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

Note by the Secretariat

Contents

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II. Reply received from a Member State

Canada[1]

[Original: English]
[24 October 2022]

Summary

In 2022, Canada was engaged in a number of diverse space activities. Canada continued to provide invaluable support to the International Space Station (ISS) through the use of the Canadarm2 and Dextre; continued the operation of Canada's satellite fleet, including the RADARSAT Constellation Mission, SCISAT and 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 International Charter 'Space & Major Disasters'. For the latest information, and more details on the programs mentioned, we invite you to view the Canadian Space Agency (CSA) website at: www.asc-csa.gc.ca.

The International Space Station (ISS)

Canada's contribution to the 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 the 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 the ISS, and pursued scientific studies related to health on the ISS including:, Marrow, SANSORI, T-Bone2, Vascular Echo, Vascular Aging, Vascular Calcium, Wayfinding, and Vection.

Planetary Sciences

Canada's OSIRIS-REx Laser Altimeter (OLA) on NASA's asteroid-sampling mission OSIRIS-REx 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 precious cargo, with an expected return in 2023.

Canada currently chairs the 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

In the context of investments for lunar exploration, Canada will be contributing Canadarm3, a smart robotic system, to the Lunar Gateway, 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 NASA's Artemis II, the first crewed mission to the Moon since 1972.

Under the Lunar Exploration Accelerator Program (LEAP), several initiatives are underway to deliver Canadian technologies to the Moon over the next 5 years. This mission will deliver a Canadian rover, carrying both US and Canadian instruments, on a NASA Commercial Lunar Payload Service Delivery flight. LEAP is also funding Canadian participation in commercial lunar missions: so far, three Canadian

[1] A shorter version of the submission by Canada is available in all the official languages of the United Nations in document A/AC.105/1271.

companies have secured flights to the Moon on at least four missions going to lunar orbit or the lunar surface.

Canada also initiated the Lunar Surface Exploration Initiative (LSEI), which involves activities to prepare potential options for consideration of the next major Canadian infrastructure contributions to human spaceflight, with a focus on the lunar surface. In this context, the 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.

The 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 for the Deep Space Healthcare Challenge, a competition to develop innovative healthcare 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, measuring 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 (HFCs) from space. It is also the only satellite able to measure all major greenhouse gases, including high quality atmospheric profiles of carbon dioxide down to 5 km. SCISAT's data has been used in multiple recent scientific discoveries.

In October, Canada announced its contribution to the Atmosphere Observing System (AOS) mission led by NASA, along with JAXA, CNES and DLR. 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 Canadian instruments on a Canadian satellite and a third instrument on a NASA satellite. The mission will provide critical data to support extreme weather prediction, climate modelling as well as monitoring disasters, such as volcanic eruptions, wildfires and extreme precipitation. The data collected by HAWC and AOS will improve our ability to predict near-term weather events, long-term climatic conditions and air quality. HAWC is planned to be launched in 2031.

Space-Based Astronomy

Canada continues to support the James Webb Telescope project, a partnership between NASA, the European Space Agency (ESA) and the CSA, which was launched on December 25, 2021. On July 12, 2022, the first full-colour images and spectroscopic data captured by the telescope were publicly release. Canada provided two instruments: the Fine Guidance Sensor (FGS) and the Near-Infrared Imager and Slitless Spectrograph (NIRISS). This partnership offers Canadian astronomers a share of the observation time on the most complex and powerful space telescope ever built.

In terms of upcoming missions, Canada is currently preparing its participation to ESA's ARIEL mission through the provision of a cryo-harness derived from JWST heritage. In addition, Canada is working with partners to explore a potential mission called LiteBIRD – a small space observatory which aims to detect primordial gravitational waves. Canada's contribution will be the read-out electronics for the telescope's detectors, and phase 0 and prototyping contracts have been executed.

Canada also continues to operate its own space telescope, the Near-Earth Object Surveillance Satellite, NEOSSat. Through the NEOSSat Guest Observer program, Canadian astronomers publish near-Earth asteroid and comet observation data to the

International Astronomical Union Minor Planet Center and participate in international observation campaigns under International Asteroid Warning Network, as well as support the photometric follow-up of exoplanet candidates from NASA's Kepler and Transiting Exoplanet Survey Satellite, and other international initiatives. NEOSSat astronomical imagery is published on CSA's Open Data portal and National Research Council of Canada's Canadian Astronomy Data Centre. Similarly, Canada is contributing a satellite in 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. These systems contribute to the NASA THEMIS mission through ground-based observations of the aurora borealis. Canada continues to collaborate with the ESA Swarm mission, which measures the magnetic fields generated by the Earth. ESA procured a Canadian Electric Field Instruments (EFI) for each of Swarm's three satellites.

Space Situational Awareness (SSA)

Canada's Sapphire satellite is still providing data on deep-space objects to the U.S. Space Surveillance Network (SSN) helping to maintain the safety of space objects in Earth orbit. The NEOSSat space telescope, is still operational and supports Canada's SSA R&D mission by tracking and characterizing space objects in orbital regimes from low-Earth Orbit (LEO) to deep-space.

Consistent with the United Nations guidance for space safety, sustainability and data sharing, the NEOSSat mission's onboard GPS-based precision ephemeris is now published on the CSA Open Data website. This data provides precise orbital positioning data of NEOSSat for the prior week and Canada's best prediction of the future position of NEOSSat to help reduce the risk of space object collision. This data may also assist the geoscience community advance atmospheric density models.

The follow-on project to Sapphire, Surveillance of Space 2, continues its project planning and will have both ground-based and space-based sensors to maintain and advance Canada's contribution to the SSN. Canada is also in the planning stages for a new SSA research microsatellite, named Redwing, to advance SSA research, development and technology demonstration in LEO.

SSA data processing continues to be a priority for Canada. A prototype Space Common Operating Picture system has demonstrated orbit determination, proximity and conjunction forecasting, space weather, orbital pattern of life and multi-sensor data integration.

Canada's Conjunction Risk Assessment and Mitigation System (CRAMS) 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 SSN. The service plays an important role in preventing on-orbit collisions.

Canada continues its active participation in the Inter-Agency Debris Coordination Committee (IADC) and the Inter-Agency Operations Advisory Group (IOAG) to develop and promote best practices in collaboration with other space agencies, including emphasis on the sustainability of space operations.

Earth Observation

In January 2022, Canada launched its whole-of-government satellite Earth observation strategy (SEO). The SEO strategy lays the foundation for strategic investments, flexible programming, and strong partnerships with stakeholders to best deliver data that meets the needs of the community and government priorities such as climate change.

The RADARSAT Constellation Mission (RCM) continues to support the Government of Canada 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 NASA's Surface Water Ocean Topography (SWOT) satellite, planned for launch in late 2022, is now complete with delivery of three instruments (Extended Interaction Klystrons) 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. Synergistic use of SWOT and RCM data is of particular interest.

In May, Canada announced the WildFireSat mission, which aims to monitor 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 of WildFireSat is to support wildfire management but will also provide Canadians with more precise information on smoke and air quality conditions. It will further enable more accurate measures on carbon emitted by wildfires, an important requirement of international agreements on carbon reporting.

In addition, the CSA continues to cooperate with NASA in the preparation and delivery of 10 Earth Observation (EO) related sessions for the annual Indigenous Mapping Workshop 2022, as part of a task under the Committee on Earth Observation Satellites (CEOS) Working Group on Capacity Building and Data Democracy. The IMW events are organized by The Firelight Group for Indigenous Nations, organizations and practitioners supporting indigenous-led geospatial research and projects.

STEM Outreach

The CSA continues to engage with education and STEM outreach collaborators, and work on Objective: Moon, a series of STEM initiatives and resources for youth and educators related to the return to the Moon. The 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 AI-enabled robotics. The CSA complemented its 'digital first' commitment to making all its content and resources available via the Internet in English and French with both virtual presentations and in-person opportunities to hear about upcoming missions and Canadian contributions to advancements in space STEM.

The CSA is taking further action to support equity-seeking groups underrepresented in space STEM fields. For example, applicants for funding opportunities are encouraged to demonstrate how their activities would meet the needs of girls, Indigenous youth, socio-economically disadvantaged groups and visible minorities.

National Technical, Science and Human Capacity Building

In 2022, Canada continued the Canadian CubeSat Project (CCP), where 15 teams composed of researchers, professors and over 600 post-secondary students, from across Canada are taking part in real space missions, by designing, building, and eventually launching, and operating their own CubeSat. The first teams will launch their CubeSats to the ISS in fall 2022 while other teams are expected to launch their CubeSats in early 2023.

The latest iteration of the Flights and Fieldwork for the Advancement of Science and Technology (FAST) initiative, awarded 22 grants to Canadian universities and colleges for research projects. These 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.

The CSA continued its stratospheric balloon initiative, STRATOS, in collaboration with the Centre national d'études spatiales (CNES). In August 2022, four zero-pressure balloons carrying eighteen 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 onboard.

Support to Global Challenges

In 2022, Canada's scientific and operational satellite missions continued to contribute to the achievement of the United Nation's Sustainable Development Goals in multiple ways. Earth Observation missions such as SCISAT, SWOT, RCM, OSIRIS on Odin and projects under smartEarth, the application development initiative, help to strengthen resiliency and adaptability to climate related hazards and natural disasters.

Canada continues working closely with international partners as part of disaster relief programs, making its Earth observation data available in times of crisis, helping to assess the impact and mitigate risk for natural and man-made disasters. While supporting domestic disasters management and relief, Canada continues to actively support the International Charter 'Space & Major Disasters', a collaboration founded by ESA, CNES and CSA, that currently has seventeen members.

Space Policy

Canada continues its internal assessment of Canada's compliance to the 21 Guidelines for the Long-term Sustainability of Outer Space Activities in order to identify gaps and areas for review to further strengthen our commitment to the safety and sustainability of outer space. It is also pursing its review of Canada's regulatory framework to ensure timely responses for industry, maintain strategic oversight for national security and enable commercial growth. Canada is also pleased to note that the third independent review of the RSSSA, required as a formal part of the Remote Sensing Space Systems Act, was completed in March 2022, and made a number of recommendations regarding areas of relevance to the Guidelines for the Long-term Sustainability of Outer Space Activities.

The CSA participated in the first meeting of the Artemis Accords signatories as they discussed the important role the Accords can play in establishing principles to conduct safe and sustainable operations beyond Low Earth Orbit. The signatories reaffirmed their assertion that the Artemis Accords are a first step but that the work needs to continue within the Committee on the Peaceful Uses of Outer Space.