

# **THE RADARSAT-1 IMAGING PERFORMANCE, 15 YEARS AFTER LAUNCH, AND INDEPENDENT REPORT ON RADARSAT-2 IMAGE QUALITY**

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## **1. INTRODUCTION**

This paper summarizes the calibration monitoring activities of the Canadian Space Agency (CSA) for the RADARSAT Program. The performance history of the RADARSAT-1 SAR since its commissioning in 1996 is reviewed, along with the calibration systems and methodologies used, in the context of the mission's thirteen-year calibration history. Independent image quality measurements for the privately-owned RADARSAT-2, launched in 2008, are also presented. It is shown that the calibration parameters of the RADARSAT-1 SAR have consistently been maintained within the mission's design goals and specifications, mostly thanks to payload stability and timely recalibrations performed using the calibration ground equipment. For RADARSAT-2, CSA's measurements reports outstanding image quality levels.

## **2. RADARSAT-1 CALIBRATION: OPERATIONS AND RESULTS**

RADARSAT-1 was Canada's first operational Earth observation satellite when launched on November 4 1995. After more than 15 years, the spacecraft still provides calibrated data to worldwide users for applications ranging from sea ice classification to maritime surveillance, disaster watch or natural resource management. Many major milestones have been completed since the satellite was declared operational in April 1996, including two Antarctic mapping missions, several antenna pattern recalibrations, processor upgrades and the development of solutions to degradation or failure of subsystems including the pitch momentum wheels. Throughout these major activities until present, the RADARSAT-1 system has maintained or exceeded its imaging performance profile as set out in the RADARSAT-1 System Specification [1].

The RADARSAT-1 calibration system is operated at the satellite operations facility of the CSA headquarters located in Longueuil, Canada [2]. The Canadian Data Processing Facility (CDPF), operated by the Geospatial Services division of MacDonald Dettwiler and Associates Ltd (MDA) in Gatineau, Canada, constitutes the

reference processing facility for RADARSAT-1 data quality control since the start of the maintenance phase, in February 1997.

Using both single beams and ScanSAR images of RADARSAT-1 Precision Transponders (RPTs) and Amazon Rainforest, SAR image quality as well as calibration were consistently monitored through measurements of impulse response function, location error and radiometric accuracy. In parallel, successive assessments of the on-board internal calibration system, performed from 1999 to 2009, showed no indication of any degradation trends in the instrument gain and noise levels.

The Amazon calibration site can no longer be used after On-Board-Recorder operations were terminated in summer 2008, as the area is outside of RADARSAT-1-certified receiving station masks. An alternate area in the Canadian boreal forest belt, under study since 2003, is now exploited for beam pattern estimation. New methods were developed to increase the level of confidence of the measurements performed at the area despite seasonal variations [3].

### **3. RADARSAT-2 IMAGE QUALITY MONITORING ACTIVITIES**

In its responsibility of independently validating the quality of RADARSAT-2 products for the Government of Canada (GoC), the CSA conducted monitoring campaigns in areas of the Amazon, and at selected sites in Canada. The compiled results are in general agreement with those obtained by MDA, the RADARSAT-2 operator. CSA reports that the performance of the RADARSAT-2 SAR instrument is notably superior to the mission requirements, to the satisfaction of the GoC users for their intended applications [4].

### **4. REFERENCES**

[1] Canadian Space Agency, *RADARSAT System Specification, Canadian Space Agency Document RSCSA-SP0002*, Rev. C, 1996.

[2] S.K. Srivastava, N.W. Shepherd, T.I. Lukowski and R.K. Hawkins, "Plans for RADARSAT image data calibration," *Adv. Space Res.*, Elsevier, vol. 17, no. 1, pp. 89-96, 1996.

[3] S. Cote, S. Srivastava, S. Muir, T. Lukowski, R. Hawkins, "SAR Image Quality and Calibration Operations for the RADARSAT Satellites at the Canadian Space Agency," *Proc. RADAR 2009 Conference*, SEE, Bordeaux, France, 2009.

[4] S. Srivastava, S. Cote, S. Muir, R. Hawkins, "Canadian Government Calibration Operations: The 13-year SAR Performance History of RADARSAT-1, and Independent RADARSAT-2 SAR Quality Measurements," *Proc. CEOS SAR Workshop*, CEOS, Pasadena, USA' 2009.