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**Committee on the Peaceful
Uses of Outer Space**

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

Note by the Secretariat

Addendum

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II. Replies received from Member States

Bangladesh

[Original: English]

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

2. Bangladesh has been utilizing both air- and space-based platforms for information communication and to develop an air-based survey system using sophisticated survey aircraft equipped with the necessary imaging instruments. Moreover, Bangladesh has a perspective plan to launch a multi-mission geostationary satellite for telecommunication, tele-broadcasting, information technology-based functioning and Earth resources observation and monitoring. It will be equipped with both optical and microwave remote sensing devices in addition to telecommunication instruments. The geostationary satellite data will be used for meteorological applications, such as the monitoring of cyclones, rainfall, floods, cold waves etc., which are regular phenomena in Bangladesh.

3. Development of an air-based survey system, polar orbiting and geostationary satellites is very important and promising for Bangladesh. Under the circumstances, the delineation and specification of the air and space boundaries of Bangladesh by the United Nations will enhance the peaceful application of air- and space-related activities in Bangladesh. Such aerospace activity will ensure more accurate spatial data to support the sustainable development of the country.

4. Bangladesh has to develop and possess independent space-based capabilities. Despite existing resource constraints in Bangladesh, such an objective necessitates individual, countrywise space allocation. However, Bangladesh does not prefer the alternative approach of depending on foreign space and airborne system facilities to developing its own. The alternative approach would also restrict the technological development of the country.

Brazil

[Original: English]

International cooperation

1. In conformity with the importance it attaches to international cooperation in space activities, Brazil, in the course of 2008, carried out joint actions and established new lines of cooperation with a number of countries. Some of these bilateral initiatives are mentioned below.

2. The joint activities with the Russian Federation relating to the development of Brazilian launchers advanced and, in November, during the visit of the President of

the Russian Federation to Brazil, an agreement was reached between the space agencies of the two countries regarding the exploration of possibilities for cooperation in the use and development of the Global Navigation Satellite System (GLONASS), operated by the Russian Federation. There was also progress in the discussion towards collaboration in telecommunications technology.

3. The visit of the President of France to Brazil in December prompted the signing of a general cooperation programme between the Brazilian Space Agency (AEB) and the Centre national d'études spatiales (CNES) of France and of three additional documents related to (a) technological cooperation in systems applied to multi-purpose platforms; (b) technological cooperation in geostationary systems for telecommunications, navigation and meteorology; and (c) Brazilian participation in the Global Precipitation Measurement (GPM) project.

4. During the visit of the President of Brazil to Italy, in November, the space agencies of the two countries signed a letter of intent that opened new opportunities for cooperation in several areas: space sciences, Earth observation, space communications, stratospheric activities, as well as training and education.

5. In consonance with the significant increase in bilateral collaboration with India in the course of 2007, and as a result of the exchange of high-level missions between the agencies of the two countries and the visit of the President of Brazil to New Delhi, a cooperation instrument was signed in April 2008 for the provision of Brazilian ground support to the Indian lunar mission Chandrayaan-1. By October, on the occasion of the launch of the Indian spacecraft, the National Institute for Space Research (INPE) of Brazil was able to give due support to the mission, in accordance with the international agreement. Furthermore, both agencies expect to sign in the near future an operational document to complement the implementing arrangement for the framework agreement concluded during the 2007 presidential visit whereby Brazil would receive and process data from Indian remote sensing satellites.

6. Among the several projects in course with the German Aerospace Center (DLR), special mention is to be made of the Multi-Application Purpose synthetic aperture radar (MAPSAR), which is presently at the stage of feasibility studies for the joint development of a satellite that will carry as a payload an L-band synthetic aperture radar (SAR).

7. Brazil maintains with several Latin American countries ongoing cooperation in various fields, specifically in the area of Earth observation and processing of satellite data.

8. AEB and the National Commission on Space Activities (CONAE) of Argentina approved in December a joint programme establishing close collaboration and technological exchange in three areas related to satellite technology and of special interest and relevance for both countries.

9. In June, the Governments of Brazil and the Bolivarian Republic of Venezuela signed a framework agreement on space cooperation that gives new impetus to the bilateral relationship and offers additional opportunities for future undertakings.

10. Joint activities are being carried out by the space agencies of Brazil and Ukraine and the binational company Alcantara Cyclone Space, created by treaty

in 2003, with a view to making it possible to conduct the qualification flight of the Cyclone-4 launcher by 2010.

11. Brazil and China are continuing their common endeavours towards the advancement of the China-Brazil Earth Resources Satellite (CBERS) programme. At present, they are engaged in the joint development of CBERS-3 and CBERS-4, the next satellites of the series scheduled to be launched.

12. Technical conversations with the United States of America took place during a meeting held in Brazil, in March, on the possible conclusion of an instrument of cooperation between AEB and the National Aeronautics and Space Administration (NASA) of the United States on Brazilian participation in the GPM programme.

Activities of the National Institute for Space Research

1. Satellites in development

13. At present, INPE is developing, in cooperation with China, the remote sensing satellites CBERS-3 and CBERS-4, which are to be launched in 2010 and 2013 respectively. In parallel, INPE is developing the remote sensing satellite Amazonia-1 and the scientific satellite Lattes-1 within the national programme. Both are based on a multi-mission platform and the launchings are planned to take place in 2011 and 2012 respectively.

2. Satellites in operation

14. In 2008, INPE kept in operation two remote sensing satellites, CBERS-2 and CBERS-2B, developed in cooperation with China and launched in 2003 and 2007 respectively. Both are equipped with three optic observation cameras, besides the environmental data collection system. The images have applications in several areas, such as in forestry, agricultural and environmental monitoring and in cartography, geology and other areas.

15. INPE also kept in operation two data collection satellites, SCD-1 and SCD-2, developed and built by Brazilians and launched in 1993 and 1998 respectively. They are used to collect data from approximately 750 automatic environmental data collection platforms distributed throughout the national territory and to transmit those data to a reception station. The data are used in several applications, such as weather forecasting, hydrographic basin monitoring, studies on ocean currents, tides and atmospheric composition, and agriculture planning.

3. China-Brazil Earth Resources Satellite images

16. In 2008, INPE, in line with the Brazilian policy on free distribution of data, supplied the CBERS images to users in Latin America, via the Internet; it has distributed more than 450,000 images since 2004.

17. As part of the CBERS international dissemination activities, representatives of Brazil and China reaffirmed their interest in international promotion of the CBERS programme through the installation or adaptation of CBERS reception stations in other countries.

18. In 2008, with a view to greater African coverage, INPE continued negotiations and technical evaluations for CBERS reception sites in Egypt, Nigeria, South Africa and Spain (Canary Islands).

19. At the same time, an advanced centre was created in the Amazon region, and the installation of a new reception antenna is planned in the city of Boa Vista. With this new instrument, the coverage of CBERS will enjoy considerable expansion in Latin America, and people in Central America and the Caribbean will be included as users.

4. Monitoring of the Amazon region

20. In 2008, INPE continued its programme of environmental monitoring of the Amazon region through satellite images. Basically, this activity is pursued in two ways: (a) annual measurement by the Satellite Monitoring of the Brazilian Amazon Forest (PRODES) system of deforestation of the Brazilian Amazon; and (b) the issuing of almost real-time deforestation warnings by the Deforestation Detection in Real Time (DETER) system, which guide the actions of the competent authorities and agencies in the area of illegal deforestation. INPE keeps both systems under continuous improvement to offer even more precise and useful information to the community.

5. Climate and meteorological forecast information

21. INPE, through the Brazilian Center for Weather Forecasting and Climate Studies (CPTEC), keeps the country informed, via a website portal, of meteorological, climatic and oceanic forecasts. This portal also presents meteorological satellite images, environmental and air quality data, and studies and reports on climate change.

22. The information shown on the website is the result of continuous research and development of models based on satellite data and comes from the application of software for meteorological, climatologic and environmental forecasting at the global and regional levels.

23. In 2008, INPE continued improving its services to benefit society in general, including, among other activities, the start-up of the implementation of an alert system for severe weather conditions.

24. INPE has also conducted observational studies on climate change as well as global and regional modelling for future climate change scenarios for Brazil and South America.

6. Space and atmospheric science

25. In the area of space and atmospheric science, INPE has studied phenomena that occur in the outer atmosphere and space, conducting research and experiments in the fields of aeronomy, astrophysics and space geophysics.

26. In 2008, INPE started the implementation of the Space Climate Programme, aimed at establishing an Internet-based alert system for geomagnetic storms. This system will allow the country to prevent damage that geomagnetic phenomena can cause to telecommunications systems, geo-positioning systems and the electrical energy supply.

Cuba

[Original: Spanish]

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

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

3. Despite the situation described above, satisfactory progress was made in attaining the annual space activity objectives. In this connection, particular mention should be made of the holding of the 13th Symposium of the Latin American Society for Remote Sensing and Space Information Systems (SELPER) in Havana from 22 to 26 September 2008.

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

1. Space meteorology

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

6. The timely and systematic dissemination by the mass media of weather forecasts, supported by high-resolution satellite images, together with the preventive evacuation measures organized by Cuba's civil defence authority, protected more than 3 million people during the passage of the hurricanes that devastated the country. Regrettably, seven persons lost their lives owing to failure to comply strictly with the measures organized by the civil defence authority.

2. Remote observation of the Earth

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

8. An assessment was made of the behaviour of fires in Cuba, using information on heat focuses detected during the period 2004-2008 by Geostationary Operational

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

9. A study was made of the behaviour of a number of focuses of the *Aedes aegypti* mosquito (which transmits dengue fever) as a function of climatic and vegetal variability, which influences the proliferation of this vector that is so harmful to human health. The effect of climatic anomalies, described by the climatic index lB1, t, C (Bultó index), and of the vegetal cover, given by the normalized difference vegetation index (NDVI), on the behaviour of the focuses was determined. Spatial statistics was applied in obtaining the time-space correlations between the variables in Cuba during the period 1998-2002. NDVI data were obtained from images provided by the advanced very high resolution radiometer (AVHRR) sensor of the National Oceanic and Atmospheric Administration (NOAA) of the United States of America NOAA-16 satellite, with a spatial resolution of 0.25 degrees of latitude and longitude.

10. The introduction of advanced technology into Cuban agriculture was highlighted by implementation of the geographic information system SIG_Citricos_C at Empresa de Cítricos Ceiba (a citrus fruit enterprise), which is making it possible to integrate, handle and update large databases so that decisions are as appropriate as possible to the real situation at all times and there is support for decision-making on, inter alia, criteria for the authorization of new planting and criteria for prioritization in the light of hurricane and plant pest risk maps. Also, thanks to this geographic information system it is possible to monitor harvesting, improve quality, plan planting campaigns and carry out land-use and environmental studies.

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

the artificial neural network created for the purpose, together with the band reflectance and vegetation indices of the image; from that, electrical conductivity maps were obtained for each plot.

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

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

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

15. The GeoCuba group adapted the Russian NEVA digital topographic map-making system for use in those GeoCuba companies which produce maps on the scale 1:25,000 so that they can comply with the editorial standards and use the symbols specified for the creation of a 1:25,000 scale digital map of Cuba. The final product is a customized system and a set of technical guidance documents that have permitted technology transfer to the other GeoCuba companies, with the result that a substantial number of 1:25,000 scale maps have been created using NEVA.

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

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

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

3. Space sciences

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

20. Collaboration between IGA and the Institute of Geophysics of the National Autonomous University of Mexico has continued, radio interferometer signal quality results relevant for the Mexican Array Radio Telescope (MEXART) interplanetary scintillation array being obtained.

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

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

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

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

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

4. Distance learning

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

5. World Space Week

27. World Space Week could not be celebrated as in previous years owing to the serious impact of the devastating hurricanes Ike and Gustav. Nevertheless, the seventh national workshop on outer space and its peaceful uses was held with great success in Jimaguayú Hall at the National Capitol building, on 9 October 2008, with 16 presentations made by various Cuban scientific institutions.

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

Libyan Arab Jamahiriya

[Original: Arabic]

1. The Libyan Arab Jamahiriya is one of the States newly involved in space technology and research. It is at the stage of training and gaining experience in space technology and its applications, but has not yet conducted research into deep space. It is, however, implementing the following projects relating to remote sensing applications and space science at the local and regional levels, in the framework of

the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III):

(a) A national network for monitoring seismicity extends throughout the territory of the Libyan Arab Jamahiriya; it aims to use modern technologies, including space technologies, to reduce the dangers posed by natural catastrophes;

(b) A multiple discriminatory capacity receiving station is the cornerstone of the Libyan space programme to serve the space requirements of the Libyan Arab Jamahiriya and the rest of Africa through its ability to receive data from several satellites photographing Earth with various discriminatory locating and spectroscopic capacities. The station was previously established by the Libyan Center for Remote Sensing and Space Science, although radar data is received from the Environmental Satellite (Envisat) of the European Space Agency and observation data from the French Satellite pour l'observation de la Terre (SPOT). The data received can be used in all the economic development programmes that are in line with development and planning policies at the national and regional levels, especially in bringing together the states of the Sahel and the Sahara;

(c) A station receiving images from SPOT to track land cover and monitor desertification is being used in several national and regional projects, particularly in regions suffering from drought, desertification and sand movements;

(d) The building and launching of the Regional African Satellite Communications Organization (RASCOM) satellite for communications and broadcasting for Africa, on which work began in late 2007.

2. Through the above projects, the Libyan Arab Jamahiriya has been able to participate with the rest of the world in implementing a set of recommendations that serve developing societies, whether locally or regionally. Nonetheless, it is necessary to take the following points into consideration at the next session:

(a) Ways of obtaining, without distinction and for national purposes, remote sensing data and information derived from it with high discriminatory capacities and the necessary equipment to build space technology capable of meeting the specific needs of developing countries;

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

(c) Notifying Member States of the organization of training opportunities and courses on space science and technology in order to facilitate the effective participation of developing countries in such opportunities and courses;

(d) Making the scientific reports produced by space agencies available to States members of the Committee on the Peaceful Uses of Outer Space, including by posting them on the organizations' websites so that they may be examined by everyone interested;

(e) Providing technical and scientific sensing services by international organizations in order to build capacities in space science and technology;

(f) Participation by the Libyan Arab Jamahiriya in long-term programmes in order to guarantee scientific support for the implementation of its pioneering programmes;

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

Russian Federation

[Original: Russian]

1. The national activities of the Russian Federation in 2008 with regard to the use of outer space for peaceful purposes were carried out by the Russian Federal Space Agency (Roskosmos) through the Russian Federal Space Programme, the Global Navigation Satellite System (GLONASS) special federal programme and other special programmes in cooperation with the Russian Academy of Sciences, the Ministry of Defence of the Russian Federation and other clients and users of space information and services.

2. In 2008, the Russian Federation carried out 27 carrier rocket launches, one of them unsuccessful. A total of 43 space objects were launched (21 Russian space vehicles and 22 space vehicles belonging to other countries).

3. The following Russian space vehicles were launched:

(a) Two manned Soyuz TMA spacecraft (Soyuz TMA-12 and TMA-13);

(b) Four Progress M unmanned cargo vehicles (Progress M-63, M-64, M-65 and M-01M);

(c) One communications satellite (Ekspress-AM33);

(d) One small extrabudgetary spacecraft (Yubileiny);

(e) Six Glonass-M spacecraft;

(f) Seven Cosmos space vehicles (Cosmos-2437, 2438, 2439, 2440, 2441, 2445 and 2446).

4. The following space vehicles belonging to other countries were launched: Thor-2R (Norway), AMC-14 (United States of America), SAR-Lupe (two satellites, Germany), Amos-3 (Israel), Orbcomm (six satellites, United States), Inmarsat-4F3 (International Mobile Satellite Organization), RapidEye (five satellites, Germany), Nimiq 4 (Canada), Astra-1M (SES Americom), THEOS (Thailand) and Ciel 2 (Canada). In addition, a GSTB-V2B satellite was launched on behalf of the European Space Agency (ESA).

5. Nineteen carrier rockets were launched from the Baikonur launch site, with 27 space vehicles launched. Six carrier rockets were launched from the Plesetsk

launch site, with nine space vehicles launched. One carrier rocket was launched from the Kapustin Yar launch site, with six space vehicles launched.

6. Russian enterprises, scientists and engineers also took part in the preparation and launch of five space vehicles (Thuraya-3 of the United Arab Emirates; DirecTV 11 of the United States; Galaxy 18 and Galaxy 19 of the International Telecommunications Satellite Organization (INTELSAT); and Echostar 11 of the United States) from the Morskoy Start launch site.

1. Manned flight programme

7. In 2008, in accordance with its international obligations regarding the development and operation of the International Space Station (ISS), the Russian Federation launched two manned Soyuz transport spacecraft and four cargo spacecraft, controlled and tracked the flight of the Russian segment of the ISS and implemented the planned programme of research and experiments.

8. In 2008, space experiments in a wide range of research areas were performed in the Russian segment of the ISS. Work was done on 50 experiments, over 40 of them Russian.

2. Space technology applications programme

(a) Space communications, television transmission and navigation

9. In 2008, space systems continued to be used in maintaining a single information space in the Russian Federation and providing modern telecommunications services for various users.

10. The orbital network for space communications, television transmission and navigation includes the following space vehicles: Ekspress-A, Ekspress-AM, Yamal-100, Yamal-200 (communications, television), Ekran-M, Bonum-1 (NTV Channel), Gonets-D1, Gonets-M (communications), Glonass, Glonass-M and Nadezhda (navigation, search and rescue). GLONASS continued to operate. In 2008, six Glonass-M space vehicles were launched.

11. At present, the number of operating satellites in GLONASS is 17. There are plans to expand the GLONASS orbital network to 18 satellites in 2009 (providing coverage of the Russian Federation) and to 30 satellites (providing global coverage) in 2011.

12. From 2010, flight trials of Glonass-K space vehicles will commence with an extended period of space operations of up to 10 years.

13. Work is being carried out on the construction and launch, in 2009, of two small Sterkh navigation space vehicles.

(b) Remote sensing of Earth, meteorological observations, environmental monitoring and natural disaster management

14. The natural resource satellites Resurs-DK1 and Monitor-E are currently in orbit. The Resurs-DK high-precision observation satellite provides images of Earth’s surface with a resolution of up to 1 metre.

15. Work is near completion on the development of two new-generation hydrometeorological satellites, the medium-orbit Meteor-M and the geostationary Elektro-L, which are expected to go into service in 2009.

16. In order to achieve the most comprehensive possible monitoring of the environment, work is under way on the creation and improvement of space facilities within the framework of an advanced Earth remote sensing satellite system that will include the following elements:

(a) Geostationary meteorological satellites for the observation of large-scale processes affecting the global weather that take place in the atmosphere and at Earth's surface in the tropics and, partly, at higher latitudes (Elektro-L);

(b) Polar-orbiting meteorological satellites at relatively low altitudes (800-1,000 kilometers) for the global integrated observation of the atmosphere and Earth's surface (Meteor-M 1 and Meteor-M 2);

(c) Real-time optico-electronic observation satellites providing information relevant to sectors of the economy connected with the use of natural resources (Monitor-E, Resurs-DK, Resurs-P);

(d) Satellites for radiophysics-based observation, equipped with radiolocators, microwave radiometers and multispectral surveying instruments for operating in the visible and infrared regions of the spectrum for studies of the ice along the Northern Sea Route in the Arctic and for many other oceanographic and oceanological studies (Meteor-M3);

(e) Observation satellites using high-precision radiolocation, for all-weather surveying of Earth, which is particularly important in high-latitude regions of the Russian Federation where many oil and gas companies are operating (Arkon-2);

(f) Satellites for the monitoring of disasters and the investigation of potential earthquake precursors (Kanopus-B).

17. In 2008, work continued on developing the main Earth remote sensing information centre of the Russian Federation. New stations for receiving, processing and storing data are being set up, and a data collection system for Eurasia was launched.

(c) Natural disaster management using space technology

18. One of the priority areas of the Russian Federation's space activities is the development of space technologies and information support for natural disaster management, including the following:

(a) The forecasting, monitoring, detection and control of hazardous phenomena in the atmosphere and at sea (hurricanes, gales, typhoons, ice formations etc.) using data from satellites of the Meteor and Elektro types obtained in various regions of the optical and radio (ultra-high-frequency) ranges of the electromagnetic wave spectrum;

(b) The monitoring, detection and control of floods using data from satellites of the Meteor and Resurs-DK1 types. New space technologies for the provision of information to facilitate natural disaster management are to be developed and applied;

(c) The detection and monitoring of forest fires that cover an area of more than 40 hectares, using the smoke plume and data from satellites of the Meteor-M and Resurs-DK1 types obtained in the visible and infrared ranges of the electromagnetic wave spectrum. Consideration is being given to equipping satellites with state-of-the-art infrared instruments for the early detection, monitoring and control of the boundaries of forest fires covering an area of more than 0.1 hectare.

3. Research programmes

19. The main space research results in 2008 were obtained during observation programmes conducted on board the ESA International Gamma-Ray Astrophysics Laboratory (INTEGRAL). Russian scientists took an active part in competitive observation programmes, in the course of which significant results were obtained in relation to the dynamics of superheavy bodies in the centres of galaxies and the evolutionary processes of neutron stars.

20. Research continued in 2008 on cosmic rays and corpuscular flows within the framework of the Russian-Italian Mission (RIM)-Pamela project. Work on the project is planned to continue until the end of 2009.

21. In the field of planetology, studies of Mars and Venus continued using the following Russian instruments, which were carried on board Mars Express and Venus Express: the Planetary Fourier Spectrometer (PFS), the Spectroscopy for Investigation of Characteristics of the Atmosphere of Mars (SPICAM), the Visible and Infrared Mineralogical Mapping Spectrometer (OMEGA), the Analyser of Space Plasmas and Energetic Atoms (ASPERA), the High Resolution Stereo Camera (HRSC) and the Mars Advanced Radar for Subsurface and Ionsphere Sounding (MARSIS). Further investigations of the planets' surface and atmosphere were made and the data obtained are being processed and analysed.

22. Work continued on board the United States Mars Odyssey spacecraft on detecting and localizing subsurface aqueous ice on Mars, using the High-Energy Neutron Detector (HEND) instrument complex, which the Russian Federation helped to develop. This makes it possible to register fast neutron flows from the surface of Mars caused by the action of solar winds. It is planned that research will continue in 2009 in the course of experiments on board the Lunar Reconnaissance Orbiter of the National Aeronautics and Space Administration (NASA) of the United States, using the Lunar Exploration Neutron Detector (LEND) instrument.

23. Investigations of gamma ray bursts and transient phenomena using the Konus A instrument within the framework of the Russian-United States Konus-WIND project, which has been under way for 14 years, continued in 2008.

24. In 2008, Russian and European scientists and engineers continued to process the results of experiments carried out in the course of the flight of the Russian robotic biosatellite Foton-M3, which carried out 26 separate scientific experiments.

4. Commercial use of space technologies in the Russian Federation

25. Work is being completed on the special Federal programme entitled "Use of the results of space activities to promote the social and economic development of the Russian Federation and its regions for the years 2009-2015", under which it is planned to establish and develop a market for space services on the basis of satellite

navigation, coordinate time, Earth remote sensing, space communications and space infrastructure technologies.

26. The main trends in the creation of innovative goods and services based on the results of space activities benefiting the Russian economy in 2008 were:

(a) Development of navigational methods, Earth remote sensing satellites, space communications and information science;

(b) Development and production of instruments for the fuel and energy complex;

(c) Development of new kinds of medical and rehabilitation technology for persons of limited physical capacity;

(d) Development of new materials and advanced processes for manufacturing them;

(e) Development of instruments for the processing branches of the food and building industries.

5. International cooperation

27. Together with various ministries and other departments, and also with enterprises developing rocket and other space technologies, Roskosmos contributed to international cooperation in the investigation and peaceful uses of outer space in 2008 in the following main areas:

(a) Launches of foreign payloads using Russian facilities;

(b) Construction, in cooperation with ESA, France and a number of European companies in the space sector, of facilities for the launching and adaptation of Soyuz-ST carrier rockets at the Guiana Space Centre in French Guiana;

(c) Cooperation in developing promising means of launching heavy payloads (Ural project);

(d) Technical support for work on improving the reliability and safety of the Brazilian satellite launch vehicle (VLS) carrier rocket;

(e) Participation in the construction of space rocket facilities for the Republic of Korea;

(f) Partnership in the establishment and operations of the ISS and in on-board investigations;

(g) Cooperation in the creation of new materials, biological products and other substances in micro gravitational conditions (Foton-M spacecraft);

(h) In the field of fundamental space research, creation of the Spektr-RG observatory, with the extensive cooperation of foreign partners;

(i) In the field of fundamental space research, implementation of the Spektr-RG Space Observatory project, with the extensive cooperation of foreign partners;

(j) Development of the International Satellite System for Search and Rescue (COSPAS-SARSAT) (with Sterkh satellites).

28. The following activities were undertaken for the further development of international cooperation, including cooperation in the implementation of The Space Millennium: Vienna Declaration on Space and Human Development,[1] adopted at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III):

(a) Carrying of payloads of foreign design and manufacture on board Russian satellites of the Meteor and Resurs types;

(b) Carrying of Russian scientific instruments on board foreign satellites within the framework of projects such as the NASA Lunar Reconnaissance Orbiter, using the LEND apparatus, and the Mars Science Laboratory, using the Dynamic Albedo of Neutrons (DAN) apparatus;

(c) Russian participation in the Global Monitoring for Environment and Security (GMES) and the Group on Earth Observations (GEO) programmes, which involve global monitoring of conditions in circumterrestrial space, the atmosphere and land and water resources and the forecasting and monitoring of natural and man-made disasters, including the monitoring of forest fires and the forecasting of earthquakes and other emergency situations, using equipment on board Meteor-M, Resurs-DK and others;

(d) Russian participation in carrying out the global community's 10-year implementation plan to establish the Global Earth Observation System of Systems (GEOSS);

(e) Participation in the work of the International Committee on Global Navigation Satellite Systems (GNSS).

29. Proposals have been drawn up for the Russian Federation to join the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters, which provides for cooperation on the use of space resources, coordination in remote sensing, and data and information exchange in situations of natural and man-made disasters.

30. The Russian Federation possesses a range of facilities that permits the launching into Earth orbit with different inclinations of payloads weighing from a few hundred kilograms to 20 tons. Thanks to their reliability and economic efficiency, its launch services are successful on the world market. The Russian Federation's Soyuz and Proton carrier rockets have been modernized (Soyuz-2 and Proton-M). Work is under way on the development of advanced launching facilities, including the Angara family of carrier rockets.

31. For the launching of small lightweight satellites, programmes are under way for the introduction of launching methods based on converted rockets within the framework of the Start, Rokot and Dnepr projects.

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[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

32. To date, the Russian Federation has concluded some 40 inter-State and intergovernmental agreements on cooperation in the investigation and use of outer space for peaceful purposes. In addition, Roskosmos has signed agreements with the space agencies of 26 countries and ESA on joint space projects.

6. Space debris

33. Space activities worldwide are leading to a constant increase in the man-made pollution of circumterrestrial space, impairing the safety of space flights. The Russian Federation is paying close attention to resolving the problems of space debris. The Russian Federation now follows the text established in 2007 for the Russian All-Union State Standard (GOST) R, "Space technology products. General requirements for products to restrict man-made pollution of circumterrestrial space". The standard was brought into line with the requirements of the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space.

34. The Keldysh Institute of Applied Mathematics and the Pulkovo Observatory in the Leningrad region have organized an international network of 18 observatories covering, for the first time, the entire geostationary orbit. Observations to date have led to the identification of about 300 new objects in the geostationary orbit.

35. The potential of space operations in the Russian Federation is such that a wide range of applications are possible, including the design and construction of spacecraft and the collection of the data required to meet the country's needs and to participate effectively in programmes carried out for the benefit of the international community. In the view of the Russian Federation, the fullest possible expansion of relations with every country in the world in the interests of the sustainable development of both the Russian Federation and all humankind is the main driving force behind the development of international cooperation in the opening up of space.