CSA Report on Earth Observation

Presented at

CEOS WGCV 37th Plenary

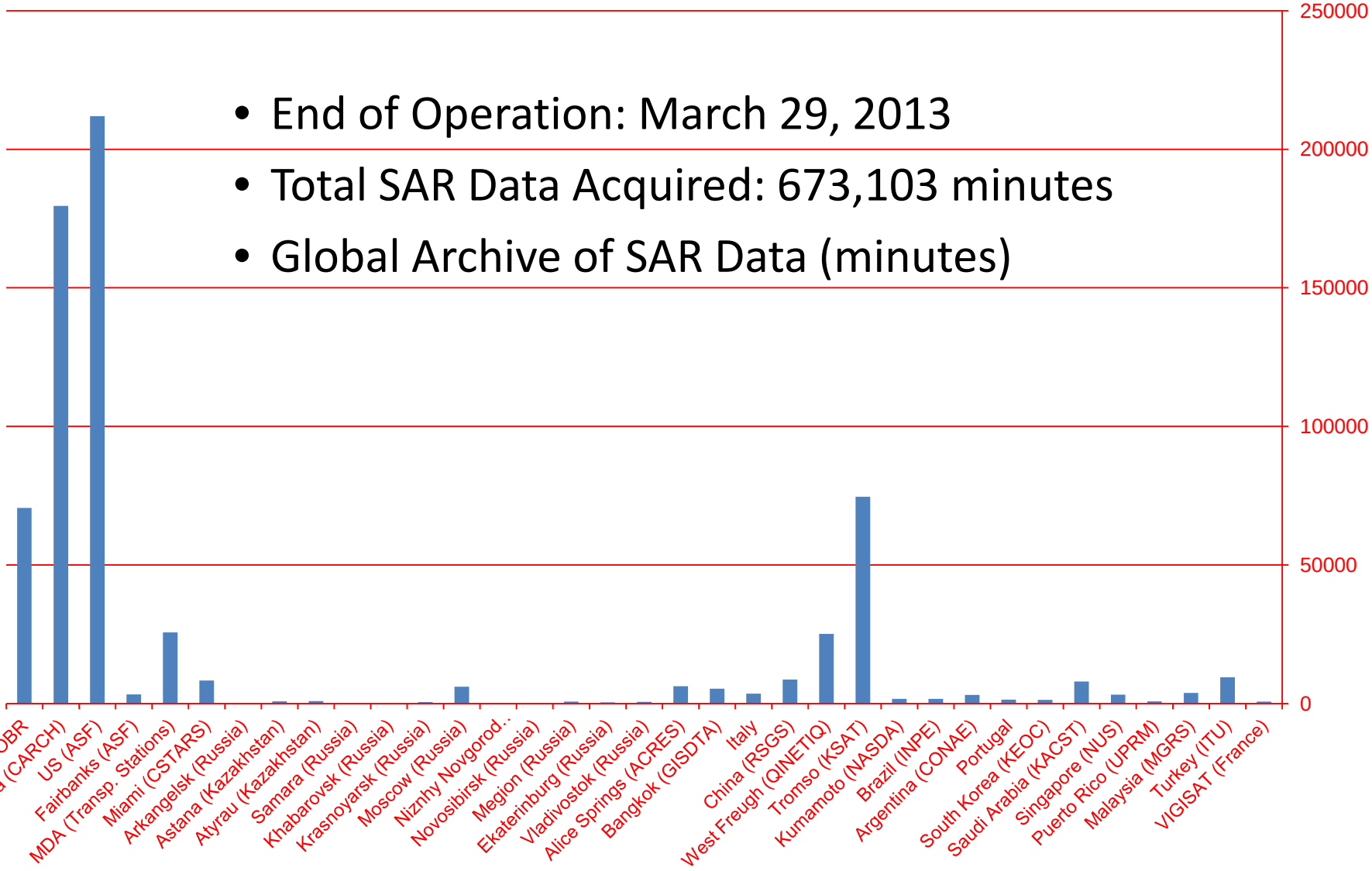
Frascati, Italy

February 17 – 21, 2014

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

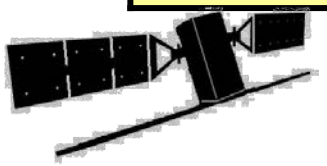
RADARSAT-1
(1996-2013)

- End of Operation: March 29, 2013
- Total SAR Data Acquired: 673,103 minutes
- Global Archive of SAR Data (minutes)



RADARSAT-2
Spacecraft Health and Anomalies

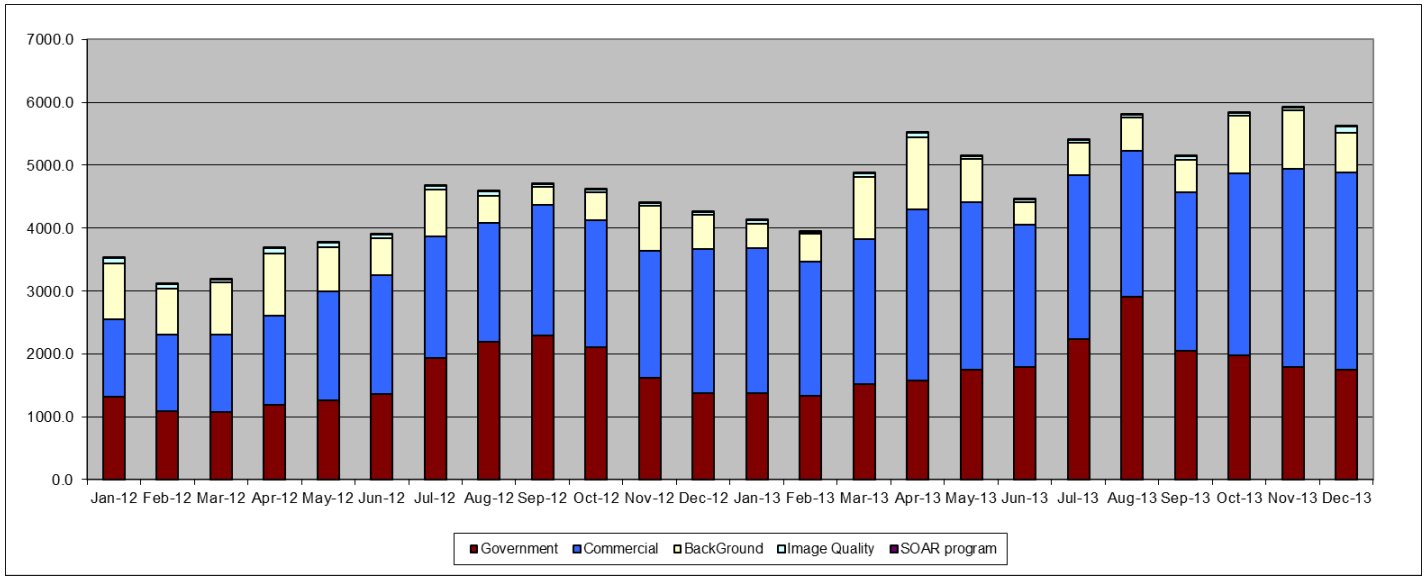
System	Status
Thermal	About 4°C increase in 5.5 years. Heater on Reaction Control Thruster #3 Fuel Control Valve show intermittent failures, now using redundant heater group. A few monitoring sensors failed with no impact.
Power	Battery and Solar array: No sign of degradation Following 2014 Eclipse period, Solar Array were kept in Sun tracking mode (Vs previous default of Body Aligned) to reduce stress on battery from multiple charge cycles causes by higher SAR demand.
AOCS	Attitude and orbit well within specifications. Now using gyro 2, 3 and 4 as gyro 1 showing aging sign.
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). Finalizing mitigation strategy should CDU#12 redundant side also fail.



Many Bus and Payload anomalies related to Single Event Upset.

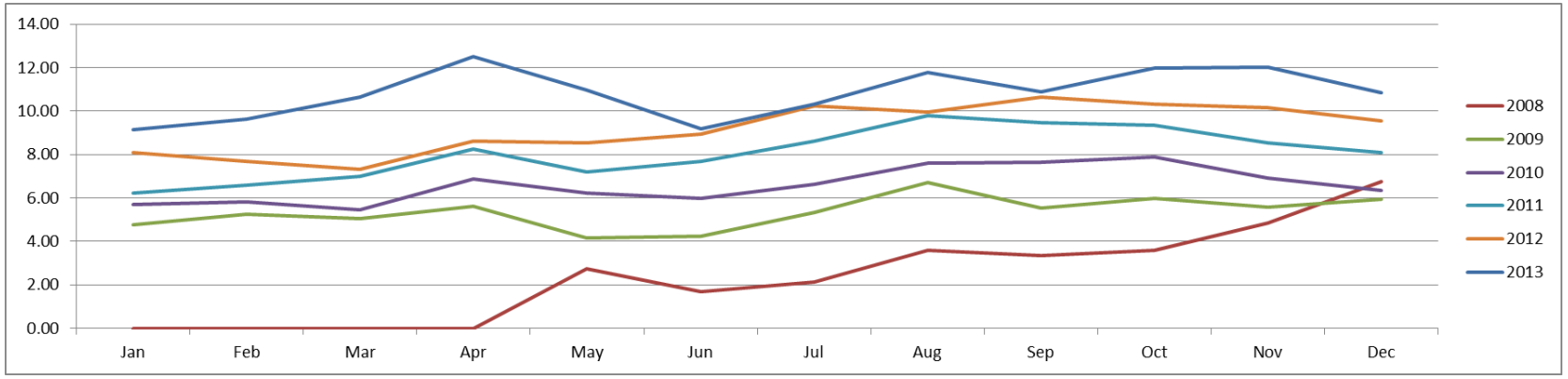
When not SEU related, most anomalies are managed through monitoring and recovery using pre-prepared and, in some cases, automatic recovery procedures.

RADARSAT-2
Minutes of SAR Data Acquisition



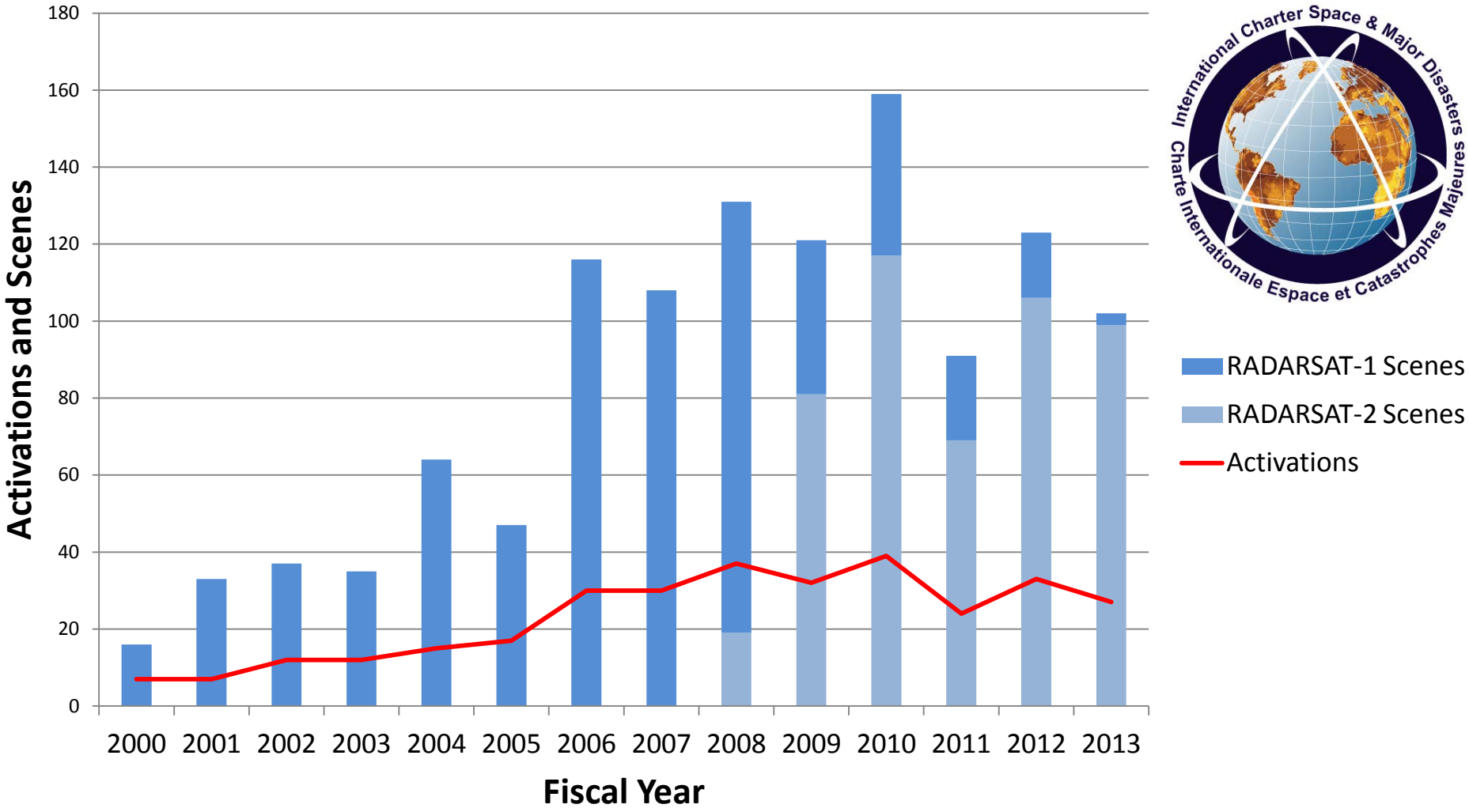
Above figure covers minutes of SAR acquired per main user group for the past 2 years

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

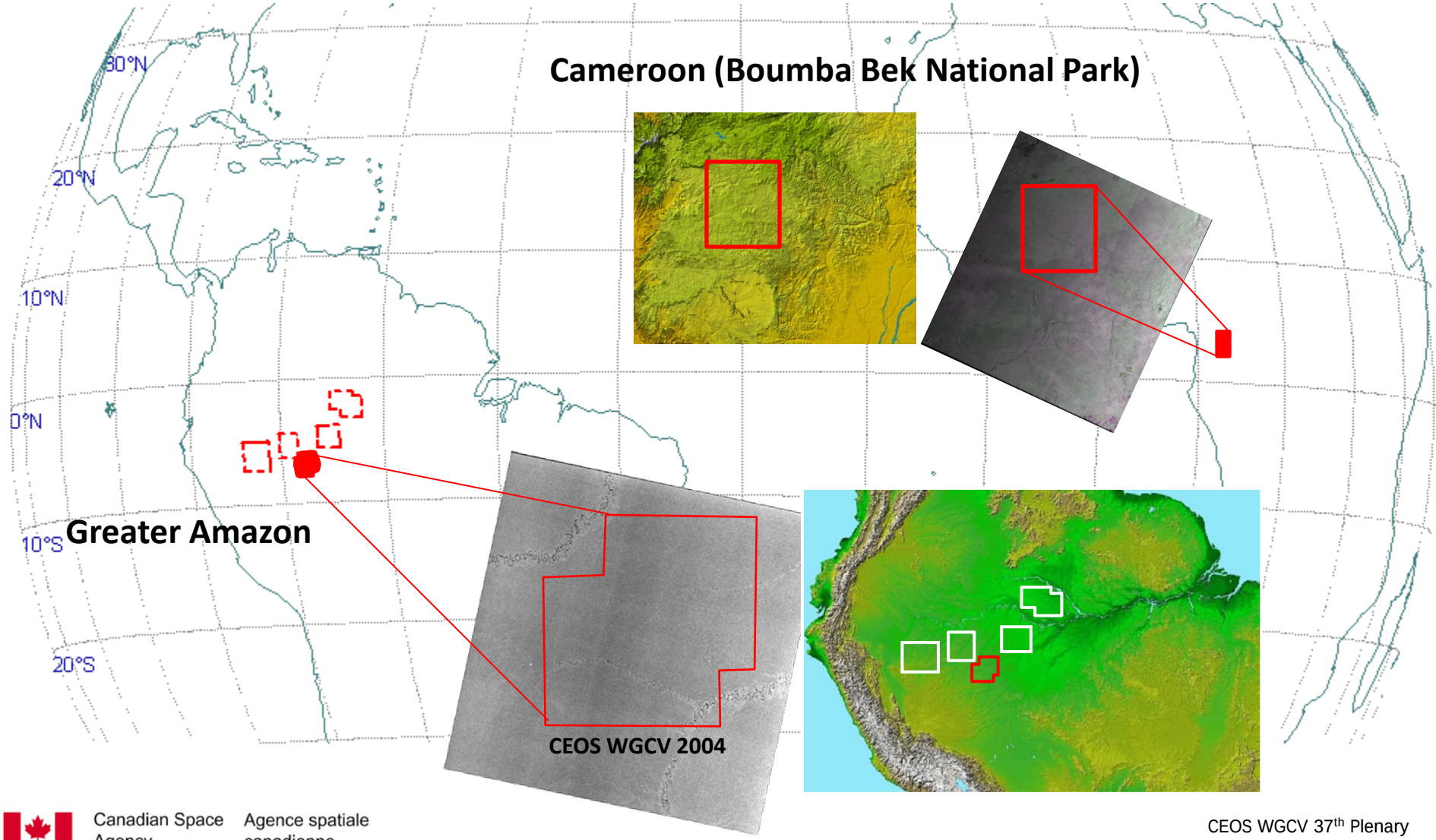


International Charter

R1 and R2 Activations and Scenes, 2000-2013



Monitoring of RADARSAT-2 SAR Radiometric Calibration



Natural SAR Cal-Val Sites as Seen by RADARSAT-2

Amazon

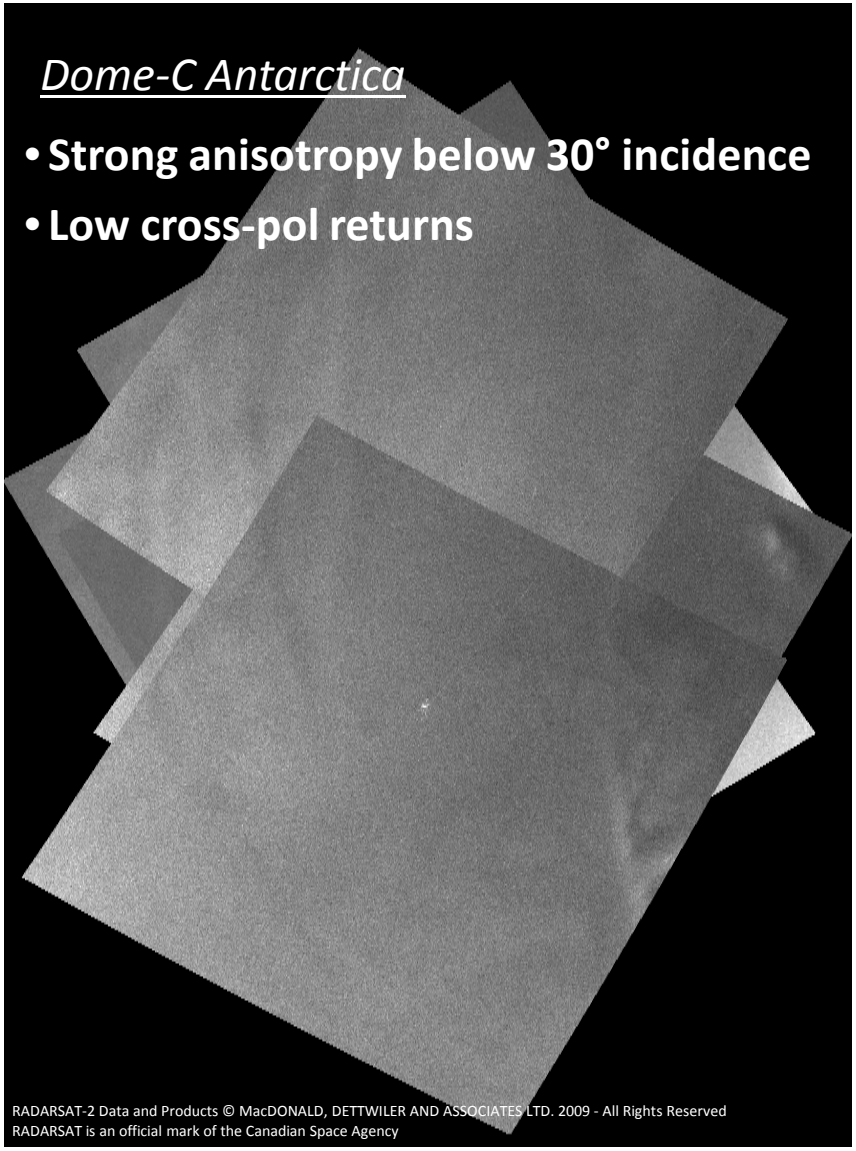
- Well characterized (backscatter variation with incidence, backscatter levels, seasonal variations)
- Flat terrain uniform vegetation coverage on a very large scale
- Deforestation nearby exploited areas

Cameroon: Boumba Bek National Park

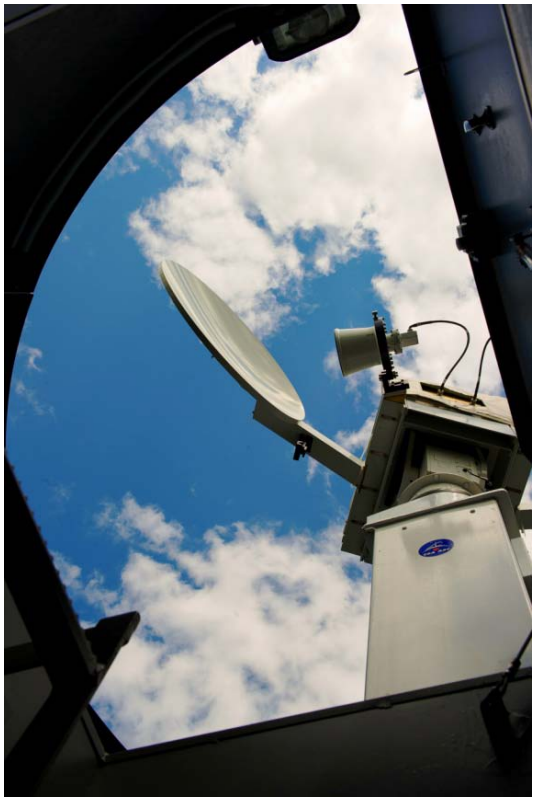
- Backscatter characteristics similar to the Amazon (backscatter variation with incidence, backscatter levels)
- Hilly terrain, less uniform vegetation coverage may affect beam pattern measurements for smaller swaths images

Dome-C Antarctica

- Strong anisotropy below 30° incidence
- Low cross-pol returns



RADARSAT Point Target Facility at CSA HQ

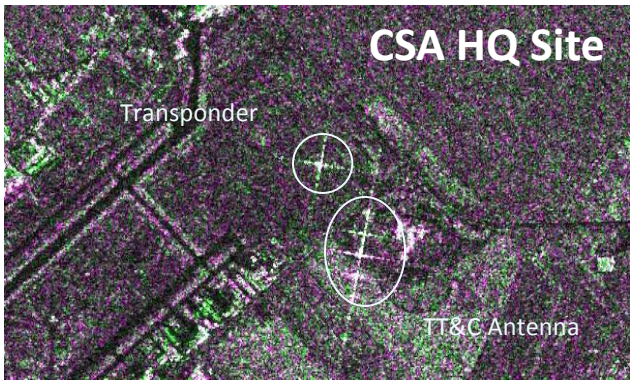


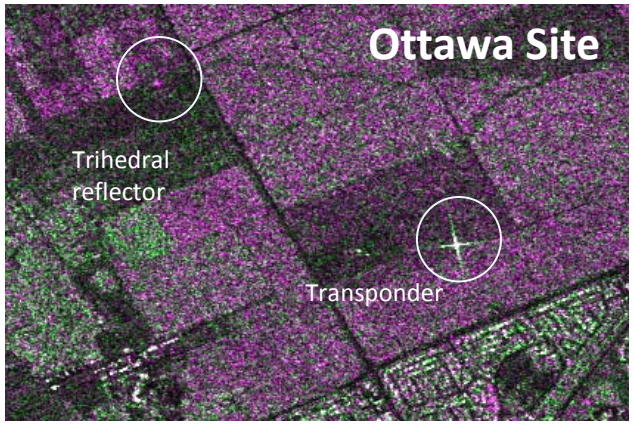
- In operations since spring 2012
- Made from upgraded RADARSAT-1 precision transponder
- For the R2 Quality Assurance mandate of the GoC, operates in conjunction with another upgraded R1 instrument in Ottawa

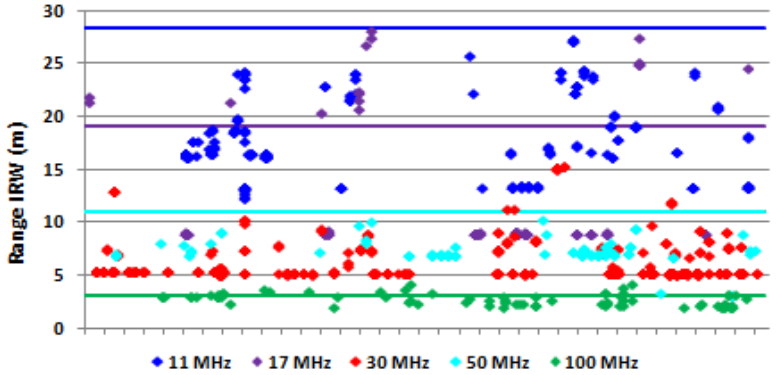
RADARSAT-2 Image Quality Assurance

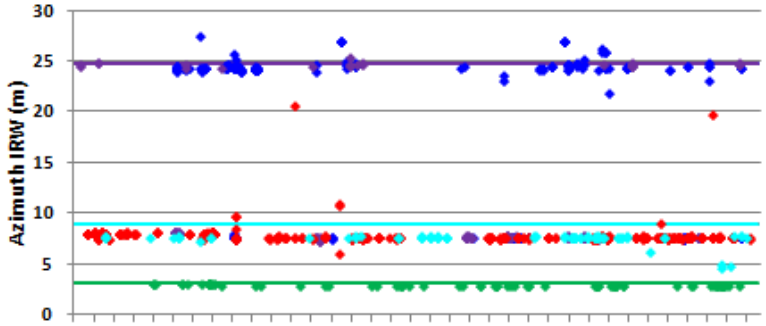
CSA executes the mandate of the Government of Canada to monitor R2 SAR performance

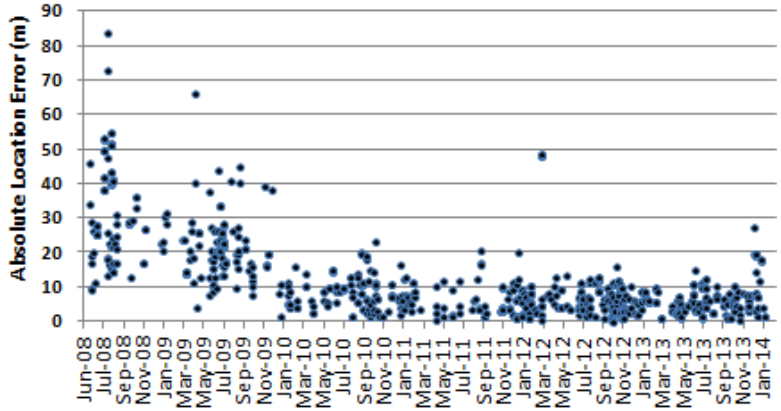
- **Excellent overall image quality results: IRW, georeference**



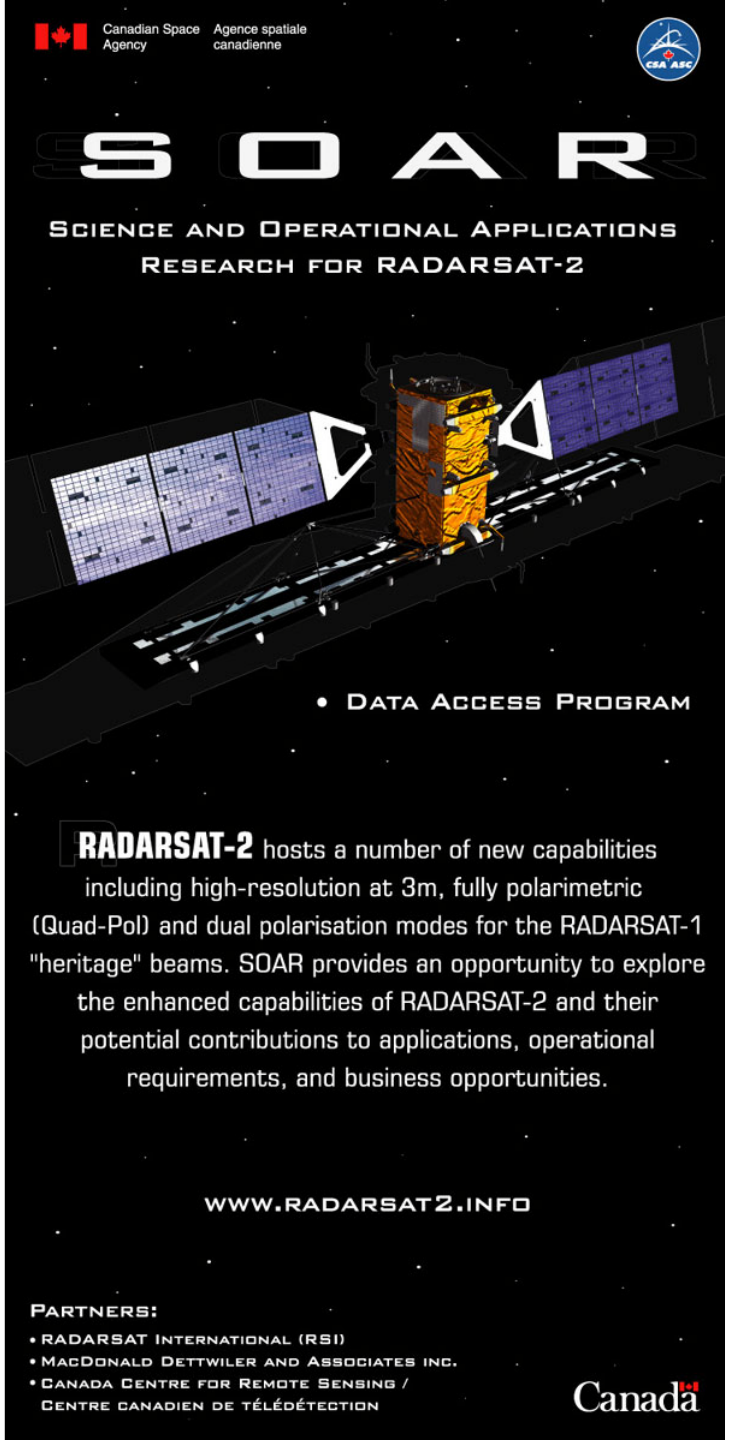








Science and Operational Applications Research (SOAR)



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

The SOAR Initiatives

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

Previous Opportunities

- SOAR-ASI: Joint initiative with ASI: COSMO-SkyMed/ RADARSAT-2
- SOAR-EU-2: Joint initiative with ESA
- 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-Geohazard (CEOS linked)
- SOAR-AF: Africa
- SOAR-CPT: Canadian Provinces and Territories
- SOAR-E: Education Canada
- SOAR-JECAM: (Crop Area monitoring)

Opportunity in Development

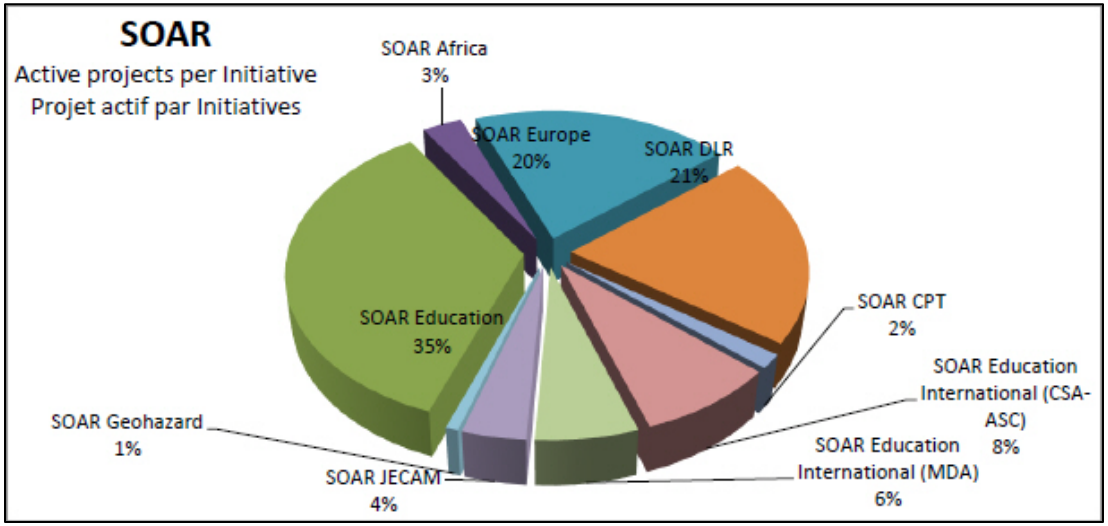
- SOAR-FCT: (Forest Carbon Tracking)
- SOAR-E G&C

Opportunities in initial negotiation

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

Submitted Projects Projets soumis	**454**
Accepted Projects Projets acceptés	182
Rejected Projects Projets rejetés	63
Projects cancelled by PI Projets annulés par le IP	14
Projects in evaluation/writing stage Projet en cours d'évaluation/rédaction	9
Closed Projects Projets fermés	186

Scenes requested Scènes demandées	6285
Scenes acquired & delivered Scènes acquises et livrées	2767
Scenes to be acquired Scènes à être acquises	3518



RADARSAT Constellation Mission (RCM)

- Three Satellites
- Design completed – Mission Critical Design Review held in Nov 2012
- Satellites and data (SAR and AIS) are Government-owned
- Planned for launch in 2018
- RCM will offer greater flexibility and imaging capacity (frequency)
  - Developed to meet the needs of operational users
- Include an Automatic Identification System (AIS) on each satellite
- Will be capable of handling both classified and unclassified Orders and Products

RCM Image Products

Raw Products

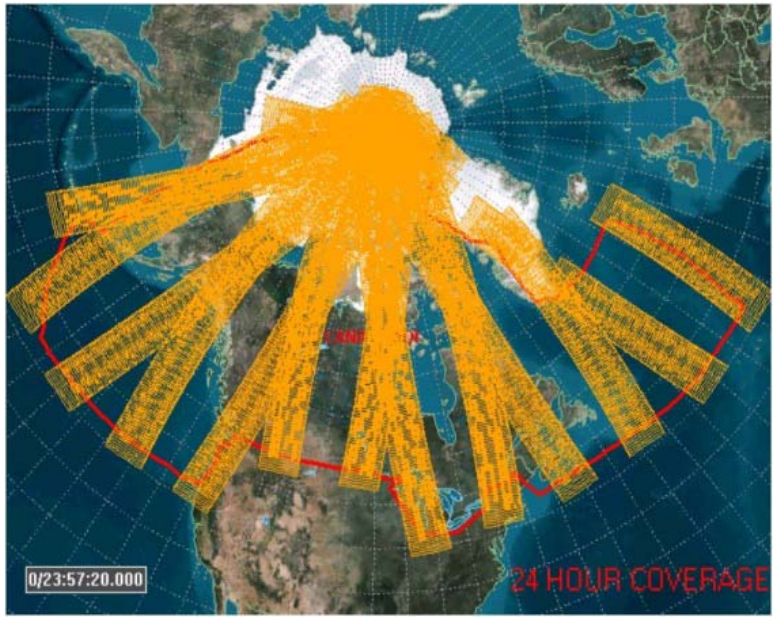
- Raw Radar data in FRED format

GCC = GeoCoded Complex
GCD = GeoCoded Detected
GRC = Ground range georeferenced Complex
GRD = Ground range georeferenced Detected

Image Products

- Variety of processing levels
  - ✓ single-look complex products (SLC)
  - ✓ multi-looked power-detected geo-referenced products (GRD, GRC)
  - ✓ geo-coded products (GCD, GCC)
- Include a “Doppler Grid” with 2 km spacing
- Same formats as RADARSAT-2: GeoTIFF images with XML meta-data + NITF 2.1 format.

RCM Daily Coverage



Current coverage with RADARSAT-2

- Major gaps in maritime approaches
- Northwest Passage (NWP) coverage also incomplete
- Canadian land mass coverage

Coverage with RCM

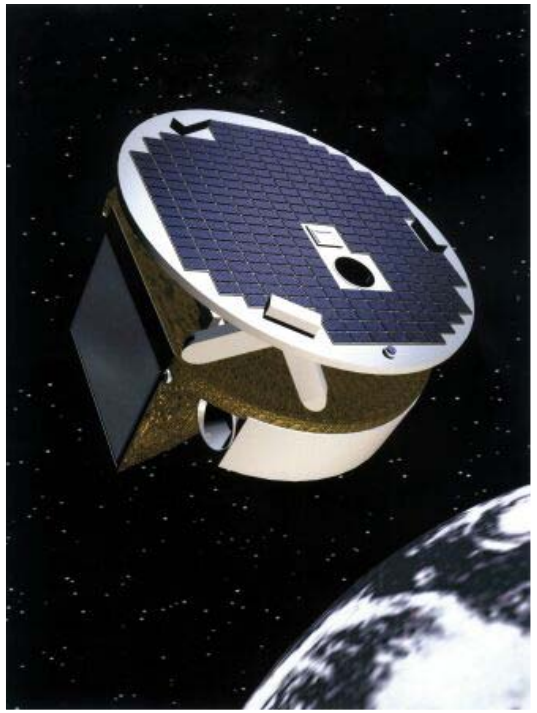
- Coverage of NWP up to 4 times daily
- Minor gaps in East and West maritime zones (completed on next day)
- Land mass coverage virtually complete

RCM Data Policy Objectives

- Priority access for Canadian operational users over Canada.
- Data freely and openly available to public as much as possible (world-wide trend toward *full and open* data sharing principles).
- Maintain commercial thrust initiated by previous RADARSAT missions as much as possible.
- Enable a level-playing-field for all Canadian value-added service providers and re-invigorate this industry.
- Protect and preserve data in the long-term.
- Comply with the Remote Sensing Space Systems Act and other GoC regulations.
- **Status: Currently in development.**

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 56,400 orbits.
- Delivering data to the scientific community using stations in Canada (Saskatoon and Saint-Hubert), ESA (Kiruna), DLR (Weilheim), NASA (ASF).
- Science data acquired vs. Planned performance > 96%
- More than 8000 Gbytes of data provided to the science team in the fiscal year 2013-14.
- 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.