CSA Report on Earth Observation

Presented at
CEOS WGCV 36th Plenary
Shanghai, China
May 13 – 17, 2013

Dr. Satish K. Srivastava
WGCV Chair &
CSA Member of WGCV
Canadian Space Agency

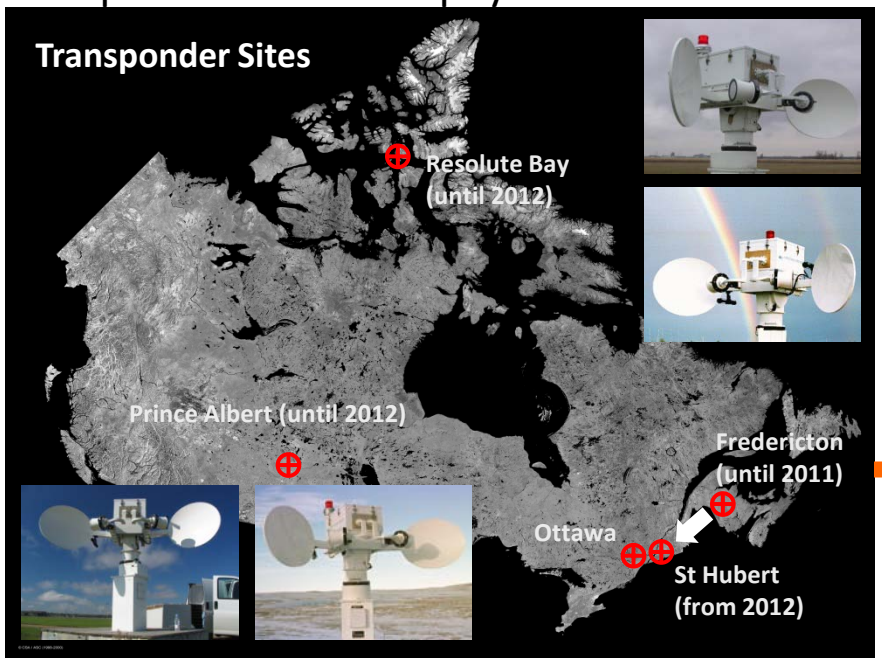
RADARSAT-1 Program Status

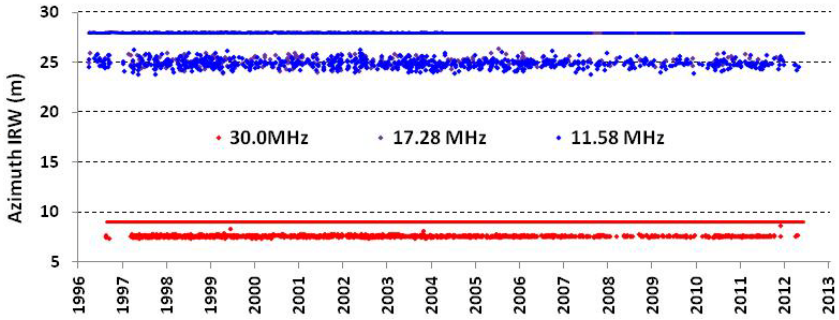
- Since 22:30 UTC March 29, 2013, it has not been possible to communicate with the satellite
- Based on a detailed review of the anomaly by a team of experts, it was announced on May 9, 2013 that the satellite was no longer operational.
- Data has been received and processed at 50 ground stations with 32 archive facilities globally, meeting a fast turnaround time of less than two hours for time critical acquisitions.
- As of March 29 2013, completed 90,828 orbits, planned 360,946 user requests corresponding to a total acquisition of 673,103 minutes of SAR data.
- Average system performance maintained better than 95%.

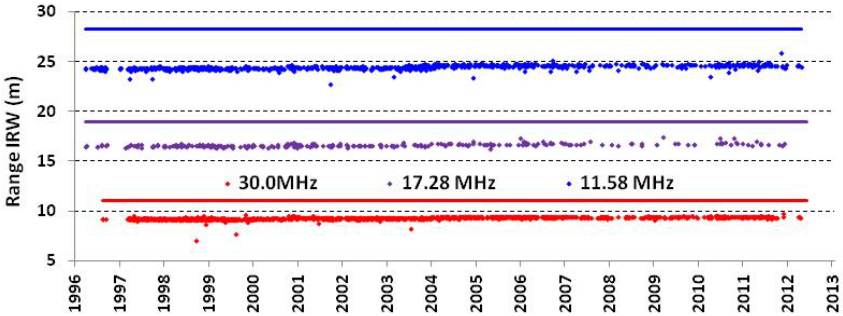
RADARSAT-1 SAR Image Quality

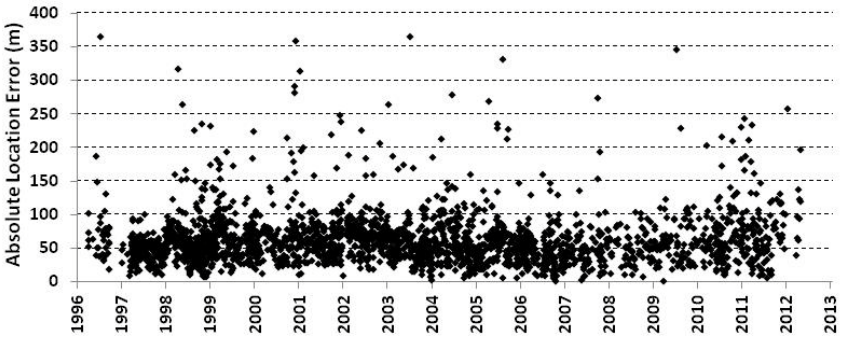
More than 16 years of successful maintenance image quality

- Impulse Response Width (IRW) and other indicators still at, or better than, initial specifications
- Stability of end-to-end SAR system, from processor to SAR payload







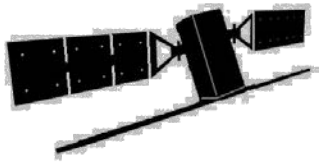


RADARSAT-2 Program Status

Spacecraft Health and Anomalies

(courtesy of MDA)

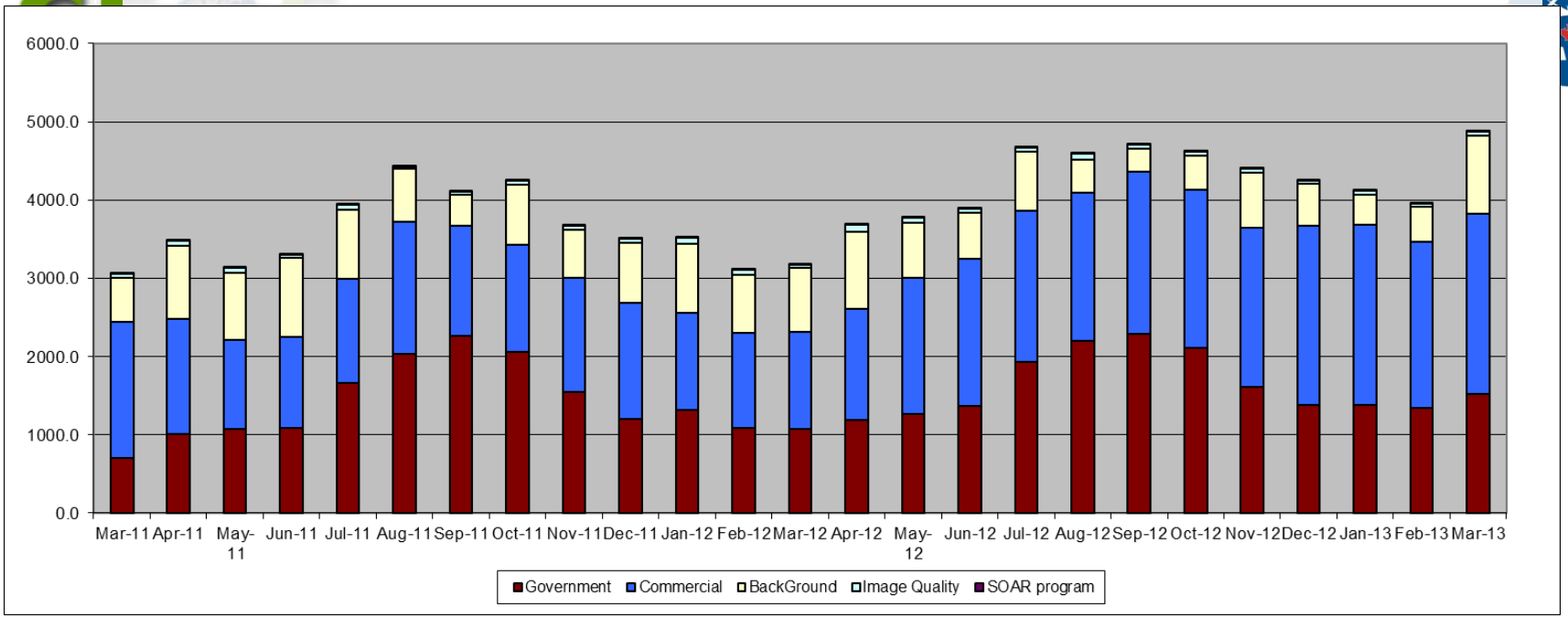
System	Status
Thermal	About 3°C increase in 4 years. A few monitoring sensors failed with no impact
Power	Battery and Solar array: No sign of degradation Re-calibrated the battery charging algorithm end of 2011 as recommended by manufacturer
AOCS	Attitude and orbit well within specifications
Propul-sion	Well within specifications. Fuel margin greater than expected
Data Handling	Well within specifications. All systems nominal.
Payload	Two Hardware failures (CDU#12 and CDU#3 heater). Software patch uploaded to spacecraft In Sep 2012 that allow mixed CDU configuration (prime/redundant).



Many Bus and Payload anomalies related to Single Event Upset

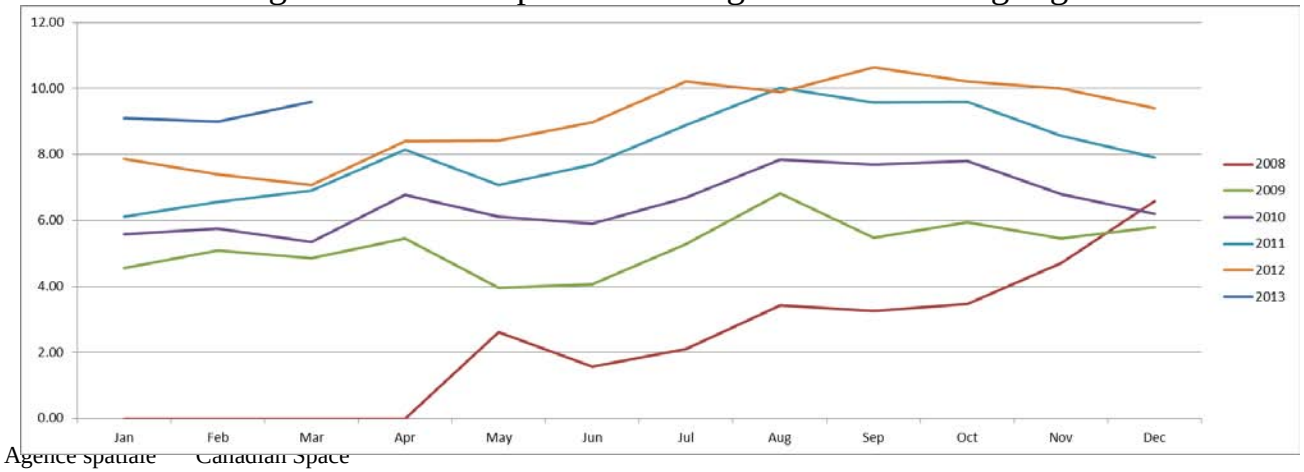
When not SEU related, most anomalies are managed through monitoring and recovery using pre-prepared and, in some cases, automatic recovery procedures.

Minutes of SAR acquisition (courtesy of MDA)

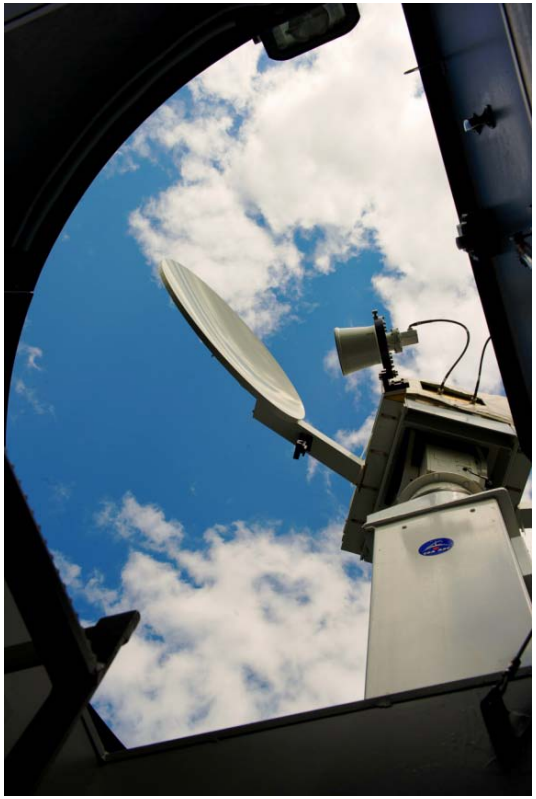


Above figure covers minutes of SAR acquired per main user group for the past 2 years

Figure below covers the average SAR on time per orbit on a given month to highlight seasonal activities



RADARSAT Point Target Facility at CSA HQ

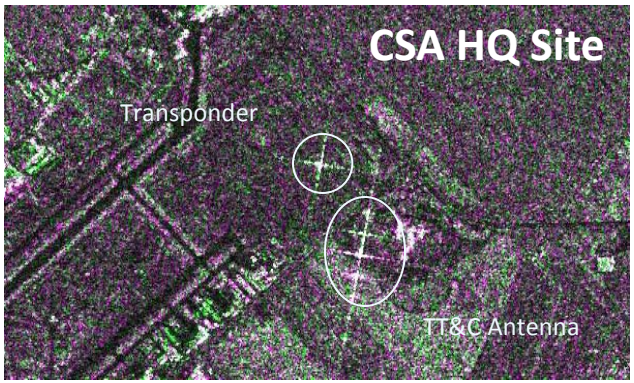


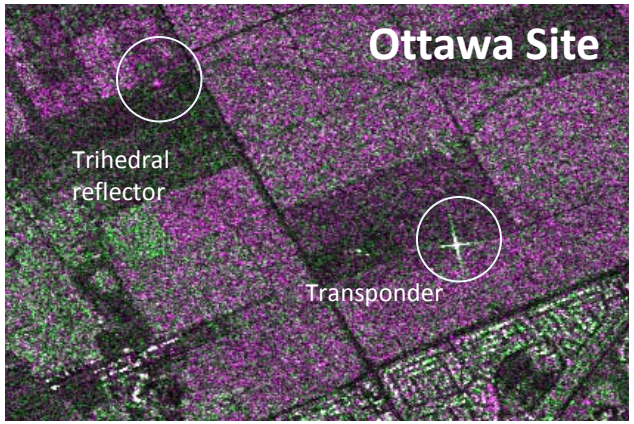
- In operations since spring 2012
- Upgraded RADARSAT-1 precision transponder: RADARSAT-1 and RADARSAT-2 operation
- For the R2 Quality Assurance mandate of the GoC, operates in conjunction with another upgraded R1 instrument in Ottawa

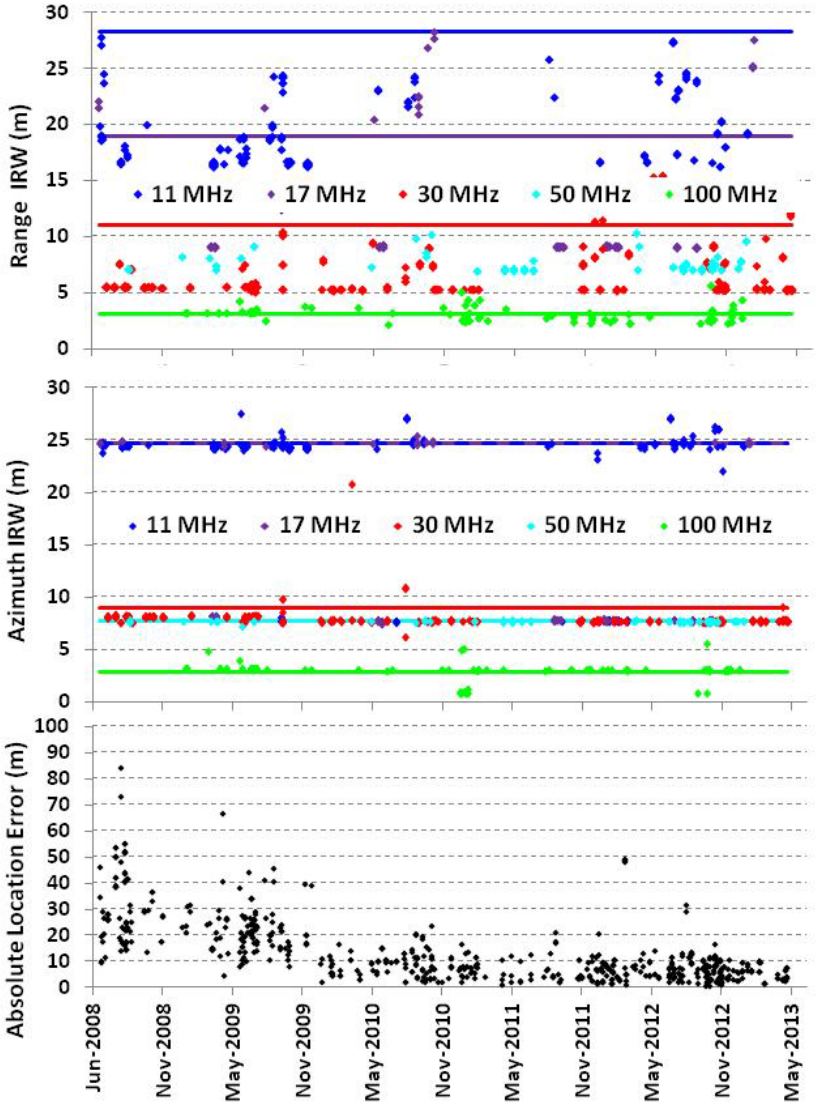
RADARSAT-2 Image Quality Assurance

CSA executes the mandate of the Government of Canada to monitor R2 SAR performance

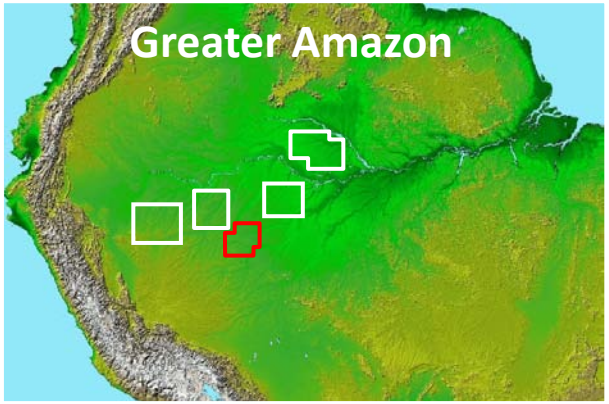
- **Excellent overall image quality results: IRW, georeference**







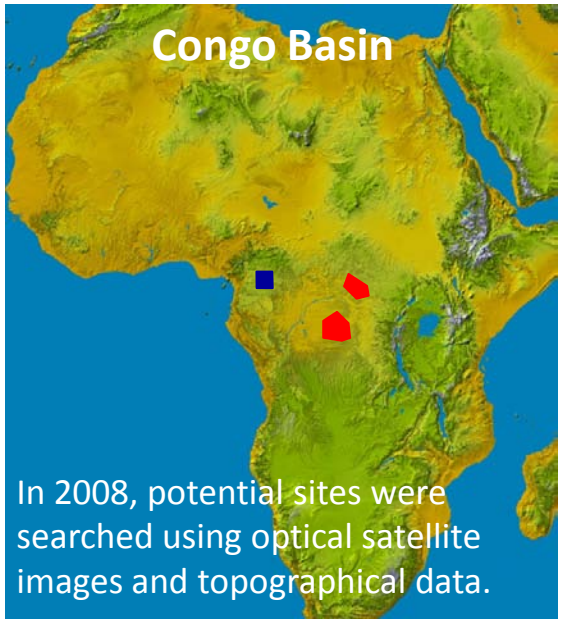
Monitoring of RADARSAT-2 SAR Radiometric Calibration



In 2006-07, RADARSAT-1 was utilized to search and validate alternate areas in the Amazon basin for future use for RADARSAT-2 cal-val.

Scenes were acquired over a year-long period for beam pattern measurements.

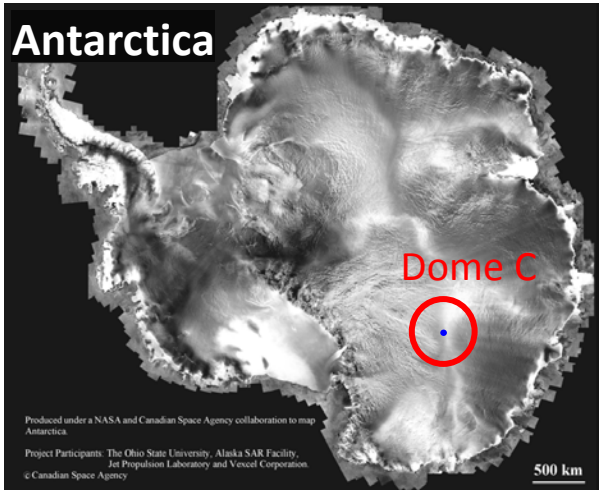
Results were consistent with RADARSAT-1 primary area (in red)



Three potential areas were identified, two of which are in protected reserves.

Areas were validated with RADARSAT-2.

Boumba Bek National Park (blue) is now exploited by the CSA in the monitoring of RADARSAT-2.

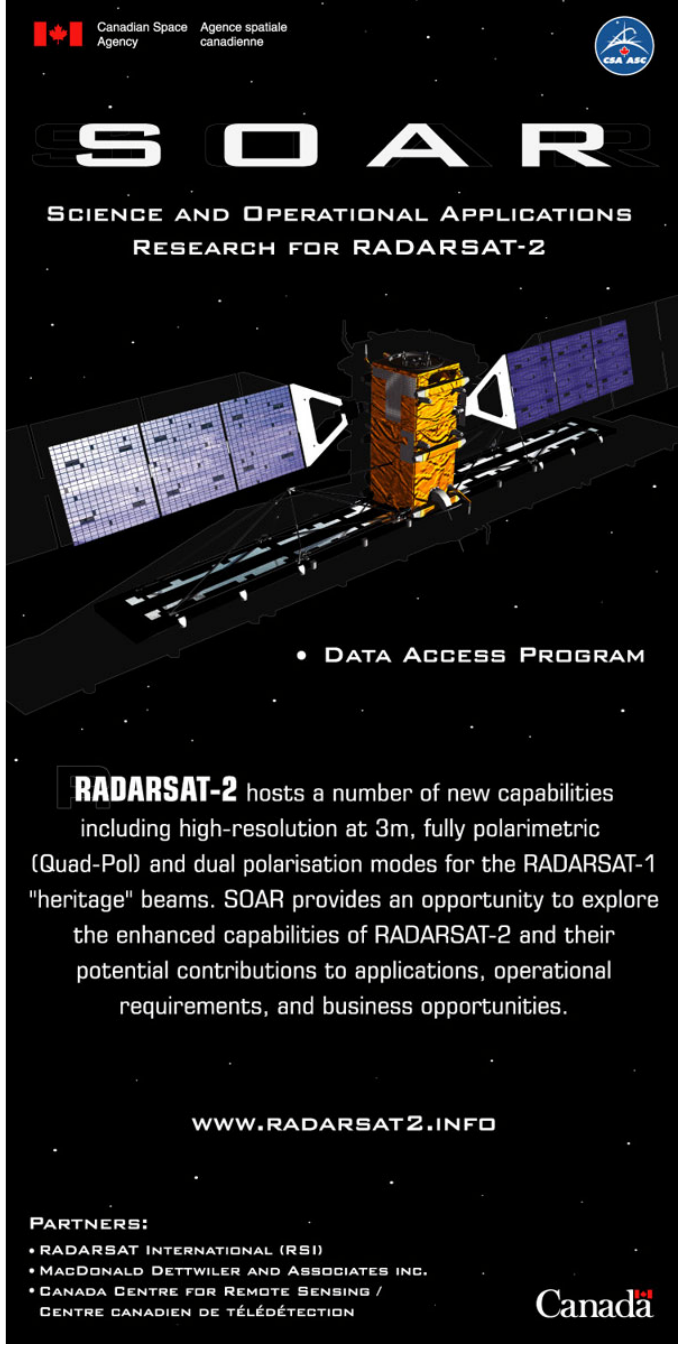


Potential site for microwave sensors (CEOS WGCV Microwave Sensor Subgroup 2008, Mark Drinkwater, ESA).

In 2008, site was surveyed with RADARSAT-1 and -2 data.

Stable, smooth backscatter range profiles, found suitable for beam pattern monitoring. Area and applicability to be better circumsbribed

Science and Operational Applications Research (SOAR)



The SOAR Program

- The SOAR Program offers **access to RADARSAT-2** data for **research and testing**

- The SOAR Program provides an opportunity to **explore the enhanced capabilities of RADARSAT-2** and expand development of applications through the loan of RADARSAT-2 data for research projects.

- The SOAR umbrella Program uses **Announcements of Opportunity** to raise interest and access to RADARSAT-2 data for R&D purposes by stakeholders other than the Government of Canada.

- SOAR is a living, evolving program with new initiatives in response to interest in collaborative efforts on the part of space agencies around the world, and to specific requests from the E.O. community.

The SOAR Initiatives

The CSA's **Earth Observation** programs, alone or in partnership with national or international organizations, issue announcements of opportunity.

Submitted Projects **Projets soumis**	385
Accepted Projects Projets acceptés	300
Rejected Projects Projets rejetés	54
Projects cancelled by PI Projets annulés par le IP	13
Projects in evaluation/writing stage Projet en cours d'évaluation/rédaction	18

Previous Opportunities

- SOAR-EI: Education International
- SOAR-DLR: Joint initiative with DLR: RADARSAT-2/TerraSAR-X
- SOAR-EU: Joint initiative with ESA
- SOAR-I: International (Pre-launch)

Current Opportunities

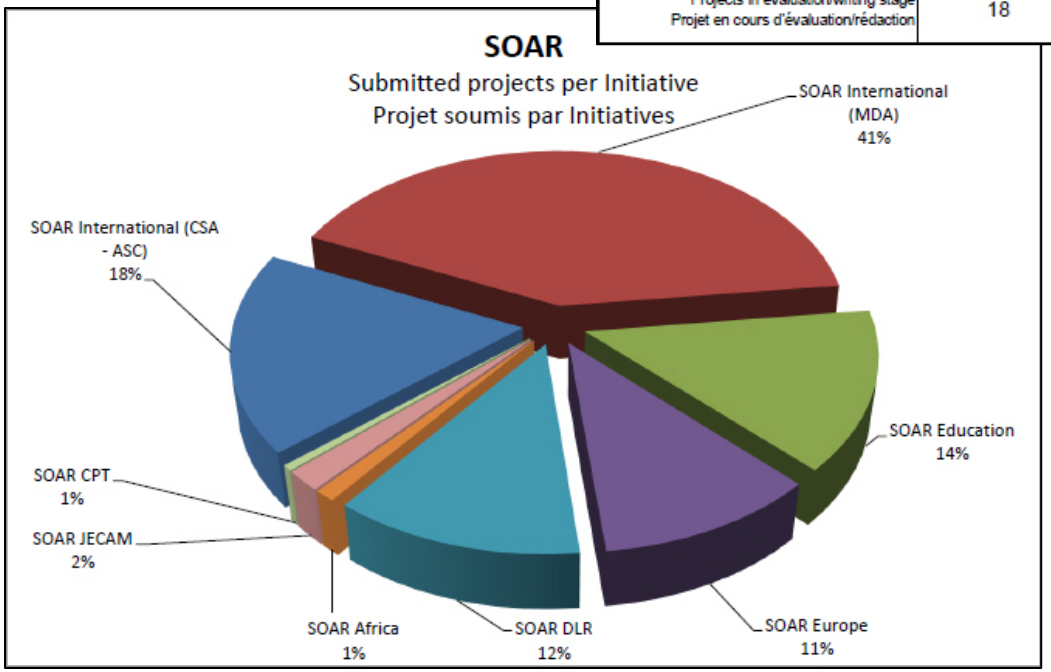
- SOAR-AF: Africa
- SOAR-CPT: Canadian Provinces and Territories
- SOAR-E: Education Canada
- SOAR-JECAM: (Crop Area monitoring)

Opportunity in Development

- SOAR-FCT: (Forest Carbon Tracking)
- SOAR-E G&C
- SOAR-ASI: Italian

Opportunities in initial negotiation

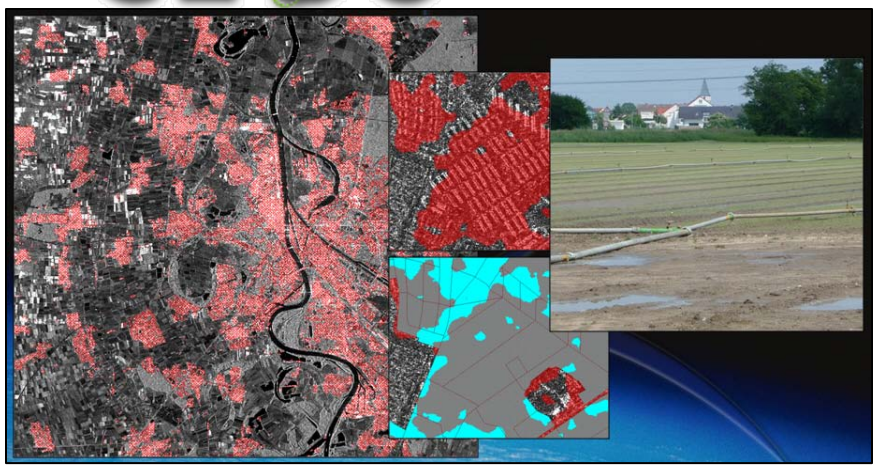
- Japan - DLR (phase 2)
- India - ESA (phase 2)
- Korea

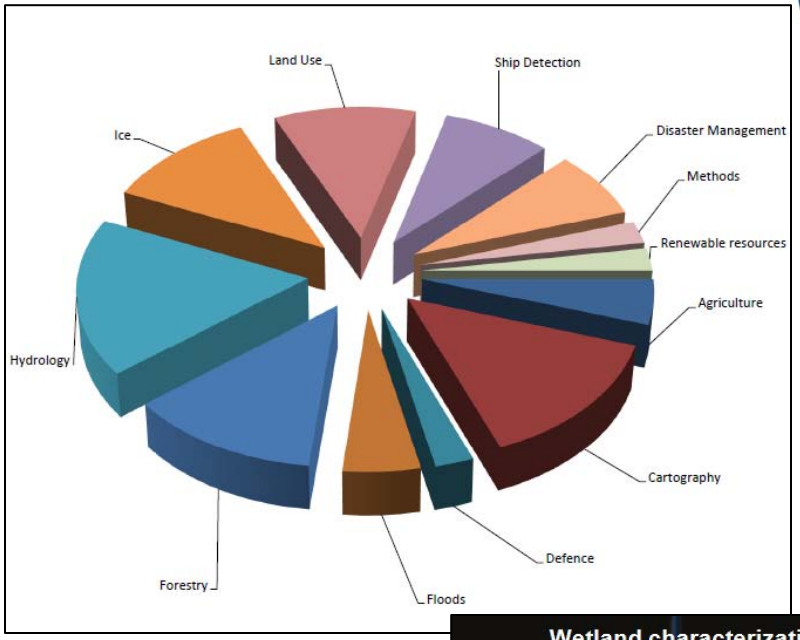


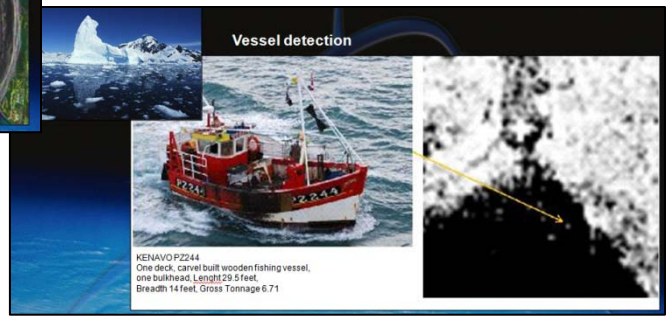
Scenes requested Scènes demandées	4650
Scenes acquired & delivered Scènes acquises et livrées	2221
Scenes to be acquired Scènes à être acquises	2429

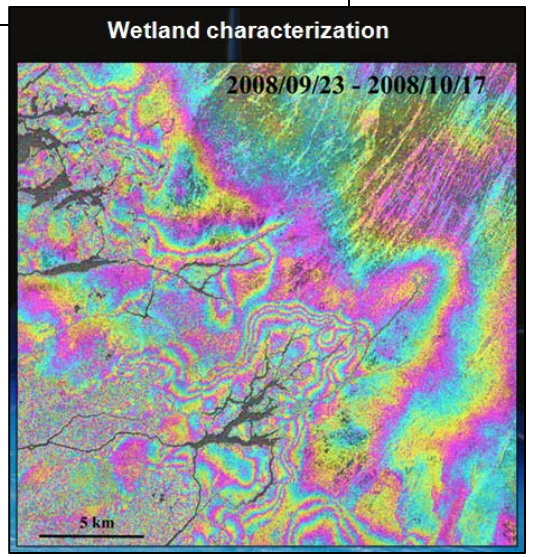
Agence spatiale Canadienne | Canadian Space Agency

SOAR Applications are Diversified









Credit:
Achim Roth *et al.*, German Aerospace Center DLR (SOAR-I 1208)
Valentin Poncos, University of Calgary (SOAR-E 5004)
Sang-Hoon Hong and Shimon Wdowinski, University of Miami and Sang-Wan Kim, Sejong University (SOAR-I 2720)
Nick Walker & Armando Marino, eOsphere (SOAR-EU 6794)

Agence spatiale Canadienne | Canadian Space Agency

Contact information

For more information on SOAR, please contact:

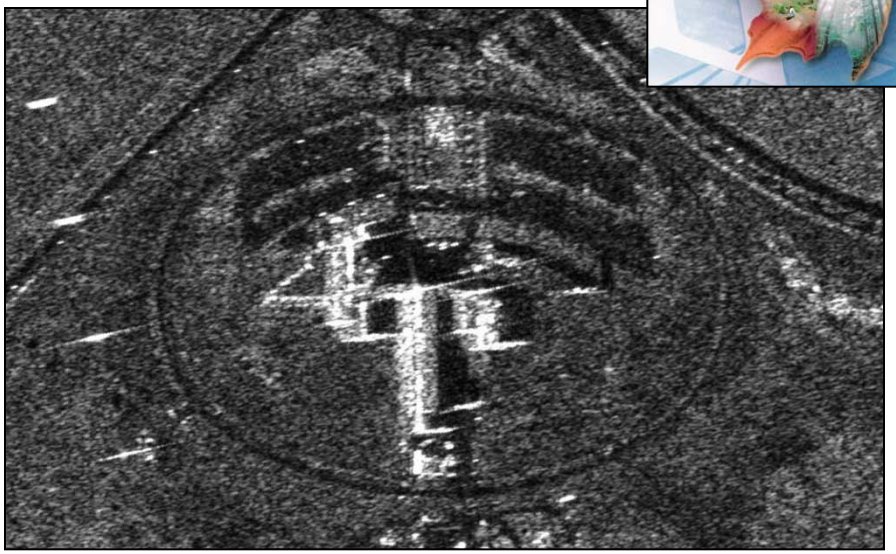
Stéphane Chalifoux, M. Sc.

SOAR Coordinator

Canadian Space Agency

E-mail : [Stephane.Chalifoux@asc-csa.gc.ca]

Government of Canada



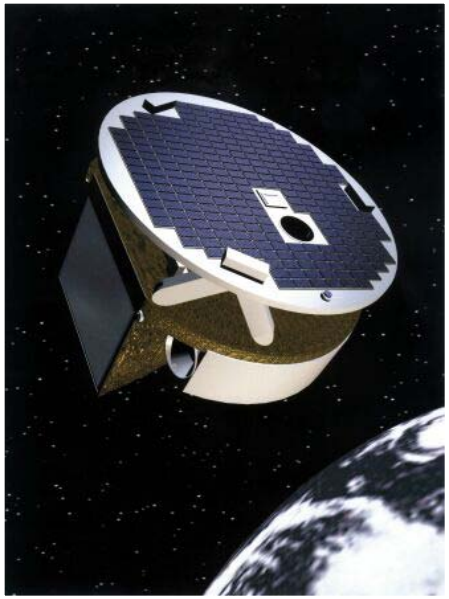
For more information:
http://www.asc-csa.gc.ca/eng/programs/soar/default.asp

Agence spatiale Canadienne | Canadian Space Agency

SCISAT Program Status (1)

- Launched in August 2003, SCISAT satellite measures numerous trace gases, thin clouds and aerosols in the stratosphere, thereby enabling a more comprehensive understanding of the several chemical processes that play a role in stratospheric ozone depletion.

- CSA has approved continuation of SCISAT operation until March 31, 2015.

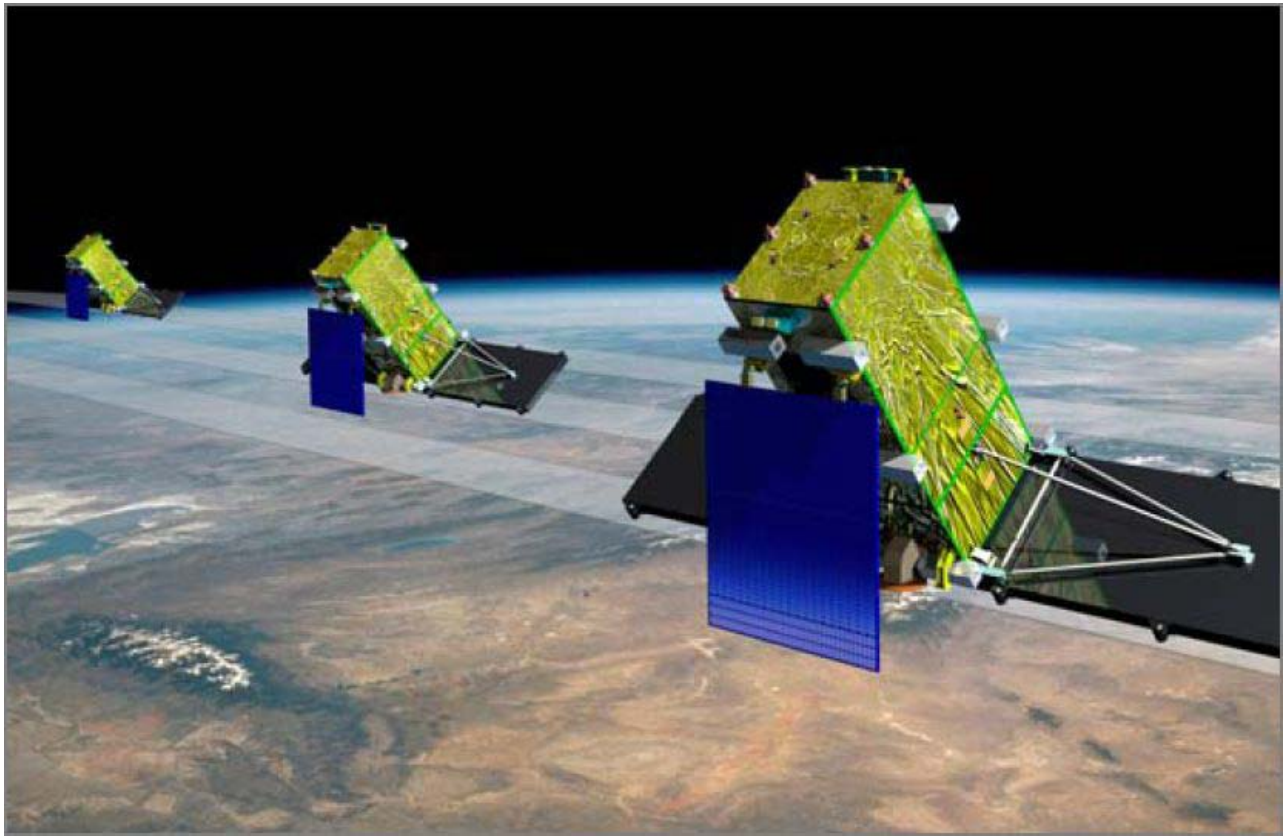


SCISAT

SCISAT Program Status (2)

- Completed 52,000 orbits
- Delivering data to the scientific community using stations in Canada (Saskatoon and St-Hubert), ESA (Kiruna), DLR (Weilhiem), NASA (ASF)
- Science data acquired vs. Planned performance > 97%
- More than 8500 Gbytes of data provided to the science team in the fiscal year 2012-13. Over 50 Gbytes provided since April 2013.
- Intensive data analyses by scientists have produced a number of new results that have been disseminated at international scientific conferences and through the publication of peer-reviewed scientific papers

RADARSAT Constellation Mission



RCM Objectives

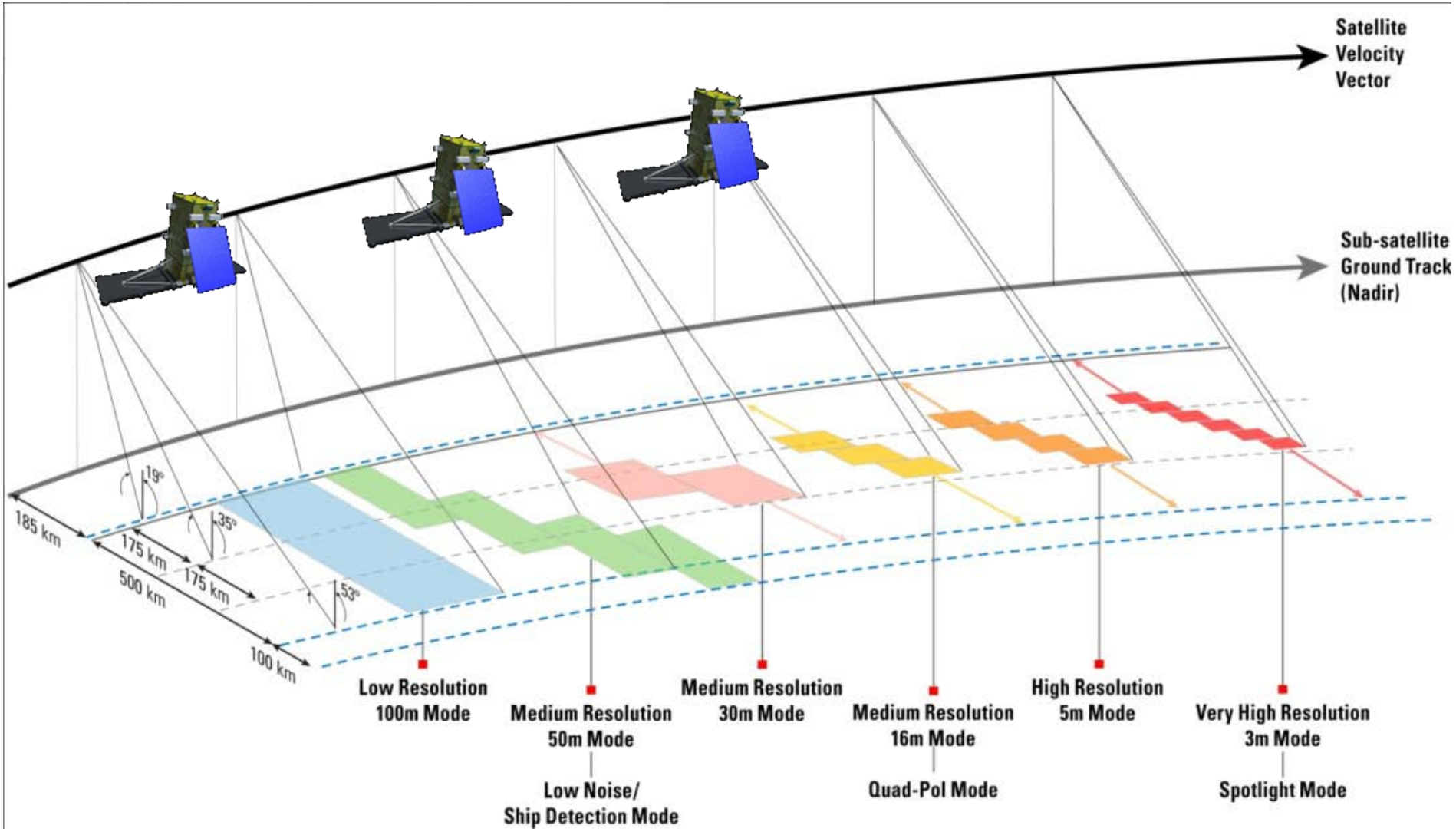
System of 3 satellites designed to:

- Support the operational requirements of Federal departments ensuring continued access to critical RADARSAT data
- Provide daily coverage over Canada and our maritime approaches
- Provide improved and faster access to anywhere on the globe

RCM addresses Federal departments mandates and Government priorities in the following areas:

- ***Maritime Surveillance***
- ***Disaster Management***
- ***Natural Resources Management***
- ***Northern Development***

RCM Imaging Modes

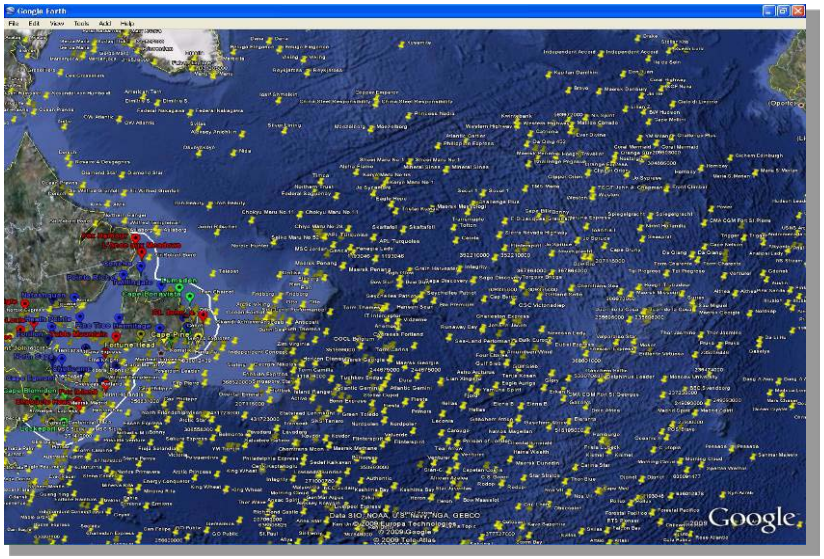


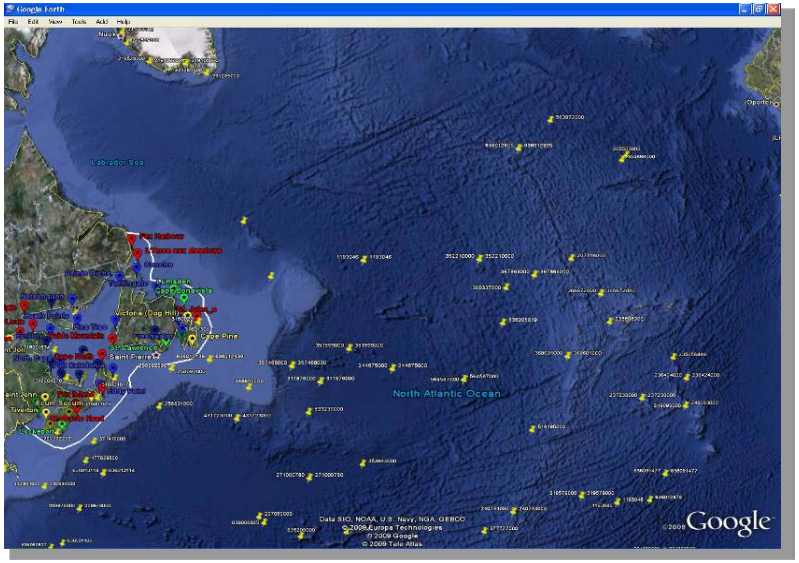
Mode Specification and Utilizations

Medium Resolution "50-metre" Mode (ScanSAR, 350km swath, 50m x 50m, 4x1 looks	Soil Moisture maps, D-Insar products Forestry clear cuts
Low Resolution "100-metre" Mode (ScanSAR, 500km swath, 100m x 100m, 8x1 looks)	Ocean wind, Sea Ice
High Resolution "5-metre" Mode (Single Beam, 30km swath, 5m x 5m, 1 look)	Target Detection, Urban (cartography), Land Cover, PS-Insar. Disaster Recovery&Assesment, Precision Agr.
Very High Resolution "3-metre" Mode (Single Beam, 20km swath, 3m x 3m, 1 look)	Target Detection, Urban (cartography), PS-Insar, Precision Agr.
CCD Stripmap "16-metre" Mode (Single Beam, 30km swath, 16m x 16m, 1x4 looks)	CCD Land, Natural Hazard monitoring, PS-Insar, Soil Moisture, Precision Agr., Protected Areas&Wildlife
CCD ScanSAR "30-metre" Mode **(**ScanSAR, 125km swath, 30m x 30m, 2x2 looks)	CCD Land, Natural Hazard Monitoring, Agriculture, Soil Moisture, Forestry, InSAR
Low Noise "Ice Detection" Mode (ScanSAR, 350km swath, 100m x 100m, 4x2 looks)	Sea Ice, Oil Spill, Ocean Wind
Ship Detection Mode (ScanSAR, 350km swath, ~25m, variable looks)	Ship Detection, Icebergs
Spotlight Mode (Single Beam, 20 km x 5km swath, 3m x 1m, 1 look)	Target detection & identification, Urban
Polarimetric Mode (Single Beam, 20 km swath, 9m x 9m, 1 look)	Target detection, Pol-InSAR, Land Classification

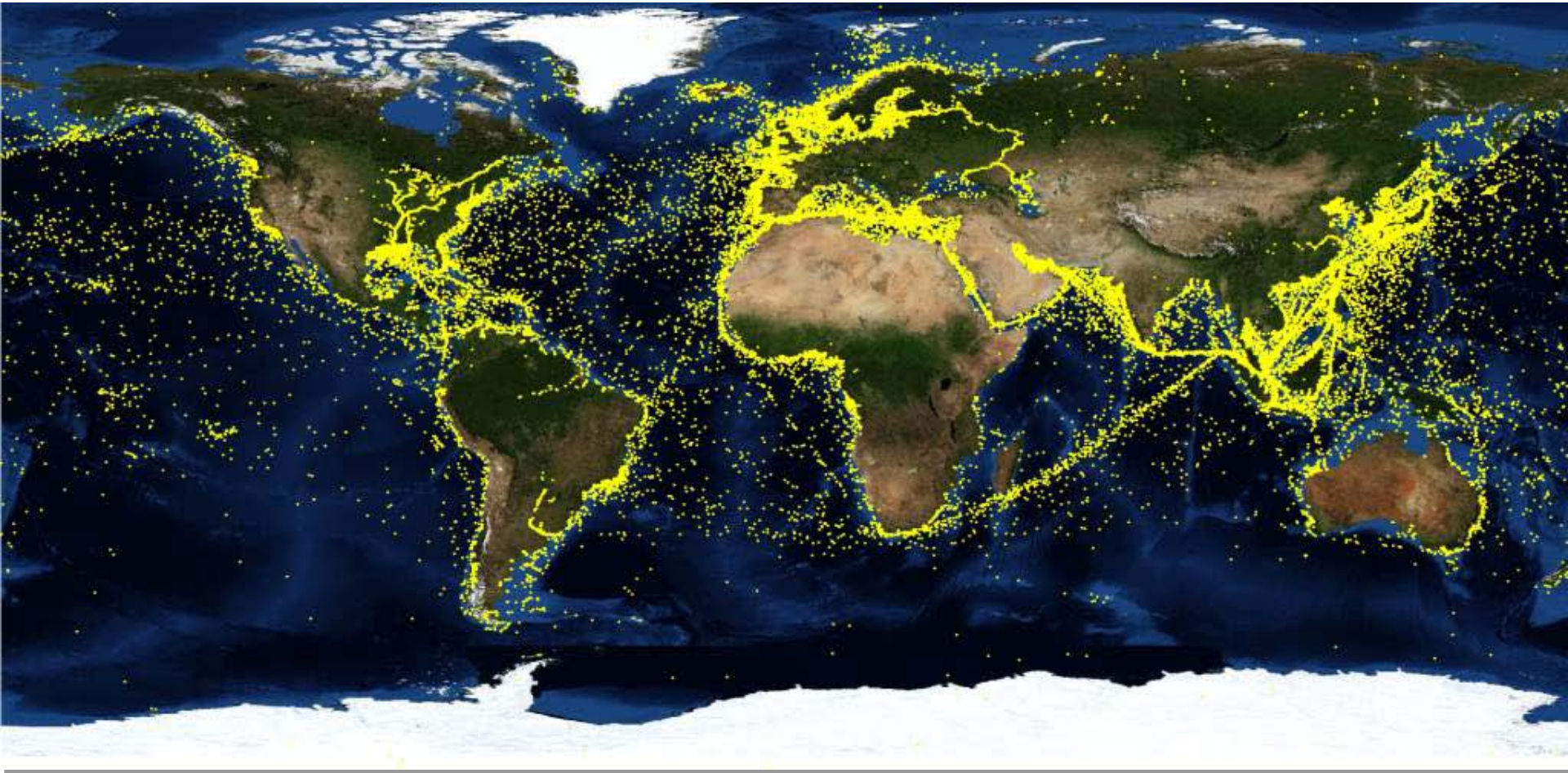
Automatic Identification System

- A 3-satellite RCM will provide a very high probability of detecting and tracking all ships approaching Canada
- Fusion of AIS data with SAR data will enable the identification of the majority of non-compliant contacts.





Global Vessel Traffic Density



September 2011– 70,000+ vessels detected

Project Schedule