DISTRIBUTED TARGET SITES FOR RADIOMETRIC MONITORING WITHIN THE RADARSAT PROGRAM: EXPLOITATION AND DEVELOPMENTS AT THE CANADIAN SPACE AGENCY

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1. INTRODUCTION

This paper presents the distributed target areas that are exploited and experimented as part of the calibration activities of the Canadian Space Agency (CSA) for the RADARSAT Program, largely for elevation beam pattern determination. The latest RADARSAT-1 beam pattern recalibration, performed in 2009, is also reported.

2. AMAZON AND BOREAL FOREST EXPLOITATION

For RADARSAT-1, the Amazon basin was established early on as a primary reference site for its isotropy and temporal stability, both already demonstrated at the early stages of the calibration operations. Routine Amazon data have been acquired over more than 11 years, utilizing a single well-characterized area throughout the mission (UL: -5.03, -65.67; LR: -9.12, -69,64 deg) and revealing very few issues.

For more than eleven years, elevation beam patterns were monitored using this area, and deviations from the reference patterns used in image processing were measured. Recalibrations were performed when consistent radiometric deviations remained beyond a pre-established threshold. While many of such recalibrations have been performed since 1998, some RADARSAT-1 beams are still operating with the original calibration of 1997. Except for one recalibration of beam Wide 2, in 2004, the 2002-2005 period saw no major changes in the antenna patterns, which suggests an advanced stage in the antenna's aging cycle.

On August 2008, the termination of On-Board Recorder (OBR) operations precluded the continuous use of the Amazon for calibration monitoring, because the area is out of range of RADARSAT-1 receiving facilities. Within masks of Canadian receiving stations, an alternate area in the Canadian boreal forest belt is now used for beam pattern extraction. While the area presents physical limitations (anisotropy, seasonal variations), the pattern shape retrievals remain relatively well preserved for large swaths. A monthly-based backscatter model of the area was

devised to mitigate seasonal variations and freeze-thaw periods. Another approach exploiting the boreal forest area makes use of the calibrated RADARSAT-2 SAR to refine the monitoring of the RADARSAT-1 beam patterns in a satellite-to-satellite calibration approach. The achieved relative radiometric accuracy is approximately 0.3 dB tighter than using the boreal forest site alone.

3. LATEST RADARSAT-1 BEAM PATTERN RECALIBRATION

The latest RADARSAT-1 payload file was issued in March 2009 and consisted in the recalibration of 6 beams. From 2003, Amazon and Boreal Forest data have progressively showed the imaging portions of the beam patterns to undergo a range offset between ascending and descending acquisitions. This trend, traced back from 2003 and gradually affecting radiometric performance after 2005, is thought to be related to a difference in platform altitude between ascending and descending passes. As a result, most of the beam pattern corrections involved the edges of the patterns. While the new patterns were elaborated using the last data sets acquired at the Amazon, the boreal forest is also used to assess the performance of the recalibration. After recalibration, prediction of the radiometric performance improvement could also be made by reprocessing the last of the Amazon datasets before OBR termination [1].

4. ANALYSIS OF OTHER POTENTIAL DISTRIBUTED TARGET SITES

An experiment was conducted in 2007 on other regions of the Amazon basin to verify the achievable radiometric accuracy of beam pattern estimations compared to the primary area [2]. In addition, RADARSAT-2 has been used by the CSA to study alternate natural sites identified in Africa and Antarctica. Backscatter uniformity and stability are examined to evaluate feasibility in retrieving antenna elevation beam patterns at these locations for efficient provision of calibrated data for future more complex mission like Radarsat Constellation. Already being used for other classes of microwave sensors, the Dome-C area in Antarctica is of particular interest because of its large scale surface smoothness and absence of seasonal variations [3]. The latitude of that site allows frequent revisits for polar orbit missions. For the sites studied, the estimates of the achievable radiometric accuracy is made assuming the RADARSAT-2 beam patterns are stable and calibrated during the acquisition campaigns.

5. REFERENCES

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