator.

(d) On 20 August 1997, the new launch vehicle, the LM-3B, a product of China's own efforts and the most powerful rocket currently in China, successfully delivered into the intended orbit the Mabuhay satellite, which was manufactured by United States Space Systems/Loral for the Philippines, an indication of the fact that rockets of the LM series are capable of delivering a 5,000 kg payload into high orbit.

E. Space debris

Since becoming a member of the Inter-Agency Coordination Committee on Space Debris in 1995, China's National Space Agency has conducted extensive research on the reduction of space debris, including, *inter alia*, minimizing the generation of space debris through eliminating the potential risks of in-orbit disintegration of the upper stage of the LM-4 launch vehicle and the completion of a three-dimensional vulnerability model structure of spacecraft and an analysis of the extent of risks for the environment of space debris. At the same time, research in the field of space debris monitoring and control is also under way at the relevant institutions.

F. International cooperation

In October 1996, the forty-seventh session of the International Astronautical Federation (IAF) was held in Beijing. It was attended by over 2,000 experts and officials from 54 countries, regions and related international organizations. Events such as major exhibitions and study tours were also arranged during the meeting. China acted as the host and offered conference services. As a practical contribution of China to the programme of peaceful uses of outer space, China covered all the in-session expenses of 29 representatives from developing countries at the United Nations/IAF seminar.

In August 1997, the International Symposium on Geo-information Science and the International Symposium on Geographic Information Systems were held in Beijing. The symposia, which were attended by over 500 representatives from 18 countries, covered geo-information science, scientific forecasting, regional sustainable development, research on global changes and access to geo-information. In addition to academic exchanges and exploring possibilities of cooperative research, demonstrations of GIS technology and presentations on new achievements were held. The symposia contributed to the development of GIS technology and its application.

Since 1995, China has provided 5-7 scholarships each year on remote sensing applications for countries in the Asian and Pacific region, making a valuable contribution to human resources development for developing countries. This initiative will continue in the future.

The Asian Pacific Multilateral Cooperation Initiative on Space Technology and Application, sponsored mainly by China, Pakistan, the Republic of Korea and Thailand, has already made substantive progress. The countries concerned have reached consensus on an intergovernmental memorandum of understanding on the cooperation project of small multi-task satellites, and intends to initial the instrument at the Fourth Multilateral Cooperation Conference on Space Technology and Application in Asia and the Pacific, to be held in Bahrain in December 1997.

In the field of space technology and application, China has signed a number of bilateral cooperation agreements with other countries, for example, the cooperation agreement between China and Chile; the agreement between China and Brazil on scientific and technological cooperation in peaceful uses of outer space; and the agreement between China and France on cooperation in research and peaceful uses of outer space. At the same time, China has also

carried out extensive cooperation in space and remote sensing application with Australia, Italy, Japan, the United States of America, the European Community and the Association of South-East Asian Nations.

LEBANON

[Original: English]

The progression of space-related activities in the economic sector of Lebanon is seriously dependent on the availability and development of the telecommunications infrastructure. This is now a major priority in Lebanon. The value of upcoming telecommunications projects alone, as noted by the Council for Development and Reconstruction, are put at US$ 617 million.

In the research sector, the Lebanese National Centre for Remote Sensing of the National Council for Scientific Research plays a pivotal role in contributing to the development and scientific needs of the country, notably in securing environmental concerns. The Centre also helps decision makers on actions and policies of relevance for the safe use of space, remote sensing and GIS.

The present report on space activities in Lebanon was prepared by the National Council for Scientific Research and is divided in two parts: (a) space-related activities in Lebanese economic sectors; (b) National Centre for Remote Sensing.

A. Space-related activities in the economic sector of Lebanon

As mentioned above, the space-related activities in the economic sector of Lebanon are dependent on the development of the telecommunications infrastructure. The Government has noticed the introduction of television broadcasting, via satellite, in order to diversify and enhance communication with the outside world, as well as the wide expansion of the Internet.

1. Telecommunications sector

Lebanon's authorities concluded that one of the keys to economic resurgence was the rebuilding of the telecommunications infrastructure. The Ministry of Post and Telecommunication is following the improvements being introduced in the satellite Earth stations involving the transition from analogue to digital transmission. There are plans for the installation of new satellite Earth stations in the locality of Jdeide (Beirut). This new installation will double the capacity of international communications. The previous report of Lebanon contained the various projects of the Ministry of Post and Telecommunication and the technical specifications of the five satellite Earth stations installed in Lebanon. These Earth stations transmit through the following satellites: Intelsat, Arabsat (1C, 1D, 2A, 2B), Intersputnik and Eutelsat.

The Lebanon Telecom 97 exhibition was held at Beirut in April 1997. The show provided further evidence of the resurgence of Lebanon in general and its telecommunications industry in particular. This exhibition marks Lebanon's return to telecommunications health.

2. Television broadcasting

The Lebanese Government introduced legislation to control television stations broadcasting to areas outside the country. The authorities delivered permits to two television stations—Future and LBC—to broadcast their programmes through Arabsat and Eutelsat.

In a short time, the two stations have become widespread among the Arab countries.

3. Internet

The Internet is expanding very quickly. In 1997, there are 20 private companies (six in 1996) connecting people in Lebanon to the Internet, using their own Earth stations to establish the communication link with the satellites. In Lebanon, and especially in Beirut, there are currently about 20,000 subscribers (5,000 in 1996).

A symposium on the information superhighway, "Mediacom", was held in Beirut in April 1997. Some 130 speakers from around the world discussed the implications of the Internet on language, education, research and culture in the Mediterranean and in the Arab world.

4. Meteorological information

The Directorate of Climatology of Lebanon has an Earth station to gather analogue images (Wefax format) from climate-related satellites (geostationary satellites). In the coming year, this administration will acquire a new Earth station recording very accurate digital images. The National Council for Scientific Research is cooperating with the Directorate of Climatology to establish a national network of meteorological stations and to assist in the research sectors where climate data are required.

B. National Centre for Remote Sensing

1. Organization structure

The Centre is headed by a director. It follows the Engineering and Technology Division of the National Council for Scientific Research, which reports to the Prime Minister. The Centre has two areas of specialization: sectoral, covering geology, water, agriculture, soil, oceans and the environment; and systems, covering image processing, GIS and shortly GPS.

2. Mission and objectives

The aims of the Centre are as follows:

(a) Cooperating with and assisting public and private sector organizations, institutes etc. in planning and implementing the use of remote sensing and GIS in their operations, with emphasis on environmental concerns;

(b) Securing databases, information, maps etc. from satellite imagery on a timely basis in different areas and disciplines and making the information available, as needs arise, to the private and public sectors;

(c) Interacting and cooperating with remote sensing centres, both regional and international, for the purpose of development, scientific progress and public welfare;

(d) Establishing the needed in-house and field support systems, laboratories and ground evidence for confirmation of remotely sensed data;

(e) Training and capacity-building of personnel for the Centre and other public agencies, and for other purposes as needs arise;

(f) Formulating and advising on actions and policies related to conventions, protocols, agreements or other matters relating to remote sensing with regional and international counterparts or Governments.

3. Services

The Centre has shared and contributed to defining needs where remote sensing is applicable in Lebanon. Similarly, it has assisted other public agencies on relevant matters, notably on the potentials of a centralized GIS.

A number of consultancies have taken shape, notably in designing and implementing projects in the following areas or in formulating actions relating to the availability of data, development and assessment studies, maps, evaluation reports etc.:

(a) Resources: water, soil, iron-ore deposits, construction materials;

(b) Agriculture: land cover and suitability, productivity and yield, rural management, soil conservation;

(c) Environment: land degradation, soil erosion, forestry, biodiversity, coastal deterioration, natural disasters and heritage.

4. Activities

The use of new technologies is essential for supplying and upgrading databases and specific information for the various development sectors in Lebanon. The Centre makes use of the wealth of data supplied from remote sensing platforms, converting, rectifying and processing them as needs arise. The above-mentioned activities are meant to serve the requirements of applied research and researchers, focusing on securing the priority needs of Lebanon. This is in line with serving the community, both public and private, and ensuring full cooperation on different levels. The major activities of the Centre include capacity-building, that is, participating in joint ventures, training, technology transfer, information systems, and attending and participating in scientific meetings. An essential part of the Centre's activities involves ground evidence, verification of material for accuracy and quality, and producing needed documents based on accurate information, both geographically and scientifically, to comply with the wishes of decision makers.

5. Current and future development

Current developments include:

(a) Delineation of natural resources relating to pedology and soil conservation (at the local level, with regional help);

(b) Developing economic potentials of iron-ore deposits lying between the Syrian Arab Republic and Lebanon (at the regional level);

(c) Undertaking thermal infra-red surveys of fresh-water sources in the marine environment (at the regional level);

(d) Application of remote sensing in the Baa'lbek archaeological area (at the local level, with assistance from the Government of Italy and the United Nations Educational, Scientific and Cultural Organization);

(e) Assessment of natural resources in the karstic coastal Mediterranean area (at the international level).

Future developments are as follows:

(a) Water conservation and climate change in degraded lands in the Middle East (at the international level);

(b) Environmental management of fruit and pine forests in the Mediterranean;

(c) Management of torrential floods for resource conservation and soil erosion;

(d) Ecosystem management of the Akkar Nahr El Kabir watershed;

(e) Upgrading and centralization of a public sector GIS;

(f) Assessment of environmental sensitivity and proper land use of coastal urban areas.

6. Cooperation with other organizations

The Centre, through its parent organization the Council for Scientific Research, has cooperative relationships with local, regional and international agencies. Locally, it works with several ministries and/or public agencies and is developing relationships with private universities and other representatives, including industry, transport, construction etc. At the regional level, the Centre has established links with relevant organizations in Egypt, Jordan and the Syrian Arab Republic and is making attempts with other countries. On the international scene, there are several working projects or agreements, such as with the Governments of Canada, France, Germany, Ireland, Italy, Malta and the United Kingdom of Great Britain and Northern Ireland, and the Centre hopes to establish links with others.

7. Fields in which assistance is welcome

In view of the above, the Centre's needs can be summarized as follows:

(a) To train its personnel, on an ongoing basis, on the basic procedures in imagery processing and remote sensing and their applications, including the handling of GIS;

(b) To find mutual benefits in securing equipment or in-kind supplies of equipment;

(c) To build up the Centre's capacities and information resources, establishing a library containing books and journals and in-kind material assistance for relevant support systems.

The Centre is ready to enter into joint-venture projects.

8. Astrophysics

There are plans to develop a network of robotic telescopes in semi-desert countries, from Morocco to the Gobi Desert, that will send stellar observations to all the astrophysical laboratories of the network by way of communications satellites.

An astrophysical laboratory is being established inside the National Council for Scientific Research to participate in the network. One of the aims of the laboratory is to propose scientific research projects.

In Lebanon, only some first-level courses in astrophysics are given by the Faculty of Sciences of the Lebanese University.

There are plans to establish, during the coming year, an astrophysical laboratory (the location has been decided and the road already built), equipped with a robotic telescope. The hydrodynamic astrophysical research can have interesting results.

The study of the system needed to transmit each morning the stellar data obtained during the previous night by each robotic telescope to all the astrophysical laboratories of the network has begun.

REPUBLIC OF KOREA

[Original: English]

Outer space activities in the Republic of Korea in 1996 and 1997 have occurred within the context of major national space programmes and have been marked by notable progress. The Republic of Korea's space programmes include both low Earth orbit (LEO) scientific mission satellite development and geostationary orbit (GEO) communication satellite programmes. They also include an experimental sounding rocket project for which a two-stage sounding rocket was launched successfully using a new launch vehicle system. The country's space activity was also pronounced in other related fields such as domestic space education and research. Owing to the ever-increasing interest in domestic space programmes, the national space budget is also now larger than ever.

The experience and technological progress gained through space activity in 1996 and 1997 have proved highly valuable to the country's future space programmes, providing the basis for their continued progress. Although current activity is still limited, the scale of future space activity is expected to increase. More domestic programmes are planned in parallel with joint international programmes, especially in the next decade. This trend is driven by technological advances in the aerospace industry and the ever-growing demand for higher living standards.

A. Major space programmes

Four major space programmes have been carried out during this period. The first is the Korea Multi-purpose Satellite (KOMPSAT) programme, which was begun in 1994 with the goal of launching the KOMPSAT in 1999. The KOMPSAT is a medium-sized satellite with multiple mission objectives, but whose primary mission is the collection of scientific data through Earth observation. During 1996 and 1997, the design of KOMPSAT was performed in collaboration with the United States spacecraft manufacturer TRW. The KOMPSAT programme is managed primarily by the Korea Aerospace Research Institute and the Ministry of Science and Technology.

Another scientific mission is the KITSAT programme being run by the Satellite Technology Research Centre of the Korea Advanced Institute of Science and Technology (KAIST). KITSAT is a small satellite programme intended to establish spacecraft technology as well as domestic scientific mission capability. KITSAT-I and KITSAT-II were launched in 1992 and 1993, respectively. Various experiments were conducted between 1996 and 1997 using KITSAT-II payloads that include a charge coupled device (CCD) Earth imaging system (CEIS), a low-energy electron detector (LEED) and an infra-red sensor experiment (IREX). The KITSAT-III assembly and test were completed in 1997 and will be ready for launch in 1998.

A third programme, KOREASAT, has produced the first GEO communication satellite of the Republic of Korea, which is now operational at a 116 degrees east longitude geostationary orbit. Significant mission operation experience was accumulated in 1996 and 1997. Mission operation systems were also developed by domestic technology during this period in order to support the KOREASAT satellite operation. As a result, mission operation technology is now at a level sufficient to operate future domestic GEO satellites independently.

Finally, the sounding rocket programme of the Republic of Korea was highlighted by the successful launch of KSR-II, which is a two-stage experimental launch vehicle designed for scientific data collection missions. Although the launch vehicle successfully flew its pre-planned flight path, data collection was unsuccessful owing to a telemetry system failure during its early flight phase. Another KSR-II will be launched in 1998 with the same mission as its predecessor. The sounding rocket programme is expected to evolve into a new advanced launch vehicle development plan. The new programme will start in 1998 with the primary goal of developing the capability of building three-stage medium-range launch vehicles.

B. Low Earth orbit scientific space programmes

Outer space activity by LEO scientific space programmes in 1996 and 1997 mainly centred around a series of experiments conducted by the KITSAT programme. Although implemented at rather basic levels owing to the small size of KITSAT, they still played a leading role in the country's outer space activities during the period 1996-1997.

The LEED experiment was conducted by KITSAT-II at the orbit altitude of 800 km. This experiment uses a 3,000 volt spiral electron multiplier with 16 measurement channels. Data from this experiment have been used for understanding the effects of solar activities on the space environment around Earth.

Also conducted was the IREX, which monitored the effects of the space environment on a KAIST-developed infra-red sensor. Another important experiment, which used a KITSAT-I payload, is the cosmic ray experiment (CRE). This experiment consists of a cosmic particle detector and a total dose measurement detector, which together have 512 measurement channels. Other experiments using the KITSAT programme include testing imaging payloads, communication payloads, digital signal processing devices and on-board computers.

Still under development is the KOMPSAT programme, which, consequently, has not yet been employed on any space missions. The KOMPSAT design was completed in 1997 and a flight module is ready to be assembled in the newly constructed Satellite Integration and Test Centre located at the Korea Aerospace Research Institute. Jointly run by the Institute and TRW, the KOMPSAT programme includes technology transfers, on-the-job training at TRW for Korean engineers and national production of key satellite subsystems. The final on-board payload specifications were also decided in 1997 and are currently being prepared for loading into the flight module. The payload includes an electro-optical camera (EOC), an ocean colour imager (OCI), and a space physics sensor (SPS) for the purposes of cartography, ocean colour monitoring and space environment monitoring, respectively. The satellite weighs about 500 kg and will be operated on a sun-synchronous orbit at an altitude of 685 km.

EOC has been programmed for a cartographic mission to provide images for the production of scale maps, including digital elevation models of the Republic of Korea from a remote Earth view in the KOMPSAT orbit. EOC is expected to collect panchromatic imagery at a ground sample discrimination (GSD) of 6.6 m and a swath width of 15 km at nadir through the visible spectral band of 510-730 nanometres.

The OCI mission is to conduct worldwide ocean colour monitoring for the study of marine biology. OCI is a multi-spectral imager generating six-colour ocean images with an 800 km swath width and 1 km GSD by the whisk-broom scanning method. Colour images are to be collected through six primary spectral bands centred at 443, 490, 510, 555, 670 and 865 nanometres or six spectral bands selected in the spectral range by ground commands after launch.

SPS consists of a high-energy particle detector (HEPD) and ionosphere measurement sensor (IMS). The mission of HEPD is to characterize the low-altitude high-energy particle environment and to study the effects of a radiation environment on microelectronics. IMS is designed to measure the density and temperature of electrons in the ionosphere.

The data obtained from the KOMPSAT programme will be distributed to various government organizations, research institutes and academic institutes for maximum use. The KOMPSAT programme will begin as scheduled in 1998, for a final launch in 1999. The KOMPSAT programme promises to be a historic landmark in the Republic of Korea's outer space activities.

C. Geostationary orbit communication satellite programmes

KOREASAT F1 and KOREASAT F2 have been operating under the control of two ground stations of the Republic of Korea since the launching of KOREASAT F1 in 1995. The ground stations periodically adjust the

orbital locations of these satellites. Ground computer systems are also fully integrated into user-friendly systems. GEO satellite operation technology has advanced to a higher level through the accumulation of experience during 1996 and 1997.

As the Republic of Korea's first GEO communication satellite, KOREASAT is also seen as a turning point for satellite broadcasting over the Korean Peninsula. The KOREASAT programme has also brought significant changes in the area of space engineering during 1996 and 1997. Moreover, it has contributed to establishing the fundamental basis for further national space research activity led by government research institutes and academic organizations. In addition, it has begun to be used in space education at the high-school level since 1997.

Meanwhile, the KOREASAT F3 programme was initiated in 1997 with preliminary design completed the same year. The KOREASAT F3 is expected to be launched into orbit in 1999, replacing KOREASAT F1. The KOREASAT F3 is partly a product of the Korean Industry Participation programme, as some companies of the Republic of Korea are participating in the manufacture of its subsystems. Other domestic GEO satellite programmes have also been announced in 1996 and 1997, and demand for domestic GEO communication satellites is expected to rise in the future. Furthermore, close cooperation between LEO and GEO satellite development programmes is expected as well, in view of the available and other resources.

D. International low Earth orbit communication satellite programmes

Several international LEO communication satellite network development projects saw domestic industry participation in 1996 and 1997. They include GLOBALSTAR, IRIDIUM, ODYSSEY and other multinational LEO satellite communication programmes. Korean companies are involved in building satellite subsystems as well as providing communication services for these projects, enhancing their own space technology level.

E. Space education and research activity

There was also intensive activity in space education and research during 1996 and 1997 in conjunction with the major space programmes. Space education activity focused primarily on university education, workshops and symposia. Space engineering curricula were expanded at the university level. A series of domestic workshops were also held on the subject of space engineering. Space research activity was also naturally active owing to the large-scale space programme activity during this period. Space research consisted of both space mission study, including Earth observation, and satellite engineering. Space research activity is expected to expand in the future in parallel with scientific space programmes planned for the years ahead.

THAILAND

[Original: English]

The space activities carried out by the National Research Council of Thailand (NRCT) are concentrated mainly on remote sensing and are discussed in the sections below.

A. Data reception

Since 1981, NRCT has operated a ground receiving station for acquiring remote sensing data from multi-satellites at the Lad Krabang facility. The station is now capable of receiving data from LANDSAT-TM, SPOT, MOS, JERS, ERS and IRS satellites and will be upgraded for Radarsat and ADEOS data in the near future.

B. Data distribution

At present, the Thailand Remote Sensing Centre (TRSC) has a large archive of satellite data such as LANDSAT-MSS, TM, SPOT, MOS, ERS-1, JERS-1 and NOAA-AVHRR. The following products are available:

(a) Photographic products, both in film and in print, in black and white or in colour, at various scales;

(b) Digital products with the following options: data density of 1,600 bpi or 6,250 bpi on computer compatible and 8 mm cartridge tape.

In 1996, the value of data distributed to both domestic and international users was approximately US$ 1.6 million.

C. Research grant allocation

Each year TRSC offers a grant of 5 million baht to remote sensing application projects proposed by Thai researchers. The grant has been instrumental in promoting the application of satellite technology within the country. In the financial year 1996, there were 11 projects funded under the grant.

D. Education, training and seminars

Most of the universities in Thailand offer a number of remote sensing courses in their curricula. In order to promote the application of remote sensing technology, TRSC offers annual training courses on the principles of remote sensing, digital analysis and geographic information systems for natural resources management to domestic users. In the past few years, TRSC, in cooperation with other agencies, has organized several forums, which were attended by over 1,000 Thai scientists.

E. Research activities

The various government agencies involved in the management of natural resources, including the Department of Forestry, the Department of Land Development, the Office of Agricultural Economics, the Survey Department and the Department of Agriculture, have applied satellite remote sensing in their respective fields.

F. Regional remote sensing promotion centres

To enhance remote sensing activities within the various regions of the country, TRSC initiated a project for the establishment of regional remote sensing promotion centres, in collaboration with the universities of each region: northern, southern and north-eastern. The objective is to develop remote sensing courses and research activities in the regional universities. The centres also act as a core agency for remote sensing technology transfer and data distribution at the regional level and could perhaps be extended to neighbouring countries. As a core agency in the region, as well as with neighbouring countries, the centres are responsible for remote sensing activities such as developing study and training programmes, distributing satellite data to local users and supporting and promoting research activities.

G. Seawatch Thailand

Seawatch Thailand, a marine surveillance and information system, is a marine environmental monitoring and forecasting system that integrates data collection and analysis, environmental modelling and forecasting with an advanced computerized system for the distribution of marine information and forecasts to interested operators and/or authorities. The project is being implemented under close cooperation between NRCT and the Oceanographic Company of Norway AS (OCEANOR) and other relevant parties, including the Harbor Department, the Meteorological Department, the Port Authority of Thailand, the Naval Hydrographic Department, the Department of Fisheries, the Petroleum Authority of Thailand, the Marine Police Division, Chulalongkorn University, Kasetsart University, Prince of Songkhla University and Burapha University.

The objectives of the Seawatch programme are as follows:

(a) To set up a marine database using the technological integration of remote sensing, the buoy network and meteorology;

(b) To archive and distribute marine data and information to relevant offices in both governmental and private sectors for use in national resources development and management;

(c) To coordinate and work with other offices in studies and research in the field of oceanography and marine resources;

(d) To coordinate and work with relevant offices in the utilization of marine data and information in national resources planning, development and preservation;

(e) To distribute knowledge and technology of the use of marine data and information for the development and management of national resources.

H. Remote sensing small satellite programme

The preparation and execution phases of the programme consist of the following:

(a) *Establishment of the remote sensing small satellite (RSSS) programme office*. The programme office has been established under NRCT;

(b) *Preliminary systems definition phase*. Most requirements and definitions are defined from the results derived from user and application needs;

(c) *Systems design phase*. This phase immediately follows the preliminary systems definition phase, once the funding arrangement has been approved by the Government of Thailand;

(d) *Systems development phase*. This phase commences concurrently with the previous phase but has a longer duration of about 36-40 months after contract signing with the programme's primary contractor;

(e) *Systems operational phase*. This phase will start after the RSSS has been successfully launched and all early orbit control and testing are completed. The phase will last at least five years (the design life of the satellites), until the end of the life of the satellite.

I. International cooperation in remote sensing and space technology

The NRCT cooperates with countries and organizations in the region as well as outside the region for the development of remote sensing technology. Cooperating countries and organizations include Australia, Canada, China, Japan, France and the United States, in addition to ASEAN, the Economic and Social Commission for Asia and the Pacific and other United Nations organs. Areas of cooperation relate to joint research technical development and human resources development.

An example of such cooperation involves the NRCT-National Space Development Agency of Japan (NASDA) pilot project. The five-year data utilization programme began in 1997 and will run until March 2002. Participating agencies are NASDA and the Remote Sensing Technology Centre (Japan) and NRCT, the Department of Town and Country Planning, the Office of Agricultural Economics, the Department of Land Development and the Department of Fisheries (Thailand).

J. Conclusions

The present report demonstrates the capabilities and experiences of Thailand in the area of remote sensing in the space programme that fall mainly under the responsibility of the National Research Council of Thailand, Ministry of Science, Technology and Environment. However, NRCT is not the only government organization that is responsible for the space programme.

The RSSS programme is a new programme that is to be approved by the Government in its multi-year programme budget. The programme and its preparation work are well in progress, and RSSS will be launched into orbit within three years after contract signing with a primary contractor. Through NRCT, Thailand will be operating the first remote sensing and environmental satellite system for monitoring the country's natural resources and environment. Thailand will be joining the technologically advanced countries in the space league and will, in the near future, have the scientific and technological capabilities of working in space, on Earth's land resources, in the environment and in the oceans.

TURKEY

[Original: English]

The Coordinating Committee on Space Sciences and Technologies (UBITEK) was established in Turkey in 1992. Its activities were supplemented by the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO) and funded mainly by the Turkish Government. Within the National Research Council (TUBITAK)/Marmara Research Centre (MRC), at Gebze-Kocaeli, a Space Sciences Department (later known as the Space Technologies Department) was also established to provide the technical and administrative consultancy and secretarial work that was needed for the activities of UBITEK. The Committee has undertaken an implementation programme, with special attention given to the following main areas.

A. Space and airborne remote sensing

A well-equipped Remote Sensing and Image Processing Laboratory (UZALGIL) is now functioning within the Space Technologies Department of the Marmara Research Centre. The needs of the Laboratory, such as hardware, software and personnel, are provided through the UNIDO project and local TUBITAK funds. Grain acreage by remote sensing and erosion mapping by remote sensing and geographic information systems, which are two national projects, and the new MOMS-2 sensors in use for environmental applications in Turkey, an international project that is being carried out in collaboration with the Government of Germany, are being implemented in the same laboratory. A World Bank project on micro-catchment rehabilitation in eastern Anatolia will also be implemented by remote sensing and GIS techniques from UZALGIL.

The establishment of a ground receiving station for data from super-high-resolution remote sensing satellites (ground discrimination of 1-3 m) is being discussed by an ad hoc committee established by the Prime Minister's Office and the corresponding satellite companies.

The Foundation for Combating Erosion (TEMA), located in Istanbul, is a non-governmental organization involved with space activities. It uses space technology to assist in the solution of problems of regional or global significance. Among its activities are the following:

(a) Increasing awareness against the dangers of desertification in the country;

(b) Supporting and financing technical practical projects that use satellite remote sensing technologies in assessing the actual and potential risk of erosion and desertification.

TEMA also financed a pilot project prepared by TUBITAK in a watershed area in western Turkey (Dalaman River).

B. Microwave technologies for use in remote sensing and space observations

A Radiophysics and Antenna Laboratory (RAL) has also been established through the national space programme. Current activities include design, production and application of various microwave and millimetre wave instrumentations and techniques, for example, scatterometer, radiometer, Doppler radar, a millimetre waves radio telescope, sensitive radio receivers—design and component productions—basic element and material studies for vegetation canopy modelling and millimetre wave tomography. A new objective of RAL is to investigate new radio techniques to find and locate anti-personnel landmines.

C. Radio astronomy

Design and implementation of a two-metre radio telescope, working in the millimetre wavelengths, have been planned in cooperation with the Ukrainian Academy of Sciences Institute of Radio Astronomy (RIAN) at Kharkov. As of May 1995, the instrument (dubbed as a 2 m sized Marmara telescope (MRT-2) has been erected at Gebze-

Kocaeli, Turkey. Its calibration is being executed in cooperation with RIAN and the University of Illinois Department of Astronomy, at Urbana, Illinois. The use of the instrument for the study of molecular clouds in the Milky Way and observations of the Sun and planets at millimetre wavelengths are planned by MRC, in cooperation with various national and international research groups. The first ozone line measurements were successfully carried out in the spring of 1997 and their results have been published.

D. Optical and space-based astronomy

TUBITAK established the Institute of Optical Observatory in the western Taurus Mountains. Other countries, such as the Netherlands and the Russian Federation, also contributed optical telescopes and related observational and other instruments. The site has excellent observing conditions (elevation of 2,500 m). Other countries and groups are encouraged to participate and include their instruments to help to enlarge the international scientific research centre around the seed observatory. An official opening ceremony for the observatory site, which was attended by the President and Prime Minister of Turkey, the Director of the Space Research Institute of Moscow and the Rector of the Kazan University, took place on 5 September 1997.

Since Turkey will be one of the best sites to observe the last solar eclipse of the millennium, which is to take place on 11 August 1999, preparations have begun to accommodate large numbers of visitors to the sites where the total eclipse will be observed by departments of physics, astronomy and space science of Turkish universities.

Turkey is also participating in the X-ray astronomy satellite experiment, known as Spectrum X-Gamma, under the coordination and leadership of the Russian Federation's Space Research Institute. There is also a strong European commitment and contribution to the complex of the X-ray satellite, which is being integrated and calibrated; the launching date has been postponed from 1996 to 1998.

E. Establishment of space-related education activities

The TUBITAK/Marmara Research Centre at Gebze-Kocaeli is making preparations for the Marmara Institute of Space Research and Education. It will be the core Turkish institute in the central and south-eastern European network of space research and educational institutions, proposed recently by the Committee on the Peaceful Uses of Outer Space. It will concentrate on such areas as satellite remote sensing and radio astronomy.

The Centre for Air and Space Research (HUZAM) of the Istanbul Technical University was established in 1995. The Centre is designed to provide education and the promotion of satellite communication, remote sensing and related technologies. Several other universities have also established research centres in the area of space science and technologies. Among them are the University of Cukurova at Adana and the Anatolian University at Eskisehir.

F. Other activities

A third satellite, in addition to the existing Turkish Communication Satellite System (TURKSAT), is under consideration by Turk-Telecom. The TURKSAT system is currently providing communication and television links in western Europe, Turkey and the central Asian republics.

Also, at least two institutions are involved in preparations for a mini/micro-satellite programme:

TUBITAK-MRC has negotiated with a corresponding group in the Russian Federation for a joint small remote sensing satellite. Funding through the Black Sea Economic Cooperative or other organizations is under consideration;

A group at the Middle East Technical University is considering building a micro-satellite for remote sensing, in cooperation with a partner in the United Kingdom of Great Britain and Northern Ireland.

These are some of the activities undertaken by Turkey in various areas to promote sustainable development, to address issues related to education and technical assistance in space science and technology and to strengthen international cooperation.