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

Contents

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I. Introduction

1. At its forty-fifth session, in 2008, the Scientific and Technical Subcommittee of United Nations Office for Outer Space Affairs recommended that the Secretariat continue to invite Member States to submit annual reports on their space activities (A/AC.105/911, para. 17).

2. The Secretariat received replies from Member States by 31 October 2008 and reproduced them in document A/AC105/923.

3. The present document contains replies of Member States received after 31 October 2008. The replies will be reproduced in addenda to document A/AC.105/923.

II Replies received from Member States

Bangladesh

[Original: English]

Space based-technology nowadays has got tremendous importance particularly because of its immense potentiality in telecommunication, tele-broadcasting and acquisition of valuable and timely information on the condition of the Earth-atmosphere system through remote sensing technology. It is a commendable effort by the United Nations (UN) to delineate, delimit and specify both the air and outer space boundary of individual countries.

Bangladesh has been utilizing both air and space-based platform for information communication, develop air-based survey system using sophisticated survey aircraft equipped with necessary imaging instruments. Moreover, Bangladesh has an aim perspective plan to launch a multi-Mission Geo-stationery satellite for Telecommunication, tele-broadcasting, Information Technology (IT) based functioning and Earth resources observation and monitoring. It will be equipped with both optical and microwave remote sensing devices in addition to telecommunication instruments. The geo-stationery satellite data will be used for Meteorological application like monitoring of cyclone, rainfall, flood, cold waves occurrence etc, which are the regular phenomena in Bangladesh.

Development of air-based survey system, polar orbiting and geo-stationery satellites are very important and promising for Bangladesh. Under the circumstances, delineation and specification of air and space boundary of Bangladesh by the UN will enhance the peaceful application of air and space related activities in Bangladesh. The aerospace activity will ensure more accurate spatial data to support sustainable development of the country.

Bangladesh has to develop and possess independent space based capabilities. Naturally such a demand necessitates individual countrywise space allocation despite existing resource constraint. However, the country does not prefer the alternative approach of depending on the foreign space and air-borne system facilities instead of developing its own. The alternative approach will also restrict the technological development of the country.

Cuba

[Original: Spanish]

In 2008, Cuba was battered by two powerful hurricanes that left behind them a desolate scene, with hundreds of thousands of destroyed homes and socio-economic facilities and with devastated crops and forests. There was a major impact on production and public services and the country's entire infrastructure, with losses of the order of $5,000 million.

The recovery process is going ahead in a spirit of confidence that the country's difficulties will be overcome thanks to the measures initiated by the Government and the support of our entire people.

Despite the situation described above, satisfactory progress was made in attaining the annual space activity objectives. In this connection, particular mention should be made of the holding in Havana from 22 to 26 September of the 13th Symposium of the Latin American Society for Remote Sensing and Space Information Systems (SELPER).

Below is a brief account of the results obtained in Cuba during 2008 in research and development relating to the peaceful utilization of outer space.

1. Space Meteorology

The Institute of Meteorology of the Ministry of Science, Technology and the Environment (CITMA) continued to improve its weather forecasting, with the achievement of 90 per cent accuracy, thanks to the eight radar installations and 68 meteorological stations that have been established and to the excellent performance of Cuba's high-resolution satellite station.

The timely and systematic dissemination by the mass media of weather forecasts, supported by high-resolution satellite images, together with the preventive evacuation measures organized by Cuba's civil defence authority, protected more than three million people during the passage of the hurricanes that devastated the country. Regrettably, seven persons lost their lives owing to failure to comply strictly with the measures organized by the civil defence authority.

2. Remote Observation of the Earth

A start was made with the creation of a bank of satellite images of the country's territory for the IDERC (Space Data Infrastructure of the Republic of Cuba) portal. The project in question, which was approved by the National Office for Hydrography and Geodesy and in which GEOCUBA and other Cuban institutions are participating, will make available, through the IDERC portal, the satellite images of Cuba's territory that can be published. At present, work is under way with a view to the following: establishment of an inventory of the satellite images of Cuba that have been acquired; creation of the bank of satellite images; establishment of policies for the publication and distribution of satellite images; publication of the satellite image bank on the Web.

An assessment was made of the behaviour of fires in Cuba, using information on heat foci detected during the period 2004-2008 by GOES satellites, I-M Imager and Terra/Aqua (Land/Water) sensors and Modis sensors. Initial processing of the information is being carried out by Brazil's National Institute for Space Research (using its "Queimadas" system), which has undertaken to transmit the results in real time to Cuba's Institute of Metrology. Such an assessment takes as its starting point the number of heat foci detected, and their behaviour is assessed on a daily, monthly and annual basis. It has been noted that during the period covered there was a close correlation between the behaviour of the foci detected with the help of satellites and the historical behaviour studied using other data sources, which demonstrates how objective the operation of the system is for Cuba. Tables and graphs illustrating the results have been drawn up. For 2008, they show that March was the month with the most heat foci (with a total of 529), followed by February and May (with somewhat over 300). The time of day when most heat foci and the highest temperatures were recorded was between 10 a.m. and 2 p.m. Fires were observed in all 14 of Cuba's provinces.

A study was made of the behaviour of a number of foci of the Aedes Aegypti mosquito (which transmits dengue fever) as a function of climatic and vegetal variability, which influences the proliferation of this vector so harmful to human health. The effect of climatic anomalies, described by the climatic index lB1, t, C (Bultó index), and of the vegetal cover, given by the Normalized Difference Vegetation Index (NDVI), on the behaviour of the foci was determined. Spatial statistics was applied in obtaining the time-space correlations between the variables in Cuba during the period 1998-2002. The NDVI data were obtained from images provided by the AVHRR sensor of the NOAA-16 satellite, with a spatial resolution of 0.25 degrees of latitude and longitude.

The introduction of advanced technology into Cuban agriculture was highlighted by implementation of the geographic information system SIG_Citricos_C at the Empresa de Citricos Ceiba (the Ceiba citrus fruit enterprise), which is making it possible to integrate, handle and update large databases so that decisions are as appropriate as possible to the real situation at all times and there is support for decision-making on – inter

alia – criteria for the authorization of new planting and criteria for prioritization in the light of hurricane and plant pest risk maps. Also, thanks to this geographic information system it is possible to – inter alia – monitor harvesting, improve quality, plan planting campaigns and carry out land use and environmental studies.

Using the multilayer perception model with momentum term of an artificial neural network and a multi-spectral image with high spatial and radiometric resolution, an estimate was made, for the first time, of the salinity of soil on which sugar cane is being grown. The area studied was at the Lázaro Romero cooperative production unit of the Héctor Molina sugar combine, in the municipality of San Nicolás de Bali (La Habana province, 22°44′N and 81°56′W). The experiments in question were carried within the framework of project El-479 financed by the Flemish Inter-University Council, Belgium. On each of the four selected sugar cane plots, 36 georeferenced soil samples were taken at three different depths and the electrical conductivity of the saturation extract was determined; half of the data was used for training of the network and half for control, in a computational program, of the artificial neural network created for the purpose, together with the band reflectance and vegetation indices of the image; from that, electrical conductivity maps were obtained for each plot.

Compaction and humidity maps were developed for an area of about half a hectare in Guantánamo province, using samples of three soil profiles (0-10; 10-20; 20-30 cm) taken at 24 points (for a total of 72 samples); with the values obtained for the different soil profiles, maps of points with a value domain were produced. The maps were interpolated with the help of ILWIS software using the Kriging method for interpolation and a GPS for measuring the accuracy of the position of each sample, for the purpose of obtaining compaction and humidity maps with their real coordinates. With these maps it will be possible to work out strategies for the next sugar cane cultivation campaigns.

Geostatistical models and artificial neural network (ANN) techniques were used in the spatial-temporal evaluation of evapotranspiration in Cuba. Using the Kriging (optimum interpolator) method in combination with ANNs, it was possible to adjust the thematic information obtained to a higher level of reality.

A project for updating Cuba's national land registry using high-resolution satellite images is being implemented with the help of multi-spectral QuickBird images from 2006. A methodology is being developed and evaluated for updating cartography and land use through satellite information processing by supervised and non-supervised classification methods. As the project progresses, a legend will be established linking land occupation categories to the land uses specified in the "Nomenclador Único de Usos de la Tierra" of the national land registry.

The GeoCuba group adapted the Russian NEVA digital topographic map-making system for use in those GeoCuba companies which produce 1:25,000 scale maps so that they can comply with the editorial standards and use the symbols specified for the creation of a 1:25,000 scale digital

map of Cuba. The final product is a personalized system and a set of technical guidance documents that have permitted technology transfer to the other GeoCuba companies, with the result that a substantial number of 1:25,000 scale maps have been created using NEVA.

The Centre for Construction Engineering and Technology (CITEC) developed a general methodology whereby advanced techniques such as land-based, aerial and satellite thermography and IR-thermal thermometry are used in the IR-thermal characterization of Cuba's land cover. The methodology involves three mutually complementing sets of data: satellite data (thermal images in the HRPT format from the NOAA satellites); aerial survey data (thermal images obtained with thermovisors); and land-based survey data (point measurements of IR-thermal radiation temperature taken with IR-thermal thermometers and surface temperature measurements taken with contact probes, and thermal images obtained with thermovisors from the ground and dominant heights). Application of the procedures that have been worked out permits determination of the lowest-level temperature and, through spatial zoning, the elaboration of a thematic map (space map) with which it is possible to study dissimilar phenomena connected with drought and forest fires and to quantify and monitor changes in the physical characteristics of the land cover.

Software was developed for facilitating both the management and the correction of topological errors detected in MapInfo digital cartography so that it meets the quality requirements for processing of the geographical information used in GIS projects.

Some areas with *Dichrostachys cinerea* and *Acacia farnesiana* were studied, and the expansion of these bush types in the Guanabo and Itabo basins, located to the north-east of Havana, is being analysed by the digital processing of satellite images and with the use of GIS tools. In that context, the zones most affected by these bush species are being determined and a study is being made of the influence of natural variables, land use and the expansion trend experienced during the period 1985-2005.

3. Space Sciences

The Institute of Geophysics and Astronomy (IGA) of CITMA continued with regular observations at the Geomagnetic Observatory, the station for vertical monitoring of the ionosphere and the Havana Radioastronomy Station, the data obtained being shared with the international scientific community. The geomagnetic measurement data are sent to Intermagnet's international geomagnetic information node in Edinburgh and the radioastronomy data are sent to World Data Centres A, B and C and to the Russian institutions that have requested them.

Collaboration between the Institute of Geophysics and Astronomy and the Institute of Geophysics of UNAM (National Autonomous University of Mexico) has continued, radio interferometer signal quality results relevant for the MEXART interplanetary scintillation array being obtained.

A prototype new-generation radioastronomy receiver for the Ku band of the electromagnetic spectrum was designed and built using a low noise transmitter. Some comparative recordings were performed with it from the Havana Radioastronomy Station, with satisfactory results.

At the Roque de los Muchachos Observatory, Spain, an IGA doctoral student continued with the photometric characterization of symbiotic stars in search of candidate systems in the galactic plane. He devised a way of obtaining a representative sample, and also some reduced spectra, from the approximately hundred available as a result of the observation campaign that has been under way for the past two years. In this campaign, use is being made of telescopes with an aperture greater than two metres owing to the weak relative brightness of most candidates.

At the Instituto Superior de Tecnologías y Ciencias Aplicadas, there was established, in January 2008, a department of aerospace studies, which is attached to the office of the Rector. The objective of the department is to promote academic work in areas connected with space sciences and technologies. It is doing so by organizing postgraduate courses and workshops and scientific events, which also lead to information exchange and academic debate. It is seeking ties with Cuban and foreign institutions interested in the processes occurring in the Earth's upper atmosphere and in other processes that occur on celestial bodies, in order to promote the further training of specialists, officials and other professionals and to carry out research projects.

A study was made of various meteorite clusters of the period 1995-2006 using the non-extensive model of fragmentation and analysing the meteorite particle distributions for 56 meteorite showers observed during that period. The mass distributions and the light intensity distributions of the meteoroids were analysed, with grouping of the observations for various showers and for all the experimental data together. The basic purpose was to validate the hypothesis that the meteoroids were generated by fragmentation processes under violent conditions. Non-linear statistics were used, on the assumption that the fragmentation processes consisted of violent collisions that occurred at stages before the actual formation of the progenitor objects.

A statistical characterization was made of the orbital features of the known potentially harmful objects, some singularities being found in the distribution of some of the features that permit the drawing of inferences about their origin and evolution. The probability of different approaches to Earth as a function of size is being determined. Also, a comparison is being made with a similar characterization for comets. It is estimated that hundreds of comets will be discovered in the years to come, and monitoring them will be one of the activities to which small observatories with modern technology can devote themselves.

4. Distance Learning

The education of children and young adults and of the population in general, remains a high priority for Cuba. Two educational television channels transmit a wide variety of programmes, and through them primary and secondary school pupils study subjects that form part of their curricula. Also, the two channels offer special courses of a general cultural nature on subjects such as astronomy, the forests of Cuba and renewable energy sources. Accordingly, all of Cuba's teaching establishments have television sets and video recorders.

5. World Space Week

World Space Week could not be celebrated as in previous years owing to the serious impact of the devastating hurricanes Ike and Gustav. Nevertheless, the Seventh National Workshop on Outer Space and its Peaceful Uses was held with great success in the Jimaguayú Hall of the National Capitol on 9 October, with 16 presentations made by various Cuban scientific institutions.

In 2008, as in the previous year, no World Space Week posters were received in Cuba owing to the blockade imposed on the country by the United States Government.

Libyan Arab Jamahiriya

[Original: Arabic]

Whereas, the Great Jamahiriya is one of the states newly involved in space technology and research and is at the stage of training and gaining experience in space technology and its applications and has no research on deep space, it is, however, implementing several projects relating to remote sensing applications and space sciences at the local and regional levels. The projects that have this objective and enter into the recommendations of UNISPACE III are as follows:

The national network of seismic monitoring extends throughout the territory of the Great Jamahiriya and aims to use modern technologies, including space technologies, to reduce the dangers of natural catastrophes.

Multiple discriminatory capacity receiving station is the cornerstone of the Libyan space programme to serve the requirements of the Great Jamahiriya and African space through its ability to receive data from several satellites photographing the earth with various discriminatory locating and spectroscopic capacities. This station was previously implemented by the Libyan Centre for Remote Sensing and Space Sciences, although radar data is received from the European satellite ENVISAT and observation data from the French SPOT satellite. The data received can be used in all the economic development programmes that are in line with development and planning policies at the national and regional

levels, especially in bringing together the states of the Sahel and the Sahara.

Receiving station from the SPOT satellite to track land cover and monitor desertification, used in several national and regional projects and particularly in the regions suffering from drought, desertification and sand movements.

Participation by the Great Jamahiriya in building and launching the Regional African Satellite Communication Organization (RASCOM) satellite for communications and broadcasting to the continent of Africa, on which work began in late 2007.

Through the above, we believe that the Great Jamahiriya has been able to participate with the rest of the world in implementing a set of recommendations that serve developing societies, whether local or regional or at the level of the continent of Africa, although we believe it is necessary to take the following points into consideration at the next session:

Ways of obtaining without distinction and for national purposes remote sensing data and the information derived from it with high discriminatory capacities and the necessary equipment to build space technology more specific to the developing countries.

Giving developing countries opportunities to acquire remote sensing with discriminatory capacities in order to obtain high quality data for the implementation of their research and strategic projects.

Notifying Member States of the organization of training and study courses on space sciences and space technology in order to facilitate effective participation of developing countries in such programmes.

Transfer of the scientific reports produced by space agencies to States which are members of the Committee on the Peaceful Uses of Outer Space or putting it on the organizations' websites so that it may be examined by everyone interested in these sciences.

Provision of technical and scientific sensing services by international organizations in order to build capacities in space sciences and technology.

Participation by the Jamahiriya in long-term programmes in order to guarantee scientific support for the implementation of its pioneering programmes.

Scientific support and participation of the United Nations in the organization of scientific conferences in the Jamahiriya held jointly with the Libyan Centre for Remote Sensing and Space Sciences on the use of space technology in the management of resources and protection of the environment and compensation for the harm caused by natural disasters (earthquakes and agricultural pests) at the local and regional levels in order to render a service to sustainable development in Africa in 2010.

Philippines

[Original: English]

1. Background

The Science and Technology Coordinating Council-Committee on Space Technology Applications (STCC-COSTA) is the national body responsible for providing coordination, cooperation and information dissemination on activities. Technological and manpower developments and issues on all fields of space technology in support of environmentally sound and sustainable national development.

2. Members

The following are members of Committee from different government and private institutions:

- Philippine Council for Advanced Science and Technology Research and Development (PCASTRD)
- Philippine Atmospheric, Geophysical and Astronomical Services Administration (P AGASA)
- University of the Philippines - Diliman (UPD)
- National Mapping and Resource Information Authority (NAMRIA)
- Department of Agriculture - Bureau of Soils and Water Management (BSWM)
- Department of Environment and Natural Resources - Mines and Geosciences Bureau (DENR-MGB)
- Department of National Defense - Office of the Civil Defense (DND-OCD)
- Philippine Institute of Volcanology and Seismology (PHIVOLCS)
- Philippine Institute of Environmental Planners (PIEP)
- Advanced Science and Technology Institute (ASTI)
- Philippine Council for Aquatic and Marine Research and Development (PCAMRD)
- Department of Transportation and Communications - Commission on Information and Communications Technology (DOTC-CICT)
- National Telecommunications Commission (NTC)

3. Responsibilities

In the conduct of its tasks, the Committee:

1. Coordinates the national and international activities on space technologies and their applications;

2. Draws-up national strategies and action plans for space technology development and oversees their implementation by appropriate agencies;

3. Facilitates exchange of information among space technology practitioners;

4. Monitors Philippine participation in both local and international seminars, workshops, conferences, technical/regional working groups in the area of space technologies and their applications;

5. Facilitates the sharing of facilities and equipment, exchange of expertise and collaboration on projects;

6. Serves as national secretariat and focal point on .space technology applications; and

7. Assists and advises national agencies on matters pertaining to space technology applications and related fields.

4. STA Activities/Initiatives for 2007

Details of the activities for the STA Sector can be gleaned through the following pages: *(please see Annex A.)*.

5. Others

Following are some of the highlights under the purview of the Secretariat of the STCC-COST A for 2007.

1. Attendance to Workshop on Spatial Data Infrastructure, Geoinformatics Center, Asian Institute of Technology (AIT), held in "Bangkok, Thailand from 22 to 24 February 2007.

– As a joint undertaking between the ASEAN Sub-Committee on Space Technology Applications (SCOSA), the Asian Institute of Technology (AIT) and the Japan Aerospace Exploration Agency (JAXA) hosted by the Asian Institute of Technology, the AIT hosted the Workshop on Spatial Data Infrastructure (SDI) on 22 to 24 February 2007. The Workshop aimed to share the experience of the ASEAN Member Countries and Japan in the development of the national and regional SDI: the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geo-spatial data. It was attended by specialist representing national survey mapping and space technology agencies from Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Singapore, Thailand and Viet Nam.

– Resource persons from Australia, Japan, UNESCAP and AIT shared the latest concepts, developments and utilization of the SDI in Australia, Japan and other regions. In addition, the participants exchanged views on follow up activities and recommended, among others, that (i) all countries, which have not done so, shall conduct in-country consultations with relevant stakeholders in establishing the national SDI, (ii) more technical assistance be provided to some countries such as CLMV on various aspects of SDI; The resources under the Sentinel Asia Project could be tapped to support the activities, and (iii) to conduct the 2nd Workshop on SDI.

2. ASEAN-Pakistan Workshop on Geo-Informatics Islamabad, Pakistan, from 10 to 12 September 2007.

The specific objectives of the Workshop were:

– To share information and experience on Geo-Information between Pakistan and ASEAN;

– To establish linkages between institutions in ASEAN with the Pakistan Space Agency (SUP ARC 0) for HRD and R&D cooperation in Geo Informatics; and

– To identify joint activities to be implemented in the future in the form of trainings and workshops; Research and Development.

Three major working groups for joint cooperative researches between SUPARCO and the ASEAN-SCOSA counterparts were developed, which are:

– Working Group on Land Use *I* Land Cover Change

– Food Security

– Hazard Mitigation

Accordingly, three (3) projects were developed for submission and possible funding under the ASEAN-Pakistan Fund.

3. Several projects proposal submitted through the ASEAN-COST (and SCOSA) were referred and evaluated.

4. International Collaborations which are under development and in the frame of Space Technology Applications for Monitoring Emerging Infectious Disease (EIDs).

– Participation in two (2) Workshops of the APEC-Technology Foresight Center Initiative on Converging Technologies to Combat Emerging Infectious Disease, held in May and October 2007 in Tokyo, Japan and Taipei, Taiwan, respectively;

– Participation in the UNESCAP-UNOOSA organized Workshop on the Use of STA for Monitoring Avian Influenza (AI) he1d in September 2007, Bangkok, Thailand.

5. International Collaborations with the Kyushu University - Space Environment Research Center (SERC) on studies on Seismo-Electromagnetics.

6. Initial and Informal Talks with previous Supervisor (Dr. Ryutaro Tateishi) for Possible Sandwich Research Programs with the Center for Environmental Remote Sensing (CEReS) of Chiba University (status: under development).

7. Conduct of In-house Pre-feasibility and Technical Feasibility Studies on Small Satellite Technology Transfer and Development (status: under development)

8. Activities related to the Sentinel Asia of the Japan Aerospace Exploration Agency (JAXA) and. through the conduct of the Fourth Joint Project Team Meeting - JPTM4 which was recently held in Makati City from 5 to 7 September 2007, was in support of this).

9. Initiatives in support to the Wideband Internetworking Demonstration and Test Satellite WINDS satellite program (in coordination with ASTI).

Ukraine

[Original: Russian]

In 2008, Ukraine continued to implement the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE-III) within the framework both of national projects and of international cooperation. For Ukraine's space sector, the year 2008 was marked by the approval of the National Scientific and Technical Space Programme of Ukraine for 2008-2012 (hereinafter referred to as "the 2008-2012 Programme") – the fourth space programme of Ukraine since it gained independence.

The aims of the 2008-2012 Programme are to further develop Ukraine's space activities and make effective use of them in solving urgent problems of national security, and to promote the introduction of advanced technologies and raise the level of science and education in Ukraine.

The basic tasks foreseen by the 2008-2012 Programme include:

1. increasing the effectiveness with which space resources are used;

2. developing advanced technologies;

3. establishing a qualitatively new level of international cooperation; and

4. creating and making effective use of space resources that meet the needs of the organs of State that have responsibility for maintaining the defensive capabilities and ensuring the national security of Ukraine.

The tasks and measures foreseen by the 2008-2012 Programme correspond to the strategic priorities established by the Presidential Decree of 12 February 2007 on Ukraine's national security policy.

These priorities are:

1. to create conditions that will ensure the health and safety of the population (through a balanced system of natural resource use, through the prevention of man-made disasters and mitigation of the consequences should one occur, and through the achievement of high levels of ecological safety and nuclear and radiation safety); and

2. to ensure favourable external conditions for the development and security of the State, by:

(a) creating a secure international environment around Ukraine, and strengthening the systems of collective security at the European and the transatlantic level;

(b) developing harmonious, mutually beneficial and good-neighbourly relations with other countries of the region;

(c) promoting mutually beneficial Ukrainian-Russian cooperation on the basis of pragmatism and openness as an essential condition for national and regional security;

(d) intensifying Ukraine's interaction with the USA and Canada, with member States of the European Union and other European countries, and with regional leader countries;

(e) creating the basis for full membership of Ukraine in the European Union; and

(f) ensuring the security of information as the structure of the global information community becomes more integrated.

Given this background, by implementing the measures foreseen by the 2008-2012 Programme it will be possible:

1. to introduce in Ukraine advanced technologies for dealing with major issues involved in sustainable development (the rational use of natural resources, the control of emergencies, the monitoring of crops) by establishing a permanently operating array of Sich satellites for Earth observation and a national system for use of the data obtained that is harmonized with international systems;

2. to develop promising space technologies, modernize Ukraine's ground-based infrastructure for space activities and create conditions for the commercial utilization of Ukrainian carrier rockets;

3. to create a satellite telecommunications network using a Ukrainian communications satellite; and

4. to expand international cooperation.

Thus, Ukraine's space activities in 2008 were directed towards the implementation of high-priority projects of Ukraine's fourth space programme, the fulfilment of obligations entered into by Ukraine within the framework of international programmes and projects, and the strengthening of effectiveness in the space sector through restructuring and commercialization, the broader introduction of advanced space technologies, the creation of conditions favourable to greater competition and private initiative, and the establishment of extensive cooperation with other States and with international organizations. Information about the implementation of high-priority projects within the framework of the 2008-2012 Programme is given below.

1. Space technology development

(a) Global navigation satellite systems

In 2008, work continued on deploying the Ukrainian coordinate time and navigation system (SKNOU) using GNSSs, GPSs and GLONASS. The system is based on technology accepted for the EUPOS project and involves the creation of three precise and user-friendly sub-systems.

Five control/correction stations (CCSs) have been deployed and are operating on a trial basis in Kharkov, Dunayivtsi, Chernigov, Feodosiya and Evpatoriya. Within the resulting pentagon (45 per cent of the territory of Ukraine), the principles of creating a system that will cover all of Ukraine have been tested. With the deployment of additional stations during the next three years, 90 per cent of the territory of Ukraine will be covered.

Work on establishing three more CCSs – in Yavorov (Lviv oblast), Lugansk and Mukachevo (Zakarpattia oblast) – and integrating them into the SKNOU is near completion; it is due to be completed by the end of November of this year. The results of round-the-clock testing of the stations indicate that the software and hardware are functioning well.

A main and a back-up navigation field control centre (NFCC) have been established in Dunayivtsi and Kharkov; they collect "raw" data from the stations for joint processing. On the basis of operational trials with the SKNOU segment already deployed, the program packages for ensuring the proper functioning of the SKNOU's geodesic sub-system after data transmission sessions have been refined.

With the processed data, posted on the NFCC website, users possessing dual-frequency receivers can perform geodesic tasks after data transmission sessions throughout and beyond Ukraine with 1-2 cm accuracy using standard software packages. The data can be used in determining the coordinates of spacecraft and aircraft, in matching space and aerial photos for purposes of Earth remote sensing, in testing new kinds of technology, etc.

The development of software for a wide-area differential correction sub-system operating at present with GPS signals is nearing completion, the present focus being on the use of GLONASS data.

During tests, local differential correction data (DCD) have been delivered in real time to users within a 100 km action radius of the individual network stations – and also wide-area DCD derived from the "raw" data. According to preliminary estimates, the wide-area DCD derived with the existing SKNOU segment will enable a large-scale user with a single-frequency navigation receiver to determine its position to within 1 m horizontally and 2 m vertically throughout Ukraine.

The system that has been created is based exclusively on domestic GLONASS and GPS monitoring resources. With the coverage of Ukraine that has been achieved and the means of data delivery to users that have

been tested, it is possible to start introducing the system for various users within Ukraine and in nearby parts of neighbouring countries.

In 2007-2008, at the meetings of the Ukrainian-Russian subcommittee on space industry cooperation, the question of creating a joint differential correction and monitoring system (DCMS) was frequently discussed, and the question is now being considered at governmental level in Ukraine and the Russian Federation. The Committee on Economic Cooperation of the Russian-Ukrainian Interstate Commission held its third session, in Kyiv, on 28 April 2008. That session led to the signing of a protocol in which – inter alia – the National Space Agency of Ukraine (NSAU) and the Federal Space Agency of the Russian Federation were requested to launch a joint project for the creation of a single navigational time zone for Ukraine and the Russian Federation on the basis of GLONASS and other global navigation satellite systems. This project is comparable in scale with the European Union's EGNOS project. Agreement has been reached on a plan for creating a single navigational time zone based on GLONASS. Ukraine's share of the work to be done on creating the joint DCMS will be carried out within the framework of the 2008-2012 Programme.

A plan has been prepared for testing technology for data exchange between the Ukrainian Centre for Navigation Field Control and the Russian DCMS Centre (in Moscow). Again, Ukraine's share of the work involved will be carried out within the framework of the 2008-2012 Programme.

For commercializing the use of GLONASS, the Russian Research Institute of Space Device Engineering and the Ukrainian Research Institute of Radio Measurements (in Kharkov) are engaged in a pilot project involving the establishment of a regional navigation system in Ukraine's Vinnitsa oblast. In August 2008, a presentation on the project was made in the offices of the Vinnitsa oblast authorities.

In order to establish a legal basis for the cooperation in question, the draft has been prepared of an agreement between the Government of Ukraine and the Government of the Russian Federation on implementation of the project for the creation of a single navigational time zone for Ukraine and the Russian Federation on the basis of GLONASS and other global navigation satellite systems; the draft has been approved by the NSAU and is currently being examined by the relevant Russian ministries and departments. Preparations for the signing of the agreement are due to be completed by the end of the first half of 2009.

Ukraine's cooperation with the European Union under the EGNOS-Galileo programme – provided for in the 1 December 2005 cooperation agreement between Ukraine and the European Union and its member States on a civil global navigation satellite system – is to take place with the involvement of the Kharkov, Dunayivtsi and Evpatoriya CCSs as part of the ground-based infrastructure of the EGNOS system.

Within the framework of Ukraine's cooperation with the Russian Federation and countries of the European Union, effective economic structures can be created for the provision of coordinate time and navigation services to users in Ukraine and neighbouring countries on a

commercial basis. Such joint activities may prove to be a serious basis for the development of transboundary cooperation between Ukraine and the neighbouring European Union member countries in – for example – preparing for the 2012 European Football Championship (EURO-2012), and also during the run-up to the 2014 Winter Olympic Games in Sochi. Relevant work is foreseen in the 2008-2012 Programme.

(b) National satellite communication system

The NSAU is continuing to work on the establishment of a national satellite communication system (NSCS). On 3 May 2007, the Ukrainian Cabinet decided on the establishment of the NSCS, including the construction of Ukraine's first telecommunications and broadcasting satellite. The document in question provides for the legal, organizational and technical measures necessary in order to enable the satellite to be launched in 2011. The NSAU has been designated the State customer for the satellite, which will be used in the development of a national satellite-based network for television and radio broadcasting, data transmission and Internet service provision.

It is foreseen that the satellite will be placed in orbit during the third quarter of 2011, being launched on a Ukrainian Zenit carrier rocket from the Baikonur space centre. Proposals for participation in the construction of the satellite have already been received from a number of companies, and the NSAU is in the process of selecting the company with which it will cooperate in the project, the cost of which – including the launching cost – will be 1300 million UAH. One third of the necessary financial resources will be provided from the State budget, as the satellite will support State programmes and be used in meeting needs of the Ministry of Defence, the Ministry of Transport and Communications, the Ministry for Emergency Situations and other departments. The remainder is to be obtained from investors, and Ukraine is interested in securing the participation of Moldova, Belarus and the transcaucasian republics that will be able to receive signals from the satellite.

(c) Earth remote sensing

With a view to expanding and modernizing the Earth observation system Sich, work continued in 2008 on the Sich-2 spacecraft, with an optical radiometer having a resolution of about 8 m. The launching of Sich-2 is planned for 2009.

Work continued in 2008 on the development of elements of a geographical information system intended to be part of the European GMES system and of GEOSS.

In this context, from 3 to 5 June 2008 the First All-Ukrainian Conference on Aerospace Observations for Sustainable Development and Security took place in Kyiv.

This conference was attended by over 150 leading space scientists and space agency and company experts from Ukraine, Russia, Belarus, Kazakhstan, the United States, Israel, France, Germany, Italy and Poland.

2. Space research

Ukraine's space research activities are focused mainly on:

1. studies of the Earth and of near-Earth space;
2. extra-atmospheric astronomy and astrophysics; and
3. space biology, microgravity physics and technological development.

In 2008, satellite and ground-based data were processed and underwent complex analysis as part of an investigation of large-scale wave processes in the ionosphere and the atmosphere.

In preparation for the international project RadioAstron, equipment is being developed to support the antenna capabilities of the NSAU's National Centre for the Management and Testing of Space Resources.

The next stage was completed of the preparations for high-priority biology and materials science experiments within the framework of the long-term Ukrainian-Russian programme of scientific and technical studies in the Russian segment of the International Space Station (ISS).

Preparations continued for the international scientific projects WSO-UV/Spektr-UV, Phobos-Grunt and Rezonans and for the Groza experiment on board a Chibis microsatellite. Ukrainian specialists are continuing to develop scientific equipment as part of those preparations.

Basic development work continued on promising space technologies under an agreement between the NSAU, France's Centre National d'Etudes Spatiales (CNES) and the International Association for the Promotion of Cooperation with Scientists from the Newly Independent States of the former Soviet Union (INTAS) on joint bidding for NSAU-CNES-INTAS projects relating to such technologies. Within the framework of such projects, basic scientific and technical work is being done on the development of atomic clocks for space systems, of heat pipes and fuel cells for spacecraft and of technology for the processing of data from observation of the Earth from space.

3. Space systems

Following the establishment of a main reference room at the National Centre for the Management and Testing of Space Resources, work is continuing on the creation and operation of an NSAU information analysis system.

Following test runs, Ukraine's system for the monitoring and analysis of conditions in outer space (SKAKO), which can be used in international programmes for minimizing space debris and preventing emergencies due to space objects, has gone into operation. The tasks of SKAKO include: detecting possible threats to the national security of Ukraine; finding and tracking pieces of space debris that constitute a serious hazard for spacecraft; forecasting the times and areas of impact of potentially dangerous space objects; and analysing the Earth observation possibilities

of spacecraft and their overflights of given territories. This system is a source of strategic information about the space activities of all countries engaging in such activities and a guarantor of Ukraine's national security.

A striking example of what the system can do was the detection of the launching of a Jericho II ballistic rocket from near Tel Aviv (Israel) on 17 January 2008. The ballistic target was tracked for almost 90 seconds by the observation and monitoring facilities of the National Centre for the Management and Testing of Space Resources (in Evpatoriya), and the coordinates of the launch site and the point of impact were calculated. Also, in February 2008, when the satellite USA-193/NROL-21 was destroyed in orbit by United States missile defence resources, Ukraine – with its electronic observation facilities – tracked and monitored the satellite in orbit and detected its destruction and the presence of fragments.

4. Cooperation with international organizations

(a) Cooperation with the United Nations Committee on the Peaceful Uses of Outer Space

During 2008, Ukrainian delegations participated in: the 45th session of the Scientific Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), held from 11 to 22 February 2008; the 47th session of the Legal Subcommittee of COPUOS, held from 31 March to 11 April 2008; and the 51st session of COPUOS, held from 11 to 20 June 2008. At all those sessions, Ukraine's representatives took an active part in the discussions on all key agenda items.

(b) Cooperation with the Inter-Agency Space Debris Coordination Committee (IADC)

The NSAU is continuing to work on minimizing the pollution of space. In its space activities, Ukraine takes account of the recommendations of the IADC, of which the NSAU is a member, and is focusing on:

1. preventing the formation and reducing the amount of space debris when Ukrainian carrier rockets are launched;

2. preventing space pollution due to the operation of Ukrainian spacecraft;

3. studying space debris with the help of Ukrainian electronic facilities; and

4. developing and introducing technical documentation on the general requirements as regards limiting the pollution of near-Earth space during the operation of Ukrainian space technology.

5. Launch vehicles

In 2008 there were eight successful launches of Ukrainian-built carrier rockets: two of a Dnepr; one of the Zenit-3SLB and five of the Zenit-3SL.

The Zenit-3SLB was launched from the Baikonur space centre. One Dnepr carrier rocket was launched from the Yasny launch base (Russia's Orenburg oblast) and the other from the Baikonur space centre. The Zenit-3SL launches were from the Morskoy Start (Sea Launch) floating launch pad in the Pacific Ocean.

On 28 April 2008, the first commercial launch of a modernized Zenit carrier rocket, under the Nazemny Start (Land Launch) programme, took place at the Baikonur space centre. The launch was carried out by International Space Services Inc. (of which the Yuzhnoye Design Office is a member), the Yuzhmash manufacturing company and a number of Russian organizations. The Zenit-3SLB (designed by the Yuzhnoye Design Office) was made up of a Zenit-2SB (Yuzhnoye and Yuzhmash), a DM-SLB upper stage (Energiya Rocket and Space Corporation) and a fairing (S.A. Lavochkin Scientific Production Association). It placed in geostationary orbit, for Israel, the AMOS-3 multipurpose satellite (weighing 1300 kg) for high-resolution digital television broadcasting via cable and general national networks, which will replace AMOS-1. With its broader functional possibilities, AMOS-3 will be able to cover the Middle East, Europe, Africa and parts of South and Central America.

6. Bilateral cooperation

In 2008, Ukraine's cooperation with other States in space exploration and the peaceful uses of outer space was based on international treaties relating to the exploration of outer space, on the international obligations of Ukraine regarding space activities and on current Ukrainian legislation governing space activities.

Ukraine's policy with regard to such international cooperation was guided by the following core principles:

1. compliance with international obligations relating to space activities;

2. accommodation of the aims and priorities of Ukraine's foreign policy and national security policy;

3. strengthening of the position of Ukrainian businesses in the global market for space technology and services; and

4. concentration of efforts on high-priority space activity areas.

The main international cooperation efforts focused on creating an international legal environment favourable to the participation of Ukrainian space sector businesses in international space projects and in foreign trade and ensuring their sustained active presence in the space services market.

Ukraine's many years of collaboration with the Russian Federation are based on close cooperation among enterprises, joint participation in international space projects, the use of Russian launch complexes for the launching of Ukrainian carrier rockets, and the existence of a long-term cooperation programme and a coordinated inter-agency plan of action premised on a long-range vision regarding the development of space technology.

In 2008, Ukraine's collaboration with Russia continued to focus on the international commercial space projects Sea Launch, Dnepr, Land Launch and Cyclone-4 and on preparations for experiments on board the Russian segment of the ISS.

On 12 February 2008, the Presidents of the two countries signed a Ukrainian-Russian plan of action up to the beginning of 2009 that provided for – inter alia – the intensification of work under the 2007-2011 Russian-Ukrainian programme of collaboration in space research for peaceful purposes. The two sides agreed on technology protection measures and on the development and use of rockets and spacecraft. Also signed was a protocol regarding amendments and additions, regarding intellectual property and confidential information, to the 27 August 1996 agreement between the Government of Ukraine and the Government of the Russian Federation on collaboration in the investigation and uses of outer space for peaceful purposes.

In 2008, the subcommittee on space industry cooperation of the Committee on Economic Cooperation of the Ukrainian-Russian Inter-State Commission held its fifth and sixth sessions, at which it considered present and future collaboration in exploring and using outer space and in developing and using rockets and spacecraft. Particular attention was paid by the subcommittee to implementation of the Land Launch, Dnepr, ISS Russian segment, CORONAS-Photon and IONOSAT projects and other joint projects.

A protocol based on the results of the sixth session provides, inter alia, for:

– the continuation of work on the ISS Russian segment and CORONAS-Photon projects, fundamental applied research, and the development of Earth remote sensing (ERS) resources and the use of ERS data;

– the establishment of a joint Ukrainian-Russian enterprise for the production of end-user navigation instruments and the equipping of navigational information systems;

– the preparation for signature of an agreement between the Government of Ukraine and the Government of the Russian Federation on the implementation of a project for the creation of a single navigational time zone covering Ukraine and Russia based on GLONASS and other global navigation satellite systems;

– the holding of a joint meeting to consider the implementation of the long-term programme of Russian-Ukrainian scientific investigations and

experiments on board the Russian segment of the ISS with the participation of Ukrainian and Russian business and other organizations;

– the design of improved variants of the Zenit launch vehicle for the Baikonur space centre with a view to increasing the competitiveness of the Land Launch programme;

– cooperation by Roskosmos in launches of Sich-2 and of experimental navigation equipment within the framework of the 2008-2012 Programme, using Dnepr launch vehicles; and

– the creation by the NSAU and Roskosmos of a working group to consider legal questions regarding the use of the results of intellectual activities involved in space projects.

Brazil remained a very important partner of Ukraine, and on 28 February 2008, at a meeting of an NSAU delegation with the senior management of the Brazilian Space Agency held in Brasilia, the Brazilian participants were informed about the status of work on developing the Cyclone-4 launch vehicle and space rocket complex. The meeting led to agreement on bringing forward planned Cyclone-4 project implementation measures.

The People's Republic of China continues to be a significant partner of Ukraine in the space sector, and joint projects are being carried out successfully within the framework of a plan of Ukrainian-Chinese cooperation in the exploration and peaceful use of outer space for the period 2006-2010 that was signed by the two parties during the fifth meeting of the Ukrainian-Chinese subcommittee on such cooperation (held in Beijing from 5 to 9 June 2006). The plan provides for the joint implementation by Ukrainian and Chinese enterprises of projects for the development of rocket and space technology. It covers 29 joint projects in the following areas: launch vehicles, satellites, space hardware (rocket and spacecraft components), and space science and electronics.

The two parties have noted that the aims of Ukraine's IONOSAT project and of the Chinese project for the development of a seismo-electromagnetic satellite are similar and complementary, so that there is scope for mutually beneficial cooperation in their implementation. Various levels of cooperation have been identified, ranging from scientific information exchange to the combining of the two projects into a joint Chinese-Ukrainian project. The two parties have agreed to initiate mutually beneficial cooperation in the field of space data exchange within the framework of the Chinese project Environment-1-B and the Ukrainian Sich-2 project. To that end they have agreed to exchange information about the technical parameters of the projects.

In 2008 there was an intensification of cooperation between Ukraine and the USA. On 31 March 2008, in Kyiv, a framework agreement between the Government of Ukraine and the Government of the United States of America on cooperation in the exploration and use of outer space for peaceful purposes was signed. The purpose of the agreement is to create a framework for space cooperation between the NSAU and NASA on a basis

of equality and reciprocal advantage with account taken of new trends in and approaches to space activities under present conditions. The agreement establishes the legal basis for space cooperation between Ukrainian and United States companies and other enterprises. It will help to promote the all-round development of long-term cooperation and partnership between Ukraine and the United States and make possible the high-quality implementation of joint initiatives of interest to the scientific sector and the industrial investment sector of both countries.

Measures to intensify space cooperation with States of the European Union and with the European Space Agency (ESA) focused on the creation of conditions favourable to the gradual acquisition by Ukraine of the status of ESA member. An important step in that direction was the signing on 25 January 2008 of an agreement between the Government of Ukraine and ESA on cooperation in the peaceful use of outer space that created the organizational and legal basis for the promotion of space cooperation between Ukrainian and European companies and other enterprises. Among the potential areas of cooperation enumerated in the agreement are: space sciences; Earth research programmes and their applications; telecommunications; microgravity studies; the development and use of ground-based space facilities; and launch vehicles.

On 17 June 2008, at the NSAU's headquarters, there was a meeting of representatives of the NSAU and of various other Ukrainian organizations and institutions engaged in space exploration and space science activities with representatives of ESA. At that meeting, with a view to identifying promising areas of space cooperation, the following were considered:

1. The Galileo project;

2. The GMES project;

3. The IONOSAT project;

4. Life sciences;

5. Prospects for using the RT-70 radio telescope in European programmes;

6. Areas of cooperation in the field of education between the NSAU and ESA;

7. Issues regarding the establishment of a working group and of a 2008 workplan for such a group;

8. The possibility of holding a Eurisy conference in Ukraine in 2009.

As a result of the meeting, a working group was established to identify areas of cooperation between Ukraine and ESA in the exploration and peaceful use of outer space.

Also with a view to intensifying the space cooperation between Ukraine and the European Union, on 29 May 2008, during the International Aerospace Exhibition in Berlin (ILA-2008), a framework agreement was concluded between the NSAU and the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt – DLR) on cooperation in

space activities. This agreement is the legal foundation for space cooperation between the NSAU and DLR on a basis of equality, mutual advantage and parity. The cooperation established by the agreement will cover areas such as: space science – astrophysics and the study of the solar system; the observation and study of climatic and environmental changes on Earth; the development and creation of orbital and suborbital platforms and the corresponding space instrumentation for observation of the Earth's surface, navigation, weightlessness studies, telecommunications and scientific experiments; space infrastructure; space law; the management of space activities; and training.

Pursuant to the framework agreement between the NSAU and France's CNES on space cooperation, in March 2008 representatives of the NSAU and CNES signed a protocol on future cooperation in the welding of highly rigid alloys; also, an NSAU-CNES working group was established.

Preparations were completed for a Ukrainian-European space project under the European Union's Twinning mechanism for the establishment of partnerships and exchanges of experience between public bodies of Ukraine and of countries of the European Union. On 22 April 2008, in Kyiv, an official ceremony took place inaugurating the Twinning project for intensifying Ukrainian space cooperation through collaboration between enterprises and organizations of Ukraine and the European Union in space activities, including their developmental, legal, scientific and industrial aspects. The main Twinning project tasks include: education and training for Ukrainian space sector workers in areas such as space legislation, personnel policy, and high-tech norms and standards; and cooperation in research under the European Commission's Seventh Framework Programme (FP7).

On 16 and 17 July 2008, at the NSAU's headquarters, there was a seminar, with the participation of European experts, on questions relating to the participation of Ukrainian specialists in research projects under the FP7. At the seminar, a general presentation was given on the FP7 and there was a discussion of ways in which enterprises, institutions and organizations affiliated to the NSAU might participate in international FP7 projects. From 27 to 29 August 2008, at the NSAU's headquarters, in the context of the Twinning project there was the first of six planned seminars on the legal framework for the space activities of European Union countries and Ukraine. The basic aims of that first seminar – the topic of which was the institutional systems for space activities of Germany, France, Ukraine and the European Union – were to familiarize the participants with the present legal system for the regulation of space activities in European Union countries and to identify possibilities of cooperation between the NSAU and ESA in the field of space law.

The third meeting of the supervisory board of the Twinning project took place at the NSAU's headquarters on 11 September 2008. It was attended by project leaders from France, Germany and Ukraine, the permanent project adviser, NSAU specialists, European experts and representatives of the Twinning project administrative office. At the

meeting, the third-quarter project report and a workplan for project activities during the fourth quarter were discussed and approved.

Cooperation between Ukraine and the Arab Republic of Egypt is continuing to expand. A framework agreement between the Government of Ukraine and the Government of the Arab Republic of Egypt on cooperation in the exploration and peaceful use of outer space was signed on 9 April 2008. With the signing of the agreement, a legal basis was created for space cooperation between Ukraine and Egypt.

In 2007, an ambitious project for the construction, launching and putting into operation of the Earth remote sensing satellite EgyptSat-1 was completed. The satellite was launched from the Baikonur space centre and placed in orbit by a converted Dnepr carrier rocket on 17 April 2007. On 10 April 2008 there was, in Egypt, a ceremony to mark the inauguration of the Egyptian ground control station for EgyptSat-1, in Cairo, which has taken over control of the satellite from the ground control station in Evpatoriya.

The principal users (besides the USA, France, Brazil, China and Egypt, which were already mentioned) of rocket and space technology and services offered by Ukrainian enterprises remain:

The Republic of Korea (manufacture of components and systems for the third-stage propulsion unit of the Republic of Korea's carrier rocket; theoretical calculations in support of carrier rocket development and testing);

India (execution of a contract for the development of a 200-ton-thrust liquid-oxygen/kerosene engine for an Indian carrier rocket; development of equipment for a production and test facility for the building of propulsion units; construction of launching and other technical systems for Ukrainian carrier rockets at India's space centre; scientific projects);

Italy (development and construction of an engine for the fourth stage of the Vega carrier rocket);

Turkey (establishment of an aerospace rocket complex; joint construction of observation satellites).

Preparations continued in 2008 for the signing of a framework agreement between the NSAU and the Bulgarian Space Agency on cooperation in the exploration and peaceful use of outer space, and also of a framework agreement between the Government of Ukraine and the Government of the Republic of Bulgaria on space cooperation.

As regards cooperation with Kazakhstan, during a Kazakh-Ukrainian conference on modern space technologies held in Almaty in October 2008 the main directions and priorities of space cooperation between Ukraine and the Republic of Kazakhstan were determined:

1. monitoring and forecasting of space weather;

2. creation of scientific space instruments for studying Sun-Earth connections and the state of the ionosphere;

3. aerospace monitoring of the natural environment and of the ecological state of different land areas;

4. participation in the World Space Observatory/Ultraviolet (WSO/UV) project;

5. creation of ground infrastructure for a high-precision satellite navigation system;

6. training, retraining and further training of professionals working in Kazakhstan's space sector.