



RADARSAT Program

Current Status

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Space Exploitation

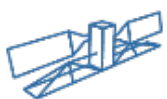
**2nd workshop on International Coordination for Spaceborne
Synthetic Aperture Radar**

28–30 September 2022 ESRIN, Frascati – Italy



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25 years of RADARSAT

The RADARSAT program has confirmed Canadian leadership in space based SAR, established the RADARSAT brand name around the world and established a Canadian presence in the global space EO market place.



| Timeline | 1995 - 2013 | 2007 - operational | 2019 - operational | Post 2026 |
|------------------------------------|---|---|--|--|
| Business Model | Government of Canada owner, operator | MDA owner, operator GC up front investment in exchange for imagery | Government of Canada owner operator | Being investigated. <i>Solution centric, hybrid</i> |
| Space Segment Configuration | 1 C band SAR satellite 800 km | 1 C band SAR satellite 800 km | 3 C band SAR satellites + AIS 600 km | Being investigated. <i>Combination of free & open, commercial purchase, int' partnerships and sovereign sensor(s)</i> |
| Capabilities | 8 – 100 m resolution | 1 – 100 m resolution | Improved reliability Increased re-visit frequency | Improved reliability and resiliency Increased re-visit frequency |
| EO Themes | Ice monitoring Disaster management Environment monitoring | Ice monitoring Ship detection Crop mapping | Maritime surveillance Ecosystem monitoring Disaster management | Maritime surveillance Land surveillance Marine weather Ecosystem monitoring Agriculture Coastal monitoring Disaster management |
| GC Scenes/yr | 5 000 | 50 000 | 250 000 | 250 000 + |
| Partnerships | NASA, NOAA, some Canadian Provinces | GC + Industry | GC + Industry | ESA, JAXA, CONAE, DLR + |
| GC user departments | NRCan, ECCC | DND, ECCC, NRCan, DFO, AAFC | DND, ECCC, NRCan, DFO, AAFC (growing) | DND, ECCC, NRCan, DFO, AAFC + |

RADARSAT-1 Open Data Project



RADARSAT-1 was Canada's first commercial Earth Observation satellite, launched on November 4, 1995, and declared non-operational on March 29, 2013, reaching 17 years of life. It was estimated that **1 800 000 images** were acquired during its lifetime.

CSA is currently implementing the RADARSAT-1 Open Data Project to make R-1 data accessible to the public:

1. Find an affordable, sustainable and scalable processing solution for RADARSAT-1 data.
2. Process the raw data into an accessible Level 1 format.
3. Ensure the data is easily discoverable and accessible.
4. Repatriate all Radarsat-1 data stored in foreign stations back into the GoC Archive by 2028.

The CSA is finalizing the request for proposals (RFP) in order to make R-1 data freely accessible to the public.

R-1 Data Recent Data Repatriation:

- West Freugh (United Kingdom, DRA, also known as DERA, QINETIQ),
- Kumamoto (Japan, NASDA),
- Alice Springs (Australia, ACRES), and
- Alaska Satellite Facility (United States, Fairbanks).

The data repatriated from those stations represent more than **710 000 images**, all available through EODMS.

More images will be available in a near future, as we are currently working on the repatriation of the remaining 24 data archiving facilities.



RADARSAT-2 reaches milestone of one million images

The millionth RADARSAT-2 image was acquired on September 11, 2022, and shows Sermilik fjord in eastern Greenland.

(Credit: RADARSAT-2 data and products © MDA Geospatial Services Inc. 2022 – All rights reserved. RADARSAT is an official mark of the Canadian Space Agency.)

RADARSAT Constellation Mission (RCM)

A strategic asset for Canada



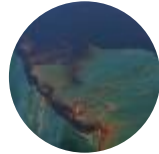
70

GC Programs & Services rely on a regular and predictable source of SAR imagery

RCM imagery is an integral part of many GC service delivery and support to policy



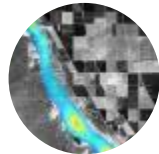
Ice & Icebergs detection & dynamics



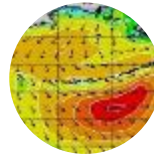
Oil detection & tracking



Maritime features and surveillance



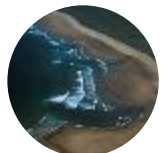
Infrastructure monitoring



Wind data



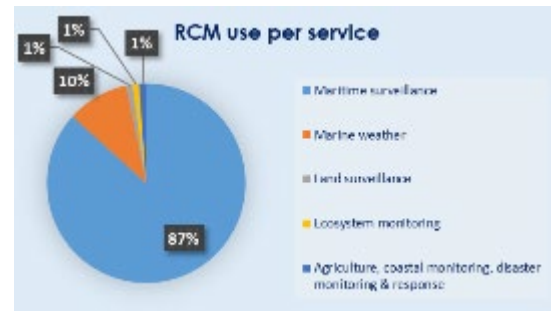
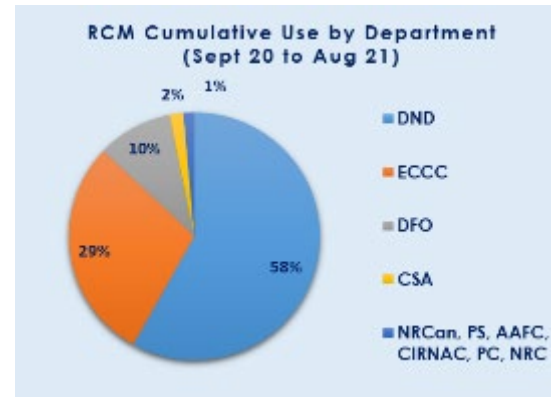
Agriculture and food systems



Wet/Humid



Support to emergency response



RCM Vetted Users

195

127

Industry & Academia

4

Non-sponsored International

18

Province & Territories

46

NPO & Sharing Partners

10

GC Departments

300 000

SAR scenes/yr used by GC

A **60 fold** increase when compared to RADARSAT 1 and demand is ever growing.

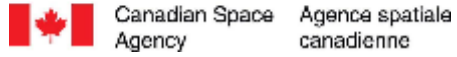
TOTAL RCM IMAGES provided to International Users

Until August 29, 2022

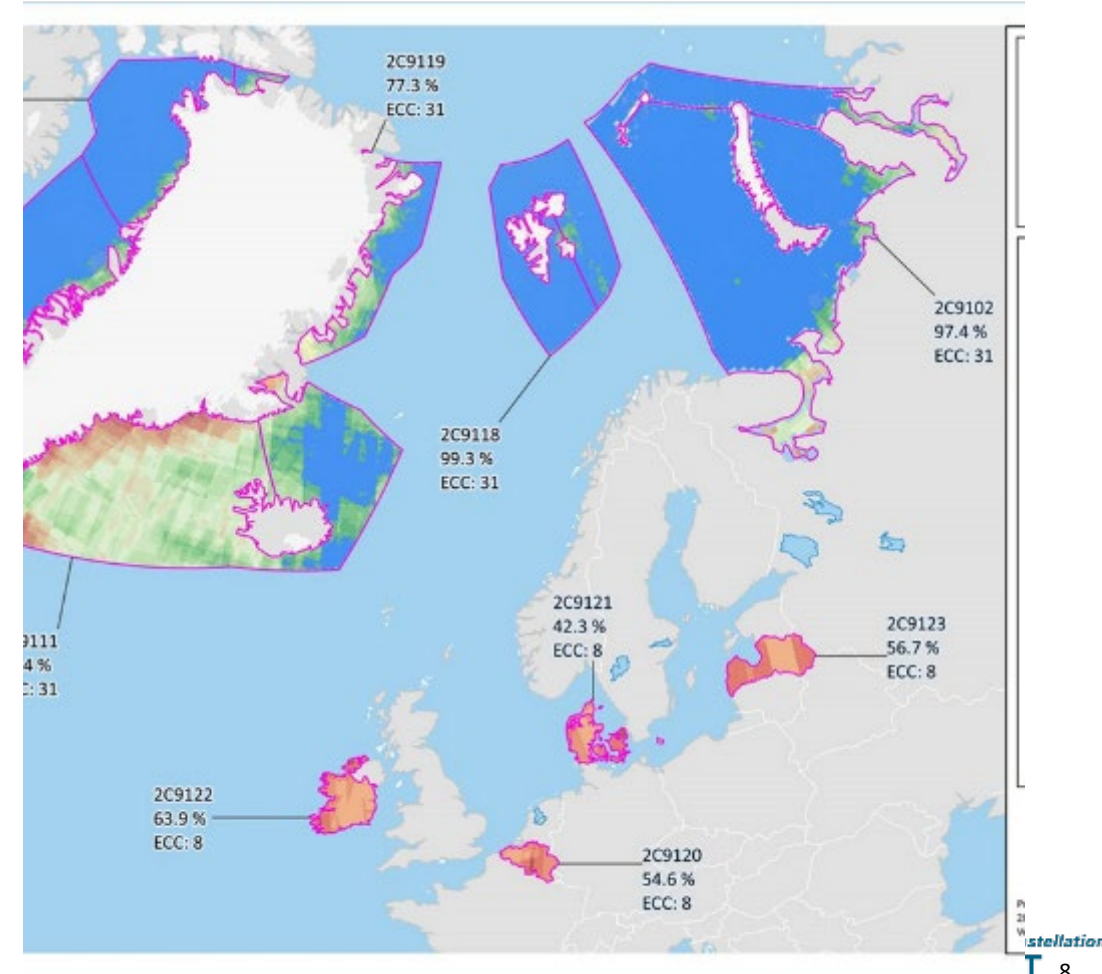
| Country | Organization | Vetted on | Image Count |
|---------------|--|------------|-------------|
| Denmark | National Space Institute, DTU Space, Technical University of Denmark | 2021-03-11 | 79,495 |
| | Danish Meteorological Institute | 2021-01-11 | 70,880 |
| Finland | Finnish meteorological institute (FMI) | 2021-04-08 | 1,870 |
| France | Télécom Paris | 2022-07-12 | 92 |
| | Institut des Géosciences de l'Environnement | 2021-12-16 | 18 |
| | Institut de Physique du Globe de Paris (IPGP) | 2021-09-01 | 3 |
| Japan | JAXA | 2021-02-05 | 6,334 |
| Netherlands | Stichting Deltares | 2021-04-08 | 3,932 |
| Norway | Norwegian Meteorological Institute | 2021-04-27 | 5,251 |
| | Nansen Environmental and Remote Sensing Center | 2021-03-01 | 30 |
| Ukraine | National Space Facilities Control and Test Center (NSFCTC) | 2022-05-09 | 5,103 |
| United States | Michigan Tech Institute | 2021-07-13 | 16 |
| | International Ice Patrol | 2021-03-11 | 184 |
| | Global Fishing Watch | 2021-02-10 | 407 |
| | NOAA/NESDIS | 2021-09-02 | 277,712 |
| | U.S. National Ice Center | 2021-04-30 | 59,882 |
| | NASA | 2021-02-26 | 96 |



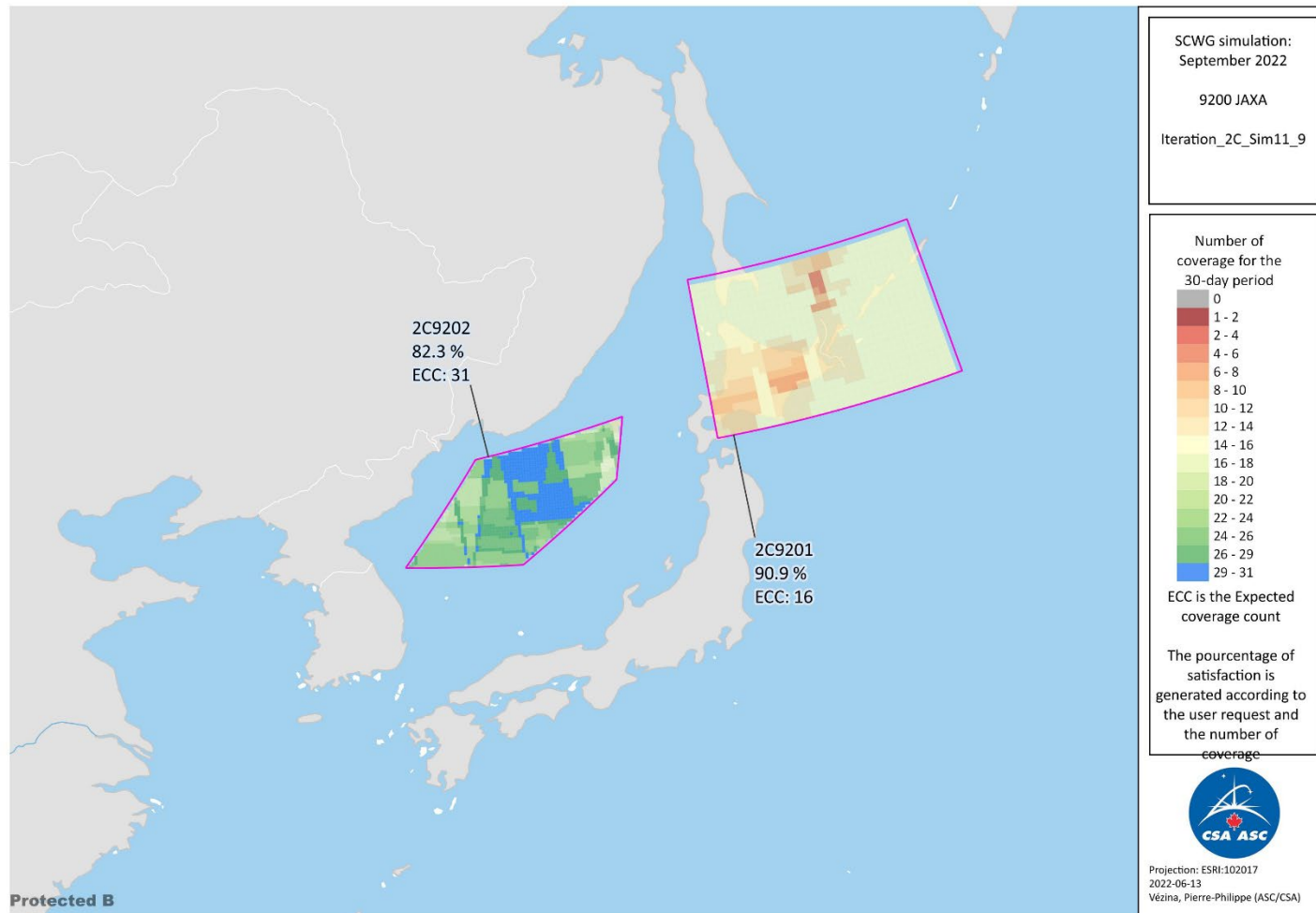
ESA observation requirements for RCM



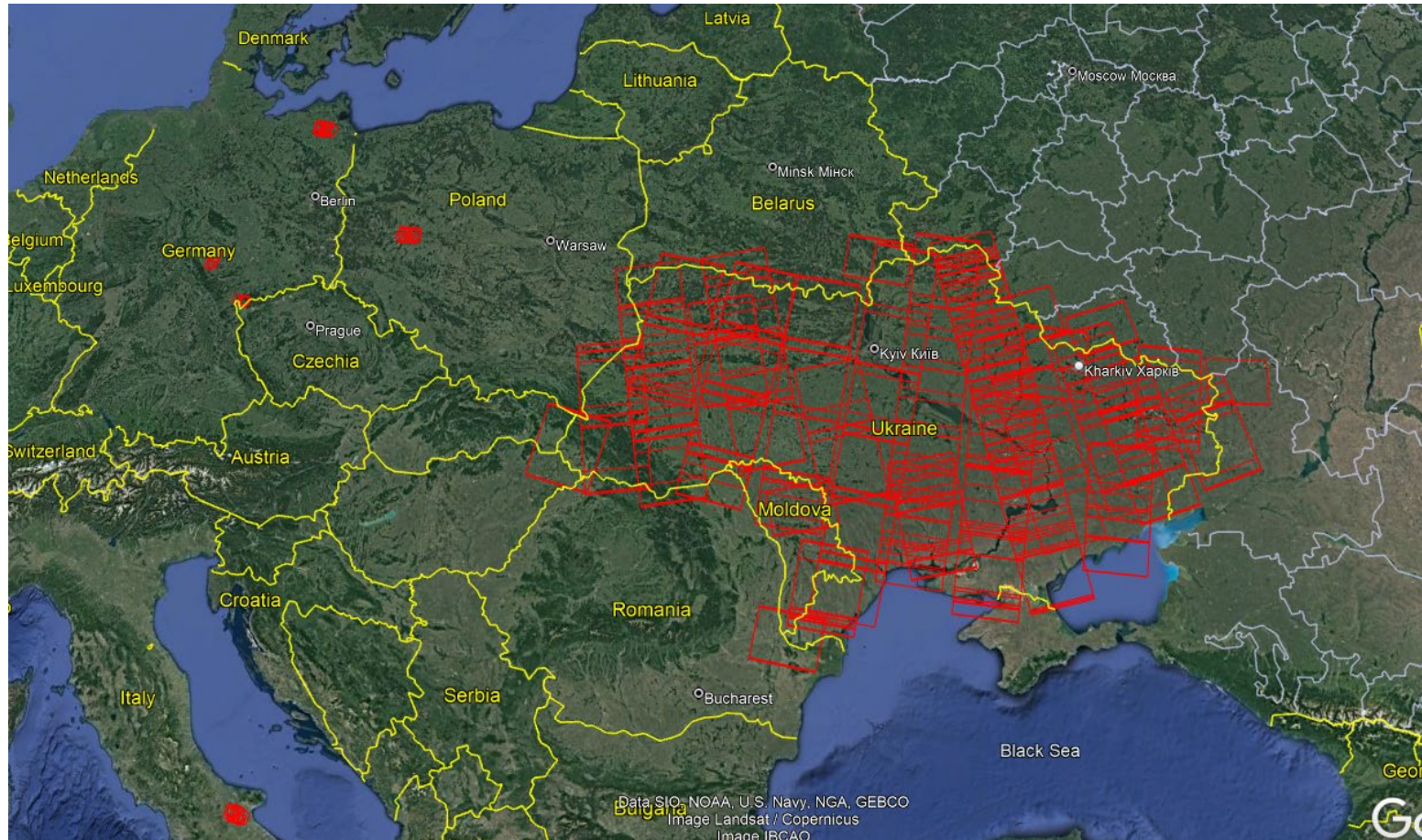
- The RCM support to European needs started in Jan 2021, for Copernicus sea-ice monitoring, and is on-going
- Following the Sentinel-1B anomaly (23/12/2021), the RCM coverage frequency of relevant sea-ice areas was increased, starting in Feb 2022 with a daily revisit
- In addition, the European Commission asked for RCM data coverage over specific European areas to evaluate the suitability of the mission to support the monitoring of agricultural activities in the context of the EU Common Agricultural Policy (CAP) which started on April 10th with a 4 day revisit



JAXA – CSA Data Sharing Collaboration



GEOGLAM - Ukraine

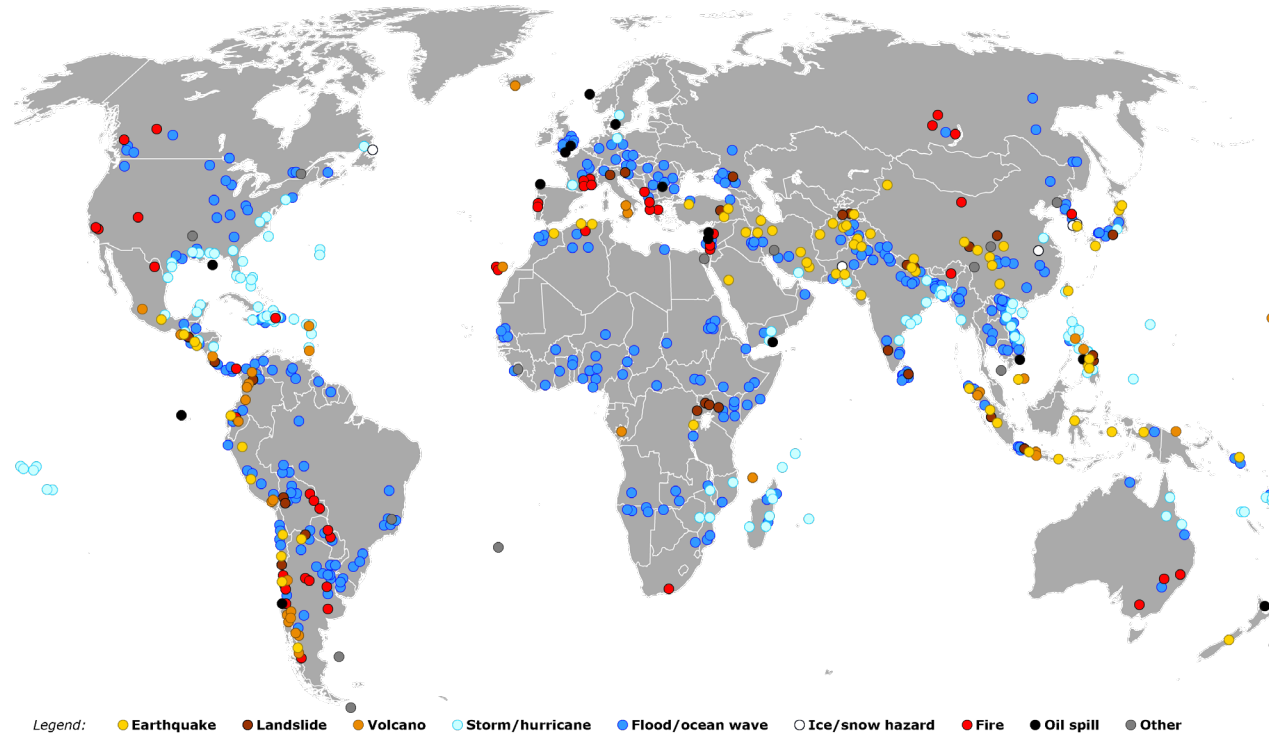


CSA implication to the International Charter 'Space and major Disasters'



SATELLITE DATA TO SUPPORT
DISASTER RESPONSE WORLDWIDE

- The Charter is an International agreement among Space Agencies to support with space-based data and information relief efforts in the event of emergencies caused by major disasters.
- Following UNISPACE III in Vienna in July 1999, **ESA** (European Space Agency) and **CNES** (Centre national d'études spatiales) initiated the International Charter in July 1999. **CSA** signed the Charter as a **founding member** on October 20, 2000. It was declared operational as of November 1, 2000.
- Today, there are 17 Charter Members and 270 satellites monitoring disasters. The Charter was activated 770 times for 131 countries.
- Since the commissioning of the **RCM**, 973 products were delivered in response to 110 events.
- The CSA is engaged in a myriad of duties: Board, Executive Secretariat, Project Management, Emergency on-Call Officer & Mission Planning Personnel.





SAR services

Space based SAR imagery touches lives of Canadians

Maritime Surveillance Service using Space Based SAR

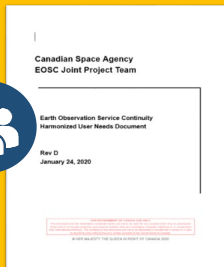


Navigating through sea ice is a real challenge for ships and their captains. A wrong move can lead to a detour from a safe route, resulting in wasted fuel or even getting stuck in the ice. Space based SAR imagery helps ensure safe, efficient navigation by providing information on ice quantity, density and strength, as well as on the ice formation cycle. It supports Canada's commercial marine sector, as well as helps improve weather forecasting methods.

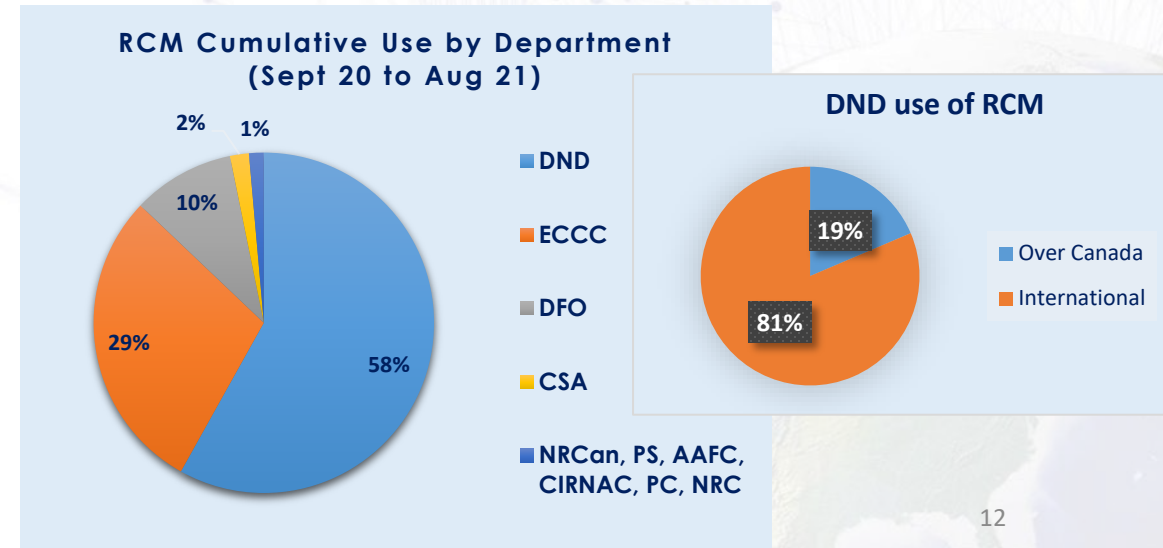
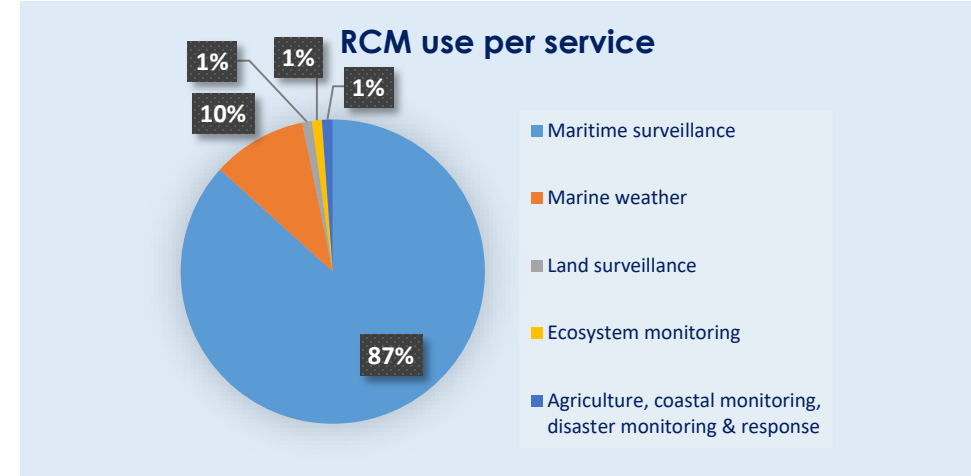
EOSC Harmonized User Needs

Comprehensive registry of GC future needs.

The HUN is the result of comprehensive and sustained consultations with key federal collaborators, DND, NRCan, DFO, ECCC and AAFC.



| Earth Observation Themes | Examples of services | EOSC observational needs (HUN) |
|--------------------------|--|--------------------------------|
| Maritime surveillance | Ice monitoring, inform transport safety | 8 |
| Land surveillance | Track urban expansion, guide wildlife protection strategies | 3 |
| Marine weather | Reduce risk to marine transits | 3 |
| Ecosystem monitoring | Biomass mapping for carbon sink estimates, climate prediction modeling | 21 |
| Agriculture | Tillage and crop residue mapping, productivity | 12 |
| Coastal monitoring | Shoreline zoning, predict tidal erosion | 3 |
| Disaster monitoring | Active volcano monitoring | 3 |
| Disaster response | Active wildfire mapping, guide on the ground interventions | 6 |





Solution Elements for Services Continuity

A strategic combination of complimentary data sources offers the best cost benefit ratio, resiliency and adaptability to ever changing markets and technology.

- Open & free data sources such as Landsat, Copernicus, NASA's NISAR and others being pursued
- Integration into GC value chain is being coordinated with User Departments, NRCan's EODMS team, and CSA Digital Earth Canada (DEC) team

Status:

- Current Investigations underway on Sentinel data and usage of this data within the GoC

- EU-ESA Copernicus data, especially from SAR C-band Sentinel -1, are important elements of the solution. Early engagement between EOSC and Sentinel-1 Next increases our ability to mutually influence system requirements that would result in enhanced capabilities.
- Several other close international partners like JAXA and DLR have well-established SAR programs in complementary L-, and X-bands, which are addressing some requirements in HUN
- Access to data from international partners is based on quid pro quo principle (bartering capabilities)

Status:

- Arrangements signed with ESA, DLR, CONAE and JAXA to investigate potential areas of collaboration (AOIs, applications etc.)

Free & Open
Data

Commercial
Data

Access
through
International
Collaboration

National /
Sovereign
System

- With arrival of Canadian and foreign "new space" and "established space" commercial systems and data offerings (IceEye, Capella, Umbra, MDA, Airbus...), commercial data becomes an important element of the overall solution.
- Current market offerings do not address all the GC needs (HUN). There is, also, a high degree of uncertainty with respect to availability of this data in the timeframe of the EOSC.
- There are also considerations of "data sovereignty" for some critical services.

Status:

- Identifying and analysing any potential source of commercial data buy to bridge the gap between RCM and EOSC (MDA-CHORUS, IceEye, Capella)

- As it comes from EOSC Phase 1 studies, C band SAR needs in HUN will, most likely, require a "sovereign system" to address the capability gap left by other solution elements to meet GC needs.
- It does not necessarily mean a GoC owned and operated system, like RCM.
- Collaboration with DND's DESSP initiative opens opportunities for mutually beneficial leveraging of capabilities.

Status:

- Multiple business models are under investigation with the support of Deloitte (from COGO, PPP, lease etc.), and EOSC contractors.

International Partnerships

What we have learned so far

| | Partner Provision | GoC Potential Offer to Partners | Viable collaboration opportunities | |
|---|---|---|---|--|
| | | | Type of Data Exchange | Theme/Application of Interest to GoC |
|  <p>DLR</p> | Access to X band imagery (HRWS) | <ul style="list-style-type: none"> • Future C band imagery • Access to GC ground stations | <p>Data Exchange Agreement via Commercial Buy from Industry OR Gov-to-Gov data exchange agreement. <i>** Pending results of DLR RFP process to award.**</i></p> | <ul style="list-style-type: none"> • Forest monitoring • Infrastructure • Targeted high resolution acquisitions (to address conflicts) |
|  <p>CONAE</p> | Access to L Band Imagery (SAOCOM) | <ul style="list-style-type: none"> • Future C band imagery • Access to GC ground stations | <p>Ad-hoc for Emergency Use</p> | <ul style="list-style-type: none"> • Flood mapping • Glaciology • seismic active region • Infrastructure • Ecosystem monitoring • Biomass • Ice monitoring, river ice, great lake ice |
|  <p>ESA</p> | Access to C and L band imagery (Sentinel NG + Rose L) | <ul style="list-style-type: none"> • Future C band imagery • Access to GC ground stations | <p>Systematic Coverage <i>(complementary/coordinated acquisition plans)</i></p> | <ul style="list-style-type: none"> • Monitoring Global Geo-hazard and Disaster • Land cover, land cover change, agriculture and Forest • Marine Environment Monitoring and Hydrology • Maritime Safety and Security • Sea and Land Ice Monitoring |
|  <p>JAXA</p> | Access to L band imagery (ALOS) | <ul style="list-style-type: none"> • Future C band imagery • Access to GC ground stations | <p>Systematic Coverage <i>(applications)</i></p> | <ul style="list-style-type: none"> • Ice • Forest • Ecosystem/Coastline • Soil Moisture • Disaster – Infrastructure integrity, monitoring seismic active areas, active wildfire, Flood |

Canadian Space Agency



Agence spatiale canadienne