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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

Contents

	<i>Page</i>
I. Introduction	2
II. Replies received from Member States	2
Armenia	2
Austria	3
Canada	5
Germany	9
Japan	11
Myanmar	14
Russian Federation	16



I. Introduction

1. At its fifty-ninth session, in 2022, the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space recommended that the Secretariat continue to invite Member States to submit annual reports on their space activities (A/AC.105/1258, para. 42).
2. In a note verbale dated 19 August 2022, the Office for Outer Space Affairs of the Secretariat invited Member States to submit their reports by 28 October 2022. The present note was prepared by the Secretariat on the basis of replies received in response to that invitation.

II. Replies received from Member States

Armenia

[Original: English]
[27 October 2022]

The Government of the Republic of Armenia continued its efforts to develop national space-related capacities and infrastructure.

On 25 May 2022, the first Earth observation satellite owned by Armenia, ARMSAT-1, was launched into space from Cape Canaveral. The satellite launch was the result of cooperation between the Armenian closed joint-stock company Geocosmos and the Spanish company Satlantis. The space mission will contribute to the development of space science and technologies and generate research activities, further enhancing space-related knowledge in Armenia. The Earth observation data received from the satellite will be used in the areas of agriculture, the prevention and management of disasters, geology and environmental protection.

The continued improvement of the space-related normative regulatory framework was among the priority areas of work. In particular, on 24 August 2022, the Government of the Republic of Armenia adopted the decision on using (operation), development, creation and testing of space equipment and objects to regulate procedures related to the use, development, creation and testing processes of space equipment and objects in the territory of the Republic of Armenia.

The further strengthening of the space-related national regulatory and legislative framework and the adoption of normative legal acts are aimed at facilitating the creation of the scientific foundations of modern space technologies and their use in various sectors of the economy in the Republic of Armenia. Furthermore, it will also contribute to the development of international scientific and scientific-technical cooperation and the integration of Armenia into the international space community.

An important milestone in this regard was the hosting of a technical advisory mission of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) in Armenia. A report on building disaster resilience through space-based technologies, prepared by the technical mission, presents a country profile of Armenia and provides recommendations for developing the capacities and efficient utilization of space technologies for disaster management and prevention.

In 2022, Armenia started cooperation with the Office for Outer Space Affairs-affiliated UR Rao Satellite Centre by sending the first student from Armenia to the Unispace Nanosatellite Assembly and Training programme of the Indian Space Research Organization.

Armenia will continue to pursue the advantages provided by the peaceful use of outer space and space technologies and applications for the achievement of the Sustainable Development Goals. Armenia will also continue its engagement in international

forums, since we believe that only through joint efforts can we overcome the global challenges that we face today.

Austria

[Original: English]
[25 October 2022]

Austrian space research

International cooperation in the physics of our solar system and the diversity of exoplanets

The Space Research Institute of the Austrian Academy of Sciences develops and builds space-qualified instruments and analyses and processes the data provided by such instruments. The institute's core engineering expertise is in building magnetometers and on-board computers, as well as in satellite laser ranging. In terms of science, the institute focuses on the physics of our solar system and the diversity of exoplanets. The institute cooperates closely with space agencies all over the world and with several national and international research institutions. The institute is currently involved in 24 projects led by the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA) of the United States of America and other national space agencies all over the world. In February, Tianwen-1 entered the orbit of Mars. In the same month, Solar Orbiter approached the Sun for the first time. It conducted its second gravity assist manoeuvre at Venus in August and at Earth in November. BepiColombo visited Venus a second time in August and had its first encounter with its target planet, Mercury, in October. In September, the NASA CubeSat mission, CUTE, was launched, dedicated to studying extrasolar planets. The launch of the James Webb Space Telescope marked an astronomical milestone that will allow the observation of exoplanets down to the infrared spectral range for the first time. See www.oeaw.ac.at/en/iwf/home.

Space weather research

The University of Graz plays a key role in the International Space Weather Action Team (iSWAT), initiated under the Committee on Space Research (COSPAR). The iSWAT Cluster H1+H2 paper, part of the update of the COSPAR Roadmap on Space Weather, written by M. Temmer (primary author) with A. Veronig (co-author), will be submitted at the end of January 2023. Furthermore, the University of Graz is the national coordinator of the International Space Weather Initiative and the national contact point and regional warning centre for the International Space Environment Service. The research groups on solar and heliospheric physics maintain groups for the ESA Space Situational Awareness Expert Service Centres on solar and heliospheric weather, providing data and tools for forecasting and nowcasting space weather events emanating from the Sun. In a recent effort, the University of Graz, in collaboration with the University of Technology Graz, became a member of the ESA Space Situational Awareness Ionospheric Weather expert. See <https://spaceweather.at>.

AVIDOS – Aviation dosimetry service

Seibersdorf Laboratories contributes to the ESA Space Weather Service Network (<http://swe.ssa.esa.int>), which operates AVIDOS. AVIDOS is an informative and educational online software developed by Seibersdorf Laboratories for the assessment of the cosmic radiation exposure of passengers and flight personnel at civil aviation flight altitudes. Seibersdorf Laboratories is also part of the Pan-European Consortium for Aviation Space Weather User Services (PECASUS) consortium, which supports the International Civil Aviation Organization with a global space weather information centre. Seibersdorf Laboratories provides the consortium with real-time global maps of radiation exposure in the atmosphere at a wide range of altitudes. See www.seibersdorf-laboratories.at/en/products/ionizing-radiation/dosimetry/avidos.

TEC-Laboratory for accredited testing of electronic components in Austria

The TEC Laboratory of Seibersdorf Laboratories is a state-of-the-art facility that tests electronic components, equipment and systems before they are sent into space. For total ionizing dose radiation tests, on-ground testing involves the use of radioactive Co-60 sources to investigate the behaviour of electronics in radiation environments. Compliance with the EN ISO/IEC 17025 standard for testing laboratories and the European standard for total ionizing dose testing ensures high-quality testing services for customers all over Europe. In addition, Seibersdorf Laboratories has joined forces with FOTEC at the University of Applied Sciences Wiener Neustadt, Aerospace and Advanced Composites and MedAustron to establish the Aerospace Testing Austria Alliance as a one-stop-shop in Austria to ensure that examinations and aerospace test campaigns are of high quality, economical and easily accessible. See www.seibersdorf-laboratories.at/en/home.

Passive Reflectometry and Dosimetry Mission: reference radiation dosimeter for a CubeSat low Earth orbit space mission

The Passive Reflectometry and Dosimetry (PRETTY) Mission is an ESA CubeSat space mission featuring a passive reflectometer and a reference dosimeter system on board a 3U CubeSat. The reference dosimeter system was developed by Seibersdorf Laboratories and features a variety of radiation sensors to investigate the Earth's space radiation environment.

The novel dosimeter system, SATDOS-1, provides the total mission dose and dose rates at regions with elevated radiation levels at the poles and the South Atlantic Anomaly, and the detection of single event effects, which are potentially fatal events caused by traversing charged particles. The PRETTY project is being realized together with ESA, Beyond Gravity Austria and Graz University of Technology. The launch of the 3U satellite is scheduled for the first quarter of 2023. See www.esa.int/ESA_Multimedia/Images/2021/09/PRETTY_CubeSat.

Radiation screening of commercial off-the-shelf components and verification of the radiation hardness assurance approach

Small satellites, such as CubeSat, have become a cost-effective manner of accessing space. Although commercial off-the-shelf (COTS) component performance capabilities often outperform traditional space-qualified components, limitations strongly complicate their use for space applications. Therefore, ESA initiated a study on the radiation screening of COTS components and the verification of the COTS radiation hardness assurance approach (CORHA). Within the CORHA study, Seibersdorf Laboratories and its partner, the University of Padua, investigated 12 commercial components (multiplexers, microcontrollers, memory devices, operational amplifiers, analogue-to-digital convertors) available on the market with respect to their total ionizing dose and single event effect response. See www.seibersdorf-laboratories.at/en/radhard/archive/2019-radhard/lecturers/beck.

Austrian space education activities

One of the six goals of the Austrian Space Strategy 2030+, adopted in 2021, is to foster talent for space by strengthening space competencies in the education system. The focus is on supporting students at all levels of education, from primary school to university graduates, as well as young professionals, thus building capacity in research, technology and business.

Motivating the next generation of space pioneers at primary and secondary schools

The European Space Education Resource Office (ESERO) project is the ESA approach to supporting the primary and secondary education community in Europe. ESERO uses space-related themes and the fascination felt by young people about space to enhance students' literacy and competencies in subjects relating to science, technology, engineering, arts and mathematics (STEAM). ESERO Austria is located

at Ars Electronica in Linz and is supported by the Austrian Research Promotion Agency and the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology. ESERO Austria supports teachers in the use of the context of space to make the teaching and learning of relevant topics more attractive and accessible to students and produces teaching materials for Austrian schools that use space as a context. In 2022, ESERO Austria, together with experts from academia, successfully continued the online webinar series for teachers entitled “Teaching the wonders of outer space in the classroom”. The online webinars are offered as an accredited teacher training course for teachers of all levels all over Austria. See <https://ars.electronica.art/esero/de>.

New Executive Master of Business Administration programme on space architecture at the Technical University of Vienna

A new Executive Master of Business Administration (MBA) programme in the management and technology of space architecture starts 23 March 2023 at the Technical University of Vienna. The interdisciplinary MBA imparts knowledge and know-how on new technologies and strategies for planning, building and living in space and reflects on synergies relating to current issues in the use of resources, technology and climate. See www.tuwien.at/mba/space.

Canada

[Original: English]

[24 October 2022]

Summary

In 2022, Canada engaged in a number of diverse space activities. Canada continued to provide invaluable support to the International Space Station (ISS) through the use of Canadarm2 and Dextre and continued the operation of its satellite fleet, including the RADARSAT Constellation Mission, SCISAT and the Near-Earth Object Surveillance Satellite (NEOSSat). Canada is currently chairing the International Space Exploration Coordination Group (ISECG) and is preparing for the next major Canadian infrastructure contribution to human spaceflight as well as contributions in food and health for deep space. Canada continues to actively support the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (also called the International Charter on Space and Major Disasters). For the latest information, and more details on the programmes mentioned, we invite you to view the Canadian Space Agency (CSA) website at www.asc-csa.gc.ca.

International Space Station

The contribution of Canada to ISS, the Mobile Servicing System (Canadarm2, Dextre and the Mobile Base System), continues to operate successfully. Human health science remains a Canadian priority for the utilization of ISS, with the development of new multipurpose medical and research platforms to address the risks associated with human space flight. Canada also initiated the development of a novel and breakthrough biological sample preparation technology for ISS and pursued scientific studies related to health on ISS including the Marrow, SANSORI, T-Bone2, Vascular Echo, Vascular Aging, Vascular Calcium, Wayfinding and Vection studies.

Planetary sciences

Canada’s OSIRIS-REx Laser Altimeter on the asteroid-sampling mission OSIRIS-REx of the National Aeronautics and Space Administration (NASA) of the United States of America played a critical role in determining the sampling site from which OSIRIS-REx acquired samples in December 2020. OSIRIS-REx is now on its way back to Earth with its cargo, with an expected return in 2023. Canada currently chairs ISECG, composed of 27 space agencies focused on enhancing international

coordination in space exploration. Canada is also working with partners to define an orbital mission to Mars carrying a synthetic aperture radar to map the Martian subsurface water ice.

Lunar initiatives

Canada will be contributing Canadarm3, a smart robotic system, to the NASA lunar Gateway programme, and creating a range of opportunities for lunar science, technology demonstration and commercial activities, as well as two astronaut flights to the Moon. A CSA astronaut will be part of the NASA Artemis II mission, the first crewed mission to the Moon since 1972.

Under the Lunar Exploration Accelerator Program (LEAP), several initiatives are under way to deliver Canadian technologies to the Moon over the next five years. The mission will deliver a Canadian rover, carrying both United States and Canadian instruments, on a NASA Commercial Lunar Payload Services delivery flight. LEAP is also funding the Canadian participation in commercial lunar missions: so far, three Canadian companies have secured flights to the Moon on at least four missions going into lunar orbit or to the lunar surface. Canada also initiated the Lunar Surface Exploration Initiative, which involves activities to prepare potential options for the next major Canadian infrastructure contributions to human spaceflight, with a focus on the lunar surface. In this context, CSA, on behalf of Canada, announced the funding of seven concept studies proposed by Canadian companies to advance options for future infrastructure to enable a sustained human presence on the Moon.

CSA is carrying out activities related to space and terrestrial food production, including the Naurvik Initiative, a renewable energy plant production system in Gjoa Haven, Nunavut (Arctic region), and working with NASA on the Deep Space Food Challenge. As space agencies around the world are planning for the next steps in human space exploration, Impact Canada and CSA partnered on the Deep Space Healthcare Challenge, a competition to develop innovative health-care technologies for people living in remote communities and crews on long-duration space missions. On 25 May 2022, 20 semi-finalists were selected to participate.

Space atmospheric sciences

Canada's SCISAT satellite, which measures ozone and ozone-depleting substances, continues to operate nominally and provides valuable data to multiple scientific coordination activities that advance climate science. It remains the only system to measure hydrofluorocarbons from space. It is also the only satellite able to measure all major greenhouse gases, including producing high-quality atmospheric profiles of carbon dioxide down to 5 km.

Canada will contribute to the Atmosphere Observing System (AOS) mission led by NASA, along with the Japan Aerospace Exploration Agency, the National Centre for Space Studies (CNES) of France and the German Aerospace Center. AOS is an international multi-satellite mission with instruments that will measure aerosols and clouds and how they interact to affect Earth's weather and climate. Canada's contribution, the High-altitude Aerosols, Water vapour and Clouds (HAWC) mission, consists of two instruments on a Canadian satellite and a third instrument on a NASA satellite. The mission will provide critical data to support extreme weather prediction and climate modelling as well as to monitor disasters, such as volcanic eruptions, wildfires and extreme precipitation. The data collected by HAWC and AOS will improve the ability to predict near-term weather events, long-term climatic conditions and air quality. HAWC is scheduled to be launched in 2031.

Space-based astronomy

Canada continues to support the James Webb Space Telescope project, a partnership between NASA, the European Space Agency (ESA) and CSA, which was launched on 25 December 2021. Canada provided two instruments: the Fine Guidance Sensor and the Near-Infrared Imager and Slitless Spectrograph. The partnership offers

Canadian astronomers a share of the observation time on the most complex and powerful space telescope ever built.

Canada is currently preparing its participation in the ESA Ariel space mission through the provision of a cryogenic harness derived from the cryogenic harness developed for the James Webb Space Telescope. In addition, Canada is working with partners to explore a potential mission called LiteBIRD, a small space observatory aimed at detecting primordial gravitational waves. Canada's contribution will be the read-out electronics for the telescope's detectors. Canada also continues to operate its own space telescope, NEOSSat. Through the NEOSSat Science Guest Observation Program, Canadian astronomers publish near-Earth asteroid and comet observation data to the Minor Planet Center of the International Astronomical Union and participate in international observation campaigns under the International Asteroid Warning Network, as well as other international initiatives. Similarly, Canada is contributing a satellite to the BRITe Constellation. The BRITe satellites have been observing the brightest stars since 2013, an exceptional lifespan for nanosatellites.

Space weather

Canada continues to operate ground imagers and magnetometers across Canada, through the support of the University of Calgary and the University of Alberta. The systems contribute to the NASA THEMIS mission through ground-based observations of the aurora borealis. Canada continues to collaborate with ESA Swarm mission, which measures the magnetic fields generated by the Earth. ESA procured a Canadian Electric Field Instrument for each of the Swarm mission's three satellites.

Space situational awareness

Canada's Sapphire satellite is still providing data on deep-space objects to the Space Surveillance Network of the United States, helping to maintain the safety of space objects in Earth orbit. The NEOSSat space telescope is still operational and supports Canada's space situational awareness research and development mission by tracking and characterizing space objects in orbital regimes from low Earth orbit to deep space. The follow-on project to Sapphire, Surveillance of Space 2, continues in the planning stages. The project will include both ground-based and space-based sensors to maintain and advance Canada's contribution to the Space Surveillance Network. Canada is also in the planning stages for a new space situational awareness research microsatellite, named Redwing, to advance space situational awareness research, development and technology demonstrations in low Earth orbit.

Canada's Conjunction Risk Assessment and Mitigation System continues to provide invaluable analysis services to help satellite operators in Canada and internationally to quickly make the best decision in response to on-orbit close approaches identified by the Space Surveillance Network. The service plays an important role in preventing in-orbit collisions. Canada continues its active participation in the Inter-Agency Space Debris Coordination Committee and the Interagency Operations Advisory Group.

Earth observation

In 2022, Canada launched its whole-of-government Strategy for Satellite Earth Observation. The strategy lays the foundation for strategic investments, flexible programming and strong partnerships with stakeholders to best deliver data that meet the needs of the community and government priorities. The RADARSAT Constellation Mission continues to support the Government in its mandate to monitor the impacts of climate change, protect our environment and foster sustainable development, manage natural resources and support disaster relief.

Canada's contribution to the NASA Surface Water and Ocean Topography (SWOT) satellite, planned for launch in late 2022, is now complete, with the delivery of three instruments (Extended Interaction Klystrons) that are at the heart of the Ka-band Radar Interferometer. Canada, in partnership with multiple Canadian universities,

is preparing for the validation and use of SWOT data to improve its coastal and water-related services.

In May, Canada announced the WildFireSat mission, which is aimed at monitoring all active wildfires in Canada from space on a daily basis. The mission will use infrared sensors to measure energy coming from wildfires. The primary goal is to support wildfire management, but the mission will also provide Canadians with more precise information on smoke and air-quality conditions. It will further enable more accurate measurements of carbon emitted by wildfires, an important requirement of international agreements on carbon reporting.

In addition, CSA continues to cooperate with NASA in the preparation and delivery of 10 Earth observation sessions for the annual Indigenous Mapping Workshop 2022, as part of a task under the Committee on Earth Observation Satellites Working Group on Capacity-building and Data Democracy. The Indigenous Mapping Workshop events are organized by The Firelight Group for indigenous nations and organizations as well as practitioners that support indigenous-led geospatial research and projects.

Science, technology, engineering and mathematics outreach

CSA continues to engage with education and science, technology, engineering and mathematics (STEM) outreach collaborators and to work on Objective: Moon, a series of STEM initiatives and resources for youth and educators related to the return to the Moon. CSA provided grants to nine organizations (science centres, universities and not-for-profit organizations) engaging young minds in a variety of hands-on STEM learning experiences, two of which specifically reach Indigenous youth. Four national-scale initiatives also received funding to develop activities and resources for primary and secondary school-aged audiences on science performed by lunar rovers and artificial intelligence-enabled robotics. CSA complemented its “digital first” commitment to making all its content and resources available via the Internet in English and French by offering both virtual presentations and in-person opportunities to hear about upcoming missions and Canadian contributions to advancements in space STEM.

National technical, science and human capacity-building

In 2022, Canada continued the Canadian CubeSat Project, in which 15 teams from across Canada are taking part in real space missions by designing, building and eventually launching and operating their own CubeSats. The first teams will launch their CubeSats to ISS in fall 2022, while other teams are expected to launch their CubeSats in early 2023.

The Flights and Fieldwork for the Advancement of Science and Technology (FAST) initiative awarded 22 grants to Canadian universities and colleges for research projects. The projects will contribute to the development of new scientific knowledge and space technologies while making it possible for students and postdoctoral fellows to acquire valuable hands-on experience in space-like missions.

CSA continued its stratospheric balloon initiative, STRATOS, in collaboration with CNES. In August 2022, four zero-pressure balloons carrying 18 payloads from Canada and Europe were launched from the Timmins stratospheric balloon base to test new technologies, conduct science experiments and take measurements. In addition, stratospheric expandable balloons were launched with educational payloads on board.

Support to global challenges

Canada continues to work closely with international partners as part of disaster relief programmes, making its Earth observation data available in times of crisis and helping to assess the impact and mitigate the risk of natural and man-made disasters. While supporting domestic disaster management and relief, Canada continues to actively

support the International Charter on Space and Major Disasters, a collaboration founded by ESA, CNES and CSA, that currently has 17 members.

Space policy

Canada continues its internal assessment of its compliance with the 21 Guidelines for the Long-term Sustainability of Outer Space Activities in order to identify gaps and areas for review to further strengthen its commitment to the safety and sustainability of outer space. Canada is also pursuing its review of the regulatory framework to ensure timely responses for industry, maintain strategic oversight for national security and enable commercial growth. Canada completed the third independent review of the Remote Sensing Space Systems Act, required as a formal part of the Act. CSA also participated in the first meeting of the Artemis Accords signatories as they discussed the important role the Accords could play in establishing principles to conduct safe and sustainable operations beyond low Earth orbit. The signatories reaffirmed their assertion that the Artemis Accords were a first step, but that the work needed to continue within the Committee on the Peaceful Uses of Outer Space.

Germany

[Original: English]
[27 October 2022]

German space activities are deeply embedded in European and international collaborations, in particular within the European Space Agency (ESA) and the European Union. Germany attaches great importance to international cooperation in the peaceful uses of outer space and has made the intensification of international cooperation a guiding principle of its space strategy. The present report provides a number of select examples of German space activities conducted with international partners.

Cosmic Kiss mission

German ESA astronaut Matthias Maurer spent approximately six months on board the International Space Station (ISS), from 2 November 2021 to 6 May 2022. His Cosmic Kiss mission lasted 176 days, during which the astronaut carried out 36 German and more than 100 international experiments. They ranged from biomedical and materials science experiments to technology and artificial intelligence testing, all of them geared towards improving life both in space and on Earth. The German contributions were selected and coordinated by the German Space Agency at the German Aerospace Center (DLR) and financed through Germany's national space programme, which is managed by the German Space Agency on behalf of the Federal Government, as well as the ESA Science in the Space Environment (SciSpacE) programme.

Italian ESA astronaut Samantha Cristoforetti arrived at ISS 10 days before Maurer returned to Earth, marking the first time in more than 10 years that two European astronauts were on ISS at the same time. Maurer and Cristoforetti held a joint press conference on ISS, demonstrating the European commitment to international cooperation in space activities.

Environmental Mapping and Analysis Program

On 1 April 2022, the Environmental Mapping and Analysis Program (EnMAP) was launched from the United States. The hyperspectral satellite consists of two spectrometers with an unprecedented resolution that are analysing solar radiation reflected from Earth's surface at wavelengths ranging from visible light to short-wave infrared. The EnMAP hyperspectral remote sensing capabilities can be used to quantify the properties of materials on Earth's surface by revealing their spectral signatures. The data finds application in a variety of fields, ranging from environmental planning and resource management to agriculture, forestry, land use, water management and geology. Providing valuable insights into the ecosystems of

the world and their composition, the EnMAP mission represents a significant contribution by Germany to the international effort to achieve the Sustainable Development Goals.

The mission was developed and built by OHB System AG and is managed by the German Space Agency on behalf of the Federal Ministry for Economic Affairs and Climate Action. The German Research Centre for Geosciences in Potsdam is responsible for the scientific coordination of the mission.

European Space Agency Living Planet Symposium

From 23 to 27 May 2022, the ESA Living Planet Symposium was held in Germany for the first time with support from the German Space Agency. The event gathered 4,700 Earth observation experts from 74 countries at the World Conference Centre in Bonn, convening under the theme “Taking the pulse of our planet from space”. It was dedicated to the contribution of Earth observation to science and society. Topics included measuring biomass, observing the world’s oceans, improving agricultural sustainability, surveying and improving air quality, documenting ice melt at the poles and developing countermeasures and using satellites for climate and crisis management, as well as the economic impact of Earth observation. The symposium was an excellent opportunity for international exchange among experts on global challenges, which can be tackled in a more focused way with the help of Earth observation.

TerraSAR-X

On 15 June 2022, the German Earth observation satellite TerraSAR-X celebrated its fifteenth anniversary. It was launched in 2007 and has been providing high-quality radar images as synthetic aperture radar data with its X-band radar sensor ever since, producing 1-m resolution image data regardless of cloud cover or daylight. As such, it enables researchers worldwide to apply data to a multitude of fields, including environmental research, vegetation monitoring, infrastructure planning, navigation and security. In more than 83,000 orbits around the Earth, the mission has acquired more than 400,000 radar images and 1.34 petabytes of data, facilitating an understanding of the changing Earth environment. Since 2010, it has been accompanied by the almost identical TanDEM-X satellite; together the satellites have created a digital elevation model of the Earth. The satellite has a strong international dimension, with more than 1,100 leading researchers from 64 countries processing its data in 1,875 ongoing research projects (as of June 2022). The mission also supports the International Charter on Space and Major Disasters. The satellite was developed on behalf of DLR with funds from the Federal Ministry for Economic Affairs and Climate Action together with Airbus Defence and Space, which contributed to the cost of development, construction and operation.

Stratospheric Observatory for Infrared Astronomy

On 28 September 2022, the Stratospheric Observatory for Infrared Astronomy (SOFIA), a joint mission between the German Space Agency and National Aeronautics and Space Administration (NASA) of the United States of America, took its last of approximately 800 flights over a span of eight years. The collected data provided insight into the development of galaxies and the evolution of stars and planetary systems, significantly contributing to the fields of astrochemistry and astrophysics. Germany supplied the airborne telescope and two spectrometers, which were funded by the Max Planck Society for the Advancement of Science of Germany and the German Research Foundation. Scientific operations were jointly coordinated by the German SOFIA Institute at the University of Stuttgart and the Universities Space Research Association of the United States.

Contributions to the Artemis I mission

Artemis I is intended to begin the return to the Moon via the Space Launch System heavy launch vehicle and the Orion spacecraft. The uncrewed test flight of the systems and their interaction with ground control is scheduled for late 2022. The European Service Module, together with the United States crew module, is part of the Orion Spacecraft, which will perform multiple orbits around the Moon in the test flight. The service module contains the main engine, supplies electricity, regulates temperature and stores fuel oxygen and water. Its parts were supplied by 10 ESA member States. Germany is the main contributor to the European Service Module, which is being manufactured by a European industrial consortium under the leadership of Airbus, the principal ESA contractor, and assembled in Bremen. German contributions through ESA are managed by the German Space Agency on behalf of the Federal Government. The Orion module is considered a key milestone for future astronautical exploration and missions to the Moon, and the European Service Module is fundamental to its operation. NASA has ordered additional European Service Modules from ESA, with the next one to be delivered in early 2023 for Artemis II.

Artemis I will also carry the Matroshka AstroRad Radiation Experiment (MARE) led by the DLR Institute of Aerospace Medicine in Cologne. For the experiment, two identical mannequins, with more than 10,000 passive sensors and 34 active radiation detectors, will fly to the Moon, one of them equipped with a newly developed radiation protection vest and the other without any protection. The sensors will measure the radiation exposure on the journey to the Moon as well as the effectiveness of mitigation measures. It is the first experiment to measure radiation exposure to the female organism outside of ISS.

Double Asteroid Redirection Test Mission

On 27 September 2022, the NASA Double Asteroid Redirection Test (DART) mission successfully made contact with the asteroid Dimorphos during a targeted approach; for the first time, the orbit of a celestial body was changed by a spacecraft. The mission is part of the Asteroid Impact and Deflection Assessment collaboration between ESA, DLR, the Observatory of the Côte d'Azur, NASA and Johns Hopkins University Applied Physics Laboratory. A follow-up mission, Hera, will be launched in 2026 by ESA to further analyse the asteroid's changed orbit. Hera will be built and developed largely in Germany, with the German contribution managed by the German Space Agency. Together, the missions will provide fundamental insights into the potential deflection of asteroids for the development of future planetary defence strategies.

Japan

[Original: English]
[20 October 2022]

1. International Space Station

Japan has been actively participating in the International Space Station (ISS) programme for the peaceful uses of outer space since its foundation. ISS is the largest international science and technology cooperation programme ever attempted in the new frontier of space. The participants in the programme seek to further the utilization of outer space for the benefit of all on Earth.

One of Japan's notable contributions to the ISS programme is the Japanese experiment module "Kibo". Japan has been promoting the utilization of Kibo to maximize its outcomes. For example, various experiments have been conducted aboard Kibo, including materials and physical science, medical science, life science and capacity-building. From April to November 2021, Japanese astronaut Akihiko Hoshide completed a long-duration mission as the commander of ISS. During the mission,

Astronaut Hoshide conducted numerous experiments, including for medical science, and joint experiments with private companies on plant cultivation for lunar exploration, and gave lectures for Asian students. Most recently, in October 2022, Japanese astronaut Koichi Wakata began a long-duration mission aboard ISS.

Japan is also contributing to capacity-building in developing and emerging countries through the utilization of Kibo, which is the only module on ISS equipped with both a robotic arm and an airlock. The unique capability clears the way for various outboard projects, such as the deployment of small satellites. The Japan Aerospace Exploration Agency (JAXA) is collaborating with the Office for Outer Space Affairs on the KiboCUBE programme, which provides developing and emerging countries with opportunities to deploy CubeSats from Kibo. So far, the satellites of Guatemala, Kenya, Mauritius and Moldova have been deployed via Kibo through the programme. In 2019, JAXA launched a new educational competition called the “Kibo Robot Programming Challenge”, in collaboration with the National Aeronautics and Space Administration (NASA) of the United States of America, and held the second series of the competition in 2021. The number of participating countries in the second series increased to a total of 286 teams from 11 countries in the Asia-Pacific region. The third series was held in 2022.

2. Space transportation

JAXA is developing the H3 Launch Vehicle, Japan’s next-generation heavy-lift launch vehicle, whose inaugural flight is slated for the Japanese fiscal year 2022. The H3 launch vehicle will play an important role in international cooperation, such as the transportation of the HTV-X to ISS. This new unmanned cargo transfer spacecraft, which is currently under development, will deliver supplies to ISS.

Additionally, JAXA is developing the Epsilon S launch vehicle, based on the technical achievements of the Epsilon launch vehicle, to strengthen Epsilon’s international competitiveness in the satellite launch market. For example, a new contract was announced in 2020 to launch the Vietnamese Earth observation satellite LOTUSat-1 via the Epsilon S launch vehicle.

JAXA is also collaborating on the CALLISTO project for space transportation technology innovation, in partnership with the National Centre for Space Studies (CNES) of France and the German Aerospace Center (DLR). The joint project is expected to demonstrate the reusability of launch vehicles, leading to a significant decrease in the cost of space transportation.

3. Space exploration and science

Space exploration

Collaboration with international partners is a key component of Japan’s space exploration missions. In June 2020, the Government of Japan updated the Basic Plan on Space Policy and the Implementation Plan, highlighting Japan’s participation in the Artemis Program. In October 2020, as part of the first Artemis Accords signatory group, Japan signed the Accords as a political commitment to establish an internationally shared framework on various principles for civil space exploration activities and the use of outer space by national space agencies. In December 2020, the Government of Japan signed a memorandum of understanding with NASA to cooperate on the civil lunar Gateway programme. Japan is expected to provide habitation capability and logistics resupply services to Gateway, using technology acquired through the operation of ISS.

In the area of lunar surface exploration, JAXA is developing the Smart Lander for Investigating Moon (SLIM), scheduled for launch in the Japanese fiscal year 2022, to demonstrate pinpoint landing technology. JAXA is also cooperating with the Indian Space Research Organization and the European Space Agency (ESA) on the Lunar Polar Exploration Mission, with a launch expected in 2025. The mission is aimed at exploring potential resources, such as water ice in the lunar polar region, to

investigate the feasibility of future resource utilization. Moreover, JAXA is conducting joint research with Japanese private companies to develop a crewed pressurized rover as a means of transportation to support sustainable lunar surface exploration in the late 2020s and beyond.

Regarding Mars exploration, JAXA is planning the launch of the Martian Moons eXploration (MMX) mission in the Japanese fiscal year 2024, which is aimed at investigating Mars and its moons, Phobos and Deimos, and collecting samples from Phobos. MMX is the next sample-return project following the successful mission of Hayabusa 2, which explored the C-type asteroid Ryugu and brought samples back to Earth in December 2020. NASA, CNES, DLR and ESA will contribute to MMX, an international cooperative mission.

Space science

JAXA continues to actively plan and conduct various space science missions with its international partners. In October 2018, BepiColombo, the ESA-JAXA joint mission to explore Mercury, was successfully launched from French Guiana by the Ariane 5 rocket. BepiColombo is currently on a seven-year journey to Mercury via multiple planetary swing-by manoeuvres and is scheduled to arrive at Mercury in December 2025.

JAXA is currently developing the X-Ray Imaging and Spectroscopy Mission (XRISM), which is aimed at investigating X-ray objects in the universe with high-throughput imaging and high-resolution spectroscopy. XRISM is a collaborative mission with NASA and ESA and is scheduled to be launched in the Japanese fiscal year 2022.

JAXA is also developing the Demonstration and Experiment of Space Technology for Interplanetary Voyage with Phaethon Flyby and Dust Science (DESTINY+) for a planned launch in the Japanese fiscal year 2024. DESTINY+ will perform a flyby and observe the asteroid Phaethon. It will also conduct an in situ analysis of cosmic dust, which is considered to be a source of organic matter on Earth, and demonstrate future technology for deep space exploration.

4. Remote sensing

Earth observation satellites can observe not only Japan, but also the entire globe. Utilizing the capabilities of such satellites, data is being used in Japan and around the world for various purposes, from monitoring daily changes, such as weather forecasting and disaster management, to future climate change prediction.

JAXA aims to provide solutions and services to the world in order to contribute to solving global social issues, such as climate change, disasters, water resources, food security and biodiversity, and achieving the Sustainable Development Goals by utilizing the space-based data collected by Earth observation satellites.

A series of Greenhouse Gases Observing Satellites (GOSAT) have been developed by Japan's Ministry of the Environment, the National Institute for Environmental Studies and JAXA. The first GOSAT, launched in 2009 as the world's first satellite dedicated to monitoring greenhouse gases, including carbon dioxide (CO₂) and methane (CH₄), has been accumulating data for more than a decade. In October 2018, Japan launched a follow-up mission, GOSAT-2. GOSAT-2 monitors the same observables, CO₂ and CH₄, but with higher accuracy across a broader range of locations, and also observes carbon monoxide to estimate local CO₂ flux more accurately and precisely.

In 2019, the Intergovernmental Panel on Climate Change adopted refined guidelines to prepare and submit an inventory report on emissions. In the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*, the role of satellite observation data was defined as a key tool for verifying the accuracy of the national inventory report. JAXA has been working closely with NASA, ESA, CNES, DLR, the European Organization for the Exploitation of Meteorological Satellites and other international partners to provide its latest findings based on space-based greenhouse

gas observation data at various conferences, including the Conference of the Parties to the United Nations Framework Convention on Climate Change.

JAXA is also promoting international cooperation in the utilization of satellite data to increase global understanding of the changing environment caused by human activities. In 2020, JAXA launched the Earth Observing Dashboard together with ESA and NASA, a website that integrates indicators derived from the Earth observation data of the three organizations to visualize the impacts of the coronavirus disease and track changes in air and water quality, greenhouse gases, economic activity and agriculture. In 2022, the Earth Observing Dashboard expanded its scope to global environmental change with additional indicators and stories.

Japan is fully committed to playing an active role in helping to maximize progress towards the Sustainable Development Goals. JAXA has been working to utilize satellite Earth observation data to monitor progress on the Goals. To this end, JAXA has cooperated with the Ministry of Internal Affairs and Communications on the surveys and research related to Goal 15.4.2 (Mountain Green Cover Index) implemented under the industry-government-academia partnership meeting for the promotion of the use of big data. The computation and validation of the indicator was carried out using satellite-based global and national land cover data. After the validation, Japan's progress on Goal 15.4.2 was officially reported in its Voluntary National Review 2021.

5. Space-based positioning, navigation and timing system

Japan has been developing a space-based positioning, navigation and timing system called the "Quasi-Zenith Satellite System" (QZSS). QZSS has been operating as a four-satellite constellation since November 2018. Three satellites are visible at all times from locations in the Asia-Oceania region. QZSS can be used in an integrated way with the Global Positioning System, ensuring a sufficient number of satellites for stable, high-precision positioning. The first satellite (QZS-1) was launched in 2010 and its replacement satellite (QZS-1R) was successfully launched in October 2021. Japan is also planning to establish a seven-satellite constellation to maintain and improve capabilities for sustained positioning by the end of March 2024.

6. Asia-Pacific Regional Space Agency Forum

The Asia-Pacific Regional Space Agency Forum (APRSAF) was established in 1993 to enhance space activities in the Asia-Pacific region. Space agencies, governmental bodies and international organizations, such as the United Nations agencies, as well as companies, universities and research institutes from over 40 countries and regions take part in APRSAF every year. It is the largest space-related conference in the Asia-Pacific region.

In 2021, Viet Nam and Japan hosted the twenty-seventh session of APRSAF online from 30 November to 3 December, under the theme "Expand space innovation through diverse partnerships." From 15 to 18 November 2022, Viet Nam and Japan will host the twenty-eighth session of APRSAF under the theme "Bridging space innovations opportunities for a sustainable and prosperous future".

Myanmar

[Original: English]
[20 October 2022]

The Government of the Republic of the Union of Myanmar has formulated a space programme (Myanmar Space Programme) aimed at realizing the aspirations to launch a national satellite and gaining control over strategic national communications and broadcasting. The second aim is to create a commercially viable and sustainable satellite-based communications industry in Myanmar, building a selective position in regional and multiregional markets.

In this respect, Myanmar issued a request for proposals dated 10 August 2015 and selected the satellite operator Intelsat, a global leader in the supply of satellite services, with the aim of setting up a venture for the joint operation of a satellite to be launched in the future, and in the meantime for the lease of satellite capacity through a five-year agreement on the satellites (Intelsat 902, located at 62 degrees East, and Intelsat 906, located at 64.15 degrees East).

The agreement was signed on 27 May 2016. The agreement mentions that the agency (Information Technology and Cybersecurity Department of the Ministry of Transport and Communications of Myanmar) desires to operate a portion of the payload of the satellite (called MyanmarSat-1) and Intelsat Global Sales and Marketing Ltd. (operator) desires to lease MyanmarSat-1 to the agency. This activity is the first step of the Myanmar Space Programme.

It is mentioned in the agreement that, for long-term service, the agency shall have the option to accept an indefeasible right of use. If the agency would like to exercise the long-term option, it has to notify the operator. According to the approval, the indefeasible right of use agreement for the Intelsat 39 satellite payload was signed on 1 June 2018. According to the indefeasible right of use agreement, the payload on the satellite is to be separately branded and marketed by Myanmar as its own satellite under the name “MyanmarSat-2” for 15 years. This activity is the second step of the Myanmar Space Programme.

The Intelsat 39 satellite was launched on 6 August 2019. The terms and conditions for the indefeasible right of use agreement are as follows:

- (a) Bandwidth: 6x72 MHz C-band and 6x72 MHz Ku-band;
- (b) Satellite orbital location: 61.95 degrees East;
- (c) Beam: Myanmar regional C-band spot beam and steerable Myanmar regional Ku-Band spot beam.

Intelsat 39 is a high-power geostationary communications satellite that can provide broadband networking and video distribution services in Africa, Europe, the Middle East and Asia. The Intelsat 39 satellite was built by Space Systems Loral on the SSL 1300 platform and carries a C and a Ku band communications payload. The satellite uses both electric and chemical propulsion for orbit raising and operates with full propulsion on orbit. The satellite was launched by Arianespace.

The third step of the Myanmar Space Programme is to launch a national satellite. Myanmar Aerospace Engineering University carried out the Earth observation microsatellite project in cooperation with Hokkaido University, Japan.

The satellite construction was carried out at Hokkaido University. The ceremony of transferring the satellite from Hokkaido University to the Japan Aerospace Exploration Agency (JAXA) was held on 21 October 2020. Under the agreement with Hokkaido University, JAXA is responsible for launching the Myanmar satellite, called “MMSAT 1”. The satellite was transported to the International Space Station (ISS) in February 2021 by JAXA and was released into orbit from ISS in March 2021.

The satellite is located in low Earth orbit at an altitude of 400 km above the Earth’s surface. It orbits the Earth longitudinally, passing above the South and North poles and traversing the Earth’s rotation. It also passes over Myanmar twice a day, once in the daytime and once in the night-time.

Each time the satellite passes over Myanmar, it is controlled by the ground control station at Hokkaido University. While MMSAT 1 is passing over Myanmar, it can capture aerial images and remote sensing data over Myanmar with its on-board optical payload. For satellite control, telemetry data are transmitted through an S-band uplink (1 kilobit per second) from the ground control station, and images and data (raw data) are transmitted through an X-band downlink (2 megabits per second) from the satellite to the ground control station. The satellite has a lifespan of two and half to three years.

The Myanmar Earth observation microsatellite launching programme includes two satellites and two ground control stations, one in Myanmar and one in Japan. There are satellite testing laboratories and a scholarship programme for trainees to study in Japan.

The project will consolidate Earth observation data and information related to the following:

- (a) Agriculture sector;
- (b) Forestry sector;
- (c) Urban planning sector;
- (d) Maritime and oceanography sector;
- (e) Mineral exploration and mining sector;
- (f) Hydrology and water resources sector;
- (g) Environmental sector;
- (h) Disaster management sector.

Using space technologies can benefit international peace, safety and security. The Government can ensure peaceful, safe, secure and sustainable space activities while performing this project. Moreover, as a milestone of the UNISPACE+50 symposium for the wider space community to exchange views on the future of international space cooperation and the peaceful uses of outer space, our country will take part as a participant in the regional and global development of present and future space science and technology for the peaceful use of outer space.

Russian Federation

[Original: Russian]
[17 October 2022]

In 2022, space activities in the Russian Federation were carried out in accordance with the Space Activities Act of the Russian Federation and other guiding documents relating to such activities.

The main civilian space activities that were carried out are as follows:

1. As at 1 September 2022, the Russian Federation had launched five space rockets, including:
 - (a) Three as part of the Russian Federal Space Programme for 2016–2025;
 - (b) One as part of the maintenance, development and use of the Russian Global Navigation Satellite System (GLONASS) federal project;
 - (c) A Soyuz-2-1b rocket within the framework of commercial programmes (Khayyam spacecraft of the Islamic Republic of Iran), launched from the Baikonur Cosmodrome).

In addition, as part of international cooperation activities with the participation of Russian experts, the Russian Soyuz-ST rocket was launched from the Guiana Space Centre.

2. As at 1 September 2022, 31 satellites had been launched, including:
 - (a) Thirty satellites to be used for socioeconomic and scientific purposes, including 26 small satellites, 10 of which were launched from the International Space Station (ISS);
 - (b) One (foreign) commercial satellite.

In addition, with the participation of Russian experts, 34 foreign satellites were launched by a Soyuz-ST carrier rocket from the Guiana Space Centre.

3. As at 1 September 2022, the Russian orbital constellation comprised 124 satellites used for socioeconomic and scientific purposes.

Compared with 2021, in the first eight months of 2022 the number of satellites (including small satellites) in the Russian orbital constellation increased by 21.

Piloted space flight programmes have been implemented and the country's international obligations with respect to the operation of ISS have been fulfilled.

The GLONASS orbital constellation of 26 satellites has continued to operate and support has been provided for the necessary ground infrastructure. In order to replenish the orbital constellation, one GLONASS-K satellite was launched on an "operating needs" basis.

The Earth remote sensing constellation included 11 satellites, including 1 satellite for natural resource monitoring, 5 hydrometeorological satellites and 5 satellites for real-time monitoring of human-caused and natural disasters.

The Gonets-M system of personal mobile satellite communications, comprising 15 satellites, was established.

In the area of fundamental space research, in 2022, in close collaboration with the Russian Academy of Sciences, the following main activities were carried out:

(a) Implementation of the Spektr-RG space X-ray observatory project, following the successful launch of the observatory (a space astrophysical observatory for the study of astrophysical objects in the X-ray band of the electromagnetic radiation spectrum) in 2019;

(b) Performance of scientific experiments using Russian instruments aboard the foreign spacecraft WIND, Lunar Reconnaissance Orbiter, Mars Odyssey, Mars Express, the Mars rover Curiosity of the National Aeronautics and Space Administration (NASA) of the United States of America and BepiColombo;

(c) The creation of a new map of the hydrogen content of Mars' soil by the Russian neutron telescope FRENDA aboard the ExoMars Trace Gas Orbiter spacecraft during the Russian-European ExoMars 2016 mission.

By decision of the Council of the European Space Agency member States, bilateral cooperation with the State Space Corporation Roscosmos on the ExoMars 2022 mission has been suspended. At present, Russian and European stakeholders are analysing possible options for further work on the Exomars 2022 project.

Work has continued on Luna-Glob (a Russian space complex comprising a landing vehicle for testing the technology for a soft landing on the Moon and for research on the lunar surface in the polar region; a launch is scheduled for 2023).

The international obligations undertaken by the Russian Federation have been met in full, and cooperation in the area of fundamental space research has continued.

While maintaining cooperative ties with its traditional partner countries, Russia is developing and establishing cooperation in the area of space activities with the other BRICS countries (Brazil, India, China and South Africa) and with States members of the Commonwealth of Independent States.

As part of the ISS programme, Roscosmos and NASA have signed an agreement on cross flights of Russian astronauts aboard United States-crewed spacecraft and United States astronauts aboard Russian-crewed spacecraft. Under that agreement, on 21 September 2022, the Russian spacecraft Soyuz MS-22, named K.E. Tsiolkovsky (in honour of the founder of theoretical astronautics on the 165th anniversary of his birth), delivered to ISS a mixed Russian-United States crew consisting of Roscosmos astronauts Sergei Prokopyev and Dmitry Petelin and NASA astronaut Francisco

Rubio. On 5 October 2022, Russian astronaut Anna Kikina left for ISS aboard the United States spacecraft Crew Dragon.

An act ratifying an agreement between the Government of the Russian Federation and the Government of the Bolivarian Republic of Venezuela on cooperation in the exploration and use of outer space for peaceful purposes has been signed.
