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ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT (CSTD)**

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Contribution by Canada

to the CSTD 2019-2020 priority theme on “Exploring space technologies for sustainable development and the benefits of international research collaboration in this context

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CSTD 2019-20 Priority Theme 2: "Exploring space technologies for sustainable development and the benefits of international research collaboration in this context"

1. Can you give examples of **projects/policies in your country aimed at using space technologies for sustainable development**? What are the main challenges confronted while trying to implement these projects/policies in your country or region?

The PowerPoint presentation attached, entitled "Space supports the Sustainable Development Goals" (UN SDGs – Presentation – EN), effectively summarises the main projects, missions and policies using space technologies in Canada in direct support to SDGs.

Canada's longstanding expertise and advancement in space based earth observation (EO) is a key asset supporting decision making in sustainable development. However, integrating the geospatial information into the reporting process remains one of our greatest challenges. Furthermore, this challenge is amplified when EO data are aimed to be used in support of the SDG indicators with official statistics and reporting, as methodologies are currently in development on the international scene. There is also a challenge related to the data quality (re: Statistics Canada Data Quality Framework) which requires: relevance, accuracy, timeliness, accessibility, interoperability and coherence.

One of the challenges also, both at national and international level, is the difficulty to properly align policies, operational and funding priorities, as well as the agenda of the different organizations involved.

2. Can you provide examples of **policies/projects/initiatives aimed at promoting international research collaboration** in the area of space technologies for sustainable development? What are the main challenges confronted in implementing these projects?

Examples:

A. The Use of Earth Observation in providing Ice Information to Arctic Communities

Earth observation data is critical to monitoring ice conditions in the Arctic for a number of reasons. Because of the extent, remoteness, and isolation of these regions, earth observation is often the only cost effective and technically feasible means of obtaining information.

For over a decade, Polar View has used earth observation satellites from Radarsat (CSA) and Sentinel 1 (ESA) in providing a Community Ice Service that decreases the risk associated with travelling over coastal sea ice in the Canadian Arctic. The service allows the selection of the shortest route around ice ridges and open water, helping to minimize travel time, fuel costs, and equipment wear, while maximizing safety.

Thanks to the international research collaboration, the service has proven to be an exemplary case for the use of earth observation to support traditional ways of life in the Arctic, to help northern communities adapt to climate change, and to improve the safety of northern residents and visitors.

B. Strengthening the Capacity for Early Warning, Risk Reduction and Management of National and Global Health Risks

A priority for the Public Health Agency of Canada (PHAC) is responding to emerging infectious

diseases, and the PHAC's National Microbiology Laboratory (NML) undertakes research and risk assessment to inform the development of programs to combat these diseases. The NML uses EO technologies, including RADARSAT data, in their research and risk assessment activities, and products are used widely in disease surveillance and disease outbreak management (i.e. mosquito-borne diseases, tick-borne diseases, chronic diseases, water-borne disease, vulnerable human populations, and disease pandemics (i.e. international disease outbreaks such as the Ebola). International research collaboration is critical for these kind of undertaking.

C. Strengthen Resilience and Adaptive Capacity to Climate-Related Hazards and Natural Disasters

Natural Resources Canada (NRCAN)-Emergency Geomatics Services and Public Safety Canada (PSC) are acquiring time-series EO data, including RADARSAT, since multiple years in order to provide critical, near real-time information to public safety authorities before, during and after river ice-jams and break-up and flood events. The RADARSAT flood products are also integrated and use by into provincial, territorial and regional governments civil security operations and are available to the public via Open Maps.

International collaboration and research is key to improve and better adapt our overall capacity to respond to climate-related hazards and natural disasters in Canada and abroad.

D. Conserving and Sustainably Use the Oceans: Effective Monitoring of Fishing Ships and Aquaculture Sites

Our oceans, our waterways and their shorelines are ecosystems that support abundant fish populations and are home to many other living ecosystems year round. By surveying the various marine and coastal ecosystems of Canada, the RADARSAT Constellation will assess the impact of human activity and climate changes on coastlines, monitor coastal erosion and rapidly identify, in combination with signals from the automatic identification system (AIS), the vessels navigating our waters and to detect those engaging in illegal fishing (i.e. ships, aquaculture sites).

International research collaboration is an integrated component of the success of this kind of projects/initiatives. The challenges in conserving and sustainably use our oceans are global per nature.

E. Statistics Canada (StatCan) in support of the Australian Bureau of Statistics (ABS)

The crop yield work by StatCan is an excellent example of how satellite imagery can be used in the production of official statistics in practice. Statistics Canada uses remote-sensing data since the early 1980s for applications such as census and survey validation, crop mapping and area estimation and support program development. In 2016, Statistics Canada became the first National Statistic Office (NSO) to replace a statistical survey with a remote sensing model-based approach.

As in Canada, Australia's decision-makers need reliable information about changes in the use, condition and value of land and how this relates to broader economic activity and the state of our environment. This information is used in policy making and spending decisions in land management and economic development. Official statistics are well placed to provide this vital information by integrating geospatial and environmental data with a range of economic indicators.

ABS is also considering EO data for statistical outputs as part of the larger administrative data initiative and has received presentations from Statistics Canada about their methods and

experiences. This has been very useful to the ABS agricultural statistics area, the Satellite Imagery TT report and EO workshop development.

Challenges:

As stated above, the main challenge at the international level resides in the alignment of policies and political agenda of the different organizations involved, operational and funding priorities.

On the technical side, the main challenges are i) the development of a global and robust method that provides accurate and qualitative results, and ii) the processing of the vast amount of satellite data and the derivation of the statistics required, including high computing and storage needs, access

3. What are the actions that the international community, including the CSTD, can take to leverage the potential of space technologies for sustainable development, including through international research collaboration in this context? Can you give any success stories in this regard from your country or region?

Amongst other initiatives within the international community, the Committee on Earth Observations Satellites (CEOS) and the Group on Earth Observations (GEO) are great mechanisms of collaboration to foster many efforts towards the priority theme. Canada is a active member of both of these bodies.

CEOS

Data is at the core of the SDGs' 2030 Agenda: its success will depend on the availability of high quality, timely and universally accessible data. The effective use of EO data in support of national monitoring and reporting against the Global Indicator Framework, as well as informed decision making on development policies, will require closer collaboration among national statistical offices and the EO data providers and communities around the world.

CEOS' role is to focus its activities around the role of being a coordination body of the Space community efforts in order to address specific issues related to satellite data. In full alignment with the intergovernmental GEO, CEOS principal role is to support the integration of satellite observations in the SDG processes for a full realisation of the 2030 Agenda on sustainable development by all countries.

A [dedicated group of Space Agencies](#) under CEOS has developed a [Handbook](#) that presents the main capabilities of satellite Earth observations, their applications and a systematic overview of present and planned CEOS agency Earth observation satellite missions and their instruments.

GEO

By 2030, GEO envisions a world in which uses of Earth observations and geospatial information to support progress on the Sustainable Development Goals are valuable, routine and customary. In the first five years of the Agenda, GEO envisions that the foundation has been laid for governments and organizations to capitalize fully on the benefits Earth observations provide to monitor, plan, and report on the SDGs through 2030.

One of [the strategic priorities](#) of GEO is Earth Observations for Sustainable Development Goals (EO4SDG). As part of the 2017-19 Work Programme, the [EO4SDG](#) has three goals and associated objectives to realize the vision and serve the purpose described above. The goals describe overarching, desired outcomes, and the objectives articulate specific, measurable results.

GOAL I: Demonstrate how Earth observations, geospatial information, and socioeconomic and other data contribute in novel and practical ways to support sustainable development efforts and the SDG.

GOAL II: Increase skills and capabilities in uses of Earth observations for SDG activities and their broader benefits.

GOAL III: Broaden interest, awareness, and understanding of Earth observations support to the SDGs and contributions to social, environmental, and economic benefits.

The EO4SDG initiative will be reconducted with new activities in the 2020-2023 GEO Work Programme, to be unveiled in November at GEO Ministerial Summit.

4. Could you suggest some contact persons of the nodal agency responsible for projects/policies, related space technologies for sustainable development and international research collaboration in this context as well as any experts (from academia, private sector, civil society or government) dealing with projects in this area? We might contact them directly for further inputs or invite some of them as speakers for the CSTD inter-sessional panel and annual session.

The following individuals are responsible for projects and policies related to space technologies for sustainable development and international research collaboration in their respective organisation:

- Statistics Canada: francois.soulard@canada.ca
- Agriculture and Agri-Food Canada: andrew.davidson@canada.ca
- Public Health Agency of Canada: stephanie.brazeau@canada.ca
- Aboriginal Affairs and Northern Development Canada: yves.theriault@canada.ca
- Canadian Space Agency: leonora.agnew@canada.ca
- Canadian Space Agency: marie-josee.bourassa@canada.ca

5. Do you have any documentation, references, or reports on the specific examples on the priority theme in your country or region?

The PowerPoint presentation attached (see Q-1) provides different examples on the priority theme in Canada.



SPACE SUPPORTS THE



**SUSTAINABLE
DEVELOPMENT
GOALS**

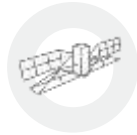


Canadian Space
Agency

Agence spatiale
canadienne

Canada

SPACE SUPPORTS THE **MISSIONS**



RADARSAT-2

RADARSAT-2 is an essential tool for the Government of Canada. Its data supports the measurement and progress of many SDGs through its contributions to the economy, innovation, agriculture, resource management, security, public safety, public health, environmental monitoring, and international collaboration.



RCM

RADARSAT Constellation Mission (RCM) is a three-satellite system, which enables any part of Canada to be imaged on a daily basis, an increase in capability compared to RADARSAT-2.



SCISAT

SCISAT measures more than 60 different atmospheric trace gases. SCISAT is the only satellite capable of measuring the five most abundant greenhouse gases and multiple key ozone-depleting substances banned under the 1987 Montreal Protocol and the 2016 Kigali Amendment.



CASSIOPE

CAScade, Smallsat and IOnospheric Polar Explorer (CASSIOPE) helps us study and better understand space weather so that we are better equipped to predict and respond to its effects. Northern communities are among those who are most vulnerable to the harmful impacts of space weather.



NEOSSAT

Near Earth Object Surveillance Satellite (NEOSSAT) monitors the space environment for dangerous asteroids and orbital debris to conduct Near Earth Object detection and as a research platform for activities in space situational awareness. The information produced by NEOSSat bolsters Canada's contribution to international efforts to maintain the safety of Canadian and international space assets.



M3MSAT

Marine Monitoring and Messaging Micro-Satellite (M3MSat) promotes international collaboration through its contributions to worldwide maritime surveillance by detecting suspicious illegal ship movements across international oceans.



SPACE SUPPORTS THE **MISSIONS**



MOPITT

Measurements Of Pollution In The Troposphere (MOPITT), a Canadian instrument on NASA's Terra satellite, scans Earth's atmosphere to gather important data on air pollution used to assess pollution reduction initiatives such as vehicle emission reduction standards, and to understand their impact of human activities.



OSIRIS

Optical Spectrograph and InfraRed Imager System (OSIRIS), an instrument on Sweden's Odin satellite, assists scientists better understand the impact of human activities and natural phenomena on the environment and climate. Its data on air quality plays a key role in international programs and organizations in which Canada participates.



SMOS

Soil Moisture Ocean Salinity (SMOS) is a European Space Agency (ESA) satellite which the CSA supports through science and application development. SMOS measures ocean surface salinity and soil moisture to better understand Earth's water cycle. It provides measurements over snow and ice-covered regions.



SWARM

SWARM, a mission led by the European Space Agency (ESA) to which Canada contributes resources, provides us with a new understanding of Earth's magnetic fields, why the magnetic north Pole is constantly shifting, and consequently provides us with insight into Earth's many natural processes.



SWOT

Surface Water Ocean Topography (SWOT), a satellite led by NASA to which Canada contributes, will enable a better understanding of our aquatic ecosystems and monitor life underwater. SWOT will also contribute to Canadian water management by measuring how lakes, rivers, reservoirs and oceans change over time.



SMAP

Soil Moisture Active Passive (SMAP) is a NASA satellite to which Canada contributes, under the leadership of ECCC and AAFC. SMAP advances our understanding of the water and carbon cycles by producing global maps of soil moisture and the freeze-thaw state of soil both in the Canadian boreal environment and globally.





SPACE SUPPORTS THE
SUSTAINABLE DEVELOPMENT GOALS



Benefits

NO POVERTY

Canadian satellites build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.

- **RADARSAT:** Indigenous Services Canada has been acquiring RADARSAT imagery for multiple years to monitor the infrastructures affected by the permafrost melting and soil movements in the North
- **CASSIOPE:** Satellites, such as CASSIOPE, help us better understand space weather so that we are better equipped to respond to its effects
- **COSPAS-SARSAT:** a satellite-based search and rescue system that supports the detection of emergency beacon signals in order to locate people in distress. The Programme's goal is to provide timely and reliable alert and location data to help local search and rescue authorities get to those in need as soon as possible.

Benefits

ZERO HUNGER



ZERO HUNGER

Canadian satellites ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality

RADARSAT:

- Agriculture and Agri-Food Canada has been acquiring RADARSAT data for multiple years to monitor agricultural lands and to implement resilient agricultural practices that increase productivity and production, help maintain ecosystems, and strengthen farmers capacity for adaptation to climate change.
- RADARSAT provides data to support farmers in assessing soil moisture and irrigation needs, and GPS technology supports innovative precision farming techniques. This helps farmers better manage risks and improve planning to boost the quality and productivity of their crops.
- Statistics Canada is also integrating EO-derived information related to crop yield statistics into their operations.





Benefits

GOOD HEALTH AND WELL-BEING

Canadian satellites strengthen the capacity of Canada for early warning, risk reduction and management of national and global health risks.

- **International Charter "Space and Major Disasters"** is an international effort to put space technology at the service of emergency responders during disasters. RADARSAT imagery regularly provides support to rescue teams on the ground.
- **RADARSAT** supports the Public Health Agency of Canada monitor the environment and gather data on health risk indicators associated with environmentally-linked infectious diseases.
- **SCISAT** measures more than 60 different atmospheric trace gases, including the 5 most abundant greenhouse gases and multiple key ozone-depleting substances banned under the 1987 Montreal Protocol and the 2016 Kigali Amendment.
- **MOPITT (on Terra)** gathers long-term data on carbon monoxide concentrations in the atmosphere helping us understand the impact of wildfires and human activities.
- **OSIRIS (on Odin)** measures ozone, aerosols, and nitrogen dioxide helping scientists better understand the impact of human activities and natural phenomena on the environment and climate.





Benefits

CLEAN WATER AND SANITATION

Canadian satellites regularly provide data that enable the protection and restoration of water-related ecosystems, including mountains, ice, forests, rivers, oceans and lakes.

RADARSAT

- RADARSAT imagery is used by ECCC to improve the quality of the land surface analyses produced by the Canadian Land Data Assimilation System (CaLDAS) in order to increase their use in ECCC's operational numerical weather and hydrological prediction systems.
- In collaboration with AAFC and NRCan, ECCC provides a complete set of land surface analyses of all variables of interest including soil moisture, snow, water extent, surface temperatures, and vegetation characteristics.
- RADARSAT also helps locate and manage ground water sources.
- **SWOT** observes ocean surfaces and measures how lakes, rivers, reservoirs and oceans are changing over time.





Benefits

INDUSTRY, INNOVATION AND INFRASTRUCTURE

Canadian satellites support the development of quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being.

They also enhance scientific research and upgrade the technological capabilities of Canada, encouraging innovation and substantially increasing the number of research and development workers.

- **RADARSAT**: Polarview, in close collaboration with CSA and the Canadian Ice Services, is developing a project titled "Safe Travel On Ice" to provide northern communities with an enhanced ability to travel safely over river, lake, and sea ice.
- **SCISAT** has detected pollutants in the atmosphere that have never been identified before from space while conducting the Atmospheric Chemistry Experiment (ACE). SCISAT is the only space-based instrument that can measure specific pollutants to assess their effects on the environment.
- **CASSIOPE** contributes to the unravelling of the mysteries of space weather. It is possible to adapt and use CASSIOPE for various missions involving science, technology, Earth observation, geologic exploration and information delivery.



Benefits

SUSTAINABLE
CITIES AND
COMMUNITIES



SUSTAINABLE CITIES AND COMMUNITIES

Canadian satellites provide essential data to reduce the number of deaths, the number of people affected, and decrease the direct economic losses of disasters, including water-related disasters, especially for Canada's Northern population.

- With **RADARSAT**, Statistics Canada is proposing to improve the characterization of built-up areas, which contributes to the improvement of land use mapping, and supports the Pan-Canadian Framework on Clean Growth and Climate Change.
- **International Charter on Space and Other Disasters**, when activated, its members use satellite images to support relief efforts, equipping response teams to save lives and limit damage to infrastructure and the environment. The Canadian Space Agency is a founding member of the Charter.
- **COSPAS-SARASAT** supports the detection and location of emergency distress beacons activated by aircraft, ships and backcountry hikers. Globally, about five people are rescued each day by teams dependent on this system.



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Benefits

RESPONSIBLE
CONSUMPTION &
PRODUCTION



RESPONSIBLE CONSUMPTION AND PRODUCTION

Canadian satellites provide stakeholders, policy makers and international partners with relevant information and awareness for sustainable development and lifestyles in harmony with nature.

- **SCISAT, OSIRIS (On ODIN), and MOPITT (on Terra)** data is available to the public, enabling the academic and policy communities to inform themselves and take responsible action.
- **RADARSAT** imagery facilitates maritime surveillance, ice monitoring, environmental monitoring, disaster management, resource management and mapping in Canada and around the world.





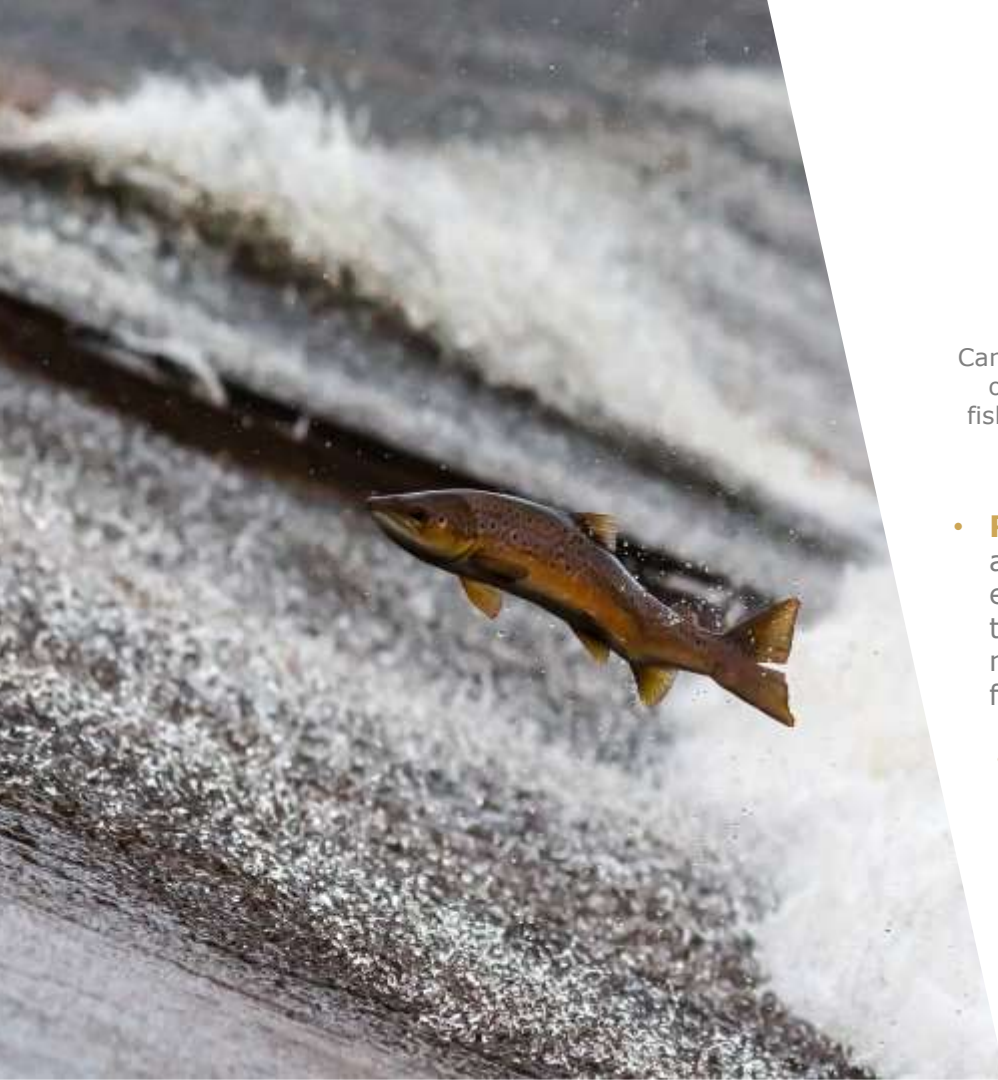
Benefits

CLIMATE ACTION

Canadian satellites strengthen resilience and adaptive capacity of institutions to climate-related extreme events. They help measure and monitor Canadian climate change strategies.

- **The International Charter "Space and Major Disasters"** is an international effort to put space technology at the service of emergency responders in the event of disasters.
- **SCISAT** observations are helping scientists better understand the effects of atmospheric chemistry, clouds and small particles.
- **MOPITT (on Terra)** gathers long-term data on carbon monoxide concentrations used to assess the impact of particular pollution reduction initiatives, such as vehicle emission reduction standards.
- **OSIRIS (on Odin)** data help scientists better understand the impact of human activities and natural phenomena on the environment and climate.
- **CloudSat** gathers information on cloud cover for the purpose of creating three-dimensional profiles.
- **SMAP** expands our knowledge of water cycles and carbon by producing global maps of soil moisture and monitoring the seasonal freeze/thaw cycle.





Benefits

LIFE BELOW WATER

Canadian satellites support the regulation of fish harvesting and monitor overfishing, illegal, unreported and unregulated fishing and destructive fishing practices, helping Canada implement science-based management plans. They also enable Canadians to sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts.

- **RADARSAT** imagery is used to assess the impact of human activity and climate change on coastlines, monitor coastal erosion and rapidly identify, in combination with signals from the automatic identification system (AIS), the vessels navigating our waters and to detect those engaging in illegal fishing.
- **SMOS** maps sea surface salinity, monitors soil moisture on a global scale, helps us better understand the water cycle, and map snow- and ice-covered areas.
- **SWOT (in development)** will observe ocean surfaces and measure how lakes, rivers, reservoirs and oceans are changing over time.



Benefits

LIFE ON LAND



LIFE ON LAND

Canadian satellites ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems in forests, wetlands, mountains and drylands, in line with obligations under international agreements.

RADARSAT

- The Canadian Forest Service has been acquiring RADARSAT imagery for multiple years in order to improve decision making capacity across the Government of Canada via enhanced ability to produce and integrate historic and current land cover, land dynamics, and forest structure information to inform reporting, monitoring, and climate change issues.
- Statistics Canada is also using RADARSAT data to compile forest inventories and monitor changes in forest ecosystems statistics.



Benefits

PEACE, JUSTICE
& STRONG
INSTITUTIONS



PEACE, JUSTICE AND STRONG INSTITUTIONS

Canadian satellites strengthen national institutions, including through international cooperation, for building capacity at all levels to prevent violence and combat terrorism and crime.

- The **RADARSAT Constellation Mission (RCM)** and **M3MSat** contribute to maritime surveillance through the detection of ship movements and the identification of illegal ship activity within and outside of Canada's waters.





SPACE SUPPORTS THE
SUSTAINABLE DEVELOPMENT GOALS

Benefits

PARTNERSHIPS FOR THE GOALS

Canadian space assets enhance regional and international cooperation through science, technology and innovation and through the enhancement of knowledge sharing on mutually agreed terms, such as with the International Space Station and COSPAS-SARSAT.

- **International Space Station:** Canada along with the USA, Japan, Europe, and Russia use the ISS to perform science experiments and test and demonstrate new technologies.
- **NEOSSat** contributes to the international effort to catalogue the near-Earth asteroids producing information that will be crucial to targeting new destinations for future space exploration missions.
- **COSPAS-SARSAT:** There are about 2,000,000 distress beacons worldwide. From 1982 to 2016, COSPAS-SARSAT helped rescue at least 43,807 people in 12,664 search and rescue events.
- **The International Charter "Space and Major Disasters"** is an international effort to put space technology at the service of rescue and emergency responders in the event of a major disaster.
- **International Student Education Board:** CSA is one of the founding members of ISEB, designed to encourage global collaboration in space education among the student community worldwide.



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