

# USING RADARSAT TO SUPPORT C-BAND SAR DATA CONTINUITY FOR THE EUROPEAN USER COMMUNITY

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## ABSTRACT

RADARSAT-1 and RADARSAT-2 have been supporting the Global Monitoring for Environment and Security (GMES) program since June 2009. The overall capacity of the RADARSAT-2 satellite has provided reliable coverage supporting the Land, Marine and Emergency users for the past five years and demand continues to grow. This paper will examine the partnership that Canada has with the European Space Agency (ESA) and the European community through the GMES program. It will also look to the future, both in terms of the Sentinel-1 launch, as well as the Canadian RADARSAT Constellation Mission (RCM) to ensure continuity of C-Band SAR coverage for the growing user community

## 1. INTRODUCTION

RADARSAT has a long history of providing reliable Synthetic Aperture Radar (SAR) data to the European community. Some of the earliest users of the RADARSAT-1 program outside of Canada included the European Maritime community. The Danish Meteorological Institute embraced the RADARSAT-1 program as did our partners in Norway. One of the first early investors in the RADARSAT-2 program prior to launch was the Norwegian Space Agency to fulfill maritime monitoring requirements and to ensure European reception facilities were available at RADARSAT-2's launch. MDA Geospatial Services Inc. (MDA) have worked with many of the large operational users within Europe over the last 18 years to develop an operational approach to delivering satellite SAR data monitoring programs throughout Europe. The Copernicus program, through the European Space Agency (ESA), has further developed the concept of Earth observation for monitoring. RADARSAT has been part of that solution since 2009. At that time, the RADARSAT-1 and RADARSAT-2 satellites provided complementary coverage with ERS and Envisat satellites to fulfill the needs of maritime monitoring programs. The growth in the utilization of satellite SAR for this sector has been substantial since those early years.

## 2. MARITIME SUPPORT AND ENVISAT REPLACEMENT

Both Canada and northern Europe are reliant on the use of satellite SAR to monitor the maritime regions of the Arctic. In 2007, ESA, the Canadian Space Agency (CSA) and MDA developed a contingency agreement to ensure the continuation of satellite SAR for this community should one of the Canadian or ESA satellite's become incapacitated. This agreement allowed for reciprocal support to assist in continuing the delivery of operationally needed SAR data to support on-going monitoring programs. In April 2012, the unfortunate demise of the Envisat satellite put the contingency agreement to the test. RADARSAT products were provided to Envisat users through MDA's ordering infrastructure for a period of three months. During that time, over 1000 images were delivered in near-real time to MyOcean users, over 100 to EMSA delivered in <30 minutes and approximately 750 images to groups such as the Supersites, Maritime Security Service (MARISS) and support of food security monitoring activities in Africa (GMFF). The Envisat replacement agreement followed, allowing MDA to continue providing considerable data each month to the maritime community. The growth in utilization of RADARSAT-2 data is illustrated in Fig 1. Using both the Norwegian and Canadian reception facilities, RADARSAT-2 products have an average delivery time of 57 minutes from acquisition to product delivery..

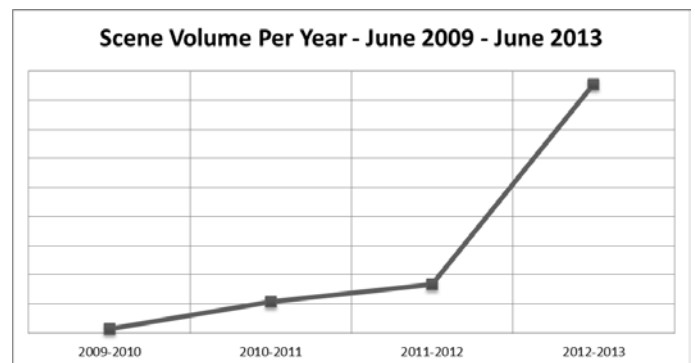


Figure 1: Yearly volumes of data to support the CORE-11 activities. The jump from year 3 to year 4 represents the on-going Envisat replacement activities.

Unfortunately, in March 2013 another satellite SAR mission completed its life. RADARSAT-1, launched in November 1995, was the first commercial satellite SAR mission. Its long operational life supported many users in the maritime community and can boast acquiring over 11,218 hours of data, through 50 certified network stations resulting in an archive of over 1.4 million scenes.

With Sentinel's launch, the Europe/Canadian partnership can continue to grow the coverage of the dynamic regions of the Arctic. The environmentally sensitive arctic region with increasing shipping and oil/gas and mineral exploration activities will require more frequent wide area coverage to support the increased interest in the arctic. Having multiple operationally focused and large capacity satellite SAR programs is necessary to ensure active monitoring programs have guaranteed and continuous access. Partnerships as demonstrated between ESA and Canada are a model for the future.

### 3. RADARSAT-2 AND EMERGENCY RESPONSE

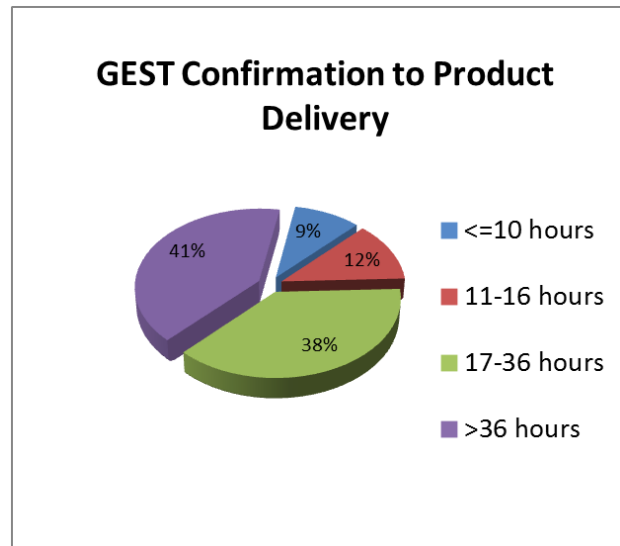
RADARSAT has supported the European community beyond Arctic and maritime monitoring. The operational model which MDA operates the RADARSAT-2 program has enabled ready access for the provision of Emergency data requests through both ESA GMES and the Disaster watch programs. MDA has worked to meet the goals of the European community with respect to the responsiveness of emergency new tasking requests. Tab 1 shows the statistics for new tasking requests from over 100 activations for GMES emergencies since 2009, resulting in over 250 products delivered.

*Table 1: RADARSAT-2 Emergency Timelines as measured for the GMES Emergency Product delivery. Statistics are based on Emergency Activations since 2009*

Time	Average	Minimum
Avg. Order Desk Response time Day hr:min	00 0:50	00 0:03
Event Notification to Product Delivery Day hr:min	01 17:27	00 11:18
Acquisition time to Product Delivery Day hr:min	00 6:57	00 0:13
Downlink time to Product Delivery Day hr:min	00 0:44	00 0:02

The European goal of achieving an acquisition within 16 hours of an emergency event notification was

reached in 21% of the activations; the 36 hours goal was met 59% of the time as illustrated in Fig 2. The percentage within 16 hours of activation demonstrates both good planning tool availability from the ESA GEST operator; and the responsiveness of MDA's operations. A combination of a 24/7 emergency hotline, and MDA's Emergency Programming services which can achieve a new tasking submission up to 4 hours before satellite uplink (uplinks occurring multiple times a day) makes these timelines possible.



*Figure 2: Response time compared to GMES Goals for EO Product Delivery from GEST Confirmation of Acquisition Request to Product Delivery from 2009 to June 2013*

The development of the Heterogeneous Missions Accessibility (HMA) Catalogue ordering functionality for the large RADARSAT-2 archive will continue to improve timelines for the provision of archive imagery, which is useful to measure the extent of emergency damage. MDA also anticipates working with ESA to implement HMA New Tasking functionality including feasibility requests which would minimize the timeline from Event Notification to the MDA Client Service proposal of available acquisitions over an emergency location. Currently MDA has achieved a 50 minute average response time since 2009, with a minimum response time of 3 minutes.

### 4. OTHER RADARSAT-2 SERVICES

RADARSAT-2 continues to build a large archive of data over Europe and the rest of the world to support many different types of user requirements. Actively supporting such groups as DORIS, SAFER, REDD and SubCoast has complemented MDAs initiatives to cover key areas of global interest. In collaboration with our ground receiving station partners around the world

MDA continues collecting RADARSAT-2 data that satisfy national, regional and international programs such as disaster monitoring and management, environmental impact assessment and climate change monitoring

Change detection (amplitude, coherence and polarimetric) and Interferometric (InSAR) analysis are active areas where MDA has made great strides in developing operational information products. Particularly utilizing InSAR technologies, these products provide valuable subsidence information for oil/gas and mining companies. Using the long time series of satellite SAR data from ERS through to the RADARSAT-2 and other commercial SAR sensors, MDA sees great benefit in developing multi-sensor/multi-beam products to monitor dynamic changes in land movement.

MDA has created an operational product which utilizes multiple stacks from any SAR sensor and combines them into a continuous time series of subsidence (InSAR) measurements. In southern California this has allowed clients to monitor a long time series of data and at a measurement cycle required to capture the dynamic movements. MDA sees the value in expanding this capability in a multi-sensor approach with such satellites as TerraSAR-x, COSMO-SkyMed and, when launched, Sentinel. A paper is presented in the Poster Session Hazards: Subsidence and Landslides session demonstrating these principles..

## **5. FUTURE**

Looking into the future, MDA has supported development activities of the Sentinel satellite program and the new Terrain Observation with Progressive Scans (TOPS) beam. RADARSAT-2, with its programmable satellite antenna, was reconfigured to create a prototype beam with the properties of the TOPS beam. This simulated data has been used to demonstrate how the beam will perform prior to Sentinel's launch and prepare for operational processing and exploitation. Discussion of the results of this work is included in the conference session: Sentinel-1 Ready for Launch.

Lastly the RADARSAT Constellation (RCM) continues to be a focus for Canada, CSA and MDA. The continuity of the RADARSAT program is a key goal of the Canadian government. On January 9, 2013, MDA signed a contract, as mission Prime, with the Canadian Space Agency to build, launch and provide initial operations for the RADARSAT Constellation Mission. RCM is a constellation of three satellites providing around-the-clock coverage. Information obtained from RCM can include repeat imaging of the same area at

different times of day, dramatically improving the frequency of monitoring coastal zones, northern territories, Arctic waterways and other areas of strategic and defence interest. RCM will also incorporate automated identification system technology, which when combined with the powerful radar images, supports the immediate detection and identification of ships worldwide. All major subcontracts are in place and work is progressing

MDA is proud of the contribution that it has and will continue to provide the European community in supplying satellite SAR data to active monitoring programs and in developing new applications and products to meet the changing information needs of the global community.