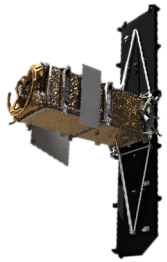


Third International SAR Workshop

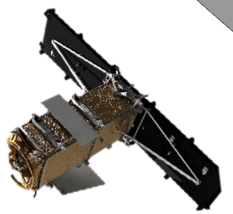
ICGS-SAR



Stéphane Chalifoux *and all.*

RCM & RADARSAT+ Mission Manager,

Space Utilization, CSA



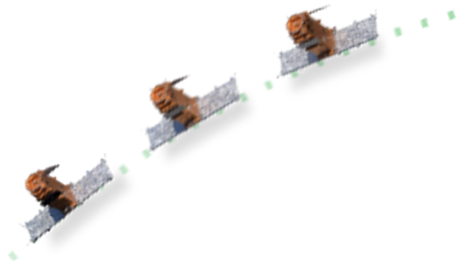
Saga Prefecture, Japan

CSA Report

WG1

Overview

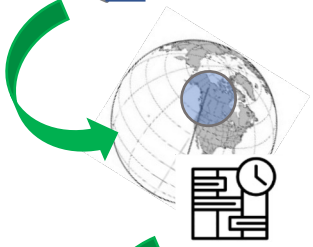
1. Misson ordering and planning
2. Data distribution and products
3. International collaboration
4. Data policy



SAR Data Management Subsystems



Order Handling



Mission Planning

…Uplink of acquisition plan,
…Imaging activity
…Downlink of raw SAR data



Reception and Archiving



Image Processor

Raw data sent to RCM archive



- Delivery to GC Authorized Users
- Copy of products sent to NRCan's EODMS

Categories of coverage

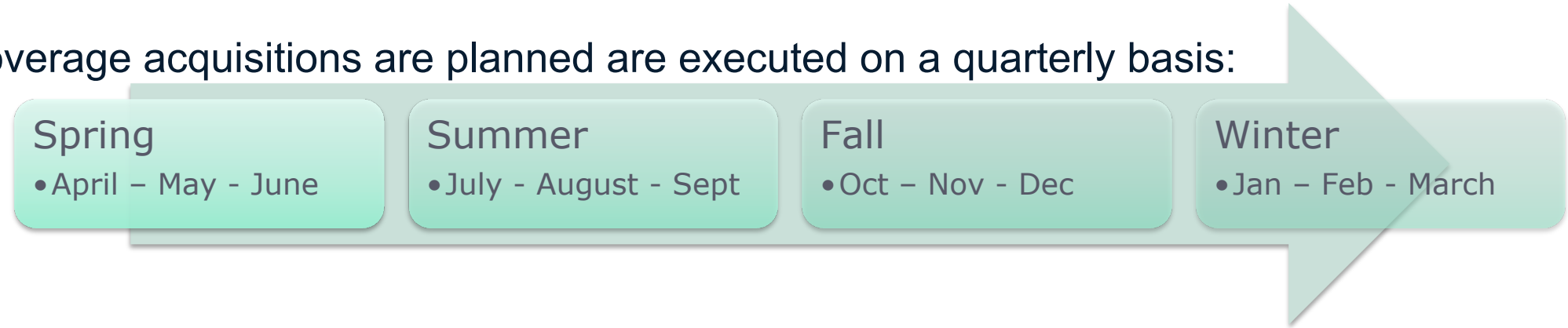
- RCM acquisitions consist mainly of 3 categories of coverage priorities:
  - Standard coverages:
    - Consists of pre-defined, pre-planned, recurrent acquisitions.
  - Ad-Hoc campaigns
    - Consist of punctual acquisitions planned by the GC government.
  - Fast tasking
    - Consist of last-minute requests, mainly for disaster response.
- For each category, these priorities are subdivided by usage (operational or research and development).
- RCM is designed to focus coverage around the Canadian land mass and the Arctic.

Standard Coverage Governance

Standard Coverages are governed by the SCWG, formed of Federal Department representatives that:

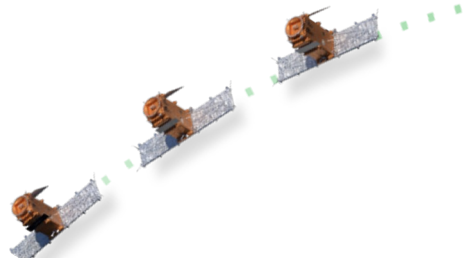
- Address issues related to fulfilment of specific Standard Coverage(s);
- Propose strategies to manage Standard Coverage order conflicts;
- Formulate planning recommendations and guidelines;
- Endorse new or revised Standard Coverages submitted by SCWG members.

Standard Coverage acquisitions are planned are executed on a quarterly basis:



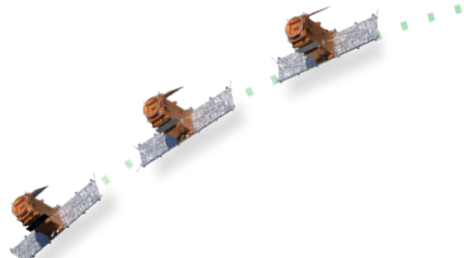
Ad Hoc campaigns

- These types of orders are placed by authorized users without coordinated planning.
- These priorities are generally lower than standard coverage orders so that they can’t affect them.
- These coverages can be single (one revisit) or standing (multiple revisit) but they have a fixed period of activities.



Fast tasking for emergencies

- These types of orders are placed by CSA at the request of an authorized users.
- They are single orders, they can be planned manually if needed.
- They required coordinated planning with operations and they can disrupt previous planning.
- They are mainly done on the behalf of the *International Charter 'Space and major Disasters'* and Canada's *Emergency Geomatics Services.*

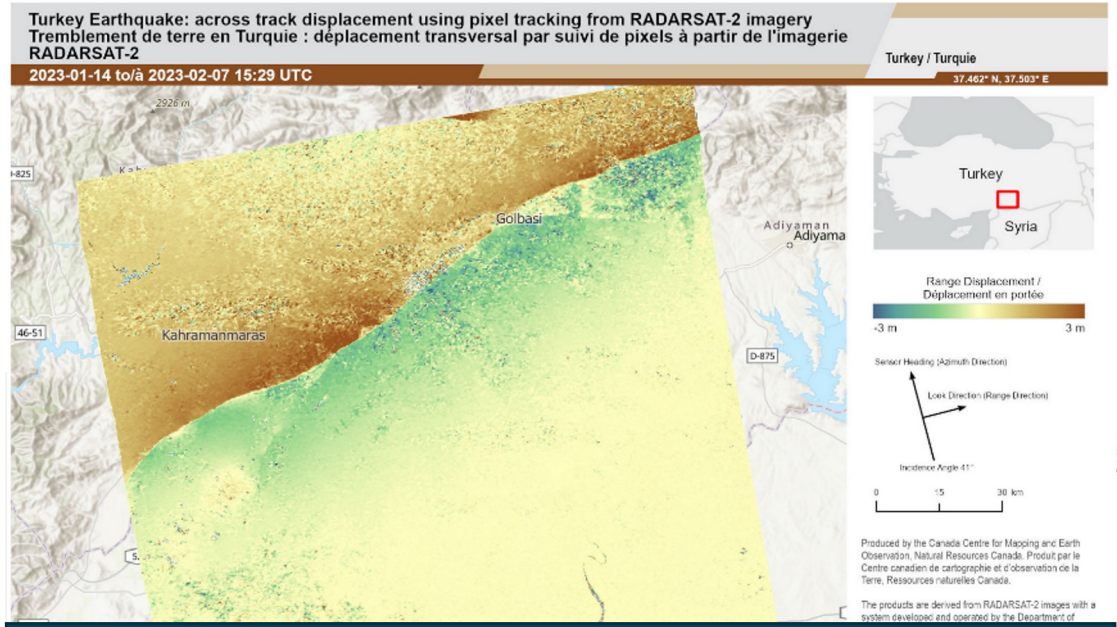



Natural Resources Canada
Ressources naturelles Canada
Earth Observation Data Management System
A part of the CCMEO Satellite Ground Segment
Canada

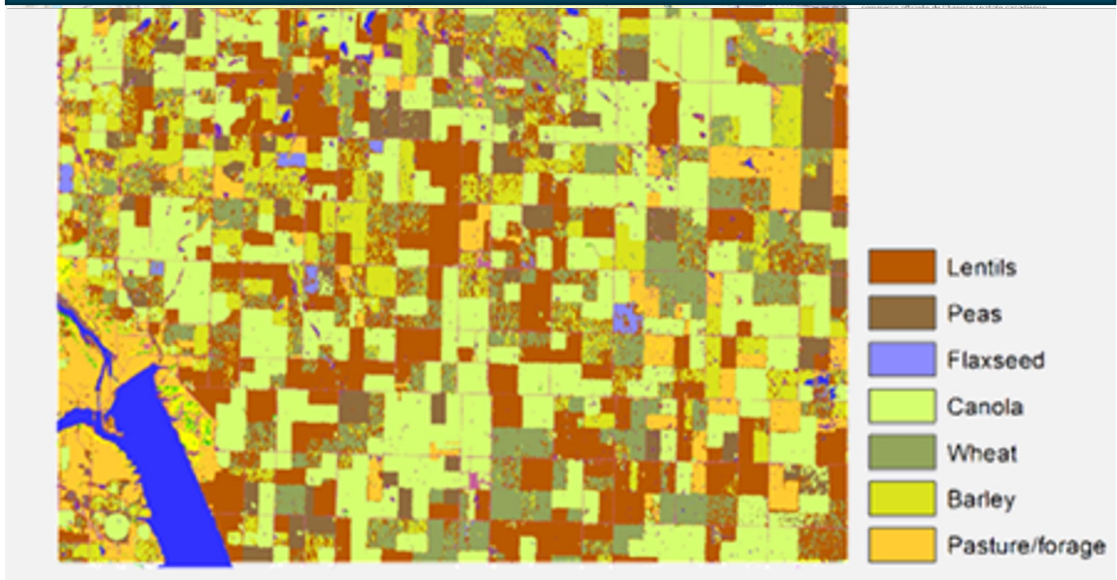
SAR Toolbox

SAR processing made simple

- Why? INSAR is really complicated… The toolbox gets you going in minutes, while avoiding common mistakes. Easy SAR processing by non-SAR experts.
- Who? Government of Canada, only. External access is considered.
- What? Supports RCM & RADARSAT-2
- How? Processing categories:
  - → **Radiometry**
  - → **Speckle Filtering**
  - → **Orthorectification & Mosaic**
  - → **Polarimetric & CP Decompositions**
  - → **Automated INSAR Processing for Land Deformation**



Range Displacement Product to support Turkey Earthquake (2023) generated from RADARSAT-2 processed by SAR Toolbox (Credit: Map produced by Emergency Geomatics Services, **Natural Resources Canada)**



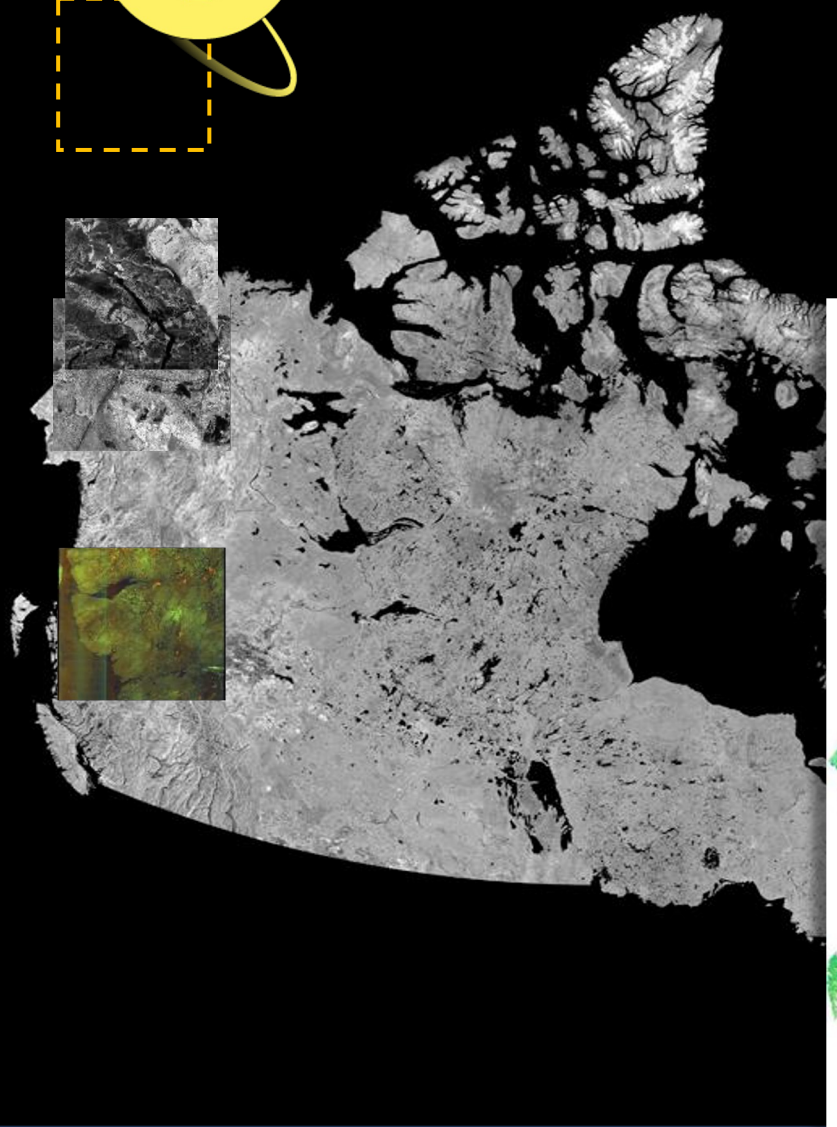
Crop Classification using Stokes Parameters generated from 30m CP RCM using SAR Toolbox (Credit: Laura Dingle Robertson, Heather McNairn & al., **Agriculture and Agri-Food Canada)**

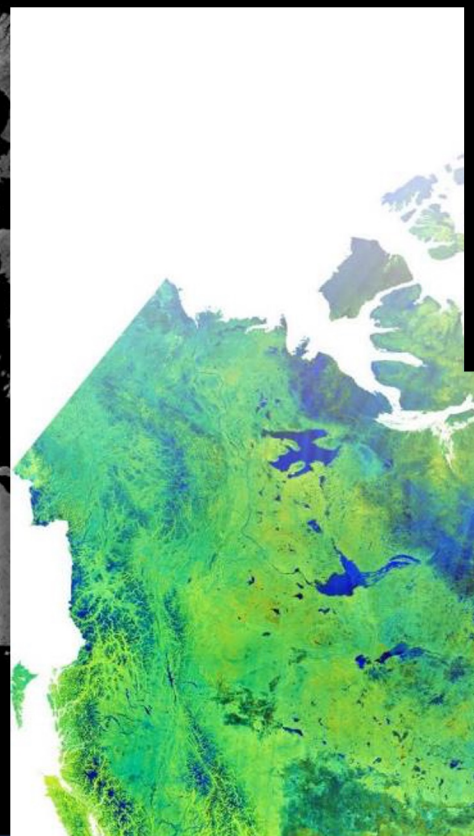
NISAR

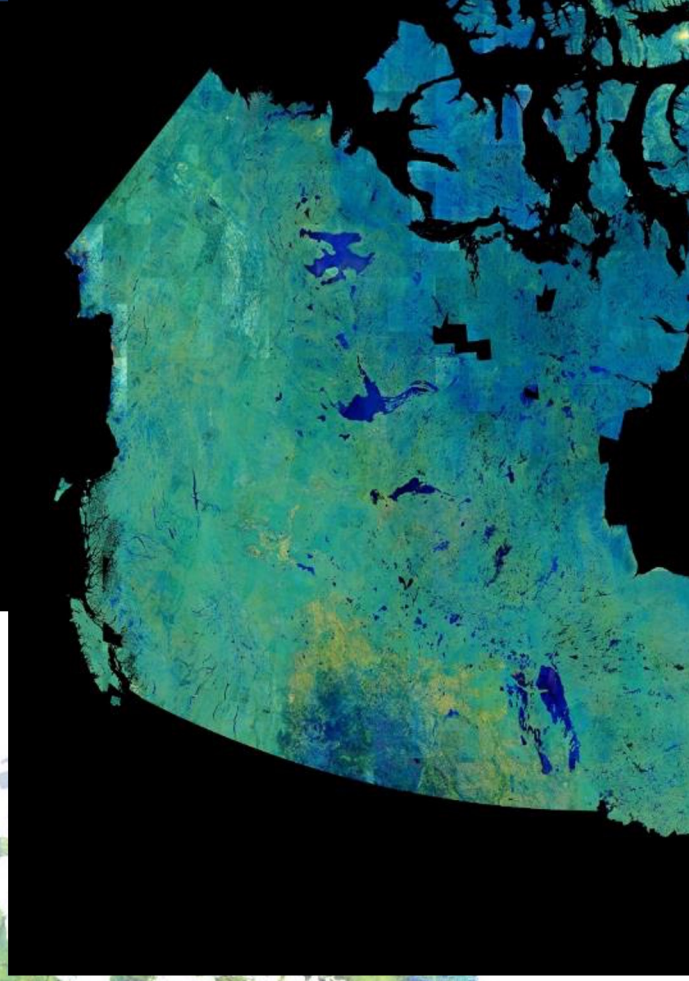
ALOS-2

TERRASAR-X

SENTINEL-1



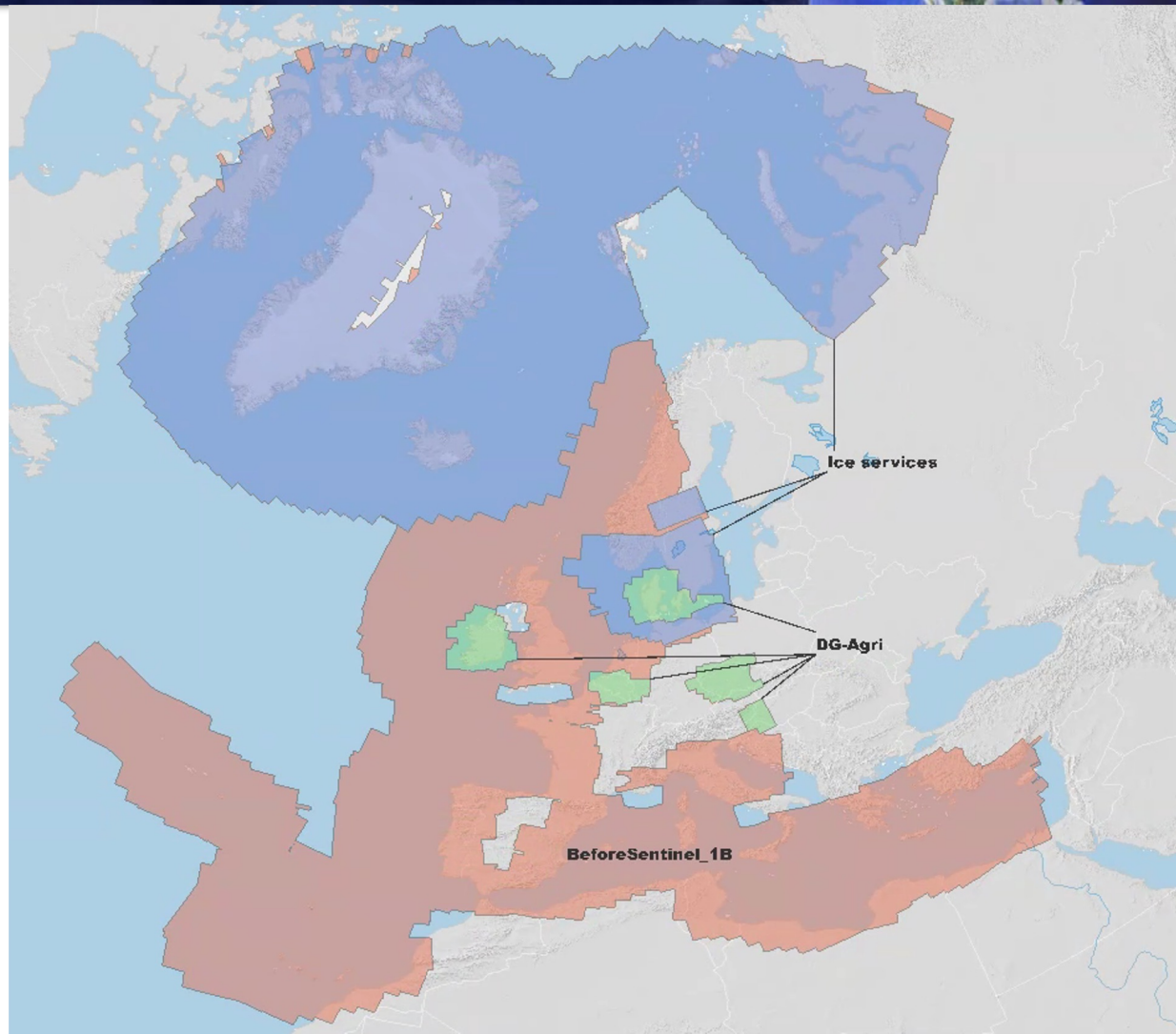




Standard coverage background mission

ESA – CSA Data Sharing Collaboration

- The RCM support to European needs started 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 requested for RCM data coverage over specific European areas in the context of the EU Common Agricultural Policy (CAP)
- In all, RCM as acquired more than 160 000 images since the launch in 2019 for ESA



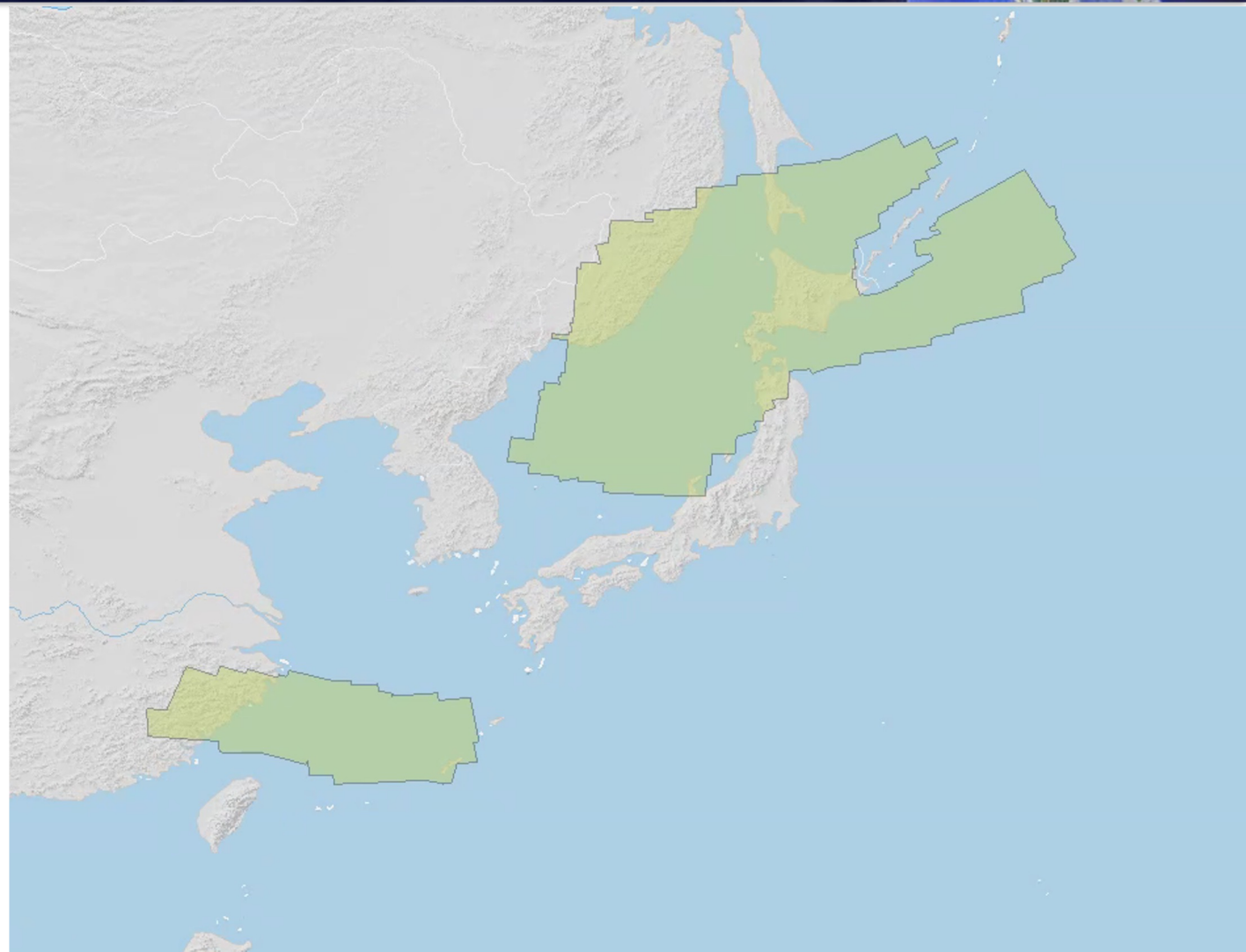
esa
European Space Agency

Copernicus
Europe's eyes on Earth

Standard coverage background mission

JAXA – CSA Data Sharing Collaboration

- RCM acquisition program for JAXA is designed for maritime monitoring
- In all, RCM as acquired more than 7000 images since the launch in 2019 for JAXA



JAXA Explore to Realize

Standard coverage background mission

IICWG – CSA Data Sharing Collaboration

- Following the Sentinel-1B anomaly (23/12/2021), IICWG as made an official request to improve coverage around the Antarctic
- In all, RCM as acquired more than 5 500 images since the launch the start of the program in 2022



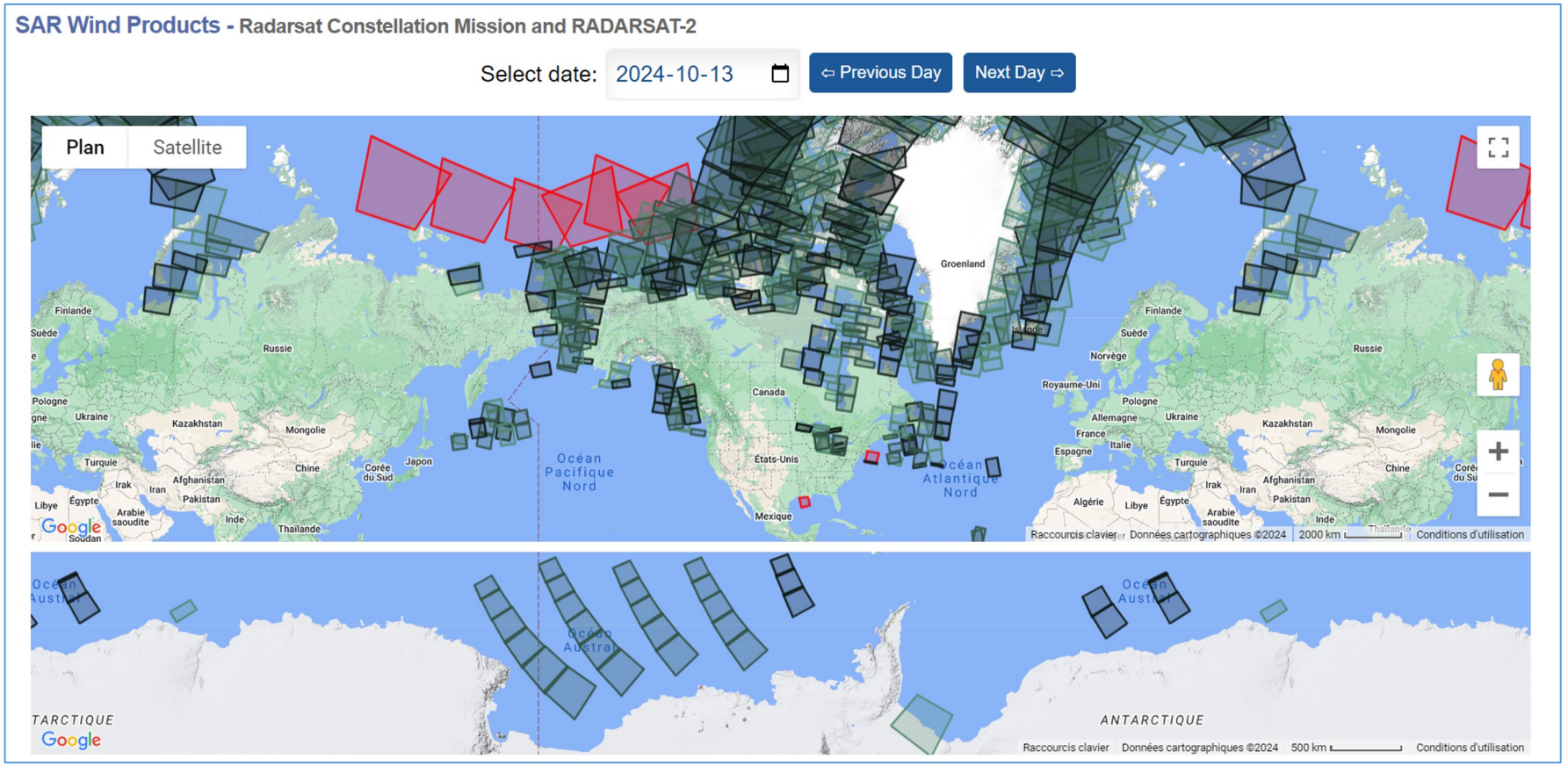
No tasking: Vetted users who download data for a SAR wind program

NOAA – CSA Data Sharing Collaboration

- NOAA's Satellite Oceanography and Climatology Division (SOCD) has been an active vetted users. They use most of the publicly available images to generate Ocean surface winds products

Here is an example of the Ocean surface winds products generated by NOAA from RCM images only on October 13th, 2024.

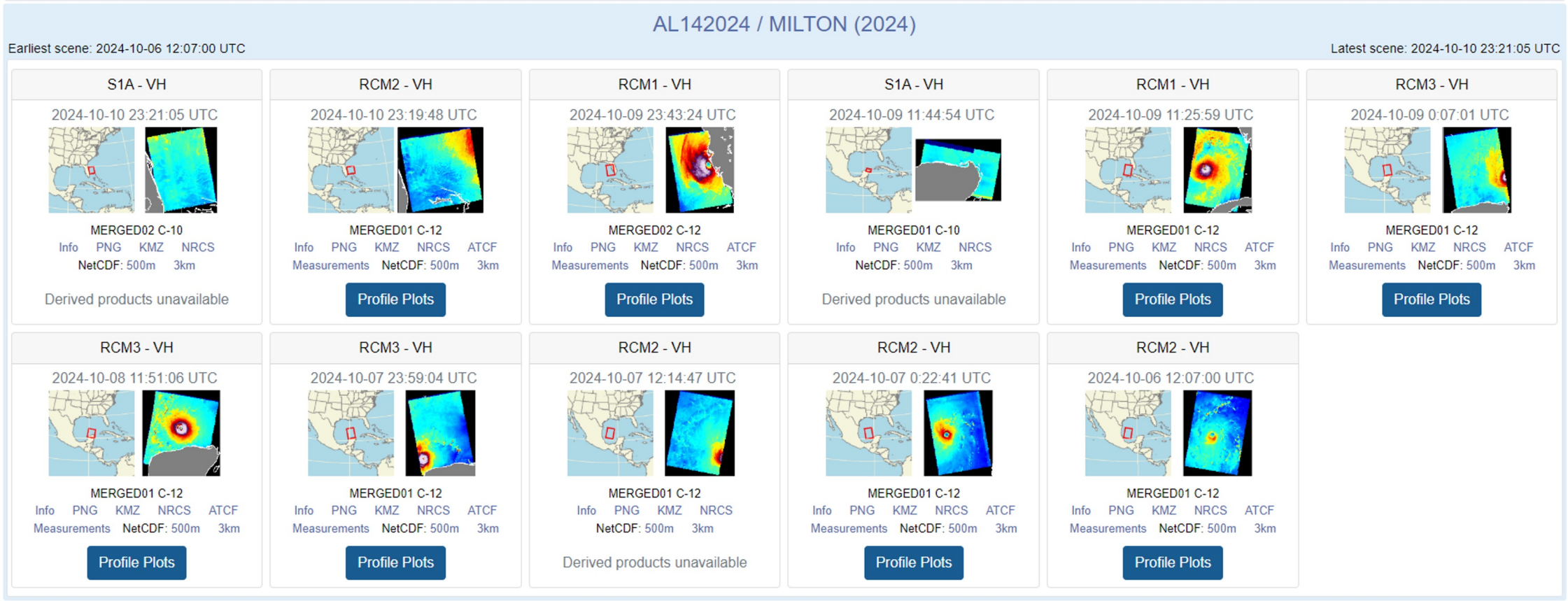
For this day alone NOAA used 487 RCM images.



Ad Hoc campaign

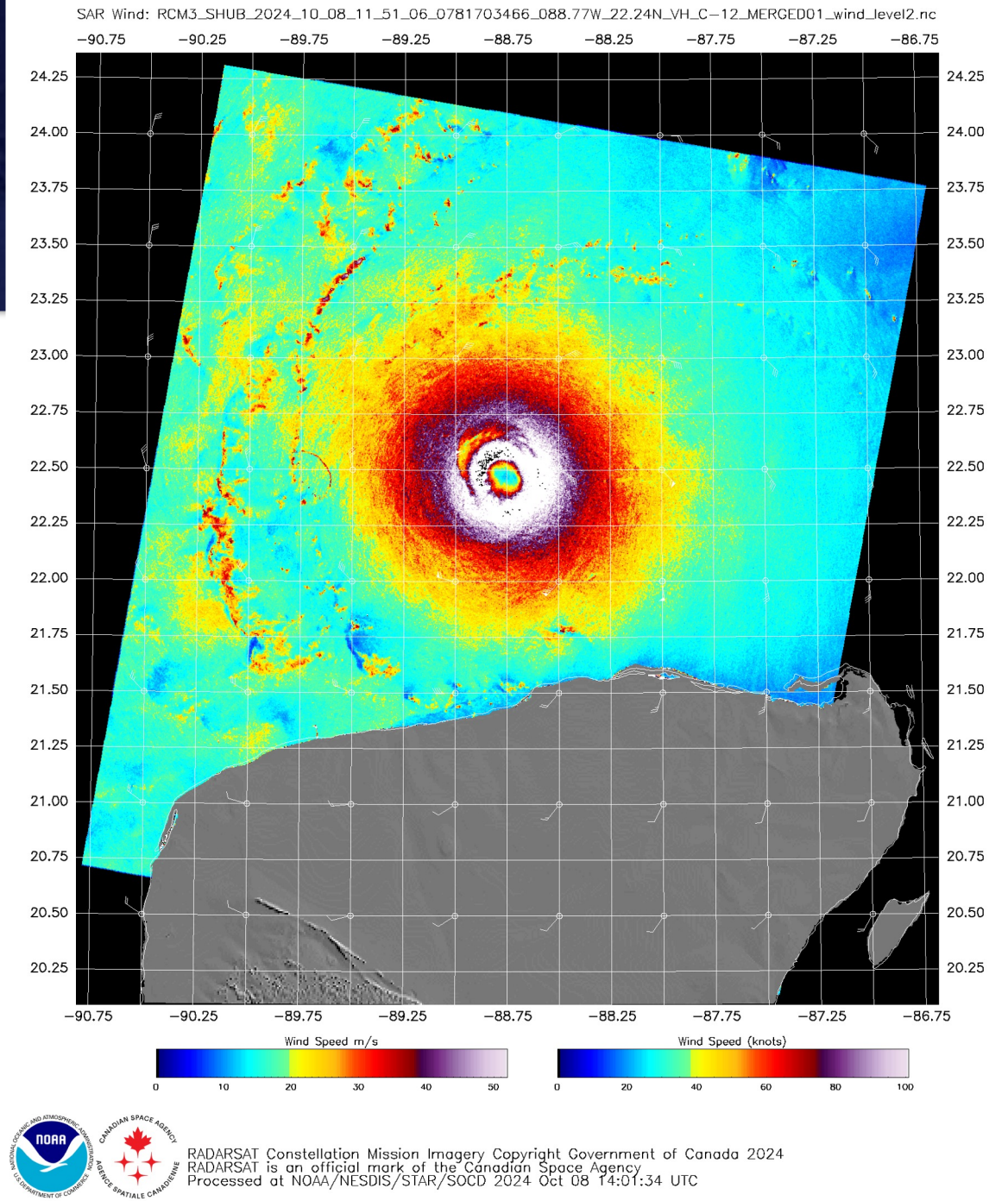
NOAA – CSA Data Sharing Collaboration

- In 2022, CSA upgraded its contribution to the hurricane watch program. Since then, the most of the NOAA's tropical cyclone products are generated from RCM images.



NOAA – CSA Data Sharing Collaboration

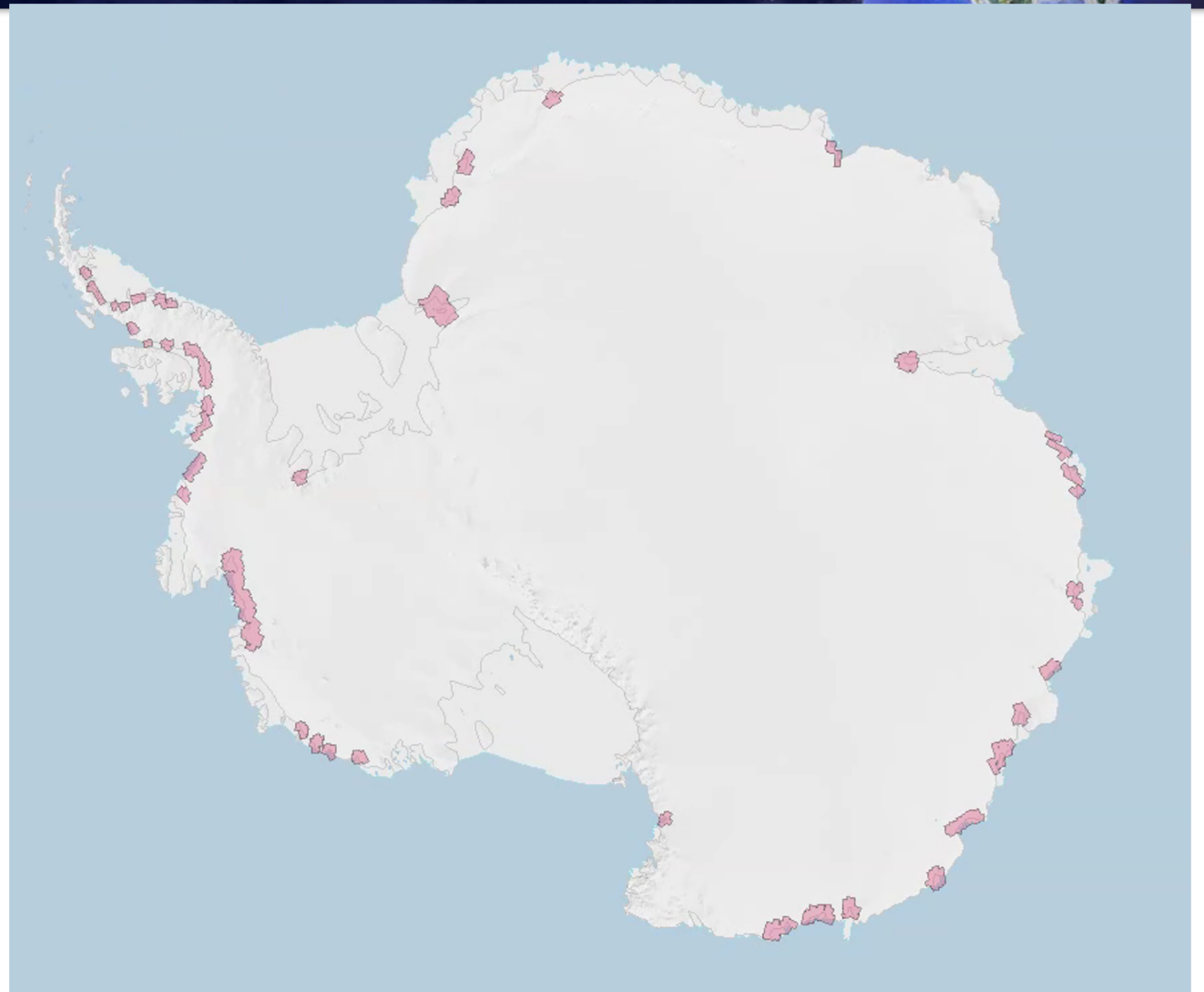
- In 2022, CSA upgraded its contribution to the Hurricane Watch program.
- This increased contribution was not only quantitative but also qualitative. With our new acquisition method, CSA increased the occurrence of hurricanes eye hits.
- As an example, here is a perfect eye hit of hurricane Milton on October 8, 2024. The high winds around the eye we're showing speeds around 100 knots (185 kph)



Standard coverage background mission

JPL – CSA Data Sharing Collaboration

- Following the Sentinel-1B anomaly (23/12/2021), the Eric Rignot research group, funded through a NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs), as made an official request to improve ice velocity and grounding line information coverage around the Antarctic.
- RCM as acquired more than 1800 images since the launch the start of the program in 2022



Ad Hoc campaign

GEO-TREES – CSA Data Sharing Collaboration



GEO-TREES: HIGH-ACCURACY GROUND DATA FOR SATELLITE-DERIVED BIOMASS MAPPING

Land vegetation is a large carbon store and represents opportunities to sequester additional carbon.

While many **Earth Observation missions aim to estimate forest carbon from space**, their calibration and validation is critical. Ultimately trust in biomass maps requires accurate ground data.

RCM data contributions

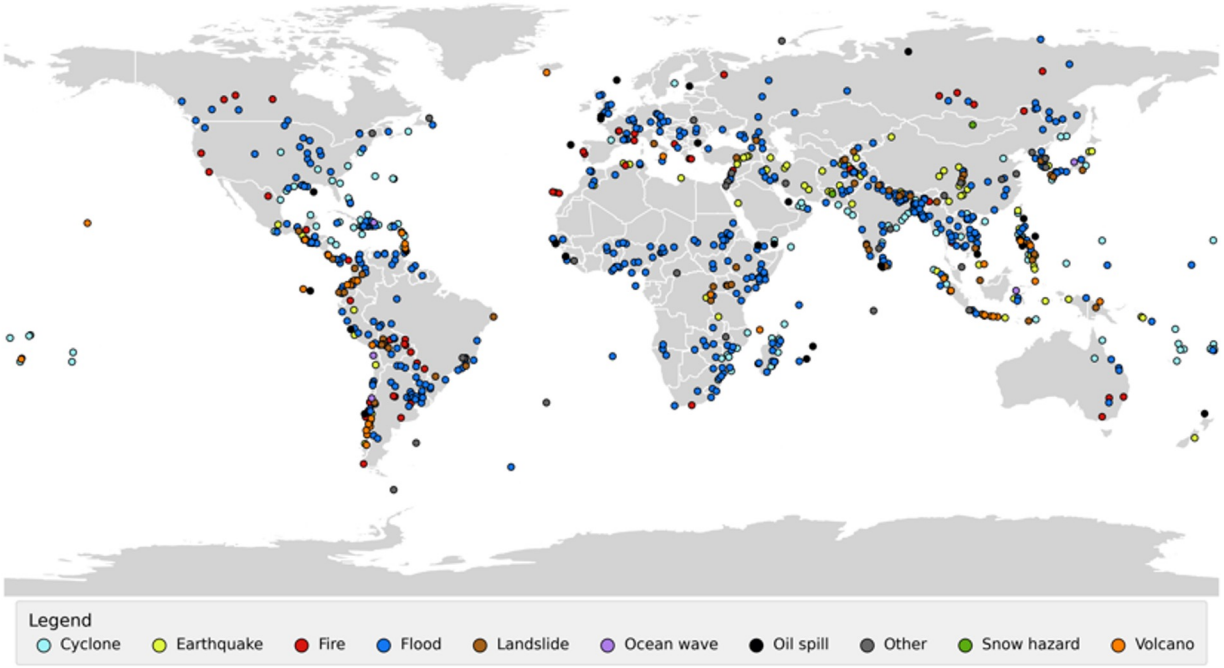
- RCM as acquired so far 84 images during a first test phase.
- A second round of acquisition will in start in 2025.

CSA implication to the International Charter ‘Space and major Disasters’

Emergency tasking

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 **919** times for **136** countries.
- Since the commissioning of the RCM, **1990** products were delivered in response to **233** events.
- The CSA is engaged in a myriad of duties:
  Board, Executive Secretariat, Project Management, Emergency on-Call Officer & Mission Planning Personnel.



UNCLASSIFIED - NON CLASSIFIÉ

Government of Canada's Sentinel NRT Mirror

```
aws s3 ls --no-sign-request s3://sentinel-products-ca-mirror/
```

STAC

Open to GC since Sep 2015.

Sentinel-1 (SAR): < 90 mins NRT delivery remains stable since 2015

Sentinel-2 (Optical): Coverage expanded to Canada-wide to support 2023 wildfire season 🔥 with usage from British Columbia and Ontario.

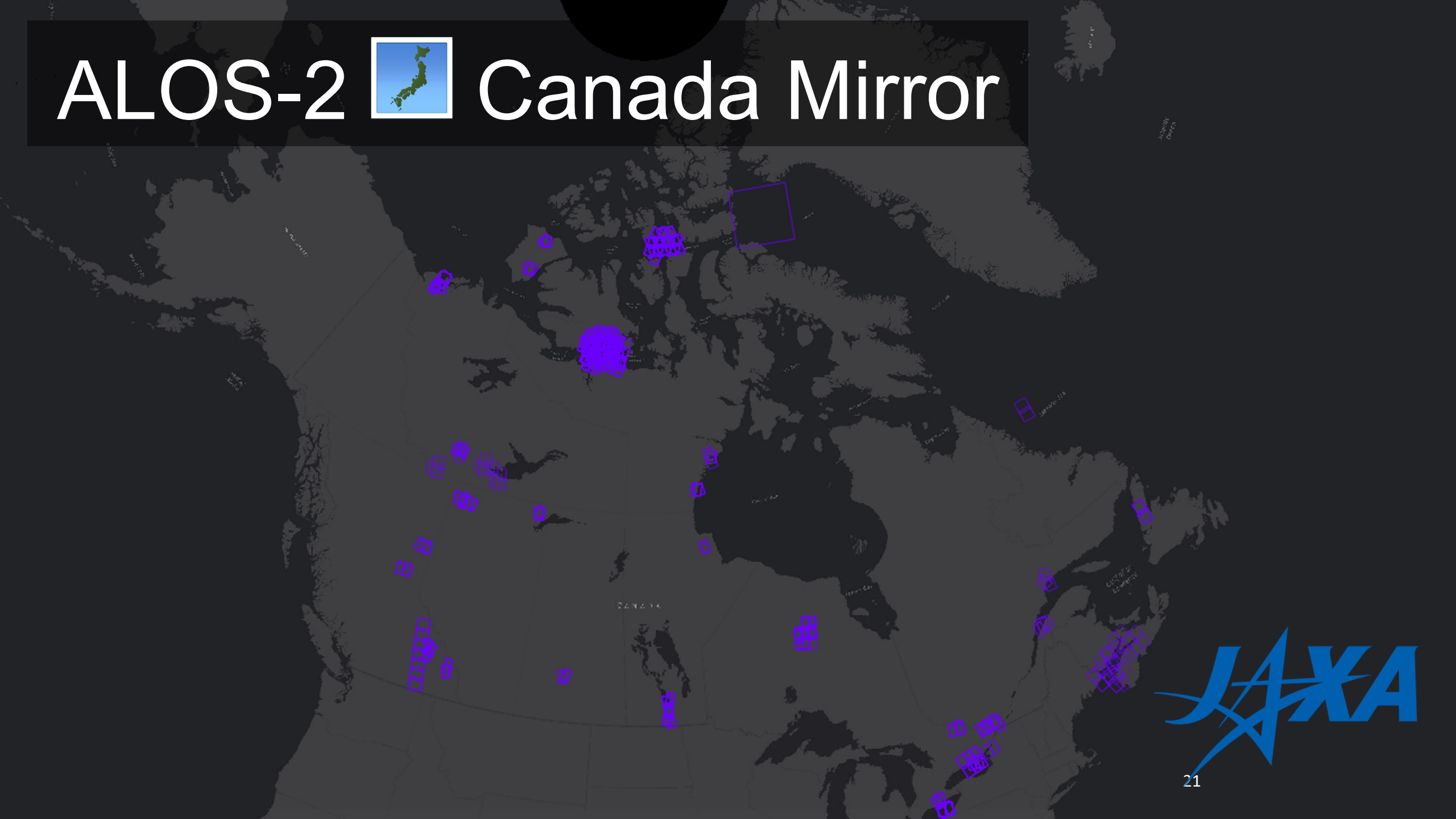
Sentinel-3: L1 EFR products from EUMETSAT, seasonally over Canada

Sentinel-6 (Altimetry): < 1.75 hrs.



Credit: ESA; A dual-polarisation composite of Montreal, captured by Sentinel-1A on 8 September 2015.

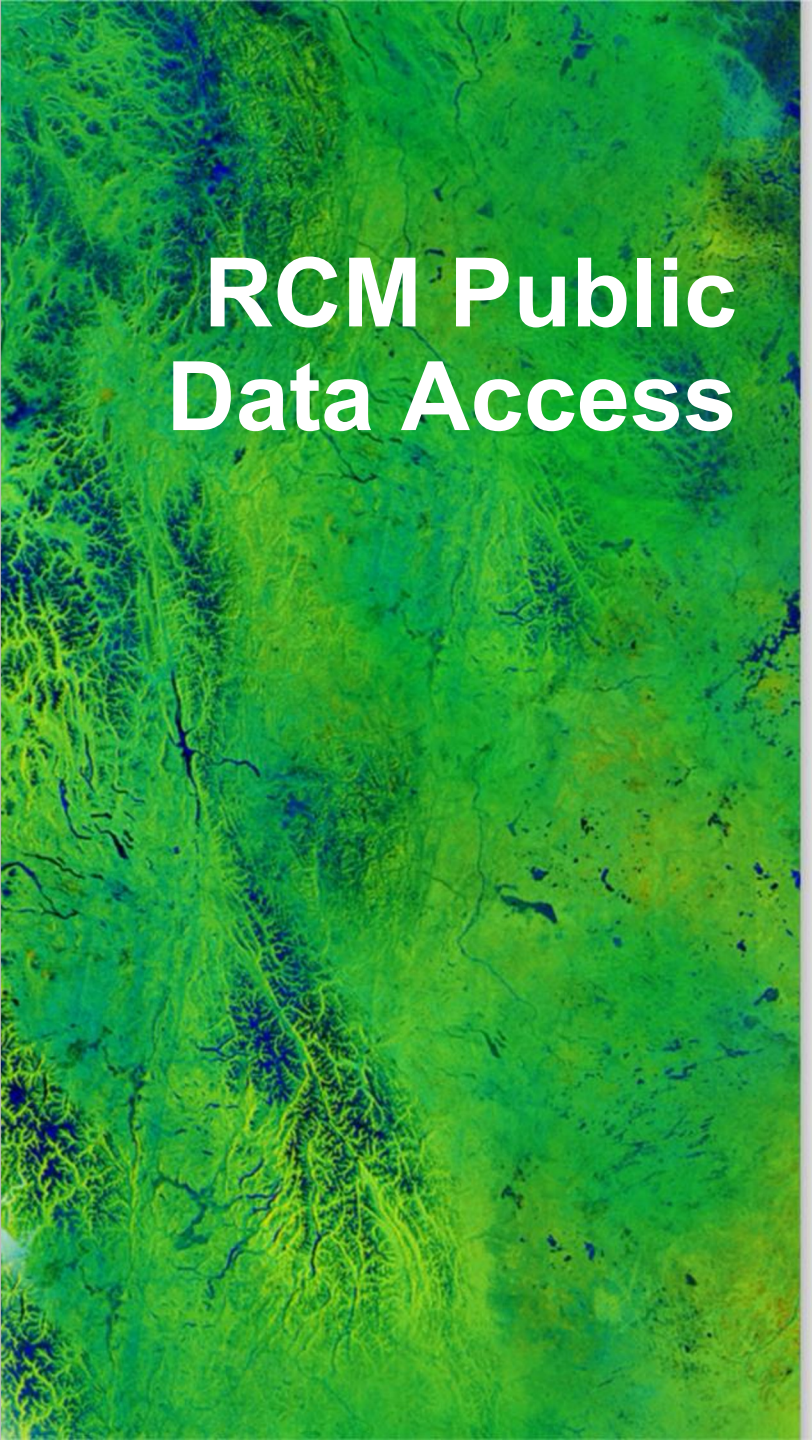
ALOS-2 Canada Mirror



International Collaborations

CSA has data sharing agreements with other space agencies to barter RCM products in exchange for acquisitions over Canada with their missions, either for operational use or R&D.

- **European Space Agency (ESA)**
  - Contingency Plan Sentinel1/RCM
- **DLR (Germany) / INTA (Spain)**
  - Tandem-X/TerraSAR-X/PAZ/RCM joint Supersite acquisitions for R&D Announcement of Opportunity
- **Japanese Space Agency JAXA**
  - Provision of ALOS-2 products over Canada
  - Provision of RCM products over Japan
- **NASA-ISRO (India) SAR collaboration**
  - NASA-NISAR
- **Surface Water and Ocean Topography (SWOT)**
  - Canadian scientists working on cal/val over Canadian sites to be covered by RCM.



RCM Public Data Access

Public users have currently access to the following products below 70 degrees of latitude:

Products with a resolution of **16 meters or coarser** covering Canada's **landmass** and inland waters, and international land.

Products with a resolution of **100 meters over world maritime areas** and products with a resolution of **50 meters or coarser over west Greenland maritime area**.

Access to **other Products requires authorization**


CANADIAN SPACE AGENCY
AGENCE SPATIALE CANADIENNE