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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

France

[Original: French]

1. Sustainable development

AltiKa: a decisive step towards altimetry for operational oceanography

1. The AltiKa mission is a programme involving bilateral cooperation with India. This is the second major cooperation programme since Megha-Tropiques (see paras. 19-21 below) and consists of putting a Ka-band altimeter into a low near-polar orbit at the same time as Jason-2, with sufficient repetitiveness for the observation of mesoscale ocean circulation (meanders and eddies). The launch is scheduled for 2009.

2. The payload will also include a dual-frequency radiometer and the Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) precise orbitography system. This experiment should take place on board India's Oceansat-3 oceanography satellite.

3. The scientific partners in France are the Oceanography and Climate Laboratory using Experiments and Digital Methods (LOCEAN), the Laboratory of Geophysical and Industrial Fluid Flows (LEGI), the Laboratory for Studies in Spatial Geophysics and Oceanography (LEGOS), the French Research Institute for Exploitation of the Sea (IFREMER) and Mercator Océan.

Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations: for cloud and aerosol climatology

4. The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) is a programme involving bilateral cooperation with the National Aeronautics and Space Administration (NASA) of the United States of America. Current uncertainties about the radiation impact of clouds and aerosols limit understanding of the climate system and the forecasting of global changes. The CALIPSO mission will provide a set of unique data on aerosols by means of a backscattering lidar on board the satellite. CALIPSO is to fly in formation with two other American missions, Aqua and CloudSat, and also with the French Polarization and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar (PARASOL) microsatellite. These will form an exceptional space observatory, the A-Train. The launch of CALIPSO should take place in 2006.

5. NASA has overall responsibility for the mission. The Centre national d'études spatiales (CNES) is providing the reconfigurable platform for observation, telecommunications and scientific uses (PROTEUS) and an infrared imager, and is responsible for the satellite and for controlling it.

6. The scientific partners for the mission in France are the Pierre Simon Laplace Institute (IPSL) and the Aeronomy Service (SA).

Global Monitoring for Environment and Security

7. Global Monitoring for Environment and Security (GMES) is an initiative of the European Commission and the major space agencies, including CNES and the European Space Agency (ESA). It has three objectives:

(a) To use ground and space data to establish services to provide environmental information to the public. Such services would be similar to those that provide meteorological information;

(b) To establish information services to support action for the protection of people and property in the event of natural or man-made disasters;

(c) To establish, in the long term, services to help European forces and organizations in humanitarian and peacekeeping interventions.

8. Three phases are planned. The first phase, which was completed in 2003, consisted of identifying possible themes for the development of specific services. The second phase, until 2007, consists of setting up pilot demonstrations for some of these services, at the request of the GMES Advisory Council and in accordance with the priorities set by the European Commission. The third phase, beginning in 2008, will focus on the actual establishment of GMES service centres to deal with a number of themes, using funding not earmarked for research and development. The first services to be set up in 2008 will make use of existing ground and space infrastructure. The projects are funded by ESA or the European Union.

9. The following areas have been identified as priorities: ocean and coastal zone management, land use and monitoring of plant resources and natural disasters. ESA has selected about 10 projects to fund and the European Commission has selected about 20.

Infrared Atmospheric Sounding Interferometer: for improved weather forecasting

10. The Infrared Atmospheric Sounding Interferometer (IASI) mission is being developed jointly by CNES and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). IASI will measure the atmospheric spectrum in infrared to establish temperature and humidity profiles with an accuracy of 1 K and 10 per cent humidity and a vertical resolution of 1 kilometre. The first launch is scheduled for April 2006.

11. In cooperation with EUMETSAT, CNES has overall technical responsibility for the instruments, the development of data processing software and the operation of the Technical Expertise Centre. The sounding interferometer will be installed on the three European meteorological operational (METOP) satellites.

12. The scientific partners in France are Météo-France, the Laboratory of Molecular Physics for the Atmosphere and Astrophysics (LPMA) and IPSL.

Jason: for operational oceanography

13. The Jason mission is the product of multilateral cooperation between CNES, NASA, the National Oceanic and Atmospheric Administration (NOAA) of the United States and EUMETSAT.

14. Following the Topography Experiment for Ocean Circulation/Positioning Ocean Solid Earth Ice Dynamics Orbital Navigator (TOPEX/POSEIDON) and Jason-1 missions, Jason-2 is to achieve the full implementation of operational oceanography using ocean altimetry from space, delivering the same kind of information about the ocean as that which meteorology provides about the atmosphere.

15. The scientific partners in France are the National Centre for Scientific Research (CNRS), IFREMER and Météo-France. The launch of the mission is scheduled for 2008.

Marine Environment and Security for the European Area

16. The first fortnightly global ocean forecasting bulletin was issued on 14 October 2005 by the Mercator Océan public interest group, which works in the field of operational oceanography. This bulletin gives the currents, temperature and salinity of all the world's oceans, from surface to floor. The dynamic model on the basis of which the forecasting can be done combines satellite observation data with data collected by buoys. These bulletins will be a key aid for security, fishing and navigation at sea, for monitoring the movement of oil slicks and for forecasting the impact of onshore currents on coastal currents.

17. Mercator Océan brings together French research organizations involved in the development of operational oceanography. These are CNES, IFREMER, the Research Institute for Development (IRD), Météo-France and the Hydrography and Oceanography Service of the Navy (SHOM). Mercator Océan is also developing the high-resolution global ocean coverage component of Marine Environment and Security for the European Area (MERSEA), which focuses on the sea and the ocean and is coordinated by IFREMER under the European GMES programme (see paras. 7-9 above).

18. A study is under way as to the type of legal structure that could meet the ongoing needs of an operational oceanography centre intended to serve as the basis for a European ocean analysis and forecasting capability. This new structure should be put in place in 2006.

Megha-Tropiques: improved knowledge of the water cycle

19. Megha-Tropiques is a bilateral cooperation programme involving CNES and the Indian Space Research Organisation (ISRO). The aim of the mission is to research atmospheric circulation, the hydrological cycle and climate change. The launch is scheduled for 2009.

20. This study of the water cycle in tropical regions is being conducted in cooperation with ISRO. The Indian Remote Sensing (IRS) satellite platform is being supplied by ISRO. The main instrument, a Microwave Analysis and Detection of Rain and Atmospheric Systems (MADRAS) imager, will be an industry first, since it will be developed in partnership with ISRO. The other instruments will be an upgraded version of the Scanner for the Radiation Budget (Scarab) and a microwave profiler of atmospheric humidity (SAPHIR).

21. The programme's scientific partners are IPSL and the Laboratory for the Study of Radiation and Matter in Astrophysics (LERMA).

Soil Moisture and Ocean Salinity

22. Soil Moisture and Ocean Salinity (SMOS) is a multilateral cooperation mission involving ESA, CNES and the Centre for the Development of Industrial Technology (CDTI)—a Spanish organization for the management of space activities.

23. The SMOS mission will allow for regular global assessment of soil-surface moisture and ocean salinity by means of a two-way L-band interferometric radiometer. CNES is participating by acting as prime contractor for the satellite, providing the PROTEUS platform and running the control and in-orbit operations centre and a distribution centre for scientific products. The launch is scheduled for 2007.

24. The scientific partners in France are the Centre for the Study of the Biosphere from Space (CESBIO), IPSL, the National Institute for Agricultural Research (INRA) and the National Centre for Meteorological Research (CNRM).

Vasco: improved forecasting of the Indian monsoon

25. Vasco is an international campaign whose objective is to improve observation and understanding of the interactions between the ocean and the atmosphere. The data collected above the Indian Ocean will provide additional information about phenomena such as El Niño and about monsoon variability. The scientific partner for the campaign in France is the Laboratory of Dynamic Meteorology (LMD).

26. Trial experiments were conducted in 2005. The campaign will be implemented in full in 2006 in the Indian Ocean and will make use of data collected by aeroclippers and boundary-layer pressurized balloons.

Stratéole-Vorcore: understanding the physical chemistry of the stratosphere

27. The Stratéole programme is an international programme for the study of the dynamics of the Antarctic winter vortex. The programme includes two experiments: Vorcore, which is concerned with the study of dynamics and mixing inside the vortex, and Voredge, which consists of a similar study at the edge of the vortex. The programme will contribute to the study of the mechanisms of stratospheric ozone depletion.

28. The Stratéole-Vorcore campaign is being conducted by CNES, in cooperation with the National Science Foundation of the United States, from the American McMurdo station located on the Antarctic continent (166º East, 78º South). The project consists of observing the dynamics of the Antarctic winter polar vortex using an original method specially developed for this purpose: a flotilla of about 20 balloons flying at a constant altitude in the lower stratosphere for several months. The balloons are equipped with a payload comprising lightweight electronic systems for position measurement and the collection of meteorological data (air temperature and pressure). Some are also equipped to take atmospheric turbulence measurements. The measurements are transmitted using the Argos (satellite-based location and data collection) telemetry system. The main investor is LMD.

29. The balloons can stay aloft for up to three months. The campaign was launched in September 2005.

Vegetation and Environment Monitoring on a New Microsatellite: for improved monitoring of vegetation

30. Vegetation and Environment Monitoring on a New Microsatellite (VENµS) is the product of bilateral cooperation with the Israel Space Agency (ISA). It is a programme of Earth observation for scientific and technological purposes. The programme features the use of a superspectral camera for vegetation monitoring, with high resolution and high repetitiveness at selected sites, and the possibility of changing orbit by means of a low thrust from an electric thruster.

31. The mission will serve to prepare for the establishment of a GMES operational observatory for the monitoring of the continental environment and the management of natural resources. The programme is being implemented within the framework of a scientific partnership with CESBIO and Ben-Gurion University of the Negev in Israel.

2. Space science

BepiColombo: discovering Mercury

32. This ESA scientific programme, in which France is participating, is being implemented in cooperation with the Japan Aerospace Exploration Agency (JAXA).

33. The purpose of the mission is to study the planet Mercury and the components are the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). The launch is scheduled for 2012.

34. France is responsible for the PHEBUS-UV spectrometer and is contributing to four experiments. The programme's scientific partners in France are the Space Radiation Studies Centre (CESR), the Centre for the Study of Terrestrial and Planetary Environments (CETP), the Institute for Space Astrophysics (IAS), the Paris Geophysical Institute (IPGP), the Astrophysics Laboratory of Marseille (LAM), the Laboratory for Space Studies and Instrumentation in Astrophysics (LESIA), and the Laboratory of Environmental Physics and Chemistry (LPCE).

Convection, rotation and planetary transits: reaching for the stars

35. Convection, rotation and planetary transits (COROT) is the product of multilateral international cooperation with Austria, Belgium, Brazil, Germany and Spain, as well as ESA.

36. It is the third mission to use the PROTEUS platform after Jason and CALIPSO and has two astrophysics-related objectives: to study the internal structure of stars through the analysis of their oscillation modes; and to detect exoplanets by observing the periodic reflex motion of stars due to the gravitational pull of their planets as they pass in-transit in front of the stars.

37. COROT aims to be the first space experiment capable of detecting telluric planets comparable to the rocky planets of the solar system. Bilateral cooperation is in place for the provision of components or sub-systems. The scientific partners in France are LESIA, LAM and IAS. The launch is scheduled for 2006.

Apparatus for the Study of Material Growth and Liquids Behaviour near their Critical Point: for the benefit of material science

38. The Apparatus for the Study of Material Growth and Liquids Behaviour near their Critical Point (DECLIC) project is a bilateral research programme involving CNES and NASA. The project will enable a research programme to be conducted under microgravity conditions to study critical fluids and phase transitions, chemical reactions in supercritical fluids and material structure during the solidification of transparent materials. The apparatus takes the form of two modules—one is electronic and the other is an optical unit—which can be transported by space shuttle. The modules will be installed on board the International Space Station and the telescience operations will be conducted from the ground by scientists under the supervision of the Centre for Assistance in the Development of Microgravity Applications and Space Operations (CADMOS). The modules will be capable of functioning for six years.

39. The scientific partners in France are CNRS, the Team on Supercritical Fluids for the Environment, Materials and Space (ESEME), the French Atomic Energy Commission (CEA), the City of Paris Industrial Physics and Chemistry Higher Educational Institution (ESPCI) and the Provence Materials and Microelectronics Laboratory.

40. The launch, which is scheduled for 2006, is dependent on the resumption of space shuttle flights.

GAIA: surveyor of the sky

41. The GAIA programme of ESA is an ambitious follow-up mission to Hipparcos. Its objective is to collect astronomical data of unprecedented accuracy (position, proper motions, parallaxes, photometric and spectrometric data) on 1 billion stars in the Earth's galaxy and the local group of galaxies. GAIA will allow the first-ever complete census of the exoplanets in orbit around the stars close to the Sun. The programme's scientific partners in France are the Galaxies, Stars, Physics and Instrumentation Laboratory (GEPI) of CNRS and the Observatoire de la Côte d'Azur (Gemini). The launch is scheduled for 2012.

Herschel and Planck Surveyor: mapping the universe

42. Two submillimetre astronomy missions, Hershel and Planck Surveyor, are part of the ESA scientific programme that France is participating in through its contribution to the ESA mandatory scientific programme and through CNES involvement in the instrumentation of the respective scientific payloads as well as through its data processing centre:

(a) Spectral and photometric imaging receivers (SPIRE) and photoconductor array camera and spectrometers (PACS) for Herschel;

(b) A heterodyne instrument for the far infrared (HIFI) spectrometer for the Herschel and Planck Surveyor.

43. The scientific partners in France are IAS, the Paris Astrophysics Institute (IAP), the Astroparticle and Cosmology (APC) Laboratory of CNRS, the Very Low Temperature Research Centre (CRBT), CESR, the Astrophysics Department of the French Atomic Energy Commission (CEA/SAP), LERMA and LAM.

Laser Interferometer Space Antenna Pathfinder: a precursor mission for the detection of gravitational waves

44. The Laser Interferometer Space Antenna Pathfinder (LISA) mission is part of the ESA science programme and is aimed at directly detecting the gravitational waves predicted by the theory of general relativity at frequencies not covered by terrestrial interferometers. Implementation of this programme requires an intermediate technology demonstration phase, involving the flight of the LISA Pathfinder satellite. Its payload, the Lisa Technology Package (LTP), is a reduced model consisting of one arm of the LISA interferometer. The launch is scheduled for 2008.

45. Participation in this mission by the French scientific community (the department of relativistic astrophysics, theory, experimentation, metrology, instrumentation and signals (ARTEMIS) of CNRS, IAP, the Annecy-le-Vieux Particle Physics Laboratory (LAPP), the Laboratory Universe and Theories (LUTH), the Space-Time Reference Systems Laboratory (SYRTE) and the French National Aerospace Research Establishment (ONERA)) will be under the aegis of the APC Laboratory, which is providing the modulation bench for the LTP laser source.

Microsatellite with Drag Control for the Observation of the Equivalence Principle: theory of general relativity

46. Microsatellite with Drag Control for the Observation of the Equivalence Principle (MICROSCOPE) is a national project being carried out in cooperation with ESA and the Centre for Applied Space Technology and Microgravity (ZARM) at the University of Bremen in Germany, with funding from the German Aerospace Center (DLR).

47. This fundamental physics experiment will test the principle of equivalence between inert and gravitational masses with an accuracy three orders of magnitude better than previous, ground-based tests. It also represents a test of the theory of general relativity, which relies on these principles of equivalence, and a constraint for theories about the unification of fundamental interactions. MICROSCOPE also has a technical objective: validation of drag compensation through the use of ultra-sensitive accelerometers and ionic thrusters.

48. CNES is the prime contractor of the complete package and of the Myriade microsatellite series. The mission centre is at ONERA, which also developed the accelerometers. The launch is scheduled for 2008.

Mid-InfraRed Imager: the first light from the universe

49. The Mid-InfraRed Imager (MIRI) is an ESA mandatory scientific project in which CNES is participating beyond its normal contribution by developing this instrument with funding from its own budget.

50. MIRI is a mid-infrared spectrographic imager developed on the basis of a partnership between Europe and the United States. MIRI will be carried on the James Webb Space Telescope (JWST) astronomy mission, the successor to the Hubble Space Telescope. JWST is scheduled for launch in 2011.

51. The scientific partners for the MIRI project in France are CEA/SAP and LESIA.

In-Orbit Cold Atom Atomic Clock Project (PHARAO): the infallible atomic clock

52. The In-Orbit Cold Atom Atomic Clock Project (PHARAO) is the French component of the Atomic Clock Ensemble in Space (ACES) programme of ESA, designed to demonstrate the great scientific and operational potential of a new generation of atomic clocks in space. The project will employ two clocks, the Swiss Hydrogen Maser and PHARAO, contributed by France.

53. CNES is the prime contractor for this clock, the target precision for which is 10-16, with a stability of 10-16/day. ACES will be installed on the external platform of the Columbus module of the International Space Station.

54. The programme's scientific developers in France are the Kastler Brossel Laboratory (LKB) and SYRTE. The launch is scheduled for 2010.

Venus Express: studying the atmosphere of Venus

55. Venus Express is the second flexible mission of the ESA scientific programme. Three experiments with French participation have been selected, including two with French prime contractors: Visible and Infrared Thermal Imaging Spectrometer (VIRTIS), Spectroscopy for Investigation of Characteristics of the Atmosphere of Venus (SPICAV) and the Analyser of Space Plasma and Energetic Atoms (ASPERA), an experiment to study the planet's ionized environment.

56. The scientific partners are LESIA, IAS, LMD and CESR. The launch took place on 9 November 2005. The arrival in orbit around Venus is scheduled for April 2006.

Picard, or the Sun's impact on climate

57. Picard is the French contribution to an international programme involving the Institut royal météorologique de Belgique (IRMB), the Belgian User Support and Operation Centre (B.USOC) and the Davos Physical Meteorological Observatory in Switzerland as scientific partners.

58. This project will help to improve understanding of the impact on the climate of solar irradiance and of the Sun's internal structure and physics. The payload consists of three instruments: a solar diameter imager and surface mapper (SODISM) imaging telescope from France, designed to measure the diameter of the Sun to within 1 milliarc-second; a solar variability Picard (SOVAP) differential radiometer; and a precision monitoring of solar variability (PREMOS 2) UV-photometer. The platform comes from the Myriade microsatellite series. The launch is scheduled for 2008.

Swarm: measuring the Earth's magnetic field

59. Swarm is a mission belonging to the ESA Earth Explorer programme. The project involves a constellation of three identical satellites designed to measure the Earth's magnetic field. CNES plans to contribute to the mission by providing absolute magnetometers on board the three satellites.

60. The scientific partner in France is IPGP. The launch is scheduled for 2009.

Time Transfer by Laser Link

61. The Time Transfer by Laser Link (TLT2) experiment under development at the Observatoire de la Côte d'Azur and at CNES aims to allow space clocks to be synchronized with remote clocks on Earth. The experiment is based on the propagation of very brief light pulses between the ground clocks and a clock placed in orbit around the Earth. The launch is scheduled for 2008.

3. Applications with benefits for society

Satellite-based location and data collection system and Search and Rescue Satellite-Aided Tracking

62. The Satellite-based location and data collection system (Argos) was established in partnership with the Environmental Studies Laboratory, and the Search and Rescue Satellite-Aided Tracking System (SARSAT) was established in partnership with the International Satellite System for Search and Rescue (COSPAS-SARSAT).

63. The Argos-2 and Sarsat-2 instruments, launched on 20 May 2005 on the NOOA-N polar-orbiting meteorological satellite, are the last second-generation instruments developed for these major international projects. The first locates and collects environmental data, while the second locates distress calls. The similarity of the missions and instruments led to the two programmes being combined in view of the larger space segment.

64. The continuity of these programmes will be guaranteed by the Argos-3 and Sarsat-3 instruments, which have been adapted for future missions. The first instruments will be launched with the IASI instrument on the European METOP satellite in 2006.

Galileo: a satellite-based navigation programme

65. The member States of the European Union and ESA have agreed on funding conditions that have enabled the development and validation phase of the Galileo Satellite Navigation System programme to begin. During this phase, an experimental satellite known as Galileo System Test Bed Version 2 (GSTB-V2) is due to be launched before June 2006. Thereafter, three Galileo satellites will be launched and the satellite navigation service will be validated in orbit.

Pléiades high-resolution satellites: recording the world in images

66. The Pléiades project is a new generation of optical Earth observation systems being developed by CNES. The Pléiades high-resolution optical observation programme is being carried out in cooperation with Italy, which is responsible for developing the COSMO-SkyMed radar system. The two optical satellites included in the French space component are scheduled for launch in 2009 and 2010.

Women International Space Simulation for Exploration bed-rest experiment

67. Women International Space Simulation for Exploration (WISE) is an international programme developed in cooperation with ESA, CNES, NASA and the Canadian Space Agency.

68. In 2005, these agencies organized two-month bed-rest experiments involving healthy female volunteers, in preparation for flights on board the International Space Station. The experiments were aimed at evaluating the consequences of a long-duration space flight and at developing nutritional and exercise countermeasures.

69. The Institute for Space Medicine and Physiology (MEDES) was responsible for conducting the experiments. Some 20 international scientists conducted experiments and studies on the cardiovascular, skeletal and muscular systems of the volunteers and also on nutrition.

4. Access to space

Ariane 5 Cryogenic Evolution type A

70. Ariane 5 Cryogenic Evolution type A (ECA) is a European programme for a heavy-lift (10-ton) launcher using a cryogenic upper stage based on the third stage of Ariane 4. ESA is the prime contractor and delegates the technical management to CNES. France contributes over 51 per cent of the funds for this programme. After the launch failure of the first flight in December 2002, the following two flights in 2005 were successful.

Automated Transfer Vehicle: an operational control centre

71. As part of the development of the European Automated Transfer Vehicle (ATV) programme, an ATV Control Centre (ATV-CC) is being set up at the CNES centre in Toulouse. ESA has assigned to CNES responsibility for the development and operation of ATV-CC. As the main control centre, ATV-CC is responsible for conducting operations and coordinating all ground facilities needed for the operations of ATV, which is a fully automated, unmanned cargo spacecraft capable of transporting 8 tons of freight. The first launch is scheduled for 2006.

Cardiovascular Laboratory: for cardiovascular research

72. The Cardiovascular Laboratory (Cardiolab) is a research model developed by CNES and DLR for the study of the cardiovascular system on the International Space Station. Cardiolab will be located in the European Physiology Modules (EPM) facility on board the European Columbus Laboratory. The scientific partners in France are the Physiology Laboratory of the Faculty of Medicine at the University of Angers and the Medicine and Space Physiology Unit of the University of Tours.

73. The launch is scheduled for 2006 and is dependent on the resumption of space shuttle flights.

Cardiomed: for the medical monitoring of astronauts

74. CNES and the Institute of Biomedical Problems (IBMP) of the Russian Academy of Sciences in Moscow have decided to consolidate experience in the cardiovascular field through the joint development of Cardiomed. Intended for the medical monitoring of astronauts, the equipment will operate on board the Russian component of the International Space Station. It will be used to determine the functional state of the cardiovascular system of astronauts during medical examinations and the monitoring of function tests.

75. The scientific partners are the Physiology Laboratory of the Faculty of Medicine at the University of Angers, and the Medicine and Space Physiology Unit of the University of Tours.

76. The launch is scheduled for 2006 and is dependent on the resumption of space shuttle flights.

Future Launchers Preparatory Programme: launchers of the future

77. The objective of the Future Launchers Preparatory Programme (FLPP), which was approved by the ESA Ministerial Council in 2003, is to carry out preparatory work for decisions on the following:

(a) The development of a next-generation launcher;

(b) New development activities designed to increase the competitiveness of Ariane 5 and Vega.

78. FLPP is an optional ESA programme. French involvement amounts to 30 per cent for the first part and 6 per cent for the second part.

Soyuz in French Guiana

79. On 7 November 2003, France and the Russian Federation signed a legal agreement to launch Soyuz from French Guiana. The decision to start the programme was made by the ESA Council in December 2004. The establishment of Soyuz at Kourou, French Guiana, offers Europe the opportunity to add to its range of launch services a medium-sized launcher whose reliability has been amply demonstrated.

80. CNES is the prime contractor and architect of the entire project and has been assigned the infrastructure work. The first launch should take place in 2008.

Vega: a small launcher for Europe

81. Vega is a small European launcher, the development programme for which was approved at the interministerial conference of ESA held in Brussels in 1999.

82. Vega will complete the range of European launchers, with a view to meeting the market demand for small satellites. Vega will be able to place a payload of 1.5 tons into low orbit. The first launch is due to take place in 2007.

83. The development of the launcher is being piloted by an integrated European team. CNES is responsible for piloting the development of the P80 first-stage motor and is an assistant contractor for the Guiana Space Centre (CSG) facilities on the former Ariane 1 site.

Russian Federation

[Original: Russian]

1. The national activities of the Russian Federation in the field of space research and the use of outer space for peaceful purposes in 2005 were carried out by the Russian Federal Space Agency in accordance with the Russian Federal Space Programme, the special federal Global Navigation Satellite System (GLONASS) programme and other special programmes in cooperation with the Russian Academy of Sciences, the Ministry of Defence, the Ministry for Civil Defence, Emergency Situations and Natural Disaster Management, the Ministry for Information Technologies and Communication, the Federal Geodesy and Cartography Agency, the Federal Hydrometeorology and Environmental Monitoring Service and other clients and users of space information and services.

2. In 2005, the Russian Federation launched 26 carrier rockets and 35 objects into space, of which 19 were Russian: two manned spaceships of the Soyuz TMA series (Nos. 6 and 7), four cargo vehicles of the Progress-M series (Nos. 52, 53, 54 and 55), two communications satellites of the Ekspress-AM series (Nos. 2 and 3), one satellite of the new Gonets-M series, six satellites of the Cosmos series (including three GLONASS satellites), the Foton M biotechnology satellite, the Monitor-E Land Remote Sensing Satellite, the Tatyana educational satellites of Moscow State University and the technological nanosatellite TNS-O.

3. Sixteen foreign space vehicles were launched: the AMERICOM-12 (AMC-12), AMC-23, DirecTV-8 and Galaxy-14 satellites, the Optical Inter-orbit Communications Engineering Test Satellite (OISETS), the Innovative Technology Demonstration Experiment Satellite (INDEX) and the XI-V satellite, three European space vehicles—the Student Space Exploration and Technology Initiative (SSETI) Express, AMC Venus Express and Galileo—and the Anik, China Disaster Monitoring Constellation-4 (DMC-4), Sina-1, TopSat, the Norwegian Student Satellite NCUBE and the UVE-1 satellite.

4. A total of 26 carrier rockets were used to launch the space objects, including 11 of the Soyuz type, seven of the Proton type, three of the Cosmos-3M type, two of the Rokot type (one of which was aborted: as a result, the CryoSat satellite was not launched) and one each of the following types: Molniya-M (aborted launch), Dnepr and Volna (aborted launch from a submarine).

5. Nineteen launches, putting 22 space vehicles into space, were made from the Baikonur launch site. There were six launches, two of which were unsuccessful, from the Plesetsk launch site.

6. Russian organizations and specialists participated in the preparation and launching of the satellites XM Radio-3, Spaceway-1, the United States' Intelsat Americas-8 and Inmarsat, as part of the Sea Launch project.

1. Manned flight programme

7. In 2005, in accordance with its international obligations regarding the development and operation of the International Space Station (ISS), the Russian Federation launched two transport spacecraft with ISS crews aboard 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:

(a) On 28 February, the Progress M-52 cargo vehicle was launched;

(b) On 15 April, the Soyuz TMA-6 spacecraft carrying the crew of the eleventh primary expedition to the ISS was launched; during their stay on ISS, the crew of the expedition made one spacewalk;

(c) On 17 June, the Progress M-53 cargo vehicle was launched from the Baikonur launch site;

(d) On 8 September, the Progress M-54 cargo vehicle was launched;

(e) On 1 October, the Soyuz TMA-7 spacecraft was launched from the Baikonur launch site carrying the crew of the twelfth primary expedition to ISS. During their stay, the crew of the expedition made one spacewalk, in November, in order to carry out work on the exterior of ISS.

8. Altogether, in 2005, Russian spacecraft delivered to ISS more than 10 tons of cargo of various types, including 2,300 kg of fuel, 1,260 kg of water, 1,150 kg of food, 620 kg of air and oxygen, 1,940 kg of equipment for on-board systems, 780 kg of medical equipment and sanitation and hygiene supplies, 250 kg of scientific equipment, 90 kg of on-board documents and 820 kg of cargo for the American segment.

9. In 2005, the expedition crews carried out experiments in the Russian segment of ISS on a wide range of scientific research subjects (work was done on 60 space experiments, of which 44 were Russian). These included contract experiments; geophysical research; medical and biological research; space biotechnology; technical research and experiments; Earth observation; and space and materials technology.

2. Space technology applications programmes

Space communications, television transmission and navigation

10. In 2005, space systems continued to be used to cater for the information needs of the Russian Federation and to provide modern telecommunication services for various users.

11. The orbital network of equipment for space communications, television transmission and navigation includes the following space objects: Gorizont, Ekspress-A, Ekspress-AM, Yamal-100, Yamal-200, Ekran-M, Bonum-1, Gonets-D1M, Fonets-M, GLONASS, GLONASS-M and Nadezhda.

12. The Ekspress-AM2 and Ekspress-AM3 satellites were launched in 2005. The satellites will be used to carry out functions for State enterprises, such as federal television and radio transmission and the creation of special satellite communication networks, and to provide a package of multiservice facilities (digital and analogue television and radio transmission, telephony, videoconferencing, data transmission and broadband Internet access). New satellites will be used to develop communication networks on the basis of very small aperture terminal technology, to create institutional and corporate networks and to provide multimedia services, including tele-education and telemedicine.

13. Advanced next generation platforms are being developed for the production of communications satellites having a mass of up to 1,000 kg, a payload mass of up to 250 kg and energy consumption of up to 2,000 watts and to establish heavy satellites having a mass of up to 3,600 kg, a payload mass of up to 1,350 kg and energy consumption of up to 10,500 watts. The new platforms will be relatively versatile and will be able to be used for the production of various types of satellite with an active service life of up to 12 years. The operation of GLONASS continued to provide navigational support for civil aircraft, naval vessels and river fleets and to be used in geodesy and cartography, for geological works and in agriculture and forestry.

14. In December 2005, three more GLONASS satellites came into operation. At present, the system has 17 satellites in operation (including 4 GLONASS-M satellites). Under the special federal programme, GLONASS will have its full complement of 24 space vehicles by 2011.

15. The space segment of the International Satellite System for Search and Rescue (COSPAS-SARSAT) currently includes two Nadezhda satellites. To replace them, work is under way on a small Sterkh satellite, which is more than five times lighter and will remain in service two and a half times longer than the existing satellites. The Sterkh satellites are to be launched in the period 2006-2007.

Remote sensing of the Earth, meteorological observations, environmental monitoring and natural disaster management

16. The Russian Federation uses space applications involving hydrometeorology and natural resources to perform its environmental monitoring activities.

17. The Russian space system for remote sensing of the Earth provides for the use of hydrometeorological satellites (of the Meteor and Elektro type) and natural-resource observation satellites (of the Resurs type). Information supplied by those satellites may be used for a wide range of purposes in such fields as agriculture, climatology and weather forecasting, cartography, efficient land use, prospecting for mineral resources, forestry, water resource management and the monitoring of emergency situations.

18. A medium-altitude meteorological satellite, Meteor-3M No. 1, is currently in orbit. Compared with its predecessor, Meteor 3, it carries a wider improved range of data-processing equipment.

19. Monitor-E, a natural-resource satellite carrying medium- and high-resolution equipment, was launched in 2005 and is undergoing flight tests. Work on the new generation of hydrometeorological satellites (the medium-orbit Meteor-M and the geostationary Elektro-L) is nearing completion. One of the planned Meteor-M satellites will be developed for oceanographic research.

20. Monitor-E will provide information from remote sensing of the Earth, which will make it possible to compile inventories of land resources; to carry out thematic mapping of territories; to monitor emergency situations and assess their consequences; to carry out geological mapping and prospect for minerals; to monitor the condition of forests and agricultural crops and forecast crop yields; to monitor drainage and irrigation; to monitor ice conditions and snow cover in inland waters; and to monitor the environment.

21. Resurs-DK, a high-precision observation satellite, is expected to be launched in 2006.

22. A Russian space system, Vulkan, is being developed for short-term forecasting of earthquakes.

23. In order to improve environmental monitoring, it has been decided to develop space facilities gradually within the framework of a prospective remote sensing system. The development and operation of the system are to be carried out in such a way as to ensure mutually beneficial cooperation with foreign partners that have themselves conducted useful work in the development and utilization of equipment for remote sensing. This requires effective and efficient forms of multidimensional international cooperation in carrying out environmental monitoring and issuing warnings of natural disasters, including tsunamis, ultimately leading to the development of national space resources and their integration into a single comprehensive international system for remote sensing of the Earth.

24. The year 2005 saw the continued development and modernization of the main terrestrial complex for receiving, processing, storing and distributing satellite-supplied information. Work was conducted on further developments to the main remote sensing information centre. New stations for receiving, processing and storing data were established and a system for the collection of data on the Eurasian area was set up.

Natural disaster management using space technology

25. 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:

(a) Forecasting, detection and monitoring of hazardous phenomena in the atmosphere and at sea, such as hurricanes, storms, typhoons and ice formations using data from Meteor-3M and Elektro-L obtained in various regions of the optical and radio (ultra-high frequency) bandwidths of the electromagnetic wave spectrum;

(b) Detection and monitoring of floods, using data from Meteor-3M, Monitor-E and Resurs-DK. New space technologies are to be developed and applied for the provision of information to facilitate natural disaster management;

(c) Detection and monitoring of forest fires that cover an area of more than 40 hectares, using data from Meteor-3M, Resurs-DK and Monitor-E obtained in the visible and infrared regions of the electromagnetic wave spectrum. Consideration is being given to equipping satellites with state-of-the-art infrared instruments in order to detect and monitor the boundaries of forest fires covering an area of more than 0.1 hectares, at the time the fire starts;

(d) All-weather detection and evaluation, at any time of day, of the extent of an oil spill on the sea surface following a tanker accident or the deliberate discharge of oil, using data from space objects with synthetic aperture radars of the Arkon-2 type.

3. Space research programmes

26. Space research provides the necessary basic data for understanding the processes taking place in the universe and assessing their effect on the Earth.

27. In 2005, within the framework of a scientific research programme, space technology was used for a detailed study of solar-terrestrial relations and the subsequent development of a heliogeophysical monitoring system. The Coronas-Foton satellite is being developed to continue the monitoring of solar activity, to conduct comprehensive research on the Earth's magnetosphere and to explore the connection between processes occurring in the Sun and in the near-Earth plasma and processes occurring on Earth.

28. The solar studies programme continued within the framework of the Coronas programme in 2005, as part of the international Coronas-F project. The Coronas-F satellite was launched in 2001 to investigate the dynamic processes in the active Sun, the characteristics of solar cosmic rays and the Sun's electromagnetic radiation in the ultraviolet and X-ray spectra, and to study solar cosmic rays, helioseismological sounding of the Sun's depths and the solar corona. The programme has provided data on the location of active areas on the Sun, facilitated the search for advance indications of solar flares and, as a result, advanced the forecasting of solar activity. Significant scientific results were obtained during the period of solar flares in 2005. The data from the satellite were received at the receiving station at Neustrelitz in Germany and the radiation-forecasting centre of the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN) in Troitsk, in the Moscow region.

29. In 2005, experimental research was carried out with regard to solar-terrestrial relations and cosmology, using the Coronas-F satellite and also the Conus-A instrument developed under the Conus-Wind project, which is a joint project with the United States of America.

30. The Odyssey spacecraft, launched in 2001 by the National Aeronautics and Space Administration of the United States, carried the Russian high-energy neutron detector (HEND). Its function is to register fast neutron fluxes, which makes it possible to determine the mineralogical composition of the surface of Mars. According to the data obtained with HEND, 15 per cent of the surface of Mars is covered with areas of permafrost, located in the north and south beyond the sixtieth parallels. It has been discovered that the soil in these areas is made up of 30-35 per cent water ice by mass. This finding has fundamentally changed earlier perceptions of Mars. Russian instruments, such as the Planetary Fourier Spectrometer, the Ultraviolet and Infrared Atmospheric Spectrometer (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 Ionosphere Sounding (MARSIS) are installed on the European satellite Mars Express and have been used to carry out a wide range of research on the surface and atmosphere of Mars.

31. The Russian committee for the international scientific research programme is conducting experiments on board the International Gamma-Ray Astrophysics Laboratory (INTEGRAL) of the European Space Agency (ESA) for the observation and study of gamma radiation from space sources, within the Russian Federation's quota of approximately 25 per cent of the exposure time.

4. Commercial uses of space technology

32. Space activities stimulate progress and create a basis for extensive and beneficial applications of the results of scientific research and development as well as of advanced space technology in practically all sectors of the country's economy.

33. A series of studies is being conducted with a view to creating the necessary economic, organizational and regulatory framework for space activities, which would promote the efficient transfer of scientific and technical achievements in rocket and other space technologies to the Russian economy and give rise to various benefits.

34. Aviation and space companies are currently enhancing their production capacity to allow for competitive high-technology commercial production that would meet world technical standards.

35. The priority areas for the development and manufacture of commercial products are as follows:

(a) Developing equipment for the fuel and energy sector, including laser meters, optoelectronic systems for flame detection in combustion components, gas density meters, multiphase pumping stations and control systems for high-level gas compressor stations;

(b) Developing new types of medical technology and means of medical rehabilitation, including devices and tools for rehabilitation of the human musculoskeletal system, special beds for burn victims, a device for extracting kidney stones and prosthetic-orthopaedic devices;

(c) Developing computer and communication tools, including radio payphones and electronic cards for operating them, large-scale terrestrial antenna systems for communications and broadcasting, and navigation systems for guiding river vessels;

(d) Developing equipment for the agro-food processing sector and the construction industry, including equipment for the production of wide polyethylene film, equipment for installing heat insulation made of polyurethane foam compositions, heating systems for vulcanizing presses and pneumatic grinding machines;

(e) Developing new materials, including aluminium foam and new ceramic materials, and advanced technological processes for manufacturing those materials.

5. International cooperation

36. The Russian Federation participates in programmes for the construction and operation of ISS and space systems for environmental monitoring, early warning of destructive natural phenomena and other emergency situations, search and rescue operations and programmes to control and reduce pollution in outer space.

37. In cooperation with other ministries and departments and enterprises engaged in the development of rocket and other space technologies, the Russian Federal Space Agency contributes to international cooperation in space activities in the following main areas:

(a) The use of Russian facilities to launch foreign payloads, in some cases through joint enterprises with foreign partners;

(b) Joint development of rocket engines, in particular RD-180 for Atlas carrier rockets;

(c) Construction, in cooperation with ESA, France and the European manufacturing industry, of facilities for launching and adapting the Soyuz-ST carrier rocket at the Guiana Space Centre in French Guiana;

(d) Partnership in the establishment and operation of ISS and in on-board scientific investigations;

(e) Cooperation with the Democratic People's Republic of Korea and India in the field of satellite navigation;

(f) Joint development with Brazil of a carrier rocket;

(g) Participation in the establishment of a space-rocket complex for the Republic of Korea;

(h) Fundamental space research, including implementation of the Service and Products for Ionosphere Electronic Content and Tropospheric Reflective Index over Europe (SPECTRE) project in wide-ranging cooperation with foreign partners;

(i) Participation in the INTEGRAL project;

(j) Implementation of projects relating to space technology (the Foton-M satellite) and meteorology (Meteor-3M with the United States' Stratospheric Aerosol and Gas Experiment (SAGE-III) instrument);

(k) Expansion of COSPAS-SARSAT.

38. The following activities may be undertaken in the context of developing international cooperation:

(a) Carrying of payloads of foreign design and manufacture on board future satellites of the Meteor-3M, Resurs-DK and Elektro-L types;

(b) Participation in the Global Monitoring for Environment and Security (GMES) programme—which involves the establishment of a terrestrial infrastructure to provide participating countries with environmental monitoring data—and collaboration in shaping the GMES framework;

(c) Participation in the European programme for monitoring forest fires and emergency situations and for forecasting earthquakes, using equipment on board Meteor-3M and Resurs-DK;

(d) Negotiations regarding cooperation in the Galileo programme;

(e) Participation in the Euro-Russian Ural programme.

39. It has been proposed that the Russian Federal Space Agency should become a party to the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters.

40. The Russian Federation's treaty-based practice of international cooperation in the field of space activities continued successfully in 2005. Action was taken on a wide range of intergovernmental agreements, of both a general and a specific nature,

relating to technology protection and also specific programmes and projects. In addition, the Russian Federal Space Agency signed agreements with the space agencies of about 20 countries and ESA on the implementation of specific projects and areas of activity.

41. Overall, thanks to active State support, space activities have every prospect of making further advances in the promotion of social, economic and scientific progress.

42. The Russian Federation complied with all its commitments to its foreign partners in relation to the ISS programme in 2005 and, during the suspension of United States shuttle flights, the Russian Federation's participation made it possible for this international project to continue.

43. The Russian Federation's space capabilities ensure that a full and self-sufficient programme of space activities can be conducted. The country's policy is to engage actively in international space programmes, jointly with the member States of the European Union, China, India, the United States and other partners. The Russian Federation considers that one of the main purposes of cooperation in space activities is to broaden international relations as comprehensively as possible in the interests of sustainable development.