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

I. Note by the Secretariat

1. In the report on its forty-sixth session, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space recommended that the Secretariat continue to invite Member States to submit annual reports on their space activities (A/AC.105/933, para. 16).

2. In a note verbale dated 31 August 2009, the Secretary-General invited Governments to submit their reports by 30 October 2009. In response to that invitation, by that date the Secretariat received replies from Armenia, Belarus, Germany, Italy, Japan, Myanmar, Poland and Thailand and made them available in document A/AC.105/953.

3. The present document was prepared on the basis of reports received from the following Member States after 30 October 2009: Cuba, Republic of Moldova, Spain and Ukraine.

4. The replies contained in the present document were not formally edited. The replies will be made available by the Secretariat, edited and in all official languages of the United Nations, in addenda 1 and 2 to document A/AC.105/953.

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II. Replies received from Member States

Cuba

[Original: Spanish]

1. Report on Space Activities carried out by Cuba in 2009

1. The annual objectives of the space activities have been satisfactorily met despite the difficult economic situation facing the country following three hurricanes that devastated the country during the past year, causing losses in the order of US dollars $15 billion, according to the latest official data. The situation was exacerbated by the United States embargo. This year the country's recovery has continued in a spirit of confidence that this complex situation will be overcome thanks to the measures initiated by the Government with the support of the entire population. Below is a brief account of the results obtained in Cuba during 2009 in developing space research and the peaceful uses of outer space.

2. Space meteorology

2. The country has accorded priority to meteorology, since hurricanes are the natural disaster that causes the greatest damage, and has modernized its meteorological stations and radar installations.

3. The Institute of Meteorology of the Ministry of Science, Technology and the Environment (CITMA) has continued to improve its weather forecasting, with the achievement of over 90 per cent accuracy, thanks to the work of the eight radar installations, 68 meteorological stations and satellite information.

4. The timely and systematic dissemination of weather forecasts in the mass media and the measures organized by the civil defence authority have been the main strategy for protecting the population against the risks of disaster.

3. Remote observation of Earth

5. The Institute of Tropical Geography developed a number of remote detection applications in environmental research, especially in the analysis of the spatial changes in the territory between different dates. Digital processing of the images captured by the Landsat satellite Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+) sensors established the various changes in land use in the area covered by the Sierra del Rosario Biosphere Reserve from the time it was declared in 1985 until 2001. It was also possible to determine the principal changes in mangrove cover of the cays (small islands or keys) situated to the north of the province of Ciego de Ávila in order to detect the change in the area covered by mangroves in relation to the region's development. A preliminary analysis was also carried out for automatic detection of changes in the area covered by the Metropolitan Park of Havana (PMH) using, as in the previous examples, Landsat images for those years. The digital information processing was carried out with the ENVI 4.5 software and culminated in supervised and non-supervised classification. Work was also done on the geographical information systems (GIS) MapInfo 9.0 and ArcGis 9.2 for map superimposition, reclassification and production.

6. The Institute of Tropical Geography applied remote sensing in the digital mapping of the Protected Areas of Cuba, starting with the space images of the Landsat 7 ETM+ satellite, digital processing of which produced an updated chart of Cuba's coastline and cays. The information obtained from the digital processing of the images was correlated to natural elements of the landscape, such as vegetation cover of national protected areas, and socio-economic aspects, such as the road system, the hydrographical network and human settlements.

7. The Institute of Tropical Geography and the Institute of Ecology and Systematics studied land-use change in the La Coca protected area caused by the degradation of the natural vegetation and the introduction of invasive species of weeds such as marabou and aroma, resulting in the loss of Cuabal (a serpentinite xeromorphic thorny shrub), a resource that caused the zone to be declared a

protected area which it is important to preserve. Maps of land use and the degradation level of that resource were prepared using satellite image change detection techniques and the tools of the geographical information systems for different years. This permitted analysis of the most important changes that took place during the period 1985-2005, providing a vital contribution to management and protection of the area.

8. Using the continental fire detection system with the "Queimadas" satellites of Brazil's National Institute for Space Research, which provides information in real time on the Internet and stores it on the system's data bank, the Institute of Meteorology developed an application for the various users needing information on fire focuses and their dispersion. The geo-referenced information on fires, obtained from the aforementioned data bank in "shape" (.shp) format, was transferred to a geographical information system. A determination was made of the MapInfo GIS procedures and options for data processing and cartographic output that contribute most to an evaluation of the spatial distribution of fires, the context and environment in which they develop, their possible evolution and existing resources for fighting them, through multilayer analysis of mapping information. Any user in Cuba can receive full information on fires detected through this application via a popular medium such as e-mail.

9. The Higher Institute of Technologies and Applied Sciences and the Institute of Meteorology developed a methodology for monitoring forest fires in Cuba, using an advanced very high resolution radiometer (AVHRR) sensor of the United States National Oceanic and Atmospheric Administration (NOAA) satellite receiving station. Monitoring of this type of natural disaster (the forest fire that broke out in the Nueva Paz area of La Habana province revealed, *inter alia*, the fire focus, the area covered and the movement of the fire front, all carried out with the GIS IDRISI for Windows 2.01 on the basis of satellite images.

10. The Institute of Tropical Geography and the Institute of Geophysics and Astronomy developed a methodology for atmospheric correction of Landsat 7 images, using the MODTRAN4 atmospheric correction model in the Fast Line-of-Sight Atmospheric Analysis of Spectral Hyper Cubes (FLAASH) module of the ENVI 4.6 software. It was based on rigorous resolution of the Radiative Transfer Equation (RTE) that connects the scattering and absorption processes. The information produced is a calibrated image with surface reflectance values, a water vapour image, a cloud map and a file of the detailed procedure.

11. On the basis of image sequences from satellites such as the Earth Probe total ozone mapping spectrometer (EP/TOMS) and the Ozone Monitoring Instrument on the Aura satellite, it was possible to determine that dust transport from the Sahara over the Atlantic to the Caribbean and Cuba is associated with synoptic-scale processes and shows marked stationary and a well-defined time-space progression, which is very similar to the time-space progression of dust storm occurrence over the Sahara and Sahel. Given the composition of this dust, the 17 per cent increase in rates of asthma in the Caribbean in recent years is attributed to the high frequency of such clouds, making the area an asthma corridor. The study of the behaviour of these dust clouds in the Caribbean and Cuba in recent years and their influence on the number of cases of respiratory infections, all using digital imaging and multivariate statistical techniques, has been developed by the Institute of Meteorology and the results placed at the disposal of the country's health authorities.

12. The Environment Agency, with its research institutes and centres, launched the project entitled "Development and implementation of the special environment space data infrastructure" as a contribution to the Space Data Infrastructure of the Republic of Cuba (IDERC) portal. A project to identify areas which might be affected by desertification in the country, using LANDSAT satellite images, is underway. Implementation of the SIG Citricos geographic information system has continued and is being extended to various agricultural enterprises in the country, offering them a tool for tasks such as monitoring harvesting, improving crop quality, planning planting campaigns and carrying out land-use and environmental studies.

13. Use of the multilayer perceptron (MLP) model with artificial neural network (ANN) feed and multispectral imaging with high spatial and radiometric resolution is continuing in studies of soil salinity within the framework of project EI-479, financed by the Flemish Interuniversity Council of Belgium.

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

15. With the use of special data (thermal images from the NOAA High Rate Picture Transmission (HRPT) satellites), aerial data (thermal images obtained with thermovisors) and land-based 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, the lowest-level temperature has been determined and, by means of spatial zoning, a thematic map (space map) has been elaborated which will make it possible to study, inter alia, dissimilar phenomena associated with drought and forest fires and to quantify and monitor changes in the physical characteristics of the land cover.

16. The project to update Cuba's national land registry using high-resolution satellite images has continued with the help of multispectral images for updating cartography and land use through satellite information by supervised and non-supervised classification methods. It will thus be possible to create a legend linking land occupation categories to the land uses specified in the uniform nomenclature of land uses of the national land registry.

4. Space sciences

17. During the year under consideration the regular observations conducted by the Geomagnetic Observatory, the station for vertical monitoring of the ionosphere and the Havana Radioastronomy Station, under the auspices of the Institute of Geophysics and Astronomy (IGA) of CITMA were continued. The data obtained were shared with the international scientific community.

18. Cooperation between IGA and the Institute of Geophysics of the National Autonomous University of Mexico (UNAM) was further enhanced, and significant improvements were obtained in the quality of the signal of the radio interferometer signal for the interplanetary scintillation array of the Mexican Array Radio Telescope (MEXART).

19. A study was carried out of the P73/Schwassmann-Wachmann 3 (SW3) comet on the basis of 27 direct images of fragment C taken with the Isaac Newton telescope at the Roque de Los Muchachos Observatory (ORM) on the island of La Palma, Spain (Canaries) and visual observations of the fragments made by the International Astromomical Union (IAU) Central Bureau for Astronomical Telegrams. One interesting result was the observation of a sudden 50-degree change in the orientation of the isophotes close to the nucleus, which took place within the space of only 12 minutes. This could be interpreted as a new emission of gases in a region of the nucleus other than that already emitting or an effect caused by the rotation of the nucleus. This work was supplemented by an analysis of the light curves and their comparison with the behaviour of fragment B. This made it possible to determine the absolute magnitude, the growth rate, the diameter of the comet and formulae for estimating future brightness and the size of the fragments in question.

20. The photometric characterization of symbiotic stars aimed at finding candidate stars for such systems in the galactic plane is being continued by a doctorate student at the Institute of Geophysics and Astronomy at the Roque de Los Muchachos Astronomical Observatory in Spain. Of the candidates, 65 have undergone spectral analysis and been classified; they include 11 new symbiotic stars and a number of rare objects in the galaxy.

21. Specialists at the Institute of Geophysics and Astronomy continued to study the directionality of the intensity of protonic energy events exceeding 10 MeV and the distribution of arrival times of plasmoids (interplanetary coronal mass ejections – ICMEs) in the immediate neighbourhood of Earth according to their positions in the Sun, using data from the international solar patrol and satellite observations, following the step-by-step multiple regression method with variation analysis in the preparation of the material.

22. The Institute has continued to study solar noise storms and proposes a method for segregating their fundamental and sporadic components based on the essence thereof and minimizing the specialist's subjective criteria. The method guarantees replicability of the results and has been successfully applied to a signal with known characteristics. In-depth study of the quasi-periodic

structures of solar radio emissions associated with solar bursts has continued with determination of some of its principal parameters, and inferences concerning the mechanism of generation and the source of the associated radio emissions have been drawn.

23. The Department of Aerospace Studies of the Institute of Technology and Applied Sciences will shortly begin its first degree course in space technology and sciences with the aim of promoting higher professional skill levels among specialists, officials and professionals and the conduct of research projects in those areas.

5. International Year of Astronomy

24. A number of events were organized to commemorate the International Year of Astronomy. These included:

(a) Information on the International Year of Astronomy appeared in various articles on the subject in the print media. There was also a weekly radio programme on astronomy, and a series of seven television programmes on the subject was broadcasted during the school holiday period;

(b) The "The Cuban Postal Rocket, Heritage and Astronomy" event was held to promote knowledge and study of the Cuban postal rocket, establish a link between astronomy and the postal and philatelic fields and fix the historic memory of the Cuban Postal Rocket as part of the country's historic postal and philatelic heritage in the minds of children, young people and adults. A postage stamp was issued to commemorate the International Year of Astronomy;

(c) A planetarium and science and technology cultural centre is under construction in the heart of the old city of Havana and will be officially opened in December. The project has been developed by the Office of the City Historian with the support of the Ministry of Science, Technology and the Environment. Its aim is to make the accumulated knowledge of humankind in the fields of astronomy, physics, mathematics and other branches of knowledge available to ordinary citizens in an agreeable and creative manner;

(d) During the year work took place on a project for the revitalization of the astronomical observatory of the University of Havana with a view to stimulating interest in scientific subjects among the general public and particularly children and young persons. The strategic objective is to awaken interest among students following general courses in studying natural and exact sciences, using astronomy as a motivator; and

(e) A number of presentations, lectures and discussions for specialists and the general public were held in connection with the Year in cultural, scientific and educational centres. Several scientific and technical festivals, with a special focus on astronomy, were organized for children, young persons and the general public.

6. World Space Week

25. The following events were reported during World Space Week:

(a) The eighth National Workshop on Outer Space and its Peaceful Uses took place in the Sala Jimaguayú in Havana during the Week. Twenty-three presentations were made by various Cuban scientific institutions;

(b) The 16th National Meeting of Amateur Astronomers was to have been held during the Week, but was postponed until December;

(c) The COSMOS Group of the Youth Communist League (UJC) Youth Technical Brigades met with IGA specialists and researchers to learn about current activities. The Cenit bulletin was presented at the meeting; and

(d) The Fotogramas television programme screened the documentary film Journey to the End of the Universe in honour of World Space Week.

26. Once again, no World Space Week posters were received. As in the previous year, the embargo imposed on Cuba by the United States Government prevented their arrival.

Republic of Moldova

[Original: Russian]

1. The present report was prepared by the Technical University of Moldova Institute of Electronic Engineering and Industrial Technologies of the Academy of Sciencies of Moldova and entitled "Aerospatial activities in Programme's framework. Exploitation of renewable energy resources in conditions of the Republic of Moldova and the development of Moldavian Microsatellite".

1. Introduction

2. The remote sensing of Earth from space appears to be an advanced industry and the number of users that utilize images from space is constantly growing. The agrarian sector of the national economy is of the upmost importance for the Republic of Moldova. The countries which keep leading positions in agricultural production, regularly monitor the state of cultured vegetables, fruits and berries with the help of satellites. However, the high cost of space photography does not allow farmers in the Republic of Moldova to purchase space photos from countries and corporations that have active satellites on the orbit. Therefore, nationally owned satellite would provide solutions for existing and other important problems of the national economy. The present project corresponds to the national priorities related to the electronic data processing for cadastral use; landslides forecast; predicting of the formation and movement of hail clouds; monitoring land plots; ecological monitoring of forests and aquatic evolution of rivers and lakes, as well as flood damages (fig.1)[1] hydrological services and others.

3. Certainly, microsatellites offer valuable missions with current and emerging technologies for all fields of science and applications and for technology demonstrations and for education and training. They are important for developing countries, such as the Republic of Moldova and other countries with emerging space technology, which would enable them to have access to space missions, applications and spin-off technologies. Together with reduced development times, the inherent reduction of launch costs offered by the reduced size and mass of spacecrafts and their more manageable proportions, small satellites become attractive for developing and establishing a national expertise in space technology.

4. The current results of our scientific teams in the implementation of the aerospatial "Moldavian Microsatellite" programme are presented in the report.

2. General objectives of the project

5. Until now there has been no work aimed at the integral development of space flight devices in Republic of Moldova. However, some industrial enterprises and research teams have participated in various research and development works of aircraft units in cooperation with various institutions of the former Union of the Soviet Socialist Republics (USSR). In some Moldavian enterprises and departments of the Technical University of Moldova research has been conducted under the development of control and manipulation of objects based on microprocessors, radio and telecommunications systems, system for processing and encoding information, which are directly related to cosmic issues or can be attached to it. The Research Laboratory of the Department of Theory of Mechanisms and Machine Bodies at the Technical University of Moldova (TUM) was involved in the implementation of the present project. It carried out research aimed at the development of systems of orientation and control driving mechanisms for the cosmic apparatus on the base of high-accuracy planetary transmissions. Within the Faculty of Power Engineering at the Technical University of Moldova a series of works and research projects have been carried out in the development of: systems of solar energy conversion into electrical energy, sources of static power converters, which are directly related to the use of solar energy for supplying electrical equipments

[1] The original unedited report submitted by the Republic of Moldova, including images and figures referred to in the text, can be found on the website of the Office for Outer Space Affairs of the Secretariat (http://www.unoosa.org/oosa/natact/natact/2009.html)

on the board of artificial satellites. There were also works in this field at other departments of the Technical University of Moldova – "Construction and Production of Electronic equipment", Telecommunications" such as: control and manipulation of objects based on microprocessors, telecommunication systems, processing systems and information encoding, which are directly related to the cosmic issues or can be attached to it.

6. The project objectives are the development of microsatellite for analyzing orbit parameters, make improvements in the satellite control, test the on-board computer (research algorithms to determinate the satellite orientation and stabilization; realization of control algorithms of the satellite system status); the test of the base components of the computer; and, finally, the research of the technologies of Earth observation for obtaining information about the land surface, in particular, of the Republic of Moldova.

7. Certainly, the demonstration of technology is an obvious application for microsatellites, which are an attractive and low-cost means of demonstrating, verifying and evaluating new technologies or services in a realistic orbital environment and within acceptable risks. One of the main objectives of this project is also to conduct, encourage and promote the research and development of space technology and industry development in the Republic of Moldova.

3. Organization of the "Moldavian Microsatellite" programme

8. Today within development and design laboratories of many technical universities around the World, research aimed at the development of microsatellites is being carried out. Some universities have already successfully launched satellites into orbit and with their help have solved scientific and educational problems. For example, the current leaders among universities of the World in the field of the design and development of microsatellites are universities from Australia, Germany (University of Berlin), Israel, the Russian Federation, the Republic of Korea and the United States of America (universities of Arizona, Colorado, Stanford and Utah).

9. The programme "Exploitation of renewable energy resources in conditions of the Republic of Moldova and development of the "Moldavian Microsatellite" was launched in January 2009. The Centre for Aerospatial Research at the Technical University of Moldova was established. The Academy of Sciences, as well as the following faculties of TUM have been involved in the programme: Radio electronics and telecommunication; Power Engineering; Machine Building; Informatics, Microelectronics and Computer Science. Therefore, the project implementation requires close cooperation with a number of enterprises from the Republic of Moldova, to mention the most important, "ComelPro" and "Topaz". The organization diagram is shown in fig. 2. It includes the following projects:

- Board systems of navigation and control;
- Telemetry and telecommunications;
- Payload (video monitoring and communications);
- Electrical power supply;
- Orientation and stabilization of the microsatellite; and
- Construction materials and microsatellite reliability. Projects of microsatellites developing require complex and intensive research and they are quite expensive, as a rule. Usually, such kinds of projects are financed by the state. It constitutes about 1500 thousands of Moldovan Leu (MDL). This programme is planned for the period of 2009 – 2012. The distribution of the state financing for the whole programme is shown in fig. 3

4. Microsatellite control and navigation

10. The navigation system has the following objectives: to ensure radio communication with microsatellites in two bands of radio carrier frequencies in both directions; to control the work of a multi-spectral scanner from the orders given from the terrestrial station and from the on-board computer; navigation, on the bases of the navigation satellites of the Global Positioning System (GPS) and GLONASS System, in any combination. This project is provided by a team from the

Faculty of Radioelectronics and Telecommunications from TUM under the leadership of the associated professor Secrieru Nicolae.

11. The onboard computer was designed to control the power and the satellite's multispectral scanner, to ensure monitoring and control systems' functioning, to maintain thermal regime, to ensure measurements of telemetry system interactions, to supply with power all the systems of the microsatellite, to ensure communication with the non-oriented microsatellite or which has orientation problems.

12. Taking into consideration the conditions in the outer space at a considerable distance from the earth station, we have concentrated the forces to solve the following design and development problems:

(a) microprocessor platform of the board computer and the ground station;

(b) operating system of the onboard computer;

(c) computer software applied to the onboard computer, the components for schema-technical design;

(d) transmission/reception devices to communicate with the micro satellite;

(e) methods for communication with the onboard computer;

(f) the monitoring block and control of energy supply;

(g) the orbit correction control unit; and

(h) the electronic encryption keys monitoring unit.

13. For the implementation of the proposed project, during 2009, a number of research activities and design works were undertaken, as well as prototyping some units for processing and modelling the navigation and control systems. The results included:

(a) electric principle diagram of the onboard computer, which includes basic devices;

(b) automatics and communication modems;

(c) operating programs for the microcontrollers for the onboard computer;

(d) electrical schemes of the emission-reception devices;

(e) electrical schemes of the telemetric system;

(f) the operating model of the satellite navigation system; and

(g) the operating model of the command system of the satellite.

5. The electricity power supply of the microsatellite

14. The power supply system of the satellite is intended for the generation, storage, distribution and regulation of electricity in all phases of the satellite operation on the orbit under cyclical programs. This project is undertaken by a team from the Faculty of Power Engineering from TUM under the leadership of the associated professor Blaj Valeriy. The supply system that was designed consists of the following elements:

(a) Primary source of electricity, which are onboard solar batteries;

(b) Accumulator batteries;

(c) Controller of battery charging;

(d) Regulation and distribution of electricity on the board. The source of the power supply unit is the solar batteries, which convert solar energy into electricity in the phases of orbit solar lighting and recharges the batteries. The power supply system ensures the necessary power consistently for all systems on board. The energy captured from the solar batteries provides power to all on board systems in the phases with solar lighting and recharge the batteries. Solar batteries and accumulators must be able to operate both separately and simultaneously. Electricity voltages are

transmitted directly to those systems and devices from the board. Other systems with high and special requirements will be powered by own converters of DC-DC type.

15. The analysis of other variants of satellites allows us to give priority to solar batteries GaAs or GaAs/Ge, which provide a quite high conversion efficiency of the solar energy into electricity (around 18 - 28%), batteries and accumulators can be Ni-Cd or Ni-Mn. In previous research a number of systems of autonomous electric power supply based on photovoltaic panels with different power converters for anti-hail service stations and water pumping for irrigation. It was decided to solve some technical and design problems for working conditions in the space, such as:

(a) selection of solar panels and accumulators;

(b) sub-system for loading accumulators;

(c) sources of individual supply;

(d) monitoring system of voltages and currents; and

(e) communication sub-systems between the supply and central processor.

16. At the base of this project realization there are some previous theoretical and applied results already obtained:

(a) in the project “System of autonomous electric power supply to consumers post anti-ice using solar energy”;

(b) in the project “Development and implementation of small irrigation system using solar energy”;

(c) in the project “Electrical generators for renewable energy sources”; and

(d) using the experience of a long-term research in the field and the scientific potential of the research teams who are concerned with the development of new systems to supply electricity from renewable sources, as well as static power converters used in adjustable electromechanical systems, automatic and controlled by microprocessors, acquisition and processing of information systems.

17. Simultaneously, a whole series of devices developed by the Institute of Electronic Engineering and Industrial Technologies of AS RM (IIETI) was adapted in this project in terms of digital signal processing and the experience can serve as a basis for the implementation of a number of items for the collection and processing data from spatial digital devices. When technical solutions were proposed, the design and execution of mock demonstrational elements for stabilized voltage converter correlated with the selection of the satellite solar battery panels were carried out. The constructive ways of schema-technical operating performance in extreme conditions have been established. They laid down the design and engineering features of the full device.

6. Microsatellite orientation and stabilization

18. This project is carried out by a team from the Faculty of Machine Building from TUM under the leadership of the academician Bostan Ion and professor Dulgheru Valeriu. The project envisages the design of conceptual diagram of the control, orientation and regulation mechanism based on the using of systems for attitude control (solar transducers, magnetometer) and for the implementation of orientation motions (rectangular electromagnetic coils, pitch flywheel); design of control, orientation and regulation system for satellite flying trajectory (SDOSM) based on the interaction with the magnetic field of the Earth; design, research and simulation of SDOSM parts: magnetometer, solar transducer, mechanism for rectangular orientation with three degrees of liberty correlated isochronously with the three parts of the magnetic induction vector; mechanism of operational orientation with pitch flywheel; inertial mechanism for passive operation and regulation of flight; determination of functional characteristics of SDOSM parts; modelling of orientation-regulation system functioning.

19. The operating mechanisms, often used in space devices so far, are harmonic and planetary transmissions. To achieve high transmission ratios of slow movements and a tendency to use high-speed electric motors, planetary transmissions are embedded in several steps. This ensures the

obtainment of a report of transmission up to 5500. However, this significantly raises the costs and reduces system reliability in it entirety. Another class of mechanical transmissions used in the electromechanical modules are harmonic transmissions, which provide a bearing capacity and a rather high kinematical precision, which is provided by a multiplicity of high gear (in gear participate simultaneously up to 40% pairs of teeth), a high transmission (up to 350 in one step), the opportunity to operate in watertight spaces. Since the harmonic construction of the transmission includes a flexible element (deformable cog wheel) reliability is reduced and the duration of operation is low.

20. A particular interest for this class of planetary transmission mechanisms presents high accuracy transmissions, developed at the "Department of Theory of Mechanisms and Machine Bodies" of the TUM. Planetary high-accuracy transmissions possess bearing capacity and high kinematical accuracy that are provided by a high gear multiplicity (within the gear there participate up to 100% pairs of teeth), a high transmission report (up to 5000 in a single step) and the possibility of operating in space watertight. Since the construction of a high accuracy transmission does not include flexible elements it has high reliability and high operating duration.

21. The research team of the department of "Theory of Mechanisms and Machine Bodies" from the Technical University of Moldova, involved in the implementation of this project, has experience of various researches on developing separate systems of driving mechanisms for the orientation and management of devices based on cosmic planetary transmissions of high-precession such as:

- the driving mechanism for space flight device made at the order of the Special Design Bureau of the Institute of Cosmic Research of the former USSR, Moscow;

- the precessional driving mechanism of the electro high-accuracy VEGA-6 space station electronic module made at the order of "COMET" (Moscow); and

- the driving mechanism of the space flight device developed at the order of a company from Krasnoyarsk (Russian Federation).

22. These proposed electromechanical modules present special constructions with high-accuracy planetary transmission and with the formation of special transducers for precise positioning of the space flight apparatus or of the basic units. To reduce production costs and weight, and increase the efficient operation under insufficient lubrication, the authors developed two modules with electromechanical high-accuracy gears and sliding bearings made of plastic. These modules have electromechanical constructive simplicity, satisfactory performance compared with the planetary transmission and harmonic dimensions, low weight and a low production cost.

7. Earth observations, video monitoring and telecommunications

23. Remote Earth observations from satellites and distribution of the remote-sensing data should help to solve very important problems, for instance, to slow the depletion of natural resources. Therefore, this project is the central project of aerospatial "Moldavian Microsatellite" programme. This project is provided under the supervision of Vladov Mihail, director of the Centre for Space Research of the Technical University of Moldova and director of "ComelPro" enterprise.

24. The system of video monitoring and telecommunications of microsatellite was developed to ensure exploring Earth remote area. It was decided that the system must be endowed with multi-spectral scanner, which allows research of the land surfaces in the visible and infrared ranges. The system of video monitoring and telecommunications should provide a telemetric control of the satellite, a telemetry transmission of information to the Terrestrial Command Item and data acquisition. It is proposed to develop the radio communication with satellite in two directions on two-range radio carrier frequencies, for instance, of 400 MHz (L - range) and 2257 MHz - (S - range). The system of video monitoring and telecommunications should ensure continuous operation on the orbit for at least some years in the vacuum, radiation and high temperature. During the work on the orbit, the system will suffer from mechanical overloading, vibration and impact blows. Most components of the system have been designed and the assembling procedure will come in the near future.

25. Certainly, remote sensing with portable ground stations and low-cost space systems has an important role. A key feature of the space system is direct down-linking to numerous small ground

stations, excluding the need for a centralized processing and distribution system. The advantages are real-time access to observations, smaller databases and ease of information distribution, even in areas not well served by communications systems. This point of view is included in the designing of this system.

8. Construction materials and microsatellite reliability

26. The project "Development of materials, structures (including nanotechnologies) and electronic devices for operation in extreme cosmic conditions" is provided under the leadership of academician Valery Kantzer, Institute of Electronic Engineering and Industrial Technologies (IIETI) of AS RM. The major objective of this project is:

(a) Research and development of new materials and elements of spatial devices and terrestrial station building blocks of MS;

(b) Design and implementation of verification stands in extreme elements apparatus MS; and

(c) Development and adaptation of developing materials and devices of IIETI, previously performed for other uses, for spatial devices, connected to technical requirements and operating in extreme cosmic conditions.

27. This project aims at developing many aspects. First, there are a series of works previously performed in IIETI, including some related to missile equipment and cosmic technology. It can be also mentioned the important aspect of a profile of the institute, concerning the investigations of materials properties at cryogenic and ultra low temperatures. Another aspect is part of the wide range of IIETI concerns in electronic devices and sensors, including the collection and processing of digital information.

28. Among some elaborations made during the years at IIETI and issues pertaining to the project it is necessary to mention the design and development of:

(a) structures of thermoelectric pyrometry measuring thermal radiation;

(b) microsystems for thermoelectric refrigeration;

(c) instruments and control systems and vacuum-metric measure of ultra-high vacuum;

(d) sensitive elements and detection systems for infra-low frequency mechanical waves for security and surveillance systems;

(e) structures and developing tenzoresistive pressure and temperature Polyfunctional transducers with a wide range of temperatures and pressures;

(f) implementation of spatial microsensors;

(g) instruments and apparatus for rapid process control;

(h) implementation of control systems;

(i) solid lasers in the near infrared;

(j) laser telemetry;

(k) mass spectrometry;

(l) autonomous sources of energy, stabilizers, etc.. for use in energy, including solar cells; and

(m) implementation of transducer for monitoring of plants and environment.

29. The images of sensors and measuring devices of high pressure and vacuum are shown in the fig. 5-7. The developed device – a vacuum quantity surveyor, – presents a measuring complex in which we enter a block of three converters and digital measurement. Converters, the operating principle of which is based on pressure dependence of elastic membrane strain of air thermo-conductivity are designed to convert air pressure into electrical signals.

30. The creation of the testing laboratory of the active component of anti-hail missiles with the equipment that simulates the conditions in the atmosphere could be mentioned among the recent elaborations. Some illustrations of this laboratory aerodynamic tube are shown in fig. 8.

31. Recently, a new system in infrared remote sensing and field TeraHertz was proposed. The way in which the system finds its application in the multispectral scanner of the satellite apparatus is illustrated in fig. 9. Thus, the basis of the performed work can be used for the spatial device of the Moldavian Satellite programme:

(a) Vacuum metrics control systems and measuring ultra-high vacuum;

(b) Wide-range pressure and temperature Polyfunctional transducers;

(c) Thermoelectric refrigeration Microsystems; and

(d) Far infrared array detectors.

9. Arguments for carrying out investigations in the programme

32. The presented programme will contribute to the development of youth and renewal of student scientific and industrial potential of the Republic of Moldova; it will create a connection between students and laboratories for the production and industrial domains; attract young inventors; create new jobs; preserve the intellectual potential of the country; develop scientific and technical directions of the national economy in the Republic of Moldova; contribute to the professional orientation of pre-university graduates.

33. Besides the educational, scientific and technical problems this programme will allow to resolve a number of concrete problems of the national economy of the Republic of Moldova: to realize the territory monitoring in order to measure soil moisture; to estimate cultivated agricultural land; to monitor and evaluate the degree of the crop maturation; to perform various cadastral works; to monitor roads; to monitor forests, rivers and lakes; to determine the extent of the river's overflow, to set the danger of ice clouds appearance; to obtain photo and video information for the country districts of interest, etc.

10. The scientific results, forms of implementation and the beneficiaries

34. The scientific, technical and instructive potential of a country and its reputation in the world is determined by the possibility of the development of advanced technology and science-intensive projects. That is why the development of a complex project, such as the launching of a spacecraft with a command and on-board navigation system and the land control system, will help to increase the reputation of the Republic of Moldova at the international arena. The economic aspects of realizing such a complex project is very difficult to estimate. Monitoring the territory of the Republic of Moldova will permit in the future to:

(a) obtain images with high-accuracy that will provide cadastral works;

(b) receive information about the cultivated agricultural lands (land area treated, and the degree of ripening of agricultural production, the quantity of harvest, setting the level of soil humidity);

(c) conduct environmental monitoring of regions;

(d) monitor movements and transports of goods on the territory of the republic; and

(e) oversee the processes of formation of clouds with the threat of hail and security services against hail.

35. At present the cost of providing these types of services in the world market arrives at values of up to several thousands of the United States Dollars. This instructional and educational project will help to develop professional habits among students; will ensure continuous contact between the science and the industry, in particular its manufacturing branch; it will also increase the interest of youth creativity and will allow the creation of new jobs, preserve the country's intellectual potential

and will be based on new scientific and technical fields in Moldavian agricultural sector. It will also inspire and attract graduates of pre-university educational institutions.

11. International cooperation in the framework of aerospace problems

36. At the current realization phase of the programme and its subsequent development is provided the establishment of cooperation relations with several universities in Romania, Russian Federation, Ukraine and the European Union etc., where similar projects have been done.

37. There is following cooperation in the framework of this programme. The active participation of our collaborators in the regional and international conferences and meetings, is one of priority activities. Recently, our delegation consisted of academician Ion Bostan, professors Dulgheru Valeriu, Secrieru Nicolae and Bostan Viorel, participated in the CRAS 2009 conference in Bucharest, Romania. Besides this conference's works, we had several meetings with other delegations. For instance, Academician Ion Bostan, Head of the Moldavian aerospatial programme discussed with Chris de Cooker, Head of the International Relations Department of the European Space Agency (ESA) the future cooperation and the involvement of the Republic of Moldova in the ESA aerospace programs. Academician Ion Bostan and Marius-Ioan Piso, director of ROSA – Romanian Space Agency and University "Polytehnica" of Bucharest, discussed a bilateral cooperation agreement and ways to promote international relations in the field of high technologies. The main areas of cooperation would include the development of small satellites and ground control systems of satellites.

38. It was agreed that we have similar needs at regional level that require some new solutions. For instance, we are ready to coordinate the satellite programs to address our specific needs and other developing areas that require special capabilities related to sensor parameters, such as specific spectral bands, spatial resolution, time resolution, cost of image, autonomy and investment level in ground equipment, and the expertise required for their utilization. Another field of cooperation would be the exchange of experience in image data collection and processing for monitoring of flood damages in our region and for the agricultural applications.

39. Our representative, Secrieru Nicolae, Head of the project "Board systems of navigation, control, telemetry and telecommunications" made a report about the Moldavian aerospace program at the symposium "Wissenschaftliches Kommunikations und Sicherheittskolloqium 2009" at University of Siegen, Germany. For improving our experience in telecommunications, these problems were discussed with Professor Doctor Karl Cristoph Ruland, Head of Institute for data communications systems from the University of Siegen (Germany). It was decided to cooperate on the common theme "Orientation and stabilization methods on capturing images from long distances associated with real time coding, compression, protection and transmission". This theme is rather topical because an important role in telecommunications and data processing is played by application of research/monitoring methods on captured images, but the high cost of images from space does not allow all users to benefit from these results to explore the land surface in agriculture, geodesy and cadastre, ecology and environmental monitoring. Good image quality can be achieved with objective lens with a big focal distance and with a high-resolution, which are installed on large aircrafts (satellites, orbital stations, aircrafts), but afterwards the cost of these images increases. Another situation is the case of small aircrafts on which high-quality objective lens can not be installed. This, however, lowers the quality of images, if the problem would be treated in traditional ways. Important factors affecting the quality of images are not only lens parameters, but the dynamics of aircraft movement, lack of stability, object orientation, that results in essential distortion of captured images. Often, to get a result it is required to repeat the operations, which is not always possible.

40. It is proposed to solve complexly the problem of capturing images using light aircrafts, applying new technologies, methods and processes of orientation and stabilization of the aircraft, simultaneously capturing images, and compressing, codifying and transmitting data in real time to the recipient. This will increase the quality and will reduce the total cost of images. As a result, images will be obtained without distortion, with a much smaller volume, coded in order to protect them and sent to recipients.

41. Another representative of our team, Vladov Mihail, director of the Centre for Space Research of the Technical University of Moldova, Head of the project "Earth observations, video monitoring

and communications", participated with a report at the conference "Scientific and technical centre of spatial missiles" in Samara, Russian Federation, and concluded a cooperation agreement. The protocol of intention on scientific and educational cooperation in the field of aerospace activities between Samara State University and the Technical University of Moldova includes:

(a) Implementation of joint research and development work in the aerospace field;

(b) Participation in the development and implementation of joint projects in the field of scientific-educational small satellite, including remote sensing of the Earth;

(c) Contribution of inter-university exchange students and university teachers to integrate into the international educational space; and

(d) Joint participation in organizing and conducting conferences and seminars on topics of interest to both parties.

42. Also, there is an agreement between our Centre for Space Research of the Technical University of Moldova and the Institute for Space Research, Bulgarian Academy of Sciences concerning bilateral cooperation and promoting of international relations in the field of high technologies. The main areas of cooperation include the development of small satellites and ground control systems of satellites.

12. Conclusion

43. Although the program "Moldavian Satellite" is at its early stage, a number of promising results have been obtained for its successful implementation. We hope that this instructive-educational programme will help to develop professional skills of the students, ensure continuous contact between the science and the industry, increase the interest and creativity of youth creativity, allow creating new jobs, preserve the country's intellectual potential and will also constitute a basis for new scientific and technical fields.

Spain

[Original: Spanish]

1. The year 2009 is the third year of the period 2007-2011 covered by the Strategic Plan for the Space Sector, the principle objective of which is to increase the dimensions and capacity of the Spanish space industry in order to reach a level in keeping with Spain's position in the world economy. During 2009, Spain has continued work on the initiatives enumerated in this Plan.

2. Within the Strategic Plan, particular mention should be made of the National Programme for the Observation of the Earth by Satellite, the purpose of which is the development of a national system of satellites capable of producing images on the basis of the two space-based observation technologies: optical and radar observation. The programme involves two satellites, a civilian satellite using optical technology (INGENIO) and a military satellite with radar technology (PAZ). They are expected to be operational in 2014 and 2012 respectively and will provide information to the Spanish community of users, both civil and military. In the development of these satellites, maximum use is being made of the Spanish space industry, which has assumed the role of principal contractor for the system, the platform and the main instrument. The two satellites will form part of the Spanish contribution to the Global Monitoring for Environment and Security (GMES) programme, the European initiative for Earth observation and security.

3. During recent years, increased participation by Spain in projects of the European Space Agency (ESA) has been promoted, and Spain has become the main contributor to some projects, such as the Space Situational Awareness (SSA) programme. This has enabled the Spanish space industry to play a more important role in several projects, while the scientific community has been able to participate more actively in decisions regarding missions. Within the context of this increase in Spain's role on the European space stage, ESA's European Space Astronomy Centre (ESAC), situated in Madrid, has been recognized by the Agency as a top-level centre.

4. Spanish participation in other international projects has also continued. Particular mention should be made of Galileo and GMES, the two projects on which the European Union and ESA are cooperating. Both programmes are of fundamental importance for Spain, which has therefore taken an active part both in terms of contribution and with regard to the participation of Spanish industry.

5. Two other major initiatives with an important Spanish presence are:

(a) The Meteosat third generation (MTG) programme, concerned with the development of the third generation of Meteosat satellites. Spain is the fourth contributor to this programme, the total value of which will exceed 2,400 million euros; and

(b) The Small Geostationary Satellite (Small GEO) programme, with the purpose of developing a new platform for telecommunications satellites, in which a very important role is played by the Spanish operator HISPASAT together with the Spanish space industry, responsible for the payload.

6. Mention should also be made of the launching of two satellites:

(a) The Soil Moisture and Ocean Salinity (SMOS) satellite, an ESA satellite to be launched in November 2009. The importance of this venture both for the Spanish administration and for Spanish industry and scientific circles should be emphasized, the SMOS mission being considered the project with the greatest scientific, technological and industrial significance among those so far implemented in Spain for ESA; and

(b) Amazonas 2, a communications satellite of the enterprise HISPASAT, which incorporates a version of the intelligent processor AmerHis – for advanced broadband services – developed by Spanish industry. Amazonas 2 is the largest satellite with pan-American coverage, including 64 transponders.

7. In addition, Spain has cooperated directly with other countries on international missions such as the Mars Science Laboratory, PRISMA or the World Space Observatory/Ultraviolet, implemented, respectively, in cooperation with the United States of America, France and Russia.

Ukraine

[Original: Russian]

1. During 2009, Ukraine has continued to implement the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) both through national projects and through international cooperation. The space activities of Ukraine in 2009, as in previous years, have been aimed towards implementing priority projects set out in the fourth National Space Programme, fulfilling the obligations undertaken by Ukraine within the framework of international programmes and projects, increasing the effectiveness of the work of the national space sector and fostering broad cooperation with other States and international organizations.

2. In addition, a key event among the space activities of Ukraine in 2009 was a retreat held by the Government of Ukraine on 10 April to address the development of the Ukrainian space sector in modern-day conditions, the first meeting of its kind. The retreat was hosted by one of the leading enterprises of the Ukrainian space sector, State enterprise “Yuzhnoye Design Office”, in the city of Dnipropetrovs’k. During the meeting, the Cabinet of Ministers of Ukraine adopted 16 decisions relating to various areas of space sector activity and providing for the creation of special conditions for its development. This has made it possible to increase planned budgetary funding for the space rocket industry by 1.8 times in 2009 and also to increase funding for the National Space Research and Technology Programme of Ukraine for 2008-2012 by eight times. Information on the measures taken to implement priority projects as part of that programme is provided below.

1. Space technology development

Global navigation satellite systems

3. Measures have been developed in Ukraine to strengthen State regulation of the development, introduction and application of satellite navigation technologies. Decision No. 959 of 9 September 2009 of the Cabinet of Ministers of Ukraine, entitled "Certain issues regarding State regulation in the area of satellite navigation", grants the National Space Agency of Ukraine (NSAU) the status of specially authorized State agency responsible for the coordination of State regulatory measures in the area of satellite navigation and related international cooperation.

4. In addition, NSAU, together with other relevant State agencies, has been tasked with preparing a draft law on State regulation in the area of satellite navigation. Furthermore, NSAU, the Ministry of Transport and Communications, the Ministry of Education and Science and the State Committee of Ukraine for Technical Regulation and Consumer Policy are to certify the System for Time Coordination, Positioning and Navigational Support for Ukraine (SKNOU), which uses global navigation satellite systems.

5. The measures established in the aforementioned Decision include the implementation by NSAU, in collaboration with the Vinnytsia, Dnipropetrovs'k and Kharkiv regional administrations, of pilot projects for the introduction of satellite navigation technologies in industry, transport and communications and also in the areas of health care and the environment for the period up to 2012.

6. Development of SKNOU using the Global Positioning System (GPS) and the Global Navigation Satellite System (GLONASS) has continued in 2009. The main instrumentation network of SKNOU comprises the Navigation Field Control Centre and a network of control and correction stations. The main function of SKNOU is to create the conditions necessary for the guaranteed provision of precise, reliable and accessible time coordination, positioning and navigation services of quality to users of GNSS information throughout Ukraine.

7. The Navigation Field Control Centre constitutes the organizational and technical core of SKNOU and is intended to carry out the following functional tasks:

(a) Collection and preliminary processing of data received from control and correction stations;

(b) Continuous monitoring of navigation fields created by the satellite navigation systems Navstar (United States of America), GLONASS (Russian Federation) and, in future, Galileo (European Union);

(c) Generation of local differential correction information and control of the quality of that information;

(e) Creation of a scale for SKNOU system time and control of its coordination with GPS time, GLONASS time and Coordinated Universal Time (UTC) (UA);

(f) Generation of wide-area differential correction information and control of the quality of that information;

(g) Distribution of differential correction information among users in Ukraine and in neighbouring territories;

(h) Support of information exchange between the Navigation Field Control Centre, control and correction stations and external users; and

(i) Monitoring of the ground-based segments of SKNOU and management of the system's operation.

8. Nine control and correction stations have been constructed and are operating on a pilot basis in the cities of Kharkiv, Dunayivtsi, Chernigov, Feodosia, Yevpatoria, Yavoriv, Mukachevo, Lugansk and Kyiv. The Research Institute for Radio Engineering Measurements, an open joint-stock company in Kharkiv, plans to construct three continuously operating control and correction stations in the cities of Vinnytsia, Sevastopol and Kirovograd by the end of 2009. The new control and correction

stations will become part of the SKNOU network. Thus, by the end of 2009, the SKNOU network will consist of 12 continuously operating stations.

National satellite communication system

9. In 2009, NSAU reached an agreement with investors concerning financing for the establishment of a national satellite communications system using a Ukrainian communications and broadcasting satellite. The company Export Development Canada is ready to provide the Ukrainian State enterprise Ukrkosmos, which comes under the management of NSAU, with the sum of 254.6 million United States dollars in credit under State guarantees for a ten-year period.

10. The following work is planned within the framework of establishment of the National Satellite Communications System:

(a) Construction of the satellite and implementation of a comprehensive series of tests both on the ground and in orbit;

(b) Launch of the satellite using a Zenit-3SLB carrier rocket, including launch insurance;

(c) Construction of ground-based facilities for control of the satellite and preparation of a central teleport and ground-based infrastructure enabling the users of satellite communication services to use the satellite resources; and

(d) Completion of work to provide frequency and in-orbit support and international coordination of satellite networks.

11. The main contractor to perform the work is the company MacDonald, Dettwiler and Associates (Canada), a leading world manufacturer of payloads for communications satellites. The satellite (which is expected to weigh 3.2 tons) is to be launched with a Zenit-3SLB carrier rocket from the Baikonur launch site in 2011. This will make it possible, inter alia, for Ukraine to carry out a substantial proportion of its telecommunications activities relating to the 2012 UEFA European Football Championship ("Euro 2012") independently.

12. The satellite will be controlled from the territory of Ukraine. The control stations will be manned by Ukrainian staff. In addition, more than 40 Ukrainian enterprises will be involved in the construction and launch of the satellite, including Yuzhnoye Design Office, State enterprise "Yuzhny Machine-Building Plant" (Dnipropetrovs'k), the open joint-stock company "Khartron" (Kharkiv) and the factory "Arsenal" (Kyiv). The planned operational lifetime of the satellite is at least 15 years.

13. The intended function of the first Ukrainian telecommunications satellite is to back up ground-based communications networks. The satellite will provide radio broadcasting and fixed-satellite services and ensure the broadcasting of satellite television, including high-definition television, access to information networks and multimedia services and the operation of corporate and State VSAT networks. The satellite will provide full television signal coverage of Ukraine. The services will be available over a wide area comprising, in addition to Ukraine, the Baltic States, Belarus, the Czech Republic, Hungary, Moldova, Poland, Romania and Slovakia.

Earth remote sensing

14. In order to expand and modernize the Sich national space system for Earth observation, work has continued in 2009 on the development of the Sich-2 satellite. The launch of the Sich-2 satellite is scheduled for 2010. The satellite, which weighs 158 kg, is intended for Earth research in the optical range, and will be equipped with an optical scanner manufactured in Ukraine with a resolution capability of 6-7 metres. The satellite will be launched into sun-synchronous orbit at an altitude of 668 km by a Dnepr carrier rocket. The launch of Sich-2 will enable Ukraine to perform tasks of major national economic importance, such as crop yield forecasting and monitoring of emergency situations, using a national Earth research satellite with its own control system.

15. In 2009, work continued on the development of a geographic information system as part of the European Global Monitoring for Environment and Security (GMES) programme and the Global Earth Observation System of Systems (GEOSS).

16. Ukrainian organizations are carrying out Earth remote sensing work in the following areas:

(a) Establishment of ground-based facilities for receiving, registering and processing Earth remote sensing data;

(b) Design of technologies to provide data support to an environmental monitoring system for the benefit of the various regions of Ukraine;

(c) Development and construction of advanced special-purpose equipment and Earth remote sensing space complexes; and

(d) Creation of space systems for the monitoring of emergency situations and regional and local changes in the environment.

17. The provision of Earth remote sensing data to Ukrainian users is the main activity of the Priroda State Research and Production Centre for Aerospace Information, Earth Remote Sensing and Environmental Monitoring, an enterprise under NSAU management. The Aerospace Imagery Fund of Ukraine, established as part of the Priroda State Research and Production Centre, is a source of information for which demand is constantly growing, as is evidenced by the number of orders received by the Centre each year for Earth remote sensing data.

18. The Priroda State Research and Production Centre collaborates constantly with enterprises and organizations engaged in such activities as the real-time monitoring of natural resources, the research and analysis of trends in the behaviour of natural processes and phenomena, the forecasting of possible consequences and the adoption of mechanisms for disaster prevention.

19. Users of Earth remote sensing information include various State agencies, specifically, the Ministry of Agrarian Policy, the Ministry for Emergencies and Protection of the Population from the Consequences of the Chernobyl Disaster, the Ministry of Education and Science, the Ministry of Defence, the National Academy of Sciences, the Ukrainian Academy of Agrarian Sciences, the State Committee of Ukraine for Land Resources, the State Committee of Ukraine for Water Resource Management, the State Statistics Committee, the Ministry for Protection of the Environment and others.

20. An analysis of the ways in which the information has been used shows that clients carried out the following activities:

- Monitoring of the Chernobyl exclusion zone;
- Mitigation of the consequences of river flooding and the waterlogging of land;
- Estimation of forest cover in the Odessa region of Ukraine;
- Monitoring of the course of the Ukrainian part of the Danube river;
- Use of satellite information to carry out a comprehensive assessment of the regions;
- Exploration for oil and gas and study of the geological composition of regions where oil and gas are found and of specific oil and gas fields;
- Basic research on the use of satellite information in oil and gas exploration;
- Development of methods and technologies for remote calculation of statistical indicators for agricultural crops;
- Forecasting of crop yield and assessment of crop condition;
- Establishment of a vegetation index;
- Monitoring of land use;
- Assessment of trends in land use;
- Mapping of erosion, the variability of subsoil and land pollution;
- Updating of topographic maps;
- Creation of a cartographic database for Ukrainian ecosystems;
- Assessment of the extent of pollution of the water table;

- Definition of the optical characteristics of the atmosphere and determination of the surface distribution of soil humidity; and

- Practical sessions in the teaching of methods of analysing multi-zone images taken from space.

2. Space research

21. On 30 January 2009, a Ukrainian satellite telescope for measuring electron and proton fluxes, STEP-F, designed and constructed by the V. N. Karazin Kharkiv National University and the first of its kind, was launched into Earth orbit to become part of the scientific equipment of the Russian Coronas-Photon satellite. On 20 February 2009, STEP-F entered into operation. A planned programme of scientific research to enhance understanding of solar activity and its influence on processes occurring on Earth is under implementation.

22. The STEP-F apparatus is intended for the continuous measurement of fluxes of electrons, protons and alpha particles which are trapped in the Earth's inner and outer radiation belts and which flow from those radiation belts into the atmosphere during solar flares and sudden ionospheric disturbances. It is also designed to provide information on the fluxes and spectra of energetic particles with a view to the study of energetic solar cosmic rays, the way in which those rays are transported in interplanetary space and changes in the Earth's radiation belts during the 24th cycle of solar activity.

23. In Ukraine, work is being carried out to establish a ground-based system for monitoring space weather. The system is intended to establish the link between space phenomena and changes in the neutrosphere, in particular, the link between solar flares and the speed of solar wind and that between solar flares and atmospheric infrasound. The construction of a device for the acoustic and electromagnetic sensing of the ionosphere and for obtaining experimental data for the construction of a physical model of the lithosphere and ionosphere is planned.

24. Cooperation with the Russian Federation in the preparation of the scientific missions "Spektr-R" (RadioAstron), Phobos-Grunt, Resonance and Spektr-UV is continuing, particularly in the preparation of the corresponding ground-based infrastructure at the NSAU National Space Technology Operating and Test Centre.

25. Work is continuing to prepare for scientific experiments in space as part of the long-term programme, adopted on 14 October 2006, of joint scientific research and experiments by the Russian Federation and Ukraine on the Russian segment of the International Space Station (ISS). Space experiments aboard the Russian segment of ISS will yield new knowledge in the areas of biology, materials science and physical and chemical processes in space conditions. Preparations for the space experiment Obstanovka-1, including the design of an on-board system for the collection of data relating to the electromagnetic environment around ISS, are in their final stages.

3. Space systems

26. Work is continuing to establish and operate an NSAU information and analysis system for the collection, processing, analysis and organization of data from functional systems in order to provide decision-making support to the authorities at various levels.

27. The system currently comprises the following:

(a) An information centre (NSAU, Kyiv);

(b) An analysis centre (National Space Technology Operating and Test Centre, Yevpatoria);

(c) The main information room of the National Space Technology Operating and Test Centre (Yevpatoria);

(d) Components of functional systems that provide Earth remote sensing information; and

(e) A centre for the reception and processing of special information (Dunayivtsi).

28. As regards specific applications of Earth remote sensing data and data from meteorological satellites, the NSAU information and analysis system is tasked, inter alia, with the following:

(a) Environmental monitoring of the territory of Ukraine and neighbouring States; and

(b) Prevention, monitoring and assessment of damage caused by natural and man-made disasters.

29. Specific tasks currently being carried out include the following:

(a) Determination of the extent of snow cover;

(b) Detection of thermal anomalies;

(c) Delineation of the area occupied by bodies of water and by water courses;

(d) Estimation of the surface area of bodies of water; and

(e) Identification of waterlogged areas.

30. These tasks are carried out using data from open-access space objects, such as the Terra satellite (and its Moderate-resolution Imaging Spectroradiometer (MODIS)) and meteorological satellites belonging to the National Oceanic and Atmospheric Administration (NOAA). Archive data generated using images with a spatial resolution of 8 to 40 metres are also used.

31. The NSAU information and analysis system is to be integrated with inter-agency systems as it continues to be developed. To date, cooperation has been established with departments of the Ministry for Emergencies and Protection of the Population from the Consequences of the Chernobyl Disaster and of the Ministry of Defence.

4. Cooperation with international organizations

Cooperation with the Committee on the Peaceful Uses of Outer Space

32. A delegation of Ukraine participated actively in the work of the forty-sixth session of the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) held from 9 to 20 February 2009. During the session, the Ukrainian candidate for the post of Chairperson of COPUOS for 2010-2011, Mr. E. I. Kuznetsov, Deputy Director-General of NSAU, gave a presentation on his vision for the future role and activities of COPUOS in 2010 and 2011 for delegations representing countries of the Eastern European regional group

Cooperation with the Inter-Agency Space Debris Coordination Committee

33. NSAU is continuing its work on minimizing space debris. Ukraine conducts its space activities in line with the recommendations of IADC, of which NSAU is a member, in the following main areas:

(a) Prevention of the formation and reduction of the quantity of space debris produced by Ukrainian carrier rockets during space launches;

(b) Prevention of space debris generated by the operation of Ukrainian space objects;

(c) Space debris research using Ukrainian radar facilities; and

(d) Preparation and introduction of regulatory and technical documentation defining general requirements for limiting debris in near-Earth space generated by the operation of Ukrainian spacecraft.

Cooperation with the International Astronautical Federation (IAF)

34. A delegation of Ukrainian space sector enterprises participated in the work of the 60th International Astronautical Congress (IAC), which is organized jointly by IAF and the International Academy of Astronautics each year and in 2009 was held from 12 to 16 October in Taejŏn, Republic of Korea. Shortly before the Congress, elections were held to appoint new members and senior officials of IAA, as a result of which Mr. Aleksandr Zinchenko, Director-General of NSAU, was

elected Trustee of the Academy's Social Sciences Section. In addition, Mr. Stanislav Konyukhov, Chief Designer and Managing Director of the State enterprise Yuzhnoye Design Office, one of the leading enterprises of the Ukrainian space sector, was elected Vice-President of the Academy.

35. Each year, IAA recognizes international teams of scientists that have achieved the greatest successes and breakthroughs in the development of space rocket technology. In particular, IAA recognizes projects such as "Space Shuttle" and the Mir orbital space station. In 2009, IAA recognized the international space project "Sea Launch" as a scientific and technological breakthrough.

36. The "Sea Launch" project is a unique achievement in science and technology and also an example of effective international cooperation among the aerospace companies Boeing (United States of America), Yuzhnoye Design Office (Ukraine), Yuzhny Machine-Building Plant (Ukraine), Energia (S. P. Korolev Rocket and Space Corporation) (Russian Federation) and engineering, construction and technology company AkerSolutions (formerly Kværner) (Norway).

37. In Ukraine, work on the construction of the three-stage carrier rocket Zenit-3SL as part of the Sea Launch programme was nominated for the 2009 State Award of Ukraine for science and technology.

38. During the work of the International Astronautical Congress, a delegation of Yuzhnoye Design Office (including representatives of the embassies of the Republic of Korea and Ukraine), headed by Mr. S. N. Konyukhov, held a meeting with senior officials of the Korea Aerospace Research Institute (KARI). As a result of the meeting, it was agreed that a delegation of the Republic of Korea would visit Ukraine at an early date to explore in detail the possibilities offered by Ukrainian enterprises in the space rocket industry and to discuss possible cooperation on the KSLV-2 project.

39. Also during the Congress, Mr. Valery Korepanov, Deputy Director of the L'viv Centre of the National Academy of Sciences-NSAU Institute of Space Research, held a meeting with the director of the Selena-2 project of the Japanese Aerospace Exploration Agency and discussed the possibility of the participation of Ukraine in that mission and the subsequent development by the L'viv Centre of an ultra-lightweight space magnetometer (in April 2009, Mr. Korepanov was awarded the Christiaan Huygens Medal for 2009 by the European Geosciences Union for significant achievements in the development of sensors and electrical and magnetic instruments for research of the Earth and of the solar system). As an outcome of the meeting, it was agreed that personal contacts would be established with a counterpart group in Japan.

40. In addition, in 2009, representatives of Ukraine participated in the activities of the Missile Technology Control Regime (MTCR), in particular:

- A meeting of MTCR technical experts (15-17 April 2009, Stockholm);
- An MTCR Reinforced Point of Contact meeting (29 and 30 April 2009, Paris);
- The preparation of materials for the eighth Regular Meeting of the Subscribing States to the International Code of Conduct against Ballistic Missile Proliferation (28 and 29 May, Vienna);
- The preparation of materials for the meetings of the working bodies of MTCR and for the MTCR Plenary Meeting (5-13 November 2009, Rio de Janeiro); and
- The preparation of materials for and participation in a regular meeting of the Working Group on Non-Proliferation and Export Control (23-25 September 2009).

41. Two preliminary notifications of launches of Ukrainian carrier rockets and an annual policy statement relating to carrier rockets and ballistic missiles in 2009 were prepared and transmitted to the Executive Secretariat of the International Code of Conduct against Ballistic Missile Proliferation through the Ministry of Foreign Affairs of Ukraine.

42. In addition, senior NSAU officials participated in eight meetings of the Inter-agency Commission on Policy Relating to Military and Technical Cooperation and Export Control.

5. Carrier rocket launches

43. In 2009, five space rockets produced in Ukraine — one Dnepr rocket, one Cyclone-3 rocket, one Zenit-3SL rocket and two Zenit-3SLB rockets — were successfully launched.

44. The Zenit-3SLB and Dnepr rockets were launched from the Baikonur launch site, while the Cyclone-3 rocket was launched from the Plesetsk launch site in the Arkhangelsk region of the Russian Federation. The Zenit-3SL rockets were launched from the Odyssey launch platform near Christmas Island in the Pacific Ocean.

45. On 30 January 2009, the 122nd and final launch of a Cyclone-3 lightweight space rocket took place at the Plesetsk launch site. There are no plans to launch more rockets of this type in future.

46. The three-stage Cyclone-3 space rocket is the latest of a series of lightweight space rockets and is modelled on the ballistic rockets of the Yuzhnoye Design Office. The rocket is produced by Yuzhny Machine-Building Plant in cooperation with Ukrainian and Russian companies. Cyclone-3 has a dual-thrust motor and can be kept launch-ready for long periods, and is intended for the launch of space objects into medium-altitude near-Earth orbit.

47. The Cyclone-3 space rocket was used to launch the Russian research satellite Coronas-Photon, which weighs 1,885 kg and is intended for research on the sun and the influence of solar activity on processes occurring on Earth. Coronas-Photon carries the satellite telescope STEP-F, which measures electron and proton fluxes and was constructed at the V. N. Karazin Kharkiv National University as part of the National Space Programme of Ukraine.

6. Bilateral cooperation

48. In 2009, the cooperation of Ukraine with other States in the area of exploration and use of outer space for peaceful purposes was based on international agreements on space exploration, the international obligations of Ukraine relating to space activities and current Ukrainian legislation governing space activities. Also in 2009, “Space-Inform”, a specialized centre for information and analysis and a NSAU information partner, continued, with NSAU support, to maintain and update databases on international space activities:

(a) “Spacefaring nations of the world”;

(b) “International space law”;

(c) “Business contacts – meetings and visits”;

(d) “Space events – dates and special and anniversary events”;

(e) “Participants in space activities”;

(f) “Reports and presentations”; and

(e) “Information and analytical materials”.

49. Ukrainian policy with regard to international cooperation has been guided by the following core principles:

(a) Compliance with international obligations relating to outer space;

(b) Fulfilment of the priorities and objectives of Ukrainian foreign policy and security policy;

(c) Strengthening of the position of Ukrainian businesses in the global market for space technologies and space services; and

(d) Focus on priority areas of space activity.

50. The efforts of Ukraine in the area of international cooperation have focused chiefly on fostering an international legal environment conducive to the participation of Ukrainian space sector enterprises in international space projects and on promoting the foreign trade activities of those enterprises and their stable and active presence in the space services market.

51. The long-standing collaboration between Ukraine and the Russian Federation is based on close cooperation among enterprises, joint participation in international space projects, the use of Russian launch complexes for the launch of Ukrainian carrier rockets and the existence of a long-term cooperation programme and of a coordinated plan of action among space agencies for the continuous development of space technology.

52. On 10 June 2009, the seventh meeting of the Ukrainian-Russian Subcommission on Cooperation in the Space Industry was held in Moscow. The delegations representing the national space agencies of the two countries at the meeting were headed by Mr. Aleksandr Zinchenko, Director-General of NSAU, and Mr. Anatoly Perminov, Director of the Russian Federal Space Agency. Issues relating to implementation of the programme for cooperation between the Russian Federation and Ukraine in the exploration and use of outer space for the period 2007-2011 and other matters concerning cooperation in the exploration and use of outer space were discussed at the meeting. During the meeting, both delegations remarked that all necessary conditions were in place for the successful development of cooperation between the Russian Federation and Ukraine in space activities. As a result of the talks, the Director-General of NSAU and the Head of the Russian Federal Space Agency signed the minutes of the seventh meeting of the Ukrainian-Russian Subcommission on Cooperation in the Space Industry held within the framework of the Committee on Economic Cooperation of the Ukrainian-Russian Inter-State Commission. It was agreed to continue joint work on the implementation of a priority project to establish a system to provide the Russian Federation and Ukraine with time coordination and navigation support using GLONASS and other global navigation satellite systems, scientific space projects, joint experiments aboard the Russian segment of ISS and cooperation in developing Earth remote sensing systems.

53. On 11 June 2009, an agreement between the Cabinet of Ministers of Ukraine and the Government of the Russian Federation on technology protection measures within the framework of cooperation in the exploration and use of outer space for peaceful purposes and in the design and use of space and rocket technologies was signed at the Ministry of Foreign Affairs of the Russian Federation. The agreement establishes the legal basis for the implementation of measures for technology protection in the course of implementation by Russian and Ukrainian space sector enterprises of joint projects, including those in which third countries are involved. In particular, the agreement sets out the legal requirements that must be met by Russian enterprises wishing to obtain authorization to participate in the Brazilian-Ukrainian Cyclone-4 project and legal conditions for the transfer to Ukrainian enterprises of scientific and technical products generated as the result of such cooperation. Those Ukrainian enterprises will be required to protect Russian technologies and products on the basis of a plan drawn up jointly for that purpose.

54. On 1 September 2009, within the framework of cooperation with the Russian Federation, a regular joint meeting of representatives of the Russian Federal Space Agency, NSAU, the Russian Academy of Sciences and the National Academy of Sciences of Ukraine was held at the National Space Technology Operating and Test Centre (Yevpatoria, Autonomous Republic of Crimea). The participants discussed joint projects and expressed satisfaction at the progress of implementation of the programme for cooperation between the Russian Federation and Ukraine in the exploration and use of outer space for the period 2007-2011. In particular, they noted the successful cooperation between Ukrainian and Russian specialists in implementing the Coronas-Photon research project on solar activity and the significant work accomplished in preparing the technical resources of the National Space Technology Operating and Test Centre for participation in the Phobos-Grunt and Spektr-R (RadioAstron) projects. It was decided that it would be expedient to expand the functional capabilities of the RT-70 radio telescope in order to enable its use in implementation of the Phobos-Grunt programme.

55. In order to strengthen scientific ties further, it was decided to create a Ukrainian component of the scientific programme that forms part of the Spektr-UV project and to step up the preparation of an agreement on cooperation in the scientific projects Spektr-UV and Millimetron. The participants agreed to continue talks regarding the participation of Ukrainian specialists in the planned Russian scientific projects Luna-Glob and Interheliozond/Polar-Ecliptic Patrol (PEP). They also agreed to introduce a new plan for cooperation in the preparation of scientific experiments aboard the Russian segment of ISS and to draw up, by April 2010, an updated version of the long-term programme of

joint scientific research and experiments by the Russian Federation and Ukraine aboard the Russian segment of ISS.

56. Acknowledging the importance of the further development of cooperation between the Russian Federation and Ukraine, the participants considered that it would be advantageous to begin drawing up a draft programme for cooperation between the two countries in the exploration and use of outer space for the period 2012-2016.

57. During the meeting, decisions relating to satellite navigation – in particular the establishment of a ground-based augmentation system to enhance GLONASS – and to the strengthening of ties between Russian and Ukrainian space sector enterprises in the area of production were adopted.

58. Joint working groups were tasked with formulating, by the end of 2009, proposals for cooperation in the area of Earth remote sensing, particularly with regard to the development of an information system for the management and exchange of Earth remote sensing data and the establishment of a shared network of Russian and Ukrainian test sites for the calibration of Earth remote sensing equipment carried aboard spacecraft.

59. Brazil has continued to be a key partner of Ukraine in recent years. Work on the construction of the Cyclone-4 space and rocket complex at the Alcântara Launch Centre is continuing as part of an international project. The Cyclone-4 is a high-performance carrier rocket constructed on the basis of proven technologies. Its characteristics and features are such as to ensure that it will become a leader in the market for services for the launch of satellites into low Earth orbit and geostationary transfer orbit.

60. In March 2009, Mr. Aleksandr Turchinov, First Vice-Prime Minister of Ukraine, held a meeting with Mr. Carlos Ganem, President of the Brazilian Space Agency, and members of a Brazilian delegation to discuss issues relating to the implementation of the Brazilian-Ukrainian Cyclone-4 project.

61. At the meeting, the participants discussed the status of implementation of the Cyclone-4 project and prospects for the development of cooperation between Brazil and Ukraine with regard to space activities. Mr. Ganem noted that the implementation of the project would be the first step in a series of joint projects. Mr. Turchinov emphasized the importance for Brazil and Ukraine of implementation of the project, even in crisis conditions, and underscored that the Government of Ukraine was constantly monitoring its progress. The participants expressed confidence that a test launch of the Cyclone-4 carrier rocket would be possible before the end of 2010.

62. On 23 March 2009, senior officials of NSAU met with leaders of the Brazilian delegation and directors of the joint Brazilian-Ukrainian company Alcântara Cyclone Space in Kyiv. The representatives of the Brazilian and Ukrainian space agencies agreed to strengthen their technical cooperation. During the meeting, the participants discussed the possibility of constructing a joint Brazilian-Ukrainian launch complex for the Cyclone-4 carrier rocket at the Alcântara Launch Centre. The Brazilian representatives gave assurances that all major difficulties had been overcome and that it remained only to resolve minor legal formalities relating to the proposed site. The Director-General of NSAU expressed the hope that a large majority of members of the Brazilian Parliament would support the planned use of the land for the site.

63. With regard to potential areas of cooperation between Brazil and Ukraine beyond the Cyclone-4 project that offered genuine possibilities for successfully uniting the efforts of Brazilian and Ukrainian specialists in conducting space activities, the following four key areas were identified:

(1) The joint development and construction of space objects and space complexes for Earth research and their systems, subsystems and components;

(2) Cooperation in the area of civilian technologies, beginning with the development and construction of efficient wind power plants with a capacity of 2,000-2,500 kilowatts. Pilot activities in this area are already under implementation;

(3) Construction of solid-fuel and liquid-fuel rocket engines; and

(4) Development of joint educational programmes on space.

China remains an important partner of Ukraine with regard to space activities.

64. A delegation of NSAU headed by the Director-General, Mr. Aleksandr Zinchenko, visited Beijing from 14 to 17 April 2009 as part of an agreement with the China National Space Administration (CNSA). The purpose of the visit was to expand cooperation as part of the plan for cooperation between China and Ukraine for the period 2006-2010, in particular through the implementation of two system projects (exchange of space-related data within the framework of the Chinese Huanjing-1B project and the Ukrainian Sich-2 project) and joint implementation of an ionospheric satellite project.

65. During the talks with CNSA, the key possibility of including some 15 new areas of cooperation in the plan and the steps to be taken in preparation for their implementation in 2009-2010 were discussed.

66. The visit was lent special significance by a meeting of the Director-General of NSAU with Mr. Dai Bingguo, member of the State Council of the People's Republic of China. During that meeting, a broad range of issues relating to cooperation between China and Ukraine with regard to space activities and ways in which to attract Chinese investment for diverse projects relating to wind and solar power and other advanced technologies were discussed.

67. During the visit, several meetings were held with leading Chinese companies: the China Precision Machinery Import-Export Corporation (CPMIEC), the China Great Wall Industry Corporation (CGWIC) and Sinovel — one of the largest Chinese companies — which manufactures wind turbines. NSAU and CGWIC signed agreements on cooperation in the area of wind and solar power that provide for the construction in Ukraine of wind turbines and wind and solar power plants. These projects will be implemented on the basis of various plans and in accordance with a number of conditions (investment, loans, commodity credit, supply of equipment and the establishment of joint enterprises).

68. At a meeting with the CITIC International Cooperation Company, which attracts funding for projects with other countries through the China Export and Credit Insurance Corporation (SINOSURE), it was agreed in a memorandum of understanding to implement a project to build a factory for the manufacture of tractors at the Yuzhny Machine-Building Plant.

69. From 26 to 31 July 2009, a delegation representing the China Precision Machinery Import-Export Corporation (CPMIEC) visited Ukraine to discuss ways to expand cooperation. During the visit, the Chinese delegation held talks with senior officials of NSAU and visited the Yuzhnoye Design Office and Arsenal, a State-owned special engineering enterprise. The Research Institute for Radio Engineering Measurements and the Institute for Superhard Materials of the National Academy of Sciences of Ukraine also participated in the talks.

70. The following areas of cooperation were discussed:

(a) Construction of satellites and use of satellite information;

(b) Design of equipment for satellite radio communication; and

(c) Use of solar energy.

At the end of the visit, the minutes of the meetings were signed.

71. On 26 October 2009, during an official visit to Ukraine by a delegation of the Government of China headed by one of the Vice-Premiers of the State Council of the People's Republic of China, an agreement to expand cooperation in the area of electro-optical infrared systems was signed between China and Ukraine. The Ukrainian co-signatories were Mr. Aleksandr Zinchenko, Director-General of NSAU; Mr. Nikolai Likholit, Director and Chief Designer of the company Arsenal; and Mr. Dmitry Peregudov, Director of the State enterprise Ukrinmash; the Chinese co-signatories were Mr. Xu Dazhe, General Manager of the China Aerospace Science and Industry Corporation (CASIC); Mr. Ji Yanshu, President of CPMIEC; and Mr. Zhao Xiao Long, Vice-President of CPMIEC.

72. The parties, noting the effectiveness of cooperation and recognizing their common interest in further pursuing mutually beneficial cooperation, expressed confidence that the cooperation between China and Ukraine would continue to develop with positive results in line with the interests of both countries in the area of outer space.

73. Within the framework of cooperation with Japan, on 9 March 2009 in Tokyo, the Director-General of NSAU signed a memorandum of understanding between NSAU and the company Sumitomo Corporation, one of the oldest commercial and industrial corporations of Japan. The memorandum of understanding provides for joint efforts to foster the development of alternative energy sources in Ukraine and to reduce emissions of greenhouse gases into the atmosphere, in accordance with the Kyoto Protocol to the United Nations Framework Convention on Climate Change. In conformity with the memorandum and also with a memorandum of understanding between NSAU and Mitsubishi Heavy Industries signed on 10 March 2009, representatives of the two Japanese companies visited Ukraine in order to discuss issues relating to cooperation in the implementation of wind power projects in Ukraine. As a result of the meetings and talks held in Kyiv and Dnipropetrovs'k, an agreement providing for further exploration of the possibilities for effective and fruitful cooperation in constructing wind turbines for wind power plants was signed by NSAU, Yuzhny Machine-Building Plant, Sumitomo Corporation and Mitsubishi Heavy Industries.

74. With regard to activities to strengthen cooperation with States members of the European Union and of the European Space Agency (ESA) in the area of outer space, it should be noted that the agreement signed on 25 January 2008 between the Government of Ukraine and ESA on cooperation in the peaceful use of outer space entered into force on 25 January 2009. The conclusion of the agreement was Ukraine's first step towards ESA membership. In order to give practical effect to the agreement, its implementation began with the development of an NSAU-ESA plan of action for 2009, which provides for cooperation in areas such as space science, Earth research programmes, microgravity research, carrier rockets and support for educational activities in the area of space science and technology.

75. In the area of space sciences, in April 2009, the second seminar on cooperation within the framework of the European initiative Global Monitoring for Environment and Security (GMES) was held in Kyiv. During the seminar, German experts proposed the establishment of a joint European-Ukrainian consortium on space weather to be supported by the German Aerospace Center (DLR), in accordance with the requirements of the third call for proposals under the European Union's Seventh Framework Programme for Research and Technological Development (FP7) (July-December 2009). The issue will be included in the agenda for the next working meeting with German experts.

76. In the area of Earth research programmes, in February 2009, a seminar was held at NSAU in Kyiv to address legal aspects of the use of aerospace data generated using Earth remote sensing. In particular, DLR specialists offered to provide assistance with regard to any aspect of legal support for the establishment of a legislative basis for the use of such data in Ukraine. In addition, a presentation was given on the law adopted by the Federal Republic of Germany on 23 November 2007 relating to the security of data obtained from satellites.

77. In the area of microgravity research, six Ukrainian proposals were prepared for an international tender announced by the International Space Life Sciences Working Group for biological and medical experiments aboard ISS.

78. In the area of carrier rockets, the work of Yuzhnoye Design Office specialists in collaboration with representatives of the Italian company Avio to verify the performance of the Vega launch vehicle continued over the course of 2009. As a result of the many talks held, comprehensive responses were provided to the questions raised and note was taken of the comments made by the Avio representatives. The Integrated Project Team, which comprises representatives of Avio and ESA, is expected to adopt a final decision in the near future concerning the delivery of a test model of the Vega launcher for the qualification flight. Meanwhile, talks concerning the serial production of the launch vehicle are being held.

79. With regard to support for educational activities in the area of space science and technology, the possibility of holding consultations regarding ways in which students could participate in ESA and NSAU youth programmes on outer space was raised during discussions with representatives of the ESA International Relations Department. The ESA Education Office responded with the proposal that Ukrainian universities participate in the European Student Moon Orbiter (ESMO) programme. To that end, it is proposed that Ukraine consider the possibility of arranging a cluster launch of the ESMO spacecraft using a Ukrainian carrier rocket. The possibility of the involvement of Ukrainian universities in work on the project was agreed upon informally with the National Aerospace

Education Centre for Ukrainian Youth, while the issue of launch services was raised during discussions with representatives of Alcântara Cyclone Space. During the Paris Air Show Le Bourget 2009, representatives of Alcântara Cyclone Space met with leaders of the ESMO project; however, no specific agreement was reached. The possibility of signing a preliminary bilateral or trilateral memorandum of understanding is being considered.

80. In February 2009, consultations were held with representatives of the European Commission at which a version of the outer space section of the draft association agreement between Ukraine and the European Commission was agreed upon.

81. During the Paris Air Show Le Bourget 2009, the Director-General of NSAU held meetings with Mr. Jean-Jacques Dordain, Director General of ESA; Mr. Johann-Dietrich Wörner, Chairman of the Executive Board of DLR; and Mr. Yannick d'Escatha, President of the French space agency Centre national d'études spatiales (CNES). The participants in the meetings discussed current issues relating to cooperation in outer space activities. In addition, emphasis was placed on the efforts undertaken by Ukraine towards obtaining ESA membership. Those efforts were welcomed by Mr. Dordain, Director General of ESA.

82. Measures are being taken to implement the European Union-Ukrainian twinning project "Boosting Ukrainian Space Cooperation with the European Union", in full conformity with the schedule of work for that project. As at 1 October 2009, the following activities had been organized and carried out:

(a) 15 visits by experts, including four visits to space sector enterprises (in Kharkiv, Dnipropetrovs'k and Yevpatoria);

(b) 13 seminars and training events;

(c) 7 meetings of the project's Steering Committee; and

(d) 12 working meetings of European experts, NSAU staff and specialists from the space sector and from the National Academy of Sciences of Ukraine.

83. In 2009, cooperation between Ukraine and Canada was stepped up. From 2 to 5 June 2009, NSAU officials undertook a working visit to Canada, where they met with senior officials of the Canadian Space Agency (CSA), MDA Corporation, Export Development Canada (EDC) and Bombardier.

84. During talks with the President of CSA, a presentation on the potential of the Ukrainian space sector was given and the possibilities of cooperation between Canada and Ukraine in the exploration and use of outer space were discussed. Agreement was reached on investment, the implementation of the project to establish a national satellite communications system for Ukraine and several other joint activities, in particular – in the area of Earth remote sensing — the use of a Ukrainian carrier rocket to launch payloads on behalf of Canada.

85. From 21 to 27 July 2009, the NSAU delegation visited Canada for a second time, as the result of which agreements were finalized with MacDonald, Dettwiler and Associates concerning the involvement of that company in the establishment of the satellite communications system for Ukraine and with EDC concerning a loan to finance that work.

86. On 23 September 2009 in Kyiv, the Director-General of NSAU met with Mr. Stockwell Day, Minister of Foreign Affairs and International Trade of Canada, to discuss future areas of space activity in which cooperation between Canada and Ukraine could be developed.

87. A Canada-Ukraine aerospace and aviation business summit organized by NSAU, the Embassy of Canada in Ukraine and the Science and Technology Center in Ukraine was held on 29 and 30 September in Kyiv. The objective of the event was to establish mutually beneficial ties between Canadian and Ukrainian enterprises and research institutes working in the areas of space and aviation. Representatives of leading Canadian and Ukrainian space and aviation sector enterprises participated in the work of the summit.

88. The main users of the rocket and space technology and services of Ukrainian enterprises (in addition to China, the Russian Federation and the United States of America, as mentioned above),

continue to be India, Israel, the Republic of Korea, Saudi Arabia, Turkey and the United Arab Emirates.

89. Cooperation with Azerbaijan and Belarus has also intensified. In 2009, the Cabinet of Ministers of Ukraine signed and approved two framework agreements on cooperation in the exploration and use of outer space for peaceful purposes, one with the Government of the Republic of Azerbaijan on 9 April and the second with the Government of the Republic of Belarus on 12 June.

90. On 4 September 2009 in Minsk, Mr. Aleksandr Zinchenko, Director-General of NSAU, and Mr. Mikhail Myasnikovich, Chairman of the Presidium of the National Academy of Sciences of Belarus, signed a document entitled "Areas for future cooperation between enterprises and organizations of Ukraine and the Republic of Belarus in implementing the Framework Agreement between the Cabinet of Ministers of Ukraine and the Government of the Republic of Belarus on cooperation in the exploration and use of outer space for peaceful purposes".

91. Planned areas of cooperation between the two countries include the joint implementation of space research and space applications, in particular, the joint design and construction of mini-satellites and microsatellites for Earth remote sensing, payloads for Earth remote sensing satellites (electro-optical and spectral equipment) and systems for the management, reception and processing of information from Earth remote sensing satellites, and the development of state-of-the-art technologies for processing Earth remote sensing data for various applications. It was agreed that information received from Belarusian and Ukrainian Earth remote sensing satellites would be shared. During the visit to Belarus, the NSAU delegation visited the United Institute of Informatics Problems of the National Academy of Sciences of Belarus, the State unitary scientific engineering enterprise Geoinformation Systems and open joint-stock company Peleng, where delegation members learned about the scientific and production capacity of those organizations.

92. One of the most recent major events among the international space activities of Ukraine was the participation of NSAU in the first international specialized symposium "Space and Global Security of Humanity", which was held in Cyprus and focused on possibilities for the establishment of a global aerospace system for monitoring natural and anthropogenic phenomena. In an address to the symposium, the Director-General of NSAU announced that a framework for the implementation of Ukrainian State policy on space activities for the period up to 2030, defining the priorities and strategic areas of Ukraine's space activities, would be prepared and approved by the end of 2009. The programme will focus particularly on the development of global security systems. In particular, the framework document will provide for the expansion of strategic cooperation with the Russian Federation and the implementation of joint science and technology programmes with regional economic groups of countries of the Commonwealth of Independent States (CIS) and the European Union and with Brazil, China, India and the United States of America.

93. The establishment of a national geographic information system as part of the European GMES initiative and GEOSS and the strengthening of cooperation with the Global Ocean Observing System (GOOS) were presented as key results of the implementation of Ukrainian State policy. In addition, NSAU, together with institutions of the National Academy of Sciences of Ukraine, forms part of the Infrastructure for Spatial Information in the European Community (INSPIRE) and cooperates with ESA and the space agencies of Germany, France, the Russian Federation, CIS member States and other countries (more than 20 countries in total).

94. In that regard, the Director-General of NSAU affirmed that Ukraine supports the proposal to establish an international aerospace system for monitoring natural and anthropogenic phenomena as an effective additional international mechanism, recognized by the United Nations, that will make it possible to exploit the aerospace potential of every space faring nation, including Ukraine, with the aim of ensuring the global forecasting and prevention of natural and man-made disasters.