

ECCC/CSA updates and reports on the medium to long-term future Earth observation plans

Presented to CGMS-52 Plenary session, agenda item 3



Executive summary of the WP

- In 2022, Canada released *Resourceful, Resilient, Ready: Canada's Strategy for Satellite Earth Observation*, which describes how Canada will take full advantage of the unique vantage point of space to address climate change and other key challenges of our time
- With leadership from Environment and Climate Change Canada (ECCC), the Canadian Space Agency (CSA) and Natural Resources Canada (NRCan), Canada has been working to define and advance initiatives to address gaps in the up-, mid- and downstream sectors of the Satellite Earth Observation (SEO) value chain
- This presentation provides an update on medium-term plans and long-term considerations related to four SEO missions: RADARSAT+, High-altitude Aerosols Water vapour and Clouds (HAWC), Terrestrial Snow Mass Mission (TSMC), and Arctic Observing Mission (AOM)
- These four missions are intended address observation gaps for many geophysical variables, including sea ice, ocean winds, snow, weather, greenhouse gasses, air quality, and space weather
- Funding has been secured for RADARSAT+ and HAWC, while TSMC and AOM continue their pre-formulation activities

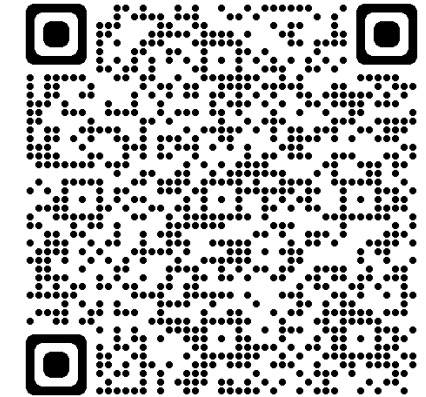
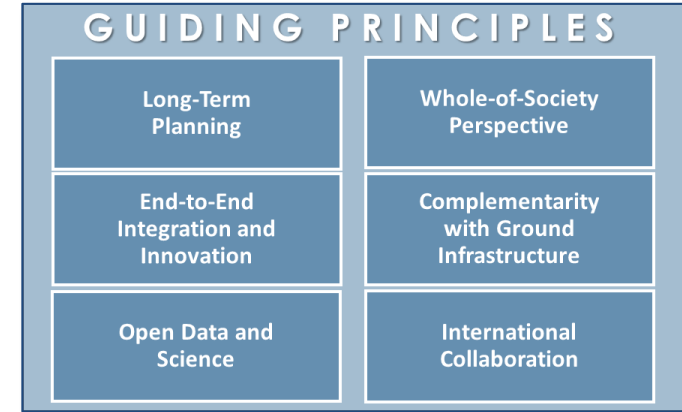
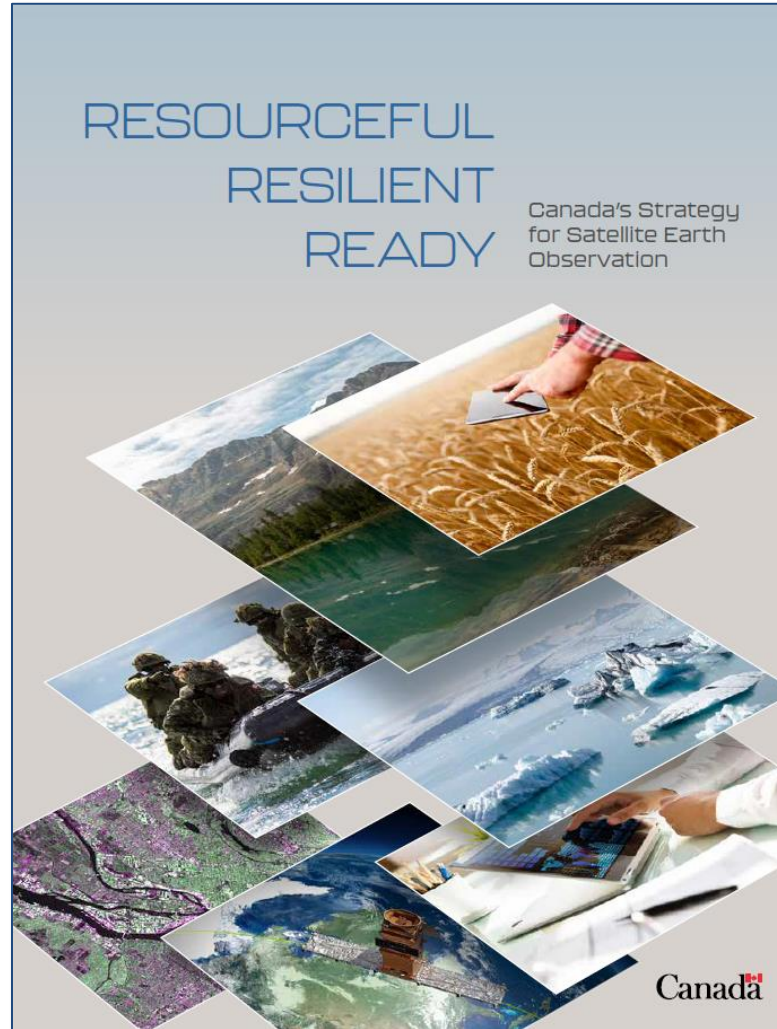
Resourceful, Resilient, Ready: Canada's Strategy for Satellite Earth Observation

Economy Press Release

Canada Announces Strategy for Satellite Earth Observation

Twenty-one Canadian organizations receive funding to make innovative use of Earth observation data LONGUEUIL, QC, Jan. 20, 2022 /CNW/

- 1) Ensure that satellite Earth observation data is free, open, and accessible to maximize science, innovation, and economic development
- 2) Harness satellite EO to tackle climate change and issues that matter to Canadians
- 3) Strengthen delivery of critical services to keep Canadians healthy, safe and informed
- 4) Inspire satellite EO skills and capacity development for the next generation



Coordination Group for Meteorological Satellites



Environment and Climate Change Canada

Environnement et Changement climatique Canada



CGMS

Resourceful, Resilient, Ready: Canada's Strategy for Satellite Earth Observation: Progress by Objective



ENSURE THAT SEO DATA IS FREE, OPEN, TO MAXIMIZE SCIENCE, INNOVATION, AND ECONOMIC DEVELOPMENT

- Increased availability of RADARSAT-1 and RCM data
- Signed Canada-Copernicus Data Sharing Arrangement
- Ongoing Review of the *Remote Sensing Space Systems Act*
- Renewed MOU between Government of Canada and EUMETSAT
- Development of Digital Earth Canada (DEC) Prototype



HARNESS SATELLITE EO TO ADDRESS CLIMATE CHANGE AND ISSUES THAT MATTER TO CANADIANS

- Surface Water Ocean Topography (SWOT) Mission – Launched late 2022
- WildFireSat Funded – \$170M
- High-altitude Aerosols, Water Vapour and Clouds (HAWC) Funded – \$200M
- GHGSat, Investment – \$20M
- Arctic Observing Mission (AOM) Pre-formulation Investment – \$6M
- Terrestrial Snow Mass Mission (TSMM) Pre-formulation Investment – \$5M



STRENGTHEN DELIVERY OF CRITICAL SERVICES TO KEEP CANADIANS HEALTHY, SAFE AND INFORMED

- Ground Station Renewal - \$80M (B2021)
- Earth Observation Service Continuity (EOSC) - \$9.9M
- Radarsat+ - \$1.012B



INSPIRE SKILLS AND CAPACITY DEVELOPMENT FOR THE NEXT GENERATION

- SmartEarth Program - \$8M
- Establishment of Federal Satellite Earth Observation (SEO) Office (CSA, ECCC, NRCan)
- Launch of Research Opportunities in Space Science (ROSS) AO 2022-27



RADARSAT+



- In 2023 the Government of Canada announced a \$1.012 billion investment for the CSA to address immediate and future EO data needs ([press release](#)), including:
 - Funding for a replacement satellite to enhance resiliency of the RCM system
 - Funding for the definition of a fourth-generation satellite system to maintain Canadian EO capabilities in the long term and meet Canada's evolving needs for satellite SAR imagery
- As part of this fourth generation of work, the GC is exploring multiple avenues to ensure continuity of services

High-altitude Aerosols, Water vapour and Clouds Mission (HAWC)

HAWC TARGET LAUNCH 2031
High-altitude Aerosols, Water vapour, and Clouds

A planned Canadian mission consisting of three cutting-edge instruments and a satellite on NASA's AOS* in collaboration with a coast-to-coast consortium of universities as well as other Government of Canada departments

ABOARD CANADIAN-LED HAWCSAT

- SPATIAL HETERODYNE OBSERVATIONS OF WATER**
SHOW will measure water vapour in the upper reaches of the lower atmosphere
- AEROSOL LIMB IMAGER**
ALI will observe mid- to high-altitude aerosol particles

WEATHER FORECASTING
AIR QUALITY MONITORING
DISASTER RESPONSE
RESOURCE MANAGEMENT
INFRASTRUCTURE PLANNING

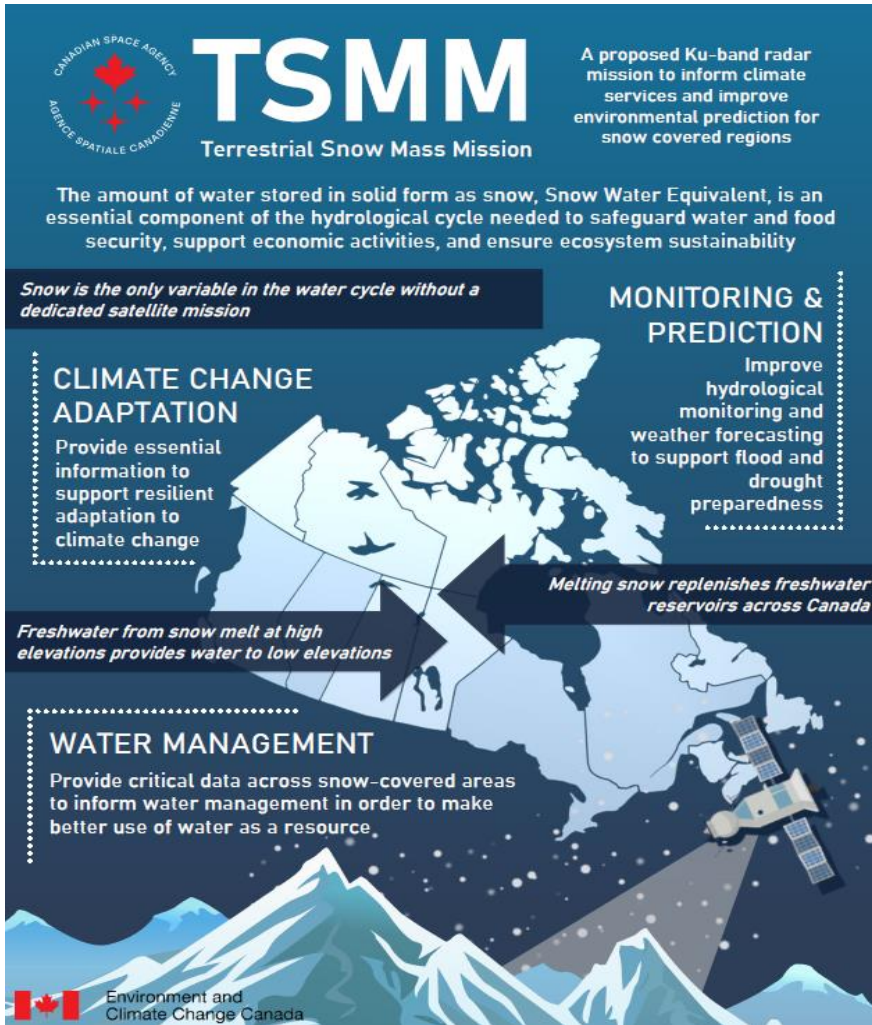
ABOARD US-LED AOS-POLAR

- THIN ICE CLOUDS AND FAR INFRARED EMISSIONS**
TICFIRE will observe water vapour and ice cloud properties as well as the energy that the atmosphere radiates to space

*The Atmosphere Observing System (AOS) is a four satellite constellation that will examine links among aerosols, clouds, atmospheric convection, and precipitation

- Announced at SpaceBound 2022, the Government of Canada has invested > \$200 million to develop HAWC
- HAWC is a multi-satellite initiative that will improve extreme weather prediction, climate modelling, and monitoring of disasters
- HAWC consists of:
 - Canadian instrument (TICFIRE) on U.S. satellite
 - Canadian instruments (ALI and SHOW) on a Canadian satellite (HAWCSat)
 - Development of HAWC science and applications
- RFIs for TICFIRE and HAWCSat were published in 2023 and provided opportunities for industry to provide feedback
- A number of RFPs to implement both TICFIRE and HAWCSat are planned to be launched in 2024.

Terrestrial Snow Mass Mission (TSMM)



TSMM
Terrestrial Snow Mass Mission

A proposed Ku-band radar mission to inform climate services and improve environmental prediction for snow covered regions

The amount of water stored in solid form as snow, Snow Water Equivalent, is an essential component of the hydrological cycle needed to safeguard water and food security, support economic activities, and ensure ecosystem sustainability

Snow is the only variable in the water cycle without a dedicated satellite mission

CLIMATE CHANGE ADAPTATION
Provide essential information to support resilient adaptation to climate change

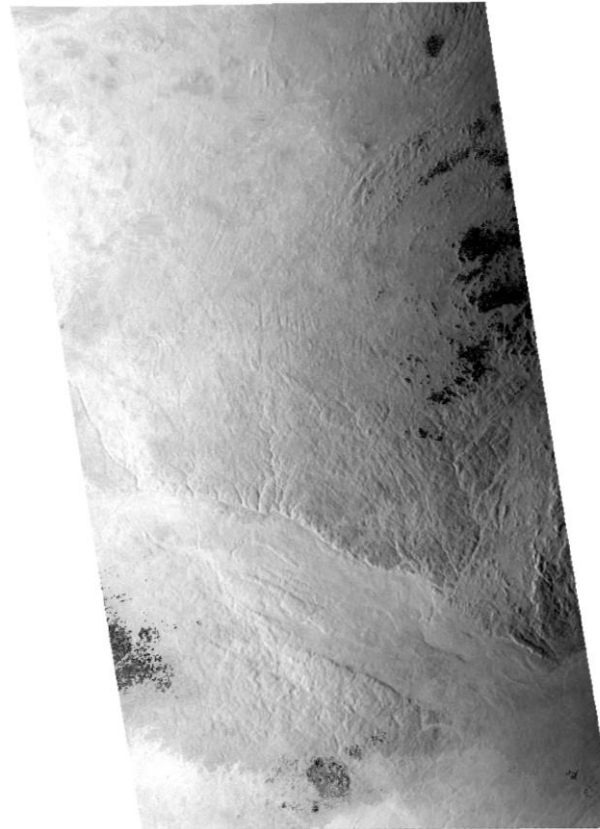
MONITORING & PREDICTION
Improve hydrological monitoring and weather forecasting to support flood and drought preparedness

Melting snow replenishes freshwater reservoirs across Canada

Freshwater from snow melt at high elevations provides water to low elevations

WATER MANAGEMENT
Provide critical data across snow-covered areas to inform water management in order to make better use of water as a resource.

Environment and Climate Change Canada



Simulated TSMM radar image (VV)
Ottawa River watershed
3 February 2023

- Mission is in a pre-formulation phase
- Detailed cost estimates are underway, including a mission design contract to refine space segment design and costing by Fall 2024
- Mission simulator recently delivered to ECCC to advance science readiness
- Continued development of international partnerships with NASA, EUMETSAT, and the Finnish Meteorological Institute
- Consortium of Canadian universities working on TSMM-related science, including airborne radar campaigns

Arctic Observing Mission (AOM)

ARCTIC OBSERVING MISSION
Proposed Canadian-led international satellite mission to provide a better understanding of the effects of climate change in the North

Observations north of ~40-45°N

Extent of coverage

Two satellites in a highly elliptical orbit
Continuous observations over northern regions

- METEOROLOGY**
Support weather and environmental predictions for the North
- GREENHOUSE GASES**
Detect and monitor greenhouse gas emissions from natural and human activity
- AIR QUALITY**
Monitor air pollutant emissions and improve air quality forecasts
- SPACE WEATHER**
Improve space weather forecasts and protect satellites and ground-based infrastructures

Canadian Space Agency / Agence spatiale canadienne
Environment and Climate Change Canada / Environnement et Changement climatique Canada

Canada

- AOM is undergoing a pre-formulation study
- A Mission Design Contract to assess mission architecture options and costs is scheduled to be completed in December 2024
- S&T development studies are ongoing with Canadian industry and academia
- Socio-economic benefit study completed in 2023, outlines significant potential benefits to Canada (presented to CGMS-52 WG III)
- Substantial proposed contributions from prospective international partners are being refined (NOAA, NASA, EUMETSAT)

Coordination Group for Meteorological Satellites



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CGMS

Key issues of relevance to CGMS:

- Canada is working to address key observation gaps of the Earth system, especially over Northern regions, and contribute to the international pool of satellite data which enables the world-class science and operations needed to protect populations from the impacts of climate change
- Funding has been secured for RADARSAT+ (replacement satellite and the design of a fourth-generation system) and HAWC, and Canada is currently in the process of implementing these missions
- ECCC has identified the proposed TSMM and AOM projects as future high-priority SEO initiatives and continues to work with the CSA and other partners to advance and evaluate these mission concepts
- TSMM and AOM pre-formulation activities are ongoing to further strengthen the scope of these missions, including international partnerships
- Canada thanks its current and prospective partners for their inputs to the development of these missions to date and will continue to strengthen those relationships to maximize the value of our missions for the global community