

NASA CSDA Webex: MDA Space

RADARSAT-2 Broad-Area SAR Data and Products

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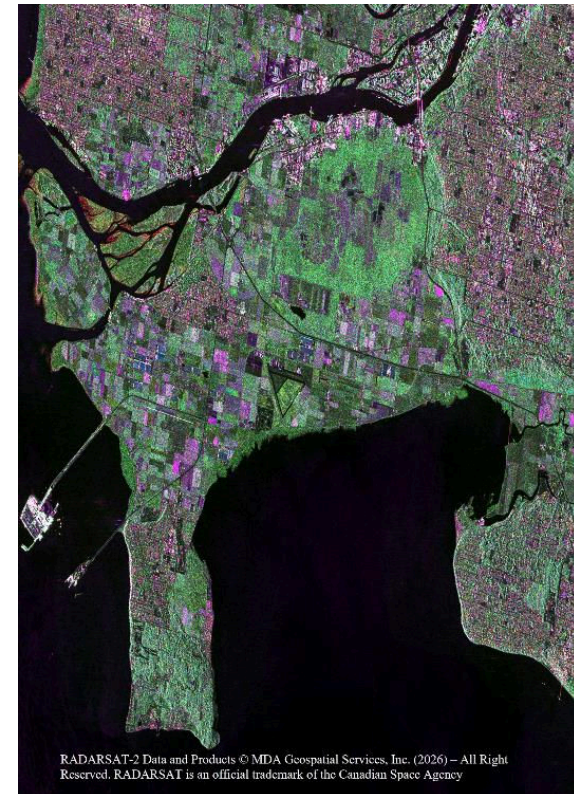
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Introduction to MDA Space



- With a 55-year record of firsts and 450+ missions, MDA Space is a trusted mission partner to the rapidly expanding global space industry
- Business areas: Satellite Systems, Robotics and Space Operations, C4ISR Services, and Earth Observation
- MDA Geointelligence supports NASA and the global Earth Observation community
 - RADARSAT-2 Satellite Synthetic Aperture Radar (SAR)
 - CHORUS Satellite Multi-Modal SAR (2027)
 - Maritime Domain Awareness Services
 - Space Domain Awareness Services



RADARSAT-2 Quad Polarization:
Wetlands, Coastal, Agriculture

RADARSAT Program Heritage



- **RADARSAT-1:** C-band SAR spacecraft designed and built by MDA. Government of Canada (GoC) owned with mission operations conducted by MDA.
- **RADARSAT-2:** C-band SAR spacecraft designed and built by MDA. Public-Private Partnership (MDA and GoC). Mission operations conducted by MDA. Commercial Data.
- **RADARSAT Constellation Mission (RCM):** C-band SAR constellation (3 satellites) designed and built by MDA. Government of Canada (GoC) owned with mission operations conducted by MDA.
- **CHORUS:** C-Band and X-Band SAR constellation designed and built by MDA. Owned and operated by MDA. Commercial Data. Tip and Cue service with trailing X-Band satellite.



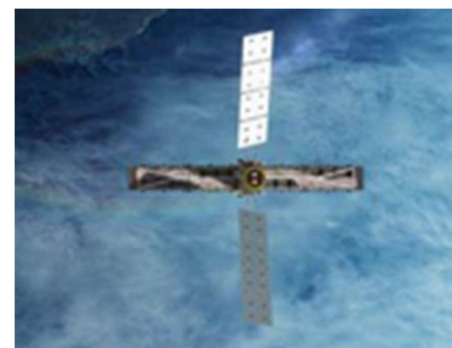
RADARSAT-1: Launched: Nov 1995
Last contact: March 2013



RADARSAT-2: Launched Dec 2007
Operational Service

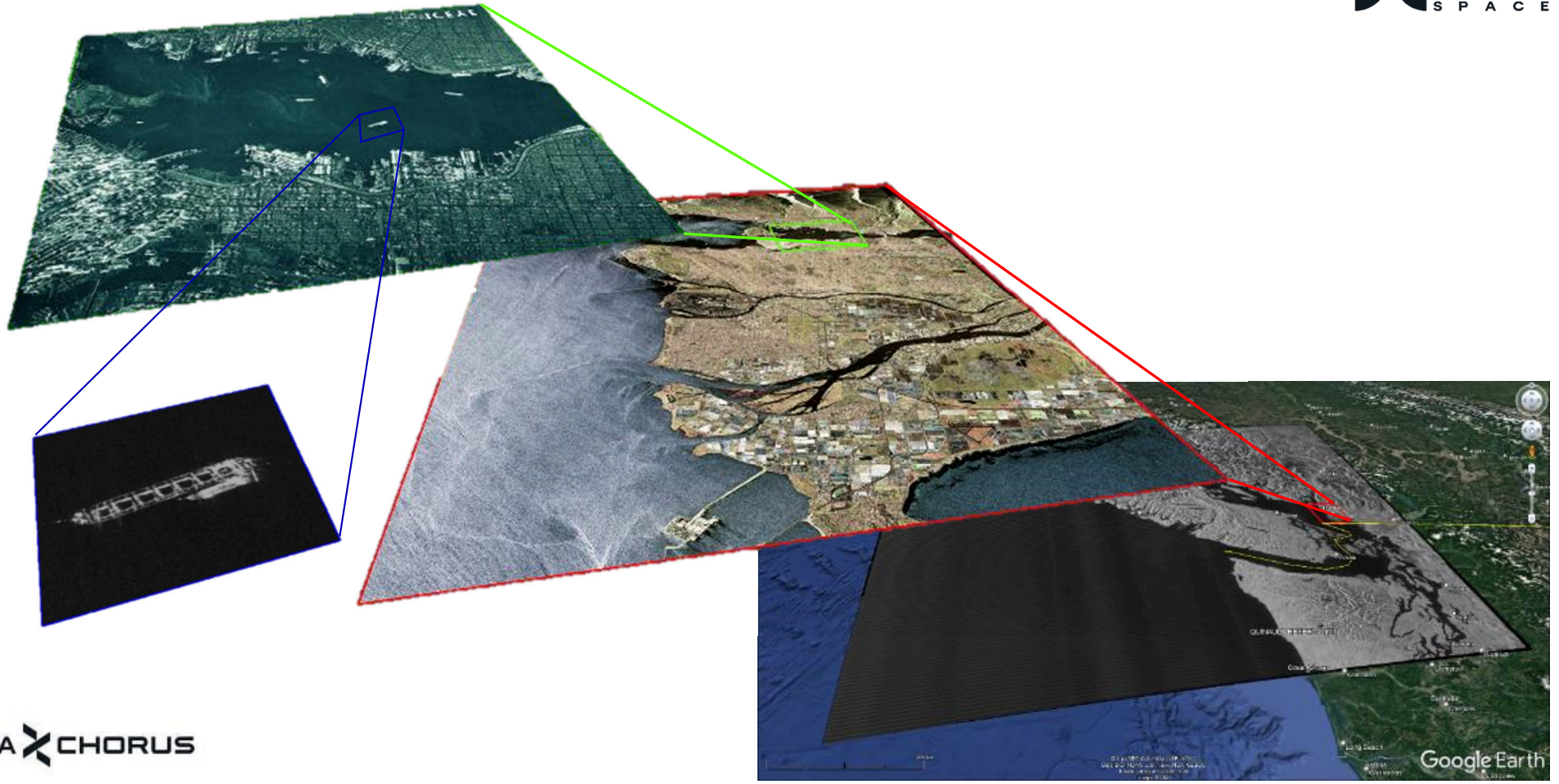


RCM: Launched June 2019
Operational Service



CHORUS: Scheduled for
Launch in 2026

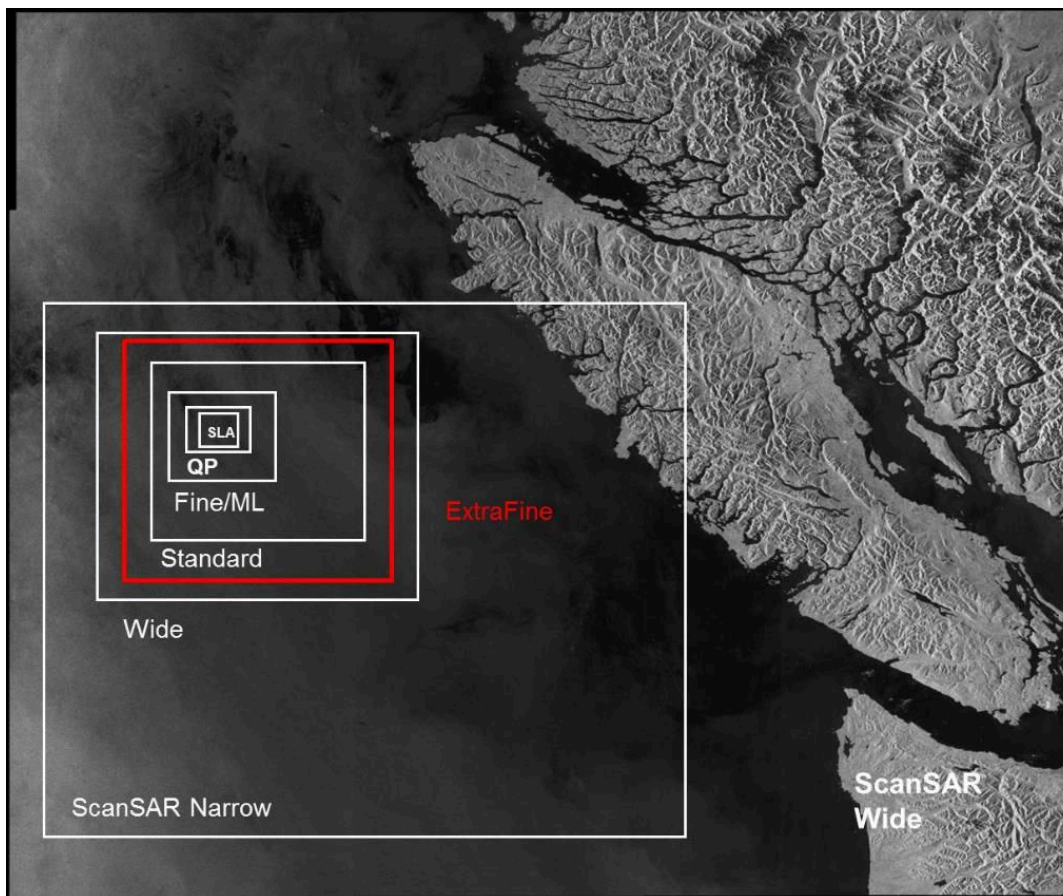
CHORUS: Multi-Modal Satellite SAR Services (2027)



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RADARSAT-2: Sensor and Data Characteristics

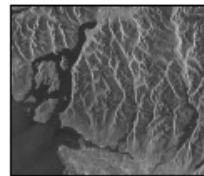
Spatial Coverage and Resolution



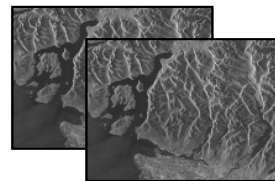
- ▣ ScanSAR Wide
 - 500 km x 500 km
 - 100 m res
- ▣ ScanSAR Narrow
 - 300 km x 300 km
 - 50 m res
- ▣ Wide
 - 140 km x 140 km
 - 30 m res
- ▣ Standard
 - 100 km x 100 km
 - 25 m res
- ▣ Fine/ML
 - 50 km x 50 km
 - 10 m res
- ▣ ExtraFine
 - 125 km x 125 km
 - 5 m res
- ▣ Quad Fine
 - 25 km x 25 km
 - 10 m
- ▣ SpotLight
 - 18 km x 8 km
 - 0.8 m x 2.2 m res

Polarimetric SAR Imaging Options

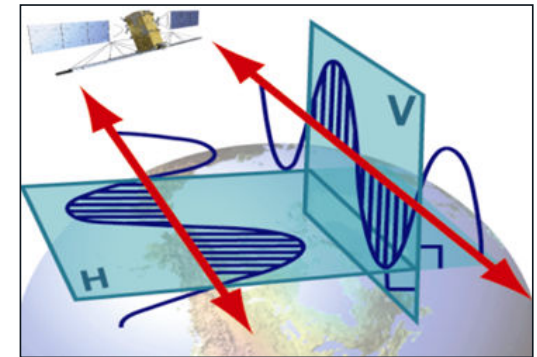
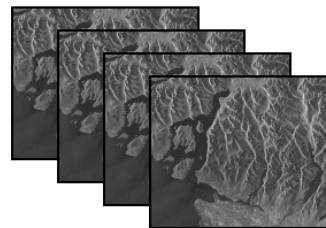
- Single Polarized
 - One of HH, HV, VH or VV



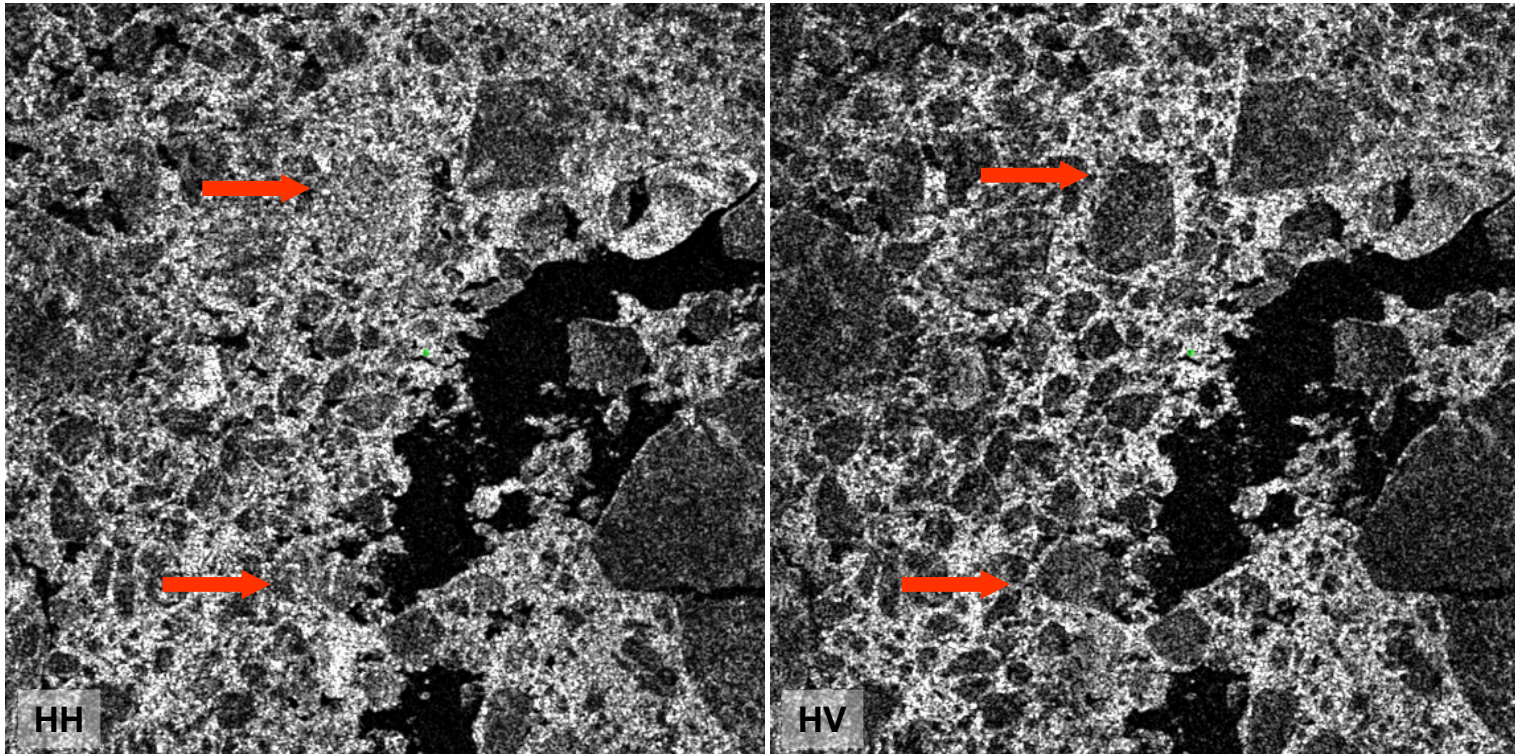
- Dual Polarized
 - HH + HV
 - VV + VH



- Quad Polarized
 - HH + HV + VH + VV
 - Interchannel phase, e.g. co-polarized phase difference δ (HH – VV)

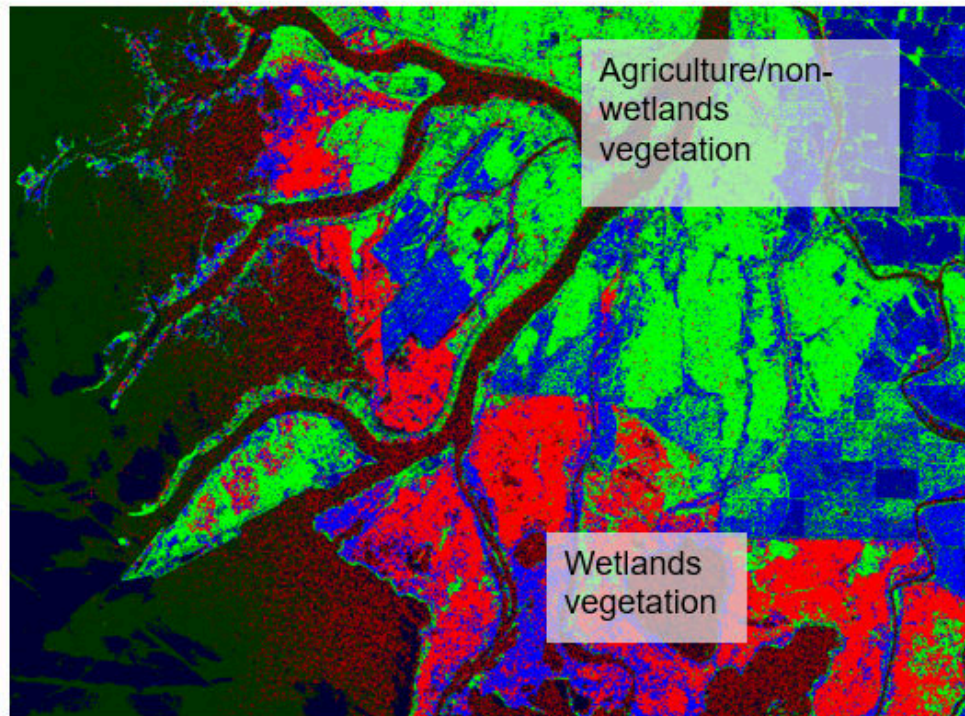


Example: Ice Feature Discrimination



RADARSAT-2 ScanSAR Wide subscene of the Beaufort Sea showing ice-feature discrimination using HH and HV polarized data. Note differences as indicated by the red arrow.

Example: Wetlands Mapping

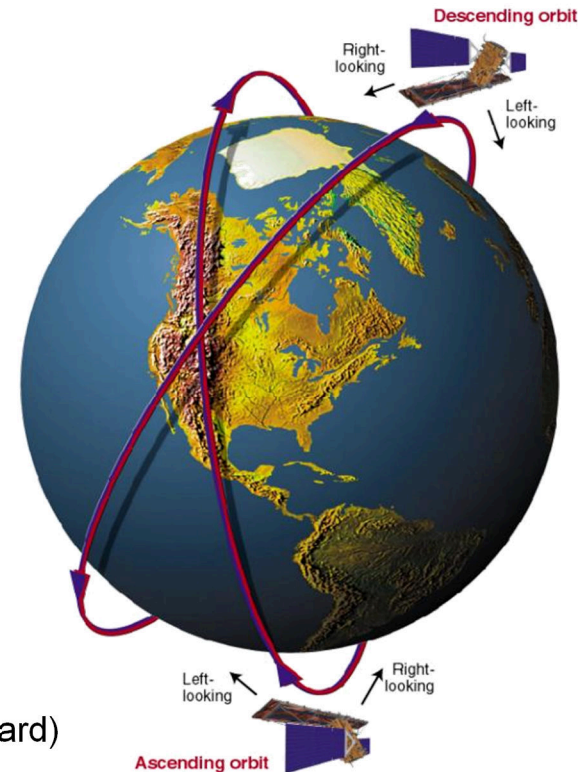


Detection of wetlands vegetation (left), in this example phragmites (right), using RADARSAT-2 quad pol data.

RADARSAT-2 Look Direction

- Radar look direction is defined relative to the radar line-of-flight.
- The default look-direction is to the right of the travel direction, but there is the option for left-looking (so-called slew maneuver)

SAR look direction for ascending (northward) and descending (southward) orbits.



RADARSAT-2 Characteristics



Launch	December 14, 2007
Wavelength	C-band (5.6 cm)
Nominal altitude	800 km
Resolution (m)	Variable - Nominal 1 to 100
Image size (Range x Azimuth) (km)	Variable - Nominal 18 x 8 (min) to 500 x 500 (max)
Orbit	Sun-synchronous with 98.6° inclination Dawn-dusk 6 AM/6 PM descending/ascending node
Orbit tube	Maintained within ± 150 m
Exact repeat	24 days
Revisit	Variable: Equatorial latitudes, nominally 2-3 days; Polar latitudes, at least daily
Polarization	Single polarized: (HH, HV, VH, VV) Dual polarized: (HH + HV) or (VH + VV) Quad polarized (phase preserving): (HH, HV, VH, VV)
Imaging modes (20)	1 Spotlight; 15 Stripmap, and 4 ScanSAR
Image products	Spotlight and Stripmap: - slant range single-look complex - ground range detected - geocoded detected ScanSAR: - ground range detected only

RADARSAT-2 Imaging Modes

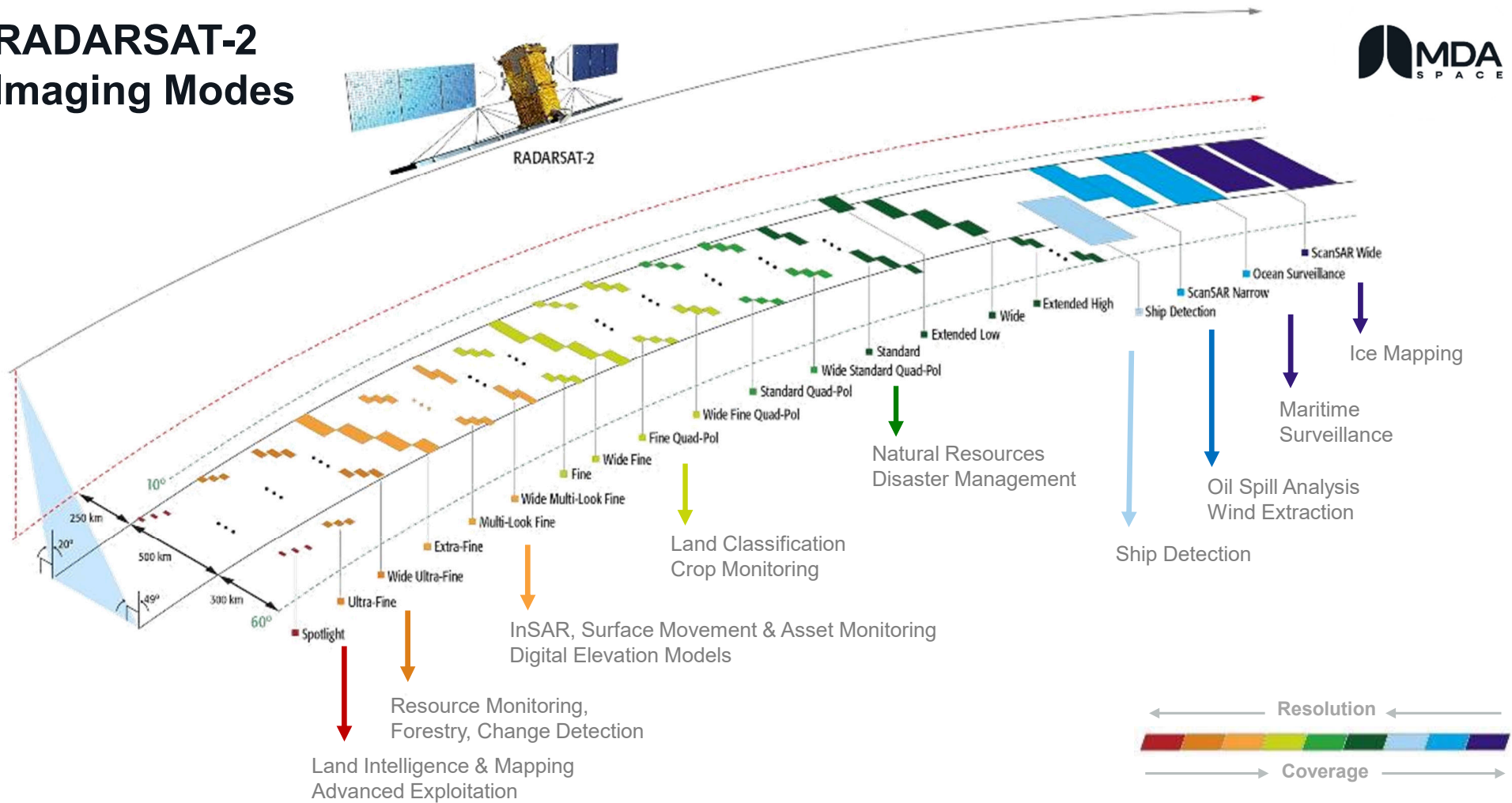
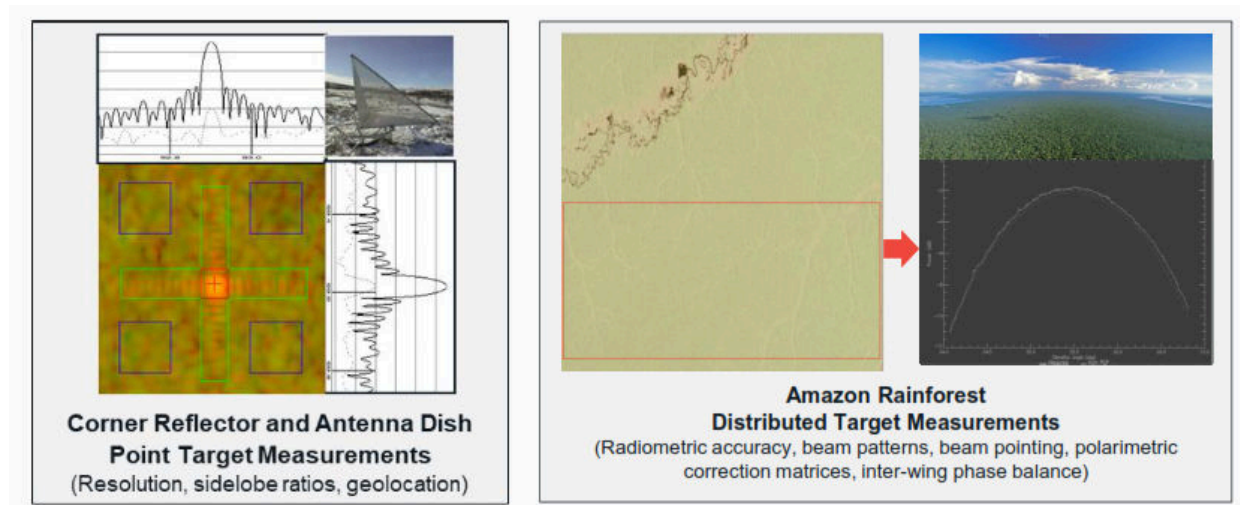


Image Quality and Calibration

- Stable Image Quality (IQ) throughout mission
- All RADARSAT-2 imaging modes are calibrated
- ~ 5000 images per year acquired for IQ and calibration analysis



RADARSAT-2 Improvements

Need

- Improved geolocation accuracy and InSAR performance

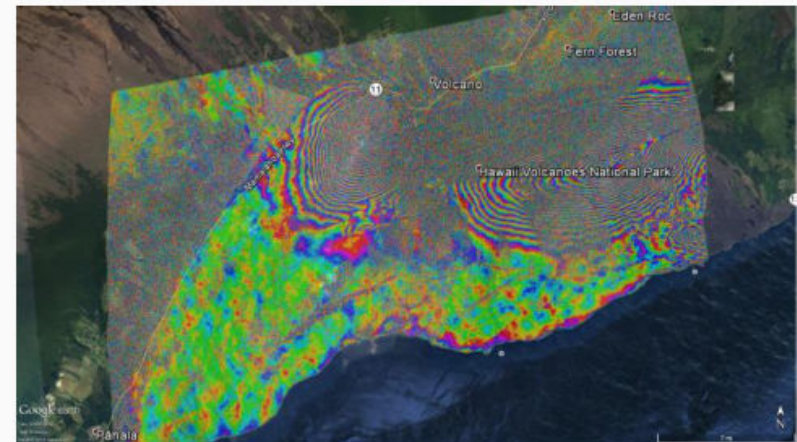
Solution

- Enhanced Definitive Orbit Tool (EDOT) to improve orbit accuracy

Result

- Improved orbit maintenance and more accurate orbit control

Ground Track Maintenance		
At Launch +/-1,000 m	2008 - 2013 +/-500 m	2013 - 2025 +/-150 m



Interferogram showing ground movement between May 1 and May 25 2018 at Kilauea Volcano in Hawaii.

RADARSAT-2:

Links to Documents and Data Availability

Data Availability and RADARSAT-2 Information



- To request access to CSDA-distributed data, complete the [CSDA Authorization form](#). The CSDA team will verify if the user is authorized for data access.
- RADARSAT-2 data availability
 - Archived (2008 – present)
 - New acquisitions
- On-line viewing of the RADARSAT-2 data archive:
 - <https://gsiportal.mda.space/explore>
 - <https://gsiportal.mda.space/guide>
- RADARSAT-2 data was evaluated by NASA and approved for the CSDA Program. The link to the RADARSAT-2 evaluation:
 - https://earthdata.nasa.gov/s3fs-public/2025-09/MDA_RS2_QA_Report_Final2.pdf

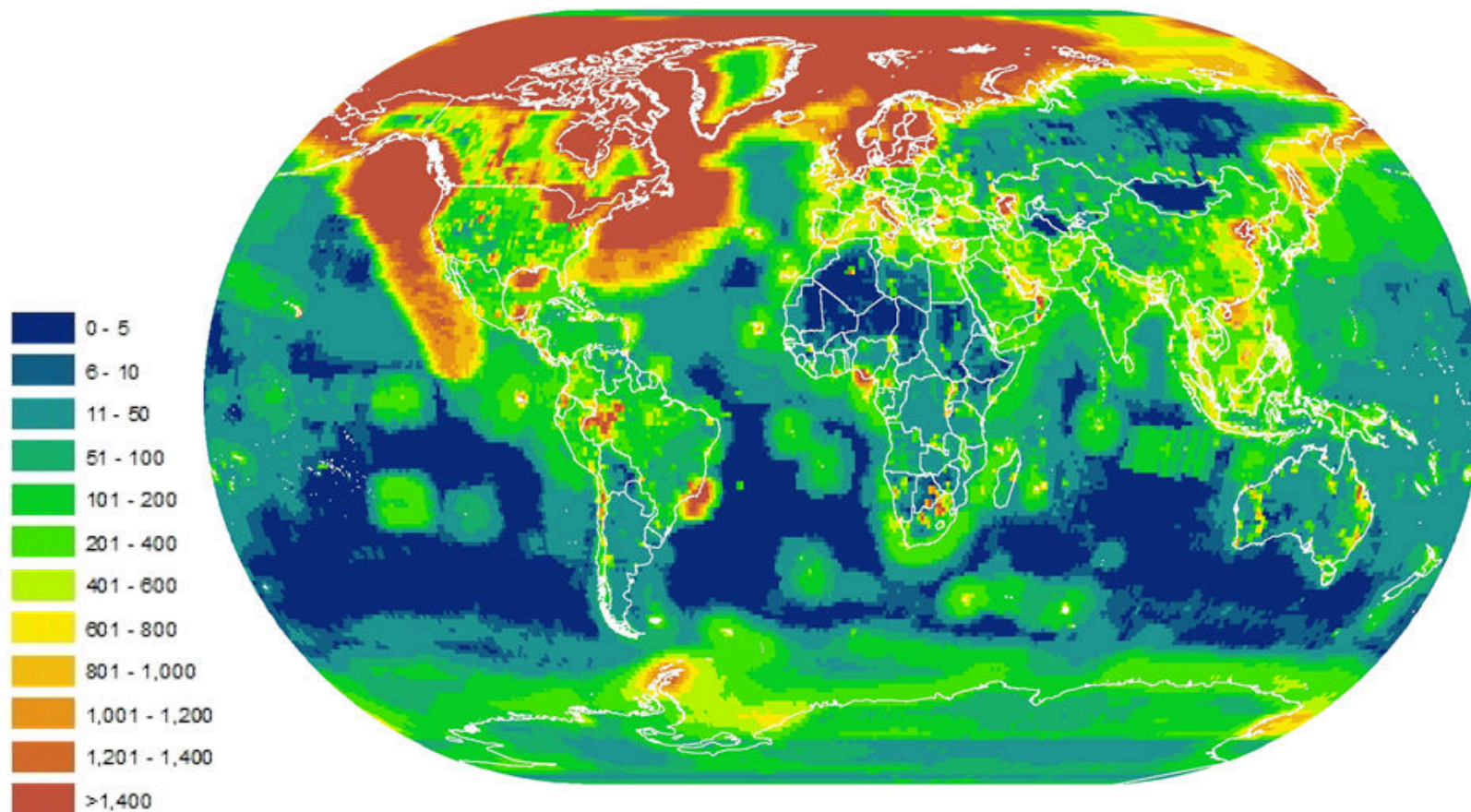
RADARSAT-2 Data: Archived vs. New Acquisition



- Archived
 - Imaging mode
 - Polarization
 - Incidence angle
 - Asc/Desc Applied before data acquisition, so these parameters **cannot** be changed after data acquisition

- New acquisitions
 - Imaging mode
 - Polarization
 - Incidence angle
 - Asc/Desc User specified

- Data processing
 - Processing Level Applied after data acquisition, so these parameters **can be** changed, e.g. SLC → SGF



RADARSAT-2 data archive from early 2008 to early 2026, with ~1.6 million acquisitions

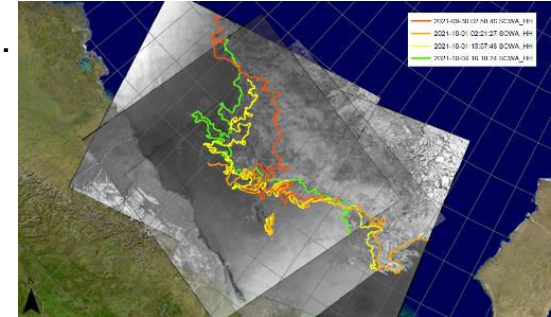
RADARSAT-2: Applications for NASA Earth Science Research

Applications and RADARSAT-2 Benefits (1/4)



Beaufort Sea Ice-Edge

- Composite of four RADARSAT-2 images acquired over a five day period. Each colour depicts the ice edge for a given day

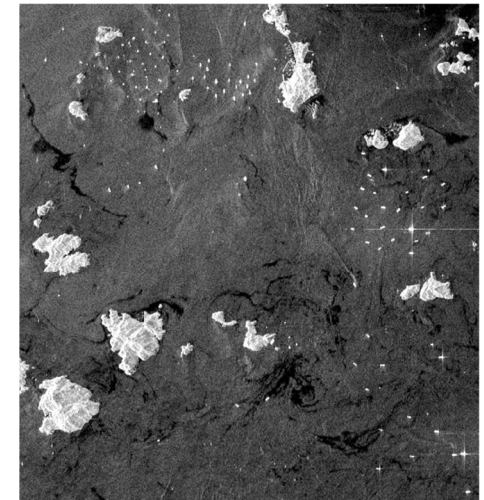


Ice Mapping: RADARSAT Application/Benefit

- Ice extent mapping to support safe shipping
- Changes in ice cover and the link to global warming
- Ice conditions to support transportation and food sources for northern communities

Illegal Fishing

- Clusters of fishing vessels (small bright dots), some of which may be engaged in illegal fishing
- Ship Detection: RADARSAT Application/Benefit**
 - Illegal fisheries monitoring to support sustainability of at-risk fish stocks
 - Monitoring ship traffic in environmentally sensitive areas

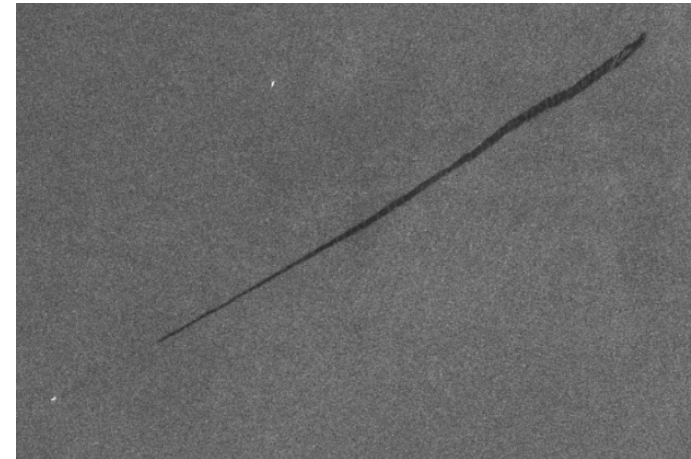


Applications and RADARSAT-2 Benefits (2/4)



Bilge Dumping

- The bilge oil appear as a long, dark line behind the ship.
- The ship appears as a bright dot on the lower left-edge of the image.



Oil Pollution: RADARSAT Application/Benefit

- Mitigate the environmental impact on the ocean and coastal zone due to:
 - Illegal bilge dumping
 - Offshore pipeline leaks
 - Offshore oil spills
- Automatic Identification System (AIS) can be used to correlate the RADARSAT-2 detected ship with ship name, registry, etc.

Applications and RADARSAT-2 Benefits (3/4)

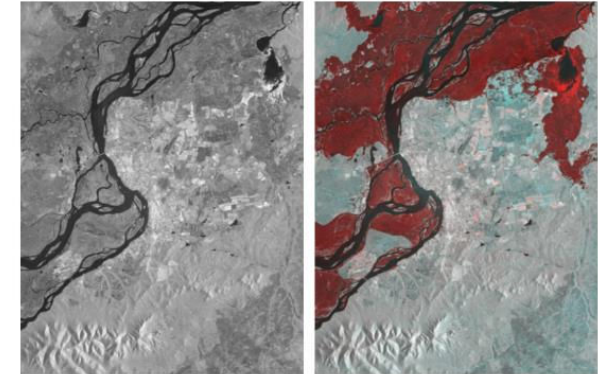


Flood Mapping

- Pre and post flood images. Flooded areas (red) for visualization

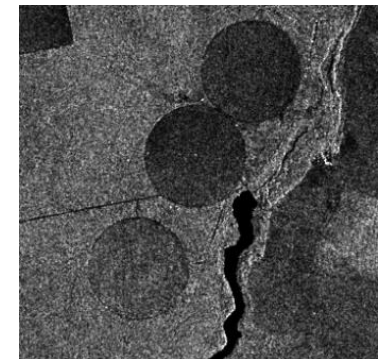
Flood Mapping: RADARSAT Application/Benefit

- Detection of flooded areas and the impact to critical infrastructure
- Impacts to food supply from agricultural crops that could suffer mortality due to sustained flooding



Soya Bean Monitoring

- Soya bean crops (central-pivot irrigation) that have been harvested (dark circles). Lighter-coloured circular area shows crops not harvested.



Agriculture: RADARSAT Application/Benefit

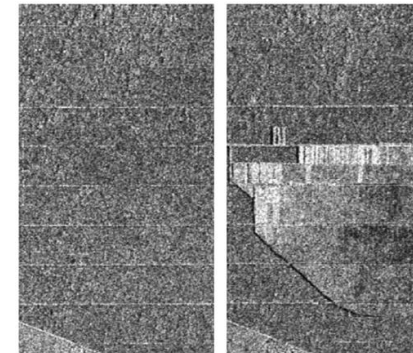
- Monitor crop growth to support food security for domestic needs and the availability of excess for export

Applications and RADARSAT-2 Benefits (4/4)



Forest Harvesting

- Pre/post forest harvesting plantation forest ~ three months separation
- Bright white areas are stacks of harvested trees awaiting shipment



Forestry: RADARSAT Application/Benefit

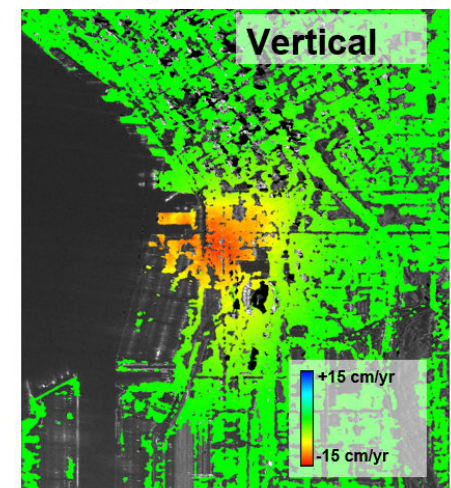
- Monitoring of harvested area to ensure compliance with environmental regulations
- Impact on carbon storage due to changes in forest cover

Land Surface Deformation (InSAR)

- Seattle construction: Tunnel boring machine got stuck and required dewatering to create a rescue shaft

Deformation: RADARSAT-2: Application/Benefit

- Stability and safety of critical infrastructure
- Deformation in coastal zones that could be impacted by rising sea levels



RADARSAT-2 Complements NASA Earth Science Priorities¹



Key enhancement: ✓ ✓ . Secondary enhancement benefit: ✓ .

NASA Earth Science Research Priorities	RADARSAT-2 Feature					
	Beam Modes ¹	Polarization ²	Incidence Angle ³	Wavelength ⁴	Orbit Control ⁵	Image Quality/Calibration ⁶
Surface Dynamics	✓ ✓	✓	✓	✓	✓ ✓	✓ ✓
Cryosphere: Sea Ice and Glaciers	✓ ✓	✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓
Sea Level Rise and Ocean Science	✓ ✓	✓	✓	✓	✓ ✓	✓ ✓
Geological Hazards and Disasters	✓ ✓	✓	✓ ✓	✓	✓	✓ ✓
Ecosystem Change	✓ ✓	✓ ✓	✓	✓ ✓	✓ ✓	✓ ✓

- Options for high resolution and wide-area coverage.
- Single, dual, quad pol options for detection and classification.
- Application specific needs or increased re-visit.
- Compliments X-L bands to enhance understanding of radar scattering behavior.
- Change detection and deformation.
- Stability of key measures including radiometric, geolocation, and polarimetric accuracy, and noise levels.

1. <https://science.gsfc.nasa.gov/earth/overview>

Note MDA Space will provide scientific and engineering support with-respect-to the selection of RADARSAT-2 imaging modes, polarization, and data processing options, among others



Question and Answer Discussion of Applications