Presentation Outline

- Update on missions and data contribution for LSI VC stakeholder
  - RSAT 1
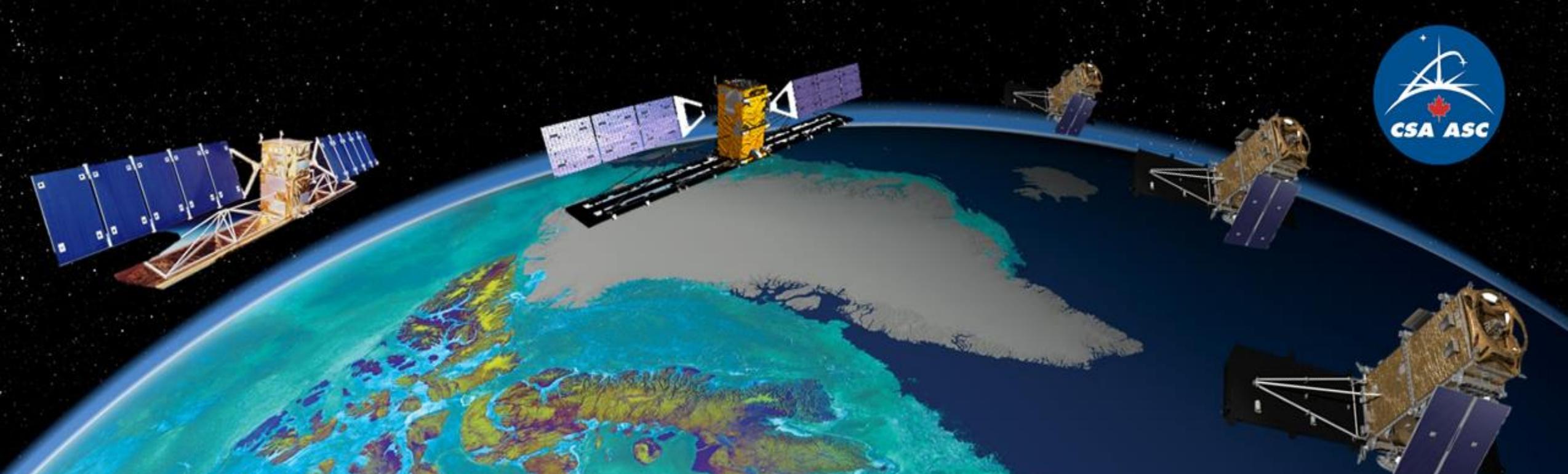 - RSAT 2 – Archives (Tropical forest, Polar regions)
  - RCM –
    - ARD
    - Couverture 30m
    - Compact pol
- Digital Earth Canada
- Circumtropical forest – collaboration with other space agencies
- Home/nest for EETT – link with LSI VC - Lucie
  - Thematic needs, available data
  - Similarly to FCT, GFOI, GEOGLAM, (SDG?) (GEO BON?),
  - Interoperability,
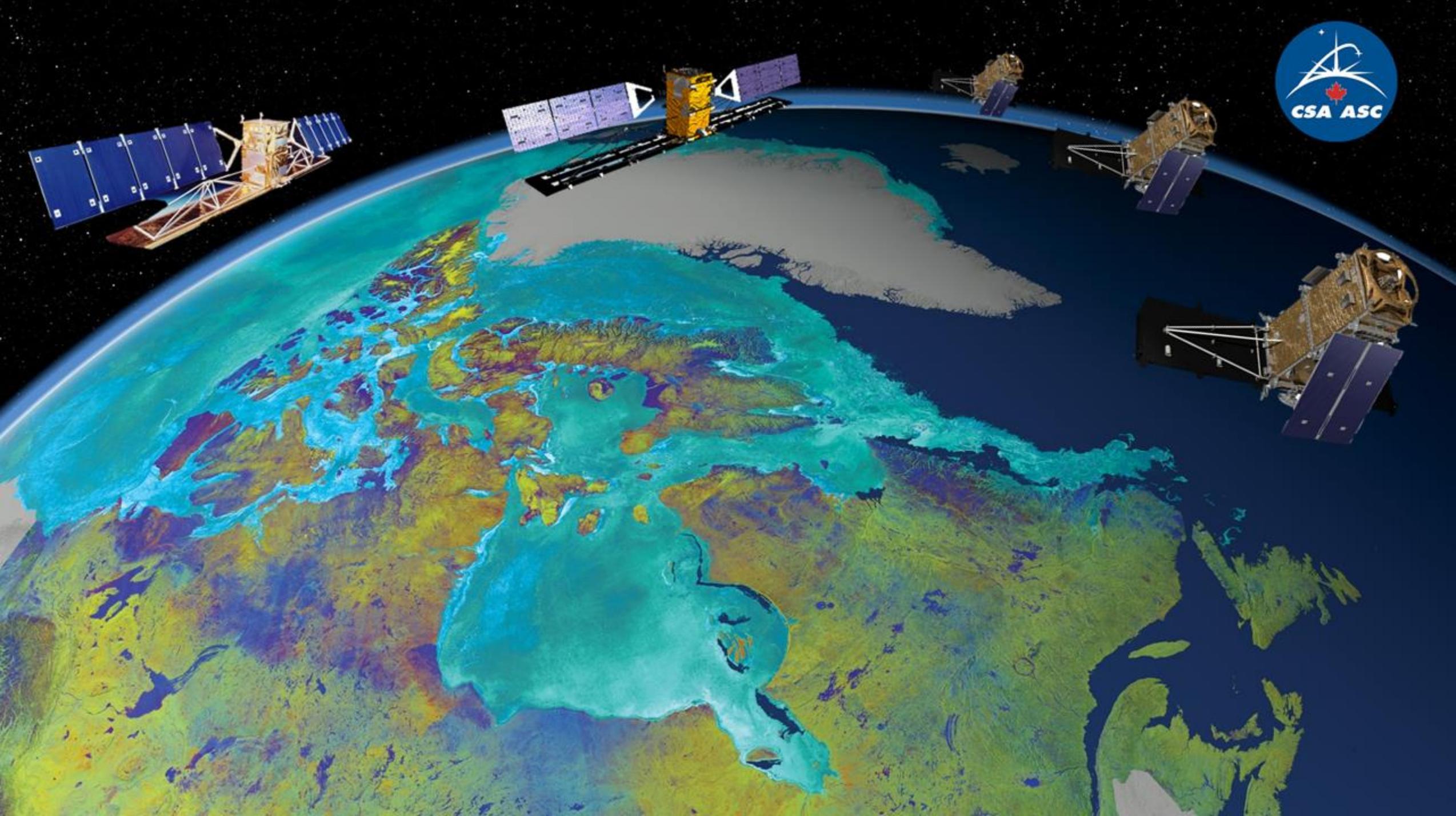
	RADARSAT-1 (1995-2013)	RADARSAT-2 (2007 -)	RCM (2018)
# of satellite	1	1	3
Mass	2750 kg	2300 kg	1430 kg
Exact revisit	24 day	24 day	4 day (12 / sat)
SAR time / orbit	28 min	28 min	15 min / sat
Antenna size	15 m	15 m	6.75 m
Polarization	HH	HH, VV, HV, VH	HH, VV, HV, VH, Compact Pol.
Look direction	Right	Right or Left	Right

RADARSAT Business Model Evolution
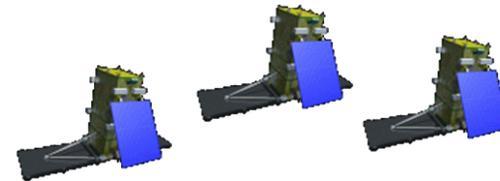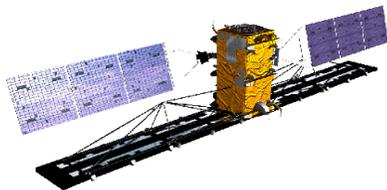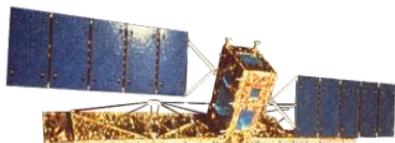
RADARSAT-1
- SAR EO is experimental
- R-1 is first operational SAR satellite worldwide
- Data available for GoC at the cost of processing
- Exclusive right to commercially distribute data to RSI (now MDA-GSI)
- Belief that R-1 would be a sound commercial deal and would bring substantial royalties to GoC

RADARSAT-2
- Privately-owned and operated by MDA
- Data sold and distributed by MDA-GSI
- MDA has a world-wide network of data resellers
- GoC has access to $450M pre-paid data credit and pays processing costs

RCM
- Government-owned and operated with contractual support from industry
- Designed to serve Canadian interests first
- Commercial component being defined
- Will comply with the Directive on Open Gov't (subject to exceptions)
- Objective to level the playing field between Value-Added Service Providers and commercial data distributor

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 as approved 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 station represent more than **710 000 images**, all available through EODMS.

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

RADARSAT 2 – Data and Archive

- Owned and operated by MDA

- Data are commercially available – i.e. ESA Third Party Mission

- Rich coherent archive
  - Polar regions since 2007 – already available for science and R&D
  - Circum-tropical forest (high-res collected since 2012 – over 80k scenes available) – to be made available in phases for science and R&D challenges

CSA QP SAR Observations

- RADARSAT 2
  - Quad Pol mode supported by RADARSAT 2
  - Mission owned by MDA and data are commercially available
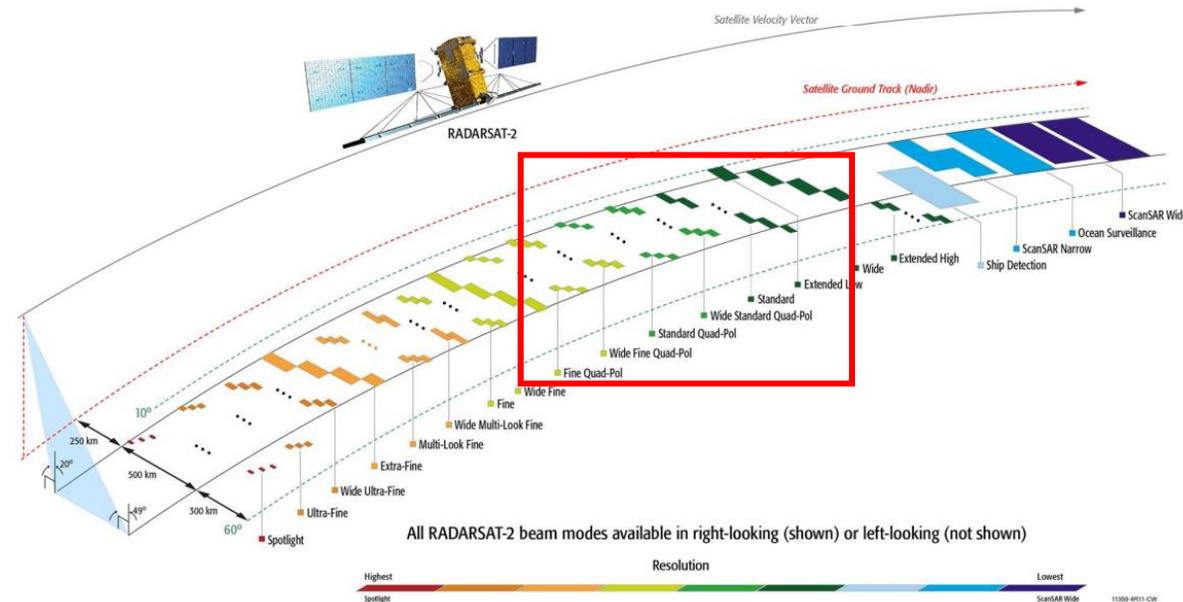
RCM data

- Archived RCM products are open data (16 m and coarser on land and 100m maritime) - Free of charge.

- Public access through Earth Observation Data Management System (EODMS) including: Pan-Canadian coverage at 30 m bi-monthly from April to December; Sites of interest at 16 m resolution; Sea areas at 100 m resolution.

The EODMS is a geospatial platform available and open to the general public by Natural Resources Canada for access to satellite data.

This tool allows users to search, preview and download Earth Observation products.

Note:
To access 1m, 3m and 5m products, a vetting process is required
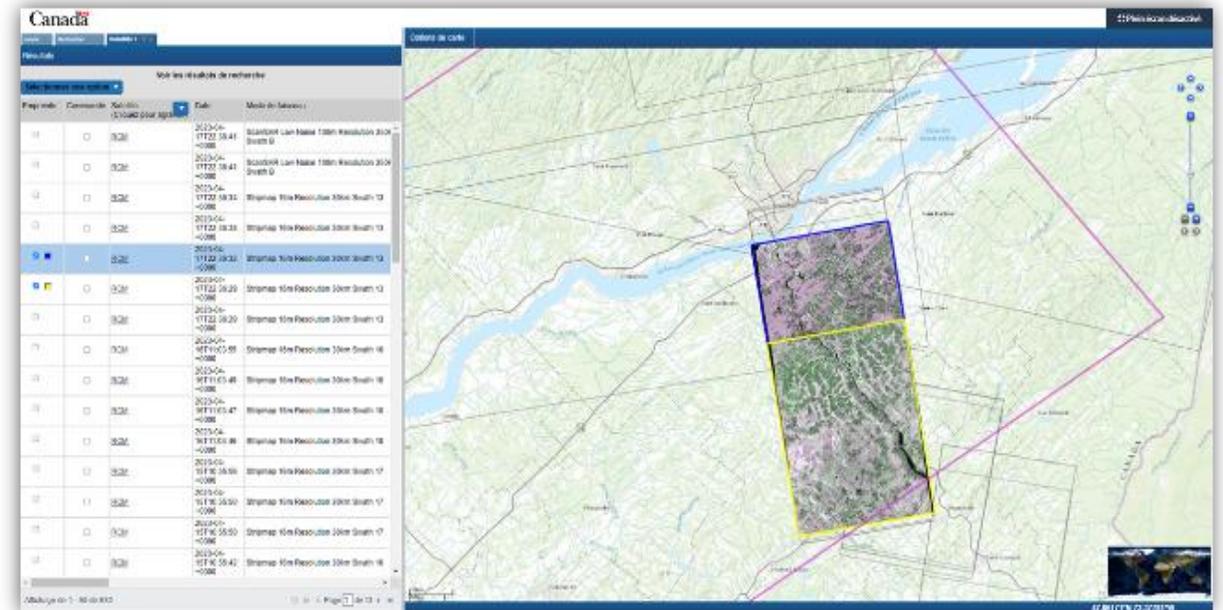
New Systematic 30m Land Standard Coverage

- Active from April to December of each year

- Parameters: 12-d revisit, Med Res 30m, Compact Polarization, MLC format (32-bit)

- Average of 56 scenes/day

- MLC 32-bit format:
  - Medium product sizes (~830 MB)
  - Easy visualization and handling (compared to SLC, which can have hundreds of individual burst images in a single product)
  - No distorted rendering over dynamic range

RCM Improved Public Data Access
(Canadian coast-to-coast 30m, Compact Polarimetry, every 12 days, from April to December)
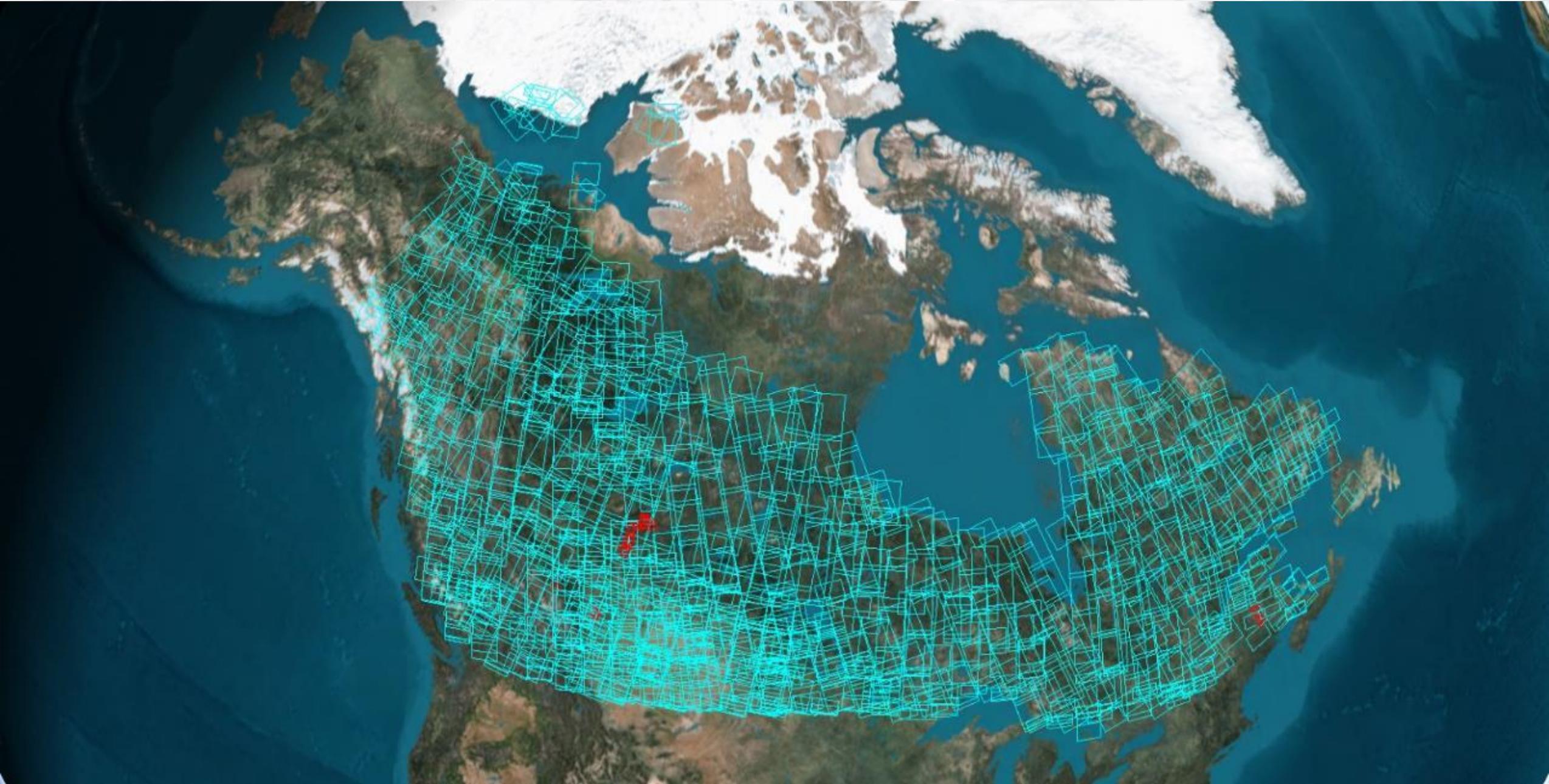
RCM Improved Public Data Access
(Canadian coast-to-coast 30m, Compact Polarimetry, every 12 days, from April to December)
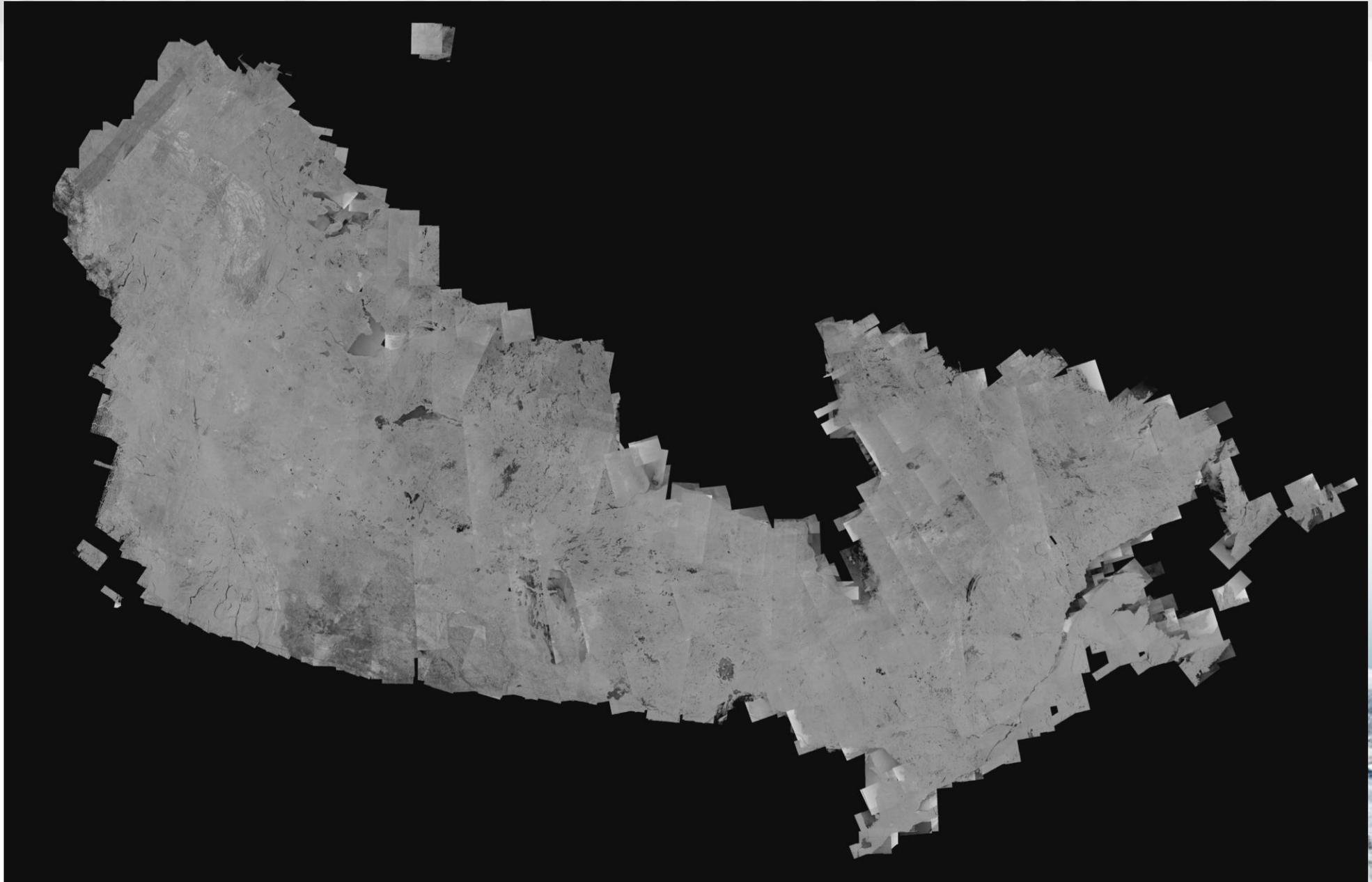
RCM Data Access

Access to 15-days acquisition plans:

[Acquisition plans of the RADARSAT Constellation Mission - Open Government Portal (canada.ca)](canada.ca)

Access to data portal:

https://www.eodms-sgdot.nrcan-rncan.gc.ca/index-en.html

More information:

MCR-INFO / RCM-INFO (ASC/CSA) mcr-info-rcm-info@asc-csa.gc.ca

CSA QP SAR Observations

- RADARSAT Constellation Mission (RCM)
  - Quad Pol mode supported – ad hoc specific acquisitions currently made over JECAM R&D sites
  - Compact Polarization options available on every beam modes – systematic acquisitions over the Canadian land-mass.

Mode	Res. m	Looks rng × az	Swath Width (accessible) km	Nominal NESZ (dB)	Polarization Options				
					HH, VV, HV or VH	VV or HH +HV	HH+VV [1]	Compact [2]	HH+VV+ HV+VH
Low Resolution 100 m	100	8×1	500 (500)	−22	✔	✔	✔	✔	
Medium Resolution 50 m	50	4×1	350 (600) [3]	−22	✔	✔	✔	✔	
High PRF m	50	4×1	350	−22	✔	✔		✔	
Hign Incidence m [4]	50	4×1	133	−22	✔	✔		✔	
Medium Resolution 30 m	30	2×2	125 (350)	−24	✔	✔	✔	✔	
Medium Resolution 16 m	16	1×4	30 (350)	−25	✔	✔	✔	✔	
High Resolution 5 m	5	1	30 (500)	−19	✔	✔	✔	✔	
Very High Resolution 3 m	3×3 @35º	1	20 (500)	−17	✔	✔	✔	✔	
Low Noise	100	4×2	350 (600) [3]	−25	✔	✔		✔	
Ship Detection	var.	5×1	350 (350)	variable	✔	✔			✔
Spotlight	1×3 @35º	1	20 (350) [5 km in az]	−17	✔	✔		✔	
Quad-Polarization	9	1	20 (250)	−24					✔

EO analytics platform

- CSA is starting the development of the Digital Earth Canada (DEC) prototypes with various use cases from Environment Canada and Natural Resources Canada.

- Optical and SAR ARD integration into DEC will be at the heart of our activities.

- Our Intent is to use and be compliant with CEOS ARD PFS, for both optical and SAR data.

- ARD products assessment will need to be discussed and established with CEOS.

Links to CEOS Ecosystem Extent Task Team (EETT)

EE community can benefit from LSI-VC's similar mission & outcomes, and scope:

- Harmonized mission/data acquisition across CEOS members (medium-high scales & optical-radar spectral range)

- Consistent development & efficient use of large amounts of data on LS & beyond (e.g. vertical info for canopy)

Lessons learnt and existing framework from LSI-VC on:

- Midstream: production approaches of comparable fundamental products. E.g. LiDAR Terrain and Canopy Top Height in progress.

- Downstream: support implementation of data for broad user access and derived product generation.

Governance:

- LSI has sub-groups (GEOGLAM, Forests & Biomass) across which EE/biodiversity is a cross-cutting theme.

C-Band for Tropical Forest

- Potential collaboration with ESA Sentinel 1

# C-Band for tropical forest monitoring attributes

- Advantages
  - Deep archive and high frequency of revisit
  - Interoperability with Sentinel 1 archive
  - Usefulness depends on the specific objectives and applications of the monitoring effort
  - Relatively insensitive to atmospheric attenuation and can penetrate clouds, useful for monitoring and change in cloudy and humid regions.
  - Monitoring of forest disturbances, such as logging and forest fires, and to monitor forest recovery following disturbances
- Limitations
  - C-band radar has limited sensitivity to small-scale forest features, such as individual trees and understory vegetation
  - May not provide detailed information on forest structure and composition.
- Other radar frequencies
  - L-band and P-band, may be more suitable for certain forest monitoring applications in the circumtropical rainforest.
  - For example, L-band radar has a longer wavelength than C-band and can penetrate deeper into the forest canopy, providing more detailed information on forest structure and biomass. P-band radar has an even longer wavelength and can provide even greater sensitivity to forest structure and biomass
  - Less widely available than C-band

▨	2 - 5
▨	6 - 25
▨	26 - 50
▨	51 - 100
▨	101 - 200
▨	201 - 400
▨	401 - 600
▨	601 - 800
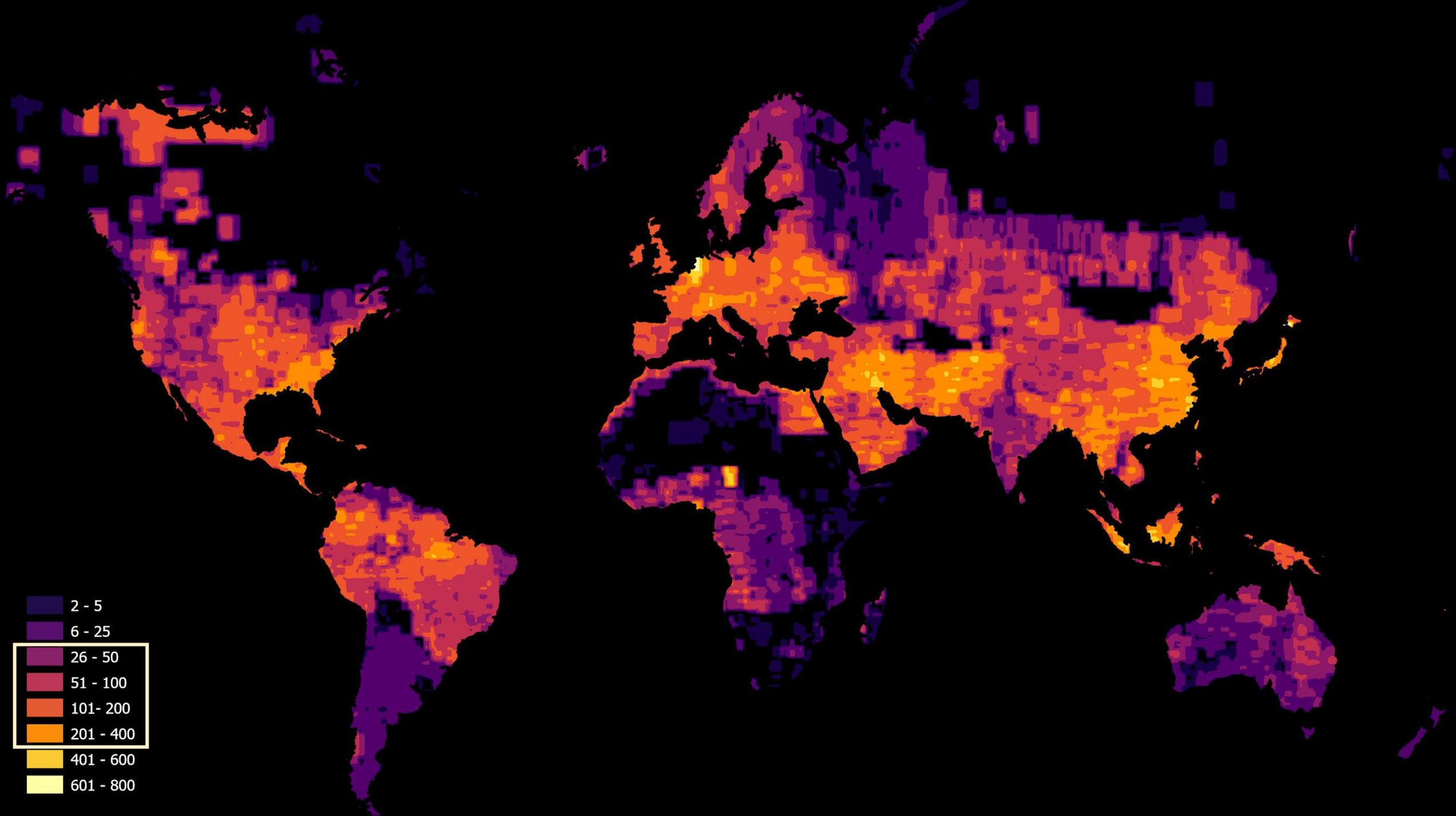
RADARSAT 2 Archive (Extra-Fine 2 and 3) Between 2012 to 2022

- The Extra-Fine Resolution Beam Mode nominally provides swath width of 125km

- Incidence angle range from 22 to 49 degrees

- SLC products

- Single polarization which can be either a linear co-polarization (HH or VV) or a linear cross-polarization (HV or VH)

| XF0W3 ASC | 21,092 |
| XF0W3 DESC | 17,964 |

| XF0W2 ASC | 21,731 |
| XF0W2 DESC | 23,856 |
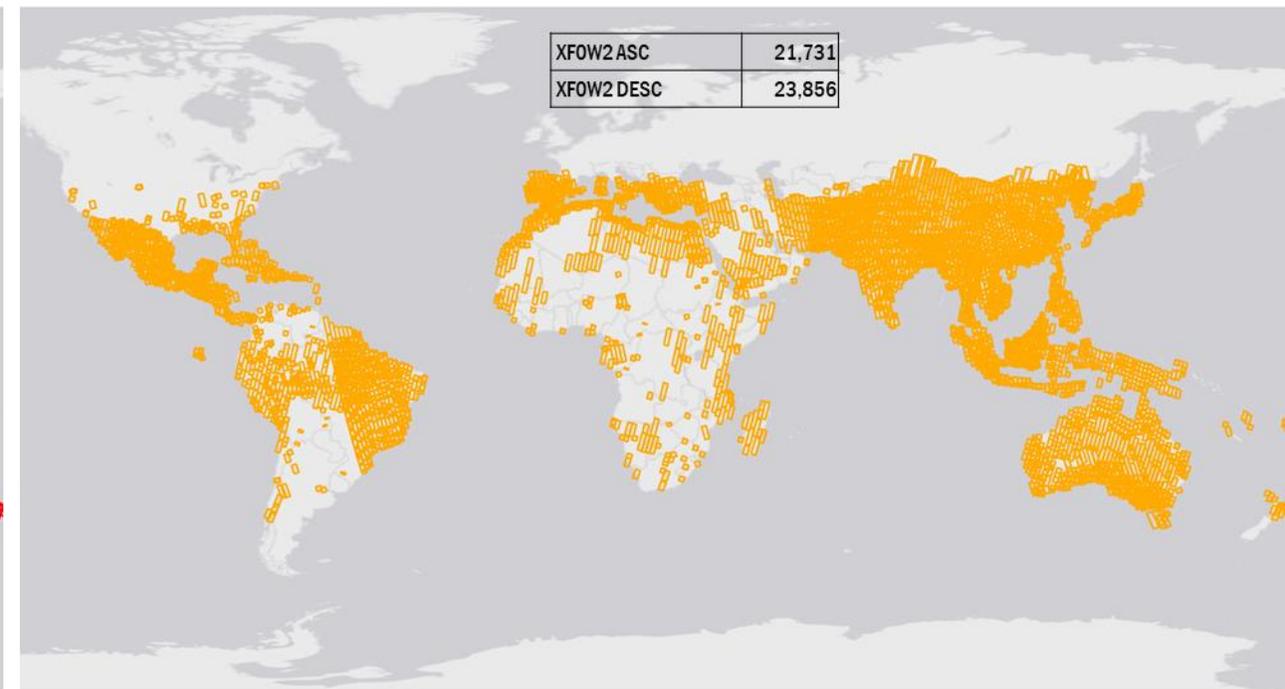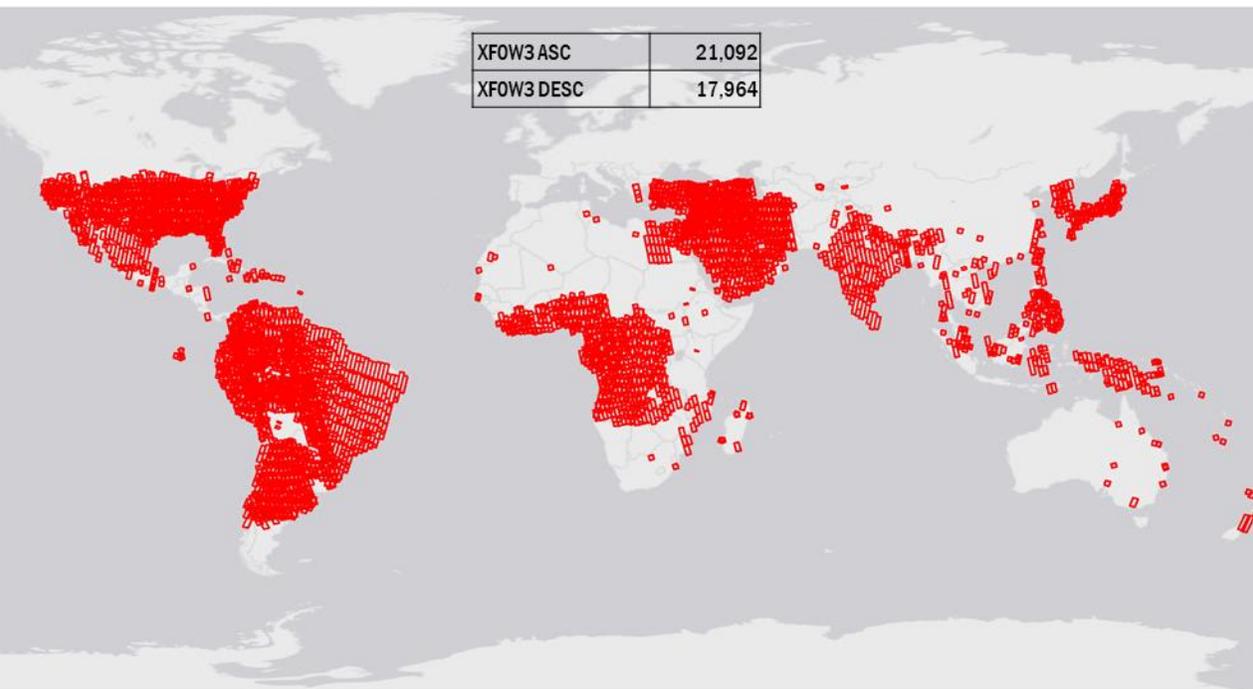
Potential Capabilities

- A multiyear Earth observation C-Band SAR dataset over the circumtropical rainforest can be used to address several science and R&D objectives, including:

- Forest mapping and monitoring: SAR data can provide detailed information on forest structure, biomass, and vegetation cover. Multiyear data can be used to monitor changes in the forest over time, including deforestation and forest degradation, and to track the recovery of forest areas after disturbances.

- Biodiversity monitoring: The rainforest is home to a diverse range of plant and animal species. SAR data can be used to identify and map different forest types, which can provide insights into the distribution and abundance of different species and their habitats.

- Carbon accounting: The rainforest is a critical carbon sink, and SAR data can be used to estimate above-ground biomass and carbon stocks. Multiyear data can be used to monitor changes in carbon stocks over time and to assess the impact of deforestation on carbon emissions.

- Natural resource management: The rainforest provides a range of valuable resources, including timber, non-timber forest products, and freshwater. SAR data can be used to monitor changes in the distribution and availability of these resources and to support sustainable management practices.

- Disaster management: The rainforest is prone to natural disasters such as floods, landslides, and wildfires. SAR data can be used to monitor these events in near-real-time and to support disaster response and recovery efforts.

- Overall, a multiyear Earth observation C-Band SAR dataset over the circumtropical rainforest can provide valuable insights into the dynamics of this critical ecosystem and support a range of science and R&D objectives related to conservation, sustainable development, and disaster management.

Potential R&D Challenges

- What is the spatial and temporal variability of forest structure and biomass in the circumtropical rainforest, and how is it affected by climate and other environmental factors?

- How has the extent and distribution of forest cover in the circumtropical rainforest changed over time, and what are the drivers of these changes?

- What are the patterns and drivers of forest disturbance in the circumtropical rainforest, including deforestation, degradation, and recovery?

- What is the relationship between biodiversity and forest structure and biomass in the circumtropical rainforest, and how does this vary across different regions and forest types?

- How do changes in forest structure and biomass affect carbon storage and fluxes in the circumtropical rainforest, and what are the implications for global climate change?

- What are the impacts of land use change, including agricultural expansion and infrastructure development, on forest cover, structure, and biomass in the circumtropical rainforest?

- What are the hydrological and biogeochemical processes occurring in the circumtropical rainforest, and how are they affected by changes in forest cover and structure?

- How can SAR data be integrated with other remote sensing and in situ data sources to improve our understanding of forest dynamics in the circumtropical rainforest?

RADARSAT-2 Archive searches: Forestry Applications (XF, MF, WUF, FQ)

Honduras
192

Cote d'Ivoire
& Nigeria
154

Borneo
394

Malaysia
1,907

TOTAL
2,647